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### **Amino acids as Medical food and their Therapeutic uses**

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#### **ABSTRACT**

The very important constituents of muscles, tissues and the blood are the '**Proteins**'. They are the sources through which the chief phenomena of life are produced. Proteins which supply the building material for the body and are concerned with vital life processes, are made up of specific organic substances called '**Amino acids**'. Almost all plants, animals and microorganisms consist of amino acids. They are needed for the normal functioning of the body and are of many types. Infants, children and adults show different intake requirements of amino acids, and this is influenced by the factors such as age, sex and physiological conditions. The deficiency of amino acids cause many disorders, and their enough supply through proper diet and normal manufacture in the body enable the cure of the ailments. The present article reviews the therapeutic power of some of the amino acids, and hence their use as '**Medical food**'.

**KEY WORDS:** Essential amino acids, Non-Essential amino acids, Therapeutic uses, Medical food.

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## **INTRODUCTION**

Amino acids are the basic constituents of proteins which are the important nitrogenous components of protoplasm of all plant and animal tissues. Proteins are complex organic compounds primarily containing carbon, hydrogen, oxygen, nitrogen, and little traces of sulphur. Besides these, proteins may also consist of phosphorus, iron, iodine, copper and some inorganic elements too. The presence of nitrogen distinguishes proteins from carbohydrates and fats. They are the vital substances present in cells, tissues, muscles and blood. Many vitamins, hormones and enzymes are also proteinaceous<sup>1</sup>.

Different types of proteins are made up of some '**building blocks**' in specific numbers which are called '**Amino acids**'. As proteins, and as the components of proteins, the amino acids are also the substances concerned with vital life processes. When the food stuff is ingested, proteins are hard to digest. They undergo a series of biochemical reactions in the digestive tract and are broken down into amino acids. In this manner, easy digestion and absorption of proteins become possible. Incomplete protein digestion, without getting broken down into amino acids result in disorders like gastric problems and bloating. Improper absorption also affects the muscular and tissue system. The other ailments due to the deficiency in proteins and amino acids are liver and kidney ailments, leading to ineffective metabolism, thereby affecting the overall growth<sup>2</sup>.

Simple proteins consist of 22 amino acids. Conjugated proteins consist of additional components besides 22 amino acids. Amongst these amino acids, many of them can be manufactured in the body itself if an adequate nitrogen source is available, and are called '**Non –essential**' or '**Dispensable**' amino acids. These are Alanine, Arginine, Asparagine, Aspartic Acid, Cystine, Glycine, Glutamine, Glutamic Acid, Hydroxyproline, Serine, Tyrosine and Proline. Certain amino acids are not produced in sufficient amounts to meet its needs, and they are called '**Essential**' or '**Indispensable**' amino acids. They must be supplied by the diet in proper proportions responsible for maintenance and growth of tissue. These include Histidine, Leucine, Isoleucine, Lysine, Methionine, Threonine, Valine, Tryptophan and Phenylalanine<sup>3</sup>.

For the proper functioning of the body and overall healthy growth, an estimated requirement of amino acids in human beings have been given by Food and Nutrition Board, National Research Council, Washington, D.C., National Academy of Sciences, long back in 1973, (Improvement of protein Nutriture), which is usually followed, however with a little revisions in all these years. The requirement estimation considered is generally in mg. per kg. of body weight per day. It varies in infants, children and adults. Accordingly the protein consumption varies too. (**Table AA**).

