14th National Nutrient Databank Conference

June 19-21, 1989
Iowa City, Iowa

- Developing an International Food Composition Database: An Illustration From the Nutrition CRSP
  Judith Ricci, N.W. Jerome, WA. Moussa, G. Galal, G.G. Harrison, A. Kirksey
- Uses of Nutrient Data in a Low Fat Diet Intervention Study: The Women's Intervention Nutrition Study
  I. Marilyn Buzzard, Laurie McBane, Sally F. Schakel

Database Applications

- Integrity Checks for Nutrient Data
  Suzanne P. Murphy
- Update on Factored Food Vocabulary (Langual)
  Elizabeth C. Smith
- Applications and Availability of International Data: Myths and Realities
  John Klensin, Roselyn M. Romberg
- An Editor's View of the Current Status of Food Composition Data
  Kent K. Stewart
- Food Frequency, Food Record/Recall Analysis, and Recipe Analysis Software
  Linda S. Hicks
- The Dietary Data Collection System - An Automated Interview and Coding System for NHANES III
  Margaret McDowell, Rita A. Warren, Diane Feskanich

Lesser Known Nutrients and Labeling Issues

- Trace Elements Emerging as Important in Human Nutrition
  Forrest H. Nielsen and Janet R. Hunt
- Food Labeling: Nutrient Descriptors, Claims and Other Initiatives
  Virginia l. Wilkening
- Industry Perspectives on Food Labeling
  Chor San Khoo
- Imputing Nutrient Values From Manufacturers' Data
  Sally F. Schake!, Rita A. Warren, 1. Marilyn Buzzard

Poster Session

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FORWARD

The National Nutrient Databank Conference has been held annually for the past 14 years. It is organized by a group of interested volunteers who give generously of their time. A steering committee and four working committees carry on the functions of organizing the conference and communicating conference activities. Interested persons are invited to volunteer for committee assignment at each conference. Committee membership and volunteer activity is sought rather than dues. The 1989 Committees and their chairs were: Steering Committee, Al Riley, Campbell Soup Company; Program Committee, Linda Posati, USDA- FIAD; Communications Committee, Betty Perloff, USDA-HNIS; Database Committee, Linda Hicks, University of Texas; and Local Arrangements Committee, Phyllis Stumbo, University of Iowa.

Proceedings are published following most of the conferences, and some are still available for purchase. A listing of proceedings publishers is given in the back of this issue. From the list of proceedings you can see that the conference has been hosted on both coasts and at several midwestern and southern locations. The conference has been sponsored by professional organizations, government agencies, and industry. The U.S. Department of Agriculture maintains the National Nutrient Databank for the United States and is a major sponsor of this conference. Industry sponsors have included a host of food and food supplement manufacturers and more recently software companies.

On behalf of the steering committee we wish to express our sincere thanks to the United States Department of Agriculture and the various industries for their generous financial support of this conference. Without their cooperation, it would not be possible to communicate the information assembled in these proceedings.

Special recognition goes to Bob Rizek, Director of the Human Nutrition Information Service, United States Department of Agriculture, for fostering growth of this conference. Dr. Rizek has guided conference planners, encouraged his staff to participate, and approved USDA financial support. Updates from USDA continues to be one of the most worthwhile aspects of the conference.

The 1990 CONFERENCE will be held in Blacksburg, Virginia on June 4-6, 1990. Information about this conference is available from Jane Wentworth, Dept. of Human Nutrition and Foods, (703) 231-6943 or Kent Stewart, Dept. Biochemistry and Nutrition, (703) 231-7986. Address for both is: Virginia Polytechnic Institute and State University, Blacksburg, VA 24061.

EXECUTIVE SUMMARY 14TH NATIONAL NUTRIENT DATABANK CONFERENCE

A Decade of Progress Meets a Decade of Challenge: U.S. Nutrient Data Yesterday, Today, and Tomorrow

OVERVIEW

In keeping with the conference theme of reviewing nutrient data development during the 1980's and looking ahead to the 1990's, the first four speakers reviewed recent nutrient database developments and predicted future activities. Suzanne Harris, International Life Sciences Institute, (ILSI), provided insights into the government's role in data development and use, David Hurt (Quaker Oats) described industry's activities, Linda Snetselaar (U of Iowa) shared her experiences with use of nutrient data in clinical trials, and Suzanne Murphy (UC Berkeley) described activities in education. Four subsequent sessions updated the conference on USDA's current nutrient data activities, use of data in clinical trials, state-of-the-art nutrition software, and trace minerals and government regulation of food labeling.

OPENING SESSION

> The National Nutrient Databank is composed of representative nutrient values for foods consumed in the United States - Suzanne Harris.

Government Activity: Two United States Department of Agriculture agencies, the Human Nutrition Information Service (HNIS) and the Agricultural Research Service (ARS), have key roles in maintaining the National Nutrient Databank (NNDB), which is composed of representative nutrient values for foods consumed in the United States. According to Dr. Harris the ARS improves analytical methods and the HNIS develops procedures for deriving representative nutrient values. Agencies using nutrient data include the United States Department of Agriculture (USDA), which conducts the National Food Consumption Survey aimed at monitoring food use; the Department of Health and Human Services, which regularly conducts the National Health and Nutrition Examination Survey (NHANES) to monitor nutrient intake and health; and the Food and Drug Administration whose Total Diet Study utilizes the National Nutrient Databank to monitor dietary safety.

Other NIH agencies concerned with health and that use the National Nutrient Databank are the NHLBI in their studies of diet, heart disease, and hypertension, and the NCI in their studies of nutrition and cancer. USDA develops nutrient data for its own use and is the major source of nutrient data used by the public. One challenge of the past decade was to increase the amount of data available for those food components thought to have important health implications. In this pursuit, analytical procedures and data development were concentrated on dietary fiber, selenium, and fatty acids in fish. Setting research priorities in the development of data is an important function of the US government.

> The regulatory nature of food composition is a deterrent to industry-generated nutrient data - David Hurt.

INDUSTRY ACTIVITY: Since the food industry is composed of many very large and very small industries, as well as a wide range of intermediate sized operations, it is not possible to characterize nutrient database activity under one generalized industry view. Having worked with 3 large food corporations in the past 19 years, Dr. Hurt shared a few of his ideas which may have wide applicability.

According to Dr. Hurt, efficiency is the driving force in most industry activities. The competitive nature of business leaves little room for non-profit activity such as provision of consumer information. Other factors such as variability in the composition of food produced in different parts of the country, in different seasons, and fluctuations in the number and kind of products on the grocery shelf, make development of reliable nutrient information on manufactured products impractical. The regulatory nature of nutrition labeling is also a deterrent to industry-generated nutrient data. If nutrient information could be provided in an informational rather than a regulatory environment, nutrient data would be provided more willingly, according to Hurt.

> Advance in both software and hardware have increased the expectation for better nutrient data - Linda Snetselaar.

CLINICAL TRIALS: In discussing the nutrient data needs of clinical trials, Dr. Snetselaar stressed the importance of timeliness in providing nutrient information to study participants. Immediate feedback is more feasible now that it was only a few years ago. The use of personal computers makes it possible to sit down with a client and characterize a very complicated diet in a matter of a few minutes. Advances in both software and hardware have increased the expectation for better nutrient data, more product-oriented nutrient data, and more imaginative interpretation of nutrient data (e.g. protein and calorie ratio over time, or percent of dietary goal reached to current date and time.) These advancements have also improved the quality of the consumption data by speeding up the coding process at study coordinating centers. This allows queries about inadequate documentation of important details of food intake data collected by interviewers to be made quicker, thus improving the likelihood that staff can remember the details of information gathered and improve inadequate descriptions.

> College campuses are usually blessed with computer experts who make development of customized computer applications feasible. Suzanne Murphy.

ACADEMIA: Dr. Murphy (UC Berkeley) described three ways that nutrient data is used in academia: (1) for classroom exercises; (2) in preparation of educational materials; and (3) as a resource when consulting with colleagues and the public. Parallel advances in nutrient data, computer hardware, and computer software have greatly improved the accessibility and utility of nutrient data on college campuses. As an example, UC Berkeley went from the use of a card punch for data input by students with a 30 minute or longer wait for results, to the use of high speed terminals with direct line to mainframes, or personal computers connected to the mainframe by modem, to accomplish interactive use of large USDA nutrient databases. Advances in hardware leading to the proliferation of microcomputers have had a tremendous impact on what is feasible for student's assignments.

College campuses are usually blessed with computer experts who make development of customized computer applications feasible. While commercially available diet analysis software have developed to a high performance level, programs often do not provide the options needed in education. At UC Berkeley a number of custom applications are available or under development. The most recent application is the expansion of the nutrient values on USDA's Home and Garden Bulletin No. 72 by selecting representative values from USDA Survey Data Base.

Looking to the future Murphy praised current efforts taking place to make accessing the USDA Survey Data Base easier. Expected progress in both software and hardware will make dietary calculations easier. And improvement in synonym abilities and menu-driven data entry will greatly facilitate nutrient analysis.

MANUFACTURED FOODS IN DATABASES: A common thread throughout the opening session was the need for nutrient values specified for products by brand name. Murphy echoed Snetselaar's pleas for better nutrient data for processed foods, but both Harris and Hurt predicted that the high price tag associated with such data specificity makes it unlikely these improvements are forth coming in the next decade.

The high price tag associated with brand-name specific nutrient data make it unlikely these improvements are forthcoming in the next decade.

Hurt estimated the cost for a complete nutrient profile of one food at $1500 or more. In addition, given the high coefficient of variation for many assays, at least six separate determinations would be required to give confidence in the data's reliability. Harris conservatively estimated the cost of adding brand name specificity to NNDB at $20 million initially and $8 million annually thereafter to maintain the data. This would exceed USDA's $4 million total annual budget for extramural nutrient analysis several fold making it unlikely that this information will be available in the foreseeable future.

SESSION II GOVERNMENT UPDATE

The cholesterol value of one large egg was found to be 212 mg. rather than the previous value of 274 mg.

Representatives of the USDA, FDA, and the National Centers for Health Statistics (NCHS) have key roles in safeguarding the food supply and monitoring the nutritional health of the nation. In the second session five speakers from these agencies described current research and monitoring activities.

Drs. Beecher and Dickey of USDA described the recent updating of beef and egg nutrient values. This effort began when commodity groups proposed a study of marketing practices and nutrient values, particularly cholesterol in eggs and fat in beef and pork.

According to Dr. Beecher The National Cattleman's Association, the National Livestock and Meat Board, and USDA conducted a national sampling of major grocery store chains for beef to ascertain total fat of today's product as purchased by consumers. Previous data (USDA Handbook No. 8-13, 1986) reflected 1/2 inch fat trim on retail cuts of beef. According to the data collected for this study, the fat trim on beef is currently a thin 1/8 inch.

The second collaborative study was conducted by the Egg Nutrition Center and USDA (Human Nutrition Information Service, Nutrition Composition Laboratory, and Agricultural Marketing Service) to determine the nutrient composition of eggs, particularly total cholesterol. Previous data was based on colorimetric analysis techniques and provided a value of 270-275 mg cholesterol/large egg (Handbook No. 8-1, 1976). Eggs were sampled nationally during Summer 1988 and Winter 1989 to determine vitamin, mineral, and cholesterol content using newer methods.

According to Dr. Dickey, after the sampling of 1,349 eggs the size remained the same, but using improved methodology the cholesterol content of one large egg was found to be 212 mg rather than the previous value of 274 mg. Dr. Dickey indicated that USDA's fat values for meat are currently being revised to show the 8% reduction in fat of cooked lean meat when fat is trimmed to 1/4" and 18% fat reduction when fat cover is only 1/8".

Dr. Beecher reported that these industry/government collaborative efforts provide timely generation of data with increased resources and cost-sharing. A close relationship between industry and government on projects of mutual interest are sometimes criticized, but these two projects proved beneficial for the generation and formulation of more accurate food composition data.

Betty Perloff (USDA) described the dual focus of the Human Nutrition Information Service's (HNIS) research mission, namely food consumption and dietary guidance. As the primary sponsor of the National Nutrient Databank, maintaining currency and accuracy of nutrient data is a primary responsibility. HNIS publishes nutrient data in books and on magnetic tape, with 18 updated sections of their 1963 Handbook No. 8, Composition of Food, being currently available and 4 additional sections planned for publication by the end of 1990 to complete a 15-year promise to update all of the 1963 Handbook No. 8 nutrient values.

HNIS will publish updates to these Handbook No. 8 sections. The first update includes 9 items in section 1 (eggs in different forms) and 14 new items in other sections (examples are canola oil in Section 4, Fats and ground turkey in Section 5, Poultry). USDA recently published a provisional table of fiber in food and is currently analyzing foods to characterize soluble and insoluble fiber fractions.

To aid in disseminating new research data and improve their ability to answer questions from the public HNIS is setting up a computerized bulletin board. This service will enable them to act as a clearing house for nutrition information and provide USDA updates in a timely fashion.

FDA's nutrition research focus is food safety. Fulfilling this watchdog function includes monitoring nutritional adequacy of the food supply as well as food contaminants. Dr. Jean Pennington described FDA's Total Diet Study in which foods sold in the US are sampled on a regular basis to monitor 11 nutritional elements, 200 pesticide residues, several industrial chemicals, and 4 toxic elements. Foods are sampled in 3 metropolitan areas in each of 4 geographical areas of the US to represent food eaten throughout the US. Recent surveys have found some nutrients to be below the RDA, particularly the minerals copper, zinc, magnesium, iron, and calcium. In previous years iodine content of the American diet has been high, but is lower in recent years presumably due to decreased use of red dye #3 (erythricin). FDA's system of cataloguing foods called LANGUAL is being refined to enable researchers in many areas to compare food data. Foods differ between countries making international comparisons difficult. For example, the percent of butter fat in dairy products differs between countries as does the percent of alcohol in alcoholic beverages. LANGUAL is designed to facilitate comprehensive food descriptions so that accurate comparisons can be made between databases.

> A food called sopa was reported on more than 800 eating occasions in Hispanic HANES.

NCHS conducts surveys of the health of US citizens mandated by the National Health Survey Act. Two National Health and Nutrition Examination Surveys (NHANES) have been conducted. The third, Hispanic HANES is the first NCHS survey to sample a subpopulation, namely Mexican-Americans, Cubans, and Puerto Ricans. Current USDA databases were tailored to the survey needs by adding ethnic foods. For example, a food called sopa was reported on more than 800 eating occasions in Hispanic HANES. Sopa is noodles that are first fried in lard and then cooked in broth and tomato sauce until the moisture is absorbed. Neither noodle soup nor spaghetti correctly characterized this food.

Ethnic foods are consumed by 90% of the American population so databases which include ethnic foods are required for most food surveys. NCHS will continue to work closely with USDA, academic groups, and other interested parties to improve the quality of food intake data.

SESSION III DATA COLLECTION IN CLINICAL TRIALS

> Highest contributors of fat in this intervention study were pizza, french fires, and cheeseburgers.

The third session featured some of the unique ways that nutrient data needs of clinical trials are satisfied. Six investigators discussed nutrient data use in clinical trials. (1) Describing the Treatment of Mild Hypertension Study (TOMHS), Brian Laing explained how food records coupled with a detailed documentation interview is used to assess compliance to a dietary prescription which is designed to minimize the possibility that diet is a confounding variable to the study. (2) Arizona State University's process of adapting the National Cancer Institute's food frequency to a self-administered form utilizing an optical reader was described by Carol Sue Goodby who explained the advantages of this procedure. (3) The MDRD trial presented unique nutrient data needs as explained by Bonnie Gillis. Treatment of renal disease involved special dietary products to be added to the database, training and assisting staff required computer programming to alert staff when out-of-range values are entered. Procedures for adding biological value of protein to a database was described. (4) The Nutrition CRSP program required country-specific tables of food composition. Judith Ricci described the development of Food Tables for Egypt. (5) Children's limited vocabulary and unfamiliarity with many food products posed unique challenges to dietary data collection in the University of Texas health study among children 1-12 years of age. Suzanne McPherson reported that highest contributors of fat in this intervention study were pizza, french fries, and cheeseburgers. (6) Marilyn Buzzard described the Nutrition Coding Center's use of nutrient data to develop a Fat Gram Counter, Score Book, and other aids useful in a study to determine the feasibility of instituting a low-fat diet with post-menopausal women.

SESSION IV DATABASE AND SOFTWARE DEVELOPMENTS

The highlight of the fourth session was demonstrations of software utilizing nutrient databases. Suzanne Murphy opened the session by explaining procedures for checking the integrity of nutrient data. Using simple calculated values, such as summing of fatty acids to approximate total fat or calculated energy levels from protein, fat, and carbohydrate grams to be compared with the analylzed energy values often identify faulty data. Edit limits also alert data users to nutrient values that are out of range. Dr. Murphy used USDA's Nutrient Database for Individual Food Intake Survey, Release 2.1 (1986) to develop edit limits for selected nutrients for 12 food groups. A characteristic range of values is determined for various food groups. Foods falling outside this range are examined for potential errors. While not ensuring accurate nutrient data this process flags out-of-range nutrient values likely to be in error

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An update on LANGUAL (formerly the Factored Food Vocabulary) was presented by Elizabeth C. Smith from FDA's Center for Food Safety and Applied Nutrition (CFSAN). LANGUAL is a computer based information retrieval tool which uses a series of 13 factors to describe and categorize food. LANGUAL provides a common language for linking dissimilar files. For example, CFSAN uses LANGUAL to link names in three databases: 1) FDA's Total Diet Study which monitors levels of contaminants and nutritional elements in the US food supply, 2) USDA Nutrient Database for Standard Reference for analytical data and 3) FDA's Scientific Information and Retrieval Exchange Network (SIREN) for bibliographic citation of FDA regulatory and petition information. LANGUAL allows the user to simultaneously retrieve information about a food from all three files.

John Klensin (INFOODS, MIT) discussed international food data and described intricacies involved in standardizing nutrient data around the world. INFOODS (International Network of Food Data Systems) publishes a periodic newsletter from the office of the Secretariat at the Massachusetts Institute of Technology. This group was formed with financial support from a variety of US private and government organizations. Regional groups encouraged by INFOODS includes NORFOODS (Nordic countries), Oceaneafoods (South Pacific Commission), Latinfoods, Afrofood (Africa south of Sahara), Asiafood (East, South, and Southeast Asia), Menafoods (North Africa and Mideastern countries) and Norfood (North America and the Caribbean countries). Major issues are choice of units for expressing food data (i.e., Vitamin A may be expressed as carotene, retinol, International Units, or Retinol Equivalents), food description (i.e., biscuits may vary in composition around the world), and analytical methods (i.e., folate values are much lower using methods that do not protect folacin from oxidation).

Linda Hicks described software developed jointly by USDA-HNIS and The University of Texas for the IBM or IBM compatible microcomputers. The Food Frequency Data Entry and Analysis Program uses the Survey Nutrient Database to quantify daily nutrient intake. Foods consumed by the individual are entered by food code and portion sizes can be quantified using food models or standard household measures. This program may be used during an interview session as well as post-interview with a completed recall. Finally, The Recipe Analysis Program allows the user to calculate the nutrient content of recipes and save these analyses in a "recipe file". The nutrients are calculated using the modified nutrient retention method which adjusts for vitamin, mineral, fat and moisture changes in the food product. All three software applications provide complete data management and editing capabilities and include color displays. Integration of these three programs, on-line coding and mouse-keyboard interface are slated for August 1989 completion. Hardware requirements for utilization of the software are 640K memory, hard disk and IBM or

> Training of interviewers is aimed at developing neutral probes for further information while maintaining a good rapport with the subject. .

compatible computer. Supporting materials include standardized data collection and entry forms and 2-D food models to help with portion size estimates.

NHANES III data collection began in 1988 and will continue for six years while surveying approximately 40,000 persons. Nutrient data will be collected using both a food frequency and 24-hour recall. Recalls for this survey are collected using an automated interactive interview on a personal computer using the Dietary Data Collection system (DDC) developed by the University of Minnesota's Nutrition Coordinating Center (NCC) from NCHS specifications. Two major advantages were envisioned for the automated interview schedule, first interviewers have difficulty in remembering a vast amount of detail for probing for food descriptions and preparation methods, and second using an automated interview means that intakes are automatically coded for later processing. Data for USDA surveys (NFCS and CSFII) form the database of over 8000 foods, but variations caused by food preparation methods results in 9000 possibilities of prepared meat and over 3000 possibilities for brand name listings. Training of interviewers is aimed at developing neutral probes for further information while maintaining a good rapport with the subject and to standardize the dietary interview as much as possible. Experienced dietary interviewers are able to conduct the 24-hour recall in about 20-30 minutes. Quality control includes observations of interviewers and cross-checking about 10 percent of the dietary recalls.

Significant progress in improving the quality and quantity of analytical data on food composition is marked by the appearance of two new journals (the *Journal of Micronutrient Analysis* and *Journal of Food Composition and Analysis*). Analysis of nutrient composition involves several steps, each subject to potential errors making data validation an important step in the process. Dr. Kent Stewart of VPI discusses eight steps in nutrient data generation and how data should be reported. Problems in the field of food composition are meager funding, out-of-date methodology, and inadequate training. Greater attention to training of food analysts is needed before increased funding or improved methodology can hope to correct current deficiencies. Challenges for the food analyst of the future are the fact that food analysis methodology has failed to keep pace with other areas of analytical chemistry and by the possibility that genetic engineering will create new foods with unknown composition.

SESSION V LESSER KNOWN NUTRIENTS AND LABELING ISSUES

The fifth and final session concerned trace minerals and food labeling. Forrest Nielsen reviewed trace mineral nutrition and discussed evidence for the essential dietary role of boron. Seven trace minerals: cobalt, copper, iodine, iron, molybdenum, selenium, and zinc have defined essential functions in man. Essentiality of thirteen other elements, including boron, are suggested. Studies supporting the essentiality of boron indicate the need is not crucial or is very low except when the animal is stressed. Intriguing studies of boron suggest a role with vitamin D in animals and calcium metabolism among post menapausal women.

> Any claim allowed under new rules to be developed must recognize that no food is "good" or "bad."

Virginia Wilkening discussed FDA rules for the use of such adjectival descriptors as "low", "very low", "free", and "reduced" on food labels. Rules were adopted in 1978 for calories, in 1984 for sodium, and were introduced for consideration in 1986 for cholesterol. These food components are of special interest because of their link to chronic diseases. FDA is considering rules that would change their long-standing proscription against claims that food moderates disease. Any claim allowed under new rules to be developed must recognize that no food is "good" or "bad" and that all nutrient information should be considered in terms of the total diet rather than being misplaced by emphasizing a single food.

> Regulations differ concerning sodium labeling and the use of words such as "reduced" when it refers to calories or other nutrients.

Chor San Khoo discussed food labeling from the industry perspective. The question of voluntary versus mandatory labeling is debatable, with some of the current inconsistencies between FDA and USDA regulation particularly vexing. Regulations differ concerning sodium labeling and the use of words such as "reduced" when it refers to calories or other nutrients. Using examples of LeMenu Frozen Product labels Dr. Khoo illustrated attempts at Campbell Soup to make labels more meaningful to the consumer. The potential for using the food label as a tool for nutrition labeling became evident when an offer on a V-8 juice label for a copy of the dietary guidelines received 12,000 requests in a 2 month period. A nutrition message included on a label of soup, of which 5 billion cans are made per year, would reach a tremendous audience. Learning how to utilize this tool for maximum consumer benefit will require research to determine the most understandable and efficient format.

Sally Schakel discussed use of food labels as part of procedures followed by the University of Minnesota Nutrition Coordinating Center (NCC) to impute values for the nutrient fields present for some foods an the NCC nutrient database. This database has approximately 2000 food profiles of which 500 are developed from manufacture's data. These support the representation of the 20,000 or so food items on the shelves of a typical supermarket. Since groups of brand name products have nearly identical nutrient values, they can be accurately represented by the same nutrient profile. NCC develops guides to link 500 or so nutrient profiles to the 3600 brand names currently in the coding guide. The NCC database is made complete by imputing values for nutrients not provided by the manufacturer. The number of values so imputed vary from 2 to 4% for the proximates to a high of 95% for carotene and retinol, values not usually reported by primary nutrient sources.

This annual conference is sponsored jointly by USDA, HNIS and selected food companies and nutrition software firms.

This year's sponsors were:
United States Department of Agriculture; Campbell Soup Company; The CBORD Group, Inc.; The Coca Cola Company; Computrition; General Foods USA; Hershey Foods Corporation; Nabisco National Soft Drink Association; The NutraSweet Company; Pepsi Cola, Inc.; The Procter and Gamble Company.

THE GOVERNMENT'S EXPERIENCE IN DATA DEVELOPMENT

Suzanne S. Harris, Ph.D.[1]

International Life Sciences Institute
Research Foundation
Human Nutrition Institute
Washington, D.C.

This year we are attending the 14th National Nutrient Databank Conference. The importance of this Conference is underscored by the fact that it has been held annually for over a decade. As we come to the end of the 1980's and look forward to the 90's, the conference program committee appropriately chose the theme "A decade of progress meets a decade of challenge." I have been asked to address this topic as it relates to the Federal government's nutrient database activities and experiences.

Both the U.S. Department of Agriculture (USDA) and the U.S. Department of Health and Human Services (DHHS) have important roles in Nutrient Database development, improvement, and use. Time doesn't permit discussing all Government programs related to these activities, so I'll try to focus on the ones of greatest interest to this audience. Reports on the current status of several of these activities are scheduled for other sessions during this Conference.

At USDA, the Human Nutrition Information Service (HNIS) operates the National Nutrient Databank where representative nutrient values are developed for foods consumed in the U.S. At the beginning of the Reagan administration, the Human Nutrition Information Service was made a separate agency within USDA, emphasizing the Department's commitment to meeting the challenges presented by the unique and important functions of this sector of USDA.

HNIS' work includes nutrient data research, collection, evaluation, and interpretation; development of procedures for derivation of representative nutrient values; identification of needed nutrient composition and related research; and planning and sponsoring the needed research to the extent that funds are available. Of course, the purpose of these tasks is to provide HNIS with the information necessary to develop, or update, nutrient values for use as standard reference food composition data. These data are then disseminated through publications (primarily Agriculture Handbook No. 8) and computer readable data sets.

HNIS also is a major user of nutrient data; i.e., in the analysis of the Nationwide Food Consumption Survey and the Continuing Survey of Food Intakes by Individuals, development of thrifty food plans upon which food stamp allotments are based, preparation of information about nutrient availability in the food supply, and development of dietary guidance materials.

The Agriculture Research Service (ARS) also has an important role related to nutrient data. The mission of the Nutrient Composition Laboratory (NCL) at ARS is to improve analytical methods for nutrient analyses, emphasizing not only efficient cost-saving techniques, but also quality control procedures to ensure that methods provide the greatest degree of accuracy and precision. All five of the ARS Human Nutrition Research Centers use nutrient databases in their research programs. Some of the Centers also generate nutrient data as part of their research studies.

While USDA is the Federal agency most people think of in terms of nutrient data, other agencies are involved in database development. A well-known Government program using nutrient data is the Department of Health and Human Services' series of Health and Nutrition Examination Surveys (HANES) conducted by the National Center for Health Statistics. Nutrient consumption data generated by HANES and the two large USDA surveys -- NFCS and CSFII -- are, in turn, used in numerous research projects in both the public and private sectors.

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[1] Formerly Deputy Assistant Secretary for Food and Consumer Services, USDA

The Food and Drug Administration (FDA) has several programs using nutrient data, including the Total Diet Study which will be discussed this afternoon. As part of this study to monitor levels of various food components in the U.S. food supply, FDA generates a sizable amount of nutrient composition data which becomes a part of the USDA Nutrient Databank and, in turn, are used in databases developed at HNIS.

The National Institutes of Health (NIH) use nutrient data in many programs. Several individuals involved with NIH clinical trials and epidemiological research regularly participate in these Nutrient Databank Conferences. The National Heart Lung and Blood Institute and the National Cancer Institute are supporting research to fill voids in nutrient data or nutrient analysis methodology.

Nutrient data are also used regularly by the military, VA hospitals, and many health programs supported by the Federal government, and by numerous programs, hospitals and universities at the state level.

The Federal government's mission is not only to develop standard reference nutrient data for Government's use, but also to make these data available for use by any individual or organization. The task of keeping these data current is enormous. New foods requiring new analyses are continually entering the market place. In 1988 alone, over 8,000 new food items were introduced. In addition, existing data frequently become obsolete by technological advances in nutrient methodology or by changes in foods -- changes which can occur swiftly or gradually and which usually are not readily apparent. Monitoring the composition of foods is a complicated and expensive process.

Over the past decade, you and others have called for improvements in the Federally maintained nutrient database. And rightly so. To meet its potential, the system for collecting and disseminating nutrient data needed to be improved. Put another way, it needed to provide more data, more rapidly, with the same resources. The goal has been, and is, to optimize the resources at hand to provide complete and current nutrient composition data for foods available in the U.S. Considerable achievements were made by the Federal government in the area of nutrient data development in the past decade even though resources were limited, and I would like to review the highlights of those achievements.

Eighteen of the 22 sections of Agriculture Handbook No. 8 are now complete. One more is planned for release this year. The remaining three sections are expected to be ready next year. Also to be published this year is a revision of the beef section issued in 1986, as well as the first supplement to the other previously published sections. This supplement will include additional food items and replacement data for food items needing revision in 11 of the first 16 sections of the handbook. Future supplements are planned on a yearly basis.

The USDA Nutrient Database for Standard Reference, the machine-readable data set corresponding to the Handbook No. 8 series, made its debut in 1981. Six subsequent releases have been made to keep current with the handbook, and it is now available in forms for both main frame and micro-computers. More information about Handbook No. 8, the supplement, and the computer data sets will be provided during today's afternoon session.

Two major developments in the 80's involved the USDA Nutrient Data Base for Individual Intake Surveys. This is the database used by USDA for analysis of the Nationwide Food Consumption Survey and the Continuing Survey of Food Intakes by Individuals. It is also being used by DHHS for the current National Health and Nutrition Examination Survey (NHANES III). The first major development regarding this database was expansion of its coverage from the 14 food components used for the 1977 Nationwide Food Consumption Survey to the 28 food components being used for current surveys.

The second major development was the design and implementation of a new automated system for updating the nutrient values on the database. This system links the survey database by computer to the Standard Reference Database (Handbook No. 8). As Handbook No. 8 and the Standard Reference Database are updated, the survey database can be updated automatically.

The benefits of this new system are many. One of particular significance is the ability to convert data on the consumption of mixed foods into data on the consumption of basic food ingredients. This conversion is possible through a set of computerized formulas and standard recipes designating the amounts of each food component in mixed food items. The system not only permits studying nutrient contribution at the primary food level, but also provides a new approach to database evaluation.

For example, using food consumption data from the 1985 CSFII and the formulas and recipe file in the new system, amounts of mixed foods consumed were converted into amounts of ingredients consumed. Consumption data for foods at this primary food level were then aggregated. For each nutrient in the database, the minimum number of foods required to reach 80% of the total intake of the nutrient was determined. For most nutrients, 100-200 foods account for 80% of the consumption of the nutrient. The nutrient values for these foods were then evaluated to determine the greatest needs for nutrient analyses.

Another benefit of the new system is that the procedure for calculating the nutrient content of mixed foods provides a prototype that can be used by other researchers. In a moment I'll discuss how the Human Nutrition Information Service is cooperating to integrate this procedure into a larger nutrient database system. This system soon will be available to other USDA research centers and ultimately to non-USDA database users.

In the past decade, HNIS has sponsored extramural nutrient analyses at a cost of $4.1 million. While an official of USDA I was frequently asked how priorities were established for studying nutrient composition of foods and I would like to review the process for you.

In the early 80's, many of the contracts were written to generate data needed to complete Handbook No. 8 -- selected vegetables, fruits, cereal products, legumes, variety meats, fast foods. Now that the Handbook No. 8 revision is nearly completed, the emphasis has changed. Current research priorities are based on two factors: (1) public health significance of food components and (2) knowledge gaps about foods that are major nutrient sources in the American diet.

Selenium is an example of a nutrient targeted for research in the 80's due to public health concerns. In 1985 selenium intake was suggested as a possible deterrent to cancer. As soon as 1985 CSFII data became available, they were used, along with provisional selenium data, to identify the greatest potential sources of selenium. One study began in 1987 and another in 1988 to provide data for estimating the mean and variability of selenium in American foods, and next year HNIS will begin adding selenium to the nutrient database for evaluating intakes from the CSFII.

Dietary fiber is another food component receiving priority in the 80's. Developing representative values for dietary fiber has been hampered by the complexities of fiber itself, i.e., the soluble and insoluble fractions, as well as the lack of consensus on appropriate analytical methods. Several different methods for measuring total dietary fiber in foods are currently in use -- each with its own set of benefits and drawbacks. HNIS published a provisional table of fiber values last year, based on one methodology -- that published by the Association of Official Analytical Chemists (AOAC). At the present time HNIS is sponsoring an international collaborative study on dietary fiber methodologies, using controlled experiments to compare different methods. Laboratories in Canada, the United Kingdom, and the U.S. are participating. One of the methods which looks promising is a simplified method developed at USDA's Nutrient Composition Laboratory.

Another area of current concern is the omega-3 fatty acid content of foods of which fish is a major source. These fatty acids are believed by some health professionals to provide protection against heart disease, and Americans are being advised by some groups to increase fish consumption. Data currently available are for fish from their natural habitat, but farm-raised fish are receiving an increasingly important share of the food market. It is not known if wild and cultivated members of a fish species have similar omega-3 fatty acid patterns, since their diets are completely different. Therefore, the fatty acid composition of wild and cultured forms of selected fish species is currently under study.

There is one obvious limitation with this method of targeting research needs -- our crystal ball may not always be clear. Considerable time is required to complete a specific set of studies once the idea is identified. The public health "pressure," if I may use that word, may diminish or disappear in the interim.

The second priority for researching foods is to fill important gaps in, or strengthen, the nutrient database used for analysis of food consumption surveys. I've already described how the 1985 CSFII data and the new system for generating the CSFII nutrient database were used to evaluate the nutrient data used for the survey. Using this technique to select foods for study, a project was conducted in 1987 to improve the analytical nutrient base for the survey. Generally, the items analyzed were frequently consumed foods and foods that were major contributors of nutrients for which intakes were below the RDA in the 1985 CSFII. Emphasis was placed on analysis of vitamin E, since its analytical base was not as strong as those for other food components.

A second project has been planned in which all nutrient values for 20 key foods will be analyzed as a check against the values currently being used. This project is a pilot study for a more extensive project tracking a larger set of foods which are major contributors of all nutrients for which the CSFII data are being analyzed. This larger set of foods will be developed from results of the 1987-88 NFCS.

Foods believed to be good sources of nutrients may also be studied even though they may not be consumed in large quantities. Information of this type is needed not only for the surveys but also by nutrition professionals who plan special diets or provide nutrition guidance. Several items falling into this category were included in the selenium studies.

Foods new to the market place are identified through contacts with the food industry or from reports in the food consumption surveys. These foods may also be targeted for nutrient analysis. For example, aseptically packaged foods, such as juices and other beverages, have been studied recently.

USDA is always striving to improve the quality of data generated through extramural contracts. Advances were made in this area in the 80's and additional improvements will be made during the 90's. HNIS has always required that contractors test their procedures against standard reference materials -- where standard reference materials exist -- and that routine intralaboratory quality control procedures be in place during the contracted work. HNIS began holding contractors' meetings in the 70's and these have continued through the 80's. With the help of the National Food Processors Association, analyses of common samples by all contractors are performed when feasible. The meetings and comparisons of common samples have been used to identify and resolve contractors' problems and to identify the difficult or variable methods of analysis.

In 1987, HNIS began an improved technique for selecting contractors. In collaboration with the ARS Nutrient Composition Laboratory, test samples are sent out during the contractor selection process and results are used in contract proposal evaluation. Standard testing materials are valuable tools for monitoring contracts involving a limited number of nutrients, where such materials are available. There is an obvious need for more of these materials covering more food components, and USDA's Nutrient Composition Laboratory is now involved in expanding the availability of test materials. In fact, several years ago NCL began collaborating with the National Institute of Standards and Technology (formerly the National Bureau of Standards) to develop standard reference materials.

The 1980's have also seen an expansion in nationwide sampling of foods for analysis. The selenium project required nationwide sampling plans because the selenium content of specific foods varies with growing location. For major selenium contributing foods, such as grain products, meats, and fish, samples were obtained within each of the nine census geographic divisions. Foods not identified as major contributors of selenium were sampled on a five region plan.

In addition, USDA has cooperated with several industry groups to develop nationwide sampling plans which, in turn, have been employed in research sponsored by these groups. These industry groups and foods are:

Produce Marketing Association -- several fruits and vegetables
United Fresh Fruit and Vegetable Association -- bananas
Cattlemen's Association -- beef
National Livestock and Meat Board -- pork
American Lamb Council -- lamb
National Turkey Federation -- ground turkey
National Broiler Council -- fat and cholesterol in fried chicken
Snack Foods Association -- chips and several other snacks

Most recently, the Egg Nutrition Center has worked with USDA to develop a national sampling plan for studying the composition of eggs. Lynn Dickey will be reporting on the results of this work and the latest beef study this afternoon.

These are very positive examples of cooperation between the Federal government and the food industry to improve the representativeness of food composition databases. The topic of Government-industry cooperation will also be addressed in greater detail this afternoon.

Also during the 80's the amount and format of nutrient data available for use with computers increased significantly. The Nutrient Database for Standard Reference is available on both magnetic tape and diskette in two different formats. The nutrient database used with the CSFII also has been made available along with the computer files used to generate the database. These files include the recipe file, the primary nutrient data set, and a table of nutrient retention factors.

The USDA has moved into the area of providing software for use with nutrient databases. HNIS' Guidance and Education Research Branch in cooperation with the USDA Extension System developed a dietary analysis software package for personal computers. It is an educational tool to provide Extension clients and other consumers with a relatively quick and easy nutritional analysis of their diets. It can be used to identify the major food sources of particular nutrients and to look at how alternate food selections would affect nutrient intake.

Computer software utilizing nutrient databases flooded the market during the 80's. To help data users evaluate and select software, USDA participated with the University of Missouri in the production of a Model for Review of Nutrient Database System Capabilities. This model was published as a monograph and is available from the University of Missouri's Dietetics Education Department.

Moving into the 90's, some would say that even though much has been accomplished in terms of nutrient data development, the cup remains half empty. I prefer to be more positive and say that it is half full. In the 90's it will be filled. USDA is looking ahead to meet your needs, as well as their own. Efforts relative to nutrient databases over the next decade will be influenced, at least partly, by the outcome of studies relating health to nutrient intake, the successes that occur in analytical methods development, and advances in computer technology. The first two factors will affect which nutrients are emphasized in nutrient data research. The latter will affect how the data are disseminated.

Handbook No. 8 will be updated on a continuing basis. Supplements are planned annually for the foreseeable future which will provide the opportunity for adding new foods and making important updates to existing data. As needs arise, data for complete food groups will be revised and replacement sections issued, as is being done for the beef products section this year. Plans are already underway to revise baby foods, fats and oils, sausages and luncheon meats, and breakfast cereals.

In view of the time and resources required to develop methodology, select and analyze samples, interpret results, and develop representative values, USDA needs assistance from the clinical, epidemiological, and nutrition communities to identify nutrients that may need increased emphasis. Information about needs and priorities obtained from you at past Nutrient Databank Conferences, and from researchers within USDA, officials of DHHS agencies, and leaders of several clinical trials, have lead HNIS to add individual fatty acids, amino acids, and selenium to the database for individual intake surveys. Other nutrients that have been proposed for study are carbohydrate fractions, total starch, soluble starch, individual sugars, and individual carotinoids. Assistance from the groups who ultimately use these nutrient data, not only to identify the nutrients but also to help plan and support the research where possible, will greatly increase the probability that needed data will become available.

In July, USDA and DHHS will receive a final report from the Expert Panel on Nutrition Monitoring that was convened in 1987 to provide a scientific review of data from the National Nutrition Monitoring System. Recommendations included in this report also will be considered when priorities are set for nutrient data research for the next decade.

One type of nutrient data that has been requested that probably will not be available in the 90's is nutrient data by brand name. With the USDA Nutrient Databank it has been possible to compare nutrient data both within and across brands. In most cases, variability within brands is as great or greater than variability across brands. This is one reason for using generic data. Of greater importance, however, is the cost associated with obtaining nutrient analysis by brands. Last year, at my request Drs. Rizek and Beecher estimated, and I think it was conservative, the cost at $200 million initially and then $70 million annually to monitor for change. In view of financial constraints within the Federal government, I think you can see why there cannot be a strong emphasis on brand name data beyond what is being done currently, i.e., mainly breakfast cereals and candies. Of course, when real differences exist between brands, different brands are treated as different food items. For the Nutrient Data Base for Individual Food Intake Surveys, descriptive information frequently includes the various brand names associated with a given set of generic nutrient values.

With the proliferation of new foods and new terminology to describe those foods (i.e., lite, lean, low salt, etc.), not to mention the introduction of various macro nutrient substitutes and new or improved products resulting from biotechnology, cooperation of the food industry is essential for the Government to meet the needs of the next decade. The cooperative projects I described earlier work to everyone's benefit because they lead to improved databases.

The Department needs continued cooperation from food companies producing processed foods. A number of companies provide the USDA Nutrient Databank with analyses of their products on a regular basis. However, cooperation has waned in the past decade; and if we are to fill that cup, their cooperation is essential, even if the data provided cover only those nutrients used in nutritional labeling. Seeking this cooperation will receive renewed emphasis by USDA early in the nineties.

Throughout the 90's, USDA also must continue to keep current and expand the Nutrient Data Base for Individual Food Intake Surveys -- a database that I believe will receive increased attention from nutrient data users in the next decade. Why is this the database of the future?

First, it is an essential component of the National Nutrition Monitoring System and is used with the system's major surveys -- NFCS, CSFII, and NHANES. It must be kept current throughout the nineties, since continuous updating is necessary for both CSFII and NHANES III. New foods will be added when they are reported on either survey, and updated nutrient values will be incorporated as they become available through Handbook 8 No. revisions. Data for additional nutrients, beyond the current 28 plus energy, will be added to the database as they are identified and research completed to provide the necessary values.

This database is already being used in an important new system that is under development jointly by USDA and the University of Texas School of Public Health in Houston. In fact, all the components of USDA's information system that generates this series of survey databases are used -- the recipe file, the Primary Nutrient Data Set, and the Table of Nutrient Retention Factors. The new joint system will maintain the integrity of the USDA database but will allow users to add additional foods and nutrients. It also provides options of using the USDA recipes, modifying them, or entering new ones. The recipe calculation program duplicates the procedure used by USDA's Nutrient Databank.

The new joint system includes programs for use with both detailed food records and food frequencies. It will include on-line interactive procedures for both food intake and recipe coding. Plans are already underway to make this system available to the USDA Human Nutrition Research Centers. Once all phases are complete, other government agencies, and then private organizations, will have access to it as well.

On the horizon at HNIS is an electronic bulletin board for providing up-to-date information about nutrient data releases. It can be accessed by other computers via telephone connections and will contain current announcements about USDA nutrient data sets, handbooks and provisional tables. It will also be a source of information about future Nutrient Databank Conferences.

Small data files such as the data from Home Economics Research Report 48 on the Sugar Content of Foods may also be installed on the bulletin board to permit data users to download the files to their own computers. This will be the Department's first step into electronic transfer of nutrient data. As computer technology advances, the dissemination of larger data files by electronic means may become a practical option. It is a technology in which USDA plans to be an active participant.

Conclusion

Many challenges will face the Federal government in the 90's in its mission to develop and disseminate useful nutrient databases. The increasing diversity found in the market place combined with the Government's commitments to nutrition and food safety will impose new requirements on both the databases and the computer systems that use these databases.

The Food and Drug Administration recently compiled their needs for food composition databases. They include:

- More data on ethnic foods, restaurant foods, deli and fast foods, and convenience products.
- Complete descriptions for foods including ingredients, processing, preservation, packing, etc.
- The ability to link food composition and other databases through common food descriptors.
- Greater flexibility and utility in retrieving information from food composition and other databases based on specific characteristics of foods.
- Standardized serving sizes established and periodically reviewed by a peer review group.
- Continued development and clarification of policy concerning the use of database data for the nutritional labeling of foods, especially mixed dishes.
- More information on the ingredients and composition of imported foods.

Many of these requirements exceed the traditional scope of nutrient databases, and will require new and innovative approaches to database and system development. I am confident that the Federal agencies involved in these activities will work together, seeking input from the food industry and the community of nutrient data users, to maximize the resources available to meet the challenges of the next decade.

NUTRIENT DATABANKS
THE ROLE OF THE FOOD INDUSTRY

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My assigned task today is to discuss nutrient databanks from the industry perspective. Specifically I have been asked to comment on what the industry is doing to assist in their development, their application of this information, and the possible future plans and needs the industry may have with respect to these data. This discussion is from my particular viewpoint, other industry spokes-persons may have a different perspective.

I will first describe what the "food industry" is and what it is not. I will confine my frame of reference to that segment of the industry which is involved with the processing of raw agriculture commodities into finished foodstuffs ready for human consumption. It is important to understand the heterogeneous nature of the processed food industry. Not only are there recognized differences in the type and mix of products manufactured, but there are major differences in their mode of operations. Some companies produce and market foods on a national scale, whereas the vast majority operate only in local or regional markets.

A significant describer often used to differentiate members of the industry is their size measured in terms of annual dollar sales. Some statistics to ponder -- the domestic processed food industry is a $350 billion enterprise. The top ten largest companies represent approximately one-quarter of the total sales dollars. The largest food company in the U.S., formed by the recent merger of Kraft and General Foods, alone represents about one-third of that portion. It takes the combined sales of the companies ranked 21st to 30th to equal the sales of Kraft-General Foods. Yet, the accumulated total sales of the top 100 largest food companies accounts for only 60% of the entire processed food industry. Clearly there are a few very, very large food companies who have the resources to support the technical and consumer information programs which can develop and utilize the information generated by the nutrient databanks. However, there are many more food companies representing the majority of the sales dollars that have only limited resources to contribute to the development or utilization of the information of the nutrient databanks. Thus the "food industry" should not be considered to be a single entity but rather looked upon as a segment of business which exists and operates for profit in a highly competitive environment.

Today the food industry is in a state of change. During the past five years there has been a number of corporate mergers. There have been 300 separate food industry related organizations involved in some type of merger activity in the past year alone. Old familiar products like Kraft Velveeta cheese is now in the same corporate family as General Food's Jello. The Pillsbury Dough boy is really indeed a "dough boy", with a British accent, being merged with the British Food concern, Grand Met. Del Monte peaches are corporately related to Nabisco Shredded Wheat and could easily be served with Standard Brand roasted peanuts all within the same corporate home. It is getting more difficult to go into the grocery store and say, "Yes, I trust that brand because I have used other products made by that company for years."

What is the impact of these activities on your particular interest of nutritional databanks? How will these changes affect their future development? The food industry has in the past provided valuable resources in methods of analyses, consumer information, and analytical data programs. Because of consolidation and competitively driven efficiencies many of these previously available programs are now being scaled down or eliminated. In the short term, those seeking information on old familiar products will have to write to new addresses or use new telephone numbers. Those of you who are maintaining nutrient databases may not know which company manufacturers what products or who within the company might have the information you are seeking. In the long term, because of the cut-back in routine services and support programs, there will quite likely be less "non-profitable" activities conducted such as routine nutrient analyses and thus fewer numbers to add to databases. Smaller companies simply lack the resources to provide the information needed for nutrient database development.

The food product mix available to the public is changing very rapidly. More products than ever are reaching the market. The average supermarket now has about 24,000 different food items on their shelves and there is a growing trend for more and more hyper-markets with even larger selections. There are hundreds of new products introduced every year. Granted, many of these "new products" are simply extensions of older products thus the nutrient data will not change; however, there are many completely new products now entering the market place designed specifically to satisfy consumer demands for lower cost, greater convenience, and/or personal preference. Some of these products may have a life span of only a few months, which means they will come, be consumed by the public, and be gone before any nutrient analyses can be developed and entered into any nutrient databank. Food stores now have more delicatessens, greater fresh fruit and vegetable selections, and more salad bars providing foods which are unaccounted for in any nutrient databank. These change are occurring so rapidly that it is nearly impossible to keep up-to-date on any nutrient database which would adequately represent the foods now available to the American public. To the industry this chaos means tremendous opportunity. When consumers change attitudes and modify buying patterns, creative companies capture these new market trends and launch new products to meet these needs. To database builders, this chaos must mean absolute and utter confusion. I do not see how it would be possible for any system to adequately keep up with the rapid changes now occurring throughout the food supply and maintain an adequate nutrient database -- even with computers.

