Dietotherapy

PLANNING THE HIGH PROTEIN DIET

THERE is overwhelming evidence of the therapeutic role of protein in various clinical situations, in severe undernutrition, following surgery or injury, in diseases of the liver and of the kidney, in infections, and in gastrointestinal disturbances.[1] The maintenance or satisfactory restoration of body protein is accomplished only when careful consideration is given to a number of interrelated factors. Among these are: (a) the level and nutritive efficiency of the protein in the diet; (b) the caloric adequacy of the diet; and (c) the acceptability of the regimen in terms of palatability, national and religious food practices, amount of food, tolerance for a given food or foods, and ability to chew and swallow. The practicability of a regimen is governed by economic factors, such as cost of the food, availability of given foods, and keeping qualities.

QUALITATIVE VARIATIONS IN PROTEIN

The determination of the concentration of the various amino acids in food proteins has established the superiority of animal foods in general as sources of the indispensable amino acids. Thus, the proteins of egg, milk, milk products other than butter, and flesh foods supply efficient mixtures of amino acids to support tissue repletion and growth.

Unfortunately, the great emphasis sometimes placed on the animal sources of protein in therapeutic situations has tended to minimize the valuable contributions which can be made by plant foods in the diet. Most of the cereal foods, nuts, and legumes contain varying amounts of all of the essential amino acids, but one or more of the amino acids usually occurs in concentrations too low to effect tissue building when these foods are used as the sole source of protein. However, if a small quantity of a food rich in the limiting amino acid is used as a supplement with the plant food, satisfactory tissue construction does occur.

Experimental studies have shown that a dietary providing as little as 10 per cent of its protein from milk and 90 per cent from cereal foods has provided an amino acid intake which is excellent for maintenance, and good for growth.[2] While such a ratio may provide satisfactory nutrition in health, clinicians usually recommend that one-half to two-thirds of the total protein intake be supplied from animal foods for the rapid replacement of protein in disease. Whether this practice constitutes extravagant usage is not known at present. Further investigation is certainly indicated to determine the effectiveness of varying proportions of plant and animal proteins in the correction of severe tissue depletion, since community disasters may make it impossible to provide such high proportions or such wide variety of animal foods.

The supplementary relationships of the proteins in plant and animal foods are useful only when the foods are simultaneously fed. In other words, the amino acids amply provided by the cereal foods, for example, cannot be used for the construction of a tissue protein unless the amino acid or acids lacking are likewise supplied then and there from another protein source. Thus, cereal and milk, a sandwich with cheese, egg, or meat filling, or a glass of milk in a meal including legumes provide satisfactory combinations of the essential amino acids. A good rule in meal planning is to include some animal source of protein at each meal. Thus, the costly foods which sometimes may be available in limited quantity may be put to their most effective use when combined with the much less expensive plant foods.

Quantitative Aspects of Planning for Protein

The amount of protein required in many pathologic conditions may be two, three, or even four times as high as that needed for health if recovery is to be assured. Allowances of 150–300 Gm. protein daily have been recommended in conditions such as wound healing, following burns, in diseases of the liver, and in severe undernutrition. These wide variations in protein requirements make it imperative for the physician to specify the approximate level of protein desired when the diet is ordered.

There has been some unjust criticism of the high-protein diets recommended in many texts and diet manuals. Most diets so described provide 110–125 Gm. of protein daily. Time and again such diets have proved to be of unquestioned value in many instances of undernutrition occasioned by previously faulty diet, disturbances of the gastrointestinal tract such as peptic ulcer and colitis, and diseases of the kidney.

The success obtained with the diets of moderately high protein content is dependent on the day-to-day ingestion of the specified quantities of high quality protein foods at caloric levels favorable to efficient use of the amino acids. These diets, as a rule, provide the most desirable base line for planning protein intakes at the higher levels needed in some disease states. They may be modified in terms of flavor, bulk, and consistency for individual needs.

