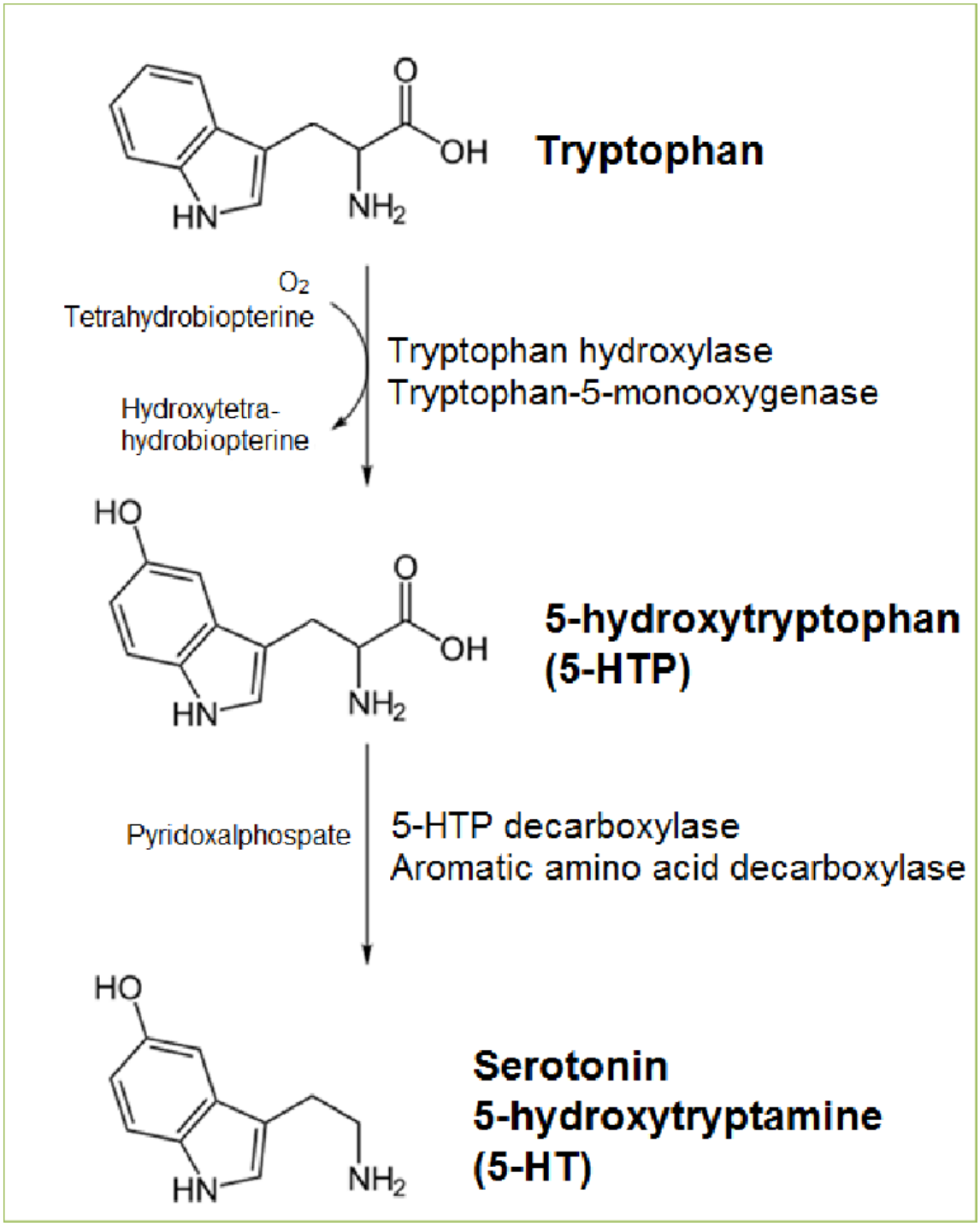
SYNTHESIS AND SIGNIFICANCE OF 5-HYDROXY TRYPTAMINE (or)

SEROTONIN



Serotonin (5-HT) is a basically a neurotransmitter.

