

COMPUTER APPLICATIONS IN CONTROLLED DIET STUDIES

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Computers were first applied in dietetics to nutrient calculations (1–6), a tedious task that readily lent itself to the new technology. Foodservice management and communication applications developed gradually as computer hardware became more accessible. This chapter will focus primarily on computer applications for nutrient calculations in research. Applications for foodservice management are discussed next, followed by a brief discussion of communication applications.

COMPUTER APPLICATIONS FOR CALCULATING RESEARCH DIETS

Research diet studies may include a feeding component, an *ad libitum* (*ad lib*) component, or both. During the *feeding component* stage, the dietitian develops a research diet that meets specific nutrient goals and then provides these foods

and beverages to participants. The foods and recipes that are included in research diets are typically those that can be carefully controlled and have a known nutrient content. The number of foods used is relatively small, as is the size of the corresponding food composition database. During the *ad lib component* stage, participants select and prepare their own foods and beverages; sometimes their choices must meet specific criteria. Because participants can choose from the wide variety of foods available in the marketplace and may prepare any of numerous recipes at home, a large food composition database may be needed.

Feeding Components of Research Diet Studies

The primary nutrient-calculation task during feeding components is determining the correct proportions of foods to

produce diets that meet specific nutrient goals. Research diet construction is an iterative process. Software is used to repeatedly calculate the nutrient content of a menu as types and amounts of foods are adjusted and readjusted to achieve specific nutrient goals.

It is critical for foods in the database to be clearly and completely described so that foods served on the research ward can be matched to foods in the nutrient database. Values should be available for the nutrients studied, as well as for overall nutrient indicators, such as iron, calcium, and vitamin A, to evaluate the nutritional adequacy of the research diet. Nutrient values should be available for every nutrient and food in the database, if possible, and any missing values should be identified on calculation reports. Because research diets typically contain unique foods and recipes and can involve rarely studied nutrients, the user should be able to add additional foods and nutrients to the database.

The purpose of the study will determine the degree of precision required for the nutrient content of the research diets. (See Chapter 11, “Designing Research Diets.”) In studies using estimated, weighed, controlled nutrient, or constant diets (7), the calculated nutrient content of the diet may suffice. For example, in studies of gastric motility, total meal volume and macronutrient content are precisely controlled, but micronutrient content is not. In studies of drug absorption, wide fluctuations in diet composition must be avoided, but it may not be necessary to verify nutrient composition with chemical analysis of the diet. Chemical verification of calculated diets may be especially important, however, when the different experimental diets must be statistically distinguishable from each other. (See Chapter 22, “Validating Diet Composition by Chemical Analysis.”)

In metabolic balance studies as well as in many other types of controlled diet studies, the actual nutrient content of the diet is determined by chemical analysis so that intake can be compared with excretion. Food composition tables are used in this type of study primarily for planning the research diets.

Food tables are also used in research diet studies to help ensure that other dietary variables do not affect the metabolic data collected. For example, when researchers conduct studies of zinc nutrition, the fiber content of the diet should not vary markedly from one diet period to another because mineral absorption could be affected. Alternatively, when investigators study nitrogen balance, if energy is extremely high during one time period and inadvertently lower in another, this difference may influence protein metabolism. Therefore, estimates of intake calculated from food composition tables play an important role in controlling for any nutrients that will not be chemically analyzed.

Ad Lib Components of Research Diet Studies

In ad lib components of research diet studies, nutrient intakes are assessed using food records, 24-hour recalls, and food

frequencies. These ad lib diets may be an unexpectedly important component of the protocol, because nutrient intake prior to the study may influence nutrient metabolism during the experimental period. For sodium or potassium, a 5- or 6-day period with a constant diet will bring the participant into a state of equilibrium, ensuring that experimental conditions will have the desired effects on subsequent days.

When extended periods of time are needed, however, as for calcium (8), it is not feasible to employ an equilibrium period to acclimate participants to a new level of intake. One way to simplify the study of calcium balance is to determine the participant’s habitual calcium intake through standard dietary recall methods and provide this level throughout the balance period (9–11).

SOFTWARE REQUIREMENTS FOR CALCULATING RESEARCH DIETS

Understanding software features helps users determine whether existing software can satisfy their research requirements or whether they must develop their own. Specific requirements will depend on the research protocol and whether there is a feeding component, an ad lib component, or both. If both components are present, two different programs may be necessary.

Nutrient-calculation programs may be categorized as having data entry features, database features, and reporting features. Weaknesses in any one of these three categories can seriously limit a software package’s usefulness. For example, the most accurate and complete database will be of little value if data entry is time consuming and error prone. On the other hand, the most user-friendly software will be of little value if its database is poorly maintained or incomplete. Finally, user-friendly software with a sound database will only be of value if the dietitian can generate the reports needed.

Data Entry Features

Entering Food Descriptions

Most of the early nutrient-calculation software packages required the user to enter food descriptions by numeric code. This meant locating the food in a code book, determining the appropriate code, and entering the code into the computer. This process is tedious and error prone, especially if participants eat a wide variety of foods or the database is large. Most nutrient-calculation software packages now allow food descriptions to be entered by typing the first few letters of the food name. Some packages offer the option of entering food descriptions either by food name or numeric code. It still may be efficient to enter food descriptions by code when the study protocol involves feeding participants a cycle of menus in which the same foods are served repeatedly.

In feeding studies, it is critical that database food descriptors be sufficiently detailed so that foods selected from the nutrient database will match what is served in the research ward or dining room. Abbreviations and descriptors should be used consistently throughout the database to facilitate locating the appropriate database entry.

Entering Food Amounts

Because database nutrient values usually are expressed per 100 g food, almost all nutrient-calculation programs allow entering amounts by weight (eg, ounces, pounds, and grams). If the research protocol involves only a feeding component, this may be sufficient. An ad lib diet component requires software that allows a wider variety of units because participants eating ad lib diets are often unable to describe amounts of food in terms of gram weights. Unit options may include:

- Volume (eg, cups, fluid ounces, tablespoons, and pints).
- Volume with multiple forms (eg, 1 cup sliced vs 1 cup mashed).
- Volume or weight before cooking (this is especially helpful when calculating the nutrient content of a recipe because many include raw ingredients that are ultimately cooked).
- Weight with refuse (eg, when the weight of a piece of meat includes the weight of the bone).
- Standard piece (eg, a “fun size” candy bar, a “medium” banana, or a “Nasco[®]” model-size muffin model).
- Shape (eg, a 2" × 3" × 1" brownie).
- Nonstandard units (eg, bite, sip, handful).
- Not specified or not further specified (ie, no details about amount).

If more of these unit options are offered, fewer manual conversions are needed and there are fewer chances of error. The advantage of the “not specified” category is that missing information is handled in a standardized way.

Entering Demographic Information

A research protocol may require demographic or other information to characterize participants. Some nutrient-calculation software will prompt for entries about age, sex, height, weight, activity level, anthropometric or laboratory measurements, and medication use. Other packages may allow the user to add customized fields for the specific information needed. If the data in these fields and subsequent calculations can be saved in ASCII field-delimited format, the values can be exported to statistical or spreadsheet software. ASCII (American Standard Code for Information Interchange) is a standard code that represents letters, numbers, and keyboard characters and enables information from 1 computer or software package to be interpreted by information from another computer or software package. These data can then be used for other calculations (eg, energy requirements), for grouping records (eg, mean nutrient intakes of males and females), or for merging with other datasets.

Edit Checks for Data Entry

Software developers can incorporate automated edit checks at most points of data entry. These checks help to minimize data entry errors. For example, automated food description edit checks will indicate whether entered letters or code numbers fail to match any of the food descriptions in the database. A user-friendly software package will then suggest alternatives. An automated food quantity edit check will prompt the user to verify or change unusually large values. Some systems may also provide for “double-keyed” data entry, wherein two users enter the same dataset. Any differences between the two are tagged for further verification. This feature is useful for large datasets to prevent errors in entering within-range values (ie, incorrect values that are not unusually large or small).

Database Features

Sources of Data for Databases

Most database developers use one of three United States Department of Agriculture (USDA) data sets as their primary source of data (Table 3–1): The Nutrient Database for Standard Reference (Release 12) (SR-12)(12), the Nutritive Value of Foods (Home and Garden Bulletin 72) (13, 14), or the Survey Nutrient Database (15). The Standard Reference Database is extensive, containing up to 81 nutrient fields for more than 5,000 foods, but there are many missing values. (Earlier versions of the Standard Reference Database were released to the public in print form as Agricultural Handbook No. 8 [16].) Home and Garden Bulletin 72 is available in printed and electronic form (13, 14); all versions include 20 nutrient fields and 960 foods, and have relatively few missing values. The Survey Nutrient Database is the main database used to calculate the nutrient content of dietary intake records collected in the Continuing Survey of Food Intakes by Individuals and the Nationwide Food Consumption Survey, and the National Health and Nutrition Examination Survey III (NHANES III) (17). This database includes 30 nutrient fields and 6,010 foods, and has no missing values.

Other sources of nutrient data may include provisional USDA information (eg, the Provisional Table on the Vitamin K Content of Foods) (18), information released by food manufacturers, foreign food composition tables, and research published in scientific journals.

Data obtained from food manufacturers present special challenges. The amount of information provided by a manufacturer may range from an extensive list of nutrient values, ingredient lists, densities, and preparation instructions to the minimal number of nutrient values required on the product label (19). In addition, the nutrient values may be based on chemical analysis or nutrient calculations of formulations, or they may be the rounded values printed on the product label. As a result, it may be hard to compare nutrient values reported for different brand name products.

Because database developers may obtain their information from many places, the source of each value in a da-

TABLE 3-1**Datasets Maintained by the USDA**

Print Version	Machine-Readable Version	Number of Nutrients	Approximate Number of Foods	Missing Values (Yes/No)
<i>Composition of Foods: Raw, Processed, Prepared</i> (Agriculture Handbook 8)	<i>Nutrient Database for Standard Reference</i> (SR-12)	81	5,975	Yes
<i>Nutritive Value of Foods</i> (Home and Garden Bulletin 72)	<i>Dataset 72-1</i> (Release 3.2)	20	960	Yes
<i>Survey Nutrient Database</i>	<i>Survey Nutrient Database</i>	30	6,010	No

tabase should be documented. Some software provide this information to the user on screen (Nutritionist V[®]) but most maintain it in other formats. A few programs have only one source of data. For example, the Food Intake Analysis System[®] (FIAS) uses only USDA survey data. When many sources are maintained the source may be catalogued by category. If this is the case, source categories should be specific enough to include the different types of data provided by food manufacturers or the different scientific journals and USDA publications from which nutrient data might be obtained (20). It is important that the people responsible for maintaining the database be experts in food composition and use standardized criteria to evaluate sources of data.

Foods Included in Databases

Food records for ad lib components are evaluated by summarizing the nutrient content of all foods consumed by the participant. Because the participant is free to choose among some 50,000 products in the consumer market as well as hundreds of recipes or variations of recipes, developing a representative database can be daunting.

