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THE INFLUENCE OF NUTRITION ON THE FORMATION OF PANS ENZYME SECRETION AND HOMEOSTASIS OF MICE OF DIFFERENT AGES IN POSTNATAL ONTOGENESIS

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Annotatsiya

Turli yoshdagi kalamushlar me'da osti bezi fermentlar sekretsiyasi va gomeostazining shakllanishga oziqlanishning ta'sirini o'rganishdan iborat. Tajribalar institut vivariysidagi turli yoshdagi (15 kunlik, 1 oylik, 1.5 oylik, 2 oylik, 3 oylik va 4 oylik) oq, zotsiz, erkak kalamushlarda bajarilgan. Kalamushlar me'da osti bezi gomogenati va qonidagi amilolitik va lipolitik faolliklar o'rganilgan.

Olingan natijalarga ko'ra kalamushlar yoshi ulg'aygan sari me'da osti bezi to'qimasi amilolitik faolligining ortish keskinligi yuqoriroq darajada amalga oshdi. Yosh kalamushlarda yetuklariga nisbatan amilolitik fermentning qonga inkretsiya darajasi yuqoriroq bo'ldi. Kuzatuvimizdagi kalamushlarning har bir yoshga ulg'ayishi davomida ma'lum darajada lipolitik faollikni bir xil ortishi kuzatildi. Oqsilga boy ovqat bilan ozuqlantirilgan kalamushlarda har ikkala fermentlar (amilaza, lipaza) faolligining postnatal ontogenezda shakllanishi tezlashdi.

Kalit so'zlar: amilaza, lipaza, amilolitik faollik, lipolitik faollik, ferment gomeostazi, postnatal ontogenez.

Аннотация

Изучение влияния питания на формирование секреции ферментов и гомеостаза поджелудочной железы у крыс разного возраста. Эксперименты проводились на белых беспородных крысах разного возраста (15 дней, 1 месяц, 1,5 месяца, 2 месяца, 3 месяца и 4 месяца) в виварии института. Изучена амилолитическая и липолитическая активность гомогената поджелудочной железы и крови крыс.

Согласно полученным результатам, резкость повышения амилолитической активности ткани поджелудочной железы по мере взросления крыс была выше. У молодых крыс

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уровень инкреции амилолитического фермента в кровь был выше, чем у взрослых. Наблюдаемое нами увеличение липолитической активности крыс в определенной степени было одинаковым с каждым возрастом. У крыс, получавших богатую белком пищу, ускорилось формирование активности обоих ферментов (амилазы, липазы) в постнатальном онтогенезе.

Ключевые слова: амилаза, липаза, амилолитическая активность, липолитическая активность, ферментный гомеостаз, постнатальный онтогенез.

Abstract

The purpose of the study is to study the influence of nutrition on the formation of pancreatic enzyme secretion and homeostasis in rats of different ages. Experiments were conducted on white, outbred, male rats of different ages (15 days, 1 month, 1.5 months, 2 months, 3 months, and 4 months) in the institute's vivarium. The amylolytic and lipolytic activity of pancreatic homogenate and blood in rats was studied.

According to the obtained results, the intensity of the increase in the amylolytic activity of pancreatic tissue was higher with age in rats. In young rats, the level of amylolytic enzyme incorporation into the blood was higher than in adult rats. It was observed that the lipolytic activity of the rats under our observation increases uniformly to a certain extent with each age. In rats fed protein-rich food, the formation of the activity of both enzymes (amylase, lipase) in postnatal ontogenesis accelerated.

Keywords: amylase, lipase, amylolytic activity, lipolytic activity, enzyme homeostasis, postnatal ontogenesis.

Relevance of the work.

Digestive gland enzymes α-amylase, lipase, creatine kinase, and acid phosphatase play a key role in the hydrolysis of nutrients, ensuring effective digestion and metabolic adaptation of food. Their activity in blood serum is an important biochemical marker reflecting the state of the pancreas, salivary glands, liver, and other organs involved in metabolism.

The activity of these enzymes changes with age due to physiological processes of ontogenesis, including the maturation of the digestive system in children, the stabilization of metabolism in adults, and involutional changes in the elderly. These changes are associated with age-related changes in the secretory activity of the digestive glands, hormonal regulation, metabolism, and tissue homeostasis.

