

Overview

Proteins are made up of smaller organic chemicals called amino acids. When proteins are digested, they are broken down into their constituent amino acids before being absorbed into the bloodstream. The body then uses these amino acids to build the kinds of proteins it needs to maintain and repair body tissues such as muscles and organs, and to grow.

There are 20 amino acids. Eleven of these amino acids can be made by the body itself, while the other nine (called Essential Amino Acids) must be obtained from food. The classification of an amino acid as essential or non-essential does not reflect its importance, because all 20 amino acids are necessary for health.

The dietary requirement for protein has two components: total nitrogen requirement (represented by essential plus non-essential amino acids), and requirements for essential amino acids. In assessing dietary protein sources, both need to be considered, as the amount of food protein needed to meet the protein requirement will depend not only on its amount and digestibility, but also on its content of essential amino acids.

Plant Sources of Protein

Plant sources of protein alone can provide adequate amounts of the essential and non-essential amino acids, assuming that dietary protein sources from plants are varied and that total calorie intake is sufficient to meet energy needs. Whole grains, legumes (beans), vegetables, seeds, and nuts, as well as commercial meat alternatives, all contain essential and non-essential amino acids.

Some plant foods are low in one kind of amino acid (e.g. grains are low in lysine), while other plant foods are higher in that amino acid (e.g. legumes are quite high in lysine). So by eating a well balanced diet that contains a variety of foods it is possible to obtain all the amino acids that the body requires. Note that while recent research shows that soy contains all essential amino acids, and is therefore a complete protein source, in my opinion it is preferable to have a varied diet and not depend on one food source to meet a particular dietary need.

The American Dietetic Association and Dietitians of Canada state in their Position Statement on Vegetarian Diets:

"It is the position of the American Dietetic Association and Dietitians of Canada that appropriately planned vegetarian diets are healthful, nutritionally adequate, and provide health benefits in the prevention and treatment of certain diseases... Plant protein can meet requirements when a variety of plant foods is consumed and energy needs are met. Research indicates that an assortment of plant foods eaten over the course of a day can provide all essential amino acids and ensure adequate nitrogen retention and use in healthy adults..."

In the past it was widely believed that in order for vegetarians to obtain adequate amounts of protein, all of the essential amino acids had to be 'balanced' at each meal. For example, grains and legumes had to be consumed at the same meal. This is referred to as 'protein combining'. However, more recent research has indicated that, while consuming a proper mix of amino acids is important, it is not necessary to consume them all at the same meal.

Protein Deficiency

Protein deficiency is rare in Western countries but has wide-ranging effects on the body. Dietary protein deficiency in humans occurs principally in children in the form of kwashiorkor, although a similar syndrome is sometimes seen in severely depleted hospital patients with increased protein catabolism.

Kwashiorkor occurs most commonly in areas of famine, limited food supply, and low levels of education, which can lead to inadequate knowledge of proper diet. Early symptoms of any type of malnutrition are very general and include fatigue, irritability, and lethargy. As protein deprivation continues, growth failure, loss of muscle mass, generalised swelling (oedema), and decreased immunity occur. A large, protuberant belly is common. Skin conditions, such as dermatitis, changes in pigmentation, thinning of hair, and vitiligo (loss of skin colour) can also occur.

Protein deficiency among well-fed vegetarians and vegans is rarely a concern. A protein deficiency may be

seen when there is also a calorie deficiency, but in such cases many nutrients would be a concern. The other possible scenario of insufficient protein intake would be where a vegan has a very poor diet that is heavily dependant on fruit or refined junk food such as sugary drinks, pastries and chips.

Excess Protein Intake

Many people in Western countries consume far more protein than the body needs, causing excess nitrogen to be excreted as urea in the urine. The excess nitrogen has been linked in some studies with kidney stones and reduced kidney function in old age. Most, but not all studies have found that when people have impaired kidney function, restricting dietary intake of protein slows the rate of kidney function decline.

The Osteoporosis Link

Excessive protein intake can also increase excretion of calcium from the body, and some evidence has linked high-protein diets with osteoporosis, particularly in regard to animal protein.

Studies attempting to uncover the effects of high animal protein intake on the risk of osteoporosis have, however, produced confusing and contradictory results. The same is true of studies attempting to find out whether vegetarians are protected against osteoporosis. Moreover, while some studies report that protein supplementation lowers death rates and shortens hospital stays or reduces bone loss among people with osteoporosis, others have found that such supplementation is of little value.

