REINVENTION OF THE FOOD GUIDE PYRAMID TO PROMOTE HEALTH

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I. INTRODUCTION

Dietary guidelines and dietary food guides are tools used to educate the public about diet, nutrition, and health. The quality of an individual's nutritional status is directly dependent on the quality of the input into nutrition, namely food, and applicable dietary supplements. Food is defined as any substance that is eaten to sustain psychological and physiological life, provide energy, and promote nutrition. It should be evident that dietary guidelines involve terms and goals pertaining to the intake of certain food components with the objective being to either strive to meet a certain set of dietary goals or strive to not exceed another set of goals (e.g., cholesterol intake). However, dietary food guides (e.g., pyramid) are food based but aimed at meeting and/or enhancing nutrition and therefore health. Consumers understand a dietary food guide because they eat food and not nutrients—nutraceuticals *per se*. Food is visible and nutrients are essentially invisible components of food. Food satisfies the palate and the psyche and provides satiation, whereas nutrients do not. For these reasons food education should be distinguished from nutrition education. It is a major flaw of the education scheme that food has not been differentiated from nutrition and health outcomes. The purpose of this chapter is to foster and make more consumer relevant the food-guide-pyramid approach to food selections and combinations aimed at enhancing the nutrition and health of the consumer.

II. HISTORY OF THE FOOD GUIDES

Food guides are food and nutrition education tools that help consumers select and eat foods that provide them with adequate nutrition to maintain health. *Health* is defined as a continuing state of soundness and vigor of body and mind. Consumers select and purchase food. Although their ultimate goal is to obtain the nutrients from foods, many consumers do not know which nutrients, at what amounts, are found in foods so that they can ensure they meet their daily and overall nutritional needs. As a result they need a simple tool to help them choose the appropriate amounts and types of foods that will provide the nutrients needed for good health.

More than 100 years ago, W. O. Atwater, the first director of the U.S. Department of Agriculture's (USDA) Office of Experiment Stations, is believed to be the first person to use the scientific process to develop dietary guidance to improve health (Welsh *et al*., 1993). His food composition tables and dietary standards for the U.S. population were first published in 1894 (Atwater, 1894). He coordinated research on nutrient requirements, food composition, food consumption, and consumer economics that led to a

scientific connection between food composition, dietary intake, and health (USDA, 1993). Variety, proportionality, and moderation in healthful eating were promoted by Atwater in a *Farmer's Bulletin* in 1902 (Welsh, 1994). In the bulletin, he states that "for the great majority of people in good health, the ordinary food materials ... make a fitting diet, and the main question is how to use them in the kinds and proportions fitted to the actual needs of the body." "Unless care is exercised in selecting food, a diet may result which is one-sided or badly balanced—that is, one in which either protein or fuel ingredients are provided in excess" (Atwater, 1902; Welsh *et al.*, 1992).

Atwater's work formed the foundation for the development of an education tool, the food guide. In 1916, Hunt first grouped foods for purposes of "nutrition" education when she created the first USDA food guide (Ahlström and Räsänen, 1973). This USDA food guide had five food groups in which foods were placed based on their nutrient contents. The five groups included (1) vegetables and fruits, (2) milk, meat, eggs, fish, cheese, dry beans, peas, and peanuts, (3) cereals (breads and starches), (4) sugar, and (5) fat (Ahlström and Räsänen, 1973; Welsh, 1994) (Table I). This food guide also included the nutritional value of the foods consumed.

Throughout the 1920s this food guide was very popular until the Great Depression created the need to consider economy in the planning of diets. Not only did consumers require guidance in planning nutritionally balanced diets, but they also needed help in doing so economically. As a result, food plans at four cost levels were developed by Stiebeling and Ward (1933). These plans were based on 12 major food groups that were to be used by consumers to assist them in making cost-effective weekly food purchases (Table I). The concept of nutrient density was used by these plans, which acknowledged that some foods could provide more nutrients at a lower cost. This concept of providing nutritious foods economically for a healthy diet remains a basic tenet of the USDA "nutrition" education program.

The first Recommended Dietary Allowances (RDAs) were published in 1941 by the Food and Nutrition Board of the National Academy of Sciences (National Research Council, 1941). These were specific recommendations on intake levels for calories and nine essential nutrients that included protein, the minerals calcium and iron, and the vitamins A, D, thiamin, riboflavin, niacin, and ascorbic acid. Food rationing during World War II, along with these new RDAs, led to the development of the USDA's *National Wartime Nutrition Guide* (Ahlström and Räsänen, 1973). This food guide was first published in 1943 and was known as the "Basic Seven." It included the following food groups: (1) green and yellow vegetables, (2) oranges, tomatoes, and grapefruit, (3) potatoes and other vegetables and fruits, (4) milk and milk products, (5) meat, poultry, fish, eggs, and dried peas and beans,

TABLE I

PRINCIPAL U.S. DEPARTMENT OF AGRICULTURE FOOD GUIDES FROM 1916 TO 1992[a]

		Protein-rich foods								Other		
Food guide	No. of groups	Milk			Meat	Breads	Vegetables and Fruits				Fats		Sugars
Hunt[b] (1916)	5	Meats and other protein-rich foods				Cereals and other starchy foods	Vegetables and fruit				Fatty foods		Sugars
# of Servings		1 c milk + 2–3 servings other				9	5				9		10
Stiebeling[c] (1930s)	12	Milk, lean meat, poultry, fish	Dry beans, peas, and nuts	Eggs		Flours, cereals	Leafy green yellow	Potatoes sweet potatoes	Other vegetables and fruits	Tomatoes and citrus	Butter	Other fats	Sugars
# of Servings		2 c 9–10/wk	1/wk	1		As desired	11–12/wk	1	3	1	—	—	—
Basic Seven[d] (1940s) Foundation diet	7	Milk and milk products	Meat, poultry, fish eggs, peas, nuts, dried beans			Bread, flour, and cereal	Leafy green yellow	Potatoes, other fruit and vegetables	Citrus, tomato, cabbage salad greens		Butter; fortified margarine		
# of Servings		2 c or more	1–2			Every day	1 or more	2 or more	1 or more		Some daily		

Basic Four[e] (1956–1970s)	4	Milk group	Meat group	Bread, cereal	Vegetable–fruit group		
Foundation diet		2 c or more	2 or more	4 or more	4 or more (use dark green/yellow vegetables frequently, citrus daily)		
Hassle-Free[f] (1979)	5	Milk–cheese group	Meat, poultry, fish and beans group	Bread–cereal group	Vegetable–fruit group		Fats, sweets, alcohol group
Foundation diet		2	2	4	4 (include vitamin C source daily, dark green/yellow vegetable frequently)		(use depends on calorie needs)
Food Guide Pyramid[g] (1984+)	6	Milk, yogurt, cheese	Meat, poultry, eggs, fish, dry beans, nuts	Breads, cereals, rice, pasta	Vegetable	Fruit	Fats, oils, sweets
Total diet		2–3	2–3	6–11 whole grain enriched	3–5 dark green/deep yellow starchy/legumes, other	2–4 citrus, other	Total fat 30% Sweets vary according to calories

[a]From Welsh (1993).
[b]"Food for Young Children" (1916), "How to Select Foods" (1917), "A Week's Food for an Average Family" (1921), "Good Proportions in the Diet" (1923).
[c]"Planning for Good Nutrition" (1939) (published two previous food plans, 1933/1936).
[d]"National Wartime Nutrition Guide" (1943), "National Food Guide" (1946).
[e]"Essentials of An Adequate Diet" (1956), "Food for Fitness – A Daily Food Guide" (1958).
[f]*Food*: "The Hassle-Free Guide to a Better Diet" (1979).
[g]"Developing the Food Guidance Systems for 'Better Eating for Better Health'" (1985).

(6) bread, flour, and cereals, and (7) butter and fortified margarine (Welsh *et al*., 1993). Because certain foods were in limited supply during the war, this guide did not list a specific number of servings for each group but emphasized the selection of alternatives from other groups to meet nutritional needs. For example, if foods from group 2 were unavailable, then it was recommended that more foods from groups 1 and 3 be consumed to ensure nutritional adequacy. In 1946, after the war, this guide was revised to include the recommended number of servings per day for each food group. This format was then used for the next 10 years as a "nutrition" education tool (Ahlström and Räsänen, 1973).

Problems associated with the Basic Seven were its complexity and lack of serving size information, so in 1956 a new food guide that streamlined the seven food groups to only four was issued by the USDA. It became known as the "Basic Four," with only (1) milk, (2) meat, (3) vegetables and fruits, and (4) bread and cereals being the four food groups. For this new food guide the fat group was eliminated and the three vegetable and fruit groups were combined into one group (Ahlström and Räsänen, 1973). The minimum number of servings for each group was listed, as well as more accurate information on the appropriate serving sizes. The Basic Four was used to create a foundation diet that emphasized foods that provided protein, iron, calcium, vitamins A and C, thiamin, riboflavin, and niacin but provided little guidance on calories, fats, or sugars. It was assumed that individuals would meet their caloric and other nutrient needs by consuming more than the recommended amounts in the guide (Welsh *et al*., 1993). This emphasis on getting enough nutrients remained the focus of nutrition education for the next 20 years (Welsh *et al*., 1993). In this schematic the four food groups were presented as equal quadrants. Lachance and Fisher (1986) urged that the proportions recommended be presented akin to a "peace" symbol to emphasize the need for at least two-thirds of the food on the plate to be of plant origin, with the remaining being of animal and dairy origin. (Interestingly, the American Institute for Cancer Research introduced the concept as the "New American Plate" in April 2000.)

The Basic Four food guide was modified in 1979 and became the "Hassle-Free Guide," which added a fifth group, which included fats, sweets, and alcohol, to the Basic Four. Like the Basic Four, it recommended a foundation diet with daily servings from the milk, meat, fruit and vegetable, and grain groups, but it also separated low nutrient density foods from the other groups. The Hassle-Free Guide promoted the moderate consumption of fats, sugars, and alcohol and highlighted calories and dietary fiber (Welsh *et al*., 1993).

