

2. Macronutrient- Protein

Protein is an essential macronutrient in the body. It is the building block for making new tissues, repairing of the worn-out tissues, and many more functions. The body requires protein for:

- Growth and repair of muscles and various body tissues/organs.
- Bones, muscles, skin, hair and nail health
- Synthesis of enzymes, hormones, essential proteins such as hemoglobin (oxygen-transporting protein in the blood)
- The building of protective antibodies and a robust immune system to defend against infection.
- Maintain a backup source of energy when there is a lack of adequate glucose from low carbohydrate intake. The diet plans which are very low in carbs, carry a significant risk of muscle loss, and are not sustainable long term.

Distribution of the proteins in the body is as follow:

- Muscles – 50%
- Bones – 20%
- Rest of the body tissues skin and organs – 30%

How much Protein one needs daily?

Protein requirement varies based on age, physical activity, and expected ideal body weight. Unlike carbohydrates, proteins are not the natural sources of the energy for the body. Therefore, replacing carbohydrates with high protein diets is not a good idea for the reasons outlined below. Medical recommendations for daily requirement of Proteins is as follows:

- Adult male/Female – 0.8gm/Kg
- Pregnant and lactating female – 1gm/Kg
- Athletic male/female – 1.5 gm/Kg
- Growing child/young adult – 1.5-2.0 gm/Kg

Clinical Signs of Protein deficiency

Severe deficiency of proteins occurs only in impoverished populations, especially amongst growing children. Low protein intake is not unusual amongst the vegetarian communities of South Asia (India) who either cannot afford relatively more expensive protein foods or because they are not well versed with principles of healthy nutrition. Since protein has many functions in the body, protein deficiency may present with many different symptoms, such as:

- The hair becomes brittle, thin, and straw-colored, with excessive hair loss. Signs of protein deficiency, especially hair loss and nail thinning, can occur after a prolonged illness or significant surgery. In these situations, the protein intake is low, and the protein breakdown is high.
- The nails grow brittle and break easily.
- The skin becomes red and flaky.
- Loss of muscle mass as occurs after a protracted illness and major surgery.
- Higher risk of bone fracture- Bone health and muscle health go together. Bone gets the blood flow when muscles contract. ***“Strong muscles build strong bones.”***
- Insufficient protein intake slows down the growth and height of growing children.
- Insufficient protein intake causes weakness of the immune system with increased risk of infections.

Vegetarian versus Nonvegetarian sources of Protein

A common misconception is that the vegetarian foods are poor sources of protein and that the vegetables, in general, do not contain any protein. Contrary to popular belief, a balanced vegetarian diet will provide adequate protein for optimal health. Vegetarian proteins have several health benefits compared to animal proteins. See the tables below:

1 cup soybean	28	100 gm Chicken	26
1 cup boiled lentils	15	100 gm Fish	22
1 cup chickpeas	15	2 Eggs	12
1 cup spinach	15	1 cup milk	8
1 cup tofu	11		
1 cup frozen peas	8		
½ cup seeds/nuts	13		

Animal Protein	Vegetable Protein
↑ Saturated Fats	No Saturated Fats
Acidic - Osteoporosis	Alkaline
No fiber – Constipation, Risk of Colon Cancer	Plenty of Fiber

Plant vs. Animal Protein			
Foods	Protein (gms)	Foods	Protein (gms)
1 cup soybean	28	100 gm Chicken	26
1 cup boiled lentils	15	100 gm Fish	22
1 cup chickpeas	15	2 Eggs	12
1 cup spinach	15	1 cup milk	8
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Nutritional value of common grains								
<i>(Note: whole grains which are not milled but freshly ground are nutritious. The full-grain flour retains their husk (fiber) and endosperm (vitamin B complex and omega3 oils). The packaged grain flours stored in the grocery shelf lacks both husk and endosperm.</i> <i>Nutritional value in Protein content of common grains in gms/100gm</i>								
<i>(Note: The Protein-rich grains are Quinoa, Amaranth, oats, and wheat)</i>								
Nutritional element	Quinoa	Ragi	Amaranth	Barley	Oats	Wheat	Sorghum	Millet
Calories	400	330	350	350	400	400	360	380
Carbohydrates	70	70	65	75	65	78	72	72
Protein	14	8	14	12	15	14	11	11
Fats	1.5	1.5	7	2.5	9	2.5	4	4
Fiber	16	3.5	6	10	6.5	7	4	4
Gluten	No	No	No	Yes	No	Yes	No	No

