

# Diet Therapy

## DIETARY PROCEDURES IN THE METABOLIC UNIT

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IN THE PAST few years there has been an increased need for dietitians trained in metabolic procedures. The principles of the different types of diets and some of the metabolic procedures have been described.<sup>1-5</sup> This article presents some of the current practices and describes the metabolic kitchen at the Massachusetts General Hospital.

### THE SELECTION AND PURCHASE OF FOODS

*Bread.* Only white bread, either salted or salt-free, is used. This bread is baked daily in the hospital from standardized recipes. Brown bread is not baked in this hospital but is purchased, and presents a problem to the dietitian who is not directly in charge of buying. The salt-free bread is low in calcium (about the same as the original low calcium bread).<sup>3</sup> It can be used for the low calcium diets, and is especially helpful if the patient eats several slices of bread daily.

*Butter.* Only salt-free butter is used. The same brand is used throughout the year and is bought by the case.

*Cereals.* The same brands of cereal, macaroni, and rice are used throughout the year. Prepared cereals include cornflakes, Rice Krispies, Shredded Wheat, and Puffed Rice. Oatmeal and farina are most popular among the cooked cereals. Macaroni, rice, and farina may be bought in bulk in quantities sufficient to last for a year.

*Eggs.* Fresh eggs are used and are probably more variable than most foods used. The

only measure taken to keep eggs constant is to buy the same grade. Even then there is often a variability of 10 grams in the weight of the individual eggs.

*Fruits.* When choosing fruits to be used on a metabolic ward, the dietitian must select ones which will have the least chemical variability and the greatest palatability. Canned fruits which may be purchased from the same lot in quantities sufficient for a study are less variable than fresh fruits which would be purchased several different times for a study of 3-4 months. Of the canned fruits, pears, peaches, applesauce, pineapple, and apricot halves are most popular. The fruits are canned with sugar. Berries, and fruits with pits such as cherries and plums do not look appetizing after they are pitted and drained. Berries with seeds present the disadvantage of plugging pipettes when stools are being analyzed. Bananas and fresh apples are not often used, since it is practically impossible to obtain them from the same source during a long balance study. The amount of canned fruit which will be needed in one year is estimated and ordered at the beginning of the year from a company which will fill the order from the same lot of canned goods. The buyer must be assured that all cans bearing the same lot number represent fruit harvested and processed at the same time of the year.

*Fruit Juice.* Canned unsweetened grapefruit, grape, and pineapple juice are selected in the same manner as the canned fruits. The only fresh juice used is lemon juice. There is more variance in fresh lemon juice than in the canned juices, but much smaller quantities are used in one diet. Frozen orange juice of the same brand throughout the years is used, and

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it is bought by the case. One case of 32-ounce cans will last from six weeks to two months, depending on the number of patients.

*Meat.* Long-term studies limit the types of meat which can be used on constant diets. The meat must be free of bone, gristle, and fat. Breast of fowl, tenderloin steaks, and ground beef meet all of these requirements. The fowl breasts are bought from the same dealer each week. Breasts are used in order to have only white meat, since white meat and dark meat are different in mineral content. Whole tenderloins are bought and trimmed by the butcher. One tenderloin will give fifteen to twenty 4-ounce steaks. Hamburger from the top of the round is used, and is probably the most constant of the three meats. Enough hamburger for a study of any length can be obtained at one time. There is no danger of a patient getting a piece of gristle in a hamburger pattie. This may happen occasionally with steaks.

*Milk.* Homogenized milk or skim milk from the same company are used. Both of these eliminate the difficulty encountered when cream is unevenly distributed in milk. Cases of evaporated milk from the same lot may be used, but most patients refuse milk rather than drink evaporated milk.

*Vegetables.* The only fresh vegetable used is the Idaho potato. A bushel at a time is set aside for the research ward, and this lasts from six weeks to two months depending on the number of patients. Vegetables other than potatoes are canned (with salt unless the diet is restricted in salt). Peas, string beans, tomatoes, whole kernel corn, beets, and carrots, are most popular. The vegetables are bought at the beginning of the year from the same lot. (Corn is not used on diets for patients whose stools are to be analyzed. It often shows up in the stool as whole kernels and interferes with pipetting.)

*Miscellaneous.* Protenum<sup>®</sup> and other high protein supplements, homogenized peanut butter, catsup, jello, saltines, graham crackers, vanilla wafers, jelly, honey, sugar, etc. have been used on constant diets. An effort is made to use the same brands of these products and

to obtain a supply which will last through one study.

