

Comparative Study of Plant and Animal Sources of Protein

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Abstract

Proteins are present in each cell of human body. Thus, proteins are essential components of daily diet to help body repair cells and make new ones. Protein is also important for growth and development in children, teens, and pregnant women. There are different sources of plant and animal proteins, and this study has attempted to analyse the differences in proteins present in plant and animal sources. The analysis of differences was done in six broad categories which are differences in presence of calories, presence of essential components of proteins, presence of fibre contents, ease of digestion, ease of absorption, alternatives of animal proteins. A comparison of nutrient contents in common sources of protein are given in the table below.

PROTEIN SOURCES							
Meat, Poultry, Eggs:				Nuts and Seeds:			
Food (Cooked)	Serving Size	Calories	Protein (g)	Food	Serving Size	Calories	Protein (g)
Chicken, skinless	3 oz	141	28	Soy Nuts	1 oz	120	12
Steak	3 oz	158	26	Pumpkin Seeds	1 oz	159	9
Turkey, roasted	3 oz	135	25	Peanuts	1 oz	166	7
Lamb	3 oz	172	23	Peanut Butter	1 Tbsp	188	7
Pork	3 oz	122	22	Almonds	1 oz	163	6
Ham	3 oz	139	14	Pistachios	1 oz	161	6
Egg, large	1 egg	71	6	Flax Seeds	1 oz	140	6
Seafood:				Dairy Products:			
Food (Cooked)	Serving Size (oz)	Calories	Protein (g)	Food	Serving Size	Calories	Protein (g)
Salmon	3	155	22	Greek Yogurt	6 oz	100	18
Tuna	3	99	22	Cottage Cheese (1% fat)	4 oz	81	14
Shrimp	3	101	20	Regular Yogurt (nonfat)	1 cup	100	11
Lobster	3	76	16	Milk, Skim	1 cup	86	8
Scallops	3	75	14	Soy milk	1 cup	132	8
Legumes, Grains, Vegetables:				Mozzarella (part skim)	1 oz	72	7
Food (Cooked)	Serving Size (cup)	Calories	Protein (g)				
Pinto Beans	½	197	11				
Lentils	½	101	9				
Black Beans	½	114	8				
Red Kidney Beans	½	112	8				
Chickpeas	½	134	7				
Black-eyed Peas	½	100	7				
Lima Beans	½	105	6				
Quinoa	½	111	4				
Peas, Green	½	59	4				
Spinach, cooked	½	41	3				

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(Source: <http://fitnessprollc.blogspot.com/>)

Introduction

Protein is a Macronutrient. It is one of the three nutrients found in the food that the body needs in large amounts. It is essential for the maintenance and building of body tissues and muscle. Proteins are made up of amino acids. Though, hundreds of amino acids exist in nature, the human body only requires 22 of these biomolecules. A human body can produce all these required amino acids except 9 of them. These 9 amino acids are called essential amino acids which must come from food. Protein deficiency includes lack of growth, loss of muscle mass, reduced immunity, weakening of heart and respiratory issues

Animal protein is a type of protein source which has an animal origin. Animal proteins are complete proteins i.e, they contain all the essential amino acids in the diet. They are 90% absorbable, 85% digestible and are low in antioxidants. However, it contains high amount of uremic toxins (organic or inorganic compounds that accumulate in body fluids of subjects with acute or chronic kidney disease and impaired kidney functions) and harbours proteolytic bacteria (helps in breaking down proteins).

There are certain nutrients which are only included in animal proteins

- Heme- iron - Available in red meat and it is readily absorbable by the human body
- Vitamin B12 - Contained in fish, meat, Poultry and dairy products
- Vitamin D - Occurs in Oily fish, eggs and dairy products
- DHA - It is an essential omega-3 fatty acid and it occurs in oily fish
- Zinc- Beef, Pork and Lamb

Though Animal proteins are complete proteins, they come with adverse health risks.

Plant protein is a type of protein source which is of plant origin. Plant proteins are incomplete proteins i.e., they provide several but not all essential amino acids in the diet. They are 60-70% absorbable and are 95% -100% digestible. However, they contain low amounts of Uremic toxins and harbours Saccharolytic bacteria (helps in breaking down sugars). A few rich sources of plant proteins include grains, Beans, nuts, legumes and a few fruits like avocado.

