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Food Comparison: Apple vs. Doughnut

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Most of us know what types of foods are healthy and which ones are unhealthy, yet research shows that we still continue to consume unhealthy foods in ever-increasing quantities. Why is that? I believe that part of the reason is that we don't totally understand why so-called unhealthy foods are bad for us, especially when viewed from the perspective that every piece of unhealthy food is taking the place of what could be a much healthier substitute.

In this article, we're going to look at two different foods – one healthy (an apple) and one unhealthy (a doughnut). We will follow these two foods through our bodies, looking at the processes of digestion and absorption, to see the different effects on our insides.

Digestion of Foods

The process of digestion starts once we have placed the food in our mouth and started to chew. A couple of things occur here. As we chew, our teeth start to break the food up and this is mixed with saliva (produced by our salivary glands) by the tongue. The saliva contains a chemical called salivary amylase, which starts breaking down complex carbohydrates, and another called mucin, which helps to soften the food. The chewed and softened ball of food is called a bolus.

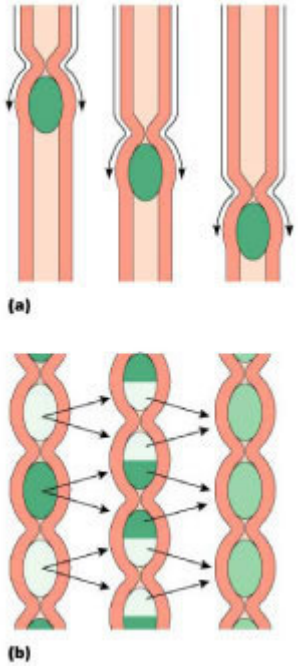

Figure 1 - Processes of the Digestive System
(a) Peristalsis – Alternating waves of contraction (occurs throughout digestive system).
(b) Segmentation – Moving materials back and forth to aid in mixing (mostly in small intestine and colon)

The bolus of food is then propelled down our esophagus by the process of peristalsis – a wave-like contraction of the muscles of our digestive system. It then reaches the stomach, where the next stage of digestion occurs. Receptors in our stomach sense that food has (or is about to) enter, and a hormone called gastrin stimulates the release of hydrochloric acid and digestive enzymes. The stomach is then turned into a highly acidic environment (acidic enough to burn your skin), and this helps to further break the food down.

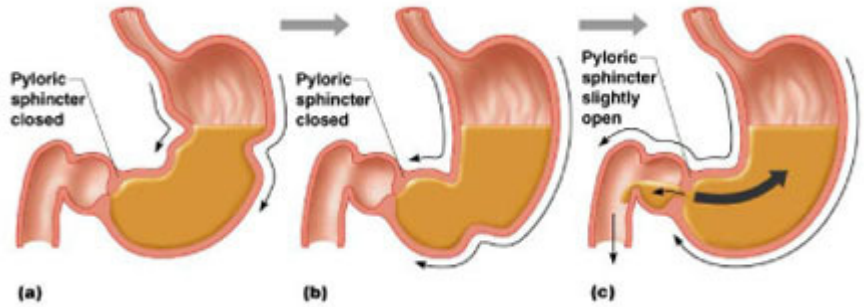

Figure 2 - Propulsion in the Stomach
- Food must first be well mixed.
- Rippling peristalsis occurs in the lower stomach.
- The pylorus meters out chyme into the small intestine (30 ml at a time).
- The stomach empties in four to six hours.

After being processed in the stomach, the food is then passed into the first part of the small intestine, known as the duodenum, which is where most of the digestive process takes place. The partially digested food is mixed with three other liquids here:

1. Bile, a substance that is released by the gallbladder to help in the digestion of fat.
2. Pancreatic juice and enzymes (released into the intestine by the pancreas).
3. Other alkaline intestinal enzymes, such as maltase, lactase and sucrose, which help to further break down different types of sugars (this is why some people have reactions to dairy products – they lack, or have very low levels of lactase, so can't break down lactose, the main sugar in dairy products).