*Salt.* Chemically pure salt is secured from the pharmacy.

#### COOKING AND WEIGHING PROCEDURES TO KEEP THE FOOD CONSTANT

*Bread.* The total for the day is weighed the previous day, wrapped in wax paper which is carefully labeled with the patient's name, the weight, and the kind of bread (salt-free or regular). Graham crackers and saltines are weighed and given to the patient in waxed sandwich bags.

*Butter.* The salt-free butter is weighed and the total must be used by the end of the day. Greater accuracy and even distribution can be assured if the dietitian butters bread and toast for the patient.

*Cereals.* The weighed cereal is placed with a measured amount of water into a cereal bowl, cooked in a steamer, and served in the same bowl. The amount of water is adapted to the patient's taste and is constant daily. Macaroni and rice are cooked in the same manner. This method is more accurate than cooking the cereal in a double boiler and weighing the cooked cereal. Proportions of water commonly used for cereals are:

- 8 to 10 cc water per gram of farina
- 5 to 6 cc water per gram of oatmeal
- 4 cc water per gram of rice
- 4 cc water per gram of macaroni.

In Boston the tap water is sufficiently mineral-free for use in these studies.

*Eggs.* Eggs are beaten, weighed into casserole dishes, scrambled in individual frying pans in a portion of the patient's butter, and served in the casserole dish.

*Fruit.* Canned fruits are drained on paper towels, and weighed into sauce dishes from which they are served. They are covered with wax paper, which is marked with the patient's name and the weight of the fruit.

*Fruit Juices and Milk.* These are weighed into glasses which are marked with the weight, kind of juice, patient's name, and the time it is to be served. Each glass is covered with a

bottle cap between two layers of wax paper, which are fastened with a rubber band. The bottle cap contains the same information as the glass. This method gives two checks on labeling. It has proved more satisfactory than the use of large soufflé cups inverted as covers.

*Meat.* Chicken breasts are thawed, cooked in the steamer, and freed of skin. The cold chicken is weighed and reheated in a casserole dish before serving. Daily portions of hamburger and steak are weighed at the beginning of the study and frozen. One is removed from the freezer daily and cooked in a small amount of the patient's butter. Individual frying pans are used and are thoroughly scraped with a flexible spatula to remove all meat particles and gravy.

*Sugar.* The total sugar to be used each day is weighed into glass creamers which are labeled with the weight and the patient's name.

*Salt.* The total salt to be used each day is weighed into flat white envelopes (Bescup drinking cups) which are fastened with a paper clip. The patient must be instructed how to pour from the envelope. Salt shakers lose salt between the shaker and the cap. The salt is dried for 48 hours in an electric drying oven, and is then stored in a covered flask to keep it free from moisture. (Salt is weighed on a balance accurate to 0.01 grams.)

*Vegetables.* The canned vegetables, with the exception of tomatoes, are drained on paper towels placed on trays. These are weighed directly into casserole dishes with lids that fit over the dish. A hamburger pattie paper with the weight of the vegetable, the patient's name, and the meal, is placed between the dish and the cover. The paper serves the dual purpose of marking the dish and preventing the collection of moisture in the dish. The casserole dishes are heated in the steamer (not pressurized). The vegetable may be served in the dish in which it is heated. Potatoes are steamed, cooled, weighed, and reheated.

*Miscellaneous.* Honey, jelly, and catsup are weighed in glass creamers or in small waxed cups with smooth sides. Jello is made by

placing the weighed amount of jello powder in a casserole dish, adding a measured amount of warm water, and allowing the mixture to gel. It is then served in the same dish. Lemonade is made by weighing the lemon juice into the glass, adding weighed sugar, and then adding the water, which has been measured in a graduate cylinder. (It is not stirred until just before serving, and the spoon is left in the lemonade for the patient to lick.) Egg-nogs are made by weighing milk, adding weighed beaten eggs, and weighed sugar.

#### ANALYSIS OF DIET

The diet is routinely analyzed once or twice during a study. More analyses may be necessary if the food is changed (e.g. a new lot of steaks) during the study. A one-quarter aliquot of the diet is sent to the laboratory, and includes everything except sugar, sodium chloride, and salt-free butter. Cereals, rice, or oatmeal are cooked before being added to the aliquot for analysis. Two or three one-quarter aliquots of meat are weighed at the beginning of the study when the meat is weighed into individual portions. When the aliquot is being prepared it is necessary only to remove one aliquot of meat from the freezer and add it to the mixture. Salt-free butter may be analyzed separately or assumed to be mineral-free fat.

