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Computerized Nutrient Analysis Systems

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Introduction

Since the early 1980s, nutrient analysis software programs have taken advantage of microcomputer technology to offer an effective and time-efficient method for calculating dietary intake for a variety of users.[1,2] For health professionals, the computerized dietary analyses can be used as a persuasive tool to provide feedback for clients about current food choices as well as healthful alternatives. For nutrition educators, the hands-on applications of dietary analysis programs are an integral part of student education. For researchers and government agencies, the computerized dietary results are an essential component for documenting and analyzing the usual food intake of individuals and groups or target populations. Computerized nutrient analysis software is also important for recipe development by chefs and caterers, as well as for label information provided by food manufacturers.

Nutrient analysis systems convert individual food choices entered from a food record or food frequency to nutrients.[3,4] Computerized data processing includes creating a data file with a food code and an amount consumed for each food item reported. The computer software then links the nutrient composition of each food, stores that information, and sums across all foods for each nutrient. Dietary analysis software is provided by a large number of companies and organizations today. These companies continually update the quality and scope of their services to stay competitive in the marketplace. However, their computer programs vary considerably in cost, ease of use, features, and capabilities. For the prospective user, the choice of software requires careful consideration of needs and available resources of staff, and financial support for computer hardware and peripherals. Characteristics and general operating features of a number of widely used commercial nutrient software programs with extensive database development are included in Table 23.1.

Primary Characteristics and Operating Features of Software Programs

Primary features of software nutrient analysis programs include 1) nutrient components of interest (e.g., macronutrients, fatty acids, amino acids, sugars, antioxidants), 2) national

TABLE 23.1

Comparison of Features in Five Selected Programs Available Nationwide

Company	Product Name(s)	Targeted End Users*	Total Number of Unique Foods/Items in Database	Diet Comparisons**	Support***	Operating Requirements	Cost of Product	Current Number of Users or Installations	Other Important Features
Computrition, Inc. Chatsworth, CA 818-701-5544 www.computrition.com	Nutritional Software Library	C, H, M	4200, small database 20,000+, large database	N, M	CE, U	WindowsNT, 98, and 2000	$495 small database $995 large database (single user system only)	N/A	Integrated with foodservice and nutrition management software systems
ESHA Research, Inc. Salem, OR 800-659-3742 www.esha.com	The Food Processor®: Nutrition analysis & fitness software	C, H, M, R	25,000+, includes the Canadian Nutrient File	N, FC, FG, M	C, CE, U	WindowsNT, 98, and 2000	$599 Educational prices available (cost to add stations)	3200	Menu analysis, recipe analysis Exercise planning
First DataBank San Bruno, CA 800-633-3453 (East); 800-428-4495 (West) www.firstdatabank.com	Nutritionist Pro Nutritionist Pro Food Labeling	H, M, R	18,000	N, FC, FG, M Food groups using diabetic exchanges	C, CE, U	WindowsNT, 98, and 2000	$595	Thousands	Professionally designed reports Ability to create menu templates to make data entry faster Ability to generate food labels
Nutrition Coordinating Center (NCC) University of Minnesota 612-626-9450 www.ncc.umn.edu	Nutrition Data System for Research (NDS-R) Academic NDS-R (for teaching purposes) Grad-Pack NDS-R (for graduate students)	R	18,000	N, FC, M System generates 12 standard reports	C, CE, U	WindowsNT, 98, and 2000	$8500 initial, $2500 additional years $690 Academic $495 Grad-Pack	Over 700 installations	Prompts for complete food descriptions, recipe ingredients, and food preparation methods Interview facilitated by multiple-pass system
University of Texas School of Public Health 713-500-9775 www.sph.uth.tmc.edu:8052/hnc/software/soft.htm	Food Intake Analysis System 3.99	R	7320	Comparison standards input by the individual user	C, U	DOS	$3500	60	Commercial version of USDA's Survey Net, used in the Continuing Survey of Food Intakes (CSFI)

* C = Consumers, H = Health Professionals, M = Medical Centers or Hospitals, R = Research
** N = Nutrients using DRI/RDA, FC = Other Food components, FG = Food Guide Pyramid food groups, M = Meals
*** C = Company Support Included in Cost, CE = Company Support Extra Cost, U = Updates available