Digestion of Proteins

Proteins are digested primarily in the acidic environment of the stomach. The stomach secretes hydrochloric acid. Therefore, the stomach juices are highly acidic; the pH of the stomach is 2.0 -2.5, and that of the body is alkaline at 7.4. Acidic juices initiate the process of protein digestion, and the enzymes in the stomach and intestines complete this process. The final breakdown product of proteins in the digestive tract is amino acids which get absorbed from the gut into the blood to be used by the body for different purposes.

Bio-availability of proteins from different foods

The bioavailability is the proportion of food protein which is available for absorption in the intestines as amino acids. Bioavailability of various protein foods is as follows:

- Animal Proteins (meat and dairy) – 90%
- Legumes and Lentils – 80%
- Grains and other plant foods – 60-90%

The factor which influences Protein utilization and muscle building:

- Amino acids absorbed from the intestines get used by the body for the synthesis of tissue proteins, including muscle mass. When the calorie and carbohydrate intake in the diet is low, the absorbed amino acids from the foods get diverted for making energy the body needs, rather than for the synthesis of new tissues/ muscles for growth and repair. A minimum amount of carbohydrates (20% of total caloric intake) are required to spare amino acids for tissue building purpose. So when a low carbohydrate diet gets prescribed for a person with diabetes with uncontrolled blood sugars, the minimum dietary allowance of 20% carb should be maintained. Preserving muscle mass is critical in a person with diabetes because muscles are responsible for using up 70--80% of glucose absorbed in the body from the digestion.
- The carbohydrates have a protein-sparing effect because they protect muscle tissue from breaking down. Diets deficient in carbohydrates (less than 20%) can cause unwanted muscle loss as well as reduced muscle endurance.

What builds muscle mass and endurance?

Healthy muscles do not mean big muscles but the muscles with endurance capacity. The following rules apply to build muscle mass with good strength:

- Optimal amounts of low glycemic carbohydrates – Building muscle require a high intake of proteins as well as the complex carbohydrates (not the refined sugars and the refined wheat flour products). Gaining muscle size requires that muscles also get filled up with enough of glycogen energy to build endurance. In a nonathletic adult, the muscles hold about 150 gm of glycogen as an instant source of energy for a sudden activity. For an athlete; the building of the endurance requires, the glycogen amount in the muscles to be 3 to 4 fold higher (up to 500 gm). The only source of glycogen in the body is the

carbohydrates. Athletic trainers who are pushing high protein/ carb deficient diets of 10-15 eggs a day and meats at every meal are merely promoting big muscles size that is for show only, not for power or the endurance. ***“Big muscles with no glycogen are like an expensive sports car with an empty petrol tank.”***

- Ensure physical activity and mobility – Ability to synthesize tissue protein from the amino acids gets diminished in people who are immobile or bedridden. The bedridden patients and astronauts (who are weightless in space) and inactive people lose muscles despite eating adequate amounts of proteins in the diet. A sedentary lifestyle is a primary reason for muscle loss in urban city dwellers. Muscles use up to 80% of glucose absorbed from the intestines. Reduced muscle mass, therefore, translates to fat storage and obesity.
- Minimize tissue injury – Surgery, illness, or trauma cause muscle breakdown; a physiological phenomenon called negative nitrogen balance. The end product of protein breakdown is nitrogen compounds – urea and ammonia. The negative nitrogen balance means too much muscle loss as nitrogen through urine. A balanced diet rich in protein as well as complex carbohydrates is necessary to minimize and rebuild muscles when there is tissue injury.
- Minimize emotional stress – Emotional distress causes the release of stress hormones such as cortisol and adrenaline. Both these hormones promote muscle and tissue breakdown in the body.

