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EFFECT OF LONG-TERM ADMINISTRATION OF MONOSODIUM GLUTAMATE ON BODY WEIGHT OF RATS AND SOME INDICES OF LIPID METABOLISM

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Monosodium glutamate (MSG) is widely known as a flavor enhancer that is used in many processed foods. In this case, permissible standards can be significantly exceeded. Debate and research continues about the potential health effects of MSG, particularly its relationship with obesity and metabolic disorders.
The aim of the work *– to study the effect of a 30-day administration of monosodium glutamate at a dose of 30 mg/kg body weight on the levels of glucose, triglycerides and total cholesterol in the blood of rats, as well as its potential role in the development of obesity.*
Materials and methods. *The study of the effect of monosodium glutamate was carried out on 3-month-old rats that received a 3 % aqueous solution per os daily, 1 ml at a rate of 30 mg/kg body weight for 30 days. The control group received a standard diet without added monosodium glutamate.*
Research results. *It has been found that after 1 month, in rats injected with monosodium glutamate, body weight was 11.5 % greater than the control, and body length decreased 6.8 %. Anthropometric indicators were used to determine the body mass index of rats, which may indirectly indicate the development of obesity. In the experimental group of rats, this figure increased 28 % compared to the control. Changes in some parameters characteristic of obesity were observed in the blood of animals administered orally with monosodium glutamate for 30 days. First of all, an increase in glucose levels was recorded 75 %, triacylglycerides – 60 %, and total cholesterol – 25 % compared to the control group of rats.*
Conclusions. *As a result of experimental studies, it has been proven that a 30-day administration of monosodium glutamate at a dose of 30 mg/kg body weight led to adverse effects on the level of glucose, triacylglycerides and total cholesterol in the blood serum of 3-month-old rats. The established changes in the body mass index of animals indicate the potential role of monosodium glutamate in the development of obesity. The results indicate the dangers of long-term use of the dietary supplement MSG, especially at a young age.*

Key words:
monosodium glutamate, glucose, triglycerides, cholesterol, blood, body mass index, rats.

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ВПЛИВ ТРИВАЛОГО ВВЕДЕННЯ ГЛУТАМАТУ НАТРІЮ НА МАСУ ТІЛА ЩУРІВ ТА ДЕЯКІ ПОКАЗНИКИ ОБМІНУ ЛІПІДІВ

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Глутамат натрію, широко відомий як підсилювач смаку, який використовується в багатьох оброблених харчових продуктах. При цьому допустимі норми можуть бути значно перевищені. Продовжуються дебати та дослідження щодо потенційного впливу глутамату натрію на здоров'я, особливо його зв'язок з ожирінням та порушеннями обміну речовин.
Мета роботи – *вивчити вплив 30-денного введення глутамату натрію в дозі 30 мг/кг маси тіла на рівень глюкози, тригліцеридів та загального холестерину в крові щурів, а також його потенційну роль у розвитку ожиріння.*
Матеріали і методи. *Дослідження впливу глутамату натрію проводили на 3-місячних щурах, що отримували 3 %-й водний розчин per os щоденно по 1 мл в розрахунку 30 мг/кг маси тіла протягом 30 днів. Контрольна група отримувала стандартний раціон без добавок глутамату натрію.*
Результати. *Встановлено, що через 1 місяць у щурів, які отримували глутамат натрію, маса тіла була більшою порівняно з контролем на 11,5 %, а довжина тіла – меншою на 6,8 %. Антропометричні показники використовували для визначення індексу маси тіла щурів, що опосередковано може свідчити про розвиток ожиріння. У щурів дослідної групи цей показник збільшився на 28 % порівняно з контролем. У крові тварин, яким перорально вводили глутамат натрію протягом 30 днів, реєстрували зростання вмісту глюкози на 75 %, тригліцеридів – на 60 %, загального холестерину – на 25 % порівняно з тваринами контрольної групи.*

Ключові слова:
глутамат натрію, глюкоза, тригліцериди, холестерин, кров, індекс маси тіла, щури.

