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ВЛИЯНИЕ ДЛИТЕЛЬНОГО ВВЕДЕНИЯ ГЛУТАМАТ НАТРИЯ НА НЕКОТОРЫЕ ПОКАЗАТЕЛИ УГЛЕВОДНОГО ОБМЕНА
EFFECT OF PROLONGED ADMINISTRATION OF SODIUM GLUTAMATE IN SOME CARBOHYDRATE METABOLISM

Аннотация: Показано, что ежедневное потребление глутамата натрия в дозе 30 мг / кг массы тела в течение 28 дней привело к повышению уровня глюкозы и глюкозо-6-фосфатазной активности и снижение лактата и лактатдегидрогеназной активности при неизменном уровне гликогена в печени крыс, что может свидетельствовать о метаболические сдвиги в обмене глюкозы.

Ключевые слова: глутамат натрия, углеводный обмен, печень, крысы.

Summary: It is shown that a daily intake of MSG at a dose of 30 mg / kg body weight for 28 days led to increased glucose and glucose-6-phosphatase activity and reduced lactate and lactic-dehydrogenase activity at a constant level of glycogen in the rats' liver, which may indicate metabolic changes in the glucose metabolism.

Key words: MSG, carbohydrate metabolism, liver, rats.

Introduction

Monosodium glutamate (MSG) –is a sodium salt of glutamic acid, an amino acid that is considered to be a potential precursor of gluconeogenesis. Despite the fact that about 25% of the population is sensitive to monosodium glutamate, it is still commonly used flavor enhancer. Thus the permissible limits could be significantlyexceeded, which leading to such metabolic and toxic effects of MSG as oxidative stress hyperglycemic conditions and changes in lipid metabolism during prolonged use [1, p. 150]. This causes a more detailed study of food supplements on the body, especially on some carbohydrate metabolism.

The aim

To investigate glucose, glycogen, lactate contents and lactic-dehydrogenase and glucose -6-phosphatase activities in liver and serum of rats under conditions of prolonged administration of sodium glutamate.

Materials and Methods

Work carried out on 90 white nonlinear rats weighing 120-160 g, which were kept in vivarium conditions in compliance with the standards of the European Convention for the Protection of Animals, adopted by I National Congress of Ukraine with Bioethics [2, p.35]. Animals were divided into two groups: experimental and intact rats that received daily per os 3% aqueous solution of sodium glutamate in 1 ml for 30 mg/kg for 28 days. This dose corresponded to 2 g of sodium glutamate to the average person. The choice of dose due to the fact that according to the literature 1-2 g of sodium glutamate to the average person does not show negative effects, while 3 g of sodium glutamate can be dangerous to human health [3, p. 204]. MSG was dissolvein an amount of 30 mg in 1 ml of distilled water at room temperature. The control group of animals received the same amount of distilled water with no MSG.

Research indicators of animals' blood serum and liver homogenate were done on 7, 14, 21 and 28 days of experiment. Decapitation of animals carried out under light ether anesthesia. Blood and liver were takenfrom animals. The resulting biological material was used for further researches.

Animals'serum had been use for studiesthat was received from whole blood by centrifugation at 1500 rev/min for 15 minutes. Glucose, glycogen, lactate contents and lactic-dehydrogenase and glucose-6-phosphatase activitiesbeen determined in rat liver postnuclear supernatant of 5% liver homogenate which was obtained after centrifugation at 900 g and prepared in 50 mM Tris-HCl buffer (pH 7.4).

Determination of glucose, glycogen, lactate contents and lactic-dehydrogenase and glucose-6-phosphatase activities in liver and serum of rats' been carried out by conventional methods with using standard reagent kits [4, p. 320]. Determination of total protein in animals'liver homogenate been done with Lowry method [5, p. 266].

Statistical analysis of the results was performing with a standard software Microsoft Excelpackage, with using the t-Student test. Arguably considered the difference if the value of $p < 0.05$.

