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INVESTIGATION OF THE INFLUENCE OF MINERAL WATER WITH INCREASED CONTENT OF ORGANIC ON THE DEVELOPMENT OF METABOLIC SYNDROME IN THE EXPERIMENT

[1,*]Gushcha, S.G., [2]Nasibullin, [3]Plakida A.L., [3]Babova I.K., [4]Balashova I.V., [5]Trubka I.A., [6]Volyanska, V.S. and [6]Kalinichenko, N.V.

[1,2,3,4,]Department of Fundamental Research of State Institution Institute Research of Medical Rehabilitation and Balneology of the Ministry of Health of Ukraine, Odessa, Ukraine
[5]Department of Children's Dentistry Shupyk National medical Academy of Postgraduate Education, Kiev, Ukraine
[6]Department of medical rehabilitation State Institution, Institute Research of Medical Rehabilitation and Balneology of the Ministry of Health of Ukraine, Ukraine, Odessa

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ABSTRACT

Background: The World Health Organization describes the metabolic syndrome (MS) as a "21st Century Pandemic." The pathogenesis of MS is complex and completely not studied, which justifies the importance of conducting research in this field, including experimental ones. Recently, in order to treat MS and its complications, along with drug therapy, non-pharmacological agents are used - natural therapeutic resources, which include mineral water (MW). MW are widely used in medical practice, due to the possibility of prolonged use, the combination of general non-specific effects on the processes of body sanogenesis in general and local pathogenetic mechanisms.
Objective: To investigate the effect of MW with increased content of organic substances on its internal application to the metabolic rate of experimental animals with the MS.
Materials and Methods: In the experiment, 40 white male rats weighing 230.0 – 250.0 g were used. For reproduction of the MS model, the animals were kept for 60 days in a standard diet, while the rats additionally received 30 grams of white bread crumbs per animal and consumed only 10% fructose solution in distilled water (as a drinking liquid). MW was injected into the esophagus of animals with a soft probe with olive, once a day for 12 consecutive days, at a dose of 1% of the body weight of the animal.
Results: At day 60 of the experiment in rats with MS, blood glucose levels were increased by 3 mmol/l ($p < 0,01$), cholesterol and triglycerides by 32 and 154% ($p < 0.01$). Weight of animals increased by 14% ($p < 0,01$), and the use of a solution of fructose by 100%. Under the influence of MW, the weight of animals decreased by 8% ($p < 0.01$), the use of a solution of fructose by 50% ($p < 0,01$). The level of glucose decreased by 2 mmol/l, the cholesterol content was completely restored ($p > 0,5$), and the content of triglycerides remained elevated ($p < 0,001$).
Conclusion: MS is a serious and long-lasting pathology, its development causes serious rearrangements in the body. Established corrective effect of MW with increased content of organic substances on separate parts of pathogenesis of MS, although not carried out in full, but is of a stable nature.

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INTRODUCTION

The relevance of complex disorders of life called "metabolic syndrome" (MS), is growing due to the spread of this phenomenon.

Corresponding author: **Gushcha, S.G.,**
Department of Fundamental Research of State Institution Institute Research of Medical Rehabilitation and Balneology of the Ministry of Health of Ukraine, Odessa, Ukraine.

The reason for this - recently increased the prevalence of MS, which can be considered an epidemic. This illness affects about 25% of the adult population of developed countries [Nigel, 2006; Chalaya et al., 2015]. An important basis for the study of MS and the active use of therapies for its components is the high risk of developing cardiovascular diseases and their complications [Belovol, 2016]. According to the National Cholesterol Education Program-Adult Treatment Panel III, the

criteria for MS syndrome are the presence of not only three violations such as abdominal obesity, hyperglycemia on an empty stomach, hypertriglyceridemia, hypertension, low cholesterol of high density lipoprotein [Simmons et al., 2016; Prasad, 2004]. The most widespread and commonplace is the point of view regarding the leading role of insulin resistance, as a mechanism that triggers the entire cascade of metabolic-interrelated MS violations [The metabolic syndrome]. Therefore, the search for therapeutic possibilities for the restoration of impaired target-cell sensitivity to insulin action remains the most promising in the prevention and treatment of MS complications [Ford, 214; Kolodenko, 2016]. In this connection, should be indicated the possibility and efficiency of regenerative medicine, in particular the use of non-medicated means of correction of the components of the MS with the help of natural therapeutic resources, which include mineral water (MW) [Dragomiretska et al., 2015; Antonyuk et al., 2016].