The larger food companies have the talent and resources to predict what the consumers want and what their attitudes are and will be in the near term. The competitive nature of business leaves little room for error. This same competitive environment stimulates creativity. For example, the success of Quaker Oats has stimulated many new products from many companies in a variety of shapes, sizes, and tastes. I suspect there is not one databank in the country that contains nutrient information on the myriad of products that now feature oat bran.

Taken in it's totality I do not believe the food industry has any direct interest in building nutrient databases per se. Unless there is an associated business interest, these types of activities will likely be considered nonessential and will not survive budget cuts when economy measures are initiated to make the "bottom-line". More consumer demand for nutrition information will likely be the most effective way to enhance the food industry's sustained interest in establishing and maintaining an adequate nutrient database. If enough people seek out this type of information and if indeed the consumers demand it, and especially if there is evidence that they alter buying behavior because of this information, then and only then will the industry respond. An alternative strategy to enhance the industry participation in providing nutrient data on new and/or existing products is through regulation or legislative action making compliance as part of doing business. Currently the information provided on the nutrition label is voluntary and there is little monitoring by the FDA for compliance. If regulations governing food labeling become more stringent as a result of the current FDA efforts to modify the food label then the industry will have no choice but to focus more resources toward generating and maintaining this information.

As a clinician working with an individual client, you can have an immediate impact on the consumer's food buying habits. By encouraging your clients to seek out those foods with nutrient information and encouraging them and others to communicate that fact with the manufacturer. Through these activities you can have an impact on the industry. If enough consumers react the same, making their demands known, then the industry will likely respond.

For the most part, the food industry has been involved with the process of nutrient databases as a result of nutrition labeling initiatives. In the early days of nutritional labeling emphasis was regulatory in nature rather than for the purpose of providing consumers information. The emphasis was on compliance, with an emphasis on accuracy of analytical information, rather than on encouraging meaningful consumer information programs within reasonable limits of variation of nutrient content of the food. If nutritional labeling rules could have been introduced in a voluntary, informational mode, minimizing the issue of compliance, there likely would have been more cooperation by industry. Because of this compliance posture many members of the industry have been cautious about what they will and will not put on a label and the amount of data and information they will make publicly available. For example, in most cases the nutrient values provided on the label understate the actual nutrient content of the product. This is done in order to ensure compliance. By definition, if the mean value for nutrients were stated on the label many individual values would be less and thus considered to be out of compliance. In the case of the "bad-guy" nutrients, i.e. cholesterol, fat, sodium, and calories, the label declaration will be greater than the actual value again, for compliance purposes. Certainly, if you need precise nutrient information for metabolic studies or other research procedures, the information on the product label is inexact and may bias your food records. Depending upon the need for precision, it may be necessary to do actual analyses of the foods as consumed.

Consumer interest in health and nutrition is having an impact on the industry's attitude about providing nutrition information on product labels and auxiliary information materials. Only a few years ago it was generally felt that nutrition would not sell products and marketing departments took a rather dismal viewpoint toward the subject. Increased public awareness, prompted by many of the government reports on the relationship of diet and health have reversed many of these old opinions. Today new products are launched BECAUSE of their nutritional "point of difference". In order to meet the consumer interest in nutrition many products now feature low sodium, low cholesterol, low calorie, high fiber -- claims which must be supported by analytical data.

The development and standardization of analytical methods is prerequisite of an expanded nutrient database. The industry has played a key role in developing and standardizing acceptable procedures. Despite tremendous advances during the ten years of the existence of nutritional labeling, many methods for nutrient analysis lack the accuracy, precision, speed, and economies to have broad application across to a diverse industry. Take the analysis for "dietary fiber" as an example. The USDA Nutritional Databank provisional table on dietary fiber was proceeded by an AOAC collaborative study wherein ten different food samples were analyzed by thirty-two different laboratories. The purpose of the study was to determine the ability of these laboratories to analyze a number of food samples for dietary fiber and to see how closely they could agree on their content. The results of the study were less than encouraging. Some products had acceptable variation of some 2.9 or 3%, whereas in some foods, the fiber content was determined to vary over 100% depending on the laboratory which did the analysis. Despite the inabilities of the various laboratories to come up with the same values for commonly eaten foodstuffs an "official method" was accepted. Food tables and nutrient databases now contain a single value for the "dietary fiber" content for many of foods as if the content is absolute and without variability. The precision and rigor for many of the other analytical methods used to determine the nutrients commonly contained in Nutrient Databank are no better. The point I wish to emphasize is that just because a database contains a value for a nutrient to two digits to the right of the decimal does not reflect the rigor and precision of the true nutrient content of that food. The methods for nutrient analyses are simply not that precise. Nor is our knowledge of the variation in nutritional content resulting from difference in growing, harvesting, distribution, and home preparation.

A justification of the "cost vs benefit" to the industry is appropriate before an expanded nutritional database can be advocated. Despite the shortcomings of the analytical methods available, values for most nutrients can be generated at a cost. Currently the minimum cost to do a comprehensive nutrient profile of a food, namely fatty acids, amino acids, macro and micro nutrients, can be $1000 to $1500 per sample. Considering that the analyses for a nutrient profile of a product, manufactured at a number of sites, must be replicated at least 6 times per site per year in order to attain and maintain a reliable estimate of the nutrient profile and that if a company manufacturers 50 to 100 separate products, it is easy to see how vast amounts of money can be spent each year just to develop and maintain a nutrient databank. Today, many corporate managers view these expenditures as being unproductive. Unless this information can be used for the generation of new markets or new products, the prospect of an expanded participation by the industry is doubtful. Development of future markets dependent upon real nutritional "points-of-difference" between products and the competition may be the rationale needed for greater industrial participation generating this information.

What will be the future role of the food industry in the development and maintenance of nutrient databases? The answer to this question will likely be determined by the resolution of a number of current issues. The revision of the nutrition label, its content and format; the resolution of the pending FDA health claims guidelines which have been in the development for over two years; and the continued public interest in the nutritional and health value of their food supply.

There are a number of regulatory and legislative initiatives currently in process which will affect the labeling of foods. Many of these relate directly to the type and amount of nutritional information which will be provided to the consumer. Included in these proposed revisions to the label will be an extension of the information provided on fat (type, amount, fatty acid profiles and % calories), carbohydrate (splitting the complex carbohydrates from the simple sugars), the dietary fiber (splitting the total into soluble and insoluble) and the possible reduction or elimination of a number of the nutrients which would appear on the label. Based upon the change in the label information which are eventually adopted, the industry will likely provide the resources to develop the necessary data to comply to the new regulations. If properly positioned these data should be available to be included into nutrient databases.

The proposed FDA regulation governing what health messages may or may not be included on the food label and in related advertisements, the purview of their sister agency the Federal Trade Commission, will likely have an impact on the type and amount of nutritional information available. For example, if a product made a statement that is was high in the soluble fiber and in turn shown to be effective for lowering cholesterol levels, then it would be expected that company would have not only the clinical data to support the cholesterol reducing claim but also have the analytical information to document the soluble fiber positioning. The marketing departments can justify and will pay to have that type of information developed.

Legislative action governing food labeling may have even a greater impact on the industry involvement in generating nutritional data. For example, if it were to become law that in order for a new product to be launched the complete nutritional profile would have to be registered with the FDA or USDA whatever the case, then these data would readily be available to nutrient database users at the time when the new product is introduced. Secondarily, if fines were levied against the corporate officers for products found to be out of compliance of a mandatory nutrition labeling program, then I would expect the industry would take a more proactive position. This positioning, however, would likely result in dramatic under declarations of the nutrient content of the product for fear of prosecution.

Alterations in the requirements to be met before nutrients are added to foods would likely favorably influence the industry's interest in maintaining nutrient databases. Currently, the FDA has a series of "guidelines" which supposedly governs the addition of nutrients to foods. Included within these statements are the provisions that nutrients may be added to foods to restore those lost during processing. In addition, nutrients may be added to meet identified public health needs into foods in a form which may be readily assimilated by those identified to be at nutritional risk. These guidelines, if implemented, would severely limit the number of foods and the number of nutrients added to foods until the industry accumulated more information, including the nutrient profiles of their products, and had better estimates of the nutritional intake of their target audiences.

As the consuming public become more interested in and expands their awareness of the nutritional content of the foods they choose to eat, the industry will become more interested in developing nutrient databases and in providing the information to the public. Consumer communication and information programs which highlight the nutritional attributes of the company's products are gaining greater acceptance as a meaningful marketing strategy. As these programs, which rely heavily upon having meaningful nutritional information, gain wider recognition it will be necessary for the industry to have more involvement with the development and maintenance of nutrient databases.

In summary, the food industry is likely to embrace the generation of more nutritional information of foods provided the public wants and can use the information.

There will likely be greater industry participation in this process if, because of legislation or regulation, it becomes part of doing business.

The public is likely to continue to demand more information on the nutritional value of their food supply. As medical costs continue to increase and as science learns more about the relationship of diet and health, the industry will take advantage of the marketing opportunities which are based upon either knowing the nutrient profile of their existing products or in developing designer foods which provide a predetermined nutrient profile.

The food industry is a great complex made up of many very different organizations and businesses. In spite of the apparent inefficiencies, the system works to feed nearly 300 million people three times a day so effectively that consumers in the US spend less of their disposable income and time on food than in any other place in the world. This is done with such efficiency in the US that overnutrition is more of a public health concern than are nutritional voids.

In order to ascertain the impact of the long term changing food supply on the health of the population or to provide proper nutritional counseling to the pubic on a short term basis, it is necessary to have some estimate of the nutritional content of the foods available for consumption.

When processing this information, it is important that the user have an understanding of where it came from, and have a clear understanding that the numbers contained in the carts or in the memory bank of the PC are, at best, "estimates" and are not to be considered absolute values. Only with the proper respect for the other sources of nutrient variability can the user properly interpret and use the information contained in the nutrient databases.

As inexact as the system is for determining the nutrient profile of foods and applying this information to individuals and/or populations, it is necessary in order to continue to advance the understanding of the relationship of diet and health, and for this alone the work must go on!

NUTRIENT DATABANKS AND EDUCATION -- A DECADE OF PROGRESS

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Educational institutions use nutrient data in a variety of ways. A major use, of course, is for classroom exercises -- either to analyze diets or to design diets. Nutrient data also are used to prepare educational materials -- various types of handouts, for example. Also, we use nutrient data as a resource when consulting with other professionals and non-professionals (often overlooked, but an important function). I receive calls almost daily asking for information on the composition of foods. Finally, educational institutions are also usually research institutions, so we use nutrient data as an integral part of many research projects. Nutrient data are used by multiple departments on our campus -- not only the Department of Nutritional Science. Others include the School of Public Health, the Anthropology Department, the Physical Education Department, and the Student Health Service.

A DECADE OF PROGRESS

The decade of progress in educational uses of nutrient data has been made possible by three parallel advances. First, of course, are the advances in nutrient data. But it would not have been possible to take advantage of these advances if there had not been parallel advances in computer hardware and software. Let me first show you where we were in each of these areas 10 years ago, and then discuss the impact of progress in each area in more detail.

The "state of the art" diet analysis system that was in use on the UCB campus in 1979 used a nutrient database (the Minilist, developed by Jean Pennington in the early 70's[1]) derived from Agriculture Handbook No. 8[2] and literature values. It was a unique database, in that it contained complete nutrient data on 48 nutrients, and was accompanied by a printed index which specified substitutions for all foods in USDA Handbook No. 456[3] (which the students used as a coding manual) with one of the 230 foods on the Minilist. However, many of the nutrient values were out of date by 1979, and several of the nutrients of current interest (such as dietary fiber) were not present. Although the first revisions of Handbook No. 8 had been published, none had been incorporated into databases in use by students or researchers.

The computer hardware in use for classroom diet analysis exercises at that time was a punched card oriented CDC 6400 mainframe system. Students were given a deck of punched cards and shown how to use keypunch machines. When their diets had been punched, they put them though a card reader, and waited for the diet totals to be listed (which was often a half-hour or more). If there were errors in the codes or portion sizes, new cards were punched and the process was repeated. Students could only use the system for the duration of the class -- since each card deck had to be preceded by a job card with a billing number, there was no option to run additional diets at a later time. Backup copies of the diet analysis program and the nutrient database also were kept on punched cards.

The diet analysis software was a FORTRAN batch program. Codes were required for subject information (in a pre-specified format) and for diet items. There were no options to save dietary totals for later use in statistical analyses, which was a great handicap for researchers (some of whom re-keyed the totals into cards, and then read them into SPSS programs).

Advances in nutrient data availability

There have been significant advances in both the quality and quantity of nutrient data over the past decade and in the <u>availability</u> of nutrient data as well. The 5 revised Handbooks No. 8 that had been released by the end of the 70's have now expanded to 17;[4] each is larger than the original handbook. This expansion of nutrient data has had an enormous impact on educational institutions. We can now answer questions on even the most esoteric of food items (usually). Furthermore, we use the electronic (tape) version of these revisions to update our research database.

However, the total cost of the 17 books is about $180, and the sheer size of the set prohibits its purchase and use in the classroom. Fortunately, a revised and expanded USDA Home and Garden Bulletin No. 72[5] was released in the mid-80's. This version is available on diskette, contains a wide variety of foods commonly consumed by students (e.g., tofu, quarter-pounder fast-food hamburgers), and gives nutrient values for an expanded set of nutrients. The cost to students is only $2.75.

Yet another advance in the availability of nutrient data has had a large impact on educational uses -- the development of USDA's Nutrient Data Base for Individual Food Intake Surveys. The current database, with over 5000 food items, is too large for classroom use (due to limitations in our current capacity for disk space), but has been used in numerous research projects. It is complete (no missing data) for 30 nutrients, and also offers a variety of fat and salt codes. I have used it in numerous research projects, and also on several occasions to provide lists of rich sources of certain nutrients. The recipe files that are used to generate the nutrient values on the Survey database are also made available in electronic form by USDA, and these have also found many applications in various research projects. Finally, the nutrient retention factors that are available on tape have been widely used in a variety of ways.

Other advances in nutrient data have come from organizations other than USDA. We have made extensive use of the trace mineral data from the Total Diet Study[6] in updating our research database. Non-government publications also have contributed to our resources on food composition -- in the scientific literature (for example, the many publications giving dietary fiber values; also, the important information being published in the new *Journal of Food Composition and Analysis*), and in book form as well. Finally, advances in the availability of nutrient information from industry have had an important impact on education -- and in some cases, a direct impact beyond the classroom since this information has the potential to reach all consumers. More comprehensive nutrition labeling on processed foods has increased consumer awareness, as have the various pamphlets that are now made available to professionals and lay persons alike (many ice cream and yogurt shops, for example, post nutrition information; McDonalds, among others, has nutrition booklets available in their fast food outlets).

Because of their specific need for nutrient databases that are appropriate for either classroom or research applications, many educational institutions have turned to compiling their own databases. Rarely do these institutions generate new nutrient data, but we do put together existing nutrient data in ways that will be particularly useful for our needs. The tremendous advances in available nutrient data have opened many possibilities for tailoring databases for educational needs.

Advances in computer hardware

Educational institutions could not have taken advantage of these advances in nutrient data availability without parallel advances in computer hardware. Advances in main frame technology have been very significant this past decade. Our campus has replaced the card-oriented CDC 6400 with a terminal-oriented IBM VM/CMS system. This shift has been accompanied by greatly increased disk storage availability and greatly decreased costs, and, of course, substantial time savings for users. High-speed terminals with direct lines or personal computers (PCs) with modems may be used to access the mainframe. Our current ability to incorporate the enormous amount of nutrient data released by USDA into our research and classroom nutrient databases would not be possible without these advances.

Communications technology also has had a great impact on educational uses of nutrient data. Not only are all campus computers (including personal computers) potentially connected to each other and to the mainframe, but off-campus personal computers or terminals can dial the mainframe and then access other mainframe users both on and off campus. Connection of multiple computer centers via networks such as Bitnet further broadens our electronic access to other campuses and institutions. The ability to easily transfer dietary and nutrient data between small and large computers via phone lines has had a major impact on the research projects that can be undertaken.

Certainly the hardware advance with the greatest impact has been the proliferation of microcomputers. At Berkeley, our reliance on the main frame has gone from 100% to 0% for classroom exercises. This has significantly diminished our costs, since currently at least, use of the microcomputer facilities is free for classes. Along with the personal computer has come advances in data storage technology, so that relatively large nutrient databases may be stored and easily accessed -- we use diskettes and hard disks for various applications. Many students have access to PC's of their own (or in their dormitories or living facilities), and thus are not limited by the availability of public-access machines. Furthermore, we offer copies of our classroom diet analysis system to our students at no cost, and a large number take advantage of this offer. Ready access to hardware has made a large difference in what we now consider feasible for a student assignment.

Advances in diet analysis software

I am going to use "diet analysis software" as a generic term for programs that access nutrient databases, although in some cases the interest is more in food items than in actual diets. Development of diet analysis software has been a high priority on many campuses this past decade. The level of programming ability is usually high, and financial support for development of educational systems is often readily available. On our campus, IBM has provided both hardware and vendor software to my department at no cost, as part of a grant to develop classroom diet analysis systems. As a result, we have made significant advances in this area over the past 10 years, and particularly in the last 3-4 years.

Most diet analysis systems now offer a dazzling array of special features. Data entry is completely interactive -- the student is prompted for each item of information, and is informed if the entry is inappropriate (an alphabetic entry for age, for example, or an unavailable food code). Many systems no longer use food codes, but display menus from which the user chooses an item. Some systems even offer lists of foods high or low in certain nutrients, for use in diet design or modification. There are usually on-line editing and error correction abilities, along with graphic output displays. Dietary totals can be viewed at any time, and in some cases, a running tally of certain nutrients is displayed on the screen. If the user gets in trouble, there are help screens available as part of the program. Both the programs and databases may be kept on hard disks or diskettes, and maintenance of either may be performed without paying mainframe charges.

Advances in vendor software (i.e., software which can be purchased) has had a great effect on our capabilities. Obviously, commercially available diet analysis systems have had an impact, and several have been used with great success in the classroom. Usually they offer an array of sophisticated features that often are beyond our capabilities to develop -- but unfortunately often at a price we cannot afford. However, tools are being offered, often as part of a PC when purchased, that facilitate development of advanced programs: spreadsheets, sophisticated graphics, split screen options (such as Windows), etc. Three systems have been developed on our campus recently and incorporate many of these advanced features. Two use the Home and Garden No. 72 nutrient database. The first, developed primarily under my direction, runs on an IBM personal computer and is geared to classroom diet analysis exercises. The second, developed by Pat Booth (a member of our faculty) runs on a Macintosh with Hypercard, and is geared to either diet analysis or diet design exercises. The third system is an updated version of the program that accesses the revised and expanded Minilist. It now runs on a PC as well as the mainframe, and uses several new programming features: an automated substitution index, a recipe file, and automatic saving of diet totals for later analysis.

An example of a new educational system using these advances

These last few months I have been working with several other members of my department to develop a revised and expanded diet analysis system for classroom use. Although we have been very pleased with our current system, which uses the Home and Garden No. 72 (HG72) database exactly as distributed, several of us wished for a broader range of nutrient values. Thus, I decided to use the information on the Survey database to expand the number of nutrients on the HG72 database.

A senior in our undergraduate program, as part of an independent study program this last semester, developed a list of foods from the Survey database that approximately correspond to those in the Home and Garden Bulletin No. 72. She entered the SDB food codes on a PC, and we uploaded them to the mainframe. Then, working in SAS, I generated a listing comparing both the food names and the nutrient values from the original HG72 base and the corresponding values from the SDB. When we were satisfied that the matches were correct, we deleted some foods (primarily those with large serving sizes, such as a loaf of bread, a whole cake or pie, etc.), and added others (primarily mixed dishes). This new subset of the SDB now resides on the mainframe while we finish checking our codes, and then will be downloaded to the PC. In addition, we have begun formatting the database so we can print our own manual (since we have added 10 new nutrients and altered the foods and food codes).

We anticipate having this version of our system working by the end of July (in preparation for use in classes at the end of August). Anyone who would like more information on the system should contact me.

A DECADE OF CHALLENGE

As hard as it is to remember back 10 years, it is even harder to imagine where we might be 10 years from now -- at the end of the century. However, here are some thoughts about what further advances we might see in each of the three areas.

It doesn't take a crystal ball to see that there will be further revisions and expansions of nutrient databases. Handbook No. 8 will be completely revised within the next few years, and no doubt the revisions to the revisions will begin. I hope there will also be continued updates to Home and Garden Bulletin No. 72, which we have found so useful. I would also hope there will be increased availability of international nutrient data, led by the pioneering work of INFOODS. Finally, an item high on my wish list is to see more availability of industry data in electronic form. Collecting, entering, and updating these data is currently a formidable task.

Obviously, we expect great advances in computer hardware over the next decade. I couldn't even begin to guess what hardware the state-of-the-art diet analysis system of 1999 will use. However, it's clear that trends toward increased speed and storage, at reduced costs, will continue. We would also expect to see continued miniaturization of components, leading to increased portability. It's possible to visualize a time when students will bring small computers to class, even as they do now with calculators. An instructor can ask everyone to obtain a list of foods high in calcium, for example. Diets can be designed <u>in class</u> (or even as part of an exam) and modified on the spot to meet specified goals. Further advances in electronic communication will also allow even greater ease of data exchange, not only within the US, but worldwide.

I'm sure there will be equally exciting advances in diet analysis software over the next decade. An immediate expectation is to have a variety of programs that will access USDA's Survey Data Base. Programs are under development in several locations, and these will be a boon to research in educational institutions. Eventually, as personal computer hardware capabilities and networking facilities expand, these systems will be applicable in the classroom. I would also expect to see continued advances in menu-driven data entry. Synonym abilities will be expanded, so that finding the right food item will be made quicker and easier. Certainly we would expect to see an even wider spectrum of interactive diet analysis software for microcomputers, offering many options that would enhance their use for educational purposes.

The continued progress in development of nutrient data, and the technology to access it, will have a profound impact on educational uses of dietary data. Specifically, it will make the instructor's job easier because points can be illustrated and reinforced almost immediately (and much of the information that had to be written on the board or in handouts can be eliminated). But more importantly, it will result in a better education for our students: ready access and use of nutrient data will result in a better understanding of nutrient sources in diets, and thus ultimately in an enhanced ability to choose, or advise others on how to choose, healthy diets.

REFERENCES

1. Pennington, J.A.T. *Dietary nutrient guide.* Westport, CT: AVI Publishing Co., 1976.

2. United States Department of Agriculture. *Composition of foods.* Agriculture Handbook No. 8. Washington, DC: U.S. Government Printing Office, 1963.

3. United States Department of Agriculture. *Nutritive values of American foods.* Agriculture Handbook No. 456. Washington, DC: U.S. Government Printing Office, 1975.

4. United States Department of Agriculture. *Composition of foods.* Agriculture Handbooks No. 8-1 - 8-17. Washington, DC: U.S. Government Printing Office, 1976-89.

5. United States Department of Agriculture. *Nutritive values of foods.* Home and Garden Bulletin No. 72. Washington, DC: U.S. Government Printing Office, 1985.

6. Pennington, J.A.T. "Revision of the Total Diet Study food list and diets." *J. Am. Diet. Assoc.* 82 (1983): 166-73.

USDA-INDUSTRY COLLABORATION IN THE GENERATION OF FOOD COMPOSITION DATA

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Recent interest in consumption of low-fat, low-cholesterol foods has prompted collaboration of the United States Department of Agriculture (USDA) and the food industry to provide current information regarding the composition of food being consumed in this decade. Accurate food composition data is required by many groups in industry and government. Food manufacturers are interested in providing up-to-date accurate composition data on the label and government agencies are interested in providing up-to-date information for food intake surveys and other research.

Industry-Government collaboration on technical problems can be beneficial for both groups. This is especially true in the area of research data generation, and specifically of nutrient composition data. Government and industry both need this information and some of our shared projects have provided cost savings for both groups. I will discuss two recently completed projects which have generated valuable data for both groups.

Scientists at the Nutrient Composition Laboratory are concerned with developing analytical methodology, and more recently are concerned with maintaining accuracy of food composition data. Agriculture Research Service has commodity specialists in laboratories at Beltsville, Maryland and in a number of agricultural research centers in other parts of the U.S. Universities are also frequently working with analytical projects and share their expertise and data to the combined effort of maintaining accurate food composition data.

USDA is also a user of nutrient data through the Human Nutrition Information Service and the Nutrition Monitoring System so there is expertise in determining what data is needed. Other government agencies also use nutrient data, such as the Agriculture Marketing Service and Food Safety and Inspection Service of USDA, and the National Center for Health Statistics.

Industry likewise provide considerable data on food composition that are incorporated into food composition handbooks published by USDA. Industries are concerned about the nutrient content of foods they produce. Industry conducts considerable analytical work on their products to comply with labeling requirements of the FDA. Industry expertise in the marketing area is especially valuable to USDA in the development of representative nutrient values. Industry has an unique insight on the future of food products, and many have provided confidential forecasts that improve USDA's food sampling plans. In addition to information, industry groups often provide manpower, food samples, and dollars for product analysis.

Some of the most valuable cooperative ventures involve development of new analytical methodologies. Industries often develop simplified methods for analysis. By sharing samples and results we can evaluate these new methods and benefit from those that are valid.

Two recent collaborative efforts illustrate the mutual benefits of these endeavors. The first began when the National Cattleman's Association and the National Livestock and Meat Board came to USDA's Human Nutrition Information Service (HNIS) and asked that USDA's meat values be reviewed. These two commodity groups claimed that meat marketing practices had undergone radical changes that were not reflected in the most current USDA publications. To address this need a study was designed with the cooperation of both commodity groups and USDA's Meat Science Research Laboratory and Nutrient Composition Laboratory at Beltsville as well as the Nutrient Data Research Branch of HNIS. The National Center for Health Statistics were also involved because of the upcoming Health and Nutrition Examination Study (HANES) study. The Agricultural Research Service and the National Cattleman's Association checkoff program both contributed funds and the study was conducted at Texas A & M University.

In this study a sampling plan was devised that selected retail beef from supermarket chains that provided at least 1/3 of the beef in a given city. In most cities two supermarket chains met the criteria of sampling. Samples were selected in sixteen cities in an attempt to assess variability and track geographical trends of meat merchandizing.

In the actual collection of samples at the representative grocery stores, two samples of each cut were purchased for chemical dissection and chemical analysis. A large ground beef sample was also taken. Thickness of both cover fat and seam fat was measured. Results of the analysis will be discussed by Lynn Dickey later in this conference.

A second recent study involved analysis of eggs. Analytical data on cholesterol in eggs was published in Handbook No. 8-1 in 1976. This was based on the calorimetric methods published at that time. Two large egg manufacturers began marketing eggs with cholesterol values of about 2/3 that published in the USDA handbook. Their carton reported 190 or so mg cholesterol, while the USDA value was 274 mg cholesterol. The Egg Nutrition Center asked that USDA reconsider their egg values and agreed to participate in a collaborative study to rectify the discrepancy. A joint endeavor between the Egg Nutrition Center and three USDA services (HNIS, the Agriculture Marketing Service, and the Nutrient Composition Laboratory) conducted a comprehensive study of the nutrient composition of eggs.

The egg study was conducted in two seasons, summer and winter, because of a suggestion in the literature of a seasonal effect. Sampling occurred in Summer of 1988 and Winter 1989. The Egg Nutrition Center provided marketing information and helped identify 200 major egg packers across the United States and asked them to become part of this project. In the first phase 118 packers contributed eggs to the study which was representative of 67% of the US egg production.

The contractor who conducted the analysis made 26 yolk composites that were analyzed for cholesterol, fat, and fatty acids. In addition 13 composites of whole eggs were analyzed for proximates, vitamins, and minerals. Because there was only a small variation between the 26 composites, only 7 yolk and 7 whole egg composites were made during the Winter phase.

Selecting the appropriate contractor to conduct the analysis was an important aspect of this study. We were fortunate to have a standard reference material for cholesterol from the National Institute for Standards and Technology (NIST) with a certified cholesterol value. We sent this material to several commercial analytical laboratories for analysis. Based on these results, a laboratory was selected using the criteria of analytical accuracy, analytical precision, and cost - with accuracy and precision weighted most heavily. In addition, the laboratory analyzed a sample of a quality control material with each batch of eggs that was analyzed. Evaluation of these results indicated that the contractor performed well throughout the project which increased our confidence in the data that were generated. Ms. Lynn Dickey will discuss the results of this study later in this conference.

These two projects illustrate the mutual benefit of collaborative efforts. Of equal importance is the opportunity for technology transfer between government and industry. Government needs the expertise of industry scientists, and industry can benefit from the expertise of government scientists. Each of us learn something as we engage in cooperative ventures, and we come to understand and appreciate the unique problems faced by each group.

USDA NUTRIENT DATABANK PROGRESS AND PLANS

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The Human Nutrition Information Service (HNIS) in Hyattsville, MD operates the National Nutrient Databank to prepare comprehensive food composition databases which are made available in published and machine-readable forms. This presentation will report on progress and plans concerning the Nutrient Data Bank and related activities at HNIS.

Eighteen of the 22 planned sections of the current revision to Agriculture Handbook No. 8, "Composition of Foods . . . Raw, Processed, Prepared" (AH-8), have been completed. They are:

AH-8-1 Dairy and Egg Products
AH-8-2 Spices and Herbs
AH-8-3 Baby Foods
AH-8-4 Fats and Oils
AH-8-5 Poultry Products
AH-8-6 Soups, Sauces and Gravies
AH-8-7 Sausages and Luncheon Meats
AH-8-8 Breakfast Cereals
AH-8-9 Fruits and Fruit Juices
AH-8-10 Pork Products
AH-8-11 Vegetables and Vegetable Products
AH-8-12 Nut and Seed Products
AH-8-13 Beef Products
AH-8-14 Beverages
AH-8-15 Finfish and Shellfish Products
AH-8-16 Legumes and Legume Products
AH-8-17 Lamb, Veal, and Game Products
AH-8-21 Fast Foods

The last two sections (Lamb, Veal, and Game Products and Fast Foods) were released since the last Nutrient Databank Conference. The four sections remaining in this revision are in preparation:

AH-8-18 Baked Products
AH-8-19 Snacks and Sweets
AH-8-20 Cereal Grains and Pasta
AH-8-22 Mixed Dishes

Handbook No. 8-20, Cereal Grains and Pasta, is in the final production stage and will be available this year. The other three sections are scheduled for completion in 1990. Also in preparation and expected to be available this year is a revision to the Beef Products section which was published in 1986. Later in today's program, Lynn Dickey will provide details about the Beef Products revision -- why it was undertaken and where the differences occur in the data.

A market basket study on pork products sponsored by the National Livestock and Meat Board is in progress. The study includes measuring fat trim levels, dissecting raw and cooked cuts into separable lean and fat, and measuring the nutrient content of the separable lean and fat. Information from this study will be used to determine if a revision to the Pork Products section of Handbook No. 8 is needed.

This year we are also beginning a series of supplements to Handbook No. 8 to update portions of previously published handbook sections when complete revisions of the sections are not needed. Since the current handbook revision uses looseleaf pages with one food item to a page, the supplements can be used easily with existing sections. They will include: (1) revised data printed on pages that will replace corresponding existing pages; and (2) newly published data printed on pages that can be inserted into the looseleaf books at the appropriate places.

The 1989 supplement will contain revised data for 55 items, i.e., 55 replacement pages for previously published items. For example, in AH 8-1, Dairy and Egg Products, nine egg items are being updated. Seven other food groups have from two to twenty items that are being revised. The supplement will also include data for 14 new items that can be inserted into the appropriate sections. Examples of the new items are canola oil and ground turkey.

In addition to the "replacement" and "insertion" pages, the 1989 supplement will include tables of data for specific nutrients. Tables of copper and manganese values will be present for AH 8-1, Dairy and Egg Products, and AH 8-2, Spices and Herbs, since these data were not available when the sections were originally prepared. Total dietary fiber will also be included for several food items. The tables covering specific nutrients will be in the form of appendices which can be inserted into specific sections of the handbook. Food item numbers will be included for each value on these tables.

The Nutrient Database for Standard Reference is the computerized data set containing all data from Agriculture Handbook No. 8. The current release is number 7, which includes data from AH 8-1 through AH 8-16. Release 8, in preparation and scheduled for release this summer, also will include data from the Lamb, Veal, and Game Products and Fast Food sections. It will also include data from the 1989 supplement.

A new computerized code manual is in preparation for the Standard Reference database to accompany both the tape and diskette versions. The code manual was designed and is being constructed under contract by Technical Assessment Systems, Inc. It will have separate data fields for food group, food description, percent refuse, refuse description, and the household measure weights and descriptions. It is designed so that additional household measures can be added in the future if information becomes available. The new manual will be included with the Standard Reference database for releases that take place after next year.

The USDA Nutrient Database for Individual Intake Surveys is another database maintained at HNIS. The current working version is being used for analysis of the 1987-88 Nationwide Food Consumption Survey and will be released to the public when the survey results are released.

Since the last conference, HNIS issued a provisional table on Total Dietary Fiber, prepared by Ruth Matthews and Pamela Pherrson. The table is based on data derived by the method of the Association of Official Analytical Chemists (AOAC). HNIS is currently sponsoring an international collaborative study on dietary fiber. Seven laboratories in Canada, England, and the U.S. are analyzing the same 50 samples of foods, under controlled conditions. Each laboratory is using at least two of the current methodologies. Results of this study will be analyzed to determine if HNIS can use data generated by methods other than the AOAC method. Lately there has been increased interest in data on soluble and insoluble dietary fiber components, but presently the database for these components is not adequate to permit deriving reasonable estimates. We are encouraging development of practical methods of analyses for these components to permit reporting them separately.

HNIS has four other analytical research projects underway. We will soon finish the second of two separate analytical studies planned to provide selenium data on major selenium contributing foods from different regions. These data will be combined to provide values for use with nationwide surveys. The second project includes analyses for copper, zinc, manganese and magnesium in a number of foods to confirm or monitor current values.

The third project is to compare the nutrient composition of several wild and cultivated species of finfish and shellfish (catfish, rainbow trout, coho salmon, oysters and crayfish). Of particular interest will be the data on cholesterol and fatty acids, especially the omega-3 fatty acids. Vitamins and minerals are also being determined. The fourth project is to provide data for items missing from our food composition database; for example, aseptically packaged milk and juice drinks. Much of the data from this contract will be included in the 1990 Handbook No. 8 supplement.

This last project also included analytical measurements on the retention of alcohol during cooking, in foods that have an alcohol containing ingredient. This phase of the contract has been completed and several retention factors for alcohol in cooked foods are now available:

Preparation Method	Percent of Alchohol Retained
No heat application, immediate consumption	100
No heat application, overnight storage	70
Alcohol ingredient added to a boiling liquid and removed from heat	85
Flamed	75
Baked, approximately 25 minutes, alcohol ingredient on surface of mixture (not stirred in)	45
Baked/simmered, alcohol ingredient stirred into mixture:	
15 minutes	40
30 minutes	35
1 hour	25
1 1/2 hours	20
2 hours	10
2 1/2 hours	5

Two research projects are planned for fiscal 1989. One involves proximates, vitamins, and minerals for 20 key food items used in the survey database. The foods selected for analysis are major consumption items, and major contributors of the various nutrients. We will use data from the 1987-88 Nationwide Food Consumption Survey to compile a larger list of key foods to be studied in detail over several years beginning in fiscal year 1990.

The second project planned for fiscal 1989 will cover fatty acids and cholesterol for the key foods and also some of the important cooking fats. In 1990 if funds are available, HNIS will conduct additional nutrient retention research, concentrating on the effects of different methods of cooking.

In addition to our extramural projects, several staff members at HNIS are serving on the American Meat Science Association's committee to establish a research protocol for deriving nutrient profiles for muscle foods. This protocol will serve as a standardized procedure to be used by any organization performing research on these foods. Four sub-committees are developing protocols for: sample selection and storage; dissection, cooking and yield; nutrient analysis; and applications for use. Co-chairmen of the committee are Robert Rizek, HNIS, and Burdette Breidenstein, Texas A & M.

We are presently installing the Nutrient Databank Bulletin Board at HNIS to provide a ready source of up-to-date information about nutrient data releases and announcements about Nutrient Databank Conferences. Information will be presented mostly in the form of bulletins which can be read while accessing the bulletin board or saved on a disk for later review. In addition, the bulletin board will include a limited number of small nutrient data files available for downloading.

During this installation and initial test phase, several bulletins and one nutrient data file are available for access on the bulletin board. Current bulletins contain information about the latest USDA nutrient databases. The data file includes information from HERR 48, Sugar Content of Selected Foods.

Nutrient Databank Conference attendees are invited to participate in the current test phase. Equipment needed include a computer, telephone line, modem (1200 or 2400 baud), and communications software. The following parameters must be set on the modem or through a communications software package: n/8/1 (n = no parity; 8 = 8 bits; and 1 = stop bit). The phone number is 301-436-5078. Comments may be left for the system's operator, and individuals contacting the board are encouraged to leave suggestions or comments that may help to improve this new service provided by HNIS.

THE TOTAL DIET STUDY AND LANGUAL

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The Food and Drug Administration's (FDA) Total Diet Study monitors the levels of contaminants and nutritional elements in the United States (US) food supply.[1] In the current program, which has been in place since April, 1982, 234 foods are purchased four times per year and analyzed individually for over 200 pesticide residues, several industrial chemicals, toxic elements, and radionuclides, and 11 nutritional elements. Daily intakes of these substances are then estimated for eight age-sex groups. Results for the intakes of nutritional elements for 1982 to 1986 were published in the May issue of the *Journal of the American Dietetic Association.*[2] These results indicate that six nutritional elements are low (less than 80% of the Recommended Dietary Allowance or below the lower end of the Estimated Safe and Adequate Daily Dietary Intake (ESADDI)) for three or more of the age-sex groups. The diets of teenage girls and adult women were low in calcium, magnesium, iron, zinc, copper, and manganese. The diets of older women were low in calcium, magnesium, zinc, and copper. The diets of teenage boys and older men were low in copper. Sodium was within the ESADDI range for all but young children and teenage boys; however, the diets evaluated did not reflect the inclusion of discretionary salt, although recipe items included salt specified by recipes and many commercial items were salted. Iodine was elevated for all age-sex groups, but iodine intakes decreased during the four-year study period. The decline in iodine was mainly due to the decreased iodine content of ready-to-eat breakfast cereals. That decrease was likely caused by a decline in the use of the red dye erythrosine (FD &C Red No. 3) by cereal manufactures. Nutritional intakes for 1987 through 1989 are under evaluation and results appear to be similar to those for 1982 to 1984.

The diets of the Total Diet Study are under revision, based on food consumption information from the 1987-88 Nationwide Food Consumption Survey (NFCS). Approximately 260 foods from the over 5,000 foods in the NFCS database will be selected to represent the US food supply. This is an increase over the 234 foods of the current program. The additional foods will reflect more ethnic dishes and mixed dishes. The number of age-sex groups represented in the Total Diet Study will increase from 8 to 14. In addition to the groups currently covered, the program will include 6-year-old children, 10-year-old children, 40-45 year-old women, 40-45 year-old men, women 70 years of age and older, and men 70 years of age and older.

This past year, a small study was conducted to compare the levels of nine nutritional elements in the diets of the eight age-sex groups as determined by Total Diet Study analysis and by calculation using data in the USDA Database for Standard Reference.[3] Results for the two methods were quite similar after corrections had been made for missing values in the USDA database. Average percent differences between the 2 methods of determining daily intakes for the 9 elements ranged for -2.6 to 11.0 for the eight age-sex groups.

Langual

Langual (previously known as the Factored Food Vocabulary) is an indexing language which has been developed and supported by the FDA Center for Food Safety and Applied Nutrition.[4] The purpose of Langual is to allow for the indexing of food characteristics that affect safety and/or nutritional values; to support the retrieval needs of users having different points of view; to facilitate the comparison of linkage of data between various data files; and to allow new descriptors to be included when needed for new food characteristics. The characteristics of foods that are currently captured by the system include product type; food source; part of plant or animal; physical state, shape, or form; extent of heat treatment; cooking method; treatment applied; preservation method; packing medium; container or wrapping; food contact surface; and user group/dietary use. Information about Langual has been presented at the last four National Nutrient Databank Conferences. A presentation tomorrow afternoon will again highlight the retrieval capabilities of Langual and indicate current innovations of the system.

Over the past several years, FDA has provided assistance in applying the Langual factors to foods in the food composition databases used by the National Cancer Institute (NCI), the National Food Agency of Denmark, and the Centre Informatique sur la Qualite des Aliments (CIQUAL) in France. The factor terms with definitions and scope notes have been translated into French, Danish, and adapted to British English. Because of this interest in Langual from sources outside FDA, it was deemed appropriate to establish an organizational structure to represent the interests and needs of users and to facilitate communication among users. The organizational structure consists of a steering committee with one member each from FDA, NCI, and CIQUAL, and two separate, but equal, executive components, one in North America and one in Europe. Each executive component will have a developmental working group and a computer/telecommunications working group. In North America these working groups are organized and in action; in Europe, they have not yet been established.

The North American developmental working group consists (as it has for the past 14 years) of classification experts, nutritionists, food technologists, and systems specialists. Currently the committee has eight members (five FDA persons and three non-FDA persons). Although the European counterpart to this group has not formed, certain key individuals have been identified from France, Denmark, and the United Kingdom. We communicate periodically with these persons and have had several opportunities to meet together for discussions. The European contacts also receive our newsletters and meeting agendas and can send their comments regarding items under discussion. Recent discussions have focused on differences in food regulations among countries and how these differences affect food descriptions (e.g., the percent of alcohol in alcoholic beverages or the percent of butter fat in dairy products).

The North American computer/telecommunications working group consists of two members (one from FDA and one from NCI) who are developing an inventory of hardware and software to be used by Langual and to establish the methods and facilities for message communication among members. Thus, Langual is in the initial stages of becoming an international food description system. We anticipate that it will allow for increased communication and exchange of food-related data among agencies and organizations within the US and in other countries.

REFERENCES

1. Pennington, J.A.T., Gunderson, E.L. "A history of the Food and Drug Administration's Total Diet Study, 1961 to 1987." *J. Assoc. Chem.* 70(5) (1987): 772-782.

2. Pennington, J.A.T., Young, B.E., Wilson, D.B. "Nutritional elements in US diets: Results from the Total Diet Study, 1982-86." *J. Am. Diet. Assoc.* 89(5) (1989).

3. Pennington, J.A.T., Wilson, D.B. "Daily intakes of nine nutritional elements -- analyzed versus calculated values." *J. Am. Diet. Assoc.* in press.

4. McCann, A., Pennington, J.A.T., Smith, E.C., Holden, J.M., Soergel, D., Wiley, R.C. "FDA's Factored Food Vocabulary for food product description." *J. Am. Diet. Assoc.* 88(3) (1988): 336-341.

NUTRIENT CHANGES IN EGGS AND BEEF

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All of us in fields related to agriculture, food, nutrition, and health are concerned that nutrient data be as complete, accurate, and relevant to current food availability as possible.

The Nutrition Monitoring Division of USDA's Human Nutrition Information Service (HNIS) is charged with the responsibility for the continuous monitoring and updating of data on the nutrient composition of foods in the American diet. The achievement of this goal requires monitoring the technological and methodological changes and advances in nutrient analysis and in food production, availability, and consumption, as well as evaluating new nutrient data and reevaluating existing data in the light of advances and changes. Communication and cooperation among government agencies, educational facilities, agriculture interests, and food industries are necessary to achieve this goal.

The following is a description of the changes in the nutrient composition values for eggs and beef in the major databases of the Human Nutrition Information Service. These changes resulted from the evaluation of data generated in studies advanced by the Egg Nutrition Center and the National Livestock and Meat Board in cooperation with USDA. Brief overviews of these studies and of the Human Nutrition Information Service procedures for incorporating the data generated by these studies into nutrient composition values will also be presented.

Changes in nutrient data for eggs result from a collaborative nationwide study. The design of this study, including sampling, handling, and analytical procedures, was established by the cooperative efforts of the Egg Nutrition Center and three USDA agencies: the Agricultural Marketing Service, the Agricultural Research Service and the Human Nutrition Information Service.

The study design included a two-season, (summer 1988 and winter 1989), nationwide, geographically balanced sampling of Grade A large eggs from suppliers representative of over 60% of the nation's egg producers. The analytical data were provided by a contracted private laboratory, which was selected on a competitive basis.

Randomly selected eggs from suppliers were separated into yolk and white, and weighed. Yolks and whites were then either proportionally recombined to form equivalent reconstituted whole eggs and then composited by region or were composited by region to provide samples for nutrient analyses.

The data provided by this study included weights for both seasons of whole raw egg in the shell, raw egg yolk, and raw egg white. A total of 1,349 eggs were weighed. Weights of whole cooked egg in the shell, cooked egg yolk, and cooked egg white for the 1989 winter season (a total of 345 eggs) were also determined. The average weights were found to be 59.1 grams for whole raw egg in the shell, 16.6 grams for raw egg yolk, and 35.4 grams for raw egg white. Whole cooked egg in the shell had an average weight of 60.2 grams, cooked egg yolk weighed 16.4 grams, and cooked egg white weighed 37.1 grams. The average shell weight was determined by difference to be 7.1 grams.

Using these weight data along with yield data from other USDA studies, average refuse, which includes shell and adhering white, was calculated to be 15% by weight of whole egg with shell. The weight of the edible portion of an average large egg is, therefore, 50 grams and the weights of yolk and white are 16.6 and 33.4 grams, respectively.

For the 1988 summer season, analytical nutrient composition data representative of 122 suppliers were provided. Data for cholesterol, fat, and fatty acids from 26 composites of raw egg yolk and data for proximates, 9 minerals, and 9 vitamins from 13 composite samples of raw whole egg were collected.

For the 1989 winter season, analytical data were provided for 7 composites of raw egg yolk for proximates, cholesterol, 9 minerals, 9 vitamins, amino acids and fatty acids. Data were also determined for 7 composites of raw egg white for proximates, 9 minerals, 9 vitamins and amino acids.

Data were also obtained for the winter season for hard-cooked egg components -- yolk and white -- for the proximates and 9 vitamins. Data collected in the 1989 winter season were representative of 108 suppliers.

To evaluate and compile these analytical data for use in HNIS' databases, the following specific procedures for calculating nutrient values from analytical nutrient and physical composition data were employed: weighting factors, calculations based on physical composition data, calculations employing retention and yield data, and nutrient aggregation calculations.

In order to obtain nutrient composition data representative of the year-round supply of eggs, the data from both the winter and summer seasons, where available, were equally weighted before averaging.

In raw egg yolk the fat, cholesterol, and fatty acid data were available for both seasons and values for these nutrients were obtained by this weighting procedure (Figure 1). The average values for the two seasons were multiplied by 50%, and the products summed to arrive at the weighted average values. The standard errors associated with these means were calculated taking into account the sample sizes of 26 and 7 associated with the respective standard errors of the seasonal averages.

For whole raw egg, analytical data from both seasons were available and were used to calculate nutrient values for all nutrients except amino acids. Amino acids were only analyzed in the winter season. The data for all of the other nutrients were seasonally weighted as in the previous example.

Analytical data for the 1989 winter season were determined on egg component parts -- yolk and white. Whole raw egg nutrient values for the winter season were therefore calculated using physical composition data.

In whole raw egg, the determinations of fat, fatty acids, cholesterol, and lipid-soluble vitamins, which are only present in the yolk, were calculated based on analytical nutrient data from raw egg yolk (Figure 2). The observed analytical values were adjusted to a 100-gram-of-whole-egg basis by multiplying them by the weight percent of yolk in the whole raw egg (33.2%).

Amounts of the other proximate constituents, vitamins, and minerals, that occur in both yolk and white were determined in a like manner (Figure 3). That is, the analytical data for these nutrients in yolk and white were multiplied by the respective weight percents of yolk (33.2%) and white (66.8%) and the products summed to arrive at the nutrient values for 100 grams of whole raw egg for the 1989 winter season.

Other procedures were used to calculate complete nutrient values for cooked forms of eggs. Analytical data for proximates and vitamins in yolk and white of hard-cooked egg were also obtained for the 1989 winter season.

For hard-cooked egg, analytical nutrient data for yolk and white were combined based on physical composition data, as discussed above, to obtain proximate and vitamin values for 100 grams of whole hard-cooked egg (Figure 4).

Mineral values for hard-cooked egg were calculated by applying retention factors to the analytical nutrient data from raw egg white and yolk (Figure 5). These calculations involve the multiplication of the analytical values for the nutrients from the raw state of the food by the appropriate retention factors for those nutrients and the specific cooking process. The resulting products are then multiplied by the weight percents of the white and yolk to arrive at mineral values representative of 100 grams of whole hard-cooked egg.