The *Dietary Guidelines for Americans* have been published every 5 years since 1980 by the USDA and the Department of Health and Human Services

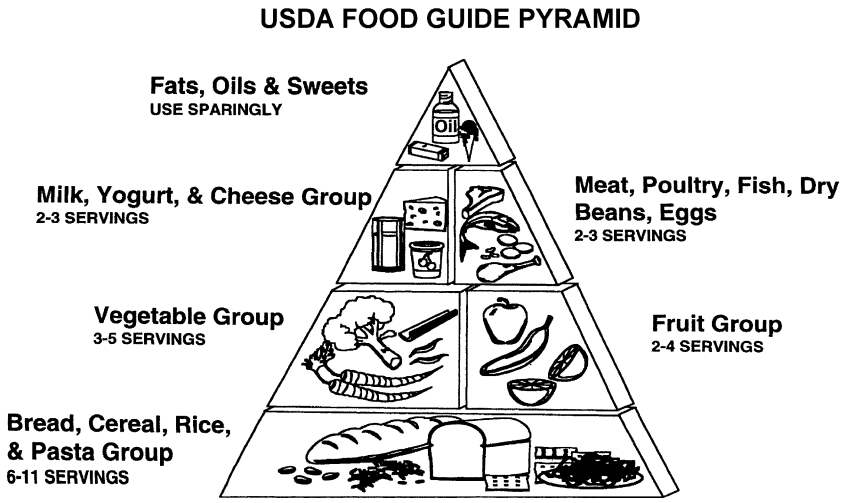

FIG. 1 U.S. Department of Agriculture Food Guide Pyramid. As revised in 1992. "Eat from the bottom up."

(HHS). The purpose of the *Dietary Guidelines* is to provide Americans 2 years and older with information on diet choices that will promote health and prevent disease (USDA, 2000). The Food Guide Pyramid is a graphic illustration of the *Dietary Guidelines* and was first issued in 1992 (Figure 1) (USDA, 1992). The current Food Guide Pyramid organizes foods according to a category (cereal, fruit, dairy, etc.) and nutrient content. For example, in the USDA Food Guide Pyramid, all fruits are grouped together and it is recommended that one select two to four servings from this group each day. Consumers are expected to select a recommended number of servings from each group to plan their diets.

Internationally, food guides come in three major shapes: circular plate, oriental pagoda, and pyramid (Painter *et al.*, 2002). The pyramid approach to food group guide combinations is used primarily in the United States, Puerto Rico, and the Philippines. In North America, Canada uses a rainbow concept, whereas Mexico and Central America use the most common and worldwide approach of a circular plate of food groupings. Whereas the emphasis of this chapter is to reconsider and reinvent the USDA Food Guide Pyramid, the recommendations for change must be science based. Yet the changes must not lose sight of the intended audience, which is John Q. Public, with essentially no education in science. Further, the recommendations made for the pyramid should be applicable as well to other food guide presentation approaches (circular, rainbow, etc.); however, this

chapter focuses on the pyramid approach as a food guide because it serves well as a model system.

III. WHY REINVENT THE PYRAMID?

Why reinvent the Food Guide Pyramid? A major drawback of the various groupings of the pyramid is that they do not distinguish caloric differences or nutrient densities of the various foods within each grouping. Given the epidemic increase in obesity in America, one of the greatest challenges facing the Food Guide Pyramid is a plan for realizing nutritionally balanced diets that are low in energy.

The USDA Center for Nutrition Policy and Promotion rightfully sees a need for the revision of the Food Guide Pyramid. The proposal of the USDA recognizes that the estimated energy requirements (EERs) of the dietary reference intakes (DRIs) to maintain weight is based on gender, age, height, weight, and activity level. The EER for men and women of reference body size decreases with age in years, but it increases for children up to the age of maturity. However, what plagues the United States is overweight and obesity in both children and adults. Some of the consumer issues of the Food Guide Pyramid elicited by the USDA pertain to perceptions of the difference between servings and portions, as well as serving size as related to the number of servings recommended. The fact is that few consumers use the current Food Guide Pyramid consciously, finding it to have too many details to follow.

Another drawback to the current Food Guide Pyramid is that the actual practices of Americans as to choices made relative to the recommendations of the pyramid are poor. Most Americans do not ingest and thus meet the recommended food proportions of the Food Guide Pyramid. Americans consume too many servings of foods with added fats and sugars and do not eat enough fruits, vegetables, dairy products, lean meats, and foods made from whole grains (Kantor, 1998, 1999). Based on two estimations (Anonymous, 1994; USDA, 1998) of data on actual consumer practices vis-à-vis the recommendations of the Food Guide Pyramid (Figure 2), one can graphically portray and contrast the food choices adult consumers have made. The ''reality'' pyramid reveals that the foods preferred and eaten are of the type best fitting the peak of the pyramid. For products with added sugars and discretionary fats, the estimated maximum that should be incorporated into the group at the peak is 27% of total food energy. However, ''in reality'' the average adult American chooses as much as 41% of their calories from this one food group (Anonymous, Consumer Reports on Health, 2000). The consequence is that their total food energy is substantially

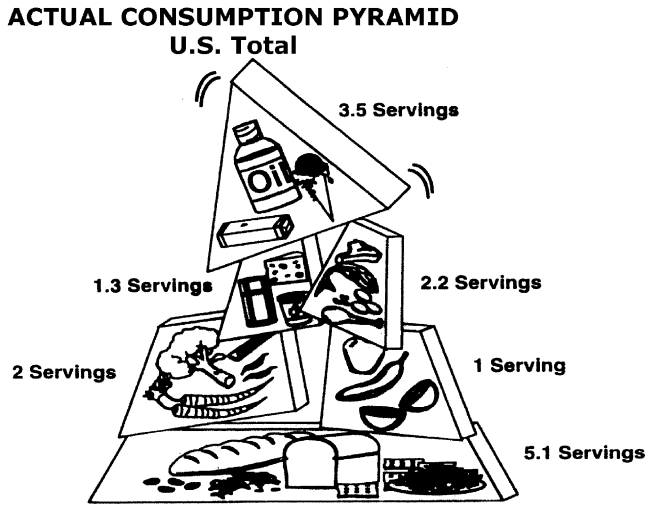

FIG. 2 Actual consumption pyramid (based on 1996 CSFII data). The percentage of total energy consumption from discretionary fats, added sugars, and related food products is now 41% in contrast to the goal of "not to exceed 27%" (Anonymous, 2000).

derived from selecting poor nutrient dense food. It, thus, creates the question about whether the current pyramid as a food guide should be modified to increase the awareness of its intended capability to effectively lead to better food choice practices. The "reality" of this finding cries out for a missing indicator of nutrient density being made available to the consumer. Consumers have no other reference point about which foods, in what proportion, can sustain and enhance health. The Nutrition Facts panel on packaged foods of the Nutritional Labeling and Education Act of 1990 (NLEA) (Food and Drug Administration [FDA], 2003) serves the purpose of describing the calories per serving. It also provides information about what to *avoid* in terms of fat, cholesterol, and sodium. There has not been a marriage of the provisions of the NLEA, the Dietary Guidelines, and the Food Guide Pyramid. The *E* in *NLEA* has not really occurred. The NLEA is "regulated" by the FDA, which has sufficient regulatory crises to ever get around to be involved in education, but to its credit it has tried on at least two occasions, only to have to set education plans aside as a major regulatory based crisis erupted. The Dietary Guidelines are a joint HHS/USDA undertaking and the Food Guide Pyramid is a USDA education effort.

Meanwhile, and more importantly, the scientific evidence supporting health claims and functional foods promotes the concept that benefits can be derived from the proper choices of foods. This concept has reached a point at which one cannot deny the need to reappraise the pyramid and, thus, the health benefits that should accrue if one elects to follow a food guide and maximize the health benefits of the resultant food and meal combinations.

For reasons that are not clear, consumers believe they are following a relative balance of the pyramid food groupings. They are confused because they observe that overweight and obesity are on the rise and they have been eating less visible fat, but they do not realize that in avoiding only fat (i.e., consuming a lower percentage of fat as a source of energy) (Chanmugam *et al.*, 2003), they have increased their energy intake overall by up to 12–14% during the last 2 decades. It does not take long at that rate of excess over the need to become overweight and later obese, and for the phenomena to begin at younger and younger ages (Zizza *et al.*, 2001).

IV. ALTERNATE SOLUTIONS PURSUED BY THE CONSUMER

The consumer is seeking solutions to their dilemma of body weight control via a number of dieting solutions, in particular shifting the macronutrient (protein/carbohydrate) composition of their daily diet. Books describing weight loss plans, based on the proportions of dietary protein to carbohydrate, are so popular that several have been or are on the bestseller lists and have been translated into several languages. These favorite weight loss/control plans advocate high-protein and low-carbohydrate dietary intake practices. Interestingly, the authors of two current popular weight loss books, Dr. Atkins' New Diet Revolution (Atkins, 2002) and the South Beach Diet (Agatston, 2003) are physicians who are debated by other physicians and we have a contest that does not benefit the consumer. The client for these books and their plans are predominantly of the Baby Boomer and X generations. Otherwise, organized weight loss and physical activity businesses abound. It is important to note that children and seniors remain in limbo. The Atkins' diet leaves the vegan in limbo, whereas the South Beach diet provides sought after vegetarian recipes.

Since 1975 or so, adult Americans have consumed an additional 12–14 % more calories daily, which alone could help explain the epidemic rise in obesity. Over a span of about one generation, the increase in obesity has become a readily apparent association with increasing expenditures for eating away from home or purchasing food to take home (Lachance, 2000). The consumer concern for health becomes subservient to the need

for convenience and rapid preparation and also influenced by the perception of the value in the amount of food for the cost.

V. PHYSICAL ACTIVITY AS A VARIABLE

The issue of the many facets of physical activity is not in the purview of this chapter. In terms of everyday physical aerobic activity, many factors other than food intake are overlooked. Security concerns bar reentry from stairwells of multistory buildings. Elevators are routinely used, even by college students, to escape a single flight of stairs. The computer age ties the individual to the screen, be it a game toy, e-mail, or serious research work. Living in air-conditioned environments lowers energy demand. What is eaten during say "Monday night football" is no help in a milieu of boisterous but limited opportunity for exercise. Of concern is the emulation by children. There has been a significant increase in the snacking of young adults (Zizza *et al.*, 2001). Other lifestyle practices also are variables. The solution to obesity is multifaceted (Lachance, 1994), but expecting the Food Guide Pyramid to deal with energy output factors and the obvious energy inputs is naive. More effective would be providing the consumer with an indicator of the nutrient density of packaged and fast foods and thus help the consumer make more uncomplicated but sophisticated choices. We are proposing that an indicator of calorie density (cost) per 1% averaged daily value of 13 nutrients would help consumers realize when a food product is excessive in calories and/or unclassified as to location in the pyramid. The concept—calories for nutrient (CFN)—is presented later in this text and its application illustrated with example figures.