In general, the more foods the database contains, the better. A database that contains many foods will require fewer substitutions and “judgment calls” during data entry. Several techniques have been used to create nutrient databases to evaluate varied intakes. For example, USDA uses a database of approximately 6,000 foods to assess the intake of the entire US population (ie, the *Survey Database* [15]), but many of the 6,000 foods are listed in both salted and unsalted form (increasing the database to about 9,000 entries) and many are also listed several times to reflect about nine different fats that might be used. The grand total is over 30,000 entries. Most programs combine USDA food values with manufacturers’ data for commercial foods. The University of Minnesota Nutrition Data System (NDS) database probably has the most extensive database providing nutrient information by brand name. Many other programs also can provide the user with the tools needed to estimate nutrient intake during ad lib periods, particularly when a limited number of nutrients are required.

In addition to listing foods by generic food type and by brand name, databases may also include a “not specified”

category for some foods. For example, databases often contain descriptions for different forms of the same food, eg, french fries cooked from fresh potatoes, frozen french fries (baked), frozen french fries (fried), and fast-food french fries. It is helpful if the database also includes an “unknown” choice (eg, “unknown type” of french fries) to use when the participant cannot provide sufficient detail about a food. Food descriptions should be mutually exclusive, so that the user does not have to make judgment calls and data collection is standardized.

When an “unknown” choice is selected for a food, the calculated nutrient content typically defaults to either the worst case (eg, the food description with the highest fat content) or to the most common practice (eg, 2% fat milk vs whole or skim milk). The software developer should use consistent criteria in assigning default choices. It is important for the user of the program to be aware of the principles underlying the developer’s choice of default options.

Public or commercial databases can be used to calculate the composition of diets developed for feeding studies, but dietitians often choose to develop a center-specific database for their particular research unit. These unique databases are seldom shared because they represent foods favored by the local staff and participants and contain recipes whose preparation has been standardized in that particular kitchen. The data generally consist of USDA values for basic foods, calculated values for recipes developed in the research kitchen, and (occasionally) chemically analyzed values for foods prepared at the center.

The preferences of the people included in a research study and the nutrients of interest will determine the types of foods needed in the database. When studies include specific ethnic groups (eg, Mexican Americans or Native Americans), the database should include the foods indigenous to those cultures. To support studies of infants and young children, the database must include infant formula and baby foods. When fat is the nutrient of interest, the software should allow changes in preparation method. If sodium is an important study variable, the database should include both salted and unsalted foods.

Regardless of the study population or nutrient of interest, databases that include foods by brand name have two

important advantages. First, in the ad lib diet component of a study, participants may tend to report many of the foods they eat by brand name, and it may be difficult to match brand name foods to a generic database entry. Brand-specific data are also helpful when commercial products are purchased for feeding studies. Second, there may be significant differences in the nutrient content of different brands of the same food. For example, the saturated fat content of various brands of margarine may vary from 0.15 to 1.5 grams per teaspoon. The growing availability of lower-fat and lower-sodium products makes the inclusion of foods by brand name in a database increasingly important. For example, in 1989 there were more than 5,600 reduced-fat products for sale in retail grocery stores (21).

Including brand names in the database also has two disadvantages. First, it becomes necessary to update the database frequently, perhaps as often as every 6 months, to keep pace with new products on the market. Second, no matter how complete the database may be, brand name data will not be available for every product.

Because it is unlikely that any database will contain all foods needed, nutrient-calculation programs should allow additional foods to be added to the database. This is particularly necessary for the feeding component of research studies because the research diet may contain special foods (such as low-protein noodles) or ingredients (such as lyophilized egg-yolk powder) and specially modified recipes not found in commercial databases. If unique foods or recipes are added to the database, software must have a facility for retaining additions when users upgrade to a new version of the software or else the data will be lost.

Recipe Calculations

Both the feeding and ad lib components of research studies may require recipe calculations. Some nutrient-calculation programs (eg, FIAS) allow the user to apply specific nutrient retention factors to raw ingredients to calculate the vitamin and mineral content after cooking (22). Other software packages (eg, NDS) include nutrients for the cooked forms of ingredients, so use of retention factors is not necessary. A third method is to use nutrient values for the raw ingredients and a retention factor for the whole dish (23). For the ad lib component, database builders must consider ways to specify amounts eaten when researchers calculate recipes without accurate yield determinations (eg, expressing amount eaten as a fraction of the whole recipe).

Nutrients Included in the Database

It may seem obvious that the database must include the nutrients addressed in the research hypotheses, but this is sometimes less than straightforward. For example, literature describing a software package may list “fiber” as one of the nutrients included in the database, but upon further inspection, the values actually represent crude fiber instead of dietary fiber. This is sometimes the case, because most database developers take the majority of their data from the older USDA Agricultural Handbook No. 8 series, which included

crude fiber but not dietary fiber (16). USDA’s 1988 “Provisional Table on the Dietary Fiber Content of Selected Foods” (24) and 1989 supplement to Handbook No. 8 listed dietary fiber values for only 300 to 350 foods. Current forms of the database (12) have more complete data.

Even if a database does include the nutrients addressed in the research hypothesis, it is essential to verify that the database is complete for all those nutrients. Many common databases include an extensive set of nutrients but provide little actual data in some nutrient fields. For example, the brochure for a software package may indicate that the database includes values for total saturated fatty acids. However, these values may be missing for a large percentage of the foods because values for some nutrients are not readily available. For example, the software developer may request information from a manufacturer about the nutrient content of frozen entrees. The manufacturer may not provide data for total saturated fatty acid content, however, because the chemical analysis can be costly. Therefore, the database developer might include the products in the database but leave the fields for total saturated fatty acids blank. Problems of this kind can cause a gross underestimation of total saturated fatty acid intake. This characteristic is sometimes referred to as *database sparseness* (its converse is *database completeness*), and it is a critical feature when databases are evaluated for use in a study.

Software developers sometimes replace missing values with estimated values. These are imputed from the nutrient content of similar foods, the nutrient content of different forms of the same food, other nutrients in the same food, published recipes, food formulas, or product ingredient lists (20). In the case of brand name products, the use of ingredient lists may provide the most accurate results. For example, to impute the total fatty acid content of a frozen entree, the software developer can use existing entries in the database to develop a “recipe” based on the ingredient list and nutrient values provided by the manufacturer. The software developer then adjusts the amount of each ingredient in the recipe until the calculated nutrient totals match those reported by the manufacturer as closely as possible (19). Imputing requires the knowledge of highly trained and experienced nutrition scientists. Adding one or more nutrient fields to a database is a job that requires formal training in food science and nutrition, as well as criteria for evaluating different sources of data (25).

In research the need for data often precedes its availability. For example, researchers wishing to study the effect of boron or choline intake on health parameters are hampered by the lack of data on the choline or boron content of foods. Investigators working in the forefront of these areas must develop their own databases and are best off choosing software that can be customized to incorporate additional data. This feature is also useful for conducting feeding studies when nutrient data are available for foods that have been chemically analyzed. As mentioned earlier, it is important to retain added nutrient fields when an updated version of software is installed.

It is important for the user to compile a complete dataset for the added nutrient field, particularly for ad lib components of research diet studies. For studies having only a feeding component, the dataset should be complete for at least the foods being fed (see the previous discussion of missing nutrient values). In either case, the nutrient-calculation program should highlight missing values when they arise.

Updating and Database Integrity

It is critical that software developers update their databases frequently to reflect the most recent analytic data available from the USDA and other sources. Up-to-date information on new and reformulated grocery items must be obtained directly through regular correspondence with the manufacturers; data on products served in fast-food franchises are obtained in a similar fashion. Standard database recipes may also require updating to reflect changes in typical preparation techniques or in the nutrient values of ingredients.

All updates and additions to a database should be cross-checked by a second person trained in database maintenance. Prior to the release of an updated database, there are a series of additional quality control procedures to use in order to minimize data entry errors. These include

1. Computerized edit checks that flag values falling outside of specified ranges for each food category in the database.
2. Validation queries, where calculated algorithms are compared with expected values for each database entry (eg, comparing the sum of soluble and insoluble fiber to the values for total fiber).
3. Comparison of repeated calculations of a set of test records to verify that differences between database versions are caused by intended modifications and not data entry errors (25).

Time-Related Databases

Dietary intake data from long-term studies are sometimes calculated or recalculated months or even years after the original data were collected. Because the composition of food products may change over time, consideration is usually given to using a database appropriate for the time when the feeding period occurred. Investigators may decide to “freeze” the database, meaning they do not adopt updated versions of the databases throughout the study, so study results are not altered by database changes. However, if time-related maintenance procedures are used by a database developer, each version of the database can be used to calculate nutrients for dietary data collected in the past as well as the present (26). This is particularly relevant for labor-intensive inpatient studies, which may accrue their participants during a period of several years.

With time-related databases, nutrients for each food can have more than one value, each for a specific time period, to account for changes in the formulations of products over time. Depending on the date of the food record, the software

selects appropriate nutrient values. No foods are deleted from the database, so food records may be recalculated even though they contain food products no longer manufactured. The manager of a time-related database must assign new values to all foods in the database (both historical and current entries) when improved data become available. This was the case when cholesterol data were updated because of better analytical technology, or when previously unavailable values, such as for the selenium content of foods, are published for the first time.

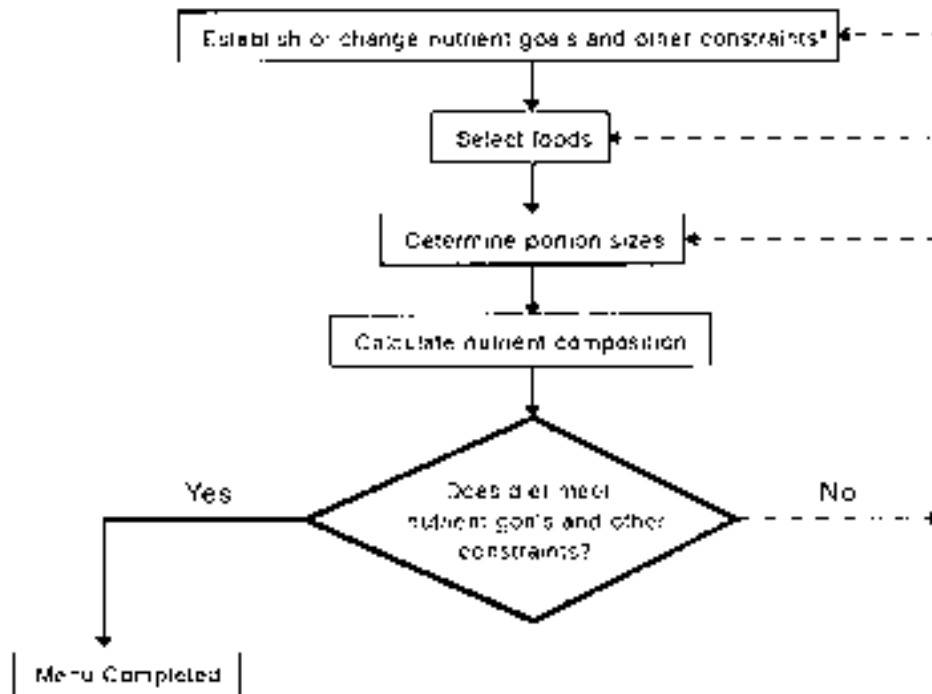
Reporting Features

Calculations Needed for Research Diet Studies

Common to almost all nutrient-calculation software packages is a report of total daily nutrient intake. The number of nutrients for which intake can be calculated usually reflects the number of nutrients in the software’s database. Many packages also report the nutrient content of each food eaten, with subtotals for each meal, as well as totals for the day. Some software packages calculate diabetic exchanges. Others compare intake to a standard, such as the Recommended Dietary Allowances (27) or the daily values developed by the Food and Drug Administration for use in food labels (28), and may allow users to enter customized standards to reflect specific research objectives. Some software translates frequency information into average daily nutrient intake.

