NUTRIENT DATA BASES IN COMPUTER PROGRAMS FOR UNDERGRADUATE FOOD SCIENCE AND NUTRITION CURRICULUM

E. H. Asp
Assistant Professor
Department of Food Science and Nutrition
University of Minnesota

Computer programs for undergraduate education that utilize nutrient data bases have special characteristics. From the program design standpoint, they must have an educational function, besides performing nutrient calculations, the task that computers do quickly, efficiently and accurately. From the program use standpoint, these programs must be easy to use because most student users will be unfamiliar with computers. Programs designed for undergraduate education at the University of Minnesota have not been limited to classroom use; they also have been used in Agricultural Extension work, hospitals, research projects, and the food service industry.

Classes in the Department of Food Science and Nutrition have been using computer programs that incorporate the use of nutrient data bases for the last 15 years. The most interesting changes that have occurred through these years have been the rapid developments in computer technology and the increased interest in determining the nutrient content of food and updating the food composition tables. The computer hardware has changed from the mainframe used in the batch mode in the early years, to another mainframe that was used in the interactive mode for several years, to still another mainframe that is currently used in the interactive mode, to the microcomputers. These changes in the hardware have been accompanied by improvements in the ability of the mainframe computers to handle nutrient data files, especially those in the programs with large data bases. The nutrient data bases in these programs have also had major updates during this time. The most recent was during the last year when the Nutrient Data Base for Standard Reference, Release 2, became the data base for the largest program. The programs developed and used here have changed along with the hardware and nutrient data bases. In fact, the programs are continually being revised and improved.

Computer programs with nutrient data bases are used by undergraduates here in intermediate and advanced Food Science and Nutrition courses. Use of these programs begins in an intermediate-level course, FScN 3272, Introduction to Food Decision Making. In this course, food science subject matter is integrated with nutrition subject matter to cover factors thought by experts to be important considerations when decisions are made about food to be provided for oneself and/or others. Three computer programs are used by students in this course. First, students learn how to use a teletype computer terminal by using a program with a limited food and nutrient data base and only a few commands. Then they use a computer-assisted instructional menu planning program, MENU, which contains a nutrient calculation program that allows the user to revise a problem menu by adding and deleting foods to meet nutrient goals established by the program. Last, students use a more complex program, NUTALLY (Nutrient Tally), with a data base containing over 5000 foods, space for 43 nutrients for each food, and several commands. Students use these programs for projects assigned during the quarter.

Published as Paper No. 1885 of the Miscellaneous Journal Series of the Minnesota Agricultural Experiment Station, St. Paul, Minnesota 55108.

Drawing on the experiences at the University of Minnesota, two aspects of the use of nutrient data bases in computer programs for undergraduate education will be discussed in this paper. They are: (1) program development; and (2) program use by students.

PROGRAM DEVELOPMENT

The question asked most often by those interested in developing a computer program that uses a nutrient data base is "How do I get started?" The next questions usually are "How can I find funding?", and "How are these programs designed and programmed for the computer?"

Getting Started

The first step in program development is to have an idea for a program. Describe the idea in enough detail so an estimate of programming and other costs associated with development and support of the program can be made. This will include investigating computer facilities and capabilities to find the appropriate computer for the program. When developing computer programs that use nutrient data bases, important considerations about the computer are: the storage capacity to handle the data base; the capability for users to manipulate files and update them easily; and quick file access time when retrieving information as the program is being used. These are considerations whether one is working with a mainframe or a microcomputer. Because nutrient data bases tend to be very large, their size may present more storage and access problems when using microcomputers than mainframe computers. The continually increasing storage capacity of microcomputers may eliminate this concern very soon, however. When planning for the use of mainframe computers it is essential to establish contact and cooperation with departmental or university computer personnel at the idea stage to discuss details of programming support available and computer charges for program development and student use.

Funding

Obtaining funds for computer program development at educational institutions requires creativity these days! Funding is often available from a source similar to the Educational Development Program fund at the University of Minnesota that provides grants for projects to improve undergraduate instruction. These grants are awarded to project proposals on a competitive basis. The early program development work here has been funded by Educational Development Program grants. Because some of the programs developed are used in Agricultural Extension work as well as in undergraduate education, and Agricultural Extension is becoming more involved in computer use, some funding has become available from this source. The nutrient data base and program update this past year has received funds from sources outside the university, including a commercial company and a non-university user of one of the programs.

Program Design

When developing computer programs and their nutrient data bases for use in undergraduate courses, objectives for the program and for the course in which the program is to be used must be considered. Programs which are developed to supplement classroom instruction must help students achieve one or more of the objectives for the courses in which they are used. For example, when computer-assisted instructional menu planning program, MENU, was developed, each level of Bloom's Taxonomy of Educational Objectives, Cognitive Domain (Bloom, 1956)--knowledge, comprehension, application, analysis, synthesis and evaluation--was used to develop objectives for the program (Asp and Gordon, 1981).

