

Role of essential amino acids in human body and its presence in spirulina

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ABSTRACT

Protein the keystone of nutrition, it is the number one diet items for healthy living because protein can be utilized as a fat or a carbohydrate, as well as utilized for its own protein value. The adult requirement of protein is one gram of utilizable protein for each 2.2 pounds of body weight. The complex protein molecule is composed of a number of units linked together. These building blocks of protein are known as amino acids. When protein is broken down by digestion, the result is 23 individual amino acids. Amino acids are of two types essential and non essential. Eight amino acids have been found necessary and essential without these eight, growth cannot take place. Moreover, unless these eight essential amino acids are present, our body cannot manufacture the remaining fifteen (non essential) amino acids. The eight essential amino acids are the very bedrock of protein, good diet, and even good health. Spirulina is considered an excellent food, lacking toxicity and having corrective properties against the pathogenic microorganisms. Its lacks cellulose cell wall and therefore does not require chemical or processing in order to become digestible. The digestibility is 83-84%. Spirulina is regarded as a rich source of protein, vitamins, essential minerals, amino acids- EFA like gamma linoleic acid and antioxidants pigments like carotene.

Key Words : Protein, Essential amino acid, Spirulina

INTRODUCTION

“Every part of human body relies on protein foundation is protein. No proteinNo protoplasm. ...no like, the basic need for protein, then, is for growth. Without protein, growth is slow or impossible. Protein is also needed for maintaining and repairing the body and for energy. The body is constantly using up protein and therefore must be continually supplied this life giving substance. Protein literally means “to come first” and if it doesn’t come first, a myriad of health problems can result. These essential eight amino acids are the “all-or nothing” amino acid. They must all be present at the same time and in the proper balance, if for example, one of the eight is present in only a small quantity, the body will utilize the remaining. Seven only to the point where the one in short supply is exhausted. When this point is reached, the remaining amount of the other are wasted. The essential eight, in a

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sense, belong to a strong union, where none will function without the presence of the other seven.

Composition :

Spirulina is a natural “algae” (cyanobacteria) powder that is incredible high in protein and nutrient. It is one of the most potent nutrient sources available. It is largely made up of protein and essential amino acids.

Physical properties		General analysis	
Composition	100%	Protein	60-70%
Appearance	Fine powder	Carbohydrate	15-25%
Colour	Dark blue green	Fats(lipid)	06-08%
Odour and taste	Mild like weed	Mineral (ash)	07-13%
Digestibility	83-84%	Moisture	03-07%
Particle size	64 mesh through	Fibre	08-10%

Table 1 : Nutritional value per 100gm			
Energy	1,213 KJ (290kcal)	Vitamin A Equiv	29 ug (4%)
Carbohydrates	23.9 gm	Beta carotene	342 ug (3%)
Sugars	3.1 gm	Lutein and zeaxanthine	0 ug
Dietary fiber	3.6 gm	Thiamine (vit.B ₁)	2.38 mg (207%)
Total fat	7.72 gm	Riboflavin (vit.B ₂)	3.67 mg (306%)
Saturated	2.65 gm	Niacin (vit. B ₃)	12.82 mg (85%)
Monounsaturated	0.675 gm	Pantothenic acid(B ₅)	3.48 mg (70%)
Polyunsaturated	2.08 gm	Vitamin B ₆	0.364 mg 28%)
Protein	57.47 gm	Folate (vit.B ₉)	94 ug (24%)
Tryptophan	0.929 gm	Vitamin B ₁₂	0 ug (0%)
Threonine	2.97 gm	Choline	66 mg (13%)
Isoleucine	3.209 gm	Vitamin C	10.1 mg (12%)
Leucine	4.947 gm	Vitamin D	0 IU (0%)
Lycine	3.025 gm	Vitamin E	5 mg (33%)
Methionine	1.149 gm	Vitamin K	25.5 ug (24%)
Cystine	0.662 gm	Calcium	120 mg (12%)
Phenylalanine	2.777 gm	Iron	28.5 mg (219%)
Tyrocine	2.584 gm	Magnesium	195 mg (55%)
Valine	3.512 gm	Magenese	1.9 mg (90%)
Arginine	4.147 gm	Phosphorus	118 mg (17%)
Histidine	1.085 gm	Potassium	1363 mg (29%)
Alanine	4.515 gm	Sodium	1048 mg (70%)
Aspartic acid	5.793 gm	Zinc	2 mg (21%)
Glutamic acid	8.386 gm	Serine	2.998 gm
Glycine	3.099 gm	Water	4.68 gm
Proline	2.382 gm		