The feeding intervention component of research studies requires special calculation features unique to the menu development process. Some nutrient-calculation software packages are able to sort a menu or the entire database by a specific nutrient. This feature is useful when investigators select food items rich or poor in certain nutrients to construct a research diet. Because the menu is repeatedly adjusted and recalculated, a screen displaying the diet’s composition, user-established target values, and the absolute difference or percent difference between the two values shows how well the diet matches the nutrient prescription. Other helpful features include computing nutrient intake per kilogram body weight and average nutrient intake for multiple days. Because some research studies use the same menu for all participants but serve different amounts depending on energy needs, an important feature is *scaling*, ie, the ability to adjust all food weights on a menu by a factor to produce menus with different energy levels. The ability to calculate basal energy expenditure and total energy need is essential during the menu development phase of a study. (See Chapter 17, “Energy Needs and Weight Maintenance in Controlled Diet Studies.”)

Features that support copying menus and editing food quantities simplify the process of calculating participants’ actual intakes for the duration of feeding studies in which the same menus are served repeatedly. When investigators



*Constraints include palatability, cost, minimum and maximum portion sizes, and production logistics.

FIGURE 3-1. Research diet development process.

work with research diets that have different nutrient goals, a time-saving printing feature records the user's request for the entire array of specific nutrients; future printing requests then can "call up" this list and do not require the individual nutrients to be specified.

Reporting Capabilities and Output Files

Most software packages can display reports on the computer monitor or on paper and sometimes as files in ASCII format. It is helpful for investigators to view reports on the computer monitor when determining the nutrient content of a single food, developing a menu that meets certain criteria, and at other times when a printed report is not needed. Reports saved as ASCII files can be edited or merged with other files to incorporate nutrient values into written materials without retyping the information. ASCII files can also be merged with other software for statistical analysis.

Developing In-house Nutrient-Calculation Software

Nutrition studies may require features not included in commercial software packages. When existing programs do not meet the nutrient-calculation or reporting requirements of a research study, users may develop customized databases and programs. Nutrient-calculation programs have been developed using database managers, Statistical Analysis System (SAS®), Fortran®, and other computer languages. These

custom applications are generally not distributed outside the unit where they were developed. Diet Planner is one such custom program, however, that has been shared among the units of the General Clinical Research Center (GCRC) program.

Developing customized programs requires a computer programmer or other staff member with programming skills. Database management software may be one of the easiest ways to develop a custom program if the software is user-friendly enough for novice developers. In practice, however, developing and managing a database and computer program require tremendous effort. The benefit of having a custom-designed program should outweigh, by a substantial margin, the additional time and personnel required to develop and maintain the database and program. See Chapter 11, "Designing Research Diets," for further discussion of developing customized menu analysis programs.

COMPUTER-ASSISTED MENU PLANNING

During research diet development, dietitians use nutrient-calculation software to repeatedly calculate the nutrient content of the diet as they adjust foods and amounts to achieve nutrient goals. Nutrient calculation, however, is just one step in the development process. As outlined in Figure 3-1, the process begins with determining nutrient goals and other constraints and ends with a menu that satisfies them. Dieti-

tians can benefit from software that automatically adjusts the menu to match the goals; for example, algorithmic and mathematical methods such as linear programming can automate food and portion size selection (29, 30). Software with these more sophisticated capabilities is sometimes called a *computer-assisted menu planning (CAMP) program*.

CAMP programs that assist with both food and portion selection can produce palatable, nutritionally adequate, and least-cost regular and modified menus for institutional food service (31), as well as menus and grocery shopping lists for patients with diabetes (32) and other dietary needs. Early CAMP programs developed for institutional foodservices during the 1960s and 1970s were inconvenient because it was difficult and time consuming to quantify all variables influencing menu satisfaction (33). In addition, factors influencing foodservice implementation could not be considered (34).

Current CAMP programs require users to select a menu before the computer determines the portions required to achieve nutrient goals. Examples include programs calculating the quantity of special formulas required to provide the phenylalanine and protein needs of patients with phenylketonuria (35), the weights of foods required to meet nutrient goals of research diets (4, 5), and the proportion of ingredients in mixed dishes that match manufacturer's nutrition label information (36, 37).

Research Diets as Mathematical Problems

Although CAMP programs are not widely used, they have the potential to reduce the time required to develop research diets. CAMP programs typically use complex mathematical techniques, such as matrix arithmetic and linear or integer programming, to develop menus meeting specific criteria. Some spreadsheet programs, such as Quattro Pro[®] and Mi-

crosoft Excel[®], have matrix, linear, and/or integer programming tools that could be used to perform these calculations.

Complex calculations typically performed by CAMP programs are shown in Figure 3–2. Consider developing a formula diet containing lard, safflower oil, and olive oil and providing 19.5 g saturated, 23.0 g monounsaturated, and 7.5 g polyunsaturated fatty acids. Determining the correct fat proportions by trial and error can be time consuming and frustrating. Mathematical techniques, on the other hand, produce an answer more quickly. To compute the answer manually, a set of equations is first developed. Each equation relates the three ingredients' nutrient composition to the target goal or prescription. Coefficients in the equations are simply the nutrient values per gram of fat (eg, lard contains 39.2 g saturated fat per 100 g and the coefficient is 0.392). (Because other formula ingredients—sugar, cornstarch, vanilla, casein, and water—are fat-free, they are not included here.) To find the solution, the equations are solved for three unknowns—amounts of lard, safflower oil, and olive oil—that satisfy all three equations. By varying the equations and adding new ones, this process can be used to determine the amount of other formula ingredients required to match other nutrient goals, such as protein, carbohydrate, and minerals.

CAMP Programs in Research

Linear programming has been used in research settings to calculate formula diets (38) and rat chows (39). CAMP programs are more readily used for developing formula diets than for mixed-food diets because of the greater range of ingredients and proportions that will produce a palatable formula. CAMP applications have been used successfully for mixed-food diets (4), however, to calculate the amounts of foods required to satisfy as many as 23 nutrient goals and maximize or minimize food cost or nutrient level without violating predetermined maximum and minimum portion sizes.

Prescription ¹		Sat, g	Mono, g	Poly, g	
		19.5	23.0	7.5	
Data	Fat Source	Amount of Fatty Acids Per Gram of Fat			
	Fat, g	Sat, g	Mono, g	Poly, g	
	Lard	x	.392	.451	.112
	Safflower Oil	y	.091	.121	.745
	Olive Oil	z	.135	.737	.084
Equations		Prescription = Lard + Safflower Oil + Olive Oil			
	19.5 g Sat	= .392x +	.091y	+ .135z	
	23.0 g Mono	= .451x +	.121y	+ .737z	
	7.5 g Poly	= .112x +	.745y	+ .084z	
Solution ²		x = 48.83 g lard			
		y = 2.63 g safflower oil			
		z = 0.90 g olive oil			

¹Sat(urated), Mono(unsaturated), and Poly(unsaturated) fatty acids.

²Satisfies all three equations.

FIGURE 3-2. Sample CAMP problem, solving 3 equations for 3 unknowns (the amounts of lard, safflower oil, and olive oil required to match a fatty acid prescription).

The CAMP program Interactive Diet Construction (IDC) calculates the composition of foods entered into a menu and determines portion sizes needed to achieve the nutrient goal(s) specified (5). The dietitian determines the menu, declares the portion size of each food as “fixed” or “variable,” and sets the desired level of key nutrient(s). The program then determines the weight of variable foods required to match the nutrient prescriptions. Foods on the menu can be all fixed, all variable, or any combination of fixed and variable where the number of nutrient goals meets or exceeds the number of variable foods. If the computer solution yields an unreasonably large or small portion or calculates a negative portion, the dietitian must add or delete foods or change amounts until the answer is acceptable. This software calculates food amounts to match nutrient goals but not to maximize or minimize a nutrient level.

Because the IDC program was developed for in-house use at one particular research center, it lacks some features commonly found in commercially developed software, such as a sophisticated search procedure, comprehensive user’s manual, database documentation, data entry windows, and display and printing options. IDC could nevertheless be a timesaver when investigators are developing formulas or traditional food menus to achieve complex diet prescriptions.

CHOOSING A NUTRIENT-CALCULATION SYSTEM FOR FEEDING STUDIES

In summary, the most important features of software for research diet design are: (1) a validated database and (2) a calculation module that facilitates iterative calculations as diets are adjusted and readjusted to achieve the research prescription. So far we have discussed the advantages of developing in-house programs and have given two examples of this type of software: Diet Planner and IDC. In most situations, however, it will be more efficient to purchase programs. Two commercially available programs designed for research (FIAS and NDS) have been described. Other programs frequently used for research diet design include CBORD Diet Analyzer, Nutritionist V, and Food Processor.

The MENU database is a new program developed at the Pennington Biomedical Research Center to facilitate the design of diets for metabolic feeding studies. This system, which uses the ETNV (Extended Table of Nutrient Values) database developed by Margaret Moore in the late 1950s, features easy transition between data entry and nutrient totals to support the many revisions required as research diets are adjusted to match study goals.

Another new software package is the ProNutra Analysis System for Metabolic Studies. This system readily lends itself to essentially every type of setting in which controlled diet studies are conducted, although it originally was designed to meet the particular needs of the General Clinical Research Center nutrition program. ProNutra provides diet design and nutrient-calculation functions, as well as kitchen management tools and modules for setting up clinic and

kitchen schedules, performing anthropometric calculations, and tracking body weight.

CITING NUTRIENT DATABASES AND SOFTWARE

Whether the nutrient-calculation program is commercial or custom designed, it is important to document the database and software in published reports. To help researchers be consistent, Monsen (40) and Murphy (41) recommend including the following information when reporting nutrient data:

- Software name.
- Software developer or vendor’s name and address.
- Copyright year, year updated.
- Version number, if applicable.
- Nutrient data source (eg, USDA, manufacturer), if appropriate—especially if the nutrient database is not commercially available. (If the list is extensive, indicate it is available upon request.)
- Database additions or modifications made by user and all sources of data.
- How missing data (eg, nutrient values and foods) were handled by user and their impact on dietary totals, if applicable.

