An Updated Food Guide for Vegetarians

Adapted to MyPlate: An Evidence Based Approach

by

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ABSTRACT

In 2002, a scientifically derived food guide pyramid for vegetarians, the Modified Food Guide for Lacto-ovo-vegetarians and Vegans was published and well received. Now that 10 years have passed, new scientific literature regarding the bioavailability of the nutrients of key concern in vegetarian diets has been published, and the graphical format of the nation's food guide has evolved from a pyramid shape into a circular plate. The objective of this research was to examine the post-2002 literature regarding the bioavailability of key nutrients in vegetarian diets; to use this information to update the recommendations made in the 2002 Modified Food Guide Pyramid for Lacto-ovo-vegetarians and Vegans; and to adapt this revised food plan to the new USDA MyPlate format. This process involved reviewing the scientific literature to determine if the DRIs for the nutrients of key concern in vegetarian diets are adequate for the vegetarian population and using this information to develop new recommendations for vegetarians if necessary, analyzing the nutrient content of representative foods in different food groups, reconfiguring the food groups so that foods with like nutrient components were grouped together, determining the number of servings of each food group required to meet vegetarians' nutrient requirements at three caloric levels, and developing sample menus. A circular plate graphic, the Vegetarian Plate, was designed to illustrate the recommendations of this updated food guide. This updated, scientifically derived food guide provides a sound base for diet planning for lacto-ovo-vegetarians and vegans. Further research is needed to assess the Vegetarian Plate's adequacy for children,

pregnant and lactating women, athletes, and individuals with medical conditions or chronic diseases.

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Chapter 1

INTRODUCTION

Over the past 15 years, the percentage of the American population that is reportedly vegetarian has tripled from approximately 1% in 1994 to 3% in 2009 (1,2). Along with the growing number of vegetarians in the United States, interest in vegetarianism has increased amongst non-vegetarian Americans, with 22% of consumers claiming to regularly consume meat substitutes in place of meat products (3). This recent increased prevalence of and interest in vegetarianism is evidenced by the addition of vegetarian meals to menus at both fast food and sit down restaurants, the offering of college courses on vegetarianism, and the increasing availability of vegetarian foods in grocery stores nationwide (3). While some people choose vegetarianism for religious or spiritual reasons, others choose it because of the health benefits it can provide. Research shows that vegetarian diets are linked to a reduced risk of a number of conditions such as obesity, hypertension, cardiovascular disease, and some types of cancers (3-7). It is the position of the American Dietetic Association (now known as the Academy of Nutrition and Dietetics) that vegetarian diets can be nutritionally adequate if properly planned (3), however, many vegetarian diets contain reduced levels of key nutrients including protein, vitamin B-12, iron, zinc, calcium, vitamin D, eicosapentaenoic acid (EPA), and docosahexaenoic acid (DHA) (3,8,9).

Food guides for Americans have existed since the early 1900s (10). The first food guides focused on consuming adequate amounts of calories, but as more was discovered about vitamins and minerals, the focus of food guides

shifted to preventing nutrient deficiencies and diet-related chronic diseases (10,11). The current food guide, USDA's MyPlate, was released in June 2011 and is based on the 2010 Dietary Guidelines for Americans (12). The recommendations made by the 2010 Dietary Guidelines for Americans and USDA's MyPlate are intended for the general population consuming a mixed diet and therefore are not adequate guides for vegetarian diet planning.

The USDA's MyPlate attempted to address the needs of individuals following vegetarian diets by including soy products and other meat alternatives in the protein group, however, such a simple substitution does not guarantee a nutritionally adequate vegetarian diet. This is because plant foods have different nutrient profiles than those of animal foods, and many nutrients from plant foods are absorbed differently in the body than those originating from animal sources. In addition, many plant foods contain a variety of nutrient inhibitors that can further interfere with the concentrations of key nutrients absorbed by the body (3,13). Research on the bioavailability of key nutrients in vegetarian diets has been conducted, and these findings can be used to develop nutrient recommendations specifically for vegetarian diets.

Researchers have developed food guides for vegetarians, but many of these are based on the pyramid structure of the USDA's former Food Guide Pyramid and MyPyramid. Haddad et al. (14) published a conceptual framework of a vegetarian food guide in 1999, but the quantities and frequencies of foods needed to insure adequate nutritional intake were not included. Venti and Johnston (15) used this framework to develop a Modified Food Guide Pyramid for Lactovegetarians and Vegans in 2002, and this food guide has been widely

accepted. Other vegetarian food guides have since been published (16,17), but, to the best of our knowledge, a food guide for vegetarians adapted to the USDA's MyPlate format does not exist.

FIGURE 1 Modified Food Guide Pyramid for Lactovegetarians and Vegans[1]

[1]Reproduced with permission from (15).

Research objective

The research objective is to examine the recent literature regarding the bioavailability of key nutrients in vegetarian diets; to use this information to update recommendations made in the 2002 Modified Food Guide Pyramid for Lacto-ovo-vegetarians and Vegans; and to adapt this revised food plan to the new USDA's MyPlate format.

Definitions of terms

A vegetarian diet is defined as one that does not include meat, poultry, seafood, or products containing these foods (2,3). A lacto-ovo-vegetarian diet is one that includes dairy, eggs, grains, fruits and vegetables, nuts and seeds,

and legumes (3). A vegan diet excludes all animal products including dairy, eggs, and honey (2,3). A food guide is a tool designed to assist the general public or specific populations in selecting foods that provide the recommended amounts of essential nutrients (8). For the purposes of this research, an adult is defined as a male or female ≤ 70 years of age.

Delimitations

A delimitation of the research is that the food guide is intended for healthy, adult vegetarians. This vegetarian food guide is not meant to be used in the planning of therapeutic diets for specific health conditions, nor is it intended for the pediatric population or individuals > 70 years of age. Additionally, since nutritional needs increase during pregnancy and lactation, pregnant and lactating vegetarians may require additional nutrient intake beyond what is recommended by this food guide. Along the same lines, vegetarian athletes may require a greater amount of calories and nutrients than could be obtaining by following the recommendations made by this food guide.

Limitations

One limitation of this research is that when calculating the nutrient profiles of the food groups included in this food guide, the average nutrient compositions of 10-15 representative foods were calculated for each group. Had we used a greater amount of representative foods for each group, the nutrient profiles may have been slightly different. The calculated nutrient profiles of the food groups included in the food guide are also limited by the accuracy of the computer analysis software.

Chapter 2

LITERATURE REVIEW

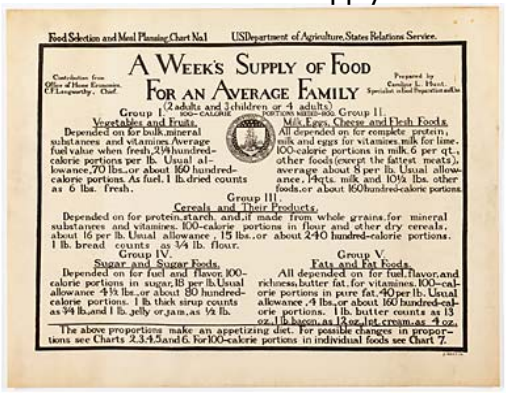
History of Food Guides

Dietary recommendations have been expressed to Americans in the form of food guides for nearly a century. These recommendations and the food guides that depict them have changed numerous times throughout history and are likely to continue evolving as the knowledge in the field of nutrition expands and the public becomes more aware of and interested in the relationship between diet and human diseases. The food guides of the early- to mid-1900s changed often, as this was a time when rapid discovery of certain vitamins and minerals, as well as the accumulation of knowledge of nutrient deficiencies occurred (10). Perhaps the most recognized food guide, the USDA's Food Guide Pyramid, was released in 1992 and was based on the 10th edition of the Recommended Dietary Allowances and the 1990 Dietary Guidelines for Americans (11). USDA's Food Guide Pyramid was updated in 2005 with creation and release of MyPyramid (18), but recently in June 2011, the USDA decided to forgo the pyramid graphic all together, and unveiled the current food guide for Americans: MyPlate (19).

Early Food Guides. The USDA first began publishing food guides in 1916 as a way of assisting the public in choosing more nutritious diets (20). These early food guides grouped foods of similar nutrient content into broad categories such as meats and grains, and this pattern has carried on into present food guides (20).

One of the first food guides for Americans was published in 1921 **(Figure 1)** and was based on what were considered to be the five food groups: vegetables and fruits, proteins, cereal grains and their products, sugars and sugar foods, and fats and fat foods (10). These five groups were designated by the different types of fuel (i.e. protein, starch, sugar, and/or fat), vitamins (i.e. vitamins A, B, and C), and ash (i.e. iron and ash) they provided (10). The recommended amounts of food from each food group to consume were not based on an individual's daily needs, but rather the weekly energy requirements of an average family (10). An early understanding of the importance of certain food components was demonstrated in the food guide. For example, the guide suggested that a family would need 240 100-kcal servings of cereal grains and their products each week, but noted that if white bread is consumed as opposed to the whole grain variety, fruit and vegetable intake should increase (10). The USDA recognized that this food guide was very preliminary and that more information on types of protein and the functions, sources, and availability of vitamins and minerals was needed (10).

FIGURE 2 A Week's Supply of Food Food Guide, 1921[1]


Food Selection and Meal Planning Chart No.1 USDepartment of Agriculture, States Relations Service.

A WEEK'S SUPPLY OF FOOD FOR AN AVERAGE FAMILY

Contribution from Office of Home Economics C.F.Langworthy, Chief. Prepared by Caroline L. Hunt, Specialist in Food Preparation and Use.

(2 adults and 3 children or 4 adults)

Group I. 100-CALORIE PORTIONS NEEDED—1050. Group II.

Vegetables and Fruits.

Depended on for bulk, mineral substances and vitamines. Average fuel value when fresh, 2½ hundred-calorie portions per lb. Usual allowance, 70 lbs., or about 160 hundred-calorie portions. As fuel, 1 lb. dried counts as 6 lbs. fresh.

Milk, Eggs, Cheese and Flesh Foods.

All depended on for complete protein, milk and eggs for vitamines. milk for lime. 100-calorie portions in milk, 6 per qt.; other foods (except the fattest meats), average about 8 per lb. Usual allowance, 14qts. milk and 10½ lbs. other foods, or about 160 hundred-calorie portions.

Group III.

Cereals and Their Products.

Depended on for protein, starch, and, if made from whole grains, for mineral substances and vitamines. 100-calorie portions in flour and other dry cereals, about 16 per lb. Usual allowance, 15 lbs., or about 240 hundred-calorie portions. 1 lb. bread counts as ¾ lb. flour.

Group IV.

Sugar and Sugar Foods.

Depended on for fuel and flavor. 100-calorie portions in sugar, 18 per lb. Usual allowance 4½ lbs., or about 80 hundred-calorie portions. 1 lb. thick syrup counts as ¾ lb. and 1 lb. jelly or jam, as ½ lb.

Group V.

Fats and Fat Foods.

All depended on for fuel, flavor, and richness; butter fat, for vitamines. 100-calorie portions in pure fat, 40 per lb. Usual allowance, 4 lbs., or about 160 hundred-calorie portions. 1 lb. butter counts as 13 oz., 1 lb. bacon, as 12 oz., 1 pt. cream, as 4 oz.

The above proportions make an appetizing diet. For possible changes in proportions see Charts 2, 3, 4, 5, and 6. For 100-calorie portions in individual foods see Chart 7.

[1]Images obtained from http://www.everydayhealth.com/diet-nutrition-pictures/delicious-propaganda-fascinating-government-food-posters.aspx. Accessed on January 9, 2012.

Additional food guides were published throughout the 1920s and 1930s, with each focusing on relevant issues at the time, such as choosing foods economically during the Great Depression, and selecting alternatives to foods that were unavailable during World War II (19,21). Standards for selected vitamins and minerals were also proposed during this time (22). These proposed standards were later taken into consideration and utilized by the government in the publishing of the first Recommended Dietary Allowances (RDAs) in 1941, which listed specific daily intakes of calories, protein, iron, calcium, vitamins A and D, thiamin, riboflavin, niacin, and ascorbic acid for healthy individuals in seventeen different age and gender categories (10). To translate these recommendations into terms the lay person could understand, various committees developed different food guides such as the *Eat the Right Food to Help Keep You Fit* food guide, which consisted of ten food groups, and the *A Guide to Good Eating* food guide, which contained seven food groups (10). These food guides were noteworthy because they were the first to incorporate information about specific vitamins and minerals and to use the term "enriched" (10).

In 1943, the *Basic Seven* food groups were introduced as part of the *National Wartime Nutrition Guide* food guide **(Figure 2)** (10,21). In the *National Wartime Nutrition Guide*, the *Basic Seven* food groups were arranged in a circular graphic, with each group representing the same sized portion of the circle to signify that no single group was more important than any other (10). In addition, the number of servings to consume from each group daily was not specified, but rather the food guide instructed the public to eat some foods from

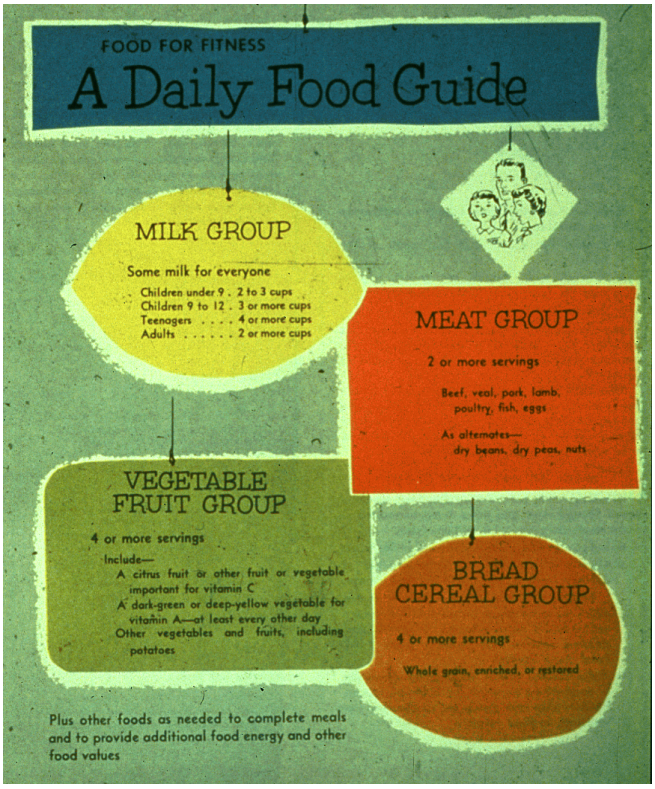
each group everyday for health (10). This particular design of the *National Wartime Nutrition Guide* was based on the fact that a number of foods were scarce, rationed, and/or unobtainable during the war (22). To further aid the public in choosing nutritious diets, the *National Wartime Nutrition Guide* listed alternatives for these scarce, rationed, and/or unobtainable foods (10). The *National Wartime Nutrition Guide* was unique because although its *Basic Seven* food groups were based primarily on the RDAs, it included a butter and fortified margarine group, which was something not seen in the RDAs (10).

FIGURE 3 The Basic Seven and the National Wartime Nutrition Guide, 1943 [1]

[1]Image obtained from http://blogs.discovermagazine.com/80beats/2011/06/02/food-guides-out-with-the-pyramid-in-with-the-plate—and-don't-forget-the-pagoda/. Accessed on January 9, 2012.

Post-war in 1946, the *National Wartime Nutrition Guide* was revamped into the *National Food Guide*, which still included the *Basic Seven* food groups and circular graphic, but was somewhat modified to include recommended servings to consume from each group (10). The *National Food Guide* served as the nation's food guide until the early 1950s when new data from the USDA's Household Food Consumption Survey and the desire for a more simple food guide led to the development of *Food for Fitness, A Daily Food Guide,* more commonly known as the *Basic Four* **(Figure 3)** (10,21).

FIGURE 4 The Basic Four and Food for Fitness Guide, 1950's-1979 [1]



[1]Image obtained from http://www.nal.usda.gov/fnic/history/basic4.htm. Accessed on January 9, 2012.

The *Basic Four*, consisting of the milk, meat, bread-cereal, and vegetable-fruit food groups, differed from the *Basic Seven* in that vegetables and fruits were

combined into one group and the butter and fortified margarine group was not included (10,11). Although fruits and vegetables were combined into one group in the *Basic Four* food guide, this group was broken down into subgroups—vitamin A-rich, ascorbic acid-rich, and other fruits and vegetables—to ensure consumption of a variety of fruits and vegetables and subsequent intake of an array of important nutrients (10). Guidelines for the minimum number of servings for each food group, as well as serving sizes for all foods, were defined in the *Food for Fitness, A Daily Food Guide* food guide to ensure that Americans were approaching the 1953 RDAs for protein, calcium, vitamin A, thiamin, riboflavin, niacin, and ascorbic acid (10,11).

Food for Fitness, A Daily Food Guide served as the nation's food guide until 1979, when the USDA issued the *Hassel Free Guide* (21). The *Hassel Free Guide* was a revised version of the *Basic Four* food groups with the addition of a fifth food group called the fats, sweets, and alcohol group (21). The purpose of adding this fifth food group was to call attention to moderating consumption of these foods and beverages (21). This new emphasis on moderation of certain foods stemmed from scientific research that found that limiting intake of particular foods might help prevent chronic disease (11,21). This new focus on the relationship between diet and chronic disease prompted the USDA to develop and publish the Dietary Guidelines for Americans in 1980 (18,21). With the release of these guidelines, the USDA started to develop a new food guidance system for Americans, which would eventually be illustrated in the well-recognized *Food Guide Pyramid* (21).

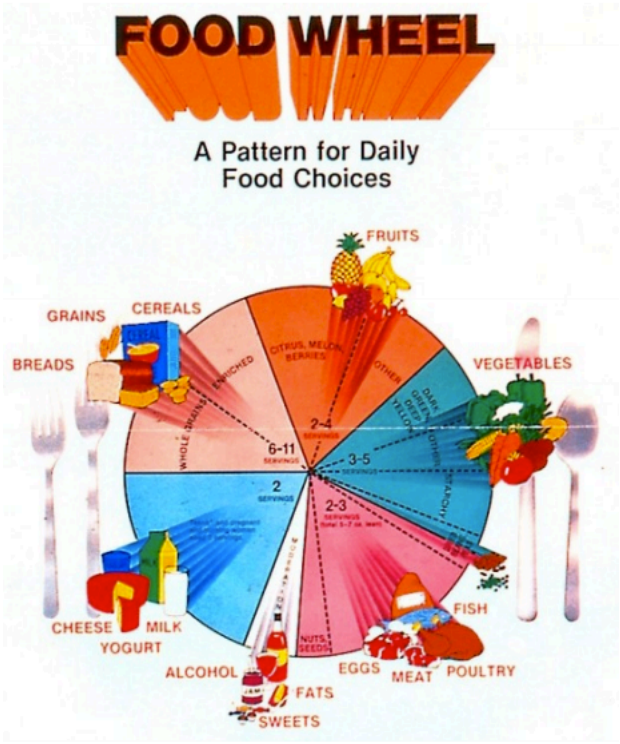
The Food Guide Pyramid. When developing the food guidance system that would become the Food Guide Pyramid, the USDA had a number of goals in mind (21). It wanted to focus on overall health versus dietary treatment of specific diseases and desired to address the entire diet rather than only targeting nutrient adequacy (21). It addition, the USDA wanted to base the food guide on the most recent dietary standards and food consumption data available and make it as useful to consumers as possible by including commonly consumed foods in each food group (21).

To develop the food groups for this new food guide, the USDA considered not only the nutrient content of foods, but also the customary use of foods and the ways in which past guides grouped different foods (21). Subgroups such as the dark, leafy green vegetable subgroup within the vegetable group were also established to bring together foods with the most similar nutrient contents (23). Serving sizes were based on a variety of factors including usual portion sizes, similarity in nutrient content, and feasibility to consumers (23). In order to determine the nutrient contribution that could be expected from each food group, nutritionists prepared nutrient profiles and composites based on food consumption surveys for each (24). Nutrients added to foods by fortification were not included in the nutrient profiles in order to avoid Americans relying on them to meet their nutritional needs (24). The nutrient profile and composite information was used to create diet patterns at three targeted intake levels—1,600, 2,200, and 2,800 kcal (24). After the food groups, serving sizes, and nutrient contributions were determined, the number of servings to recommend from each food group had to be established (21).

Ensuring nutrient adequacy and focusing on moderation of certain foods were the two factors used to determine the number of recommended servings for each food group (25).

The first depiction of this new food guide was the *Food Wheel*, which was illustrated for a joint USDA-American Red Cross nutrition course in 1984 (24). This was followed by a tabular graphic that focused on how to follow the Dietary Guidelines for Americans (21).

FIGURE 5 The Food Wheel, 1984[1]

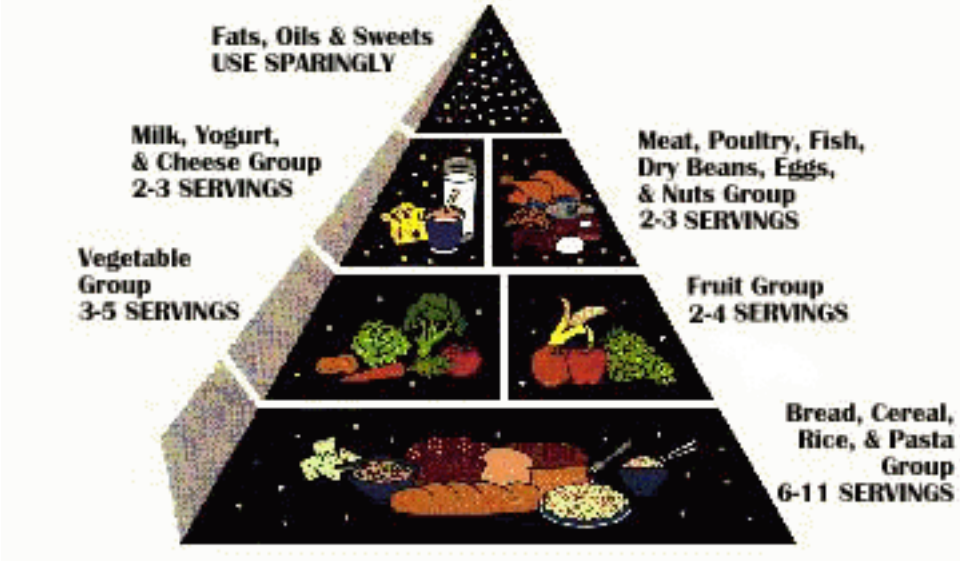


[1]Image obtained from http://www.examiner.com/slideshow/previous-usda-food-guidelines#slide=34499501. Accessed January 9, 2012.

Both graphics received little attention and were not favored by consumers, so in 1988, the USDA contracted with a market research firm to develop a new graphic to illustrate the food guide and compile a publication devoted entirely to

the food guide (21). An ample amount of consumer research was done in the development of this new food guide graphic, and multiple graphic representations including a shopping cart, bowls, a pie chart, a picnic design, and a pyramid were tested (26). Results from this consumer research showed that consumers favored the pyramid design and that this graphic was most effective in conveying the key messages of variety (multiple food groups), proportionality (serving sizes and numbers of servings), and moderation (limitation of fats and sugars) of the food guide (11,21,22). And so, the graphic that emerged was the Food Guide Pyramid, which was released to the public by the USDA in April 1992 (18,21).

FIGURE 6 The Food Guide Pyramid, 1992-2005[1]



[1]Image obtained from http://www.nal.usda.gov/fnic/Fpyr/pmap.htm. Accessed January 9, 2012.

The Food Guide Pyramid served as the nation's food guide until 2005 (18). In its 17-year existence, the Food Guide Pyramid became a ubiquitous icon for nutrition policy and dietary guidance in the United States (18), one that

was used as an educational tool in a wide variety of settings, and surveys showed it was well recognized by at least 75% of Americans (21). Although majority of Americans were familiar with the Food Guide Pyramid, many failed to meet the recommendations set forth by it (21). For example, results from one study of a nationally representative sample found that 43% of adults did not meet the recommendations made by the Food Guide Pyramid for fruit consumption, and 72% of adults failed to meet the recommendations for the dairy group (27). Throughout the 17 years in which the Food Guide Pyramid was used, new research about nutrition, health, diet, and food consumption patterns had been conducted, and with this information, the USDA knew a comprehensive reassessment of the Food Guide Pyramid needed to be conducted (28). In this reassessment, the USDA discovered that the Food Guide Pyramid had become incompatible with existing scientific research and that the development of a new food guide was necessary (28).

USDA's MyPyramid. After reviewing the 2005 Dietary Guidelines for Americans and the scientific research that had been published since the release of the Food Guide Pyramid, the USDA decided to focus on certain key points in the new food guide, many of which had to do with reducing cardiovascular disease risk (18). These points of focus included emphasizing the value of consuming whole grains and unsaturated fats, limiting sodium intake, and stressing the importance of daily physical activity (18,29). In the redesigning of the food guide graphic, a variety of pyramid-based, pyramid-influenced, and non-pyramidal images which not only depicted nutrition recommendations, but also the idea of being physically active, were tested with consumers (29).

These consumer preference studies found that consumers favored the pyramid-based and pyramid-influenced graphics the most, and especially liked the ones that illustrated the physical activity recommendation with a human figure moving toward the top of the pyramid (29).

FIGURE 7 MyPyramid, 2005-2011[1]

[1]Image obtained from http://healthinformatics.wikispaces.com/MyPyramid.gov. Accessed January 9, 2012.

With scientific research and results from consumer preference studies in mind, the USDA developed and released a new food guide for Americans called MyPyramid in April 2005. As its name suggests, MyPyramid was a pyramid-shaped food guide that featured a human figure walking up a staircase along one side. Unlike the Food Guide Pyramid, MyPyramid had non-traditional sectioning stemming vertically from the tip of the pyramid to its base instead of horizontally from one side of the pyramid to the other (18). These sections were of varying color and width, representing the six food groups (grains, fruits,

vegetables, milk, meat and beans, and fats and oils) (18). MyPyramid was also different from the Food Guide Pyramid and other past food guides in that food images and text regarding serving sizes were omitted from its colored food group sections (18). To retrieve this information, consumers were encouraged to go to the food guide's accompanying online tool for individualized nutritional recommendations based on age, gender, and physical activity level (18,22).

Regardless of age, gender, and physical activity level, MyPyramid recommended that every individual consume three servings of dairy per day (18). MyPyramid also recommended that half of grains consumed be whole grains and that diets be high in fruits and vegetables (29). Interestingly, MyPyramid did not categorize potatoes in the vegetable group, likely because majority of Americans consume potatoes in the fried form, and excessive consumption of such food items can lead to adverse cardiovascular effects (30). All meats, eggs, legumes, nuts, beans, and seeds comprised the meat and bean group (18). These foods were grouped together due to their similar protein content, and guidelines for this group recommended choosing protein sources that are lean and low in fat (29).

Although the USDA had good intentions with MyPyramid, many critics and health professionals found it to be flawed. One major problem with MyPyramid was that it was impossible to interpret without accessing the accompanying online tool (31). Millions of Americans do not have Internet access, many of which are classified as low income and in most need of nutrition information (31). For those people able to access the online tool, a plethora of information was found, however, consumers claimed that the

website was complex and somewhat difficult to navigate and that only extremely motivated individuals or those with a lot of time to explore could get the full individualized recommendations MyPyramid hoped to offer (18). In calculating these personalized recommendations, one problem with MyPyramid was that it did not take height and weight, two of the most important determinants of caloric needs, into consideration (22). Recommended intakes based solely on age, gender, and physical activity level could easily be off by hundreds of calories (22).

Critics also found flaws in the general recommendations made by MyPyramid. For example, the recommendation to make half of grains consumed whole grains implied that consuming the other half of grains in the refined form is acceptable (18). This could be problematic, as the excessive consumption of refined grains is associated with increased risks for developing cardiovascular disease and diabetes (32). In addition, the focus on obtaining protein from low fat sources ignored the fact that the types of fat provided by some protein sources are actually beneficial (18). For instance, nuts and seeds, both of which are categorized into the meats and beans group, tend to be high in monounsaturated and polyunsaturated fat, which have been shown to have positive effects on cardiovascular health (33). A problem was also seen in the recommendation that all adults consume three servings of dairy per day, primarily because meeting this recommendation could result in the intake of extra unnecessary calories (18). Although the USDA made this recommendation claiming that the intake of this amount of dairy would allow Americans to meet the Dietary Reference Intakes for nutrients such as calcium and potassium,

scientific research shows that the nutrients in dairy products can be obtained from other dietary sources, thus suggesting that three daily servings of dairy may not be suitable for all individuals (18).

