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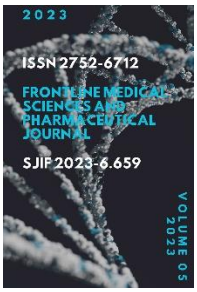

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Research Article

DEVELOPMENT OF ENZYME SYSTEMS OF CAVITY HYDROLYSIS IN EARLY POSTNATAL ONTOGENESIS

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ABSTRACT

The development of the gastrointestinal tract is a complex genetically programmed, dynamic process, the period of transition from placental-amniotrophic to lactotrophic and from post-definitive nutrition.

KEYWORDS

Pancreas, α-amylase, protease and triglyceride lipase activities.

INTRODUCTION

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The main energy and plastic substances - carbohydrates, proteins and lipids - are consumed by mammals, including humans, in the form of various products of plant and animal origin. These large-molecular polymers and oligomers, before being included in the metabolism, are subjected to mechanical and chemical (enzymatic) processing in the gastrointestinal tract, breaking down to monomeric compounds devoid of species specificity. Only after this, the nutrients become suitable for the intermediate stages of metabolism and energy.

It is known that the postnatal development of the gastrointestinal tract is a genetically programmed process, significant changes in which take place during the transition from lactotrophic to mixed nutrition and from differential nutrition is critical in the life of mammals. At this time, there are significant changes in the quantity and quality of incoming nutrients, which determines the further course of development of the organism [1]. Nutritional imbalance during the period of lactotrophic nutrition of life causes stable morphofunctional changes in various organs and systems in humans and animals [2, 3]. Under natural conditions of existence, the newborn organism is reliably protected from malnutrition due to the unique composition and changes in the quantity and quality of mother's milk throughout lactation [4].

The aim of this research is to study the development of enzyme systems of cavitary hydrolysis in early ontogenesis and the effect of turkesterone on the activity of pancreatic enzymes.

MATERIAL AND RESEARCH METHODS

The experiments were performed on growing outbred white rats. After birth, rat pups from different litters were mixed and 8 individuals were left for each lactating female.

After the animal was slaughtered, the abdominal cavity was opened, the pancreas and small intestine were removed, and the organs were placed on an ice-cooled glass plate. Then the organs were carefully dissected from fat and other adjacent tissues. The pancreas was weighed, crushed with scissors, the resulting slurry was mixed and homogenized for 45 seconds in a glass homogenizer with a Teflon pestle in the presence of small pieces of duodenum, which were added to activate

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zymogenic enzymes. For homogenization, Ringer's solution (pH 7.4) was used at the rate of 1 ml per 100 mg of tissue. The resulting homogenate after the necessary dilution was used to determine various enzymatic activities.

The activity of α-amylase (Ugolev, 1969) [8], the protease complex (Ugolev and Timofeeva, 1969) [9], and triglyceride lipase (Tietzetal., 1966) [10] was determined in the obtained homogenates. Activities were calculated per 1 g of protein and expressed in g/min of cleaved starch for α-amylase, in μmol/min of formed glycine for the protease complex, and in μmol of hydrogen ions formed during hydrolysis of triglycerides.

Statistical processing of the results was carried out using the Student-Fisher test.

RESULTS AND ITS DISCUSSION

The offspring of mammals, including humans, for a certain time after birth, is completely dependent on nutrition from a nursing mother, then, simultaneously with mother's milk, consumes solid food, switching to a mixed diet, and, finally, after reaching the functional maturity of various organs and systems, primarily digestive, refuses milk and switches to definitive food. Changes in the quality and quantity of food correspond to shifts in the activity of digestive enzymes. Abdominal hydrolysis or the initial stages of hydrolysis are carried out in the cavity of the small intestine under the action of digestive juices (gastric, pancreatic, bile, intestinal juice). As a result, macromolecules of proteins, carbohydrates, and fats are broken down into oligomers, fatty acids, etc., which easily overcome the gastrointestinal barrier.

Before presenting data for an objective assessment of the results obtained, we would like to draw attention to the natural course of development of the hydrolytic systems of the pancreas. For greater clarity of the described results, in the figure, the values of pancreatic hydrolase activities during the period of milk feeding and withdrawal are presented as a percentage compared to the maximum level taken as 100%. (Fig. 1).

