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BEEF FACTS: Nutrition

Beef/Meat-Containing vs. Vegetarian Diets & Health

Recent interest in vegetarian diets is being fueled, in part, by activists trying to discredit the health benefits of animal foods such as beef. This review examines vegetarian diets and the potential health consequences of a diet deprived of meat, such as beef.

Vegetarianism: An Overview

What is a Vegetarian Diet? A vegetarian diet is broadly defined as a diet excluding animal products such as meat, poultry and fish (1). However, there is no single vegetarian eating pattern. As shown in Table 1, vegetarian diets differ widely in the extent to which animal products are excluded. A lacto-ovo-vegetarian diet – which is the most popular – is based on grains, vegetables, fruits, legumes, seeds, nuts, dairy products and eggs, but contains no meat, fish or poultry (1). A vegan diet, which is similar to the lacto-ovo-vegetarian diet but also excludes dairy products, eggs and other animal products, is one of the most restrictive vegetarian diets (1). Lack of consistency in the word "vegetarian" has led to the suggestion that it be replaced with the term "plant-based" (2,3). However, this term may be inappropriate given that a plant-based diet can still contain animal products (Table 1).

Estimates of the prevalence of vegetarianism in the U.S. vary considerably, in part because of the broad spectrum of dietary practices under the umbrella definition of "vegetarianism" (4). According to a recent poll of 968 adults, an estimated 2.5% of the population, or 4.8 million people, are vegetarians, defined as those who never eat meat, poultry or fish (5). About one-quarter of this population consumes no animal products of any kind (i.e., vegans) (5). Similarly, a survey commissioned by the National Live Stock and Meat Board found that about 2% of respondents classified themselves as vegetarians (6). However, when respondents' diets were analyzed, less than 1% consumed no red meat and even fewer consumed no meat, poultry or fish (6).

Motives for following a vegetarian eating pattern range from expected health advantages to concerns about the environment and economics to religious beliefs (1,2). For some people, young women in particular, following a vegetarian diet may be an acceptable way to mask an eating disorder (7).

Table 1. Comparison of Omnivore and Vegetarian Diets (4).

	Foods Consumed						
	Beef, pork, other red meat	Poultry	Fish, other seafood	Eggs	Milk, other dairy products	Grains, legumes, vegetables	Fruits, nuts
Omnivore	•	•	•	•	•	•	•
Semi-vegetarian*		•	•	•	•	•	•
Pollo-vegetarian		•		•	•	•	•
Pesco-vegetarian			•	•	•	•	•
Lacto-ovo-vegetarian				•	•	•	•
Lacto-vegetarian					•	•	•
Ovo-vegetarian				•		•	•
Vegan						•	•
Fruitarian							•

*The term semi-vegetarian may refer to a person who limits the amount rather than the type of flesh foods consumed.

Are Vegetarians Healthier than Omnivores? The healthfulness of vegetarian and meat-containing diets depends on food choices made within the framework of each of these diets (8,9). Several epidemiological studies indicate that vegetarians have lower morbidity and mortality from chronic degenerative diseases such as heart disease (10-12). However, "low intake of red meat does not seem to be an adequate explanation for the general good health of vegetarian populations," states Walter Willett, MD, professor of epidemiology at the Harvard School of Public Health (8). Higher intakes of fruits, vegetables, dietary fiber, antioxidants and phytochemicals from vegetarian diets than from nonvegetarian diets may contribute to vegetarians' good health (8). Nondietary aspects of a vegetarian lifestyle such as regular physical activity and abstinence from smoking and alcohol may also be contributing factors.

A common misperception is that vegetarian diets are lower in fat than meat-containing diets. Yet, a recent study of health-conscious vegetarian and nonvegetarian women aged 18 to 50 years found no differ-

ences in the women's fat, energy, or carbohydrate intakes or in their relative body weight (13).