Finally, nutrient values for other cooked forms of eggs, such as fried and scrambled, were calculated using nutrient aggregation calculations. Using this computerized procedure, nutrient values for whole raw egg are combined proportionally with nutrient values for the other foods included in the recipe (Figure 6). In this example for scrambled egg, the other foods are whole milk, margarine, and salt. A yield factor for the recipe, in this case 90% due to a moisture loss of 10%, and retention factors specific to the food ingredients and cooking method need to be specified. Derived values of the ingredients to which proportional weights and retention factors have been applied are then summed. The appropriate moisture and fat changes are made, and the values are divided by the combined weight of the ingredients to arrive at values for 100 grams of the food form (Figure 7).

Using the analytical nutrient and physical composition data obtained from this study and the methods discussed, Agriculture Handbook No. 8 nutrient values have been updated for the following nine egg items:

Whole egg, raw, fresh or frozen
Egg white, raw, fresh or frozen
Egg yolk, raw, fresh
Egg yolk, raw, frozen
Whole egg, cooked, fried
Whole egg, cooked, hard-cooked in the shell
Whole egg, cooked, omelet
Whole egg, cooked, poached
Whole egg, cooked, scrambled

The new data on eggs will be included in the 1989 Supplement to the Agriculture Handbook No. 8 Series, which will be released later this year. The new data will also be incorporated in updates of the machine-readable data sets, the USDA Nutrient Database for Standard Reference and the USDA Nutrient Data Base for Individual Food Intake Surveys.

Comparing the nutrient values for whole raw egg from this study with values previously published in Agriculture Handbook (AH) No. 8 in 1976, a significant difference in the value for cholesterol is apparent. This difference is 123 mg per 100 grams, which is a reduction of approximately 22% from the value published in 1976.

The Continuing Survey of Food Intake by Individuals (CSFII), where food intake information is converted into nutrient intake information, shows that the intake of cholesterol by women ages 19 to 50 was 280 milligrams per day in 1985. In 1985, 40% of women's cholesterol intake was provided by eggs. This includes eggs eaten separately and those eaten as part of a mixture. The new cholesterol value for eggs would lower this estimated nutrient intake to approximately 255 mg per day, or a reduction of about 9%, assuming that the kind and amount of food eaten has remained constant.

In addition to eggs, the nutrient composition of beef has also changed. On the average, current retail cuts of beef contain less fat than those sold prior to 1986.

The nutrient data changes in beef result from two recent research studies on the nutrient composition and current marketing practices for beef. The first of these, conducted by Texas A & M University for the National Livestock and Meat Board, began in the spring of 1987 and examined the effect of fat trim level on the fat content of beef retail cuts. This study analyzed 12 of the same type of beef retail cuts analyzed by the USDA for Agriculture Handbook No. 8-13, Beef Products (1986). These cuts are:

flat half brisket	tenderloin steak
point half brisket	top loin steak
arm pot roast	round tip roast
blade roast	top round
small end rib roast	eye round
large end rib roast	bottom round

Top sirloin was also analyzed in this study rather than wedge bone sirloin, which appears in the current AH-8-13. Twenty-four Choice grade and six Select grade carcasses of varying yield grades were used for these determinations.

The carcasses were broken down into typical retail cuts with 1/4-inch fat cover. Dissection studies to determine the physical composition (that is, the proportions of lean, subcutaneous fat, intermuscular fat, and refuse) were performed on these raw retail cuts trimmed to 1/4-inch fat cover and on cooked cuts which had been trimmed to 0-inch and 1/4-inch fat cover prior to cooking. Dissection data were not obtained for raw cuts trimmed to 0-inch fat cover.

Fat and moisture composition studies were performed on the raw and cooked retail cuts which had been trimmed to 0-inch and 1/4-inch fat cover. Cooking yield and fat retention data were also determined for the cooked retail cuts trimmed to 0- and 1/4-inch fat.

Using regression analyses as influenced by USDA quality and yield grades, Texas A & M calculated values for the percentages of each dissectable component (i.e., lean, fat, bone, and connective tissue) in raw and cooked retail cuts and calculated the chemical fat and moisture content of separable lean of raw retail cuts.

The observed fat trim level of retail beef cuts was determined in a second study, which was also conducted by Texas A & M. This was a nation wide market basket survey conducted in the fall of 1987 and the spring of 1988. This study surveyed beef retail cases in supermarkets in 12 cities across the United States.

Fat thickness measurements, the numbers and weights of retail-cut packages in meat cases, and dissection data on randomly selected packages were gathered. It was concluded from this survey that the average nation wide supermarket beef retail cuts are currently trimmed to 1/8-inch fat cover. The contribution of each retail cut to the total weight content of the meat case was also determined.

The results of these two studies are now being used to update nutrient data values for retail cuts of beef to reflect the current retail practice of trimming fat cover more closely. Prior to 1986, retail cuts of beef were usually trimmed to 1/2-inch fat cover and the nutrient values in the current (1986) AH-8-13 reflect that practice.

Nutrient values for the total edible portion (separable lean and fat) of retail cuts trimmed to 0-inch and 1/4-inch fat cover are being recalculated for the revision of AH-8-13. In these calculations predicted values based on dissection data from the above-mentioned studies and the average marbling and yield grades are being used to provide the necessary tissue proportions for the cuts.

In a comparison of the 1986 AH-8-13 nutrient values with the 1989 updated values for the total edible of roasted eye of round (Figure 8), it is apparent that the change in trimming practice results in reductions in fat, fatty acids, and energy and increases in moisture and protein in 100 grams.

Overall, the average values for lipid content of the total edible portion (separable lean and fat) of cooked retail cuts of beef are approximately 3% lower for 1/4-inch trim fat cover and 33% lower for 0-inch trim 10 cuts as compared to the 1/2-inch trim cuts published in the 1986 AH-8-13. Raw, total edible, trimmed to 1/4 inch is approximately 12% lower than the raw, total edible of 1/2-inch trim.

In the recalculations of the nutrient values for the separable lean of retail cuts, the updated lipid and moisture values from the studies will be combined with values for the other nutrients for separable lean from the 1986 handbook. Earlier research by USDA established that, except for lipid and moisture, there is no correlation between quality grade (which is largely dependent on fat content) and other nutrients.

The lipid content of the cooked separable lean of cuts trimmed to 1/4-inch and 0-inch fat cover was on the average 8% and 18% lower, respectively, than those cuts in the 1986 AH-8-13. The raw separable lean is, on the average, 8% lower in fat than raw separable lean in AH-8-13.

Information from the market basket study was used to recalculate the nutrient composition of the various composites of retail cuts such as beef, not further specified, and steaks and roasts. These composites are given in AH-8 and the USDA Nutrient Databases for Standard Reference and for Individual Food Intake Surveys. These composites will now reflect the nutrient data for individual cuts weighted for their contribution to the average nationwide supermarket meat case, i.e., the availability of retail beef cuts. Formerly, the best estimate of composite data was calculated on the basis of each cut's contribution to the beef carcass.

To promulgate these extensive nutrient data changes in beef, AH-8-13, Beef Products, is being revised. The revision, to be published later this year, will contain updated nutrient profiles of most of the cooked retail cuts presented in the 1986 section, trimmed to 1/4-and 0-inch fat cover and of the raw, retail cuts trimmed to 1/4- inch fat cover. Other cuts not included in the study will also have their values for separable lean and fat adjusted to represent cuts containing tissue proportions more representative of those found in the recent beef market basket survey. These cuts are full cut round, flank, shank, t-bone, porterhouse, and rib eye steaks.

Updated nutrient values for separable lean and fat of Prime grade retail cuts will be included in the revision of AH-8-13. Although Prime grade cuts were not included in the recent research, estimates of their physical composition based on earlier studies (which are included as an addendum figure in the current AH-8-13) will be used to update nutrient data for cuts trimmed to 1/4-inch fat cover.

In order to keep the size of the revision manageable, there will be no data pages for the raw separable lean of individual retail cuts except for the raw separable lean composite of retail cuts. Proximate constituents and calories of the raw separable lean of individual retail cuts per 100 grams will be given in an appendix table.

The new data for beef cuts have already been used to create new values for beef for the USDA Nutrient Data Base for Individual Food Intake Surveys. This database is being used to process data from the 1987-88 Nationwide Food Consumption Survey.

In the fulfillment of the responsibilities to monitor and update nutrient information, the Human Nutrition Information Service will continue to revise, refine and publish nutrient values for foods as the data become available through expansions and advances in methodological and technological food-centered research.

Figure 1

Weighting Factors
(Weighting by Seasons)

Raw egg yolk values for	Summer 1988 (N - 26)		Winter 1989 (N - 7)		Weighted Average & (Standard error)
. Fat					30.87 (0.092)
. Cholesterol	Average Values x.5	+	Average Values x.5	=	1,281 (7.1)
. Fatty Acids					

Figure 2
Calculations Based on
Physical Composition Data
1989 Winter Season

Raw egg yolk values for:	Per 100 g of yolk				Per 100 g of whole egg
. Fat					
. Cholesterol	Observed Analytical Values	X	Weight (%) of Yolk in Whole egg (33.2)	=	Values for Whole Egg
. Fatty acids					
. Lipid soluble vitamins					

Figure 3
Calculations Based On
Physical Composition Data
1989 Winter Season

Raw yolk Values:	Per 100 g of yolk				
. Proximates . Vitamins . Minerals	Observed Analytical Values	X	Weight (%) of Yolk in Whole egg (33.2%)		
Raw White values:	**Per 100 g of white**			=	Values for Whole Egg
. Proximates . Vitamins . Minerals	Observed Analytical Values	X	Weight (%) of White in Whole egg (66.8%)		

Figure 4
Calculations Based On
Physical Composition Data
Hard-Cooked Eggs

Hard-Cooked yolk values:	Per 100 g of yolk

. Proximates . Vitamins	Observed Analytical Values	X	Weight (%) of Yolk in Whole egg (33.2%)

Hard-cooked white values:	Per 100 g of white

= **Values for Whole Hard-Cooked Egg**

. Proximates . Vitamins	Observed Analytical Values	X	Weight (%) of White in Whole Egg (66.8%)

Figure 5
Calculations Based on Retention
And Physical Composition Data
Hard-Cooked Eggs

Raw white values:	Per 100 g of white

. Minerals	Observed Analytical Values	X	Nutrient Retention Factors	X	Weight (%) of White in Whole Egg (66.8%)

Raw yolk values:	Per 100 g of yolk

= Values for **Whole** Hard-Cooked Egg

. Minerals	Observed Analytical Values	X	Nutrient Retention Factors	X	Weight (5) of yolk in Whole egg (33.2%)

Figure 6
Nutrient Aggregation Calculations

Scrambled Egg — Food Code: 112-0010
Yield: 90.0 — Fat change: 0.0
Moisture change: -10.0 — Fat ID:

Database 3 No.	Ingredient	Retention	Grams
01-111123	Whole egg, raw	103	50
01-000077	Whole milk	2151	15.2
04-000132	Margarine	0000	2.4
23-989630	Salt	0000	0.2

Figure 7
Nutrient Aggregation Calculations
Scrambled Egg

Ingredient	Weight	Energy	Water	Fat	Cholesterol
Whole egg, raw	50.0	74.7	37.7	5.01	212.57
Whole milk	15.2	9.4	13.4	0.51	2.07
Margarine	2.4	17.3	0.4	1.93	0.00
Salt	0.2	0.0	0.0	0.00	0.00
SUBTOTAL	67.8	101.2	51.5	7.45	214.64
Moist./fat change	-6.8	0.0	-6.8	0.00	0.00
Yield	61.0	101.2	44.6	7.45	214.64
Per 100 grams	100.0	165.9	73.2	12.21	351.75

Figure 8
Comparison of 1986 and Updated Values:
For: Beef, Round: Eye of Round, Separable Lean and Fat,
All Grades, Cooked Roasted

Nutrients	AH-8-13 (1986)	Updated AH-8-13 (1/4" fat trim)	Updated AH-8-13 (0" fat trim)
		per 100 g	
Water (g)	57.47	59.43	64.14
Food energy (kcal)	243	229	171
Protein (g)	26.77	26.79	28.8
Total lipid (g)	14.23	12.75	5.36
Fatty acids:			
Saturated, total(g)	5.79	4.98	1.97
Monounsaturated(g)	6.36	5.48	2.28
Polyunsaturated(g)	0.52	0.46	0.18

CULTURAL CONSIDERATIONS IN ANALYZING DIETARY DATA FROM THE HISPANIC HEALTH AND NUTRITION EXAMINATION SURVEY

Margaret McDowell, M.P.H., R.D. and Catherine M. Loria, M.S., M.A.

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Health survey programs undertaken by NCHS are mandated by the National Health Survey Act. Since 1970, two National Health and Nutrition Examination Surveys (NHANES) have been conducted. Hispanic HANES is the first HANES survey conducted exclusively on a U.S. subpopulation group. Although each of the previous NHANES samples numbered more than 20,000 examined persons, they included insufficient numbers of Hispanics to permit estimation of health characteristics for Mexican-Americans, Cubans or Puerto Ricans, or for these groups combined. The primary goal of Hispanic HANES was to produce estimates of health and nutrition status for three major Hispanic subgroups that are comparable to estimates available for the general U.S. population.

Hispanic HANES was a sample of 3 special subgroups of the population in selected areas of the U.S. rather than a national probability sample. Self-reported ethnicity or "national origin" was used to determine Hispanic eligibility. Eligible Hispanic families had at least 1 family member identified as being in one of the 3 Hispanic subgroups: Mexican-American, Cuban, and Puerto Rican. Approximately 12,000 individuals were examined during the Survey between July 1982 and December 1984.

The survey components and data collection methodologies used in Hispanic HANES were similar to previous NHANES surveys so that findings reported for Hispanics could be compared to those for the general U.S. population. Health issues of special importance and relevance to Hispanics such as the use of health care services, and the prevalence of diabetes, hypertension, and gallbladder disease received special emphasis during Hispanic HANES. Four task forces comprised of experts, identified important cross-cultural issues to consider in the design of survey components, questionnaire translation, dietary data collection, and community outreach. The task forces provided guidance to NCHS staff throughout the survey planning process.

The nutrition assessment component provides baseline information on the nutritional status of the 3 Hispanic subgroups. The dietary questionnaires used during two previous NHANES surveys were adapted for use in the Survey with the help of the Dietary Task Force. The Hispanic HANES food frequency questionnaire obtained information on the qualitative aspects of the diet and patterns of food consumption among Hispanics. The Dietary Task Force identified examples of representative foods for the broad groups of foods included in the questionnaire. A separate questionnaire on the use of special diet plans, use of table salt and dietary practices was administered. Dietary recalls were administered in the Mobile Examination Centers by trained bilingual interviewers. Abstract food models were used to quantify amounts of food eaten. Actual intakes for the previous day (24 hours) were recorded.

All dietary recalls were coded by the dietary interviewers. The Hispanic HANES coding manual is a reorganized subset of the coding manual developed by USDA for the 1977-78 Nationwide Food Consumption Survey (NFCS). The Hispanic HANES coding manual included approximately 1,600 "core" NFCS foodcodes and their descriptors. These include foodcodes for Puerto Rican foods reported during the USDA Puerto Rico Individual Intake Survey conducted in 1977-78. The Hispanic HANES coding manual was expanded during the Survey with approximately 300 additional foodcodes from the NFCS manual. The use of the USDA database during Hispanic HANES was planned to facilitate comparisons of foods reported during NCHS and USDA Surveys, and to simplify the effort required to maintain a current nutrient database.

Originally, Hispanic HANES data were to be analyzed with the 1977-78 NFCS nutrient data and special USDA nutrient data for Puerto Rican foods which corresponded to the NFCS coding manual. Shortly after the Hispanic HANES data collection effort was completed in 1984, USDA released the 1985 Continuing Survey of Food Intakes by Individuals (CSFII) Data Base. NCHS was faced with a difficult decision --

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whether to proceed with plans to use the NFCS database or, adopt the more current CSFII database. NCHS decided to adopt the CSFII database because the CSFII nutrient values were more representative of the time period during which Hispanic HANES data were collected. Changing databases created a problem though for processing Hispanic HANES data which were collected and coded with the NFCS database.

USDA released the NFCS-CSFII Linking File which as the name implies, was designed to link the NFCS and CSFII databases. For NCHS, the decision to adopt the CSFII database was not a matter of simply reprocessing Hispanic HANES data with the Linking File to update the Hispanic HANES dataset because the two USDA databases were different. For example, some NFCS foodcodes were deleted altogether from the CSFII database, new CSFII foodcodes were created, code descriptions were changed, and some NFCS foodcodes were combined into CSFII foodcodes. NCHS completed a thorough review of the Linking File on a case by case basis to evaluate the impact of the database changes on the coding of Hispanic HANES data.

Another problem encountered during the editing of the Hispanic HANES dataset involved foods reported in the field for which there were no existing CSFII foodcodes. These foods were originally assigned a temporary field foodcode until either a new code or an existing NFCS code could be assigned to the foods. The foods included new products such as breakfast cereals, and Hispanic foods, particularly mixed dishes. The USDA foodcodes which were assigned to some of the Hispanic foods reported during Hispanic HANES were unsuitable. A special USDA database for Puerto Rican foods was available at the time the Hispanic HANES began; there were no comparable databases for Mexican-American or Cuban foods prior to the start of the Survey.

Recently, NCHS has had the opportunity to add some Mexican-American foods to the NFCS database for use in the third National Health and Nutrition Examination Survey (NHANES III), a six-year national survey which began in October 1988. The decision to add these foods was based on the high frequency with which they were reported in Hispanic HANES and the lack of suitable NFCS foodcodes. Preliminary nutrient data available for these foods can be used to illustrate problems with coding decisions for foods reported during Hispanic HANES.

The first example is "sopa seca de fideo," literally translated to mean "dry noodle soup" (Table 1). During preparation, dry vermicelli noodles are browned in fat, often lard; the noodles are then cooked in broth and tomato sauce until the moisture is absorbed. Sopa is similar in appearance to spaghetti and is often eaten as a first course before the main dish is served. Sopa was reported more than 800 times during Hispanic HANES.

Sopa seca was originally coded with the NFCS code for spaghetti with meatless tomato sauce. The USDA recipe for spaghetti with meatless tomato sauce however, does not include fat as an ingredient (Table 1). As expected, one difference between these two foods is their fat content. Fat is a primary contributor to the total energy content of sopa seca (Table 2). Coding sopa seca as spaghetti obscures a source of dietary fat for a substantial number of Mexican-Americans.

The next example illustrates the problem which results when several distinctive foods are coded with one foodcode. "Salsa" is a broad term which is used to denote a wide range of cooked and uncooked sauces which are commonly eaten by Mexican-Americans; salsas are often added to foods at the table or eaten in larger quantities in mixed dishes such as enchiladas. Two salsa codes were available at the start of Hispanic HANES to differentiate between red and green sauces; red sauces are prepared with red tomatoes, while green sauces are typically prepared with tomatillos, a small, green, husk-covered fruit which is unrelated botanically to the tomato.

Cooked red chili sauce was reported about 100 times during Hispanic HANES; the uncooked version of red chili sauce was reported about 800 times. The cooked and uncooked red salsas were originally coded using the NFCS tomato-chili sauce code. Selected nutrient values for the NFCS tomato-chili sauce, as well as nutrient values based upon typical recipes for uncooked and cooked red salsa are shown (Table 3). A comparison of nutrient data for tomato-chili sauce and uncooked salsa reveals large differences in total energy and carbohydrate content. The tomato-chili sauce contains substantially more carbohydrate and sodium than either salsa. The nutrient values for tomato-chili sauce are based upon a commercial formulation which includes sugar and more salt, whereas the salsa consumed by Mexican-Americans is often homemade. Even if purchased as taco or picante sauce, these products contain much less sugar than tomato-chili sauce. Finally, note the difference in the fat content of the cooked red salsa versus the tomato-chili and uncooked salsa. The cooked salsa is the only sauce shown which contains added fat and should be differentiated from uncooked salsa by having its own foodcode.

The last example is for a sauce which bears little resemblance in composition, taste or appearance to an existing codebook entry. Table 4 shows a recipe for "Mole Poblano", a traditional sauce in Mexican cookery. Mole was reported 70 times during Hispanic HANES; mole is often served over chicken or turkey or used as an ingredient in the preparation of enchiladas. Given the list of ingredients, it would be difficult, if not impossible, to find one or even multiple codes to approximate the nutrient composition of mole.

In the remaining time, several reasons for improving the capability of national survey databases to report information about the consumption of ethnic foods will be listed. Our ability to record and report information about the consumption of Hispanic and other ethnic foods is important not only to improve the quality of food consumption data, but to assure the availability of data to examine eating behavior among ethnic groups. Additionally, survey databases provide vital information about the dietary sources of nutrients for ethnic groups.

An important consideration for NCHS is that Mexican-Americans will be oversampled during NHANES III, a six-year national survey. Detailed information about certain ingredients and food preparation methods will be collected using an automated interactive dietary interview system. Appropriate foodcodes are needed to code the data for Hispanic HANES and NHANES III to facilitate comparisons between surveys.

A final point to consider is that most, if not all Americans consume ethnic foods. The popularity of ethnic foods, both home-made and commercially prepared, has grown. A recent marketing survey conducted by the Market Research Corporation of America reported that 90% of the U.S. population consumed ethnic foods (excluding pizza and spaghetti) at home or away from home during 1986-87.[1] Therefore, it should not come as a surprise to survey planners that a wide variety of ethnic foods are reported during our national nutrition surveys as well.

In conclusion, the ethnic and cultural diversity of the U.S. food supply today must be considered in survey planning and reporting efforts. Survey programs such as NHANES can demonstrate their commitment to this effort by supporting research to expand and improve the quality of dietary intake and nutrient composition databases. NCHS plans to release the Hispanic HANES dietary recall dataset later this year. In the meantime, NCHS will continue to work closely with USDA, academic groups, and other interested parties to improve the quality of food intake and nutrient composition databases.

REFERENCES

1. Tacos take over as No. 1 "ethnic" food, 5-year study finds. *J. Am Diet Assoc* 89 (1989): 202.

Table 1. Recipes for sopa seca de fideo and spaghetti with meatless tomato sauce

Sopa seca de fideo[1]	Spaghetti with meatless tomato sauce[2]
1/3 lb dry vermicelli	6 c cooked spaghetti
8 oz tomato sauce	2 1/2 c tomatoes, canned
2 T lard	4 oz tomato paste
2 T vegetable oil	1/2 cup raw onion, chopped
1 clove garlic	1 clove garlic
1 c chicken broth	1 3/4 c water
1/2 t salt	2/3 t salt
1 small onion	1 T sugar

1. Source: Hanson B. Mexican Cookery. HP Books. Tucson, AZ. 1980

2. Source: USDA Recipe File

Table 2. Total fat and energy values for sopa seca de fideo and spaghetti with meatless tomato sauce[1]

Nutrient[2]	Sopa seca de fideo	Spaghetti with meatless tomato sauce
Energy, kcal	173	63
Fat, g	9	0.3

1. Source: Preliminary USDA-HNIS data
2. Nutrients per 100 g food

Table 3. Selected nutrient values for three sauces[1]

Nutrient[2]	Tomato-chili sauce	Red salsa, uncooked	Red salsa, cooked
Energy, kcal	104	18	114
Fat, g	0.3	0.2	10
Carbohydrate, g	25	4	6
Sodium, mg	1,338	390	228

1. Source: Preliminary USDA-HNIS data
2. Nutrients per 100 grams food

Table 4. Recipe for mole poblano de guajolote[1]

6 ancho chiles	1/2 teaspoon anise
4 pasilla chiles	4 tablespoons sesame seeds
4 mulato chiles	2-3 sprigs fresh coriander
1 1/2 tablespoons lard	1 tortilla, cut up
1 1/2 tablespoons oil	2 medium tomatoes, peeled, seeded, and chopped
2 onions, chopped	
4 cloves garlic, chopped	
1/2 cup blanched almonds	1 1/2 ounces unsweetened chocolate
1/4 cup peanuts	
1/4 cup pumpkin seeds	
1/2 cup raisins	salt
1/2 teaspoon ground cloves	1/2 teaspoon ground cumin
1/2 teaspoon cinnamon	4 cups chicken or turkey stock
1/2 teaspoon coriander seeds, ground	

Source: Lambert Ortiz, Elisabeth. The Complete Book of Mexican Cooking. Balantine Books, New York. 1967.

THE COLLECTION AND USE OF NUTRIENT DATA IN THE TREATMENT OF MILD HYPERTENSION STUDY (TOMHS)

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INTRODUCTION

This paper will describe the process used to collect dietary data in the Treatment of Mild Hypertension Study (TOMHS). Issues related to the collection of dietary data in large-scale clinical trials will also be discussed.

TOMHS is a randomized, placebo-controlled, double-blind clinical trial which addresses the optimal treatment of mild hypertension in adults. Two phases of the study are envisioned. Phase I began in 1986 and there are currently 902 Phase I participants at clinical centers in Birmingham, Chicago, Minneapolis, and Pittsburgh. The primary aim of TOMHS is to compare non-pharmacologic therapy in combination with each of five active drug treatments, versus non-pharmacologic therapy alone. There are six different treatment groups, all of which receive the same non-pharmacologic therapy focusing on weight loss and reduction of sodium and alcohol intake. Five groups receive active drug treatment (chlorthalidone, acebutolol, doxazosin, enalapril, or amlodipine) and one group receives placebo.

Men and women, ages 45-69, who were free of cardiovascular disease, were screened for eligibility for TOMHS Phase I at a series of clinic visits. Qualifying blood pressure was 85-99 mm Hg for those taking anti-hypertensive medications at entry and 90-99 mm Hg for untreated individuals. There was an upper-limit weight exclusion set at 150 percent of ideal weight.

The non-pharmacologic intervention program used in TOMHS began with an initial intensive period which lasted for 6 months. During that time there was a series of 13 intervention sessions which introduced the information and skills necessary to achieve the desired lifestyle changes. A less intensive maintenance period followed with sessions continuing at 6-week intervals. The goals of the non-pharmacologic intervention are to reduce weight by at least 5 percent from baseline, to reduce sodium intake by at least 30 percent from baseline, and to limit alcohol intake to no more than 2 drinks per day.

Rationale for Collecting Dietary Data in TOMHS

The primary reasons for collecting dietary data in TOMHS are 1) to assure between-group comparability at baseline, and 2) to evaluate intervention effect. Information concerning between-group comparability is important so that any significant differences in nutrient intake observed at baseline can be accounted for in subsequent analyses. Data on intervention effect is useful as an assessment of compliance with study goals for dietary sodium, calories, and alcohol. Dietary data can also be used to monitor potential untoward effects of the intervention, such as reduced intakes of calcium or iron, or changes in appetite caused by study medication.

Dietary data also provides information which is useful in the evaluation of intervention efficacy. Figure 1 illustrates the results of an analysis which addresses one aspect of intervention efficacy. This figure shows fat calories as a percent of total calorie intake at baseline, 6, and 12 months for TOMHS participants. At baseline, fat calories account for 37 percent of total calorie intake. That figure is reduced to 30 percent at 6 months and the reduction is maintained at one year. The results of this analysis suggest that participants have heeded advice to reduce fat intake as a weight loss strategy. Another analysis which provides helpful guidance in planning intervention approaches is a food group analysis. The relative contribution of various food groups to the intake of target nutrients can be learned in this way and educational efforts can be directed accordingly.

Finally, dietary data offers a way to keep study participants apprised of their progress. This kind of feedback has demonstrated value both as an intervention tool and as an incentive for continuing participation. The self-selected populations commonly enrolled in dietary trials are typically very health-conscious, and information concerning dietary adequacy is of great interest to them. Examples of feedback provided to TOMHS participants will be described below.

Design of Dietary Data Collection Forms and Procedures

An important preliminary consideration for TOMHS was the selection of a data collection method. The method chosen was a 24-hour food record to be completed at home by the participant just prior to a scheduled visit to the clinic. A record was used, as opposed to a recall method, primarily because data was collected on two consecutive days at baseline and there was concern that participants wouldn't be able to recall intake accurately over a 2-day period. It was also felt that food records, in combination with a detailed documentation interview, would yield more complete dietary information.

Another important consideration was the schedule of data collection. Two consecutive days of food records were collected at baseline, followed by single-day records at 6-month intervals through the first 24 months of the study. The rationale for collecting multiple days at baseline was to get a good estimate of baseline intake to serve as a basis for subsequent determinations of dietary change. It was also felt that multiple, non-consecutive, single-day records spread throughout the follow-up period would allow more flexibility in later analyses. These follow-up records will be analyzed both singly and in combination.

The food record form used in TOMHS was designed to capture as much dietary sodium as possible. Sodium presents a special challenge because of the discretionary nature of salt use. Sodium is present in many food items as purchased, and more sodium, in the form of salt, is often added to food during preparation and at the table. Figure 2 depicts the heading of the food record form given to TOMHS participants. They are asked to record the time of each meal or snack, and also where each item is prepared. The home or restaurant information is used primarily for specifying the type of fat used in preparation. A detailed description of foods eaten goes in the center column along with amounts. Participants are also asked to indicate for each food item whether salt is added during preparation and at the table. An algorithm is used to calculate the amount of sodium to be added depending on the response to these items. For salt added at the table, 200 mg of sodium is added for each "yes" response, and 0 mg for a "no" response. For salt added in preparation, a "yes" response triggers the addition of sodium according to a standard recipe for the item, and a "no" response adds 0 mg of sodium. A response of "unknown" typically defaults to a "yes."

The Dietary Data Collection Process

The first step in the data collection process is the distribution of the food record form to study participants. When participants were given food records for the first time at baseline they received detailed instructions on how to complete the record. On subsequent visits these instructions are reviewed, especially for those who have experienced difficulty with the process.

The next step is the food record review. The participant brings a completed food record to the clinic where he or she meets with a study dietitian who conducts a food record review. This process is one of elaboration and clarification. The reviewer probes for whatever descriptive information is lacking, using a set of standardized food models to verify amounts. Reviewers are trained to use open-ended questions and to avoid judgmental reactions or responses. The reviewers make any necessary notations on a separate form to which the original record is affixed. Additional forms detailing recipes or food supplement use may also be attached. After the record has been reviewed it is checked for completeness by another reviewer.

The reviewed food records are then forwarded to the TOMHS Coordinating Center, where they are batched for eventual shipment to the Nutrition Coordinating Center (NCC) in Minneapolis. Coding of the food records and calculation of the nutrient totals takes place at the NCC. If a record requires any further clarification at this stage, an inquiry is directed back to the individual who conducted the original review.

Next, computer tapes containing the raw nutrient data are sent back to the TOMHS Coordinating Center. At this point the data is just a summary of daily nutrient totals, along with the appropriate dates and participant ID numbers. These daily totals are then merged with other TOMHS data and manipulated to yield a variety of reports.

Finally, in the last step, selected reports are returned to the clinics and, in some cases, to study participants. The dietary assessment report shown in Figure 3 summarizes the results of a single food record. It is given to participants at the next visit following a visit to collect the food record. Daily nutrient totals and a breakdown of calorie sources are listed and recommended intakes (specific to age and sex) are provided as a point of reference. Figure 4 shows the Personal Profile, which is also distributed to participants periodically. This report combines food record results with other health information, including weight, level of physical activity, and serum cholesterol. The information is presented in a historical context so participants can follow their progress over time.

Quality Control Procedures

A variety of quality control procedures are employed in TOMHS to assure the quality of food record data. The food-record coders at the NCC are trained and certified according to their own standards, and NCC performs duplicate coding on a random sampling of the TOMHS records submitted to them. The NCC calculation system has some built-in safeguards, such as on-line edit checks which flag unusual nutrient values for individual food items, and thresholds for daily nutrient totals which flag extremely high totals. The TOMHS food record reviewers are also trained and certified according to NCC guidelines.

Cost of Collecting Dietary Data

Costs associated with collecting dietary data in TOMHS include those for design and production of data collection forms; training of food record reviewers; labor involved in giving instructions to participants, reviewing records, and handling the completed forms; food models and related equipment; and coding and calculation. Taking these factors into account, the cost of collecting dietary data in TOMHS Phase I will be well in excess of $100,000. This cost is understandable, considering the scale of TOMHS and the labor-intensive nature of the dietary data collection process. However, there is frequently pressure from funding sources to justify the considerable expense involved in collecting this kind of data. In some instances it may be necessary to get by with just enough dietary data to satisfy the primary purposes outlined earlier, while other questions of significant research interest remain unanswered. It is hoped that some of the new developments being reported on at this conference will make the data-collection process more cost-effective so that large-scale clinical trials can take full advantage of its promise.

Figure 1.

Fat Intake At Baseline, 6 Mo, And 12 Mo

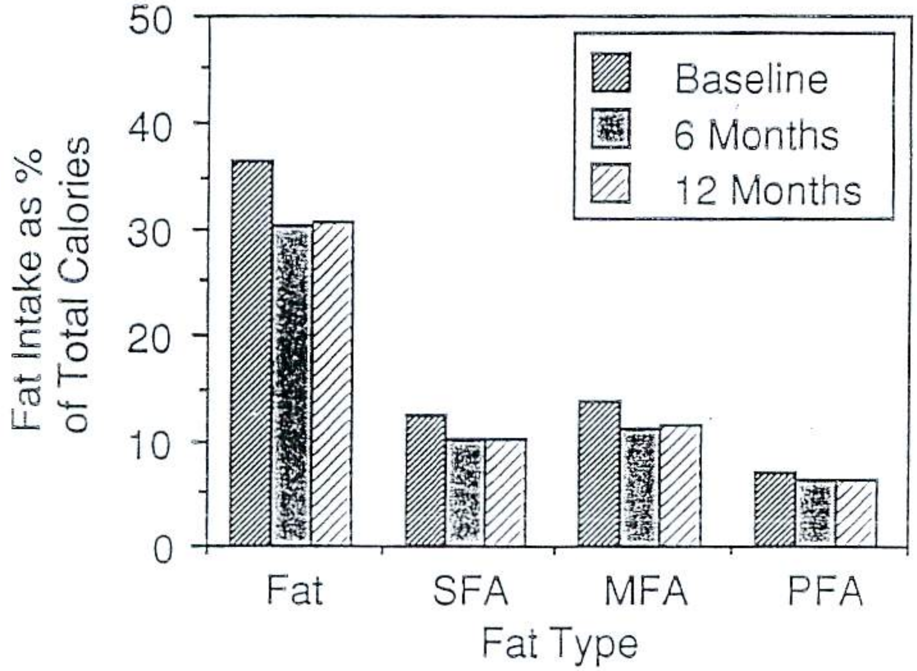


Figure 2.

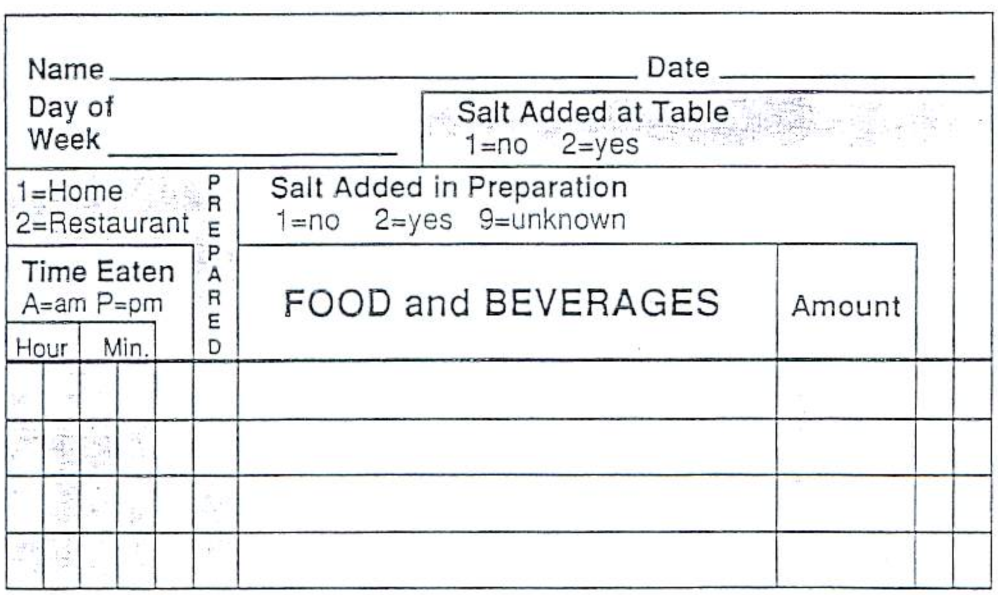


Figure 3.

Treatment of Mild Hypertension Study Coordinating Center
University of Minnesota - Minneapolis, Minnesota

12MO DIETARY ASSESSMENT

Participant ID:
Participant Name:
Date of Assessment: 04/24/88

Age: 60
Height: 65.5
Weight: 194.0

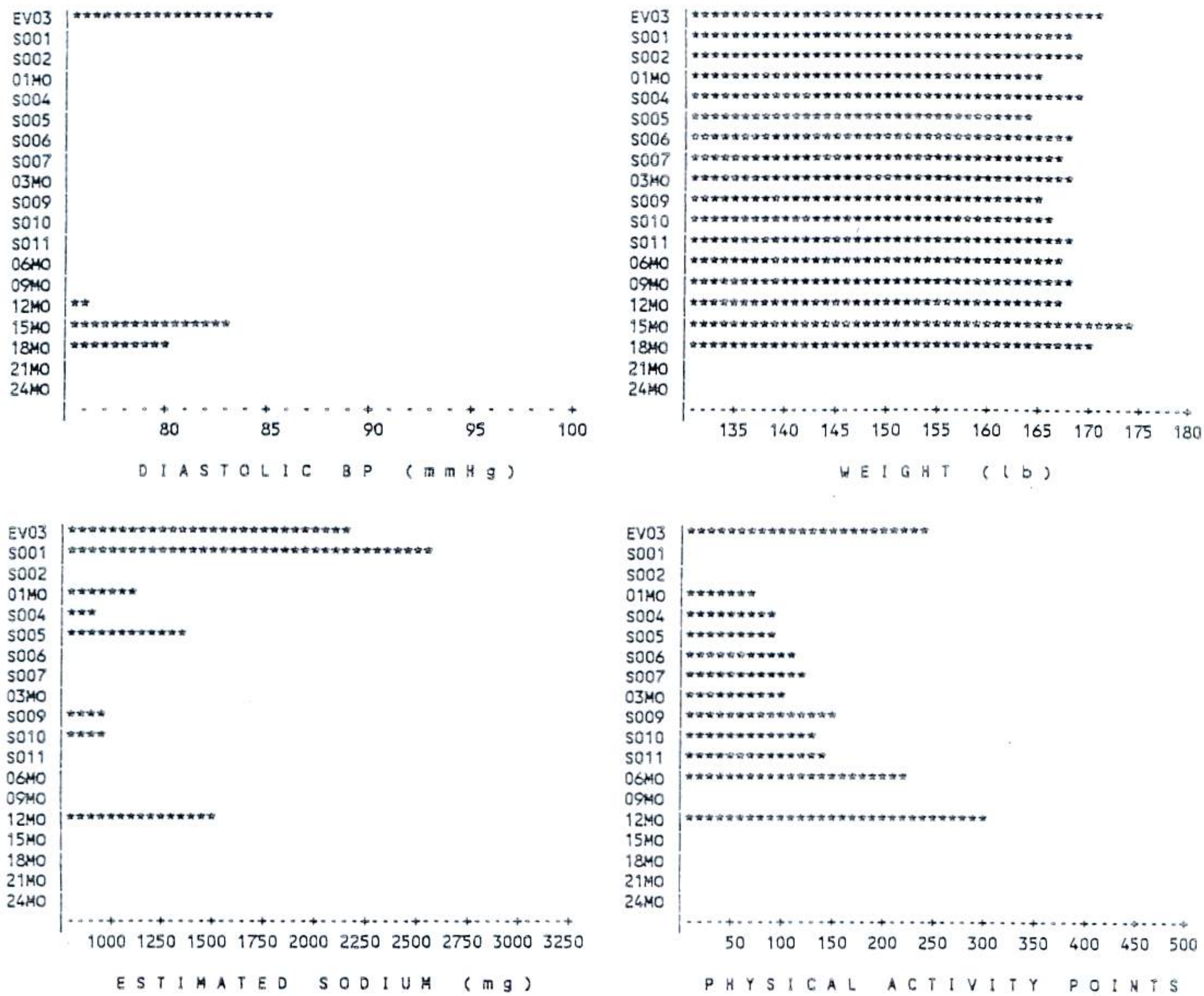
Nutrients	Units	Recommended Intake*	Actual Intake	Comments
Calories	kcal		3338.00	
Protein	gm	56	145.80	
Fat - Total	gm		146.80	
Saturated Fat	gm		49.40	
Carbohydrate	gm		357.90	
Vitamin A	IU	5000	5165.00	
Vitamin C	mg	60	45.70	
Thiamin	mg	1.2	2.14	
Riboflavin	mg	1.4	2.80	
Niacin	mg	16	40.91	
Calcium	mg	800	993.10	
Iron	mg	10	24.90	
Sodium	mg		4584.00	
Alcohol	gm		0.00	
Cholesterol	mg	<300	1222.80	
Protein	% calories	12-20	17.50	
Fat - Total	% calories	<30	39.60	
Saturated Fat	% calories	<10	13.30	
Carbohydrate	% calories	50-70	42.90	
Alcohol	% calories		0.00	

COMMENTS OR RECOMMENDATIONS

Figure 4.

PERSONAL PROFILE 01/04/89

Participant ID
Participant Name



Intervention Session	Date	Diastolic BP (mmHg)	Weight (lb)	Est. Sodium (mg)	Physical Activity Points	Serum Cholesterol (mg/dl)
EV03	06/18/87	85	171.0	2190	240	215
S001	06/22/87		168.0	2583		
S002	06/29/87		169.0	778		
01MO/S003	07/08/87	70	165.0	1137	70	
S004	07/13/87		169.0	912	95	
S005	07/20/87		164.5	1397	95	
S006	08/12/87		168.5	651	117	
S007	08/17/87		167.0	783	125	
03MO/S008	09/15/87	70	168.0	763	100	
S009	09/28/87		165.0	980	150	
S010	10/26/87		166.0	970	135	
S011	11/17/87		168.0		143	
06MO/S012	12/14/87	74	167.0		225	
09MO	03/14/88	75	168.0			
12MO	06/06/88	76	167.0	1507	300	225
15MO	09/13/88	83	174.0			
18MO	12/19/88	80	170.0			
21MO						
24MO						

OPTICAL SCANNING TECHNOLOGY FOR EVALUATING FOOD FREQUENCIES IN CANCER STUDIES

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Optical Mark Readers in conjunction with personal computers offer an easy, accurate and relatively inexpensive method for the collection and entry of questionnaire-type data. Scanning data requires less than half the time than manual entry would take for a comparable form. Scanning also yields more accurate results with fewer errors in the final data. These result in cost savings in both personnel and analysis costs. Scanning does not require a highly skilled individual, although some troubleshooting skills are required.

The University of Arizona and the Arizona Cancer Center have developed an optically scanned modified version of the National Cancer Institutes (NCI) Health Habits and History Questionnaire (HHHQ). The NCI's software is user friendly and allows for modifications to be made to their software. After several trials using the NCI's original HHHQ it became apparent that several modifications were necessary to allow for our continued use of a food frequency questionnaire for collection of dietary data. First, our subjects did not like assigning numerical values for the times per day, week or month for every food. Second, some commonly eaten Southwestern foods (e.g. Salsa) were needed to be added to the regular food list. Third, data coding, entry time and entry errors proved to be a substantial problem. Fourth, we wanted a more complete vitamin/mineral supplement use question that directly asked for a large array of individual supplements. Finally, we needed to increase estimates of several nutrients important in our cancer studies, including Vitamin A, Beta-Carotene, Vitamin E and Dietary Fiber. We chose therefore to develop a modified questionnaire to be analyzed using the NCI's software in a format which could be optically scanned, we refer to this as the Arizona Food Frequency Questionnaire (AFFQ). The AFFQ now exists in two formats, differing in length and readability due to differences in type face size and ink color. The smaller type red questionnaire (dev. 8/86) is 4 double sided pages the larger type blue questionnaire (dev. 6/87) is 4 double sided pages. The blue questionnaire has been found easier to read and fill out by elderly persons.

The initial costs of the system (Table 1) includes layout and printing of questionnaires, scanner and autofeed purchase, the scanner maintenance contract and software costs. An IBM compatible computer with a serial I/O port and printer are also needed, although neither needs to be solely dedicated to the scanner. The largest expense was the 2 years needed for development, debugging and verification of all the phases and programs associated with this project. A half-time research assistant and a quarter-time programmer were the primary staff used for development. With the system operational, ongoing costs are relatively minor and include the maintenance contract, additional questionnaires as needed and scanning personnel. Please note that these personnel cost will be less than would be required for manual entry of this questionnaire.

Table 1
Review of Costs, not including personnel

5000 copies of 6 page questionnaire	$2000	
Scanner	$3295	
50 Sheet Autofeed for Scanner	$ 850	
Yearly Maintenance Contract	$ 456	
DBSCAN software	$ 595	
HHHQ software	FREE	
IBM compatible PC with Port		Variable

The AFFQ was designed and printed in early 1987. Modifications to the original HHHQ included the deletion of 2 foods and the addition of 22 foods. The deleted foods were not consumed as specified on the questionnaire in this region. The 22 additional foods were added to include regionally important foods and to increase estimates of several nutrients important in our cancer studies, listed previously. Food additions were completed in two ways. First, some foods grouped in the HHHQ as one food entry were split into separate entries. Second, several foods were simply added to the questionnaire, like salsa, and popcorn, for regional and nutrient requirements.

Next, it was necessary to develop appropriate food consumption frequencies, as the HHHQ requires individuals to designate numbers per time of consumption and the optical mark reader reads darkened bubbles and cannot discern written numbers. The frequencies initially chosen were as follows; more than once a day; once a day; 4-6 times a week; 2-3 times a week; 1-3 times a month; less than once a month; rarely never. We are currently reviewing these initial frequencies, and increases in the upper end of the scale may be needed, especially in the beverage consumption areas. As with the HHHQ a serving size designated as small, medium or large must also be chosen. Many of the open ended food section are for individuals to write in foods that they frequently consume which are not listed elsewhere on the questionnaire and food database. This flexibility makes this software a very usable and customized tool.

The next major hurdle in the questionnaire development was determining the proper layout of the questionnaire, two important factors had to be considered. First, the optical mark reader reads both sides of the page during a single pass. This restricted the placement of answer bubbles, the bubbles could not overlap on the front and back pages. You can see this on any optically scanned forms by holding them up to the light and observing that the placement of the answer bubbles will be offset. Secondly, the questionnaire had to progress in a logical order, for accurate completion by study participants. Once the questionnaire was in production the job of programming began.

Two pieces of software were purchased for the actual scanning and analysis. DBSCAN enables the scanner to scan, it is only one of several software packages available to perform this task. Of course, the NCI'S HHHQ software packages which generates the nutrient output data was also necessary. Other software packages used, which we already owed, included, Turbo Pascal for all our programing, SPSS-PC for data analysis, DBASE 3+ for the vitamin database and Word Perfect to produce training and technical manuals.

The first programming step was to diagram the placement of every possible answer bubble for DBSCAN (4 pages for red, 6 pages for blue) to optically scan all pages of both AFFQ versions. Since each page is scanned twice to eliminate scanner errors the next programming task was the error checking program. The error checking program identifies and corrects inconsistencies in form completion and blanks in multiple answers (Table 2). This program allows the scanner operator to correct these errors interactively. A screen with questionnaire identifiers and the identified error asks for the correct response.

Then came the monumental task of converting the cleaned scanned data into the HHHQ format. This required changing the scanned frequencies from the one digit code read by the scanner into the 3 digit code used by NCI. The scanned food order had to be rearranged into the order designated by NCI. Our designated cereal had to be transformed into the NCI's codes. Specific codes needed to be placed at the beginning and end of each line of data. Each of these steps had to be finely checked and validated for any possible errors. Our data specifications then had to be defined to the NCI software. Unfortunately, this step had to be repeated when NCI updated their program. The good news was that their updated software made this process much simpler and friendly. Also, since we added a number of foods to our questionnaires the nutrient database and portion size database of the NCI software had to be updated. With these steps complete we were then able to run our questionnaires through the NCI's software for analysis.

Table 2
Errors Detected by Correction Program

Blank Fields in any answer fields
Two or more answers indicated in any field
Scanner error- different numbers between
first and second scans

Our next step was to write a program to estimate nutrients from our expanded supplement usage question. This also required the development of a supplement database. This was accomplished using Dbase and currently contains over 150 vitamin preparations, this can also be easily updated for future supplements. Since the vitamin analysis program is the last step in our analysis, it was designed to formulate specific output files. This program rewrites the 2 NCI output files (all nutrients, carotene output files) along with the supplement output information with and without supplement information for our various analytical objectives. Each programming step was validated, corrected and revalidated many times. Several changes made by NCI necessitated us to rework some of our programs. As with any program development every time we thought all the bugs were worked out a new one seemed to rear its ugly head. Some of these problems were created by us and a few were NCI's, which have been corrected in their latest software version. NCI was extremely helpful during this whole process; even examining our files to make sure we were consistent with their programming. After 2 years the entire process is up and running smoothly.