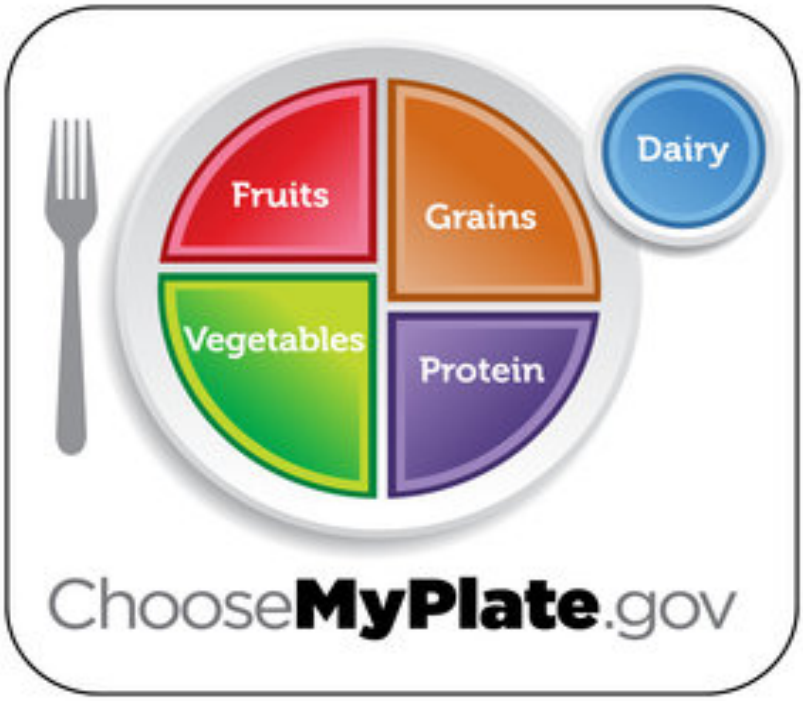
The criticism about MyPyramid that the USDA faced led to the realization that perhaps this food guide was too complex. Consequently, a few years after the release of MyPyramid, the USDA decided to do a complete overhaul of the nation's food guide—an overhaul that rejected the pyramid shape that had become so well recognized throughout the past 19 years.

USDA's MyPlate. On June 2, 2011, First Lady Michelle Obama and Agriculture Secretary Tom Vilsack revealed a new food guide, USDA's MyPlate, to Americans (34). This circular plate-shaped graphic serves as the nation's current food guide and is meant to serve as a reminder to consumers to make healthier food and meal choices (34). MyPlate is composed of five food groups: fruit, vegetable, grains, protein, and dairy (34,35). The fruit and vegetable food groups make up half of the plate image, with the vegetable section representing a slightly greater proportion than the fruit section (35). The other half of the plate is comprised of the grains and protein food groups, with the grains section taking up a larger proportion than the protein section (35). The dairy group is illustrated as a circular drinking glass pictured near the upper right side of the plate (35).

One of the goals in the designing of MyPlate was to keep the graphic simple and uncomplicated (34). Serving sizes and illustrations of representative foods in each food group are not featured in the MyPlate graphic, nor is any mention of physical activity (35). Instead, consumers are encouraged to visit

the food guide's accompanying website, ChooseMyPlate.gov, to access the key messages of the food guide, physical activity recommendations, and personalized daily food plans complete with serving size recommendations and sample menus (34–36).

FIGURE 8 MyPlate[1]



[1]Image obtained from http://blog.affinityhealth.org/make-healthy-choices-with-myplate#.UEtoDo5j7dk. Accessed January 9, 2012.

Upon visiting ChooseMyPlate.gov, consumers will find the key messages of MyPlate, which are based on the 2010 Dietary Guidelines for Americans (34,35). The key messages are divided into three sections: "Balance Calories," "Foods to Increase," and "Foods to Reduce." The messages under the "Balance Calories" heading are "Enjoy your food, but eat less;" and "Avoid oversized portions" (35). The "Foods to Increase" section makes recommendations to "Make half your plate fruits and vegetables;" "Switch to fat-free or low-fat (1%)

milk;" and "Make at least half your grains whole grains" (35). Lastly, under the "Foods to Reduce" section, suggestions are made to "Compare sodium (salt) in foods like soup, bread, and frozen meals, and choose foods with lower numbers;" and "Drink water instead of sugary drinks" (35).

Due to its recent release, not much scientific literature has been published regarding MyPlate to this date. That being said, a number of health professionals have voiced their opinions on the nation's new food guide. The general consensus is that MyPlate is an improvement from USDA's MyPyramid, however, many critics feel that certain aspects of MyPlate are still flawed (36–39).

Although being uncomplicated was one of the primary goals in the development of MyPlate (34), the simplicity of the design brings up many problems (37–39). For instance, there is no depiction of any type of dietary fat in the MyPlate graphic, leaving consumers to wonder how fat fits into a healthy diet (38,39). The absence of dietary fat from this food guide graphic may lead some Americans to believe that all types of dietary fats are bad and should be limited, which is certainly not the case (38). In keeping with a simple design, an illustration representing a physical activity recommendation was also left out of the MyPlate graphic (38,39). Additionally, similar to MyPyramid, one problem with MyPlate is that in order to view the food guide's key messages and get information about recommended serving sizes, consumers must access the online component, which poses an issue for those without internet access (39).

Vegetarian Diets

Definitions. A vegetarian is defined as an individual who does not consume meat, seafood, or products made from or containing these foods (e.g. chicken broth) (3,40). The subtypes of vegetarianism are characterized by the extent to which non-meat animal products are included in the diet. A vegetarian who consumes eggs and dairy products in addition to grains, vegetables, fruits, legumes, nuts, and seeds is identified as a lacto-ovo-vegetarian (3). The Adventist Health Study-2 found that lacto-ovo-vegetarianism is the most common vegetarian diet, with 34% of the surveyed cohort claiming to follow a vegetarian diet inclusive of eggs and dairy products (41). Another type of vegetarian diet is the lactovegetarian diet, which is one that includes dairy products but excludes eggs. A vegetarian diet that is free of all animal products including eggs, dairy products, and foods derived from animal products such as honey and gelatin, is characterized as a vegan diet (3,41). Veganism is a less popular form of vegetarianism, with recent vegetarian polls reporting that approximately 1% of Americans follow this vegetarian diet variation (2).

It is important to note that there is a difference between vegetarian diets and plant-based diets. While a vegetarian diet is absent of meat all the times, a plant-based diet, while primarily based on vegetables, fruits, legumes, and whole grains, includes meat, fish, and/or poultry in small quantities, but often not on a daily basis (42,43).

Prevalence. Over the past 15 years, the percentage of Americans that are vegetarians has increased considerably from 1% to 3% (1,40). Although

this proportion is still relatively small compared to the omnivorous population, interest in vegetarianism has grown among many Americans, with 22% reportedly consuming meat substitutes in place of meat products on a regular basis (3). Americans' growing interest in vegetarianism is also evidenced by an increased availability of vegetarian cookbooks, magazines, and scholarly journals, as well as college courses on animal rights and vegetarian nutrition (3). Additionally, a variety of food service establishments, including sit-down restaurants, fast food restaurants, and university dining halls now offer foods suitable for vegetarian diets on their menus (3). Vegetarians are no longer required to visit natural food stores or other specialty grocers to purchase vegetarian foods, because food products catering to vegetarians, including fortified foods such as soy milk and meat analogs, have become commonplace on the shelves of grocery stores nationwide (3). With this, the U.S. market for vegetarian foods is expected to hit $1.6 billion by the end of 2011, which is significant change from the 2006 market of $1.17 billion (3).

Health benefits of vegetarian diets. In comparison to omnivorous diets, vegetarian diets tend to be lower in saturated fat and cholesterol, and higher in potassium, magnesium, vitamin C, vitamin E, dietary fiber, monounsaturated fatty acids, folate, carotenoids, flavonoids, and other phytochemicals (3,6). The nutrient profile of vegetarian diets is associated with many health benefits including a lower body mass index, lower blood lipid levels, lower blood pressure, and a reduced risk for developing cardiovascular disease, type 2 diabetes, and certain types of cancer (3).

In general, vegetarians are said to have a lower body mass index than nonvegetarians. Findings from two large cohort studies, the Oxford Vegetarian Study consisting of 3,277 Western adults and the Adventist Health Study-2 consisting of 89,224 Seventh Day Adventist subjects, support this association (3,6,41,44). Preliminary analyses from the Adventist Health Study-2 found that vegans tend to have a lower mean body mass index as compared with lacto-ovo-vegetarians (23.1 kg/m^2 vs 25.5 kg/m^2) (41). A positive correlation between meat consumption and body mass index, with body mass index increasing with greater frequencies of meat consumption, was also found (41). Along the same lines, a study of Seventh Day Adventists in Barbados found that the number of obese individuals who had been vegetarian for at least five years was 70% less than the number of obese omnivores (45). Individuals who had been vegetarians for less than five years were found to have BMI values close to those of the omnivores, suggesting that long term vegetarianism has the greatest health benefits (45). The fact that vegetarians tend to have lower BMIs than omnivores is thought to be associated with their high consumption of foods low in energy and high in dietary fiber, such as fruits and vegetables (3,41).

Studies suggest that vegetarians have a lower risk for cardiovascular disease than nonvegetarians (3,5,6,44). This is thought to be associated with the way in which certain components of vegetarian diets positively affect factors associated with cardiovascular disease risk including plasma lipid levels and blood pressure. Numerous epidemiological studies have consistently shown that vegetarians have lower plasma total cholesterol levels than nonvegetarians

(3,6). An increase in LDL-cholesterol is associated with the consumption of animal fats, and for this reason, vegetarians typically have lower LDL-cholesterol concentrations than omnivores as well (41). These recognized effects of vegetarian diets on lipid levels have been displayed in intervention trials as well (46). For example, a 74-week randomized control trial consisting of 99 subjects found that those assigned to follow a low-fat vegan diet experienced greater reductions in total cholesterol and LDL-cholesterol than those who followed a conventional diet (total cholesterol: - 20.4 mg/dL vs. -6.8 mg/dL; $p=0.01$, LDL-cholesterol: - 13.5 mg/dL vs. 3.4 mg/dL; $p=0.03$) (46). The decrease in lipid levels seen with the consumption of a vegetarian diet is thought to be caused by the presence of fiber, nuts, plant sterols, and soy isoflavones in this diet type, as each of these foods/food components have been shown to independently reduce total and LDL-cholesterol concentrations (3).

Epidemiological studies have also consistently found vegetarians to be at a lower risk for hypertension than nonvegetarians (3,5,41). The EPIC-Oxford study consisting of 11,004 British men and women found significant differences in mean systolic and diastolic blood pressure amongst meat eaters, fish eaters, vegetarians, and vegans (all $p<0.005$) (5). The greatest differences were seen between the meat eaters and the vegans, with the meat eaters having the highest age-adjusted mean systolic and diastolic blood pressure values and the vegans having the lowest (5). For systolic blood pressure, the difference between the age-adjusted values for meat eaters and vegans was 4.2 mmHg for men and 2.6 mmHg for women (5). When looking at diastolic blood pressure, the difference between the age-adjusted values for meat eaters and

vegans was 2.8 mmHg for men and 1.7 mmHg for women (5). Similar findings were observed in preliminary analyses of the Adventist Health Study-2 (41). It is believed that body mass index accounts for much of the age-adjusted variation in blood pressure seen between meat eaters and vegetarians (3,5,41). Other factors in vegetarian diets that are thought to have beneficial affects on blood pressure include potassium, magnesium, calcium, antioxidants, and dietary fiber (3). Intake of these nutrients often results from the consumption of fruit and vegetables, which are typically found in abundance in vegetarian diets and have been shown to significantly reduce blood pressure (3).

A number of epidemiological studies have found that vegetarians have lower rates of type 2 diabetes than nonvegetarians (3,41,44). Preliminary results from the Adventist Health Study-2 show a dramatic trend in the prevalence of type 2 diabetes in vegetarians as compared to omnivores (41). It was found that while omnivores have a 1.00 relative risk for having type 2 diabetes, lacto-ovo-vegetarians have a relative risk of only 0.39 (95% CI, 0.36-0.42, $p<0.0001$), and vegans have a further reduced relative risk of 0.22 (95% CI, 0.18-0.28, $p<0.0001$) (41). Along the same lines, results from the Nurses' Health Study published in 2004 observed a positive association between type 2 diabetes and intake of red meat and other processed meats (47). The relative risk for type 2 diabetes for every one serving increase in intake of red meat is 1.26 (95% CI, 1.21-1.42) and that for every one serving increase in intake of processed meat is 1.38 (95% CI, 1.23-1.56) (47). Intervention trials suggest that a vegetarian diet may be an effective therapy for type 2 diabetes (47). For example, a 74-week, randomized, controlled, clinical trial examining the effects

of a low-fat vegan diet as compared to a conventional diabetic diet recommended by the American Diabetes Association on glycemia found that the vegan diet had greater effects (46). After adjusting for medications, the change in Hb A_{1c} from baseline to the 74^{th} week was -0.34% for the vegan diet and -0.14% for the conventional diet ($p<0.43$) (46). It is believed that the positive effects vegetarian diets have on the prevention and treatment of type 2 diabetes involves the traditionally high fiber content of vegetarian diets (3). Consumption of dietary fiber aids in the prevention of postprandial glycemic spikes, which improves glycemic control and reduces incident diabetes (3).

Vegetarianism has been linked to a possible reduced risk for breast, prostate, and colorectal cancer (3,6,7,41). The EPIC-Oxford Study consisting of 63,550 adult men and women reported that the standardized incidence ratio for breast cancer for vegetarians is 90% (95% CI, 77%-104%), while that for nonvegetarians is 107% (95% CI, 100%-116%) (7). One supposed reason for the decreased risk of breast cancer seen in vegetarians involves insulin-like growth factor-I (6). There is some evidence that increased levels of insulin-like growth factor-I may be linked to an increased breast cancer risk, and it has been found that vegans have lower plasma levels of this growth factor than meat eaters, thus suggesting a potential reason for the decreased prevalence (6). Additionally, vegetarians tend to consume ample amounts of phyto-estrogen-rich soy products, which have been proposed to reduce breast cancer risk (3,6). Regarding prostate cancer, the EPIC-Oxford Study observed that the standardized incidence ratio is 106% (95% CI, 77%-144%) for vegetarians compared to 129% (95% CI, 112%-149%) for nonvegetarians (7). As with

breast cancer, it is thought that high levels of insulin-like growth factor-I are associated with an increased risk for prostate cancer, and therefore because vegetarians typically have lower levels of insulin-like growth factor-I than nonvegetarians, the prevalence of prostate cancer is reduced in this population (6). While some studies have reported a reduced prevalence of colorectal cancer among vegetarians, others have found the rates to be higher than meat eaters. The EPIC-Oxford study reported a 102% (95% CI, 80%-129%) standardized incidence ratio for colorectal cancer for vegetarians but only a 84% (95% CI, 73%-95%) standardized incidence ratio among nonvegetarians (7). The authors of the EPIC-Oxford study believe that these results were partially due to chance, as other studies have found a significant positive association between red meat consumption and risk of colorectal cancer, thus suggesting that vegetarians should have a decreased prevalence of the disease when compared to nonvegetarians (3,6,7,41).

Nutritional Adequacy of Vegetarian Diets

While vegetarian diets are associated with a reduced risk of a number of diseases, a main criticism of this type of diet is the possibility of nutrient deficiencies that arises from the elimination of entire food groups. Much of this criticism is in regards to poorly planned vegetarian diets. It is the position of the American Dietetic Association (now known as the Academy of Nutrition and Dietetics) that appropriately planned vegetarian diets are healthful, nutritionally adequate, and appropriate for individuals at all stages of the life cycle (3). That being said, protein, vitamin B-12, iron, zinc, calcium, vitamin D, selenium,

eicosapentaenoic acid (EPA), and docosahexaenoic acid (DHA) are nutrients of key concern in vegetarian diets.

Protein. Because vegetarian diets do not contain meat and vegan diets are void of all animal products, individuals who follow these diets may have difficultly consuming adequate amounts of protein if their diets are not properly planned. While animal proteins are composed of all of the essential amino acids and are considered to be complete proteins, plant proteins lack some of the essential amino acids (most often lysine or sulfur-containing amino acids) and are therefore considered to be incomplete proteins (3,9,48). The plant protein soy is often considered to be a complete protein because it contains all of the essential amino acids, but in reality, the overall essential amino acid content of soy is quite low, with it containing a quantity of essential amino acids that is approximately 85% less than that of milk (48). It is often recommended that vegetarians eat complementary proteins (i.e. different plant proteins who collectively provide all of the essential amino acids) at the same meal, however, research suggests that this is not necessary, as a variety of plant proteins over the course of the day can provide an adequate supply of the essential amino acids to vegetarian individuals (3,48).

The DRI for protein is 0.8 g/kg, but this is based on the assumption that 45% to 50% of total protein consumed comes from an animal source (9). Vegetarians have been found to consume only about 21% of their daily protein intake from animal sources, and this does not include vegans who refrain from consuming animal products entirely (9). One study reported that 20% of adult vegans have experienced hypoproteinemia (49).

The DRI recommendation of 0.8 g/kg of protein per day is not generalizable to the vegetarian population because plant proteins tend to be of lower quality than animal proteins, with digestibility scores 10% to 30% less than those of animal proteins (9). For example, the protein digestibility score of animal proteins typically ranges from 94% to 99%, while the protein digestibility score of different varieties of beans and lentils ranges from 72% to 84% (48). In calculating protein recommendations, the DRI used 88% as the reference total protein digestibility score, but one study of 22 vegetarian women found that the total protein digestibility score of these subjects' diets was 82±1%, which is significantly different from the DRI reference value ($p<0.001$) (9). The largest percentage of the protein in this study's participants' diets came from cereal protein (34±3% of total protein intake) (9), which has a protein digestibility score ranging from 72% to 77% (48).

The DRI for protein reports that the nitrogen requirement of adults consuming a plant-based diet is not significantly different than that of those consuming an animal-based or mixed diet (104 mg/kg/d vs. 107 mg/kg/d, $p=0.62$), and states that a varied diet ensures an adequate protein intake for vegetarians (50). The American Dietetic Association (now known as the Academy of Nutrition and Dietetics) states that vegetarians and vegans are able to meet protein requirements, but notes that requirements for these individuals, especially vegans, may be slightly higher than the DRI (3). The previously described study consisting of 22 vegetarian women concluded that the DRI for protein for vegetarians may need to be adjusted to 1 g/kg/d to account for the decreased bioavailability of plant protein (9).

Vitamin B-12. Natural sources of vitamin B-12 are found almost exclusively in foods of animal origin, and for this reason vegans and some vegetarians typically have a high prevalence of vitamin B-12 deficiency and higher concentrations of plasma homocysteine (13,51,52). Vitamin B-12 deficiency is sometimes hard to detect in vegetarians and vegans because these diets tend to be rich in folic acid (13,51,52). Folic acid has been shown to disguise the hematological symptoms of vitamin B-12 deficiency, resulting in the deficiency being undetectable until after neurological symptoms, including dementia, disorientation, and mood disturbances, manifest (13,51,52).

Lacto-ovo-vegetarians are less likely than vegans to be vitamin B-12 deficient because they consume dairy and eggs, both of which contain some vitamin B-12 and if consumed regularly in combination with vitamin B-12 fortified foods can help meet the RDA of 2.4 mcg/d (3,13). It is important to consider, however, that while eggs contain 0.9–1.4 mcg of vitamin B-12, majority of which is found in the yolk, the is bioavailability is reportedly less than 9% (53). The RDA is based on the assumption that 50% of dietary vitamin B-12 is absorbed by healthy adults (53). Additionally, milk provides 0.3–0.4 mcg/100 g of vitamin B-12, but the vitamin B-12 content has been shown to decrease significantly during processing and exposure to fluorescent light (53).

That being said, one study reported that while the average daily intake of vitamin B-12 among male lacto-ovo-vegetarians (2.7 mcg/d) exceeds the RDA vitamin B-12 intake among female lacto-ovo-vegetarians (2.1 mcg/d) falls short of the recommended intake (13). Additionally, the average daily intake of

vitamin B-12 among both male and female vegans (1.0 mcg/d) falls well below the RDA (13). While certain plant foods such as green and purple nori contain substantial amounts of vitamin B-12, these are not usually commonplace in the American diet (53). In order for vegans to meet the RDA for vitamin B-12, they must rely on foods fortified with the vitamin such as fortified soy and rice beverages, some breakfast cereals, or Red Star Vegetarian Support Formula nutritional yeast (3,13). Even when consuming fortified foods, it is often difficult for vegans to meet the vitamin B-12 recommendations, and because of this, vitamin B-12 supplements (10 mcg/d) are often recommended for this population (3,8,13,52).

Iron. The RDA for iron is 18 mg/day for women and 8 mg/day for men (54). It is reported that the mean iron intakes among female lacto-ovo-vegetarians and vegans closely approaches the RDA (14.7 mg/day among lacto-ovo-vegetarians and 17.8 mg/day among vegans), and that of male lacto-ovo-vegetarians and vegans exceeds the RDA (17.6 mg/day among lacto-ovo-vegetarians and 20.4 mg/day among male vegans) (13). A study of Buddhist vegetarians reported that three major food groups that are sources of iron amounted to 77-78% of their total iron intake (55). These groups were grains, vegetables including sea vegetables, and legumes (55). The iron obtained from these foods, as well as the primary form of iron in vegetarian diets in general, is of the nonheme variety, which is much less well absorbed than heme iron (3,54). Even though vegetarians typically consume adequate amounts of iron, the actual amount of iron absorbed is usually much less than that estimated by the RDA (13,56).

Non-heme iron is very sensitive to inhibitors of absorption. The calcium in dairy is an inhibitor of iron absorption (3,57). The relationship between calcium intake from a meal and the inhibition of iron absorption can be described as an inverse S-shape, with amounts of calcium less than 40 mg showing no inhibitory effect, and amounts greater than 300 mg showing no further decrease in iron absorption (57). It is assumed that ≥ 100 mg of calcium at a meal inhibits iron absorption by 50% (57). Supplemental calcium in amounts ranging from 1000 mg/day to 1500 mg/day have little effect on serum ferritin concentrations (54). Phytic acid, which is found in whole grains, nuts, lentils, and legumes, is another inhibitor of non-heme iron absorption (56). While foods that contain phytic acid are commonly consumed as a part of a vegetarian diet, the amount of phytic acid in each source varies. For example, lentils contain 0.08-0.30 g/100g and red kidney beans contain 0.34-0.58 g/100g (58). Polyphenols, such as the tannic and chlorogenic acids found in tea, coffee, red wine, cinnamon, oregano, and various cereals, vegetables (e.g spinach), and beans, inhibit non-heme iron absorption (56,57,59). Both phytic acid and polyphenols inhibit iron absorption by complexing with the iron, causing the inability of the body to absorb it (58).

In a series of six studies containing 16-17 female subjects each, Petry et al. (59) examined the influence of the polyphenols in beans relative to the phytic acid in beans on iron absorption. The first three studies involved the addition of 20, 50, and 200 mg of bean polyphenols in the form of red bean hulls being added to bread meal. The fourth, fifth, and sixth studies used red bean porridge to examine the influence of the following on iron absorption:

polyphenol removal in the presence of phytic acid, the removal of both polyphenols and phytic acid, and phytic acid removal in the presence of polyphenols. (59). It was discovered that 50 mg of polyphenols from beans lowered iron absorption by 14% ($p<0.05$), and 200 mg of polyphenols from beans lowered iron absorption by 45% ($p<0.001$) (59). The mean total iron absorption from the red bean porridge was 2.5%, but removing the polyphenols and phytic acid increased absorption 2.6-fold ($p<0.001$) (59). Dephytinization did not increase iron absorption in the presence of polyphenols, but in their absence, iron absorption increased 3.4-fold ($p<0.001$) (59). This study concluded that the polyphenols and phytic acid in beans inhibit iron absorption, and it appears that their inhibitory effect on iron absorption is not additive (59).

Certain food components have been shown to counteract the iron absorption-inhibiting effects of calcium, phytic acid, and polyphenols. Ascorbic acid substantially enhances iron absorption by improving absorption in the lumen of the gut, which keeps iron more soluble and absorbable and prevents it from being bound to inhibitory ligands (3,13,57). There seems to be a linear relationship between ascorbic acid intake and iron absorption up to at least 100 mg of ascorbic acid per meal (54). Some food preparation techniques such as soaking and sprouting beans, grains, and seeds, and leavening of bread can help enhance iron absorption (3,13). For example, phytate and iron are concentrated in the aleurone layer and germ of grains, so milling white flour and white rice reduces the content of both iron and phytate, but because the phytate content is reduced, the iron that remains has a greater bioavailability (54). Additionally, the inhibitory effect of soybean protein on iron absorption is

decreased when the soy protein is fermented, as found in products such as miso and tempeh (54).

Even with the aid of iron absorption enhancers, the iron absorption in vegetarian diets is approximately 10%, which is significantly lower than the 18% absorption from a mixed Western diet (54,56). For this reason, the iron requirement for vegetarians is 1.8 times higher, with pre-menopausal females vegetarians requiring 32 mg/day and males and post-menopausal females requiring 14 mg/d (54). Iron supplementation may be necessary for pre-menopausal vegetarians, as it is reported that this population has iron intakes of 11-18 mg/d, which is significantly lower than the RDA (56).

Zinc. In traditional American diets, zinc primarily comes from animal sources such as meat, poultry, and seafood (56,60). Legumes, whole grains, nuts, and seeds are examples of plant foods that are good sources of zinc and are suitable for vegetarian diets, but these foods are also rich in phytic acid, which is an inhibitor of zinc absorption (3,13,61). Although phytic acid lowers zinc absorption, choosing unrefined foods can help to counteract this effect, as they tend to have higher zinc contents than refined foods (56). For example, it has been found that while the zinc in whole wheat bread has a bioavailability of only 16.6%, which is less than half of the 38.2% bioavailability in white bread, a greater amount of zinc is absorbed from whole wheat bread as compared to white bread (0.22 vs. 0.15 mg, respectively) because whole wheat bread contains a greater amount of zinc to begin with (56).

Dietary protein is thought to enhance the bioavailability of zinc, but many plant sources of protein are typically rich in phytic acid, which counteracts

the absorption-enhancing effect of dietary protein (56,61). Additionally, there is some controversy over how casein, the protein that is found in milk, affects zinc absorption (43). Some older studies report that casein has slight inhibitory affect on zinc absorption (61,62), which can be problematic for vegetarians who rely heavily on dairy for other nutrients, but more recent studies claim that like other dietary protein, casein may have an absorption-enhancing effect on zinc (43). In one study of 48 Mexican women who habitually consumed a plant-based diet, it was found that the addition of 250 mL of milk to the diet for 14 days increased zinc absorption by 50%, and the addition of 150 mL of yogurt increased zinc absorption by 68% as compared to the control group ($p<0.05$) (43). Subjects who consumed the plant-based control meal were found to absorb 7.1±1.2% of the zinc in the meal (43). In contrast, subjects who consumed the same plant-based meal with the addition of 250 mL of milk absorbed 10.6±1.2% of the zinc, and those who consumed the meal with the addition of 150 mL of yogurt had a zinc absorption of 11.9±1.2% ($p<0.05$) (43).

The bioavailability of zinc in omnivorous diets is typically greater than that in vegetarian diets (3,56). In a crossover design study consisting of 21 women aged 33±7 years, participants consumed controlled lacto-ovo-vegetarian and nonvegetarian diets that provided 9.1 and 11.1 mg zinc, respectively, and with molar ratios of phytate to zinc of 14 and 5, respectively, for 8 weeks each (60). The World Health Organization categorizes a diet with a phytate-zinc molar ratio of 5–15 as having moderate zinc bioavailabilty (30-35% absorption) and diets with phytate-zinc molar ratio as having high zinc bioavailability (50–

55% absorption) (56). While the nonvegetarian diet consumed by participants contained approximately 6.5 ounces of meat daily (mostly beef), the lacto-ovo-vegetarian diet included legumes and unrefined bread and cereal products, as well as three times more phytic acid (60). Upon radioisotopically measuring zinc absorption and performing statistical analyses, it was found that zinc was less efficiently absorbed from the lacto-ovo-vegetarian diet as compared with the absorption efficiency from the nonvegetarian diet (26% vs. 33%; $p < 0.01$) (60). Resultantly, the total zinc absorption from the lacto-ovo-vegetarian diet was significantly lower than that from the nonvegetarian diet (2.4 mg/d vs. 3.7 mg/d; $p<0.001$) (60).

Calcium. About 75% of the calcium consumed in the United States is derived from dairy products (63). Lacto-ovo-vegetarians have been shown to have calcium intakes similar to, or higher than, those of nonvegetarians, but vegans often struggle to meet the RDA of 1000 mg per day since their diets do not include dairy products (3). This is concerning because calcium is a nutrient that plays a key role in maintaining bone health, preventing bone loss, nerve conduction, muscle contraction, cell adhesiveness, mitosis, and blood coagulation (63,64). While milk and other dairy products are the best sources of calcium, other, non-dairy sources of calcium such as broccoli and leafy green vegetables do exist, however, they provide lower amounts of calcium per serving (3,63,64). Even though the calcium in some of these non-dairy sources has a higher bioavailability than the calcium in milk, the high absorbability cannot be overcome by the low calcium content (63,64). For example, an

person would need to consume 2.25 cups of broccoli or 5 cups of spinach in order to get the same amount of calcium absorbed from one cup of milk (64).