Table AA:- Some of the important estimated amino acid requirements in Human beings

S. No.	Amino acids	Requirement mg/kg. of body weight/day (Approx)		
		Infant	Child	Adult
		(3-6 Mths.)	(10-12 Yrs)	
1.	Histidine (Essential Amino acid)	33	12	10
2.	Isoleucine (Essential Amino acid)	80	28	12
3.	Leucine (Essential Amino Acid)	128	42	16
4.	Lysine (Essential Amino Acid)	97	44	30
5.	Sulphur- containing amino acids (Non-Essential Amino acid)	45	22	10
6.	Aromatic Amino Acids	132	22	16
7.	Threonine (Essential Amino Acid)	63	28	15
8.	Tryptophan (Essential Amino Acid)	19	5	4
9.	Valine (Essential Amino Acid)	89	25	14

## THERAPEUTIC USES OF SOME OF THE AMINO ACIDS

As the proteins are important in maintaining various tissue systems and physiological conditions, so are the amino acids. The appropriate amounts and requirements of the essential amino acids have to be met according to the age and sex in human beings for the effective functioning<sup>4</sup>. Many research have shown the judicious uses of amino acids for dramatic cure of different ailments. Hence they are nowadays called ‘**Medical foods**’. Some of the important amino acids, both essential and non-essential, known for their therapeutic uses, along with their deficiency symptoms are discussed as follows:

- **Histidine**

Histidine is a proteinogenic amino acid, vital for proper tissue growth and repair. The blood circulation is enhanced by its activity, and histidine also favours the formation of glycogen in the liver. Thus, histidine plays a significant role in metabolic activities in human body. Infants require histidine in enough amounts. Free form of histidine in blood is detected in less amounts in patients suffering from rheumatoid arthritis. Oral intake of histidine is a great relief in arthritis, but it could be the cause of acidity in persons with ulcers and other stomach disorders. It cures joint pains and other orthopaedic problems. Histidine has its rich sources in root vegetables and green vegetables, such as beans, cauliflower, potatoes etc. Also the grains like rice and wheat are histidine sources. L-Histidine helps in blood production and in maintaining the myelin sheath that surround the nerve cells, and thus supports the functioning of the nervous system<sup>5</sup>.

- ***Lysine***

Lysine has strong anti-virus effect. It eliminates virus infections more efficiently when used along with vitamin C, vitamin A and zinc. Lysine deficiency in the diet may cause headaches, nausea, dizziness and anaemia. Cold, sores and female reproductive cycles are also influenced by lysine. The four important health benefits of lysine include protection against cold sores by blocking arginine, improve calcium absorption and retention, promote wound healing by creating collagen, and help in reducing anxiety by blocking stress response receptors. Other possible health effectiveness of lysine are control of blood pressure, diabetes, pneumonia, nephrosis and acidosis. Lysine is the natural remedy for genetical herpes as well as rickets in children. The main sources of lysine are nuts, seeds, sub- acid fruits and vegetables. Lentils, beans, soya milk and pistachio are also known to be high in lysine<sup>6</sup>.

- ***Valine***

The essential amino acid known for the growth of mammary glands and ovaries is valine. It is the important amino acid used in the biosynthesis of proteins. It works with the two branched-chain amino acids, isoleucine and leucine, and is known for many therapeutic uses. It regulates blood sugar, repair tissues and provide the body with energy. Many of the nervous and digestive disorders are also cured. Higher levels of valine leads to diabetes because of causing insulin resistance. However, dietary valine is essential for hematopoietic stem cell self-renewal. L-valine has its common therapeutic uses as its role in muscle synthesis and maintenance, hence in muscle metabolism; and also in managing stress, nervousness and insomnia. Immune system is regulated by L-valine. Lack of this amino acid makes a person sensitive to touch and sound. Additional importance of valine is in detoxication, and in treatment of diseases related to gall bladder and liver. Dietary sources of valine are vegetables such as mushroom, leafy green and sesame seeds. Also dairy products, meat, fish, lentils, peanuts, apples and almonds are rich in valine<sup>7</sup>.

- ***Isoleucine and Leucine***

Isoleucine and leucine are the branched amino-acids. Leucine is known to stimulate protein synthesis in muscles. As a dietary supplement, leucine has been reported to slow the degradation of muscle tissue in aged rats. Muscle mass in healthy elderly men, however, is disturbed by long-term leucine supplementation. Insulin resistance results in humans and rodents due to high blood levels of leucine. Isoleucine is also helpful in promoting muscle recovery after exercise. It is actually broken down for energy within the muscle tissue. Isoleucine is essential for maintaining the nitrogen balance important for proper body functioning. Metabolism of spleen, pituitary glands and thymus is also

regulated by leucine. Leucine and isoleucine are thus complementary to each other, working for reducing muscle fatigueness and muscle soreness, thereby strengthening muscle growth. High leucine foods include seafoods, fish, beef, chicken, pork, and also beans and nuts. Similar are the rich sources of isoleucine too. Some of the important ones are sunflower seeds, nuts, cashew nuts, avocados, olives, legumes, eggs and other dairy products<sup>8</sup>.