The time necessary for completion of the questionnaire from participant to analysis varies with the participant, how completely it was filled out, the number of extra foods listed and the number of questionnaires to be analyzed in any run. Instructions for completing the questionnaire are included on the first page of the questionnaire, and its completion takes approximately 20 minutes. Once the questionnaire is returned, the staff reviews each questionnaire for completeness, improperly filled out questionnaires, including those with more than 5 lines left blank, missing serving sizes and those not filled out with a #2 pencil. The program staff then contacts the subject to correct these problems, prior to their arrival to the scanning personnel. In our experience most questionnaires arrive complete, and this process averages about 5 minutes per questionnaire.

The scanning staff then prepare all questionnaires for scanning. We usually scan 25 questionnaires at a time. Although the automatic feeder has a 50 page capacity, we have determined that 25 questionnaires are the optimum number from both a time and archiving perspective. Initial questionnaire preparation includes coding the study ID, the open ended food question, the other fruit and vegetable questions, the specified cereals and the vitamin preparations. This coding can be done using a #2 pencil or a high graphite ink pen like the Sharpie (easiest). The forms are then separated and collated, each page is scanned separately, and each set of pages must be in the identical ID order. This ID order is checked in the COMBO program to be sure we are not combining different people data. This preparation takes between 2 and 3 hours for 25 questionnaires. Then each page is scanned twice, the error correction program run, and the corrected data combined using the COMBO program.

The data is now in the proper format for the NCI's software. Next the data is run through the NCI's DIETEDIT program to determine the correctness of the data. Correct questionnaires are then analyzed by NCI'S DIETANAL program and printouts generated for the participants and study personnel, if desired. The vitamin analysis program then analyzes the supplement data and rearranges the output into our final output file. The scanner personnel then run initial statistics using SPSS-PC and all files are archived (for 25 forms, all files generated completely fill one disk). This process takes 2 to 3 hours for 25 questionnaires. The total process from initial reception of the questionnaires from subjects to archiving takes between 6 and 8 hours for 25 questionnaires (Table 3). This is much less time than double manual entry would require, and is subject to fewer errors. For our purposes the output data is then transferred to a mainframe computer for further analysis. Please note that all the output files generated by DBSCAN, COMBO, NCI's software and our vitamin analysis program are ASCII files.

Table 3
Time for Questionnaire Completion and Scanning

Per Questionnaire	
Participants filling out questionnaire	20-30 Minutes
Initial inspection of questionnaires	5-10 Minutes
Per 25 Questionnaires	
Coding, Collating and sorting	2-3 Hours
Scanning, Error Checking, Combining Complete Analysis, Archiving	1.5-2 Hours

The next process was the development of instruction and technical manuals along with staff training. Manuals have been written for all users covering all steps of the questionnaires administration, coding, scanning etc. These include instructions to subjects, methods for reviewing returned forms for completeness, all coding (Study ID's, ID's, extra foods, nutritional supplements, cereal types etc), step by step analysis and common trouble shooting ideas. A separate technical manual describing the complete process of questionnaire development, changes from the NCI's original HHHQ, programming assumptions, programming design, etc., is also available.

Past and current studies at the University of Arizona and the Arizona Cancer Center using the optically scanned AFFQ include: Beta-carotene Pharmacologic Study; Colon Cancer Prevention Project (3 separate projects); Skin Cancer Prevention Clinical Trails; Cutaneous Epidemiology Study; Chemoprevention of Skin and Oral Cancer Program Project; Project AGEWELL; and Flinn Foundation Grant studying Diabetes. These studies have included both men and women, with ages ranging from 18 up; however, by far the largest number are those older than 40. Over 2000 forms have been scanned and analyzed.

Quality assurance and control methods currently used include the previewing of all questionnaires prior to scanning and error reconciliation, repeat analysis of 10% of questionnaires, software based edit checks and nutrient outlier assessment (primarily using NCI's program assessments). Test-retest reliability studies have been done and more are currently being completed. Relative external validation using 7-random-day-diet-records have and will be done routinely.

Comparisons of results using the scanned AFFQ and the original HHHQ were done on a small sample from the Fiber/Calcium Colon Cancer Prevention Trial (Table 4). The two samples were similar in age and socioeconomic composition (I, unfortunately, do not have a slide of this; however, the table is available in the text of this talk). The standard deviations are smaller for all nutrients examined in the scanned version, indicating that there were fewer extreme values in the scanned forms, which we have interpreted as fewer subject response errors. The scanned data also appears more consistent with NHANES values than are those from the original HHHQ version.

Table 4
Nutrient Estimates From Scanned AFFQ and Original HHHQ
(Mean - + SD)

Nutrient	Scanned AFFQ Females N=41	Males N=63	Original HHHQ Females N=16	Males N=36
Energy (kcal)	1467 - + 432	1843 - + 479	1831 - + 847	1914 - + 679
Protein (gms)	58.6 - + 2.8	72.3 - + 20.3	75.8 - + 42.8	75.4 - + 30.4
%kcal	15.9 - + 2.8	15.8 - + 2.1	16.0 - + 2.9	15.6 - + 2.6%
Carbohydrate (gms)	179 - + 54.3	207 - + 57.5	196 - + 78.0	207 - + 78.5
%kcal	49.0 - + 6.4	45.2 - + 6.1	44.4 - + 9.7	43.9 - + 9.1
Fat gms	55.8 - + 21.5	73.2 - + 23.5	81.3 - + 45.9	79.1 - + 37.2
%kcal	34.2 - + 5.9	35.7 - + 5.4	38.9 - + 8.3	36.0 - + 7.0
Calcium (mgs)	767 - + 341	877 - + 332	1036 - + 1005	827 - + 479
Dietary Fiber (gms)	15.7 - + 6.2	16.9 - + 6.5	13.8 - + 5.2	14.0 - + 6.7

Test-retest reliability, have been performed using Beta-Carotene Pharmacologic Study to determine intraindividual variance in questionnaire response. No statistically significant differences were seen using paired t-tests except in Beta-Carotene intake in women (Table 5). This study was an intervention study designed to decrease Beta-Carotene intake in high Beta-Carotene consumers, so differences were expected. Correlation studies have been performed, but unfortunately I do not have that data to present here. Further studies are currently being performed to test the test-retest reliability in other populations. However, based on our preliminary data and that from NCI we are confident that individuals are able to accurately fill out this questionnaire.

Table 5
Beta-Carotene Pharmacology Study

Test-Retest AFFQ Beta-Carotene Intake by Sex

Mean (mgs) - + SD

	Baseline	Final Month
Men (N=20)	1.8 - + 1.6	1.9 - + 1.3
Women N(20)	1.6 - + 1.5	1.0 - + 0.8

Relative external validation using 7-random-day-diet-records have shown some statistically significant differences. In our comparisons, food records were analyzed using the Nutritionist III program. It provides an easy screen-based coding and entry system. However, it is unable to provide for all our analytical needs. Current efforts include the linking of the Nutritionist III food data to the USDA database to allow us to utilize the USDA database for more comprehensive analysis while retaining the ease of entry to the

Nutritionist III program. Seven hundred days of food records from the Beta-carotene Pharmacology Study were coded and entered using the Nutritionist III database and evaluated against the AFFQ. Significant differences were seen. Interestingly, these difference were sex dependent. Grams of intake were significantly higher in food intake among both males and females. This may be due to the highest frequency of consumption being 2 times a day. This frequency may be too low to account for beverage consumption, specifically water, coffee and soft drinks, and is currently under review. Males showed significantly higher food record consumption of iron, thiamin, and niacin. One variable, dietary fiber, was significantly higher in the food frequency estimates (Table 6). In women only grams of intake were significantly higher in the food records, while Vitamin A was significantly higher in the food frequency estimates (Table 7).

Table 6
Comparisons of Nutrient Differences for
Males by AFFQ and Food Record Analysis

Nutrient	AFFQ Intake	FR Intake
Grams**	1659 - + 479	2815 - + 968
Iron**	13.6 - + 4.9	17.3 - + 6.7
Thiamin**	1.26 - + 0.48	1.79 - + 0.65
Niacin**	17.8 - + 6.2	25.3 - + 9.3
Dietary Fiber**	16.0 - + 4.9	12.6 - + 4.2

**p<0.01

Table 7
Comparisons of Nutrient Difference for
Females by AFFQ and Food Record Analysis

Nutrient	AFFQ Intake	FR Intake
Grams**	1577 - + 437	2395 - + 647
Vitamin A*	7079 - + 3807	4952 - + 593

*p<0.05
**p<0.01

Correlation coefficients for AFFQ and food record comparisons for selected nutrients (Table 8) are not as high as reported by NCI (Block 1988). However, we expect to see some improvement when we are able to use the USDA database rather than the current Nutritionist III's. It appears that both sexes were able to estimate percent of calories from macronutrients better than micronutrient intakes. There also appears to be large sex differences and no consistent directional differences in the micronutrient intakes. These same macronutrient and micronutrient pattern differences were evident in two other studies where these same comparisons were made. These involved different age groups, one study with 20 college-aged individuals and the other with a significantly greater number of the same age group participants. Increases in individual numbers helps to pull the correlation coefficients up some, but not into the desired range. Efforts are currently underway to identify the sources of the underestimation. These may be addressed by changes in the frequency of consumptions at the upper end or portion size assumption changes made by the program or a combination of these. While, multiple random-day diet records provide a gold standard for assessing dietary intake, they are not without inherent errors. The pattern of data similarities and differences suggests that there are random error components, rather than systematic sources of bias, operating in both measures independently. Unfortunately, the trials performed so far do not permit us to better understand these sources of error. Future effort will be expended in this area.

Table 8
Correlation Coefficients for Selected Nutrients
by Sex, AFFQ with 7-Random-Day-Diet-Records

Nutrient	Males	Females
Grams	0.44*	0.34
Calories	0.52*	0.56*
%Cal Protein	0.49*	0.17
%Cal Carbohydrate	0.45*	0.61**
%Cal Fat	0.38*	0.44*
%Cal Alcohol	0.79**	0.98**
Vitamin A	0.06	0.74**
Vitamin C	0.66**	0.25
Dietary Fiber	0.14	0.35

* $p<0.05$
** $p<0.01$

Current activities at the University of Arizona and the Arizona Cancer center include ongoing test-retest validations and linking the Nutritionist III database to the USDA database for reliability studies. We are also currently working on developing an optically scanned Hispanic version of the HHHQ; however, much more development needs to be done before completion of this project. We are also developing other types of questionnaire data to be optically scanned, as we have found the time savings and the relatively error-free data to be of tremendous value.

STUDIES OF DIET AND CARDIOVASCULAR DISEASE IN CHILDREN

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The Southwest Center for Prevention Research at the University of Texas Health Science Center School of Public Health is one of four centers funded by the Centers for Disease Control since 1986 to establish research and demonstration centers in health promotion and disease prevention. The activities of the SWCP have been developed under the theme "From Healthy Children to Healthy Adults." Within the research core the overall objective has been to provide a cross-sectional profile of the general health status of children, including assessment of known risk factors for cardiovascular disease.

One of the activities of the research core has been the assessment of the dietary intake of school-age children. The rationale and objectives of these dietary studies, the difficulties associated with dietary intake assessment among children and the results of some of these studies will be discussed.

Cardiovascular disease is the most common cause of morbidity and premature mortality in the United States. Epidemiologic and clinical studies have identified several risk factors which are associated with cardiovascular disease in adults. Some of these risk factors cannot be altered, such as age, sex, race and family history; however, some of the risk factors such as obesity, hypertension, elevated blood cholesterol levels, lack of exercise and smoking can be altered.

Studies have suggested that lifestyle patterns are established early in life and that risk factors exist at early ages and track into adult life. We know that serum lipids rise sharply after the first year of life, then rise slowly until age 5 or 6. Serum lipid levels plateau between ages 6 and 10, followed by a sharp decrease at puberty in both girls and boys. In the mid to late teens lipid levels begin to rise again.

We also know that individuals consuming diets that are high in saturated fat and cholesterol often have higher levels of LDL cholesterol which has been associated with an increased risk of developing coronary heart disease. Cross cultural ecological studies show that both children and adults in countries with low levels of coronary heart disease have low levels of serum cholesterol. Thus, evidence supports the idea that early intervention to influence children not to adopt diets that are high in fat may reduce serum lipid levels and thus reduce risk of cardiovascular disease as an adult.

The Southwest Center for Prevention Research has been conducting studies of the health of children in The Woodlands, Texas, a newly developed community 45 miles north of Houston. Working within the Conroe Independent School District we have been allowed to go into the schools located in the Woodlands and conduct health surveys of the children in grades 1 through 12. Detailed data have been collected regarding total cholesterol, blood pressure, body size, physical fitness and academic achievement test scores of the children and the medical history of the child and family. In the older children use of drugs, alcohol and tobacco and tobacco related products, as well as some measures of psychological well-being have been collected.

Assessment of dietary intake has also been part of these health surveys. The objectives of the dietary studies conducted by the Southwest Center for Prevention Research were: 1) to determine the usual dietary intake of school-age children, so as to determine the percentage of fat being consumed by children; 2) to identify the food sources of the cardiovascular related nutrients among school-age children to aid future interventions targeted at dietary changes; and 3) to develop a simplified food frequency questionnaire which could be used to estimate the intake of these nutrients for monitoring the long term dietary patterns of the children.

Valid and reliable dietary intake assessments are difficult to accomplish in any population, and children have their own special set of measurement problems which must be overcome. First, the ability of the child to remember what they have consumed over any defined period of time is a critical issue. All dietary assessment procedures except the dietary record must address the issue of memory bias. Food records allow the child to keep a written record of what was eaten as the day progresses, rather than thinking back in time about food that was eaten.

The ability to remember is tied very closely to the age of the child. The younger the child the less likely the child would be able to remember what they have consumed in the past. Unfortunately, data do not exist concerning the ages at which children can and can not remember into the past, nor how long into the past a child at a given age can remember. If a child is very young then the primary caregiver of the child may be needed to assist the child with providing accurate information regarding dietary intake. This situation can then get more complicated because a single child may have multiple care-givers, each of which must then get involved in the assessment procedure making the logistics of data collection very complicated.

Children may also have an overall unfamiliarity with the labeling and packaging of food items which will decrease their ability to accurately describe the types of foods that they have consumed. Children are not usually intimately involved with the food purchasing, nor food preparation activities at younger ages, reducing their exposure to the food until they sit down to consume it. Some common misconceptions about food among children include references to "butter", used as a generic name for either margarine or butter, and to "milk", as a generic name for any percent fat milk. Indeed, many children have no knowledge that milk can be purchased with different amounts of fat.

The type of dietary assessment method for use with children is also dependent on the ability of the child to read directions and to write legible what they may have consumed. Inability of the child to read or write requires an interviewer to question the child or to observe the child during the time period of the study. The necessity of collecting portion size data is debated, often depending on the end use of the data and the study objectives. In order to quantify the amount of the food consumed, the child must be able to estimate their portion size of the foods consumed in reference to household measures or to some type of food models. Ability to estimate portion size often requires the child understand some basic mathematics. Selection of a food model or a household measure may be done relatively easily; however, if only a portion of the whole model was eaten, an understanding of fractions is necessary.

Food records were selected as the dietary assessment method to use in The Woodlands research. This method is not dependent on the memory of the child and with adequate instructions has been shown to provide reliable and valid estimates of dietary intake. The children included in the dietary assessment were ages 10-18, thus these children were old enough to record their own intakes without the aid of a primary caregiver. During a 50-minute training session the children were trained how to record the foods they consumed on the food record form and how to quantify the portion size of each food using two dimensional food models. These food models represent standard household measures as well as geometric shapes, glasses and bowls. In-house validation of these models has shown that these models are very accurate. These models will be shown in our demonstration of the survey nutrient database. The children were asked to keep 3 random, nonconsecutive food records over a three week period, to include one weekend day and two weekdays. The children were asked to complete a home pantry inventory prior to beginning their food records. This home food inventory familiarized the children with the types of food found in their home and provided the coders with background information regarding each child. The food records were coded and nutrient intakes calculated using the USDA Nutrient Data Base for Individual Intake Surveys, Version 2.0.

The study population consisted of 138 children from science classes at one intermediate, junior high and high school. A total of 81 girls and 57 boys participated in the research. The schools and classes were not chosen to be representative either of the school district or of The Woodlands.

The dietary intake of these children is very similar for both boys and girls to other populations. Caloric intake for girls is identical for the Woodlands, NFCS, HANESII and Bogalusa populations and quite similar for boys. Intake of total fat was also quite similar to that of these other populations for both boys and girls.

Although absolute intake of calories and all nutrients was greater among boys than among girls, intake of macronutrients, expressed as percent of calories and cholesterol expressed as mg/1000 kcal was similar in both boys and girls for example, the mean intake of total fat was the same in boys and girls, 35.6%. Thus, all subsequent results are presented from aggregated data from the combined group of boys and girls.

To investigate other nutrient intake differences among the children, they were divided according to their percentage of total fat intake. Those who consumed less than 30%, between 30% and 37% and those consuming greater than or equal to 38% of calories from fat, corresponding to low, moderate and high-fat diets. Sixteen percent of the children consumed less than 30% of calories from fat. In contrast 34% consumed diets that contained greater than 38% of calories from fat. Intake of all fatty acids and cholesterol increased as total fat increased. The percent of calories from protein increased and that of carbohydrate decreased with increasing levels of total fat intake.

As mentioned earlier, one of our objectives was to identify the food sources of the cardiovascular disease related nutrients for prevention activities and for the development of a food frequency questionnaire. Because of the differences in level of fat intake among these children, it was possible to investigate whether the actual food sources contributing to fat intake differed among the children according to their total fat intake grouping. To investigate this, the percent contribution of each individual food item to the intake of each nutrient was calculated from the food items reported eaten by the children. Individual foods were consolidated into mutually-exclusive food types according to their nutrient density and the ways individual foods are perceived and used by individuals. A comparison of the rank order and percent contribution of food items to saturated fatty acid intake among the children consuming high and low-fat diets is shown along with the percent difference. The difference in percent contribution of the nutrient intake attributable to a food source is calculated as the amount in the high-fat diet minus the amount in the low-fat diet. A positive difference indicates that the percent contributed in the low-fat group was less than that contributed in the high-fat group, while a negative difference indicates that the contribution of the food source was greater in the low-fat group. While 7 of the top ten foods that contributed to saturated fatty acid intake in the high-fat group were also identified among the top ten contributors in the group of children who consumed a low fat-diet, major differences were seen in the amount of fat these foods contributed to saturated fatty acid intake. For example, the beefsteak group which was the largest contributor to saturated fatty acid intake in the high-fat consuming group, contributed more that 9% to intake, and in the low-fat consuming group contributed only about 3% to intake. Three foods that were among the top ten contributors to saturated fatty acid intake among those children who ate high-fat diets, pizza, french fries and hamburgers/cheeseburgers contributed more saturated fatty acids in the group consuming lower-fat intakes. Overall the top ten sources of dietary saturated fatty acids contributed 52% to the total population intake of saturated fatty acids in the high-fat consumption group, while these same foods contributed 47% of total saturated fatty acid intake in the group of children eating low-fat diets.

Eggs, while being the largest contributor to cholesterol intake in both the high and low-fat consumption groups, provided more that 3.5 times as much to total population cholesterol intake among the children eating high-fat diets. Other major differences occurred for the beef group, ice cream and shrimp. Here again the top ten contributors in the high-fat group contributed almost 13% less cholesterol to intake of the group consuming low-fat diets.

In summary, these data show that the nutrient intake of these children is similar to other reported data showing that children are consuming diets that contain the same amount of fat as that eaten by adults and lower than amounts consumed a number of years ago. These data do not support the idea that the recommendation that children should consume a diet containing less than 30% total fat and less than 10% saturated fatty acids is an unusual dietary pattern. More than 15% of the children consumed less than 30% of calories as total fat and 7% ate less than 10% of calories as saturated fatty acid, and 97% of children ate less than 300 mg of cholesterol per day. These data also show that a large percentage of children are eating diets containing greater than 38% of kilocalories as total fat and greater than 10% of kilocalories from saturated fatty acids. Data in the literature suggest that, to varying degrees, cholesterol levels track in children and that children with higher levels of serum cholesterol probably have an increased risk of having higher levels of serum cholesterol as adults. In conclusion, we feel that the current dietary recommendations in regard to fat intake are possible and acceptable within the range of intakes seen in this population of healthy children.

In keeping with the theme of this conference of looking at the past present and future, there are three items which need to be addressed. Past research activities have emphasized the need for access to manufacturers' data to keep current with our continually evolving marketplace. A goal for our future should be to develop close working relationships with the food manufacturers, and to centralize the distribution of these data to all users. Support is needed for this to happen. Second, having completed numerous dietary assessments among low, middle and upper income persons, white, black and Hispanic persons, children, elderly, both chronically ill and healthy free living persons, we have found that the USDA Nutrient Data Base for Individual Intake Surveys contains the type of needed information. The recipe items, the diversity of food choices, (almost 6000 food items), and the ability to vary the 6000 food items according to the type of fat or for salt has been invaluable. The type of data that is within the Survey database is appropriate for doing research with a variety of populations. We have had very little difficulty finding foods or creating a recipe for any of our studies. The future demands that we as database users strive to put together the most accurate nutrient database that is possible and then agree that we will all use this database and work from a common ground. Individuals may utilize whatever software they desire to access the nutrient information, but we need to all work from a common set of nutrient values. Researchers need to work with each other, using the same nutrient information for like foods. Comparability of study results is impossible when every study is working from a different version or type of nutrient data set. We need a common database, with a mechanism for updating that is uniform for all users. Then these database conferences can be used as a forum for planning new directions for the database, to include additions of foods and nutrients. And third, we need to increase the number of nutrients available in the database in the most accurate manner possible. In closing, the future challenges epidemiologists to refine the dietary intake methodologies to increase the reliability and validity of intake data. The future challenges the nutrient database experts to agree upon a common source of nutrient intake data coupled with a plan to ensure regular updating of nutrient information and a mechanism for obtaining manufacturers data.

DEVELOPING AN INTERNATIONAL FOOD COMPOSITION DATABASE: AN ILLUSTRATION FROM THE NUTRITION CRSP

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INTRODUCTION

Many types of research on human dietary intake rely on food composition tables to convert quantitative data on food and beverage consumption to the caloric and nutrient content of a diet. For this reason, the appropriate food composition database must be identified and applied to the research.

Scientists conducting research on United States populations have access to a large network of food composition databases. For them, the selection issue often depends only on the appropriateness of the database for testing particular scientific hypotheses. The complexity of this process can increase significantly in international research. The required approach can range from the minor modification of a preexisting database to the complete construction of local, regional, or national food composition tables. This paper highlights the approach used to develop a food composition database for Egypt.

In 1981, the Office of Nutrition, United States Agency for International Development (USAID) provided funds to support the Nutrition Collaborative Research Support Program (CRSP).[7] The research program investigated cross-culturally the effect of chronic mild-to-moderate undernutrition on human functional outcomes believed to shape the development of individuals, households, and communities.

Since the Nutrition CRSP aimed to generate information that could be generalized to most of the less developed world, the program implemented a "parallel projects" approach in three countries with different biological and sociocultural ecosystems. The three selected field sites were Kalama, Egypt; the Solis Valley, Mexico; and Embu District in Eastern Province, Kenya.

Each of the three country projects posed an identical core of key research questions. However, methodologic procedures to answer these questions differed among projects to accommodate environmental characteristics, resources, and sociocultural contexts unique to each field situation. For example, the country-specific food composition database developed for Egypt had to take into account the specific foods and beverages of Egypt, Egyptian food preparation and preservation methods, current food composition tables and earlier attempts at developing a local food composition database.

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DESCRIPTION OF THE EGYPT PROJECT STUDY SITE

Kalama, Egypt, is a periurban community of approximately 10,000 individuals situated in the Nile River delta just 25 kilometers north of downtown Cairo. Kalama's climate is hot and humid, and rainfall is extremely sparse falling no more than six times per year. There are three distinct seasons - the very hot, humid and dusty summer from April to August, the mild autumn from late September to November and the cool winters from December to March.

In 1982, over 50 percent of Kalama's predominantly Moslem population was under 21 years of age. An average household consisted of approximately six individuals. Two-thirds of all village households were nuclear families, consisting of a married couple and their unmarried offspring; the remaining one-third were extended family households. Most older village women have little or no formal education. However, recent trends indicate that norms of female education are changing as the younger generation of females are strongly encouraged to attend school.

Agriculture is the basis of economic life. However, employment in the non-agricultural sector is continuously increasing particularly for the younger generations.

THE EGYPT NUTRITION CRSP FOOD COMPOSITION DATABASE

The Egypt Nutrition CRSP Food Composition Database contains information on energy and 15 nutrients for over 1,000 unique entries. The food composition database, assembled by food groups, includes the following information for each food or beverage item:

1. Name and brief description;
2. A four-digit food identification code;
3. All applicable two-digit "state of food" codes;
4. An edible portion factor for converting food intake data recorded in grams "as purchased" into grams of "edible portion" consumed;
5. The energy content in the edible portion of 100 grams of each dietary item "as acquired" or "as purchased";
6. Fifteen food components in 100 grams of the edible portion of each dietary item. Refer to Table 1;
7. Reference number indicating the source of the food composition data.

Information presented subsequently in this paper reviews the method for developing the Egypt Nutrition CRSP Food Composition Database. The review proceeds from general to specific and concludes with a discussion of the potential errors associated with its use.

GENERAL APPROACH TO DEVELOPING AN INTERNATIONAL FOOD COMPOSITION TABLE

Studies on human dietary intake require culturally appropriate and sensitive research methods. This principle also applies to the construction of locally relevant international food composition tables.

The general approach requires five major steps. The first step involves identifying and evaluating available unpublished in-country and published food composition tables applicable to the country.

The second major step entails establishing familiarity with the environmental and sociocultural context of food consumption. This is accomplished by conducting focused ethnographic and social survey research to gather information on 1) the typical dietary pattern identified by both the local and scientific names of foods, 2) factors which alter the typical dietary pattern, 3) seasonal availability of plant and animal foods, 4) household food acquisition strategies, 5) community-specific measures of quantifying foods and beverages, 6) standard measures of quantifying foods and beverages consumed, and 7) local cuisine and culinary practices including traditional food processing and preparation.

Step three utilizes the ethnographic and social survey data to construct a food coding system based on the local dietary pattern. The system must incorporate all known locally-consumed foods and beverages and accommodate expansion as changes in food habits occur. Each food code or identification number must be unique to accurately link food consumption data with corresponding food composition data during the computerized conversion of foods and beverages to energy and nutrients.

The fourth step involves organizing the database. Here, food composition data gathered from the field, select laboratory analyses such as those for composite diets, and published tables of food composition come together in a format which reflects both the dietary practices of the community and the specific needs of the scientific investigation.

The fifth and final step checks the completed database for internal integrity and validity. Arithmetic or data entry errors can be detected and corrected, while other less obvious sources of error can be identified for discussion when reporting study results.

CREATING A FOOD COMPOSITION DATABASE FOR EGYPT

Experiences from the Egypt Nutrition CRSP follow. We illustrate how the five-step approach was applied to develop an international food composition database.

STEP:1 Reviewing and Evaluating Available Food Composition Tables

United States and Egyptian scientists reviewed and evaluated Egyptian and other Middle Eastern food composition tables and collaboratively decided to create a food composition database specifically for the Egypt Nutrition CRSP. Working within financial and technologic constraints, four major steps were taken to develop the Egypt project's food composition database.

STEP:2 Obtaining Qualitative and Quantitative Information on the Sociocultural Context of Food Consumption in Kalama

The Kalama Dietary Pattern

A food frequency protocol in combination with qualitative observation on local food consumption provided data on the Kalama dietary pattern. The dietary items obtained from this methodologic approach formed the core of the project's food composition database.

The Kalama dietary pattern mirrors the traditional rural Egyptian diet. Bread, the dietary staple, is consumed daily by virtually all individuals and accounts for most of their daily caloric intake. Other principal components of the dietary pattern include; sugar, fava beans (or broad beans), home-made cheese from goat's or buffalo's milk, rice, and stewed vegetables available seasonally. Meat and poultry are consumed infrequently and fish, rarely.

Factors Altering the Dietary Pattern

Significant alterations to the typical dietary pattern occur during frequent Moslem religious observances. During these periods the typical dietary pattern expands to include a variety of festive mixed dishes, sweets, meat, ceremonial fruits, and nuts.

Household recipes for specially prepared foods were obtained during holidays (and also periods of usual consumption). This procedure increased the accuracy in estimating dietary intake by accounting for interhousehold intracommunity variability in food preparation methods. The Egypt project identified 11 dietary items for which standardized recipes were obtained.

Seasonal Availability of Dietary Items

Knowledge of the local agricultural cycle helps to predict the seasonal market availability of a variety of locally produced fruits and vegetables. Information on seasonal diversity of foods ensures that the food composition database captures the entire range of items in the annual diet.

In Kalama, the primary agricultural crops include maize, beans, parsnips, carrots, leaf crops, and some other vegetables. In the winter citrus fruits are harvested. Fresh dates are available in the late summer and autumn and in the summer, tropical fruits such as watermelon, guava, and mangoes are widely available.

Household Food Acquisition Strategies

Knowledge of food acquisition strategies helps in designing a food composition database since differences in commercial preparation and processing techniques introduce the potential for variation in food composition. In Kalama, households acquire dietary items from both commercial and home-based sources.

When commercially prepared foods play a significant role in the dietary pattern, their food composition should be determined by laboratory analyses to avoid potential errors resulting from imputed data. This will improve the database's accuracy in estimating individual energy and nutrient intakes.

Standard Measures of Quantifying Foods and Beverages

The Egypt Nutrition CRSP relied on ethnographic data to develop culturally-appropriate food intake research methods. Similarly, the format of the food composition database must be compatible with food intake data. Two basic format decisions were made.

The first concerns the use of local household measures versus metric weights to record dietary items. The Egypt Nutrition CRSP decided that food intake data should be obtained in household measures and then converted to metric. This decision was based on the variability of food preparation and measuring techniques in village households and the local professional tradition in obtaining dietary data. Quality control measures were applied rigorously to ensure accuracy in the measurement and conversion process. Therefore, the food composition database reports the food composition of 100 grams of each dietary item.

The second decision concerns the use of "as purchased" versus "edible portions" of dietary items. In Kalama, the traditional style of communal eating from a common serving dish makes it difficult, if not impossible, to precisely quantify individual food intake. Therefore, data collectors recorded quantities of food "as acquired" for preparing a given dish for family consumption, i.e. quantities of ingredients were recorded in the "as purchased" state. On the other hand, commercially-prepared foods were recorded in the "edible portion" state. To accommodate the data collection protocol, the project added an "edible portion" factor to the food composition database to convert grams of foods "as purchased" to grams of "edible portion."

Aspects of Cuisine: Traditional Food Preparation and Processing

Ethnographic research identified a range of food preparation and processing methods in Kalama permitting women without access to the convenience of refrigeration to safely store, preserve, and prepare foods in a hot dry climate. These were taken into account in estimating nutrient content since food preparation and processing can alter food composition.

In Kalama, many foods such as fruits, vegetables, and cheese are preserved by pickling or salting. In addition, women traditionally cook foods for long periods of time; "stewed" vegetables are very common. Cooked dishes prepared in two-day quantities are periodically reheated to prevent spoilage and the "next day portion" of day-old prepared dishes are reheated up to the boiling point just before eating.

Due to these realities, the Egypt Nutrition CRSP developed a "state of food" coding system to accompany the basic food identification code to specify food preparation and preservation methods. Step 3 provides more information on the food coding system.

STEP 3: Developing the Food Coding System

The need to specifically determine the energy and nutrient content of a food item led to the development of a sophisticated yet simple four-digit food coding system. This system linked food consumption data with the corresponding food composition data during the computerized conversion of foods to energy and nutrients.

The four-digit food code has three main features: 1) the ability to accommodate existing foods and beverages while permitting future expansion within the system, 2) a system of grouping foods based on traditional food groups and frequency of consumption within food groups, and 3) a complementary two-digit "state of food" coding system to specify both preparation method and "technologic" state, i.e. the "state" of food as consumed. Refer to Figure 1.

The first two digits of the four-digit food code represent the food group, e.g. cereals/cereal products. The second two digits of the four-digit food code denote the specific member of the food group, e.g. rice.

The two-digit state of food codes even further describe the food or beverage item to facilitate a more accurate estimation of its energy and nutrient content. Examples of states of food are boiled, stewed, and raw.

STEP 4: Organizing the Egypt Nutrition CRSP Food Composition Database

The core of the Egypt Nutrition CRSP Food Composition Database was obtained from three published tables of food composition. Additional information was obtained from the Egypt Nutrition Institute's unpublished food composition tables, nutrient labels supplied by manufacturers of commercially prepared products, proximate analyses performed by two United States laboratories, and other imputed data derived from standardized local recipes. Integrating these data from several sources while ensuring accuracy and consistency in the final composite product demanded a systematic approach and an eye for detail.

Data from Published Tables of Food Composition

Information on food energy and other nutrients were carefully and systematically selected from three primary reference documents - *Food Composition Tables for the Near East* (FAO[1]), *Food Composition Tables for Use In East Asia* (FAO[2]), and *Bowes and Church's Food Values of Portions Commonly Used.*[3]

When nutrient information on cooked foods was unavailable, vitamin and mineral losses from cooking were estimated and nutrient values were reduced accordingly. The publication, *Provisional Table on Percent Retention of Nutrients in Food Preparation* (USDA[4]), provided standardized percents reflecting proportion of nutrients retained in different foods after cooking by a variety of methods. Knowledge of local culinary practices were invaluable in applying data from this document.

Data from Laboratory Analysis

Two United States laboratories provided data on the energy, available carbohydrate, fat, and protein content of commonly consumed "fast foods" in Kalama. To maintain consistency with the rest of the database, total carbohydrate was estimated. Thus, laboratory results on available carbohydrate were then converted to total carbohydrate by adding grams of dietary fiber to grams of available carbohydrate.

Data from Recipes

The energy and nutrient composition of eleven Egyptian composite or mixed dishes were derived from local recipes in a systematic way. Information on the energy, protein, fat, and total carbohydrate content of each ingredient in a recipe was obtained from the Egypt Nutrition CRSP Food Composition Database. The sum of the energy and nutrients of all ingredients equalled the recipe's total.

Next, the total weight of the ingredients in a recipe was adjusted to reflect net changes in weight and nutrient content per unit weight after cooking or baking. Examples include the increase in caloric density associated with a decrease in weight from moisture loss during baking or an increase in weight from fat absorption during frying. The publication, *Food Yields Summarized by Different Stages of Preparation* (USDA[5]) provided data on proportional weight changes.

Finally, the energy, protein, fat and carbohydrate content of 100 grams of the prepared recipe was calculated by a simple proportionate adjustment.

STEP 5: Checking the Food Composition Database for Internal Integrity and Validity

After the Egypt project's food composition database was assembled, manually checked, and double entered, an algorithm checked the database for internal inconsistencies. The Atwater energy equivalent factors were applied to the values for protein, fat, and total carbohydrate to calculate approximate energy content for each dietary item. The calculated energy value was compared to the database energy value and differences greater than five percent were flagged, checked, and corrected as necessary.

The Egypt Nutrition CRSP food composition database was validated against the results of laboratory analysis. Seven Kalamans of different age, sex and physiologic state (females only) provided individual food consumption data and concomitant 24-hour composite dietary samples for the validation protocol. For each of the seven individuals, the energy, protein, fat and total carbohydrate values derived from the individual food intake data using the food composition database were compared to the results of proximate laboratory analysis. The percentage difference is expressed relative to laboratory values. The results indicate a mean difference ranging from 7.9 percent for carbohydrate to 70.3 percent for fat. Refer to Table 2.

SOURCES OF ERROR IN ESTIMATING DIETARY INTAKE

Despite the care in developing food composition databases, users of food composition tables should be aware of potential errors and inconsistencies in the data. There are many reasons for this including the natural nutrient variability, diversity in food preparation techniques even when recipes are used, and errors derived from the laboratory methods used to determine the energy and nutrient content. Additional sources of error are often introduced in developing countries due to inherent technologic, cultural, and economic constraints in conducting certain types of research in this setting. Errors in the Egypt Nutrition CRSP data base stem from such factors as an inability to completely account for the variability in traditional food preparation and the inclusion of both home-prepared and commercially-prepared mixed dishes in the dietary pattern. These problems can be resolved with advances in research.

Finally, food composition data permit an estimate of only the total level of energy and nutrients in dietary items. Critical factors in determining dietary adequacy such as actual digestibility and bioavailability of nutrients certainly extend beyond the capacity of any food composition table. Even though the specific Atwater energy equivalent factors adjust for digestibility, diets which are relatively high in dietary fiber (as are many in the tropics and semi-tropics) may not be as well-digested as the factors predict (Murphy[6]).

The reduced bioavailability of some nutrients poses a special problem in these settings. For example, the major source of dietary iron for some populations may be from plant sources with little bioavailable iron. In addition, complementarity with other dietary items especially those high in some types of fiber and phytates may reduce both the digestibility of the diet and the bioavailability of some nutrients (e.g. zinc). To further compound the problem, the high prevalence of diarrheal disease can also significantly reduce the absorptive capacity of the intestinal mucosal surface in individuals already at risk to malnutrition.

CONCLUSIONS

This paper reviewed the conceptual and procedural approaches for developing an international food composition database using a recent Egyptian case as an example. The limitations of food composition tables have also been discussed here and by others (Watt;[7] Rand;[8] Wu Leung;[9] Hertzler and Hoover;[10] Mayer[11]). Please note however, that food composition tables are not the only potential source of error in the estimation of dietary intake. The validity and reliability of methods to measure dietary intake are well-documented and also warrant consideration when planning studies and interpreting dietary information (Brown;[12] Block;[13] Walker and Blettner[14]).

Finally, the development of food composition tables is never static. It requires continuous expansion, reorganization, update, and revalidation; however, despite these precautions nutrient information on a particular dietary item may be either incomplete or entirely lacking. Our responsibility in these circumstances is to make rational well-documented decisions when filling in the blanks until the time when adequate sampling and standardized laboratory analysis can provide more representative, valid and reliable substitutes for this imputed information.

REFERENCES

1. Food and Agriculture Organization of the United Nations. Food composition tables for the Near East. FAO Food and Nutrition Paper 26. Rome: Food and Agriculture Organization of the United Nations, 1982.

2. Food and Agriculture Organization of the United Nations. Food composition tables for use in East Asia. Rome: Food and Agriculture Organization of the United Nations, 1982.

3. Pennington, J.A.T., Church, H.N. Bowes and Church's food values of portions commonly consumed. 13th ed. Philadelphia: JB Lippincott, 1980.

4. United States Department of Agriculture. Provisional table on percent retention of nutrients on food preparation. United States Department of Agriculture. Human Nutrition Information Service, 1984.

5. United States Department of Agriculture. Food yields summarized by different stages of preparation. Agricultural Handbook No. 102. Washington, D.C.: Agricultural Research Service, 1975.

6. Murphy, S. Personal communication, 1989.

7. Watt, B.K. Concepts in developing a food composition table. *Journal of the American Dietetic Association.* 40 (1962): 297-300.

8. Rand, W.M. Food composition data: problems and plans. *Journal of the American Dietetic Association. 85 (1985): 1081-1083.*

9. Wu Leung, W.T. Problems in compiling food composition data. *Journal of the American Dietetic Association.* 40 (1962): 19-22.

10. Hertzler, A.A., Hoover, L.W. Development of food tables and use with computers. *Journal of the American Dietetic Association.* 70 (1977): 20-31.

11. Mayer, J. Food composition tables: basis, uses and limitations. *Postgraduate Medicine.* 28 (1960): 295-307.

12. Brown, K.H. Measurement of dietary intake. *Population and Development Review.* 10 (suppl.),(1984): 69-91.

13. Block, G. A review of validations of dietary assessment methods. *American Journal of Epidemiology.* 115 (1982): 492-505.

14. Walker, A.M., Blettner, M. Comparing imperfect measures of exposure. *American Journal of Epidemiology.* 121 (1985): 783-790.

Figure 1. Food Coding System. Egypt Nutrition CRSP.

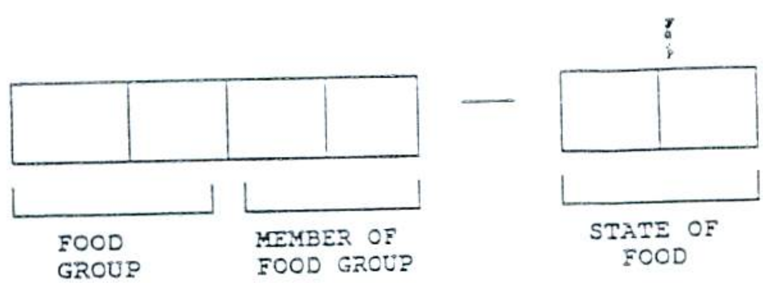

Table 1
Food components in the Egypt Nutrition CRSP Food Composition Database.

FOOD COMPONENT	UNIT(S) OF PRESENTATION
Energy	kilocalories
Water	grams
Protein (animal sources)	grams
Protein (plant sources)	grams
Fat (animal sources)	grams
Fat (plant sources)	grams
Total carbohydrate	grams
Calcium	milligrams
Iron (animal sources)	milligrams
Iron (plant sources)	milligrams
Sodium	milligrams
Thiamin	milligrams
Riboflavin	milligrams
Niacin	milligrams
Vitamin A (retinol)	retinol equivalents micrograms of retinol
Vitamin A precursor (B-carotene)	retinol equivalents micrograms of B-carotene
Ascorbic acid	milligrams
Crude fiber	grams
Ash	grams

Table 2
Summary of percentage differences between food composition database and laboratory analysis.

Sample	Percent differences			
	Protein	Fat	Carbohydrate	Kcal[b]
Adult male	-11.6	11.5	-13.7	-9.1
Non-pregnant non-lactating	10.2	97.7	-5.9	13.9
Pregnant 9 months	18.7	57.0	2.3	19.1
Lactating 7 months	-5.6	11.5	1.3	2.2
Pregnant 4 months and lactating 15 months[c]	63.9	252.7	59.6	91.4
School-age child	24.1	63.9	28.0	31.3
Toddler	-7.2	-2.5	-16.1	-12.1
Mean difference	13.2	70.3	7.9	19.5

[a] Difference is expressed relative to laboratory values.
[b] Kcals determined using Atwater energy equivalent factors.
[c] Possible error in sample preparation for analysis.

USES OF NUTRIENT DATA IN A LOW FAT DIET INTERVENTION STUDY: The Women's Intervention Nutrition Study

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The Women's Intervention Nutrition Study (WINS) is a multi-institutional study designed to assess compliance to a low-fat diet protocol in postmenopausal women who have had prior surgery for breast cancer. The purpose of this paper is to discuss the various uses of nutrient data in the dietary intervention and assessment components of WINS.

WINS organization and study design

The collaborative study, which is funded by the National Cancer Institute (NCI), is administered by the American Health Foundation in New York City. The nutrition components of the study are coordinated by the University of Minnesota's Nutrition Coordinating Center (NCC), and the statistical coordination is performed at the University of California at Los Angeles. The clinical centers participating in WINS include the American Health Foundation, New York, NY; Baylor-Methodist Hospital, Houston, TX; Emory University, Atlanta, GA; Evanston Hospital, Evanston, IL; Harbor-UCLA Medical Center, Los Angeles, CA; New England Deaconess Hospital, Boston, MA; and Wayne State University, Detroit, MI.

Three hundred participants will be recruited during the first two years of the four-year study. Eligibility criteria include surgery for breast cancer within the past six months, 50 years of age or over, fat intake greater than 25% of energy intake at entry, and the ability to comply with the dietary data collection procedures. Additional clinical criteria must also be met.

Potential subjects are entered into a two to four week prerandomization period to assess compliance to the dietary data collection procedures and to determine fat intake as percent of energy intake (% fat). Subjects who meet all eligibility requirements are randomized into one of two study groups: a nonintensive intervention group which receives counseling for nutritional adequacy only, and an intensive intervention group which receives counseling to reduce fat intake to 20% of calories in addition to counseling for nutritional adequacy. Nutritional adequacy is defined as meeting at least two-thirds of the Recommended Dietary Allowance (RDA[1]) for nutrients for which RDA values are available.

WINS intervention protocol

The protocol for the intensive intervention group consists of biweekly individual counseling sessions for the first two months of intervention, followed by monthly visits for the next six months and bimonthly visits for the final four months. A 12 month follow-up period consists of semiannual visits for dietary assessment only. Visits for the nonintensive intervention participants are scheduled at three months, six months and semiannually thereafter.

Participants in the intensive intervention group are instructed in the Low-Fat Eating Plan (LFEP) which is a step-by-step intervention protocol for reducing fat intake. The protocol was originally developed for the Nutrition Adjuvant Study, a low-fat diet and breast cancer study initiated by the NCI.[2] The LFEP is based on individualized intervention using a combination of education, goal setting, evaluation and feedback, and participant self-monitoring.

The first step of the LFEP consists of learning to identify high and low-fat foods and to reduce fat in recipes and other food preparation methods. The second step involves calculation of an individualized daily Fat Gram Goal and learning how to count fat grams. The third step involves the setting of long and short term goals for reducing fat intake. In addition to these three steps, a variety of optional modules address specific problems relating to adherence to the LFEP. These modules include topics such as Eating Away From Home, Meal Planning, Family Involvement, Fast and Easy Cooking, Packing Your Lunch, Low Fat Desserts, and Cooking with Dried Beans, Peas and Lentils. A more detailed description of the LFEP is presented elsewhere.[3]

Description of the nutrient calculation system used for WINS

The nutrient database used for calculation of WINS data is version 16 of the NCC nutrient database. The NCC database is routinely updated to maintain currency with USDA publications and data tapes, with the scientific literature, and with the changing and expanding marketplace. Food manufacturers are contacted annually to obtain updated information on existing products as well as on new and reformulated products.

Completeness of the nutrient data is considered critical for the calculation of accurate dietary intakes for research purposes. Missing values are imputed whenever possible based on established guidelines.[4] Imputed values are replaced with analytic data when they become available.

Given the many potential sources of error in the handling of data for a comprehensive nutrient database and calculation system, another critical factor for accurate calculation of dietary intakes is data validation. Prior to releasing a new version of the nutrient database or processing data for a new study, nutrients are calculated for a set of test records, and the calculations are compared with previous results from the same set of records. Any discrepancies must be verified to document that they are intended modifications to the database or to the calculation system. The test records are selected to ensure representation of a wide range of food items and to include all software calculation routines. NCC procedures for data validation were previously presented,[5] and some of these issues are further addressed in these proceedings.[6]

Another potential source of error in nutrient calculations is the error associated with manual amount conversions. This type of error is minimized by providing the ability to enter amounts in any standard units of weight or household volume measures, in terms of standard three-dimensional shapes, or in terms of food models. Foods may also be quantified in terms of food specific serving portions, such as a "slice" of bread, a "large" apple, or a "pat" of butter.

Meeting the nutrient data requirements for WINS

The target nutrients for WINS are total fat and energy, both of which are required for determining % fat intake. Additional nutrients of interest include the other energy producing nutrients (protein, carbohydrate and alcohol) and the RDA vitamins and minerals for assessing nutritional adequacy. The individual fatty acids are of interest for monitoring the adequacy of the essential fatty acids on the low-fat diet as well as for determining the relative proportions of the three major classes of fatty acids (saturated, monounsaturated and polyunsaturated fatty acids). There is also interest in tracking changes in dietary fiber associated with conversion to a low-fat diet.

In preparation for the low-fat diet studies, NCC guidelines for grouping foods together in the nutrient database were modified to enhance specificity for fat in some categories. For example, the range of fat content permitted within a single entry in the meat category was reduced from 5% (i.e., 5 grams of fat per 100 grams of edible meat) to 2.5%. This resulted in the addition of a number of new entries to the database.

The new guidelines for increasing fat specificity also applied to the brand name and fast-food coding guides, which specify the coding for thousands of commercial products. With many new products entering the marketplace, especially those making claims for lower fat and/or calories, a large amount of effort is required to keep the nutrient calculation system up-to-date for commercial products.

Accurate calculation of fat and fatty acid intakes requires designation of the amount and type or brand of fat used in food preparation. The NCC system permits the optional specification of all major fat ingredients in recipes and other food preparation methods. On-line coding procedures facilitate access to the recipes in the database and permit rapid modification of the type or amount of recipe ingredients. Computerized algorithms automatically calculate the amounts of fat and other ingredients used in various preparation methods for meats, eggs, or vegetables based on the amount of the food consumed.

