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Study of Pancreatic Enzymes

Bakhtiyar Bakhshullayevich Takhirov
Bukhara State University, Candidate of biological sciences, associate professor

Muhayo Bafoevna Tagaeva, Zarnigor Kakhorova
Bukhara State University

Abstract: The article contains information about the enzymes in the preparations used in the treatment of the pancreas, their extraction from natural products, the structure and function of the enzymes of the pancreas.

Key words: Trypsin and chymotrypsin papain, amylase, carboxypeptidase, phenylalanine, tryptophan, methionine, pancreatin, catabolism.

Introduction: Most of the drugs used in the treatment of the pancreas contain proteinases of animal and plant origin: papain is obtained from unripe papaya fruits and bromelain is obtained from pineapple. [4]. Bromelain is a high molecular weight glycoprotein found in the juice of green fruits, with the highest amount found in the pineapple plant. This proteolytic enzyme is similar to other enzymes in terms of activity. Papain is a monothiol cysteine protease, the nature of activity is "green" pepsin. The range of action of papain is not only acidic, like pepsin, but also neutral and alkaline pH values (3.0-12.0 optimal pH5), playing a major role in maintaining activity. Papain splits proteins into polypeptides and amino acids, hydrolyzes any peptide bonds, except for proline and glutamic acid bonds with the dissociated carboxyl group. Papain is widely used in relation to cleavable proteins, many animal and bacterial proteases.

Results: Trypsin and chymotrypsin are hydrolyzable proteinases.

Peptide bonds differing from each other at the site of exposure to the polypeptide chain of the protein, the absorption center of Trypsin actively interacts with the lysine/arginine residue by hydrolysis of this peptide bond. These enzymes are proteins that are present in significant amounts in most people, which provides a large hydrolytic capacity of trypsin depending on the amount of protein to form small peptides. Chymotrypsin cleaves the side chains of hydrophobic amino acids (phenylalanine, tryptophan, methionine, etc.) into small peptide fragments. These proteinases are enzymes of general proteolysis and have low specificity. Especially trypsin and chymotrypsin are active due to the presence of peptide bonds against denatured proteins formed during inflammation.

Pancreatin is a drug prepared from the pancreas of animals, with proteolytic, lipolytic and glucolytic activity. In the acidic environment of gastric juice, pancreatin is partially inactivated and the therapeutic effect is lost

Amylase is an enzyme that hydrolyzes glycosidic bonds in polysaccharides. The main function of the enzyme is to digest starch and glycogen. The cleavage of cell wall polysaccharides determines the bacteriostatic effect of amylase, which is most clearly manifested in lysozyme, an enzyme of this subclass.

has an anti-inflammatory effect.[6]

The mechanisms of action of amylase are as follows.

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The mechanism of systemic action of enzyme mixtures is complex and determined by the following pharmacological effects:

- anti-inflammatory: the process of optimizing the inflammatory process, not only reducing it, as in the case of taking non-steroidal anti-inflammatory drugs;
- in combination with the effect on the rheological properties of fibrinolytic and thrombolytic blood, it can significantly accelerate the resorption of hematomas;
- decongestant: prevention and treatment of swelling as a result of enzymatic degradation of extravasally released proteins and peptides, consists in reducing their amount.
- As for the osmotic effect, the lysis of microthrombi also contributes to the elimination of decomposition products from the affected tissues;
- due to the reduction of inflammatory mediators and oncotics by pain-relieving, conditional, direct splitting enzymes, pressure in the tissues, reduction of edema in them and improvement of microcirculation;
- -immunomodulatory: enzymes have a regulatory effect on the immune system, it cannot be considered immunosuppressive or immunostimulatory.

