The Artificial Stomach

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The digestive system is one of the most important organ systems in the human body. It absorbs and breaks down nutrients and vitamins, which are then circulated through out the internal environment, refueling starving cells. Despite its anatomic simplicity (stomach, small intestines, then large intestines), physiologically, it is a dynamic and complex organ system, incorporating endocrine, enzyme, mechanical and chemical functions and reactions.

Its general function is to break down food into the most simple, usable, parts possible, and then absorb them into the blood or lymph for energy or further processing. It does this by first, using a mix of enzymes, chemicals, and mechanical movement in the stomach to digest the food. The food, or chyme, as it is called once it is in the body, moves into the small intestine where it is exposed to several enzymes, each designed to digest a specific thing (such as lipids, proteins, carbohydrates, and sugars). Lining the small intestines are folds, which are covered in small hair like protrusions called villi, which are further covered in micro villi. These microvilli absorb the products of digestion into the blood.

Generally, to study digestion, a type of food is exposed to a specific enzyme, perhaps in a beaker, and a reaction is observed. This procedure is not too accurate, and neglects to integrate some of the more important processes in digestion, such as mechanical, other enzymes, and even structure of what is being digested.

The artificial stomach, a project lead by Dr. Martin Wickham, for the Institute of Food research, in London, aims to create an environment that more accurately mimics digestion, including all of its processes.

The machine, which is a little bit larger then a desktop computer, is comprised of special anti corrosive plastics and metals. It has three distinct sections, each representing a different part of the digestive system. The machine was designed using in-vivo human data of the digestive system. This makes it accurately depict the process of digestion, as possible.

The first section is comparable to the main body of the stomach, where food is introduced to stomach acids, digestive juices, and mechanical movement. The material then moves onto the second section, which would be considered the antrum of the stomach. Here, time is spent specifically on mechanical and shearing forces, breaking the physical form of the material extensively. The final step of the process emulates the duodenum of the small intestine. Through out all three processes, using a computer, different levels of enzymes, acids, bicarbonate, phospholipids, and even bile, can be added to the process.

Throughout the entire process, computers allow the user to monitor the progress of the food, and also predict possible hormonal responses. Because of this, the machine has proved useful in many areas. The biggest area would be in the pharmaceutical industry. Because of how closely it mimics real human digestion patterns, pharmacists can observe many qualities of a drug, such as how it reacts during digestion, when it is released, duration of release and, how well and where absorption would theoretically occur. With this data, the drug could be altered to have optimal efficiency by working with the digestive system. Another area of interest is learning how to manipulate the digestion process. For example, altering the rate of glucose absorption, for diabetics, or making it feel full, for obese patients.

Sources:

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