VI. IMPACT OF CULTURAL DIVERSITY

The pyramid concept has been easily adapted to various cultures such as Arabic, Chinese, Cuban, Indian, Mexican, Native American, Russian, and Thai to name a few (USDA, 2003). The eating habits of Americans are diverse, which reflects the multicultural origins of Americans. Several key dietary pyramid patterns reflect the diversity of the U.S. consumer (Figures 3 through 6): vegetarian, Mediterranean, Latin American, and Asian. Unfortunately only 25% of adult Americans in 1996 (USDA CSFII) consumed the number of servings per day recommended by the USDA Food Guide Pyramid and the Dietary Guidelines on which the "official" pyramid (Figure 1) evolved (Katz, 1998). (The Food Guide Pyramid has not been revised since 1992 but is scheduled for a revision by 2005 or sooner.)

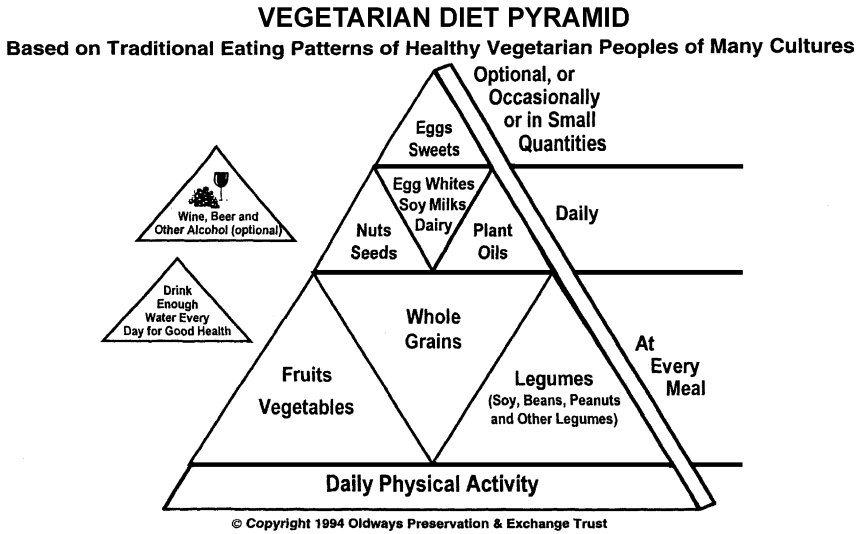

FIG. 3 Vegetarian diet pyramid (Oldways, 1994). Most striking is the emphasis on whole grain and complete lack of cereal grain products that do not contain whole grain flour, such as pastas and breads.

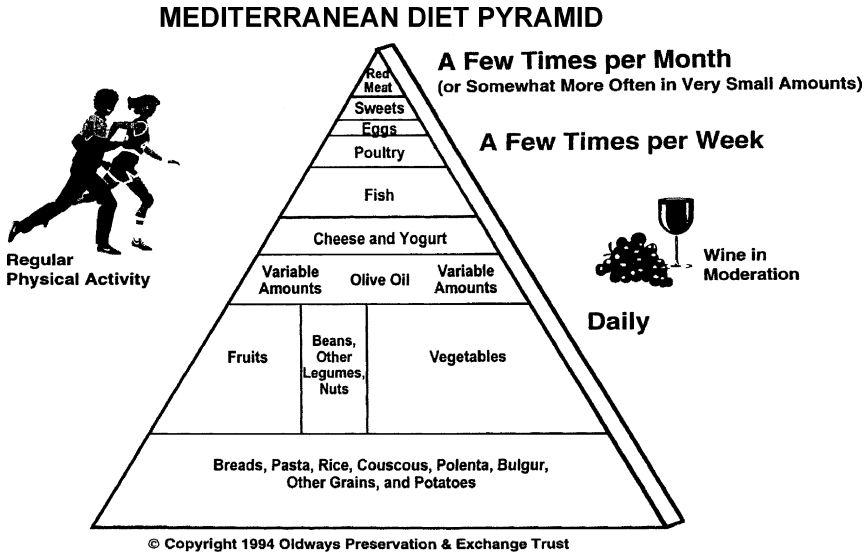

FIG. 4 Mediterranean diet pyramid (Oldways, 1994). No specific mention is made of whole grain products. Legumes and nuts are given equal status with fruits and vegetables. Olive oil is specifically designated.

FIG. 5 Latin American diet pyramid (Oldways, 1994). Equal status is given to grains, tubers, legumes, and nuts, along with fruits and vegetables.

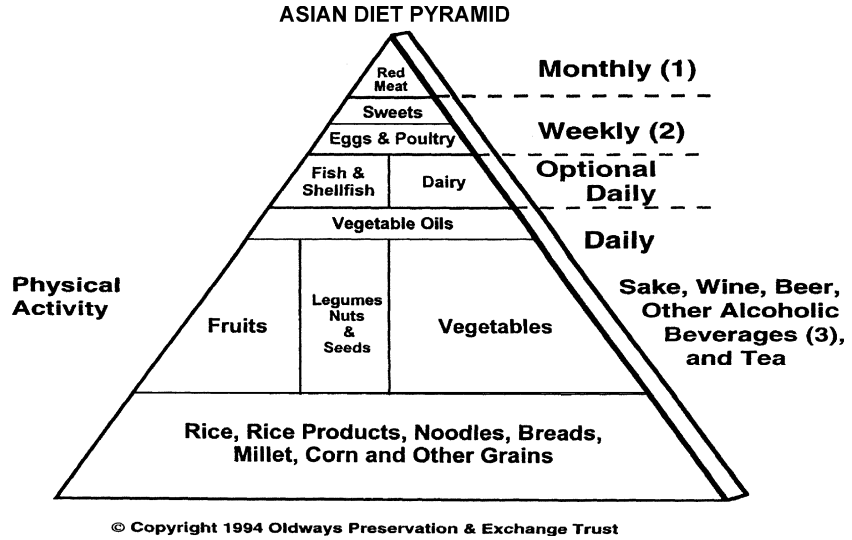

FIG. 6 Asian diet pyramid (Oldways, 1994). Legumes, nuts, and seeds are given equal status with fruits and vegetables; included is tea as a beverage. Optional are alcoholic beverages on a daily basis.

One of the major differences among the various pyramids regards the placement of legumes, nuts, and seeds. It is a more important category than simply their contribution to the protein content of the diet without a specific recommendation as to servings per day. Note that when legumes, nuts, and seeds of this food grouping are dissected out and placed into the foundation tier of the pyramid, one to two daily servings becomes specifically recommended.

The USDA pyramid recommends six to nine servings per day of vegetables and fruits; however, only 24% of Americans consume five or more servings of fruits daily and only 50% consume three to five servings of vegetables per day (Katz, 1996). Federal agencies complicate the issues when they promote dietary interventions that emphasize deviating from the recommendations of the various food groupings. An example is the five-a-day program of the National Cancer Institute (NCI), which promotes the daily consumption of at least five servings per day of fruits *and* vegetables (NCI, 2003). It is an admirable goal but self-evidently not the official recommendation. Even with the five-a-day serving promotion, an increase in the daily eating of vegetables and fruits has been exceedingly poor (<1% a year).

The low intakes of fruits and vegetables result in nutrients such as the carotenoid precursors of vitamins A, vitamin C, and fiber being low in many diets. The three most popular fruits consumed by Americans, namely oranges, apples, and bananas, account for half of the fruit eaten by Americans. As for vegetables, Americans prefer "head lettuce" (mostly iceberg), frozen and fresh potatoes, potato chips and "shoestrings," and canned tomatoes (Kantor, 1999). These "vegetables," really one vegetable, one tuber, and one fruit, accounted for almost half of the vegetables consumed in America in 1996 (Kantor, 1999). Intakes of fruits and vegetables are better in households with a higher educational level (Roos *et al.*, 2001).

VII. REINVENTING THE PYRAMID

Two major changes in the pyramid need to occur. The first is that the base (foundation) of the pyramid must be changed to foster the meal-by-meal selection and ingestion of vegetables, legumes, nuts, seeds, and fruits. Second, the cereal grain category needs to be acknowledged for its whole grains, for which, in contrast to refined grain products, there is scientific evidence of health benefits (Jacobs *et al.*, 1998, 1999; Liu *et al.*, 1999, 2000; Miller *et al.*, 2000; Slavin *et al.*, 1999; Thompson, 1994). However, because only 20–30% of the cereal grain foods category is whole grain (with the associated health benefits), it can no longer serve as the base of the pyramid but can continue to serve as a primary source of whole grains and energy and as a mainstay carrier

for public health–enrichment practices. The cereal grains should be moved up the pyramid from the foundation to the second tier and thus serve in bridging the cereal grain product source foods of the base with the dairy and protein sources just above them, where all the makings of many types of sandwiches take place, be it cream cheese or lox on a bagel to cheese and various meat sandwiches or the adding of milk to ready to eat cereals.

Based on the science we now have available in terms of dietary sources of recognized recommended dietary allowance nutrients and health promoting nonnutrient bioactive phytochemical factors (i.e., nutraceuticals), the foundation of the pyramid should be reinvented (Figure 7 and Table II) and constructed of vegetables (Figure 8), fruits (Figure 9), and legumes, nuts, and seeds (Figure 10).

The second tier becomes the next most important source of nutrients, nutraceuticals, and in particular sources of cereal grain energy (Figure 11). Not included in this tier are cereal grain–based products that have a CFN content in excess of 50 calories per averaged 1% of 13 essential nutrients expressed in daily value (DV) per serving. These dessert type of foods ranging from apple pie to cake and croissants to donuts are as much a

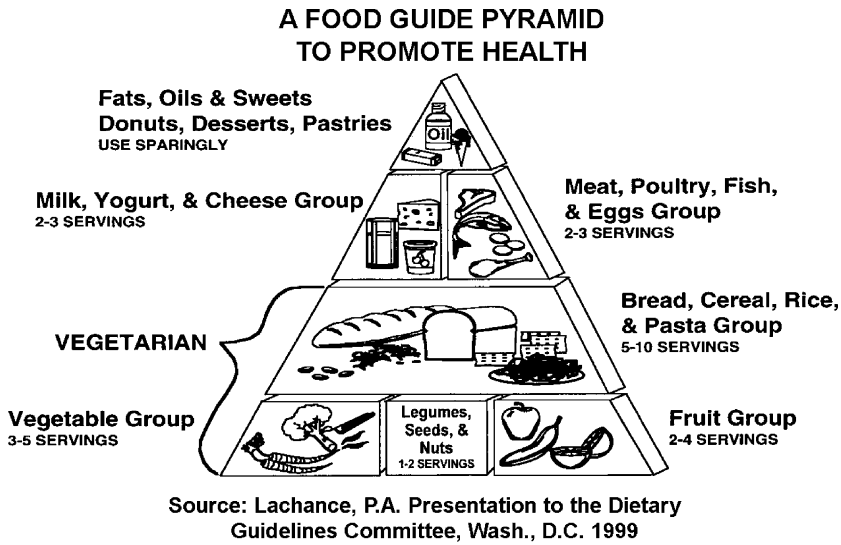

FIG. 7 A food guide pyramid to promote health. Recognition is made of the role of "functional" foods. The foundation of the pyramid is vegetables, legumes, seeds, nuts, and fruits. Cereal grain products, both whole grain and products with a nutrient density less than 50 calories for nutrient, are moved to the second tier. The foods of the two bottom tiers meet the needs of the vegan. This recommendation also coincides with the majority of health claims data (Table II).

