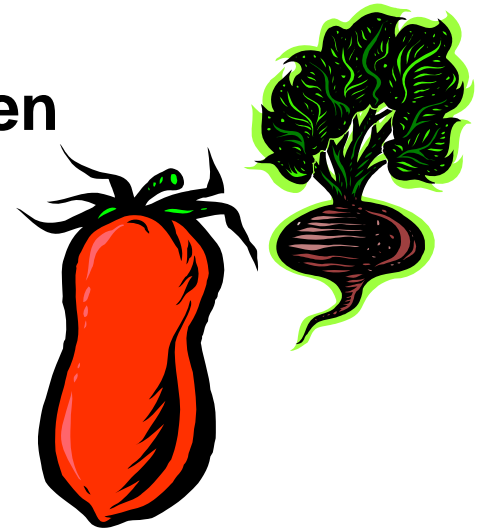


Estimating Consumption of Agricultural Commodities Using NHANES Dietary Intake Information:

**EPA's Use of the "What We Eat in America"
Dietary Consumption Survey**

**Presented by Joanne M. Holden
Nutrient Data Laboratory
BHNRC,ARS, USDA**



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Outline

- **Intro to EPA's Office of Pesticide Programs (OPP)**
- **Dietary Exposure Assessment in OPP**
 - **Exposure Assessment Software and Modeling**
- **NHANES/WWEIA Food Consumption Survey**
- **NDL Food Formulation Program**
- **OPP and "Food Recipes"**
 - **"Food" to "Food Commodity" Conversions**

EPA's Office of Pesticide Programs

- **Registers pesticides used on food crops, in and around the home, for industrial purposes, and for public health protection**
- **Determines safety of pesticides by assessing dietary and residential/occupational exposures and associated risks**
- **Establishes legal limits (aka “tolerances”) for pesticides on agricultural commodities**

EPA's Office of Pesticide Programs

- **Dietary (Food +Water) Assessments**
 - Information on pesticide residues in food and water are combined with consumption information to produce distributions of estimated exposures
- **Residential Assessments**
 - Information on use practices, activity patterns, and pesticide concentrations in various residential media are used to produce estimates of exposures in the home
- **Occupational Assessments**
 - Information on application rates, activities, contact rates, and pesticide concentrations are used to assess exposures to mixers/loaders applicators, and re-entry workers

EPA's Office of Pesticide Programs

- **Use of NHANES Data**
 - **Food Consumption Survey Data (WWEIA)**
 - **Nutrient Data Laboratory Food Formulation Software**
 - **Pesticide Bio-monitoring Data**

Dietary Risk Assessment:

Estimating Exposure

- **Dietary exposure estimates are derived from two distinct pieces of information:**
 - **The amounts of foods people eat:**
 - **USDA's Continuing Survey of Food Intake by Individuals (CSFII) 1994/96/1998**
 - **NHANES "What We Eat in America"**
 - **NDL Estimates for Ingredients in commercial foods**
 - The amount of pesticide in and on food (i.e., pesticide residues)**
 - **field trial data**
 - **monitoring data**
 - **USDA PDP**
 - **FDA**
 - **market basket survey**

Exposure Assessment Software and Modeling

- OPP uses a number of software models to perform its risk assessments:

DEEM-FCID/Calendex



ILSI Research Foundation

SHEDS-Multimedia



- Dietary Exposure Equation:

$$\text{Dietary Exposure}_{\text{(mg ai/kg bwt)}} = \sum_{i=1}^n (\text{Consumption}_i_{\text{(gm food/kg bwt)}} \times \text{Unit Conversion}_{\text{(1 kg food/1000 gm food)}} \times \text{Residue}_i_{\text{(mg ai/kg food)}}) \quad (1)$$

where n = number of unique foods (or food commodities) consumed

Exposure Assessment Software and Modeling

- The modeling tools rely on probabilistic techniques (Monte-Carlo) to evaluate exposure
 - Techniques are routinely applied by OPP for virtually all of its pesticide risk assessments
 - More accurate estimates of entire range of exposures and their associated probabilities
- Allow the Agency to characterize and quantify the variability in dietary exposure across various subgroups of interest