TABLE 23.2

Examples of Dietary Components Available from Computerized Nutrient Analysis

Energy Sources	**Fiber**	**Fatty Acids**
Energy (kilocalories)	Total dietary fiber	SFA 4:0 to 22:0
Total protein	Soluble fiber	MUFA 14:1 to 22:1
Total fat	Insoluble fiber	PUFA 18:2 to 22:6
Total carbohydrate	Pectins	Trans FA 16:1 to 18:2
Alcohol		
Animal protein	**Vitamins**	**Amino Acids**
Vegetable protein	Vitamin A RE	Tryptophan
% Calories protein	Beta-carotene RE	Threonine
% Calories fat	Retinol	Isoleucine
% Calories carbohydrate	Alpha-tocopherol RE	Leucine
% Calories alcohol	Beta-tocopherol RE	Lysine
	Gamma-tocopherol RE	Methionine
Fat and Cholesterol	Delta-tocopherol RE	Cystine
Cholesterol	Vitamin C	Phenylalanine
Total sat fatty acids (SFA)	Vitamin D	Tyrosine
Total mono fatty acids (MUFA)	Vitamin K	Valine
Total poly fatty acids (PUFA)	Thiamin	Arginine
Total trans fatty acids (TFA)	Riboflavin	Histidine
% Cal SFA	Niacin	Alanine
% Cal MUFA	Folate	Aspartic acid
% Cal PUFA	Vitamin B_6	Glutamic acid
	Vitamin B_{12}	Glycine
Carbohydrates	Pantothenic acid	Proline
Starch	Biotin	Serine
Fructose		
Galactose	**Minerals**	**Other**
Glucose	Calcium	Aspartame
Lactose	Chromium	Saccharin
Maltose	Copper	Ash
Sucrose	Magnesium	Caffeine
	Manganese	Oxalic acid
	Phosphorous	Phytic acid
	Potassium	Sucrose polyester
	Selenium	3-methylhistidine
	Sodium	Water
	Zinc	

standards or guidelines used for evaluation (e.g., DRI/RDAs, U.S. Dietary Guidelines, National Cholesterol Education Program), and 3) comparison by food groups, diabetic exchanges, selected food items, or meal patterns. Many programs begin with client profile information such as gender, age, height, weight, pregnancy or lactation status for women, and tracking information (name, address, phone number, case number). With some program packages, dietary standards can be tailored to fit a specific client's needs, such as calculating energy needs or targeted weight goals. The final presentation of the data may take the form of two- and three-dimensional pie and bar charts, Food Pyramid or DRI comparisons, nutrient summaries, or ranking foods in descending or ascending order based on any nutrient. Data may be collected and averaged for individuals or groups for a specified period, from days to weeks. Nutrients commonly included in software systems results are listed in Table 23.2.

Additional features that may be relevant to users include the software program's ability to provide food–drug interaction data; to incorporate nutrition support regimens; to incorporate a recipe database; to add and/or modify foods, nutrients, and recipes; to scale and/or cost recipes; to provide a shopping list; to plan meals and/or provide sample menus;

and to compare a meal with one-third RDA values (for menu planning). The software may have data export capability (for export into statistical analysis software packages or word processing programs so that text can be edited, or logos or other graphics added), support for scannable questionnaires (useful for health surveys, food frequency checklists, or entering calorie count data from inpatient menus), support for multi-user application, and interface capability with foodservice management software.

Basic Questions to Ask When Considering Different Software Systems

Depending on the projected use of a nutrient analysis system, many or all of the following basic questions may apply when evaluating individual programs:

- *What are the operating system and hardware requirements?* Would this involve an investment in new equipment and peripherals?
- *Who is the target audience of the output?* Are consumers, health professionals, Medical Centers or Hospitals and/or Research included?
- *What are the total number and types of foods contained in the database?* How many foods are included? Are baby foods, convenience foods, fast foods, regional specialties, ethnic specialties, and nutritional supplements included?
- *What specific nutrients or food components are in the database?* Are only a dozen or more than 100 nutrients or other components calculated? Can the database be altered?
- *How complete is the database?* What is the extent of missing values? When data for specific nutrients are missing, are they estimated or left as zero (reducing the usefulness of nutrient reports)? Are missing nutrient values identified on reports, so that they are not misleading?
- *How is the quality of database maintained?* As new nutrient data become available, how often does the software vendor respond?
- *What is the ease of inputting for foods and amounts?* Are there numeric code, food name, and search feature options for entering a food? Is online help provided to distinguish food listings and store frequently used food or meal categories for ready access? Does flexible entry of portions allow choices by weight, volume, and/or dimensions?
- *Is there an accommodation to support food frequency data?* Is this available in a scannable form?
- *Which nutrient standards are used, and are they up to date?* Are the latest DRIs used? Are standards omitted for subpopulations (children, pregnant or lactating women)?
- *What is the variety and quality of on-screen feedback for viewing reports?* Can on-screen reports be used for client counseling? Is the software interactive, allowing a user to experiment with dietary choices while offering instantaneous feedback about the bottom-line impact on nutrient intake?
- *What is the variety and quality of printed reports?* Does the program provide easy-to-understand graphics (e.g., bar graphs, pie charts) in comparing intake with designated standards? Are graphical comparisons available with several stan-

dards, such as the Food Pyramid or NCEP, included? Is the report's final message well formatted and descriptive?

