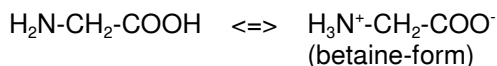


Omnipresent and multifunctional – amino acids in skin care

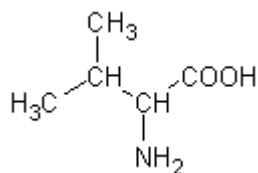
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Amino acids are indispensable from the vegetable and animal kingdom including men through to microorganisms like bacteria, fungi and viruses. There is no life on earth without these basic elements. Why and which specific amino acids are vital for the human skin is described in the following.

Amino acids were among the first molecules that developed in the "primeval soup" of the earth by interaction of carbon, hydrogen, nitrogen and oxygen amidst electric discharges and high-energy radiation. As the term already indicates, they are amine but at the same time also acid molecules. Amines are derived from the chemical compound ammonia and are alkaline compounds and together with acids they can form salts. This is exactly what occurs with amino acids equipped with an amino group (-NH₂) and an acid group (-COOH) in the same molecule which actually is a characteristic phenomenon of this substance class. These specific compounds are also called inner salts or betaines, shown in the following example of glycine (aminoacetic acid):



Most important are L- α -amino acids. Alpha (α) means that the amino group is located at the C-atom of the carbon chain neighboring the COOH-group: as can be seen in the example of valine below:

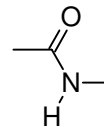


Physiological amino acids

If there occur four different residues at the α -carbon atom, and in case of valine there are -NH₂, -CH(CH₃)₂, -COOH and H, the residues may arrange as mirror image pair (stereo isomers) where the layout cannot be aligned. Therefore they are differentiated with the capital letters **D** and **L**. That is the reason for the term L- α -amino acids.

Many of the amino acids like the above mentioned glycine can be synthesized by the hu-

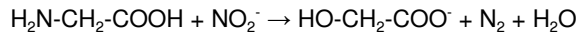
man organism however there are also amino acids that cannot be built up. The latter mentioned are called **essential** amino acids and have to be assimilated with the daily nutrition. Essential for the human body are the L- α -amino acids isoleucine, leucine, lysine, methionine, phenylalanine, threonine, tryptophan, valine and histidine (for children). The amino acids in our nutrition mostly occur in form of proteins. Amino acids in proteins have aliphatic bonds via their amino and acid groups. These are also called amide or peptide bonds.



The bond in assimilated proteins is broken up by enzymes (peptidases). In a later stage, the released amino acids are used again for the natural synthesis of peptides and proteins in the body. For this process also the nucleic acids are required which are the carriers of genetic information and key substances of the protein biosynthesis.

Natural Moisturizing Factor (NMF)

The skin contains proteins as for instance the keratin of the horny layer, as well as free amino acids. The amino acids and urea of the NMF have excellent water-retaining capacities. That is why they are vital for the skin hydration. Furthermore they provide a natural protection against free radicals. The skin with an impaired NMF is not only prone to dehydration but also exposed to the radical compounds in our environment. That is the reason why the products explicitly designed to increase the skin hydration in dry skin should contain amino acids instead of any water retaining substances. The protecting principle is clearly visible in the chemical reaction of the amino acid glycine with the nitrite forming from the omnipresent nitric oxide radicals.



The reaction of glycine with nitrite results in an alpha hydroxy acid (AHA), in this specific case glycolic acid, and in harmless nitrogen and water. The nitrite will be destroyed. As the radicals can sustain inflammatory processes the recovery of an intact NMF is the most important precondition for getting a grip on inflammatory barrier disorders in the long run. Frequently this fact is neglected in dermatological therapies with the consequence that topical pharmacological drugs are applied.