To further improve the accuracy of fat determinations, collaboration with the USDA's Nutrient Composition Laboratory (NCL) was initiated to evaluate fat uptake in selected food preparation methods. Analysis of the fat and fatty acid composition of fried eggs has resulted in a change in the NCC preparation algorithm for the amount of fat added for fried eggs. Other preparation algorithms are being reevaluated based on the analytic results provided by the NCL.

The nutrient database used for calculation of WINS data will remain stable for the duration of the four year study. The only changes permitted in the study-assigned database are additions of new entries for foods or beverages not previously included in the database. No changes are allowed in values for existing entries, since this could confound the interpretation of the dietary data during the study. To provide the flexibility for future reanalysis of WINS data, no entries will ever be deleted from the database, even though some foods may no longer be available in the marketplace. This ensures that the WINS dietary data can be reanalyzed at a later date to take advantage of updated values or the expansion of the nutrient database to include additional food components of future research interest.

Uses of nutrient data for development of WINS intervention tools

A number of intervention tools, developed to enhance compliance with the LFEP, required accurate and updated information on the fat content of common foods and beverages. Major sources of data for the development of these tools included the NCC nutrient database and the Manufacturers' File, a noncomputerized file of nutrient and ingredient information on thousands of commercial foods produced in the United States and Canada. Information from the NCC Codebook was used to provide güidelines for estimating "unknown" amounts, such as the amount of fat to be added to a grilled sandwich or to breaded and fried meats or vegetables.

The **Fat Gram Counter** is a booklet listing over 400 commonly consumed foods and the corresponding fat content in grams per common portion. Foods are organized by food group, and fat gram values are rounded to whole digits for ease of computation. The Fat Gram Counter is designed primarily to help participants self-monitor their daily fat intake. It includes guidelines for estimating amounts of "accessory" foods such as the amount of butter or margarine on a slice of bread or the amount of creamer used in a cup of vending machine coffee. An example of a page from the Fat Gram Counter is shown in Figure 1.

The **Brand Name Guide** is a similar tool which lists brand name products that meet the guidelines of the LFEP. It includes guides for estimating fat content of products which do not provide nutrition information on their labels. Label reading tips are provided for each category of commercial products to help participants make decisions about unlisted products. An example of a page from the Brand Name Guide is shown in Figure 2.

High Nutrient Food Lists provide listings of major food sources for the nutrients for which RDA levels have been established. Development of the High Nutrient Food Lists required updated information on the vitamin and mineral content of foods. Major database updates for vitamin B6, vitamin B12, folacin, zinc, and magnesium were completed in preparation for the low-fat diet studies. Fat composition data were also required for developing these tools since the LFEP versions of the lists include only those foods which are relatively low in fat.

Breads, Cereals and Other Grain Products

	Portion	Fat Grams
Breads, Pancakes, waffles		
Matzoh ball, 2" diameter	1	8
Muffin, plain, bran, corn, etc.	1	3
English	1	1
Nut bread, 4 1/2" x 2 1/2" x 1/2"	1 slice	10
Pancake 4" diameter	1	3
Pita or pocket bread 7" diameter	1	1
Popover	1	4
Roll, hard or dinner	1	2
Taco shell	1	2
Tortilla, 6" diameter, corn, plain		
not fried	1	1
flour, plain, not fried	1	3
Waffle, 7" diameter	1	14
Cereals, Cold		
Bran, unprocessed	1 Tb	0
Granola	1/4 c	5
Ready-to-eat cereal	1 c	1
Wheat germ	1 Tb	1
Cereals, cooked		
Bulgur	1 c	1
Kasha, buckwheat groats, millet	1 c	2
Oat bran	1 c	2
Oatmeal	1 c	2
Ralston, corn grits, farina		
Cream of Wheat, etc.	1 c	0
Pasta and Rice, Cooked		
Noodles, chow mein	1 c	11
Noodles, egg, macaroni, spaghetti, etc.	1 c	1
Rice, fried	1 c	15
Rice, white, brown or wild	1 c	1
Baking ingredients		
Baking flour mix (Bisquick, etc.)	1 c	17
Cornmeal, dry	1 c	2
Cornstarch	1 Tb	0
Flour, white or whole wheat	1 c	1
Matzoh meal	1 c	1

Figure 1 Example of pages from the Fat Gram Counter.

Breads, Cereals and Other Grain Products

	Portion	Fat Gram
Crackers		
Bread sticks, 5" long	1	0
Crackers with cheese or		
peanut butter filling	4 crackers	6
Graham crackers	4 crackers	4
Melba toast	4 crackers	1
Matzoh, 6" diameter	2 crackers	1
Oyster crackers	5 crackers	1
Ritz	4 crackers	3
Rusk or Zwieback	1 cracker	1
Ry-Krisp	2 whole	1
Soda, saltine crackers	4 crackers	1
Wheat Thins	4 crackers	1

Cakes, Cookies, Pies and Other Baked Goods

	Portion	Fat Grams
Cake, angel food	1 pc	0
Cake, other types, 3"x3"x1" or 1/14 of		
2 layer cake, without icing	1 pc	10
with icing	1 pc	14
Cupcake, without icing	1 cupcake	5
With icing	1 cupcake	7
Cheesecake, 9" diameter,		
cream cheese	1/8 pie	38
cottage cheese	1/8 pie	12
Coffee cake with topping,		
3"x3"x1"	1 pc	10
Cookies, Rice Krispie bar 2"x1"	1	1
Brownies and other bar cookies		
2"x1"	1	4
Low fat cookies (fig bars, fortune, pfeffernuesse, spice, vanilla wafers)	1 avg	1
All other cookies (chocolate chip, peanut butter, oatmeal, Oreo, sugar, etc.)	1 avg	3
Cream puff with filling	1	8
Croissant, 5" long	1	13
Doughnut, cake, 3" diameter	1	7
yeast (raised) 4" diameter	1	10
Eclair with filling	1	12
Fruit crisp	1/2 c	13
Fruit pie tart (Hostess, etc.)	1	23
Icing, chocolate, fudge,		
confectioner's sugar, etc.)	1 Tb	2
boiled white	1 Tb	0
Pastry, Danish, 3" square	1	14

Uses of nutrient data for WINS dietary assessment

WINS diet assessment methods include the four-day food record (4DR) for estimating current individual intake and the unannounced 24-hour recall collected by telephone (TR) for assessing group intake. The 4DRs, which consist of four consecutive days including one weekend day, are collected at baseline, 3, 6, 12, 18, and 24 months. The TRs are collected at baseline and semiannually throughout the study. All dietary data are collected by dietitians who are trained and certified as research interviewers.

The primary purposes of the 4DRs include tracking individual changes in % fat intake, assessing nutritional adequacy by comparison with RDA levels, and investigating individual changes in food and nutrient intakes. Therefore, calculation of the 4DRs requires updated nutrient information for all of the nutrients of interest. Determination of % fat intake is especially critical at baseline since this is one of the eligibility criteria.

The primary purpose of the unannounced TRs is to provide a relatively unbiased assessment of differences in % fat intake between the two intervention groups at regular intervals throughout the study. Since % fat is the major outcome variable for WINS, complete and accurate nutrient data for fat and energy are essential.

Another important aspect of dietary assessment is the analysis of nutrient intake by food groups. Multiple food grouping schemes are maintained in the NCC nutrient database. Investigation of changes in the intake of individual foods and food groups associated with adherence to a low-fat diet is one of the objectives of WINS. A fat-based food grouping scheme, such as the one developed collaboratively by the USDA and the National Heart, Lung and Blood Institute,[7] will be used for food group analysis of WINS data. Calculation of the average daily intake of individual foods and food groups by weight as well as by percent contribution to a particular nutrient will permit detailed analysis of the changes in food intake patterns associated with the Low Fat Eating Plan.

In conclusion, it is clear that an accurate, complete, and up to date nutrient database and a highly specific nutrient calculation and data analysis system are essential for the development of intervention materials and for the dietary assessment components of WINS.

REFERENCES

1. *Food and Nutrition Board: Recommended Dietary Allowances.* 9th rev. ed., 1980. Washington, D.C.: National Academy of Sciences, 1980.

2. Chlebowski, R.T., Nixon, D.W., Blackburn, F.L., Jochimsen, P., Scanlon, E.F., Insull, W., Buzzard, I., Elashoff, R., Butrum, R., Wynder, E.L.: "A breast cancer Nutrition Adjuvant Study (NAS): protocol design and initial patient adherence." *Breast Cancer Res. Treat.* 10 (1987): 21-29

3. Buzzard, I.M., Asp, E.H., Chlebowski, R.T., et al.: "Diet intervention methods to reduce fat intake: nutrient and food group composition of self-selected low fat diets." *J Am Diet Assoc,* in press, 1989.

4. Sievert, Y.A., Schakel, S.F., Buzzard, I.M.: "Maintenance of a nutrient database for clinical trials." *Controlled Clinical Trials*, in press, 1989.

5. Buzzard, I.M., Sievert, Y.A., Schakel, S.F.: "Database validation procedures." In: *Proceedings of the Eleventh National Nutrient Databank Conference*, The University of Georgia, Athens, GA, 1986, pp. 76-85.

6. Murphy, S.P.: "Integrity checks for nutrient databanks." In: *Proceedings of the Fourteenth National Nutrient Databank Conference*, University of Iowa, Iowa City, IA, 1989.

7. Brewer, E.R., Kassim, N., Cronin, F.J., et al.: "Food group system of analysis with special attention to type and amount of fat-methodology." *J Am Diet Assoc,* 87 (1987): 584-592.

Breads and Other Grain Products

	Portion	Fat Grams
French Toast, Pancakes, Waffles		
Waffle, frozen, Downyflake,		
Blueberry	1 waffle	2
Jumbo Homemade size	1 waffle	1
Other Grain Products		
Oven coating mix, Shake 'N Bake:		
Barbecue Chicken	1/4 envelope	2
Barbecue Pork	1/4 envelope	2
For Fish	1/4 envelope	2
For Pork	1/4 envelope	1
Oven fry, Home style flour recipe	1/4 envelope	1
Traditional Pork	1/4 envelope	2
Rice Medley, Green Giant		
Rice Original (frozen)	1/2 c	3
Crackers		
Animal crackers, Nabisco Barnum's	3 crackers	1
Ralston	5 crackers	1
Sunshine	3 crackers	1
Better Cheddar Snack Thins,		
Nabisco	5 crackers	2
Bran Wafers, Featherweight	4 crackers	1
Captain's Wafers, Lance	3 crackers	2
Cheese Snacks, Ralston	4 crackers	1
Chicken in a Biskit, Nabisco	2 crackers	1
Flatbread, Ideal	1 piece	0
Graham crackers:		
Keebler Honey grahams	4 crackers	2
Ralston	3 crackers	1
Mealmates, Nabisco	2 crackers	2
Melba toast, Lance	2 pieces	0
Stella D'Oro Alm/Toast	2 pieces	1
Oyster, Ralston	10 crackers	1
Rye Twins, Lance	3 crackers	2
RyKrisp, Natural	10 whole	1
Seasoned	2 whole	1
Sesame	2 whole	2
Saltine, Keebler, Zesta	5 crackers	2
Nabisco Premium	5 crackers	2
Ralston Purnia	5 crackers	2
Sunshine Krispy	5 crackers	1
Sesame, Lance	2 crackers	1
Sociables, Nabisco	5 crackers	2
Unsalted crackers, Estee	2 crackers	1
Wheat snacks, Ralston	2 crackers	1
Wheat Thins, Nabisco	5 crackers	2
Wheat Twins, Lance	3 crackers	2
Wheat Wafers, Featherweight	4 crackers	1
Wheatsworth, Nabisco	3 crackers	2

Cakes, Cookies and Other Baked Goods

Label Tip: *Avoid baked goods which contain shortening, oil or eggs as one of the first few items in the ingredient list or with more than 2 Fat Grams per serving (unless approved by your nutritionist). All items listed are prepared as directed on the package.*

	Portion	Fat Grams
Cakes and Frostings		
Cake mix, all flavors,		
Dia-Mel	1/10 cake	2
Estee	1/10 cake	2
Cake mix, angel food		
all brands	1/10 cake	0
Frosting mix,		
Betty Crocker, Fluffy White	1 Tb	0
Cookies		
Brownie Mix, Estee, 2"x2"	1 piece	2
Butter, Ralston	1 cookie	1
Buttercup, Keebler	1 cookie	2
Chocolate chip, Estee	1 cookie	1
Devil's Food, Nabisco	1 cookie	1
Egg Biscuits, Stella D'Oro	1 cookie	1
Egg Jumbo, Stella D'Oro	2 cookies	1
Fig Bar, Keebler	1 cookie	1
Nabisco Fig Newtons	1 cookie	1
Sunshine	1 cookie	1
Fudge, Estee	1 cookie	1
Ginger snaps, Nabisco	3 cookies	2
Sunshine	4 cookies	2
Golden Fruit, Sunshine	4 cookies	2
Mallopuffs, Sunshine	1 cookie	2
Oatmeal, Estee Oatmeal Raisin	1 cookie	1
Social tea biscuit, Nabisco	3 cookies	2
Vanilla wafer, Keebler	2 cookies	2
Nabisco Nilla Wafer	3 cookies	2

Coldcuts and Sausages

Label tip: *Avoid coldcuts and sausages with more than 3 Fat Grams per serving (unless approved by your nutritionist).*

	Portion	Fat Grams
Bar-B-Que Loaf, Oscar Mayer	1 slice	3
Bologna, beef Lebanon, Oscar Mayer	1 slice	3
Chicken, smoked, Buddig	1 slice	2
Corned beef, Lean Supreme		
Slender Sliced	1 oz	2
Oscar Mayer jellied loaf	1 slice	2

Figure 2 Examples of Pages from the Brand Name Guide.

INTEGRITY CHECKS FOR NUTRIENT DATA

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Although the importance of using automated methods to check the integrity of nutrient databases is generally recognized, the process is not implemented by all developers. Developers who carefully check the validity of their databases need to be distinguished from those whose procedures do not include these types of checks. Research results can be seriously biased if diets are analyzed using databases with inaccurate values, yet users usually have no consistent way of determining the quality of nutrient data. Although the use of automated integrity checks certainly does not ensure accurate nutrient data, it is one step in a process that all developers should undertake. At the 11th National Nutrient Databank Conference, I gave a brief report on the procedures we routinely use at U.C., Berkeley, and Marilyn Buzzard, Yvonne Sievert, and Sally Schakel gave a comprehensive overview of their procedures at the Nutrition Coordinating Center at the University of Minnesota.[1,2] In response to many requests from my colleagues, I have undertaken to formalize these procedures, and extend them to additional nutrient databases. This paper describes the preliminary results of the project.

PURPOSE

The primary goal in undertaking this project was to develop automated methods of checking the integrity of nutrient databases. Specifically, a set of edit limits would be developed which could be used by developers in checking nutrient values on their databases. Several desirable attributes of the edit limits were considered:

- They should be flexible so they could be responsive to changes in foods and nutrient values over time;
- They should be generated from the data, rather than being pre-set by subjective criteria;
- They should identify a manageable subset of nutrient values that should be examined for possible re-validation.

A secondary goal was to develop a reporting format that developers and users would find useful in describing the integrity of nutrient databases.

BACKGROUND AND METHODS

USDA's Nutrient Data Base for Individual Food Intake Surveys (SDB), Release 2.1 (1986), was used to generate edit limits. This database was chosen because it is a large, well-validated nutrient database, developed by the federal agency with the responsibility for maintaining national food composition data (HNIS, USDA), and in wide use for nationwide dietary assessment.

Food groups

Food groups were defined using the coding scheme from the SDB. The SDB foods were divided into 12 groups, based primarily on the high-order digit of the food code (1 through 9). Group 9 (sugars, non-alcoholic beverages, and alcoholic beverages) was divided into three groups (groups 9, 10, 11). Mixed dishes from four groups were combined into a twelfth group, based on the high-order 2 digits of the food code.

Nutrient variables

Edit limits per 100 grams of food were developed for the nutrients on the SDB: water, energy, protein, fat, saturated fat, monounsaturated fat, polyunsaturated fat, cholesterol carbohydrate, dietary fiber, alcohol, vitamins A, E, C, B6 and B12, carotene, thiamin, riboflavin, niacin, folacin, calcium, phosphorus, magnesium, iron, zinc, copper, sodium, and potassium.

Calculated variables

Five calculated variables were developed as follows:

SUM PROX (proximate) = sum of water, protein, fat, carbohydrate, and alcohol. Ash values are not carried on the SDB, so ash was excluded from this calculation.

KCAL DIFF = difference between the energy (kcal) calculated: (4 x protein) + (4 x carbohydrate) + (9 x fat) + (7 x alcohol); and the energy value recorded on the database.

KCAL % DIFF = difference between calculated and recorded energy as a percent of recorded energy: (KCAL DIFF/KCAL)*100.

FAT DIFF = difference between the fat (g) calculated: saturated fat + monounsaturated fat + polyunsaturated fat; and the fat value recorded on the database.

FAT % DIFF = difference between the calculated and recorded fat as a percent of recorded fat: (FAT DIFF/FAT)*100.

Generation of edit limits

The 5245 unique food items on USDA's SDB were used to generate edit limits for nutrient values. For SDB food items with multiple fat codes, the default entry was used; if there were salted and unsalted options, the default entry was used. Univariate statistics were examined for all foods on the database, and for foods divided into 12 food groups. The 1st and 99th percentile for each food group was chosen as a logical edit limit -- approximately 50 foods on this large database should fall below the 1st and above the 99th percentile for each nutrient. Using the minimum and maximum values as edit limits gave very large ranges, which seemed less useful. For smaller data bases of 1000 to 2000 food items, a developer would need to examine only 10 to 20 high and low values for each nutrient. To partially avoid the need to examine foods which were only slightly outside the limit, the upper limit was rounded up and the lower limit was rounded down to the closest integer.

Edit checks

An example of a reporting format for food items in the meat-fish-poultry group is shown in the attached table, using food items from the University of California, Berkeley, Minilist. Similar tables (not shown) were generated for two other nutrient databases (Home and Garden Bulletin No. 72 Data Set and Nutritionist III). All responded well to the integrity checks applied.

SUMMARY

It is hoped that these procedures will be useful to nutrient database developers. The edit limits were successfully used to provide pertinent information about three quite different (in number of foods and number of nutrients) nutrient databases, which indicates that the edit limits are reasonable, and may be used with some confidence by other developers.

When examining nutrient values that fall outside the edit limits, it is important to consider the possible reasons for out-of-range values.

- Approximately 1% of values are expected to fall outside the ranges, since the limits are based on the 1st and 99th percentiles.

- Differences in the specific foods chosen for databases (versus those on the SDB) may result in values that are correctly outside the limits.

- For databases which carry nutrients per serving size, rounding errors for foods with small serving sizes may be magnified into large errors when nutrients per 100 grams are calculated.

- Errors may exist in the SDB, and thus may generate incorrect edit limits.

- Errors may exist in the database being checked.

Note that only one of the five possibilities is that the values on the database being examined are actually in error. Examination of out-of-range values requires the assistance of a person with adequate knowledge of food composition data to distinguish among the possibilities.

This methodology will find nutrient values that are clearly out of the normal range, but does not identify errors of smaller magnitude. Thus, these checks do not ensure integrity, and certainly do not replace careful validation of nutrient values. However, checking for edit limits can be a useful final step when developing nutrient databases.

The development of these edit limits is still in the preliminary stage, and much remains to be done to refine and extend the methodology. Comments and suggestions are welcome.

I would like to acknowledge, and express my appreciation of the help I received from Marilyn Buzzard and Sally Schakel of the Nutrition Coordinating Center at the University of Minnesota, Betty Perloff of the Human Nutrition Information Service, USDA, and Laurie North of N-Squared Computing.

For more information, or to obtain a copy of the edit limits, contact:

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REFERENCES

1. Murphy, S.P. "Data integrity -- methods for data validation." In: *Proceedings, 11th National Nutrient Databank Conference*. Athens, GA: Georgia Center for Continuing Education, The University of Georgia, 1986.

2. Buzzard, I.M., Sievert, Y.A., Schakel, S. "Database validation procedures." In: *Proceedings, 11th National Nutrient Databank Conference*. Athens, GA: Georgia Center for Continuing Education, The University of Georgia, 1986.

RANGE CHECKS FOR MEAT/FISH/POULTRY GROUP
UCB MINILIST, 1985 VERSION
(N=34)

Limit	Low Limit	High	%Low	%High	%Missing
Proximate sum (w/o ash)	88	101	0	0	0
Calc - reported kcal	-10	3	0	0	0
Percent kcal diff	-7	2	0	0	0
Calc - rep't fat (g)	-3	0	-1	-	-
Percent fat diff	-28	-3	-	-	-
Water (%)	23	81	6	3	0
Energy (kcal)	93	535	3	6	0
Protein (g)	8	34	3	3	0
Fat (g)	0	46	0	6	0
Sat fat (g)	0	17	0	3	0
Mono fat (g)	0	22	-	-	-
Poly fat (g)	0	7	0	6	0
Cholesterol (mg)	37	628	3	0	0
Carbohydrate (g)	0	16	0	6	0
Dietary fiber (g)	0	1	0	0	0
Alcohol (g)	0	0	-	-	-
Vitamin A (IU)	0	37709	-	-	-
Vitamin A (RE)	0	11313	0	3	0
Carotene (RE)	0	13	-	-	-
Vitamin E (mg ATE)	0	6	0	0	0
Vitamin C (mg)	0	35	0	0	0
Thiamin (mg)	0	1	0	0	0
Riboflavin (mg)	0	4	0	3	0
Niacin (mg)	1	16	3	3	0
Vitamin B6 (mg)	0	2	0	0	0
Folacin (mcg)	1	471	0	0	0
Vitamin B12 (mcg)	0	72	0	3	0
Calcium (mg)	5	183	6	3	0
Phosphorus (mg)	50	481	0	3	0
Magnesium (mg)	8	72	3	3	0
Iron (mg)	0	11	0	0	0
Zinc (mg)	0	28	0	6	0
Copper (mg)	0	8	0	0	0
Sodium (mg)	49	2684	6	6	0
Potassium (mg)	54	575	0	3	0

[1] A dash means nutrient values are not available. Fat difference cannot be calculated since values for monounsaturated fatty acids are not available.

UPDATE ON THE FACTORED FOOD VOCABULARY (LANGUAL)

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The Factored Food Vocabulary is a computer-based information retrieval tool developed at the Center for Food Safety and Nutrition (CFSAN) of the Food and Drug Administration (FDA). Work began on it in 1975 and continues today by a group known as the LANGUAL Developmental Working Committee. During the past year the Factored Food Vocabulary was renamed LANGUAL and is now being viewed as an international language for foods. LANGUAL provides a standard vocabulary for the description of food products in databases. Its structure is based on the idea that a food product may be described by a combination of several characteristics, each of which may serve as a point of retrieval. LANGUAL is composed of 13 viewpoints or "factors":

PRODUCT TYPE
FOOD SOURCE
PART OF PLANT OR ANIMAL
PHYSICAL STATE, SHAPE OR FORM
EXTENT OF HEAT TREATMENT
COOKING METHOD
TREATMENT APPLIED
PRESERVATION METHOD
PACKING MEDIUM
CONTAINER OR WRAPPING
FOOD CONTACT SURFACE
CONSUMER GROUP/DIETARY USE
ADJUNCT CHARACTERISTICS OF FOOD

Each factor contains a number of factor terms or descriptors, one or several of which may be selected to describe a food product. With most factors, a single descriptor is selected; however, multiple factor terms may be employed in TREATMENT APPLIED, COOKING METHOD, FOOD CONTACT SURFACE, and for special dietary characteristics found in CONSUMER GROUP/DIETARY USE. A food product such as corn flakes is described as follows:

FACTOR	FACTOR TERM
PRODUCT TYPE	Breakfast cereal
FOOD SOURCE	Field Corn
PART OF PLANT OR ANIMAL	Seed or kernel, skin removed, germ removed (endosperm)
PHYSICAL STATE, SHAPE OR FORM	Whole, shape achieved by forming, thickness <0.3 cm.
DEGREE OF PREPARATION	Fully cooked
COOKING METHOD	Cooking method not applicable
TREATMENT APPLIED	Sucrose added; Flavoring or spice extract or concentrate added; Vitamin added; Iron added; Flaked; Water removed
PRESERVATION METHOD	Dehydrated or dried
PACKING MEDIUM	No packing medium used
CONTAINER OR WRAPPING	Paperboard container with paper liner
FOOD CONTACT SURFACE	Wax; Paperboard or paper
CONSUMER GROUP/DIETARY USE	Human food, no age specification, regular diet

Many factor terms in LANGUAL have definitions describing what they are, what they include or exclude, and how they are intended to be used within the vocabulary.

Brown sugar

Food dictionary -- soft sugar whose crystals are covered by a film of refined dark syrup that imparts color, flavor and moisture.

LANGUAL also contains many synonyms, including scientific names for organisms and vernacular terms.

Citrus sinensis	USE	Orange
Shredded	USE	Divided into pieces, thickness <0.3 cm.

Finally, each set of terms for a specific factor is arranged hierarchically from broader to narrower terms. This arrangement provides a meaningful classification that relates terms within a factor to each other.

- Carbohydrate
  - Sugar
    - Fructose
    - Lactose
    - Sucrose
      - Brown sugar
      - White sugar

At CFSAN, an information retrieval system called the Food Monitoring Database uses LANGUAL to link food names in three databases: FDA's Total Diet Study, which monitors levels of contaminants and nutritional elements in the U.S. food supply; the U.S. Department of Agriculture (USDA) Nutrient Database for Standard Reference, which contains nutrient analytical data; and FDA's Scientific Information and Retrieval Exchange Network (SIREN), which contains bibliographic citations of FDA regulatory and petition information. To search the Food Monitoring Database, LANGUAL factor terms describing food products are entered into the program; food product names that meet the description criteria are simultaneously retrieved from each database. Once a list of names is retrieved, each database may be queried individually for analytical or bibliographic data. For example, the SIREN file may be searched for regulatory or petition citations to orange juice, the USDA Handbook No. 8 file might be searched for mean levels of ascorbic acid in orange juice, or the Total Diet Study may be searched for contaminant levels of carbaryl in orange juice. Thus, LANGUAL provides a common language for linking dissimilar files.

During the past year efforts at CFSAN have been directed toward indexing a backlog of food product names from SIREN. Since last September more than 2,000 foods have been indexed; approximately 2,500 remain to be indexed. When this long-range effort is complete, approximately 7,000 food product names will have been indexed. This volume of indexing has led to software enhancements designed to facilitate the indexing process. The most important of these enhancements is automatic factoring or "Autofactor", with which new database with new food names is entered in the Food Monitoring Database, each new food name is compared with existing food names in the file. If a match or a high degree of similarity is found, LANUAL factor terms from the existing food name may be automatically selected to describe the new food. Additional factor terms may be added to complete the food description. This technique has substantially reduced the time needed to index a food product and has ensured consistency of indexing. For those who might consider using LANGUAL, Autofactor is a tool that should not be overlooked.

Another software enhancement, which is still in the developmental phase, is the display of a portion of hierarchy and a definition within the indexing context. Formerly, hierarchy, definitions, and factor terms were viewed in one file and then index terms were applied from another. Now both these functions are available in a single computer program. Since one of the basic rules for LANGUAL is to index as specifically as possible, this enhancement provides a way to check that the most specific factor term has been used.

Additionally, once the portion of hierarchy is displayed, the definition for the displayed term may be viewed, ensuring that the term is used correctly.

The LANGUAL vocabulary continues to grow, with new terminology being introduced from SIREN and international indexing efforts. Requests from France, Denmark, and England have been reviewed by the LANGUAL Developmental Working Committee. The committee is devising a factor that arrays scientific names of food sources by taxonomic classification and is considering methods of expanding food product descriptions to include all ingredients.

New databases will be indexed by LANGUAL and added to the Food Monitoring Database. The food composition database used for the 1987-88 Nationwide Food Consumption Survey and for the National Health and Nutrition Examination Survey (NHANES III) as well as CFSAN's Food Labeling and Product Surveillance (FLAPS) files are under consideration. International interest and usage is expected to continue. Thus, LANGUAL will continue to provide a unifying language to describe food products and a means of linking databases dissimilar in origin, structure, or use.

APPLICATIONS AND AVAILABILITY OF INTERNATIONAL DATA: MYTHS AND REALITIES

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INFOODS Involvement and History

INFOODS was created as the consequence of a series of conclusions about the necessity and desirability of international work on, and exchange of, food composition data. Almost from the beginning, we concluded that most of this work should be done in regions of the world with similar food cultures, rather than centrally as a single international activity. As we have discussed at earlier Databank conferences,[1] there has also been some doubt about the amount and quality of data available in much of the rest of the world, and it was felt that a regional approach might be more effective in developing data where none existed. During the last six years, regional groups have been organized to cover most of the world. As our earlier reports have indicated, some of them, including EUROFOODS and NORFOODS, had organizations and activities in operation before INFOODS itself was fully organized; others, such as AFROFOODS and MENAFOODS, are still in the process of holding organizational meetings. The project's initial goals and thinking were discussed in more detail in the report of the organizational meeting.[2]

During its initial four years of operation, INFOODS also initiated several scientific and standardization activities to address gaps in the literature, to help focus its own efforts, and to respond to its particular mandate to provide the technical structure for efficient and unambiguous data interchange among regions. The results of that work appear in several publications, discussed below, and in plans for additional work.

Development of National and Regional Tables

There have been large changes in worldwide food composition activities over the last fifteen or twenty years. At the beginning of that period, many countries outside North America and western Europe relied on externally-compiled or regional tables, the latter often compiled by FAO in conjunction with the US government.[3] Today, most countries have produced national tables or have active development efforts underway to produce them.

There is a great deal of activity: within the last six months, we have received, or received notification of, new tables from such diverse countries as Iceland[4] and Chile.[5] Many of these tables are exceptionally interesting relative to what we have historically expected. For example, the tables from Japan[6] not only consist exclusively of original analytic values, but values are not carried forward from one edition to the next: there is no imputation of value from previous versions of the tables. The Soviet tables are also based exclusively on original analytic values, and the forthcoming edition will probably contain English translations of food and nutrient names. New tables are under development in the South Pacific area, with values for many indigenous foods, especially root crops, not reflected in earlier tables. New tables are being developed for parts of Africa, both locally and with the assistance of scientists from other countries. Even such smaller countries as Malaysia are producing their own tables,[7] with apparently high analytic quality. All of these are intended as national food composition tables. If one includes the byproducts of activities such as Nutrition CRSP, which could be used as, or incorporated into, food composition tables, the list would become even longer. Many of these efforts are being strongly influenced by INFOODS efforts and recommendations for methods, terminology, and description of foods and nutrients.

Things are also changing in the computerized database area. The first generation of nutrient composition data to be released in computer-readable form, including the USDA standard reference database tapes, tended to reflect the organization and structure of the printed tables. More recent efforts have often developed database structures more suitable for active manipulation by computer, or easy transfer into other systems. INFOODS has initiated efforts to develop regional data centers, compatible with INFOODS interchange recommendations, in East Asia, Southeast Asia, and Latin America (we have tentative approval to initiate work on the latter in early 1990). EUROFOODS has restarted its efforts to build a common table and database for the European Community and associated countries; that center should be INFOODS-compatible as well.

The irony of these developments is that, having had a leadership role in food composition work for many years, the US and North America are in serious danger of slipping behind other countries and regions. Instead of keeping up or taking the lead, the US has been indulging in complacency and intra- and inter-organizational struggles that squander the limited resources available. We have also initiated expensive and misguided efforts to create monolithic consolidated databases by forcing or bribing other countries and researchers into particular models and ill-defined purposes, rather than participating in truly cooperative international efforts.

The Regions and Their Activities

EUROFOODS held its fourth plenary meeting from 30 May through 2 June in Uppsala, Sweden. Over 90 representatives from 24 countries were present. EUROFOODS has been concentrating on improved communication within greater Europe. It was organized roughly concurrently with INFOODS, and its first major meeting was held earlier. The meeting included reports of several new and important scientific developments in food composition work carried out under EUROFOODS auspices, in addition to reports of continuing work of general interest. The proceedings of the EUROFOODS conference will be published as a special issue of the INFOODS Newsletter, probably early in the last quarter of this year.

NORFOODS works closely with EUROFOODS, and most of its members participate in both. At the same time, NORFOODS -- an official activity of the Nordic Council of Ministers -- meets regularly and carries out activities of mutual interest to improve food studies and food composition data and their interchange within the Nordic countries. The governmental support and long traditions of cooperation make NORFOODS probably the best organized and most active of the regional groups.

OCEANIAFOODS held its first full conference in Canberra, Australia, in May, 1987. Another meeting is planned for the near future. A major effort is underway to prepare new tables, based primarily on original data, for the South Pacific Commission. New tables, built on INFOODS recommendations, are being completed in New Zealand, and a new Australian database has been released.

LATINFOODS, has held several informal meetings and a two formal ones, the most recent in Chile last November. LATINFOODS is reaching agreement on standards for sample identification and table construction, and is working toward the development of a regional data center.

AFROFOODS, including Africa south of the Sahara, held an organizational meeting in September, 1988, at the Third Africa Food and Nutrition Congress in Harare, Zimbabwe. Plans are being made, and resources sought, for a conference later this year or early in 1990.

ASIAFOODS, covering East Asia, South Asia, and Southeast Asia, held an organizational meeting in 1984.[*] Additional meetings of subgroups have been held in conjunction with nutritional congresses in the region. Discussions are underway that may lead to the development of regional data centers in Asia during the next few years.

MENAFOODS began to organize this year, with participation from North African and Middle Eastern countries. Commitments have been received from several countries, and an organizing committee selected.

NOAFOODS, covering the English-and French-speaking portions of North America and the Caribbean, is largely dormant, and is likely to remain so until resources and a location are identified for a regional data center. Annual "National Nutrient Databank" meetings in the USA continue to bring experts and users of food composition data together for discussions of topics of interest and serve some of the functions of a regional organization.[9]

Publications and New Results

(1) Users and Needs: INFOODS sponsored a conference in March, 1985, to provide a better understanding of the ways in which food composition data were used, and the problems associated in storing, organizing, and processing them. This conference in many respects followed up the organizational meeting, focusing on these specific topics. The results of the conference were summarized in a book[10] published two years ago.

(2) Index and directory efforts: For the scientist in search of data values from outside his or her own country or region, one of the most important tools is a good directory of what tables are available. FAO used to produce such directories,[11] but stopped doing so. More recently, in-depth directories have been produced in a few regions, notably here in Europe[12] and in North America.[13] INFOODS has supplemented these, and provided listings for regions without their own more detailed listings, with an international directory. That directory has been published in two editions, the more recent one last September,[14] and additional editions will be produced when the volume of new tables and corrections requires them. Resources are being sought for a more ambitious, and more computer-intensive, project that would provide an international index of food composition data and databases, organized by foods and nutrients, not only by geography.

(3) Food component identification: Somewhat unexpectedly, differences among countries and their tables about which nutrients and other food components are included in tables and how these are analyzed raise major challenges to comparison of results that are based on different tables. For example, some countries report only carotene for "vitamin A". Others report carotene and retinol, while still others report retinol equivalents, and so forth.[15] Misunderstandings occur when these values are compared as if they were all the same. INFOODS first surveyed this problem to determine its extent and to understand how precise various food tables were about identifying the methods used and chemicals being reported. The problem is quite extensive, and, not surprisingly, tables differ as significantly in their degree of precision and detail about nutrient and method identification as they do about other element of data quality. A system of identifying specific foods components was then developed using a great deal of international participation and comment.[16] While that system was designed primarily for data interchange purposes, it may also be useful for organizing tables and reporting methods of analysis and calculation in printed tables. Several countries have already begun to use it in these ways.

(4) Analysis methods and table compilation: Much of the complexity and detail of the food component identification system stems from historical differences in procedures and approaches. If we could start over today, rather than using older tables and data, and could agree on a single set of standards and conventions, many of the problems would be eliminated. Unfortunately, starting over is unrealistic and will be for some time: there is a great deal of very useful older data. However, for new tables and databases, and for extensive revisions of existing tables, determining how to do things well and in a generally-agreed-upon fashion is more desirable than simply describing what was done in the past without making normative judgments about those practices. INFOODS initiated two efforts to provide guidance for the developers of new tables and databases. The first of these, concerned primarily with methods of food selection, sampling and analysis, has culminated in a manuscript by Heather Greenfield and David Southgate. The second concentrates more on the organization of food composition tables and databases for specific tasks and on ways of estimating values that have not been directly measured. Both are expected to be published before the end of this year.

(5) Data Interchange: The data interchange system itself is designed to provide a standard format for transferring food composition data among regions. It may be useful as well for data transfer and organization within regions and even within countries. The system is very precise and permits storing and transferring any

data, or information about the data, that are available without need for the separate introductions, usage notes, and ancillary files that have characterized formats and database organizations in the past.
Preparing a file for interchange involves converting it to a special structured format in which all data, and all descriptions of data, are specifically and precisely identified with special names or "tags". Unlike historically more common data formats, this permits whatever information is associated with the file to be represented and exchanged, without requiring extra space or data fields for information -- whether nutrients or description -- that is not available for the file. The specific details of the interchange system have been explained at conferences and are covered in a series of working papers that have been widely circulated. Those working papers and some new results have been consolidated into a lengthy technical manuscript that includes rules for syntax as well as all of the tags that are not associated with food component identification. We expect to publish this manuscript when all of the ideas can be tested together and in context, i.e., in conjunction with the implementation of the first regional data center.

(6) A forum for scientific papers: Finally, the INFOODS-sponsored *Journal of Food Composition and Analysis* published its first issue in late 1987, and has been publishing issues at regular intervals. It is now operating to a great extent independently of the Secretariat. Subscriptions are available through Academic Press.

Goals and Progress

From one perspective, INFOODS has had three goals:

(i) Improving communication among scientists interested in food composition data and organizing effective regional groups. Partially because the time was right for regional development, and in a few cases without significant input from INFOODS staff, this process has been very successful. A periodic INFOODS newsletter and the *Journal of Food Composition and Analysis* also contribute to improved communications.

(ii) Identifying the scientific barriers to effective inter-country and inter-regional use of food composition data, and eliminating or lowering those barriers. Significant progress has been made, especially in the areas of guidelines, data identification, and facilities for meaningful data interchange. In other areas, much work still remains to be done, either to solve problems or at least to increase the general understanding of them. The area of food coding and nomenclature is especially important: many systems have been proposed as meeting all needs and being applicable for broad international use, and the usual assumption is that precise food identification is a problem that must be solved. These assumptions have led both to good systems and serious fallacies, discussed in more detail below.

(iii) Providing for actual international data availability and exchange. Many of the prerequisite problems in this area are now solved, as mentioned above: An up-to-date directory of tables has been completed, and several regions, including EUROFOODS, have developed comprehensive surveys of data available in their areas. An interchange system has been designed and tested with data from several tables from various parts of the world. The next step, and the one on which INFOODS is concentrating its efforts, involves the development and construction of operational regional data centers that can retain and exchange data and, where appropriate, act as a focus for specifically data-related activities within their regions.

Status of the Secretariat

With the completion of the initial specific INFOODS core tasks and expiration of the initial core funding, the INFOODS Secretariat has entered a period of consolidation and reorganization, focusing its efforts on obtaining the resources to construct regional centers in a few parts of the world. The proposals and discussions so far assume joint efforts, with the Secretariat providing assistance and technical expertise, but with most of the actual development work being done within the target regions, by regional personnel.

Fund-raising efforts so far have concentrated on regions in developing areas, partially on the assumption that the more developed areas will eventually take care of themselves; however, we are looking for independent or partnership arrangements in developed areas as well.

Partially as a result of this shift in emphasis, visible Secretariat activities have been considerably reduced in scale. The Secretariat does, however, continue to represent INFOODS at regional meetings, including all of the regional meetings mentioned above, and, when resources permit, at important scientific activities related to food composition. For example, the Secretariat has organized an INFOODS session for the nutrition meetings in Seoul this August; I hope to see some of you there. The Newsletter will be published less frequently and less regularly, at least until we have more to report, and incoming letters and requests are taking longer to be answered. We apologize for any inconvenience, but these delays should not be taken as an indication that we have disappeared; we have not.

What can be Done with International Data?

All of the work and organizational effort we have described provide mechanisms and incentives for improvements in food composition data in individual countries and regions and provides the basic structure for efficient data interchange among them. These arrangements provide an affirmative answer to the obvious question of "can the data be moved?". Once the regional data centers are in place, we should have a positive answer to "can it be done smoothly and efficiently?" as well. Although, unless there is some activity in North America, the answer could be "no" here and "yes" in the rest of the world. However, in some respects, questions have been answered out of order: the more serious questions of "is it of any use?", "can the data be interpreted?", "is it possible to match foods from different tables?" have so far remained unanswered. There are tentative answers for some of these questions. For others, there is even less certainty. The controlled comparative studies that are needed to produce definitive answers have not been done, and it appears that there is no interest in supporting the required research.

These fundamental questions have been blocked by the focus on food names.[17] The belief that, if only all food composition tables used the same naming system, then all other problems would disappear would, if true, eliminate the need to answer them. Not only are there obvious reasons why this is not the case -- naming foods does not relate, for example, to comparing nutrients measured in widely different ways -- but it has become unclear that food naming, per se, is even a worthwhile question for investigation.

Food Terminology and Classification: The key question or an interesting distraction?

This food-naming problem and its implications are particularly acute where international or cross-cultural data are of interest. It has been the most controversial of the questions INFOODS has had to deal with, in part because many people seem to have strongly-held opinions about it. The INFOODS conclusions are perhaps somewhat radical, and treated in more length below.

The question of food names, coding, and description, is key to many ideas for comparing values between different tables and databases, as well as to food coding for dietary studies. The idea of developing a single international nomenclature system, on which everyone can standardize, is quite seductive. Unfortunately, it does not appear to be practical, and regional systems that focus on particular goals and objectives seem to be more reasonable. Systems such as the EUROFOODS-developed EUROCODE 2[18] have precisely the correct set of properties:

> The code's coverage reflects the foods of a relatively small number of countries, with fairly similar foods.
>
> The goals for use of the system are well-defined and limited.

As one moves away from this set of properties, systems inevitably become either more complex and less problem-specific or very general and imprecise. They may even become unworkable. This is not a defect in any particular system that is subject to improvement by adding or changing a few terms; it is inherent in the nature of the underlying foods and varying societal assumptions about them. This is perhaps best illustrated by a series of examples.

(1) For dietary assessment purposes, a food coding system should reflect only those distinctions among products that the consumer can make in the marketplace. Additional distinctions and the attempt to elicit them in a survey are, at worst, sources of scientific error and, at best, merely a waste of time and classification effort. By contrast, a regulatory database may require considerable additional classification information and coding; organizing principles based only on consumer distinctions might not be useful. Adequate computer programming would permit use of the less-precise parts of a very detailed system for dietary assessment without other effects, but only if the detailed system was designed using appropriate criteria for a dietary assessment system. No one has yet demonstrated that this can be done optimally for a general-purpose food composition database.

(2) A multilingual thesaurus is a useful supplement to a food coding system and such thesauri have been constructed, primarily for agricultural products generally,[19] animal foods,[20] but also for human ones. However, once a system is adapted to regions with widely differing food cultures,. a simple thesaurus, which translates words of one language into words of another, is no longer sufficient: it is necessary to describe the foods in great detail, comparing them to local products when they exist. In the terminology of thesaurus systems,[21] this implies carefully-translated scope notes, not merely translation of terms.

(3) Some of the food similarities implied by the ability to create multilingual (and multicultural) scope notes simply do not exist, i.e., there are no corresponding foods in different countries. Similarly, marketplace distinctions in one country may be different than those in others: more precise in one place, less in others. One can easily invent a system that permits local variations to compensate for this, but then one has a common method for building coding systems with similar features, not a single international system.

An example from another area that many of you have encountered may help to illustrate the underlying problem. Since computer systems began to become important for processing things besides numbers, there has been a concern about eliminating the tyranny of character sets, based on US English, in which most European -- and other -- languages could not be correctly expressed. After a slow start, there has been considerable development in registration of national graphic character sets,[22] and devices to handle them. If the registration sequences are used, one may still not be able to use a French character set on a US-developed device, but at least no assumption will be made that it is "pure" ASCII. At the same time, the hardware and software technology now permits more convenient use of multiple or extended character sets: many of you have noticed that INFOODS has gradually succeeded in spelling your names and organization names correctly, something we could do only by marking in letters that did not appear in US English with a pen just a few years ago.

(4) In some cases, where the differences between marketplace distinctions in one country and those in another are only a higher degree of distinction in one than the other -- for example, it is well-known that Denmark and France identify far more distinct cheeses than the USA -- it appears possible to build an international system by adding hierarchical levels for those countries which will use them, with others ignoring those levels. This is useful, practical, and important, as long as its implications are understood: comparisons between the foods of those countries can be carried out only at the minimum of the level of distinction made in either. There is no way that a coding system will invent information that does not exist, and it is improbable that the use of such a system will, of itself, change what manufacturers sell in the marketplace.

(5) More serious problems arise when one group of countries have different, non-overlapping systems for naming or selling foods. The most commonly cited example in this area is that of cuts of meat,[23] but there are others.

(6) And, of course, while no coding system can eliminate simple errors, such as the identification of a highly processed cheese product as "cheddar",[24] more complex and precise systems may be more prone to errors than simpler systems in single countries, where terminology is more obvious. Description of foods in prose can act as a useful check on complex classifications and can be used to resolve or approximate differences among them. If the "cheddar" above were also described as a "soft, processed cheese product with several ingredients", then the potential for serious scientific error when comparing values in multiple tables would be reduced. On the other hand, if that description were there, it is not clear that assigning a specific *name* to the product adds much information, at least outside the country that produced the food table in question.

In summary, these difficulties, especially the potential for errors of classification and the lack of precisely analogous foods that makes multilingual thesauri very difficult, are strong arguments that the "general food code" problem should not be the primary focus of international efforts.
Instead, efforts should concentrate on the development, where needed, of highly-specific problem-oriented codes and the development of good food description procedures and checklists for more general comparison and exchange of values. If that approach is taken, the unsolvable problem of a universal food nomenclature will become moot.

REFERENCES

1. Klensin, John C., "INFOODS Update: 1988", *Proceedings of the 13th Nutrient Databank Conference,* Ithaca, NY: The CBORD Group, 1989, pp. 27-37.

2. Rand, W.M., Young, V.R., "Report of a planning conference concerning an International Network of Food Data Systems (INFOODS)", *Am. J. Clin. Nut.,* 39 (1984): 144-151.

3. Wu Leung W.T., Busson F., Jardin C. *Food Composition Table for Use in Africa.* Bethesda, MD: United States Department of Health, Education, and Welfare, 1968; Rome: Food and Agriculture Organization, 1968. Also, Wu Leung WT, Butrum RR, Chang FH, Rao MN, Polacchi W. *Food Composition Table for Use in East Asia.* Bethesda, MD: United States Department of Health, Education, and Welfare, 1972; Rome: Food and Agriculture Organization, 1972. And Polacchi, W, McHargue, JS, Perloff, BP. *Food Composition Tables for the Near East.* UN Food and Agriculture Organization and USDA Human Nutrition Information Division, Consumer Information Center. Rome: FAO, 1982.

4. Íslenskar Næringarefnatöflur (*Icelandic Food Composition Tables*), Reykjavík, 1988.

5. Tabla de Composición Química de Alimentos Chilenos and *Materias grasas de consumo habitual y potencial en Chile,* Santiago: Departamento de Ciencias de los Alimentos y Tecnología Química, 1985.

6. Resources Council, Science and Technology Agency, *Standard Tables of Food Composition in Japan*, 5th edition, 1986.

7. Tee E. Siong, *Nutrient Composition of Malaysian Foods -- A Preliminary Table,* Kuala Lumpur: Division of Human Nutrition, Institute for Medical Research, 1985.

8. Rand, W., Stuckey, A., Valyasevi, A., Tontisirin, K., *Proceedings of the First ASIAFOODS Conference,* Bangkok: Prayurawong Co., Ltd., 1985.

9. See, for example, Hicks, L.S., Reed, D.B., Pillow, P., *Designs for Applications, Proceedings of the Twelfth National Nutrient Databank Conference,* April, 1987, Ithaca, NY, USA: The CBORD Group, 1988. The proceedings of the 1988 conference are in press, also published by the CBORD Group. The 1989 conference is scheduled for June 18-21.

10. Rand, W.M., Windham, C.T., Wyse, B.E., Young, V.R., *Food Composition Data: A User's Perspective,* Tokyo, United Nations University, 1987.

11. UN Food and Agriculture Organization (FAO), *Food Composition Tables: Updated Annotated Bibliography,* Rome: FAO, 1975.

12. EUROFOODS Computer Committee, Inventory of Food Composition Tables and Nutrient Data Banks in Europe, Heidelberg, 1985; Arab, L, et al., eds., *European Food Composition Tables in Translation,* Berlin: Springer-Verlag, 1987; West, C, "Inventory of Food Composition Tables and Nutrient Data Banks in Europe", 1989.