Caloric Intake Affects Protein Requirement

In time of stress the caloric requirements of the body take precedence over other demands, so that carbohydrate, fat, and protein are nonselectively oxidized to provide energy. Thus, the use of high levels of nutritively efficient protein in the dietary is essentially a wasteful procedure unless adequate amounts of carbohydrate and fat are provided simultaneously to supply the needed calories. Far too often high protein foods or proprietary products of limited palatability have been forced upon patients with little regard to the total caloric intake, whereas a more reasonable protein level used in conjunction with a liberal intake of carbohydrate and enough fat for palatability could have resulted in more efficient use of protein.

No precise caloric level can be suggested, since the needs will vary from individual to individual, as well as in different pathologic conditions. In most situations, the requirement is well above that stated for normal individuals under conditions of health. For the adult, it may range from 2500 to 4500 calories, or even higher, depending upon the restlessness of the patient, the elevation of temperature, and the energy required for the process of tissue repletion.

Cereal foods, including breakfast cereals, breads of all kinds, cereal pastes such as macaroni, spaghetti, and noodles, lend themselves especially well to increasing the caloric level of the diet, since they are bland in flavor, easily digested, relatively high in carbohydrate content, and provide acceptable combinations with animal protein foods.

Moderate amounts of sugar, jellies, jams, and syrups may be used in beverages and on breads, but their excessive use may dull the appetite. Glucose, inexpensively available under several trade names, lends itself well for use in beverages, since it is less sweet than sucrose and thus may be used in greater concentrations.

Fats used in moderate quantities are usually desirable because the caloric level of the diet is noticeably increased without the addition of much bulk. The palatability of the diet containing fat is greater than that in regimens severely restricted in fat.

The fat of milk, cream, butter, and egg yolk is well tolerated by most people, while less highly emulsified fats may be unacceptable. Like concentrated sweets, fats must not be used to excess, since they have a high satiety value. A beverage containing considerable proportions of cream taken midmorning or midafternoon may destroy the appetite for the succeeding meal, thus defeating its essential purpose.

Planning Dietaries for Increased Protein Content

The high protein diet should be based on the patient's total nutritional needs, rather than on protein *per se*. It should involve the patient as an individual—his likes and dislikes, tolerance for foods, patterns of eating—and should not impose upon him an alien, unpalatable regimen which may lead to a life-long dislike for essential foods.

A basic pattern for meal planning has been described in an earlier paper.[3] When there are no serious hindrances to the use of a variety of foods, this pattern should be used as the starting point for increasing the protein and caloric intake. One way in which the protein level of this plan may be increased to approximately 125 Gm. daily is indicated below. Approximately 80 per cent of the protein in this diet is supplied from animal sources. It will be noted that the caloric allowance is likewise liberal, and that mineral and vitamin allowances generously exceed those in the Recommended Dietary Allowances for persons in health.[4]

HIGH PROTEIN DIET

Suggested foods	Household measure	Approximate weight	Average protein
		Gm.	*Gm.*
Milk	1 qt.	960	34
Eggs	3	150	18
Meat, poultry or fish	7 oz. (cooked)	210	52
Whole grain or enriched cereal	1/2 cup cooked or 3/4 cup dry	30 (dry)	2
Whole grain or enriched bread	5 slices	150.	13
Potato	1 small	100	2
Green or yellow vegetable	1 serving	100	2
Other vegetable	1 serving	100	2
Citrus fruit	1 serving	100	...
Other fruit	1 serving	100	...
Butter or fortified margarine	4 tbs.	60	...
Sugar, sweets	3 tbs.	45	...
			125

Nutritive value of this diet: Calories, 2825; protein, 125 Gm.; fat, 145 Gm.; carbohydrate, 255 Gm.; calcium, 1.6 Gm.; iron, 19 mg.; vitamin A, 13,300 I.U.; thiamine, 1.65 mg.; riboflavin, 3.30 mg.; niacin, 16.2 mg.; ascorbic acid, 130 mg.