Both vegetarian and omnivorous diets can be healthful if they are appropriately planned, include a variety of foods and are consistent with dietary guidelines (1,14,15). Current dietary guidelines to promote health and prevent disease do not recommend that meat be eliminated from the diet (14-16).

Vegetarian Diets: Nutrients of Potential Concern

Like omnivorous diets, well-planned vegetarian diets can meet dietary recommendations for essential nutrients (1). However, the more foods eliminated from the diet, the greater the risk for nutrient deficiencies (1). Including meat, such as beef, in the diet makes it easier to meet nutrient needs for vitamin B_{12}, iron and zinc – nutrients often in short supply in many Americans' diets (17,18, Table 2). A recent study found that high users of beef are more likely to meet 100% of the Daily Value (DV) for protein, iron, zinc and B-vitamins than are people consuming lower amounts of beef or non-users (19,20). Including beef in the diet also improves the overall dietary quality (19,20).

Table 2. Nutrients (% Daily Value) Provided by Beef Versus Vegetarian Alternatives (17).

	Vitamin B_{12}	Iron	Zinc	Protein
Daily Value	6 µg	18 mg	15 mg	50 g
%Daily Value*				
Beef**(3 oz)	37	14	39	50
Tofu***(1/2 cup)	0	10	8	20
Pinto Beans****(1/2 cup)	0	12	6	14
Black Beans****(1/2 cup)	0	10	6	15
Chickpeas (1/2 cup)	0	13	8	15
Peanut Butter (2T)	0	3	6	16
Almonds (1 oz)	0	7	6	12

*Daily Values are based on a caloric intake of 2,000 calories per day.
**Beef, composite of trimmed retail cuts, separable lean only, trimmed to 1/4" fat, all grades, cooked.
***Tofu, firm, prepared with calcium sulfate and magnesium chloride.
****Mature seeds, cooked, boiled, without salt.

The 2000 *Dietary Guidelines for Americans* states "Meat, fish, and poultry are major contributors of iron, zinc, and B vitamins in most American diets. If you choose to avoid all or most animal products, be sure to get enough iron, vitamin B_{12}, calcium, and zinc from other sources" (14). For vegetarians or people who exclude meat, such as beef, from their diets, the following nutrients are of potential concern.

- **Vitamin B_{12}.** Meeting dietary recommendations for vitamin B_{12} can be difficult for vegetarians, particularly vegans who exclude all animal products from their diets (1). Foods of animal origin are the major dietary source of vitamin B_{12} (1,17,21). However, further research is needed regarding how to best optimize the bioavailability of vitamin B_{12} from foods (21). Vitamin B_{12} deficiency can be very serious, leading to anemia and irreversible damage to the nervous system (22,23). Recently, severe optic neuropathy with loss of eyesight was diagnosed in a 33 year old French patient who followed a strict vegan diet for 13 years (23). Nutritional deficiencies, particularly of vitamin B_{12}, were held responsible for this patient's irreversible optic nerve damage. All vegetarians are advised to make a conscious effort to consume sufficient vitamin B_{12} from vitamin B_{12}-supplemented foods or vitamin preparations (1).

- **Iron**. Iron deficiency is the most common nutritional deficiency in the U.S., primarily affecting young children and women of childbearing age, particularly pregnant women (24,25). As many as 9% of children ages one to three are iron deficient and 3% have iron deficiency anemia (24). Among nonpregnant women ages 16 to 49, iron deficiency affects 11%, with anemia occurring in 3% to 5% of this population (24). In children, iron deficiency causes developmental delays and behavioral disturbances (26,27). Recent research indicates that iron deficiency in the early years may have long-lasting behavioral and developmental effects (28,29). In pregnancy, iron deficiency increases the risk for preterm delivery and subsequent low infant birth weight (30).