Conversion of Food to Food Commodities

Food Consumption
(in gram amounts)

X

Recipes
(aka 100 gram files)



Food Commodity Consumption

Reported Amounts Consumed

Example CSFII Food Diary (28517-2-2)

(1 yr Male, 13.6 kg bwt (30 lbs), Height=28", healthy, no food allergies)

SEQN	Time of Day	Food Description	Amount (unit code)	Consumption (gm)	Food Source
1	7:00 AM	Milk, cow's, fluid, whole	6 fl.oz (10205)	183	Store
2	10:15 AM	Egg, whole, fried W/ LARD	2 XX (60919)	92	Store
3		White potato, home fries W/ LARD	2 C (10205)	388	Store
4	6:00 PM	Chicken, drumstick, with or without bone, roasted, skin eaten	1 XX (61343)	52	Store
5		White potato, home fries W/ LARD	1-2 C (10205)	388	Store
6	8:00 PM	Milk, cow's, fluid, whole	6 fl.oz (10205)	183	Store

Recipe for
“White potato, home fries with lard
(71403000-200001)”

	RAC Code	Commodity (RAC)	Food Form (CSFFCM)	Food Form Description	Grams Per 100g
White potato, home fries with Lard (71403000-200001)					
1	01032990	Potato, tuber, w/peel	213	Fresh, Fried	82.6
2	03002370	Onion, dry bulb	213	Fresh, Fried	10.2
3	19022740	Pepper, black and white	213	Fresh, Fried	0.034
4	25002930	Pork, fat	213	Fresh, Fried	6.8

What We Eat in America (WWEIA)

- What We Eat in America (WWEIA) is the dietary intake interview component of the National Health and Nutrition Examination Survey (NHANES).
- Nationally Representative/Statistically-Based
 - Intakes of individuals residing in 50 states and D.C.
- Data released in 2-year cycles
- Contains Food Consumption Data for ~ 7000 foods
 - Unique 8 digit food code
- Oversampling of various subpopulations
- Consisted of:
 - 2 non-consecutive days
 - DAY 1: in-person 24 hour recall at MEC
 - DAY 2: telephone interview (ca. 3-10 days later)

WWEIA Data Files

For each 2-year data release cycle, two dietary intake data files are available...

1) Total Nutrient Intakes File –

- Contains one record per day for each survey participant.
- Each record contains details of intake of food and water and daily totals of nutrient intakes

2) Individual Foods File –

- Contains one record per food for each survey participant
- Day 1 and Day 2 are in separate files (must be combined)
- Foods are identified by USDA WWEIA food codes.
- Each record contains information about
 - when and where the food was consumed,
 - whether the food was eaten with other foods,
 - amount eaten, and
 - amounts of nutrients provided by the food.

Nutrient Values for WWEIA

- NDL develops and maintains the National Nutrient Database for Standard Reference
- Values for 65 components are obtained from analytical projects, the food industry, or standard calculations (e.g., factors, formulations, recipes)
- Database of 3000 foods is released to FSRG
- Foods eaten "as is" and as food ingredients

FNDDS-SR-Link* for Apple Crisp

Food code	SR code	Seq num	SR description	Weight (g)
53415100	18069	1	BREAD,WHITE,COMM PREP(INCL SOFT BREAD CRUMBS)	168.8
53415100	14429	2	WATER,TAP,MUNICIPAL	51.8
53415100	19335	3	SUGARS,GRANULATED	100
53415100	9004	4	APPLES,RAW,WO/SKIN	586.6
53415100	4610	5	MARGARINE,REG,STK,COMP,80% FAT,W/SALT	28.2
53415100	2047	6	SALT,TABLE	1.0
53415100	2010	7	CINNAMON,GROUND	1.7

This is a recipe in the FNDDS-SR-LINK. Sometimes in the FNDDS there is a one to one link between an FNDDS code and a single SR item code. In other cases, the nutrient profile is calculated by FSRG from SR ingredients.

