Vegetarianism – Part 2: Nutritional Aspects of a Vegetarian Diet

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Part 1 of this series presented a philosophical and historical perspective on the practice of vegetarianism. Here, we continue our comprehensive look at this dietary regimen with an examination of the nutritional aspects of the vegetarian diet.

People who are considering a vegetarian diet will undoubtedly have questions about the nutritional value of this approach to eating. What are the advantages compared with a traditional meat-based diet? Does the vegetarian diet provide sufficient amounts of protein and other nutrients required by the body? Are there concerns about deficiencies of specific nutrients that need to be considered? Health-care providers can give a valuable service to patients by supplying them with information that answers such questions.

The Vegetarian Diet

Vegetarian diets depend heavily on the following plant foods: grains and cereals, legumes (including beans and peas), fruits and vegetables, and nuts and seeds. Some adults may be concerned that a vegetarian diet will not supply enough protein, but that notion is unfounded and outdated. Organizations such as the American Dietetic Association and the American Heart Association have stated that a vegetarian diet can meet the body's need for protein.[1,2]

Vegetarian foods contain all the essential amino acids (certain ones, such as lysine or sulfur-containing amino acids, may be present in small amounts). The practice of combining plant-based foods to complement their amino acid content – or simply eating a wide variety of plant-based foods every day – will ensure that the body receives the amino acids it needs.

The discerning use of whole grains, legumes, nuts and seeds, vegetables, sprouts, and fruit will cover the RDA of the nutrients found in meat, without the heavy cholesterol count. Many vegetarian mainstays not only are economical sources of protein but also are replete with other nutrients. A meal composed of whole grains, beans, potatoes, carrots, cabbage, spinach, and watercress, for example, provides a wide variety of nutrients.[3]

Compared with the average American, vegetarians eat less fat and more carbohydrates and still manage to fit in more than 100% of the RDA of calcium. Their intake of vitamins A, B, and C is higher as well. Vitamin B1 is more plentiful in the vegetarian diet because it is found in wheat germ, buckwheat, and legumes.[4]

Even vegetarians who do not consume dairy products can obtain enough calcium from their diet with some proper planning. While a cup of whole milk contains 288 mg of calcium, a quarter-cup of sesame seeds has 580 mg of calcium – far more than the dairy source.[5] Sesame seed butter – known in the Middle East as tahini – can be used to make a delicious, rich-tasting, high-protein addition to salads, vegetables, or pasta.

Nutritional Advantages of Vegetarianism

Plant foods contain a variety of helpful chemicals and phytonutrients that act as free-radical scavengers, protecting against the oxidation effects of normal bodily processes and degradation by environmental pollutants. Much current scientific research is focusing on the potentially healthful properties of phytonutrients. In addition, the various forms of fiber contained in plant foods help the digestive system run smoothly.

Here are some of the nutritional benefits of vegetarian eating:

Lignans. These chemical compounds, contained in plants, are classified as phytoestrogens because of their estrogenlike effects. Lignans are the focus of a growing number of researchers who are studying them, in part, for their ability to help the body's hormone systems. Research indicates that phytoestrogens may help protect against various disorders, including prostate, breast, bowel, and other cancers; cardiovascular disease; brain function disorders; menopausal symptoms; and osteoporosis.[6]

Plant lignans take a number of forms, and many of them are metabolized by human intestinal bacteria into two compounds: enterolactone and enterodiol. Precursors of these compounds are found in many vegetarian foods, such as seeds (flax, pumpkin, sunflower, poppy), whole grains (rye, oats, barley), bran (wheat, oat, rye), fruits (particularly berries), and vegetables.