  Iron status may be compromised in vegetarians because of the lower amount and bioavailability of iron in their diets (1,31). Iron in food is present in two forms – heme iron in meat, poultry and fish and nonheme iron present in a variety of animal and plant foods (32). The absorption of heme iron (e.g., in beef) is much greater than that of nonheme iron in plant-based foods. Dietary components, such as vitamin C, can enhance non-heme iron absorption whereas phytates, tannins and phosphates in plant foods can inhibit absorption of this form of iron (32). Absorption of nonheme iron can be increased when meat, such as beef, is consumed in the same meal.

  A recent cross-over study of 21 women ages 20 to 42 who consumed lacto-ovo-vegetarian and nonvegetarian (3/4 beef, 1/4 chicken) diets for eight weeks each found that nonheme absorption was 70% lower from a vegetarian diet than from a non-vegetarian diet containing beef (33,

Figure 1. Absorption of Nonheme Iron in Vegetarian and Nonvegetarian Women (33).

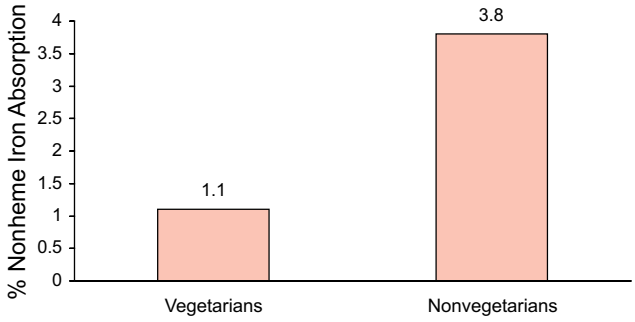


Figure 2. Differences in Zinc Metabolism Between Vegetarian and Nonvegetarian Women (41).

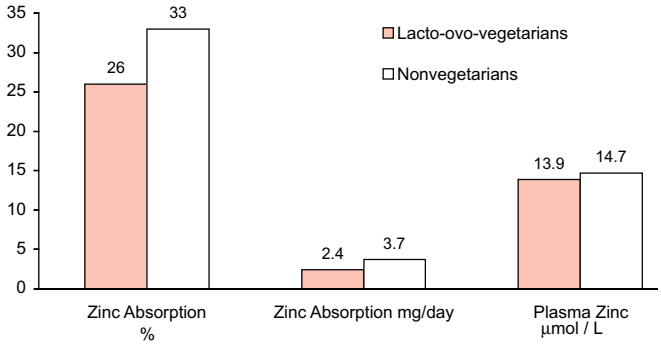


Figure 1). The iron status of vegetarians is controversial (33,34), in part because of their dietary choices and the presence of dietary enhancers and inhibitors of iron absorption (35).

- **Zinc.** Many Americans, especially young children, adolescent females and older adults are at risk for zinc deficiency (18,36). Further, there is growing appreciation for the several and potentially severe health consequences of zinc deficiency (26,37-39). These include growth retardation, male hypogonadism, changes in taste acuity, delayed wound healing, decreased immunity and impaired cognitive functions.

  Animal foods, such as meat, poultry and fish, are major sources of bioavailable zinc (17,38). Beef, for example, is the number one source of zinc in Americans' diets (31). The bioavailability of zinc from vegetarian diets may also be low owing to the presence of phytates and other substances in plant foods that inhibit zinc absorption (38,40). A 35% reduction in the total amount of zinc absorbed was found in young women who consumed a lacto-ovo-vegetarian diet compared to a nonvegetarian diet (41, Figure 2). This decrease in the amount of zinc absorbed was explained by a 21% decrease in zinc absorption efficiency and a 14% decrease in dietary zinc intake associated with the vegetarian diet (41). For vegetarians, especially vegans, meeting recommendations for zinc can be challenging (1).

- **Protein.** Unlike meat (e.g., beef) and other animal foods which provide "complete" protein, some plant proteins are "incomplete" or lacking in sufficient amounts of one or more of the essential amino acids (42). However, if a variety of plant foods is consumed over the course of a day, adequate amounts of essential amino acids can be met (1). Vegetarian diets are typically lower in protein than omnivorous diets, but vegetarians in general consume recommended amounts of protein (1).