- ***Tryptophan***

Of all the essential amino acids, tryptophan is one of the well known therapeutic agents. It is beneficial for optic and digestive systems, and reproductive system of females. It wards off signs of premature old age such as baldness, deterioration of sex glands, brittleness of teeth enamel and cataract of the eyes. Tryptophan is essential for proper utilization of vitamin A by the body, as well as for blood clotting and digestive juices. This amino acid can also regulate the nervous system disorders, quietens anxiety, and effective food remedy for insomnia. Tryptophan may also be used as natural painkiller. The rich food sources of tryptophan are seeds, nuts, soya, spinach, meat etc. It is also used as food medicine, and is effective if taken with low protein food such as fruit juice or bread<sup>9</sup>.

- ***Threonine and Glutamine***

Threonine is known to have prominent role in the immune system. Threonine in the body gets easily converted into another amino acid, called glycine, which calms the central nervous system. Besides being used to treat various nervous system disorders, such as multiple sclerosis disorders, spastic paraparesis, spinal spasticity, threonine also regulates cardiovascular and liver functioning. L-threonine supplements are beneficial for bone strength. This amino acid along with vitamin B, ascorbic acid, magnesium, iodine, potassium, and other amino acids like tryptophan, lysine and glutamic acid is a good remedy for mental illness. Malfunctioning of brain in children can be prevented by threonine. It is the essential amino acid for complete development of child. Threonine is an important constituent in many body proteins, and also necessary for the formation of tooth enamel protein, collagen and elastin. Different types of milk, essentially cow's milk, seeds, and green vegetables are the good sources of threonine. Glutamine is the non-essential amino acid known as '**Sobriety nutrient**'. It is effective in the treatment of alcoholism, as it usually reduces the irresistible craving for alcohol<sup>10</sup>.

## **DISCUSSION AND CONCLUSION**

Amino acids are the basic constituents of proteins. The proteins are actually the important food components that supply the building material for the body. Proteins are responsible for the

overall growth and in restoring the wear and tear of tissues. For easy digestion and absorption, the protein nutrients are broken down into amino acids through some chemical reactions.

The normal functioning of the human body requires amino acids, either manufactured within the body with enough nitrogen source or derived from the diet if cannot be synthesized in adequate amounts. Amino acids are considered effective in supporting the major physiological systems such as optic system, nervous and muscular systems, blood and bones, as well as digestive and skin systems. The anti-cancer and anti-ageing properties of amino acids owe to their importance in treatment or prevention of many ailments.

When the diet lacks one or more of the essential amino acids, the symptoms experienced are similar to those of vitamin deficiencies. These may include eye infection, poor muscle tone, low blood pressure, anemia, weight loss, fatigue, joint pain, obesity, allergies, slow healing of wounds, and low immunity. The glands and growth in children is stunted due to the insufficient amounts of amino acids in their daily diets. Several research has led to the successful use of amino acids in the treatment of many diseases such as, burns, ulcers, liver and kidney diseases<sup>11</sup>.

The free-radicals and their harmful effects causing early ageing and age-related diseases are restricted with the intake of proper diet with right proportion of amino acids, minerals and vitamins. The best food proteins with all the essential amino acids constitutes '**Medical food**' that are importantly cheese, meat, eggs, almonds, and vegetables. Amino acids are needed at every stage of life, from infancy to old age, stimulating growth, maintaining physiology and repairing worn out tissues. Thus the sufficed amounts of amino acids taken in through food or supplements attributes to vigour, vitality and long life.

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