Source: USDA Nutrient Database

Nutrient level of Spirulina :

Besides basic nutrients such as amino acids, essential fatty acids, vitamins and minerals, Spirulina supplies many phytonutrients that are lacking in most of our diets. Moreover, Spirulina supplies common nutrients at high levels; comparing Spirulina with other foods shows its unusual nutrient profile.

A few examples:

Nutrient profile of Spirulina vs other foods

- 180% more calcium than whole milk
- 670% more protein than tofu
- 3100% more beta carotene than carrots
- 5100% more iron than spinach
- More antioxidant and anti-inflammatory activity in 3 g of Spirulina than in five servings of fruits and vegetables.

Essential amino acids and their biological functions :

An essential amino acid or indispensable amino acid is an amino acid that cannot be synthesized natively by the organism being considered, and therefore must be supplied in its diet. Essential amino acids are “essential” not because they are more important to life than the others, but because the body does not synthesize them. They must be present in the diet or they will not be present in the body.

The essential amino acids and their functions include:

Tryptophan :

tryptophan is the largest amino acid and is a precursor of serotonin and melatonin, which means that it can regulate mood and sleep, it also reduces anxiety and depression; helps in the treatment of migraine headaches; helps the immune system; helps reduce the risk of artery and heart spasms; works with Lysine in reducing cholesterol levels.

Lysine :

Lysine ensures the adequate absorption of calcium; helps form collagen (which makes up bone cartilage and connective tissues); aids in the production of antibodies, hormones and enzymes. Recent studies have shown that Lysine may be effective treatment against herpes by improving the balance of nutrients that reduce viral growth. A deficiency of Lysine may result in fatigue, inability to concentrate, irritability, bloodshot eyes, retarded growth, hair loss, anemia, and reproductive problems.

Valine :

Valine is necessary for muscle metabolism and the repair of tissues and can be useful in the treatment of liver and gallbladder disorders, it also promotes mental vigor, muscle coordination, and calm emotions.

Methionine :

This amino acid aids in the production of sulphur, which is necessary for normal

metabolism and it is also essential for the synthesis of hemoglobin and glutathione that fights against free radicals. It helps lower cholesterol levels by increasing the liver's production of Lecithin. It reduces liver fat, protects the kidneys, and acts as a natural chelating agent for heavy metals, regulates the formation of ammonia and creates ammonia-free urine which reduces bladder irritation, and promotes hair growth.

Leucine:

Leucine is one of three essential amino acids that increase muscle mass and helps muscle recover after exercise. It also regulates blood sugar and supplies the body with energy. These functions make it invaluable when the body is stressed. Leucine is used clinically to help the body heal, and it also affects brain function and can be used in place of glucose in 'fasting' states. Leucine and Isoleucine provide ingredients for the manufacturing of other essential biochemical components in the body, some of which are utilized for the production of energy, stimulants to the upper brain, and promote alertness.

Isoleucine :

Isoleucine is important for the regulation of blood sugar.