13. Hoover, L.W., *Nutrient Databank Directory,* 7th Edition, Columbia, MO, USA: University of Missouri, 1988.

14. Heintze, D., Klensin, J.C., Rand, W.M., *International Directory of Food Composition Tables,* Second Edition, Cambridge, MA, USA: INFOODS Secretariat, 1988.

15. Rand, W.M., Klensin, J.C., Campbell, J.A., "INFOODS: A World-Wide Effort to Organize Data on the Composition of Foods", *J. Canadian Dietetic Assn.,* 49, 3 (Summer 1968), pp. 158-163.

16. Klensin, J.C., Feskanich, D., et al., *Identification of Food Components for INFOODS Data Interchange,* Tokyo: United Nations University. In press.

17. Butrum, R.R., "NCI Food Data Needs: Impact on Coding Systems", in Rand, WM, Windham, CT, et al., reference 10. Also Butrum, RR, "Considerations in Designing a System for Description of Food and Flexible Retrieval of Relevant Data", in Glaeser, PS (ed.), The Role of Data in Scientific Progress, Elsevier Science Publishers, 1985.

18. Arab, L., et al, eds., *European Food Composition Tables in Translation,* Berlin: Springer-Verlag, 1987, pp. 132ff.

19. UN Food and Agriculture Organization (FAO), *AGROVOC, A multilingual thesaurus of agricultural terminology,* Rome: FAO, 1982.

20. Harris, L.E., Händler, H., Rivière, R., Réchaussat, L., *International Feed Databank System, An introduction into the system with instructions for describing foods and recording data,* International Network of Feed Information Centers, Publication No. 2, 1980.

21. See International Standard ISO5127, *Documentation and Information -- Vocabulary,* especially part 6, Documentary Languages.

22. See International Standards ISO 2022, *Information Processing -- ISO 7-bit and 8-bit coded character sets -- code extension techniques;* ISO 8859, *Information Processing -- 8-Bit single byte graphic character sets;* and the character set registrations under ISO 2375 (about 150 in recent count) maintained by the European Computer Manufacturer's Association (ECMA) in Geneva.

23. Arab, L., "Epidemiological Uses of Food Composition Data in the European Context", in Rand, et al., *op. cit.*, reference 10, page 59. Also see Ahola, M, Nordic Food Dictionary, discussed in *Proceedings of the IV EUROFOODS Conference,* in press.

24. Campbell, J.A., Unpublished working paper, INFOODS planning conference, Bellagio, Italy, 1983.

AN EDITOR'S VIEW OF THE CURRENT STATUS OF FOOD COMPOSITION DATA

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INTRODUCTION

The importance of the knowledge of the chemical composition of foods has seen a resurgence in the past decade. The increased use of epidemiology in the various investigations of the interrelationships of diet and health as well as the increased concern over food safety have generated significant pressures to improve the quality and quantity of food composition information. Those working in the area of food composition data have made significant progress in providing the needed data on food composition. Examples of the progress made can be noted in the issue of revised Handbook No. 8 (the HNIS has released 18 of the planned 22 sections in this time period) and the appearance of two new journals for the field (the *Journal of Micronutrient Analysis* began publication in 1985 and the *Journal of Food Composition and Analysis* began publication in 1988). At this conference a Handbook No. 8 nutrient data set is available on CD-ROM for micro-computer systems.

These are significant advancements, and the community has a right to feel proud in the increase of the amount of data available (both in terms of the foods covered and of the nutrients covered), in the publication of two peer-reviewed scientific journals for the field, and in the use of modern micro-computer systems for the data dissemination. However, the work of those in food composition is not finished. Quite the contrary! The continuing need for good data by the medical epidemiologists and the increased concern about the safety aspect of the chemical composition of foods means that we will need to provide even more and even better food composition data.

It is the purpose of this paper to attempt to provide my personal view of what are the components of "good" food composition data so that we can improve the quality of the composition data. I will also note some of the other current problems in the field. This paper should be viewed as a continuation of previous papers in this field and not as a definitive final statement of what are the components of good composition data. The paper will deal with food composition data in its broader connotation of data on nutrient, toxicant, and non-nutrient components of food.

Data Generation

The steps in the generation of food composition data are shown in Table 1. The first seven steps are generally recognized to be components of the data-collection process. I have included data validation as a eighth step because it is my personal observation that food composition data are frequently erroneous, often due to some mistake of the analyst. It is important to note that errors can be made even when an approved method is used for the assay, and even when an approved laboratory does the assay. Since <u>all</u> analysts seem to have the capacity to make these errors, I believe that it is only rational to require that all analytical procedures have data validation as an integral part of the analytical methodology. This concept is slowly being incorporated into accepted methods for food analysis.

I have been asked which are the most important steps in the data generation. The answer is that they are all equally important. The key thing about nutrient data generation is that the process is a continuum; an error in any step will usually result in an error in the final data. It is quite rare that errors in one step are corrected by careful work in another step or that two errors will cancel each other. Thus a evaluation of a data set requires an evaluation of all of the steps used in the assay procedure.

Key to the evaluation of the data set is the detailed documentation of what has occurred in each of the steps. Such documentation is frequently available for the analyte extraction and the selective analyte assay; it is only infrequently available for the first four steps and the final three steps. I believe that there would be a significant improvement in the quality of food composition data if the publishers of food composition data and the developers of food data bases would insist that the analysts provide in depth documentation for all the steps in the acquisition of food composition data.

Many of the components of data acquisition have been discussed in detail elsewhere in the analytical chemical, food-science, and nutrition science literature. It is not appropriate to review the basic concepts of food analysis at this time. Rather I will focus on some key areas which I believe have been frequently overlooked to the detriment of the generation of good food composition data and the users of that data.

Sample identification

A key problem in the generation of food composition data is an adequate description of the samples which are to be assayed. The description of a food sample is an extraordinary complex problem about which experts have argued for years. My personal view is that the samples must be described in sufficient detail that the end user of the composition data will know for which food(s) the data apply.

The problems are really how much identification is needed and how much is possible. Frequently the question of which nutrient is of concern is also an issue. For example, the data to date indicate that the amount of protein and fat per hundred grams of a fast-food hamburger is rather constant between fast food franchises and generic description "fast-food hamburger" is sufficient. However, the amount of sodium in canned soups is recipe dependent, and the recipes vary between manufacturer. In such a case the sample may need to be described by brand name. In the case of many chemical contaminants of food, the levels in foods are not controlled and then a brand name and lot number description might be needed.

Nutrient levels in plant foodstuffs are known to vary by variety, year of harvest, season, and location of cultivation. However, it is probably overkill and possibly a waste of resources to require such detail in sample description if the end user of the data cannot distinguish between the foods thus described. Perhaps a weighted, pooled average would be more appropriate in such cases. Thus, in the end, the use to which the data will be put is important when deciding how much sample description is needed.

Analyte Extraction and Selective Analyte Assay.

The choice of extraction and assay technique is also a function of the food stuff and component. If the food stuff is a single compound or a very simple mixture in an inert matrix, then rather simple assays can be used. The assay of vitamins in vitamin pills is an example. On the other hand, if the food stuff consists of a complex mixture in an actively metabolizing material, more complex assays are needed. In most cases of the assay of the chemical composition of foods, the analyte(s) should be quantitatively separated from the other components of the food, positively identified, and then quantified.

It is not good practice to use a single assay for the determination of a biological activity which can be invoked by multiple chemical structures. For example, there are six chemical structures which have vitamin B_6 activity. Each form has a sightly different biological activity and these activities vary between species. Thus an animal biological activity assay based upon feeding a mixture of these forms to a non-human species has a significant probability of yielding incorrect data of the vitamin B_6 activity of that food for humans. Similarly, chemical assays based upon some simple chemical reaction of one of the forms will probably yield incorrect results. The general rule of thumb in such cases is that you need one assay per active form. The usual procedure is to use chromatography to separate the active forms from each other and then to quantify each form separately.

It is known that analyte(s) can be destroyed by the extraction and/or the assay process; created or destroyed by the enzyme systems in the foodstuff. Furthermore, cases are known where the assay procedures are positively or negatively influenced by other components of the foodstuff. Thus ideally, each assay procedure should be tested on the food of interest by doing recovery studies on "spiked" samples to insure quantitative recovery. The production or destruction of components with similar biological activity can differ with their chemical structure. Thus when spiking studies are done, the spike should contain all known forms of the component of interest.

Data validation procedures

It is really rather easy to make an error in any of the steps in the generation of food composition data. Thus, those generating the data and those using the data should give significant attention to the validation of the data. The processes of developing protocols for data validation are still being developed. The primary conceptual areas for validation seem to be 1) the appropriateness of the methodology (shipping, storage, homogenization, extraction, and assay), 2) the internal laboratory analytical control procedures (replicates, internal standards, reference materials, check standards, etc.), 3) and comparison of the data with data from similar samples. Probably the best present check for the validity of data is to have an expert analyst evaluate both the data and the process by which the data were obtained. Peer-reviewed scientific journals have institutionalized such a review process and for this reason the users of food composition data should use such journals as primary data sources.

Zero values

The use of "0 levels" can present special problems to the user of food composition data. Most end users of composition data interpret a zero level to mean literally that there is no analyte in the sample. However, to an analyst a zero level means only that the sample did not have an analyte concentration high enough to be measured using the specified analytical method. Experience has taught the analyst that other more sensitive methods might indicate that some analyte was present in the sample. Thus to the analyst a "zero level" doesn't technically mean "no analyte", but only "less than the detection limit". A considerable amount of confusion arises because of these different concepts of a zero level.

I believe that zero should not be used as a reported data point. When the assay indicates that the concentrations are below the detection limit of the method and instrumentation, the data should be reported as "less than X" where X is the detection limit of the system. The adoption of the convention of using "less than . . ." should significantly reduce the apparent contradictions in data sets from different methods and laboratories, and should be of significant benefit to the field. I am aware that this proposal may cause some technical difficulties to those developing and/or maintaining composition databases; however, I believe that the improved communications and reduced actual error will justify the adoption of such a concept of not reporting "zero" as a level of a component in foods.

Significant Figures

One of the most frequently asked questions of food composition data is "Does one food or diet have a different amount of the compound of interest (nutrient, toxicant, color, stabilizer, . . .) than another?" It is important that data on the chemical composition of foods be presented in a manner that permits the user of that data to readily answer this question. Basically this means that the precision of the data should be intuitively apparent from the data itself. The technique of reporting significant figures is designed to communicate the precision of the data.

There is no universally agreed upon protocol for determining how many digits should be reported. The *Journal of Food Composition and Analysis* uses the following significant figure convention. In their notation, the number of digits reported is determined by the relationship between the mean and its standard deviation (SD). The reported value of the mean should contain all the digits known with certainty (i.e. those not affected by addition or subtraction of the SD) and only the first uncertain digit (i.e. moving from left to right, only the first digit of the mean which is affected by addition or substraction of the SD). To accurately portray the value of the SD, it is reported with one decimal place more than the mean.

For example, assume that the initial calculations from an assay shows that the mean value for a nutrient content is 123.45 and the standard deviation is $\pm$ 1.57. Using the calculations outlined above, it is seen that the digits 1 and 2 in the mean are known with certainty and the 3 is the first uncertain digit. The remaining uncertain digits of the mean are rounded off. Since the SD is reported with one decimal place more than the mean, the SD should be reported as 1.6 and the assay value should be reported as having a mean of 123 and a SD of $\pm$ 1.6. See Fig. 2.

Current Problems Areas in the Arena of Food Composition Data

Societal concerns with diet and human health have led to a significant interest in the levels of nutrients, pesticides, toxicants, contaminants, and heavy metals in foods and related agricultural materials. If we are to improve our food system we need better information on the levels of these compounds in our foods. A key part of our ability to systematically acquire the needed information is the ability of analysts to make accurate quantitative chemical measurements. However, the assays for the compounds and activities of interest frequently are complex and difficult. In many cases the assays need to be very selective and quite sensitive. Our ability to acquire the accurate data needed to improve human health is dependent upon the availability of good methodology and trained analysts. Improvement is needed in both areas.

As I have monitored the progress of our ability to measure the compounds of interest in our foods, I have been struck by the apparent discrepancies between the significant and rapid advancements in analytical capability that have been made in analytical chemistry, biochemistry, and molecular biology and the rather slow pedestrian development of food analysis. Food analysis is a two-tier system characterized by the presence of a few selective, sensitive, modern assay systems with good validation protocols and the presence of many non-selective, insensitive, and time consuming assays in which the validation protocols are inadequate or not available. The presence of the few modern sophisticated analytical groups who do use up-to-date techniques to make measurements of certain components in foods suggests that improvements can be made in our food analysis capabilities.

What is to be done? There are problems in funding, in out-of-date methodology, and in training. I do not believe that increased funding alone will bring improvement to food analysis. There is little understanding that better methods are needed in order to meet the demands for more data, but a crusade for better methods is unlikely to bring improvement at this time.

I believe that the major problem is that we do not have enough adequately trained analysts and that the key to improvement is training. We have neglected the training of food analysts for at least three decades. This neglect has resulted in inadequate numbers of people who understand how to properly measure the critical compounds in our diet. Centers and programs for the training of analysts are in short supply and integrated approaches to such training are rare. Given the importance of the diet to public health, now is the time to increase the number of properly trained analysts. We need to develop training programs to teach analysts modern, selective, sensitive, validated assay techniques for the analysis of foods and agriculture products.

The needs for adequately trained analysts cut across countries, industries, and governments. Thus I believe that it is now appropriate that state, national and international agencies and professional organizations start work on joint programs for improved training of our food analysts.

If we have adequate numbers of trained analysts, they will ensure that the needed assays will be properly done and that the needed new methodologies will be developed. With such resources we can get the analytical data needed to maintain and improve our food supply. I believe that if we can demonstrate that the appropriate resources are available to get good data, the needed funding will be available. We have come a long way towards the goal of a safe, nutritious and economical food supply and, given the potential of the current new technologies, we should be able to make significant improvements in the food supply in the next few years.

Food Composition and Biotechnology

We are in the midst of a revolution in biology brought about by advances in biotechnology. The astounding developments in our ability to alter the genome of any species by insertion of new genes most assuredly will have significant impact on the production and processing of human foods. Genetic manipulations of micro-organisms have already led to significant changes. Examples include the production of specific products such as growth hormone and insulin, the enhanced capacity of plants to deal with environmental stress such as freeze resistance, and the development of disease resistant cultures for fermentation processes. Further efforts in the manipulation of micro-organisms should lead to the production of pure components for food use, feed stocks for manufacturing, and the development of algae and bacteria cell lines for use as human foods. Extensive efforts are underway to improve plant and animal production by insertion of new genes into the genomes of plants and animals. Such efforts include attempts to obtain enhanced pest and disease-resistance, feed efficiency, and growth. Other projects involve the use of biotechnology to improve processing of food products. Within the next five years, we should see significant alterations in the raw materials used for food production and the processes used to transform those raw materials into finished food products. Within ten years it seems reasonable to expect significant numbers of new and/or altered foods as a result of predictable advances in biotechnology.

Progress in biotechnology presents special challenges for those who deal with any aspect of food composition analysis or data. The basic assumptions of our information system have been that the composition of normal components of a food (or a food stuff) could be predicted by knowledge of the concentrations of those normal components in the similar class of foods. It has been uncommon for the concentration to vary by more than fifty percent, and such alterations in concentration have usually been caused by a rare genetic mutation, an occasional selected breeding program, or a radical change of recipe and/or process.

Biotechnology is different, and it will require an alteration in the assumptions of our food composition information system. When new or modified genes are inserted into an organism, new gene products result. The altered genomes not only produce new products, but these new gene products have the potential of altering the metabolic control mechanisms of the organism. Such altered control mechanisms have the potential of changing the levels of other metabolic products which initially would not appear to be affected by the new gene. Unfortunately, our current knowledge of metabolic control is inadequate to a priori predict the compounded effects of altering the genome of an organism. Thus there is the potential that some normal food components (nutrients and non-nutrients) will be found at unexpected levels (either significantly higher or lower) in genetically engineered organisms. Thus it would seem to be a reasonable course of action to determine the nutrient and non-nutrient profile of new food products developed by biotechnology and to compare those profiles with the profiles of foods that have been historically known to be safe and nutritious.

This is a tall order, since in many cases we do not have a nutrient and non-nutrient profile for the plant and animals currently used as the raw material for food production. The most severe problem is in the area of food safety. Most of our food safety programs are based upon historical evidence. We frequently do not know the levels of toxicants in the foods we eat. We only know that it is apparently safe to eat them. There is a lot of work to be done before we can answer the question "Will these new levels of natural toxicants in the new foodstuffs be acceptable from a safety viewpoint?"

Table 1

THE STEPS IN THE GENERATION OF FOOD COMPOSITION DATA

FOOD SAMPLE SELECTION

FOOD SAMPLE SHIPPING AND STORAGE

FOOD SAMPLE HOMOGENIZATION

ANALYTE EXTRACTION

SELECTIVE ANALYTE ASSAY

CALCULATION OF RESULTS FROM RAW DATA

PREPARATION OF REPORT

DATA VALIDATION

Table 2
Selection of Significant Figures

	MEAN	SD
Raw Data	123.45	1.57
Mean-SD	121.88	-
SignificantFigures	123	1.6

FOOD FREQUENCY, FOOD RECORD/RECALL ANALYSIS AND RECIPE ANALYSIS SOFTWARE

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The compilation of machine readable nutrient databases has facilitated the development of microcomputer based application software designed to meet user requirements in the area of nutrition research. The Food Frequency Data Entry and Analysis Program, The Food Record/Recall Data Entry and Analysis Program, and the Recipe Analysis Program are three such applications designed and developed collaboratively by the USDA Human Nutrition Information Service and the University of Texas School of Public Health.

Prior to discussing these applications, information concerning our development history as well as goals for future collaborative efforts will be reviewed.

In 1986, the University of Texas School of Public Health acquired the in-house version of USDA'S Nutrient Data Base for Individual Food Intake Surveys along with accompanying programs for recipe analysis. This is the same system which created the nutrient databases used for estimating intakes from the Continuing Survey of Food Intakes by Individuals (CSFII), the 1987 Nationwide Food Consumption Survey (NFCS) and also for Hispanic HANES. The current version of the database contains approximately 6,000 foods and nutrient values per 100 grams for 30 nutrients. Because the foods in the database are those reported to have been consumed on a nationwide basis, many ethnic foods and mixed dishes are included.

Following acquisition of the database, software development at the School of Public Health has focused on applications which will meet the collective requirements of nutrition research efforts occurring both at USDA-HNIS and research institutions. The long term development goal is to integrate all applications into one system; with the addition of on-line coding of foods and/or recipes, and capabilities for including additional nutrients and foods while maintaining the integrity of the Survey Nutrient Data Base.

This demonstration will preview three component applications; the Food Frequency Data Entry and Analysis Program, the Food Record/Recall Data Entry and Analysis Program and the Recipe Analysis Program. All applications provide complete data management and editing capabilities and include color displays. Full integration of the component applications, as well as on-line coding and mouse-keyboard interface will be completed by late August.

All of the programs are written in the C programming language for use with MS-DOS version 2.0 and above. Program output is in ASCII format and may be easily imported into most statistical analysis systems. The applications require at least 640K of memory, hard disk storage, and will run on IBM and IBM compatible microcomputers. The Food Frequency Data Entry and Analysis application may be used independently of the other applications on a system with either two floppy diskette drives or one floppy diskette drive and a hard disk drive.

In terms of supporting materials, standardized data collection and entry forms have been developed for both the Food Frequency and Food Record/Recall applications. These forms are simple to complete and may be self-administered or used in a direct interview setting.

To assist subjects in estimation of portion sizes consumed, a catalog of two-dimensional food models was developed. These models were drawn to scale from actual three-dimensional household measures and other selected representations of sizes of food portions. The food model catalog includes baby bottles, baby spoons and bowls of various sizes, thus lending the capacity to quantify intakes of infants and children. Although the food models are frequently used to quantify intake, the user is not required to use them. The entry programs also accept standard weights, household measures, and the full metric system of measures as valid measures.

The Food Frequency Data Entry and Analysis application will contain a packaged set of materials, including the standardized questionnaire/data entry form, the catalog of food models, and software to perform data entry, editing, and nutritional analysis. The user then selects the food items to include on the questionnaire, and prepares a gram weight and a nutrient file specific for these foods. The gram weight file defines the gram weight of each food model and/or household measurement to be used to quantify intake for each food on the questionnaire. The nutrient file defines the nutrients to be included for analysis in terms of 100-gram portions for each food on the questionnaire. The user must select the resource(s) for obtaining gram weight and nutrient data. For example, these data may be extracted from a nutrient data-base, from nutrient composition tables, from manuals or from laboratory analysis.

With the questionnaire constructed and the supporting gramweight and nutrient files in place, the Food Frequency application is operational. The user is prompted to enter data from each of the response categories of the questionnaire. On-line editing capabilities allow the user to edit previously entered questionnaires or edit data directly during the course of an interview.

Reported data on the frequency of food use, portion size and the nutrient density of each food item are used to produce two output files. The first file summarizes the average daily nutrient intake of a subject from those foods on the questionnaire, on an average day in the past month. The second file reports the quantities of nutrients in each food consumed during the month. The nutrient analysis program also provides the option to print these files in a report format; examples of which are provided with the handout materials.

For the Food Record/Recall Data Entry and Analysis application, a standardized data collection form has been designed. Subject intake may be quantified using the food models or standard household measures. The user is prompted to enter food record data by food code, pending completion of the on-line coding data entry feature. On-line editing capabilities allow the user to edit previously entered food records or to edit data directly during the data entry session.

The nutrient analysis program accesses the Survey Nutrient Data Base and gram weight file to calculate the nutrient content of each reported food. Two output files are produced, one of which contains the quantities of nutrients in each food consumed. The second file contains the total nutrient intake per person per day.

The nutrient analysis program also provides the option to print these files in a report format. An attractive feature of the report generation function allows the user to customize the report. Options for customization include selection of the nutrients to be included in the report, user defined comparison standards, and the ability to select comparison of nutrient intake by total amount or by density. Examples of report output are provided with the handout materials.

The Recipe Analysis application utilizes the modified nutrient retention method of calculating nutrient content of recipes.[1] This method involves application of retention factors to vitamin and mineral values for each recipe component and then adjustment for fat and moisture changes, to derive yields and nutrient values for the recipe. Detailed descriptions of these procedures have been presented at previous conferences.[1,2,3]

As recipes are created and/or modified, they may be saved to a batch file, thus maintaining the integrity of the recipe file contained in the Survey Nutrient Data Base.

The Recipe Analysis program provides the option to produce recipe reports which express the nutrient content of recipes in 100-gram portions. This is very useful for generating nutrient values for recipes which are to be added to the database.

Thus far, we have progressed swiftly in the development of component applications which eventually will be integrated into one complete system. With the assistance of HNIS, continued success is anticipated.

REFERENCES

1. Perloff, B. "Recipe Calculations for the NFCS Database." *Proceedings of the 10th National Nutrient Databank Conference.* NTIS, Springfield, VA, 1985; pp. 11-21.

2. Powers, P. "Recipe Calculations -- New Research in Methodologies." *Proceedings of the 11th National Nutrient Databank Conference.* University of Georgia, Athens, GA, 1986; pp. 46-50.

3. Joseph, H. "Recipe Calculations -- Where Do We Stand?" *Proceedings of the 12th National Nutrient Databank Conference.* Houston, TX, pp. 135-140.

5341512 APPLE FRITTERS

YIELD: 79.0 MOIS CHANGE: -35.0 FAT CHANGE: 14.0 FAT ID: 4031 SHORTNNG,REG,SOY/COT

X	NO	NDBNO	INGREDIENT INPUT NAME	PDS NAME	MEASURE	GRAMS	PERCENT	RETENTION CODE	RETENTION DESCRIPTION
0	1	9004	APPLES,RAW,PARED	APPLE,RAW,W/O/SKIN	2 C	220.000	33.883	153	FRU,FRSH,NO CIT,SAUT
0	2	94390	FLOUR	WHEAT FLOUR,ALL-PURP	1 C	115.000	17.711	305	FLOUR/MEAL,SAUTEED
0	3	1077	MILK	3.3% FAT,WHOLE MILK	2/3 C	162.700	25.058	2151	MILK,HEATED,10 MIN
0	4	1123	EGGS	WHOLEEGG,FRESH/FRZN	2	100.000	15.401	103	EGGS,FRIED,SCRAMBLED
4	5	4031	SHORTENING	SHORTNNG,REG,SOY/COT	1TBSP	14.100	2.172	0	
0	6	92200	SUGAR	SUGARS,GRANULATED	3 TBSP	37.500	5.775	0	

COMPONENTS	WEIGHT	ENERGY	MOISTURE	PROTEIN	FAT	SAT. F.A.	MONO. F.A.	POLY. F.A.
	G	CAL	G	G	G	G	G	G
1 APPLES,RAW,PARED	220.000	125.400	185.312	0.330	0.682	0.112	0.029	0.200
2 FLOUR	115.000	418.600	13.800	12.075	1.150	0.184	0.092	0.506
3 MILK	162.700	99.365	143.150	5.353	5.434	3.383	1.570	0.202
4 EGGS	100.000	157.319	74.570	12.140	11.150	3.348	4.455	1.449
5 SHORTENING	14.100	124.544	0.000	0.000	14.100	3.525	6.275	3.330
6 SUGAR	37.500	144.375	0.188	0.000	0.000	0.000	0.000	0.000
SUBTOTALS:	649.300	1070.302	417.523	29.898	32.516	10.552	12.421	5.037
MOIS/FAT CHANGE:	-136.353	803.574	-227.255	0.000	90.302	22.725	40.451	22.725
YIELD:	512.947	1874.476	190.274	29.898	123.418	33.277	52.873	29.762
PER 100 GRAMS:	100.000	365.433	37.094	5.829	24.061	6.487	10.308	5.802

COMPONENTS	CARBO	CALCIUM	IRON	MAGNESIUM	PHOSPHORUS	POTASSIUM	SODIUM	ZINC
	G	MG	MG	MG	MG	MG	MG	MG
1 APPLES,RAW,PARED	32.548	8.360	0.154	6.600	15.400	222.740	0.000	0.088
2 FLOUR	87.515	18.400	5.060	24.150	100.050	109.250	2.300	0.759
3 MILK	7.592	194.264	0.081	21.367	151.962	246.490	79.723	0.618
4 EGGS	1.200	56.100	2.090	12.290	180.100	129.900	138.300	1.440
5 SHORTENING	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6 SUGAR	37.313	0.000	0.038	0.000	0.000	1.125	0.375	0.000
SUBTOTALS:	166.257	277.124	7.423	64.907	447.512	710.505	220.698	2.905
MOIS/FAT CHANGE:	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
YIELD:	166.257	277.124	7.423	64.907	447.512	710.505	220.698	2.905
PER 100 GRAMS:	32.412	54.026	1.447	12.654	87.243	138.514	43.025	0.566

COMPONENTS	COPPER	VIT C	THIAMIN	RIBOFLAVIN	NIACIN	VIT B6	FOLACIN	VIT B12
	MG	MG	MG	MG	MG	MG	MCG	MCG
1 APPLES,RAW,PARED	0.061	6.160	0.030	0.020	0.180	0.091	0.440	0.000
2 FLOUR	0.146	0.000	0.551	0.411	5.475	0.041	11.960	0.000
3 MILK	0.016	1.300	0.056	0.264	0.137	0.062	6.915	0.465
4 EGGS	0.062	0.000	0.074	0.286	0.059	0.114	48.750	1.315
5 SHORTENING	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
6 SUGAR	0.007	0.000	0.000	0.000	0.000	0.000	0.000	0.000
SUBTOTALS:	0.293	7.460	0.711	0.980	5.851	0.308	68.065	1.780
MOIS/FAT CHANGE:	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
YIELD:	0.293	7.460	0.711	0.980	5.851	0.308	68.065	1.780
PER 100 GRAMS:	0.057	1.454	0.139	0.191	1.141	0.060	13.269	0.347

COMPONENTS	VIT A	VIT A	CAROTENE	A-TOCO. EQ.	CHOLEST	ALCOHOL	TO.D.FIBER
	IU	RE	RE	MG	MG	G	G
1 APPLES,RAW,PARED	72.600	6.600	6.600	0.594	0.000	0.000	5.060
2 FLOUR	0.000	0.000	0.000	0.425	0.000	0.000	2.645
3 MILK	205.002	50.437	4.881	0.146	22.127	0.000	0.000
4 EGGS	520.000	156.000	0.000	0.740	547.600	0.000	0.000
5 SHORTENING	0.000	0.000	0.000	2.045	0.000	0.000	0.000
6 SUGAR	0.000	0.000	0.000	0.000	0.000	0.000	0.000
SUBTOTALS:	797.602	213.037	11.481	3.950	569.727	0.000	7.705
MOIS/FAT CHANGE:	0.000	0.000	0.000	13.181	0.000	0.000	0.000
YIELD:	797.602	213.037	11.481	17.131	569.727	0.000	7.705
PER 100 GRAMS:	155.494	41.532	2.238	3.340	111.069	0.000	1.502

FOOD FREQUENCY REPORT

SUBJECT:	1	NAME:	DEMO SUBJECT	START TIME:	09:30A	INTERVIEWER:	1
DATE:	06/05/89	OTHER:	FEMALE	END TIME:	10:00A	TITLE:	DEMO STUDY

NUTRIENT (UNITS)		TOTAL MONTHLY INTAKE (28 DAYS)	AVERAGE DAILY INTAKE DURING THE MONTH
ENERGY	KCAL	29883.44	1067.27
TOTAL FAT	GM	1898.83	67.82
SAT. FAT	GM	588.83	21.03
MONO. FAT	GM	748.54	26.73
POLY. FAT	GM	463.77	16.56
CHOLESTEROL	MG	2094.99	74.82
CARBOHYDRATE	GM	2771.88	99.00
PROTEIN	GM	529.29	18.90

MONTHLY INTAKE OF INDIVIDUAL FOOD ITEMS

		GRAMS/ MONTH	ENERGY KCAL	TOTAL FAT GM	SAT. FAT GM	MONO. FAT GM	POLY. FAT GM
1	LOWFAT MILK	735.00	374.63	14.11	8.75	4.04	0.51
2	COFFEE OR HOT TEA	1894.38	18.35	0.00	0.00	0.00	0.00
3	MARGARINE	1596.00	10981.76	1220.52	240.36	532.27	399.54
4	BEEF STEAK,ROAST	255.60	875.59	66.30	27.09	32.54	2.39
5	DRY CEREAL	887.38	3441.25	32.23	13.23	5.75	3.35
6	PANCAKES	238.67	663.01	22.36	8.18	8.45	5.08
7	MACARONI AND CHEESE	1344.00	4104.76	214.23	100.50	72.12	23.74
8	SOFT CHEESE	1020.60	3188.37	284.34	179.01	81.04	3.59
9	ORANGES	3303.38	1449.85	4.29	0.56	0.56	0.39
10	SODA-REGULAR ANY FLA	10368.36	4247.13	0.00	0.00	0.00	0.00
11	PUDDING PIES	204.87	537.46	29.95	11.04	10.57	5.27

FOOD FREQUENCY REPORT

MONTHLY INTAKE OF INDIVIDUAL FOOD ITEMS

		CHOLESTEROL MG	CARBOHYDRATE GM	PROTEIN GM
1	LOWFAT MILK	55.13	36.53	25.58
2	COFFEE OR HOT TEA	0.00	2.08	0.00
3	MARGARINE	47.24	12.13	14.68
4	BEEF STEAK,ROAST	229.02	4.12	61.09
5	DRY CEREAL	0.00	709.33	71.83
6	PANCAKES	244.58	91.30	20.73
7	MACARONI AND CHEESE	436.82	380.05	159.60
8	SOFT CHEESE	913.23	26.34	135.23
9	ORANGES	0.00	368.00	30.06
10	SODA-REGULAR ANY FLA	0.00	1080.45	0.00
11	PUDDING PIES	168.38	60.35	10.49

NUTRIENT INTAKE DAY 1 (06/05/89)

SUBJECT: 1 NAME: DEMO START TIME: 09:30A INTERVIEWER: 2
OTHER: FEMALE END TIME: 10:00A TITLE: DEMO SUBJECT

NUTRIENT (UNITS)		TOTAL NUTRIENT INTAKE	NUTRIENT DENSITY	RDA 30YR.FEMALE(UNITS)	PERCENT OF RDA 30YR.FEMALE
ENERGY	KCAL	2401.31	N/A	2000.00 KCAL	120.07
			Percent of KCAL		
PROTEIN	GM	84.53	14.08	46.00 GM	183.77
CARBOHYDRATE	GM	344.72	57.42	---	---
TOTAL FAT	GM	71.22	26.69	---	---
SATURATED FAT	GM	22.19	8.32	---	---
MONO UNSAT FAT	GM	28.07	10.52	---	---
POLY UNSAT FAT	GM	15.20	5.70	---	---
			Per 1000 KCAL		
CHOLESTEROL	MG	262.71	109.40	---	---
DIETARY FIBER	GM	25.14	10.47	---	---
VITAMIN A	IU	23112.75	9625.05	4000.00 IU	577.82
VITAMIN A	RE	2576.21	1072.83	800.00 RE	322.03
BETA-CAROTENE	RE	2202.37	917.15	---	---
THIAMIN	MG	2.15	0.90	1.10 MG	195.45
RIBOFLAVIN	MG	2.74	1.14	1.20 MG	228.33
NIACIN	MG	26.51	11.04	13.00 MG	203.93
VITAMIN B6	MG	2.31	0.96	2.00 MG	115.27
FOLACIN	MCG	488.71	203.52	400.00 MCG	122.18
VITAMIN B12	MCG	13.87	5.77	3.00 MCG	462.24
VITAMIN C	MG	247.63	103.12	50.00 MG	495.25
CALCIUM	MG	1055.83	439.71	800.00 MG	131.98
PHOSPHORUS	MG	1481.61	617.00	800.00 MG	185.20
MAGNESIUM	MG	481.44	200.49	300.00 MG	160.48
IRON	MG	21.50	8.95	18.00 MG	119.46
ZINC	MG	57.80	24.07	15.00 MG	385.33
COPPER	MG	6.45	2.68	---	---
SODIUM	MG	5017.30	2089.41	---	---
POTASSIUM	MG	4152.46	1729.25	---	---
			Percent of KCAL		
ALCOHOL	GM	13.03	3.80	---	---

NUTRIENT INTAKE DAY 1 (06/05/89)

DAILY INTAKE OF INDIVIDUAL FOOD ITEMS

	GRAMS	ENERGY KCAL	PROTEIN GM	CARBOHYDRATE GM	TOTAL FAT GM	SATURATED F. GM
1 9210000 Coffee,NS type	360.00	3.60	0.00	0.00	0.00	0.00
1 5410201 Crackers,graham	56.00	215.04	4.48	41.05	5.25	1.25
1 6310701 Banana,raw	114.00	104.88	1.17	26.71	0.55	[illegible]
1 6121000 Orange juice,NFS	342.38	154.07	2.33	36.91	0.21	0.02
2 5840801 Won ton soup	482.00	420.13	25.16	31.89	13.83	[illegible]
2 5120101 Bread,whole wheat	52.00	126.36	5.46	24.80	1.56	0.27
2 1410701 Cheese,Mozzarella	28.35	79.36	7.79	0.89	4.85	3.08
2 7511300 Lettuce,raw	16.00	2.08	0.16	0.33	0.03	0.00
2 7410100 Tomatoes,raw	123.00	23.37	1.09	5.34	0.26	0.04
2 7550610 Mustard sauce	3.33	6.74	0.36	0.50	0.41	0.02
2 7310101 Carrots,raw	56.00	24.08	0.58	5.68	0.11	0.02
2 9241032 Soft drink,cola-type	240.00	4.80	0.00	0.00	0.48	0.17
2 1146010 Yogurt,frozen,chocol	193.00	210.37	7.53	37.44	3.86	2.49
2 5410201 Crackers,graham	42.00	161.28	3.36	30.79	3.95	0.94
3 7220120 Broccoli,cooked,NS f	183.00	119.27	5.38	10.03	8.06	1.55
3 2715020 Oyster sauce(inc sca	129.00	172.97	5.46	10.10	11.16	3.09
3 5620500 Rice,cooked,NFS(assu	205.00	223.45	4.10	49.51	0.20	0.06
3 5811013 Egg roll,with meat	85.00	157.06	6.64	12.39	8.39	[illegible]
3 9230200 Tea,leaf	240.00	2.40	0.00	0.72	0.00	0.00
3 9310100 Beer,ale	360.00	151.20	1.08	13.68	0.00	0.00
3 5322201 Cookie,fortune	8.00	38.30	0.39	5.37	1.55	[illegible]

	MONO UNSAT FAT GM	POLY UNSAT FAT GM	CHOLESTEROL MG	DIETARY FIBER GM	VITAMIN A IU	VITAMIN - RE
1 9210000 Coffee,NS type	0.00	0.00	0.00	0.00	0.00	[illegible]
1 5410201 Crackers,graham	2.11	1.45	0.00	1.06	0.00	[illegible]
1 6310701 Banana,raw	0.05	0.10	0.00	2.28	92.34	[illegible]
1 6121000 Orange juice,NFS	0.03	0.04	0.00	0.34	257.05	[illegible]
2 5840801 Won ton soup	8.77	2.30	123.57	1.69	1726.18	[illegible]
2 5120101 Bread,whole wheat	0.26	0.56	0.00	5.38	0.00	[illegible]
2 1410701 Cheese,Mozzarella	1.37	0.14	15.31	0.00	173.04	[illegible]
2 7511300 Lettuce,raw	0.00	0.02	0.00	0.24	52.80	[illegible]
2 7410100 Tomatoes,raw	0.04	0.11	0.00	1.85	1393.59	[illegible]
2 7550610 Mustard sauce	0.23	0.08	0.00	0.09	0.39	[illegible]
2 7310101 Carrots,raw	0.00	0.04	0.00	1.95	15752.23	[illegible]
2 9241032 Soft drink,cola-type	0.17	0.17	0.00	0.00	0.00	[illegible]
2 1146010 Yogurt,frozen,chocol	1.08	0.10	15.44	0.00	165.98	[illegible]
2 5410201 Crackers,graham	1.59	1.09	0.00	0.30	0.00	[illegible]
3 7220120 Broccoli,cooked,NS f	3.40	2.53	0.00	6.78	2925.42	[illegible]
3 2715020 Oyster sauce(inc sca	4.15	2.93	35.95	0.28	585.30	[illegible]
3 5620500 Rice,cooked,NFS(assu	0.06	0.09	0.00	0.41	0.00	[illegible]
3 5811013 Egg roll,with meat	3.93	2.19	51.54	0.93	61.74	[illegible]
3 9230200 Tea,leaf	0.00	0.00	0.00	0.00	0.00	[illegible]
3 9310100 Beer,ale	0.00	0.00	0.00	0.72	0.00	[illegible]
3 5322201 Cookie,fortune	0.57	0.48	4.38	0.04	11.20	[illegible]

NUTRIENT INTAKE DAY 1 (06/05/89)

DAILY INTAKE OF INDIVIDUAL FOOD ITEMS

	BETA-CAROTENE RE	THIAMIN MG	RIBOFLAVIN MG	NIACIN MG	VITAMIN B6 MG	FOLACIN MCG
1 9210000 Coffee,NS type	0.00	0.00	0.00	0.93	0.00	0.00
1 5410201 Crackers,graham	0.00	0.07	0.34	1.96	0.04	9.52
1 6310701 Banana,raw	9.12	0.05	0.11	0.62	0.56	21.77
1 6121000 Orange juice,NFS	27.39	0.27	0.06	0.69	0.15	149.95
2 5840801 Won ton soup	164.38	0.64	0.49	9.01	0.31	36.78
2 5120101 Bread,whole wheat	0.00	0.13	0.06	1.46	0.06	30.16
2 1410701 Cheese,Mozzarella	2.84	0.01	0.10	0.03	0.02	2.31
2 7511300 Lettuce,raw	5.28	0.01	0.00	0.03	0.01	8.35
2 7410100 Tomatoes,raw	138.39	0.07	0.06	0.74	0.06	11.55
2 7550610 Mustard sauce	0.09	0.01	0.01	0.11	0.00	1.09
2 7310101 Carrots,raw	1575.23	0.05	0.03	0.52	0.08	7.34
2 9241032 Soft drink,cola-type	0.00	0.00	0.00	0.00	0.00	0.00
2 1146010 Yogurt,frozen,chocol	3.56	0.36	0.31	0.15	0.08	15.44
2 5410201 Crackers,graham	0.00	0.05	0.26	1.47	0.03	7.14
3 7220120 Broccoli,cooked,NS f	250.01	0.15	0.37	1.35	0.25	122.19
3 2715020 Oyster sauce(inc sca	12.66	0.13	0.22	1.85	0.06	10.33
3 5520500 Rice,cooked,NFS(assu	0.00	0.23	0.02	2.05	0.10	4.10
3 5311013 Egg roll,with meat	1.37	0.13	0.14	1.67	0.12	11.12
3 9230200 Tea,leaf	0.00	0.00	0.02	0.00	0.00	12.00
3 9310100 Beer,ale	0.00	0.04	0.11	1.30	0.18	25.20
3 5322201 Cookie,fortune	0.00	0.02	0.02	0.15	0.00	0.72

	VITAMIN B12 MCG	VITAMIN C MG	CALCIUM MG	PHOSPHORUS MG	MAGNESIUM MG	IRON MG
1 9210000 Coffee,NS type	0.00	0.00	7.20	3.60	21.60	0.2[illegible]
1 5410201 Crackers,graham	0.16	0.00	22.40	83.44	24.08	1.[illegible]
1 6310701 Banana,raw	0.00	10.37	5.34	22.30	33.06	0.3[illegible]
1 6121000 Orange juice,NFS	0.00	133.18	30.81	54.79	34.24	0.[illegible]
2 5840801 Won ton soup	0.35	6.29	59.20	239.13	38.53	3.7[illegible]
2 5120101 Bread,whole wheat	0.00	0.00	51.48	118.56	53.56	1.5[illegible]
2 1410701 Cheese,Mozzarella	0.25	0.00	207.32	148.53	7.45	0.1[illegible]
2 7511300 Lettuce,raw	0.00	0.52	3.04	3.20	1.44	0.0[illegible]
2 7410100 Tomatoes,raw	0.00	21.55	8.61	29.29	13.53	0.5[illegible]
2 7550610 Mustard sauce	0.00	0.04	7.53	12.07	4.30	0.14
2 7310101 Carrots,raw	0.00	5.21	15.12	24.54	8.40	0.23
2 9241032 Soft drink,cola-type	0.00	0.00	7.20	19.20	0.00	0.24
2 1146010 Yogurt,frozen,chocol	0.79	1.15	259.52	202.55	25.09	0.1[illegible]
2 5410201 Crackers,graham	0.12	0.00	16.30	62.59	18.06	1.47
3 7220120 Broccoli,cooked,NS f	0.01	112.10	203.13	98.50	108.57	2.09
3 2715020 Oyster sauce(inc sca	10.66	3.91	86.09	129.71	28.60	3.37
3 5520500 Rice,cooked,NFS(assu	0.00	0.00	20.50	57.40	22.55	2.37
3 5811013 Egg roll,with meat	0.23	2.78	17.11	81.48	13.17	1.[illegible]
3 9230200 Tea,leaf	0.00	0.00	0.00	2.40	2.40	0.[illegible]
3 9310100 Beer,ale	0.53	0.00	18.00	43.20	21.60	[illegible]
3 5322201 Cookie,fortune	0.00	0.00	2.88	6.40	0.95	0.17

NUTRIENT INTAKE DAY 1 (06/05/89)

DAILY INTAKE OF INDIVIDUAL FOOD ITEMS

	ZINC MG	COPPER MG	SODIUM MG	POTASSIUM MG	ALCOHOL GM	GRAMS
1 3210000 Coffee,NS type	0.04	0.04	3.60	248.40	0.00	360.00
1 5410201 Crackers,graham	0.46	0.17	375.20	215.04	0.00	56.00
1 6310701 Banana,raw	0.18	0.12	1.14	451.44	0.00	114.00
1 6121000 Orange juice,NFS	0.17	0.15	3.42	650.51	0.00	342.00
2 5840801 Won ton soup	2.43	0.29	1522.14	571.73	0.03	482.00
2 5120101 Bread,whole wheat	0.98	0.19	274.04	141.96	0.00	52.00
2 1410701 Cheese,Mozzarella	0.89	0.01	149.60	25.39	0.00	28.35
2 7511200 Lettuce,raw	0.04	0.00	1.44	25.28	0.00	15.00
2 7410100 Tomatoes,raw	0.14	0.09	9.84	254.61	0.00	123.00
2 7550610 Mustard sauce	0.08	0.01	0.12	9.30	0.00	3.33
2 7310101 Carrots,raw	0.11	0.03	19.60	130.38	0.00	56.00
2 9241032 Soft drink,cola-type	0.19	0.06	21.60	4.80	0.00	240.00
2 1146010 Yogurt,frozen,chocol	1.25	0.02	100.36	331.35	0.00	133.00
2 5410201 Crackers,graham	0.35	0.13	281.40	161.23	0.00	42.00
3 7220120 Broccoli,cooked,NS f	0.27	0.13	545.15	284.35	0.00	183.00
3 2715020 Oyster sauce(inc sca	48.55	4.71	495.02	223.36	0.00	128.00
3 5520500 Rice,cooked,NFS(assu	0.84	0.17	766.70	57.40	0.00	205.00
3 5311013 Egg roll,with meat	0.63	0.07	406.10	158.47	0.10	85.00
3 9220200 Tea,leaf	0.02	0.02	0.00	33.40	0.00	240.00
3 9310100 Beer,ale	0.07	0.03	25.20	90.00	12.96	360.00
3 5322201 Cookie,fortune	0.03	0.01	15.12	4.30	0.00	8.00

THE DIETARY DATA COLLECTION SYSTEM -- AN AUTOMATED INTERVIEW AND CODING SYSTEM FOR NHANES III

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PART I

The National Health and Nutrition Examination Survey III;
presented by Margaret McDowell, M.P.H., National Center for Health Statistics

The third National Health and Nutrition Examination Survey (NHANES III), is a national survey conducted by the National Center for Health Statistics (NCHS) of the U.S. Public Health Service. The purpose of the Survey is to assess the health and nutritional status of children and adults living in the United States. Data collection began in October, 1988, and will continue for the next six years. Approximately 40,000 individuals two months of age and older are expected to participate in the Survey. Data collection methods for NHANES III include detailed interviews, physical and dental examinations, and laboratory tests. The final list of examination components, and the procedures used to obtain these data, are the result of extensive planning and pilot testing.

The nutrition assessment tools used in the Survey will provide data for nutrition monitoring to assess the nutritional status of the population over time, reference data for nutritional biochemistries, anthropometric data, and nutrient intakes, and data for research to examine relationships between diet and health.[1] NCHS sponsored a workshop in 1986 to review dietary data collection methodologies which could be used in the Survey. Recommendations were made to continue collection of both food frequency and 24-hour recall data during NHANES III.

The decision to adopt an automated interactive interview methodology for the 24-hour recall component was a major change from earlier NHANES surveys. Previously, dietary recalls were recorded on hard copy and coded by the dietary interviewers. During NHANES III, approximately 30,000 dietary recalls will be collected on personal computers using the Dietary Data Collection system (DDC). The recalls are sent to the minicomputer system which is used for all data collection in the Mobile Examination Centers during NHANES III. Dietary data transmittals are mailed from the field to NCHS in computer tape format for editing and processing.

The University of Minnesota's Nutrition Coordinating Center (NCC) developed the prototype of the DDC system used during NHANES III with grant support from the National Cancer Institute. Later, funding from NCHS and the Food and Drug Administration was used to adapt the DDC for use in NHANES III based on NCHS specifications.

The critical features of the NHANES III automated interactive dietary interview system identified by NCHS included the following:

(1) ability to conduct open-ended interviews using structured probes to ensure standardized data collection;

(2) ability to collect information on brand name products, ingredients, cooking methods, and the use of fat and sodium in food preparation;

(3) ability to identify foods eaten together;

(4) ability to information on the time of day food was eaten, the name of the meal or snack, and place where food was consumed;

(5) ability to edit dietary recalls both during and after the dietary interview;

(6) automated coding of foods to the USDA database;

(7) ability to record new information about foods which are not currently in the system during the actual interview.

The DDC system was specifically adapted for the Survey based on these specifications. Representatives from the contracting agencies who have worked with NCHS to develop the DDC program and dietary interview procedures will talk about their agencies' roles. Rita Warren from the University of Minnesota will describe the DDC system and database maintenance. Diane Feskanich from Westat, Inc., will describe the dietary interviewer's role in using the DDC system to its maximum potential.