TABLE II
HEALTH CLAIMS SUPPORT REINVENTION OF THE PYRAMID

- Calcium-rich foods and reduced risk of osteoporosis: dairy, vegetables, legumes
- Low-sodium foods and reduced risk of high blood pressure: fruits, vegetables, nuts
- Low-fat diet and reduced risk of cancer: plant foods
- A diet low in saturated fat and cholesterol and reduced risk of heart disease: plant foods
- High-fiber foods and reduced risk of cancer: plant foods
- Soluble fiber in fruits, vegetables, and grains and reduced risk of heart disease
- Soluble fiber in oats and psyllium seed husk and reduced risk of heart disease
- Fruit- and vegetable-rich diet and reduced risk of cancer
- Folate-rich foods and reduced risk of neural tube defects: leafy vegetables, legumes, peanuts
- Sugar alcohols and reduced risk of tooth decay
- Soy protein and reduced risk of heart disease: legume
- Whole-grain foods and reduced risk of heart disease and certain cancers
- Plant sterol and plant stanol esters and heart disease: bamboo shoots, nuts, vegetable oils
- Potassium and reduced risk of high blood pressure and stroke: fruits, vegetables

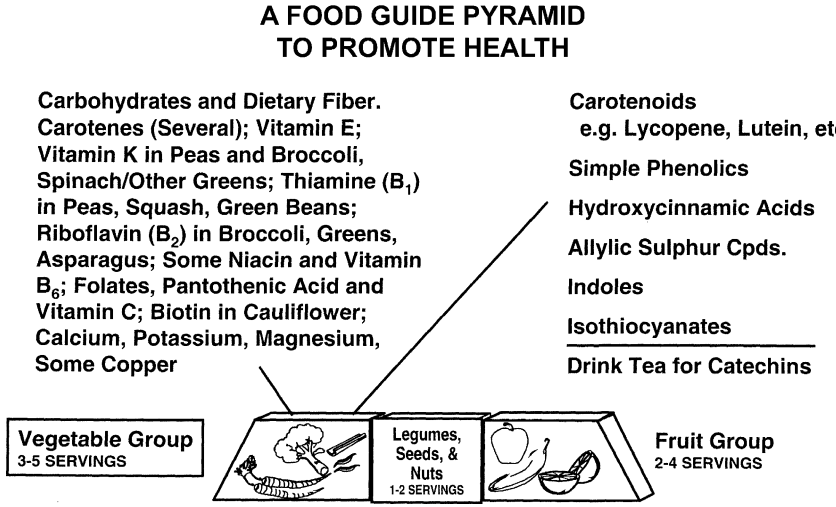

FIG. 8 A food guide pyramid to promote health—vegetables. The key phytonutrient nutraceuticals of vegetables are at the base of the health promotion pyramid.

concern as discretionary fats and added sugars and thus must be relocated to the peak tier of the pyramid (Figure 7).

Figures 12A and B describe the third tier of the pyramid containing a grouping of the high-quality nutrient and protein sources of dairy products

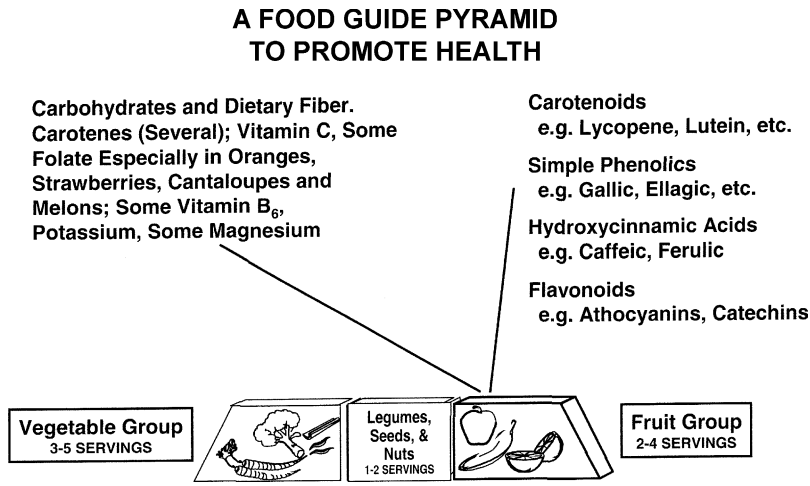

FIG. 9 A food guide pyramid to promote health—fruits. The key phytonutrient nutraceuticals of fruits are at the base of the health promotion pyramid.

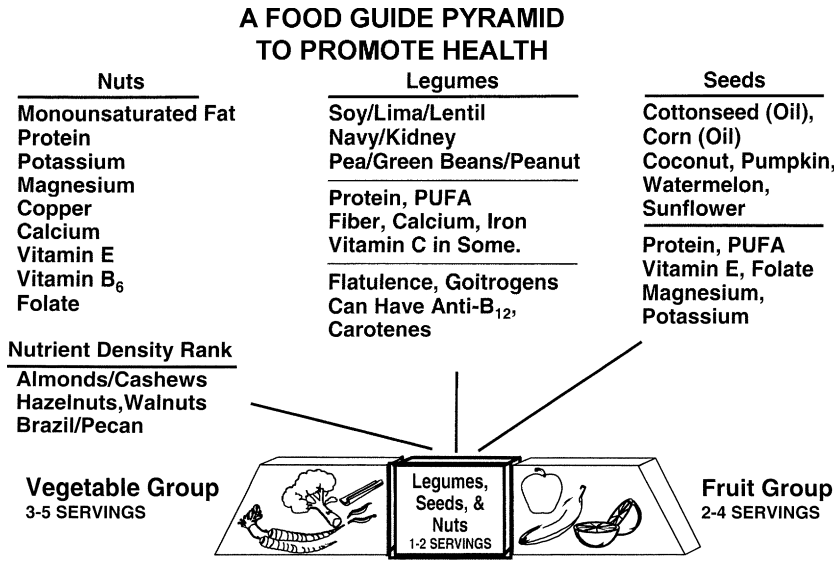

FIG. 10 A food guide pyramid to promote health—legumes, seeds, and nuts. Legumes, seeds, and nuts are relocated to the base of the health promotion pyramid for their phytonutrient nutraceuticals.

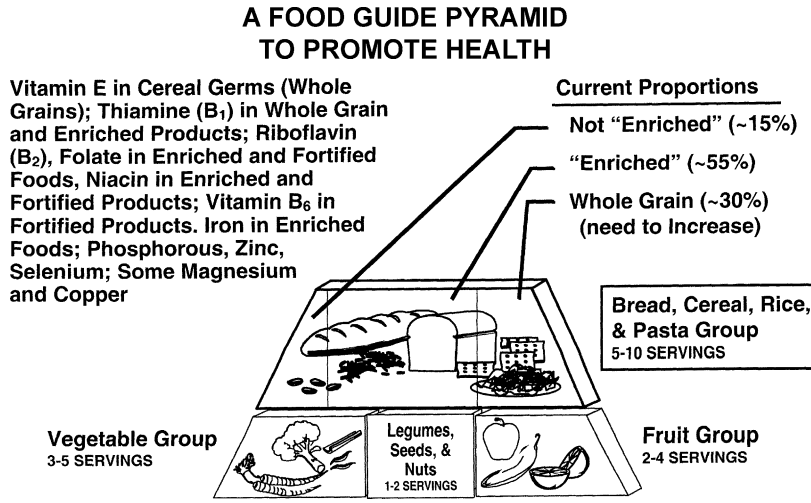

FIG. 11 A food guide pyramid to promote health—cereal grains. This food group consists of whole, enriched, and nonenriched cereal grains. Only whole grain foods have high nutrient/nutraceutical content and related health benefits.

(Figure 12A) and a grouping of the classic animal protein sources such as meat, fish, and poultry and eggs (Figure 12B). The protein food group relinquishes legumes, nuts, and seeds to the foundational tier, makes possible the provisioning of all the basic food needs of the vegan, and provides key nutrients and nutraceuticals such as the rich source of vitamin E in nuts.

Figure 13 illustrates that not only sweets, fats, and oils belong in this peak of the pyramid, but also any foods such as donuts, which have a poor nutrient density that is a high cost in calories for a low input of essential nutrient (e.g., high CFN) and are foods essentially devoid of nutraceuticals.

A further obvious benefit of the combination of a new base (foundation) to the pyramid of vegetables, legumes, seeds, nuts, and fruits, coupled to a cereal grain array of basic traditional grain foods such as breads, pastas, rice, and so on, is that the two-tier combo provisions all the nutrient and energy needs of the vegan. The lacto and ovo food products can be tapped as needed by the lacto and/or ovo-vegetarian. By moving legumes and nuts from a protein content categorization in the current pyramid to a functional food categorization coupled with vegetables and fruits (in a culture that consumes excess protein), the potential for superior nutritive balance and health benefits emerges. Cereal grains around the world are the major source of energy and protein complementation needs, as well as the nutrient needs of concern to the vegan through the combination of lysine-limiting cereal grains with methionine-limiting legumes, nuts, and selected other foods.