Providing this information in published reports will help investigators evaluate the validity of new research.

OTHER COMPUTER APPLICATIONS IN FEEDING STUDIES

In addition to calculating the nutrient composition of research diets and ad lib dietary intakes, computers can also expedite management and educational tasks associated with nutrition studies. These tasks include: producing kitchen food production sheets and food labels, monitoring inventory and food budgets, tracking numbers of meals served, producing written materials for participants, and generating graphs and slides for presentations. This section briefly outlines personal computer software that research dietitians may find useful, discusses computerizing foodservice tasks, and describes computer communications (eg, electronic mail).

General Software Applications

Many general-purpose programs can streamline research activities and improve the appearance of printed materials.

Word Processors

Word processing programs used with laser printers offer investigators valuable resources for preparing patient education materials, training and management documents, and research reports. Such software also can simplify mass

mailings for recruitment activities. These programs can be used for instant revision, reformatting, and error correction, and they allow typefaces and type sizes to be mixed within a text. Some packages have special options to enhance writing, such as a thesaurus; they also check for spelling mistakes and literacy level (ie, readability). Some software will also print labels (42). Common word processing programs include WordPerfect[®], Microsoft Word[®], and Lotus Word Pro[®] (43).

Desktop Publishing

Desktop publishing programs combine word processing and graphic design features. They enable the user to change typefaces and layout, incorporate diagrams and graphs into the text, and shade sections of text for emphasis. These are complex programs that require considerable training, but they can make educational materials, newsletters, and handouts attractive and effective. Popular desktop publishing software includes Adobe PageMaker[®] and Microsoft Publisher[®] (43).

Spreadsheets

Spreadsheets are electronic tables that support entering, deleting, and modifying data. Mathematical formulas are entered and stored so that calculations may be performed instantly when data are entered or modified. Spreadsheets are commonly used for budgets and cost comparisons. They also may be used for manipulating nutrient or other dietary data. As shown in Table 3-2, spreadsheets can be used for “what if” calculations (42), such as “what happens to energy requirements if age is increased or decreased by 10 years?”

Spreadsheets are especially useful for repetitive calculations. For example, some research studies serve the same menu to all participants but scale the food amounts proportionately for each participant to provide the required energy level. For this purpose, spreadsheet programs can automatically calculate larger or smaller weights for each food. Spreadsheets have also been used to store data on the number of meals served and produced daily, monthly, and year-to-date reports (44).

Spreadsheets generally do not have word processing features, but some word processors can “import” spreadsheet data. Spreadsheets have multiple reporting options and may also have graphics capabilities that enhance printed materials. Popular spreadsheet programs include Lotus 123[®], Microsoft Excel[®], and Corel Quattro Pro[®] (43).

Database Management Systems

In general, database management systems (DBMSs) are like electronic filing cabinets for storing information. Data are entered in rows (records) and columns (fields) similar to a spreadsheet. Groups of records with the same type of information are called *tables* or *data files*. Information can be entered, deleted, and modified quickly. Databases can be searched and a subset of files with specific characteristics retrieved without physically manipulating or moving records. For instance, all protein studies with more than 40 meals served in January can be selected from a file containing data about many studies. Reporting options enable the user to determine how the data are printed, such as in columns, free-form reports, or labels (45). Popular programs include Microsoft Access[®], Corel Paradox[®], and dBase[®] (43).

DBMSs in cost and features offered. Some products require the user to write computer programs to use the software and others do not. “Flatfile” databases store all related data in a single file, whereas other DBMSs allow multiple tables that are linked through one or more common fields. Multitable databases are flexible, easily updated, and more easily perform complex data tasks (46), but an easily learned flatfile or nonprogrammable database package may be all that is needed for most foodservice uses (47).

Statistical Analysis

It may be necessary to summarize the dietary information that has been collected during a study. Spreadsheet and DBMS programs can perform some statistical calculations and facilitate printing data summaries. More sophisticated analyses can be performed on a personal computer with pro-

TABLE 3-2

Using a Spreadsheet to Calculate the Energy Requirement for a Male at Different Ages

Column	1	2	3	4	5	6	7
Name	Height (cm)	Weight (kg)	Age (yr)	Gender	BEE*	Activity Factor	Energy Requirements (Kcal/day)
Doe, John	178	80	36	Male	1,815	1.5	2,723
When age is:							
Increased	178	80	46	Male	1,747	1.5	2,621
Decreased	178	80	26	Male	1,883	1.5	2,825

* BEE = Basal Energy Expenditure:

If male, then BEE = $66 + (13.8 \times \text{weight}) + (5 \times \text{height}) - (6.8 \times \text{age})$.

If female, then BEE = $655 + (9.6 \times \text{weight}) + (1.8 \times \text{height}) - (4.7 \times \text{age})$.

Energy requirement (kcal/day) = BEE \times Activity Factor.

grams such as SPSS/PC+[®], SAS[®], BMDP/PC[®], and Systat[®] (48). Applications designed for clinical research, such as Prophet 5.0 (which runs on current Windows[®] and UNIX[®] [Sun OS, Solaris, SGI IRIX, and Digital UNIX]), offer convenient data management tools and are user-friendly. Consulting with a statistician during the design phase of a study as well as during data analysis can help in the choice of appropriate software. (See Chapter 2, “Statistical Aspects of Controlled Diet Studies.”)

If nutrient data will be statistically analyzed, the nutrient-calculation program should export the data in a row and column format suitable for statistical, spreadsheet, or DBMS programs.

Graphics for Presentation of Data

Graphs provide a “picture” of data and help the reader understand large amounts of information (49, 50). At the same time, the researcher should not be tempted to generate a fancier picture than is needed to portray the data accurately and efficiently. (Helpful discussions of this topic are found in two books by Tufte [51, 52].) Graphs can be generated either by programs specifically designed for this purpose or by spreadsheet and DBMS programs. Programs for use with Microsoft Windows include Microsoft PowerPoint for Windows[®], Corel Presentations[®], Harvard Graphics[®], and Lotus Freelance Graphics.

Graphics software packages vary in features but most, including those mentioned, can produce simple word, bar, and line graphs. (Pie charts are not recommended because they are visually complex and do not foster good quantitative comparisons [49]). Programs such as SigmaPlot[®] generate bar and line graphs with error bars for presenting scientific data. For three-dimensional, contour, and trajectory technical graphs, or graphs with large amounts of data, specialized programs are available (50). Graphs also facilitate management and training activities in the context of feeding studies. Production staff can benefit from graphic presentation of inventory and food census data; students can learn much from graphic displays of food composition and metabolic balance data.

Other Software

Other specialty programs are available for checking grammar, producing calendars for research participants or kitchen staff (53), making departmental or project organizational charts (54), and scheduling employees (55, 56).

COMPUTER-ASSISTED FOODSERVICE MANAGEMENT

The computer can assist with many foodservice tasks in the research diet kitchen, such as budgeting, conducting food inventories, and generating kitchen food production sheets

and food labels. The following should be considered before automating foodservice tasks because not all such tasks will benefit from computer assistance (57):

- What problems decrease the effectiveness of the foodservice (eg, frequently running out of food supplies)? Would computerizing the task increase effectiveness?
- What routine, repetitive tasks do not require human judgment (eg, writing labels)? These are ideally suited to computerization.
- What data or information are needed quickly (eg, food production information) to avoid delays in implementing the diet? Would effectiveness increase if this information were available sooner?
- What data are needed for decision making (eg, projected food costs for a new study)? Would effectiveness increase if data were available when needed?
- Are the required data and procedures readily available for input (eg, is there a standardized version of every recipe)?
- Is the benefit of computerization greater than the time and cost of development (ie, should custom software be developed to meet on-site needs or can those needs be adjusted to fit existing software)?

Foodservice tasks form a complex interrelated system with the menu at its core (58). The simplified diagram in Figure 3–3 shows how the research diet directs many foodservice tasks. The ideal software package would integrate all nutrient-calculation and foodservice functions by using one or more linked databases or passing shared data among programs. Once research diet foods and amounts are entered, nutrient composition can be calculated and food production sheets or menus can be generated without manually reentering or transferring the diet data into another program or data file.

The most efficient way to computerize foodservice tasks is to purchase existing software. Users may need to be creative, however; it may be necessary to modify the commercial package. Some institutional market software integrates foodservice and nutrient-calculation features. These programs support typical activities such as cycle menus, inventory and purchasing management, bid analysis, menu costing, forecasting, recipe database, scaled recipes and production sheets, diet order tracking, menus for participants, and employee scheduling (59).

Bar code technology has the potential for widespread application in research kitchen management. Bar code technology may be used in foodservices for ordering, receiving, keeping inventory, and tracking supplies. A bar code is a series of black bars and white spaces of varying widths that correspond to letters, numbers, and symbols and can be read by a machine (scanner) that shines light across the bars. Because black absorbs light and white reflects light, the patterns of light can be decoded and translated into information the computer understands. For example, the universal product code (UPC) found on nearly all grocery items is used at the supermarket to calculate grocery bills and subtract food from

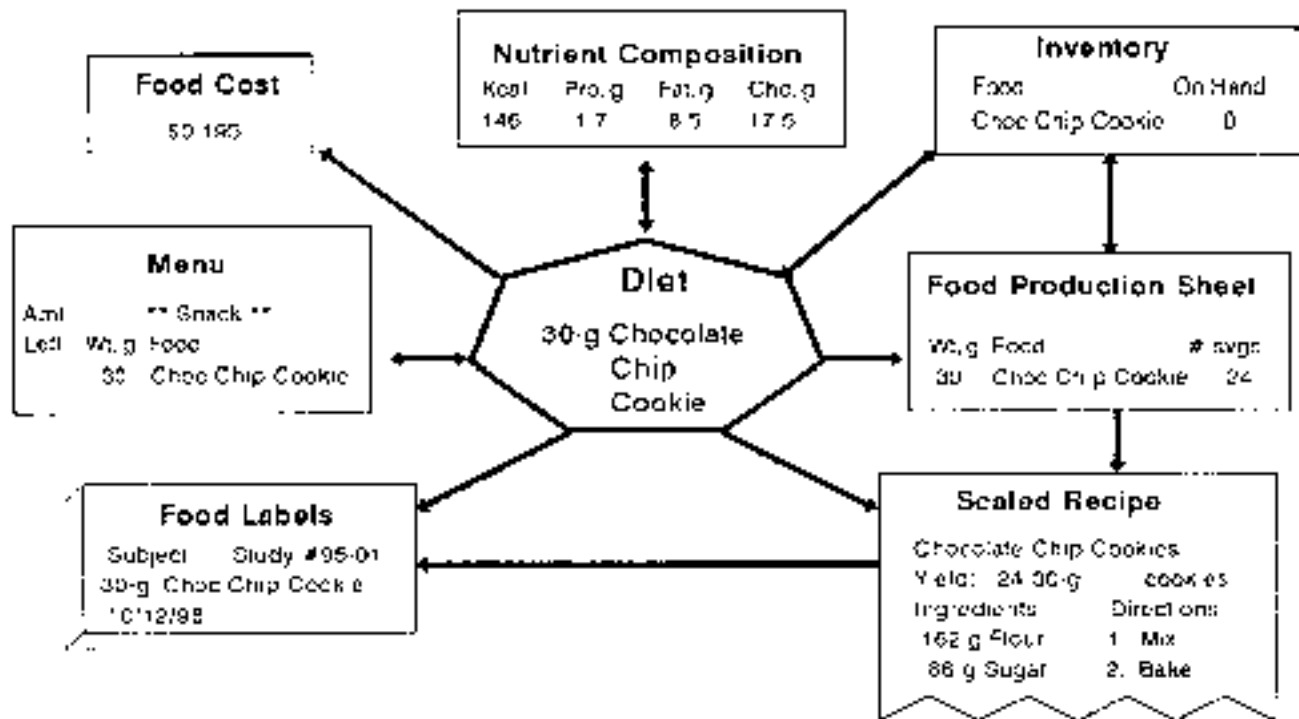


FIGURE 3-3. Relationship (simplified) among research diet, nutrient calculation, and foodservice tasks. (Abbreviations: Amt, amount; CHO, carbohydrate; Choc, chocolate; kcal, kilocalories; Pro, protein; svgs, servings; wt, weight)

