

VEGETARIANS

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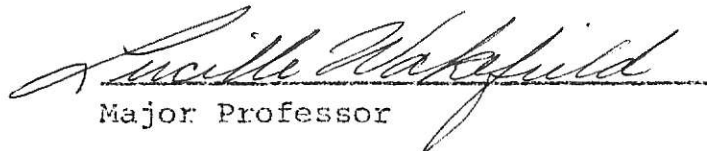
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INTRODUCTION

An individual has many varied food patterns to select from when trying to satisfy his food needs. If the individual has the objective of meeting the standards of good nutrition several of the alternative diets may be automatically eliminated. Webster defines nutrition as "the interrelated steps by which a living organism assimilates food and uses it for growth and for replacement of tissue." It can only be rated as good when the individual chooses those foods which will furnish sufficient nutrients to meet the recommended standards (1). The basic 4 food groups are an easy pattern for individuals to follow without much difficulty to achieve their nutritional needs. If one of the basic food groups were fully or partially omitted from the diet, would it still be feasible to adequately meet the standards of good nutrition? The preceding question is a very controversial topic, particularly when pertaining to vegetarianism. Vegetarianism is an old term, or maybe more correctly stated, an old habit having a come back.

The "new" vegetarian is similar, yet also very different from the vegetarian of the past. Resemblances will be found in their food habits with divergence in their beliefs and attitudes.

"Vegetarian" describes one who abstains from the consumption of meat, fowl, fish and possibly eggs and dairy products (2). Today the single term vegetarian can not adequately account for all of the varied forms of vegetarianism. Vegetarianism can be

categorized into types: Lacto-ovo-vegetarian---diet consists of vegetables, milk, cheese and eggs (3,4); Lacto-vegetarian---total vegetable diet supplemented with milk and cheese (3); Vegan or Pure Vegetarian---pure vegetable diet, avoidance of all animal foods (2,3).

Before researchers can work effectively with vegetarians to determine their food habits, additional information must be obtained (2,5). Interviews are conducted to obtain diet histories and information about vitamin and mineral supplements that are taken, and also to find the use of tobacco and alcohol. Personal data is obtained in relation to age, height, weight, occupation, education, and religion. After thoroughly questioning the individual as to his vegetarian habits they can be categorized according to the type of vegetarian and information is gained concerning his attitudes and beliefs. Many times an individual who claimed to be a vegetarian was found to be a non-vegetarian according to the diet history and interview (5).

The purpose of this paper was to become acquainted with the food habits and nutritional adequacy of the vegetarian diet. An understanding of vegetarianism is necessary before one can work effectively with a vegetarian.

REVIEW OF LITERATURE

Background and Motivations

What is the cause of this current resurgence to vegetarianism? Those who have chosen a type of vegetarianism have based their judgment on many distinct reasons, involving religion, ethics and health matters.

To the typical American, food is a matter of taste and habit, occasionally influenced by such items of controversy as cholesterol, fat, sugar, calories and salt content (6). To the vegetarian, food is of extreme importance in leading a contented, harmonious life. An opinion which may be held among vegetarians is that a well-balanced vegetarian diet encourages intellectual development, increases the capacity for mental labor and promotes longevity (6). Many vegetarians also believe they can purify their bodies and souls through a new religion and lifestyle that includes vegetarianism. The word "vegetable" is a derivative of the Latin word *vegetus*, which means "whole, sound, fresh, lively," a definition which explains why so many follow this dietary ritual (7).

Religion

Because our civilization has been strongly influenced by the teachings of the Bible, the biblical account of eating non-flesh dietaries should be considered. The scriptures stated the human diet was to consist of fruits, seeds, and nuts (Genesis 1:29) with several modifications following later. Transgression of the divine laws imposed conditions that limited productivity so the original diet was altered to include the herb, or plant itself (Genesis 3:18); thus vegetables were included in the menu. When vegetation was destroyed, permission was granted for the use of flesh as food (Genesis 9:3). Animals were preserved in the ark during the flood, with seven pairs of each type of "clean" animal and only one pair of each "unclean"

animal (Genesis 7:2). The permission to kill flesh for food evidently included only the clean animals of which more than one pair existed (8).

Today vegetarians believe that if God had meant for man to eat meat, He would have endowed him with physical characteristics similar to the carnivora. Such characteristics include claws for snaring prey, large teeth for eating, and a short gastro-intestinal tract to eliminate the animal toxins before being absorbed (7).

The Seventh-Day Adventists are a religious group of Lacto-ovo-vegetarians. The Seventh-Day Adventist Church is an evangelical religious body formed in the middle of the last century. Through their beliefs in inspiration, a health reform program was adopted very early by the members. Alcohol was first eliminated, then tobacco, and finally the flesh of animals. Lacto-ovo-vegetarianism is recommended. The Seventh-Day Adventists are a very organized group of vegetarians, with their diets based on nutritional information. Diets are planned to meet recommended allowances, yet avoid eating meat (8).

Monks abstain from eating meat because it is a luxury and, therefore, not in accordance with their motto of simple living. Buddhists and Hindus avoid meat due to their respect for animal life (6). Buddhists and Monks differ from the typical vegetarian practice in that over 60 percent of their calories come from a refined cereal, usually polished rice (9).

Vegetarianism was brought to America from England in 1817 by Reverend William Metcalf and 41 followers. Metcalf, who inspired the rapid growth of the English vegetarian society,

organized a convention of diet reformers in New York in 1850. At this convention the ground work was laid for the American Vegetarian Society (8).

The establishment of the Battle Creek Sanitarium in the late nineteenth century was the greatest American endeavor in vegetarianism. The institution's primary objective was to provide medical care through diet (6, 8). The institution became widely known for the health foods industry which grew out of the continuous experimentation to provide a wholesome, palatable, non-flesh diet (8). Dr. J.H. Kellogg was a significant contributor to the research at the institution and eventual success in development of breakfast cereals (6, 8).

Ethics

The new vegetarians share some very plausible beliefs about their diets and why they chose these diets. Ethics are by far the most important motivational factor. The highest and most significant purpose in life is spiritual development, therefore, life in all forms is sacred. All living creatures have a right to live out their normal life span. For some individuals being shown around a slaughter house or living close to or actually on a farm where animals were raised for eating may have resulted in experiences which led them to see immense cruelty in the use of animals as food. For some an extreme aversion to the actual eating of the flesh of animals may have developed in childhood or early adult life. In either case, the experience usually caused a fairly immediate decision to forsake meat and fish. A very small group of individuals may have been reared in a vegetarian household,

causing them to be unable to consider eating the flesh of animals (7, 10).