For example, in newborns and infants, the activity of pancreatic enzymes is reduced due to the underdevelopment of the pancreas, while in elderly people, the decrease in activity is often associated with atrophy of acinar cells and tissue fibrosis. These features indicate the importance of determining age-specific data ranges for the correct interpretation of laboratory data. The study of enzymatic activity depending on age improves the diagnosis of pathologies such as pancreatitis, myocardial infarction, or oncological diseases, as well as allows for the identification of subclinical disorders, contributes to the development of personalized approaches to prevention and treatment.

In 2017, Penjoyan G.A., Model G.Yu. and others conducted a study aimed at assessing the potential of the newborn's digestive tract by analyzing amniotic fluid, umbilical cord and maternal blood serum, as well as digestive gland hydrolases in the newborn's stomach [6].

The authors note that lactotrophy in newborns and infants on natural feeding requires the participation of hydrolytic enzymes of the digestive glands and small intestine for the digestion of milk and complementary foods [1, 2, 3, 4, 7].

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This is a necessary condition for the normal growth and development of the child during breastfeeding and mixed feeding. Assessment of the digestive potential of newborns allows predicting the effectiveness of digestion.

Purpose of the work. To study the influence of nutrition on the formation of pancreatic enzyme secretion and homeostasis in rats of different ages.

Experimental methods on animals: The experiments were conducted on white, outbred, male rats of different ages in the institute's vivarium. The rats of the control group were fed mixed feed (containing protein, fat, carbohydrates), the first experimental group was fed only bread, the second experimental group bread and butter, and the third experimental group, like the control group, was additionally fed boiled egg white.

After reaching a certain age (15 days, 1 month, 1.5 months, 2 months, 3 months, and 4 months), they were decapitated under anesthesia, and the pancreas was isolated from them. The blood isolated during decapitation was collected in special test tubes. The glands were mixed with a physiological solution in a 1:10 ratio, from which a homogenate was prepared. Amylolytic and lipolytic activity in the filtrate and blood serum were determined by the calorimetric method. The obtained results were compared with the indicators of 4-month-old adult rats.

Analysis of the obtained results. Changes in the activity of digestive enzymes, growth and development of the digestive tract, the formation of regulatory processes, metabolic shifts, and the influence of the external environment depend on physiological processes in the body. Enzyme activity depends on the formation of organs in young organisms and on metabolic stability in mature organisms.

Table 1

The indicator of the hydrolytic enzymes in the blood serum and the homogenate of the pituitary gland in mice of different ages fed with mixed feed (M±m) (control group)

The age of rats	Pancreatic homogenate		Blood serum	
	Amylase	Lipase	Amylase	Lipase
15 days	143,3±12,8*	59,0±6,8*	30,4±2,6*	28,2±1,6*
1 month	280,2±25,0*	150,2±18,3*	49,3±2,3*	27,1±2,0*
1.5 months	284,2±16,7*	146,8±10,2*	51,2±4,8*	31,0±1,5*
2 months	527,0±3,7*	184,3±4,1*	70,6±11,2*	43,4±6,6*
3 months	909,0±48,9*	202,5±13,0*	86,7±3,3	53,3±0,5*
4 months	1405,8±127,5	262,5±16,1	96,1±3,0	68,2±1,4

Note: ** differences in enzyme activity in rats of different ages compared to 4-month-old rats are reliable.*

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Among the animals we studied, the most mature were 4-month-old rats, the indicators of which were compared with the indicators of animals of other ages. Because all functions in the body of 4-month-old rats, including the secretory activity of the pancreas and enzyme homeostasis, are fully formed.

The activity of the enzymes studied in our experiments is not the same in the pancreatic homogenate and blood serum of 4-month-old rats (Table 1), the amylolytic activity in the pancreatic tissue homogenate is almost 5.5 times higher than in blood serum, since the amylolytic activity in the blood mainly consists of pancreatic (P) and salivary (S) α-isoamylases. The P-type, which is secreted only by the pancreas, is organ-specific, while the S-type, in addition to the salivary glands, is found in tears, sweat, amniotic fluid, lungs, the epithelium of the testes, and fallopian tubes [5].