the store's inventory (60). Bar codes are quick and accurate because they eliminate manual data entry and its associated errors. Bar code labels can be purchased or made on site with printers having a bar code option (60). For more information about this technology, contact Director, Research Kitchen, USDA Human Nutrition Research Center, Houston, Tex; Computype Inc, Millersville, Md; and Intermec Technologies Corp, Everett, Wash.

Although research and institutional foodservices have much in common, research units seldom use commercial foodservice software. Some units have customized programs; others use nutrient-calculation software, word processors, desktop publishers, spreadsheets, and DBMSs alone or in combination. Because some programs—but not all—enable the export and import of data, software packages should be carefully evaluated before purchase (42). Because developing specialized applications requires considerable time and expertise, potential users should discuss the software with researchers who have achieved satisfactory results. Examples of customized applications are given in the following examples.

Example 1. Food Production Sheets for Cooks

After a research menu is planned, all food must be prepared and exact portions weighed and stored for service. Detailed production sheets may be printed to guide kitchen workers.

Generating the lists of foods to weigh and recipes to make is a repetitive task used for all diet studies. It has been cost effective for some research units to develop customized programs.

A sample computergenerated food production sheet is shown in Exhibit 3-1. The software uses a previously entered research diet data file and a database that classifies foods as “weighed fresh daily,” “weighed in bulk” before the study begins, or “prepared from recipes.” The production sheet in Exhibit 3-1 lists the foods weighed prior to the study and those with special recipes. Foods weighed fresh daily, such as brewed coffee, are listed separately (not shown). The foods are listed in a format that documents the food preparer (who initials each item under “Init”), the kitchen storage location (location is recorded under “Store” when food is placed in storage), and the number of servings remaining after the study is over (recorded under “Post-Study Inventory”). A word processor is used to add special directions, such as “Weigh egg whites and yolks together.” The program also automatically generates a file for printing self-adhesive food labels.

If developing a custom program is not feasible, spreadsheets or DBMSs can be used to generate food production sheets. Alternatively, the output from nutrient-calculation software can be imported to a word processor and modified. The production sheet shown in Exhibit 3-2 lists the total weight of foods required for one study day. To facilitate fluid intake estimates, the weights of “fluid” and “solid” foods are listed in separate columns.

EXHIBIT 3-1**Food Production Sheet from Custom-Designed Program (University of Iowa GCRC)**

Dr. Casey's Diet Study #99-99

Constant Diet

Foods to Weigh for: Ima Sample

Needed by (Date): _____

Done ¹	Init ²	Weight (g)/Food	Servings ³	Store ⁴	Post-study ⁵ Inventory
Foods to Weigh					
<input type="checkbox"/>	_____	65.0 Egg whites (weigh with yolks)	12	_____	_____
<input type="checkbox"/>	_____	7.0 Egg yolks, fresh (weigh with whites)	12	_____	_____
<input type="checkbox"/>	_____	3.0 Butter	12	_____	_____
<input type="checkbox"/>	_____	5.0 Butter	24	_____	_____
<input type="checkbox"/>	_____	10.0 Butter	12	_____	_____
<input type="checkbox"/>	_____	4.0 Butter	12	_____	_____
<input type="checkbox"/>	_____	0.5 Salt	12	_____	_____
<input type="checkbox"/>	_____	0.2 Salt	12	_____	_____
<input type="checkbox"/>	_____	25.0 Cracked-wheat bread	12	_____	_____
<input type="checkbox"/>	_____	25.0 40% Bran Flakes, Kellogg's	12	_____	_____
<input type="checkbox"/>	_____	40.0 Hamburger bun	12	_____	_____
<input type="checkbox"/>	_____	95.0 Turkey brst #1260 Plantation brand	12	_____	_____
<input type="checkbox"/>	_____	25.0 Milk chocolate candy (Hershey's)	12	_____	_____
<input type="checkbox"/>	_____	20.0 Potato chip w/soy oil (hydrogenated)	12	_____	_____
Recipes					
<input type="checkbox"/>	_____	45.0 Grd beef, cooked, lean (20% fat)	12	_____	_____
<input type="checkbox"/>	_____	45.0 Brownie	12	_____	_____
<input type="checkbox"/>	_____	110.0 Mashed potatoes w/milk	12	_____	_____
<input type="checkbox"/>	_____	100.0 Sage stuffing	12	_____	_____
<input type="checkbox"/>	_____	10.0 Tea beverage	12	_____	_____
CMDSIP:SAMPLE.KIT ⁶		DATA FILE:SAMPLE.DAT ⁷			
10-JAN-98					

¹Done = Checked off after food is weighed and stored.²Init = Initialed by staff member completing task.³Servings = Number of servings required.⁴Store = Kitchen location to store food.⁵Post-study inventory = Number of servings remaining at end of study; used to verify that appropriate number of servings were consumed (excess is prepared for unexpected needs).⁶CMDSIP: SAMPLE.KIT = Text filename.⁷DATA FILE: SAMPLE.DAT = Data file containing code is used for nutrient calculations and to generate food production sheet and food labels.**Example 2. Food Labels**

Printed food labels are much appreciated by kitchen staff. The labels eliminate the problem of illegible handwriting and smeared ink and save considerable amounts of time. Food labels may include items such as the participant's name or identification number, investigator's name, food description, portion size, date prepared, and intended meal. Label files can be printed directly onto adhesive labels. The labels must have an adhesive backing that sticks to storage containers or vials for extended time periods and withstands extremes of heat, cold, dryness, or moisture. Labels that ad-

here in the kitchen refrigerator may fall off in -20°C freezers. If the study design requires *blinding*, the labels must not include any information that would indicate which experimental diet the participant is receiving.

Example 3. Recipes

Nutrient-calculation software seldom supports the printing of scaled recipes, but this is a common feature of institutional foodservice software. Recipe databases in institutional software include recipe name, recipe number, ingredient

EXHIBIT 3-2**Low-Protein Diet-Production Sheet****(Generated by Downloading Input from Nutrient-Calculation Program into Word Processor)**

Food	Fluid	Solid
Orange juice 240 g	240	
Coffee—brewed 400 g (200 + 200)	400	
White sugar 35 g		35
Sugar-frosted flakes 25 g		25
Low-protein corn bread 70 g		70
Peaches 135 g		135
Cream—half & half 100 g + distilled H ₂ O 100 g	200	
Butter 45 g (15–15–15)		45
Jelly 45 g (15–30)		45
Diet Coke 355 g	355	
Diet mandarin orange slice 355 g	355	
Potato chips 28 g		28
Bagel 85 g		85
Low-protein rigatoni 80 g (dry weight)		80
Low-protein spaghetti sauce 120 g		120
Low-protein DP ¹ bread 64 g		64
Iceberg lettuce 100 g		100
Tomato 75 g		75
Olive oil 30 g		30
Red wine vinegar 15 g	15	
Low-protein cinnamon cookies 40 g		40
Low-protein butterscotch cookies 40 g		40

BREAKFAST	LUNCH	DINNER
Orange juice 240 g	Bagel 85 g	LP rigatoni 80 g dry
Coffee 400 g	Butter 15 g	LP spaghetti sauce 120 g
White sugar 35 g	Jelly 30 g	Iceberg lettuce 100 g
Sugar-frosted flakes 25 g	Potato chips 28 g	Tomato 75 g
LP ² corn bread 70 g	Diet Coke 355 g	Olive oil 30 g
Peaches 135 g	LP cinnamon cookies 40 g	Red wine vinegar 15 g
Half & half 100 g + distilled H ₂ O 100 g		LP DP bread 64 g
Butter 15 g		Butter 15 g
Jelly 15 g		Diet mandarin orange slice 355 g
		LP butterscotch cookies 40 g

New York Hospital-Cornell Medical Center GCRC.

¹DP = dp brand.²LP = low-protein.

names and code numbers, ingredient quantity, recipe directions, yield, and other information (61). Research units without this computer support sometimes use spreadsheet or DBMS programs to store recipe data and print scaled recipes. Exhibit 3–3 shows a recipe printed from a spreadsheet program. Research recipe directions can also be manually prepared and revised using a word processor.

Example 4. Research Menus, Diet Setup, Foodservice, and Compliance Monitoring

Kitchen staff need a menu to guide research diet setup and service, but typing menus can be tedious. This task is even more difficult if the protocol calls for blinding (masking), because one must be on guard against inadvertently breaking

the treatment code in menus, instructions, or messages for staff or participants. Some units have developed programs that automatically generate kitchen menus from their nutrient-calculation software. Exhibit 3–4 is a computer-generated menu from one such customized program. The program uses a data file from a previously entered research diet to produce a menu to document diet setup, monitor participant compliance, and make a duplicate diet preparation for laboratory analysis. Food storage locations, meal times, and directions for kitchen staff are added with a word processor.

Other research units copy the nutrient-calculation program output into a word processing file and modify it to produce a menu for kitchen use. Exhibit 3–5 shows a sample menu that was generated with this method. Foods for the day are listed at the top; to facilitate fluid intake estimates, the weights of “fluid” foods are listed in a separate column.