PART II

The Dietary Data Collection System and Nutrient Database;
presented by Rita A. Warren, M.S., R.D., Nutrition Coordinating Center, University of Minnesota

The primary purpose for developing an automated dietary data collection system related to the need for a standardized interview. The nutrition data system, which had been in place at the University of Minnesota since 1974, included three major components: the training of interviewers; centralized coding; and centralized data processing for nutrient calculations.[2] It was recognized that the least standardized component of the system was the dietary interview which was limited by the ability of the trained interviewer to remember a vast amount of detail for probing for food descriptions and preparation methods.

To address this need, an NIH proposal was developed which included an interactive interview for collecting dietary data at the level of detail required by diet-disease related research studies. This grant proposal was funded in 1984 by the National Cancer Institute (NCI). In addition to the main objective of standardizing the way dietary data are collected, a secondary objective of the proposed microcomputer based system was the capability of automating the coding.[3] A further goal of the project was to provide a data collection system that could be used with any comprehensive nutrient database.

Following an open-house demonstration of the prototype system in May 1986, the DDC system was selected for use in the NHANES III. NCC nutritionists and computer scientists worked directly with the nutritionists and computer staff at the National Center for Health Statistics (NCHS) to customize and test the DDC system for the Survey.[4] This included mapping the DDC foods database to the USDA's Nationwide Food Consumption Survey (NFCS) database which was chosen as the primary database for the Survey. Nutrient calculations and analysis of the data will be handled at the NCHS after all coding decisions have been made.

Database maintenance must be continued throughout the six years of the study. The DDC system must be routinely updated based on USDA updates for the USDA surveys (NFCS and CSFII). As NCHS processes Survey recalls, foods are identified which cannot be found in the system or which are captured in notes by the interviewers. These foods are then added to the database by NCC. New brand name foods which enter the market throughout the six years of the study will also be added to the database. As better data become available, such as improved recipes for Mexican-American foods, the database will be updated. This is important to NHANES III because of the oversampling of certain population groups, such as Hispanics. Likewise, NHANES III's focus on children as young as two months requires that special attention be focused on database maintenance of baby foods.

There are over 8000 "base" foods in the DDC system. Significantly more possibilities for classifying foods exist because of the way the food hierarchies are set up to collect detail on specificity. The DDC system collects detail for preparation methods (such as broiling, baking, panfrying meats, etc.), brand names, ingredient detail (such as mayonnaise in a potato salad or artificial sweeteners in beverages) and fat and sodium used in the preparation of the food. For example, there are over 9000 possibilities for variations on preparing meats. There are over 3000 possibilities for brand name listings. These three categories of foods alone -- the base foods plus the meat preparations and the brand name listings -- represent about 20,000 foods, but the possibilities are endless. By using variable ingredients such as type of fat, dairy products, meats, gravies, dressings, and frostings in recipes or combination foods, almost any food or food combination can be captured with the degree of detail needed by the Survey.

PART III

The Dietary Interviewer in NHANES III.
presented by Diane Feskanich, M.S., Westat, Inc.

Conducting the 24-hour recall is the major task of the dietary interviewer, but not the only task. After the interview is completed, the interviewer is required to review the recall for completeness and clarity and edit the recall using the DDC system. Notes may be added at this time to further document the interview. For example, the interviewer might add a Note to bran muffins, stating that the muffins were made with whole wheat flour instead of white flour. (See Attachment 1.) This Note would be reviewed at NCHS to determine whether the correct food codes were assigned.

Also during the edit process, any amount that was recorded as "unknown" during the interview may be changed to a default amount if a default standard exists for that food. For example, if a subject was unable to estimate the amount of blue cheese dressing that was on her hamburger, the interviewer would enter the quantity of dressing as "unknown". During editing, the interviewer would change this "unknown" entry to 1 TB based upon a default standard of 1 TB of dressing per sandwich. (See Attachment 1.)

The dietary interviewer is also responsible for gathering information from outside sources, such as babysitters, schools, or community feeding programs, when the respondent does not know what foods were consumed at one of the meals. This situation occurs most often with proxy interviews. For example, a mother might act as a proxy for her very young child, providing most of the information about what the child had to eat on the previous day. However, she might not know what was served for lunch at the day care center. In this case, the interviewer must attempt to contact the day care center and locate someone who can provide the information.

Interviewers also perform market checks to collect information about commercial foods not contained in the DDC system. The Missing Food screen is used to record as much detailed information about the food as the subject can provide during the interview. However, for commercially purchased foods, the interviewer is also instructed to find the food in the local grocery store and send the label information to NCHS for review.

All interviewers complete a comprehensive training course.[5] The first few days of training focus on the general features of the DDC system and the microcomputer. Interviewers learn how to use the computer keyboard to enter information into the system.

The use of proper interviewing technique is emphasized during training. Interviewers must be able to elicit detailed information using neutral probes while maintaining a good rapport with the subject. They must also learn how to probe to ensure that all foods and beverages consumed are reported.

Training is designed to standardize the dietary interview as much as possible. The design of the DDC system itself provides a high degree of standardization by prompting the interviewer for all of the details required to describe and quantify a food. However, the interviewer is still responsible for selecting the best response to these prompts. The training sessions focus on training the interviewer to probe for and select the most appropriate choices from among those displayed on the DDC system screens.

For example, the DDC system will prompt the interviewer for the amount of an English muffin consumed by the subject. The system permits the interviewer to enter the quantity in terms of the dimensions of a cylinder or in terms of the number of standard sized English muffins consumed. Though it might be possible to ask the subject to describe the English muffin by its diameter and thickness if it is homemade, it is better not to ask the subject to estimate the dimensions of a commercially purchased English muffin. The DDC system contains information on the standard size of commercial English muffins, and this information is probably more accurate than the size estimates that can be provided by the subject.

Practice sessions and role-playing activities serve to improve the interviewer's confidence level, efficiency, and accuracy in using the DDC system. All dietary interviewers in NHANES III have training in foods and nutrition. But even experienced dietary interviewers must acquire some new skills to become proficient in the use of an interactive data collection system.

We have found that the best candidates for dietary interviewer training are those who have an education in dietetics, nutrition, or home economics, good interview skills, and some previous experience using a computer system and/or computer keyboard. After completing the training sessions and some initial experience using the DDC system in the field, the dietary interviewers in NHANES III have been able to conduct the 24-hour dietary recall interviews in about 20 - 30 minutes, depending upon the age of the subject, the complexity of the diet, and whether or not a proxy was used for the interview.

Several procedures are used in the field to monitor interviewer performance. Interviewers are observed during actual dietary interviews and are assessed on their use of the DDC system and the food models. They are also observed for use of neutral probes, appropriate mannerisms and eye contact, and the general flow of the interview. Continued monitoring is done through audio-taped interviews and general quality control analysis of 24-hour recall data.

As another form of quality control, approximately 10 percent of the dietary recalls are cross-checked between interviewers. Interviewers check one another's work for completeness, clarity, and accuracy. Any discrepancies between interviewers are sent to NCHS for resolution.

REFERENCES

1. Woteki, C.E., Briefel, R.D., Kuczmarski, R. "Contributions of the National Center for Health Statistics." *Am J Clin Nutr* 47 (1988): 320-28.

2. Dennis, B., Ernst, N., Hjortland, M., Tillotson, J., Grambsch, V. "The NHLBI nutrition data system." *J Am Dietet Assoc;* 77(6) (1980): 641-647.

3. Feskanich, D., Buzzard, I.M., Welch, B.T., Asp, E.H., Dieleman, L.S., Chong, K.R., Bartsch, G.E. "Comparison of a computerized and a manual method of food coding for nutrient intake studies." *J Am Dietet Assoc;* 88(10) (1988): 1263-67.

4. Feskanich, D., Buzzard, I.M., Briefel, R. "Computerized 24-hour dietary recall data collection for NHANES III." In: *Proceedings of the Twelfth National Nutrient Databank Conference*, Houston, TX, 1987: 103-107.

5. *Third National Health and Nutrition Examination Survey (NHANES III) Dietary Interviewer's Training Manual.* Prepared by Westat, Inc., 1650 Research Blvd., Rockville, MD 20850.

Attachment 1

Sample report from a 24-hour dietary recall interview using the DDC system

8:00 A **BREAKFAST** Home

1. Juice/nectar/flavored drink, orange, juice, reconstituted from frozen, not fortified, unsweetened
   0.75 G2

2. Beverage: coffee
   2.1 coffee, regular, made from ground,plain
   1.00 MUG
   2.2 cream, creamer, [Poly Rich]
   1.00 container (single serving)

3. Muffins, bran, with fruit
* Note: muffins were home made with whole wheat flour instead of white flour
  2.00 medium (approx 2 1/4" diam x 1 1/2")

  I: Fat used in recipe, margarine, [Promise - stick]

12:00P **LUNCH** Restaurant

4. Sandwich: hamburger
   4.1 hamburger/ground beef, 15% fat/extra lean/round/sirloin
   1.00 cylinder Shape: 4" diameter x 1/2" height

   P: Fried
   I: Fat used in frying, unknown-commercially prepared
   I: Salt, unknown if salt added in preparation

   4.2 Dressing for salads, blue cheese or roquefort, regular
   4.3 Lettuce, iceberg
   0.25 CP shredded
   4.4 Tomato,red,raw
   2.00 thin slice (1/8" thick)
   4.5 Rolls,hamburger
   1.00 medium (4" diam x 1 3/4")

5. Potato, salad,"mayo" dressing, without egg
   0.50 CP
   I: Mayonnaise or mayo type dressing, real, regular

6. Coke, [Coke]
   1.00 can (each 12 FO)

3:00P **SNACK** Work

@ 7. Missing Food: pies
   Green Tomato Pie: homemade pie, double pastry crust,unknown fat used in pastry, filling was green tomato slices and syrup - subject doesn't think there was any type of fat in the filling. Subject ate 1 slice which was 1/8th of 9 inch diam pie.

7:00P DINNER/SUPPER Home

8. Lasagna, beef
    1.00 cube shape: 4" length x 3" width x 1.5" height

    I: hamburger/group beef, 25%-30% fat/regular
    I: ricotta cheese, part skim milk
    I: mozzarella cheese, part skim milk

9. Salad, lettuce salad
    9.1 Lettuce, iceberg
        1.00 BL
    9.2 carrots, raw
        2.00 TB sliced
    9.3 tomato, red, raw
        3.00 cherry
    9.4 cucumber, raw
        3.00 slice
    9.5 dressing for salads, [Kraft Italian Reduced Calorie]
        2.00 TB

10. Burgundy wine
    6.00 FO

9:00P SNACK Home

11. ice cream and frozen desserts,[Haagen Dazs ice cream - other flavors]
* Note: ice cream flavor was mint chocolate chip
    0.50 CP

I = ingredient P = preparation * = note + = unknown amt @ = missing food
amount of food consumed compared with usual intake:

usual volume of tap water consumed:	number of glasses/cups:	2.00
	size of glass/cup:	8.00 FO
	total volume:	16.00 FO

type of salt added at table:	ordinary salt
how often is salt added at table:	occasionally
days during past month with no food or money:	none
meals skipped during past month due to lack of food or money?	no
usually prepared meals at home?	shared preparation
respondent:	SAMPLE PERSON
language of interview:	ENGLISH
quality of recall:	RELIABLE
interviewer's work:	COMPLETED

TRACE ELEMENTS EMERGING AS IMPORTANT IN HUMAN NUTRITION

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INTRODUCTION

At present, only seven trace elements have defined essential functions in humans. These elements are cobalt, copper, iodine, iron, molybdenum, selenium and zinc. Essential functions have been identified for manganese in animals, but not in humans. Signs of chromium deficiency have been described for humans, but a specific biochemical role for chromium has not been demonstrated conclusively. A number of other elements in addition to the aforementioned nine elements have been suggested to be essential nutrients including arsenic, boron, bromine, cadmium, fluorine, lead, lithium, nickel, silicon, tin, and vanadium. Deficiencies of only four elements -- cobalt as vitamin B-12, iodine, iron, and zinc -- occur with known sufficient frequency in humans so as to be of concern to health professionals. Nonetheless, the trace elements are often suspected of being the missing link in some of the unexplained human diseases such as atherosclerosis, osteoporosis, osteoarthritis, hypertension, and ischemic heart disease. Efforts to demonstrate that trace element deficiencies are the missing links generally have been unsuccessful. Perhaps some of the failures have occurred because the experimental approach has not been correct in the past. Recent studies examining the need for various trace elements by animals under some form of nutritional, metabolic, hormonal or physiological stress have indicated that these are situations in which some of the trace elements may be of nutritional significance.

Biological Roles of the Trace Elements

Trace elements have four known roles in living organisms. They include: 1) In close association with enzymes, some of the trace elements are an integral part of the catalytic centers at which the reactions of biological chemistry occur. Working in concert with a protein, and frequently with other organic coenzymes, the trace element attracts substrate molecules and facilitates their conversion to a specific endproduct. 2) Some trace elements donate or accept electrons in reactions of reduction or oxidation. These redox reactions are of primary importance in the generation and utilization of metabolic energy through the "burning" of foods in cells. Chemical transformations of molecules frequently involve redox reactions. 3) Some trace elements, especially iron, bind, transport and release oxygen in the body. 4) Some trace elements have structural roles, imparting stability and three dimensional structure to important biological molecules.

Homeostatic Regulation of the Trace Elements

When an essential trace element is absent or too low for adequate activity of an essential function, death occurs. As the intake of the trace element increases, the following occurs: 1) The organism survives but with suboptimal health and well-being. 2) An intake is reached in which optimal health and well-being are maintained. The range of intakes at which this occurs usually is quite large because of powerful homeostatic mechanisms. 3) A decline in health and well-being, and finally death, as regulatory mechanisms are overcome by increasing intakes that become toxic.

Homeostatic regulation involves the processes of absorption, storage and excretion. The relative importance of these three processes varies among the trace elements. The amount absorbed from the gastrointestinal (GI) tract often is the controlling mechanism for cationic trace elements such as copper, iron, and zinc. If the body is low in the trace element, the percent of the element absorbed from the GI tract is increased, and vice versa. Anionic trace elements such as boron, iodine and selenium are usually absorbed quite freely and completely from the gastrointestinal tract. Excretion through the urine, bile, sweat and breath is therefore the major mechanism for controlling the amount of these trace elements in the organism. Some trace elements are prevented from causing adverse reactions when present in high quantities by being stored at inactive sites (e.g., copper as metallothionein; iron as ferritin). Release of a trace element from storage forms also can be important in preventing deficiency.

Factors Affecting Trace Element Requirements

Although trace elements play key roles in a variety of processes necessary for life, the occurrence of overt simple or uncomplicated deficiencies of any of the trace elements is probably relatively uncommon because of the powerful homeostatic mechanisms which the human body possesses. However, there are situations which may make a trace element nutritionally significant. These include: 1) inborn errors of metabolism that affect absorption, retention, or excretion; 2) alterations in metabolism and/or biochemistry as a secondary consequence to malnutrition, disease, injury, or stress; 3) marginal deficiencies (slight deviation from an optimal intake of an essential nutrient) induced by various dietary manipulations or by direct or indirect interaction with another nutrient or drug; and 4) the enhanced requirement for a trace element caused by a sudden or severe change in the system requiring that element. The preceding probably can be summarized by the statement that the insufficient intake of a specific trace element would become obvious only when the body is stressed in some way that enhances the need, or interferes with the utilization, of that element.

Recently, Tapp and Natelson[1] presented the formula:

Pathological Effects = Stress x Organic Vulnerability

This formula seems quite applicable to trace element nutrition. In other words, pathological effects are not likely to be seen if a trace element deficiency (organic vulnerability) is not multiplied by some significant stress. Likewise, pathological effects are not likely to be large if stress is not accompanied by an organic vulnerability, or a lack of a trace element. However, the multiplication of a suboptimal intake of a specific trace element times the presence of some nutritional, metabolic, hormonal, or physiological stress affected by that element most likely would lead to serious pathological consequences.

The preceding concept is supported by the knowledge about the need for the established trace elements iron and zinc. Severe signs of iron deficiency most often occur when low dietary intake is combined with the stress of blood loss or rapid growth. Reports of zinc deficiency in humans usually are associated with a condition that enhances the need for zinc; these include rapid growth, malabsorption, inflammatory bowel disease, intestinal parasites, liver disease, renal disease, chronic inflammatory conditions and inborn metabolic errors.

Examining the possibility that other trace elements are of importance for humans under some form of stress has revealed several candidates of potential nutritional concern; these include arsenic, boron, chromium, copper, manganese, molybdenum, nickel, selenium, silicon and vanadium. This is demonstrated by findings with boron, which will be discussed most extensively here.

NUTRITIONAL SIGNIFICANCE OF BORON

Animal Studies

Seventy years after boron was first suggested to be essential for plants,[2] an experiment was done indicating that boron might be essential for chicks. Hunt and Nielsen[3] reported that boron deprivation depressed growth and elevated plasma alkaline phosphatase activity in chicks fed inadequate cholecalciferol. Subsequent experiments suggested that cholecalciferol deficiency enhanced the need for boron and that boron might interact with cholecalciferol metabolism, which in turn affected calcium, phosphorus, or magnesium metabolism.[4] After those experiments it was found that the response to changes in dietary boron is markedly influenced by dietary methionine, potassium, magnesium, cholecalciferol, aluminum, and calcium.[5,6,7,8,9] Generally, animal studies have shown that when the diet was manipulated to possibly cause changes incellular membrane integrity (potassium or magnesium deficiency) or in hormone responsiveness (magnesium or cholecalciferol deficiency, aluminum toxicity), a large number of responses to dietary boron occur. On the other hand, when the animal was fed a diet apparently optimal in all respects, the response to dietary boron was not very marked. These findings suggested that the need for boron was not crucial, or was quite low, when the animal was not under any nutritional or metabolic stress, but that there was an enhanced need for boron when the animal needed to respond to a stressful situation that adversely altered hormonal or cellular membrane status.

Studies with humans also indicate that boron may be of nutritional concern under certain metabolic or nutritional stressful situations, for example, with a low dietary intake of magnesium, or when hormonal changes occur (menopause) which causes an increased loss of calcium from bone. A study done with 12 postmenopausal women housed in a metabolic unit showed that dietary boron markedly affected several indices of mineral metabolism.[10] After the women had consumed a conventional diet supplying about 0.25 mg boron per day for 119 days, they were given a boron supplement of 3 mg per day for 48 days. Boron supplementation reduced the urinary excretion of calcium; the depression seemed more marked when dietary magnesium was low. Boron supplementation also elevated the serum concentrations of estradiol-17! and ionized calcium; the elevation seemed more marked in the magnesium-low women.

Recently, another study with five men over the age of 45, five postmenopausal women on estrogen therapy, four postmenopausal women not on estrogen therapy, and one premenopausal woman fed a magnesium-low diet (115 mg/2000 kcal) gave findings indicating that boron affects calcium metabolism.[11] After the subjects had consumed a conventional diet supplying about 0.23 mg boron per 2000 kcal for 63 days, they were given a boron supplement of 3 mg per day for 49 days. When compared between the last 42 days of depletion and the last 35 days of repletion, several indicators of calcium status were significantly different ($p < 0.05$). In each group of four or five, plasma ionized calcium was increased by the boron supplementation. When all 15 individuals were used in the comparisons, serum 25-hydroxycholecalciferol (29.1 vs 32.3 ng/ml) was lower, and serum calcitonin (74.1 vs 59.0 pg/ml), osteocalcin (3.41 vs 2.53 ng/ml), and glucose (93 vs 88 mg/dl) were higher during boron depletion than during boron repletion.

The subjects which were receiving estrogen therapy to prevent calcium loss from bone had the highest plasma ionized calcium and lowest serumosteocalcin. Boron supplementation after 63 days of boron depletion tended to make the values of the other two groups more like those of the women receiving estrogen therapy. These types of changes were the same for serum 25-hydroxycholecalciferol, calcitonin and glucose. Thus, the boron supplementation was construed as being beneficial to calcium metabolism. In other words, boron probably has an important role in the maintenance of normal bones. Moreover, this role becomes more apparent under conditions in which increased calcium loss from the bone is quite likely.

NUTRITIONAL SIGNIFICANCE OF OTHER TRACE ELEMENTS

Arsenic

Studies with rats, chicks, and hamsters have revealed that the nature and severity of the signs of arsenic deprivation are affected by several dietary manipulations, including variations in the concentrations of zinc, arginine, choline, methionine, taurine, and guanidoacetic acid, all of which can affect methyl-group metabolism[12,13] and thus polyaminesynthesis in which arsenic apparently has a role.[14] Most likely, arsenic is needed by humans. Furthermore, evidence for this need will probably be obtained under conditions in which lipid or methyl-group metabolism is stressed such that there is an enhanced need for arsenic.

Chromium

Chromium is another trace element whose need by humans apparently is influenced by nutritional or physiological stress. The dietary need for chromium seems to change when normal insulin-dependent metabolism of carbohydrate, protein and fat is upset. Stress, including trauma, infection, surgery, and intense heat or cold, elevates the secretion of hormones, which alters glucose metabolism and apparently affects chromium metabolism. In experimental animals, the stress of a low-protein diet, controlled exercise, acute blood loss, or infection aggravated the signs of depressed growth and survival caused by chromium-deficient diets.[15] In humans, severe trauma and exercise elevated the excretion of chromium in urine.[16]

Copper

Epidemiological studies and observations on experimental animals indicating that a low intake of dietary copper can adversely affect cardiovascular health, and affect the metabolism of some predictors of heart disease including plasma cholesterol[17,18] became of interest to nutritionists when it was found that many diets contain substantially less copper than was previously believed.[19] Apparently less than 25% of diets in the United States contain the 2 mg of copper thought to be required daily. However, attempts to produce signs of copper deficiency in adult humans have not yielded consistent changes in examined copper status indicators, e.g., plasma cholesterol. Milne and coworkers[20] fed eight men and eight women diets low in copper for periods ranging from 42 days to 120 days in four separate studies. Only one man showed definite signs of copper depletion similar to those observed in animals; the signs were significantly depressed plasma copper and erythrocyte superoxide dismutase, and increased plasma cholesterol.[20,21] Only two of the other men exhibited similar trends; however, the changes were not significant and were within the normal range. Two men also showed impaired glucose tolerance.[22] No changes in serum ceruloplasmin were found in the men.

In the one study with women, plasma copper, cholesterol, and erythrocyte superoxide dismutase were unaffected by the dietary copper manipulations. However, copper depletion depressed enzymatic ceruloplasmin and cytochrome-c oxidase in platelets and mononucleated white cells.[20]

Animal studies suggest that the inability to obtain consistent signs of copper deficiency in adult humans may be caused by factors of sex, genetic makeup, dietary sulfur amino acids, and dietary carbohydrate. For example, Fields and co-workers[23,24] have shown that fructose instead of starch as the dietary source of carbohydrate markedly increases the severity and extent of copper deficiency signs in rats. They[23,24] also reported that male Sprague-Dawley rats fed a copper-deficient high-fructose diet displayed anemia, hypertrophic hearts, and mortality; female rats fed the same diet did not. Nielsen[25,26] found that, with males, regardless of copper status, a supplement of 6 or 12 mg of methionine/g diet elevated plasma cholesterol. In these groups, copper deficiency did not cause a noteworthy additional increase in plasma cholesterol in the male Sprague-Dawley rats, but did cause an apparent increase in the male Long-Evans rats. On the other hand, copper deficiency did not elevate plasma cholesterol in male Long-Evans rats fed a supplement of 6 mg cystine/g diet. With the females, adding sulfur amino acids to the diet did not increase plasma cholesterol concentrations. Regardless of dietary sulfur amino acids, copper deficiency elevated plasma cholesterol concentrations in females.

Thus, copper is another trace element whose nutritional need is apparently markedly influenced by several nutritional, metabolic and physiologic factors. Most likely, the practical importance of copper in human nutrition will be established only after stressors which enhance the need for copper have been identified.

Manganese

The essentiality of manganese for various animal species is well established. Thus, it is surprising that an unequivocal case of manganese deficiency in humans has not been described. Manganese may be another trace element whose importance is manifested under special situations. There are a few manganese metalloenzymes; they include arginase, pyruvate carboxylase and manganese-superoxide dismutase. Perhaps stressing humans so that they have an enhanced need for one of these enzymes will be the situation which will show the nutritional importance of manganese. This suggestion is supported by findings which show that conditions causing the production of superoxide radicals, including exposure to hyperbaric oxygen, ozone, or ethanol, increases the activity of manganese superoxide dismutase in rats and monkeys.[27,28,29] Also, manganese-deficient rats are more susceptible to ethanol toxicity than normal rats[30]; ethanol toxicity increases superoxide production.

Molybdenum

A patient receiving prolonged parenteral nutrition therapy developed a syndrome described as acquired molybdenum deficiency. This syndrome, exacerbated by methionine administration, was characterized by hypermethioninemia, hypouricemia, hyperoxypurinemia, hypouricosuria and very low urinary sulfate excretion.[31] In addition, the patient suffered mental disturbances that progressed to coma. Supplementation of the patient with ammonium molybdate improved the clinical condition, reversed the sulfur handling defect, and normalized uric acid production. Thus, an excessive intake of methionine, or other situations requiring the enhanced activity of the molybdoenzyme sulfite oxidase, may be the stress which makes molybdenum nutrition of concern.

Epidemiologic findings have implicated molybdenum deficiency in the incidence of esophageal cancer in Africa, China, and Russia.[32] Cancer is often caused by xenobiotic compounds. The molybdoenzymes xanthine oxidase, aldehyde oxidase, and sulfite oxidase may be involved in the detoxification of xenobiotic compounds.[33] Possibly, humans stressed by an exposure to certain xenobiotics also have an enhanced need for molybdenum.

Nickel

Vitamin B-12 status was found to affect the response of methionine/methyl group-depleted rats to nickel deprivation.[34] An interaction between nickel and vitamin B-12 affected growth, kidney weight/body weight ratio, plasma concentrations of copper, iron and molybdenum, liver concentrations of calcium, copper, and molybdenum, and kidney concentrations of copper, manganese, and nickel. With almost all the variables affected by dietary nickel, the effects were influenced by vitamin B-12 status. With many of the variables, vitamin B-12 deprivation made, or tended to make, the nickel-supplemented rats essentially the same as the nickel-deprived rats. As a result, it was suggested that vitamin B-12 is necessary for the optimal expression of the biological role of nickel. Thus, the need for nickel by humans may become evident under situations in which one of the vitamin B12-dependent enzyme systems is functioning suboptimally.

Selenium

Selenium was first shown to be nutritionally important by using vitamin E-deficient animals.[35] Close examination of the data indicates that a very limited number of deficiency signs are caused exclusively by selenium deficiency; most signs are enhanced by the lack of either vitamin E or antioxidants.[36,37] Human diseases involving selenium apparently are not simple selenium deficiencies.[38] For example, it has been suggested that Keshan disease, which responds to selenium supplementation, also involves another factor. Suggested possibilities include various toxins, hypoxia, or infectious agents, particularly viruses.[39]

Silicon

Signs of silicon deficiency have not been described for humans. Nonetheless, the nature of the signs of silicon deficiency in animals has resulted in the speculation that the lack of silicon is involved in several human disorders, including atherosclerosis, osteoarthritis, and hypertension, as well as the aging process. Recently, findings have been obtained which suggest that silicon protects rats against aluminum-induced abnormal behavior.[40] The findings included that high dietary aluminum decreases the silicon content in selected regions of the brain, including those thought to be involved in Alzheimer's disease, and that brain aluminum content was elevated by aluminum supplementation of rats maintained on a low-silicon diet; no elevation occurred in rats maintained on a silicon-supplemented diet. Perhaps as humans age, the need for silicon increases, especially with unusual dietary habits such as the high consumption of aluminum.

Vanadium

Recently it was found that some haloperoxidases from red and brown algae[41,42] and from lichens[43]require vanadium to be active. In rats, it was found that as dietary iodine increased from 0 to 0.33 +g/g diet, thyroid peroxidase activity decreased, with the decrease more marked in vanadium-supplemented (38.1 to 12.3 units/mg protein) than vanadium-deprived (18.7 to 10.3 units/mg protein) rats.[44] Perhaps there is an enhanced need for vanadium in animals and humans with subnormal thyroid status.

STATUS OF TRACE ELEMENTS IN NUTRIENT DATABANKS

The preceding shows that an increasing number of studies have been performed to examine the importance of trace element nutriture with various forms of nutritional, metabolic, hormonal, or physiologic stress in animals and humans. These studies indicate that situations will be found in which a trace element is of nutritional significance. Thus, many of the elements described in the preceding should be considered as desirable inclusions in nutrient data banks. However, at present, trace element data in nutrient data banks are quite limited. Of the elements discussed, the USDA Standard Reference Tape or the Revised Handbook No. 8 series includes food composition data only for iron, zinc, copper and manganese. The revision of Handbook No. 8 is still incomplete and the 1963 Handbook No. 8 did not list zinc, copper or manganese (also magnesium) in foods. Thus, values for these nutrients are not available on the USDA Standard Reference tape for food groups that remain to be released; these foods include lamb, snacks, sweets and baked products. Furthermore, copper and manganese were late additions to the nutrients included in the Handbook No. 8 revision. As a result copper is missing from the first two sections, and manganese did not appear until the 5th section of the revision.

Other major nutrient databases released to the public which include trace element values include the Continuing Survey of Food Intake by Individuals (CSFII), release 2.1, and McCance and Widdowson's *The Composition of Foods*;[45] both of these sources contain values for copper and zinc (and magnesium). Although these nutrient databases can be used to fill holes in the USDA Standard Reference Tape, this proves to be a difficult task. Food descriptions rarely match exactly, thus the nutrient database manager is faced with imputing values for foods described more specifically, less specifically, or merely similar to a food for which data are available. If the imputing has not been done conservatively, with a sound basis and with a flag to identify values as imputed, the "complete" hole-free nutrient database may be less valuable than the original incomplete one. By imputing data, several private nutrient databases have developed "complete" data for several trace elements which are not complete on the USDA Standard Reference Tape. However, the quality of this "complete" data depends upon the specific procedures used for imputing.

The only other sources of information about trace elements beyond the major nutrient databases are literature reports which contain a limited number of foods -- from a few to about 200. Some of this literature can be useful for roughly evaluating whole diets, if the literature includes both foods highly concentrated in the element of interest and foods which supply substantial amounts of the element because they are widely consumed. An example of a report which may allow a rough evaluation of whole diets is that by Pennington et al.[46] This report lists the trace elements iron, zinc, copper, manganese and selenium contained in 234 foods in the FDA total diet study. The foods in this study were sampled to be geographically representative for the United States. This report provides copper, manganese and selenium (and iodine) data not available from the USDA Standard Reference Tape, and for enough representative foods that contents of total diets can be estimated.

Schubert, et al.,[47] compiled data from other primary sources, systematically evaluated for quality, on the selenium contents of 114 foods chosen for selenium concentration and frequency of consumption in the USDA 1977-78 Nationwide Food Consumption Survey. Because this foodlist is intended to include all significant sources of selenium in the U.S. diet, it also can be useful for estimating the selenium contents of whole diets. A group of Finnish scientists issued a report[48] which may allow a rough evaluation of the trace elements molybdenum, nickel, chromium, selenium, silicon, boron, and arsenic in whole diets. Two reports which provide the vanadium content of a limited number of foods, but which would be less useful for evaluating diets are those by Pennington and Jones,[49] and by Byrne and Kosta.[50]

It should be recognized that using these abbreviated food lists to estimate the trace element contents of diets involves extensive approximations comparable to inputing values into a large database. Although working with condensed food lists involves substantial approximations, this process is still more desirable than trying to estimate the trace element contents of diets using a variety of publications listing only a few foods. These reports may vary widely in analytical methods, sample handling, sampling plans, and analytical quality control. Generally, for the trace elements arsenic, boron, nickel, silicon, vanadium, chromium, and selenium, food composition values published before 1975 should be viewed with a great suspicion or distrust. Even today, methods to determine accurately the concentration of some trace elements in biological material are still being developed, e.g. boron and vanadium. Thus, even recent publications indicating the content of some trace elements in foods can be accepted only with caution.

Basically, the preceding discussion should indicate that, except for a few major trace elements, only sparse data of uncertain reliability are available to evaluate the dietary content of trace elements emerging as important in human nutrition. The data for some of these trace elements, especially boron, chromium and selenium, are likely to be in great demand by nutrient databank users in the near future. Thus, the theme of this conference "A decade of progress meets a decade of challenge" seems quite appropriate for the trace elements. Although some progress has been made in recognizing the importance of trace elements in nutrition to the point that some are included in major nutrient databases, a major challenge lies ahead. More trace element data is needed. Nutrient databank managers are going to become vividly aware that trace elements other than copper, iron and zinc are important in human nutrition.

REFERENCES

1. Tapp, W.N., Natelson, B.H. *Faseb J.* 2 (1988): 2268.

2. Agulhon, H. *Ann. Inst. Pasteur* 34 (1910): 321.

3. Hunt, C.D., Nielsen, F.H. (1981), *Trace Element Metabolism in Man and Animals,* Vol. 4, McC. Howell, J., Gawthorne, J.M., White, C.L., eds., Australian Academy of Science, Canberra, Australia, pp. 597-600.

4. Hunt, C.D., Shuler, T.R., Nielsen, F.H. (1983), *4: Spurenelement Symposium*, Anke, M., Baumann, W., Braunlich, H.E., Bruckner, C., eds., Karl-Marx Univ. and Friedrich-Schiller Univ., Liepzig and Jena, D.D.R., pp. 149-155.

5. Nielsen, F.H., Shuler, T.R., Zimmerman, T.J., Uthus, E.O. *Biol. Trace Element Res.* 17 (1988): 91.

6. Nielsen, F.H., Shuler, T.R., Zimmerman, T.J., Uthus, E.O. *Magnesium*, 7 (1988): 133.

7. Nielsen, F.H., Zimmerman, T.J., Shuler, T.R. *Proc. N.D. Acad. Sci.* 42 (1988): 61.

8. Hunt, C.D., Nielsen, F.H. *Proc. N.D. Acad. Sci.* 41 (1987): 50.

9. Shuler, T.R., Nielsen, F.H. *Proc. N.D. Acad. Sci.* 41 (1987): 49.

10. Nielsen, F.H., Hunt, C.D., Mullen, L.M., Hunt, J.R. *FASEB J* 1 (1987): 394.

11. Nielsen, F.H. *FASEB J* 3 (1989): A760.

12. Nielsen, F.H., Uthus, E.O. (1984) *Biochemistry of the Essential Ultratrace Elements,* Frieden, E., ed., Plenum, New York, NY, pp. 319-340.

13. Nielsen, F.H. (1988), *Essential and Toxic Elements in Human Health and Disease,* Prasad, A., ed., Alan R. Liss, New York, NY, pp. 277-292.

14. Uthus, E.O., Poellot, R., Brossart, B., Nielsen, F.H. *FASEB J* 3 (1989): A1072.

15. Mertz, W., Roginski, E.E. *J. Nutr.* 97 (1969): 531.

16. Borel, J.S., Anderson, R.A. (1984), *Biochemistry of the Essential Ultratrace Elements,* Frieden, E., ed., Plenum, New York, NY, pp. 175-199.

17. Klevay, L.M. (1984) *Metabolism of Trace Metals in Man,* Rennert, O.M., Chan, W.-Y., eds., CRC Press, Boca Raton, FL, pp. 129-157.

18. Klevay, L.M. *Med. Hypotheses* 24 (1987): 111.

19. Klevay, L.M. (1982), *Inflammatory Diseases and Copper,* Sorenson, J.R.J., ed., Humana, Clifton, NJ, pp. 123-136.

20. Milne, D.B., Klevay, L.M., Hunt, J.R. *Trace Element Metabolism in Man and Animals,* Vol. 6 (1989) (in press).

21. Klevay, L.M., Inman, L., Johnson, L.K., Lawler, M., Mahalko, J.R., Milne, D.B., Lukaski, H.C., Bolonchuk, W., Sandstead, H.H. *Metabolism* 33 (1984): 1112.

22. Klevay, L.M., Canfield, W.K., Gallagher, S.K., Henriksen, L.K., Lukaski, H.C., Bolonchuk, W., Johnson, L.K., Milne, D.B., Sandstead, H.H. *Nutr Rpts Int.* 33 (1986): 371.

23. Fields, M., Lewis, C., Scholfield, D.J., Powell, A.S., Rose, A.J., Reiser, S., Smith, J.C. *Proc. Soc. Exp. Biol. Med.* 183 (1986): 145.

24. Fields, M., Lewis, C.G., Beal, T., Scholfield, D., Patterson, K., Smith, J.C., Reiser, S. *Proc. Soc. Exp. Biol. Med.* 186 (1987): 183.

25. Nielsen, F.H. *J. Trace Elements Exp. Med.* 1 (1988): 157.

26. Nielsen, F.H. *FASEB J.* 2 (1988): A1422.

27. Dreosti, I.E., Manuel, S.J., Buckley, R.A. *Br. J. Nutr.* 48 (1983): 205.

28. Dubick, M.A., Keen, C.L. *Toxicol. Lett.* 17 (1983): 355.

29. Keen, C.L., Tamura, T., Lonnerdal, B., Hurley, L.S., Halsted, C.H. *Am. J. Clin. Nutr.* 35 (1983): 836.

30. Zidenberg-Cherr, S., Hurley, L.S., Lonnerdal, B., Keen, C.L. *J. Nutr.* 115 (1985): 460.

31. Abumrad, N., Schneider, A.J., Steel, D., Rogers, L.S. *Am J. Clin. Nutr.* 34 (1981): 2551.

32. Luo, X.M., Wei, H.J., Yang, S.P. *J. Nat. Can. Inst.* 71 (1983): 75.

33. Rajagopalan, K.V. (1980), *Enzymatic Basis for Detoxification,* Vol. 1, Jacoby, W.B. ed., Academic Press, New York, NY, pp. 295-309.

34. Nielsen, F.H., Zimmeramn, T.J., Shuler, T.R., Brossart, B., Uthus, E.O. (1989), *J. Trace Elements Exp. Med.* (in press).

35. Schwarz, K., Foltz, C.M. *J. Amer. Chem Soc.* 79 (1957): 3292.

36. Shamberger, R.J. (1984), *Biochemistry of the Essential Ultratrace Elements*, Frieden, E., ed., Plenum, New York, pp. 201-237.

37. Levander, O.A. (1986), *Trace Elements in Human and Animal Nutrition,* 5th ed. Mertz, W., ed., Academic Press, Orlando, FL, pp. 209-279.

38. Levander, O.A. *Annu. Rev. Nutr.* 7 (1987): 727.

39. Yang, G. Chen, J., Wen, Z, Ge, K., Zhu, L., Chen, X., Chen, X. *Adv. Nutr. Res.* 6 (1984): 203.

40. Carlisle, E.M., Curran, M.J. *Alzheimer Dis. Associat. Disord.* 1 (1987): 83.

41. Vilter, H. *Phytochem.* 23 (1984): 1387.

42. Krenn, B.E., Plat, H., Wever, R. *Biochem. Biophys. Acta.* 912 (187): 287.

43. Plat, H., Krenn, B.E., Wever, R. *Biochem. J.* 248 (1987): 277.

44. Uthus, E.O., Nielsen, F.H. *FASEB J.* 2 (1988): A841.

45. Paul, A.A., Southgate, D.A.T. (1978), *McCance and Widdowson's The Composition of Foods,* Elsevier/North Holland Biomedical Press, New York.

46. Pennington, J.A., Young, B.E., Wilson, D.B., Johnson, R.D., Vanderveen, J.E. *J. Am. Dietet. Assoc.* 86 (1986): 876.

47. Schubret, A., Holden, J.M., Wolf, W.R. *J. Am. Dietet. Assoc.* 87 (1987): 285.

48. *Acta Agriculturae Scandinavica. Suppl. 22* (1980).

49. Pennington, J.A.T., Jones, J.W. *J. Am. Dietet. Assoc.* 87 (1987): 1644.

50. Byrne, A.R., Kosta, L. *Sci. Tot. Environ.* 10 (1978): 17.

FOOD LABELING: NUTRIENT DESCRIPTORS, CLAIMS, AND OTHER INITIATIVES

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One of the Food and Drug Administration's (FDA's) current priorities is to foster good nutrition on a wider scale than previously. This is a challenge since knowledge of many nutrition issues is in flux although consumer interest is growing. To respond to consumer interest, we must find the best way to communicate current scientific knowledge to the public; food labels are a primary means by which we communicate.

For a brief historical overview, I will begin in 1969 when President Nixon called a White House Conference on Food, Nutrition, and Health to develop a national policy aimed at: 1) eliminating hunger and malnutrition due to poverty, and 2) improving the nutritional health of all Americans. Following the conference's recommendations, FDA implemented several significant initiatives, chief among them nutrition labeling and full ingredient labeling.

Nutrition labeling is required only if a food product makes a nutritional claim, such as "low calories" or "contains vitamin C" or when the food is enriched or fortified. Currently, over 55% of food labels carry nutrition labeling. On the actual label, the manufacturer must declare what is a serving size of the product, how many calories are in that serving, plus the amount of protein, carbohydrate, fat and sodium in that serving. That information is followed by the percentage of the U.S. Recommended Dietary Allowance (RDA) of protein, vitamins A and C, thiamine, riboflavin, niacin, calcium, and iron. The U.S. RDA's were developed by FDA to simplify the RDA into one set of values that could be used for all food labels (except those for infants and children less than 4 years of age). Manufacturers are given the option of listing other vitamins and minerals if they contribute at least 2% of the U.S. RDA. Also, fatty acids and cholesterol may be added under the fat designation.

These requirements satisfied most people's interest in nutrient information on foods for several years. However, consumer interest in nutrition and health increased dramatically subsequently. This interest has been fueled by many advances in nutrition science and education. Chief among them are: 1) *The Dietary Guidelines for Americans,* 2) *The Surgeon General's Report on Nutrition and Health*, and 3) The National Research Council's report entitled: *Diet and Health, Implications for Reducing Chronic Disease.*

For the past 10 - 15 years, a striking increase has occurred in consumers' perceptions of the health benefits to be gained through reducing certain food components to lower the risk of chronic diseases. The public is rapidly assimilating the idea that excessive dietary fats and cholesterol are bad for health. Manufacturers, eager to benefit from consumers' interest in diet and health issues, are taking an active role in developing new food products, or new marketing strategies for older well-established products, that highlight beneficial attributes of the foods.

To this end, the use of what we call "adjectival descriptors" has increased greatly in the past few years. These "adjectival descriptors" used in labeling or advertising describe the products by terms such as "low," "very low," "free," or "reduced" -- referring to the levels of calories, sodium, fat, cholesterol, or other components.

Such descriptors can certainly be of major value to consumers who, either on medical advice or on their own initiative, wish to modify their diets. However, FDA has been concerned over the use of such descriptors without precisely and quantitatively defining the terms so that they are understood by everyone, and used consistently across the market place. Accordingly, past regulatory action has been taken to define the terms. In 1978, after a lengthy public rule-making process which included public hearings, descriptors relating to calories were defined.

"Low calorie" foods were defined as foods containing 40 or less calories per serving and 0.4 or less calories per gram. Reduced calorie foods were defined as foods having a caloric reduction of at least 1/3 which are otherwise nutritionally equivalent to the foods for which they substitute. The label for such foods must describe the comparison upon which the claim is made, including the calorie content of the food and that of the food for which it substitutes.

Final regulations governing sodium descriptors were published in 1984. These define "Sodium free" as "less than 5 mg sodium/serving", "very low sodium" is defined as "35 mg or less per serving", and "low sodium" as "140 mg or less/serving." "Reduced sodium" was defined as a reduction of at least 75% from the original product. A statement of comparison is required on the label.

Most recently, FDA published a proposed rule in November 1986 to define "cholesterol free," "low cholesterol," and "reduced cholesterol" and to make other revisions to current fat and cholesterol labeling rules.

The proposal defines "Cholesterol Free" as "less than 2 mg/serving". It defines "Low Cholesterol" as less than 20 mg/serving, and "reduced cholesterol" as a reduction in cholesterol of 75% or more from the food it resembles in organoleptic properties and for which it substitutes. For foods which cannot achieve a 75% reduction, yet have a substantial reduction from a reference food, it was proposed that comparative claims be allowed, provided that the label of such foods bears clear and concise quantitative information concerning the extent that the cholesterol was reduced, comparing the product's cholesterol content per serving with that of the food it replaces.

The goal of these actions is to assist the consumer in identifying the amount of fatty acids and cholesterol in foods. Thus, naturally, nutrition labeling will be required whenever such claims are made. Also, label declaration of either fatty acid or cholesterol content would require declaration of both. FDA feels strongly that it is misleading to declare one without the other, since the two are inter-related as causative factors in heart disease. The one exception to this rule is that fatty acid information will not be required on foods that do not contain enough fat to influence total intake of fatty acids. FDA has defined such low fat foods as any food that contains less than 2 g fat/serving or less than 10% fat on a dry weight basis. Therefore, with the exception of these low fat foods, food product labels which make a cholesterol claim must declare saturated and polyunsaturated fatty acid content.

Many comments were received to the proposed cholesterol rule that touched on issues outside of the rule. For instance, several commentors suggested that FDA develop similar adjectival descriptors relating to fat ("fat free," "low fat") and to fatty acids. In light of the dietary recommendations to lower fat intake, FDA agrees with the need for such terminology and has begun to develop a proposed rule to address such descriptors.

The calorie, sodium, and cholesterol labeling rules address simple truthful statements about the content of the food, such as "low calorie" or "low sodium" claims. These claims, or adjectival descriptors, make no statement about the ramifications of the nutritional characteristics of the food to health. In fact, FDA policy has in the past prohibited any explicit discussion of disease or health on food labels. FDA had enforced this policy by charging that a food so labeled was either a misbranded food or an illegal drug.

Faced with increasing interest on the part of industry and some nutrition educators to use the food label to convey health-related information to consumers, and faced with an increasing scientific database linking diet and disease, FDA opted to modify our long-standing policy in such a way as to permit appropriate health messages without opening the door to misleading, or outright fraudulent, claims. In August, 1987, FDA issued proposed regulations which would allow health-related claims or information to be placed on food labels if the messages are appropriately formulated for use on labels and are consistent with existing law and regulations.

As stated in the regulation, "Information on a food label representing, suggesting, or implying a food is adequate or effective in the prevention, cure, mitigation, or treatment of any disease or symptom will be deemed to be misbranded unless it complies with the criteria for health messages." The following criteria were proposed:

1) Information on food labeling should be educational in nature and limited to a discussion of the relationship between nutrition and health.

2) Information should be based on, and be consistent with, widely accepted, well-substantiated, peer-reviewed scientific data (including data derived from clinical studies) and generally recognized medical and nutritional principles.

3) The information must emphasize the importance of a total dietary pattern.

4) Information on food labeling must not overemphasize or distort the role of a food in enhancing good health. No one food will cure, or cause, a disease.

A draft of the final health claims rule was sent to the Office of Management and Budget last fall for policy review. It has not yet been released.

Another initiative is shelf labeling of foods. These in-store nutrition programs have been developed by many supermarkets to take advantage of shopping as an opportunity to communicate nutrition information to consumers. These programs have provided nutrition information through displays, posters, flyers, or shelf cards or tags. These labels are considered by FDA as an extension of food labeling, and therefore must use these definitions I've discussed earlier for calorie and sodium claims.

The same holds true for cholesterol claims; however, in the case of fat, definitions have not been developed by public rulemaking. Therefore, we have worked with many grocery chains to arrive at the following definitions for shelf labeling purposes: 1) Low fat = less than 2 g fat/serving and less than 10% fat on a dry weight basis, and 2) Reduced fat = a reduction of 50% or greater. If a company wants to make claims about fatty acids, they are to calculate polyunsaturated fatty acids as the sum of all cis-cis-methylene interrupted fatty acids, and saturated fatty acids as the sum of lauric, myristic, palmitic and stearic fatty acids.

Additionally, if fiber claims are desired, the shelf labeling program may claim that a product is a "fair" source if it contains 2 g fiber/serving, a "good" source if it contains 5 g/serving, and an "excellent" source if it contains 8 g/serving. Other nutrients for which there are U.S. RDAs may claim to be a source of that nutrient if they furnish 10% of the U.S. RDA, a "Good" source if they furnish 25% and an "excellent" source if they furnish 40% or more of the U.S. RDA.

Until these varied initiatives are completed, FDA would like to urge industry and consumers to make better use of the quantitative information within the nutrition label. The quantitative information is the most important factual information needed by the consumer. The use of this information will keep us out of the Good Food/Bad Food dichotomy that is so futile. Consumers must be made aware of the importance of the total diet rather than misplaced emphasis on particular foods. Only by having nutrition labeling on as many food products as possible, and by educating consumers on how to properly use this nutrient information, will consumers have a chance to sort through competing health messages and label claims to be able to select a diet with which they are satisfied and which will fulfill their nutritional needs.