For systemic effects, polyenzyme drugs can damage the protective biofilms of microbial colonies, increase the concentration of antibiotics in tissues by improving microcirculation, the rheological properties of the drug, the resorption of native enzyme molecules occurs through pinocytosis (receptor-mediated and there are no special receptors for molecules while);

- endocytosis through intestinal cells; paracellular diffusion; The basic mechanism of absorption amylase study is:

Absorption of local enzymes with a complex macromolecular structure from the small intestine and maintenance of enzymatic activity in the blood.

For a long time, the question of whether large protein molecules can be resorbed from the intestine has been a topic of discussion. In this regard, studies have been conducted using various methods to determine the presence of unchanged enzymes in the circulating blood. [7]

Chymotrypsin, an enzyme of the hydrolase class that breaks down proteins and peptides; found in the pancreatic secretion of animals and humans. Together with trypsin, it participates in the breakdown of food proteins in the small intestine.

Chymotrypsin (English. Chymotrypsin) is a proteolytic enzyme, endopeptidase, hydrolyzing peptides and proteins. Chymotrypsin (EC 3.4.21.1) is synthesized in the pancreas in the form of proenzymes chymotrypsinogen A and chymotrypsinogen B, and in this form enters the duodenum as part of the pancreatic juice. , where chymotrypsinogens are converted by trypsin. α-, β- and β-chymotrypsins.

Chymotrypsin prefers bonds formed by COOH groups of amino acids with hydrophobic side chains and has a wider effect than trypsin. Unlike trypsin, chymotrypsin curdles milk.

Chymotrypsin is most active at pH 7.5 to 8.2.[8]

Chymotrypsin is an enzyme of the hydrolase class that catalyzes the hydrolysis of peptide bonds located away from the ends of the protein chain (endopeptidase). From max. rate catalyzes the hydrolysis of bonds formed by the carboxyl groups of hydrophobic amino acids. It also hydrolyzes esters and amides formed from amino acids.

Chymotrypsin is an enzyme of most vertebrates. It is synthesized in the pancreas in the form of an inactive precursor of chymotrypsinogen (proenzyme or zymogen).

Trypsin hydrolyzes peptide bonds in proenzyme 4 and removes two dipeptides from the molecule at positions 14-15 and 147-148. The resulting three fragments of the chymotrypsin molecule remain

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connected by two disulfide bonds. Chymotrypsin, together with trypsin, participates in the breakdown of proteins in the small intestine. Two different forms of chymotrypsin - A and B - are released, which differ in the composition of amino acids. Deputy. 6000-1.jpg modification of bovine chymotrypsin A (6000-2.jpg-X; mol. m. 25 thousand) is well-studied, the formation of a cut from the proenzyme is intermittent. edited forms of chymotrypsin A6000-3.jpg. The enzyme has 6 SS bonds; the dimensions of the molecule are close to spherical (5.5 x 3.5 x 3.8 nm). Max. catalytic 6000-4.jpg-chymotrypsin activity is manifested at pH 7.8-9.0; Chymotrypsin action groups are important for catalytic manifestation: hydroxyl serine-195 (numbering of amino acid residues in chymotrypsin to their positions in the proenzyme is assumed to match), imidazole histidine-57 and carboxyl aspartic acid-102 ("active triad"). This triad is stabilized by an ionic bond between the α-amino group of isoleucine-16 and the carboxyl group of aspartic acid-194. 6000-5.jpg-substrate sorption in the active center of chymotrypsin is ensured by a hydrophobic gap. Its dimensions of 1.0 x 0.5 x 0.4 nm are optimal for binding the side chains of hydrophobic amino acid residues (tryptophan, phenylalanine, leucine, tyrosine) and the configuration allows only a certain orientation of the substrate. The catalytic mechanism includes the step of sorption of the hydrolysis substrate, cleavage of the peptide bond with the formation of an acyl enzyme, and the last. transfer of an acyl group to a nucleof. recipient. Chymotrypsin inhibitors - heavy metal ions, boron. to you, diisopropylphosphorus phosphate, etc.