Threonine :

Threonine is an important constituent of collagen, elastin, and enamel protein. It helps prevent fat build-up in the liver, helps the digestive and intestinal tracts function smoothly, and assists metabolism and assimilation of nutrients. It is also important for anti body production

Phenylalanine:

There are three forms of phenylalanine: D-phenylalanine, L-phenylalanine and DL-phenylalanine. This amino acid is a precursor to catecholamine's that regulate the central and peripheral nervous system. It is also used by the brain to produce Norepinephrine, a chemical that transmits signals between nerve cells and the brain. It helps keep a person awake and alert, reduces hunger pangs, and functions as an antidepressant and helps improve memory.

Arginine :

Arginine may improve immune responses to bacteria, viruses and tumor cells. It also promotes wound healing and regeneration of the liver. It is involved in the release of growth hormones and is considered crucial for optimal muscle growth and tissue repair.

Health properties of spirulina :

Spirulina can be used as a partial supplementation or complete replacement for protein in aqua feeds. Spirulina is a feed supplement for the all fishes, giant freshwater prawns and marine water shrimps and significantly improvement occurs on growth, survival, immunity, viability and feed utilization. Spirulina is a cheaper feed ingredient with high protein than others of animal origin. Spirulina diet is found as most suitable supplementary feeding to reduce the cultivation time and mortality, and increase shell thickness of shrimp carapace.

Feeding of spirulina helps to improve disease resistance and an improvement in survival rate. Fast growth occurs when fed a diet containing spirulina meal (Britz, 1996)

Spirulina has some great health-boosting qualities:

- Spirulina is 65% protein and amino acids including the essential fatty acid gamma linolenic acid (GLA) which has gotten a lot of attention for its anti-inflammatory properties, especially when taken with other quality Omega-3 supplements like Fermented Cod Liver Oil. (I suspect that the benefits of GLA in Spirulina are even more than what the studies have found since these studies often use vegetable oils for their GLA source, and the other inflammatory compounds in vegetable oils can interfere with the anti-inflammatory ability.) It contains all essential amino acids.

- *Immunomodulatory property:* Spirulina is an effective immune modulator. It exhibits anti-inflammatory properties, in particular by inhibiting the release of histamine from mast cell with mediated allergic reactions. It shows antioxidant and free radical scavenging properties. Spirulina exposure enhances the phagocytic functions of macrophages in aquatic culture animals. It also has antiviral and anticarcinogenic properties. It improves the bacterial gut tract clearance potential of fish/shrimp and spirulina supplements develop the phagocytic cell. Spirulina is safe to use in terms of improved immune competence without compromising the performing behaviors of aquatic culture animals. A novel sulphate polysaccharide of spirulina inhibits the replication of several enveloped viruses.

- The nutrients of spirulina help to fight free radicals, cell-damaging molecules absorbed by the body through pollution, poor diet, injury, or stress. By removing free radicals, the nutrients help the immune system fight cancer and cellular degeneration. Spirulina is a powerful tonic for the immune system. This enzyme is a major source of super oxide in an animal's body, and is involved in dozens of degenerative processes involved in disease resistance, aging and similar processes in fish, shrimp and other aquatic animal.

- *Spirulina in building red blood cells and stem cells:* Spirulina is rich in a brilliant blue polypeptide called Phycocyanin. Phycocyanin affects the stem cells that make up the cellular immune system and red blood cells that oxygenate the body. Phycocyanin stimulating hematopoiesis, (the creation of blood), emulating the affect of the hormone erythropoietin, (EPO). Phycocyanin also regulates production of white blood cells, even when bone marrow stem cells are damaged by toxic chemicals or radiation.

- *Spirulina Anti-Viral and Anti-Cancer abilities:* Calcium-Spirulan is a unique polymerized sugar molecule extract of spirulina and contains both Sulfur and Calcium. The treatment of this water soluble extract has better recovery rates when infected with a lethal Herpes virus. This mechanism occurs because Calcium-Spirulan does not allow the virus to penetrate the cell membrane to infect the cell. The virus is stuck, unable to replicate. It is eventually eliminated by the body's natural defenses. Spirulina can prevent or inhibit cancers in aquatic animals, and fishes. The unique polysaccharides of spirulina enhance cell nucleus enzyme activity and DNA repair synthesis.

