Digestive Enzymes
Nutritional therapy

SYNONYMS
enzymes, digestive enzymes

EFFECT
Introduction
Digestive enzymes are required both for optimal digestion of all macronutrients and for the absorption of fat-soluble vitamins. Good digestion increases the biological availability of nutrients, improves food tolerance and inhibits the formation of toxins and other damaging substances in the gastrointestinal tract. This reduces accompanying symptoms such as bloating, flatulence, stomach ache, bowel movement problems, fatigue and various related aspecific symptoms.

An excellent manner of investigating the effect of digestive enzymes is through TNO's TIM digestion model ("TNO Intestinal Model"). This dynamic computer-controlled model simulates the entire physiological food digestion in a human's gastrointestinal tract and determines various digestion parameters in the stomach, small intestine and colon, as well as microbiotics.

The most stable and effective enzymes are plant and microbe-derived enzymes. These enzymes do not degrade during passage through the stomach and retain their effect. These enzymes are also active over a much wider range of pH values (2-8), meaning they are active over a longer distance in the gastrointestinal tract. For greater biological activity it is preferable to combine enzymes from various sources. This type of complex can be enriched with a number of other specialised enzymes, such as maltase, lactase, alpha galactosidase and invertase. A complex for human consumption contains no fungal residues. It only contains enzymes and has no unpleasant pungent flavour or odour.

Enzyme functions
Listed below are the digestive enzymes that are approved for human use, including the corresponding units by which the standardised enzyme activities are expressed.

- Protease or proteolytic enzymes separate dietary proteins into easily digestible peptides and amino acids. The enzyme activity of proteolytic enzymes are expressed in HUT (Haemoglobin Unit; enzymatic hydrolysis of denatured haemoglobin) or SAPU (Spectrophotometric Acid Protease Units)
- Papain separates dietary proteins into peptides and amino acids and also has starch-separating and, to a certain extent, fat-separating properties. The enzyme activity of papain is expressed in NF (National Formulary)
- Bromelain also separates dietary proteins and, like Papain, supports the effect of fungal proteolytic enzymes. Bromelain supports the digestion in pepsin and/or trypsin deficiency. The enzyme activity of bromelain is expressed in GDU (Gelatine Digesting Units)
- Amylase breaks down complex sugars (starch) into tri-, di- and monosaccharides. The enzyme activity of amylase is expressed in DU (Dextrinising Units)
- Glucoamylase or amyloglucosidase also breaks down starch-type carbohydrates. The enzyme activity of glucoamylase is expressed in AGU (Amyloglucosidase Units)
- Lactase or beta-galactosidase separates the disaccharide lactose into the simple sugars galactose and glucose. The enzyme activity of lactase is expressed in ALU (Acid Lactase Units)
- Invertase separates the disaccharide sucrose into the simple sugars glucose and fructose. The enzyme activity of invertase is expressed in SU (Sarett glucose oxidase Units)
- Alpha-galactosidase breaks down sugars such as raffinose, stachyose and verbascose and helps in the digestion of grain, legumes and varieties of cabbage. The enzyme activity of alpha-galactosidase is expressed in GalU (Galactosidase Units)
- Lipase digests fats and increases the absorption of lipophilic nutrients (vitamins A and D). The enzyme activity of lipase is expressed in FIP (Federation Internationale Pharmaceutique).

Safe
Fungal strains such as Aspergillus oryzae and Aspergillus niger have been used in the food industry for the fermentation of food for many decades and were given the GRAS (Generally Recognised As Safe) label by the FDA. Unlike, for example, Aspergillus flavus, these strains do not produce any mycotoxins such as aflatoxins. Furthermore, by means of rigorous procedures, these fungal enzymes are purified from fungal cells, spores and other damaging substances. Digestive enzymes are tolerated extremely well. They can also be used during pregnancy provided that the pregnant woman keeps to the recommended dose. However, the risk of an allergic reaction can never be ruled out as enzymes are also proteins (see contraindications).

