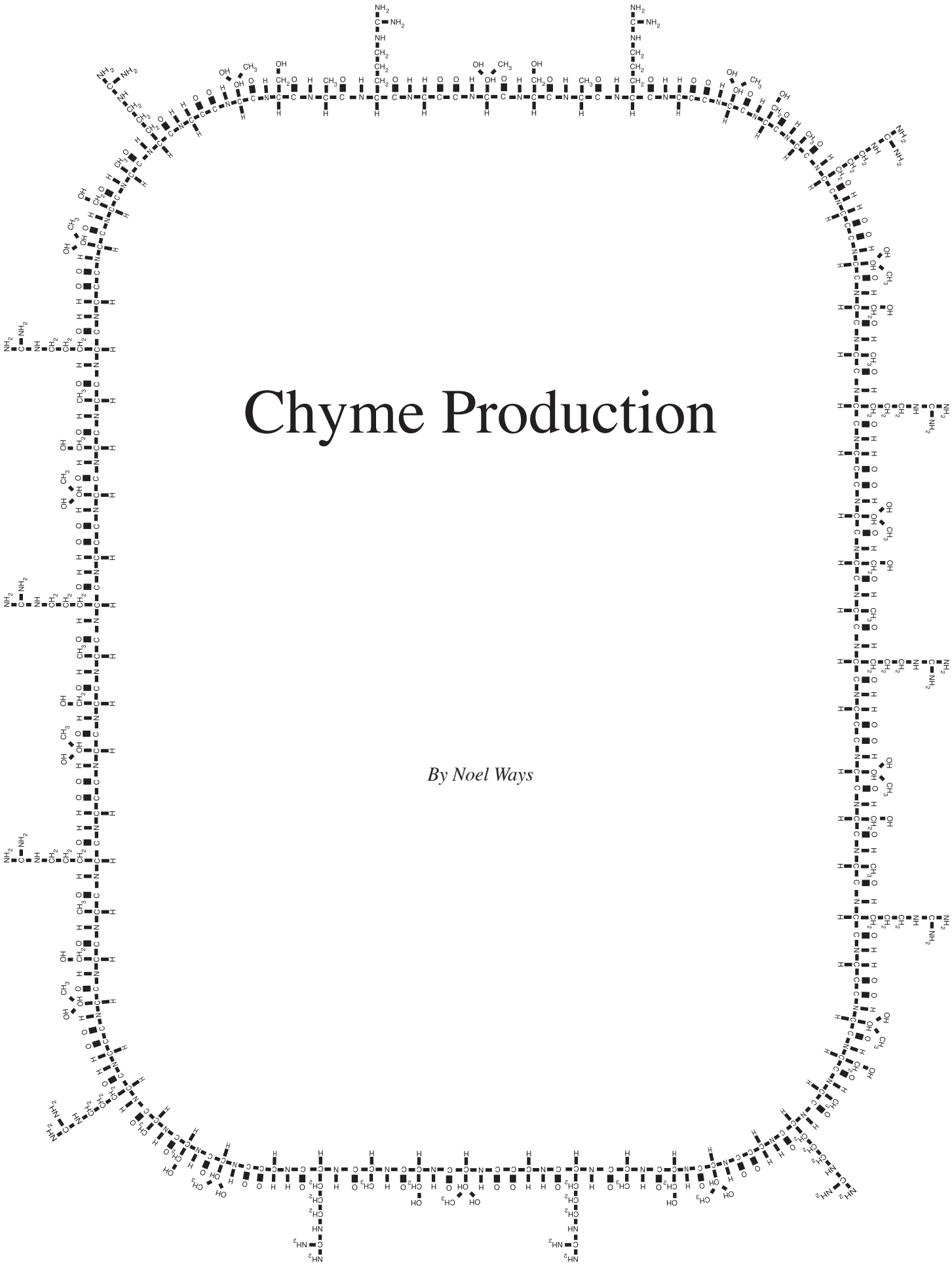
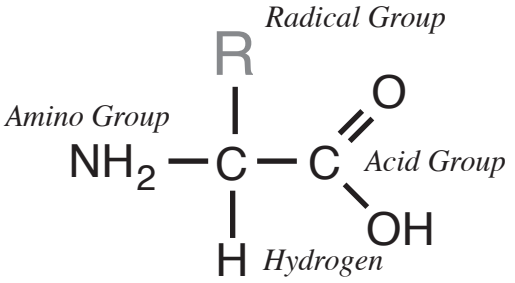


