Glucose and cellulose digestion

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Monosaccharides, also known as simple sugars are monomers of carbohydrates. They are absorbed immediately in the small intestine without further chemical breakdown. Glucose, fructose and galactose are examples of commonly ingested monosaccharides. Glucose is absorbed in the intestinal villi via co-transport with sodium ions, it then enters the capillary blood for eventual transport to the liver.

More complex sugars, such as polysaccharides, oligosaccharides and disaccharides have to be broken down by various enzymes before they are absorbed in the small intestine. Salivary amylase, present in the saliva, breaks down polysaccharides into oligosaccharides, which are smaller fragments of two to eight linked glucose molecules. Once in the stomach, the acidity deactivates this enzyme. The polysaccharides that survived the salivary amylase are further broken down in the intestine by pancreatic amylase. Intestinal brush border enzymes further hydrolyze oligosaccharides and disaccharides into their constituent monosaccharides. Such enzymes include dextrinase, glucoamylase, maltase, sucrase and lactase. Chemical digestion ends in the small intestine because the colon does not secrete digestive enzymes.

Humans do not have the enzymes necessary for the digestion of every type of polysaccharide into absorptive monosaccharides. For example, they lack enzymes capable of breaking down cellulose. Cellulose is a linear polymer made of glucose subunits linked by β-1,4 bonds. Humans specifically do not produce enzymes capable of cleaving the beta glycosidic linkage in cellulose. In general, higher eukaryotes in general have not been recognized to produce endogenous cellulases [1]. Cellulolytic enzymes are however produced by a wide variety of bacteria and fungi, aerobes and anaerobes, mesophiles and thermophiles [2]. The presence of symbiotic protozoa or bacteria has been used to explain cellulose digestion in invertebrates and herbivorous cattle [2]. Microorganisms including fungi, bacteria and antinimycetes produce mainly three types of cellulase components -endo-1,4-β-D-glucanase, exo-1,4-β-D-glucanase and β-glucosidase - either separately or in the form of a complex [4]. These microorganisms are not part of the human gut flora.

[1] Pierre Béguin and Jean-Paul Aubert, (1994): The biological degradation of cellulose, *FEMS Microbiology Reviews*, 13:25-58

[2] . Watanabe and G. Tokuda, (2001): Animal Cellulases, *Cellular and Molecular Life Sciences*, 58:1167-1178

[4] Bhat, M.K., Bhat, S, (1997): Cellulose degrading enzymes and their potential industrial applications, *Biotechnology Advances*, 15:583-620