- **Other.** Vegetarians who eliminate animal foods from their diet may restrict their intake of CLA (conjugated linoleic acid) (43,44). Animal foods provide 97.6% of the CLA consumed, with beef providing over one-third (36.2%) of this amount (19). Although the human requirement for CLA is unknown, findings from laboratory animal and *in vitro* studies indicate that specific isomers of CLA have promising health benefits ranging from reducing cancer risk, to lowering blood lipids, to altering diabetes risk and to favorably affecting body composition (43,44).

Vegetarian Population Groups At Nutritional Risk

Well-planned vegetarian diets can be nutritionally adequate for all segments of the population, especially if good sources of vitamin B_{12}, iron, zinc, calcium and vitamin D are included (1,14). However, eliminating all animal foods from the diet may not meet nutrient needs for population groups which have high nutrient needs due to accelerated growth or disease (1). For these population groups, vegetarian diets must be very carefully planned and supplemented with specific nutrients. Discussed below are some nutritional considerations related to vegetarian diets, or eliminating foods, such as meat, from the diet, at vulnerable stages of the life cycle.

- **Infancy and Childhood.** Infants breastfed by vegan mothers may develop vitamin B_{12} deficiency if their mothers' diets are not supplemented with vitamin B_{12} during lactation. Because of the risk

for neurological damage associated with vitamin B_{12} deficiency, all vegan infants should receive vitamin B_{12} supplements (1). A daily supplement of iron is recommended for all infants who are breastfed beyond 4 to 6 months (1). For very young children following vegetarian diets, supplements of vitamin B_{12} and iron may be necessary (45). Vitamin B_{12} deficiency and lower scores on intelligence tests were recently found in adolescents who had been fed a strict vegetarian diet devoid of meat up to 6 years of age (46).

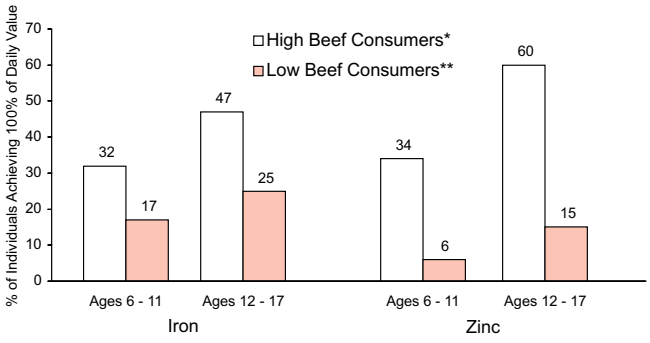
Many children ages 6 to 11 consume less than optimal amounts of iron and zinc, according to government data (18,19). Even when beef, the major dietary source of these nutrients, is included in children's diets, intakes of iron and zinc are low (19). Among children categorized as "high" consumers of beef (68 g/day or approximately 2.4 ounces), only 32% met 100% of the DV for iron and only 34% achieved 100% of the DV for zinc (19, Figure 3). For "low" (29 g/day or slightly more than one ounce) beef consumers, recommendations for iron and zinc were met by only 17% and 6% of children, respectively (19). When beef is eliminated from the diet, as in vegetarian diets, intakes of iron and zinc can be expected to be even lower. For children following a vegetarian diet, especially a vegan diet, meeting iron and zinc needs is a major challenge.

- **Older Children/Adolescents.** Similar to their younger counterparts, older children or adolescents who are "high" beef consumers still fall short of meeting 100% of the DVs for iron and zinc (19, Figure 3). As beef and other animal products are excluded from the diet of vegan adolescents, an even higher percentage of these teens will not meet recommendations for iron and zinc unless diets are well planned.