Signal substances and hormones

In part, amino acids are biologically active themselves and form precursors for signal substances or hormone-like substances. Examples:

- **L-glutamic acid** is a neurotransmitter. It is the base substance for L-thyroxine which is a hormone-like amino acid of the thyroid gland, and GABA (gamma aminobutyric acid) which also is a neurotransmitter.
- **L-histidine** is the base substance for the biogenic histamine that plays a major role in allergic reactions. Among others histamine is responsible for the itching and burning of the skin.
- **L-lysine** and **L-methionine** together form L-carnitine that is essential for the energy generation in the mitochondria.
- **L-tryptophan** is the base substance for both the biogenic amine serotonin which has manifold effects in the central nerve system and on the blood vessels, and for melatonin (epiphysis hormone) which controls the circadian rhythm in the body.
- **L-tyrosine** forms the biogenic amines dopamine (happiness hormone), noradrenaline (neurotransmitter, increasing blood pressure) and adrenaline (stress hormone) via the amino acid L-DOPA.
- **L-cysteine**: among other features, L-cysteine is the precursor of taurine (2-aminoethan sulfonic acid) which is vital for our immune system.

Short chained peptides

For the past few years now, peptide chains from some of the amino acids, the so-called **oligopeptides**, have been frequently used in cosmetic products. They excel by their broad spectrum of active agents and in combination with a penetration supporting cream base they

are able to permeate the skin barrier. Depending on the amino acid sequence they stimulate the collagen formation, have neuromuscular effects in terms of a reduction of wrinkles or they fortify the immune system. Others influence the water balance in the skin or participate in redox reactions like **glutathione** (gamma-L-glutamyl_L-cysteinyl-glycine) – just to mention some of the most important effects. Glutathione even sometimes is used in cosmetic products as a radical scavenger.

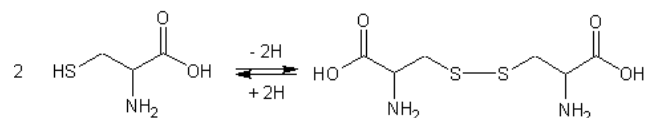
Smoothing and moisturizing are also **protein hydrolysates** which consist of short chained peptides or of free amino acids. They are formed by hydrolysis of proteins, formerly mainly collagen and today mostly of vegetable or silk proteins. Interesting substances too are their condensates with longer chained fatty acids (proteinhydrolysate condensates). They have excellent skin caring effects.

Enzymes

Amino acids also form the peptide structure of the enzymes. Coenzyme A for example consists of the sulfur-containing amino acid L-cysteine, pantothenic acid and adenosine diphosphate (ADP). It plays a major role in the fatty acid metabolism. L-cysteine in peptide chains is the working point of cysteine endopeptidases. Typical representatives of these proteolytic enzymes are **papain**, which is gained from the papaya fruit, and **bromelain** which occurs in pineapples. Both the enzymes are used for cosmetic peelings. Enzyme peelings are very gentle for the skin and can be used in form of masks for the bad and acne prone skin. The enzyme powder is mixed with water just before application.

Perms & Co

With the help of a so-called disulfide bridge the amino acid L-cysteine can link with another L-cysteine molecule:



This type of reaction is of far reaching importance in nature as it enables the cross-linkage of peptide chains via L-cysteine units. This provides a high mechanical stability for the L-cysteine rich fiber protein, the keratin of hairs and nails.

The disulfide bridge can be dissolved – the keratin respectively the hair then becomes soft again. This occurs for instance when the hairs

are permed and more precisely during the first phase of the perming, the reduction, during which the hair is put in curlers. The original stability then is regained with the oxidation process, either with hydrogen peroxide or atmospheric oxygen.

Self tanning products

Dihydroxy acetone (DHA) is the most frequently used self tanning agent. The tanning is based on a reaction of free amino groups of both amino acids and proteins in the horny layer with DHA, a process during which a condensation reaction occurs which can be compared with the reaction of sugar like substances with amino acids or proteins during the roasting or baking process. It became known as Maillard reaction. Appetizing smells containing the volatile reaction and degradation products of the amino acids then emerge in the kitchen.

There is a multitude of different and rarely occurring amino acids in nature with most varying functions which however cannot be covered in detail in this context. Yet, in connection with the above mentioned cysteine its analogue substance **selenocysteine** should be mentioned in which the sulfur atom is replaced by a selenium atom. Among other things, this specific amino acid is a component of glutathione peroxidases or in other terms, of enzymes activated by cellular oxidative stress.

Dr. Hans Lautenschläger