3.2 Mouth to the Stomach

Digestion begins in the mouth, both mechanically and chemically. Mechanical digestion is called mastication, or the chewing and grinding of food into smaller pieces. The salivary glands release saliva, mucus, and the enzymes, salivary amylase and lysozyme.

Figure 3.21 The mouth

Salivary amylase cleaves the alpha 1-4 glycosidic bonds in the starch molecules, amylose and amylopectin. However, salivary amylase cannot cleave the branch points in amylopectin where there are alpha 1-6 glycosidic bonds, as shown in the figure below. Overall this enzyme accounts for a minor amount of carbohydrate digestion.

α 1-4 glycosidic bonds

Glycoside = sugar

Amylose – All α 1-4 glycosidic bonds

α 1-4 glycosidic bonds

Branch points are

α 1-6 glycosidic bonds, amylase can’t cleave

Amylopectin

Figure 3.22 Enzymatic action of salivary amylase. Purple arrows point to alpha 1-4 glycosidic bonds that can be cleaved. The yellow arrows point to the alpha 1-6 glycosidic bonds that cannot be cleaved.
Lysozyme helps break down bacteria cell walls to prevent a possible infection. Another enzyme, lingual lipase, is also released in the mouth. Although it is released in the mouth, it is most active in the stomach where it preferentially cleaves short-chain fatty acids in the sn-3 position. Lingual lipase has a small role in digestion in adults, but may be important for infants to help break down triglycerides in breast milk.

**Check Yourself**

What macronutrients are digested in our mouth? By what enzymes?

**Swallowing**

Now that the food has been thoroughly chewed and formed into a bolus, it can proceed down the throat to the next stop in digestion. It will move down the pharynx where it reaches a "fork in the road", with the larynx as one road and the esophagus as the other. The esophagus road leads to the stomach; this is the direction that food should go. The other road, through the larynx, leads to the trachea and ultimately the lungs. This is definitely not where you want you food or drink going, as this is the pathway for the air you breathe.

![Figure 3.23 Cross section of face. The epiglottis covers larynx to prevent food and drink from entering the lungs](image)

Fortunately, our body was designed in such a way that a small tissue, called the epiglottis, covers the opening to the trachea. It directs the food down the correct road as shown below.
Figure 3.24 Epiglottis is like a traffic cop guiding food down the correct digestion road

**Esophagus**

Before being correctly guided into the esophagus, the bolus of food will travel through the upper esophageal sphincter. Sphincters are circular muscles that are found throughout the gastrointestinal tract that essentially serve as gates between the different sections. Once in the esophagus, wavelike muscular movements, known as peristalsis, occur, as shown in the animation & video in the links below.

<table>
<thead>
<tr>
<th>Web Links</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peristalsis Animation</td>
</tr>
<tr>
<td>Video: Peristalsis (0:57)</td>
</tr>
</tbody>
</table>

At the end of the esophagus the bolus will encounter the lower esophageal sphincter. This sphincter keeps the harmful acids of the stomach out of the esophagus. However, in many people this sphincter is leaky, which allows stomach acid to reflux, or creep up, the esophagus. Stomach acid is very acidic (has a low pH). The ruler below will give you an idea of just how acidic the stomach is. Notice that the pH of gastric (term used to describe the stomach) fluid is lower (more acidic) than any of the listed items besides battery acid.
The leaking of the very acidic gastric contents results in a burning sensation, commonly referred to as "heartburn." If this occurs more than twice per week and is more severe, the person may have gastroesophageal reflux disease (GERD). The following videos explain more about these conditions.

**Web Links**

*Video: Acid Reflux (1:28)*
*Video: GERD 101 (0.55)*

**Table 3.21 Review of Chemical Digestion in the Mouth**

<table>
<thead>
<tr>
<th>Macronutrient</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbohydrates</td>
<td>Salivary amylase cleaves 1,4-glycosidic bonds</td>
</tr>
<tr>
<td>Lipids</td>
<td>Release of lingual lipase</td>
</tr>
<tr>
<td>Protein</td>
<td>None</td>
</tr>
</tbody>
</table>

**References & Links**

Link

Videos
Peristalsis Animation - http://www.youtube.com/watch?v=o18UycWRsaA
Acid Reflux - http://www.youtube.com/watch?v=SW-QfyDSY5I