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Melatonin

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Introduction

Melatonin is a pineal hormone. The cyclical secretion of this amine derivative has many different physiological effects.

Structure & Secretion

Melatonin is an indole amine; an amine derivative. Amine derivatives are relatively small molecules; melatonin having a molecular weight of 232. This hormone is produced from enzymatic processing of the amino acid tryptophan.

Melatonin is:

- Water-soluble
- Synthesized in the cytoplasm of pinealocytes
- Stored in secretory vesicles
- Released by exocytosis
- Transported in the blood as a dissolved molecules
- Quickly degraded (half-life of minutes)
- Bound by receptors found on the surface of target cell membranes
- Capable of activating a second messenger system within the target cell and changing the activity of existing proteins.

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- Melatonin can be found circulating in the blood plasma and urine of all animal, demonstrating the diurnal pattern: levels highest at mid-night (or mid-dark) periods and levels lowest at mid-day (or mid-light) periods. A diurnal pattern can also be seen in cerebrospinal fluid of primates only

Pineal gland is a small pine-cone shaped organ, which produces melatonin. It is part of the epithalamus lies deep within the brain, in the posterior portion of the roof of the third ventricle. It contains specialized secretory cells called pinealocytes, neurons, and neuroglia, mainly astrocytes. Unmyelinated axons of nerve fibers form synapses with the pinealocytes, their synaptic vesicles containing norepinephrine. Serotonin is also found in the sympathetic nerve terminals, as well as the pinealocytes.

The pineal gland is said to be a neuroendocrine transducer in which a neural input is transduced into a chemical signal. The pineal gland acts as an intermediate between external conditions and internal secretion of melatonin.

Biosynthesis

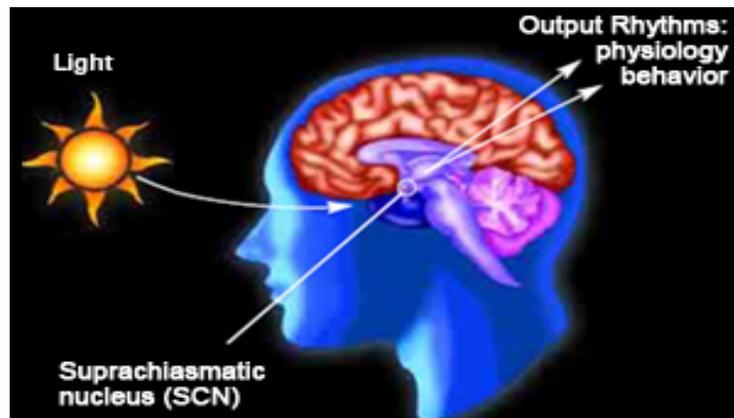
When light is depleted, the amino acid tryptophan is converted to 5-hydroxytryptophan by the enzyme tryptophan hydroxylase. 5-hydroxytryptophan is then converted to 5-hydroxytryptamine, or serotonin, by the enzyme 5-hydroxytryptophan decarboxylase. Serotonin is converted into N-acetyl serotonin by the enzyme N-acetyl transferase, which is then O-methylated to N-acetyl-5-methoxytryptamine or melatonin by hydroxyindole-O-methyltransferase.

It is believed that N-acetyl transferase activity is the main control for melatonin biosynthesis, as it is the rate-limiting step in the reaction. Degradation of melatonin occurs in the liver, where melatonin hydroxylase converts melatonin to 6-hydroxymelatonin, which can be excreted in the urine.

Regulation

The locus of control varies among animals. In birds, an internal "clock" is within the pineal gland itself, leading to the rhythmic release of melatonin. In mammals, however, photic cues from the eyes are processed by the supra chiasmatic nucleus (SCN) in the hypothalamus.

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