A primary inhibitor of calcium absorption is oxalate, and in general, the bioavailability of calcium in a food is inversely associated with its oxalic acid content. Oxalates are found in foods such as spinach, rhubarb, sweet potatoes, and walnuts, and reduce calcium bioavailability by forming insoluble complexes with the nutrient. While foods high in oxalic acid have calcium bioavailablites ranging from 5% to 22%, those with low concentrations of oxalic acid (e.g. kale, broccoli, and bok choy) have calcium bioavailabilities ranging from 35% to 62% (63,64). One exception to this is soybeans. Soybeans are high in both oxalic acid and phytic acid, another inhibitor of calcium absorption, yet the calcium in soy products has a relatively high bioavailability (63). The RDA for calcium assumes a 30% absorption (65).

The low calcium content of common plant sources makes it difficult for most Americans, especially vegans, to meet the recommendations for calcium exclusively from these foods. For this reason, it is recommended that these individuals include calcium-fortified foods and/or calcium supplements in their diets. The calcium salts that are found in supplements and are used to fortify foods have bioavailabilites similar to that of the calcium in milk (63). Consuming just 300 mg of fortified or supplemental calcium provides an amount of absorbable calcium equivalent to that found in one cup of milk (approximately 96 mg) (63). It is important to note that supplemental calcium is best absorbed in quantities ≤500 mg, so individuals taking 1000 mg/day in calcium supplements should split the dosage and take 500 mg at two separate

times during the day to ensure that they are properly meeting the RDA of 1000 mg/day (64).

One example of a food often fortified with calcium is soymilk, which has become increasingly popular in the United States in the recent years. Soymilk in most commonly fortified with calcium carbonate (66). In a crossover design study, Zhao et al. examined the calcium bioavailability in calcium carbonate-fortified soymilk and tricalcium phosphate-fortified soymilk as compared with that in cow's milk in 20 premenopausal, healthy, young women (66). Upon using a dual stable isotope technique, it was found that calcium absorption from the calcium carbonate-fortified soymilk (21.1±0.057%) did not differ from that of the cow's milk (21.7±0.040), but both were higher ($p<0.05$) than that from the tricalcium phosphate-fortified soymilk (18.1±0.039%) (66). This study concluded that the efficiency of calcium absorption is similar in both calcium carbonate-fortified soymilk and cow's milk in premenopausal, healthy, young women (66).

Vitamin D. Vitamin D is most commonly associated with its role in maintaining bone health, but it also plays a number of other roles in the body including regulating immune function, reducing inflammation, and decreasing the risk of developing chronic diseases (13). Very few foods naturally contain vitamin D, but among those that do are seafood, fish oil, and beef liver (67). Since the vegetarian population abstains from consuming these foods, the amount of vitamin D in their diets is typically much lower than the RDA of 600 IU. The Adventist Health Study-2 found the mean dietary intake of vitamin D among non-Hispanic white vegetarians to be 120 IU and that among black

vegetarians to be 151 IU (p=0.005) (68). Similarly, the EPIC-Oxford Study found the mean dietary intake of vitamin D among vegetarians to be 48±44 IU/day and that among vegans to be 28±24 IU/day (p<0.001) (69). Another study conducted by Dunn-Emke et. al reported the mean vitamin D content of a low-fat vegan diet to be 236±152 IU (70).

In attempts to achieve adequate vitamin D intake, lacto-ovo-vegetarians and vegans should focus on consuming foods fortified with vitamin D. Vitamin D-fortified foods that are appropriate for lacto-ovo-vegetarians include cow's milk and yogurt, and those suitable for both lacto-ovo-vegetarians and vegans include certain brands of soymilk, rice milk, orange juice, and breakfast cereals (3,13,67). It is important to note that the form of vitamin D typically used to fortify breakfast cereals is animal-derived vitamin D_3 (69), which may pose a concern to the vegan population. While consumption of vitamin D-fortified foods will contribute more vitamin D to the diets of lacto-ovo-vegetarians and vegans than non-fortified foods, the amounts of the vitamin they contribute may still be inadequate (68). For example, one cup of fortified cow's milk, milk substitute, or orange juice typically contains less than 100 IU of vitamin D (68), indicating that a vegetarian would have to consume six servings of one of these fortified beverages to meet the recommendation of 600 IU per day.

In addition to obtaining vitamin D from fortified foods, vegetarians can meet at least a part of the recommendation via exposure to sunlight (70). When ultraviolet radiation from the sun penetrates uncovered skin, it converts cutaneous 7-dehydrocholesterol to previtamin D_3, which in turn becomes vitamin D_3 and can be stored in fat and the liver (67). It is reported that

approximately 5–30 minutes of sun exposure between 10 AM and 3 PM at least twice a week to the leads to sufficient vitamin D synthesis (67), and it is estimated that light-skinned individuals obtain 90-100% of the recommended amount of vitamin D from sunlight (68). That being said, time of day, the season, cloud cover, smog, skin melanin content, and sunscreen usage are all factors that can affect ultraviolet radiation exposure and subsequent vitamin D synthesis (3,67). It is recommended that individuals who are unable to get adequate sunlight exposure or do not have access to vitamin D-fortified foods take dietary supplements to meet their vitamin D requirements (3).

Selenium. Selenium is a nutrient that is essential to human health (71). It functions as a component of several selenoproteins, such as thyroid hormone deiodinases, selenoprotein P, and glutathione peroxidases, playing a key role in antioxidant and redox reactions, as well as in hormonal and inflammatory systems (71,72). Fish, poultry, and red meat are foods considered to be rich in selenium, but the actual content of selenium in these foods can vary depending on the selenium content in the animals' tissue, which is directly dependent on the selenium content of the soil from which the animals' diet is sourced and can vary greatly by region (56,71). The bioavailability of selenium is dependent upon the chemical form in which it is consumed (56,71). Selenocysteine and selenomethionine are more bioavailable than the inorganic forms of selenium, selenate and selenite (71). Additionally, plant sources of selenium tend to be less bioavailable than animal sources because the dietary fiber content interferes with absorption (71).

In a 14-week controlled trial Turner-McGrievy et. al (73) examined the changes in the macronutrient and micronutrient content of participants' diets when they switched from their regular diets to vegan diets. At baseline, the mean selenium content of the participants' (non-vegan) diets was found to be 50±60 µg per 1000 kcal per day, but when the participants switched to a vegan diet, their selenium intake decreased to an average of 30±20 µg per 1000 kcal per day (73). Another study confirmed these findings, reporting that a vegetarian-type diet is inversely correlated with total selenium intake (-3.94 ± 2.28, p= 0.08) (71).

One way by which vegans and lacto-ovo-vegetarians can increase their selenium intake and ensure that they are meeting the recommendation of 55 µg/day is via the consumption of Brazil nuts, which are the most highly concentrated source of selenium (72). A single Brazil nut is said to contain an average of 50 µg of selenium, which is just slightly below the RDA (72). Thomson et. al (72) investigated the efficiency of Brazil nuts in increasing selenium status in comparison to selenomethionine supplements. In this randomized controlled trial, 59 healthy, New Zealand adults were randomly allocated to consume two Brazil nuts (providing approximately 100 µg of selenium), a supplement providing 100 µg of selenium in the form of selenomethionine, or a placebo each day for 12 weeks (72). Plasma selenium and glutathione peroxidase activities were measured at baseline and at 2, 4, 8, and 12 week and it was found that plasma selenium increased by 64.2%, 61.0%, and 7.6%, and plasma glutathione peroxidase increased by 8.3%, 3.4%, and 1.2% in the Brazil nut, selenomethionine supplement, and placebo

groups, respectively (72). The changes in the Brazil nut group were significantly greater than those experienced in the selenomethionine supplement group (p=0.032) and the placebo group (p=0.002) (72). This study concluded that the consumption of 2 Brazil nuts daily is as effective as supplementation with 100 µg of selenium as selenomethionine in increasing the concentration of plasma selenium and the activity of glutathione peroxidase (72).

Omega-3 Fatty Acids. Omega-3 fatty acids are essential in the diet, as they cannot be synthesized by humans (74). Omega-3 fatty acids are traditionally classified by length, ranging from the shortest, alpha-linolenic acid (ALA), to the longest, docosahexaenoic acid (DHA) (74). The long-chain omega-3 fatty acids eicosapentaenoic acid (EPA) and DHA are recognized for their physiologic benefits including cardioprotective and anti-inflammatory effects (74–76). In addition, DHA has a physiological role in the visual process and synaptic functioning (76).

The primary source of EPA and DHA is seafood, but these two fatty acids are also found in organ meats, eggs, and dairy products (76,77). While lacto-ovo-vegetarians can get small amounts DHA from eggs (20 mg DHA/egg) and milk (20 mg DHA/30 g fat), their diets are very low in EPA (<5 mg/day) (75,76). Along the same lines, vegan diets contain negligible amounts of EPA and DHA, as they are free of all animal products (75).

EPA and DHA are critical regulators of brain structure and function and are thought to be associated with mood states (76,78). Omnivores with low intakes of EPA and DHA are shown to have impaired mood states, and one

study looked to see if these findings are consistent in the vegetarian population (78). This study, consisting of 138 healthy Seventh Day Adventist men and women examined associations between mood state and intake of omega-3 fatty acids (78). As compared to the 78 omnivore participants, the 60 vegetarians in this study had significantly lower mean intakes of EPA (0.005 ± 0.004 g vs. 0.093 ± 0.027 g; $p<.001$), DHA (0.015 ± 0.007 g vs. 0.162 ± 0.040 g; $p<.001$), and AA (0.011 ± 0.003 g vs. 0.086 ± 0.011 g; $p<.001$) (78). Additionally, mean total scores on the DASS and POMS mood scales of the vegetarian subjects were significantly lower than the omnivore subjects participants ($p<.001$), indicating better mood states among the vegetarian participants (78). This study concluded that despite lower intakes of EPA and DHA, the vegetarian diet profile does not seem to adversely affect mood (78). This challenges what is known in the literature about the link between omega-3 fatty acids and brain function, and suggests an unrecognized benefit of vegetarian diets, which are inherently low in EPA and DHA (78).

The low intake of EPA and DHA among vegetarians and vegans results in these individuals having low levels of these long-chain omega-3 fatty acids in their blood (76,77,79). This effect is significantly more pronounced in vegans, since their diets are void of animal products in their entirety (75). Sanders (76) suggested that plasma proportions of EPA and DHA may not pose a concern in vegetarians as long as they have a high ALA intake, which will reduce the omega-6:omega-3 ratio. Vegetarian diets tend to be rich in ALA, which is commonly found in plant-based foods such as leafy green vegetables, walnuts, canola oil, flax seed oil, and soybean oil (74). Through a series of elongation

and desaturation reactions, humans can convert ALA to EPA and DHA, but this process is not very efficient, with approximately 5–10% of ALA being converted to EPA and 2–5% to DHA in healthy individuals (75). Additionally, vegetarian diets tend to be high in linoleic acid (LA), an omega-6 fatty acid that competes with ALA for the same rate-limiting desaturase enzyme (77,78). Because ALA and LA utilize the same desaturase enzyme, the omega-6:omega-3 ratio is often used to assess the balance of essential fatty acids in the diet (75). Vegans and lacto-ovo-vegetarians tend to have elevated omega-6:omega-3 ratios as compared to omnivores (<14:1–20:1, <10:1–16:1, and <10:1, respectively) (75). It is suggested that the optimal omega-6:omega-3 ratio to maximize the conversion of ALA to DHA is 2:1-4:1 for the vegetarian and vegan populations (75).

It is recommended that vegans and lacto-ovo-vegetarians attempt to maximize the conversion of omega-3 fatty acids by obtaining <1.5–2% of calories from omega-3 fatty acids, and 5.5-8% from omega-6 fatty acids each day (75). Processed foods tend to be high in omega-6 fatty acids, so one method to decrease omega-6 fatty acid intake is to limit processed foods and focus on consuming whole food sources of omega-6 fatty acids, such as sunflower seeds, walnuts, wheat germ, and soy foods, all of which relatively minor contributors to overall omega-6 fatty acid intake (75). Whole foods rather than oils are better sources of omega-6 fatty acids because they contribute phytochemicals, fiber, B vitamins, and other nutrients to the diet (75).

It is also recommended that vegetarians consume approximately 1.1-2.2 g ALA/1000 kcal/d to facilitate the conversion to EPA and DHA in the body (75). Eggs are a direct source of DHA for lacto-ovo-vegetarians, but they contribute very little EPA (75). For vegans, the only plant sources of long-chain omega-3 fatty acids are microalgae and seaweed. DHA-rich microalgae is available in supplement form, and the recommended dosage for lacto-ovo-vegetarians and vegans is 100-300 mg/d (75). Supplementing with DHA in dosages larger than 300 mg/d may negatively affect LDL-cholesterol levels. In an 8-week double-blind, placebo-controlled, parallel design study, Geppert et al. (79) investigated the effects of a DHA supplement providing 0.9 g DHA/d as compared to a placebo on lipid levels in normolipidemic vegetarians (n=114). At the end of this study, it was found that the proportion of DHA in plasma phospholipids increased from 2.8% to 7.3% in the DHA supplement group ($p<0.001$), but this group also experienced a 6.9% increase in LDL cholesterol ($p<0.001$) (79).

Chapter 3

METHODS

In 1997, at the 'Third International Congress on Vegetarian Nutrition,' Haddad et al. (14) proposed a "conceptual framework" that was intended to stimulate discussion among nutrition and health professionals regarding the development of a food guide for vegetarians. Venti and Johnston (15) utilized this framework to systematically formulate the Modified Food Guide for Vegetarians. Published in 2002, this vegetarian food guide was well received and adapted by a number of textbooks. Now that ten years have passed, it was deemed necessary to review the scientific literature published since the release of the Modified Food Guide for Vegetarians and make any necessary updates to this food guide. In addition to updating the content of the 2002 Modified Food Guide for Vegetarians, the intent was to adapt it to a graphical format similar to that of the nation's current food guide, MyPlate.

Updating the Nutrient Requirements for Vegetarians

The most recent DRI books, many of which had been updated since 2002, as well as the Dietary Guidelines for Americans were carefully considered when determining which updates needed to be made to the recommendations set forth by the Modified Food Guide for Vegetarians. In addition, the most current scientific research on nutrient bioavailability and digestibility played a key role in determining necessary updates to be made. The Modified Food Guide for Vegetarians included protein, vitamin B-12, iron, zinc, calcium, and vitamin D as the nutrients at risk for inadequacies and/or of key concern in vegetarian diets. Each of these nutrients was considered in the update, but it

was determined that omega-3 fatty acids and selenium were two additional nutrients that needed to be included in our review of the scientific literature. For those nutrients that were shown to have reduced bioavailabilities in the plant form, specifically iron and zinc, modifications to the government-recommended intake levels were made. The digestibility of plant protein in comparison to animal protein was also carefully considered, and necessary modifications to the government-recommended protein intake were made.

Identification of Commonly Consumed Foods in Each Food Group

In determining the composition of the different food groups for the updated vegetarian food guide, focus was placed mainly on those groups established in the 2002 Modified Food Guide for Vegetarians: grains, vegetables, leafy green vegetables, fruits, dried fruits, beans and protein foods, dairy (lacto-ovo-vegetarian), non-dairy (vegan), nuts/seeds, and oils. The food groups featured in USDA's MyPlate were also taken into consideration. Venti and Johnston (15) composed each food group of foods that were said to be common to each group. As a part of the updating of the vegetarian food guide, these food lists were both updated and expanded upon reviewing food consumption data and considering food trends (Appendix A: Table A1). Commonly consumed fruits and vegetables were taken from "Top 20" charts published by the United States Food and Drug Administration (80). The list of grains was updated with information taken from a publication released by the Whole Grains Council regarding whole grain intake among Americans (81). Bean and nut consumption patterns were reviewed to ensure that all commonly consumed types of beans and nuts were accounted for (82,83). The types of

cheese included in the nutrient profiles were updated with information issued by the Wisconsin Milk Marketing Board about the top manufactured cheeses (84), with the assumption that the top manufactured types of cheese are a direct reflection of commonly consumed varieties. A set number of foods common to each food group was not used, but rather emphasis was placed on ensuring that a variety of foods in each group were represented.

Computer analysis (The Food Processor for Windows, ESHA Research) was used to determine the nutrient profiles of the representative foods in each food group (Appendix A: Tables A2-A11). Serving sizes were based on those established by the USDA for the MyPlate food guide: one serving of grains is equivalent to 1 slice of bread, 1 cup of ready-to-eat cereal, or ½ cup of cooked rice, cooked pasta, or cooked cereal; one serving of fruit is equivalent to 1 cup of fruit, 1 cup of 100% fruit juice, or ½ cup of dried fruit; one serving of vegetables is equivalent to 1 cup of raw or cooked vegetables, or 2 cups of raw leafy green vegetables; 1 serving of nuts and seeds is equivalent to 1 ounce nuts or seeds, or 2 tablespoons of nut butter (e.g. peanut butter); 1 serving of beans and protein foods is equivalent to ¼ cup cooked beans or soybeans, 1 egg, 2 ounces of tofu, or 1 ounce of tempeh; 1 serving of dairy and dairy substitutes is equivalent to 1 cup of milk, yogurt, or soymilk, or 1 ½ ounces of cheese (35).

After computing the nutrient profiles for each food in each food group, the mean of the nutrient values for the foods in each group was taken to illustrate the average amount of macronutrients and micronutrients that would be obtained from one serving from each of the food groups (Appendix A: Table

A13). Prior to computing the nutrient profiles of each food, there was some uncertainty regarding in which group certain representative foods, such as those that could be classified as both protein and dairy (e.g. Greek yogurt and cottage cheese), should be placed. In order to place these foods, their computed nutrient profiles were compared to the mean nutrient profiles calculated for each food group. The foods in question were put into the group with a macronutrient and micronutrient content most similar to its own.

Development of Diet Plans and Sample Menus

Diet plan guidelines were formulated by calculating the necessary number of food group servings for nutrient adequacy at three caloric levels: 1500 kcal, 2000 kcal, and 2500 kcal. Necessary modifications were made to ensure that the diet plans meet or exceed (with the exception of energy) the recommended, or proposed, nutrient requirements of both lacto-ovo-vegetarians and vegans. Upon verifying nutritional adequacy of the guidelines, sample menus were created to provide examples for how nutrient needs can be met through the consumption of a variety of foods. In the constructing of the sample menus, the key messages of MyPlate ("Make half your plate fruit and vegetables;" "Make at least half of your grains whole grains;" and "Switch to fat-free or low-fat milk") (35) were incorporated where appropriate, keeping in mind that inherent differences between the common American diet and meatless diets do exist.

Updating the Vegetarian Food Guide Graphic

In addition to updating the content of the Modified Food Guide for Vegetarians, its graphic was adapted from the classic pyramid shape to a format

similar to that of MyPlate. When deciding on the details of the new graphic, we not only referred to MyPlate, but also to the Harvard School of Public Health's Healthy Eating Plate as guides. To best illustrate the recommendations of our vegetarian food guide, we made the decision to include actual food items as well as serving sizes in each food groups' section of our plate. In contrast to MyPlate, but similar to the Modified Food Guide Pyramid for Vegetarians, recommendations for daily physical activity and water consumption were incorporated into the graphic.

Chapter 4

RESULTS

Modifying Recommendations for Nutrients

Post-2002 scientific literature was reviewed for information on the bioavailabilities of the nutrients of key concerns in vegetarian diets. The DRI for protein is 0.8 g/kg, which is based on the assumption that assumption that 45% to 50% of total protein consumed comes from an animal source (9). Additionally, plant proteins tend to have digestibility scores 10% to 30% less than those of animal proteins (9). To compensate for the lower digestibility scores of plant-based sources of protein, it is recommended in the updated food guide for vegetarians that 1 g/kg be consumed each day (9,50). The RDA for vitamin B-12 is 2.4 ug/d, which remains constant in the updated food guide for vegetarians. Because vitamin B-12 is not present in plant foods, it is recommended in the updated food guide for vegetarians that foods fortified with vitamin B-12 be consumed in order to meet the recommendation. The RDA for vitamin D is 600 IU/d (for adults <70 years of age), which remains the same in the updated food guide for vegetarians. The RDA for calcium is 1000 mg/d (for females ≤ 51 years of age and males ≤ 70 years of age), which assumes 30% absorption (65). In reviewing the scientific literature, it was found that plant sources of calcium that are low in oxalate have bioavailabilities ranging from 35% to 62% (85-88), and thus no alteration to the recommendation of 1000 mg of calcium per day was made in the updated food guide for vegetarians. The Food and Nutrition Board acknowledges the reduced bioavailability of iron in the plant (non-heme) form by providing RDAs

specifically for the vegetarian population (54). The RDA for iron for vegetarian males is 14 mg/d and that for females is 32 mg/d (54). These recommendations remain constant in the updated food guide for vegetarians. The recommendation for selenium in the updated food guide for vegetarians is the 55 ug/d, which is that same as the RDA (72). Because selenium is most commonly found in animal foods, it is suggested that lacto-ovo-vegetarians and vegans consume fortified grains and/or Brazil nuts to meet the recommendation. A 1-ounce serving of Brazil nuts provides approximately 320 μg of selenium. The recommendation for omega-3 fatty acid in the updated food guide for vegetarians is 1.6 g/d for males and 1.1 g/d for females, which is consistent with the DRI (75).

The EAR for zinc is 9.4 mg/d for males, which is calculated based on an absolute need of 3.84 mg/d and an assumed absorption of 41% (54). The zinc requirement of females is 72% of that of males, and thus the EAR for zinc for females is 6.8 mg/d. The RDA for zinc for males is 11 mg/d and that for females is 8 mg/d. When consumed within meals, the absorption of zinc from plant-based sources is 16-20% on average (85,89). Considering the absolute need of 3.84 mg/d and assuming a 16% absorption, the updated zinc recommendation for lacto-ovo-vegetarians and vegans is 29 mg/d for males and 21 mg/d for females.

Table 1 provides a comparison of the DRIs, the recommendations made in the original Modified Food Guide for Vegetarians, and the recommendations used for this updated food guide for vegetarians.

TABLE 1 Comparison of DRIs, Recommendations Made in the 2002 Modified Food Guide for Vegetarians, and Updated Recommendations for Daily Nutrient Intakes

Nutrient	DRI	2002 Modified Food Guide for Vegetarians	Updated Food Guide for Vegetarians
Protein	0.8 g/kg	1 g/kg	1 g/kg[1]
Vitamin B-12	2.4 µg	2.4 µg	2.4 µg
Vitamin D	600 IU	400 IU	600 IU
Calcium	1000 mg	1100 mg	1000 mg
Iron	8 mg (males)	10 mg (males)	14 mg (males)[1,2]
	18 mg (females)	22 mg (females)	32 mg (females)[1,2]
Selenium	55 µg	-	55 µg
Zinc	11 mg (males)	12 mg (males)	29 mg (males)[1,3]
	8 mg (females)	9 mg (females)	21 mg (females)[1,3]
Omega-3 Fatty Acids	1.6 g (males)	-	1.6 g (males)
	1.1 g (females)	-	1.1 g (females)

[1]Differs from the DRI.

[2]Coincides with vegetarian-specific recommendation made for iron by the Food and Nutrition Board.

[3]Based on 16% absorption with meals; see Methods for calculations.

Reconfiguration of Food Groups and Changing of Serving Sizes

After analyzing the nutrient content of the representative foods in each food group and computing the mean nutrient contribution of each food group, the data were examined closely and the decision to reconfigure some of the food groups was made **(Table 2)**. The 2002 Modified Food Guide for Vegetarians separated dried fruits from fresh fruits and fruit juices due to the greater amount of iron they contain. Upon closely examining the nutrient analysis data, it was concluded that dried fruits actually contain amounts of iron similar to that of most fresh fruits, and thus, the fruit group and dried fruit group were combined into a single group, now called the fruit and dried fruit group. Along with the combining of the fresh fruits and dried fruits into a single food group, the serving size of the dried fruits was reduced from ½ cup to ¼ cup to more closely match the mean nutrient contributions of the fresh fruits. Winter squash was added to the vegetable group due to its high omega-3 fatty

acid content (1.89 g/cup). Nut butters were combined with nuts and seeds to form a singular food group called the nuts, nut butters, and seeds group. Along with combining the nut butters with the nuts and seeds, the serving size of the nut butters was reduced from 2 tablespoons to 1 tablespoon to more closely match the mean nutrient contributions of the nuts and seeds.

Significant alterations to the bean and protein foods group and the dairy group were made. Eggs were removed from the bean and protein foods group so that all of the foods within the group would be suitable for both vegans and lacto-ovo-vegetarians. Soy-based meat substitutes (e.g. tofu and meatless burgers) were removed from the bean and protein foods group and placed into a newly created soy and dairy substitutes group. Ultimately, the processed imitation meat products (meatless burgers, meatless chicken, meatless deli slices, and meatless hot dogs) were removed from the food guide entirely, in efforts to deemphasize the intake of processed foods and promote the intake of whole foods. It was decided that the dairy group would be intended solely for lacto-ovo-vegetarians and that the dairy substitutes suitable for vegans would be removed from the group and added to the soy and dairy substitutes group. Milk products, cheeses, and eggs were combined into one food group called the dairy and eggs group. Conducting the nutrient analyses cleared up the prior uncertainty regarding in which group Greek yogurt and cottage cheese belonged, and it was determined that the nutrient contributions of these two foods most closely match with those in the dairy and eggs food group. The alterations made to the previously existing bean and protein foods group

TABLE 2 Representative Foods in Reconfigured Food Groups

Food Group							
Grains	**Fruit and Dried Fruit**	**Vegetables**	**Green Leafy Vegetables**	**Nuts, Nut Butters, and Seeds**	**Beans and Quinoa**	**Dairy and Eggs**	**Soy and Dairy Substitutes**
Amaranth	Apple	Asparagus	Bok Choy	Almonds	Black Beans	Low Fat Milk	Soybeans
All Bran	Apple Juice	Bell Pepper	Chinese Cabbage	Brazil Nuts	Garbanzo Beans	Skim Milk	Miso
Barley	Apricot	Broccoli	Collard Greens	Cashews	Kidney Beans	Low Fat Fruited Yogurt	Tempeh
Bran Chex	Avocado	Brussels Sprouts	Kale	Flaxseed	Lentils	Nonfat Fruited Yogurt	Tofu
Brown Rice	Banana	Carrots	Mustard Greens	Hazelnuts	Lima Beans	Nonfat Plain Yogurt	Fortified Tofu
Bulgur Wheat	Blueberries	Cauliflower	Spinach	Macadamia Nuts	Navy Beans	Cottage Cheese	Almond Milk
Cheerios	Cantaloupe	Celery	Swiss Chard	Peanuts	Pinto Beans	Nonfat Greek Yogurt	Enriched Rice Milk
Corn Flakes	Grapefruit	Corn	Turnip Greens	Pecans	Refried Beans	Egg	Rice Milk
Corn Grits	Grapes	Cucumber		Pine Nuts	White/Cannellini Beans	Egg Substitute	Fortified Soy Milk
Corn Tortilla	Honeydew	Green Beans		Pistachios	Quinoa	Egg Whites	Nonfat Soy Milk
Cous Cous	Kiwi	Iceberg Lettuce		Pumpkin Seed Kernels		American Cheese	Soy Plain Yogurt
Cream of Wheat	Nectariane	Leaf Lettuce		Sunflower Seed Kernels		Cheddar Cheese	
English Muffin	Orange	Onion		Tahini		Feta Cheese	
Flour Tortilla	Orange Juice	Portabella Mushroom		Walnuts		Goat Cheese	
Granola (low fat)	Peach	Potato		Wheat Germ		Mozzarella Cheese	
Grape Nuts	Pear	Summer Squash		Almond Butter		Provolone Cheese	
Millet	Pineapple	Sweet Potato		Peanut Butter		Swiss Cheese	
Multigrain Bread	Plum	Tomato					
Oatmeal	Pomegranate	Winter Squash					
Pasta	Strawberries						
Pita	Raspberries						
Plain Bagel	Watermelon						
Popcorn (low fat)	Dried Apples						
Raisin Bran	Dried Apricots						
Raisin Bread	Dried Cranberries						
Rye Bread	Dates						
Shredded Wheat	Figs						
Wheatberries	Dried Mango						
Wheat Thins	Dried Pineapple						
White Bread	Prunes						
White Rice	Raisins						
WW Bread[1]							
WW Crackers[1]							
WW English Muffin[1]							
WW Pasta[1]							
WW Pita[1]							
WW Tortilla[1]							

[1]WW= whole wheat.

resulted in only beans and quinoa remaining in the group, and thus the food group was renamed the beans and quinoa group.

