15.8B: Formation, Storage, and Release of Thyroid Hormones

Thyroid hormones (T4 and T3) are produced by the follicular cells of the thyroid gland and regulated by thyroid-stimulating hormone (TSH).

Learning Objectives

• Describe the relationship between thyroxine (T4) and triiodothyronine (T3)

Key Points

• Because the effects of T4 in vivo are mediated via T3 (T4 is converted to T3 in target tissues), T3 is three- to five-fold more active than T4.
• Thyroxine is believed to be a pro-hormone and a reservoir for the most active and main thyroid hormone T3. T4 is converted as required in the tissues by iodothyronine deiodinase.
• Thyroid hormones (T4 and T3) are produced by the follicular cells of the thyroid gland and are regulated by thyroid-stimulating hormone secreted by the anterior pituitary gland.

Key Terms

• thyroid-stimulating hormone: A hormone that stimulates the thyroid gland to produce thyroxine (T4), and then triiodothyronine (T3), which stimulates the metabolism of almost every tissue in the body.
• triiodothyronine: A thyroid hormone also known as T3 that plays a key role in many physiological processes and is the much more active than T4.
• thyroxine: A thyroid hormone also known as T4, thought to be a pro-hormone and a reservoir for T3.
The thyroid hormones thyroxine (T4) and triiodothyronine (T3) are produced from thyroid follicular cells within the thyroid gland, a process regulated by the thyroid-stimulating hormone secreted by the anterior pituitary gland.

Thyroglobulin, the pre-cursor of T4 and T3, is produced by the thyroid follicular cells before being secreted and stored in the follicular lumen. Iodide is actively absorbed from the bloodstream by a process called iodide trapping. In this process, sodium is co-transported with iodide from the basolateral side of the membrane into the cell, and then concentrated in the thyroid follicles to about thirty times its concentration in the blood.

Through a reaction with the enzyme thyroperoxidase, iodine is bound to tyrosine residues in the thyroglobulin molecules to form monoiodotyrosine (MIT) and diiodotyrosine (DIT). Linking two moieties of DIT produces T4. Combining one particle of MIT and one particle of DIT produces T3.

Proteases digest iodinated thyroglobulin, releasing the hormones T4 and T3, the biologically-active agents central to metabolic regulation. T3 is identical to T4, but it has one less iodine atom per molecule.

T4 is believed to be a pro-hormone and a reservoir for the more active and main thyroid hormone T3. T4 is converted as required in the tissues by iodothyronine deiodinase.

**Thyroid hormone**: Diagrammatic representation of thyroid hormone synthesis in a thyroid follicle.

### Effects of Iodine Deficiency

If there is a deficiency of dietary iodine, the thyroid will not be able to make thyroid hormone. A lack of thyroid hormone will lead to decreased negative feedback on the pituitary, which in turn, will lead to increased production of thyroid-stimulating hormone, which causes the thyroid to enlarge (goiter).

This enlarged endemic colloid goiter has the effect of increasing the thyroid’s ability to trap more iodide, compensating for the iodine deficiency and allowing it to produce adequate amounts of thyroid hormone.