Health

Many of today's youth are interested in the emotional appeal of "back to the land". Vegetarianism appears to be a natural outgrowth of problem-ridden industrial societies. Youth are looking for a) a new economy that does not encourage abuse of technology, b) pure produce that does not require the use of chemical fertilizers or pesticides, and c) avoidance of synthetic elements in our food (3, 6, 7).

Health status may contribute to development of a vegetarian diet. If one were ill for a prolonged period, then followed a friend's advice to go on a vegetarian diet and improved, chances are he will continue to follow this diet (10). Vegetarians believe animal flesh contains toxins, virulent bacteria, impure fluids, too much uric acid and not any of the right kinds of nutrients. Pure, edible, and certain to put one on the road to good health are descriptive of foods from the vegetable kingdom (7).

Drugs

Drugs may be a related reason for the young to adopt a vegetarian diet. Experiences with drugs are said to increase spirituality or sensitivity to the life of man and animals. Drugs are on the pathway to awareness. Heightened consciousness and increased desire for pure foods are supposedly brought about by the use of drugs. Vegetarianism offers a route back to reality and to health from the sickness caused by drugs (2). The new

vegetarians may have adopted their restricted diet as a crutch which helps them to refrain from returning to drug use (11).

Vegetarianism--A Way Of Life

True vegans are rare, even among Seventh-Day Adventists (12). If one were a true vegetarian or vegan, his food habits as well as his way of living would be affected. Veganism embraces a great deal more than the rejection of specific animal foods. The Charter of the Veganism Society states this very clearly:

"Veganism is a way of living which excludes all forms of exploitation of, and cruelty to, the animal kingdom, and includes a reverence and compassion for all life. It applies to the practice of living on the products of the plant kingdom to the exclusion of flesh, fish, fowl, eggs, honey, animal milk, and its derivatives, and encourages the use of alternatives for all commodities derived wholly or in part from animals. Veganism remembers man's responsibilities to the earth and its resources and seeks to bring about a healthy soil and plant kingdom and a proper use of the materials of the earth" (10).

Vegans will, whenever possible, buy clothes and foot wear made of synthetic materials rather than animal products. Women vegans exclude the use of cosmetics made with animal products. Animal experiments, zoos and keeping of animals are all disapproved by vegans. Most vegans believe in herbal medicine with very few using vaccinations and immunizations (10).

A majority of vegetarian views on nutrition differ from those of nutritionists. They believe that conventional nutritional and

medical standards are irrelevant. Vegetarians would like to see more emphasis on preventive rather than curative "pill pushing" medicine (2).

Food Habits

Along with vegetarians there is a rise in the popularity of "health" or "natural" foods (2). Vegetarians prefer natural foods. They prefer food which has not been milled, crushed, preserved, or processed in any way and is free of additives. Frozen foods may be partially rejected because they are expensive (7, 10, 11). Vegans tend to eat little refined sucrose and take most of their sugar in the form of fruits (13). Those vegans and vegetarians who use sugar prefer brown sugar as it is a more natural product. White sugar is avoided because of the bone charcoal used in the refining process (10). The decreased amount of refined sugar consumed by vegetarians could possibly render them less prone to developing coronary thrombosis (13).

Vegan and vegetarian diets can be adequately planned to meet the nutritional requirements of all age groups. Vegetarian diets can provide sufficient calories, protein and specific amino acids for pregnancy and lactation (9, 14, 15). Table 1 gives an example of an adequate vegetarian menu. Caloric distribution of selected foods are included in Table 2. ★

Vegan and vegetarian diets are inadequate if they: a) are low in calories or b) contain a high degree of refined cereals or starchy foods (15). Adequately nourished vegetarian populations usually follow a varied dietary pattern which includes legumes, vegetables and fruits plus whole grain cereals (9).

TABLE 1

One-day vegetarian menu (14)

Breakfast	Lunch	Dinner
orange juice--4 oz.	soy patties with tomato sauce--2	vegetable soup--1
cooked oatmeal--1 c.	baked potato--1	sandwich
milk (LV)--4 oz.	margarine--1 pat	whole wheat bread
soymilk (PV)--4 oz.	cooked fresh or	2 slices
peanut butter-1 tbl.	frozen peas--2/3 c.	garbanzo-egg filling (LV)
clear hot cereal	shredded carrot	savory garbanzos (PV)
beverage if desired	salad--1/2 c.	sliced peaches--1/2 c.
	dressing--1/2 tbl.	walnut-stuffed dates--4
	wheat roll	milk (LV)--8 oz.
	margarine--1 pat.	soymilk (PV)--8 oz.
	strawberries, fresh or	
	frozen without sugar--3/4 c.	
	milk (LV)--8 oz.	
	soymilk (PV)--8 oz.	

LV = Lacto-ovo-vegetarian

PV = pure vegetarian or vegan

TABLE 2

Caloric distribution of selected foods of adult men on various diets (14)

food	per cent calories		
	non-vegetarian	lacto-ovo vegetarian	pure vegetarian
milk	10.6	16.6	2.1*
meat	12.9	--	--
cereal			
dark	5.5	16.0	13.8
white	8.8	4.5	1.4
legumes	1.2	4.0	5.7
nuts	3.4	4.5	15.0
fruits	9.3	19.0	30.0
fat, visible	10.8	8.2	11.3
desserts (sweets), including honey, syrup, molasses, soft drinks	25.0	11.9	7.0

*Soymilk

Lacto-ovo-vegetarian eating patterns closely parallel the eating habits of the typical American with the exclusion of meat. The principle substitutions for meat are milk, cheese, eggs, legumes, and some nuts (5, 16).

In one particular study, which was carried out by McKenzie in London concerning lacto-ovo-vegetarian food habits, the results indicated: 70 percent ate 4 or more eggs per week; 70 percent had more than 1 pound cheese per week, 36 percent had one to three pints of milk per week, and 35 percent had more than three pints of milk per week (10). Pure vegetarians or vegans exhibit food consciousness which is quite evident. The vegans usual dietary intake included cereals, legumes, nuts, large quantities of fruits and vegetables plus juices, vegetable oils and olives. Few desserts were consumed with liberal amounts of honey being used (10). Nearly all vegans had been vegetarians before attempting their new vegan diet. It has been indicated by most vegans that it would be impossible to go directly from an omnivore diet to a vegan diet. Most vegans are alone within their family in choosing this way of life (10).