The reconfiguration process resulted in the following food groups in the updated food guide: the grains group, the fruit and dried fruit group, the vegetable group, the green leafy vegetable group, the nuts, nut butters, and seeds group, the beans and quinoa group, the dairy and eggs group, and the soy and dairy substitutes group. Once the new food groups were decided, the mean nutrient contributions of each food group were calculated (**Table 3**).

Determination of Number of Servings at Different Caloric Levels

In determining the number of servings of each food group to recommend at the different 1500, 2000, and 2500 kcal levels, the mean nutrient contributions of each food group (Table 3) were closely examined and the updated nutrient recommendations (Table 1) were considered. Additionally, the MyPlate principle of "make half your plate fruits and vegetables" was kept in mind (35). It was also recognized that vegans would not be consuming foods from the dairy and eggs group, and thus the nutrients obtained by the foods in this group need to be obtained from the other food groups.

With these things considered, meal plans were formulated for lacto-ovo-vegetarians and vegans at the 1500, 2000, and 2500 kcal levels **(Table 4)**. At the 1500 kcal level, it is recommended that lacto-ovo-vegetarians consume 6 servings from the grains group, 3 servings from the fruit and dried fruit group, 3 servings from the vegetables group, 2 servings from the green leafy vegetables group, 1 serving from the nut, nut butters, and seeds group, 2 servings from the beans and quinoa group, and either 1 serving from the dairy and eggs

TABLE 3 Mean Nutrient Composition of One Serving of Each Food Group[1,2]

Food Group	Energy (kcal)	Protein (g)	Carbohyrates (g)	Fiber (g)	Total Fat (g)	Saturated Fat (g)	Vitamin B-12 (µg)	Vitamin D (IU)	Calcium (mg)	Iron (mg)	Selenium (µg)	Sodium (mg)	Zinc (mg)	Omega-3 Fatty Acids (g)	(n-6)/(n-3) Ratio
Grains	104.91±41.07	3.28±1.63	21.76±11.08	2.82±3.22	1.17±0.94	0.20±0.20	0.92±2.32	9.47±20.58	39.48±51.39	3.47±5.50	7.45±5.51	112.69±106.05	1.18±1.17	0.14±0.63	15.80±10.88
Fruits and Dried Fruits[3]	90.78±36.31	1.15±0.84	21.29±9.16	2.96±2.42	0.85±2.62	0.12±0.39	0.00±0.00	0.00±0.00	21.38±17.39	0.41±0.23	0.47±0.48	6.14±8.42	1.05±2.78	0.03±0.04	2.47±4.53
Vegetables	42.91±32.39	1.97±1.29	9.39±7.55	2.46±1.36	0.33±0.42	0.07±0.10	0.00±0.01	0.51±2.09	26.11±16.11	0.63±0.48	2.25±4.81	23.37±26.68	0.37±0.30	0.13±0.43	3.24±10.68
Green Leafy Vegetables	27.38±17.62	2.33±1.02	5.25±3.78	2.25±1.01	0.34±0.25	0.05±0.03	0.00±0.00	0.00±0.00	126.36±58.99	1.38±0.62	0.89±0.27	61.70±43.40	0.27±0.15	0.08±0.07	1.35±1.89
Nuts, Nut Butters, and Seeds[4]	92.92±16.21	2.92±0.98	3.36±1.42	1.48±0.85	8.47±2.52	1.06±0.60	0.00±0.00	0.00±0.00	17.88±15.54	0.66±0.28	22.00±79.18	1.28±1.57	0.69±0.33	0.29±0.82	283.43±437.57
Beans and Quinoa	64.71±16.75	3.86±0.36	11.52±2.99	3.41±0.67	0.51±0.53	0.07±0.07	0.00±0.00	0.00±0.00	19.62±9.49	1.18±0.29	1.71±1.11	28.28±83.95	0.55±0.18	0.05±0.03	4.41±8.80
Dairy and Eggs	122.88±57.52	9.89±3.55	9.52±15.14	0.00±0.00	4.99±5.00	3.30±3.29	0.71±0.48	28.11±41.54	222.47±140.64	0.29±0.35	9.59±5.72	215.67±156.85	1.11±0.62	0.06±0.06	2.28±4.09
Soy and Dairy Substitutes	86.90±46.60	4.83±3.34	11.30±9.55	0.93±0.78	2.57±1.50	0.30±0.38	0.81±1.22	43.69±46.44	154.12±140.91	0.80±0.60	1.20±1.70	167.74±373.22	0.69±0.23	0.08±0.08	7.96±9.07

[1] Based on standard USDA serving sizes unless otherwise noted.

[2] Values listed as Mean±SD.

[3] Serving size of 1/4 cup used for dried fruits; standard USDA serving size is 1/2 cup.

[4] Serving size of 1 tablespoon used for nut butters; standard USDA serving size is 2 tablespoons.

group and 1 serving from the soy and dairy substitutes group, or 2 servings from the dairy and eggs group. At the 1500 kcal level, it is recommended that vegans consume 6 servings from the grains group, 3 servings from the fruit and dried fruit group, 3 servings from the vegetables group, 3 servings from the green leafy vegetables group, 1 serving from the nut, nut butters, and seeds group, 3 servings from the beans and quinoa group, and 1 serving from the soy and dairy substitutes group. At the 2000 kcal level, it is recommended that lacto-ovo-vegetarians consume 7 servings from the grains group, 3 servings from the fruit and dried fruit group, 4 servings from the vegetables group, 2 servings from the green leafy vegetables group, 1 serving from the nut, nut butters, and seeds group, 3 servings from the beans and quinoa group, and either 3 servings from the dairy and eggs group and 1 serving from the soy and dairy substitutes group, or 4 servings from the dairy and eggs group. At the 2000 kcal level, it is recommended that vegans consume 8 servings from the grains group, 3 servings from the fruit and dried fruit group, 4 servings from the vegetables group, 3 servings from the green leafy vegetables group, 2 serving from the nut, nut butters, and seeds group, 5 servings from the beans and quinoa group, and 1 serving from the soy and dairy substitutes group. At the 2500 kcal level, it is recommended that lacto-ovo-vegetarians consume 8 servings from the grains group, 4 servings from the fruit and dried fruit group, 5 servings from the vegetables group, 2 servings from the green leafy vegetables group, 2 servings from the nut, nut butters, and seeds group, 4 servings from the beans and quinoa group, and either 4 servings from the dairy and eggs group and 1 serving from the soy and dairy substitutes group, or 5 servings

from the dairy and eggs group. At the 2500 kcal level, it is recommended that vegans consume 10 servings from the grains group, 4 servings from the fruit and dried fruit group, 6 servings from the vegetables group, 2 servings from the green leafy vegetables group, 2 servings from the nut, nut butters, and seeds group, 7 servings from the beans and quinoa group, and 1 serving from the soy and dairy substitutes group.

TABLE 4 Number of Servings from Each Food Group Necessary for Nutrient Adequacy at the 1500-, 2000-, and 2500-kcal Levels

	Lacto-ovo-vegetarian Diet			**Vegan Diet**		
	Energy Level (kcal)					
	1500	2000	2500	1500	2000	2500
Food Group	**Number of Servings**					
Grains	6	7	8	6	8	10
Fruit and Dried Fruit	3	3	4	3	3	4
Vegetables	3	4	5	3	4	6
Green Leafy Vegetables	2	2	2	3	3	3
Nuts, Nut Butters, and Seeds	1	1	2	1	2	2
Beans and Quinoa	2	3	4	3	5	7
Dairy and Eggs	1	3	4	0	0	0
Soy and Dairy Substitutes[1]	1	1	1	1	1	1
Total Number of Servings	19	24	30	20	26	33

[1]Lacto-ovo-vegetarians may elect to omit the 1 serving from the soy and dairy substitutes group and replace it with an additional serving from the dairy and eggs group.

Table 5 summarizes the amount of kcal, protein, carbohydrates, fiber, total fat, saturated fat, vitamin B-12, vitamin D, calcium, iron, selenium, sodium, zinc, and omega-3 fatty acids provided by the 1500, 2000, and 2500 meal plans for lacto-ovo-vegetarians and vegans. A breakdown of the nutrients provided by the recommended amounts of servings of each food group at the 1500, 2000, and 2500 kcal levels for lacto-ovo-vegetarians and vegans is provided in Appendix C.

Addressing the Need for Supplementary Foods

Upon examining the total amount of nutrients provided by the recommended amount of servings of each food group at the different caloric levels (Table 5), it was observed that the amount of calcium provided by the 1500 kcal meal plan for vegans (991 mg) is very slightly lower than the RDA (1000 mg). Additionally, the amount of zinc provided by the 1500 and 2000 kcal meal plans for both lacto-ovo-vegetarians and vegans is lower than the newly calculated recommendations for both males and females (21 mg/d and 29 mg/d, respectively). To account for these calcium and zinc deficits, it was determined that supplementary foods would be recommended as a part of the updated food guide for vegetarians.

The RDA for calcium is 1000 mg/d, or 7000 mg/week, which assumes an absorption of 30% (65). At the 1500 kcal level, the vegan meal plan provides 990.85 mg calcium/d or approximately 6936 mg calcium/week, creating a deficit of 64 mg/week. Of the representative fruits analyzed, oranges provide the most calcium (74 mg in a medium orange). It is therefore recommended in the updated food guide that an orange be eaten one time per week to abet adequate calcium intake. This recommendation is for all caloric levels to account for any deficits in calcium that may arise from consuming enough calcium-fortified foods.

When foods containing zinc are consumed independently of meals, the absorption of the nutrient is approximately 60% (85). It is recommended in the updated food guide for vegetarians that zinc-rich foods be consumed as snacks to allow for maximum absorption and ensure that zinc requirements are met.

TABLE 5 Total Nutrients Provided by Recommended Number of Servings at the 1500-, 2000-, and 2500-kcal Levels[1]

Lacto-ovo-vegetarian Diet	Energy (kcal)	Protein (g)	Carbohyrates (g)	Fiber (g)	Total Fat (g)	Saturated Fat (g)	Vitamin B-12 (µg)	Vitamin D (IU)	Calcium (mg)	Iron (mg)	Selenium (µg)	Sodium (mg)	Zinc (mg)	Omega-3 Fatty Acids (g)	(n-6)/(n-3) Ratio
1500 kcal	1516.40	59.10	280.40	46.92	28.13	6.58	7.16	147.36	1065.23	30.82	78.61	1329.37	15.43	2.01	2.96:1[2]
2000 kcal	1974.69	87.99	342.11	55.61	40.12	13.52	9.56	220.69	1595.38	36.68	112.97	1925.05	19.73	2.44	2.25:1[2]
2500 kcal	2492.79	111.10	419.03	68.75	56.28	18.25	11.25	265.91	1941.77	43.33	140.43	2312.53	24.66	3.15	3.04:1[2]
Vegan Diet															
1500 kcal	1485.61	55.40	287.65	52.58	23.99	3.40	6.51	126.38	988.74	33.09	75.39	1203.68	15.12	2.07	2.82:1[2]
2000 kcal	1959.67	74.61	367.04	68.99	35.99	4.98	8.47	160.09	1150.38	43.69	105.72	1510.32	19.60	2.87	3.96:1[2]
2500 kcal	2475.51	93.98	473.67	89.33	40.86	5.78	10.43	194.31	1342.18	54.66	136.55	1845.14	24.81	3.52	3.34:1[2]

[1]Values based on calculated mean nutrient composition of each food group dervied from nutrient analysis of representative foods.

[2] Total (n-6)/(n-3) ratio listed as an overall diet ratio. Overall diet ratio determined by calculating the proportion of the total number of servings the recommended number of servings of each individual food group comprises, multiplying the food group-specific proportion values by the (n-6)/(n-3) ratio specific to each food group, summing these products, and lastly, dividing by the total number of food groups.

Two foods rich in zinc are dried apricots (13 mg zinc per ¼ cup serving) and raisins (8 mg zinc per ¼ cup serving). To go about formulating a recommendation for how frequently zinc-rich snacks should be consumed, the average contribution of zinc of the lacto-ovo-vegetarian diet at the 1500 kcal level and the zinc requirement of females was considered. Based on the updated recommendation, a vegetarian female requires 21 mg of zinc per day, or 147 mg of zinc per week. At the 1500 kcal level, the lacto-ovo-vegetarian diet provides an average of 15 mg of zinc per day, or 108 mg of zinc per week, creating a deficit of 39 mg of zinc per week. A ¼ cup serving of dried apricots or raisins provides an average of 10 mg of zinc, and thus a little under four servings of either of these dried fruits would need to be consumed throughout the week to ensure that zinc requirements are fully met. It is therefore recommended in the updated vegetarian food guide to snack on dried apricots or raisins four times per week to abet adequate zinc intake.

Development of Sample Menus

One-day sample menus were developed for the 1500 kcal meal plans for lacto-ovo-vegetarians and vegans (**Table 6**). The recommendation of snacking on raisins or dried apricots most days of the week was incorporated into these sample menus to illustrate how including these foods abets in the achievement of adequate zinc intake. Detailed nutritional breakdowns of the sample menus are provided in Appendix D (Table D1 and Table D2).

TABLE 6 Sample Lacto-Ovo-Vegetarian and Vegan Menus (1500-kcal Level)[1,2]

Lacto-ovo-vegetarian Menu	**Number of Servings and Food Group**
Breakfast	
½ cup fortified nonfat plain yogurt	½ dairy and eggs
8 large strawberries, sliced	1 fruit and dried fruit
½ cup lowfat granola[3]	2 grains
2 tablespoons flaxseed	1 nuts, nut butters, and seeds
1 cup fortified orange juice	1 fruit and dried fruit
1 cup black coffee	
1 cup water	
Snack	
3 cups popcorn	1 grain
1 cup water	
Lunch	
¼ cup lentils	1 beans and quinoa
½ cup quinoa	1 beans and quinoa
1 cup diced tomato	1 vegetable
2 cups raw spinach	1 leafy green vegetable
1 4" whole wheat pita	1 grain
1 cup water	
1 cup unsweetened iced tea	
Snack	
¼ cup dried apricots	1 fruit and dried fruit
1 cup water	
Dinner	
2 ounces fortified tofu, sautéed	1 soy and dairy substitutes
½ cup brown rice	1 grain
1 cup broccoli, sautéed	1 vegetable
1 cup bok choy, sautéed	1 leafy green vegetable
½ cup bell pepper, sautéed	½ vegetable
½ cup asparagus, sautéed	½ vegetable
1 cup water	
Snack	
1 cup bran Chex[3]	1 grain
½ cup skim milk	½ dairy and eggs
1 cup water	

Vegan Menu	**Number of Servings and Food Group**
Breakfast	
½ cup oatmeal	1 grain
1 large banana	1 fruit and dried fruit
2 tablespoons flaxseed	1 nuts, nut butters, and seeds
1 cup fortified orange juice	1 fruit and dried fruit
1 cup black coffee	
1 cup water	
Snack	
3 cups popcorn	1 grain
1 medium carrot	½ vegetable
½ cup celery	½ vegetable
1 cup water	
Lunch	
¼ cup black beans	1 beans and quinoa
¼ cup pinto beans	1 beans and quinoa
2 corn tortillas	2 grains
1 cup tomatoes, diced	1 vegetable
2 cups raw spinach	1 leafy green vegetable
1 cup unsweetened iced tea	
1 cup water	
Snack	
¼ cup dried apricots	1 fruit and dried fruit
1 cup water	
Dinner	
½ cup quinoa	1 beans and quinoa
½ cup barley	1 grain
1 cup portabella mushrooms, sautéed	1 vegetable
2 cups kale, sautéed	1 leafy green vegetable
2 cups Swiss chard, sautéed	1 leafy green vegetable
1 cup water	
Snack	
1 cup All Bran[3]	1 grain
1 cup fortified nonfat soy milk	1 soy and dairy substitutes
1 cup water	

[1] Individuals living outside of the United States may have difficulty obtaining adequate amounts of selenium from their diets due to the the fact that the soil in other countries tends to have less selenium. For these specific individuals, it is recommended that two Brazil nuts be consumed each day to ensure that selenium requirements are fulfilled.

[2] For indivudals who are unable to get at least 15 minutes of sun exposure twice a week, it is recommended that Vitamin D supplements be taken daily.

[3] May be substituted with a different breakfast cereal that is fortified with vitamin B-12 and iron.

Design of Updated Graphic

In updating the food guide's graphic, the format was changed from a pyramid graphic to a circular plate image to reflect the format of MyPlate. This newly designed graphic is called the Vegetarian Plate. The Vegetarian Plate graphic features a large plate divided into different colored sections to represent each of the food groups. Each section is brightly colored and is illustrated with representative foods specific to the food group and the recommended number of servings. A small plate representing recommendations for supplementary foods is featured beside the large plate. A water glass is used to illustrate fluid

recommendations, and a male and a female figure engaging in exercise are used to depict physical activity recommendations.

FIGURE 9 The Vegetarian Plate

Chapter 5

DISCUSSION

In the creation of the Vegetarian Plate, a scientific approach was used to address the potential nutrient inadequacies of lacto-ovo-vegetarian and vegan diets. Post-2002 scientific literature on the absorption, bioavailability, and digestibility of protein, vitamin B-12, zinc, iron, calcium, vitamin D, selenium, and omega-3 fatty acids was thoroughly examined to design meal plans that would address the potential nutrient shortcomings of lacto-ovo-vegetarian and vegan diets. The evidence-based approach utilized is the utmost important feature of the Vegetarian Plate, one that sets it apart from other vegetarian diet plans.

USDA's MyPlate, for example, addresses the needs of individuals following vegetarian diets by including soy products and other meat alternatives in the protein group. This recommendation fails to acknowledge the scientific evidence backing the fact such a simple substitution does not guarantee a nutritionally adequate vegetarian diet since protein is not the only nutrient of concern for lacto-ovo-vegetarians and vegans. Additionally, in recommending processed imitation meat products as a good protein source for vegetarians, MyPlate does not enforce the consumption of whole, unprocessed foods. The recommendations set forth by the Vegetarian Plate, however, show that lacto-ovo-vegetarians and vegans individuals can fully meet their nutrient needs through the consumption of whole, unprocessed foods.

Additionally, experts have pointed out numerous flaws of MyPlate, all of which are addressed in the Vegetarian Plate. One of the primary criticisms of

MyPlate is that serving sizes as well as recommended numbers of servings to consume are absent from the graphic. Instead, individuals must log on to the MyPlate.gov website to access this information. This is problematic since some people do not have Internet access. The Vegetarian Plate graphic features the recommended number of servings to consume daily from each food group, and serving sizes, as well as sample menus are included in the supplementary guide materials. These very specific recommendations provide lacto-ovo-vegetarians and vegans access to diet plans regardless of whether they have access to the Internet.

Whereas the sections of the MyPlate graphic feature only the names of the food groups, the sections of the Vegetarian Plate are illustrated with both the names of the food groups and graphics of foods representative of each group. This provides individuals a general idea of what constitutes a grain, leafy green vegetable, soy food, etc. without even having to refer to the supplementary guide materials. The MyPlate graphic features a drinking glass to the right of the plate, which is used to depict the dairy group. This aspect of the graphic fails to acknowledge that dairy products are not appropriate for all individuals, particularly those who are lactose intolerant or vegan, and also that not all dairy products come in a drinkable form.

The MyPlate graphic also does not depict any recommendations for drinking water or physical activity. As with the MyPlate graphic, the Vegetarian Plate graphic features a drinking glass, but this is used to depict water recommendations. Additionally, the Vegetarian Plate graphic features images of

male and female individuals engaging in physical activity, suggesting that lacto-ovo-vegetarians and vegans should partake in physical activity daily.

Potential Adverse Effects of Poorly Planned Vegetarian Diets

The spectrum of vegetarian individuals varies widely, with some choosing to consume soda, French fries, and macaroni and cheese daily (8), others sticking to vegan diet composed of strictly raw foods, and many consuming diets that fall somewhere in between. It is clear that certain approaches to vegetarianism do not always equate to a healthful, varied diet rich in whole, unprocessed foods, which is why adequate dietary planning is essential. Failing to properly plan a lacto-ovo-vegetarian or vegan diet will likely result in inadequate nutrient intakes and, over time, adverse health effects.

The population-based Farmingham Osteoporosis Study (90) found that lower protein intakes were significantly related to bone loss at femoral and spine sites ($p \leq 0.04$). More specifically, a low intake animal protein was significantly related to bone loss at femoral and spine bone mineral density sites ($p < 0.01$) (90). Other studies have reported that inadequate calcium intake is also significantly associated with an increased risk for vertebral fractures (91,92). In a case report of a 14-year old male cross-country runner who followed a strict vegan diet, it was found that this patient had bilateral femoral stress fractures, which are rarely seen in young athletes (93). In addition to the implementation of low-impact conditioning and stretching, treatment consisted of nutritional counseling to ensure that the patient was receiving adequate calcium and protein from his vegan diet, as physicians suspected that the patient's diet was inadequate prior to injury (93). While this particular patient

was expected to make a full recovery and safely return to his regular activity, much of this is attributed to his young age, implying that the case may not be the same for an adult (93).

In a case report of a 33-year-old vegan male who was referred to a physician for an evaluation of progressive vision loss, it was found that severe bilateral optic neuropathy with very poor vision (less than 20/400 in both eyes), central scotomata, dyschromatopsia, and atrophy of the optic disks were present (94). Additionally, upon neurologic examination, sensory peripheral neuropathy was found (94). Laboratory tests showed deficiencies in vitamins B-12, thiamin, A, C, D, and E, zinc, and selenium, which were all linked to the lack of eggs, dairy products, and other sources of animal protein in the patient's diet (94). It was thought that the deficiencies in vitamins B-12 and thiamin were primarily responsible for the nutritional optic neuropathy present (94). Daily administration of 1000 µg of intramuscular vitamin B-12 for one week resulted in the disappearance of the sensory neuropathy, but there was no recovery in vision (94).

Addressing the Recommendations Made in the Vegetarian Plate

Zinc and calcium. Even with the careful planning that went into developing the Vegetarian Plate there are still potential nutrient inadequacies. Although the Vegetarian Plate zinc intake for males averages 157% of the RDA and that for females averages 249% of the RDA, it averages only 69% and 95% of the calculated needs (for males and females, respectively) for vegetarian populations based on the scientific evidence. Additionally, while all of the diet plans except for the 1500-kcal vegan plan meet at least 100% of the RDA for

calcium for women ≤ 51 years of age and men ≤ 70 years of age, vegetarians (especially vegans) may have difficultly meeting the RDA for calcium on a daily basis. The potential zinc and calcium inadequacies are addressed in the Vegetarian Plate by the addition of supplementary foods to the diet. It is recommended that lacto-ovo-vegetarians and vegans snack on dried apricots or raisins four days of the week, as these two foods provide an average of 10 mg of zinc in a ¼ cup serving. It is recommended that these dried fruits be enjoyed as snacks instead of with meals because the bioavailablity of zinc is increased when food sources are consumed independently of other foods (16-20% vs. 60% bioavailability) (85,89). Potential calcium inadequacies are addressed in the Vegetarian Plate by the recommendation of consuming a medium sized orange, providing 74 mg calcium, once a week. This recommendation is especially important for vegans, since dairy products, which are good sources of calcium, are absent from their diets. To maximize the calcium content of vegan diets, the Vegetarian Plate three servings of green leafy vegetables in the 1500-, 2000-, and 2500-kcal vegan diet plans. Green leafy vegetables are bioavailable plant-based sources of calcium, with most varieties providing at least 100 mg of the mineral per serving. Consuming fortified dairy substitutes or fortified orange juice is another way by which vegans can increase the calcium contents of their diets. Strategies to abet adequate calcium and zinc status are exemplified in the sample lacto-ovo-vegetarian and vegan diet menus (Table 6).

Vitamin D. The Vegetarian Plate diet plans do not meet the RDA for vitamin D of 600 IU/day for adults <70 years of age. While some plant-based

foods are fortified with small amounts of vitamin D, the top sources of vitamin D are cod liver oil, swordfish, salmon, and tuna fish (67), and thus vegetarians are not likely to fulfill their vitamin D needs from diet alone. Studies suggest that vegetarians can abet adequate vitamin D status via sunlight exposure, which facilitates the conversion of custaneous 7-dehydrocholesterol to previtamin D_3, ultimately becoming vitamin D_3, which is stored in the liver and fat (67,70). As a part of the Vegetarian Plate, it is recommended that individuals get 15 minutes of sun exposure twice a week to ensure that vitamin D needs are met. It is important to consider that a number of factors such as time of day, cloud cover, and sunscreen usage can affect ultraviolet radiation exposure and subsequent vitamin D synthesis (3,67). If individuals are unable to get adequate sunlight exposure, the Vegetarian Plate recommends a dietary supplement to fulfill their vitamin D requirements.

It is noteworthy that mushrooms contain trace amounts of vitamin D (67). Similar to humans, mushrooms are capable of naturally producing vitamin D when exposed to sunlight or sunlamps, and mushroom growers therefore have the ability to increase the vitamin D content of these vegetables by exposing them to ultraviolet light (95). While a single serving of portabella mushrooms that have not been exposed to ultraviolet light contains approximately 8 IU of vitamin D, exposing this mushroom variety to ultraviolet light increases its vitamin D content to 375 IU (95). Different varieties of ultraviolet light-exposed mushrooms are beginning to hit the market, but they are not widely available at this time (67). As these ultraviolet light exposed mushrooms become more widespread in grocery stores, vegetarians will have

an option that will allow them to meet their vitamin D requirements solely through diet.

Importance of consuming fortified grains. When following the recommendations set forth in the Vegetarian Plate, it is important that individuals fulfill the suggested number of servings from the grains group through the consumption of fortified grains whenever possible, as they are key sources of vitamin B-12, iron, and selenium in these diet plans. Breakfast cereals are commonly fortified with a number of the vitamins and minerals that are essential to vegetarians, and it is therefore recommended that they be consumed on a regular basis to help to achieve adequate nutrient status. If fortified grains are not consumed, lacto-ovo-vegetarians may need to take vitamin B-12 and iron supplements to fulfill their requirements. Selenium requirements, on the other hand, may be met by consuming two Brazil nuts daily.

Caloric content of diet plans. With the exception of the 1500 kcal lacto-ovo-vegetarian diet plan, the number of calories provided by the diet plans in the Vegetarian Plate fall slightly short of the defined caloric levels. First, the calculated caloric content of each diet plan is based on mean values, and the actual amount of calories consumed by individuals following the diet plans will vary depending on the specific foods chosen to meet the recommended number of servings from each food group. While caloric content of the 1500 kcal lacto-ovo-vegetarian diet plan is 1516- kcal (Table 5), the sample 1500-kcal lacto-ovo-vegetarian menu provides 1431 kcal **(Table E1)**, showing that the actual number of calories consumed while following these diet plans will vary slightly

from day to day. Second, in the creation of the diet plans, the number of calories provided was intentionally kept slightly below the defined caloric levels to allow room for the use of cooking oils and condiments in the diets. It is recommended that condiments without large quantities of added fats and added sugars be selected. It is recommended that oils rich in omega-6 fatty acids not be used as primary cooking oils to ensure that the omega-3:omega-6 fatty acid ratio of the diet stays within the recommended 2:1-4:1 range. Oils that are rich in omega-6 fatty acids include safflower oil, grapeseed oil, sunflower oil, corn oil, cottonseed oil, and soybean oil (75). Flaxseed oil is the richest source of alpha-linolenic acid (0.28:1 omega-6:omega-3 fatty acid ratio), but it is not suitable for cooking because it is highly unstable and should not be heated (75). With an omega-6:omega-3 fatty acid ratio of 2:1, canola oil is an excellent cooking oil option (74,75).

Omega-3 fatty acids. In updating the 2002 Modified Food Guide Pyramid for Lactovegetarians and Vegans, the omega-3 fatty acids needs of vegetarians were addressed. Discussion exists over whether it is essential for vegetarians to consume and/supplement their diets with the long-chained omega-3 fatty acid, DHA, in order to achieve adequate omega-3 fatty acid status. Through a series of elongation and desaturation reactions, humans can convert the short-chained omega-3 fatty acid found in plants, ALA, to EPA and DHA, but it is important to note that vegetarian diets tend to be high in LA, an omega-6 fatty acid that competes with ALA for the same rate-limiting desaturase enzyme (75,77,78), hence the concern over whether a direct source of DHA is necessary.