Eating enough protein daily is important for the development of overall health. Protein is necessary for critical processes such as immune function, cellular processes, cell structure, and growth, among others. Thus, it's essential to consume enough protein on a daily basis. There are many sources of plant and animal proteins. ***This report has attempted to study about the differences in animal and plant proteins and suitable alternatives to plant proteins.***

Characteristics and Differences: An assessment

Difference in calories of plant and animal protein

Plant protein sources are less in calories than animal protein sources. Easily available sources of plant proteins such as soyabeans have densely packed protein contents which provides more amount of proteins with just little amount of consumption, thus leading to lower calories intake. Animal protein sources are not so densely packed with proteins hence more quantity needs to be consumed to ensure the required number of proteins. Moreover, food sources from animals are more in calorific values and are associated with higher risk of cardiovascular diseases. Protein sources such as processed red meat, eggs, are often reported at the extremes of the risk range. Also, studies prove that substitution of plant protein for animal protein, especially that from processed red meat was associated with lower risks of diseases.

Articles
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Presence of essential components of proteins

Plant proteins consumption should ensure the availability of important protein components such as isoflavones as many of the plant protein sources lack these essential protein components. Studies have proved that animal protein sources are richer in essential components than plant proteins. Research conducted on people consuming only plant proteins found certain metabolic disorders prevalently than on the people who consumed both animal protein sources and mixed protein sources. The difference between animal and plant proteins lies in the number of amino acids present in them. A few of the animal's products are complete sources of protein providing all nine amino acids. These animal protein-rich foods

are fish, eggs, red meat, and poultry products like chicken. On the other hand, most plant products lack in either one or the other required essential amino acid. *Some plant proteins, such as quinoa, are complete proteins—which means they contain all 9 essential amino acids that we need.* This makes plant proteins less efficient in providing a complete protein nutrition Protein has major role in defining a person’s Healthy Eating Index which is a measurement of healthiness of the food consumed by a person. Protein from animal sources might lead to a better score on the HEI. When plant foods such as beans, peanuts, and wheat, which are rich in total protein but lack one or more of the essential amino acids, several nutritional experts combine these incomplete plant protein sources to meet the body’s needs. For instance, a peanut butter sandwich is a tasty example of a combination that results in a complete protein source. While wheat used to make bread is low in the amino acid lysine, peanuts are rich in it, resulting in a complete protein meal or snack.

Whey protein: Found in dairy products such as milk, cheese, and yogurt, whey protein is a popular dietary protein supplement and one of the main proteins found in dairy products. Its biological components have been shown to demonstrate a range of immune-enhancing properties. Whey can also work as an antioxidant, antihypertensive, antiviral, and antibacterial agent.

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Song, M., Fung, T. T., Hu, F. B., Willett, W. C., Longo, V. D., Chan, A. T., & Giovannucci, E. L. (2016). Association of animal and plant protein intake with all-cause and cause-specific mortality. <i>JAMA internal medicine</i> , 176(10), 1453-1463.
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7760812/
https://encyclopedia.pub/2269
https://yumuniverse.com/plant-based-protein-information-chart/
https://www.myfooddata.com/articles/vegetables-high-in-protein.php

Dietary Fibre content of plant and animal proteins

Studies have confirmed that fibre content is more in plant protein sources than animal sources leaving plant protein sources to be healthier than animal sources. Animal protein sources such as egg, meat and dairy lack fibre content while plant protein sources such as dry fruits, vegetables etc. have fibre content ensuring the availability of fibre content while providing essential proteins.

Articles
https://www.hsph.harvard.edu/nutritionsource/what-should-you-eat/protein/
Plant Protein and Animal Proteins: Do They Differentially Affect Cardiovascular Disease Risk
https://connect.uclahealth.org/2021/04/22/is-plant-based-protein-for-you-heres-what-you-need-to-know/
https://link.springer.com/article/10.1007/s00394-021-02729-3
https://www.pcrm.org/good-nutrition/nutrition-information/protein

Digestibility of proteins in plant Vs animal

Animal proteins are harder to digest than plant proteins by human body. Research confirms that, however, lower proportion of the amino acids in plants end up getting digested, thus not getting absorbed and utilized for things like muscle-building as efficiently. Additionally, there are certain ingredients common in plant-based protein sources that can possibly cause indigestion. For example, a plant protein like soy can cause gas, bloating and discomfort in some people which are indicators of slower absorption and digestion. Plant-based proteins, though, are also high in fibre.

Articles
Hossain, M. A., Nahar, N., & Kamal, M. (1997). Nutrient digestibility coefficients of some plant and animal proteins for rohu (<i>Labeo rohita</i>). <i>Aquaculture</i> , 151(1-4), 37-45.
https://www.gainful.com/blog/what-is-the-easiest-protein-to-digest/#:~:text=In%20general%2C%20animal%20proteins%20tend,our%20bodies%20than%20plant%20protein%20.
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https://www.fatsecret.co.in/calories-nutrition/plix/plant-protein/1-scoop
https://www.popsci.com/plant-protein-healthier/