Клінічна та експериментальна патологія 2024. Т.23, №1 (87). С. 49-52.

Висновки. *30-денне введення глутамату натрію в дозі 30 мг/кг маси тіла призводить до несприятливого впливу на рівні глюкози, тригліцеридів і загального холестерину в сироватці крові 3-місячних щурів. Встановлені зміни індексу маси тіла тварин вказують на потенційну роль глутамату натрію у розвитку ожиріння. Отримані результати свідчать про небезпечність тривалого вживання харчової добавки глутамату натрію, особливо в молодому віці.*

Introduction

Monosodium glutamate (MSG), the sodium salt of glutamic acid, is one of the most common food additives in the world, used to enhance taste and consumed in food products, both at home and in public catering [1].

The use of MSG has increased significantly over the past 30 years. Despite the fact that about 25 % of the world's population is sensitive to monosodium glutamate, it remains a widely used taste enhancer by increasing the sensitivity of the taste buds of the tongue [2]. In this case, the permissible standards for its use can be significantly exceeded. Scientists have proven [3, 4, 5] that long-term use is associated with the development of a number of pathological conditions, in particular metabolic syndrome, diabetes mellitus, liver diseases, dyslipidemia and obesity, hypertension and other diseases of the cardiovascular system.

Obesity is one of the most common diseases in the world, which is characterized by excessive deposition of fat in the body and contributes to, and in a significant part of cases is the main cause of, the development of cardiovascular, neuroendocrine and oncological diseases, which leads to loss of ability to work and a reduction in life expectancy for a significant part of the population obese patients [6].

Today, the participation of monosodium glutamate in the obesity of the majority of people who abuse food in fast food restaurants remains controversial. Scientists suggest [7] that people may eat larger portions of foods with MSG because they simply taste better. Other evidence suggests [8] that MSG may influence the body's appetite-regulating signaling systems. It is known [9, 10] that monosodium glutamate increases the sensitivity of taste buds, which leads to addiction similar to drugs, resulting in the formation of dependence on food that is rich in this food additive. All this leads to a more detailed study of the effect of this food additive on the body and its permissible quantities that are safe for consumption.

The aim of the study

To study the effect of a 30-day administration of monosodium glutamate at a dose of 30 mg/kg body weight on the levels of glucose, triglycerides and total cholesterol in the blood of rats, as well as its potential role in the development of obesity.

Materials and Methods

The work was carried out on 90 white non-linear sexually mature male 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 the National Congress of Ukraine on Bioethics. Instruments used in scientific research were subject to metrological control.

A study of the effect of monosodium glutamate was carried out on three-month-old rats that received a 3 % aqueous solution per os daily, 1 ml at a rate of 30 mg/kg body weight for one month, which corresponds to 2 g of monosodium glutamate per person and does not have a negative effect. The control group of animals received the same amount of distilled water without monosodium glutamate.

Within one month, changes in the body weight were analyzed in rats of both groups. Body length was measured and body mass index (BMI) was calculated – this is the ratio of body weight in grams to the square of body length in square centimeters. After 30 days, the rats were decapitated under light ether anesthesia, the blood was collected in test tubes and left without an anticoagulant for at least 30 min at 38 °C. Animal blood serum obtained by centrifugation of whole blood at 1000 g for 15 minutes was used for research.

In the blood serum of rats, determination of the content of glucose, triglycerides and total cholesterol was carried out according to generally accepted biochemical methods using standard sets of reagents [11].

Statistical processing of the results was carried out using Student's t-test. The difference between the control and experimental indicators was considered significant at $p < 0.05$. Data are presented as the arithmetic mean (M) and their standard error (m): $M \pm m$.

Research Results and Discussion

As a result of the studies, it was shown that the introduction of the dietary supplement monosodium glutamate for 30 days led to the development of obesity in rats. Table 1 shows anthropometric parameters in two groups of rats. It was found that after 1 month, the animals that were administered monosodium glutamate had an 11,5 % increase in body weight compared to control animals. At the same time, body length decreased 6,4 % in the group of experimental rats that were found to be obese.