Lignan studies are beginning to show positive results. Tests have found that flaxseed, very high in lignans, offers antioxidant protection in the lungs of mice, and that flaxseed lignan extract reduces cholesterol and blood sugar levels in human patients.[7,8] A study of Finnish men showed significant associations between elevated levels of the lignan byproduct enterolactone and reduced risk of death from coronary heart disease and cardiovascular disease.[9]

Sesame lignans have been shown to enhance the antioxidant effectiveness of vitamin E.[10] Sesamin and sesaminol are the most abundant of these lignans. Research shows that sesamin "works to improve liver function and accelerate the decomposition of alcohol, ... lower high blood pressure, reduce the blood cholesterol level, and prevent breast cancer."[11] Research on rats, meanwhile, "shows that sesaminol slows aging and prevents a variety of ailments, including heart disease, strokes, and diabetes."[12]

Soy protein. There are many scientific data to back the favorable claims made about soy products. Their protein contributions parallel those of meat, but they are free of the saturated fat and uric acid contained in both organic and nonorganic meat. In addition, soy foods do not contain the additives, hormones, and antibiotics used in nonorganic animal foods.

The Asian diet contains soy isoflavones, which are phytoestrogens that may be considered the counterpart of lignans. Soy isoflavones have been the subject of favorable scientific inquiry regarding their apparent beneficial health effects. Rates of prostate cancer are much lower in Japan and China than in the West, with the phytoestrogen content of soy widely hypothesized as the reason.[13]

For individuals who do not eat a lot of soy-based foods, plant matter such as cereals and grains may have effects similar to that of the rich phytoestogen-containing soy compounds found in Asian diets.[14]

Chemicals from cruciferous vegetables. Cruciferous vegetables are an important part of a healthy vegetarian diet. They contain the chemicals I3C and DIM, which can help convert estradiol to 2-hydroxyestrone and therefore help protect the body against certain cancers.

Edible cruciferous vegetables include kale, collard greens, Chinese broccoli, cabbage, brussels sprouts, kohlrabi, broccoli, broccoflower, Romanesco broccoli, cauliflower, wild broccoli, bok choy, mizuna, rapini (or broccoli de rabe), flowering cabbage, Chinese cabbage, turnip root and greens, rutabaga, Siberian kale, canola/rapeseed and greens, wrapped heart mustard cabbage, mustard seeds, tatsoi, Ethiopian mustard, radish, daikon, horseradish, wasabi, arugula (rocket), watercress, garden cress, and komatsuna.[15]

Radish, daikon, horseradish, wasabi, rocket, watercress, and garden cress do not belong to the *Brassica* category, which is usually touted as the healthful genus of cruciferous vegetables par excellence, but the literature generally points to the beneficial properties of these vegetables as well.[16]

Glucosolinate, an essential compound of cruciferous vegetables, is not released until the plant cell wall is broken. Juicing vegetables or lightly steaming them will initiate this process more efficiently than does chewing them in a raw state. Raw cruciferous vegetables are delicious in their own right, however, and should not be underestimated as sources of fiber.

High fiber content. Among the virtues of vegetarian food is its high fiber content. Fiber is contained only in plant foods, not in animal foods. It is the indigestible part of food that helps move it through the digestive tract, and increased levels are associated with lowered incidence of degenerative diseases. Even though research on the importance of fiber goes back decades, its role still is not universally accepted in the medical world. Dr. Denis Burkitt, in research conducted 35 years ago, explains that fiber has been "neglected because it contributes little nutritionally despite its important role in maintaining normal gastrointestinal function."[17]

Dietary fiber has a critical role in regulating the passage of fecal wastes. A low-fiber diet tends not to provide enough weight and bulk to fecal waste to move it through the intestinal tract properly; the waste instead becomes more concentrated and sluggish, remaining in the body longer. If an individual obtains most of his or her protein from meat, chances are that he or she is at least mildly constipated.

Burkitt's work substantiates the wisdom of the common vegetarian practice of eating "whole foods" – whole grains, whole-wheat breads and pastas, fruits and vegetables. "Many diseases common in modern western civilization have been related to the amount of time it takes food to pass through the alimentary tract, as well as to the bulk and consistency of stools," he writes. "These factors are influenced by fiber in the diet."

Lack of fiber leads to "changes in gastrointestinal behavior" that are suspect in such ailments as appendicitis, diverticulitis, gall bladder disease, cardiovascular disease, diabetes, hemorrhoids, varicose veins, hiatus hernia, and certain forms of cancer.[18] Many observers have noted that these problems occur far less often among non-Western, non-urban peoples who consume traditional high-fiber diets. Epidemiological studies have shown that the occurrence of a large-bowel disease such as diverticulitis is due to lack of fiber in the diet, a deficiency that can be attributed to the refining of carbohydrate foods.