EXHIBIT 3-3

Scaled Recipe Generated from Spreadsheet Program

RK ¹ —APPLE OR CHERRY CRISP		Nutrient Data:				Diabetic Exchanges:	
		Kcal	220	Fruit	1		
		PRO (g)	2	Bread	2		
		CHO (g)	37	Fat	2		
		Fat (g)	8				
		Na (mg)	96				
		K (mg)	119				RECIPE 4967
Portion size 120 g or ½ c (1-g scoop)							
Ingredients:	Amt for 1²	Amt for 3	Amt for 5	Amt for 7	Amt for 10	Amt for 12	Amt for 15
Granulated sugar	20 g	¼ C	½ C	¾ C	¾ C	1 C	1¼ C
Margarine	10 g	2 Tbsp	3½ Tbsp	¼ C	½ C	½ C	¾ C
Flour	10 g	¼ C	½ C	¾ C	¾ C	1 C	1¼ C
Apple slices, canned, OR Sweet cherries, canned	80 g	1½ C	2½ C	3½ C	5 C	6 C	7 C
Preparation Instructions:				Modifications			
1. Mix sugar, margarine, and flour until crumbly.				Research diets: Prepare as listed.			
2. Spray small casserole dishes with PAM®.				Regular diets: Prepare as listed.			
3. Weigh 80 g fruit into each casserole.				Diabetic diets: NOT ALLOWED.			
4. Top with 40 g crumb mixture.				Low-sodium diets: USE SALT-FREE MARGARINE (sodium content 1.3 mg per serving).			
5. Bake at 375° until topping is brown (approximately 15 minutes).							
6. Serve immediately or freeze.							
7. To freeze: Cover with aluminum foil, label with name and date; freeze until needed.							
To reheat: Place in oven at 350° for 5–7 minutes or microwave for 1½ minutes.							

¹RK = Research kitchen.

²“Amount for 1” is used for weighed diets; multiple-serving recipes are for general use (University of North Carolina at Chapel Hill GCRC).

The box at the bottom lists foods per meal with a “Taken” column for recording actual food intake.

Menus may also be printed from a spreadsheet or DBMS program using a reporting option. Exhibit 3–6 is a spreadsheet that shows menus for two participants and includes columns for recording the weight of refused (uneaten) food.

Example 5. Inventory

A food inventory system may be helpful, especially when researchers deal with large volumes of food or with long-term studies for which it is impractical to purchase all the food for the entire study at one time. Some centers use custom programs to monitor their perpetual inventories. When a case of food is received, the quantity is entered onto the computer and a label, such as shown in Figure 3–4, is affixed to each case. As the case is opened, the label is removed and the food subtracted from the computerized inventory. Reorder points are established for each food, and reports showing items to reorder are printed once a week. A *reorder point* is the minimum number of cases in an inventory list before food is reordered. For example, if the reorder point = 2 (cases), additional food is reordered when all but

2 cases are removed from inventory. A sample reorder point report is shown in Exhibit 3–7. A similar system could also be developed using a DBMS program.

Example 6. Budget and Food Costs

Research dietitians may be required to forecast, monitor, and document food costs and other expenses. Budget and food cost data can be stored and manipulated using spreadsheet, DBMS, or statistical packages. Exhibit 3–8 shows a sample spreadsheet for calculating food costs. The total cost was calculated by dividing the total items received by the items per purchasing unit (PU) and multiplying by cost per PU.

COMPUTER NETWORKS AND COMPUTER-MEDIATED COMMUNICATION

The computers that operate nutrient-calculation and food-service software are sometimes connected to other computers (nodes) and peripheral computer equipment (eg, printers) as part of a computer network. Networks allow resource sharing (eg, storage media, databases, programs, printers)

EXHIBIT 3-4

**Research Menu Corresponding to Food Production Sheet from Exhibit 3-1
Generated from Custom-Designed Program (University of Iowa GCRC)**

Name: Ima Sample Date: _____
 Dr. Casey #99-99 Period: 1 2
 Constant Diet Day: 1 2 3 4 5
 CMD SIP: Sample.Men^a _____ g/2761.7g = _____
 Diet wt + 250^b/Calc wt + 250 H₂O^c = .98 - 1.02^d
 Blended Wt^e: _____ g Init^f

Code No ^g	(X) CRC Done ^h	(X) ATE All ⁱ	(X) Left Some ^j	Reason Left Code # ^k	AMT Left g ^l	(g)	BREAKFAST @? ^m
1032	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____	_____	120	Orange juice?
710	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____	_____	65	Scrambled eggs:
720	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____	_____	7	Egg whites, fresh
280	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____	_____	3	Egg yolks, fresh
1290	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____	_____	0.5	Butter?
210	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____	_____	25	Salt?
280	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____	_____	5	Cracked-wheat bread?
399	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____	_____	25	Butter?
944	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____	_____	180	40% Bran Flakes, Kellogg's?
500	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____	_____	180	2% Milk
							Brewed coffee
Code No	(X) CRC Done	(X) ATE All	(X) Left Some	Reason Left Code #	AMT Left g	(g)	LUNCH @?
274	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____	_____	40	Hamburger bun?
280	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____	_____	5	Butter?
391	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____	_____	11	Catsup, reg
960	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____	_____	4	Yellow mustard
1020	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____	_____	10	Onion, raw
1130	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____	_____	10	Dill pickle?
840	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____	_____	45	Hamburger, lean (20% fat), panfry, well?
1290	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____	_____	0.2	Salt?
370	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____	_____	40	Carrot, raw
400	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____	_____	40	Celery, raw
269	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____	_____	45	Brownie?
480	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____	_____	300	Coca Cola

(continued)

and computer-mediated communication. A metanetwork of many interconnected computer networks may eventually be as common as telephone networks are today (62).

There are several ways to communicate with others via computer. One way is through a local area network (LAN). Computers in a LAN are connected in a closed circuit network by a set of cables; the network is maintained by a system manager. This configuration usually occurs among personal computers in the same building and is useful for communicating within and among departments. A LAN enables everyone to transfer information and to have access to the same programs and equipment, such as printers (63).

Another way to communicate via computer is using larger networks. Such networks support communication across a wider area. The Internet is the world's largest group of interconnected networks. The Internet is accessed through a university connection or an Internet service provider (ISP)

such as CompuServe[®] or America Online[®]. The Internet facilitates transfer of data files and machine-readable documents, an important consideration in research endeavors. Two other useful Internet features are electronic mail and the World Wide Web (WWW or Web).

E-mail is probably the most commonly used Internet feature. Researchers may find e-mail useful (62, 64, 65) for many reasons. Some of these are improvements to traditional surface mail. For example, e-mail allows simultaneous mass mailing, eliminates stamps, eliminates paper copies unless needed, and is usually faster and less expensive than surface mail. E-mail also circumvents certain difficulties with telephone communications, such as time zone differences, work interruptions, and missing phone calls and return calls. Security in e-mail is usually low; encryption is necessary for confidential messages or messages including otherwise restricted information about study participants (62, 66).

EXHIBIT 3-4 (cont.)

Code No	(X) CRC Done	(X) ATE All	(X) Left Some	Reason Left Code #	AMT Left g	(g)	DINNER @?
1526	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____	_____	95	Turkey breast w/o skin?
1203	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____	_____	110	Mashed potatoes?
280	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____	_____	10	Butter?
804	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____	_____	45	Canned chicken gravy?
1475	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____	_____	100	Sage stuffing?
125	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____	_____	75	Green bean, CANNED W/SALT, drained?
280	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____	_____	4	Butter?
910	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____	_____	40	Tossed salad: Lettuce, crisphead
1520	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____	_____	40	Tomato, raw
1350	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____	_____	17	French dressing?
1056	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____	_____	110	Peach, juice pack, drain?
1510	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	_____	_____	200	Tea beverage

Code No	(X) CRC Done	(X) ATE All	(X) Left Some	Reason Left Code #	AMT Left g	(g)	HS SNACK @?
342				_____	_____	25	Hershey's Milk Chocolate?
35				_____	_____	100	Apple w/o core
1204				_____	_____	20	Potato chips?
19				_____	_____	360	Diet 7-UP

^aSAMPLE.MEN = Text filename.

^bDiet wt + 250 = Actual weight of foods plus 250 g distilled water used to rinse containers. Notes b-f refer to duplicate diet prepared for laboratory analysis.

^cCalc wt + 250 H₂O = Sum of all food weights on menu plus 250 g water for rinsing containers. Total weight is generated from nutrient data file and menu program and adjusted manually if needed (eg, to account for moisture loss during cooking eggs).

^d.98–1.02 = Ratio of actual duplicate weight to calculated weight; duplicate diets not within this range are discarded.

^eBlended wt = Weight of duplicate diet after blending.

^fInit = Initialed by staff completing task.

^gCode no = Code identifying food in nutrient database.

^hCRC done = Checked when food has been retrieved from storage or weighed fresh for this study day.

ⁱAte all = Checked if subject ate each specific food.

^jLeft some = Checked if subject did not finish food.

^kReason left code no = Reason subject did not finish food; codes are listed on menu back and include items such as "too much food," "didn't like food," and "forgot."

^lAmt left g = Weight of uneaten food in grams.

^m? = Foods weighed in bulk before the study are identified with question mark. Using a word processor, the ? is replaced with the food storage location. The ? after the meal name is replaced with the meal time.

The WWW is an information retrieval system. It is a multimedia portion of the Internet supporting pictures and sound and using page layout concepts. Web documents and menus contain hyperlinks that "link" to other documents on the Web. A tool called a *browser* enables the user to connect to a specific site by specifying its location (eg, <http://www.nih.gov> for the National Institutes of Health). Exam-

ples of browsers include Netscape Communicator, Mosaic, Lynx, Microsoft Internet Explorer, Hot Java, and Opera. Researchers can find valuable research and grant information at the various private and public Web sites.

Many useful resources providing information related to nutrient-calculation software are summarized in Table 3–3. Whenever possible, software should be tested before purchase. Some vendors demonstrate their software at meetings such as the National Nutrient Data Bank Conference and The American Dietetic Association Annual Meeting or offer demonstration disks to potential buyers. A few universities have nutrient-calculation programs for review. The National Agricultural Library in Beltsville, Md, maintains a listing of nutrient analysis, foodservice, and health and nutrition education software that is updated regularly. This list can be viewed at the Web site: <http://www.nal.usda.gov/fnic/software/software.html>. USDA nutrient data are also

Date Arrived	Food	Date Pulled
8/10/98	Apples	<input type="text"/>
Lot #	Box #	Staff Initials
3587-46	1-5	<input type="text"/>

FIGURE 3-4. Sample label attached to food cases and used to monitor food inventory at the Grand Forks Human Nutrition Research Center.