Recipes

- Hence, need to convert WWEIA from an “as eaten” food basis (e.g, pizza, hamburgers, etc.)
to
a food commodity basis (e.g, tomato sauce, wheat flour, apples, soybean oil, beef, milk, etc.)
- Conversion performed by means of standard recipe (aka “100 gram”) files to produce a parallel food commodity database
 - **Food Commodity Intake Database (FCID)**

Nutrient Data Lab's Recipe and Formulation Tools

- **Recipe - A recipe is the list of ingredients and their known weights or measures in a multi-ingredient food item. Final item is adjusted for “yield” and nutrient retention**
- **Formulation - A formulation is the estimated weight of ingredients in a multi-ingredient commercial food item**

NDL Formulation Estimations Will Assist the OPP

- **If there is an FNDDS food code that links to a single SR item that is a multi-ingredient food (e.g. apple pie)**
- **If label ingredients are available for the SR item**

Formulation Estimation Process

Select SR ingredients that best match the industrial ingredients



Select some **known nutrient values** for the food item as 'Program Targets'



Select SR items that best match the label ingredients



Add additional guidance to the program to assist it in estimating the percentage of each ingredient and calculating nutrient values based on these percentages (i.e. use nutrient values from the ingredients to calculate final, estimated, nutrient values for the commercial product). Each nutrient estimation is a weighted mean of the ingredient nutrient values.

Selected nutrients are targeted for best-fit matching

Nutrient Data Bank System - REAL

Formulation

Action Edit Query Record Window Utility Main Menu Outlier Reports Help

Main Menu Save < > Add Tab Copy Run Query Formulate Calculator

Identifier: 278696 Type: Formulated Created By: LLEMAR
Food Group: 08 Sub Group: Creation Date: 04-10-2009
Initial Name: Modification Date: 04-13-2009
Edited Name: Commercial apple pie LIST Include NDB No. In Edited Name Brand Name:
Approved:
Ingredient Basis: 278701 Component Basis: Target Nutrient Basis: 67635 Help
Food Supply: Ingredient: PDS: SR: Special: Proprietary:
Lipid Conversion Factor: .5342 Retinol Factor: 204.5002 RAE Factor: 4.6190 1 of 1

SOURCE INGREDIENTS TARGET PRODUCT NUTRIENTS NAME WEIGHT PREP INST

Number	Name	Target Value	Calculated Value	Unit	Key Nutrient	Model Error
X 421	Choline, total	7.1890	7.3864	mg	<input type="checkbox"/>	2.75
X 431	Folic acid	23.0000	23.0006	mcg	<input checked="" type="checkbox"/>	.00
X 432	Folate, food	4.0000	4.7790	mcg	<input type="checkbox"/>	8.48
X 435	Folate, DFE	43.1000	48.8951	mcg_DFE	<input type="checkbox"/>	13.45
X 501	Tryptophan	.0260	.0222	g	<input type="checkbox"/>	-14.61
X 502	Threonine	.0540	.0542	g	<input type="checkbox"/>	.33
X 503	Isoleucine	.0730	.0664	g	<input type="checkbox"/>	-9.03
X 504	Leucine	.1290	.1337	g	<input type="checkbox"/>	3.64
X 505	Lysine	.0700	.0530	g	<input type="checkbox"/>	-24.24
X 506	Methionine	.0320	.0315	g	<input type="checkbox"/>	-1.51

Print Help Total Model Error: 8.27

formulate.fmb

Record: 47/91 ... List of Valu... <OSC>

Folic acid targeted as best indicator of flour %

Total model error is the summation of the absolute value of individual model errors of the nutrients targeted for matching

Final Formulation Estimation

Nutrient Data Bank System - REAL

Formulation

Action Edit Query Record Window Utility Main Menu Outlier Reports Help

Main Menu Save < > Add Tab Copy Run Query Formulate Calculator

Identifier 278696 **Type** Formulated **Created By** LLEMAR
Food Group 08 **Sub Group** **Creation Date** 04-10-2009
Initial Name **Modification Date** 04-13-2009
Edited Name Commercial apple pie **LIST** **Include NDB No. In Edited Name** **Brand Name**
Approved
Ingredient Basis 278701 **Component Basis** **Target Nutrient Basis** 67635 **Help**
Food Supply **Ingredient** **PDS** **SR** **Special** **Proprietary**
Lipid Conversion Factor .5342 **Retinol Factor** 204.5002 **RAE Factor** 4.6190 **1 of 1**