A content outline for the subject matter to be covered in the program was derived from the course objectives. This outline was used with Bloom's Taxonomy to develop general objectives and specific learning outcomes for each level of the taxonomy using the method designed by Gronlund (Gronlund, 1976).

Selection of the foods and nutrients to include in the nutrient data base depends on the objectives for the program and the characteristics of the students who will use the program. Students starting to learn how to use computer programs find it much easier to work first with programs that use a limited food and nutrient data base; for example, 500 to 600 foods and 11 nutrients for each food, than with programs with large data bases. Students here move to programs with larger data bases (more foods and more nutrients) as their skills in using computer programs improve. Other decisions to be made when developing the food and nutrient data base include: which foods and which forms of the food to use; which unit(s) of measurement to use, e.g., nutrients per serving of food, nutrients per unit of measurement, nutrients per 100 grams edible portion; which nutrients to include; and the source(s) of the nutrient data.

Students entering the "Introduction to Food Decision Making" course here have certain characteristics that must be considered in program design. These students have generally had little or no experience in the use of computers, and many of them have difficulty using math skills. They are unfamiliar with the concept of nutrient data base in a computer program and its relationship to food composition tables. Their knowledge about kinds of food and the preparation and processing terms used to identify food in the food composition tables is limited. These students also are unfamiliar with how food quantities are designated, such as the appropriate serving size for various foods and the conversion of As Purchased quantities to the Edible Portion using percentage refuse data. Their skill in using nutrient names and units of measurements is limited, and they have difficulty identifying food sources of specific nutrients. If students are to become skilled in the use of this information, the computer programs they use must be designed to give them the opportunity to learn and practice these skills.

Computer programs developed for students must be easy for them to use. Students are not always computer experts, yet they are expected to be able to follow program directions and communicate with a program by using its commands. In programs developed here, the directions for using the program, questions, commands, descriptions of the commands and prompts for the user are easy to follow and self-contained in the program, eliminating the need to refer to separate documentation.

Coding of the food items and quantities and the input into the program have been simplified as much as possible, but do vary among the programs the students use. For example, each entry is verified immediately after input in a program students use first to give them practice in checking for accuracy. Students quickly learn that accuracy of the output is no better than accuracy of the input. In programs students use later, an entire list of entries is input, checked for accuracy and the necessary corrections made before continuing with the program.

The output of nutrient data from a computer program must be organized or formatted on the video display or printout so it is easy for the students to read and interpret. Interpretation of the nutrient data from these programs often requires more expertise than is required in the use of computers. In programs students use first, only a few nutrients are included in the output, while in programs used later, the user chooses the number of nutrients desired in the output from several options available. It is important that programs used in education include both (1) nutrient information a professional would want for a client, and (2) options that illustrate various capabilities of computers for displaying the output. The interpretation of numerical output can be enhanced with additional calculations and different types of graphics, depending on the needs of the user. For example, in order to facilitate data interpretations, a calculation and graphing routine is included in programs developed here that prints out and graphs the percentages of a designated Recommended Daily Allowance that is fulfilled by the total for each nutrient for a food list.

The factors just outlined also apply when selecting and using an existing program rather than developing one. Unfortunately, although there appear to be many programs available, an existing program can seldom be found that fulfills all the requirements for use in a new educational setting. It usually must be modified to fit the computer system, the objectives for its use, or in some other way. These modifications can be expensive, therefore, existing programs and their nutrient data bases should be carefully investigated and evaluated before being acquired.

PROGRAM USE BY STUDENTS

Before computer programs with nutrient data bases are used by undergraduate students, it is important to teach the background information that enables students to understand these programs. Because students have had little or no computer experience prior to entering the "Introduction to Food Decision Making" course, they are quite apprehensive about being required to use computer programs for class projects. Their apprehension disappears, however, after they have had the opportunity to learn to use a computer terminal and a program with a limited nutrient data base and only a few commands.

Three questions students frequently ask before using computer programs are: (1) "What is a computer program and what does it do?"; (2) "What is a nutrient data base and how is it used by a computer program?"; (3) "What must I do to be able to use computer programs with nutrient data bases?" The subject matter for the computer unit of the "Introduction to Food Decision Making" course has been organized to answer these questions. The following course activities were developed to provide students with the necessary skills to use computer programs with nutrient data bases as a tool for performing nutrient calculations.

1. Lectures and reading assignments covering basic information about computer programs and how they function, emphasizing use of commands to communicate with programs through computer terminals to input data and receive feedback or output.

2. Lectures describing food composition tables, journal articles and commercial companies as sources of data for nutrient data bases for computer programs.