Many adolescents and young adults are motivated to consume vegetarian diets by environmental or ethical, but not health, concerns (1,47). As such, reports of nutrient deficiencies among adolescent vegetarians are not unexpected (47). For some adolescents, following a vegetarian diet may be a first step toward eating disorders, such as anorexia nervosa (7). Recent legislation allowing soy to substitute for meat (e.g., beef), poultry and seafood in school lunches and breakfasts (48) makes it especially important for students to consume well-planned diets to ensure they meet needs for essential nutrients like zinc, iron, protein and B-vitamins.

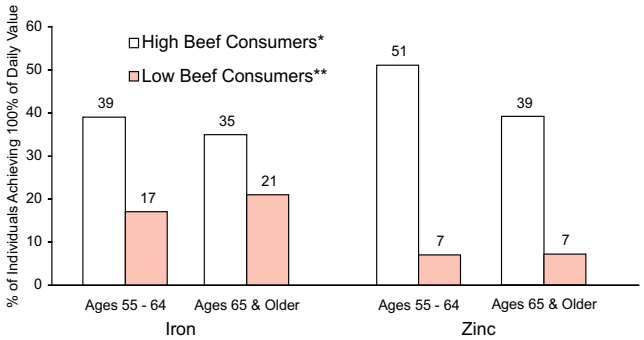
- **Pregnant and Lactating Women.** Vitamin B_{12} supplements are needed during pregnancy and lactation for women who exclude all animal foods from their diet. For both vegetarian and nonvegetarian pregnant women, iron supplements are usually recommended (30). Iron status should be monitored for all lactating women.
- **Older Adults.** Older adults who follow vegetarian diets need to pay particular attention to their intakes of iron, zinc and vitamin B_{12}. As shown in Figure 4, "high" beef consumers fail to meet 100% of the DVs for iron and zinc (19). With the elimination of beef and other animal foods from older vegetarians' diets, their risks for iron and zinc deficiencies can become even greater. Vitamin B_{12} deficiency is of concern for older adults

Figure 3. Percent of Children and Adolescents Achieving 100% of the Daily Value for Iron and Zinc Based on Tertiles of Beef Consumption Value in the U.S. (19).



*68 g/day for children ages 6 to 11 and 98 g/day for children ages 12 to 17
**29 g/day for children ages 6 to 11 and 42 g/day for children ages 12 to 17

Figure 4. Percent of Older Adults Achieving 100% of the Daily Value for Iron and Zinc Based on Tertiles of Beef Consumption Value in the U.S. (19).



*101 g/day for adults ages 55 to 64 and 87 g/day for adults ages 65 and older
**48 g/day for adults ages 55 to 64 and 36 g/day for adults ages 65 and older

– both vegetarians and omnivores – due to impaired absorption of this vitamin with advancing age (22).

Excluding all sources of meat, such as beef, from older adults' diets limits gains in fat-free mass and skeletal muscle mass achieved with resistance training, according to a recent 12-week study of 19 men ages 51 to 69 (49). The men consuming an omnivorous diet experienced greater gains in fat-free mass and skeletal muscle mass during resistance training than did the men who consumed lacto-ovo-vegetarian diets (49). Preventing loss of muscle strength and mass in later years lowers risk for many age-related disorders and helps older adults maintain their independence (49).

Summary

Like meat-containing diets, well-planned vegetarian diets can meet dietary recommendations for essential nutrients (1). However, for certain population groups including children, adolescents, pregnant and lactating women, and older adults who follow a vegetarian eating pattern, meeting nutrient needs becomes particularly challenging. This is especially true for people consuming vegan diets (1).

Eliminating meat such as beef from the diet increases risks for deficiencies of vitamin B_{12}, iron and zinc (19). Even population groups categorized as "high" consumers of beef fail to meet 100% of the DVs for iron and zinc (19). The key to a healthful diet – be it meat-containing or vegetarian – is to consume a variety of foods in moderation consistent with dietary recommendations (14,15).

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