The presence of α-amylase in blood flow, observed in normal and pathological conditions, is a phenomenon that has been studied for decades. The level of amylase in blood serum serves as an important diagnostic marker, especially in diseases of the pancreas (acute and chronic pancreatitis), salivary glands, obstruction of the glandular ducts, and damage to the intestinal mucosa. The mechanisms of amylase transport into the blood include duacriny - a process by which the exocrine cells of the salivary glands and pancreas perform an endocrine function, secreting the enzyme simultaneously into the digestive tract and bloodstream, as well as the partial absorption of amylase into the blood from the ducts or small intestine [10].

Our results showed that the ratio of pancreatic homogenate and amylolytic activity in blood serum of rats of different ages differs sharply from these indicators in adult rats; if the amylolytic activity in the pancreatic homogenate of 15-day-old rats was equal to one-tenth of this indicator in adult rats, then in adult and 15-day-old rats this activity in the blood was one-third. Consequently, the “leakage” of the amylolytic enzyme into the blood is higher in young rats than in adults.

Age-related changes in the amylolytic activity of the pancreas and blood serum of the rats under our direct observation became more pronounced as they approached the level of maturity. If from 15 days to 1, 1.5 months the amylolytic activity of pancreatic homogenate increased to 10%, then in 2-month-old rats it increased by 17%, in 3-month-old rats by 30%, and in 4-month-old, adult rats by 35%. This is, of course, due to the fact that as rats mature, the intensity of metabolism in their body changes to ensure growth and development, and the secretory process of the digestive glands increases.

The age-related increase in amylolytic activity in the blood differed from that of glandular tissue. From 15 days to 1 month, the amylolytic activity in the blood of rats increased by 63%, and at the next 2 months, compared to the previous age, it increased by 45% at 2 months, by 22% at 3 months, and by 10% at 4 months. Consequently, the formation of the amylolytic enzyme in the blood during postnatal ontogenesis proceeds differently than in glandular tissues, that is, the introduction of this enzyme into the blood of young rats is more intensive than in adult rats.

Lipases are a family of enzymes that catalyze the hydrolysis of triglycerides to free fatty acids and glycerin. They are active in various tissues: liver lipase is expressed in the liver, hormone-sensitive lipase in adipocytes, lipoprotein lipase in vascular endothelium, and pancreatic lipase in the small intestine [9].

The second enzyme we studied is lipase, pancreatic lipase, activated by bile acids and colypase, plays a key role in the digestion of fats and the absorption of fat-soluble vitamins (A, D, E, K). It also affects the pathogenesis of fatty necrosis, acute and chronic pancreatitis. Lipases also participate in the mechanism of action of cholesterol-reducing drugs.

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According to our results, the content of lipase in pancreatic homogenate and blood serum is several times lower than that of amylase. This, of course, indicates the uneven intensity of carbohydrate and fat metabolism in the body. In mature (4-month-old) rats, the lipolytic activity of pancreatic homogenate and blood serum is not the same, in the blood this activity is almost 4 times lower than in glandular tissue, since the main source of serum lipase is the pancreas, which is produced in small quantities by the stomach, intestines, leukocytes, and lungs [8].

As can be seen from Table 1, the lipolytic activity in the pancreatic homogenate of adult and 15-day-old rats is in the ratio of one-fourth. The ratio of lipolytic activity in the blood of adult and 15-day-old rats is similar. Consequently, during the formation of postnatal ontogenesis, the ratio of lipolytic activity of glandular tissue and blood is preserved.

The formation of lipolytic activity in the pancreas and blood of the rats under our observation in postnatal ontogenesis differed from the formation of amylolytic activity. As the rats under our observation grew older, the activity of enzymes in the pancreas and blood increased. The degree of increase in amylolytic activity in the gland varied at different ages, i.e., this increase was higher in the main 3- and 4-month-old rats. Changes in lipolytic activity were uniformly linear, i.e., with age changes in the rats under our observation, a certain increase in this activity was observed with each age increase.

When feeding experimental rats with various feeds, a peculiar formation of pancreatic homogenate and blood enzymes in postnatal ontogenesis was observed. The results obtained in rats fed only bread, bread+butter showed changes similar to the control group. Mixed feed (carbohydrates, fats, protein) + boiled egg white accelerated the formation of both enzymes in postnatal ontogenesis in rats. The amylolytic activity of pancreatic homogenate in 1-month-old rats was 2.5 times higher than in 15-day-old rats, and in experimental animals in subsequent periods this indicator increased by 1.5 times per month, and the formation of homeostasis of this enzyme was completed.