- *Antimicrobial Property:* Spirulina excretes variable quantities of products from its metabolism such as organic acid, vitamins and phyto hormones. Cell extract of spirulina has shown antimicrobial activities against pathogenic

– *Bio-mineralization activities*: Spirulina thrives in high alkaline waters and it incorporates and synthesizes many minerals and derivative compounds into its cell structure. Transformed into natural organic forms by Spirulina, minerals become chelated with amino acids and they are more easily assimilated by the body. Along with adequate calcium and magnesium in the water (especially for marine organisms), Spirulina helps insure proper electrolyte function, calcium levels over calcium and other mineral.

– *Enhance the Reproduction activity*: Research has shown that fresh and saltwater fish and shrimp exhibit superior growth, maturity, energetic behavior, and more elegant coloring when fed spirulina. It is also well documented that spirulina improves spawning, fecundity, fertility and hatching rates. It stimulates the reproductive processes, increases survival rates of younger fish, post larvae and promotes the appetite of fish/prawn to attain full matures

– *Spirulina as a colorant*: The color appearance is the most important characteristic in case of shrimps and fishes for choice and demand in food market. Spirulina diet promotes the physiological activities for generating the color pigmentations and glazing appearance in various parts of body. Carotenoids are responsible for the development of various colors of crustaceans (Britton *et al.*, 1981). Astaxanthin has been shown to be the predominant carotenoid associated with the red body color of the black tiger prawn *Penaeus monodon* (Howell and Matthews, 1991). Spirulina platensis and Pacifica stain contains the highest levels off-carotene and zeaxanthin of any natural source .They both are converted to astaxanthin through an oxidative process for the desire red pigment. A marked increase in carotenoid content of the carapace of black tiger shrimp (*Penaeus monodon*) occurred when spirulina-supplemented diets are given. A practical strategy for the improved pigmentation of cultured *P. monodon* is the incorporation of spirulina diet for one month before harvest.

- Spirulina contains Omega 3-,6 and 9s and is especially high in Omega-3s.
- Spirulina is extremely high in Chlorophyll, which helps remove toxins from the blood and boost the immune system.
- Spirulina has a very high concentration of bio-available iron and is excellent during pregnancy and for those with anemia and will not cause constipation.
- Spirulina is also incredibly high in calcium with over 26 times the calcium in milk, making it excellent for children, the elderly and during pregnancy.
- Some research has suggested that Spirulina may be helpful in allergies and allergic reactions.
- Spirulina’s phosphorus content makes it helpful as part of a tooth remineralization regimen.
- Emerging evidence suggests that it binds with radioactive isotopes and may be useful for radioactivity exposure or radiation therapy.
- The protein in Spirulina is highly usable and has a net protein utilization rate of between 50-61%.
- Spirulina can bind with heavy metals in the body and help remove them.
- Spirulina can increase fat burning during exercise.

Conclusion :

This paper deals with role of amino acid in the body. Essential amino acids are “essential”

not because they are more important to life than the others, but because the body does not synthesize them. They must be present in the diet or they will not be present in the body. Although proteins from plant sources tend to have a relatively low biological value, in comparison to proteins from eggs, or milk, they are nevertheless “complete” in that they contain at least trace amount of all of the amino acids that are essential in human nutrition. Eating various plant foods in combination can provide a protein of higher biological value. Spirulina is a natural “algae” (cyanobacteria) powder that is incredible high in protein and nutrients. When harvested correctly from non- contaminated ponds and bodies of water. It is one of the most potent nutrient sources available. It is largely made up of proteins and essential amino acids. Spirulina contains more than 65 percent complete proteins, and provides various health benefits to humans. On the basis of present study, it can be concluded that spirulina has a great scope in the field of product development and can be utilized for achieving food and nutrition security for nation.

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