3. Display of several examples of food composition tables including USDA Agriculture Handbook No. 8 (Watt and Merrill, 1963), its printed updates, sections 8-1 through 8-9, and a printout of the nutrient data from the Nutrient Data Base for Standard Reference, Release 2 computer data tape; USDA Agriculture Handbook No. 456 (Adams, 1975); USDA Home and Garden Bulletin No. 72 (U.S. Department of Agriculture, 1981); and "Bowes and Church's Food Values of Portions Commonly Used" (Pennington and Church, 1980).

4. Reading assignments of two journal articles, one by Hertzler and Hoover (1977) covering use of food composition tables as nutrient data bases for computer programs, and one by Hepburn (1982) describing the USDA national nutrition data bank.

5. Lectures describing the food and nutrient data included in the data bases for the programs students will use for class assignments, followed by a class discussion of the following handouts covering how programs with nutrient data bases operate:

   (a) Directions for using teletype terminals in student computer labs.
   (b) Program printout giving directions for using the MENU program.
   (c) Program printout giving directions and examples of the output for the NUTALLY program.

6. Reading assignments of two journal articles chosen from a list of six articles describing the nutrient calculations performed by different computer programs, each with a different nutrient data base.

7. Problem sets designed to give students practice in finding, calculating and using data to be entered as input into each of the computer programs they will use for class assignments. Problem sets include:

   (a) Designating the recommended serving size in household measures for a list of foods.
   (b) Converting food weights and measures from common units to metric and the reverse.
   (c) Calculating Edible Portion from As Purchased weight and percentage refuse for the foods listed.
   (d) Hand calculating and totaling the amounts of several nutrients in a list of foods as would be done by a computer program.
   (e) Calculating the gram weight for one serving for a list of foods.
   (f) Choosing food codes and specifying food quantities for input into the TALLY and NUTALLY programs.

8. Field trip to the student computer lab where students are supervised by the instructor as they learn how to use computer terminals and programs.

After students learn how to use computer programs with nutrient data bases, they complete two class projects designed to require use of most of the options available in our programs. Students must enter foods into the program (usually foods in a food intake) and then use the program to calculate and print out the nutrient content for each food, the totals for each nutrient for each meal, snack and for the day, percentage of the RDA specified, and graphs of the RDA percentages. The projects also require students to use a computer program to revise a menu to meet specified nutrient goals by deleting and adding foods and adjusting food quantities until the goals are met as indicated by the totals printed out. The student also assumes the role of a professional to interpret the nutrient data in the program output. This interpretation may involve identifying foods that are good or poor sources of specific nutrients, using the data for additional calculations that provide more information, or comparing nutrient totals with recommendations.

SUMMARY

The development and use of computer programs with nutrient data bases for undergraduate education in food science and nutrition provide challenges for food scientists, nutritionists and educators. Describing an idea for a program, obtaining funding and developing an idea into a program is the first challenge. The second is to use the program in an educational setting. To develop basic skills in using computer programs with nutrient data bases, undergraduate students must first learn the background information that enables them to understand these programs and how they are used. After skills in program use have been developed, students should have the opportunity to use and improve these skills by using computer programs for complex projects in advanced courses.

LITERATURE CITED

Adams, C.F. 1975. "Nutritive Value of American Foods in Common Units." Agriculture Handbook No. 456, Agricultural Research Service, United States Department of Agriculture, Washington, D.C.

Asp, E.H. and Gordon, J. 1981. Development of a computer-assisted program for undergraduate instruction. J. Nutr. Educ. 13 Supplement 1:S91-S95.

Bloom, B.C. (ed.) 1956. "Taxonomy of Educational Objectives: Handbook I, Cognitive Domain." David McKay Company, Inc., New York.

Gronlund, N.E. 1976. "Measurement and Evaluation in Teaching." 3rd ed., Macmillan Publishing Company, Inc., New York.

Hepburn, F.N. 1982. The USDA national nutrition data bank. Am. J. Clin. Nutr. 35:1297-1301.

Hertzler, A.A. and Hoover, L.W. 1977. Development of food tables and use with computers. J. Am. Dietet. Assoc. 70:20-29.

Pennington, J.A.T. and Church, H.N. 1980. "Bowes and Church's Food Values of Portions Commonly Used," 13th ed., J.B. Lippincott Company, Philadelphia.

U.S. Department of Agriculture. 1981. "Nutritive Value of Foods." Home and Garden Bulletin No. 72, Consumer Nutrition Center, Science and Education Administration, Washington, D.C.

Watt, B.K. and Merrill, A.L. 1963. "Composition of foods--raw, processed, prepared." Agriculture Handbook No. 8, Consumer and Food Economics Research Division, Agricultural Research Service, United States Department of Agriculture, Washington, D.C.