Vegans and lacto-ovo-vegetarians refrain from the use of stimulant foods as caffeine and alcohol. They also encourage a low intake of cola drinks (5).

If vegetarianism is to rise above the fad status three major criteria must first be satisfied: a) vegetable diets must be complete with the standard daily requirements of the human body; b) vegetable diets must either alleviate or eliminate

the food problem in certain parts of the world; and c) vegetable diets must provide reinforcement for bio-ethics in regard to wildlife, agriculture and natural resources (6).

Nutritional Adequacy

Protein

Vegetarian diets are adequate in all nutrients providing special consideration is taken in the planning of these diets. The nutrient content of vegetarian diets is included in Table 3. The major concern revolves around protein and the amino acid pattern. Vegetarians have to combine several different foods to meet their daily need for protein. Fig. 1 shows how various food items may be combined to produce more complete proteins. A completely adequate protein supply can be obtained entirely from vegetable sources, if the supply of amino acids is carefully considered in the planning stages.

Vegetable and animal proteins should not be differentiated. By combining different proteins in various ways, vegetable proteins can not be distinguished nutritionally from proteins of animal origin (14). Vegetable mixtures supplying the amino acids in appropriate proportions are as efficient in meeting protein needs at minimum levels of intake as protein from animal sources (17).

Requirements for protein are much lower in healthy individuals, than what is commonly suggested if the quality is good. Minimum levels are satisfactory only when calories are fully adequate. If the calorie level is not high enough, part of the protein will be utilized for energy and protein deficiency will develop (17).

TABLE 3

Approximate nutrient composition of one-day vegetarian
diet 14, 18

nutrient	lacto-ovo vegetarian	pure vegetarian	recommended allowance*
kilocalories	2,030	2,040	2,000
protein (gm.)	78	75	46
fat (gm.)	76	77	
carbohydrate (gm.)	260	265	
calcium (mg.)	1,110	740	800
iron (mg.)	18	24.8	18
vitamin A (I.U.)	12,600	14,600	4,000
riboflavin (mg.)	2.2	2.3	1.2
thiamin (mg.)	2.5	2.9	1.0
niacin (mg.)	18.6	22.9	13.0
ascorbic acid (mg.)	185	185	45

*For women 23 to 50 years of age.

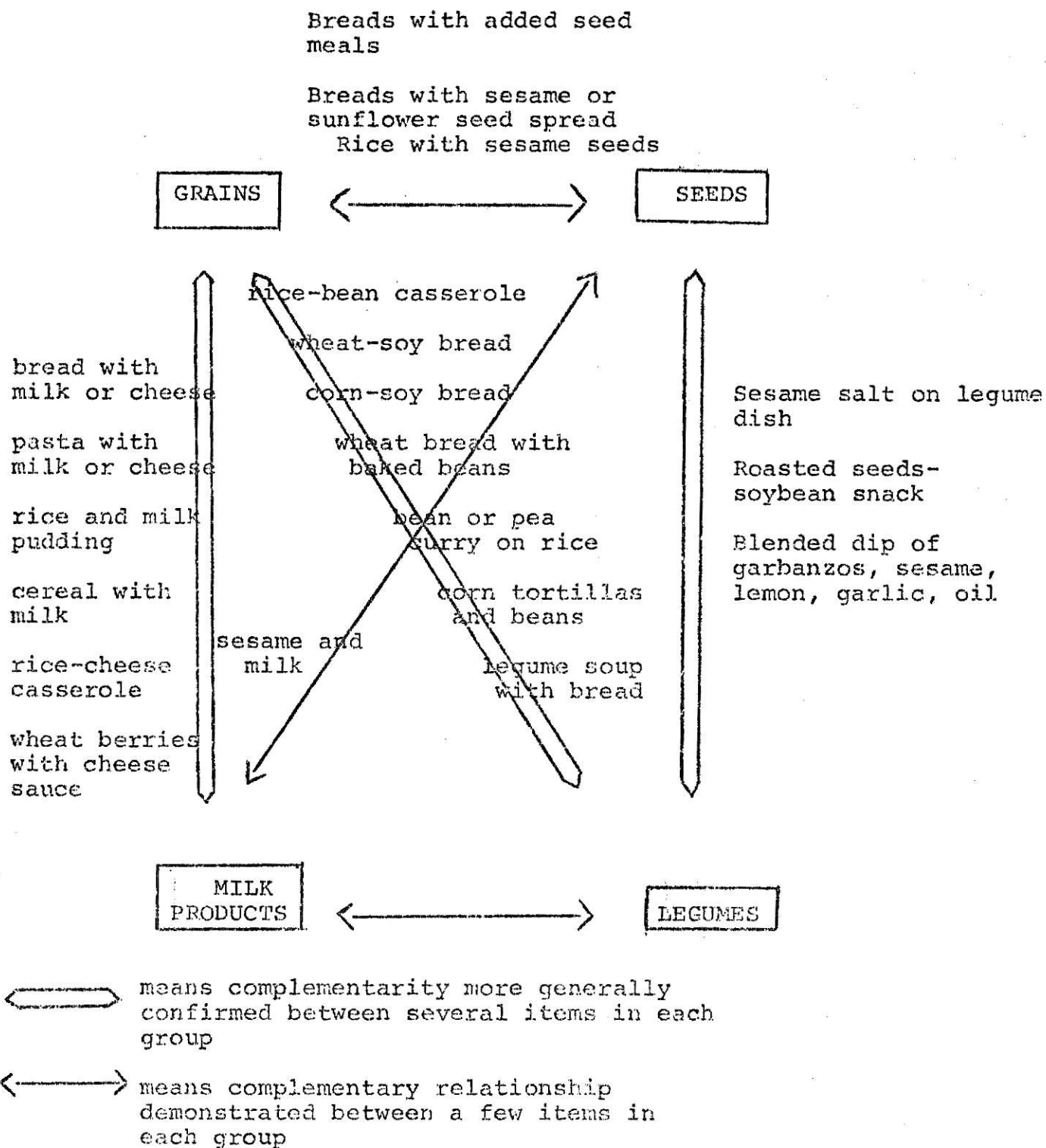


Fig. 1 Summary of Complementary Protein Relationships (19)

Biological value of proteins is determined by the amount and ratio of the essential amino acids which are supplied in the food. Protein retention is measured in relation to protein absorption with the assumption that more protein will be retained when the essential amino acids are present in sufficient quantity to meet the needs for growth. Nitrogen in the food intake plus urinary and fecal nitrogen are assessed when determining biological value. Absorbed amino acids which have been deaminated comprise urinary nitrogen. Fecal nitrogen represents that which was unabsorbed plus nitrogen from sloughed off cells. A protein with a biological value of 70 or above (70 percent of the nitrogen intake is retained) is considered capable of supporting growth, as long as the caloric value of the diet is adequate (20, 21). Egg, milk, and meat represent proteins of high biological value of 100. Low biological value proteins are peanut flour, gliaden which is a protein found in wheat, and gelatin (21, 22).