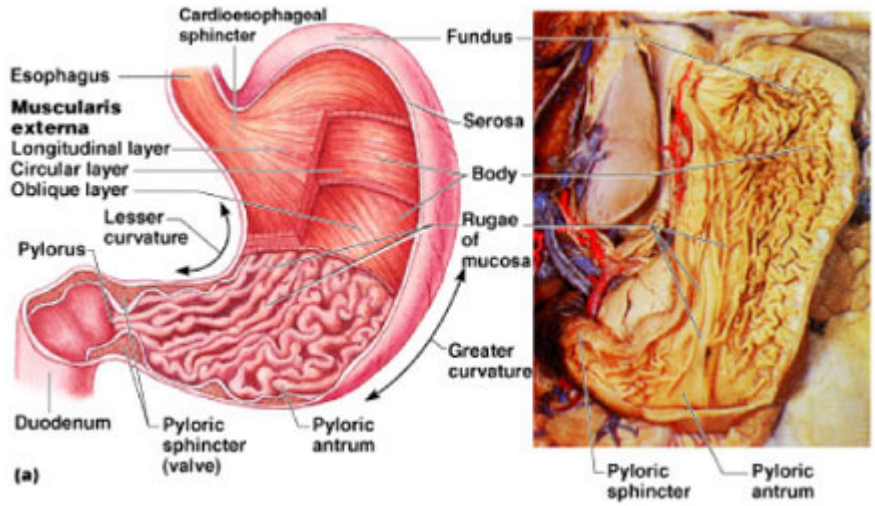

Figure 3 - Stomach Anatomy

By this stage, most foods have been digested. Dietary fibre, however, is not digested, and it helps to keep food remains and waste products moving through the rest of the small intestine and then into the large intestine (bowel) for excretion, preventing the build up of toxic waste.

Absorption

Now that the food has been processed, it needs to be absorbed by the body, so it can provide us with the energy and nutrients we need. This occurs mainly in the small intestine, which has small, finger-like structures called villi protruding from the walls.

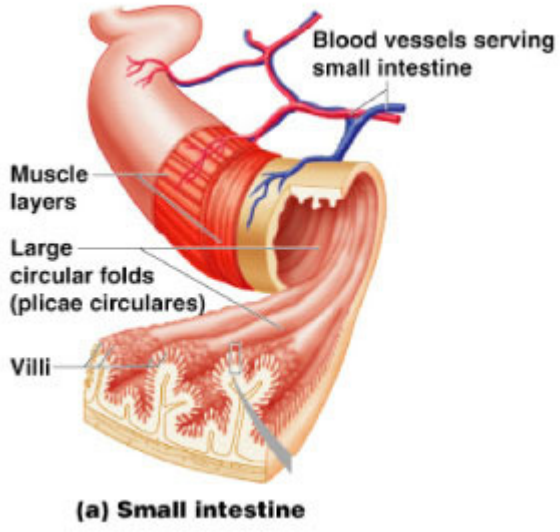

Figure 4 - Villi of the Small Intestine

The process of digestion breaks the food up into tiny particles, which are collected by the villi and passes into the bloodstream going to the liver, where the blood is filtered to remove any toxins and the nutrients are processed. Protein, most carbohydrate and some fats use this pathway to be absorbed. From the liver, the nutrients are delivered to the organs and cells of the body via the bloodstream, where they are used to assist in the millions of chemical processes and reactions that occur every second within our cells. There are a few important points of note here:

1. We have around 50 to 70 TRILLION cells in our bodies, and every one of them needs a steady supply of nutrients to stay alive, reproduce and communicate with each other. This communication process is vital for our very survival as the body is one huge ecosystem of cells – if you disturb one part of the ecosystem, the organism (our body) will not function effectively.

2. The processes of digestion and absorption require energy, vitamins and minerals to take place. Thus, the body will lose nutrients through these processes. If a food contains lots of nutrients, the body ends up with a net gain of energy, vitamins and minerals. However, if we eat foods that don't contain a lot of vitamins and minerals ("empty" calories), the body will actually have a net loss of nutrients by digesting and absorbing that food, which puts a strain on the body's reserves.