Results and discussion

The most active form of carbohydrates biochemical metabolism in the body is glucose, which can eitherbe formed and converted into other compounds, with the largest portion of energy utilized in catabolic cycles. As a result of studies found that daily administration of sodium glutamate for 28 days led to a significant increase of glucose in the rats'liver homogenate compared with controls. Thus the initial stages of the experiment (7th and 14th day) the likely changes glucose wasn't noted (Fig. 1).

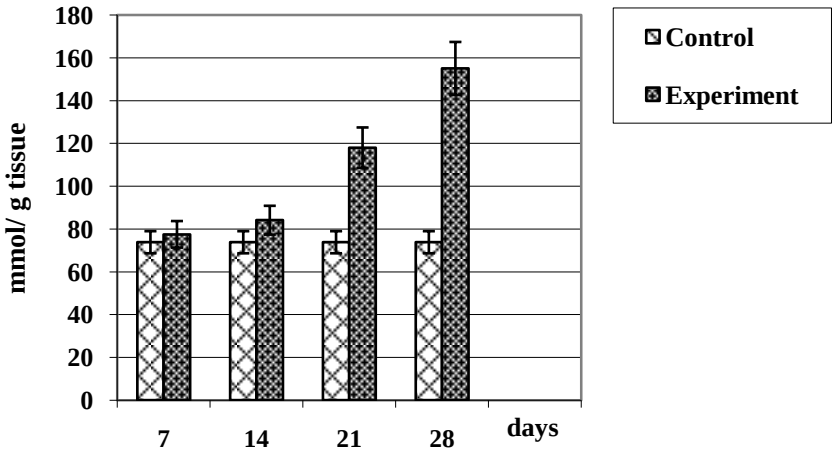

Fig. 1. The content of glucose in the rats' liver homogenate under long-term administration of sodium glutamate

After a consuming food which rich in carbohydrates, blood accumulates excess glucose, which is reserved as glycogen in the liver and muscles. It was found that the glycogen level in the liver homogenate of experimental animals remained at the level of the control group during the four-week sodium glutamate introduction (Fig. 2).

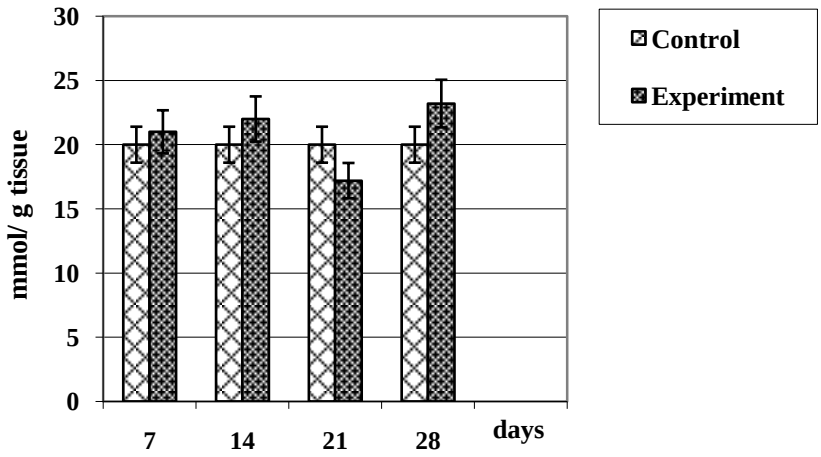

Fig. 2. The content of glycogen in the rats'liver homogenate under long-term administration of sodium glutamate

While glycolysis passage in the human body, some glucose can oxidize under anaerobic condition, which leads to the formation of lactate. Studies have shown that daily administration of sodium glutamate for 28 days led to a possible reduction of lactate in rats' liver homogenate. Reduction of lactate in rat liver has noted for 14 day administration of sodium glutamate and this trend remained to the end of the experiment (Fig. 3).