EXHIBIT 3-5**Research Menu Generated by Downloading Output from Nutrient Calculation Program into Word Processor
(Cornell University Medical College GCRC)**

Balance Diet: Daily Menu Dates: _____

Patient Name: _____

Food/Amount	Solid	Fluid
Coffee, Inst Max ¹ 4 g + 800 g dist ² H ₂ O	4 g	800 g
Half & half 50 g + 50 g dist H ₂ O		100 g
White sugar 20 g	20 g	
Uns ³ bread white 40 g + 40 g + 40 g	120 g	
FTWT ⁴ red raspberry preserves 20 g	20 g	
Ardmore juice, apple 120 g		120 g
Ardmore juice, pineapple 120 g		120 g
Uns butter 40 g	40 g	
FTWT Familia ⁵ original 45 g	45 g	
FTWT UNS tunafish 120 g	120 g	
FTWT Soyamaise 20 g	20 g	
Lettuce 50 g + 50 g	100 g	
Tomato 50 g + 50 g	100 g	
Corn oil 10 g + 10 g	20 g	
Vinegar 10 g + 10 g		20 g
Coca Cola Classic 355 g + 355 g		710 g
Balance chicken 120 g	120 g	
FTWT apricot preserves 15 g	15 g	
White rice (cooked) 175 g	175 g	
FTWT green beans 150 g	150 g	
FTWT corn chips 30 g	30 g	

MENU

Breakfast	Taken	Lunch	Taken	Dinner	Taken
40 g uns bread, toasted + 20 g FTWT red rasp preserves	_____	SANDWICH: 40 g uns bread + 120 g FTWT uns tuna + 20 g FTWT soyamaise	_____	120 g bal chicken + 15 g apricot pres + 20 g uns butter	_____
4 g coffee + 800 g dist H ₂ O + 20 g white sugar	_____	SALAD: 50 g lettuce + 50 g tomato + 10 g corn oil + 10 g vinegar	_____	SALAD: 50 g lettuce + 50 g tomato + 10 g corn oil + 10 g vinegar	_____
45 g FTWT Familia original	_____	355 g Coca Cola Classic	_____	40 g uns bread + 20 g uns butter	_____
120 g Ardmore pineapple juice	_____			355 g Coca Cola Classic	_____
120 g Ardmore apple juice	_____			175 g white rice (cooked)	_____
50 g half & half + 50 g dist H ₂ O	_____			150 g FTWT green beans	_____
				30 g FTWT corn chips	_____

¹Inst Max = Instant Maxwell House coffee.²Dist = Distilled.³Uns = Unsalted.⁴FTWT = Featherweight brand.⁵Familia = Familia grain and fruit cereal.

EXHIBIT 3-6**Research Menu for Two Subjects Generated from Spreadsheet
(University of North Carolina at Chapel Hill GCRC)**

PROJECT 753 DIET RECORD SHEET

DATE:

Patient: _____ Patient: _____

Food and Beverages	Intake (g or PKT)	Refusal (g or PKT)	Intake (g or PKT)	Refusal (g or PKT)
BREAKFAST: (Mo¹) IN UNIT				
RK ² orange juice	240	_____	240	_____
Corn flakes	20	_____	30	_____
Whole-wheat toast	40	_____	56	_____
Redi-Pat margarine	15	_____	12	_____
Jelly	15	_____	25	_____
Sugar (weigh into medicine cup)	15	_____	10	_____
Decaf coffee	200	_____	200	_____
Whole milk	240	_____	240	_____
LUNCH: PACK AT & GIVE AT BREAKFAST				
RK grape juice	240	_____	240	_____
RK turkey breast	45	_____	47	_____
Whole-wheat bread	50	_____	50	_____
Kraft Mayonnaise	22	_____	25	_____
RK pineapple	150	_____	150	_____
Sugar (add to pineapple)	8	_____	8	_____
Salt	1 PKT	_____	1 PKT	_____
Pepper	1 PKT	_____	1 PKT	_____
DINNER: IN UNIT				
RK apple juice	240	_____	240	_____
RK ham	50	_____	60	_____
RK sweet potatoes	100	_____	100	_____
RK green beans	75	_____	75	_____
Redi-Pat margarine (add to vegetable)	10	_____	10	_____
CRU ³ yeast rolls	0	0	27	_____
Redi-Pat margarine (for dinner roll)	0	0	5	_____
RK peaches	150	_____	150	_____
Sugar (add to peaches)	16	_____	16	_____
Decaf iced tea	200	_____	200	_____
Salt	1 PKT	_____	1 PKT	_____
Pepper	1 PKT	_____	1 PKT	_____
NOURISHMENT: GIVE AT DINNER				
Graham crackers	28	_____	28	_____
RK grapefruit juice	240	_____	240	_____
Sugar (add to juice)	0	0	15	_____

¹Mo. = Monday.²RK = Research kitchen.³CRU = Clinical research unit.

available through the National Agricultural Library's Web site at <http://www.nal.usda.gov/fnic/foodcomp/> (Table 3-3).

CONCLUSION

Computers are an invaluable aid to the dietitian in supporting controlled diet research. Nutrient-calculation systems are the most developed software application for this purpose. Linear

programming or other mathematical procedures promise further assistance in the design of defined diets for metabolic research. Developing cost-effective computer support for research diet foodservice requires nutrition managers to carefully define their needs if they wish to use programming designed for a broader audience. The most successful future applications will be flexible enough to accommodate a variety of foodservice needs and methods of operation.

EXHIBIT 3-7**Inventory Reorder Point Report Generated from Custom-Designed Program (USDA Grand Forks Human Nutrition Research Center)**

DIETARY INVENTORY SYSTEM REORDER POINT REPORT

03/05/93 09:50:45

LOCATION = Metabolic Kitchen / food item

PAGE : 1

Potato, canned LOT: SPN1N63	UNIT/CASE = 24	BRAND = Butter Kernal UNIT WT. = 16 oz	VENDOR = Hugos REORDER POINT = 2	QTY ON HAND = 2
Butter, salted LOT: MARCH0993D	UNIT/CASE = 36	BRAND = Bridgemans UNIT WT. = 1 lb	VENDOR = Bridgemans REORDER POINT = 1	QTY ON HAND = 1
Cinnamon, ground LOT: 7462B	UNIT/CASE = 6	BRAND = Schilling UNIT WT. = 1 oz	VENDOR = Hugos REORDER POINT = 2	QTY ON HAND = 2
Cornflakes LOT: OCT301993	UNIT/CASE = 24	BRAND = Kellogg's UNIT WT. = 12 oz	VENDOR = Hugos REORDER POINT = 1	QTY ON HAND = 1
Drink mix, wild strawberry LOT: 1F28FA12	UNIT/CASE = 144	BRAND = Wyler's UNIT WT. = .18 oz	VENDOR = Hugos REORDER POINT = 1	QTY ON HAND = 0.5
Ice cream, vanilla LOT: TG2344M	UNIT/CASE = 4	BRAND = Bridgemans UNIT WT. = ½ gal	VENDOR = Bridgemans REORDER POINT = 2	QTY ON HAND = 1
Mayonnaise, real LOT: to order	UNIT/CASE = 12	BRAND = Kraft UNIT WT. = 32 oz	VENDOR = Hugos REORDER POINT = 1	QTY ON HAND = 0
Oil, vegetable LOT: 12283AA2	UNIT/CASE = 12	BRAND = Crisco, soybean UNIT WT. = 32 oz	VENDOR = Hugos REORDER POINT = 1	QTY ON HAND = 1
Parmesan cheese, grated LOT: to order	UNIT/CASE = 12	BRAND = Kraft UNIT WT. = 8 oz	VENDOR = Hugos REORDER POINT = 1	QTY ON HAND = 0
Peas, frozen LOT: to order	UNIT/CASE = 12	BRAND = Birdseye UNIT WT. = 16 oz	VENDOR = Hugos REORDER POINT = 2	QTY ON HAND = 0

¹Qty = Quantity.**PRODUCTS CITED****Food and Nutrition Software**

Auto Nutritionist IV, CAMP Program: One commercial program with this function is Auto Nutritionist IV[®], First DataBank. The Hearst Corp, 1111 Bayhill Dr, San Bruno, CA 94066–3035. (800) 633–3453; <http://www.firstdatabank.com>.

Diet Analyzer: The CBORD Group, Inc, 61 Brown Road, Ithaca, NY 14858. (607) 257–2410.

Food Intake and Analysis System (FIAS): University of Texas Houston Health Science Center, Human Nutrition Center, PO Box 20186, Houston, TX 77225. (713) 500–9343.

Food Processor: ESHA Research, 4263 Commercial St, SE, Suite 200, Salem, OR 97302–3938. (503) 585–6242 or (800) 659–3742, e-mail: esh@esha.com.

Interactive Diet Construction (IDC) (CAMP Program): General Clinical Research Center, Medical College of

South Carolina, Charleston, SC 29425. (803) 792–3357.

Moore's Extended Nutrient (MENU) Database: Database Manager, Pennington Biomedical Research Center, 6400 Perkins Rd, Baton Rouge, LA 70808–4124. (504) 763–2500, e-mail: Champacm@mhs.pbrc.edu.

Nutrition Data System (NDS): Nutrition Coordinating Center, University of Minnesota, 1300 South Second St, Lower Level, Minneapolis, MN 55414. (612) 627–9429.

Nutritionist V: First DataBank. The Hearst Corp, 1111 Bayhill Dr, San Bruno, CA 94066–3035. (800) 633–3453; <http://www.firstdatabank.com>.

ProNutra: ProNutra Nutrient Analysis System for Metabolic Studies. Princeton, NJ: Princeton Multimedia Technologies, 145 Witherspoon Street, Princeton, NJ 08540. System development was supported by a Small Business Innovation Research Grant (R44-RR11678) from the National Center for Research Resources, Bethesda, Md.

EXHIBIT 3-8**Food Cost Spreadsheet (University of North Carolina at Chapel Hill GCRC)**CRU¹ DIETARY EXPENSE 7/98

Category	Description	Purchase Unit	Cost/PU ²	Units/PU	7/7/ 98	7/14/ 98	7/22/ 98	7/28/ 98	7/31/ 98	Total Cost
CANNED	SOUP-TOMATO-IND ³	24/7.3OZCN ⁴ /CS ⁵	\$ 7.87	24	15		8			\$7.54
CANNED	SOUP-VEGETABLE-IND	24/7.3 OZ CN/CS	\$ 7.59	24						\$0.00
COND ⁶	SEASON-MRS.DASH-IND	300 PKG ⁷ /CS	\$13.02	1						\$0.00
COND	SALT SUBSTITUTE-IND	2/1000/CS	\$18.00	2						\$0.00
COND	SUGAR SUB-IND	2/1250 BX ⁸ /CS	\$11.34	2						\$0.00
CANNED	TUNA-DIET	24/6.5 OZ CN/CS	\$29.79	24						\$0.00
CANNED	APPLESAUCE-UNSWT ⁹	24/16 OZ CN/CS	\$10.16	24						\$0.00
CANNED	FRUIT COCKTAIL-UNSWT	24/16 OZ CN/CS	\$20.19	24						\$0.00
CANNED	PEACH HALVES-UNSWT	24/16 OZ CN/CS	\$18.89	24						\$0.00
CANNED	PEACHES SLICED-UNSWT	24/16 OZ CN/CS	\$18.89	24						\$0.00
CANNED	PEAR HALVES-UNSWT	24/16 OZ CN/CS	\$16.89	24						\$0.00
CANNED	PINEAPPLE-SLI ¹⁰ UNSWT	24/20 OZ CN/CS	\$17.50	24						\$0.00
STAPLES	GELATIN-CHERRY SF ¹¹	12/3.4 OZ PKG/CS	\$33.75	12			1			\$2.81
STAPLES	GELATIN-LIME-SF	12/3.4 OZ PKG/CS	\$31.97	12						\$0.00
CANNED	JUICE-TOMATO-SF	24/18 OZ CN/CS	\$11.71	24						\$0.00
STAPLES	PICKLES-CHIPS-SF	12/16 OZ JR ¹² /CS	\$18.60	12						\$0.00
CANNED	SOUP-CHIX ¹³ NOODLES-SF 24	24/7.3 OZ CN/CS	\$ 8.73	24	3		4			\$2.55
CANNED	SOUP-TOMATO-SF	24/7.3 OZ CN/CS	\$ 7.70	24	4					\$1.28
CANNED	SOUP-VEGETABLE-SF	24/7.3 OZ CN/CS	\$ 7.97	24		3		4		\$2.32
STAPLES	BROTH-BEEF-SF	6/50 PKG BX/CS	\$29.19	6						\$0.00
STAPLES	BROTH-CHICKEN-SF	6/50 PKG BX/CS	\$29.20	6						\$0.00
STAPLES	GRAVY/BRN ¹⁴ SCE ¹⁵ MIX-SF	24/3 OZ BX/CS	\$51.57	24						\$0.00
STAPLES	GRAVY/CHIX MIX-SF	24/4 OZ BX/CS	\$54.08	24						\$0.00