3. The body does not have reserves of all nutrients. For example, carbohydrate stores are limited, and protein stores are almost non-existent. When we look at vitamins, the body stores fat-soluble vitamins (A, E, D and K) but has no storage facility for water-soluble vitamins (B vitamins, vitamin C and folate). Therefore, it is very important that we get a steady supply of water-soluble vitamins.

4. Vitamins and minerals from natural foods are easily digested and absorbed by the body, but this is not always the case with synthetic forms that we get from tablets. Also, we need to realize that a multi-vitamin/mineral pill contains around 30 to 40 nutrients, whereas the average natural food can contain between 10,000 and 15,000 nutrients. The cocktail of these nutrients are much more beneficial than consuming synthetic forms of essential vitamins and minerals – there is just no substitute for natural foods!

What Happens to our Apple and our Doughnut?

Now that we have an understanding of the bodily processes involved, let's have a look at the fate of our two different foods as they are digested and absorbed by the body.

The apple, which contains water (about 80%), carbohydrate (15%, mainly fructose with some dietary fibre) and a small amount of protein (5% or less) has been mostly digested by the time it gets through the small intestine. This process starts in the mouth, as we chew it into pieces and saliva starts to

break down the carbohydrate. The stomach will help to break down the small amount of protein, but further carbohydrate breakdown is suspended due to the highly acidic environment. When the apple mush (now called chime) enters the small intestine, the environment is changed from acid to alkaline by the release of bicarbonate (very similar to good old baking soda) from the pancreas. The digestive enzymes here can now get to work on breaking down the carbohydrate into tiny pieces, which are absorbed by the villi (along with the protein) and transported to the liver. The liver will then remove any toxins from pesticides ,etc and complete the final part of digestion, releasing the nutrients contained in the apple.

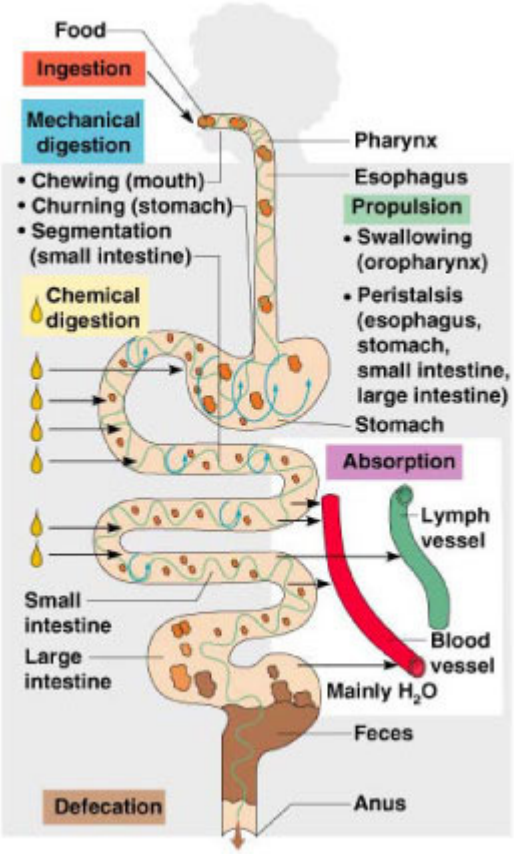

Figure 5 - Processes of the Digestive System

The body has used up energy and nutrients to complete this process, but it is rewarded with an abundance of nutrients from the apple. Firstly, there are amino acids from the protein, which are sent to a pool from which individual cells can access in order to repair themselves and communicate with other cells. Next, we have energy released from the carbohydrate, which goes to fuel our muscles, nervous system and brain. Because most of the sugar is fructose, it is stored in the liver until it is needed, helping blood sugar to remain relatively steady.

The humble apple also contains an abundance of nutrients for the body. Just under the skin lies half of the Vitamin C content of the apple. It also contains calcium, phosphorus, iron, Vitamin A and a healthy dose of potassium. In addition to those, the skin contains a compound called quercetin, a powerful antioxidant that reduces cardiovascular risk. If that wasn't enough, the flavonoids and phytochemicals that it contains seem to help fight against cancer. Finally, the skin contains lots of fiber, which helps to improve bowel function and reduced cholesterol absorption.