Meal Pattern	*Sample Menu*
BREAKFAST:	
Citrus fruit—1 serving	Orange juice
Cereal—1/2 cup	Oatmeal
Milk for cereal and to drink—1 cup	Milk
Eggs, any style—2	Scrambled eggs
Toast—1 slice	Wholewheat toast
Butter—2 tsp.	Butter; jelly
Beverage	Coffee
Cream—2 tbs.	Cream
Sugar, jelly—1 tbs.	Sugar for coffee and cereal
LUNCH OR SUPPER:	
Meat, fish, or poultry—3 oz.	Ground beef patty, large, on buttered bun
Vegetable: green, leafy, or yellow—1 serving	Buttered asparagus tips
Bread—1 slice	
Butter or fortified margarine—3 tsp.	
Fruit—1 serving	Sliced fresh peaches with blueberries and 1/4 cup cottage cheese
Milk—1 cup	Milk
	Peanut butter cookie*
DINNER:	
Meat—3 oz.	Roast veal with currant jelly
Potato—1	Mashed potato
Vegetable—1 serving	Glazed carrots
Bread—1 slice	Hot dinner roll
Butter—3 tsp.	Butter
Milk—1 cup	Milk
Dessert	Chocolate mint pudding*
Beverage	Tea with sugar, lemon
EVENING:	
Sandwich	Liverwurst sandwich on wholewheat bread
Bread—2 slices	
Butter—2 tsp.	
Meat, fish, poultry or cheese—1 oz.	
Eggnog	Eggnog, pineapple flavor

* Provide protein and calories in addition to totals listed in column 1.

The suggested meal pattern is only one of numerous ways in which the foods might be arranged. It is well to note that no midmorning and midafternoon feedings are suggested in this plan since it has been found that many patients will have a higher total intake of nutrients if such feedings are not permitted to detract from the customary meals. However, easily digested but substantial feedings in the evening may be used to advantage.

TABLE I

Nutrient Values of Foods Containing Approximately Equivalent Amounts of Protein*

Food	Household measure	Weight	Calories	Protein	Fat	Carbohydrate	Calcium	Iron	Vitamins				
									A	Thiamine	Riboflavin	Niacin	Ascorbic acid
		Gm.		*Gm.*	*Gm.*	*Gm.*	*Mg.*	*Mg.*	*I.U.*	*Mg.*	*Mg.*	*Mg.*	*Mg.*
Milk, fresh	1 cup	244	165	9	10	12	288	0.2	390	0.09	0.42	0.3	3
Milk, evaporated	1/2 cup	126	175	9	10	13	306	0.2	505	0.06	0.45	0.3	1
Milk, fermented (Yogurt)	5/8 cup	140	130	9	5	13	320	..	180	0.09	0.05	...	2
Milk, nonfat solids	3 tbs.	23	85	8	Tr.	12	299	0.1	9	0.08	0.45	0.3	2
Cheese, cheddar	1 oz.	30	120	8	10	1	217	0.3	420	0.01	0.13	Tr.	0
Cheese, cottage	3 tbs.	42	40	8	Tr.	1	40	0.1	8	0.01	0.12	Tr.	0
Egg, whole	1 medium	54	80	6	6	..	26	1.3	550	0.05	0.14	Tr.	0
Egg white	2	62	30	7	0	..	4	0.2	0	0	0.16	Tr.	0
Beef, hamburg	1 oz.	30	120	7	9	0	3	0.8	0	0.02	0.06	1.4	0
Beef, round, cooked	1 oz.	30	70	8	4	0	3	1.0	0	0.02	0.07	1.7	0
Beef, strained	1 1/2 oz.	45	45	8	2	0	4	1.9	0	0.01	0.12	1.5	0
Lamb chop, cooked	1 oz.	30	125	7	11	0	3	0.9	0	0.04	0.08	1.7	0
Lamb, leg, cooked	1 oz.	30	80	7	6	0	3	0.9	0	0.04	0.08	1.5	0
Liver, beef, cooked	1 oz.	30	65	7	3	3	5	2.4	16,050	0.08	1.19	4.5	10
Liver, strained, infant	1 1/2 oz.	45	45	7	2	1	10	3.0	8,160	0.02	0.92	2.7	0
Pork, ham, cooked	1 oz.	30	110	7	9	0	4	0.9	0	0.19	0.07	1.4	0
Chicken, cooked	1 oz.	30	60	9	2	0	4	0.5	0	0.01	0.05	1.9	0
Fish, med. fat, cooked	1 oz.	30	45	7	2	0	4	0.3	24	0.02	0.02	2.4	0
Bread, white, enriched	3 slices	90	240	8	3	45	30	0.6	0	0.06	0.06	0.9	0
Beans, baked	1/2 cup	130	150	8	3	24	53	2.4	110	0.06	0.05	0.6	3
Peanut butter	2 tbs.	30	180	8	14	6	20	0.6	0	0.08	0.04	4.6	0
Soybeans	1/3 cup, cooked	20 (dry)	70	8	3	3	47	1.6	24	0.21	0.06	0.4	0
Yeast, brewer's	5 tsp.	18	65	9	Tr.	7	14	3.6	0	2.93	0.72	7.2	0