Absorbability of proteins in plant Vs animal sources

Although all proteins are made of the same amino acids, their sequences and structure can be different. The structure of plant-based proteins is different from animal-based proteins. Animal based proteins do not have a complete amino acid sequence like in plant-based protein hence plant-based proteins are difficult to be broken down and get absorbed. \

Articles
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https://www.puregym.com/blog/animal-protein-vs-plant-protein-which-is-best-for-building-muscle/

Alternatives to animal proteins from plant sources

For meeting protein requirements, generally, animals are considered perfect. However, due to many diseases in animals, their consumption is not safer for human health. Also, plant-based proteins are replacing animal-based proteins, due to various limitations, such as increased cost, limited supply of nutrients, hazard for human health, freshwater depletion, and susceptibility to climate change. Plant-based proteins are considered vegan food, provide an ample number of amino acids, are directly absorbed by the body, and help in treating various disease ailments.

Moreover, the proteins derived from plant-based foods are rich in fiber, polyunsaturated fatty acids, oligosaccharides, and carbohydrates. Hence, they are mainly associated with a reduction in cardiovascular diseases, low-density lipoprotein (LDL) cholesterol, obesity, and type II diabetes mellitus. Different sources of plant-based protein that include cereals (wheat, rice, millet, maize, barley, and sorghum), legumes (pea, soybean, bean, faba bean, lupin, chickpea, and cowpea), pseudocereals (buckwheat, quinoa, and amaranth), nuts, almonds, and seeds (flaxseed, chia, pumpkin, sesame, and sunflower) were well-explored.

As plant-based proteins aren't complete, different plant based diets can be consumed together to balance the need of amino acids in the human body. For example, lysine is often limiting in grain proteins, but such proteins are good sources of the sulfur-containing amino acids. On the other hand, legumes are often rich sources of lysine but are limiting in sulfur-containing amino acids. Consumption of these two protein sources over the course of the day allows them to “complement” one another, helping to meet requirements for both types of indispensable amino acids.

Alternative plant food to substitute for animal proteins:

- Pumpkin seeds, sesame seeds and flax seeds can be good sources of heme iron
- Fortified juice, tofu, swiss cheese act as sources of Vitamin B12
- Mushrooms and fortified plant products (like almond milk) help in providing vitamin D
- DHA can be found in brussel sprouts, berries, walnuts, spinach etc
- Cashews, pumpkin seeds, tofu, whole wheat bread, chickpeas are good sources of zinc
- Soya, tofu, jackfruit, black beans, chickpeas act as good meat alternatives

Comparison of nutrient contents in common sources of protein

PROTEIN SOURCES							
Meat, Poultry, Eggs:				Nuts and Seeds:			
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Ham	3 oz	139	14	Pistachios	1 oz	161	6
Egg, large	1 egg	71	6	Flax Seeds	1 oz	140	6
Seafood:				Sunflower Seeds	1 oz	140	6
Food (Cooked)	Serving Size (oz)	Calories	Protein (g)	Chia Seeds	1 oz	138	5
Salmon	3	155	22	Walnuts	1 oz	185	4
Tuna	3	99	22	Cashews	1 oz	162	4
Shrimp	3	101	20	Dairy Products:			
Lobster	3	76	16	Food	Serving Size	Calories	Protein (g)
Scallops	3	75	14	Greek Yogurt	6 oz	100	18
Legumes, Grains, Vegetables:				Cottage Cheese (1% fat)	4 oz	81	14
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Spinach, cooked	½	41	3				
www.fitnesspromiddleton.com							

(Source: <http://fitnessprollc.blogspot.com/>)

Articles

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<https://www.healthline.com/nutrition/protein-for-vegans-vegetarians>

<https://www.everydayhealth.com/diet-nutrition/best-plant-based-sources-of-protein/>

<https://www.hsph.harvard.edu/nutritionsource/what-should-you-eat/protein/>

Conclusion

Though there are conflicts on deciding which source-animal or plant is best for human body, the importance of proteins in adequate amount in daily diet has been established by many studies. This study has tried to compare the differences in health benefits and other benefits provided by animal sources of protein to plant source. The outcomes of the study are given below.

1. Plant based protein sources such as nuts, cereals, pulses etc. have more health benefits compared to animal sources of proteins such as egg, dairy and meat.
2. Risk of diseases like cardiovascular disorders, metabolic dysfunctions are more for animal-based protein sources.
3. In case of digestion, animal sources of proteins are better than plant sources as the amino acids contained in animal sources are simple and those in plant sources are complex.
4. The amino acid contents of animal sources are simple and easily absorbable into human body than plant sources. Even if the plant proteins are absorbed, not all of the components are absorbed into human body.
5. Protein contents are densely packed in animal sources than plant sources, so in order to ensure the daily requirements of proteins, more quantity of source has to be consumed in case of plants.
6. Plant sources of proteins are less in calories than majority of the animal sources.