It is believed to play a central role in modulation of vasoconstriction, anger, aggression, body temperature, mood, sleep, sexual desire, and appetite as well as stimulation of vomiting reflex etc

Structurally it contains indole ring, hydroxy group and ethyl amine group being attached to the ring.

Serotonin can affect the functioning of cardiovascular system, muscles, the endocrine system.

Serotonin - a chemical manifestation of personality:

High level of serotonin: obsessive-compulsive disorders e.g. compulsive hand-washing

Low levels of serotonin: depression, suicide

Sources

- ✓ The serotonin is found abundantly in gut and blood plasma, but it can not enter the brain.
- ✓ Meat and banana are the direct sources of serotonin.
- ✓ The main source of serotonin is L-tryptophan, an amino acid, which is found in proteins. So proteins are the main sources of serotonin: meat, eggs, milk, fishes, pulses,
- ✓ Enough calcium, magnesium and oxygen are also needed for serotonin production.
- ✓ Besides these vitamin B6 also promotes its production.

When we have enough Serotonin we have:

- ➢ Emotional stability
- ➢ Reduces aggression
- ➢ Sensory input
- ➢ Sleep cycle
- ➢ Appetite control

Serotonin Deficiencies result in:

- ➢ Irritability
- ➢ Irrational emotions
- ➢ Sudden unexplained tears
- ➢ Sleep disturbances
- ➢ Migraine

Optimum serotonin level are also supposed to have positive impact on learning and cognition.

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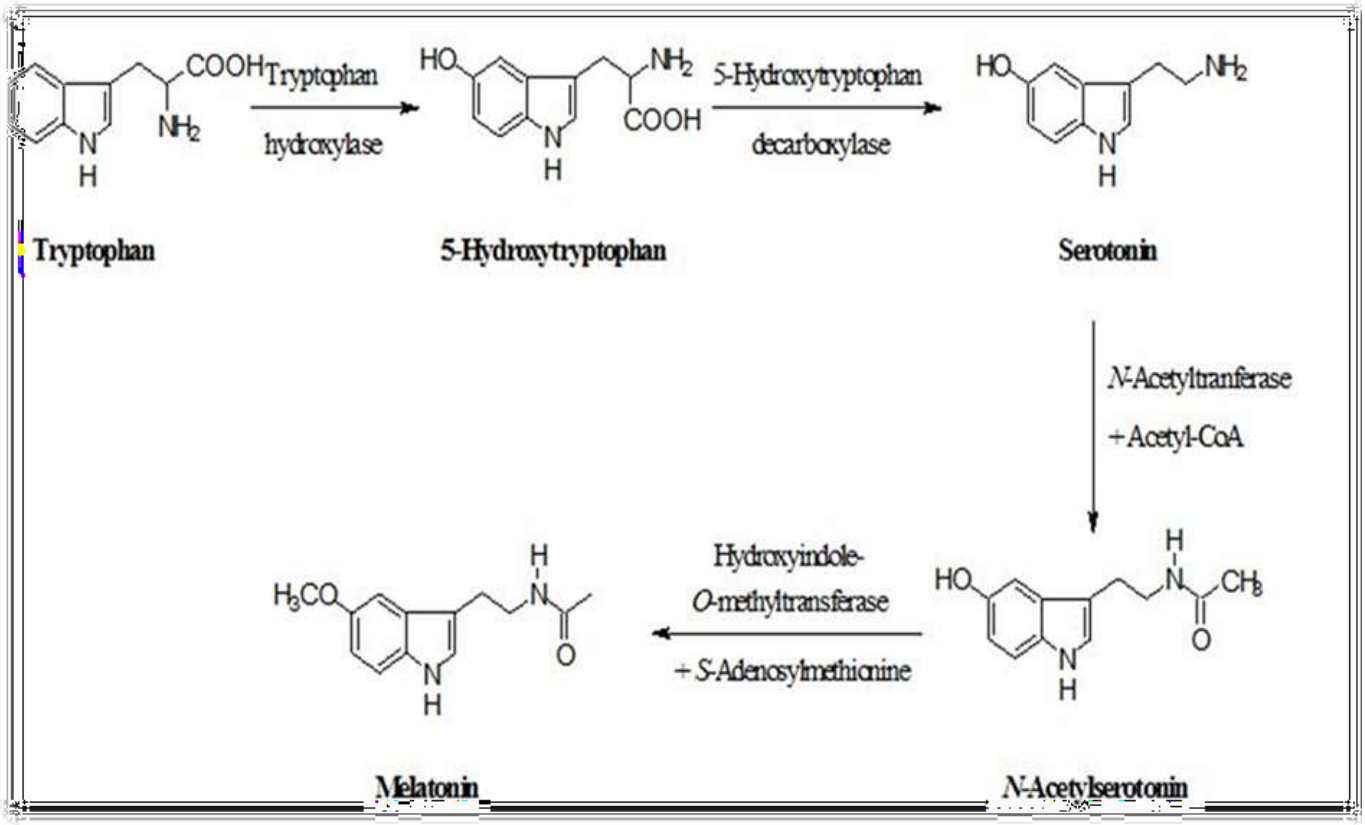
SYNTHESIS AND SIGNIFICANCE OF MELATONIN