Upon review of the scientific literature, it was concluded that consumption of long-chained omega-3 fatty acids is not necessary to ensure adequate omega-3 fatty acid status, but rather ingestion of the short-chained ALA can promote similar physiological benefits as the long-chained omega-3 fatty acids. In the Lyon Diet Heart Study, for example, 605 subjects who had just experienced their first myocardial infarction were randomly assigned to receive either instruction on modifying their diet to consume less saturated fats and greater amounts of foods high in ALA or no specific dietary instruction at all (96). During a mean 27-month follow-up, both total mortality and cardiovascular death were significantly reduced in the group of participants instructed to consume more ALA (HR: 0.30; 95% CI: 0.11, 0.82; p=0.02; and HR: 0.24; 95% CI: 0.07, 0.85; p=0.02, respectively) (96). Another study, the Indo-Mediterranean Diet Heart Study, randomly assigned 1000 patients to consume either a diet rich in ALA diet similar to the National Cholesterol Education Program Step-I diet (97). The ALA group consumed 1.8±0.4 grams of ALA each day, while the control group consumed 0.8±0.2 grams of ALA daily (97). At a two-year follow-up, total cardiac end points were found to be significantly fewer in the ALA group as compared to the control (39 vs. 76 events, $p<0.001$) (97). Sudden cardiac deaths and non-fatal myocardial infarctions were also reduced in the ALA group as compared to the control group (6 vs. 16, p=0.015; 21 vs. 43, $p<0.001$, respectively) (97). The results from these heart studies suggest that ALA is effective in decreasing cardiovascular disease risk.

In order to address the competition between LA and ALA and maximize the conversion of ALA to DHA and EHA, special attention was paid to ensuring that the omega-6:omega-3 fatty acid ratios in the diet plans in the Vegetarian Plate are within the recommended 2:1-4:1 range. Processed foods are abundant in omega-6 fatty acids, and it is therefore suggested that individuals following the recommendations set forth in the Vegetarian Plate minimize consumption of processed foods, instead filling their plates with a variety of whole foods. In addition to decreasing intake of omega-6 fatty acids, it is recommended that those following the Vegetarian Plate diet plans aim to consume foods that are good sources of ALA such as flaxseed (3.2 grams per 2 tablespoon serving), winter squash (1.9 grams per 1-cup serving), and walnuts (1.1 grams per 1-ounce serving).

Soy. While soy foods have been praised among the vegetarian population for their high protein content and versatility, controversy remains in the scientific literature regarding the protective value of soy towards heart disease, osteoporosis, and particularly cancer (3,98). Soybeans and the foods made from them are sources of isoflavones, which are which are naturally-occurring diphenolic compounds that act as both estrogen agonists and antagonists by differentially binding to estrogen α and β receptors and/or altering enzymes involved in hormonal metabolic pathways (98,99). While the typical diets of Asian individuals contain a daily average of 25 mg of soy isoflavones, usual American diets contain 1-3 mg of soy isoflavones per day (99). In Asian populations, whole foods such as tofu, miso, and natto account for 90% of the soy protein and isoflavone intake, whereas in Western

populations, much of the soy protein comes from processed soy products (98). Hsu et al. (99) investigated the effects of a whole food soy extract and the soy isoflavones, genistein and daidzein, on apoptosis in prostate cancer cells. After a 48-hour period, it was found that at equal concentrations (25μmol/L) soy extract exposure resulted a significantly higher percentage of cells undergoing apoptosis as compared to genistein or daidzein exposure ($p<0.001$) (99). These data exemplify the importance of whole foods as a soy source.

Genistein is abundant in soy protein isolate, a processed form of soy that is commonly found in energy bars, protein-based meal replacement powders, and dietary supplements (100,101). In a mouse study, Allred et. al (100) reported that genistein increased estrogen-dependent (MCF-7) breast tumor growth in a dose-dependent manner, with dosages of 150 ppm and 300 ppm causing the greatest amount of tumor cell proliferation. Similarly, another study found that when mice were xenografted estrogen-dependent breast tumors (MCF-7) were fed genistein at 750 ppm for 11 weeks, tumor growth and cellular proliferation significantly increased as compared to the control group of mice ($p<0.01$) (101). Following the 11-week period, genistein was removed from the mice's diet, and it was observed that tumor growth regressed and tumor size reduced 7-fold ($p<0.05$) over a span of 9 weeks (101).

Due to the controversy that remains over the potential benefits and risks of soy consumption, the decision was made to limit soy intake to one serving per day in the diet plans in the Vegetarian Plate, regardless of caloric level. Lacto-ovo-vegetarians may also choose to forgo consuming soy all together, instead opting to consume an extra serving of dairy in its place. The results

from the studies reviewed suggest that taking a whole food-based approach to consuming soy is favorable when it comes to cancer prevention (98,99). While tempeh, soynuts, and edamame retain all of the fiber and fatty acids found in the whole soybean, processed soy foods tend to be high in soy protein isolate and lack some of the nutrients that whole soy foods provide (98). With this in mind, the decision was made to eliminate processed soy foods (meatless burgers, meatless chicken, meatless deli slices, and meatless hot dogs) from the list of representative soy foods. Thus, the mean nutrient contribution from the soy and dairy substitutes group used to formulate the diet plans for the Vegetarian Plate is based on the nutrient composition of whole soy foods.

Limitations

Intended population. The recommendations set forth by the Vegetarian Plate are limited by the fact that they are intended for healthy, adult lacto-ovo-vegetarians and vegans under the age of 70. The caloric and nutrient requirements of vegetarian athletes may be greater depending on frequency, duration, and intensity of physical activity. Additionally, since nutritional needs increase during pregnancy and lactation, pregnant and lactating vegetarians may require additional calories and nutrients (e.g. iron) beyond what can be obtained by following the diet plans. Lastly, the diet plans in the Vegetarian Plate are not intended for children, nor are they intended to serve as therapeutic diet plans for those individuals with medical conditions or chronic diseases. It is recommended that athletes, pregnant and lactating women, children, and individuals with medical conditions wishing to follow a vegetarian

diet seek additional guidance from a health professional, such as a Registered Dietitian, to ensure that their nutrient requirements are appropriately met.

Nutrient analysis software. The creation of the diet plans in the Vegetarian Plate was limited by the information available from the ESHA Food Processor nutrient analysis software used. While the ESHA Food Processor database nutritional information on over 35,000 foods, some of the representative foods analyzed in the creation of the guidelines for the Vegetarian Plate were not found in the program, and thus, other sources had to be utilized. The specific foods for which nutrient information was obtained from a source other than ESHA Food Processor are: wheatberries, flaxseed, miso, fortified tofu, and soy plain yogurt. The sources of the nutritional information for these foods are listed as footnotes in **Tables B1, B5, and B8**. Additionally, for the foods in which nutritional information was obtained from the ESHA Food Processor database, values for specific nutrients were sometimes missing. This was particularly the case with the omega-3 fatty acid content of foods, and consequently the omega-6:omega-3 fatty acid ratio, as this information was not provided in the ESHA Food Processor database for a number of foods, particularly some of those in the soy and dairy substitutes group. Had the ESHA Food Processor database provided values for each nutrient of interest for every representative food analyzed, the mean nutrient contribution of each food group (Table 3) would have likely differed.

Chapter 6

CONCLUSION

The objective of this research was to update the 2002 Modified Food Guide Pyramid for lacto-ovo-vegetarians and vegans to include novel findings from post-2002 scientific literature regarding the bioavailability, digestibility, and absorbability of nutrients of primary concern in vegetarian diets: protein, vitamin B-12, iron, zinc, calcium, and vitamin D, selenium, and omega-3 fatty acids. Following a review of the scientific literature, it was determined that the DRI is appropriate for vegetarians for all nutrients with the exceptions of protein and zinc. In the updated version of the food guide, the Vegetarian Plate, it is recommended that vegetarians increase their protein intake to 125% of the DRI of 0.8 g/kg/d, amounting to 1 g/kg/d. It is also recommended in the Vegetarian Plate that male vegetarians increase their zinc intake to 263% of the RDA of 11 mg/d, amounting to 29 mg/d and that female vegetarians increase their zinc intake to 233% of the RDA of 9 mg/d, amounting to 21 mg/d. The Vegetarian Plate encourages individuals to supplement their diets with one serving of raisins or dried apricots most days of the week to achieve adequate zinc status.

For three nutrients, calcium, vitamin D and the omega 3 fatty acids, additional recommendations were made to assure nutrient adequacy. To address a potential calcium deficit, the Vegetarian Plate recommends that individuals supplement their diets with a medium sized orange once a week to contribute more calcium to the diet. A dietary supplement is recommended for those vegetarians who are unable to get 15 minutes of sun exposure two times per week to assure vitamin D adequacy. Finally, the Vegetarian Plate places

emphasis on maintaining the dietary omega-6:omega-3 fatty acid ratio within the 2:1-4:1 range by consuming whole, unprocessed foods and decreasing omega-6 fatty acid consumption while increasing omega-3 fatty acid consumption (in the form of ALA).

A new Vegetarian Plate graphic was developed to provide information regarding serving sizes from eight food groups, recommended number of servings to be consumed daily from each food group, and examples of foods in each food group. The Vegetarian Plate graphic also advocates adequate fluid consumption and physical activity. This updated, scientifically derived food guide provides a sound base for diet planning for lacto-ovo-vegetarians and vegans. The Vegetarian Plate takes a whole food approach to diet planning and demonstrates that nutrient needs can be met without the intake of processed foods or dietary supplements. Further research is needed to assess the Vegetarian Plate's adequacy for children, pregnant and lactating women, athletes, adults over 70 years of age, and individuals with medical conditions or chronic diseases.

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APPENDIX A

TABLES: NUTRIENT ANALYSIS OF REPRESENTATIVE FOODS IN ORIGINAL FOOD GROUPS

TABLE A1 Representative Foods in Original Food Groups

Food Group										
Grains	**Fruits**	**Dried Fruit**	**Vegetables**	**Green Leafy Vegetables**	**Nuts and Seeds**	**Nut Butters**	**Beans**	**Meat Substitutes**	**Dairy and Substitutes**	**Cheese**
Amaranth	Apple	Apple	Asparagus	Bok Choy	Almonds	Natural Smooth Almond Butter	Black	Cottage Cheese	Almond Milk	American
All Bran	Apple Juice	Apricot	Bell Pepper	Chinese Cabbage	Brazil Nuts	Natural Smooth Peanut Butter	Garbanzo	Egg	Enriched Rice Milk	Cheddar
Barley	Apricot	Cranberries	Broccoli	Collard Greens	Cashews		Great Northern	Egg Substitute	Fortified Soy Milk	Feta
Bran Chex	Avacado	Dates	Brussels Sprouts	Kale	Flaxseed		Kidney	Egg Whites	Low Fat Milk	Goat
Brown Rice	Banana	Figs	Carrots	Mustard Greens	Hazelnuts		Lentils	Nonfat Greek Yogurt	Nonfat Soy Milk	Mozzarella
Bulgur Wheat	Blueberries	Mango	Cauliflower	Spinach	Macadamia Nuts		Lima	Meatless Burger	Rice Milk	Munster
Cherrios	Cantaloupe	Pineapple	Celery	Swiss Chard	Peanuts		Navy	Meatless Chicken	Skim Milk	Provolone
Corn Flakes	Grapefruit	Prunes	Corn	Turnip Greens	Pecans		Pinto	Meatless Deli Slices	Low Fat Fruited Yogurt	Swiss
Corn Grits	Grapes	Raisins	Cucumber		Pine Nuts		Refried	Meatless Hot Dog	Nonfat Fruited Yogurt	
Corn Tortilla	Honeydew		Green Beans		Pistashios		Soybeans	Miso	Plain Yogurt	
Cous Cous	Kiwi		Iceberg Lettuce		Pumpkin Seed Kernels		White/Cannellini	Quinoa	Soy Yogurt	
Cream of Wheat	Nectariane		Leaf Lettuce		Sesame Seeds			Seitan		
English Muffin	Orange		Onion		Sunflower Seed Kernels			Tempeh		
Faro	Orange Juice		Portabella Mushroom		Tahini			Tofu		
Flour Tortilla	Peach		Summer Squash		Walnuts					
Graham Crackers	Pear		Sweet Potato		Wheat Germ					
Granola	Pineapple		Tomato							
Grape Nuts	Plum									
Millet	Pomegranate									
Multigrain Bread	Strawberries									
Oatmeal	Raspberries									
Pasta	Watermelon									
Pita										
Plain Bagel										
Popcorn										
Raisin Bran										
Raisin Bread										
Rye Bread										
Saltines										
Shredded Wheat										
Wheatberries										
White Bread										
White Rice										
WW Bread[1]										
WW Crackers[1]										
WW English Muffin[1]										
WW Pasta[1]										
WW Pita[1]										
WW Tortilla[1]										

[1]WW= whole wheat.

TABLE A2 Original Nutrient Analysis- Grains[1]

Representative Food	Serving Size[2]	Weight (g)	Energy (kcal)	Protein (g)	Carbohyrates (g)	Fiber (g)	Total Fat (g)	Saturated Fat (g)	Vitamin B-12 (µg)	Vitamin D (IU)	Calcium (mg)	Iron (mg)	Selenium (µg)	Sodium (mg)	Zinc (mg)	Omega-3 Fatty Acids (g)	(n-6)/(n-3) Ratio
Amaranth	1/2 cup cooked	123.00	125.46	4.67	22.99	2.58	1.94	-	-	-	57.81	2.58	6.77	7.38	1.06	-	-
All Bran	1 cup	62.00	161.20	8.15	46.03	18.17	3.04	0.39	11.66	79.98	241.18	10.91	5.83	161.20	7.69	0.09	13.07
Barley	1/2 cup cooked	78.50	96.56	1.77	22.15	2.98	0.35	0.07	0.00	0.00	8.64	1.04	6.75	2.36	0.64	0.02	9.50
Bran Chex	1 cup	62.67	205.66	4.33	52.71	7.59	1.62	0.30	2.00	53.30	133.55	21.61	4.95	353.63	5.00	0.03	20.50
Brown Rice	1/2 cup cooked	97.50	109.20	2.26	22.92	1.76	0.81	0.17	0.00	0.00	9.75	0.52		0.98	0.60	0.01	28.00
Bulgur Wheat	1/2 cup cooked	91.00	75.53	2.74	16.91	4.10	0.22	0.04	0.00	0.00	9.10	0.87	0.55	4.55	0.52	0.00	0.00
Cheerios	1 cup	28.00	102.76	3.17	20.91	2.83	1.65	0.27	1.74	40.04	114.24	8.90	7.98	159.88	4.44	0.03	20.89
Corn Flakes	1 cup	28.00	101.08	1.85	24.39	0.70	0.17	0.05	2.65	1.01	1.12	8.12	2.32	202.44	0.05	0.01	13.50
Corn Grits	1 packet	28.00	100.52	2.05	21.29	1.18	0.60	0.10	0.00	0.00	105.84	10.85	4.79	294.00	0.18	0.01	31.33
Corn Tortilla	1 6-inch	15.00	35.00	0.50	7.50	0.50	0.50	0.00	-	-	-	-	-	2.50	-	-	-
Cous Cous	1/2 cup cooked	78.50	87.92	2.98	18.31	1.10	0.13	0.02	0.00	0.00	6.28	0.30	21.59	3.93	0.20	0.00	0.00
Cream of Wheat	1/2 cup cooked	125.50	62.75	1.81	13.20	0.63	0.26	0.04	0.00	0.00	109.19	4.69	3.51	7.53	0.16	0.01	10.00
English Muffin	1/2 muffin	28.50	66.12	2.28	13.11	-	0.51	0.09	-	-	51.30	0.40	-	98.33	-	0.02	10.50
Flour Tortilla	1 6-inch	30.00	93.60	2.49	15.41	0.93	2.33	0.57	0.00	0.00	38.70	1.00	6.66	190.80	0.16	0.02	25.33
Granola (low fat)	1/4 cup	24.50	94.82	1.96	19.97	1.49	1.27	0.32	2.99	20.09	9.56	0.91	4.24	53.66	1.89	0.01	55.67
Grape Nuts	1/2 cup	58.00	208.22	7.24	46.46	5.10	1.07	0.18	3.67	40.02	22.62	22.07	5.28	290.00	3.22	3.48	13.50
Millet	1/2 cup cooked	87.00	103.53	3.05	20.59	1.13	0.87	0.15	0.00	0.00	2.61	0.55	0.78	1.74	0.79	0.03	16.00
Multigrain Bread	1 slice		120.00	4.00	22.00	2.00	1.50	0.00			100.00	1.44	-	150.00	-	-	-
Oatmeal	1/2 cup	40.00	148.40	5.48	27.27	3.76	2.75	0.44	0.00	0.00	18.80	1.86	13.60	1.20	1.28	0.04	22.00
Pasta	1/2 cup cooked	70.00	110.60	4.06	21.60	1.26	0.65	0.13	0.00	0.00	4.90	0.90	18.48	0.70	0.36	0.01	15.00
Pita	4"	28.00	77.00	2.55	15.60	0.62	0.34	0.05	0.00	0.00	24.08	0.73	7.59	150.08	0.24	0.01	25.50
Plain Bagel	1 mini	26.00	71.50	2.73	13.88	0.60	0.42	0.06	0.00		4.68	0.93	-	138.84	0.23	0.01	16.50
Popcorn (low fat)	3 c, popped	24.00	101.76	3.02	17.28	3.41	2.28	0.34	0.00	0.00	2.64	0.55	2.06	212.16	0.92	0.06	0.80
Raisin Bran	1 cup	59.00	189.98	5.07	45.64	6.55	1.29	0.21	3.02	40.12	27.73	7.53	2.12	250.75	2.05	0.04	11.17
Raisin Bread	1 slice	26.00	71.24	2.05	13.60	1.12	1.14	0.28	0.00	0.00	17.16	1.91	5.20	81.38	0.19	0.01	16.00
Rye Bread	1 slice	32.00	82.56	2.72	15.46	1.86	1.06	0.20	0.00	0.00	23.36	0.91	9.89	211.20	0.36	0.02	12.33
Shredded Wheat	1 cup	49.00	168.07	5.43	39.17	5.68	0.97	0.20	0.00	0.00	22.05	1.61	-	1.96	1.23	-	-
Wheatberries[3]	1/2 cup cooked	45.00	150.00	6.00	32.00	6.00	0.50	0.00	-	-	20.00	1.44	-	0.00	-	-	-
Wheat Thins	7 crackers	-	65.63	1.31	9.19	0.44	2.63	0.44	-	-	8.75	0.47	-	122.50	-	-	-
White Bread	1 slice	25.00	66.50	1.91	12.65	0.60	0.82	0.18	0.00	0.00	37.75	0.94	4.33	127.75	0.19	0.04	8.71
White Rice	1/2 cup cooked	79.00	102.70	2.13	22.25	0.32	0.22	0.02	0.00	0.00	7.90	0.95	5.93	0.79	0.39	0.01	6.00
WW Bread[4]	1 slice	28.00	69.16	3.63	11.56	1.90	0.94	0.21	0.00	0.00	29.96	0.68	11.28	132.16	0.50	0.02	9.00
WW Crackers[4]	5 crackers	23.00	98.21	2.43	16.00	2.37	3.25	0.47	0.00	0.00	8.28	0.77	2.32	161.92	0.60	0.19	7.26
WW English Muffin[4]	1/2 muffin	33.00	66.99	2.90	9.29	2.21	0.48	0.11	0.00	0.00	87.45	0.81	13.30	120.12	0.53	0.02	15.80
WW Pasta[4]	1/2 cup cooked	70.00	86.80	3.73	18.58	3.15	0.38	0.07	0.00	0.00	10.50	0.74	18.13	2.10	0.57	0.01	20.00
WW Pita[4]	4"	28.00	74.48	2.74	15.40	2.07	0.73	0.11	0.00	0.00	4.20	0.86	12.32	148.96	0.43	0.01	20.00
WW Tortilla[4]	1 each	45.00	130.00	4.00	22.00	3.00	3.50	1.00	-	-	-	-	-	320.00	-	-	-

[1] All data obtained from Food Processor unless otherwise noted.

[2] Based on standard USDA serving sizes.

[3] Nutrient data obtained from http://www.bobsredmill.com/hard-red-wheat-berries.html.

[4] WW= whole wheat.

TABLE A3 Original Nutrient Analysis- Fruit[1]

Representative Food	Serving Size[2]	Weight (g)	Energy (kcal)	Protein (g)	Carbohyrates (g)	Fiber (g)	Total Fat (g)	Saturated Fat (g)	Vitamin B-12 (µg)	Vitamin D (IU)	Calcium (mg)	Iron (mg)	Selenium (µg)	Sodium (mg)	Zinc (mg)	Omega-3 Fatty Acids (g)	(n-6)/(n-3) Ratio
Apple	1 small	149.00	77.48	0.39	20.58	3.58	0.25	0.04	0.00	0.00	8.94	0.18	0.00	1.49	0.06	0.01	4.00
Apple Juice	1 cup	-	110	0.00	29.00	0.00	0.00	0.00	-	-	-	-	-	10.00	-	-	-
Apricot	3 each	105.00	50.4	1.47	11.68	2.08	0.41	0.03	0.00	0.00	13.65	0.41	0.11	1.05	2.10	0.00	0.00
Avocado	1/2 avocado	100.00	160	2.00	8.53	6.70	14.66	2.13	0.00	0.00	12.00	0.55	0.40	7.00	0.64	0.13	12.85
Banana	1 large	136.00	121.04	1.48	31.06	3.54	0.45	0.15	0.00	0.00	6.80	0.35	1.36	1.36	0.20	0.04	1.67
Blueberries	1 cup	148.00	84.36	1.10	21.45	3.55	0.49	0.04	0.00	0.00	8.88	0.41	0.15	1.48	0.24	0.09	1.50
Cantaloupe	1 cup diced	156.00	53.04	1.31	12.73	1.31	0.30	0.08	0.00	0.00	14.04	0.33	0.62	24.96	0.28	0.08	0.80
Grapefruit	1 medium	246.00	78.72	1.55	19.88	2.71	0.25	0.02	0.00	0.00	29.52	0.22	0.74	0.00	0.17	0.02	2.00
Grapes	1 cup	151.00	104.19	1.09	27.33	1.36	0.24	0.08	0.00	0.00	15.10	0.54	0.15	3.02	0.11	0.02	4.00
Honeydew	1 cup diced	170.00	61.2	0.92	15.45	1.36	0.24	0.07	0.00	0.00	10.20	0.29	1.19	30.60	0.15	0.05	1.00
Kiwi	2 each	138.00	84.18	1.57	20.23	4.14	0.72	0.04	0.00	0.00	46.92	0.43	0.28	4.14	0.19	0.06	6.25
Nectariane	1 medium	156.00	68.64	1.65	0.50	2.65	0.50	0.05	0.00	0.00	9.36	0.44	0.00	0.00	0.27	0.00	0.00
Orange	1 3 1/16 inch	184.00	86.48	1.73	21.62	4.42	0.22	0.04	0.00	0.00	73.60	0.18	0.92	0.00	0.13	0.02	2.00
Orange Juice	1 cup		120	1.00	28.00	0.00	0.00	0.00	-	-	20.00	0.00	-	25.00	-	0.00	0.00
Peach	1 2 3/4 inch	-	70.3794	1.64	17.22	2.62	0.45	0.04	0.00	0.00	10.83	0.45	0.18	0.00	0.31	0.00	0.00
Pear	1 medium	178.00	103.24	0.68	27.52	5.52	0.21	0.02	0.00	0.00	16.02	0.30	0.18	1.78	0.18	0.00	0.00
Pineapple	1 cup chunks	165.00	74.25	0.91	19.50	-	0.21	-	-	0.00	21.45	0.41	0.00	1.65	0.13	-	-
Plum	1 cup slices	165.00	75.9	1.16	18.84	2.31	0.46	0.03	0.00	0.00	9.90	0.28	0.00	0.00	0.17	0.00	0.00
Pomegranate	1 4 inch	275.00	228.25	4.59	51.43	11.00	3.22	0.33	0.00	0.00	27.50	0.83	1.38	8.25	0.96	0.00	0.00
Strawberries	8 large	147.00	47.04	0.98	11.29	2.94	0.44	0.03	0.00	0.00	23.52	0.60	0.59	1.47	0.21	0.10	1.29
Raspberries	1 cup	123.00	63.96	1.48	14.69	8.00	0.80	0.02	0.00	0.00	30.75	0.85	0.25	1.23	0.52	0.16	1.92
Watermelon	1 cup diced	152.00	45.6	0.93	11.48	0.61	0.23	0.03	0.00	0.00	10.64	0.36	0.61	1.52	0.15	0.00	0.00

TABLE A4 Original Nutrient Analysis- Dried Fruit[1]

Representative Food	Serving Size[2]	Weight (g)	Energy (kcal)	Protein (g)	Carbohyrates (g)	Fiber (g)	Total Fat (g)	Saturated Fat (g)	Vitamin B-12 (µg)	Vitamin D (IU)	Calcium (mg)	Iron (mg)	Selenium (µg)	Sodium (mg)	Zinc (mg)	Omega-3 Fatty Acids (g)	(n-6)/(n-3) Ratio
Apple	1/2 cup	43.00	104.49	0.40	28.33	3.74	0.14	0.02	0.00	0.00	6.02	0.60	0.56	37.41	0.09	0.01	4.00
Apricot	1/2 cup	65.00	154.24	2.20	40.72	4.75	0.33	0.01	0.00	0.00	35.75	1.73	1.43	6.50	25.35	0.00	0.00
Cranberries	1/2 cup	60.00	184.80	0.04	49.42	3.42	0.82	0.06	0.00	0.00	6.00	0.32	0.83	1.80	0.07	0.02	21.00
Dates	1/2 cup	80.00	229.60	2.96	58.88	-	0.88	-	0.00	-	63.20	1.44	-	7.20	0.15	-	-
Figs	1/2 cup	74.50	185.51	2.46	47.58	7.30	0.69	0.10	0.00	0.00	120.69	1.51	0.45	7.45	0.41	0.00	0.00
Mango	1/2 cup	60.00	210.00	0.00	51.00	1.50	0.00	0.00	0.00	-	120.00	0.54	-	30.00	-	0.00	0.00
Pineapple	1/2 cup	60.00	195.00	0.00	51.00	1.50	0.00	0.00	0.00	-	30.00	0.00	-	30.00	-	0.00	0.00
Prunes	1/2 cup	87.00	208.80	1.90	55.58	6.18	0.33	0.08	0.00	0.00	37.41	0.81	0.26	1.74	0.38	0.02	2.00
Raisins	1/2 cup	72.50	216.78	2.23	57.41	2.68	0.33	0.04	0.00	0.00	36.25	1.36	0.44	7.98	15.95	0.01	3.00

[1] All data obtained from Food Processor unless otherwise noted.

[2] Based on standard USDA serving sizes.

TABLE A5 Original Nutrient Analysis- Vegetables[1]

Representative Food	Serving Size[2]	Weight (g)	Energy (kcal)	Protein (g)	Carbohyrates (g)	Fiber (g)	Total Fat (g)	Saturated Fat (g)	Vitamin B-12 (µg)	Vitamin D (IU)	Calcium (mg)	Iron (mg)	Selenium (µg)	Sodium (mg)	Zinc (mg)	Omega-3 Fatty Acids (g)	(n-6)/(n-3) Ratio
Asparagus	1 cup	242.00	53.24	5.81	9.95	4.84	0.53	0.12	0.00	0.00	55.66	2.20	14.76	33.88	1.45	0.07	2.67
Bell Pepper	1 cup	149.00	29.80	1.28	6.65	2.53	0.25	0.09	0.00	0.00	14.90	0.51	0.00	4.47	0.19	0.01	5.00
Broccoli	1 cup	71.00	19.88	2.12	3.72	2.13	0.25	0.04	0.00	0.00	34.08	0.62	2.13	19.17	0.28	0.13	0.31
Brussels Sprouts	1 cup	88.00	37.84	2.97	7.88	3.34	0.26	0.05	0.00	0.00	36.96	1.23	1.41	22.00	0.37	0.10	0.50
Carrots	2 medium	122.00	50.02	1.13	11.69	3.42	0.29	0.05	0.00	0.00	40.26	0.37	0.12	84.18	0.29	0.00	0.00
Cauliflower	1 cup	107.00	26.75	2.05	5.32	2.14	0.30	0.06	0.00	0.00	23.54	0.45	0.64	32.10	0.29	0.01	1.00
Celery	1 cup	100.00	16.00	0.69	2.97	1.39	0.17	0.04	0.00	0.00	40.00	0.20	0.40	80.00	0.13	0.00	0.00
Corn	1 large ear	143.00	122.98	4.68	26.74	2.86	1.93	0.47	0.00	0.00	2.86	0.74	0.86	21.45	0.66	0.01	47.00
Cucumber	1 cup	104.00	15.60	0.68	3.49	0.52	0.11	0.04	0.00	0.00	16.64	0.29	0.31	2.08	0.21	0.00	0.00
Green Beans	1 cup	100.00	31.00	1.83	6.97	2.70	0.22	0.05	0.00	0.00	37.00	1.03	0.60	6.00	0.24	0.07	0.57
Iceberg Lettuce	2 cup	133.34	20.00	1.33	4.00	1.33	0.00	0.00	-	-	0.00	0.00	-	13.33	-	0.00	0.00
Leaf Lettuce	2 cup	72.00	10.80	0.98	2.07	0.94	0.11	0.01	0.00	0.00	25.92	0.62	0.43	20.16	0.13	0.06	0.33
Onion	1 cup	160.00	64.00	1.76	14.94	2.72	0.16	0.06	0.00	0.00	36.80	0.34	0.80	6.40	0.27	0.00	0.00
Portabella Mushroom	1 cup	86.00	18.92	1.81	3.33	1.12	0.30	0.05	0.04	8.60	2.58	0.27	16.00	7.74	0.46	0.00	0.00
Potato	1 cup	75.00	57.75	1.52	13.10	1.65	0.07	0.02	0.00	0.00	9.00	0.59	0.23	4.50	0.22	0.01	3.00
Summer Squash	1 cup	113.00	18.08	1.37	3.79	1.24	0.20	0.05	0.00	0.00	16.95	0.40	0.23	2.26	0.33	0.06	0.50
Sweet Potato	1 cup	133.00	114.38	2.09	26.76	3.99	0.07	0.03	0.00	0.00	39.90	0.81	0.80	73.15	0.40	0.00	0.00
Tomato	1 cup	180.00	32.40	1.58	7.00	2.16	0.36	0.05	0.00	0.00	18.00	0.49	0.00	9.00	0.31	0.00	0.00

[1] All data obtained from Food Processor unless otherwise noted.