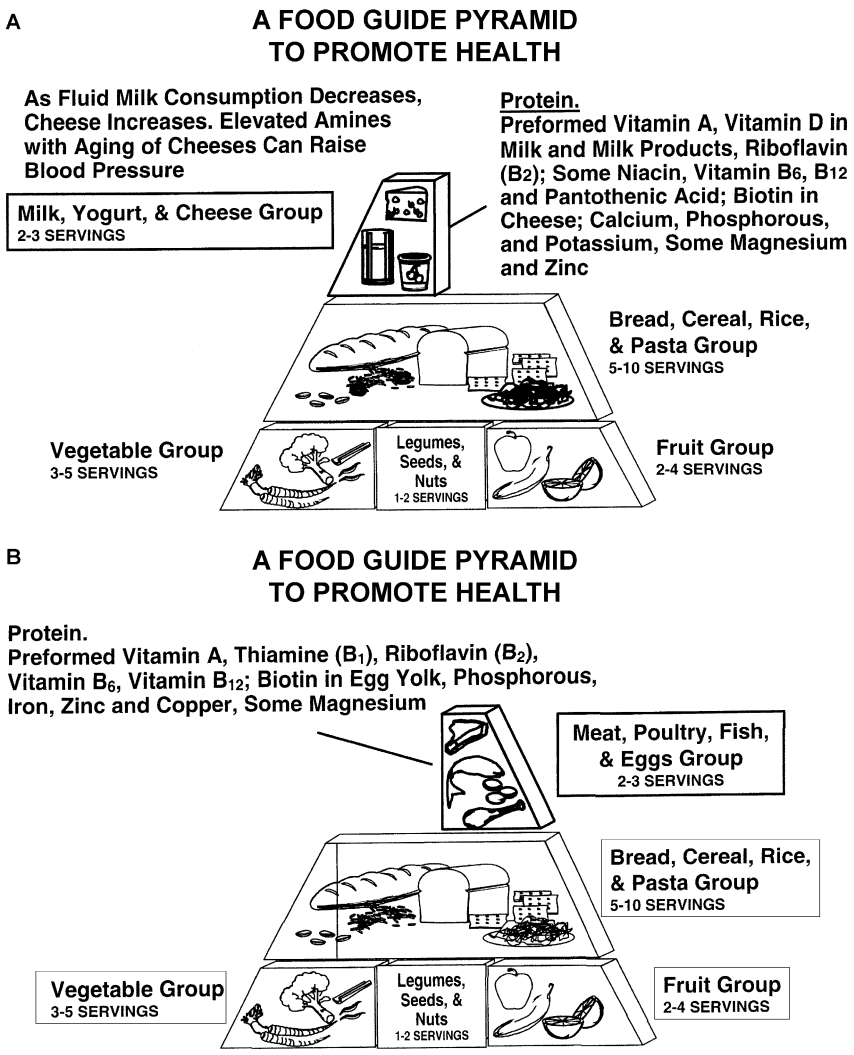

FIG. 12 (A) A food guide pyramid to promote health—dairy. Dairy foods can be rated in terms of nutrient density. (B) A food guide pyramid to promote health—protein foods. Protein foods can be rated in terms of nutrient density.

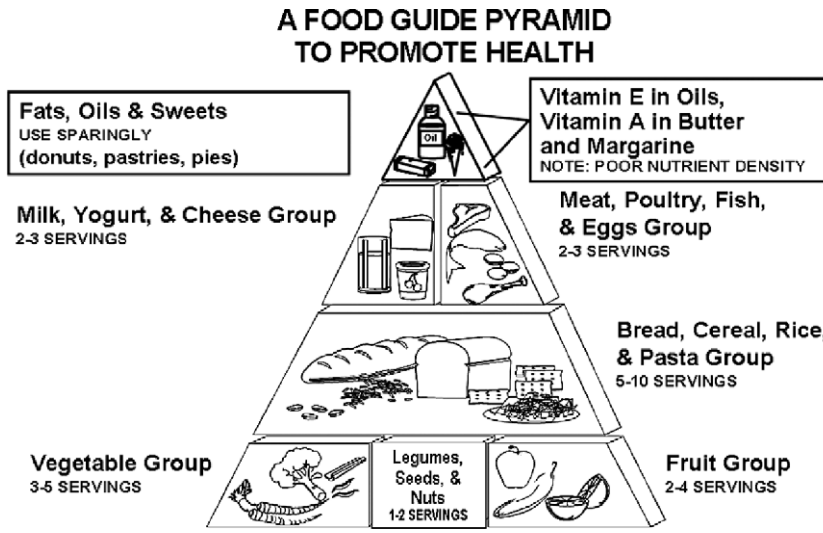

FIG. 13 A food guide pyramid to promote health—high-energy foods. Foods with added sugar or fats have a high caloric density (calories for nutrient [CFN]), as do sweet goods, such as doughnuts, pastries, and pies; these foods are easily rated if the CFN is provided.

VIII. THE CALORIES FOR NUTRIENT TO ASSESS CALORIC DENSITY

The CFN of a serving of any food can be ascertained from a food database (e.g., UDSA http://www.nal.usda.gov/fnic/foodcomp) by determining the average of the daily values (DVs) of 13 key nutrients (protein, thiamin, riboflavin, niacin, folate, vitamin B6, vitamin B12, vitamin C, vitamin A, calcium, magnesium, iron, and zinc) divided into the calories per serving (Table III). The concept of the CFN or calories required to deliver 1% of the averaged DV of 13 indicator nutrients is a criterion for assisting choices based on the cost in calories for 1% averaged nutrient per serving. It was conceptualized in 1986 by Lachance and Fisher.

We are proposing that the CFN information be precalculated for the consumer and placed on the Nutrition Facts label in lieu of ‘‘calories from fat.’’ The FDA has determined that this calculation has little or no meaning to the consumer (Crawford, Acting FDA Commissioner at 16 March 2004 NNR Symposium, Washington, DC). The CFN would assist consumers and the overall implication of their choices in terms of calorie density for nutrient content (i.e., CFN) per serving and not only the contribution of fat and/or sugar stated on the label. The CFN informs one about the cost in calories to

TABLE III
REPRESENTATIVE CALORIES FOR NUTRIENT (see text)

Food	Serving	CFN	GI[a]	Fiber (g)	Fiber (%DV)
Dairy					
2% milk	1 c	12		0	0
Ice cream, vanilla	1/2 c	44	62	0.5	2
Yogurt, plain low fat	8 oz	11	36	0	0
Yogurt, fruit, low fat	8 oz	22		0	0
Cheddar cheese	1 1/2 oz	24		0	0
American cheese	2 oz	21		0	0
Meats, poultry, fish, nuts, and legumes					
Egg, fried	1 large	19		0	0
Beef, roasted	3 oz	12		0	0
Pork chop, broiled	3 oz	12		0	0
Chicken breast, roasted	3 oz	11		0	0
Chicken breast, fried	3 oz	11		0	0
Tuna, white, canned in water	3 oz	13		0	0
Baked beans, vegetarian	1/2 c	17	40	13	52
Kidney beans, canned	1/2 c	18	23	16	64
Lentils, cooked	1/2 c	11	28	15.5	62
Peanuts, roasted	1 oz	27	15	2	8
Peanut butter	2 Tbsp	31		2	8
Almonds	1 oz	27		3.5	14
Walnuts	1 oz	40		2	8
Sunflower seeds	1 oz	26		3	12
Fats and sweets					
Mayonnaise	1 Tbsp	272		0	0
French salad dressing	1 Tbsp	164		0	0
Olive oil[b]	1 Tbsp	119		0	0
Soybean oil[b]	1 Tbsp	120		0	0
Butter	1 Tbsp	129		0	0
Margarine	1 Tbsp	122		0	0
M&Ms	1 serving	95		0.5	2
Reese's peanut butter cups	2 cups	53		1.5	6
Strawberry jam	1 Tbsp	109	51	0	0
Sherbet, orange	1/2 c	55		0	0
Cola soda[b]	12 fl oz	284	63	0	0
Wine	3.5 fl oz	111		0	0
Beer	12 fl oz	38		0.5	2
Fast-food meals					
Hamburger, fries and soda		33		2.5	10
Cheeseburger, fries, and soda		31		2.5	10
Hamburger, fries, soda, and milkshake		23		2.5	10
Fruits					
Apple	1 medium	39	40	4	15

(*continued*)

TABLE III (*continued*)

Food	Serving	CFN	GI[a]	Fiber (g)	Fiber (%DV)
Applesauce	1/2 c	58		1.5	6
Apple juice	6 fl oz	62	40	0	0
Banana	1 medium	16	51	3	12
Cantaloupe	1/2 c	4		1	4
Orange	1 medium	5	48	3	12
Orange juice	6 fl oz	6	46	0	0
Strawberries	1/2 c	3	40	3	12
Vegetables					
Asparagus, cooked	1/2 c	2		2	8
Broccoli, cooked	1/2 c	2		3	12
Carrots, cooked	1/2 c	1	92	2	8
Cauliflower, cooked	1/2 c	3		2	8
Potato, baked, flesh	1 medium	17	78	4	16
Potato, baked, flesh with butter	1 medium	20		4	16
Potato, baked, flesh with sour cream	1 medium	19		4	16
Potato, boiled	1 medium	20	54	1.5	6
Potato, French fried	10 strips	34	75	1.5	6
Potato chips	1 oz	37	51	1	4
Tomato	1/2 c	4		1	4
Tomato sauce	1/2 c	5		2	8
Catsup	1 Tbsp	15		0	0
Grains					
White bread	1 slice	20	70	0.5	2
Whole wheat bread	1 slice	21	73	2	8
Danish pastry, fruit	1 pastry	52	59	1	4
Chocolate cake with frosting	1 piece (1/8 of 18 oz cake)	79	38	1	4
Doughnut, glazed	1 medium	50		1	4
Apple pie	1 piece (1/6 of 8″ pie)	102		2	8
Chocolate chip cookie	2 cookies	61		no data	no data
Oreo cookies	3 cookies	115		1	4
Shredded Wheat cereal	1 oz	26	75	5	20
Wheaties	1 c	3		3	12
Puffed wheat	2 1/2 c	19	67	1.5	6
Cheerios	1 c	5	74	3	12
Oatmeal, cooked	1/2 c	27	66	4	16
Saltine crackers	4 crackers	29	74	1	4
Egg noodles	1/2 c	24	32	2	8
Spaghetti	1/2 c	25	35	2	8
White rice	1/2 c	30	50	0.5	2
Brown rice	1/2 c	31	50	3.5	14

[a]GI; glycemic index. From Foster-Powell (2002).

[b]Represents calories per serving, as there are negligible amounts of nutrients with which to calculate caloric density (calories for nutrient [CFN]) in these foods.

deliver 1% of the DV of an average of 13 nutrients. (The DV is derived from the U.S. RDA developed by the FDA for nutrition labeling.) Even when the FDA elects to update the DV so that they are based on the RDIs (Institute of Medicine, National Academy of Sciences), the nutrient component of the CFN ratio will shift accordingly and there will occur a one-time change in the CFN numerical value. The nutrition facts information panel changes can be made to coincide with packaging changes.