Melatonin, chemically (N-acetyl-5-methoxy tryptamine) is a hormone secreted by pineal gland in the brain. Melatonin produced by the retina and the gastrointestinal (GI) tractacts as a paracrine hormone.

It found in a wide spectrum of organisms including, animals, plants, bacteria and fungi.It helps regulate other hormones and maintains the body's circadian rhythm.

Melatonin (N-acetyl-5-methoxytryptamine) is primarily synthesized and secreted by the pineal gland . The synthesis of melatonin in the pineal gland involves several steps.

Synthesis of Melatonin



Secretion of melatonin

Under natural environment, melatonin is secreted during the night in the healthy human, as in all other species. Melatonin being a lipophilic molecule, it is not stored but directly released by diffusion of the pineal gland and released into the cerebrospinal fluid and the circulation. Although the eye contributes significally to circulating melatonin levels in a few species(sea bass, frog, quail, pigeon), retinal melatonin acts primarily within the eye.

In humans, serum concentrations of melatonin is low during the day and is significally higher at night with peak between 02:00 am and 04:00 am, when measured with high-specificity assay. The onset of secretion usually takes place around 09:00 pm- 02:00 am and the offset around 07:00 am-09:00 am in adults in the temperature zone.

Circadian Rhythm Effect

Circadian rhythm is any biological process that displays an endogenous, entrainable oscillation of about 24 hours.In humans and most diurnal mammals, melatonin is secreted at night with a strong circadian rhythm and maximum plasma levels that occur around 2 to 4 AM.

The role of melatonin for the seasonal changes in physiology and behavior of various photoperiodic species has been extensively documented for a long time.

In winter nights there is increases duration of melatonin secretion. Summer nights melatonin secretion reduces with longer days.

Anti oxidant effect

Melatonin is a very potent free radical scavenger recipient and a general antioxidant. As an antioxidant melatonin binds potently the toxic hydroxyl and hyperoxide radicals. The antioxidant properties of melatonin have been proved in homogenized tissues. The antioxidant activity of melatonin may reduce damage caused by some types of Parkinson's disease, may play a role in preventing cardiac arrhythmia and may increase longevity.