* Protein, fat, carbohydrate have been rounded off to the nearest whole gram; calories have been rounded off to the nearest 5.

Supplementation of the High Protein Diet

Even the liberal diet outlined above will be inadequate to meet the protein and caloric needs of some individuals. Extremely high levels of intake are difficult to achieve unless one resorts to the use of concentrated foods of high protein content and can persuade the patient to consume the foods from day to day. Table I lists a variety of foods in amounts which are interchangeable with respect to their protein value. Other nutrient values are also given, since considerable variations in the diet may occur depending upon the substitutions which may be used. For example, hard cheeses contain only one-third as much riboflavin as milk supplying the same amount of protein; cottage cheese is not comparable to milk as a source of calcium; and flesh foods are negligible in their calcium content.

Skim milk powder, for a number of reasons, is ideal for supplementing the protein content of the diet: (a) the quality of the protein is superior; (b) its high protein concentration makes it possible to increase greatly the protein level of the diet without a material increase in the bulk content of the diet; (c) its bland flavor makes it readily acceptable to most individuals and permits its use in a variety of ways; (d) the tolerance and digestibility quotients are high; (e) the cost is far less than that of other foods which provide equivalent protein (see Table II); (f) the keeping qualities are excellent; and (g) it is readily transported and stored with minimum space requirements. A number of more costly proprietary products recommended by physicians for protein supplementation incorporate skim milk powder as a primary constituent.

The following beverages employing skim milk powder provide palatable nourishments of high protein concentration.

High Protein Milk

1 cup skim milk powder
1 quart whole milk

Sprinkle milk powder on top of milk. Beat with rotary beater until smooth. Chill thoroughly before serving.

Flavor variations: Add 1–2 tablespoons chocolate syrup.

Protein content: 16 Gm. per cup (8 fluid ounces).

High Protein Eggnog

(1¼ Quarts)

4 eggs
1–2 tablespoons sugar
1 quart whole milk
1 cup skim milk powder

Beat eggs with sugar. Add milk and mix. Sprinkle milk powder over milk-egg mixture and beat until smooth. Flavor with vanilla and nutmeg as desired. Chill thoroughly before serving.

Protein: 19 Gm. per cup (8 fluid ounces).

While greater amounts of milk solids have sometimes been used in the above beverages, the consistency tends to become viscous and the acceptance by the patient is decreased. Whenever low fat regimens are required, the above beverages may be prepared using twice the recommended amounts of powdered skim milk and substituting water for the whole milk. Such beverages are less palatable than those made with whole milk.

Strained meat as canned for infant use is a welcome addition to the liquid diet which must be increased in its protein content. When diluted with broth or bouillon, strained beef or veal provide especially acceptable soups. Most patients are unable to take strained meat in amounts which will give protein levels comparable to those achieved with milk and milk solids. Moreover, the cost is relatively high (see Table II).