Nitrogen equilibrium has been defined as nitrogen excretion within 95-105% of the nitrogen intake (23). Normal, healthy individuals can maintain nitrogen equilibrium on protein intakes of 30-35 gm. per day. Equilibrium at 30 gm. of protein is only possible with the use of very high quality protein such as egg (23).

Complete vegetable diets are capable of achieving nitrogen balance. It would be difficult to obtain a mixed vegetarian diet to produce loss of body nitrogen without resorting to high levels of sugar, jam, jellies, and other essentially protein

Severe deficiencies of thiamin were first observed by Wernicke in 1881 (thus the name Wernicke's Syndrome; a condition, found often in old age or alcoholism marked by a loss of memory and disorientation), but it was not until later that it was definitely known that thiamin was a deciding factor in the disease. In later stages of deficiency, the peripheral nerves undergo structural changes along with changes in consciousness and irreversible damage to the cerebral structures. In the brain, lesions are found in and around the ventricular gray matter in terms of hemorrhaging, proliferation of blood vessels and glial cells with neuron degeneration (24).

The earliest of the neuromuscular diseases was defined as beri-beri, a thiamin deficiency disease, and because of this much more research has been conducted around this vitamin. Even though there is a large amount of knowledge concerning thiamin deficiencies, there have been few definite reasons for the increased susceptibility of the peripheral nerves to thiamin deficiency (25).

Early signs of biochemical changes in thiamin deficiency include hyperpyruvemia (excess accumulation of pyruvates) and decreased brain cocarboxylase (enzyme necessary for the oxidation of pyruvate). The thiamin pyrophosphate is the cocarboxylase and is also necessary for tissue metabolism. A defect in this energy metabolism system is thought to be the basis for neurological disturbances, because of the nervous systems' need for energy in its functioning. In test animals, it has also been shown that there is a significant decrease in the amount of glutamic acid produced in the brain, again relating to energy metabolism (25).

Signs of thiamin deficiency such as anorexia, depression, lassitude, loss of muscle coordination and partial paralysis could, in short, be

protein is not significantly affected if the dietary protein, whether of animal or plant origin, is above a certain level (13, 27). Hardinge and Stare found no statistical differences between albumin and globulin levels or hematological findings in vegetarians or non-vegetarians (16).

According to Swensied, nitrogen equilibrium can be achieved on a minimum amount of essential amino acids representing 0.6 gm. of nitrogen. The body tissues have a remarkable ability to synthesize the remaining amino acids required for protein formation (28). The essential amino acids are threonine, valine, leucine, isoleucine, phenylalanine, tryptophan, methionine, lysine, plus histidine for children (22). The essential amino acid content of vegetarian diets is included in Table 4.

Establishment of nutritional requirements for the sulphur amino acids methionine and cystine are of considerable importance. Peanuts, soybeans and legumes are examples of plant proteins widely used as sources of nitrogen, which are relatively low in methionine (29, 30).

Legumes are notably low in tryptophan. All cereals are deficient in lysine, and some such as corn, also have a low tryptophan level (30). The proteins of fruits and vegetables which are usually not considered important in protein nutrition may serve an important supplemental role to the cereal proteins (20).

Certain strains of corn have been discovered, such as opaque 2, which has an increased lysine and tryptophan content to equal approximately 90 percent of the nutrition of skim milk. Work has also been done with increasing the protein content of wheat (6, 20).

TABLE 4

Essential amino acids in diets of adult male
vegetarians and non-vegetarians (14)

① Amino Acid	⑫ non-vegetarian	⑬ lacto-ovo-vegetarian	⑭ pure vegetarian	⑮ *recommen- dation
isoleucine (gm.)	6.6	5.4	4.0	1.4
leucine (gm.)	10.1	8.2	6.0	2.2
lysine (gm.)	8.3	5.4	3.7	1.6
phenylalanine + tyrosine (gm.)	10.4	8.8	7.0	2.2
methionine + cystine (gm.)	4.3	3.2	2.7	2.2
threonine (gm.)*	5.0	3.8	2.9	1.0
tryptophan (gm.)	1.5	1.2	1.1	0.5
valine (gm.)	7.1	5.6	4.3	1.6
protein intake (gm.)	121.3	97.2	81.5	65.0

*Recommendation is twice the minimum of Rose's.

There has been no relationship found between tryptophan need and caloric intake required for maintaining bodyweight, or the age of the subjects (31). Tryptophan requirement for rats is influenced by the type and level of protein fed (28).

Valine is not considered to be a limiting factor in mixed foods diets. There is a great deal of variation found in the amount of valine needed for nitrogen equilibrium. Protein intake would have to be below 25 gm. before valine would be considered deficient (32). Soybeans, lentils, and peanut butter are all favorable sources of valine (22).

Individual differences in threonine requirements vary considerably due to physiological and psychosomatic influences. A decrease of threonine from minimum levels in the diet would cause an increase in nitrogen loss (24).

The variability among individuals in their requirement for leucine was greater than any of the other essential amino acids. In one particular study, the subject who needed the least amount of leucine for nitrogen balance had the highest caloric intake for the maintenance of body weight (33). Peanut flour, peanut butter and soybeans are adequate sources of leucine (22).

Individuals may experience extreme discomfort when isoleucine is deficient in the diet. Symptoms of isoleucine deficiency include loss of appetite, nausea, dryness of skin and mucous membranes, easy fatigue and headaches. An isoleucine deficient diet may cause a nitrogen loss of 1 gm. per day. Deprivation of isoleucine definitely involves metabolic changes (28).