METHODS

To investigate the effect of MW "Lotus 77" on its internal application on the metabolic rate of white rats with metabolic syndrome. The experiment was conducted on 40 white male rats of the Vistar line of outbred breeding, obtained from the private enterprise “Biomodelservice”, Kyiv, Ukraine. Experimental studies were conducted in accordance with the rules established by the Directive of the European Parliament and the Council (2010/63 / EU), by the order of the Ministry of Education and Science, Youth and Sports of Ukraine No. 249 of March 1, 2012 "On Approval of the Procedure for conducting scientific experiments, experiments on animals by scientific institutions" and methodical recommendations [Kozhemyakin, 2017].

During the experiment, the animals were in the experimental biological clinic (vivarium) of the UkrRIMRKB Ministry of Health of Ukraine in the conditions of free access to food and water. The animals were kept in standard laboratory conditions: photoperiod - light / darkness 12:12; air temperature - 20 ± 2 ° C; Humidity - 55 ± 10%. The rats were kept (contained) in cages of food plastic (400 × 550 × 250 mm) with soft wood chips as bedding. The experiment lasted 72 days. At the beginning of the experiment, the weight of the animals was 230,0 – 250,0 g.

The animals were divided into three groups

- I group - 16 intact rats (control);
- II group - 12 rats, in which the model of the metabolic syndrome was recreated;
- III group - 12 rats, which, on the background of development of metabolic syndrome (from 60 to 72 days of experiment), conducted water loading by packed and degassed MW "Lotus". MW was injected into the animal's esophagus with a soft probe with olive, once a day for 12 consecutive days, at a dose of 1% of the body weight of the animal, in the evening (approximately at 17.00), taking into account the features of the daily biorhythm of the rats. A number of experimental models of the MS have been known [14], but we have selected and modified the model without the use of excessive vegetable or animal fats in the diet, as well as the use of less fructose concentrations than in conventional models (20 or 30% solution of fructose). For reproduction of the MS model, the animals were kept for 60 days (8 weeks) in a standard diet (full fodder, grain, vegetables), but the rats additionally received 30 g of white bread per animal and consumed only 10% fructose solution in distilled water (as a drinking liquid) in the mode of free access to drinking water.

Table 1. Dynamics of changes in animal weight and fluid intake of rats with the MS model and rats with MS which received MW

Indicators	I Control group	II Group with Model of MS	III Group with Model of MS And the MW course
Body weight, g	100	114*	106
Consumption of 10% solution of fructose, ml	—	200*	130*
The amount of food consumed bread white bread crackers, g	100	190*	120*
Mixed feed, g	100	60*	90*
Vegetable blend, g	100	90	115*

1. 100% of the data received from the control group of animals;
2. * - significant changes in relation to control ($p < 0,05$).

Table 2. Biochemical indices in rats with a model of MS and rats with a model of MS and a course of MW, (M ± m)

Blood Indicators	I group	II group		III group	
	$(M_1 \pm m_1)$	$(M_2 \pm m_2)$	p_1	$(M_3 \pm m_3)$	p_2
Glucose, mmol/l	5,11 ± 0,22	8,06 ± 0,33	< 0,01	6,16 ± 0,13	< 0,05
Cholesterol, mmol/l	1,63 ± 0,10	2,15 ± 0,11	< 0,01	1,61 ± 0,06	> 0,5
Triglycerides, mmol/l	1,10 ± 0,06	2,80 ± 0,27	< 0,01	3,08 ± 0,32	< 0,01
MSM_{254}, c.u.	0,34 ± 0,02	0,30 ± 0,01	> 0,5	0,30 ± 0,01	> 0,5
MSM_{280}, c.u..	0,22 ± 0,01	0,31 ± 0,01	< 0,01	0,30 ± 0,01	> 0,5
Creatinine, mkmol/l	47,80 ± 0,63	59,04 ± 1,78	< 0,05	67,97 ± 1,71	< 0,01
Urea, mmol/l	2,80 ± 0,27	3,71 ± 0,21	< 0,05	6,76 ± 0,39	< 0,01
Uric acid, mkmol/l	292,52 ± 6,87	486,17 ± 15,32	< 0,01	260,27 ± 21,71	> 0,5

Notes:
1. P - significant changes relative to control ($p < 0,05$);
2. P_1 - calculated between the indices of the II and the I group;
3. P_2 - calculated between the indices of the III and the I group.