In addition, benign and malignant tumors and ulcerative colitis are "more dependent on environmental than on genetic factors," according to Burkitt.[19] The colon's "environment" is predominantly determined by the food that passes through it. Prolonged bowel transit time also is suspect in colon and rectal cancer. Low-fiber diets not only slow digestion but also may lead to changes in the type and number of fecal bacteria. The wrong proportions or wrong type of these bacteria (or both) correspond to increased incidence and severity of bowel disease.

Folic acid. Studies have found that folic acid levels were usually higher in vegetarians than in omnivore control groups, which often were deficient in this nutrient.[20] The best sources of folic acid are fruits and vegetables. Folate can be found in the following foods: arugula, asparagus, avocados, beans, dried beans, beet greens, beets, bok choy, brewer's yeast, broccoli, brussels sprouts, cabbage, cauliflower, chard, chickpeas, citrus fruits, dandelion greens, escarole, garbanzo beans, kale, leafy green vegetables, lentils, mâche, mustard greens, orange juice, oranges, peas, pinto beans, radicchio, rapini, savoy cabbage, soybeans, Swiss chard, turnip greens, and wheat germ.

Deficiency Concerns in the Vegetarian Diet

In addition to concerns about protein intake, individuals who are considering a vegetarian diet may question whether they will obtain sufficient amounts of certain nutrients.

Iron. Obtaining enough iron is a dietary concern for non-meat-eaters. And it is true that iron from plant sources is slightly different from the iron contained in meat. Vegetarian foods that help supply a proper intake of iron include leafy green vegetables; dried fruits such as apricots, figs, and raisins; and blackstrap molasses.

In addition to consuming iron-containing foods, vegetarians would be wise to monitor their iron status. Physicians, whether in primary care, family practice, or internal medicine, and other licensed professionals can order certain blood tests from any laboratory in America to evaluate iron status. The first and most fundamental of these tests is the complete blood count (CBC) with differential, which is designated by the laboratory code CPT 85025. The CBC with differential measures the red blood cell count, hemoglobin level, and hematocrit percent, among other factors. Although the reference range for normal status will differ from one laboratory to the next, as a general rule the patient should be above the low end of a lab's reference range. In particular, women who are menstruating (and especially those with a heavy flow) should monitor their iron status periodically. The CBC with differential is an economical, inexpensive first-level test that will allow them to do so.

If one or more of the factors tested above – red blood cell count, hemoglobin level, or hematocrit percent – are below the reference range, additional tests of iron status are needed. This next level of testing would include serum iron, designated by the laboratory code CPT 83540, and total iron binding capacity (TIBC), with the laboratory code CPT 83550. The combination of low serum iron, high TIBC, and low saturation level indicates that a patient's iron status is low.[21]

If any uncertainty about iron status remains after data have been collected from the tests above, the third level of testing would be a measurement of serum ferritin, designated by the laboratory code CPT 82728. Other than a bone marrow examination, serum ferritin is the most reliable indicator of total body iron stores.[22]

Vitamin B12. Vegetarians must be careful to obtain this nutrient in sufficient quantity. While vitamin B12 is generously supplied in meat and dairy foods, most plants contain low levels of B12 or none at all.

How can vegetarians ensure that they obtain enough vitamin B12? Tempeh and miso contain high levels of this nutrient because it is produced by bacteria during fermentation. Miso contains about 0.17 mcg of vitamin B12 per 100 g (0.03 mcg per tablespoon), while tempeh has 3.9 mcg per 100 g. In addition, 100 g of miso boast 9.7 g of usable protein. Miso accounts for nearly 10% of the protein intake in modern Japan and is relied upon as a primary food staple.

Vegetarians may want to monitor their vitamin B12 status with the following blood tests, which offer a comprehensive evaluation of this nutrient: First, a laboratory can measure the patient's red blood cell mean corpuscular volume (MCV) as part of the CBC with differential blood test (designated by laboratory code CPT 85025). A significant rise in MCV – indicating that the red blood cells are enlarged – may be an important early indicator of a vitamin B12 deficiency.[23] If MCV is increasing toward the upper end of the reference range or beyond, then B12 is insufficient in the body.