Chyme Production

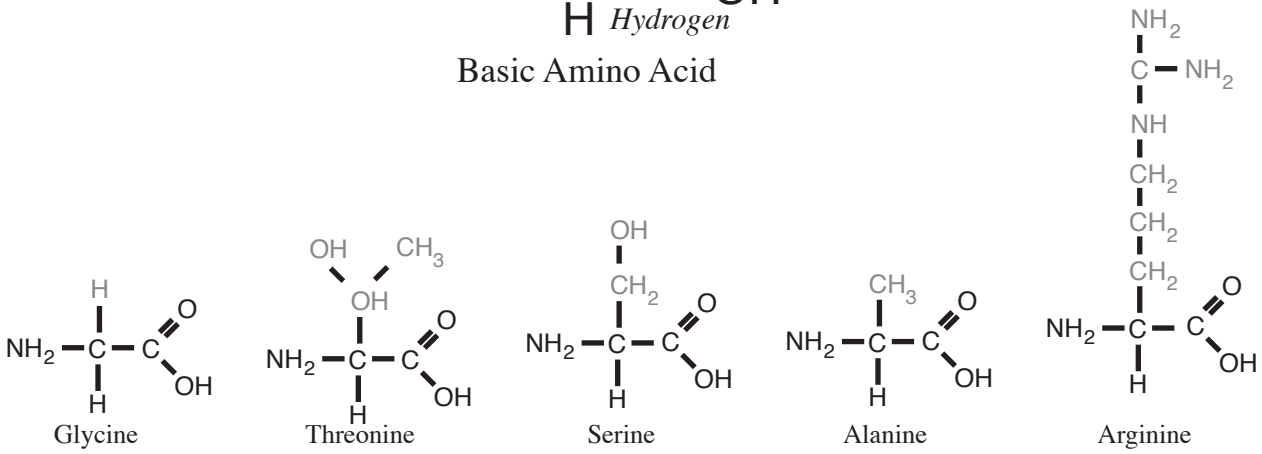
By Noel Ways

Review of Protein Structure

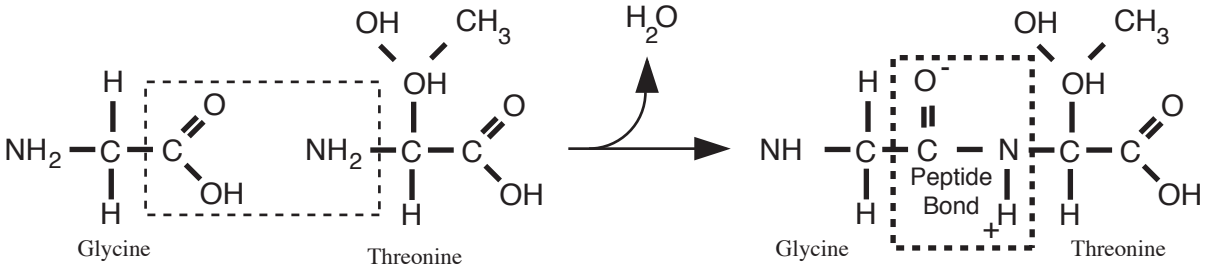
Proteins are polymers of amino acids. Characteristic to all amino acids (the monomer of proteins) is a structure that consists of an amino group (- NH2), hydrogen (- H), and an acid group (- COOH); all covalently bonded to a central carbon. Looking at the basic structure of an amino acid at right, one notes an additional "R" group. The "R" stands for radical, and it is here that the variations between different amino acids occur. There are 20 different types of amino acids necessary for protein synthesis, and each amino acid will differ only in it's "R" group. Six examples are shown below.



