<u>Synthesis of Hormones:</u>

The synthesis of all hormones is determined at the genetic level. Through the biological process hormones are produced within endocrine cells, and are regulated by precursor availability and enzyme activity.

1. Synthesis of Peptide Hormones: Peptide Hormones (e.g., Insulin, FSH) are synthesized by translational method. Several steps are involved in the transfer of information (gene expression) encoded in the polynucleotide language of DNA to the poly-amino acid language of biologically active proteins (hormones).

1) Genes are transcribed to mRNA

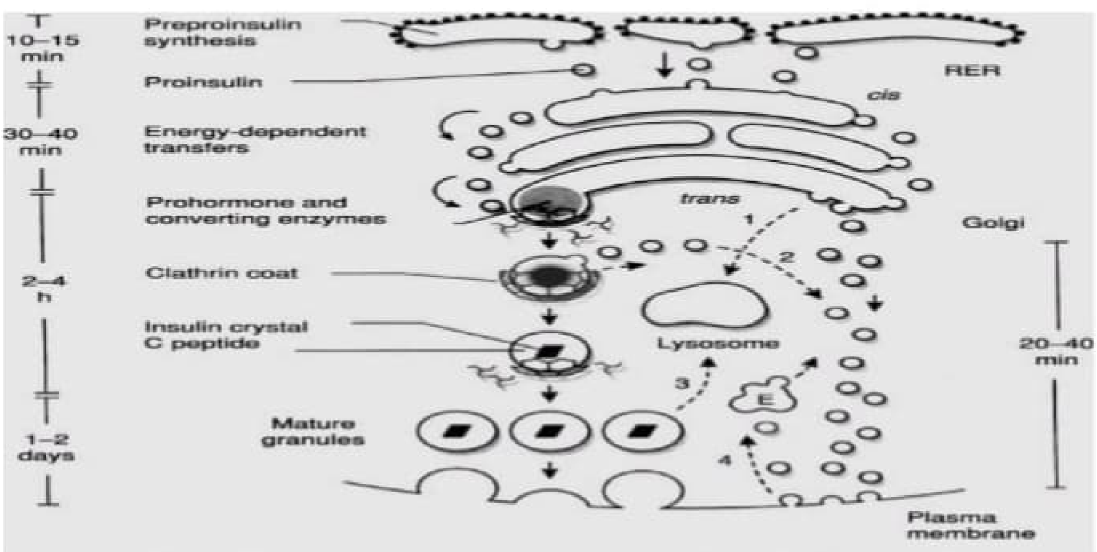
2) mRNA is translated at ribosomes into preprohormones

3) Per hormones are converted to prohormones (parent molecule) in the endoplasmic reticulum.

4) Pro-hormone is extended at their amino termini by a hydrophobic amino acid sequence, called signal peptide or leader peptide. With the help of signal peptide pro-hormone passes into the Golgi complex via endoplasmic reticulum.

5) The pro-hormone is then converted into hormone proper by enzymic action and finally secreted by exocytosis.

Following schematic representation shows the steps in cellular synthesis of peptide hormone



2. Synthesis of Steroid Hormone:

The synthesis of steroid hormones such as, adrenal medullary hormones, steroid hormones involves the action of multiple enzymes.

All the steroid hormones are syntesized from precursor cholesterol molecule. Synthesis of non-peptide hormones occurs within the cells from their precursor molecules by sequential actions of several enzymes. They may be synthesized within mitochondria or within endoplasmic reticulum. They are then secreted either by active exocytosis or by simple diffusion.

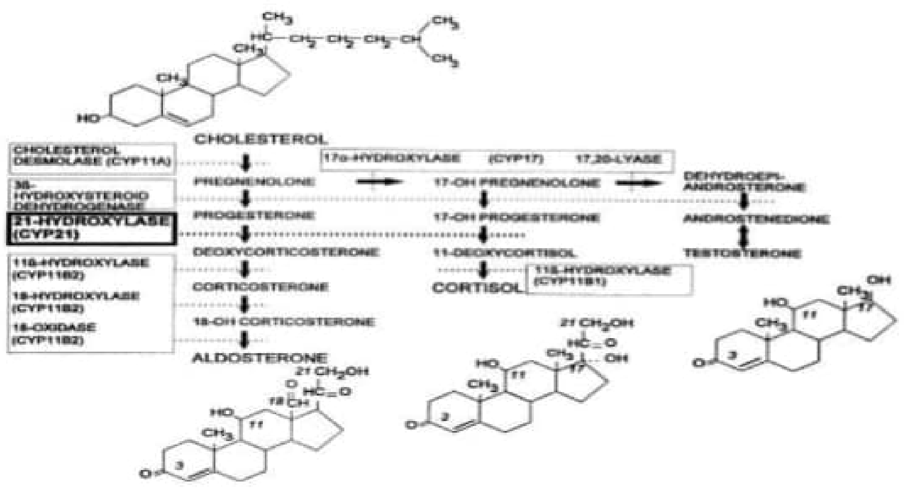


Fig - Steroid Hormone Synthesis Pathways from Cholesterol.

This diagram illustrates the biosynthetic pathways by which cholesterol is converted into adrenal steroid hormones, including progesterone, mineralocorticoids (aldosterone), glucocorticoids (cortisol), and androgens (testosterone). Each enzymatic step is shown within labeled boxes, with cytochrome P450 enzymes identified by their "CYP" designations. Key enzymes such as CYP11B2 and CYP17 possess multiple catalytic activities. The chemical structures of cholesterol, aldosterone, cortisol, and testosterone are placed near their respective pathway branches. In the adrenal cortex, aldosterone is synthesized in the zona glomerulosa, cortisol in the zona fasciculata, and androgens in the zona reticularis.

3) Synthesis of Thyroid Hormones (T3, T4) are synthesized in follicular cells via iodine uptake, oxidation by thyroid peroxidase (TPO), and coupling on thyroglobulin.

Iodide Trapping: Follicular cells actively transport iodide from the bloodstream across their basolateral membrane using the Na+/I- symporter (NIS).

Thyroglobulin Synthesis: Follicular cells produce a large glycoprotein called thyroglobulin (Tg), which contains numerous tyrosine residues. This is secreted into the follicular lumen (colloid) via exocytosis.

Oxidation of Iodide: Iodide is transported into the colloid by the transporter. At the apical membrane, the enzyme thyroid peroxidase (TPO) oxidizes iodide into reactive iodine using hydrogen peroxide.

Iodination (Organification): TPO attaches the reactive iodine to the tyrosine residues on the thyroglobulin molecule. This forms monoiodotyrosine (MIT) (one iodine) and diiodotyrosine (DIT) (two iodines).

Coupling Reaction: TPO facilitates the coupling of these iodinated tyrosines while they are still attached to thyroglobulin:

DIT + DIT forms Thyroxine (T4).

MIT + DIT forms Triiodothyronine (T3).

Storage: The hormones remain bound to thyroglobulin and are stored as colloid in the follicular lumen for up to several months.