- *Can the reports be customized?* Can reports be reformatted or can specific information and comments be added?
- *Is the report capable of using different measures for comparison*? Does the report include food groups, diabetic food exchanges, glycemic index values?
- *Can multiple-day intakes be summarized?* Can the report include several days or weeks for comprehensive analysis?
- *What are the formulas used for calculating ideal body weight and energy requirements?* Are current and reasonable standards used?
- *Can exercise data be incorporated into caloric requirements?* Does the report include exercise recommendations?
- *Can key sources of each nutrient be identified in the food records?* Can lists of food sources of key nutrients be generated?
- *What is the quality of software documentation, on-line help, and tutorials?* Are they easy to understand and specific to user needs?
- *What is the quality of product support and ongoing maintenance?* Is there sufficient technical support provided to answer user needs?
- *What are the system utilities*? Are there utilities for backing up valuable data and reports?
- *Finally, what does the complete system, with updates and service, cost?* Are there additional costs to add stations or for multiple users?

Importance of Nutrient Databases

Dietary intake data collected using both food records and food frequency questionnaires or checklists rely heavily on food databases. Multiple factors affect the accuracy of the database, including the source of nutrient information, the number of foods and nutrients in the database, the method of handling missing values, and the frequency of updating the database. Several published reports have compared nutrient calculations among a limited number of database systems.[5-12] When the database calculations have been compared to a standard[13-15] or tested against chemical analyses from a single source,[16-18] most found nutrients to be within 15% of reference values. For example, a recent comparison from 4 different databases and their deviations from chemically analyzed values of 36 menus showed that the database values for the nutrients examined had relatively good accuracy: 7 nutrients deviated by values <10%, 5 by 10 to 15%, and only one by 15 to 20%.[19] There are several potential reasons for these variations, including:

1. Nutrient variability in the food supply
2. Frequent changes in the nutrient content of processed foods
3. Nutrient information from food labels is permitted to vary from actual nutrient content by a large margin
4. Estimated or imputed values for missing nutrient information by database developers is a source of error in nutrient estimates

5. Food substitutions or misidentification of foods entered
6. Constraints of chemically determined nutrient values used for comparison (e.g., sample collection, assayed values)

It is important to note that no standardized benchmarks have been established for comparing nutrient calculation output.

Most nutrient analysis systems in the U.S. contain the USDA National Nutrient Database (NNDB) complemented by nutrition information from other scientific sources and food companies.[20] The NNDB was developed and implemented in 1985, and includes the most recent USDA Nutrient Database for Standard Reference and the Primary Nutrient Data Set for USDA Nationwide Food Surveys. The USDA's National Nutrient Databank System (NDBS) is the repository of several types of food information, including food names, food descriptors, food formulations and recipes, the composition of foods, food yields, nutrient retentions, factors for deriving energy, protein, and fatty acid values of foods, and weights for various measures of foods. It currently contains data for over 6200 foods and up to 82 nutrients. The NDBS contains systematic and common food names, source information, and information about analytical methods. The development of representative food composition values involves the acquisition, documentation, evaluation, and aggregation of food composition data compiled from a wide variety of sources. The USDA does not have dedicated intramural analytical laboratories to support the NDBS, and limited data are provided by ongoing research programs. Thus, to meet user needs it is dependent on other sources including the scientific literature, food industry, academia, other government agencies, and contracts sponsored by the Nutrient Data Laboratory. The latest 1999 USDA Nutrient Database, Release #13, includes added food composition data for several hundred new items and added data on selenium and vitamin D compared to the 1998 Release.[21] An online database search program is available on the USDA Nutrient Data Laboratory home page: www.nal.usda.gov/fnic/foodcomp.

Limitations of Nutrient Analysis Software Reports

Nutrient analysis software has its own unique limitations.[4] The calculations of nutrient intake are not exact because there are too many variables in the analysis, including the database and the program's calculation methods. However, these software-related variables are minor in comparison to the larger human challenges to accuracy. Clients and subjects tend to give inaccurate reports of actual food intake using both food records and food frequencies. Data entry is also highly dependent on interpreting and selecting the right match from the food database.

Individuals may also misinterpret the results. Computer-generated printouts tend to convey an authoritative tone, often leading to the perception that the reports are more precise than they really are. Individuals unfamiliar with DRI/RDA comparisons may easily misinterpret them as minimal nutrient needs, assuming that they should be at 100% to avoid deficiencies. Even professionals may have difficulty drawing specific conclusions from the new DRI/RDA comparisons for individuals.

To use nutrient analysis reports effectively, a health professional should provide individual counseling, including:

1. Specific comments and/or supplementary resources for interpreting printouts

2. Explanations of the limitations of the analysis
3. Suggestions for ways to improve dietary intake (e.g., list food sources for specified vitamins or minerals)
4. Specific comments about the appropriateness of different nutrition supplements
5. Other resources for further guidance, as appropriate.

Conclusion

Nutrient or dietary analysis software designed to aid in calculations offers an important adjunct for improving dietary intake and health for individuals and population. However, health professionals and consumers alike need to be aware of both the benefits and limitations of the various systems and reports available.

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