¹CRU = Clinical research unit; ²PU = Purchasing unit; ³IND = Individual; ⁴CN = Can; ⁵CS = Case; ⁶COND = Condiment;⁷PKG = Package; ⁸BX = Box; ⁹UNSWT = Unsweetened; ¹⁰SLI = Sliced; ¹¹SF = Salt free; ¹²JR = Junior; ¹³CHIX = Chicken; ¹⁴BRN = Brown;¹⁵SCE = Sauce.**General Applications Software****Version 1: Full-length URLs and publishers****Access (98):** Microsoft (<http://www.microsoft.com/access/>)**America Online:** America Online, Inc (<http://www.aol.com>)**BMDF/PC:** SPSS (<http://www.spss.com/support/Documents/BM-122995-03.html>)**CompuServe:** CompuServe Interactive Services, Inc (<http://www.compuserve.com>)**Digital UNIX:** Digital Equipment Corporation (<http://www.unix.digital.com/>)**Excel:** Microsoft (<http://www.microsoft.com/office/excel/>)**Freelance Graphics:** Lotus (<http://www.lotus.com/home.nsf/welcome/freelance>)**GroupWise:** Novell, Inc (<http://www.novell.com>)**Harvard Graphics (98):** SPC Software Publishing (<http://www.harvardgraphics.com>)**Hot Java (1.1.4):** Sun Microsystems, Inc (<http://www.java.sun.com/products/hotjava/>)**Internet Explorer (4.0):** Microsoft (<http://www.microsoft.com/ie/ie40/>)**IRIX (6.5):** Silicon Graphics, Inc (<http://www.sgi.com/software/irix6.5/>)

TABLE 3-3**Sources of Additional Information**

Resource	Description	Contact
Journals		
<i>Foodservice Information Systems Report</i> (previously <i>Byting In</i>)	Computer newsletter for food and nutrition professionals	Center Publications Cyntergy Corporation 656 Quince Orchard Road Gaithersburg, MD 20878-1409 (301) 926-3726
<i>Food and Nutrition News</i>	Includes reviews of several commercially available nutrition-related software packages in alternate issues	National Cattlemen's Beef Association 444 N Michigan Ave Chicago, IL 60611 (312) 467-5520
<i>Journal of The American Dietetic Association</i>	Includes reviews of several commercially available nutrition-related software packages in alternate issues	The American Dietetic Association 216 W Jackson Blvd Suite 800 Chicago, IL 60606-6995 (312) 899-0040
<i>Nutrition Today</i>	Includes reviews of several commercially available nutrition-related software packages in alternate issues	Williams & Wilkens, Publishers 351 West Camden St Baltimore, MD 21201-2436 (800) 638-6423 Editor: (814) 237-1078
Catalogs		
<i>Microcomputer Software Collection</i>	List of approximately 180 software packages and a brief description of each	Food and Nutrition Information Center National Agricultural Library 10301 Baltimore Blvd Beltsville, MD 20705-2351 (301) 504-5719 http://www.nal.usda.gov/fnic/software/software.html
<i>National Nutrient Databank Directory</i>	Annotated listing of nutrient-calculation software	Department of Nutrition and Dietetics 238 Alison Hall University of Delaware Newark, DE 19716 (302) 831-8729
<i>US Department of Agriculture Nutrient Database</i>	Food composition tables	Food and Nutrition Information Center National Agricultural Library 10301 Baltimore Blvd Beltsville, MD 20705-2351 (301) 504-5719 http://www.nal.usda.gov/fnic/foodcomp
Meetings		
International Conference on Dietary Assessment Methods	Biannual meeting to address the diverse needs of nutrient database users and developers	Department of Preventive Medicine and Community Health Medical College of Virginia PO Box 980212 Richmond, VA 23298-0212 (804) 828-3258
National Nutrient Databank Conference	Annual meeting to address the diverse needs of nutrient database users and developers	Research Leader Nutrient Data Laboratory USDA Agricultural Research Service Beltsville, MD 20705 (301) 734-8491

- Lotus 1-2-3:** Lotus (<http://www.lotus.com/>)
- Lynx:** University of Kansas (http://www.cc.ukans.edu/lynx/help/Lynx_users_guide.html)
- Mosaic for Windows (3.0):** NCSA (<http://www.ncsa.uiuc.edu/SDG/Software/WinMosaic/HomePage.html>)
- MSWord X.X:** Microsoft Corporation (<http://www.microsoft.com/office/word/>)
- Netscape Communicator:** Netscape Communications (<http://www.netscape.com>)
- Opera (3.21):** Opera Software (<http://www.operasoft.com>)
- PageMaker (6.5):** Adobe (<http://www.adobe.com/prodindex/pagemaker/main.html>)
- Paradox (8.0):** Corel Corporation (<http://www.corel.com/products/wordperfect/paradox8/index.htm>)
- PowerPoint (97) for Windows:** Microsoft (<http://www.microsoft.com/office/powerpoint/>)
- Presentations (7.0):** Corel Corporation (<http://www.corel.com/products/wordperfect/cp7/index.htm>)
- Prophet (5.0):** GTE Internetworking (<http://www-prophet.bbn.com/prophet-home.htm>)
- Publisher (98):** Microsoft (<http://www.microsoft.com/products/business.htm>)
- Quattro Pro (6.0):** Corel Corporation (<http://www.corel.com/products/wordperfect/cops/index.htm>)
- SAS:** SAS Institute Inc (<http://www.sas.com>)
- SigmaPlot:** SPSS (<http://www.spss.com/software/science/sigmaplot>)
- Solaris (2.6):** Sun Microsystems, Inc (<http://www.sun.com/solaris/>)
- SPSS:** Statistical Product & Service Products, Inc (<http://www.spss.com>)
- Sun OS:** Sun Microsystems, Inc (see Solaris above)
- Systat (8.0):** SPSS (<http://www.spss.com/software/science/systat/systat8.htm>)
- Visual dBase (7):** Inprise (<http://www.inprise.com/VdBASE/>)
- Windows 98:** Microsoft Corporation (<http://www.microsoft.com/windows98/>)
- Wordperfect (8.0):** Corel Corporation (<http://www.corel.com/products/wordperfect/wp8dragon/index.htm>)
- Word Pro:** Lotus Development Corporation (<http://www.lotus.com/>)
- World Wide Web Consortium** (<http://www.w3.org>)
- Excel:** Microsoft (<http://www.microsoft.com>)
- Freelance Graphics:** Lotus (<http://www.lotus.com>)
- GroupWise:** Novell, Inc (<http://www.novell.com>)
- Harvard Graphics (98):** SPC Software Publishing (<http://www.harvardgraphics.com>)
- Hot Java (1.1.4):** Sun Microsystems, Inc (<http://www.java.sun.com>)
- Internet Explorer (4.0):** Microsoft (<http://www.microsoft.com>)
- IRIX (6.5):** Silicon Graphics, Inc (<http://www.sgi.com>)
- Lotus 1-2-3:** Lotus (<http://www.lotus.com>)
- Lynx:** University of Kansas (<http://www.cc.ukans.edu>)
- Mosaic for Windows (3.0):** NCSA (<http://www.ncsa.uiuc.edu>)
- MSWord X.X:** Microsoft Corporation (<http://www.microsoft.com>)
- Netscape Communicator:** Netscape Communications (<http://www.netscape.com>)
- Opera (3.21):** Opera Software (<http://www.operasoft.com>)
- PageMaker (6.5):** Adobe (<http://www.adobe.com>)
- Paradox (8.0):** Corel Corporation (<http://www.corel.com>)
- PowerPoint (97) for Windows:** Microsoft (<http://www.microsoft.com>)
- Presentations (7.0):** Corel Corporation (<http://www.corel.com>)
- Prophet (5.0):** GTE Internetworking (<http://www-prophet.bbn.com>)
- Publisher (98):** Microsoft (<http://www.microsoft.com>)
- Quattro Pro (6.0):** Corel Corporation (<http://www.corel.com>)
- SAS:** SAS Institute, Inc (<http://www.sas.com>)
- SigmaPlot:** SPSS (<http://www.spss.com>)
- Solaris (2.6):** Sun Microsystems, Inc (<http://www.sun.com>)
- SPSS:** Statistical Product & Service Products, Inc (<http://www.spss.com>)
- Sun OS:** Sun Microsystems, Inc (<http://www.sun.com>)
- Systat (8.0):** SPSS (<http://www.spss.com>)
- Visual dBase (7):** Inprise (<http://www.inprise.com>)
- Windows 98:** Microsoft Corporation (<http://www.microsoft.com>)
- Wordperfect (8.0):** Corel Corporation (<http://www.corel.com>)
- Word Pro:** Lotus Development Corporation (<http://www.lotus.com>)
- World Wide Web Consortium** (<http://www.w3.org>)

Version 2: Short URLs and publishers

- Access (98):** Microsoft (<http://www.microsoft.com>)
- America Online:** America Online, Inc (<http://www.aol.com>)
- BMDP/PC:** SPSS (<http://www.spss.com>)
- CompuServe:** CompuServe Interactive Services, Inc (<http://www.compuserve.com>)
- Digital UNIX:** Digital Equipment Corporation (<http://www.unix.digital.com>)

Other Products

Bar Code Technology

- Computype, Inc:** 1120C Benfield Boulevard, PO Box 987, Millersville, MD 21109-0987. (800) 437-5712; <http://www.computypeinc.com>.
- Intermec Technologies Corporation:** 6001 36th Avenue West, PO Box 4280, Everett, WA 98203-9280. (800) 347-2636; <http://www.intermec.com>.

Food Models

Nasco, Inc: 901 Janesville Ave, Fort Atkinson, WI 53538
(414) 563-2446 and Nasco West, 4825 Stoddard Rd,
Modesto, CA 95356. (209) 545-1600.

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