Conceptually, if 1% of the recommended nutrients for the day cost 50 calories; the CFN label reads *50*; it means that the consumer has elected a 5000 (50×100) calorie-per-day lifestyle food energy intake in the choice being made to meet an array of all recommended nutrients. Even at a lifestyle goal of fulfilling 70% of daily recommended nutrient intake adequacy, it would mean choosing to ingest a 3500 calories/day lifestyle, and thus, the food choice serving(s) may be contributing calories in excess of need. The frequency of servings of poor choices of foods with a high CFN points to the excess calories that contribute to overweight and obesity. Humans need "fun foods" in their everyday lives, but decisions about whether it will be a fruit or a chocolate donut are necessary to control body weight gain. Unless the person is a lumberjack or a marathon runner or expends more than 5000 Kcal/day in routine physical activity, the penalty over time of consuming foods with a high CFN will be overweight and obesity (body weight exceeding 20% of the ideal weight for height and body type or BMI > 25). Requiring a CFN calculation to be displayed on the label of each product would aid consumers in ascertaining the caloric cost consequences of each food. See Table III for the CFN of some representative foods (for the nutrients in question). Food energy sources are no longer scarce in the diets of most Americans because if they were scarce, obesity would not be on the rise.

Figures 14, 15, and 16 provide illustrations of the CFN concept in a given food as altered by the choice of the processed version chosen, for example of apples and boiled potatoes as compared to apple juice and french fries, or the choice of product because of changes in one ingredient (e.g., fat content of fluid milk). The CFN can be used to make choices between foods within a category or different types of foods or beverages or combinations of food such as a bagel with cream cheese (Figure 17). Representative CFNs for each food group of the reinvented pyramid are given in Figure 18. The CFNs rise accordingly as food groups move to the top tier. We suggest that the consumer will look for these low CFNs and understand that one serving per day of legumes, nuts, and seeds with a CFN of 20 in the foundation tier is diluted by the much lower CFNs of vegetables and fruits.

A question can be how to differentiate between products that are truly whole grain (51% or greater whole-grain flour) and traditional refined cereal

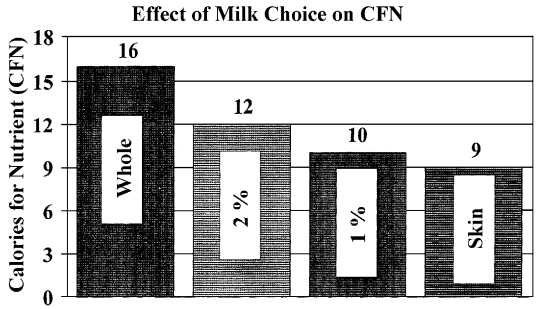

FIG. 14 Effect of milk choice on caloric density (calories for nutrient [CFN]). Higher fat products have a higher caloric density.

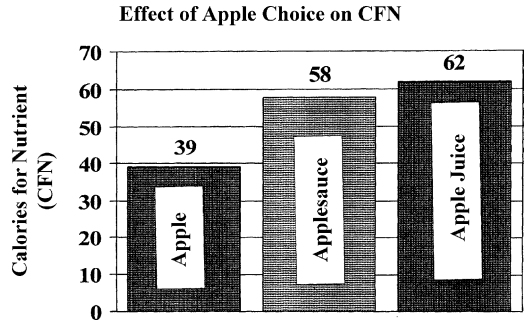

FIG. 15 Effect of apple choice on caloric density (calories for nutrient [CFN]). The CFN of apple products reflects loss in nutrients via processing.

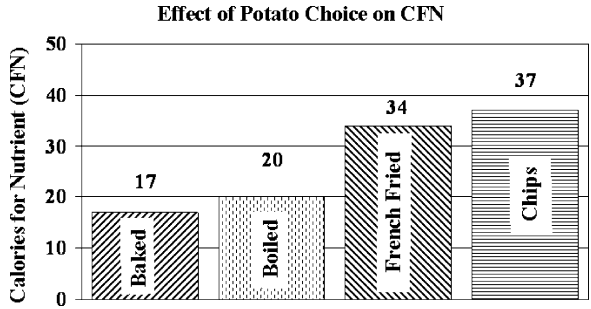

FIG. 16 Effect of potato choice on caloric density (calories for nutrient [CFN]). The CFN of potato products reflects added fat and some loss of nutrients via preparation.

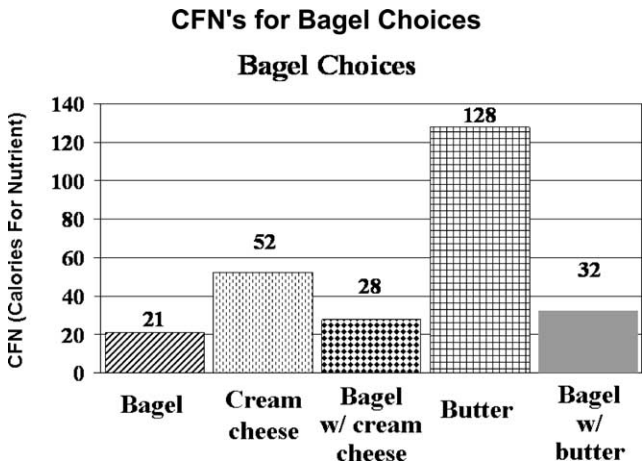

FIG. 17 Effect of spread choice on caloric density (calories for nutrient [CFN]) for bagel. The CFN of adding one ounce of cream cheese or one tablespoon of butter.

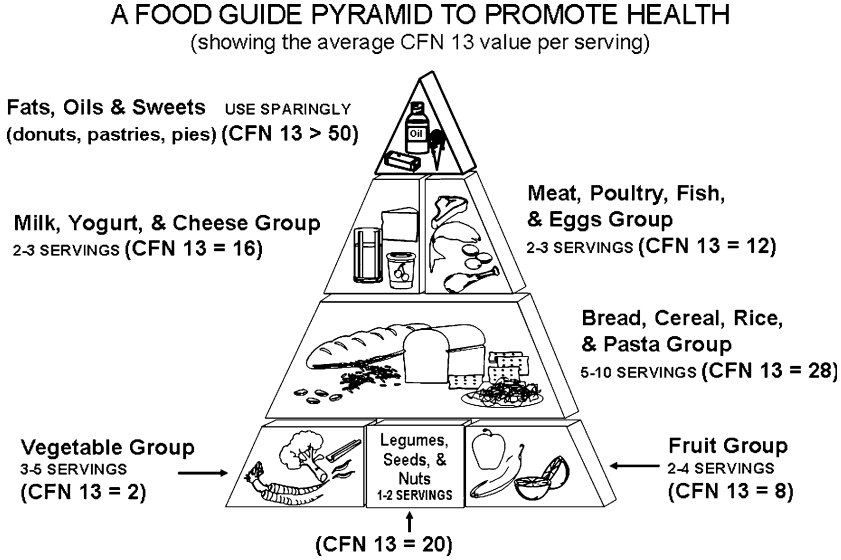

FIG. 18 Average caloric density (calories for nutrient [CFN]) for each food group of the pyramid. The CFN for each major food group of the pyramid reflects the high content of nutrients, in particular for the vegetable and fruit groups. Foods with high caloric value but poor nutrient content need to be used sparingly.

grain products such as white bread, cornmeal, and rice, in comparison with those products containing some fraction of cereal grain ingredients but that are "fun" foods more in line with desserts. These "tasty" cereal grain products (croissants, donuts, danishes and pastries, cookies and cakes, etc.), which have a cost of 50 calories or more per average 1% of the daily RDA must be booted up to the fun/dessert category at the top of the pyramid. This means that the cereal grain tier has the whole-grain and the basic cereal food products such as enriched bread, but that those foods that are not 51% whole grain and have a high CFN content because of added sugars, fat, or both (such as apple pie) also automatically qualify for the peak tier of the pyramid.

Beverages such as water, milk, and tea or an occasional glass of wine may be sources of caloric energy but with other health benefits because of their role as functional foods. Carbonated beverages and drinks with low juice content (e.g., token 10% or less) are recreational and belong in the peak of the pyramid.

A. INDEPENDENCE OF "ORGANIC" AND NON-GMO CLAIMS

As consumer acceptance of the "organic food" increases, it is repeating the phenomena of shifting business away from Mom-and-Pop health food stores to specialty corporate market chains (e.g., Wild Oats Natural Marketplace). Classic supermarkets also are purveyors of the standardized (meeting criteria established by the USDA) organic products including an increasing array of combined "organic" and non–genetically modified organism (non-GMO) fresh and snack foods. In terms of the Food Guide Pyramid, no changes are needed because these factors are independent variables offered by the purveyors and the purchase decision chosen by the consumer.

B. FURTHER RATIONALES FOR REINVENTING THE PYRAMID

Equally important justifications for the modification of the foundation of the Food Guide Pyramid are the data of the consistent coherent tradition of emerging scientific activity pertaining to (1) the scientific agreement that underlies the approval of positive health claims and (2) nutraceutical content.

Our attempt to justify the various food groups by the "glycemic index" and "dietary fiber" content of a set of representative foods fails because the data are too limited. In general, the hypothesis was that foods in the "fun-food" peak would be low in fiber and higher in glycemic index, whereas the foundation foods of vegetables, legumes, nuts, seeds, and fruits would be sources of dietary fiber and have lower glycemic indices. The available

glycemic index data (Monro, 2003; Foster-Powell, 2002) are too limited to use (see Table III for evidence of gaps).

What does emerge is the need to reemphasize the importance of plant foods and the concurrent density of bioactive phytochemicals (nutraceuticals), which are in addition to the density of nutrients in vegetables, legumes, nuts, seeds, and fruits, as well as whole grains in the food choices that are based on the reinvented pyramid. The findings of the scientific literature (Albert *et al*., 2002; Cohen *et al*., 2000; Finley, 2003; Hebert *et al*., 1998; Jian *et al*., 1999; Kris-Etherton *et al*., 1999; Michaud *et al*., 1999; Tsai *et al*., 2004; Verhoven *et al*., 1996; Zhang *et al*., 1992) relative to realizing health benefits transcend the ''nutrient–nutritive value'' rationale and food group classification of the USDA pyramid.