Deficiency or excess of chymotrypsin is manifested in digestive diseases. The enzyme is used in medicine to break down necrotic tissue. tissues, thinning and easing sputum, with thrombophlebitis, etc. Chymotrypsin, trypsin and elastase represent a group of serine proteases due to the presence of serine in the active site. They belong to the same family and make up 44% of the total protein of the exocrine pancreas. According to modern concepts, chymotrypsin and trypsin (similar to the situation with pepsin and gastricin in the stomach) exist in the form of many isoforms.

Discussion: The mechanism of action of chymotrypsin is that chymotrypsin is a protease that catalyzes the hydrolysis of a peptide bond with aromatic amino acids (Trp, Phe, Tyr) next to it. The reaction is catalyzed by chymotrypsin, which shows the principle of stability of the transition state and is a classic example of general acid-base catalysis and covalent catalysis.

When determining chymotrypsin in feces, chymotrypsin is one of the most persistent proteolytic and lipolytic pancreatic enzymes, and is stored in feces at room temperature for up to two weeks. Changes in fecal chymotrypsin can be used to detect pancreatic enzyme secretion disorders, particularly in patients with chronic pancreatitis.

The study is carried out three days after canceling all oral enzyme preparations. It is preferable to take a small amount (1 g) of the daily volume of feces. The principle of the method is based on the cleavage of M-acetyl-tyrosine-ethyl ether with chymotrypsin to form acidic products titrated with alkali. With a serious violation of the exocrine function of the pancreas, the test reveals a significant decrease in the amount of chymotrypsin. At the same time, with moderate functional impairment, a large number of false-positive and false-negative results were recorded. In this regard, the determination of fecal chymotrypsin is recognized by most authors as an indicative test for the detection of specific exocrine diseases of the pancreas of various nature.

Chymtoripsin is also the trade name of the medicinal product, INN code "D03BA Proteolytic enzymes", there are the following indications for its use: thrombophlebitis, periodontal disease (inflammatory-dystrophic forms), osteomyelitis, sinusitis, otitis media, iritis, iridocyclitis, intracapsular extraction cataracts, bleeding in the anterior chamber of the eye, swelling of the periorbital region after operations and injuries; tracheitis, bronchitis; pleural empyema, exudative pleurisy; burns, purulent wounds, bedsores. Carboxypeptidases (EC 3.4.16 - 3.4.18) are proteolytic enzymes that hydrolyze (extend) the peptide bond of the C-terminal amino acid residue. (Compare with aminopeptidases, which cleave the peptide bond of the N-terminal amino acid residue). Several types of carboxypeptidases exist in humans, animals, and plants.

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Carboxypeptidases perform a variety of functions ranging from catabolism to protein maturation. First, carboxypeptidases involved in digestion were studied (pancreatic carboxypeptidases A1, A2 and B). At the same time, most of the known carboxypeptidases do not participate in the process of catabolism, but contribute to the maturation of proteins or the regulation of biological processes. For example, carboxypeptidases are involved in the biosynthesis of neuroendocrine proteins such as insulin. Carboxypeptidases are also involved in blood clotting, making growth factors, wound healing, reproduction, and more.

Carboxypeptidase A and Carboxypeptidase B (English carboxypeptidase A and B) proteolytic enzymes, exopeptidases are necessary to study the mechanism of action of carbopesidase.

Carboxypeptidases A and B are synthesized in the pancreas in the form of proenzymes procarboxypeptidase A and procarboxypeptidase B, and in this form enter the duodenum as part of pancreatic juice, where procarboxypeptidases A and B are converted under the influence of trypsin. Carboxypeptidases A and B.

Carboxypeptidase A (EC 3.4.17.1) consists of 307 amino acid residues, has a molecular weight of about 344,000 and cleaves all C-amino acid residues from peptides except arginine, lysine, proline and hydroxyproline, aromatic and hydroxyproline. aliphatic amino acids. Carboxypeptidase B (EC 3.4.17.2) consists of 300 amino acid residues, with a molecular weight of about 34,000 and catalyzes the basic amino acids by cleaving only the C-terminal residues of arginine and lysine.

