

## • hydroxyproline

The hydroxylation of prolyl and lysyl side chains in procollagen requires ascorbic acid (vitamin C). As a result patients with vitamin C deficiency (scurvy) form a collagen with insufficient hydroxyproline that denatures spontaneously at room temperature. Prolonged deficiency of vitamin C causes **scurvy** (i.e. gingival inflammation and bleeding gums, dry mouth and eyes, bruising, fatigue).

Collagen accounts for approximately 25% of the body protein in adults and 15% to 20% in children. It is most abundant in strong, tough connective tissues. **Type I** collagen is by far the most abundant collagen in the body. It has a most unusual amino acid composition, with **33% glycine** and **10% proline**. It also contains **hydroxyproline** and **hydroxylysine**.

The basic structural unit of collagen fibrils, the **tropocollagen** molecule, consists of three intertwined polypeptides. In the case of type I collagen, it has a very unusual amino acid sequence, with glycine in every third position. Tropocollagen is the longest known protein and is formed from procollagen, which is **secreted by fibroblasts**. The three helical polypeptides of the tropocollagen molecule are wound around each other in a right-handed triple helix. **Note:** The long, ropelike tropocollagen molecules form fibrils by aligning themselves in parallel. Once secreted outside the cell **tropocollagen** units are crosslinked through covalent bonding between adjacent lysine residues to produce mature collagen.

**Remember:** Vitamin C influences the formation of collagen, which is the organic matrix found in dentin and cementum (see note #1 below).



### Notes

1. **Hydroxyproline** and **hydroxylysine** are **nonstandard amino acids** that are present in few other proteins. For this reason, their concentration in a particular tissue is a **good estimate of the collagen content** as well. They **are not used directly** in the reactions of protein synthesis. These amino acids are formed by the hydroxylation of proline and lysine (by lysyl hydroxylase). This hydroxylation involves  $\alpha$ -keto-glutarate, oxygen,  $\text{Fe}^{2+}$  and vitamin C (ascorbic acid), which is required because it restores iron to its reduced state ( $\text{Fe}^{2+}$ ).

2. **Collagen** and **reticular fibers** make up the stroma of all lymphoid tissues **except** the thymus.