These conflicting findings may occur in part because dietary protein produces opposing effects on bone. On one hand, dietary protein increases the loss of calcium in urine, which should increase the risk of osteoporosis. On the other hand, normal bone formation requires adequate dietary protein, and low dietary protein intake has been associated with low bone mineral density. Current research shows that finding the balance between too much protein and too little protein remains elusive, although extremes in protein intake - either high or low - might possibly increase the risk of osteoporosis.

Soy foods such as tempeh, soy milk, soy beans, and soy protein powders may be beneficial in preventing

osteoporosis. This is because the isoflavones from soy seem to protect against bone loss. Although the use of soy in the prevention of osteoporosis looks hopeful, no long-term human studies have examined the effects of soy or soy-derived isoflavones on bone density or fracture risk.

Although the studies mentioned above have some conflicting findings, one does wonder why in Western countries where people generally derive over three quarters of their calcium from dairy products, and generally have a calcium-rich diet, they also seem to have the highest incidences of osteoporosis in the world.

Requirements and RDI

There is much debate around the world about the Recommended Dietary Intake (RDI) for protein. The Australian National Health & Medical Research Council (NHMRC) has set the RDI for Australian adults at 0.75 g/kg body weight/day for women, and 0.84 g/kg body weight/day for men. Requirements for protein are affected by age, weight, state of health, level of activity, and other factors, and these figures cover the protein needs of 97.5% of the population (twice the coefficient of variation of requirement data). No further correction is deemed necessary with respect to protein quality as the average adult Australian diet supplies the essential amino acids at levels which would meet their needs. In Europe many countries are stating that the RDI can be as low as 0.25 g/kg body weight/day.

Most adults in the Western world eat about 100 grams of protein per day, or about twice what their bodies need and at least as much as any athlete requires.

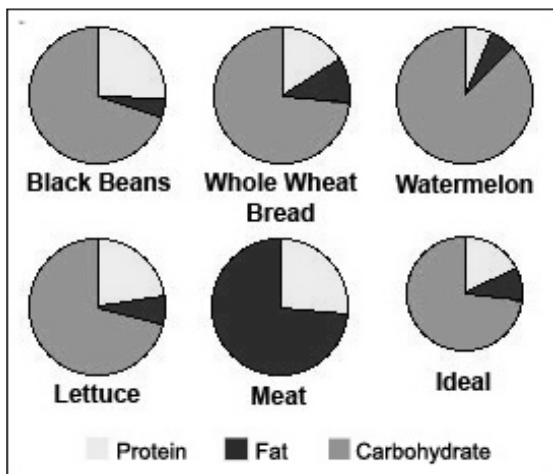
Vegetarian Dietary Sources

Although most vegetarian diets meet or exceed the Recommended Dietary Intake for protein, they often provide less protein than non-vegetarian diets. This lower protein intake may be associated with better calcium retention in vegetarians and improved kidney function in individuals with prior kidney damage. Further, lower protein intakes may result in a lower fat intake with its inherent advantages, because foods high in protein are also frequently high in fat.

In addition to this there are several advantages to eating plant rather than animal protein:

- Plant proteins do not contain any cholesterol or saturated animal fats, both of which are associated with heart disease.
- Plant proteins are rich in antioxidants, calcium, zinc, and other nutrients.
- Plant proteins are high in fibre, which reduces the risk of bowel diseases, including bowel cancer.
- Women can reduce the risk of developing breast cancer by regularly eating soy products.

For comparison, here are some common foods, showing how much of their calories comprise protein, fat and carbohydrate:



The best plant source of protein is legumes (including lentils, kidney beans, chick peas, split peas, lima beans, mung beans, baked beans etc.), and soy products such as tempeh. The highest source per 100 grams is cooked soy beans, with 13.5 grams of protein.

Quinoa is another very good source of protein with 16-20 grams per 100 grams. Quinoa can easily be added to soups, casseroles and many other dishes to enhance protein content.

Nuts and seeds are very high in protein, but because they also contain quite high levels of fat, they should be eaten in moderation. The highest sources per 100 grams are pepitas (pumpkin seeds) with 25-33 grams of protein, and peanuts with over 27 grams of protein.

Grains, such as breakfast cereals, bread, rice and pasta are lower in protein, but still contribute useful amounts to the diet. Some vegetables also add to the overall protein intake.

(Refer to the following page for a chart of common foods and their protein content.)

Summary

Protein deficiency among well-fed vegetarians and vegans is rarely a concern. By basing your protein intake around legumes, mixed nuts and quinoa, and by also regularly consuming rice, sunflower seeds, pepitas, tahini, wholegrain breads, and other protein rich foods, you can quite easily ensure that your protein requirements are met.