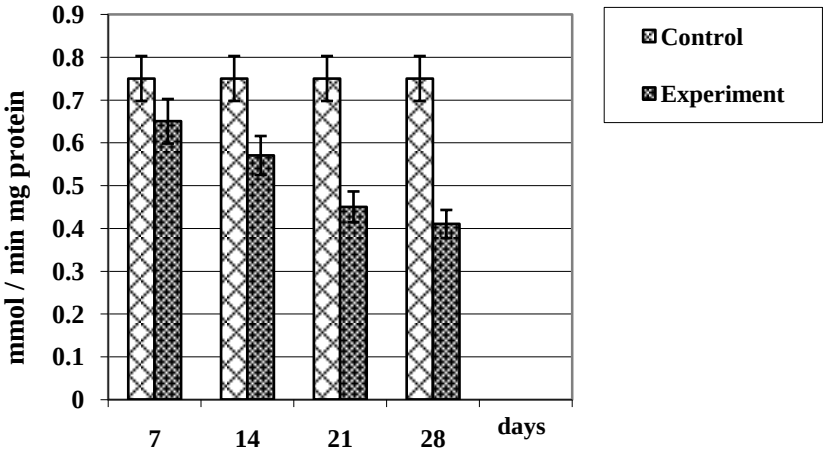

Fig. 3. The content of lactate in rats' liver homogenate under prolonged administration of sodium glutamate

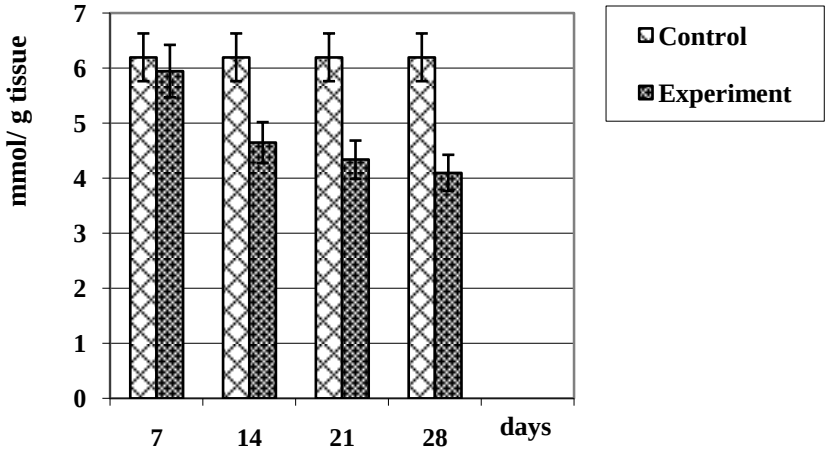

Fig. 4.Lactic-dehydrogenase activity of rats' liver homogenate under prolonged administration of sodium glutamate

The confirmationof lactate content change is possible decline of lactic-dehydrogenase activity in rats' liver homogenate (which is the glycolysis' final levelenzyme) under the action of sodium glutamate (Fig. 4). We can assume that the inactivation of the enzyme in the liver caused by the redistribution in the LDH isoenzyme content that provides growth up of pyruvate /lactate ratioand evidence about active course of oxidative processes in the tissue - namely the activation of oxidative decarboxylation of pyruvate.

Suchchanges may be the result of MSG chronic action on individual links of glucose metabolism, especially gluconeogenesis. Found that the action of sodium glutamate in rat liver homogenate significantly increased glucose-6-phosphatase activity at 21 and 28 days compared with the control group (Fig. 5). A significant increase of glucose-6-phosphatase activity in rats demonstrateincreased glucose formation by the liver through gluconeogenesis and it entry into blood by the action of sodium glutamate.