Protein efficiency ratio involves calculating weight gain of a growing animal in relation to its protein intake when calories and protein sources are adequate. The ratio depends on the assumption that weight gain of a growing animal is in proportion to gain in body protein (21). *The protein efficiency ratio of the average vegetarian diet and its content of lysine, methionine, and tryptophan were all much lower than those of a diet containing milk proteins (34).

Signs of severe protein deficiency include falling hair, lassitude, depletion of plasma proteins, abdominal enlargement due to edema, ascites, and negative nitrogen balance. Clinical protein deficiency has not been described in American adults who are vegans, except for those individuals on a highly restricted vegetable intake as in the Zen Macrobiotic diet. *A frequent recommendation to vegetarians and especially young children is to include milk or cheese in their diet. One cup of milk, whole or skim, provides 9 gm. of protein and 7 gm. of protein can be obtained in one ounce of cheddar cheese (30).

Vitamins

Vegetarian diets have a plentiful supply of vitamins. The vitamin content of vegetarian diets depends on age and variety of plant, season of harvest, period of storage and method of cooking (25).

Adequate supplies of vitamin A are found with very little difficulty. Vitamin A occurs chiefly in the form of carotene, the provitamin present in green foods (25). One-half cup steamed spinach provides over twice the daily requirements of vitamin A. Carrots, broccoli, kale, and dandelion greens are excellent sources of vitamin A. Little vitamin A is lost under normal conditions of processing due to its high degree of stability (21).

Vitamin D is necessary to facilitate the transport of calcium across the intestinal wall (35). There are no plant sources for vitamin D. Individuals must synthesize the vitamin for themselves (25). In the presence of ultra-violet light, vitamin D is formed from its precursor 7-dehydrocholesterol (35). This same process is applied industrially in the synthesis of vitamin D to be added to margarine, milk and many infant foods. Adults will have some storage of vitamin D in their liver if reared on an omnivore or lacto-ovo-vegetarian diet. Deficiencies could possibly develop in children weaned to a vegan diet if they do not have adequate sun-bathing (25).

Fruits and vegetables provide a satisfactory supply of vitamin C for vegetarians. Beverages prepared and processed from rose hips, are known to contain substantially more vitamin C than citrus drinks (6). Vitamin C is easily destroyed by cooking methods. Adequate levels of vitamin C are more of a problem with omnivores because vegetarians eat a large percentage of their fruits and vegetables raw (25).

Vegetarians have a thiamin intake which exceeds that of omnivores because of their large consumption of grains and soybeans (15, 34). Soybeans, lima beans, peas, wheat germ and salad greens supply suitable amounts of thiamin in a vegetarian diet (6).

Lacto-ovo-vegetarians have no reason to be concerned with developing a riboflavin deficiency. Riboflavin could be deficient in vegan diets because of the low content in cereals and exclusion of milk and cheese from their diet. Alternative sources of riboflavin are spinach, asparagus and wheat germ (6, 25).

Vitamin B₁₂ is the most complex of all vitamin molecules. Vitamin B₁₂ occurs in several forms known as cobalamins because of the single cobalt atom (22).

Carefully selected vegetarian diets may furnish all nutrients and especially amino acids in sufficient amounts, but still be deficient in vitamin B₁₂ (34). Complete vegetarian diets that exclude milk products provide virtually no vitamin B₁₂ (6, 27, 30). Animals concentrate the vitamin in the liver which is a very good source of B₁₂ (25).

Intrinsic factor is responsible for the absorption of B₁₂. Efficiency of vitamin B₁₂ absorption is much greater with lower levels of B₁₂ in the diet. The liver is the principal storage site for vitamin B₁₂. The stored supply may contain 2000 to 5000 mcg. of B₁₂ which is sufficient for three to five years (15,22). The obligatory daily rate of loss of vitamin B₁₂ is about 0.1% of the body pool. A minimal daily dietary intake of 0.6 to 1.2 mcg. is adequate to maintain health, although an intake of 3 to 4 mcg. is desirable (15).

Development of vitamin B₁₂ deficiency depends on the length of time on the diet (15). Slight symptoms may take several years to show up. Children are more susceptible to deficiencies than adults. Many individuals can stay on a pure vegan diet for many years and still show signs of good health (9). There are possible explanations for certain vegans never requiring a vitamin B₁₂ supplement. These vegans could possibly be absorbing intestinal synthesized vitamin B₁₂. Another reason may be a natural enterohepatic circulation of vitamin B₁₂ and economizing their small body store (36).

Vitamin B₁₂ deficiency affects every cell in the body (13). The most common and earliest signs of B₁₂ deficiency develop in the mouth with a sore tongue. Paresthesia, which is abnormal skin sensations such as burning or itching, is fairly common. The main B₁₂ deficiencies observed in experimental studies are related to reproductive processes such as menstrual disorders. A very common characteristic of prolonged B₁₂ deficiency is gradual degeneration of the spinal cord and pains in the back, often referred to as "vegan" back (13, 37). Three main conditions associated with B₁₂ deficiency are mental disorders, nervous lesions, and megaloblastic anemia (13). Anxiety about the illness itself may be the cause of any neurotic or depressive symptoms (38).

Prolonged deficiency of B₁₂ and folic acid will result in megaloblastic anemia according to a study conducted by Ellis in London (13). The effect of cobalamin in nucleic acid synthesis, which may involve the formation of deoxyribose from ribose, is very pronounced in erythrocytes which develop quite rapidly (21, 39). Serum folate is usually high in vegans because of their increased consumption of fruits and vegetables (13, 15, 25). High folate prevents development of megaloblastic anemia in the presence of low serum B₁₂ (13, 27). It is dangerous to treat a megaloblastic anemia due to vitamin B₁₂ deficiency with folic acid. Folacin may cure the anemia, but allow an underlying neurological disease to develop (13, 21). If the megaloblastic anemia is primarily caused by vitamin B₁₂ deficiency and responds to folic acid therapy, the anemia will most likely recur (21).

Minerals

Obtaining adequate calcium in a lacto-ovo-vegetarian diet is a relatively easy task. If half the total daily calories are taken in the form of milk, cheese, fruits, and vegetables, the person could be fairly sure of a liberal calcium supply (6).

Serum calcium was found by Ellis et al to be significantly lower in vegetarians than omnivores, but both levels were within a normal range. The lower serum level is not caused by inadequate dietary sources. Omnivores exhibit a greater dissolution of bones which causes their serum calcium level to rise (40).