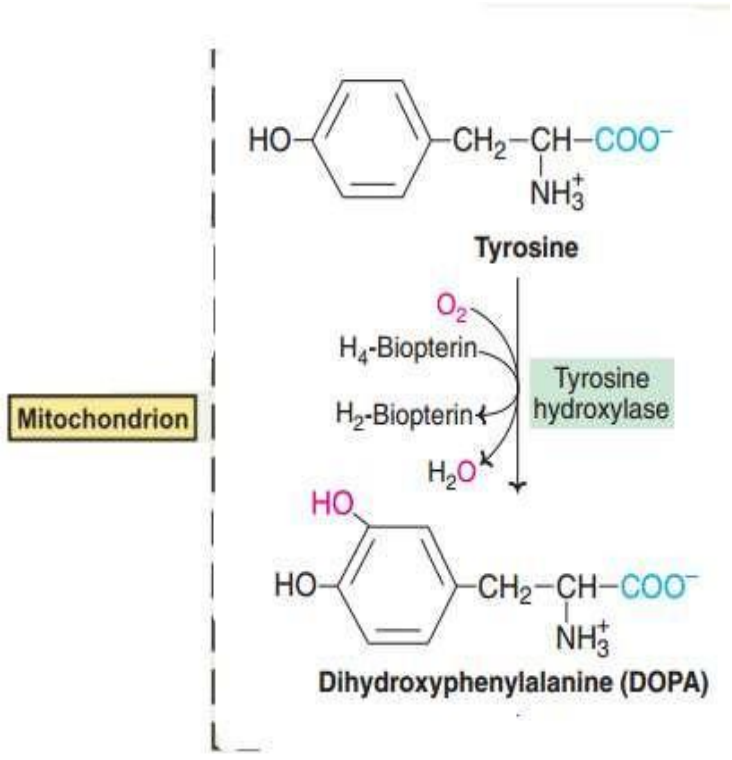
A deficient production of melatonin or (Hypomelatonism) can result in anxiety and mood disorders, lowered basal body temperature insomnia, elevated estrogen/progesterone ratio, and immune suppression associated with cancer.And there are many reasons that cause to low melatonin levels such as (alcohol, Vitamin B12, caffeine, Beta-blocker medications, Cigarettes, Frequent stress, antidepressants).

Excess melatonin or we can say (hypermelatonism) is associated with seasonal affective disorder (SAD), lowered estrogen/progesterone ratio, low thyroid and adrenal function, and hypotension, extreme fatigue and lack of energy, increased need for sleep, carbohydrate cravings, exposure to light improve

Synthesis of Catecholamines and its Significance

- Tyrosine is taken up actively by cells of adrenal medulla pheochromocytes and neuroglial cells
- Conversion of tyrosine to DOPA (Inmitochondrion)
- Conversion of DOPA to dopamine (In cytoplasm)
- Conversion of dopamine to norepinephrine (In granules/vesicles)
- Conversion of Nor-epinephrine to epinephrine (In cytosol)

Conversion of tyrosine to DOPA (Di hydroxy phenyl alanine)



Tyrosine hydroxylase is involved in the conversion

Tyrosine is hydroxylated to 3,4- dihydroxyphenylalanine (DOPA) by tyrosine hydroxylase.

It is a rate limiting enzyme & requires tetrahydrobiopterin as coenzyme.

Conversion of DOPA into DOPAMINE

DOPA-decarboxylase is involved in the conversion

DOPA undergoes PLP-dependent decarboxylation to give dopamine.

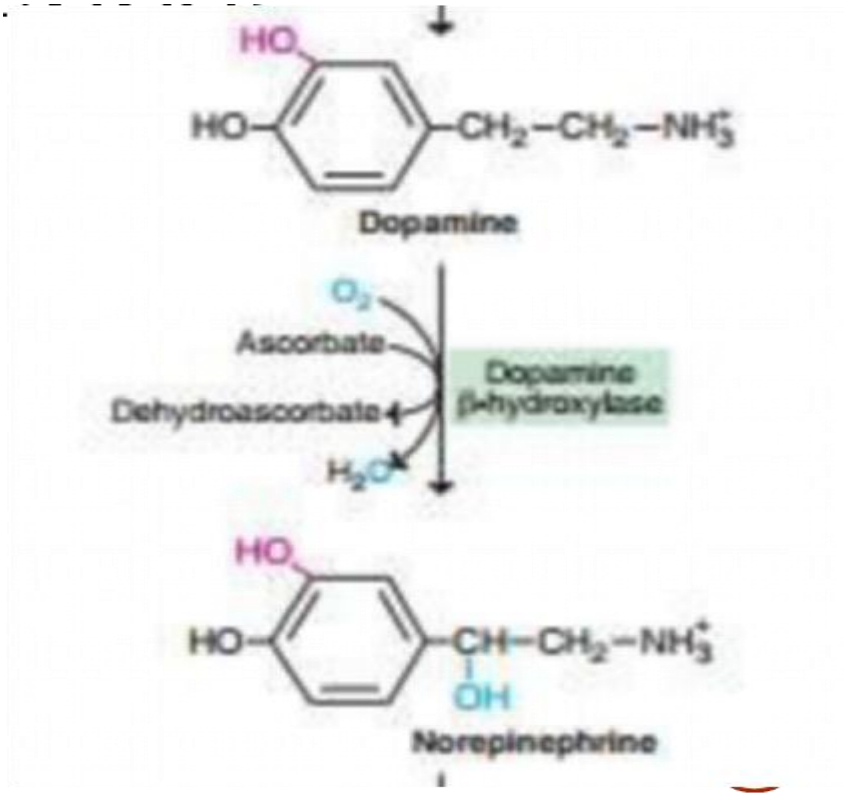
In Parkinsonism, the dopamine content in brain is reduced.