[2] Based on standard USDA serving sizes.

TABLE A6 Original Nutrient Analysis- Leafy, Green Vegetables[1]

Representative Food	Serving Size[2]	Weight (g)	Energy (kcal)	Protein (g)	Carbohyrates (g)	Fiber (g)	Total Fat (g)	Saturated Fat (g)	Vitamin B-12 (µg)	Vitamin D (IU)	Calcium (mg)	Iron (mg)	Selenium (µg)	Sodium (mg)	Zinc (mg)	Omega-3 Fatty Acids (g)	(n-6)/(n-3) Ratio
Bok Choy	1 cup cooked	170.00	20.40	2.65	3.03	1.65	0.27	0.03	0.00	0.00	158.10	1.77	0.68	57.80	0.29	0.07	0.75
Chinese Cabbage	2 cups raw	140.00	18.20	2.10	3.05	1.40	0.28	0.04	0.00	0.00	147.00	1.12	0.70	91.00	0.27	0.07	0.80
Collard Greens	2 cups raw	72.00	21.60	1.76	4.29	2.59	0.30	0.04	0.00	0.00	104.40	0.14	0.94	14.40	0.09	0.08	0.73
Kale	2 cups raw	134.00	67.00	4.42	13.40	2.68	0.94	0.12	0.00	0.00	180.90	2.28	1.21	57.62	0.59	0.24	0.78
Mustard Greens	2 cups raw	112.00	29.12	3.02	5.49	3.70	0.22	0.01	0.00	0.00	115.36	1.64	1.01	28.00	0.13	0.02	1.00
Spinach	2 cups raw	60.00	13.80	1.72	2.18	1.32	0.23	0.04	0.00	0.00	59.40	1.63	0.60	47.40	0.32	0.08	0.21
Swiss Chard	2 cups raw	72.00	13.68	1.30	2.69	1.15	0.14	0.02	0.00	0.00	36.72	1.30	0.65	153.36	0.26	0.01	6.00
Turnip Greens	2 cups raw	110.00	35.20	1.65	7.84	3.52	0.33	0.08	0.00	0.00	209.00	1.21	1.32	44.00	0.21	0.09	0.50

[1] All data obtained from Food Processor unless otherwise noted.

[2] Based on standard USDA serving sizes.

TABLE A7 Original Nutrient Analysis- Nuts and Seeds[1]

Representative Food	Serving Size[2]	Weight (g)	Energy (kcal)	Protein (g)	Carbohyrates (g)	Fiber (g)	Total Fat (g)	Saturated Fat (g)	Vitamin B-12 (µg)	Vitamin D (IU)	Calcium (mg)	Iron (mg)	Selenium (µg)	Sodium (mg)	Zinc (mg)	Omega-3 Fatty Acids (g)	(n-6)/(n-3) Ratio
Almonds	1 oz	17.25	102.64	3.73	3.66	1.88	8.98	0.70	0.00	0.00	47.61	0.66	0.40	0.52	0.57	0.00	1299.00
Brazil Nuts	1 oz	16.63	109.06	2.38	2.04	1.25	11.04	2.52	0.00	0.00	26.60	0.40	318.70	0.50	0.67	0.01	513.50
Cashews	1 oz	17.13	98.30	2.62	5.60	0.51	7.94	1.57	0.00	0.00	7.71	1.03	2.00	2.74	0.96	0.03	47.88
Flaxseed[3]	2 tbsp	14.00	74.76	2.56	4.04	3.82	5.90	0.51	0.00	0.00	35.70	0.80	3.56	4.20	0.61	3.19	0.26
Hazelnuts	1 oz	18.00	100.98	2.71	3.17	1.69	11.23	0.81	0.00	0.00	22.14	0.79	0.74	0.00	0.45	0.01	140.00
Macadamia Nuts	1 oz	16.50	118.47	1.29	2.21	1.32	12.55	1.97	0.00	0.00	11.55	0.44	1.93	0.66	0.21	0.03	6.50
Peanuts	1 oz	18.25	106.76	4.32	3.93	1.46	9.06	1.26	0.00	0.00	9.86	0.41	1.37	1.10	0.60	0.00	0.00
Pecans	1 oz	12.38	87.86	1.18	1.68	1.16	9.19	0.78	0.00	0.00	8.91	0.35	0.50	0.12	0.63	0.12	19.78
Pine Nuts	1 oz	16.88	113.57	2.31	2.21	0.62	11.54	0.83	0.00	0.00	2.70	0.93	0.12	0.34	1.09	0.03	207.19
Pistachios	1 oz	15.38	87.18	3.22	4.52	1.52	6.89	0.84	0.00	0.00	16.45	0.62	1.54	0.92	0.36	0.04	55.04
Pumpkin Seed Kernels	1 oz	14.75	65.11	4.40	2.17	0.96	7.23	1.26	0.00	0.00	7.67	1.19	1.39	2.66	1.13	0.02	179.18
Sunflower Seed Kernels	1 oz	16.00	93.12	3.09	3.85	1.78	7.97	0.84	0.00	0.00	11.20	0.61	12.69	0.48	0.85	0.01	468.29
Tahini	1 oz	15.00	88.80	2.61	3.23	0.71	7.95	1.11	0.00	0.00	21.15	0.66	5.16	5.25	0.69	0.06	57.03
Walnuts	1 oz	12.50	81.75	1.90	1.71	0.84	8.14	0.77	0.00	0.00	12.25	0.36	0.61	0.25	0.39	1.14	4.19
Wheat Germ	1 oz	15.00	59.00	4.00	7.00	3.00	1.50	0.00	-	-	0.00	1.08	-	2.00	1.50	-	-

[1] All data obtained from Food Processor unless otherwise noted.

[2] Based on standard USDA serving sizes.

[3] Nutrient data obtained from http://whfoods.org/genpage.php?tname=nutrientprofile&dbid=57.

TABLE A8 Original Nutrient Analysis- Nut Butters[1]

Representative Food	Serving Size[2]	Weight (g)	Energy (kcal)	Protein (g)	Carbohyrates (g)	Fiber (g)	Total Fat (g)	Saturated Fat (g)	Vitamin B-12 (µg)	Vitamin D (IU)	Calcium (mg)	Iron (mg)	Selenium (µg)	Sodium (mg)	Zinc (mg)	Omega-3 Fatty Acids (g)	(n-6)/(n-3) Ratio
Natural Smooth Almond Butter	2 tbsp	32.00	196.48	6.71	6.02	3.30	17.76	1.33	0.00	0.00	111.04	1.12	0.77	0.00	1.05	0.00	1361.00
Natural Smooth Peanut Butter	2 tbsp	32.00	188.16	8.03	6.26	1.92	16.12	3.36	0.00	0.00	13.76	0.60	1.79	0.00	0.93	0.03	176.00

[1] All data obtained from Food Processor unless otherwise noted.

[2] Based on standard USDA serving sizes.

TABLE A9 Original Nutrient Analysis- Beans[1]

Representative Food	Serving Size[2]	Weight (g)	Energy (kcal)	Protein (g)	Carbohyrates (g)	Fiber (g)	Total Fat (g)	Saturated Fat (g)	Vitamin B-12 (µg)	Vitamin D (IU)	Calcium (mg)	Iron (mg)	Selenium (µg)	Sodium (mg)	Zinc (mg)	Omega-3 Fatty Acids (g)	(n-6)/(n-3) Ratio
Black Beans	1/4 cup	43.00	56.76	3.81	10.20	3.74	0.23	0.06	0.00	0.00	11.61	0.90	0.52	0.43	0.48	0.05	1.18
Garbanzo Beans	1/4 cup	41.00	67.24	3.63	11.24	3.12	1.06	0.11	0.00	0.00	20.09	1.18	1.52	2.87	0.63	0.02	27.75
Kidney Beans	1/4 cup	44.25	56.20	3.84	10.09	2.83	0.22	0.03	0.00	0.00	15.49	0.98	0.49	0.44	0.44	0.08	0.65
Lentils	1/4 cup	49.50	57.42	4.46	9.96	3.91	0.19	0.02	0.00	0.00	9.41	1.65	1.39	0.99	0.63	0.02	3.50
Lima Beans	1/4 cup	45.50	57.33	3.66	10.61	3.43	0.17	0.04	0.00	0.00	12.91	1.07	2.18	1.34	0.46	0.02	2.40
Navy Beans	1/4 cup	45.50	63.70	3.74	11.85	4.78	0.28	0.04	0.00	0.00	31.40	1.07	1.32	0.00	0.47	0.08	0.78
Pinto Beans	1/4 cup	42.75	61.13	3.85	11.21	3.85	0.28	0.06	0.00	0.00	19.67	0.89	2.65	0.43	0.42	0.06	0.71
Refried Beans	1/4 cup	59.50	54.15	3.22	9.08	3.03	0.70	0.23	0.00	0.00	19.64	0.99	3.87	267.16	0.39	0.08	1.54
Soybeans	1/4 cup	38.75	47.28	4.22	3.85	2.02	2.02	0.24	0.00	0.00	24.41	0.88	-	2.33	0.53	0.14	4.97
White/Cannellini Beans	1/4 cup	44.75	62.20	4.35	11.23	2.82	0.16	0.04	0.00	0.00	40.28	1.66	0.58	2.69	0.58	0.03	1.14

[1] All data obtained from Food Processor unless otherwise noted.

[2] Based on standard USDA serving sizes.

TABLE A10 Original Nutrient Analysis- Meat Substitutes[1]

Representative Food	Serving Size[2]	Weight (g)	Energy (kcal)	Protein (g)	Carbohyrates (g)	Fiber (g)	Total Fat (g)	Saturated Fat (g)	Vitamin B-12 (µg)	Vitamin D (IU)	Calcium (mg)	Iron (mg)	Selenium (µg)	Sodium (mg)	Zinc (mg)	Omega-3 Fatty Acids (g)	(n-6)/(n-3) Ratio
Egg	1 each	56.00	80.08	7.03	0.40	0.00	5.33	1.75	0.50	45.92	31.36	0.98	17.19	79.52	0.72	0.06	15.82
Egg Substitute	1/4 cup	60.00	28.80	6.00	1.20	0.00	0.00	0.00	0.20	39.60	43.80	1.19	24.78	119.40	0.59	0.00	0.00
Egg Whites	1/4 cup	60.75	31.59	6.62	0.44	0.00	0.10	-	0.05	0.00	4.25	0.05	12.15	100.85	0.02	-	-
Meatless Burger	1/2 burger	35.50	47.93	1.63	8.63	2.59	1.31	0.14	-	-	11.72	0.46	-	188.15	0.11	-	-
Meatless Chicken	1/2 patty	37.50	55.00	7.50	3.00	1.00	1.40	0.00	0.60	-	40.00	1.80	-	140.00	1.50	-	-
Meatless Deli Slices	1 oz	28.42	54.64	7.10	3.28	1.64	1.64	0.00	-	0.00	10.93	0.59	-	163.93	-	-	-
Meatless Hot Dog	1 oz	28.13	50.00	6.88	3.13	1.88	1.25	0.00	-	0.00	12.50	0.45	-	243.75	-	-	-
Miso[3]	2 tbsp	34.38	68.40	4.02	9.10	1.86	2.06	0.40	0.02	0.00	19.60	0.86	2.40	1281.50	0.88	0.16	5.88
Quinoa	1/2 cup	92.50	111.00	4.07	19.70	2.59	1.78	-	0.00	-	15.73	1.38	2.59	6.48	1.01	-	-
Seitan[4]	1 oz	-	40.00	7.00	1.33	0.33	0.67	0.00	-	-	6.67	0.48	-	106.67	-	-	-
Tempeh	1 oz	28.60	56.00	5.20	2.67	-	3.25	0.97	0.04	0.00	27.43	0.61	0.00	4.00	0.45	0.03	21.00
Tofu	2 oz	56.67	47.60	5.04	1.30	0.45	2.49	0.28	-	-	70.83	0.68	-	2.27	-	-	-

[1] All data obtained from Food Processor unless otherwise noted.

[2] Based on standard USDA serving sizes.

[3] Nutrient data obtained from http://www.whfoods.com/genpage.php?tname=nutrientprofile&dbid=37.

[4] Nutrient data obtained from http://www.westsoytofu.com/products/detail.html/seitan/seitan-strips.

TABLE A11 Original Nutrient Analysis- Dairy and Substitutes[1]

Representative Food	Serving Size[2]	Weight (g)	Energy (kcal)	Protein (g)	Carbohyrates (g)	Fiber (g)	Total Fat (g)	Saturated Fat (g)	Vitamin B-12 (µg)	Vitamin D (IU)	Calcium (mg)	Iron (mg)	Selenium (µg)	Sodium (mg)	Zinc (mg)	Omega-3 Fatty Acids (g)	(n-6)/(n-3) Ratio
Almond Milk	1 cup	227.00	60.00	1.00	8.00	1.00	2.50	0.00	-	100.00	200.00	0.36	-	150.00	-	-	-
Enriched Rice Milk	1 cup	248.00	120.00	1.00	25.00	0.00	2.00	0.00	1.50	100.00	300.00	0.00	-	90.00	-	-	-
Fortified Soy Milk	1 cup	244.00	130.00	11.00	13.00	0.75	4.00	0.44	3.00	40.00	200.00	1.80	-	100.00	0.90	-	-
Low Fat Milk	1 cup	244.00	102.48	8.22	12.18	0.00	2.37	1.54	1.15	117.12	305.00	0.07	8.05	107.36	1.02	0.00	0.00
Fortified Nonfat Soy Milk	1 cup	245.00	70.00	6.00	10.00	0.75	0.00	0.00	-	100.00	250.00	1.80	-	105.00	-	0.00	0.00
Rice Milk	1 cup	245.00	120.00	1.00	25.00	0.00	2.00	0.00	-	0.00	20.00	0.00	-	90.00	-	-	-
Skim Milk	1 cup	245.00	83.30	8.26	12.15	0.00	0.20	0.15	1.23	115.15	298.90	0.07	7.60	102.90	1.03	0.00	0.00
Low Fat Fruited Yogurt	1 cup	245.00	238.50	8.67	47.70	0.00	2.17	1.08	-	86.73	216.81	0.00	-	119.25	-	-	-
Nonfat Fruited Yogurt	1 cup	245.00	232.75	10.78	46.55	0.00	0.49	0.29	1.15	0.00	372.40	0.17	14.70	142.10	1.81	0.02	1.00
Nonfat Plain Yogurt	1 cup	245.00	137.20	14.04	18.82	0.00	0.44	0.29	1.49	0.00	487.55	0.22	8.82	188.65	2.38	0.00	0.00
Soy Plain Yogurt[3]	1 cup	225.00	190.00	10.00	25.00	2.00	6.00	1.00	-	-	450.00	1.08	-	20.00	-	-	-

[1] All data obtained from Food Processor unless otherwise noted.

[2] Based on standard USDA serving sizes.

[3] Nutrient data obtained from http://www.wholesoyco.com/our-products/24oz-soy-yogurt/plain/item/plain.

TABLE A12 Original Nutrient Analysis- Cheeses[1]

Representative Food	Serving Size[2]	Weight (g)	Energy (kcal)	Protein (g)	Carbohyrates (g)	Fiber (g)	Total Fat (g)	Saturated Fat (g)	Vitamin B-12 (µg)	Vitamin D (IU)	Calcium (mg)	Iron (mg)	Selenium (µg)	Sodium (mg)	Zinc (mg)	Omega-3 Fatty Acids (g)	(n-6)/(n-3) Ratio
American Cheese	2 oz	38.00	125.40	6.99	2.98	0.00	9.57	5.66	0.48	6.84	216.60	0.22	6.12	480.70	1.21	0.07	4.42
Cheddar Cheese	1.5 oz	42.00	169.26	10.46	0.54	0.00	13.92	8.86	0.35	10.08	302.82	0.29	5.84	260.82	1.31	0.16	1.57
Feta Cheese	1/3 cup	50.00	132.00	7.11	2.05	0.00	10.64	7.48	0.85	0.20	246.50	0.33	7.50	558.00	1.44	0.14	1.22
Goat Cheese	1.5 oz	42.00	112.56	7.78	0.37	0.00	8.85	6.12	0.08	6.30	58.80	0.80	1.18	154.56	0.39	0.00	0.00
Mozzarella Cheese	1.5 oz	42.00	106.68	10.19	1.16	0.00	6.69	4.25	0.34	5.04	328.44	0.09	6.05	259.98	1.16	0.06	2.43
Provolone Cheese	1.5 oz	42.00	147.42	10.74	0.90	0.00	11.18	7.17	0.61	8.40	317.52	0.22	6.09	367.92	1.36	0.12	1.75
Swiss Cheese	1.5 oz	42.00	159.60	11.31	2.26	0.00	11.68	7.47	1.40	8.40	332.22	0.08	7.64	80.64	1.83	0.15	1.77

[1] All data obtained from Food Processor unless otherwise noted.

[2] Based on standard USDA serving sizes.

TABLE A13 Original Nutrient Analysis- Mean Nutrient Content of Each Food Group[1]

Food Group	Energy (kcal)	Protein (g)	Carbohyrates (g)	Fiber (g)	Total Fat (g)	Saturated Fat (g)	Vitamin B-12 (µg)	Vitamin D (IU)	Calcium (mg)	Iron (mg)	Selenium (µg)	Sodium (mg)	Zinc (mg)	Omega-3 Fatty Acids (g)	(n-6)/(n-3) Ratio
Grains	104.91	3.28	21.76	2.82	1.17	0.20	0.92	9.47	39.48	3.47	7.45	112.69	1.18	0.14	15.80
Fruit	89.47	1.35	20.00	3.35	1.12	0.16	0.00	0.00	19.98	0.40	0.45	5.73	0.36	0.04	1.96
Dried Fruit	187.69	1.35	48.88	3.88	0.39	0.04	0.00	0.00	50.59	0.92	0.66	14.45	6.06	0.01	3.75
Vegetables	41.08	1.98	8.91	2.28	0.31	0.07	0.00	0.51	25.06	0.62	2.34	24.55	0.37	0.03	3.38
Green Leafy Vegetables	27.38	2.33	5.25	2.25	0.34	0.05	0.00	0.00	126.36	1.38	0.89	61.70	0.27	0.08	1.35
Nuts and Seeds	92.49	2.82	3.40	1.50	8.47	1.05	0.00	0.00	16.10	0.69	26.70	1.45	0.71	0.11	230.58
Nut Butters	192.32	7.37	6.14	2.61	16.94	2.35	0.00	0.00	62.40	0.86	1.28	0.00	0.99	0.01	768.50
Beans	58.34	3.88	9.93	3.35	0.53	0.09	0.00	0.00	20.49	1.13	1.61	27.87	0.50	0.06	4.46
Meat Substitutes	55.92	5.67	4.52	1.12	1.77	0.35	0.20	12.22	24.57	0.79	9.85	203.04	0.66	0.06	10.67
Dairy and Substitutes	134.93	7.27	22.13	0.41	2.01	0.44	1.59	65.90	281.88	0.45	9.79	110.48	1.43	0.00	0.20
Cheeses	136.13	9.23	1.46	0.00	10.36	6.72	0.59	6.47	257.56	0.29	5.77	308.95	1.24	0.10	1.88

[1] Means based on nutrient analyses of representative foods in each food group.

APPENDIX B

TABLES: NUTRIENT ANALYSIS OF REPRESENTATIVE FOODS IN RECONFIGURED FOOD GROUPS

TABLE B1 Nutrient Analysis Based on Reconfigured Food Groups- Grains[1]

Representative Food	Serving Size[2]	Weight (g)	Energy (kcal)	Protein (g)	Carbohyrates (g)	Fiber (g)	Total Fat (g)	Saturated Fat (g)	Vitamin B-12 (µg)	Vitamin D (IU)	Calcium (mg)	Iron (mg)	Selenium (µg)	Sodium (mg)	Zinc (mg)	Omega-3 Fatty Acids (g)	(n-6)/(n-3) Ratio
All Bran	1 cup	62.00	161.20	8.15	46.03	18.17	3.04	0.39	11.66	79.98	241.18	10.91	5.83	161.20	7.69	0.09	13.07
Barley	1/2 cup cooked	78.50	96.56	1.77	22.15	2.98	0.35	0.07	0.00	0.00	8.64	1.04	6.75	2.36	0.64	0.02	9.50
Bran Chex	1 cup	62.67	205.66	4.33	52.71	7.59	1.62	0.30	2.00	53.30	133.55	21.61	4.95	353.63	5.00	0.03	20.50
Brown Rice	1/2 cup cooked	97.50	109.20	2.26	22.92	1.76	0.81	0.17	0.00	0.00	9.75	0.52		0.98	0.60	0.01	28.00
Bulgur Wheat	1/2 cup cooked	91.00	75.53	2.74	16.91	4.10	0.22	0.04	0.00	0.00	9.10	0.87	0.55	4.55	0.52	0.00	0.00
Cheerios	1 cup	28.00	102.76	3.17	20.91	2.83	1.65	0.27	1.74	40.04	114.24	8.90	7.98	159.88	4.44	0.03	20.89
Corn Flakes	1 cup	28.00	101.08	1.85	24.39	0.70	0.17	0.05	2.65	1.01	1.12	8.12	2.32	202.44	0.05	0.01	13.50
Corn Grits	1 packet	28.00	100.52	2.05	21.29	1.18	0.60	0.10	0.00	0.00	105.84	10.85	4.79	294.00	0.18	0.01	31.33
Corn Tortilla	1 6-inch	15.00	35.00	0.50	7.50	0.50	0.50	0.00	-	-	-	-	-	2.50	-	-	-
Cous Cous	1/2 cup cooked	78.50	87.92	2.98	18.31	1.10	0.13	0.02	0.00	0.00	6.28	0.30	21.59	3.93	0.20	0.00	0.00
Cream of Wheat	1/2 cup cooked	125.50	62.75	1.81	13.20	0.63	0.26	0.04	0.00	0.00	109.19	4.69	3.51	7.53	0.16	0.01	10.00
English Muffin	1/2 muffin	28.50	66.12	2.28	13.11		0.51	0.09	-	-	51.30	0.40	-	98.33	-	0.02	10.50
Flour Tortilla	1 6-inch	30.00	93.60	2.49	15.41	0.93	2.33	0.57	0.00	0.00	38.70	1.00	6.66	190.80	0.16	0.02	25.33
Granola (low fat)	1/4 cup	24.50	94.82	1.96	19.97	1.49	1.27	0.32	2.99	20.09	9.56	0.91	4.24	53.66	1.89	0.01	55.67
Grape Nuts	1/2 cup	58.00	208.22	7.24	46.46	5.10	1.07	0.18	3.67	40.02	22.62	22.07	5.28	290.00	3.22	3.48	13.50
Millet	1/2 cup cooked	87.00	103.53	3.05	20.59	1.13	0.87	0.15	0.00	0.00	2.61	0.55	0.78	1.74	0.79	0.03	16.00
Multigrain Bread	1 slice		120.00	4.00	22.00	2.00	1.50	0.00	-	-	100.00	1.44	-	150.00	-	-	-
Oatmeal	1/2 cup	40.00	148.40	5.48	27.27	3.76	2.75	0.44	0.00	0.00	18.80	1.86	13.60	1.20	1.28	0.04	22.00
Pasta	1/2 cup cooked	70.00	110.60	4.06	21.60	1.26	0.65	0.13	0.00	0.00	4.90	0.90	18.48	0.70	0.36	0.01	15.00
Pita	4"	28.00	77.00	2.55	15.60	0.62	0.34	0.05	0.00	0.00	24.08	0.73	7.59	150.08	0.24	0.01	25.50
Plain Bagel	1 mini	26.00	71.50	2.73	13.88	0.60	0.42	0.06	0.00		4.68	0.93	-	138.84	0.23	0.01	16.50
Popcorn (low fat)	3 c, popped	24.00	101.76	3.02	17.28	3.41	2.28	0.34	0.00	0.00	2.64	0.55	2.06	212.16	0.92	0.06	0.80
Raisin Bran	1 cup	59.00	189.98	5.07	45.64	6.55	1.29	0.21	3.02	40.12	27.73	7.53	2.12	250.75	2.05	0.04	11.17
Raisin Bread	1 slice	26.00	71.24	2.05	13.60	1.12	1.14	0.28	0.00	0.00	17.16	1.91	5.20	81.38	0.19	0.01	16.00
Rye Bread	1 slice	32.00	82.56	2.72	15.46	1.86	1.06	0.20	0.00	0.00	23.36	0.91	9.89	211.20	0.36	0.02	12.33
Shredded Wheat	1 cup	49.00	168.07	5.43	39.17	5.68	0.97	0.20	0.00	0.00	22.05	1.61	-	1.96	1.23	-	-
Wheatberries[3]	1/2 cup cooked		150.00	6.00	32.00	6.00	0.50	0.00	-	-	20.00	1.44	-	0.00	-	-	-
Wheat Thins	7 crackers		65.63	1.31	9.19	0.44	2.63	0.44	-	-	8.75	0.47	-	122.50	-	-	-
White Bread	1 slice	25.00	66.50	1.91	12.65	0.60	0.82	0.18	0.00	0.00	37.75	0.94	4.33	127.75	0.19	0.04	8.71
White Rice	1/2 cup cooked	79.00	102.70	2.13	22.25	0.32	0.22	0.02	0.00	0.00	7.90	0.95	5.93	0.79	0.39	0.01	6.00
WW Bread[4]	1 slice	28.00	69.16	3.63	11.56	1.90	0.94	0.21	0.00	0.00	29.96	0.68	11.28	132.16	0.50	0.02	9.00
WW Crackers[4]	5 crackers	23.00	98.21	2.43	16.00	2.37	3.25	0.47	0.00	0.00	8.28	0.77	2.32	161.92	0.60	0.19	7.26
WW English Muffin[4]	1/2 muffin	33.00	66.99	2.90	9.29	2.21	0.48	0.11	0.00	0.00	87.45	0.81	13.30	120.12	0.53	0.02	15.80
WW Pasta[4]	1/2 cup cooked	70.00	86.80	3.73	18.58	3.15	0.38	0.07	0.00	0.00	10.50	0.74	18.13	2.10	0.57	0.01	20.00
WW Pita[4]	4"	28.00	74.48	2.74	15.40	2.07	0.73	0.11	0.00	0.00	4.20	0.86	12.32	148.96	0.43	0.01	20.00
WW Tortilla[4]	1 each	45.00	130.00	4.00	22.00	3.00	3.50	1.00	-	-	-	-	-	320.00	-	-	-

[1] All data obtained from Food Processor unless otherwise noted.

[2] Based on standard USDA serving sizes.

[3] Nutrient data obtained from http://www.bobsredmill.com/hard-red-wheat-berries.html.

[4] WW= whole wheat.