Carboxypeptidases are Zn metalloenzymes. Both carboxypeptidases exhibit maximal catalytic activity at pH = 7.5.

In addition to carboxypeptidases A and B, there are a number of other carboxypeptidases that are not directly related to gastroenterology.

Digestion means the processing of complex substances (proteins, fats, carbohydrates) into simple substances with the help of enzymes for further absorption. The processing process is carried out as food masses move along the gastrointestinal tract. In the oral cavity, food is mixed with saliva, which has amylase activity, and mechanically processed. The importance of the stomach is the precipitation and dilution of food under the influence of hydrochloric acid and pepsin, the denaturation and initial hydrolysis of proteins, and the creation of a food bolus for evacuation to the duodenum.

The main hydrolytic processes take place in the small intestine, where nutrients are broken down into monomers, absorbed and enter the blood and lymph. The process of processing nutrients in the small intestine has three consecutive, interconnected stages, which AM Ugolev (1967) called the "digestion-transport conveyor" concept

1. cavity digestion
1. 2.membrane digestion
2. Absorption

Cavity digestion involves the formation of chyme and the hydrolysis of food components into oligo- and monomeric form.

Pancreatic enzymes (PZh) play the main role in the digestion of food in the abdominal cavity. The short chains of proteins, carbohydrates and fats formed during cavitary hydrolysis are finally broken down by membrane digestion mechanisms. Pancreatic enzymes absorbed into nutrients continue to play an active role at this stage, which opens in the parietal mucosa. The final hydrolysis of nutrients occurs in the outer membrane of enterocytes with the help of intestinal fluids.

Summary: After that, the last stage begins - absorption, that is, the transfer of the separated components of nutrients from the intestinal lumen to the internal environment of the body.

Cavity digestion takes place in the cavity of the small intestine and is mainly carried out by pancreatic enzymes. The pancreas produces a secret that contains enzymes that hydrolyze all kinds of

nutrients: proteins, carbohydrates, fats. The list of the main enzymes of the pancreas and their participation in digestion is given in the table. Enzymes that hydrolyze carbohydrates and fats (α-amylase, lipase) are released in an active state, and proteolytic enzymes (trypsin, chymotrypsin, elastase, carboxypeptidase) are released in the form of activated proenzymes in the lumen of the small intestine.

Table 1. Digestive enzymes of the pancreas

Enzymes	Form of secretion	The effect
α-amylase	active	breakdown of polysaccharides (starch, glycogen) into maltose and maltotriose.
Lipase	active	participates in the hydrolysis of triglycerides to form monoglycerides and fatty acids.
trypsin.	Trypsin proenzyme activated by enterokinase (trypsinogen.	It breaks down proteins and polypeptides inside the protein molecule, mainly in the arginine and lysine zone.
hemotropsin	Chymotrypsin proenzyme (chymotrypsinogen) activated by trypsin.	Breaks internal protein bonds in the zone of aromatic amino acids, leucine, glutamine, methionine.
Elastase	proelastase, activated by trypsin	It digests elastin, a connective tissue protein
Carboxypeptidase A and B	Proenzyme activated by trypsin	It separates the external bonds of proteins from the carboxyl end, including aromatic (A) and basic (B) amino acids.

An important role in their activation is played by intestinal enzymes (enterokinase) and a change in the pH value of the environment from 9.0 in the pancreatic ducts to 6.0 in the lumen of the duodenum. The leading role in this case belongs to the bicarbonates of pancreatic secretion. Inadequate production of bicarbonates lowers the pH level of the duodenum and makes the main enzymes working in the villi of the small intestine ineffective. At a neutral (about 6) pH level, the intestinal enzyme enterokinase converts inactive trypsinogen into active trypsin, and trypsin, in turn, activates other proteolytic enzymes.

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