Postnatal formation of homeostasis of amylolytic activity in the blood proceeded somewhat differently, in 1-month-old rats this activity increased by 2.2 times compared to 15-day-old rats. In the subsequent 2 and 3-month periods, the amylolytic activity in the blood increased by 20%, 7%, and 10% compared to the previous age, i.e., the change in amylolytic activity in the blood manifested as a wave.

The second enzyme we studied was lipase, and we determined the activity of this enzyme in the pancreatic tissue homogenate and blood serum of rats of different ages in our observation. The formation of pancreatic homogenate lipolytic enzymes in postnatal ontogenesis was proposed and acquired a wave-like appearance. Increased lipolytic activity of the glandular tissue occurred mainly at the age of one month. The lipolytic activity of pancreatic homogenate in 1-month-old rats increased by 3.2 times compared to 15-day-old rats. In the subsequent 2-3-month periods, this activity increased by 7% and 2% compared to the previous age, while in 4-month-old rats it increased by 26% compared to 3-month-old rats.

If we consider the formation of lipolytic activity in the blood, the direction of changes in the pancreatic tissue homogenate is preserved, but slightly different from it, that is, it was found that this activity in the blood of 1-month-old rats increased by 2.7 compared to 15-day-old rats. Changes in lipolytic activity in the blood of animals of the next age compared to the previous age increased by 41% in 2-month-old rats and almost reached the indicators of adult rats. Thus, the lipolytic activity in the blood of experimental rats fed with additional protein increased to adult levels in the first 2 months of life.

From the results obtained, the following conclusions can be drawn:

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1. In young rats, the intensity of "leakage" of the amylolytic enzyme into the blood is higher than in adult rats;
2. As rats mature, the intensity of the increase in amylolytic activity of pancreatic tissue increases.
3. The level of difference in lipolytic activity in the glandular tissue and blood of rats of all ages is preserved.
4. The change in lipolytic activity was uniformly linear, i.e., during the change in age of the rats we observed, a certain increase in this activity was observed with each age.
5. In rats fed protein-rich food, the formation of the activity of both enzymes (amylase, lipase) in postnatal ontogenesis accelerated.

References

1. Adamkin, D. Kh. Nutrition Strategy for Infants with Very Low Birth Weight / D. Kh. Adamkin; translated from English, edited by E. N. Baybarina. - Moscow: Publishing Group "GEOTAR-Media," 2013. - 776 p.
2. 2. Berezov, T. T. Biological Chemistry: Textbook / T. T. Berezov, B. F. Korovkin. - Тошкент, 2020. - 115p.
3. 3. Bordin, D. S. The influence of excessive bacterial growth in the small intestine on the course of chronic pancreatitis / D. S. Bordin, Yu. V. Osipenko, L. V. Vinokurova, E. A. Dubtsova // Experimental and Clinical Gastroenterology. - 2012. - No. 7. - P. 3-
4. 4. Kon, I. Ya. Fundamentals of Natural Feeding of Children of the First Year of Life / I. Ya. Kon, M. V. Gmoshinskaya, E. M. Fateeva // Children's Nutrition. Guide for Doctors / edited by V. A. Tutelyan, I. Ya. Konya. - Тошкент, 2020. - Vol. II, Ch. 1. - P. 277-339.
5. 5. Korotko, G. F. Salivary gland secretion and elements of saliva diagnostics / G. F. Korotko. - Moscow: Academy of Natural Sciences, 2006. - 192 p.
6. 6. Korotko, G. F. Complex Assessment of the Digestive System.
7. Cerk, I. K. Regulation of adipose triglyceride lipase: A review / I. K. Cerk, L. Wechselberger, M. Oberer // Current Protein & Peptide Science. – 2018. – Vol. 19, no. 2. – P. 221–233.
8. Holmes, R. S. Comparative studies of mammalian acid lipases: Evidence for a new gene family in mice and rats (Lipo) / R. S. Holmes, L. A. Cox, J. L. VandeBerg // Comparative Biochemistry and Physiology Part D: Genomics and Proteomics. – 2010. – Vol. 5, no. 3. – P. 217–226.
9. Rothman, S. Conservation of digestive enzymes / S. Rothman, C. Liebow, L. Isenman // Physiological Reviews. – 2002. – Vol. 82, no. 1. – P. 1–18.