INDUSTRY PERSPECTIVES ON FOOD LABELING

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Nutritional labeling impacts many segments of the population, including government, industry, consumers and educators. Each of these groups are interested in what goes on the food label. I will give you the industry perspective on nutritional labeling. We in industry are faced with congressional bills being introduced that control what can be included on the product label and with the issuance of dietary recommendations we feel we should respond with information on our food labels.

To give you a quick summary of what has happened in the last year or so in the industry, I will briefly describe some of the issues that we have debated among ourselves. It is important for you to understand that industry groups are often like children in a large family -- we do not always agree with one another. We have our own ideas, and our own likes and dislikes; so to get 15 or 16 major industries together to agree on an issue as important as nutritional labeling is very difficult. Table 1 lists some of the common issues which we have debated; that we consider must be discussed before we can agree on a common format for product labels. This list gives only 16 of the 50 or so that were debated in a recent meeting in Washington, D.C.

The key issue we debated among ourselves was: "Should nutritional labeling be mandatory or voluntary." Right now it is on a voluntary basis, except that a nutritional label becomes mandatory when a nutritional claim is made. However, more and more industries are coming to realize that providing product information for consumers is important and are beginning to accept the idea of mandatory nutritional labeling which is advocated by Campbell Soup Company.

The other issue that we have to wrestle with is that we have differing regulations from different regulatory agencies. This is something that other speakers at his conference have alluded to . There currently is a task force working to resolve differences between USDA and FDA regulations. Just to give you an example: currently under FDA regulations if you label, sodium is part of the mandatory labeling, however under USDA regulation you do not always have to put sodium on the nutritional label. USDA gives you the option, with them it is not mandatory.

Another issue we are facing is lack of consistency with use of the word "reduced". FDA requires "reduced" to be a 75% reduction. In USDA products it may be a 25% reduction. If you have a product line with a split between USDA products and FDA products, you might have a situation where half of the product line can be described as reduced, but the other half cannot. Those differences need to be resolved.

Another issue that plagues industry is how to reduce the complexity of the label information. Those of us in industry have done considerable consumer testing. Generally consumers do not understand the way information is currently expressed in the label. For example, the information on a LeMenu Frozen Product label is presented as facts, or as numbers. Being facetious, I would like to describe the label as schizophrenic. If you look at the top, which is what we call the "macro nutrient" labeling, you will find information on serving size which can be expressed in ounces, or grams, or in units. Next energy is expressed in calories, and protein, fats and so on are in grams. Then we show electrolytes, sodium and potassium, in milligrams. You may have percent of calories from fat, then you would have a percentage. Finally the vitamins and minerals are in percent USRDA. Those of us in the professional arena have a hard time keeping track of both the metric system and customary system of weights and in distinguishing between the NAS RDA and the USRDA. One of the problems we are finding is that the consumer simply does not understand the different kinds of information provided. The issue becomes "How can the consumer make use of this information -- And get something meaningful out of it?"

Another issue is that nutrition information is mostly in English. We have areas of the US where the population is mostly Hispanic. The nutritional information is not available to those individuals in their native language. Many of you will also realize that the type-size of labels make it impossible to read if you need bifocals, I for one have difficulty in reading numbers on some labels. One thing I do routinely is review labels for type size because as I get older it gets more and more impossible to read small print. We are cramming more and more information onto the label and hoping the consumer can read and understand them. We have an aging population, and these things need to be taken into consideration as we review the nutrition label issue.

Regulatory authority is becoming an issue as both federal and state agencies issue regulations. There are some states that want some say in what goes on food labels. The food industry is faced with conflicting federal regulations and now some states want to regulate labeling. There must be a resolution in the form of uniformity of regulations for food labels.

In designing a label one of the first things we ask ourselves is "What is the label supposed to be used for?" There is considerable information on the label, and we must design it carefully to ensure that the information is useful. We have considered several design proposals for our labels. If the label is supposed to reflect food composition information, then all that is needed is the content of the food and the ingredients. Now if we want to add one extra layer on top of that and say, "We want it to have a nutrition education component" then we have a different expectation for the label. And this is exactly what I foresee because nutritional trends and nutritional concerns change frequently. You may have a label that will change often in terms of nutrient emphasis. Is that what a label should be? I think not.

In the food industry we should not be emphasizing what I call "Hot Buttons" of nutrition. If the label is meant to reflect the key concerns in terms of diseases, it would address chronic diseases which currently are the key nutritional concern in this country. With chronic diseases we are worried about fat, cholesterol, and saturated fat. If emphasis is placed on these nutrients at the expenses of other nutrients such as the B vitamins, then the label will be in a constant state of flux. I do not think that is what good nutrition education is about, and I do not think that is the information we want to give to our consumer.

The next question that we raise is "What should be on the label?" We have right now 12 to 14 nutrients that are mandatory nutrients, and other nutrients are optional. One of the things we at Campbell Soup did to help us understand what should be on the label when we have the chance to revamp the label, was participate in a workshop held jointly by Public Voice and FMI in Washington in the Spring of 1989. This workshop included working groups of government agencies, food industries, and consumer activist groups. Table 1 summarizes issues identified and proposals discussed at the workshop.

The government's recommendation was that there should be basically three kinds of information on the label. First, what they called the core information consisting of nutrients listed in Table 2. Many of these nutrients are already on the label. One thing I noticed is that the B vitamins are not included in the core nutrients with this proposal. Second, extra information was added onto the list of ingredients such as fat source and percentages for ingredients. The third recommendation was for adjectival descriptors such as "low", "reduced", and so forth. When the industrial group was asked "What do you think labels should include?" the response was that core nutrients are important, but they should be given options in terms of other vitamins and minerals.

When consumer groups were asked what kind of information needs to be put on the label, the overwhelming response was fat, sodium, and cholesterol, information related to chronic diseases. So we have three different groups, with three different agendas. We need to be sure the three groups are joined together.

The other issue we must ask ourselves, and this is perhaps the most important issue (after we decide what label is going to be used for and what should be on the label) is "How should the information be expressed?" I think that is one of the most difficult problems we are encountering. We do not know the best way to convey information to the consumer on the food label. Several of the options we talked about are whether we should express this in terms of numbers, of text, or of numbers and text. Should it be a stop and go kind of indicator to show whether this product contains this and that. If we do the latter, we run into a situation of trying to define a food as a "good" food or "bad" food, and that is not good nutrition science.

One of the things we have tried at Campbell Soup is to experiment with several options for conveying nutrition information on the label and I can tell you it is very difficult. We will not know what the solution is without a massive consumer study. On trial labels we have provided the information currently required by regulation and then to highlight some of the key nutrients that were emphasized in the dietary guidelines: namely fats, calories, sodium, and cholesterol. Then we attempted to relate these to what should be the total day's intake of these components. We are giving the total fat in the product, but what consumers are asking us is "How much fat do I need?" and "How much sodium do I need?" We give the vitamin and mineral requirement by expressing them as percent USRDA, but when it comes to the macro nutrients, we do not offer any guidance. The consumer must set their own standards. So what we tried to do, at least for the macro nutrients, is to highlight some of the key nutrients that are expressed in the US Dietary Guidelines. We are in the process of evaluating to see whether this extra description is helpful. We won't have the results for another six months or so.

Another attempt we made at developing understandable labels is to depict information based on charts and histograms, again relating it to the total day's intake. But, this is not easy information. These graphics may be useful in signs, but when we show it to informal groups of consumers they have problems figuring out where the bars should be, where the 100% bar is, and so forth.

We concluded that bars are difficult, so we took off the bars and tried columns of numbers next to each other, that show what you need in terms of fat. Next to the grams of fat for that product we show how much fat is needed per day based on a 2000 or 2700 calories diet, projected to 30% fat. We did the calculation and put it on the label and asked "What do you think?" Well, it was a little better but it was still confusing to our informal consumer group.

One of the key things that is coming out of our testing, is that there is a knowledge gap. We need to follow nutrition labeling with extensive nutrition education materials. The consumer must understand the label information if they are to make intelligent purchasing and food selection choices, and make choices in terms of menu planning.

Since bars did not work we decided to try pie charts. This was the suggestion from the business section. Pie charts work well in business; pie charts are simple and easy. But when we tried them on food labels they didn't work. It got the worst rating of all the labels. So if you are considering pie charts, don't. They do not work.

This gives you some sense of what is happening in the food industry. There is a lot of debate concerning product labeling. This is something the food industry must come to grips with. Considering enacted legislation and new congressional bills being introduced, sooner or later there is going to be mandatory labeling.

At Campbells we believe that all food products should be labeled, not just on a voluntary basis, but on a mandatory basis. We believe the consumer has a right to know what is in the products they buy. Every product should bear food composition information because that is the only basis the consumer has for making comparisons.

For mandatory labeling to be effective you need to have an aggressive educational program. We at Campbells feel very strongly that nutrition labeling must be clear and relevant....and uniform across the country. If the consumer is entitled to information they should have information that is understandable, and pertinent. To help the consumer use the information there needs to be a broad based, comprehensive nutrition education program, national in scope and conducted at many levels.

And finally all segments of the food industry need to put aside their differences and rally around this educational effort to give it momentum. One of the things the food industry fears most is change. We at Campbells have taken the leadership role in voluntary nutritional labeling of all our products since the early 1970's. We spearheaded sodium labeling for soup categories in the 1980's. We feel that our willingness to provide the consumer with information needed to make buying decisions has given us increased credibility with the consumer. But sometimes we are penalized for this leadership. Sometimes the consumer looks at this information and concludes from our nutrition label, that we provide voluntarily, that our products are unsatisfactory for one reason or another. Then they decide to buy another brand which chooses not to nutrition label, because they think the unlabeled product might be lower. But of course if you are the leader in any new idea or project, people like to feature you because you are so highly visible, so that in the long run the benefits far outweigh the negative aspects of full nutritional labeling, and more importantly it benefits the consumer.

We feel very strongly that nutrition labels can be an important component of nutrition education. The nutrition label has the power of penetration that most other nutrition education materials do not have. Many food products have very high penetration in the household. For example, soup is about a 99% household penetration. Approximately 5 billion cans of soup are made each year. If you used this label for carrying a particular nutrition message, you could very easily penetrate that message into a very large number of households within a year. We did a little experiment with V-8 juice label. We offered to the consumer a copy of the dietary guidelines. I had to enlarge this label 5 times to show the offer to a small group. It was a very tiny blurb on the label. I told our marketing section to just print 15,000 copies of the dietary guidelines, as I was sure no one would see it and there would be very little response. In two months we had 12,000 requests. It amazes me how powerful the label could be to provide nutrition information. In two months we were able to distribute 12,000 copies of the US Dietary Guidelines from a juice label. Can you imagine what you can do with 5 billion cans of soup?

The nutrition message is important and there should be greater emphasis on nutrition education in the elementary and secondary schools, and in the medical schools. The federal government and the states need to support this activity. Nutrition plays an important part in health, and in a day and age when increasing concern is expressed about health and fitness by our young people, nutrition education becomes more and more important. Nutrition education should be part of nutrition labeling or the labeling will not benefit the consumer. We at Campbell Soup are trying to promote a major national commitment to nutrition education. Some of you may remember that after the Russians beat us into space with Sputnik, we mounted a massive effort to upgrade science in our schools. I hope that is not the kind of crises we must have to get nutrition education rolling in this country. Fitness is popular with the public. People are making serious efforts to achieve fitness. Our nutrition education message should tie into this popular movement. To be successful with nutrition education we need a joint effort. We need industry, the government, the consumer, and academicians to work together to achieve nutrition awareness and better nutritional intake. Somehow in the United States we never have the opportunity to have different groups work harmoniously together. In Europe and in Canada there seems to be much more harmony as far as these groups working together. In order for nutrition labeling to provide the consumer with useful nutrition education we must work together as a group.

Table 1. Common concerns of industry groups about nutritional labels on food products.

- Voluntary VS mandatory labeling
- Purpose of the label
- Labeling regulation inconsistencies among Federal Agencies (USDA/FDA)
- Balance science with consumer needs
- User friendly format and uniformity
- Type size
- Complexity of information
- Satisfy special needs (Non-English, older, etc)
- Economic value of nutrition labeling
- Competitive nature of label information
- The 60% of foods not labeled (Meat, Bakery, Deli, Fresh Produce)
- Lack of consistent label education program
- Labeling important for implementing public health goals
- Information Overload

Source: Public Voice, FMI Conference, 1989

Table 2. What should be on the nutrition label?

Government	Industry	Consumer
CORE NUTRIENTS		
Serving size	X	X
Calories	X	
Protein (g, %USRDA)	X	
Fat (g, % Kcal)	X	X
Saturated fat	X	X
Cholesterol	X	X
Fiber	X	X
Carbohydrate	X	
Sodium	X	X
Sugar	Op	X
Calcium	Op	
Iron	Op	
Vitamin A	Op	
Vitamin C	Op	
INGREDIENT		
Fat source	X	
Fats (and/or)	X	
Percent of ingredients		
Symbols for formulation change		
Adjectival Descriptors		
Low, Reduced, Natural	X	

Op = optional

Source: Public Voice/FMI Conference, 1989

IMPUTING NUTRIENT VALUES FROM MANUFACTURERS' DATA

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Brand Name Foods in the American Diet

Brand name food products are becoming an increasingly important part of nutrient databases. With over 20,000 brand name food products on the shelves in a typical supermarket[1] and over 8000 new food items introduced to consumers in 1988,[2] brand name foods have become an integral and expanding part of the American diet. Participants in dietary intake studies routinely report food choices by brand name rather than by generic description -- such as "Cheerios," rather than "ready-to-eat oat cereal rings." Therefore, it is necessary for a nutrient database that is used for research studies to include brand name products either within the database itself or with guides that link brand name foods to database entries.

The NCC Nutrient Database

The Nutrition Coordinating Center (NCC) at the University of Minnesota maintains a nutrient database that consists of 94 nutrient fields and approximately 2000 food entries. Although only 300 of these entries are based directly on commercial products, many thousands of products can be coded using the basic 2000 database entries. This is possible through the use of brand name coding guides which will be described later. A database of this size allows NCC to update with new nutrient values or add nutrient fields more completely and easily than could be done with a larger database. In an average month, approximately 500 data changes are made in the NCC database, either as updated or additional nutrient values or non-nutrient information (e.g., food densities, common serving amounts).

Obtaining Manufacturers' Information

To obtain updated nutrient and ingredient information for commercial products, over 350 food manufacturers are contacted each year. Information about foods already in the system, as well as about new products, is requested. The data that are obtained from manufacturers come in many forms. Some provide an extensive list of nutrient values, ingredient lists, densities and preparation instructions (Figure 1). Others provide the minimal number of nutrient values used for label declarations (Figure 2). Regardless of the type of data received, each piece of manufacturer's information is useful in determining how to code the product and ultimately provide it with values for the 94 nutrient fields in the database. Other sources of brand name information are product labels, scientific journals, popular magazines and newspaper articles.

Imputing Nutrient Values

Because manufacturers do not provide values for all 94 nutrient fields for their food products, NCC nutritionists use several procedures to impute missing values from manufacturers' information. Missing nutrient values are imputed to provide a reasonable estimate of the nutrient content, rather than leaving a gap in the database which would be calculated as a zero in the analyses of nutrient intakes. Values generally are imputed from one of the following sources of nutrient data: a similar food; another form of the same food, such as converting from raw to cooked values using retention factors; a known nutrient value that is associated with the missing nutrient; or recipes or formulations. Figure 3 shows the number of imputed values in each nutrient field in the NCC database and the percentage of missing values. Eighty-three of the nutrient fields have fewer than 10% missing values. Missing values are allowed in the database for foods that are consumed in very small quantities, such as spices, or where there is no data to indicate whether the nutrient exists in the food. Beta-carotene and retinol show a high percentage of imputed values since they are calculated primarily from vitamin A using the FAO/WHO algorithms.[3]

Use of Manufacturers' Information

Manufacturers' information that is received for brand name foods is added to the NCC database either on brand name product guides, which link commercial products to existing database entries of similar nutrient composition, or by creating new database entries added as either elemental foods (non-recipe foods) or as formulations (recipes). Imputed values are determined for brand name foods incorporated into each of these three components of the database.

1. **Brand Name Product Guides**

For most brand name foods, the NCC uses coding guides which assign an existing database entry to each brand name product. This method permits similar foods to be represented by a single database entry. Thirty-six hundred brand name products appear on the current coding guides. A list of the NCC brand name guides is presented in Figure 4. Determining which foods are similar in nutrient content to an NCC database entry requires guidelines for grouping based on food type and on nutrients of importance within the general food group. For example, similarities in fat, protein, sodium, calcium, riboflavin and vitamin A are used to group cheeses. Limit values have been established for common nutrients. Differences in nutrient values between foods must fall within these limit ranges for the foods to be considered enough alike to be coded in the same way. The limits that NCC uses per 100 grams of food are shown in Figure 5 and are based primarily on percentages of the USRDAs. Smaller deviations from the true manufacturer's value are required for nutrients that are of particular interest to NCC studies. A portion of the coding guide for processed meats is shown in Figure 6. This guide illustrates that seven brands of corned beef are coded in the same way, but three brands of deviled ham are not enough alike to be represented by the same database entry.

By using guides which assign brand name foods the nutrient profile of a representative food, NCC is in fact using imputed values, rather than actual manufacturers' values, for these foods. However, NCC estimates of nutrient content provide a reasonably accurate nutrient profile and permit the handling of thousands of name brand products while maintaining a relatively compact and complete database. For most foods, these groupings will provide nutrient values which are not substantially different from those derived from the rounding already used by manufacturers for FDA labeling.

2. **Elemental Database Entries**

When a product does not closely match the nutrient profile of an existing entry in the database, a new entry is created. In the NCC database, there are approximately 300 entries based on brand name foods. Two hundred of these are elemental, or nonrecipe, entries. Elemental entries are added when the manufacturer provides many of the nutrient values of the product and few must be imputed. Missing values for these entries are imputed by one of the previously mentioned techniques. For example, Figure 7 illustrates an entry for 100 grams of a fortified cocoa mix which contains cocoa, whey, sugar, and salt. The values with a reference code of "75" are those provided by the manufacturer of a common brand name product. The value for caffeine is taken from a scientific journal for a generic cocoa mix.[4] Because this cocoa is fortified with vitamin A palmitate, retinol is calculated as the sole source of vitamin A. Other nutrient values were imputed by NCC using an estimate of the proportion of each major ingredient from the product label.

To estimate the ingredient proportions, an NCC computer software program is used. The product ingredients are entered in the order found on the label and assigned a likely percentage (grams per 100 grams of product) of the total formulation (Figure 8). Some of these proportions are obtained from the Food Product Formulary series[5,6,7,8] which gives typical recipes for commercial products; others are estimated by an NCC nutritionist based on the order of ingredients on the product label and a knowledge of similar products or "recipes." In the row titled "mfg", the values of nutrients from the manufacturer are entered, either per 100 grams or per serving. Using multiple screens, up to 25 nutrient values can be entered.

The computer then calculates the nutrient content of the formulation and compares it to the manufacturer's values. The differences per 100 gm of product are shown in the last row, and differences which exceed NCC established limits are highlighted. If the differences exceed the NCC limits, the nutritionist must adjust the formula by changing the proportion of the ingredients until the calculated nutrient values are within the established limits. The limits that NCC has set are the same as those used for grouping brand name foods on coding guides. After the formulation has been determined, the computer calculates values for all of the nutrient fields. Those values which were missing in the original entry are now inserted so that the nutrient profile of the product is complete. Reference codes are used to indicate which nutrients are imputed and which were obtained from manufacturers or from literature sources.[9] By using reference codes, imputed values can easily be identified and replaced with analytic values as they become available.

3. **Recipe Database Entries**

A similar procedure is used for the 100 commercial products that are entered as recipes in the database. Recipes are added for products for which there is limited nutrient data and thus most values must be imputed. An example is a ready-to-eat rice cereal in which manufacturer's information provided only label values for protein, fat, carbohydrate and sodium per serving and for the fortification nutrients of thiamin, riboflavin and niacin in %USRDA. Using the software program described previously, it was determined that the proximate nutrients of the cereal corresponded to those of a puffed rice cereal entry, while the fortified vitamins were above the established limits (Figure 9). Therefore, this cereal was entered as a recipe in the database with ingredients of puffed rice, thiamin, riboflavin and niacin. From these ingredients, the computer automatically calculates the nutrient composition. In this case, all of the nutrients are imputed. The seven nutrient values provided by the manufacturer are not actually inserted into the database, but are used to determine a reasonable recipe of ingredients that provides very similar nutrient values.

Another case in which a recipe would be used for a commercial product is where the type of an ingredient might vary among manufacturers for an otherwise similar product. For example, NCC has an entry for potato chips in which the type of ingredient oil can be varied, an important feature for cardiovascular studies. The use of a recipe allows the fatty acid profile for the particular oil in a brand name potato chip to be calculated in the nutrient analysis. Figure 10 illustrates two different fatty acid profiles that would occur for a cup of potato chips, one with a soybean/cottonseed blend as the ingredient oil and the other with safflower oil. A recipe in which the ingredient fat can be specified eliminates the need for separate database entries for potato chips made with different ingredient oils.

Conclusion

Nutrient databases must provide nutrient values for an ever increasing number of brand name food products. Since nutrient information for these foods is often incomplete, imputing is used to provide a more complete nutrient profile. Techniques used to impute nutrient values may include the use of representative values from similar foods or calculated values derived from estimates of product formulations.

REFERENCES

1. Personal Communication, Food Marketing Institute.

2. Friedman, M., Dornblaser, L. "Processors soft-pedal new product pace in '88." *Prepared Foods*. February, 1989, pp. 92.

3. Food and Agriculture Organization/World Health Organization Expert Committee on Nutrition. *Requirements of vitamin A, thiamine, riboflavin and niacin*. FAO Nutrition Meeting Report Series No. 41. Rome: FAO. 1967.

4. Craig, W.J., Nguyen, T.Y. "Caffeine and Theobromine levels in cocoa and carob products." *J. Fd. Sci.* 49 (1984): 302.

5. Long, L., Komarik, S., Tressler, D. *Food Products Formulary, Volume 1. Meats, Poultry, Fish Shellfish.* 2nd ed. AVI Publishing Co., Westport, Connecticut. 1975.

6. Tressler, D., Sultan, W. *Food Products Formulary, Volume 2. Cereals, Baked Goods, Dairy and Egg Products.* AVI Publishing Co., Westport, Connecticut. 1975.

7. Tressler, D., Woodroof, J. *Food Products Formulary. Volume 3. Fruit, Vegetable and Nut Products.* AVI Publishing Co., Westport, Connecticut. 1976.

8. Inglett, M., Inglett, G. *Food Products Formulary. Volume 4. Fabricated Foods.* AVI Publishing Co., Westport, Connecticut. 1982.

9. Schakel, S.F., Sievert, Y.A., Buzzard, I.M. "Sources of data for developing and maintaining a nutrient database." *J. Am. Diet. Assoc.* 88 (1988): 1268.

Figure 1 Nutrient Composition

Product: Brand X
VANILLA TAPIOCA

Package Weight: 3.25 Ounces
As Packaged Serving Size: 23.034 Grams
Makes 1/2 CUP

As Prepared Serving Size: 145.034 Grams
1/2 CUP

Preparation Directions

Cook contents of 3.25 oz pkg with 2 cups vitamin D fortified whole milk
Yield = 2 cups

Phenylalanine per 1/2 c serving: 1 MG dry mix; 195 MG prep.

Ingredients:
Sugar, Tapioca, Cornstarch, Dextrose (Corn sugar), Salt, Coconut Oil with BHA (Preservative), artificial flavor, artificial color (including yellow 5), natural flavor.

Nutrients	Units	Per 100 gms As Packaged	Per 100 gms As Prepared
CALORIES	KCAL	370.08	110.46
PROTEIN	G	0.142	2.790
CARBOHYDRATE TOTAL	G	94.120	18.868
FAT TOTAL	G	0.131	2.830
POLYUNSATURATED FAT FDA	G	0.002	0.105
POLYUNSATURATED FAT TOT	G	0.002	0.105
SATURATED FAT FDA	G	0.072	1.450
SATURATED FAT TOTAL	G	0.086	1.762
MONOUNSATURATED FAT	G	0.006	0.813
CHOLESTEROL	MG	0.00	11.44
SODIUM	MG	477.39	117.04
POTASSIUM	MG	4.64	128.18
CAFFEINE	MG	0.00	0.00
MOISTURE	G	4.278	74.695
FIBER CRUDE	G	0.031	0.005
FIBER DIETARY	G	NA	NA
ASH	G	1.303	0.813
SUGAR TOTAL	G	67.042	14.567
VITAMIN A	IU	0.00	105.99
VITAMIN CM	G	0.00	0.79
THIAMINE	MG	0.0000	0.0320
RIBOFLAVIN	MG	0.0000	0.1363
NIACIN	MG	0.000	0.071
CALCIUM	MG	4.03	101.08
IRON	MG	0.121	0.061
VITAMIN D	IU	0.00	34.48
VITAMIN E	IU	NA	NA
VITAMIN B6	MG	NA	0.0353
FOLIC ACID	MCG	NA	4.21
VITAMIN B12	MCG	0.0000	0.3003
PHOSPHORUS	MG	4.15	79.23
MAGNESIUM	MG	1.68	11.57
ZINC	MG	0.080	0.332
COPPER	MG	0.0285	0.0382
PANTOTHENIC ACID	MG	NA	0.2641

NA = Data Not Available, TR = Trace

Figure 2 Brand Y

PRODUCT	SERVING SIZE	CAL	PROTEIN g.	FAT g.	CARBO g.	SODIUM mg.	CHOLESTEROL mg.
Gelatin Desserts	1/2 cup	8	1	0	<1	10	0
Pudding-Chocolate	1/2 cup	70	5	<1	13	75	2
Vanilla	1/2 cup	70	4	<1	13	75	2
Lemon	1/2 cup	70	4	<1	12	75	2
Butterscotch	1/2 cup	70	4	<1	13	80	2
Cake Mix-Chocolate	1/10 cake	100	2	2	17	110	0
Lemon, White	1/10 cake	100	2	2	18	75	0
Whipped Topping	1 tbs.	4	<1	<1	<1	5	0
Cookies	1	25	<1	1-2	3	<5	0-5
Duplex Sandwich Cookies	1	40	<1	2	5	5	0
Assorted Creme Filled Wafers	1	30	<1	2	4	5	0
Creme Filled Wafers Chocolate, Vanilla	1	20	<1	1	3	<5	0
Snack Wafers-Chocolate, Vanilla, Strawberry	1	80	<1	4	11	<5	0
Snack Wafers-Chocolate Coated	1	120	2	7	14	10	<5
Fructose	1 tsp.	12	0	0	3	0	0
Salt-Free Seasonings	1 tsp.	0	0	0	0	<2	0
Salad Dressings	1 tbs.	4-6	0	0	1-2	80-150	0
Barbecue Sauce	1 tbs.	16	0	0	4	3	0
Cocktail Sauce	1 tbs.	10	<1	0	3	2	0
Soup Mixes-							
Cr. of Mushroom	6 oz.	50	2	1	9	60	<1
Tomato	6 oz.	60	3	<1	10	50	<1
Cream of Chicken	6 oz.	50	2	1	8	60	2
Cream of Veg.	6 oz.	60	2	<1	14	60	<1
Tomato Vegetable	6 oz.	60	2	0	13	50	0
Cocoa	6 oz.	50	4	<1	9	75	2
Brownie Mix	2" x 2"	45	1	2	8	15	30
Unsalted Crackers	2	30	<1	1	5	<5	<1
Unsalted Pretzels	5	25	<1	<1	5	<5	0
6 Calorie Wheat Wafers	1	6	<1	<1	1	<5	<5
Wheat Snax	1 oz.	110	4	1	22	35	0
Chocolate Bars	2 squares	60	1	4-6	4-5	10	2
Crunch Chocolate Bar	2 squares	45	1	3	4	10	2

Figure 3 Percents of missing and imputed values in Version 16 of the NCC nutrient database.

Nutrient field	Percent missing	Percent imputed
Calories	0	4
Protein	0	2
Total fat	0	3
Total carbohydrate	0	3
Alcohol	0	1
Ash	1	9
Water	2	9
Caffeine	0	4
Cholesterol	1	7
Total SFA	1	29
SFA 4:0	1	9
SFA 6:0	1	10
SFA 8:0	1	11
SFA 10:0	1	12
SFA 12:0	1	15
SFA 14:0	1	20
SFA 16:0	1	24
SFA 17:0	2	8
SFA 18:0	1	24
SFA 20:0	2	9
SFA 22:0	2	8
Total MFA	1	30
MFA 14:1	1	8
MFA 16:1	1	19
MFA 18:1	1	24
MFA 20:1	1	11
MFA 22:1	2	6
Total PFA	1	30
PFA 18:2	1	24
PFA 18:3	1	21
PFA 18:4	2	6
PFA 20:4	1	7
PFA 20:5	2	6
PFA 22:5	2	6
PFA 22:6	2	6
Total dietary fiber	0	56
Water soluble dietary fiber	13	62
Water insoluble dietary fiber	11	51
Pectins	35	32
Tryptophan	1	39
Threonine	1	38
Isoleucine	1	38
Leucine	1	38
Lysine	1	38
Methionine	1	38
Cystine	1	39
Phenylalanine	1	39
Tyrosine	1	39
Valine	1	39
Arginine	1	39
Histidine	1	39
Alanine	1	40
Aspartic Acid	1	40
Glutamic Acid	1	40
Glycine	1	40
Proline	1	40
Serine	1	40

Nutrient field	Percent missing	Percent imputed
Animal Protein	0	70
Vegetable Protein	0	77
Starch	2	57
Sucrose	2	48
Galactose	13	26
Glucose	15	42
Fructose	22	36
Lactose	8	41
Aspartame	0	1
Saccharin	0	1
Total Vitamin A	0	7
Beta-carotene	0	95
Retinol	0	95
Total alpha-tocopherol equivalents	2	73
Alpha-tocopherol	2	48
Beta-tocopherol	3	12
Gamma-tocopherol	3	38
Delta-tocopherol	2	28
Vitamin D	24	6
Vitamin C	1	5
Thiamin	1	5
Riboflavin	1	4
Niacin	1	5
Folacin	10	11
Vitamin B6	9	9
Vitamin B12	6	9
Pantothenic acid	3	18
Calcium	1	4
Iron	1	4
Magnesium	4	7
Phosphorous	2	4
Sodium	0	5
Potassium	1	4
Copper	13	8
Zinc	5	11
Selenium	11	34

Figure 4

Brand Name Product Guides

Processed Meats
Fast Foods
Commercial Entrees

Cocoa and Milk Type Beverages
Cheeses
Ice Cream and Frozen Treats
Yogurts
Creamers and Toppings

Margarines
Oils
Shortenings
Salad Dressings

Cereals
Granola Bars

Snacks and Chips
Crackers
Cookies
Candy

Vitamins
Drugs

Beverages
Dietetic Products

Figure 5

Nutrient Limits for Grouping Foods

Protein	5 g	Vitamin	C6 mg
Fat	2.5 g	Thiamin	0.3 mg
CHO	10 g	Riboflavin	0.34 mg
Dietary Fiber	2.5 g	Niacin	2 mg
Caffeine	5 mg	Folate	20 mcg
Sodium	100 mg	Vitamin B6	0.4 mg
Potassium	100 mg	Vitamin B12	1.2 mcg
Calcium	50 mg	Pantothenic Acid	2 mg
Iron	1.8 mg	Vitamin A	125 I.U.
Phosphorous	50 mg	Vitamin D	1 mcg
Magnesium	20 mg	Vitamin E	2 mg
Copper	0.4 mg	Cholesterol	30 mg
Zinc	1.5 mg		

Figure 6

BRAND NAME PROCESSED MEATS

PRODUCT	MANUFACTURER	CODE	SERVING SIZE IF UNKNOWN
CHICKEN SLICE, SMOKED	LAND O'FROST	13730	
CHICKEN, SLICES	ECKRICH (CALORIE WATCHER)	13755	SL=1.O OZ
CORNED BEEF	OSCAR MAYER	10066	SL=.75 OZ
CORNED BEEF, PRESSED & FORMED	KLEMENT	10066	SL=4.2 GM
CORNED BEEF, SLICED	CARL BUDDIG	10066	SL=4.2 GM
CORNED BEEF, SLICED, SLENDER	ECKRICH (CALORIE WATCHER)	10066	SL=4.2 GM
CORNED BEEF, SLICED, SLENDER	ECKRICH (LEAN SUPREME)	10066	SL=4.2 GM
CORNED BEEF, THIN SLICED	LAND O'FROST	10066	SL=4.2 GM
CORNED BEEF, TOP ROUND	KLEMENT	10066	SL=4.2 GM
COTTO SALAMI	HORMEL	13771	SL=0.8 OZ
COTTO SALAMI	KLEMENT	13771	SL=0.8 OZ
COTTO SALAMI	OSCAR MAYER	13771	SL=0.8 OZ *
COTTO SALAMI, BEEF	ECKRICH	13219	SL=0.8 OZ
COTTO SALAMI, BEEF	OSCAR MAYER	13219	SL=0.8 OZ *
COTTO SALAMI, TURKEY	LOUIS RICH	13748	SL=1.O OZ
DEVILED HAM	ARMOUR	13235	CAN=4.5 OZ
DEVILED HAM	LIBBY'S	13243	CAN=3.0 OZ
DEVILED HAM SPREAD	UNDERWOOD	13250	CAN=4.5 OZ
DUTCH LOAF, LUNCHEON MEAT	KLEMENT	13466	SL=1.O OZ
DUTCH LOAF, LUNCHEON MEAT	THORN APPLE VALLEY	13698	
FRANKS	ECKRICH	13516	LK=1.6 OZ
FRANKS, BACON & CHEDDAR CHEESE	OSCAR MAYER	13516	LK=1.6 OZ
FRANKS, BEEF	ECKRICH	13201	LK=1.6 OZ
FRANKS, BEEF	KAHN (HILLSHIRE FARMS)	13201	LK=1.6 OZ
FRANKS, BEEF	OSCAR MAYER	13201	LK=1.6 OZ
FRANKS, CHEESE	ECKRICH	13516	LK=2.0 OZ
FRANKS, CHEESE	OSCAR MAYER	13516	LK=1.6 OZ
FRANKS, JUMBO	ECKRICH	13516	LK=2.0 OZ
FRANKS, JUMBO	KAHN (HILLSHIRE FARMS)	13516	LK=2.0 OZ
FRANKS, JUMBO BEEF	ECKRICH	13201	LK=2.0 OZ
FRANKS, JUMBO BEEF	KAHN (HILLSHIRE FARMS)	13201	LK=2.0 OZ
FRANKS, NACHO STYLE CHEESE	OSCAR MAYER	13516	LK=1.6 OZ
FRANKS, TURKEY	LOUIS RICH	13730	LK=1.6 OZ
FRANKS, TURKEY CHEESE	LOUIS RICH	13730	LK=1.6 OZ
GOURMET LOAF, LUNCHEON MEAT	ECKRICH (CALORIE WATCHER)	13482	SL=1.O OZ
HAM, CHOPPED	ECKRICH (ALL VARIETIES)	11213	SL=1.O OZ
HAM, CHOPPED	HORMEL	12229	
HAM, CHOPPED	OSCAR MAYER	13698	SL=1.O OZ
HAM, COOKED	KLEMENT	10108	
HAM, CRACKED BLACK PEPPER	OSCAR MAYER	10108	SL=.75 OZ
HAM, DANISH IMPORTED	ECKRICH	10108	
HAM, DEVILED	ARMOUR	13235	CAN=4.5 OZ
HAM, DEVILED	LIBBY'S	13243	CAN=3.0 OZ
HAM, HARDWOOD SMOKED	ECKRICH (LEAN SUPREME)	10108	SL=1.O OZ
HAM, HONEY	OSCAR MAYER	10108	SL=.75 OZ
HAM, ITALIAN STYLE, CKD	OSCAR MAYER	10108	SL=.75 OZ

*THIN SLICE: 1 SL = 0.52 OZ; THICK SLICE: 1 SL = 1.33 OZ.

Figure 7

COCOA MIX, DRY

Nutrient	Ref	Value	Nutrient	Ref	Value
Water (g)	83	2.41	Vit C (mg)	75	46.10
Calories	75	376.00	Carotene (mcg)	84	0.00
Protein (g)	75	3.53	Retinol (mcg)	84	720.00
Fat (g)	75	1.51	Vit A (IU)	75	2399.00
CHO (g)	75	84.67	Vit E (mg)	75	18.94
Ash (g)	75	3.50	Vit D (mcg)	75	0.04
Caffeine (mg)	44	20.80	SFA (g)	83	0.90
Chol (mg)	75	0.61	MFA (g)	83	0.50
Ca (mg)	75	89.00	PFA (g)	83	0.05
Fe (mg)	75	17.87	Glucose (g)	83	0.00
Mg (mg)	75	240.00	Fructose (g)	83	0.00
P (mg)	75	259.00	Sucrose (g)	83	71.04
K (mg)	75	682.00	Lactose (g)	83	7.86
Na (mg)	75	682.00	Dietary Fib (g)	83	4.21
Zn (mg)	75	9.88A	Protein (g)	83	1.17
Cu (mg)	75	1.88V	Protein (g)	83	2.52

Figure 8

Cocoa Beverage Mix

		Kcal	Pro (g)	Fat (g)	CHO (g)	Na (mg)
Sugar	75.9g	292.21	0.00	0.00	75.52	0.76
Cocoa Powder	11.9g	35.58	2.00	2.82	5.75	0.71
Whey	10.7g	36.27	1.26	0.06	7.86	103.58
Salt	1.5g	0.00	0.00	0.00	0.00	581.37
Total	100.0g	364.06	3.26	2.88	89.13	686.42
MFG	100.0g	376.00	3.50	1.50	91.70	681.00
Diff/100g	0.00	-11.94	-0.24	1.38	-2.57	4.42

Figure 9

Fortified Rice Cereal

	Kcal	Pro (g)	Fat (g)	CHO (g)	Na (mg)	Thi (mg)	Rib (mg)	Nia (mg)
Puffed Rice 100g Cereal	402	6.30	0.50	89.80	3.00	0.11	0.10	3.00
Total 100g	402	6.30	0.50	89.80	3.00	0.11	0.10	3.00
MFG 100g	353	7.05	1.00	89.30	10.00	2.68	1.83	35.25
Diff/100g 0.00	49	-0.75	-0.50	0.50	-7.00	-3.32	-1.73	-32.25

Figure 10

Fatty Acid Profile of Potato Chips
with Two Ingredient Oils
(g/CP)

	Cottonseed/Soybean Oil	Safflower Oil
Saturated Fatty Acids	1.45g	0.67g
Monounsaturated Fatty Acids	1.45g	0.85g
Polyunsaturated Fatty Acids	3.90g	5.28g

NUTRIENT DATASETS PRODUCED BY HNIS

D.B. Haytowitz

USDA - Human Nutrition Information Service
Hyattsville, MD

The Human Nutrition Information Service publishes Agriculture Handbook No. 8, "Composition of Foods," and other food composition tables. The data in these publications are also available on magnetic tape and, in some cases, on 5-1/4 inch diskettes. Data sets described are the USDA Nutrient Data Base for Standard Reference, Data Set 72-1, the USDA Nutrient Data Base for Individual Food Intake Surveys (Release 2), the Primary Nutrient Data Set for USDA Nationwide Food Consumption Surveys, the USDA Table of Nutrient Retention Factors, and the Recipe file for Release 2 of the USDA Nutrient Data Base for Individual Food Intake Surveys. Information is presented on number of foods included and nutrients covered in each data set, as well as other features of each data set.

IDENTIFYING FOODS CONSUMED AS INGREDIENTS OF MIXTURES

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Food intakes from food consumption surveys have traditionally included food mixtures in the food group of the main ingredient. For example, survey food items such as cheeseburgers have been classified in the meat, poultry, and fish group, and chicken noodle soup, in the grain group. Thus, non-meat foods such as cheese and bread from the cheeseburger have been represented in values of food intake provided by the meat, poultry, and fish group; similarly, non-grain foods such as chicken and vegetables have been represented in values for the grain group. A system under development to report intakes of food mixtures separated into ingredients has been tested using 1-day food intake records for women, 19 to 50 years of age, from the 1985 continuing survey of Food Intakes by Individuals (CSFII). This test also utilized two computerized recipe systems: one which generated the documentation of the ingredients of mixtures. Results showed that 38% of the weight of meat-based mixtures came from meat, poultry, or fish components, 26% from vegetables, and 13% from grains. Grain ingredients comprised 34% of the weight of grain-based mixtures; vegetables, 23%; milk and cheese, 12%; and meat, poultry, or fish, 9%.

MAINTENANCE OF THE U.S. DEPARTMENT OF AGRICULTURE FOOD CODES.

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The U.S. Department of Agriculture (USDA) Food Code for Individual Food Intake Surveys is used by the USDA for the Nationwide Food Consumption Surveys (NFCS) and the Continuing Survey of Food Intakes by Individuals (CFSII). It is also being used by the National Center for Health Statistics (NCHS) for the current National Health and Nutrition Examination Survey (NHANES), NHANES III. It includes complete food descriptions, common measures, and gram weights.

These Food Codes are maintained by USDA's Food Consumption Research Branch (FCRB) of the Human Nutrition Information Service (HNIS). Decisions regarding updates are made by an interdepartmental committee of staff from FCRB and representatives from NCHS.

When a food or quantity consumed by a survey respondent can not be coded with existing Food Codes information and is not covered by existing Coding Guidelines, a Request for Information (RFI) is forwarded to the committee. Each RFI is discussed by the committee, and a decision is made to 1) code with existing code(s) with no change or 2) to update the Food Codes and/or Coding Guidelines to accommodate the item. In addition to modifying the Food Codes in response to RFI's, the Food Codes are reviewed in detail prior to the start of new surveys.

Food Code updates typically involve the creation of a new code, the addition of an item to an existing code, or the addition of a common measure and corresponding gram weight. When an update involves gram weights, HNIS's Guidance and Education Research Branch provides this information. FCRB incorporates the updates into the Food Codes. Concurrently, HNIS's Nutrient Data Research Branch assigns nutrient values to new codes and incorporates them into the Nutrient Database.

INFLUENCE OF PHYSICAL TRAINING ON COPPER, IRON AND ZINC STATUS OF SWIMMERS.

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The nutritional status of 16 female and 13 male members of the University of North Dakota varsity swim team and 13 female and 15 male nontraining, age-matched controls was assessed before and at the end of a six month competitive season to determine the influence of physical training on copper, iron and zinc status. An analysis of seven-day dietary records of participants who consumed self-selected diets was calculated by GRAND nutrient database system. Mean daily energy, protein and carbohydrate intakes increased ($p < 0.05$) in the swimmers. Estimated intakes of copper, iron and zinc increased ($p < 0.05$) in the male swimmers and decreased ($p < 0.05$) in the male control subjects. Slight decreases in percent body fat in female swimmers (1.6%) and in male swimmers (1.9%) were observed. Fat free mass increased slightly in female swimmers (1.6 kg)and fat mass decreased (0.5 kg). No changes occurred in hematocrit or hemoglobin. Serum ferritin concentrations declined ($p < 0.05$) in the female controls over time and increased ($p < 0.05$) among male swimmers after training. Total iron-binding capacity decreased in female controls and swimmers, and male controls. Plasma copper, iron and zinc were within the ranges of normal and did not change. Erythrocyte superoxide dismutase, a copper and zinc containing enzyme, increased ($p < 0.01$) in the swimmers after training. In summary, our findings indicate that intensive swim training does not decrease copper, iron and zinc status of young adults when intakes are adequate and that an increase in erythrocyte superoxide dismutase activity is a functional adaptation to aerobic training.

AN AUTOMATED SYSTEM FOR DIETARY DATA QUERIES FOR CLINICAL TRIALS: THE MODIFICATION OF DIET IN RENAL DISEASE STUDY (MDRD)

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The MDRD Study is a multicenter clinical trial designed to determine whether restriction of dietary protein and phosphorous and/or reduction of blood pressure will reduce the rate of progression of chronic renal disease. The NCC is responsible for the research quality of processed dietary data and reports of actual nutrient intakes of study patients. Needed clarifications ("queries") of patients' dietary intakes are critical to this processing procedure. A unique automated system for capturing, communicating and reporting these queries has been developed for MDRD.

A key compound of this system is a "query" database. This database is linked to the dietary data entry system and allows direct entry of questions on required food detail and confirmation of unclear items (judgement calls). The "query" database archives data on the question type, the time and method for query transmittal, the dietary submitter, the NCC staff requesting the information, identifiers (Eg. food groups) for characterizing the questionable food item, and the text of the question and the query response.

Its time management feature tracks the status of queries. The computer searches daily for all new queries. It also locates any query not answered within the three day response period. These queries are then automatically sorted into a file to be sent via electronic mail. The system stores the query response date and the last date that a change was made for that item.

This automated system has provided important benefits to the MDRD Study: 1) General study reports and performance reporting to clinical centers can be tailored to target specific problem areas; and 2) It has also expedited data processing time, enabling timely release of patient reports.

IMPUTING AMINO ACID VALUES FOR INCORPORATION INTO A NUTRIENT DATABASE

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The nutrient database at the Nutrition Coordinating Center (NCC) was recently expanded to include data for eighteen amino acids. The primary data source for amino acid values was the USDA Database for Standard Reference, Release 6. USDA sources provided 54 percent of the amino acid values incorporated into the NCC nutrient database. When amino acid data could not be found in the USDA database, scientific journals were reviewed for analytical values. Other sources of information included manufacturers' data, other food tables and recipes or food formulas. When amino acid data were not available, values were imputed based on standardized procedures developed at the Nutrition Coordinating Center. Approximately 40 percent of the amino acid values in the NCC database were imputed by one of the following methods: 1) calculated from a different form of the same food, 2) calculated from a similar food having a similar protein source, 3) calculated from ingredient list or food formulary, 4) calculated from the major protein source in the food, or 5) assumed zero based on the type of food. The incorporation of the amino acid values into the database accommodates new and growing research interests and allows clinical studies to evaluate associations between amino acid intake and diseases related to amino acid metabolism.

USING COMPUTER ALGORITHMS TO ASSIGN FOOD EXCHANGES TO THE DAIRY GROUP IN THE USDA HANDBOOK NO. 8.

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The Food Exchanges have been a useful field tool for analyzing diets. The Exchanges were revised in 1987 to reflect current macronutrient content of foods found in food composition tables. The USDA Handbook No. 8 contains the nutrient content of almost 5000 foods. A CD-ROM software product containing the entire Handbook No. 8 was used as the database for this project. A series of algorithms were defined to have the computer search the CD-ROM database to exchange foods in the Dietary Group from Handbook No. 8 and assign the number of exchanges. The Dairy Group was chosen to test the algorithms because of its varied foods including milk, eggs, fruited yogurt, and cream. These foods would traditionally have been exchanged as milk, meat, fruit/milk, and fat respectively. Some basic assumptions had to be made in order to correctly exchange each food. A range of grams of protein, carbohydrate, and fat had to be defined to accommodate the specific amounts found in a food. Also, the calorie contribution by protein, carbohydrate, and fat had to match the total calorie content serving size of the food. Comparing the total calories to the number of exchanges served as a manual check on the accuracy of the exchange algorithm. Only whole or half exchanges were assigned because they can be dealt with realistically in a person's diet, but one quarter or one third exchanges cannot. The computer algorithms were generally successful in correctly assigning food exchanges to the Dairy Group. By renumbering the algorithms, the remaining USDA Food Groups will be exchanged.

A NATIONWIDE STUDY OF THE CHOLESTEROL, PROXIMATE, VITAMIN AND MINERAL LEVELS IN LARGE EGGS.

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A nationwide two-phase study of large eggs was conducted to determine mean levels of cholesterol, proximates, vitamins, and minerals. Eggs were collected at random from the top 118 U.S. egg handlers, representing approximately 60% of the retail egg market. During Phase 1 (July, 1988) 25 composites of egg yolks were prepared and analyzed for cholesterol, fat, and fatty acids. For vitamins and minerals, 12 composites of whole eggs were analyzed. In Phase II (February, 1989) 7 composites each of yolks and whites were prepared from eggs obtained from the same handlers as in Phase I. Cholesterol was extracted by direct saponification followed by quantification by gas chromatography. All analytical methods were validated and monitored by quality control materials throughout both phases of the study. Preliminary results indicate an average of 213 mg cholesterol/egg and contrasts with the previous value of 274 mg listed in USDA's Agriculture Handbook No. 8-1 (1976). The coefficient of variation for the composites for cholesterol was less than 5%, indicating low variability in the product. Values per egg for iron, (0.72 mg), folacin, (23 mg), and vitamin B 12 (0.50mg) were lower (20-50 %) than previous USDA data while riboflavin (0.25mg) and vitamin B 6 (0.07mg) were higher (23-63%) than data had indicated.