INDICATIONS
Good digestion is of essential importance to maintain good health and to aid recovery from illness. Listed below are the main indications of digestive enzymes.
Exocrine pancreatic insufficiency. Exocrine pancreatic function can be insufficient in numerous health problems.

Digestive complaints. Indigestion in general, such as feeling full, bloating, flatulence, stomach ache which can be accompanied by nausea and deviating acid levels and/or faeces consistency such as diarrhoea, constipation, fatty defecation and undigested food residues.

Malabsorption and dysbiosis

Irritable bowel syndrome

Detoxification and colonic irrigation regimens

Diabetes type 1 and 2. Respectively 50% of patients with diabetes type 1 and 35% of patients with diabetes type 2 suffer from a certain degree of exocrine pancreatic insufficiency.

Celiac disease. In addition to resorption disorders, a certain degree of exocrine pancreatic insufficiency is characteristic of Celiac disease. Long-term digestive enzymes can be used for the repair of the bowel and the digestive functions. Daily use of enzymes (amongst others papaya proteinases and Aspergillus oryzae) taken with meals protects the bowel and makes this less sensitive to ‘residues’ of gluten that are unintentionally eaten with food.

Lactose intolerance

Candida syndrome

Food intolerances. Digestive enzymes can be used generally, but also specifically to promote the (partial) detoxification of grain products and other antigens and/or antinutrients.

Food allergies (slow allergic reactions). Digestive problems can possibly result in the absorption of large peptides that form immune complexes, thus eliciting allergies.

Auto-immunity. Immunological mimicry can occur based on protein sequences from the food in combination with increased intestinal permeability. Improvement in digestion and the intestinal barrier can reduce the immunological provocation.

Autism. In autism, there can be increased production of exorphins from grain and cow’s milk products. Digestive enzymes can also be useful in diets such as gluten and casein-free diets; as a result of the peptidase deficiency, exorphins from other foods can also occur. Although positive effects have been seen in practice, a randomised clinical trial (six months) revealed no significant improvements.

Chronic pancreatitis

CONTRA-INDICATIONS

Pancreatitis, first phase of the acute form, ileus, gall bladder empyema (accumulation of pus), biliary tract obstruction, liver function abnormalities (serious).

SIDE EFFECTS

No adverse effects are known in the oral use of digestive enzymes.

INTERACTIONS

The majority of medicines, also including antiepileptic agents, antidepressive agents and other psychiatric medication have been developed in such a way that they are insensitive to physiological amounts of digestive enzymes in the small intestine. It is therefore improbable that their effect would be affected by ingestion of oral digestive enzymes.

Digestion, specifically protein digestion, and the absorption of vitamin B12 are affected by the use of gastric acid inhibitors. As they kill off microbiotics, antibiotics can inhibit digestion and therefore the resorption of nutrients.

DOSE

In all enzyme formulas, an effective dose is extremely important. Unfortunately, in many enzyme products, the exact dose is unfathomable because often the enzyme activity is wrongly expressed in milligrams. The milligram total of a certain enzyme says nothing about that enzyme’s activity. For that reason, the only correct way of expressing the potency of an enzyme product is by stating the amount of enzymes in units, which is an expression of the speed at which the enzyme in question converts substrate (also see above under “Enzyme functions”). Therefore, when purchasing an enzyme formula, pay attention to abbreviations such as, for example, GDU, ALU, HUT or SAPU in the ingredients declaration. It is important that the enzymes are in physical contact with the food that they have been added to. Hence, it is not sufficient to mix the enzymes with the food (shortly) before it is eaten (the food may not be hot).

SYNERGISM

In particular in exocrine pancreatic insufficiency there can be a significant need for the mineral zinc and fat-soluble vitamins A and D.

REFERENCES

4. Lankisch PG. What to do when a patient with exocrine pancreatic insufficiency does not respond to pancreatic enzyme substitution, a practical guide. Digestion. 1999;60 Suppl 1:97-103