TABLE B2 Nutrient Analysis Based on Reconfigured Food Groups- Fruit and Dried Fruit[1]

Representative Food	Serving Size[2]	Weight (g)	Energy (kcal)	Protein (g)	Carbohyrates (g)	Fiber (g)	Total Fat (g)	Saturated Fat (g)	Vitamin B-12 (µg)	Vitamin D (IU)	Calcium (mg)	Iron (mg)	Selenium (µg)	Sodium (mg)	Zinc (mg)	Omega-3 Fatty Acids (g)	(n-6)/(n-3) Ratio
Apple Juice	1 cup	-	110.00	0.00	29.00	0.00	0.00	0.00	-	-	-	-	-	10.00	-	-	-
Apricot	3 each	105.00	50.40	1.47	11.68	2.08	0.41	0.03	0.00	0.00	13.65	0.41	0.11	1.05	2.10	0.00	0.00
Avocado	1/2 each	100.00	160.00	2.00	8.53	6.70	14.66	2.13	0.00	0.00	12.00	0.55	0.40	7.00	0.64	0.13	12.85
Banana	1 large	136.00	121.04	1.48	31.06	3.54	0.45	0.15	0.00	0.00	6.80	0.35	1.36	1.36	0.20	0.04	1.67
Blueberries	1 cup	148.00	84.36	1.10	21.45	3.55	0.49	0.04	0.00	0.00	8.88	0.41	0.15	1.48	0.24	0.09	1.50
Cantaloupe	1 cup diced	156.00	53.04	1.31	12.73	1.31	0.30	0.08	0.00	0.00	14.04	0.33	0.62	24.96	0.28	0.08	0.80
Grapefruit	1 medium	246.00	78.72	1.55	19.88	2.71	0.25	0.02	0.00	0.00	29.52	0.22	0.74	0.00	0.17	0.02	2.00
Grapes	1 cup	151.00	104.19	1.09	27.33	1.36	0.24	0.08	0.00	0.00	15.10	0.54	0.15	3.02	0.11	0.02	4.00
Honeydew	1 cup diced	170.00	61.20	0.92	15.45	1.36	0.24	0.07	0.00	0.00	10.20	0.29	1.19	30.60	0.15	0.05	1.00
Kiwi	2 each	138.00	84.18	1.57	20.23	4.14	0.72	0.04	0.00	0.00	46.92	0.43	0.28	4.14	0.19	0.06	6.25
Nectariane	1 medium	156.00	68.64	1.65	0.50	2.65	0.50	0.05	0.00	0.00	9.36	0.44	0.00	0.00	0.27	0.00	0.00
Orange	1 3 1/16 inch	184.00	86.48	1.73	21.62	4.42	0.22	0.04	0.00	0.00	73.60	0.18	0.92	0.00	0.13	0.02	2.00
Orange Juice	1 cup	-	120.00	1.00	28.00	0.00	0.00	0.00	-	-	20.00	0.00	-	25.00	-	0.00	0.00
Peach	1 2 3/4 inch	180.46	70.38	1.64	17.22	2.62	0.45	0.04	0.00	0.00	10.83	0.45	0.18	0.00	0.31	0.00	0.00
Pear	1 medium	178.00	103.24	0.68	27.52	5.52	0.21	0.02	0.00	0.00	16.02	0.30	0.18	1.78	0.18	0.00	0.00
Pineapple	1 cup chunks	165.00	74.25	0.91	19.50	-	0.21	-	-	0.00	21.45	0.41	0.00	1.65	0.13	-	-
Plum	1 cup slices	165.00	75.90	1.16	18.84	2.31	0.46	0.03	0.00	0.00	9.90	0.28	0.00	0.00	0.17	0.00	0.00
Pomegranate	1 4 inch	275.00	228.25	4.59	51.43	11.00	3.22	0.33	0.00	0.00	27.50	0.83	1.38	8.25	0.96	0.00	0.00
Strawberries	8 large	147.00	47.04	0.98	11.29	2.94	0.44	0.03	0.00	0.00	23.52	0.60	0.59	1.47	0.21	0.10	1.29
Raspberries	1 cup	123.00	63.96	1.48	14.69	8.00	0.80	0.02	0.00	0.00	30.75	0.85	0.25	1.23	0.52	0.16	1.92
Watermelon	1 cup diced	152.00	45.60	0.93	11.48	0.61	0.23	0.03	0.00	0.00	10.64	0.36	0.61	1.52	0.15	0.00	0.00
Dried Apple	1/4 cup[3]	21.50	52.25	0.20	14.17	1.87	0.07	0.01	0.00	0.00	3.01	0.30	0.28	18.71	0.04	0.00	4.00
Dried Apricot	1/4 cup[3]	32.50	78.33	1.10	20.36	2.37	0.17	0.01	0.00	0.00	17.88	0.86	0.72	3.25	12.68	0.00	0.00
Dried Cranberries	1/4 cup[3]	30.00	92.40	0.02	24.71	1.71	0.41	0.03	0.00	0.00	3.00	0.16	1.67	0.90	0.03	0.01	21.00
Dried Dates	1/4 cup[3]	40.00	114.80	1.48	29.44	-	0.36	-	0.00	-	25.68	0.59	-	2.93	0.06	-	-
Dried Figs	1/4 cup[3]	37.25	92.75	1.23	23.79	3.65	0.35	0.05	0.00	0.00	60.35	0.76	0.22	3.73	0.20	0.00	0.00
Dried Mango	1/4 cup[3]	30.00	105.00	0.00	25.50	0.75	0.00	0.00	0.00	-	60.00	0.27	-	15.00	-	0.00	0.00
Dried Pineapple	1/4 cup[3]	30.00	97.50	0.00	25.50	0.75	0.00	0.00	0.00	-	15.00	0.00	-	15.00	-	0.00	0.00
Prunes	1/4 cup[3]	43.50	104.40	0.95	27.79	3.09	0.17	0.04	0.00	0.00	18.71	0.40	0.13	0.87	0.19	0.01	2.00
Raisins	1/4 cup[3]	36.25	108.39	1.11	28.70	1.34	0.17	0.02	0.00	0.00	18.13	0.68	0.22	3.99	7.98	0.01	3.00

[1] All data obtained from Food Processor unless otherwise noted.

[2] Based on standard USDA serving sizes unless otherwise noted.

[3] Differs from USDA serving size of 1/2 cup.

TABLE B3 Nutrient Analysis Based on Reconfigured Food Groups- Vegetables[1]

Representative Food	Serving Size[2]	Weight (g)	Energy (kcal)	Protein (g)	Carbohyrates (g)	Fiber (g)	Total Fat (g)	Saturated Fat (g)	Vitamin B-12 (µg)	Vitamin D (IU)	Calcium (mg)	Iron (mg)	Selenium (µg)	Sodium (mg)	Zinc (mg)	Omega-3 Fatty Acids (g)	(n-6)/(n-3) Ratio
Bell Pepper	1 cup	149.00	29.80	1.28	6.65	2.53	0.25	0.09	0.00	0.00	14.90	0.51	0.00	4.47	0.19	0.01	5.00
Broccoli	1 cup	71.00	19.88	2.12	3.72	2.13	0.25	0.04	0.00	0.00	34.08	0.62	2.13	19.17	0.28	0.13	0.31
Brussels Sprouts	1 cup	88.00	37.84	2.97	7.88	3.34	0.26	0.05	0.00	0.00	36.96	1.23	1.41	22.00	0.37	0.10	0.50
Carrots	2 medium	122.00	50.02	1.13	11.69	3.42	0.29	0.05	0.00	0.00	40.26	0.37	0.12	84.18	0.29	0.00	0.00
Cauliflower	1 cup	107.00	26.75	2.05	5.32	2.14	0.30	0.06	0.00	0.00	23.54	0.45	0.64	32.10	0.29	0.01	1.00
Celery	1 cup	100.00	16.00	0.69	2.97	1.39	0.17	0.04	0.00	0.00	40.00	0.20	0.40	80.00	0.13	0.00	0.00
Corn	1 large ear	143.00	122.98	4.68	26.74	2.86	1.93	0.47	0.00	0.00	2.86	0.74	0.86	21.45	0.66	0.01	47.00
Cucumber	1 cup	104.00	15.60	0.68	3.49	0.52	0.11	0.04	0.00	0.00	16.64	0.29	0.31	2.08	0.21	0.00	0.00
Green Beans	1 cup	100.00	31.00	1.83	6.97	2.70	0.22	0.05	0.00	0.00	37.00	1.03	0.60	6.00	0.24	0.07	0.57
Iceberg Lettuce	2 cups	133.34	20.00	1.33	4.00	1.33	0.00	0.00	-	-	0.00	0.00	-	13.33	-	0.00	0.00
Leaf Lettuce	2 cups	72.00	10.80	0.98	2.07	0.94	0.11	0.01	0.00	0.00	25.92	0.62	0.43	20.16	0.13	0.06	0.33
Onion	1 cup	160.00	64.00	1.76	14.94	2.72	0.16	0.06	0.00	0.00	36.80	0.34	0.80	6.40	0.27	0.00	0.00
Portabella Mushroom	1 cup	86.00	18.92	1.81	3.33	1.12	0.30	0.05	0.04	8.60	2.58	0.27	16.00	7.74	0.46	0.00	0.00
Potato	1 cup	75.00	57.75	1.52	13.10	1.65	0.07	0.02	0.00	0.00	9.00	0.59	0.23	4.50	0.22	0.01	3.00
Summer Squash	1 cup	113.00	18.08	1.37	3.79	1.24	0.20	0.05	0.00	0.00	16.95	0.40	0.23	2.26	0.33	0.06	0.50
Sweet Potato	1 cup	133.00	114.38	2.09	26.76	3.99	0.07	0.03	0.00	0.00	39.90	0.81	0.80	73.15	0.40	0.00	0.00
Tomato	1 cup	180.00	32.40	1.58	7.00	2.16	0.36	0.05	0.00	0.00	18.00	0.49	0.00	9.00	0.31	0.00	0.00
Winter Squash	1 cup	205.00	75.90	1.80	18.10	5.70	0.70	0.10	0.00	-	45.10	0.90	0.80	2.10	0.50	1.89	0.60

[1] All data obtained from Food Processor unless otherwise noted.

[2] Based on standard USDA serving sizes.

TABLE B4 Nutrient Analysis Based on Reconfigured Food Groups- Leafy, Green Vegetables[1]

Representative Food	Serving Size[2]	Weight (g)	Energy (kcal)	Protein (g)	Carbohyrates (g)	Fiber (g)	Total Fat (g)	Saturated Fat (g)	Vitamin B-12 (µg)	Vitamin D (IU)	Calcium (mg)	Iron (mg)	Selenium (µg)	Sodium (mg)	Zinc (mg)	Omega-3 Fatty Acids (g)	(n-6)/(n-3) Ratio
Bok Choy	1 cup cooked	170.00	20.40	2.65	3.03	1.65	0.27	0.03	0.00	0.00	158.10	1.77	0.68	57.80	0.29	0.07	0.75
Chinese Cabbage	2 cups raw	140.00	18.20	2.10	3.05	1.40	0.28	0.04	0.00	0.00	147.00	1.12	0.70	91.00	0.27	0.07	0.80
Collard Greens	2 cups raw	72.00	21.60	1.76	4.29	2.59	0.30	0.04	0.00	0.00	104.40	0.14	0.94	14.40	0.09	0.08	0.73
Kale	2 cups raw	134.00	67.00	4.42	13.40	2.68	0.94	0.12	0.00	0.00	180.90	2.28	1.21	57.62	0.59	0.24	0.78
Mustard Greens	2 cups raw	112.00	29.12	3.02	5.49	3.70	0.22	0.01	0.00	0.00	115.36	1.64	1.01	28.00	0.13	0.02	1.00
Spinach	2 cups raw	60.00	13.80	1.72	2.18	1.32	0.23	0.04	0.00	0.00	59.40	1.63	0.60	47.40	0.32	0.08	0.21
Swiss Chard	2 cups raw	72.00	13.68	1.30	2.69	1.15	0.14	0.02	0.00	0.00	36.72	1.30	0.65	153.36	0.26	0.01	6.00
Turnip Greens	2 cups raw	110.00	35.20	1.65	7.84	3.52	0.33	0.08	0.00	0.00	209.00	1.21	1.32	44.00	0.21	0.09	0.50

[1] All data obtained from Food Processor unless otherwise noted.

[2] Based on standard USDA serving sizes.

TABLE B5 Nutrient Analysis Based on Reconfigured Food Groups- Nuts, Nut Butters, and Seeds[1]

Representative Food	Serving Size[2]	Weight (g)	Energy (kcal)	Protein (g)	Carbohyrates (g)	Fiber (g)	Total Fat (g)	Saturated Fat (g)	Vitamin B-12 (µg)	Vitamin D (IU)	Calcium (mg)	Iron (mg)	Selenium (µg)	Sodium (mg)	Zinc (mg)	Omega-3 Fatty Acids (g)	(n-6)/(n-3) Ratio
Brazil Nuts	1 oz	16.63	109.06	2.38	2.04	1.25	11.04	2.52	0.00	0.00	26.60	0.40	318.70	0.50	0.67	0.01	513.50
Cashews	1 oz	17.13	98.30	2.62	5.60	0.51	7.94	1.57	0.00	0.00	7.71	1.03	2.00	2.74	0.96	0.03	47.88
Flaxseed[3]	2 tbsp	14.00	74.76	2.56	4.04	3.82	5.90	0.51	0.00	0.00	35.70	0.80	3.56	4.20	0.61	3.19	0.26
Hazelnuts	1 oz	18.00	100.98	2.71	3.17	1.69	11.23	0.81	0.00	0.00	22.14	0.79	0.74	0.00	0.45	0.01	140.00
Macadamia Nuts	1 oz	16.50	118.47	1.29	2.21	1.32	12.55	1.97	0.00	0.00	11.55	0.44	1.93	0.66	0.21	0.03	6.50
Peanuts	1 oz	18.25	106.76	4.32	3.93	1.46	9.06	1.26	0.00	0.00	9.86	0.41	1.37	1.10	0.60	0.00	0.00
Pecans	1 oz	12.38	87.86	1.18	1.68	1.16	9.19	0.78	0.00	0.00	8.91	0.35	0.50	0.12	0.63	0.12	19.78
Pine Nuts	1 oz	16.88	113.57	2.31	2.21	0.62	11.54	0.83	0.00	0.00	2.70	0.93	0.12	0.34	1.09	0.03	207.19
Pistachios	1 oz	15.38	87.18	3.22	4.52	1.52	6.89	0.84	0.00	0.00	16.45	0.62	1.54	0.92	0.36	0.04	55.04
Pumpkin Seed Kernels	1 oz	14.75	65.11	4.40	2.17	0.96	7.23	1.26	0.00	0.00	7.67	1.19	1.39	2.66	1.13	0.02	179.18
Sunflower Seed Kernels	1 oz	16.00	93.12	3.09	3.85	1.78	7.97	0.84	0.00	0.00	11.20	0.61	12.69	0.48	0.85	0.01	468.29
Tahini	1 oz	15.00	88.80	2.61	3.23	0.71	7.95	1.11	0.00	0.00	21.15	0.66	5.16	5.25	0.69	0.06	57.03
Walnuts	1 oz	12.50	81.75	1.90	1.71	0.84	8.14	0.77	0.00	0.00	12.25	0.36	0.61	0.25	0.39	1.14	4.19
Wheat Germ	1 oz	15.00	59.00	4.00	7.00	3.00	1.50	0.00	-	-	0.00	1.08	-	2.00	1.50	-	-
Natural Smooth Almond Butter	1 tbsp[4]	16.00	98.24	3.35	3.01	1.65	8.88	0.66	0.00	0.00	55.52	0.56	0.38	0.00	0.53	0.00	1361.00
Natural Smooth Peanut Butter	1 tbsp[4]	16.00	94.08	4.01	3.13	0.96	8.06	1.68	0.00	0.00	6.88	0.30	0.90	0.00	0.47	0.01	176.00

[1] All data obtained from Food Processor unless otherwise noted.

[2] Based on standard USDA serving sizes unless otherwise noted.

[3] Nutrient data obtained from http://whfoods.org/genpage.php?tname=nutrientprofile&dbid=57.

[4] Differs from USDA serving size of 2 tbsp.

TABLE B6 Nutrient Analysis Based on Reconfigured Food Groups- Beans and Quinoa[1]

Representative Food	Serving Size[2]	Weight (g)	Energy (kcal)	Protein (g)	Carbohyrates (g)	Fiber (g)	Total Fat (g)	Saturated Fat (g)	Vitamin B-12 (µg)	Vitamin D (IU)	Calcium (mg)	Iron (mg)	Selenium (µg)	Sodium (mg)	Zinc (mg)	Omega-3 Fatty Acids (g)	(n-6)/(n-3) Ratio
Black Beans	1/4 cup	43.00	56.76	3.81	10.20	3.74	0.23	0.06	0.00	0.00	11.61	0.90	0.52	0.43	0.48	0.05	1.18
Garbanzo Beans	1/4 cup	41.00	67.24	3.63	11.24	3.12	1.06	0.11	0.00	0.00	20.09	1.18	1.52	2.87	0.63	0.02	27.75
Kidney Beans	1/4 cup	44.25	56.20	3.84	10.09	2.83	0.22	0.03	0.00	0.00	15.49	0.98	0.49	0.44	0.44	0.08	0.65
Lentils	1/4 cup	49.50	57.42	4.46	9.96	3.91	0.19	0.02	0.00	0.00	9.41	1.65	1.39	0.99	0.63	0.02	3.50
Lima Beans	1/4 cup	45.50	57.33	3.66	10.61	3.43	0.17	0.04	0.00	0.00	12.91	1.07	2.18	1.34	0.46	0.02	2.40
Navy Beans	1/4 cup	45.50	63.70	3.74	11.85	4.78	0.28	0.04	0.00	0.00	31.40	1.07	1.32	0.00	0.47	0.08	0.78
Pinto Beans	1/4 cup	42.75	61.13	3.85	11.21	3.85	0.28	0.06	0.00	0.00	19.67	0.89	2.65	0.43	0.42	0.06	0.71
Refried Beans	1/4 cup	59.50	54.15	3.22	9.08	3.03	0.70	0.23	0.00	0.00	19.64	0.99	3.87	267.16	0.39	0.08	1.54
White/Cannellini Beans	1/4 cup	44.75	62.20	4.35	11.23	2.82	0.16	0.04	0.00	0.00	40.28	1.66	0.58	2.69	0.58	0.03	1.14
Quinoa	1/2 cup	92.50	111.00	4.07	19.70	2.59	1.78	-	0.00	-	15.73	1.38	2.59	6.48	1.01	-	-

[1] All data obtained from Food Processor unless otherwise noted.

[2] Based on standard USDA serving sizes.

TABLE B7 Nutrient Analysis Based on Reconfigured Food Groups- Dairy and Eggs[1]

Representative Food	Serving Size[2]	Weight (g)	Energy (kcal)	Protein (g)	Carbohyrates (g)	Fiber (g)	Total Fat (g)	Saturated Fat (g)	Vitamin B-12 (µg)	Vitamin D (IU)	Calcium (mg)	Iron (mg)	Selenium (µg)	Sodium (mg)	Zinc (mg)	Omega-3 Fatty Acids (g)	(n-6)/(n-3) Ratio
Low Fat Milk	1 cup	244.00	102.48	8.22	12.18	0.00	2.37	1.54	1.15	117.12	305.00	0.07	8.05	107.36	1.02	0.00	0.00
Skim Milk	1 cup	245.00	83.30	8.26	12.15	0.00	0.20	0.15	1.23	115.15	298.90	0.07	7.60	102.90	1.03	0.00	0.00
Low Fat Fruited Yogurt	1 cup	245.00	238.50	8.67	47.70	0.00	2.17	1.08	-	86.73	216.81	0.00	-	119.25	-	-	-
Nonfat Fruited Yogurt	1 cup	245.00	232.75	10.78	46.55	0.00	0.49	0.29	1.15	0.00	372.40	0.17	14.70	142.10	1.81	0.02	1.00
Nonfat Plain Yogurt	1 cup	245.00	137.20	14.04	18.82	0.00	0.44	0.29	1.49	0.00	487.55	0.22	8.82	188.65	2.38	0.00	0.00
Cottage Cheese	1/2 cup	113.00	81.36	14.00	3.07	0.00	1.15	0.73	0.71	0.00	68.93	0.16	10.17	458.78	0.43	0.01	2.00
Nonfat Greek Yogurt	1 cup	227.00	120.00	20.00	9.00	0.00	0.00	0.00	-	-	150.00	0.00	-	85.00	-	-	-
Egg	1 each	56.00	80.08	7.03	0.40	0.00	5.33	1.75	0.50	45.92	31.36	0.98	17.19	79.52	0.72	0.06	15.82
Egg Substitute	1/4 cup	60.00	28.80	6.00	1.20	0.00	0.00	0.00	0.20	39.60	43.80	1.19	24.78	119.40	0.59	0.00	0.00
Egg Whites	1/4 cup	60.75	31.59	6.62	0.44	0.00	0.10		0.05	0.00	4.25	0.05	12.15	100.85	0.02	-	-
American Cheese	2 oz	38.00	125.40	6.99	2.98	0.00	9.57	5.66	0.48	6.84	216.60	0.22	6.12	480.70	1.21	0.07	4.42
Cheddar Cheese	1.5 oz	42.00	169.26	10.46	0.54	0.00	13.92	8.86	0.35	10.08	302.82	0.29	5.84	260.82	1.31	0.16	1.57
Feta Cheese	1/3 cup	50.00	132.00	7.11	2.05	0.00	10.64	7.48	0.85	0.20	246.50	0.33	7.50	558.00	1.44	0.14	1.22
Goat Cheese	1.5 oz	42.00	112.56	7.78	0.37	0.00	8.85	6.12	0.08	6.30	58.80	0.80	1.18	154.56	0.39	0.00	0.00
Mozzarella Cheese	1.5 oz	42.00	106.68	10.19	1.16	0.00	6.69	4.25	0.34	5.04	328.44	0.09	6.05	259.98	1.16	0.06	2.43
Provolone Cheese	1.5 oz	42.00	147.42	10.74	0.90	0.00	11.18	7.17	0.61	8.40	317.52	0.22	6.09	367.92	1.36	0.12	1.75
Swiss Cheese	1.5 oz	42.00	159.60	11.31	2.26	0.00	11.68	7.47	1.40	8.40	332.22	0.08	7.64	80.64	1.83	0.15	1.77

[1] All data obtained from Food Processor unless otherwise noted.

[2] Based on standard USDA serving sizes.

TABLE B8 Nutrient Analysis Based on Reconfigured Food Groups- Soy and Dairy Substitutes[1]

Representative Food	Serving Size[2]	Weight (g)	Energy (kcal)	Protein (g)	Carbohyrates (g)	Fiber (g)	Total Fat (g)	Saturated Fat (g)	Vitamin B-12 (µg)	Vitamin D (IU)	Calcium (mg)	Iron (mg)	Selenium (µg)	Sodium (mg)	Zinc (mg)	Omega-3 Fatty Acids (g)	(n-6)/(n-3) Ratio
Miso[3]	2 tbsp	34.38	68.40	4.02	9.10	1.86	2.06	0.40	0.02	0.00	19.60	0.86	2.40	1281.50	0.88	0.16	5.88
Tempeh	1 oz	28.57	56.00	5.20	2.67		3.25	0.97	0.04	0.00	27.43	0.61	0.00	4.00	0.45	0.03	21.00
Tofu	2 oz	56.67	47.60	5.04	1.30	0.45	2.49	0.28	-	-	70.83	0.68	-	2.27	-	-	-
Fortified Tofu[4]	2 oz	-	46.67	4.67	1.33	0.45	2.00	0.00	0.32	53.20	133.00	0.72	-	0.00	-	-	-
Almond Milk	1 cup	227	60.0	1.00	8.00	1.00	2.50	0.00	-	100.00	200.00	0.36	-	150.00	-	-	-
Enriched Rice Milk	1 cup	248	120.0	1.00	25.00	0.00	2.00	0.00	1.50	100.00	300.00	0.00	-	90.00	-	-	-
Rice Milk	1 cup	245	120.0	1.00	25.00	0.00	2.00	0.00	-	0.00	20.00	0.00	-	90.00	-	-	-
Fortified Soy Milk	1 cup	244	130.0	11.00	13.00	0.75	4.00	0.44	3.00	40.00	200.00	1.80	-	100.00	0.90	-	-
Fortified Nonfat Soy Milk	1 cup	245	70.0	6.00	10.00	0.75	0.00	0.00	-	100.00	250.00	1.80	-	105.00	-	0.00	0.00
Soy Plain Yogurt[5]	1 cup	225	190.0	10.00	25.00	2.00	6.00	1.00	-	-	450.00	1.08	-	20.00	-	-	-

[1] All data obtained from Food Processor unless otherwise noted.

[2] Based on standard USDA serving sizes.

[3] Nutrient data obtained from http://www.whfoods.com/genpage.php?tname=nutrientprofile&dbid=37.

[4] Nutrient data obtained from http://www.nasoya.com/products/tofu/tofu-plus-firm.html.

[5] Nutrient data obtained from http://www.wholesoyco.com/our-products/24oz-soy-yogurt/plain/item/plain.

APPENDIX C

BREAKDOWN OF NUTRIENTS PROVIDED BY THE RECOMMENDED NUMBER OF SERVINGS AT THE 1500-, 2000-, AND 2500-KCAL LEVELS

TABLE C1 Nutrient Contribution from the Recommended Number of Servings of Each Food Group in the 1500 kcal Lacto-Ovo-Vegetarian Diet Plan[1]

Food Group	Number of Servings	Energy (kcal)	Protein (g)	Carbohyrates (g)	Fiber (g)	Total Fat (g)	Saturated Fat (g)	Vitamin B-12 (µg)	Vitamin D (IU)	Calcium (mg)	Iron (mg)	Selenium (µg)	Sodium (mg)	Zinc (mg)	Omega-3 Fatty Acids (g)	(n-6)/(n-3) Ratio
Grains	6	629.46	19.68	130.56	16.92	7.02	1.20	5.52	56.82	236.88	20.82	44.70	676.14	7.08	0.84	15.80
Fruit and Dried Fruit	3	272.34	3.45	63.87	8.88	2.55	0.36	0.00	0.00	64.14	1.23	1.41	18.42	3.15	0.09	2.47
Vegetables	3	128.73	5.91	28.17	7.38	0.99	0.21	0.00	1.53	78.33	1.89	6.75	70.11	1.11	0.39	3.24
Green Leafy Vegetables	2	54.76	4.66	10.50	4.50	0.68	0.10	0.00	0.00	252.72	2.76	1.78	123.40	0.54	0.16	1.35
Nuts, Nut Butters, and Seeds	1	91.91	2.96	3.44	1.49	8.31	0.97	0.00	0.00	17.33	0.67	2.22	1.33	0.69	0.31	268.09
Beans and Quinoa	2	129.42	7.72	23.04	6.82	1.02	0.14	0.12	14.26	39.24	2.36	10.96	56.56	1.06	0.08	5.04
Dairy and Eggs	1	122.88	9.89	9.52	0.00	4.99	3.30	0.71	28.11	222.47	0.29	9.59	215.67	1.11	0.06	2.28
Soy and Dairy Substitutes	1	86.90	4.83	11.30	0.93	2.57	0.30	0.81	46.64	154.12	0.80	1.20	167.74	0.69	0.08	7.96
Total	17	1516.40	59.10	280.40	46.92	28.13	6.58	7.16	147.36	1065.23	30.82	78.61	1329.37	15.43	2.01	2.96:1[2]
% kcal from Macronutrients[3]	-	-	16	74	-	17	-	-	-	-	-	-	-	-	-	-
DRI	-	-	0.8 g/kg	130	38/25[4]	-	-	2.4	600	1000	14/32[4,5]	55	1500	11/8[4]	1.6/1.1[4]	2:1-4:1[6]
% DRI	-	-	adequate to 163 lb.	216	123/188[7]	-	-	298	25	107	220/96[7]	143	89	140/193[7]	126/183[7]	falls within recommended range
Adjusted Recommendation for Vegetarians			1 g/kg	-	-	-	-	-	-	-	-	-	-	29/21[4]	-	-
% Adjusted Recommendation	-	-	adequate to 130 lb.	-	-	-	-	-	-	-	-	-	-	53/73[7]	-	-

[1] Based on mean nutrient contribution of representative foods in each food group.

[2] Total (n-6)/(n-3) ratio listed as an overall diet ratio. Overall diet ratio determined by calculating the proportion of the total number of servings the recommended number of servings of each individual food group comprises, multiplying the food group-specific proportion values by the (n-6)/(n-3) ratio specific to each food group, summing these products, and lastly, dividing by the total number of food groups.

[3] Acceptable Macronutrient Distribution Ranges, as established by the Food and Nutrition Board are as follows: protein- 10-35% of total kcal, carbohydrates- 45-65% of total kcal, fat- 20-35% of total kcal.

[4] Listed as male/female recommendations.

[5] DRI for iron listed is specific to the vegetarian population.

[6] Recommendation based on DRI of <4:1 and the vegetarian-specific range suggested by Davis and Kris-Etherton (75).

[7] Listed as percent male/female recommendations.