As dopamine will not enter into the brain cells, the precursor, L-DOPA is used as a drug in Parkinsonism.

Alpha methyl DOPA will inhibit DOPA decarboxylase & prevent production of epinephrine; so it is an antihypertensive drug

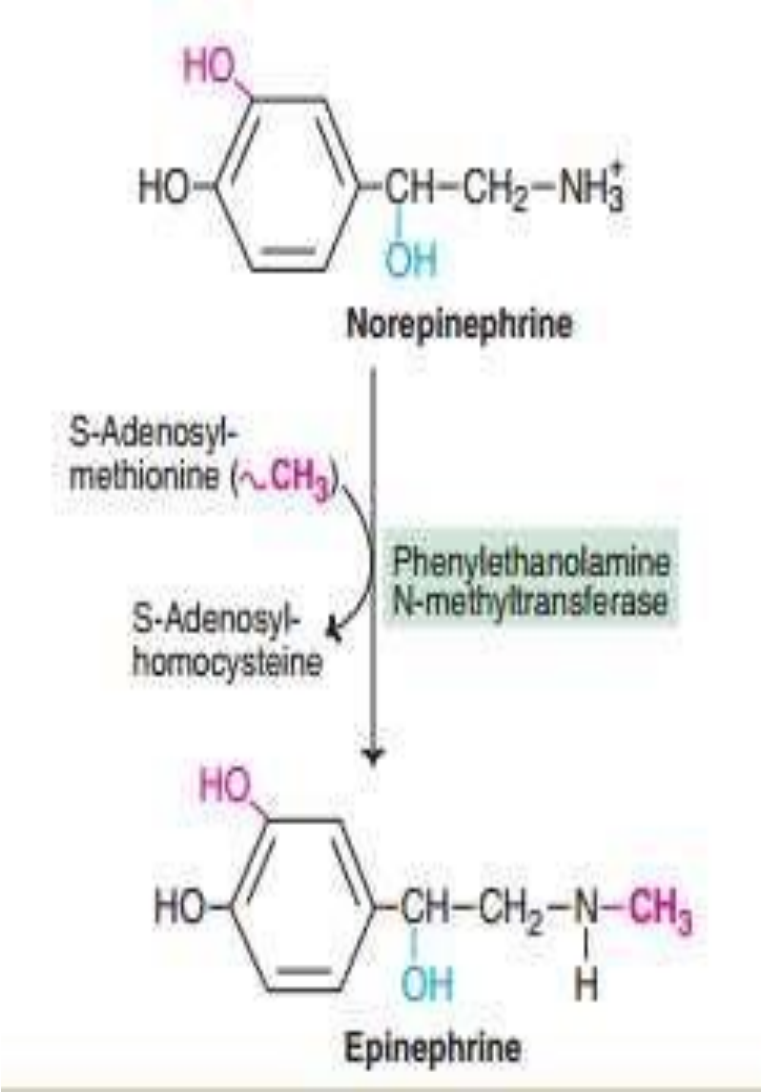
Conversion of Dopamine to Nor Epinephrine (Nor adrenaline)

- Dopamine from cytosol enters Chromaffin granules of Pheochromocytes or granulated vesicles of brain cells or nerve endings.
- Dopamine is hydroxylated to Norepinephrine by the enzyme Dopamine- β-hydroxylase, a Copper-containing enzyme.
- Vitamin C is required for the reaction.