Next, the patient's serum level of vitamin B12 can be measured via the test designated by laboratory code CPT 82607. In some cases, however, uncertainty about a patient's B12 status may remain even after data on MCV and serum vitamin B12 have been collected. In such cases, a more definitive (albeit expensive) test of urine methylmalonic acid (MMA) will help complete the picture. This test,

designated by the laboratory code CPT 83921, is an excellent determinant of vitamin B12 status. Indeed, there is growing evidence that elevated urine MMA levels may be a more definitive indication of early cobalamin (B12) deficiency than is MCV.[24–26]

The blood tests described above will help vegetarians identify a problem with their vitamin B12 status. But in addition to monitoring the status of this nutrient in their bodies, there is evidence that adult vegetarians also should supplement with vitamin B12. The proper dosage for any individual depends on many factors, but a reasonable place to start is with a moderate dose of 1000 to 2000 mcg per day in a sublingual form. The person's B12 status can then be tested to determine whether a higher or lower dose is indicated. Injections of vitamin B12 also are an option and are in wide use.

Another step in the testing process would be to determine the folate (folic acid) level as well, via the laboratory codes CPT 82746 and CPT 82747. Measurement of both serum and red cell folate levels is a reliable way to determine whether the folate status is adequate.[27]

Omega-3 fatty acids. These fatty acids are deficient in the diet of many Americans, and especially vegetarians who do not eat fish. Omega-3 fatty acids play an important role in preventing the negative effects of inflammation. They are involved in the synthesis of prostaglandins, a class of lipids that increase and decrease various functions relating to the inflammatory response, clotting, and the relaxation of blood vessels.[28,29]

According to the University of Maryland Medical Center, evidence shows that omega-3 fatty acids "reduce inflammation and may help lower risk of chronic diseases such as heart disease, cancer, and arthritis." In addition, they are "highly concentrated in the brain and appear to be important for cognitive (brain memory and performance) and behavioral function."[30] A website on attention deficit disorder reports that deficiencies of omega-3s have been "tied to dyslexia, violence, depression, memory problems, weight gain, cancer, heart disease, eczema, allergies, inflammatory diseases, arthritis, diabetes, and many other conditions."[31]

Vegans obtain omega-3 fatty acids from alpha-linolenic acid. According to the University of Maryland Medical Center, dietary sources of "alpha linolenic acid include flaxseeds, flaxseed oil, canola (rapeseed) oil, soybeans and soybean oil, pumpkin seeds and pumpkin seed oil, perilla seed oil, tofu, walnuts and walnut oil."[32] Researchers differ on how much alpha-linolenic acid is converted into the usable forms of eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA).[33,34] However, this conversion tends to be on the low side.

Vegetarians who eat fish can obtain omega-3 fatty acids from cold-water fish such as wild salmon, sardines, and herring. Two non-seafood sources of EPA and DHA are seaweed and edible marine algae.

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The Macrobiotic Diet

Another approach to vegetarian eating that has both advantages and disadvantages is the macrobiotic diet. Many people have embraced the principles of this diet – some in an effort to achieve optimum health and others hoping to overcome illness. Many claim that the diet has helped them deal with diseases as serious as cancer. On the other hand, doctors and others warn against forsaking traditional medical care in favor of diets.

Given these opposing views, a closer look at macrobiotics is warranted. The diet was first popularized in Japan by George Ohsawa, who was seriously ill as a teenager and cured himself with a diet that had been developed by a Japanese army doctor. Ohsawa went on to name the diet (macrobiotics) and develop and promote it.

Here, we will discuss the advantages and potential shortcomings of macrobiotics.

The potential benefits. The macrobiotic diet emphasizes high-fiber, organically grown whole foods and rejects meat, dairy products, and processed foods. These basic principles are fundamental to healthful living. Science is beginning to understand the role of animal foods, saturated fats, and simple sugars in the formation of tumor and cancer cells. Macrobiotics has been emphasizing this for more than a quarter of a century.