Osteoporosis may be defined as an absolute loss of bone substance. There is a gradual and steady decline in bone mass beginning around 35 to 45 years of age. Bone responds to an acid load by dissolution of its basic salts. The dissolution of bone may lead to liberation of basic salts, elevation of serum pH, and metabolic alkalosis (40, 41).

Acid production is related to nutrition. There is a high correlation between the amount of acid produced as reflected by the urine pH, and the amount of acid ash, therefore omnivores produce urine with an acid pH (13, 40, 41).

The therapy for osteoporosis may lie in its prevention. It might be worthwhile to consider decreasing the rate of bone dissolution by use of a diet favoring alkaline ash. Fruits, vegetables, vegetable proteins and moderate amounts of milk would contribute towards an alkaline ash (13, 41).

Vegetarians do not exhibit much more of a problem with obtaining adequate iron levels than non-vegetarians. There is

no evidence of increased iron deficiency anemia among vegetarians than in the rest of the population. Kidney and lima beans are especially high in iron as well as many leafy vegetables (6, 25).

Over a period of years, some vegetarians may ingest an excess of iron. A systemic iron overload may damage the myocardium and liver, especially in a person with a protein deficient diet (30).

Fats

The average American diet has shown an increase in total fat intake which has resulted from an increase in the consumption of meats. A slight increase in the P:S ratio has been noted because of the general tendency to substitute margarine and vegetable oils for butter and other fats. These changes in dietary fat still do not meet the recommendations of the American Heart Association. The recommendations are intended to cause a decrease in serum cholesterol and the occurrence of heart disease. Diets which meet the recommendations and are effective in lowering cholesterol contain approximately 30 percent of the total calories as fat with a P:S ratio above 1.0 (41).

Non-vegetarians who eat significantly more meat, fish, and fowl also have higher intakes of fat, saturated fatty acids, and cholesterol than vegetarians (5). Vegans have a P:S ratio approximately 5 times that of non-vegetarians, which is probably due to the different types of fat consumed. Arachidonic acid is not present in vegan diets but is easily synthesized by linoleic (27). The intake of oleic acid was found to be quite high in vegans as compared to omnivores (27, 42). Total serum

phospholipids, triglycerides, and esterified fatty acids were lower in vegans than non-vegetarians (27).

Plasma lipid levels can be lowered by the ingestion of large amounts of vegetable oils rich in linoleic acid. The type of fat consumed is more important than the total fat intake. As the P:S ratio increases the level of serum cholesterol decreases (43).

In general animal fats contain more saturated fatty acids and vegetable fats are higher in unsaturated fats. Fats of fish and other aquatic animals are comparatively low in saturated fatty acids and high in polyunsaturated fats (44).

Hospital admissions of patients with coronary heart disease were 40 percent fewer for Seventh-Day Adventist men and 15 percent fewer for Seventh-Day Adventist women than non-vegetarians who were similar in age, height, weight and sex (5). There is a high correlation between intake of saturated fats, with the sources being mainly animal products, and coronary heart disease (7).

Erhard conducted a study in San Francisco and found vegans have a lower serum cholesterol level than lacto-ovo-vegetarians or non-vegetarians. The cholesterol level was more directly affected by the intake of animal fat than by amount of total fat (7, 13). American vegans may consume up to 25 percent of their fat calories as cocoa, nut oil or in margarine (13).

Serum cholesterol level of adult Seventh-Day Adventists has been found to be significantly lower than age matched non-vegetarians. The depressed cholesterol level may be influenced by factors other than diet alone. Abstinence from tobacco, alcohol and low

intake of caffeinated beverages may be related to the lower cholesterol level (45).

The cholesterol level of non-vegetarians under 25 years of age is not affected by eating meat, fish or fowl according to West and Hayes (5). There is a physiologic mechanism in young people which is capable of equating dietary differences and maintaining lower blood cholesterol levels than older people on the same diet. As age progresses this mechanism fails. With the failing of the compensatory mechanism, cholesterol will play an increasingly significant role in elevating the serum cholesterol level (43).

Vegetarians have a significantly higher intake of fiber (5). In recent years several studies have suggested the increased fiber may possibly be a factor contributing to the lower cholesterol level. The fiber content would affect the bacterial flora, which in turn could possibly affect cholesterol metabolism (15, 46). The large fiber intake has not caused any alimentary problems and constipation is practically eliminated (46).

Reduced Weight

Vegans usually are on the average of 20 pounds lighter than x omnivores (13, 16). Intake of calories for vegetarians may be less than non-vegetarians. Obesity is less prevalent in vegetarians which is to their advantage. It is almost impossible to obtain an extremely high number of calories in vegetables and fruits due to their low caloric density. Vegetables and fruits have a high water content and low fat content (25). A

vitamin B₁₂ deficiency may be responsible for the reduced weight of vegans. It has been observed on a vitamin B₁₂ deficient diet quantities of carcass fat on rats is taken off, which could be restored by supplementing with B₁₂ (13).

Planning Vegetarian Diets

A diet devoid of meat may provide all the necessary nutrients for growth and good health if it is carefully selected and planned. The diet should contain sufficient amounts of protein from milk, eggs and cheese. Plant proteins from nuts and dry legumes must also be included (4).

The fundamental consideration when planning a vegetarian diet is to choose a wide variety of foods and use only a minimum number of refined products. The Basic 4 food groups serve as a guide for planning vegetarian diets with the major change dealing with the meat group (14).

When planning a vegetarian diet there are several guidelines to follow. The amount of empty calories should be decreased significantly. Thirty-five percent of the calories in the average American diet is made up of empty calories from concentrated sugars and sweets. Commercially prepared plant proteins are not essential but facilitate menu planning and preparation. Use of vegetarian cookbooks can be very beneficial. An increased use of nonfat or low-fat milk products, such as cottage cheese, will provide both protein and vitamin B₁₂. Cereal and bread in whole grain form should be increased due to supplying iron and B-vitamins. The extent of increase should not be so large that it would eliminate other necessary foods (14).

The following recommendations should be followed when changing from a lacto-ovo-vegetarian diet to a vegan diet. Breads and cereals need to be increased along with fruits and vegetables. Use of soybean milk, which is fortified with vitamins and minerals including calcium, phosphorus, riboflavin, and vitamin B₁₂, in place of regular milk will provide calcium, riboflavin, protein and vitamin B₁₂. Green leafy vegetables are also a very good source of calcium and riboflavin (Table 5). It is very important to obtain an adequate supply of calories. When calories are extremely low the body will utilize protein to meet its needs for energy (14).