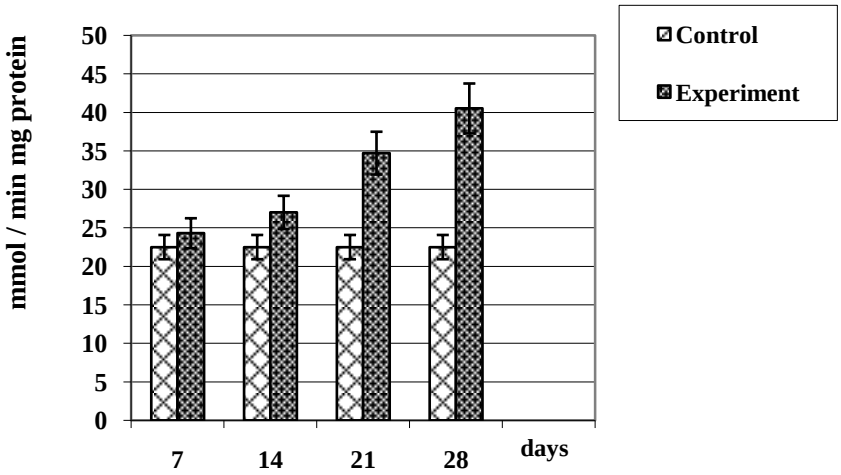

Fig. 5. Glucose-6-phosphatase activity of rats' liver homogenate under prolonged administration of sodium glutamate

In addition to furthering the experiment monitored the animal. Thus, weight of control animals while experiment increased to 30,4 grams. In the group of animals which was injected with MSG the increase in body weight was 76,2 grams, that is 50% above the initial reference level and 32% more than the mass of the animals in the control group on 28day of the experiment. Moreover, a significant change of this indicator in the experimental group has noted the 21 day experiment, where weight gain was 42% compared to baseline control values.

The increase in body weight can be explained by the fact that MSG is exciting main mediator in the central nervous system and stimulates the hunger center, as result it increases food intake. It is known that MSG increases the sensitivity of taste receptors, thus forming addiction to food that is rich in this food additive, which is similar to drug [6, p. 484; 7, p. 25].

Thus, obtaining data cast doubt on the generally accepted claim that the use of the food additive MSG in small amounts - 30 mg / kg body weight, which is 2 grams per day in terms of man, may be safe for human health. Monosodium glutamate which under normal circumstances is involved in the metabolism of proteins, carbohydrates and lipids showed a significant effect on some parameters of carbohydrate metabolism in the animals liver, which may indicate the activation of aerobic glycolysis and gluconeogenesis in the tissue after a four-week oral administration of sodium glutamate in the dosage 30 mg / kg body weight.

Conclusion

The increasing glucose and glucose-6-phosphatase activity and reduced lactate and lactic-dehydrogenase activity at a constant level of glycogen in the rats' liver were found, which indicates that the metabolic changes in glucose metabolism, especially the activation of aerobic glycolysis and induction of gluconeogenesis in the tissue after four-week introduction of sodium glutamate in dosage 30 mg/kg body weight.

Literature

1.Дубовая Г. А. Влияние глутамата натрия на живые организмы/ Г. А. Дубовая, Ю. Н. Дубовая, Д. П. Татаренко // Вісник ЛНУ імені Тараса Шевченка. – 2013. – № 19, Ч. І. – С. 149 – 155.

2. Мальцев А.И.Этическая оценка методик проведения исследований / В.И. Мальцев, Д.Ю. Белоусов // Еженедельная аптека. – 2001. – № 4. – С. 35-40.

3. Курбат М.Н. L-Глутамат: современный взгляд на известную аминокислоту / М.Н. Курбат // Нейрохимия. – 2009. – Т. 26, № 3. – С. 202–207.

4. Ройтберг Г.Є. Лабораторна та інструментальна діагностика захворювань внутрішніх органів / Г.Є. Ройтберг, А.В. Струтинскій. – К: Біном, 1999.– 662 с.

5. Lowri O.H.Protein measuperment with Folin phemol reagent / O.H. Lowri, N.J. Rosenbrough, A.L. Farr // J. Biol. Chem. – 1951. – V. 123, № 1.– P. 265 – 273.

6. Freeman M. Reconsidering the effects of monosodium glutamate: a literature review / M. Freeman // J Am Acad Nurse Pract. 2006. – Vol. 18, № 10. – P. 482–486.

7. Eweka A.O. Histochemical Studies of the effects of monosodium glutamateon the liver of adult wista rrats/ A.O.Eweka, P.S. Igbigbi, R.E. Ucheya// Annals of Medical and Heals Sciences Research.– 2011.– № 1.– P.– 21-29.