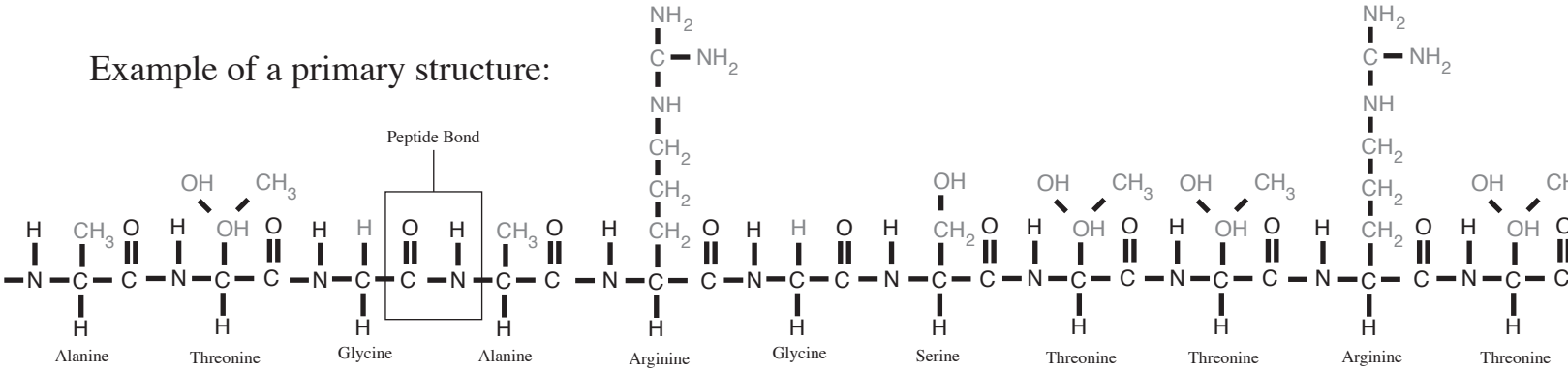
Basic Amino Acid



When covalently bonding two amino acids together by a dehydration synthesis, a peptide bond is formed. Note that the peptide bond has ***CHARGES***. Additional amino acids may be added to lengthen the chain. As the linear sequence of amino acids expands, the polymer is called the primary structure.



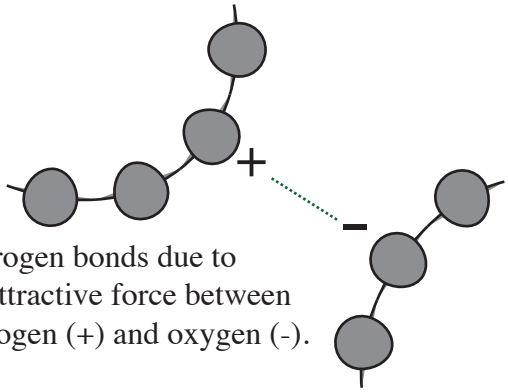
Example of a primary structure:



The primary Structure could also be represented this way:

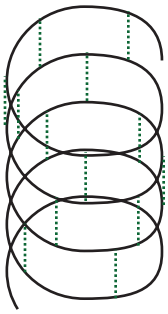
A–T–G–A–Ar–A–G–S–T–T–A–T

As the linear primary structure increases in size, the attractive forces of the peptide bonds are drawn together. As they do so the primary structure begins to take on a secondary structure. These attractive bonds created by the positive and negative charges are called hydrogen bonds. The secondary structure includes characteristic pleating and helical structural formations.

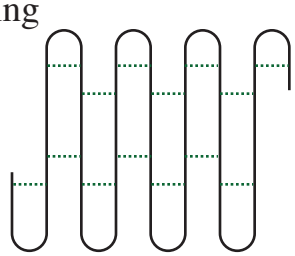


Hydrogen bonds due to the attractive force between hydrogen (+) and oxygen (-).

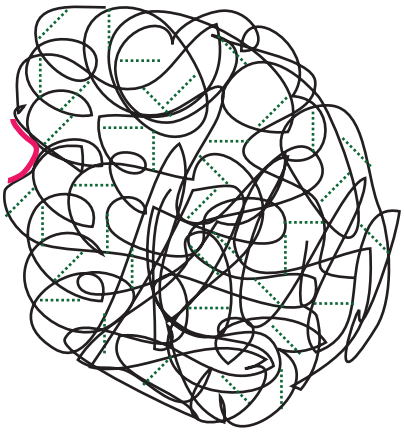
Helix



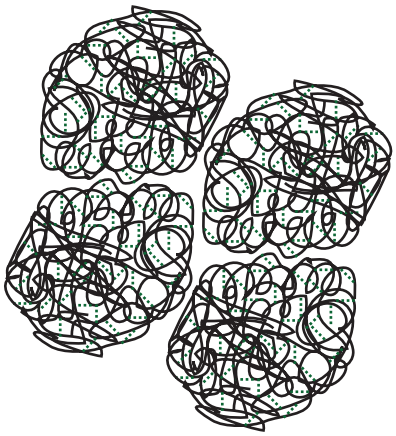
Pleating



As the primary and secondary structure continues to grow, a complex irregular geometry develops as the protein repeatedly folds on itself. This level of structural organization is called the *tertiary structure*. It is the unique configuration of the tertiary structure that frequently gives a protein its unique properties and functions.