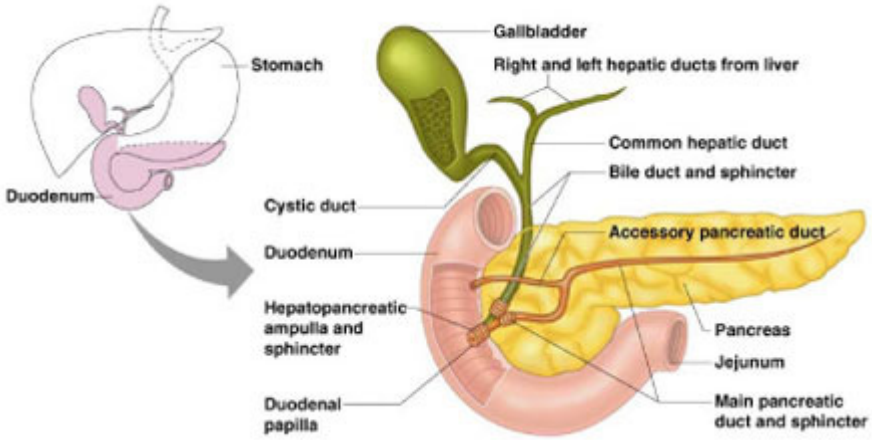

Figure 6 - Chemical Digestion in the Small Intestine

The doughnut, however, is a different proposition altogether. It is loaded with saturated fats, trans fats and refined sugar and is largely devoid of any nutritional value, other than energy, which it has in abundance. Digestion of the carbohydrate component will start in the mouth and the stomach will assist in further breaking the doughnut down. When it reaches the small intestine, the simple sugars will be readily digested and then absorbed by the villi. The bile that is released by the gallbladder will help to break down the different fats, but the picture here gets a little complicated. Saturated and trans fats take a different pathway than the more healthy fats, such as monsaturated or polyunsaturated, and the pathway dictates whether the fats are healthy or unhealthy. The healthier fats generally are absorbed via the liver, whereas saturated and trans fats pass through the villi and are converted into triglycerides, the main form of fat storage in the body. They are also coated in cholesterol (from the liver) and hence the fats in a doughnut will raise the bad (LDL) cholesterol and reduce the good (HDL) component.

Trans fats, however, surpass saturated fats in the damage that they do. They have been shown to wreak havoc with the body's ability to regulate cholesterol and massively increase your risk of heart disease. They also get into the membrane (outer lining or skin) of our cells, causing them to harden. This has a negative effect on the functioning of our cells and disturbs the delicate ecosystem that I referred to earlier. In addition to that, a 2006 study reported by the American Diabetes Association showed that replacing healthy fats with trans fats (so that trans fats accounted for 8% of energy intake) led to a very significant weight gain (around 7%) – despite the fact that the amount of energy was the same. Also known as trans fatty acids, trans fats are the most damaging of all fats to our health, even more so than saturated fats. Although a small amount of trans fats are produced in nature (through the digestive processes of cows and sheep, hence they are present in small amounts in beef, dairy products and lamb), the majority of trans fats in our diets come from the food processing industry. They are produced by the chemical process of hydrogenation of oils, which turns oils into solids and increases the shelf life of products, as well as improving the texture of a food. The greatest source is deep fried foods, such as French fries, but trans fats are also present in high amounts in cakes, cookies, biscuits, some breads (especially croissants and pastries), processed foods (especially pies, sausage rolls etc), snack foods (potato chips, some muesli bars) and margarines (in small amounts). All US and most European foods must declare how much trans fats are in the product (Denmark has banned all foods with more than 2% trans fats), but there is no requirement to declare it in Australia and NZ. Look out for trans fat on the label or the words hydrogenated or partially hydrogenated. My conclusion? Trans fats are the fats of the devil and should be avoided at all costs.

The Take Home Message

Hopefully this article has demonstrated why nutritionists and dieticians are always harping on about eating natural foods. It is not just the energy content that is important, but the nutrients within the foods play a large role in our long-term health. Although there is room for everything in moderation, the vast majority of your food should be natural and healthy. As a general rule, I tell my clients that if a food looks like it has never been alive at any point, then it's best avoided or at least put in the category of "occasional food."