If you are concerned that your protein intake may not be adequate we recommended that you see an Accredited Practising Dietitian who specialises in vegetarian nutrition (refer to the Dietitians page on our website).

References

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National Food Authority (1992). *Nutritional Values of Australian Foods*. Department of Community Services and Health. Australian Government Publishing Service, Brunswick, Vic.

American Dietetic Association and Dietitians of Canada (2009). *Vegetarian Diets. Position and Practice Papers*, Volume 109, Issue 7, Pages 1266-1282 (July 2009). (<http://www.eatright.org/About/Content.aspx?id=8357&terms=vegetarian+diets>)

Myths about Vegetarianism
<http://www.all-creatures.org/mfz/myths-vegprotein-why.html>

Approximate amount of Protein in 100g food portions:

| Food (100 g) | Protein (g) | Food (100 g) | Protein (g) |
|--|-------------|---------------------------------------|-------------|
| Pepitas (pumpkin seeds) | 25-33 | Crispbread, wholemeal | 10.5 |
| Peanut butter | 27.7 | Water cracker | 9.9 |
| Wheatgerm | 24.4 | Bread, brown | 9.7 |
| Sunflower seeds | 22.7 | Muesli, toasted | 9.2 |
| Sesame seed | 22.2 | Bread, light rye | 9.0 |
| Tahini | 20.4 | Chickpeas, dried, boiled | 8.9 |
| Pistachio nut | 19.7 | Bread, white, regular | 8.6 |
| Almonds, with skin | 19.5 | Bun, fruit, glazed | 8.4 |
| Fry's vegetarian burgers | 19.2 | Haricot beans, dried, boiled | 8.2 |
| Nutrisoy Tofu-Tempeh | 18.6 | Kidney beans, dried, boiled | 7.9 |
| Quinoa | 16-20 | Pappa Nutal vegetarian burgers | 7.6 |
| Oatbran, raw | 17.3 | Australian Eatwell vegetable sausages | 6.4-8.4 |
| Cashew, raw | 17.0 | Broad bean, boiled | 6.9 |
| Wheat bran, unprocessed | 16.7 | Cake, chocolate, home prep. | 6.9 |
| Amaranth | 15-18 | Lentils, dried, boiled | 6.8 |
| Chia seeds | 15.6 | Biscuit, plain, sweet | 6.4 |
| Sanitarium tinned meat alternatives | 10.9-21.9 | Lima beans, dried, boiled | 6.4 |
| Zoglo's Vegetarian Choice meat alternatives | 12-20 | Mixed beans, canned, drained | 6.4 |
| Tempeh | 14-18 | Biscuit, chocolate | 6.2 |
| Veggie Delights (Sanitarium) meat alternatives | 10.3-21.4 | Green peas, raw | 5.8 |
| Hazelnut | 14.8 | Pasta, wholemeal, boiled | 5.8 |
| Brazil nut | 14.4 | Biscuit, oatmeal | 5.7 |
| Kingland Soy Cheddar Cheese | 13.8 | Australian Eatwell vegetable burgers | 4.6-5.5 |
| Soybeans, dried, boiled | 13.5 | Biscuit, cream | 4.9 |
| Rye flour, wholemeal | 12.8 | Broccoli, boiled | 4.7 |
| Wheat flour, wholemeal | 12.1 | Pasta, white, boiled | 4.0 |
| Pretzels | 11.7 | Fig, dried | 3.6 |
| Tofu | 10-13 | Soy milk, regular (100ml) | 3.4 |
| Breakfast biscuit, wholewheat | 11.1 | Rice, brown, boiled | 3.2 |
| Wheat flour, white | 10.8 | Redwood Cheezly | 2.8 |
| Rolled oats, raw | 10.7 | Rice, white, boiled | 2.3 |

Note: While dairy products and eggs contain protein levels as high as some of the plant-based sources listed above, the quality of the animal protein sources are inferior from a human health point of view. The conclusions of many scientific studies have correlated animal-based diets (which include dairy and eggs) with disease. The China Study for example concluded that diets high in animal protein (including casein in cow's milk) are strongly linked to diseases such as heart disease, cancer and type 2 diabetes. The authors of the study also state that osteoporosis is linked to the consumption of animal protein because animal protein, unlike plant protein, increases the acidity of blood and tissues. They add that to neutralise this acid, calcium, a very effective base, is extracted from the bones, which weakens them and puts them at greater risk for fracture. (Campbell, T. Colin (2006), *The China Study: The Most Comprehensive Study of Nutrition Ever Conducted and the Startling Implications for Diet, Weight Loss and Long-term Health*. Benbella Books, ISBN 1-932100-38-5, page 205.)