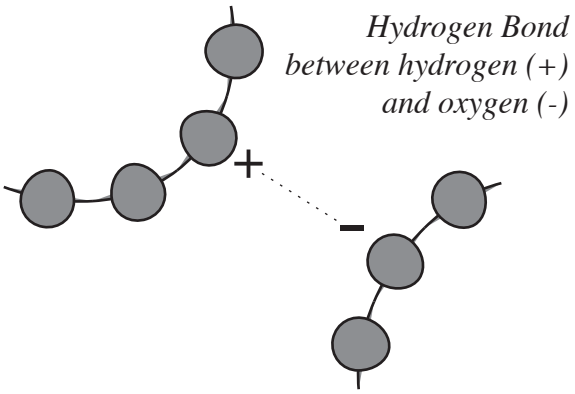
The last level of structural organization that occasionally occurs is the *quaternary structure*. Here, more than one protein are bonded together.

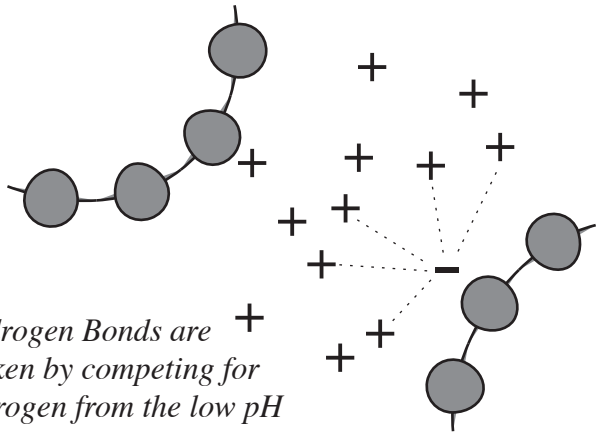


Catabolism of Complex Protein Structure

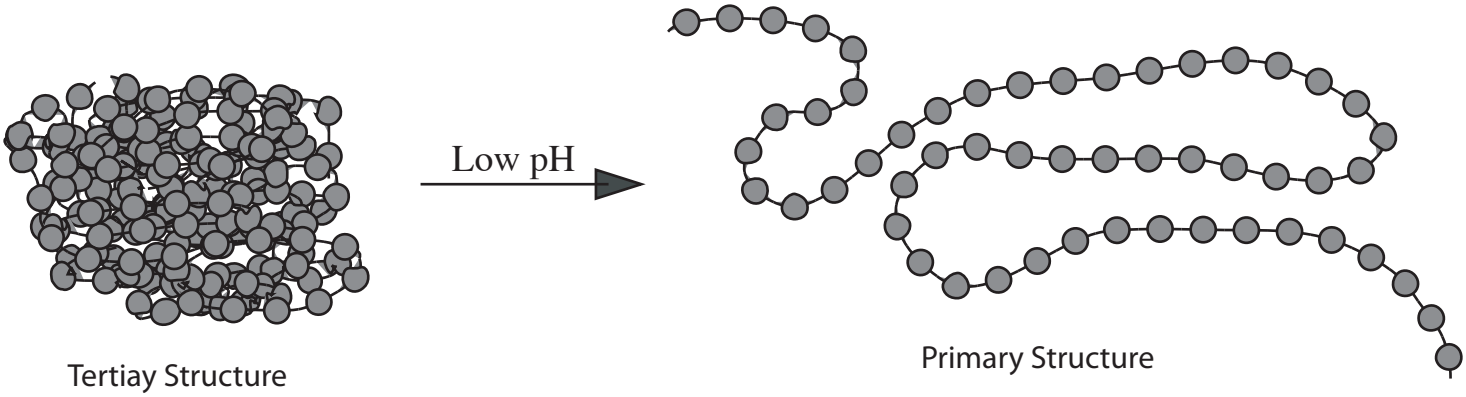
Digestion and absorption of food require that it be converted into a liquid form for processing. Once in this liquid form, the "nutrient broth" is called ***chyme***. As many tissue/food materials use protein for structural purposes, an essential part of the production of chyme is the breakdown of tissue structure, and by extension, protein structure.

To accomplish this task, ***parietal cells*** within the ***gastric pits*** secrete concentrated Hydrochloric Acid, creating a pH within the lumen of the stomach around 1.5 to 2.0. This high concentration of H+ interferes by competitive means with the hydrogen bonds, thereby destroying all attractive forces holding the protein together. Once these bonds are broken the protein unravels into its primary structure, as illustrated below.





Once the complex structure of the protein has been destroyed, the linear sequence (primary structure) is exposed.