C. HEALTH CLAIMS SUPPORT THE REINVENTION OF THE PYRAMID

As mandated by the 1990 NLEA, health claims in food labeling can be petitioned from the FDA. The intent is to educate the public about recognized diet–disease interrelationships. Several relationships with significant scientific agreement have been identified and several have been issued. Many of the official health claims have a direct association with one or more of the plant food groups (see Table II). There are now 15 or more health claims, which are based on ''significant scientific agreement.'' In the interim, an FDA proposal was issued permitting the placement of a health claim on the label but identifying one of four categories (A, B, C, or D) of scientific rigor substantiating the health claim. Purveyors do not desire to have a ''qualified'' product claim in a ''B, C, D'' format to be misconstrued by the consumer as an overall product rating and the proposal is unlikely to survive.

The following discussion is offered as evidence of the need (based on the scientific agreement of the health claim) to relocate the Food Guide Pyramid base, or foundation tier, from cereal grains to vegetables, legumes, seeds, nuts, and fruits (citrus and berries). Some health claims point to particular body systems (e.g., bone) or biomarkers (e.g., blood cholesterol level); however, the irrefutable observation can be made that the greater the number of different health claims that are positively associated to a particular food grouping, the stronger the emphasis should be to advocate choosing and consuming foods from particular food grouping(s) (see Table II). Thus, one could argue that the emphasis on the health-claim benefits of fruits and vegetables in ''reducing the risk of cancer'' or the role of leafy vegetables as a source of food folate and thus neural tube defect prevention and thus the

role of soluble fiber in disease prevention gives priority to the foundational position of vegetables, legumes, seeds, nuts, and fruits great merit. In contrast, a health claim for the "fun foods," as well as sugars and oils at the peak of the pyramid, has not been forthcoming and the likelihood that a heath claim would emerge for foods within this category is practically nil. Of the 12 functions of food, 9 are psychosocial. It makes psychological, social, and hedonistic commonsense that foods with poor nutrient density should reside in the peak of the pyramid and that most foods chosen as a finishing touch to a meal invariably have a high caloric density.

Of intermediate recognition in the third tier are dairy products as a major source of calcium-rich and vitamin D–enriched foods and "the reduced risk of osteoporosis." The meat group, also on the third tier, offers high-quality sources of protein and other nutrients. However, note that the health-claim benefits of soy and soy products are properly placed as "legumes" in the foundation tier of the reinvented pyramid.

IX. FOODS PROVIDING THE MOST NUTRACEUTICALS ARE FUNCTIONAL FOODS

Fruits and vegetables *per se* are recognized as being associated with a reduced risk of cardiovascular disease (CVD) and cancer. In fact, practically all the "approved" health claims can be associated with the base of the reinvented pyramid and the number of qualifying food diminishes as one moves up the pyramid. For example, vegetables, legumes, nuts, seeds, and fruits are all sources of dietary fiber and thus "a reduced risk of cancer and a reduced risk of coronary heart disease" (FDA, 1998; Rolls *et al.*, 2004). In fact, if one searches for the food combinations with the most benefit in thwarting both cancer and CVD, then it becomes evident that the composition of the vegetables, legumes, seeds, nuts, and fruits delivers certain health attributes (Dragsted *et al.*, 2004). These include high potassium, low sodium (unless added), an array of antioxidants including the vitamin E of tree nuts, a naturally occurring selection of monounsaturated and polyunsaturated lipids, and a number of vitamins, such as folates, and minerals such as magnesium, manganese, zinc, and others. The array of nutrient-dense foods including legume (especially soy and peanut) proteins coupled with whole-grain products makes protein complementation fully satisfactory for the vegan. The synergy in the function of these nutrients with the bioactive properties of phytochemicals such as the non-vitamin precursor carotenoids and the flavonoids, to name a few, confirms the powerhouse of the reinvented pyramid by making the base of the pyramid a source and density of health-promoting factors rather than a source and density of macronutrient calories.

A. PYRAMID MUST RECOGNIZE BIOACTIVE NUTRACEUTICALS

The results of emerging science substantially support a strong association between certain foods and their phytochemicals or biomarkers and the thwarting of actual chronic disease. An estimated 40% of all human cancers are believed to be related to diet (World Cancer Research Fund, 1997). Finley (2003) proposed that the "antioxidant responsive element" may explain the protective effects of cruciferous vegetables on cancer and observes that "the relationship of diet to cancer is not necessarily because of the inclusion of carcinogens in our diet, but may be a consequence of the exclusion of anti-carcinogens from our diets." One can make the analogous arguments relative to the exclusion of dietary hypocholesterolemic compounds and the risk of CVD. This is a new and vital rationale for the role of diet in chronic disease prevention. For the consumer, this premise moves away from foods "to avoid" to a positive message of which foods "to emphasize." Therefore, it is imperative to make appropriate changes in the pyramid array and therefore evolve an improved guidance as to (1) what foods and food groups (categories) to emphasize on a daily/frequency basis and (2) to reeducate the public about the major rationales in the pyramid and the consequential health benefits.

Whereas all foods are invariably sources of energy, not all foods are substantial sources of nutrients and complementary bioactive nutraceutical compounds that thwart the pathogenesis of chronic diseases. The phytochemicals that have been found to be beneficial can be categorized into several chemical composition groupings (Table IV) (Guhr and Lachance, 1997). These are fiber; antioxidants; allylic sulfides; isothiocyanates; indoles; terpenes; flavonoids; phytoestrogens; and saponins. The flavonoids have many subgroupings such as catechins (e.g., in tea) and proanthocyanidins (e.g., in purple grapes). If one desires to arrange these phytochemicals by food sources, then the categories are simpler and recognizable. These are five: dark green and yellow vegetables, legumes (including soy bean products and peanuts) and tree nuts, citrus and berries, the cruciferous vegetables such as broccoli, cabbage, cauliflower, kale, turnip etc., and the sulfur-rich vegetables garlic, onion, leek, and chive. Both black and green tea may be the beverage of choice.

X. PHYTOCHEMICALS AND COLOR-CODED EATING PLANS

Two sets of writers (one on the East Coast and one on the West Coast) have published books about healthy eating plans based on favoring certain combinations of food plants based on their natural colors (Heber and

TABLE IV

A LIST OF SOME PHYTOCHEMICAL GROUPS, THEIR SOURCES AND ORGANOLEPTIC/AESTHETIC OR NUTRITIVE PROPERTIES

Phytochemical group	Some phytochemicals in the phytochemical group	Sources	Organoleptic/aesthetic or nutritive properties
1. Phenols	Simple phenols, phenolic acids, hydroxy cinnamic acid derivatives, flavonoids	Almost all fresh fruits and vegetables, cereal grains, tea (black and green), nuts	Flavor, color, or aroma
2. Indoles	Indole-3-carbinol, indole-3-acetonitrile, L-tryptophan	Cruciferous vegetables (including brussel sprouts, kale, cabbage, broccoli, cauliflower, spinach, watercress, turnip, radish)	Pungent flavor
3. Isothiocyanates	Phenethyl isothiocyanate, benzyl isothiocyanate, sulforaphane	Cruciferous vegetables (including brussel sprouts, kale, cabbage, broccoli, cauliflower, spinach, watercress, turnip, radish)	Pungent flavor
4. Allylic sulfur compounds	Diallyl sulfide, diallyl disulfide, *S*-allyl cysteine, allyl propyl disulfide, ajoene	*Allium* vegetables (including garlic, onion, leek, shallot, chive, scallion)	Flavor
5. Monoterpenes	D-limonene, D-carvone	Citrus oils, vegetable oils, spice oils	Flavor, aroma
6. Monoterpene like	Perryl alcohol	Cherries	Flavor
7. Carotenoids	α-carotene, β-carotene, α-cryptoxanthin, β-cryptoxanthin, lutein, lycopene, zeaxanthin	Most red to yellow fruits and vegetables	Color
8. Antioxidant vitamins	Vitamin C, vitamin E	Fruits and vegetables, whole cereal grains	Nutrient
9. Antioxidant mineral	Selenium	Garlic, whole cereal grains	Nutrient

Bowerman, 2002; Joseph *et al.*, 2002). Both diets provide an eating plan of several days that illustrates how best to combine foods of different color categories, thus reflecting the different phytochemicals that impart both color and medicinal properties within color category. Starting with the premise that a number of foods have been used for their medicinal properties, the authors organize into four (Joseph *et al.*, 2002) or seven (Heber and Bowerman, 2002) major color-coded categories of fruits and vegetables and then demonstrate the proper assemblage into model recipes. The Heber and Bowerman colors are as follows: red, in which one finds strawberries and raspberries and tomatoes and red bell peppers; orange-yellow, in which one finds oranges, mangoes, grapefruit, and the vegetables carrots, sweet potatoes, and winter squash; the green fruit such as kiwi and avocado; the green vegetables such as kale, broccoli, and spinach; and the blue-purple fruit such as blueberries, concord grapes, and dried plums and the vegetables purple cabbage and eggplant.

The color system for planning diets does permit a recipe or meal-planning method to indirectly access most phytochemical protective compounds. One cannot expect the consumer to be aware of the chemical classification of phytochemicals wherein color is not a predominant or concurrent attribute. The limiting goal has to be convincing the consumer of the importance of eating a variety of fruits and vegetables, seeds, nuts, or legumes each day. In other words, the foundation foods are vegetables, legumes, nuts, seeds, and fruits, colored or not.

The consumer further needs to realize that if a fruit or vegetable is not part of the breakfast habit, the probability of obtaining five to seven servings of fruits or vegetables in a given day is practically nil. Needless to say, if the consumer does not have a breakfast habit, other changes in diet choices will be needed.

Innumerable scientific studies (Bidlack *et al.*, 1998, 2000; Ho *et al.*, 1992, 1993; Lachance, 1997) have been published on various aspects of these nutraceutical phytochemicals. These studies range from epidemiological studies, clinical trials, and basic *in vitro* and *in vivo* cell line and animal and related mechanistic investigations. The end points of these trials have been aimed at thwarting the pathogenesis of major chronic diseases such as CVD, cancer, and diabetes. The most coherent, consistent beneficial results have been those in which the conditions were preventative or ameliorated by distinct foods or the combinations of whole foods. It is again clear, therefore, that the base of the pyramid must be allocated to the promotion of the daily intake of vegetables, legumes, seeds, nuts, and fruits to emphasize the importance of these foods for their health benefits.