#### PROCEDURE FOR STARTING A DIET

The choice of a patient for a metabolic study is made by the physician. The patient on a metabolic study should understand that he is to be on a constant diet, since this may be the most difficult part of the study for him. This information should be made available to the patient before he agrees to come to the research ward.

Using only one menu for an entire study has the disadvantage of being more monotonous for the patient, but has several advantages. The patient can have a trial period for the diet, whereas it would be impractical to have trial periods for two or three diets which are changed every third or fourth day. Much less time is needed for the dietitian to figure



one diet, and there are fewer possibilities for errors when changes are not made every three days. Also, only one diet need be analyzed by the laboratory. The foods used on a constant diet are somewhat limited, and the patient usually chooses the food he likes best; therefore, the few changes which can be made do not seem to justify the extra work for all the people involved.

When the patient enters the ward, the dietitian explains the constant diet and helps the subject choose a menu for trial according to the diet prescription ordered by the physician. Three to five days are needed to adjust the diet for most patients; however, one day of trial has been used if the study is as short as two weeks. The three trial days enable the patient to try different foods and become accustomed to eating everything given to him. During this time the dietitian should follow the weight chart to see if the number of calories in the diet are sufficient to maintain a constant body weight. The dietitian should have all the food needed by the end of the trial period.

After the patient has been placed on a constant diet, no changes are made in the diet without the physician's orders. If the patient is too ill to eat at some meal and the food cannot be eaten later, the food is saved for laboratory analysis. Birthdays and holidays will be difficult for some patients, since little can be done to celebrate except to use holiday tray covers and napkins. The only allowable variations in constant diets are simple ones, such as having eggs scrambled one day and in an eggnog another day. Dinners and suppers may be reversed, or individual foods changed from one meal to another, but this accomplishes little.

Patients tend to choose fewer calories than they have been eating outside the research ward. There are possibly three reasons for this—the fear of having more food than one can eat after the study has been in progress a week or two, the tendency to want less food if the same food is to be eaten every day, and the lower caloric value of the individual foods offered on a constant diet. The latter is particularly true of desserts if the patient has

been accustomed to eating cakes, pastries, ice cream, etc.

Salt is the only condiment normally used for constant diets. Mixtures of foods are discouraged because of the difficulty in calculating replacements in case of spilling, and because of the time required to make individual mixtures for several metabolic studies.

Constant diets are lower than normal diets in fiber content and are often constipating to the patient. The food is bland and simple. A patient who has been on a diet for a month or two needs to “go easy” on seasonings, fried foods, etc., for the first few days after the study has been completed. Too often the patient overeats the first day and feels uncomfortable.

#### THE CALCULATION OF SPECIAL DIETS

Dietitians with no previous experience in metabolic work may be unfamiliar with the calculation of diets requiring the balancing of milliequivalents. One of the most difficult to calculate is the neutral ash, 150-mg calcium diet, since the acid and base must be balanced, the calcium kept low, and adequate amounts of other nutrients supplied. If the patient does not like foods low in calcium, or if he chooses foods with an excess of acid ash or basic ash, the diet may present a problem. If a patient chooses foods higher in calcium, portions will be restricted and calories will be low unless the diet is supplemented with extra amounts of food such as butterfat, honey, jelly, and sugar. This may be unpleasant for the patient. If a patient chooses small servings of foods forming acid ash, foods forming basic ash must also be restricted.

#### SPECIAL EQUIPMENT USED IN THE METABOLIC KITCHEN

1. Torsion Balance—accurate to 0.1 gram. Several types are available; the type which will allow two dishes to be balanced simultaneously is more desirable. Information may be obtained from Torsion Balance Company, 92 Reade Street, New York City.

2. Trip Balance. This scale is not as accurate as the above for less than a gram, since the pointer cannot be read between gram



