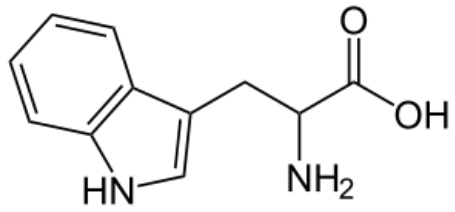
Tryptophan

Tryptophan is a non-polar, essential and aromatic amino acids.

Metabolism of Tryptophan



Tryptophan

Tryptophan is an Amino Acid, in which **Kyurenine-anthranilate pathway** marks the main metabolic pathway. In the first step, the five-membered heterocycle (pyrrole) is cleaved, then the side chain is shortened, and finally the benzene core is cleaved to linearize the molecule. Pyrrole is cleaved in the initial step in the presence of an enzyme called. **Tryptophan pyrrolyses** (tryptophanoxygenases, or also tryptophandioxygenases, which are the same enzyme) form the compound **N-formylkynurenine**. This enzyme is found in the liver and its activation takes place with the helpo of glucocorticoids and glucagon.

In the following reaction, formic acid and kynurenine are formed. The resulting kynurenine can be further changed using three metabolic pathways, of which the main pathway is the one where the reaction catalyzed by **kynurenine hydroxylase** takes place to form **3-hydroxykyurenine**. This metabolic pathway of tryptophan continues via **3-hydroxyanthranilate**, when another amino acid, alanine, is produced with the help of the **kynureninase** enzyme. Another important role of kynurenine is the transamination to **xanthurenate**.

The benzene nucleus is cleaved by oxidase in the 3-hydroxyanthranilate molecule to form 2-amino-3-carboxymuconate semialdehyde. This semialdehyde changes through further reactions to the less important aminomuconate, α-ketoadipate and glutaryl-CoA. In the next step, the molecule is shortened to the final product, which is **acetoacetate**. 2-Aminomuconic acid semialdehyde can be non-enzymatically cyclized to picolinic acid.

Tryptophan is an important precursor of up to 50% of pyridine nucleotides in the body, as they are formed from 2-amino-3-carboxymuconate semialdehyde. 2-Amino-3-carboxymuconate semialdehyde spontaneously cyclizes to **quinolinate** (non-enzymatically). Quinolinate is bound to ribonucleotide by means of the enzyme quinolinate **phosphoribosyltransferase**. At the same time, one of the most important reactions of amino acids takes place - decarboxylation, where the final product of this reaction is **nicotinamide**. Kynurenine hydroxylase is an enzyme that is inhibited by estrogens in women, which is why women are more susceptible to Pellagra, a disease whose main manifestation is a Niacin deficiency.

A number of neurotransmitters such as kynureic acid and its amine kynuramine and quinolinate are produced from kynurenine. Quinolinate ranks among the agonists of some glutamate (excitatory) receptors, and kynurenate, on the other hand, is their antagonist.

Tryptophan also produces a very important neurotransmitter - **Serotonin** (5-hydroxytryptamine). Tryptophan hydroxylation will first take place with the help of **tryptophan-5-monooxygenase** and THB (tetrahydrobiopterin) followed by decarboxylation. Serotonin in the brain acts through serotoninergic receptors (5-HT receptors). It affects the contraction of smooth muscles in arterioles and bronchioles, causing their vasodilation. Decarboxylation of tryptophan also produces **tryptamine**, the function of which has not yet been clarified. It is important as a regulator.

Melatonin is also an important neurotransmitter. Melatonin induces sleep. It is N-acetyl-5-methoxytryptamine formed in the pineal gland and in the retina. The first reaction is N-acetylation, followed by O-methylation. Melatonin is released in a circadian rhythm, which means that it is released at a regular time, mostly at night.

The so-called carcinoid is also known, which is a small tumor arising in the abdominal cavity and pathologically capable of producing serotonin. An increased concentration of 5-hydroxyindoleacetic acid, which is an important metabolite of serotonin, is then found in the urine.

Tryptophan cannot be sufficiently absorbed in the intestine, so it is broken down by intestinal bacteria into indole, indolacrylic or indolepyruvic acid. These acids are subsequently excreted in urine from the body. If these acids are excreted in the urine, we are talking about Hartnup's disease. It mainly manifests itself as a disturbance in the transport of neutral amino acids (including tryptophan) through the brush border of the small intestine and in the renal tubules.

Links

Related articles

- Amino Acids

References

- MATOUŠ, Bohuslav. *Základy lékařské chemie a biochemie.* 1. edition. Galén, 2010. 540 pp. ISBN 978-80-7262-702-8.