SOURCE INGREDIENTS TARGET PRODUCT NUTRIENTS NAME WEIGHT PREP INST

Min Whole Grain % Summed Whole Grain % 0

Ingredient List

Rank	Food Item Identifier	NDB NO	Edited Name	Ingrd Subst	Whole Grain	Lower Bound	Exact Amount	Upper Bound	Relax Order	Est. % Wt.	% Fat Loss	Nutr Lost w/ Fat	% Moist Loss	Ret ID
X 1	63980	9004	Apples, raw, without skin	<input type="checkbox"/>	<input type="checkbox"/>	0	<input type="checkbox"/>	100	<input type="checkbox"/>	65.833	<input type="checkbox"/>	<input type="checkbox"/>	50.00	0151
X 2	68433	20081	Wheat flour, white, all-purp	<input type="checkbox"/>	<input type="checkbox"/>	0	<input type="checkbox"/>	100	<input type="checkbox"/>	16.583	<input type="checkbox"/>	<input type="checkbox"/>		0304
X 3	62720	4610	Margarine, regular, 80% fat	<input type="checkbox"/>	<input type="checkbox"/>	0	<input type="checkbox"/>	100	<input type="checkbox"/>	13.244	<input type="checkbox"/>	<input type="checkbox"/>		
X 4	68254	19335	Sugars, granulated	<input type="checkbox"/>	<input type="checkbox"/>	0	<input type="checkbox"/>	100	<input type="checkbox"/>	3.877	<input type="checkbox"/>	<input type="checkbox"/>		
X 5	62198	2047	Salt, table	<input type="checkbox"/>	<input type="checkbox"/>	0	<input type="checkbox"/>	100	<input type="checkbox"/>	.363	<input type="checkbox"/>	<input type="checkbox"/>		
X 6	62161	2010	Spices, cinnamon, ground	<input type="checkbox"/>	<input type="checkbox"/>	.1	<input type="checkbox"/>	.3	<input type="checkbox"/>	.1	<input type="checkbox"/>	<input type="checkbox"/>		
X				<input type="checkbox"/>	<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>		<input type="checkbox"/>	<input type="checkbox"/>		

Select Ingredients Water Ingredients Refresh Formulation Report Common Substitutions Whole Grains Help Help

formulate.fmb

Record: 1/1 <OSC>

NHANES-FCID

- Will be based on WWEIA and SR Procedures
 - Current FCID based on CSFII 1994-96/1998
- Food “as-eaten” translated to agricultural (food) commodities (EPA food vocabulary)
- Foods commodities also coded for:
 - Cooked status (e.g., Cooked, Uncooked)
 - Food form (Fresh, Frozen, etc.)
 - Cooking method (Baked, Boiled, etc.)
- **Approximately 570 food commodities**
 - From ca. 7000 foods in WWEIA
 - 8 digit food commodity code
 - E.g., 01032990 = Potato, tuber, w/ peel

Future Plans/Directions

- Complete FCID-NHANES 99+
 - Comparison with 1994-96/1998 FCID
 - Eating occasion basis
- US EPA's Exposure Factors Handbook
 - Electronic files
- Eating Patterns
 - Seasonal Consumption Patterns??
 - Geographic Consumption Patterns??
- International Comparisons/Databases

Conclusions

- **The resulting food commodity consumption database (FCID) derived from WWEIA and NDL procedures will be incorporated into OPP's pesticide exposure models as a replacement for the current CSFII data**

For Further Information...

***Available Information for Assessing
Exposure to Pesticides in Foods***

A Users Guide

<http://www.epa.gov/fedrgstr/EPA-PEST/2000/July/Day-12/6061.pdf>

**David Miller
(miller.davidj@epa.gov)**

Thank you!