• Vegetarian diets which have proved inadequate include: a) vegan diets that were not supplemented with vitamin B₁₂; b) vegetarian diets in which 95 percent of the calories were provided by protein low starchy foods; c) diets depending to a large extent on refined cereals such as corn meal or white rice; d) inadequate calorie intake for maintenance requirements (6, 9, 14).

Educating Vegetarians

Vegetarians have many different needs requiring an individualistic approach to work with them. These people often refuse any advice from professionals as they associate it with the establishment. Traditional approaches to nutrition proved to be very inadequate when working with vegetarian groups in Berkeley in 1971. Appealing to their faddish way of life works much better than lecturing about the "Basic Four". Moderation and variety are key words in discussions about diet with vegetarians. The ultimate goal of the discussion will be to present both sides of

TABLE 5

Greens compared with milk as sources of nutrients (14)

food*	protein	calcium	riboflavin	iron	vitamin B ₁₂
	gm.	mg.	mg.	mg.	mcg.
milk	7.0	234	340	0.2	1.2
soymilk	6.0	60	120	1.5	0.6
broccoli	7.2	206	460	2.2	
turnip greens	6.0	490	480	3.6	
greens**	6.7	305	390	3.0	
soybeans	19.6	120	260	5.0	

*1 cup or 200 gm.

**greens included: broccoli, brussels sprouts, collards, dandelion greens, kale, mustard greens, spinach, and turnip greens.

information and the final decision will be left up to the vegetarian (3).

Plant Protein vs Meat Protein

How and why has the United States acquired the reputation of being a meat oriented country? Many beliefs about meat protein have been culturally conditioned. Attitudes have designated non-meat protein sources to an inferior position. Americans are at the mercy of the advertising culture, their tastes are manipulated. To survive in the future, attitudes must be reconditioned. We must be conditioned to respond favorably to non-meat sources of protein.

Plant proteins offer an infinite array of exploration in view of sources, merchandising, and economic aspects. We should make the most of the earth's capabilities of production and minimize the disruption necessary for this production.

How does the conversion of plants to meat occur? The steer eats grass and we get steak. Man is the obvious beneficiary in this complex system. Livestock could serve as a factory in converting humanly inedible sources such as cellulose and low quality protein from plants into high quality protein for human use. Unfortunately this ideal arrangement is not taken advantage of. Enormous quantities of high quality foods are fed to animals.

Cattle do not need protein to produce protein. Why not feed cattle urea which is humanly inedible, as a source of nitrogen in place of grains? The micro-organisms which convert nitrogen into protein require protein for their growth. In order to manufacture

protein by using nitrogen from urea, carbohydrates such as those from grains must be supplied. Urea supplies only nitrogen as opposed to grain which also supplies energy, vitamins and minerals necessary to cattle (49).

United States plants one-half of its' agriculture land to feed crops. Animals consume 78 percent of the grains. Russia feeds 28 percent of their grains to animals. When trying to interpret the percentage it actually means in the United States in 1968, 20 million tons of protein which could have been eaten by man, were fed to livestock. These protein sources include 89 percent of the oat crop, 64 percent of the barley crop and 95 percent of the soybean crop (19).

Animal conversion of plant proteins to meat is very inefficient. The ratio of nutrients put into an animal to the nutrients recovered for human consumption is high. The average ratio of protein conversion in livestock in the United States is 8 to 1 (19).

The protein production ratio in North America for beef and veal is 21 to 1. A cow must be fed 21 pounds of protein to produce 1 pound of protein for human consumption (Fig. 2).

Another method for evaluating the inefficiency of livestock is by comparison with plants in the amount of protein produced per acre. An acre of cereals produces five times more protein than an acre devoted to meat production; legumes produce ten times more; and leafy vegetables fifteen times more protein (19))

With the exclusion of dairy cattle, the average ratio for protein conversion in livestock in North America is 10 to 1.

**THIS BOOK
CONTAINS
NUMEROUS PAGES
WITH DIAGRAMS
THAT ARE CROOKED
COMPARED TO THE
REST OF THE
INFORMATION ON
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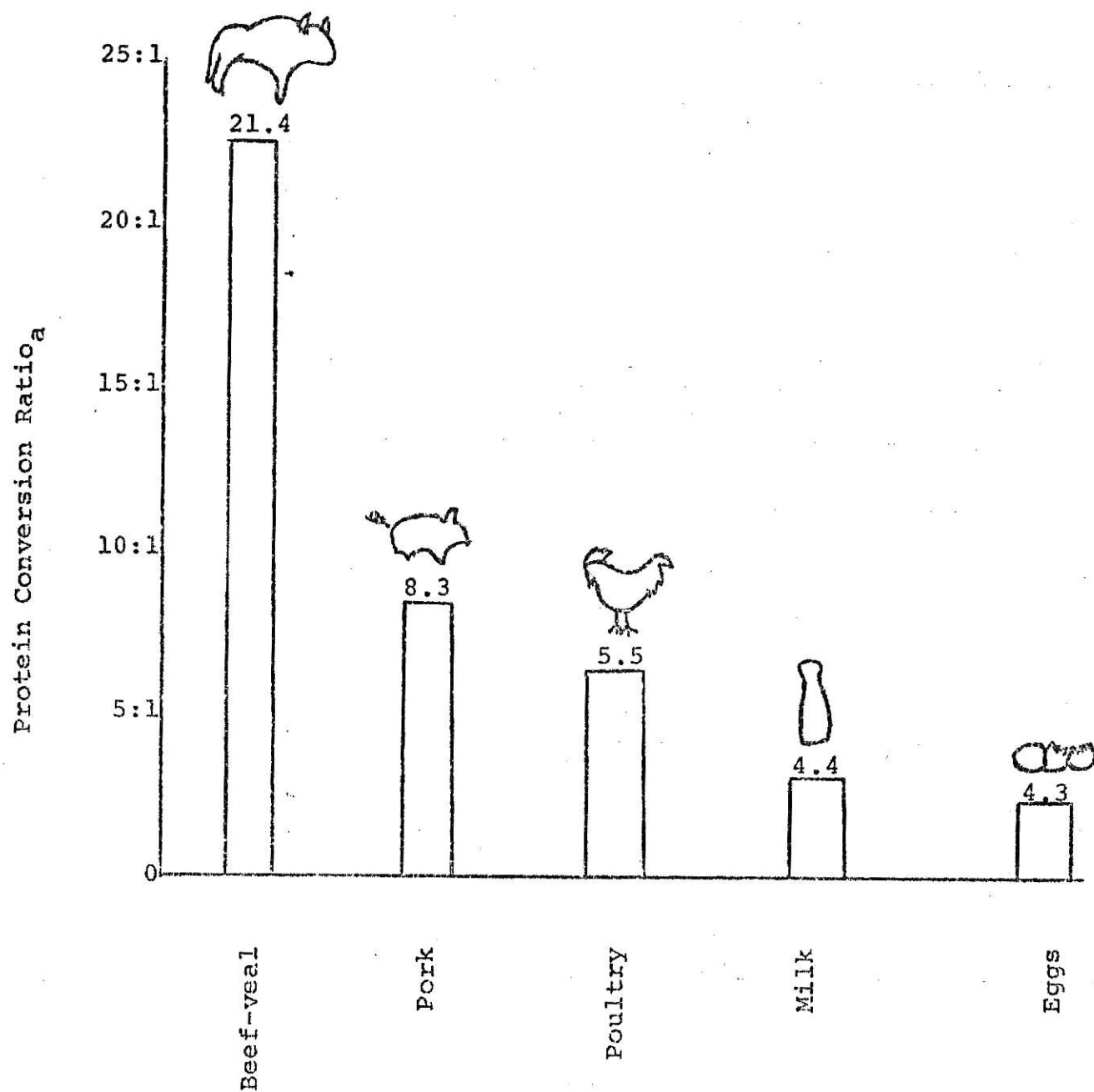