Acid reflux disease, acid-blocking medication, and protein Indigestion

Acid reflux disease (heartburn) is a common problem in modern city dwellers who eat large meals at a late hour of the night and go to bed immediately after that. Obese individuals with a large mass of the abdominal fat are also at high risk for acid reflux. Currently, obesity and late-night evening is the most common cause of acid reflux disease. Unfortunately, most people who get started on the medications for acid-reflux continue taking these medications forever. A more sensible approach will be a food and lifestyle change to overcome obesity and eliminate late-night eating behavior.

The acid –reflux medications suppress the natural acid secretion in the stomach. Acid is required in the stomach to digest the proteins. The drug-induced low acidity in the stomach invariably leads to a new problem of protein indigestion. The symptoms of acid reflux disease eventually get replaced with signs of food indigestion which causes a similar or even a more severe level of the discomfort such as- bloating, heartburn from the reflux of undigested food, fermentation of the undigested food with flatulence and more. The loss of acidity in the stomach from taking these drugs causes not just protein indigestion but reduces the absorption of the micronutrients such as calcium and iron.

The way to get rid of the problem of indigestion, as well as the need for the acid- reflux medications, is to do the following:

- Make food and lifestyle changes to minimize acid reflux at night – Eat early before 8 PM at least 3 hours before bedtime. Eat small meals at night, eat alkaline foods (green and other vegetables, moong dal, banana), reduce acidic foods (meats, lentils other than moong, sugar, fried foods, dairy products).
- Work on lowering abdominal obesity by food and lifestyle changes (Note: Review the section on this website- Understand new science of obesity to prevent and reverse it by natural solutions)
- Take 1-2 tablespoons of apple cider vinegar in a glass of water 30-60 minute before the meal to help rebuild stomach acidity and digestion.

Proteins in the vegetarian diet: How to maximize the nutrition potential?

(Modified From the table -Complementary protein dishes; in the Book – Nutrition Science, sixth edition by B. Srilakshmi)

Animal proteins have all the nine essential amino acids and therefore, are considered superior to vegetable proteins. However, for centuries, vegetarian civilizations have lived healthy by combining foods which provide all the nine essential amino acids. The vegan societies globally are multiplying fast, that will not be the case if the vegetarian diet was protein deficient. Eating vegetarian requires eating smart. Good examples of food combinations which offer a healthy mix of essential amino acids in a vegetarian diet are as follow:

- Rice with Beans and Legumes (Rajma, black-eyed peas, green peas, Bengal gram, Chickpeas)
- Rice with Curds/ Milk
- Chapati made with freshly ground flour eaten with a variety of lentils and legumes.
- Cracked wheat savory porridge with lentils, green peas, peanuts, nuts and seeds, and vegetables
- Rice Pulav with chickpeas, green peas, and Bengal gram.
- Multigrain Roti/Chapati from flour mix of Whole wheat Oats, Ragi, Bengal gram and Millet.
- Enhance protein content of chapatis by Kneading the wheat flour dough with mixed boiled lentils or sattu (ground roasted chana powder) or ground green peas.
- Enhance protein content of fresh chutneys by adding Sattu (Roasted Bengal gram powder), sesame seeds, flaxseeds, and peanuts.
- Enhance the protein content of Upma and Poha by minimizing the grain content and adding cooked chickpeas/Bengal gram, seeds, and nuts along with vegetables.

Harmful effects of High Protein Diets

(Delamaris I: Adverse effects associated with protein intake above the recommended dietary allowance for adults. Review of 32 studies. ISRN Nutrition, 2013.)