Cost Considerations

Individuals in the home as well as the dietary departments in hospitals are usually cost conscious. To recommend costly foods to people unable to buy them is admitting defeat. Table II gives a comparison of the costs of equivalent amounts of protein from various food sources. At the time of this writing the prices of beef and veal are considerably lower than those of preceding months, while pork prices are somewhat higher. Although some cuts of beef and veal provide relatively inexpensive sources of protein, it will be noted that meats with a relatively high proportion of waste—e.g., chops, steak, chicken—attain the status of luxury items. The protein from yogurt, widely publicized in lay publications, costs approximately half again as much as

TABLE II

Comparative Costs of Equivalent Amounts of Protein from Natural Foods

Food	Food cost per pound as purchased*	Protein content per pound of food†	Cost of 100 Gm. Protein
		Gm.	
ANIMAL SOURCES			
Milk, non-fat solids	$0.32	162	$0.20
Cheese, cottage	0.29	89	0.32
Liver, beef	0.39	89	0.44
Hamburg	0.37	73	0.47
Veal shoulder	0.35	70	0.50
Cheese, cheddar	0.59	114	0.52
Veal leg	0.49	84	0.58
Haddock fillet	0.49	82	0.60
Beef, boneless rolled roast	0.53	84	0.63
Milk, whole, 3.25% fat	0.24 (per qt.)	34 (per qt.)	0.71
Salmon, red, canned	0.65	92	0.71
Tuna, canned	0.86	108	0.79
Frankfurter	0.55	65	0.85
Lamb, leg	0.59	68	0.86
Chicken, dressed, fryer	0.49	51	0.96
Beef, roundsteak, boneless	0.87	89	0.98
Egg, medium size, grade A	0.81	73	1.11
Ham, smoked	0.75	67	1.12
Yogurt	0.32	28	1.14
Beef, chipped	1.80	156	1.16
Beef, porterhouse steak	0.75	64	1.17
Meat, strained for infants (beef, veal, pork, lamb, or liver)	1.01	76	1.33
Pork chops, loin	0.89	60	1.48
Lamb chop, rib	0.89	51	1.74
Ice cream	0.60	18	3.33
PLANT SOURCES			
Navy beans, dry	0.14	97	0.15
Oatmeal	0.12	65	0.18
Peanuts	0.35	88	0.40
Peanut butter	0.49	119	0.41
Bread, white, 4% milk solids	0.18	39	0.46
Wheat cereal, ready-to-eat	0.30	49	0.60
Rice	0.24	35	0.70
Yeast, brewer's	1.30	168	0.80

* Supermarket prices as of July 10, 1953.

† Protein content on basis of food as purchased.

that of fresh whole milk and more than five times as much as that from non-fat milk solids. No significant difference in nutritional value of various fermented milks, including yogurt, has been observed.

SUMMARY

Factors which affect the planning of the high protein diet include the nutritive efficiency of the protein, the amount of protein necessary in various pathologic conditions, the calorie level of the diet, and the patient's acceptance of the diet.

A plan has been presented for a diet containing 125 Gm. protein and approximately 2800 calories. Consideration has been given to the choice of supplementary foods to further increase the protein content of this diet, or to provide substitutes for foods in the suggested list. Skim milk powder is, in most instances, by far the best food for enhancing the protein content of the diet.

The cost of protein from various food sources has been compared.

A high protein, high calorie diet of natural foods can be planned to meet the requirements of most individuals in terms of total nutrient needs, consistency of foods, amount of bulk, and acceptability. When such diets are prepared with every regard for eye and taste appeal and presented to the patient as an important part of his therapy, there can be a markedly reduced need for expensive, unbalanced, and unpalatable feedings whether taken orally or by tube.—CORINNE H. ROBINSON.

REFERENCES

1. POLLACK, H., and HALPERN, S. L.: Therapeutic Nutrition, Publication 234, National Academy of Sciences-National Research Council, Washington, D. C., 1952.
2. SHERMAN, H. C.: *Chemistry of Food and Nutrition*, 8th edition, The Macmillan Company, New York, 1952, p. 212.
3. ROBINSON, C. H.: Food therapy begins with the normal diet. J. CLIN. NUTRITION 1: 150, 1953.
4. FOOD AND NUTRITION BOARD: Recommended Dietary Allowances (revised), Reprint Series 129, National Research Council, Washington, D. C., 1948.