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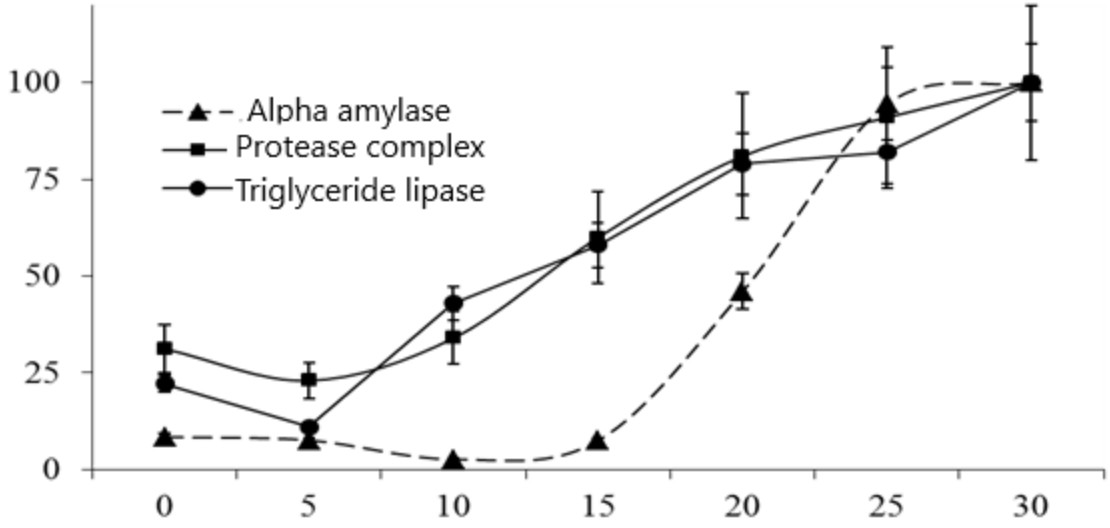

Fig. 1. Development of the specific activity of pancreatic enzymes in the early ontogenesis of rats - (M±m, при n=5-6)

The abscissa shows the age of rats in days;

On the y-axis, the activity of enzymes in arb. units.

From figure 1, it can be seen that in newborn rats, the specific activity of α-amylase was manifested at a rather low level (12.5±0.9 g/min/g of protein). On the 5th day after the birth of rats, it was 9.4±0.6 g/min/g of protein, and on the 10th day it was 12.4±0.6 g/min/g of protein. i.e., the enzyme activity remained approximately at the same level, then, starting from the 15th day of life, the activity of α-amylase gradually increased (from 19.4 ± 1.1 g/min/g of protein) and on the 30th day after the birth of rats it reached the maximum level (up to 165.1±1.1 g/min/g protein).

Similar genetically programmed shifts took place in the development of the activity of the protease complex. Namely, during the neonatal period, in 5- and 10-day-old rats, the proteolytic activity of the pancreas was 64.1±4.3; 58.8±5.7 and 41.1±3.9 g/min/g protein, respectively. During periods of transition from milk nutrition to independent nutrition, the activity of proteases increased. In 15-day-old rats it was 90.4±12.3 g/min/g of protein, and in 20-day-old rats it was 150.1±14.3 g/min/g of protein. The activity of proteolytic

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enzymes of the pancreas reached its maximum value after the withdrawal of 202.3±20.4 g/min/g of protein in 25-day-old rats and 246.6±21.2 g/min/g of protein in 30-day-old rats.

Age-dependent dynamics of shifts in activity was also noted in relation to pancreatic triglyceride lipase. In newborn, 5-, 10-, 15-, 20-, 25-, and 30-day-old rats, enzyme activity was recorded at the level of 156.0±11.1 g/min/g of protein; 154.9±12.3 g/min/g protein; 144.7±12.3 g/min/g protein; 156.1±12.3 g/min/g protein; 154.9±12.3 g/min/g protein; 219.1±12.3 g/min/g protein and 299.3±12.3 g/min/g protein, respectively.

Thus, the specific activity of pancreatic hydrolases at the early stage of postnatal life undergoes significant shifts. In rats that have completely switched to self-feeding, compared with newborn rats, the specific activity of pancreatic α-amylase increases by 13.2 times, the protease complex - by 6.0 times, and the activity of triglyceride lipase - by 1.9 times (Fig. 1).

It is known that in many immaturally giving birth animals, including rats, the secretion of the pancreas during lactation is at a low level. By the time of withdrawal, which in rats occurs at the end of the third week of postnatal life, α-amylase sharply increases and the activity of the complex of proteases and triglyceride lipase of the pancreas increases sharply [Ugolev, 1985; Briefly, 2005; Weir, 2016].

The obtained data of groups of animals, as well as the above literature data, show that abrupt changes in the hydrolytic activity of the enzyme systems of the initial stage of carbohydrate hydrolysis appear in early ontogenesis, namely, during the transition from dairy to definitive food.

CONCLUSIONS

The development of the activity of enzymes involved in the cavitary digestion of nutrients, the dynamics changes during the period of early postnatal ontogenesis. The activity of pancreatic enzymes (α-amylase, a complex of proteases, triglyceride lipase) after the birth of rats is manifested at a relatively low level, increases during the weaning period and remains at a high level after the transition to self-feeding.

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