TABLE I.  
Example of a 150-mg Calcium, Neutral Ash Diet

Amt.	Food	Acid	Base	CHO	Pro	Fat	Ca	Mg	K	Na	P	Cl	S
g		mEq	mEq	g	g	g	g	g	g	g	g	g	g
100	Grapefruit juice	—	4.1	11.1	0.4	0.1	0.010	0.008	0.139	0.005	0.017	0.002	0.005
20	Farina (un-cooked)	2.0	—	15.3	2.2	0.3	0.004	0.005	0.024	0.013	0.025	0.015	0.031
90	Bread	5.8	—	47.7	8.1	1.1	0.027	0.027	0.097	0.401	0.087	0.558	0.048
70	Salt-free butter	0.2	—	—	0.7	59.8	0.010	trace	0.009	0.004	0.011	0.009	0.007
120	Hamburger	19.8	—	—	24.4	9.5	0.015	0.029	0.405	0.101	0.245	0.091	0.276
140	Tomato	—	7.8	3.9	1.0	0.2	0.015	0.017	0.373	0.025	0.037	0.040+	0.019
20	Rice (uncooked)	1.7	—	15.5	1.4	0.1	0.002	0.007	0.014	0.005	0.020	0.008	0.023
100	Applesauce	—	3.4	19.7	0.2	0.1	0.007	0.006	0.116	0.010	0.011	0.004	0.001
60	Chicken	7.0	—	—	15.3	1.5	0.009	0.016	0.223	0.054	0.130	0.047	0.155
100	Potato	—	8.9	19.1	2.0	0.1	0.011	0.027	0.496	0.024	0.056	0.035	0.029
60	Peas	—	0.5	5.8	2.1	0.1	0.013	0.016	0.171	0.162	0.073	0.019+	0.033
100	Pears	—	3.7	18.4	0.2	0.1	0.013	0.009	0.129	0.008	0.016	0.004	0.007
50	Lemon juice	—	1.9	4.2	0.5	0.2	0.011	0.005	0.074	0.006	0.006	0.002	0.004
100	Pineapple juice	—	6.1	13.0	0.3	0.1	0.008	0.010	0.270	0.016	0.011	0.051	0.009
60	Sugar	—	—	60.0	—	—	—	—	—	—	—	—	—
20	Grape jelly	—	—	13.0	—	—	0.002	—	—	—	—	—	—
<i>Totals</i>		36.5	36.4	236.7	58.8	73.3	0.157	0.182	2.540	0.834	0.745	0.885+	0.647

*Note:* The diet is considered essentially neutral if the milliequivalents agree within 0.5. Amounts of minerals are generally expressed in milligrams and milliequivalents.

The following formula may be used for calculating milliequivalents:

$$\frac{\text{milligrams}}{\text{atomic weight}} \times \text{valence} = \text{milliequivalents}$$

$$\text{e.g. } \frac{157 \text{ milligrams calcium}}{40} \times 2 = 7.85 \text{ milliequivalents}$$

or the following factors may be used:

Mineral	Atomic weight	Valence	Conversion factor
Calcium	40.07	2	0.05
Magnesium	24.32	2	0.0822
Potassium	39.10	1	0.02557
Sodium	23.00	1	0.0435
Phosphorus	31.04	2	0.06443
Chlorine	35.46	1	0.0282
Sulfur	32.06	2	0.0624

$$\text{e.g. } 157 \text{ milligrams calcium} \times 0.05 = 7.85 \text{ milliequivalents}$$

marks. These balances must be checked often. Obtainable from Hanson Scale Company, Northbrook, Illinois.

3. A balance accurate to 0.01 gram is useful for salt.

*Note:* All balances should be checked routinely each year or more often if necessary.

4. Graduate Cylinders. 250-cc volumes are useful for measuring tea and coffee. Cylinders of less volume may be used for measuring fluids returned on trays of patients who may not be on complete metabolic studies.

5. Flexible spatulas. Stainless steel spatulas are used instead of knives on the trays. The patients can clean the plates with these spatulas and they are necessary for scraping the individual frying pans. Suitable flexible spatulas may be obtained from The McDonald Company, 23 Lansdowne Street, Boston, Massachusetts.

6. Casserole Dishes. Individual Hall china casserole dishes with lids fitting over the casserole rather than inside the casserole, to prevent collection of moisture in the dishes.

7. Frying Pans. Individual size frying pans are used. Frying pans may be obtained from the McDonald Company (above).

8. Steamer. A steamer is not found in some units, but they are quite helpful in heating foods and in cooking many foods. The steamer is not pressurized. It was obtained from Cleveland Range Company, Cleveland, Ohio. This steamer is small enough to set on a regular counter workspace rather than on the floor.

9. Freezer. At least two cubic feet of freezer space is needed for each person on a metabolic study.

10. Dripolator. Drip coffee is more constant than percolator coffee when the grounds are weighed and the water is measured. It is impossible to have coffee made exactly the same way each day in a percolator, and if the patient drank much coffee, this could possibly make a difference in studies closely controlled in potassium.

*Summary:* The present dietary procedures and a description of the metabolic kitchen at

Massachusetts General Hospital have been presented.

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