Fig. 2 Livestock Protein Conversion Efficiency (19)

a. No. of lbs. protein fed livestock to produce 1 lb. protein for human consumption.

Recognizing the 20 million tons of grains fed to livestock in 1968, a very low level of 10 percent was retrieved as protein for human consumption. Eighteen million tons of protein became inaccessible to man. This vast amount of protein would be sufficient to provide every person in the world with 12 grams of protein a day. This amount of protein would be equivalent to 90 percent of the yearly world protein deficit (19).

Heavy use of land through grazing and raising crops is depleting the soil. In 1940 Kansas wheat was 17 percent protein, 1951 the wheat was 14 percent protein and currently the wheat is about 11 to 12 percent protein (19).

Many questions need to be answered concerning protein conversion ratio and making the best use of land. Why is such a large percentage of grain fed to livestock when it could be utilized by humans? Could the protein conversion ratio be effectively decreased? Will the use of fertilizers be sufficient to postpone depletion of the soil? These questions and many others will hopefully be answered with continued research in the field of plant protein utilization (19).

Meat Substitutes

There are a wide variety of meat substitutes available made from vegetable products (4). These plant protein foods may be referred to as "meat analogs". A number of these products combine various proportions of legumes, nuts and cereals (14). Unless there is a specific reason for avoiding imitation meats, their use will provide assurance of an adequate protein intake and add

variety to the diet (4). Since these foods are made from plant sources they do not contain cholesterol or saturated animal fats (14).

Human consumption of soybeans has increased due to its high protein, phosphorous, iron and calcium content. Today the soybean is being commercially processed for humans in products such as soybean bacon, yogurt and cookies (6, 27). Possibly in the future soybeans will be more favorably accepted by a larger portion of the population as an economical and adequate source of protein.

SUMMARY

Vegetarians may be designated as either lacto-ovo-vegetarian or vegan depending on whether milk products and eggs are included in the diet. Many factors come into play when choosing a type of vegetarianism to follow. Religion, ethics, and health matters are significant forces in finalizing the decision. Ethics seems to be the main influencing factor among the new vegetarians.

Lacto-ovo-vegetarians have a diet quite similar to a non-vegetarian with the exclusion of meat. Since vegans do not consume meat, eggs, or milk products, their diet depends heavily on fruits, vegetables, and legumes.

Nutritional adequacy may be a problem with vegetarian diets if they are not carefully planned. Proteins and amino acids are a major concern. Vegetarians must combine several food types to meet their daily need for protein. Vitamins and minerals are supplied in great abundance through the vegetables and fruits except possibly vitamin B₁₂. Vegan diets, which exclude milk products, provide no vitamin B₁₂. Vitamin B₁₂ deficiency affects every cell in the body and may take three to five years to occur.

Obtaining adequate calcium in a lacto-ovo-vegetarian is a relatively easy task. Fruits, vegetables, and soymilk would provide calcium for vegans. The occurrence of osteoporosis may be reduced in vegetarians more than omnivores because of their diet favoring alkaline ash.

Saturated fats and cholesterol are higher in non-vegetarians than vegans. Vegans have a P:S ratio approximately five times that of non-vegetarians.

Vegetarians must be dealt with in an individualistic manner when trying to advise them about their diet. Appealing to their faddish way of life works much better than the traditional lecturing method.

A large percentage of grains are fed to cattle for the production of meat. Animal conversion of plant proteins to meat is very inefficient. A cow must be fed 21 pounds of protein to produce 1 pound of protein for human consumption.

There is increasing availability of meat substitutes today. These products combine varying proportions of legumes, nuts and cereals. The meat analogs provide assurance of an adequate protein intake plus adding variety to the diet.

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VEGETARIANS

by

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ABSTRACT

Many factors come into play when deciding whether or not to be a vegetarian. Religion, ethics and health matters all make significant contributions towards finalizing the decision.

Vegetarians must carefully plan their diets to achieve nutritional adequacy. Several different foods must be combined for vegetarians to meet their daily need of protein. Vitamin B₁₂ offers a possible problem. Vegans who have no intake of milk or milk products could develop vitamin B₁₂ deficiency. Saturated fats and cholesterol level are significantly higher in non-vegetarians than vegans due to the different types of fat consumed.

Grains are fed to livestock to produce the steaks we eat. Animal conversion of plant protein to meat is very inefficient. Cattle must be fed 21 pounds of protein to produce 1 pound of protein for human consumption.

Varying proportions of legumes, nuts, and cereals are combined for substitute meat products used by many vegetarians. Meat analogs provide assurance of an adequate protein intake plus add variety to the diet.