XI. ADDRESSING THE ENERGY INTAKE ISSUES

Can one expect the Food Guide Pyramid to assist in helping consumers with their estimated energy requirements (EERs)? Without separate guidance on the cost in calories needed to meet the RDAs and access to the health benefits of the nutraceuticals of functional foods, the Food Guide Pyramid has limitations. The irony is that nutritionists conducting nutrient assessments know that the most highly variable diet analysis data are that of energy intake, yet it is the only "nutrient" that consumers can measure for themselves as often as they wish by stepping onto a scale, preferably in the nude and facing a full-length mirror. The key question the consumer needs to answer is "did this amount of calories cause a change, up or down, in body weight?" Without a change in choices made, serving size, and activity levels, the chances of a change in body weight occurring are low. Poorly recognized is the role of "where" the choice of foods is made and the impact of serving size. There is increasing evidence that consumers making purchases away from home (not where they are eaten) "disinhibits" their health concerns and practices in favor of the economic or emotional value of the food eaten. The correlation of rate of increase in obesity with the rate of spending for food purchased away from home is startling (Lachance, 2000). This observation brings in question the limitation of the CFN concept if it were to appear only on packaged foods. A solution would be the requirement that the first-level packaging of each fast-food item should be required to include the imprinting of total calories for the particular serving size purchased and the CFN. On cups and beverage containers, three sets of the CFN could be easily imprinted in advance for carbonated beverage, milkshake, and Slurpee drinks.

The proposed reinvented pyramid is a simpler presentation for addressing the energy intake concerns faced by consumers. It brings up the issue of whether the presentation of food groups should return to the plate configuration rather than the pyramid. In initial studies the USDA claims that the pyramid was favored over the plate; however, the official plate displayed equal proportions of four major food groups. Partitioning the plate into a "peace " symbol presentation with emphasis on two-thirds plant foods to one-third animal foods is okay, but "hungry" portions can still defeat the control of calories. At a steakhouse, the proportions would obviously be reversed. The pyramid does add a segment at the peak for discretionary fats and added sugars. We again propose that any food with a CFN higher than 50, such as donuts and various desserts or snacks, should be parked in the peak tier of the pyramid. National survey data (National Health and Nutrition Examination Survey) has revealed that this "peak" segment is toppling

with the provisioning of about 40% of the energy intake because so many food choices with a CFN of 50 or greater make up this upper tier of the pyramid.

The reinvented Food Guide Pyramid as proposed makes the low CFN foods the primary (e.g., foundation of the pyramid) source of nutrients and nutraceuticals at low energy cost and, depending on the choice of preparation selected (steamed vs deep fried), highly likely to be effective in the control of body weight. One can couple the advantage of products of high health benefit and low CFN, with the third dimension being the adoption of routine physical activity levels such as walking stairs to walking miles indoors (as on a treadmill) or outdoors. There may also be a spiritual dimension because, in theory, regular church-goers have a lower rate of obesity than that observed in the general population.

XII. REVAMPING THE CEREAL GRAIN–BASED FOOD GROUP

Bread is the staff of life, but donuts are not. People rarely eat one-half of a croissant or a danish. The vending machine dispenser has a package of four Oreo cookies, not two medium cookies. There is no serving container for sale at the cinema that provides only one cup of popcorn, but that is the official USDA/FDA serving size!

On the other hand, cultures that eat tortillas rather than bread, eat several tortillas. A Chinese meal is understood to include rice, unless other versions of the food (e.g., pork fried rice) are requested. In Italian restaurants, a pasta side-dish is automatic, with the choice being what style of pasta is preferred. Croutons may or may not be included in the salad, provided as part of the meal or ordered à la carte.

Whole-grain flour is defined as having the compositional ingredients of bran, germ, and endosperm in the flour, as is present in the native state. For health-claim purposes, the food must include 51% of whole-grain flour by weight. In addition to dietary fiber, whole-grain flour has considerable antioxidant properties, as well as an array of B vitamins and key minerals that are over and above providing dietary fiber.

There is no question that whole grains exert health benefits, but the American intake is about 20–30% of the cereal grain category. There is a long history of cardiovascular health benefits associated with the routine consumption of whole-grain products (Jacobs *et al.*, 1998, 1999; Liu *et al.*, 1999). Evidence of benefits of whole grains in diabetes has emerged (Liu *et al.*, 2000).

The foundation of the classic USDA pyramid is based on cereal grain foods serving as energy sources, but energy sources are no longer limiting

in the dietary. Only whole grains and the products thereof have shown significant health benefits. Because the whole-grain cereal products exert the scientifically derived health benefits, these foods must become the second tier of the pyramid. Interestingly, the foods of these bottom two tiers are able to provide for the complete sustenance of the vegan. This fact demonstrates the essentiality of the bottom two tiers of a revised pyramid of food guidance. It should be noted that those cereal grain products that have a CFN of 50 or more should not be accounted for in this tier but moved to the peak of the pyramid as foods to use sparingly.

XIII. COMMUNION WITH OTHER PYRAMIDS

A. OLDWAYS PYRAMIDS

As pointed out by Ferro-Luzzi and Sette in 1989, the Mediterranean diet pyramid is based on an amalgamation of the diverse dietary patterns of several countries. The concept of the Mediterranean diet is said to have originated from the Seven Countries Study initiated by Ancel Keys in the 1950s (Hu, 2003). There are 15 countries that border on the Mediterranean. One can best describe the diet in the Mediterranean countries as having "a high availability of *protective* food items" (DeCarli and La Vecchia, 1991), with an emphasis on fruits, vegetables, vegetable fats, high-soluble dietary fiber, and a consumption of alcoholic beverages. It is a diet in which legumes and nuts are joined with vegetables and fruits as one tier. Potatoes are coupled with cereal grains.

Oldways Preservation and Trust Exchange, a nonprofit company, has created diet pyramids that represent traditional cultural eating patterns associated with good health (Escobar, 1997; Oldways, 2003). The "healthy eating pyramids" developed by Oldways Preservation and Trust Exchange include Mediterranean, Asian, Latin American, and vegetarian pyramids. A comparison of the Vegetarian Pyramid (Figure 3), the Mediterranean Pyramid (Figure 4), the Asian Pyramid (Figure 5), and the Latin American Pyramid (Figure 6) reveals that all have in common the coupling into one tier of fruits, vegetables, legumes, and nuts (seeds are included in the Asian Pyramid). The Mediterranean Pyramid recommends a high fat intake, but it is substantially from olive oil, which is singled out, and no other oils are mentioned. The Latin American Pyramid also incorporates grains and tubers in the same foundation tier. The Vegetarian Pyramid separates seeds and nuts and emphasizes whole grains (essentially and naively excluding any mention of refined grains or products thereof).

B. WILLETT AND STAMPFER HEALTHY EATING PYRAMID

Willett and Stampfer (2003) have proposed a "rebuilding" of the 1992 USDA Food Guide Pyramid, which they call the *Healthy Eating Pyramid*. First, they make a case for distinguishing between healthy and unhealthy types of fats and carbohydrates. Fruits and vegetables are recommended, but dairy product consumption is limited. The authors state that the emphasis on percentage of calories from fat in the diet does not necessarily relate to the incidences of coronary heart disease (CHD). They point to the high incidence of CHD in Finland in contrast to Crete and the even higher incidence in Japan albeit only 8–10% calories are from fat. Obviously the type of fat makes a difference and their pyramid builds its base on plant oils and whole-grain foods. "Refined" grain products as well as potatoes, pasta, and sweets are to be used sparingly. Vegetables and fruits are promoted in the second tier, with emphasis "in abundance" for vegetables. Nuts and legumes are promoted as a separate third tier. The bottom three tiers fulfill the needs of the vegan.

The Healthy Eating Pyramid is not a mirror image of the Mediterranean Pyramid. It is strongly based on a philosophy of the redistribution of fats and types of fats. In the animal food tiers, eggs, poultry, and fish are okay up to two servings. The dairy products tier suggests only one to two servings per day and suggests the alternative of a calcium supplement. No mention is made of the much needed complementation of vitamin D. Alcohol in moderation with meals is okay, as well as a multivitamin preparation. No mention is made of supplement ready-to-eat (RTE) cereals such as Total® cereal.

XIV. HOW SHOULD THE CONSUMER APPROACH THE PYRAMID FOR FOOD CHOICE GUIDANCE?

The consumer wants to eat "healthy." There is no way to explain the plethora of print and some electronic media that promotes a proper diet. Dieting and cookbooks pervade the nonfiction bestseller lists and other indicators of concern. They are trying to understand why certain foods are acceptable in one culture and not in another, for example, white rice. Is eating pasta really all that bad when there are so many Italian restaurants? Some foods have a historical documentation of sparing diseases and death, such as potatoes. But why are high-CFN "potato chips" on the diet plate? The consumer has been eating less red meat than in the days after World War II. Fish is very expensive and the controversy of overfishing and

mercury/dioxin contamination makes the consumer hesitate. Consumers drink less fluid milk than decades ago and they wonder whether that is smart in view of the numerous osteoporosis stories found everywhere. They are slowly switching from drinking considerable amounts of carbonated beverages to bottled waters. Tea remains the beverage of choice but not to the young. Are we really being honest with ourselves when we are told in various ways that there are three meals a day and two snacks? How important is it to eat a healthy breakfast? Are the home fries and the eggs really all that bad? (This combination, in terms of protein quality, is superior to eggs alone.)

Unequivocally, for a guaranteed amount of the most nutrients *and* the benefits of protective compounds in the foods, we should plan on plant foods dominating at least two-thirds of the plate (the lower two tiers of the pyramid) and most of that should be *first* vegetables, *second* fruits (would you believe tomatoes?), and *third* a handful of nuts or a serving of a legume (would you believe peas), and all three *complemented* by a salad of mixed greens, carrot pieces, and maybe a few olives. Whole-grain products also complement with nutrients and nutraceuticals. The entree can be most anything from mussels to eggplant parmigian to chicken breast to hamburger or steak, half of which, if eaten at a restaurant, you can take home for another meal.

XV. PRACTICAL APPROACH OF FOOD GUIDES

A consumer friendly and instructional food guide not only should be a list of food groupings, but should also convey the proportions recommended from the various food groups. Whereas health claims for foods within a grouping assist the user in identifying the relative importance of certain foods, the balance of the dietary depends on the combinations of food servings made from within a food guide segment and in combination with foods from other groupings. The reinvented pyramid is a solid guide, based on the science underpinning of health claims and a high density of phytochemicals having protective health benefits. Coupled with an index of physiological costs in calories per nutrient, the consumer can learn to make healthy choices whether at home or on the road.

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