A prevailing misconception amongst the young population and their Gym trainers is that a very high protein diet is necessary for keeping the body lean, muscular, and healthy. Some young body-building trainers are going for the extreme in high protein diets of recommending 10-15 eggs a day, meats at every meal and synthetic protein powders.

Additionally, recommending many health-threatening eating practices to their uninformed young clients. Preaching such dangerous trend is the mastermind of bodybuilding coaches and Gym-trainers, who, unfortunately, have little knowledge of body physiology. There are well defined medical recommendations on daily protein requirements for specific groups of population (see the section above on – How much Protein one needs daily). Asian societies have genetically less muscle mass, and as such, have relatively lower protein requirements compared to white Caucasians.

It is essential to be aware of the harmful effects of high protein diets. In a review of 32 studies on high protein/meat diets, Delamaris found that high consumption of proteins above the recommended doses in humans leads to:

- a) *Kidney damage and osteoporosis (bone thinning)* – Super high protein diets promoted by bodybuilding trainers such as eggs in dozens, meat every meal and synthetic protein powders can pose a significant threat to kidneys. The kidneys have to eliminate the acidic end products of protein metabolism. The body is alkaline at a pH of 7.4. The acidic waste in the body requires buffering agent such as calcium from the bones. A change in blood acidity caused by a high protein diet accelerates osteoporosis by depleting bones of their calcium (University of Rochester study funded by the National Institute of Health, USA). Excessive calcium released from the bones gets excreted through kidneys, increasing the risk of kidney stones.
- b) *Dehydration and electrolyte imbalance due to the frequent urination* – The high amount of protein waste product – urea requires a large amount of water to get flushed out of kidneys. This flushing effect loses both the water and electrolytes; increasing the risk of dehydration and electrolyte imbalance. Typically, this presents as severe muscle cramps (a warning sign) in the individuals who consume high protein diets.
- c) *Big muscles with no strength or endurance* – High protein diets are typically combined with low carbohydrate intake. Glucose is the primary energy source for muscles. Professional athletes who wish to build endurance for more prolonged and intense exercise capacity, vigor and vitality require large glycogen store in their muscles. Glycogen is the immediate reserve of glucose in the muscles. An average individual

can store about 150 gm of glycogen in the muscles. A professional athlete who has built a perfect level of endurance, on the other hand, may save as much as five times the glycogen in the muscles to provide glucose energy for a prolonged bout of activity.

It is meaningless to have big muscles for physical appearance only and with no endurance capacity. To build healthy muscle tissue, which can indeed perform requires a proper balance of protein, carbohydrates as well as exercise.

“The big muscles of high protein, carb deficient dieters are like an expensive sports car with all its bells and whistles but no petrol to run them.”

- d) *High Uric acid and Uric acid Kidney stones and gout* – Diets rich in animal proteins (Meat and Dairy) increase in the blood levels of the Uric acid. The high uric acid leads to painful gouty arthritis and uric acid stones in the kidneys. Obesity and fatty liver are invariably associated with a high uric acid level. The best management of high blood uric acid is food and lifestyle modification of lowering animal protein intake, reducing body weight, and fatty liver.
- e) *Brain fog and food Cravings* – Glucose is the primary source of energy for the brain. High protein/carb deficient diets mean less glucose available for the brain. When brain cells are in starvation mode, there is brain fog (not feeling clear-headed) and food cravings.
- f) *Constipation* – High protein diets rich in animal proteins lack fiber, so constipation is always the rule.
- g) *Insomnia and depression* – Because protein is not a source of brain energy, it is not unusual for the individuals on high protein diets to be moody, lethargic, irritable, depressed and have brain fog with an inability to focus on a task. Foods which are rich in cheese can cause headaches, migraine, and insomnia from excessive histamine levels in the body.
- h) *Bad breath (halitosis)* – High protein/low carb diets force the body to use fats for energy. When the body burns fats for energy, blood ketone levels get high. In small amounts, ketones are not a problem and help with fat loss. However, if the diet is deficient in carbohydrates, excess amounts of ketones accumulate in the body which gets excreted from the body via the lungs, giving breath an unpleasant fruity smell. The breath order worsens if there is associated dehydration from eating high protein diets.