Macrobiotics is more than just a diet, however. It is a way of life that seeks to establish balance and harmony, optimal health, and long life. According to this philosophy, the entire universe, including the food that one consumes, is understood in terms of the dualism between expansion (yin) and contraction (yang). On the continuum from yin to yang, the extreme ends stand in complete opposition. One can reach a state of physical and spiritual harmony by achieving a balance between the yin and yang opposition. Yin is the passive, female element, responsible for such qualities as silence, stillness, cold, and darkness. Foods with yin qualities promote relaxation and expansion. Yang is the active, male element, responsible for such qualities as sound, motion, heat, and light. Foods with yang qualities promote contraction and activity.[35]

Examples of extreme yang foods are eggs, meat, poultry, and salt. Examples of extreme yin foods are sugar, chocolate, honey, saccharin, alcohol, refined flour, tropical fruits, and chemicals such as most food additives.[36] The macrobiotic diet proposes that followers avoid the extreme foods because they tend to cause imbalance and disharmony. Better choices are foods that fall in the middle of the spectrum, including grains, most vegetables, legumes, and sea vegetables.

The basic guidelines of the macrobiotic discipline are as follows: 50% of the food in any meal should be grains; approximately 25%, fresh vegetables; 10%, soups; 10%, beans and bean products; and 5%, sea vegetables. Although fish, fruit, seeds, and nuts are not recommended as such, they may be eaten occasionally. Fruits may be eaten two or three times a week, for example, and those that are locally grown are preferred. Most foods should be gently cooked, although a portion of the vegetables may be eaten raw. All foods should be organically grown and natural, unprocessed, and unaltered. Beverages should be mellow, nonaromatic, and nonstimulating.

Followers of macrobiotics are encouraged to eat mostly locally grown, seasonal foods. Michio Kushi, who was instrumental in bringing the macrobiotic way to the US, explains that different climatic regions produce different soil types that affect the chemical composition of foods grown in them. According to macrobiotics, an individual will obtain the most beneficial food qualities from seasonal foods that are grown in his or her native region.

The macrobiotic diet is specifically designed to eliminate the bodily imbalances that lead to disease, and many individuals attest to its benefits. Among the typical claims: They sleep better and for fewer hours than before, feel more vital when awake, and have better health and more energy. Many adherents believe that macrobiotics will increase in popularity as the incidence of degenerative disease increases.

The potential disadvantages. Despite the benefits of macrobiotics, there are some possible shortcomings that need to be considered as well.

They include:

- Proponents do not focus on the need for supplements, believing that all of a person's nutritional needs should be met by the diet. We do not agree that the diet alone can fulfill this role.
- Proponents do not emphasize raw-food juicing or a strong exercise regimen, both of which are essential to a long, healthy life.
- From a dietary standpoint, macrobiotics tends to rely too heavily on tamari, miso, and other high-sodium foods. Salt draws water out of the blood cells, dehydrating tissue and potentially interfering with water retention. Excessive sodium overburdens the kidneys and forces the heart to work overtime responding to dehydration, hypertension, and increased blood pressure levels. To further complicate matters, the diet discourages the intake of water and other beverages, which would ameliorate the high-sodium-intake problem.
- Macrobiotics prominently promotes the intake of starchy vegetables and sea vegetables, but not dark leafy greens, which are an important source of vitamin E, vitamin A, and calcium. Vitamin E is an antioxidant that protects the integrity of red blood cells and keeps the aging process in check. Vitamin A, or carotene, strengthens eyes and the epithelial tissues that line the passages in respiratory and digestive systems. Calcium is essential for strong bones and teeth and the prevention of degenerative skeletal disease such as osteoporosis. Dark leafy greens should not be eliminated from the diet or underused.

In sum, the macrobiotic diet offers physicians and consumers some insight into the relationship between nutrition and health. However, it should complement medical therapies rather than replace them. In addition, macrobiotics should not be viewed as the best or only alternative diet simply because it is superior to standard American fare. Perhaps macrobiotics can be improved as new information on nutrition emerges, even if that means questioning some of its basic principles. Individuals have different needs, and a dietary regimen should be flexible enough to account for wide variations in principles and applications.

Coming in Part 3: Practical aspects of the vegetarian diet, including economics and taste.

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Notes

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