Conversion of Dopamine to Nor Epinephrine (Nor adrenaline)

- Nor-epinephrine comes out of the chromaffin granules into cytosol, where it is methylated.
- CH3 group is donated by “active” methionine (S adenosyl methionine) and the enzyme catalyzing the reaction is N-methyl transferase.
- This reaction does not take place in nerve cells, where synthesis stops at Norepinephrine stage.
- Epinephrine after synthesis in cytosol moves back to chromaffin granules, where it is stored



Conversion of Nor-Epinephrine to Epinephrine (Adrenaline)

Nor-epinephrine comes out of the chromaffin granules into cytosol, where it is methylated.

CH3 group is donated by “active” methionine (S adenosyl methionine) and the enzyme catalyzing the reaction is N-methyl transferase.

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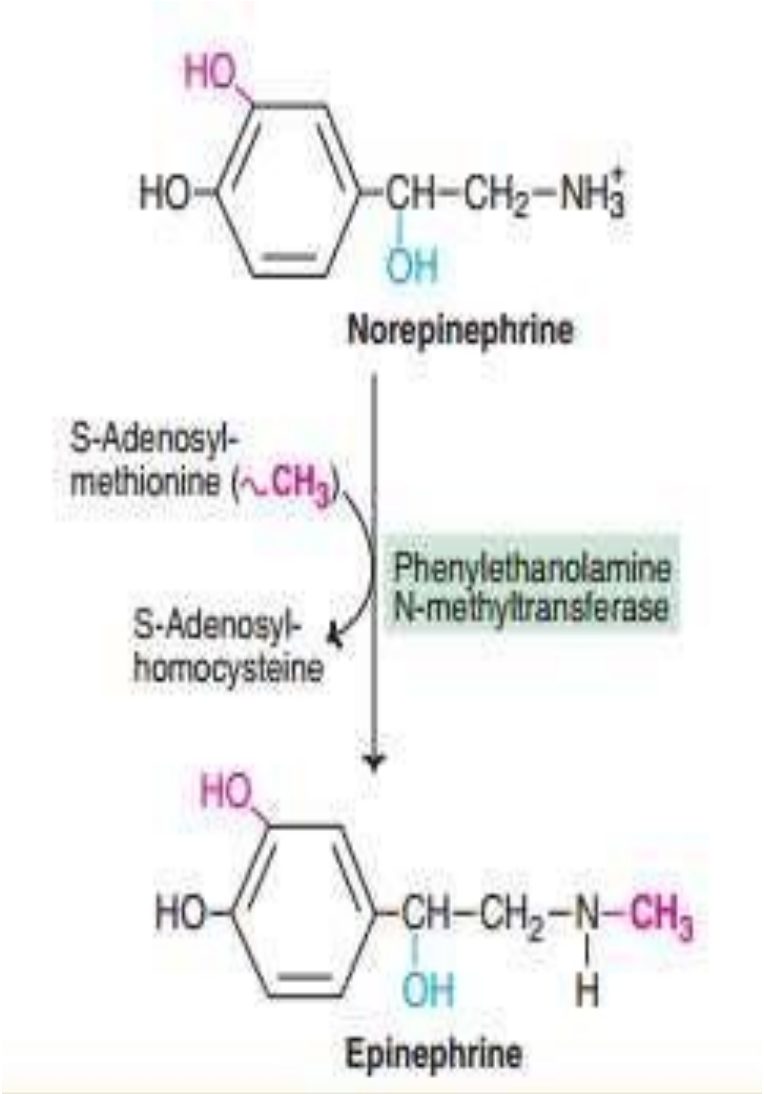
Epinephrine after synthesis in cytosol moves back to chromaffin granules, where it is stored



Dopamine :

Dopamine is a neurotransmitter, a chemical responsible for sending messages between the brain and different nerve cells of the body. It's responsible for many functions, including memory, sleep, mood, pleasurable reward, behavior and cognition

Nor- Epinephrine (Nor adrenaline):

The general function of norepinephrine is to mobilize the brain and body for action. Norepinephrine release is lowest during sleep, rises during wakefulness, and reaches much higher levels during situations of stress or danger, in the so-called fight-or-flight response.

Epinephrine (Adrenaline):

adrenaline include increasing the heart rate, increasing blood pressure, expanding the air passages of the lungs, enlarging the pupil in the eye (see photo), redistributing blood to the muscles and altering the body's metabolism, so as to maximise blood glucose levels (primarily for the brain).