Misconception: Commercial Protein Supplements are good for Muscle and Bodybuilding

The commercial food markets currently are flooded with a variety of protein supplements -Protein Powders, Protein shakes, Energy bars, Protein biscuits, and more. Many of these

products get promoted as “Body Building Miracles.” The exercise trainers and bodybuilding instructors frequently coerce their young clients to consume these products. That could subject them to health risks. People typically turn to protein supplements, presumably for several reasons:

- Lose weight – As a supplement to high protein low carb diet plans (Wrong advice).
- Make big muscle mass to enhance looks (Wrong advice).
- Improve energy or physical strength(wrong advice) – That is scientifically an unfounded concept because glucose and not the protein is the source of energy for the muscles.
- Medical dietary supplement(correct advice) – Patients who are recovering from significant illness or surgery and have digestive problems need protein supplements.

Amongst all the above reasons for taking a protein supplement, the only reasonable and sensible indication is the medical dietary supplement. There are three common forms of protein supplements:

- a) Whey Protein – Whey is the watery by-product from cheese or paneer manufacturing. It is freeze-dried to a powder form and sold commercially as a medical-grade protein. Whey protein is water-soluble, fat-free, and easy to digest. It is a fast protein, gets rapidly absorbed, and of benefit as a nutritional supplement in illness. If a diabetic patient considers using whey protein as a supplement, he/she should be aware that it may lower both the blood sugar and blood pressure. Whey protein is abundant in amino acids and stimulates the beta cells of the pancreas to secrete more insulin. Whey protein may also reduce appetite by slowing stomach emptying time.

(Mignone et al. World Journal of Diabetes, 2015)

- b) Casein Protein – Curdled clumpy milk protein produced by fermentation of milk is casein protein (Paneer is an excellent example of concentrated casein protein). It is a slowly absorbed protein because of high-fat content. The casein protein carries the saturated fats portion of the milk with it, so both cheese and paneer are rich in saturated fats. For every 100 gm, paneer has 18 gm protein and 20 gm saturated fat. Paneer, therefore, has to be consumed with caution, especially by people who are obese, diabetic, and have heart disease. It is interesting that paneer was a rare food item in the routine Indian cuisine 50 years ago and currently has become the most consumed food item. Promotion of Paneer as a source of healthy vegetarian protein by healthcare professionals has misled the population magnifying the problems of obesity and Type2 diabetes.
- c) Soy Protein – This protein is the most common component of energy bars and breakfast bars. Raw cheap genetically modified soy powder gets used in these preparations. The best way to eat soy is like the Orientals do- a precooked and fermented soy preparation like Tofu and Tempeh and not the raw powder, which is hard to digest and can cause

diarrhea and upset stomach. The Nutella, Nutri nuggets and textured vegetable protein (TVP) from soybean are precooked easy to digest preparations of soybeans available in India. Madhyapradesh in India is the biggest producer of Soybeans, and the state has released a Youtube video to teach making soy products such as milk, tofu protein, and Tofu halva, etc. (the video is available on this website)

- d) Pea Proteins (also called vegan or plant protein) – The new favorite vegetable protein in the market is pea protein. It is gaining popularity as a safe, healthy protein for making commercial vegetarian burger patties, kabobs, and more. The natural green peas are a good source of protein. With 20% calories coming from the starchy carbohydrate and 50% calories from protein. Most pea protein powders sold as protein supplements (Pea protein isolate) are free from starch and are quite expensive. These vegetarian protein powders are fat-free but have zero micronutrients as these get destroyed during processing