Anthropometric indicators were used to determine the body mass index of animals, which may indirectly indicate the development of obesity. In the experimental group of animals that were administered monosodium glutamate, this figure increased 28 % compared to the control.

In table 2 the biochemical parameters of the blood serum of rats after oral administration of the dietary supplement monosodium glutamate for one month are shown. Changes in the content of glucose, triglycerides and total cholesterol, characteristic of metabolic syndrome, have been established.

First of all, an increase in glucose levels was recorded 75 %, triglycerides – 60 %, and total cholesterol – 25 % compared to the control group of rats.

The findings suggest that MSG may have significant effects on metabolic parameters and the development of obesity in rats. Changes in the body weight, glucose, triglycerides, and total cholesterol indicate a potential association between MSG intake and metabolic disorders. To date, a number of scientists have suggested that the properties of monosodium glutamate to cause obesity are associated with a violation of the endocrine regulation of the control of the feeling of satiety and insulin secretion.

Table 1

Anthropometric indicators of rats after 30-day oral administration of monosodium glutamate dietary supplement, (M±m, n = 45)

Indicators	Control group	Experimental group
Body weight, g	110,5 ± 6,25	123,2 ± 7,02
Body length, cm	12,5 ± 0,73	11,65 ± 0,76
Body mass index	0,71 ± 0,04	0,91 ± 0,05*

*Note: * – probable difference between comparison groups, p<0.05.*

Table 2

Biochemical parameters of rat blood serum during 30-day oral administration of the dietary supplement monosodium glutamate, (M±m, n = 45)

Indicators	Control group	Experimental group
Glucose, mmol/l	6,20 ± 0,24	10,85 ± 1,30*
Triglycerides, mmol/l	1,15 ± 0,15	1,84 ± 0,19*
General cholesterol, mmol/l	3,53 ± 0,18	4,41 ± 0,39*

*Note: * – probable difference between comparison groups, p<0.05.*

A number of studies [6, 8, 12] have shown that the mechanism by which MSG causes obesity includes the induction of hypothalamic lesions, hyperlipidemia, oxidative stress, leptin resistance and increased expression of peroxisome proliferator-activated receptors gamma and alpha.

Moreover, there is evidence [9] indicating a key role of leptin in the development of obesity. The physiological function of which is to prevent the development of obesity under conditions of excess food intake into the body. It has been experimentally proven [13, 14] that in obesity, an increase in leptin levels in the blood serum is caused by resistance of the hypothalamus to the central action of lipocytokine through negative feedback mechanisms or defects in transport across the blood-brain barrier. Tissue resistance to leptin develops gradually, activating the growth of adipose tissue [15].

Other researchers have found [8, 16] that the mechanism of the negative effect of monosodium glutamate on the body is similar to the induction of diabetes mellitus. Consumption of this dietary supplement resulted in a decrease in pancreatic beta cell mass, an increase in oxidative stress and metabolic rate, a decrease in glucose transport into adipose tissue and skeletal muscle, as well as insulin insensitivity and a decrease in the number of insulin receptors in adipose and muscle tissue.

Thus, both our own research results and literature data indicate the potential role of monosodium glutamate in the development of obesity. These results highlight the importance of further research into the long-term effects of MSG consumption on metabolic health and weight regulation.

Conclusions

1. The results of experimental studies showed that a 30-day administration of monosodium glutamate at a dose of 30 mg/kg body weight led to adverse effects on the levels of glucose, triglycerides and total cholesterol in the blood serum of 3-month-old rats.

2. The established changes in the body mass index of animals indicate the potential role of monosodium glutamate in the development of obesity. The results indicate the dangers of long-term use of the dietary supplement MSG, especially at a young age.

Prospects for further research

Further research is needed to determine the underlying mechanisms and long-term effects of MSG consumption on metabolic health and weight regulation.

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