TABLE C2 Nutrient Contribution from the Recommended Number of Servings of Each Food Group in the 1500 kcal Vegan Diet Plan[1]

Food Group	Number of Servings	Energy (kcal)	Protein (g)	Carbohyrates (g)	Fiber (g)	Total Fat (g)	Saturated Fat (g)	Vitamin B-12 (µg)	Vitamin D (IU)	Calcium (mg)	Iron (mg)	Selenium (µg)	Sodium (mg)	Zinc (mg)	Omega-3 Fatty Acids (g)	(n-6)/(n-3) Ratio
Grains	6	629.46	19.68	130.56	16.92	7.02	1.20	5.52	56.82	236.88	20.82	44.70	676.14	7.08	0.84	15.80
Fruit and Dried Fruit	3	272.34	3.45	63.87	8.88	2.55	0.36	0.00	0.00	64.14	1.23	1.41	18.42	3.15	0.09	2.47
Vegetables	3	128.73	5.91	28.17	7.38	0.99	0.21	0.00	1.53	78.33	1.89	6.75	70.11	1.11	0.39	3.24
Green Leafy Vegetables	3	82.14	6.99	15.75	6.75	1.02	0.15	0.00	0.00	379.08	4.14	2.67	185.10	0.81	0.24	4.05
Nuts, Nut Butters, and Seeds	1	91.91	2.96	3.44	1.49	8.31	0.97	0.00	0.00	17.33	0.67	2.22	1.33	0.69	0.31	268.09
Beans and Quinoa	3	194.13	11.58	34.56	10.23	1.53	0.21	0.18	21.39	58.86	3.54	16.44	84.84	1.59	0.12	5.04
Dairy and Eggs	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Soy and Dairy Substitutes	1	86.90	4.83	11.30	0.93	2.57	0.30	0.81	46.64	154.12	0.80	1.20	167.74	0.69	0.08	7.96
Total	21	1485.61	55.40	287.65	52.58	23.99	3.40	6.51	126.38	988.74	33.09	75.39	1203.68	15.12	2.07	2.82:1[2]
% kcal from Macronutrients[3]	-	-	15	77	-	15	-	-	-	-	-	-	-	-	-	-
DRI	-	-	0.8 g/kg	130	38/25[4]	-	-	2.4	600	1000	14/32[4,5]	55	1500	11/8[4]	1.6/1.1[4]	2:1-4:1[6]
% DRI	-	-	adequate to 152 lb.	221	138/210[7]	-	-	271	21	99	236/103[7]	137	80	137/189[7]	129/188[7]	falls within recommended range
Adjusted Recommendation for Vegetarians			1 g/kg	-	-	-	-	-	-	-	-	-	-	29/21[4]	-	-
% Adjusted Recommendation	-	-	adequate to 122 lb.	-	-	-	-	-	-	-	-	-	-	52/72[7]	-	-

[1] Based on mean nutrient contribution of representative foods in each food group.

[2] Total (n-6)/(n-3) ratio listed as an overall diet ratio. Overall diet ratio determined by calculating the proportion of the total number of servings the recommended number of servings of each individual food group comprises, multiplying the food group-specific proportion values by the (n-6)/(n-3) ratio specific to each food group, summing these products, and lastly, dividing by the total number of food groups.

[3] Acceptable Macronutrient Distribution Ranges, as established by the Food and Nutrition Board are as follows: protein- 10-35% of total kcal, carbohydrates- 45-65% of total kcal, fat- 20-35% of total kcal.

[4] Listed as male/female recommendations.

[5] DRI for iron listed is specific to the vegetarian population.

[6] Recommendation based on DRI of <4:1 and the vegetarian-specific range suggested by Davis and Kris-Etherton (75).

[7] Listed as percent male/female recommendations.

TABLE C3 Nutrient Contribution from the Recommended Number of Servings of Each Food Group in the 2000 kcal Lacto-Ovo-Vegetarian Diet Plan[1]

Food Group	Number of Servings	Energy (kcal)	Protein (g)	Carbohyrates (g)	Fiber (g)	Total Fat (g)	Saturated Fat (g)	Vitamin B-12 (µg)	Vitamin D (IU)	Calcium (mg)	Iron (mg)	Selenium (µg)	Sodium (mg)	Zinc (mg)	Omega-3 Fatty Acids (g)	(n-6)/(n-3) Ratio
Grains	7	734.37	22.96	152.32	19.74	8.19	1.40	6.44	66.29	276.36	24.29	52.15	788.83	8.26	0.98	15.80
Fruit and Dried Fruit	3	272.34	3.45	63.87	8.88	2.55	0.36	0.00	0.00	64.14	1.23	1.41	18.42	3.15	0.09	2.47
Vegetables	4	171.64	7.88	37.56	9.84	1.32	0.28	0.00	2.04	104.44	2.52	9.00	93.48	1.48	0.52	3.24
Green Leafy Vegetables	2	54.76	4.66	10.50	4.50	0.68	0.10	0.00	0.00	252.72	2.76	1.78	123.40	0.54	0.16	1.35
Nuts, Nut Butters, and Seeds	1	91.91	2.96	3.44	1.49	8.31	0.97	0.00	0.00	17.33	0.67	2.22	1.33	0.69	0.31	268.09
Beans and Quinoa	3	194.13	11.58	34.56	10.23	1.53	0.21	0.18	21.39	58.86	3.54	16.44	84.84	1.59	0.12	5.04
Dairy and Eggs	3	368.64	29.67	28.56	0.00	14.97	9.90	2.13	84.33	667.41	0.87	28.77	647.01	3.33	0.18	2.28
Soy and Dairy Substitutes	1	86.90	4.83	11.30	0.93	2.57	0.30	0.81	46.64	154.12	0.80	1.20	167.74	0.69	0.08	7.96
Total	24	1974.69	87.99	342.11	55.61	40.12	13.52	9.56	220.69	1595.38	36.68	112.97	1925.05	19.73	2.44	2.25:1[2]
% kcal from Macronutrients[3]	-	-	18	69	-	18	-	-	-	-	-	-	-	-	-	-
DRI	-	-	0.8 g/kg	130	38/25[4]	-	-	2.4	600	1000	14/32[4,5]	55	1500	11/8[4]	1.6/1.1[4]	2:1-4:1[6]
% DRI	-	-	adequate to 242 lb.	263	146/222[7]	-	-	398	38	160	262/115[7]	205	128	179/247[7]	153/222[7]	falls within recommended range
Adjusted Recommendation for Vegetarians			1 g/kg	-	-	-	-	-	-	-	-	-	-	29/21[4]	-	-
% Adjusted Recommendation	-	-	adequate to 194 lb.	-	-	-	-	-	-	-	-	-	-	68/94[7]	-	-

[1] Based on mean nutrient contribution of representative foods in each food group.

[2] Total (n-6)/(n-3) ratio listed as an overall diet ratio. Overall diet ratio determined by calculating the proportion of the total number of servings the recommended number of servings of each individual food group comprises, multiplying the food group-specific proportion values by the (n-6)/(n-3) ratio specific to each food group, summing these products, and lastly, dividing by the total number of food groups.

[3] Acceptable Macronutrient Distribution Ranges, as established by the Food and Nutrition Board are as follows: protein- 10-35% of total kcal, carbohydrates- 45-65% of total kcal, fat- 20-35% of total kcal.

[4] Listed as male/female recommendations.

[5] DRI for iron listed is specific to the vegetarian population.

[6] Recommendation based on DRI of <4:1 and the vegetarian-specific range suggested by Davis and Kris-Etherton (75).

[7] Listed as percent male/female recommendations.

TABLE C4 Nutrient Contribution from the Recommended Number of Servings of Each Food Group in the 2000 kcal Vegan Diet Plan[1]

Food Group	Number of Servings	Energy (kcal)	Protein (g)	Carbohyrates (g)	Fiber (g)	Total Fat (g)	Saturated Fat (g)	Vitamin B-12 (µg)	Vitamin D (IU)	Calcium (mg)	Iron (mg)	Selenium (µg)	Sodium (mg)	Zinc (mg)	Omega-3 Fatty Acids (g)	(n-6)/(n-3) Ratio
Grains	8	839.28	26.24	174.08	22.56	9.36	1.60	7.36	75.76	315.84	27.76	59.60	901.52	9.44	1.12	15.80
Fruit and Dried Fruit	3	272.34	3.45	63.87	8.88	2.55	0.36	0.00	0.00	64.14	1.23	1.41	18.42	3.15	0.09	2.47
Vegetables	4	171.64	7.88	37.56	9.84	1.32	0.28	0.00	2.04	104.44	2.52	9.00	93.48	1.48	0.52	3.24
Green Leafy Vegetables	3	82.14	6.99	15.75	6.75	1.02	0.15	0.00	0.00	379.08	4.14	2.67	185.10	0.81	0.24	1.35
Nuts, Nut Butters, and Seeds	2	183.82	5.92	6.88	2.98	16.62	1.94	0.00	0.00	34.66	1.34	4.44	2.66	1.38	0.62	268.09
Beans and Quinoa	5	323.55	19.30	57.60	17.05	2.55	0.35	0.30	35.65	98.10	5.90	27.40	141.40	2.65	0.20	5.04
Dairy and Eggs	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Soy and Dairy Substitutes	1	86.90	4.83	11.30	0.93	2.57	0.30	0.81	46.64	154.12	0.80	1.20	167.74	0.69	0.08	7.96
Total	26	1959.67	74.61	367.04	68.99	35.99	4.98	8.47	160.09	1150.38	43.69	105.72	1510.32	19.60	2.87	3.96:1[2]
% kcal from Macronutrients[3]	-	-	15	75	-	17	-	-	-	-	-	-	-	-	-	-
DRI	-	-	0.8 g/kg	130	38/25[4]	-	-	2.4	600	1000	14/32[4,5]	55	1500	11/8[4]	1.6/1.1[4]	2:1-4:1[6]
% DRI	-	-	adequate to 205 lb.	282	182/276[7]	-	-	353	27	115	312/137[7]	192	101	178/245[7]	179/261[7]	falls within recommended range
Adjusted Recommendation for Vegetarians			1 g/kg	-	-	-	-	-	-	-	-	-	-	29/21[4]	-	-
% Adjusted Recommendation	-	-	adequate to 164 lb.	-	-	-	-	-	-	-	-	-	-	68/93[7]	-	-

[1] Based on mean nutrient contribution of representative foods in each food group.

[2] Total (n-6)/(n-3) ratio listed as an overall diet ratio. Overall diet ratio determined by calculating the proportion of the total number of servings the recommended number of servings of each individual food group comprises, multiplying the food group-specific proportion values by the (n-6)/(n-3) ratio specific to each food group, summing these products, and lastly, dividing by the total number of food groups.

[3] Acceptable Macronutrient Distribution Ranges, as established by the Food and Nutrition Board are as follows: protein- 10-35% of total kcal, carbohydrates- 45-65% of total kcal, fat- 20-35% of total kcal.

[4] Listed as male/female recommendations.

[5] DRI for iron listed is specific to the vegetarian population.

[6] Recommendation based on DRI of <4:1 and the vegetarian-specific range suggested by Davis and Kris-Etherton (75).

[7] Listed as percent male/female recommendations.

TABLE C5 Nutrient Contribution from the Recommended Number of Servings of Each Food Group in the 2500 kcal Lacto-Ovo-Vegetarian Diet Plan[1]

Food Group	Number of Servings	Energy (kcal)	Protein (g)	Carbohyrates (g)	Fiber (g)	Total Fat (g)	Saturated Fat (g)	Vitamin B-12 (µg)	Vitamin D (IU)	Calcium (mg)	Iron (mg)	Selenium (µg)	Sodium (mg)	Zinc (mg)	Omega-3 Fatty Acids (g)	(n-6)/(n-3) Ratio
Grains	8	839.28	26.24	174.08	22.56	9.36	1.60	7.36	75.76	315.84	27.76	59.60	901.52	9.44	1.12	15.80
Fruit and Dried Fruit	4	363.12	4.60	85.16	11.84	3.40	0.48	0.00	0.00	85.52	1.64	1.88	24.56	4.20	0.12	2.47
Vegetables	5	214.55	9.85	46.95	12.30	1.65	0.35	0.00	2.55	130.55	3.15	11.25	116.85	1.85	0.65	3.24
Green Leafy Vegetables	2	54.76	4.66	10.50	4.50	0.68	0.10	0.00	0.00	252.72	2.76	1.78	123.40	0.54	0.16	1.35
Nuts, Nut Butters, and Seeds	2	183.82	5.92	6.88	2.98	16.62	1.94	0.00	0.00	34.66	1.34	4.44	2.66	1.38	0.62	268.09
Beans and Quinoa	4	258.84	15.44	46.08	13.64	2.04	0.28	0.24	28.52	78.48	4.72	21.92	113.12	2.12	0.16	5.04
Dairy and Eggs	4	491.52	39.56	38.08	0.00	19.96	13.20	2.84	112.44	889.88	1.16	38.36	862.68	4.44	0.24	2.28
Soy and Dairy Substitutes	1	86.90	4.83	11.30	0.93	2.57	0.30	0.81	46.64	154.12	0.80	1.20	167.74	0.69	0.08	7.96
Total	30	2492.79	111.10	419.03	68.75	56.28	18.25	11.25	265.91	1941.77	43.33	140.43	2312.53	24.66	3.15	3.04:1[2]
% kcal from Macronutrients[3]	-	-	18	67	-	20	-	-	-	-	-	-	-	-	-	-
DRI	-	-	0.8 g/kg	130	38/25[4]	-	-	2.4	600	1000	14/32[4,5]	55	1500	11/8[4]	1.6/1.1[4]	2:1-4:1[6]
% DRI	-	-	adequate to 306 lb.	322	181/275[7]	-	-	469	44	194	310/135[7]	255	154	224/308[7]	197/286[7]	falls within recommended range
Adjusted Recommendation for Vegetarians			1 g/kg	-	-	-	-	-	-	-	-	-	-	29/21[4]	-	-
% Adjusted Recommendation	-	-	adequate to 244 lb.	-	-	-	-	-	-	-	-	-	-	85/117[7]	-	-

[1] Based on mean nutrient contribution of representative foods in each food group.

[2] Total (n-6)/(n-3) ratio listed as an overall diet ratio. Overall diet ratio determined by calculating the proportion of the total number of servings the recommended number of servings of each individual food group comprises, multiplying the food group-specific proportion values by the (n-6)/(n-3) ratio specific to each food group, summing these products, and lastly, dividing by the total number of food groups.

[3] Acceptable Macronutrient Distribution Ranges, as established by the Food and Nutrition Board are as follows: protein- 10-35% of total kcal, carbohydrates- 45-65% of total kcal, fat- 20-35% of total kcal.

[4] Listed as male/female recommendations.

[5] DRI for iron listed is specific to the vegetarian population.

[6] Recommendation based on DRI of <4:1 and the vegetarian-specific range suggested by Davis and Kris-Etherton (75).

[7] Listed as percent male/female recommendations.

TABLE C6 Nutrient Contribution from the Recommended Number of Servings of Each Food Group in the 2500 kcal Vegan Diet Plan[1]

Food Group	Number of Servings	Energy (kcal)	Protein (g)	Carbohyrates (g)	Fiber (g)	Total Fat (g)	Saturated Fat (g)	Vitamin B-12 (µg)	Vitamin D (IU)	Calcium (mg)	Iron (mg)	Selenium (µg)	Sodium (mg)	Zinc (mg)	Omega-3 Fatty Acids (g)	(n-6)/(n-3) Ratio
Grains	10	1049.10	32.80	217.60	28.20	11.70	2.00	9.20	94.70	394.80	34.70	74.50	1126.90	11.80	1.40	15.80
Fruit and Dried Fruit	4	363.12	4.60	85.16	11.84	3.40	0.48	0.00	0.00	85.52	1.64	1.88	24.56	4.20	0.12	2.47
Vegetables	6	257.46	11.82	56.34	14.76	1.98	0.42	0.00	3.06	156.66	3.78	13.50	140.22	2.22	0.78	3.24
Green Leafy Vegetables	3	82.14	6.99	15.75	6.75	1.02	0.15	0.00	0.00	379.08	4.14	2.67	185.10	0.81	0.24	1.35
Nuts, Nut Butters, and Seeds	2	183.82	5.92	6.88	2.98	16.62	1.94	0.00	0.00	34.66	1.34	4.44	2.66	1.38	0.62	268.09
Beans and Quinoa	7	452.97	27.02	80.64	23.87	3.57	0.49	0.42	49.91	137.34	8.26	38.36	197.96	3.71	0.28	5.04
Dairy and Eggs	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Soy and Dairy Substitutes	1	86.90	4.83	11.30	0.93	2.57	0.30	0.81	46.64	154.12	0.80	1.20	167.74	0.69	0.08	7.96
Total	33	2475.51	93.98	473.67	89.33	40.86	5.78	10.43	194.31	1342.18	54.66	136.55	1845.14	24.81	3.52	3.34:1[2]
% kcal from Macronutrients[3]	-	-	18	67	-	20	-	-	-	-	-	-	-	-	-	-
DRI	-	-	0.8 g/kg	130	38/25[4]	-	-	2.4	600	1000	14/32[4,5]	55	1500	11/8[4]	1.6/1.1[4]	2:1-4:1[6]
% DRI	-	-	adequate to 258 lb.	364	235/357[7]	-	-	435	32	134	390/171[7]	248	123	226/310[7]	220/320[7]	falls within recommended range
Adjusted Recommendation for Vegetarians			1 g/kg	-	-	-	-	-	-	-	-	-	-	29/21[4]	-	-
% Adjusted Recommendation	-	-	adequate to 207 lb.	-	-	-	-	-	-	-	-	-	-	86/118[7]	-	-

[1] Based on mean nutrient contribution of representative foods in each food group.

[2] Total (n-6)/(n-3) ratio listed as an overall diet ratio. Overall diet ratio determined by calculating the proportion of the total number of servings the recommended number of servings of each individual food group comprises, multiplying the food group-specific proportion values by the (n-6)/(n-3) ratio specific to each food group, summing these products, and lastly, dividing by the total number of food groups.

[3] Acceptable Macronutrient Distribution Ranges, as established by the Food and Nutrition Board are as follows: protein- 10-35% of total kcal, carbohydrates- 45-65% of total kcal, fat- 20-35% of total kcal.

[4] Listed as male/female recommendations.

[5] DRI for iron listed is specific to the vegetarian population.

[6] Recommendation based on DRI of <4:1 and the vegetarian-specific range suggested by Davis and Kris-Etherton (75).

[7] Listed as percent male/female recommendations.

APPENDIX D

DETAILED NUTRIENT ANALYSES OF SAMPLE LACTO-OVO-VEGETARIAN AND VEGAN MENUS

TABLE D1 Detailed Nutrient Analysis of 1500 kcal Lacto-Ovo-Vegetarian Sample Menu[1]

Name of Food	Serving Size	Weight (g)	Energy (kcal)	Protein (g)	Carbohyrates (g)	Fiber (g)	Total Fat (g)	Saturated Fat (g)	Vitamin B-12 (µg)	Vitamin D (IU)	Calcium (mg)	Iron (mg)	Selenium (µg)	Sodium (mg)	Zinc (mg)	Omega-3 Fatty Acids (g)	(n-6)/(n-3) Ratio
Fortified Nonfat Plain Yogurt	1/2 cup	113.5	55.0	5.00	7.50	0.00	0.00	0.00	0.24	50.00	200.00	0.00	-	80.00		-	-
Strawberries	8 large	147	47.04	0.98	11.29	2.94	0.44	0.03	0	0	23.52	0.60	0.59	1.47	0.21	0.10	1.29
Granola (low fat)	1/2 cup	49	189.63	3.92	39.94	2.99	2.55	0.64	5.98	40.18	19.11	1.81	8.48	107.31	3.77	0.01	55.67
Flaxseed	2 tbsp	14.00	74.76	2.56	4.04	3.82	5.90	0.51	0.00	0.00	35.70	0.80	3.56	4.20	0.61	3.19	0.26
Fortified Orange Juice	1 cup	-	110.00	2.00	26.00	0.00	0.00	0.00	-	100	350.00	0	-	0	-	-	-
Popcorn (low fat)	3 c, popped	24	101.76	3.02	17.28	3.41	2.28	0.34	0.00	0.00	2.64	0.55	2.06	212.16	0.92	0.06	0.80
Lentils	1/4 cup	49.50	57.42	4.46	9.96	3.91	0.19	0.02	0.00	0.00	9.41	1.65	1.39	0.99	0.63	0.02	3.50
Quinoa	1/2 cup	92.50	111.00	4.07	19.70	2.59	1.78	-	0.00	-	15.73	1.38	2.59	6.48	1.01	-	-
Tomato	1 cup	180	32.40	1.58	7.00	2.16	0.36	0.05	0.00	0.00	18.00	0.49	0.00	9.00	0.31	0.00	0.00
Spinach	2 cups raw	60	13.80	1.72	2.18	1.32	0.23	0.04	0.00	0.00	59.40	1.63	0.60	47.40	0.32	0.08	0.21
WW Pita	4 inch	28	74.48	2.74	15.40	2.07	0.73	0.11	0.00	0.00	4.20	0.86	12.32	148.96	0.43	0.01	20.00
Dried Apricot	1/4 cup	32.5	78.33	1.10	20.36	2.37	0.17	0.01	0.00	0.00	17.88	0.86	0.72	3.25	12.68	0.00	0.00
Fortified Tofu[2]	2 oz	-	46.67	4.67	1.33	0.45	2.00	0.00	0.32	53.20	133.00	0.72	-	0.00	-	-	-
Brown Rice	1/2 cup cooked	97.5	109.20	2.26	22.92	1.76	0.81	0.17	0.00	0.00	9.75	0.52	-	0.98	0.60	0.01	28.00
Broccoli	1 cup	71	19.88	2.12	3.72	2.13	0.25	0.04	0.00	0.00	34.08	0.62	2.13	19.17	0.28	0.13	0.31
Bok Choy	1 cup cooked	170	20.40	2.65	3.03	1.65	0.27	0.03	0.00	0.00	158.10	1.77	0.68	57.80	0.29	0.07	0.75
Bell Pepper	1/2 cup	74.5	14.90	0.64	3.32	1.27	0.13	0.04	0.00	0.00	7.45	0.25	0.00	2.24	0.10	0.01	5.00
Asparagus	1/2 cup	121	26.62	2.90	4.97	2.42	0.27	0.06	0.00	0.00	27.83	1.10	7.38	16.94	0.73	0.04	2.67
Bran Chex	1 cup	62.67	205.66	4.33	52.71	7.59	1.62	0.30	2.00	53.30	133.55	21.61	4.95	353.63	5.00	0.03	20.50
Skim Milk	1/2 cup	245	41.7	4.13	6.08	0.00	0.10	0.07	0.61	57.58	149.45	0.04	3.80	51.45	0.51	0.00	0.00
Totals	-	-	1430.59	56.86	278.73	44.84	20.07	2.47	9.15	354.25	1408.79	37.26	51.24	1123.41	28.39	3.76	-
% kcal from Macronutrients[2]	-	-		16	78	-	13	-	-	-	-	-	-	-	-	-	-
DRI	-	-		0.8 g/kg	130	38/25[3]	-	-	2.4	600	1000	14/32[3,4]	55	1500	11/8[3]	1.6/1.1[3]	2:1-4:1[5]
% DRI	-	-	-	adequate to 156 lb.	214	118/179[6]	-	-	381	59	132	266/116[6]	93	75	258/354[6]	235/342[6]	-
Adjusted Recommendation for Vegetarians			-	1 g/kg	-	-	-	-	-	-	-	-	-	-	29/21[3]	-	-
% Adjusted Recommendation	-	-	-	adequate to 125 lb.	-	-	-	-	-	-	-	-	-	-	98/135[6]	-	-

[1] Based on mean nutrient contribution of representative foods in each food group.

[2] Acceptable Macronutrient Distribution Ranges, as established by the Food and Nutrition Board are as follows: protein- 10-35% of total kcal, carbohydrates- 45-65% of total kcal, fat- 20-35% of total kcal.

[3] Listed as male/female recommendations.

[4] DRI for iron listed is specific to the vegetarian population.

[5] Recommendation based on DRI of <4:1 and the vegetarian-specific range suggested by Davis and Kris-Etherton (75).

TABLE D2 Detailed Nutrient Analysis of 1500 kcal Vegan Sample Menu[1]

Name of Food	Serving Size	Weight (g)	Energy (kcal)	Protein (g)	Carbohyrates (g)	Fiber (g)	Total Fat (g)	Saturated Fat (g)	Vitamin B-12 (µg)	Vitamin D (IU)	Calcium (mg)	Iron (mg)	Selenium (µg)	Sodium (mg)	Zinc (mg)	Omega-3 Fatty Acids (g)	(n-6)/(n-3) Ratio
Oatmeal	1/2 cup	40.00	148.40	5.48	27.27	3.76	2.75	0.44	0.00	0.00	18.80	1.86	13.60	1.20	1.28	0.04	22.00
Banana	1 large	136.00	121.04	1.48	31.06	3.54	0.45	0.15	0.00	0.00	6.80	0.35	1.36	1.36	0.20	0.04	1.67
Flaxseed	2 tbsp	14.00	74.76	2.56	4.04	3.82	5.90	0.51	0.00	0.00	35.70	0.80	3.56	4.20	0.61	3.19	0.26
Fortified Orange Juice	1 cup		110.00	2.00	26.00	0.00	0.00	0.00	-	100.00	350.00	0.00	-	0.00	-	-	-
Popcorn (low fat)	3 c, popped	24.00	101.76	3.02	17.28	3.41	2.28	0.34	0.00	0.00	2.64	0.55	2.06	212.16	0.92	0.06	0.80
Carrot	1 medium	122.00	25.01	0.57	5.84	1.71	0.15	0.02	0.00	0.00	20.13	0.18	0.06	42.09	0.15	0.00	0.00
Celery	1/2 cup	50.00	8.00	0.35	1.49	0.70	0.09	0.02	0.00	0.00	20.00	0.10	0.20	40.00	0.07	0.00	0.00
Black Beans	1/4 cup	43.00	56.76	3.81	10.20	3.74	0.23	0.06	0.00	0.00	11.61	0.90	0.52	0.43	0.48	0.05	1.18
Pinto Bean	1/4 cup	42.75	61.13	3.85	11.21	3.85	0.28	0.06	0.00	0.00	19.67	0.89	2.65	0.43	0.42	0.06	0.71
Corn Tortilla	2 6-inch	30.00	70.00	1.00	15.00	1.00	1.00	0.00	-	-	-	-	-	5.00	-	-	-
Tomato	1 cup	180.00	32.40	1.58	7.00	2.16	0.36	0.05	0.00	0.00	18.00	0.49	0.00	9.00	0.31	0.00	0.00
Spinach	2 cups raw	60.00	13.80	1.72	2.18	1.32	0.23	0.04	0.00	0.00	59.40	1.63	0.60	47.40	0.32	0.08	0.21
Dried Apricot	1/4 cup	32.50	78.33	1.10	20.36	2.37	0.17	0.01	0.00	0.00	17.88	0.86	0.72	3.25	12.68	0.00	0.00
Quinoa	1/2 cup	92.50	111.00	4.07	19.70	2.59	1.78		0.00		15.73	1.38	2.59	6.48	1.01	-	-
Barley	1/2 cup cooked	78.50	96.56	1.77	22.15	2.98	0.35	0.07	0.00	0.00	8.64	1.04	6.75	2.36	0.64	0.02	9.50
Portabella Mushroom	1 cup	86.00	18.92	1.81	3.33	1.12	0.30	0.05	0.04	8.60	2.58	0.27	16.00	7.74	0.46	0.00	0.00
Kale	2 cup raw	134.00	67.00	4.42	13.40	2.68	0.94	0.12	0.00	0.00	180.90	2.28	1.21	57.62	0.59	0.24	0.78
Swiss Chard	2 cup raw	72.00	13.68	1.30	2.69	1.15	0.14	0.02	0.00	0.00	36.72	1.30	0.65	153.36	0.26	0.01	6.00
All Bran	1 cup	62.00	161.20	8.15	46.03	18.17	3.04	0.39	11.66	79.98	241.18	10.91	5.83	161.20	7.69	0.09	13.07
Fortified Nonfat Soy Milk	1 cup	245.00	70.00	6.00	10.00	0.75	0.00	0.00	-	100.00	250.00	1.80	-	105.00	-	0.00	0.00
Totals	-	-	1439.74	56.05	296.23	60.81	20.42	2.36	11.70	288.58	1316.36	27.59	58.35	860.27	28.07	3.88	-
% kcal from Macronutrients[2]	-	-		16	82	-	13	-	-	-	-	-	-	-	-	-	-
DRI	-	-		0.8 g/kg	130	38/25[3]	-	-	2.4	600	1000	14/32[3,4]	55	1500	11/8[3]	1.6/1.1[3]	2:1-4:1[5]
% DRI	-	-	-	adequate to 154 lb.	227	160/243[6]	-	-	488	48	132	197/86[6]	106	57	255/351[6]	243/353[6]	-
Adjusted Recommendation for Vegetarians			-	1 g/kg	-	-	-	-	-	-	-	-	-	-	29/21[3]	-	-
% Adjusted Recommendation	-	-	-	adequate to 123 lb.	-	-	-	-	-	-	-	-	-	-	97/134[6]	-	-

[1] Based on mean nutrient contribution of representative foods in each food group.

[2] Acceptable Macronutrient Distribution Ranges, as established by the Food and Nutrition Board are as follows: protein- 10-35% of total kcal, carbohydrates- 45-65% of total kcal, fat- 20-35% of total kcal.

[3] Listed as male/female recommendations.

[4] DRI for iron listed is specific to the vegetarian population.

[5] Recommendation based on DRI of <4:1 and the vegetarian-specific range suggested by Davis and Kris-Etherton (75).

[6] Listed as percent male/female recommendations.