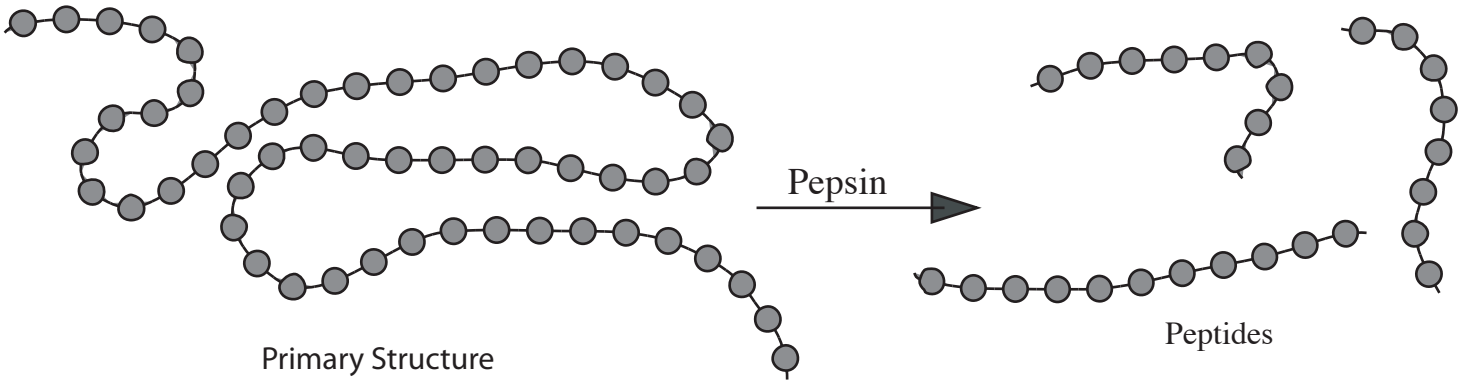


Once protein structure is in its primary form, the next step in chyme production is to chop up the protein into small fragments called peptides. To accomplish this step, ***Chief Cells*** of the Gastric Pits secrete an inactive protein-digesting enzyme called ***pepsinogen***. The inactive form is important so that the enzyme does not digest the cells that are making it.

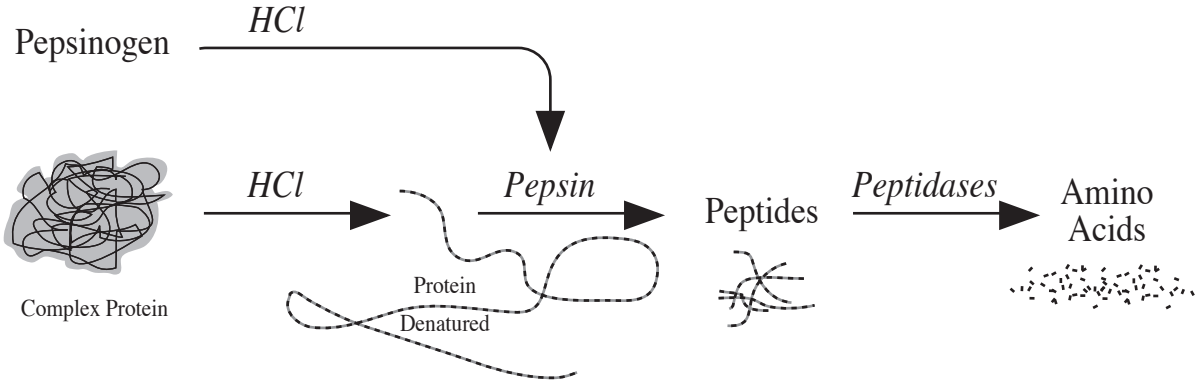
Activation occurs in a very low pH environment. When the pepsinogen enters the lumen of the stomach, the same low pH that broke down protein sturcture, now also activates the pepsinogen into an active protein digesing form called ***pepsin***.

Pepsinogen (inactive) $\xrightarrow{\text{Low pH}}$ Pepsin (active)

The pepsin, now hydrolyzes (catabloizes) the primary structure at specific loci, breaking the protein up into small amino acid chains called peptides.



Hydrochloric acid, therefore, has two functions that must work concurrently. First, the acid will break hydrogen bonding, thereby denaturing the protein into the primary structure. Secondly, the inactive pepsinogen will be activated in the presence of HCl.



As protein breakdown proceeds, the structure of foodstuffs is significantly compromised. And the continuing ***Stomach Churning*** mixes stomach contents with the gastric juices creating a high caustic but nutrient-rich broth called ***Chyme***.