By biochemical methods in blood serum were determined glucose, cholesterol, triglycerides and markers of endogenous intoxication - MSM_{254} and MSM_{280}, creatinine, urea and uric acid. Determination of glucose concentration in blood was carried out by glucose oxidant method [15]. The methodical techniques and techniques used in the research were published in the manual and approved by the order of the Ministry of Health of Ukraine No. 692 of 09/28/2009 [16]. The obtained data were compared with similar indices of intact rats (control group). The statistical processing of the data obtained in the series of experiments was carried out by the method of indirect differences, while the reliable shifts were those that were within the probabilities according to the Student tables P <0,05 [17]. During the experiment, each day, we recorded the weight of animals, the amount of fructose and water consumed and the amount of food consumed. The study used mineral water refers to the high content of organic matter (0,009 - 0,017 mg / dm^3), weakly mineralization (total mineralization is 0,82-0,017 g/dm3) hydrocarbonate-magnesium-sodium MW. Well relates to the display of Romanov Zbruchanske deposit MW and located in the National Park "Podolski Tovtry", 200 meters from the r. Zbruch.

The formula of the chemical composition of water

$$\text{C org. } 0{,}009 — 0{,}017 \quad M_{0{,}82 — 0{,}84} \frac{HCO_3 71 - 72SO_4 13 - 17Cl 13 - 16}{(Na + K)63 - 66Mg 20 - 21Ca 14 - 16}$$

Analysis

Table 1 shows data on the dynamics of changes in physiological parameters of animals with MS and animals, which was received by the MW on the background of pathology development. The weight of animals with MS significantly increased by 14% (<0.01), and under the influence of CF, decreased by 8% and did not differ from controls (p> 0.5). The amount of consumed white breads (sources of carbohydrates) in animals of group II increased by 90%, and the amount of mixed fodder, on the contrary, decreased by 40% against the background of appetite deterioration.

Animals of the III group under the influence of MW had positive changes - the appetite of animals revived: the consumption of white bread decreased by 70%, and the use of mixed fodder and a mixture of vegetables increased by 30 and 15% compared with the indicators of the II group. The consumption of fructose solution in animals against the backdrop of MS development exceeded the control data by 100% (animals consumed almost 50 ml of fructose solution per day, and probably thirst), while in the group of rats with MS , which received dosed MW, the consumption of fructose solution decreased by 50%. It should be emphasized that the animals of the II group on the 72nd day of the experiment had a slippery appearance, the furs were dull and liquid. The animals looked stagnant, lethargic and tired, but during manipulations (drinking MB, etc.) they behaved confusedly - were frightened and annoyed, drawing attention to frequent urination. There is a significant decrease in glucose ($p < 0,05$), but its level still exceeds the control by 1 mmol/l.

The content of cholesterol, MSM_{280} and uric acid is completely restored ($p > 0,5$), but the content of triglycerides remains at the level of the rats with a pathological model, and the content of creatinine and urea exceeds the corresponding indices of rats with MS by 18 and 80% ($p < 0,01$). Animals of group III, which received MW, at the end of the experiment did not look restrained and tired, frustration and frequent urination disappeared.

In rats with MS (Group II), a significant increase content of glucose in the blood was 3 mmol / l (58%) $p < 0,01$, an increase of the content of cholesterol and triglycerides by 32 and 154% respectively at $p < 0,01$ (Table. 2). Also, the content of markers of endogenous intoxication - MSM_{280} increased by 41% ($p < 0,01$), creatinine and urea by 23% ($p < 0,01$) in the blood. The uric acid content increased by 66% compared with the control group ($p < 0,01$). The internal dosage introduction of MW to experimental animals with the MS model facilitated the partial normalization of disturbed metabolic parameters.

Conclusion

Thus, the use of MW with increased content of organic substances on the background of development of MS significantly reduces the level of glucose, completely restores the content of cholesterol and uric acid ($p > 0,5$), which indicates the effect of the organic matter of this MW on the restoration of lipid management and to a lesser extent Carbohydrate metabolism. It should be noted that the metabolic syndrome is a serious and long-lasting pathology, its development causes severe complications in the organism, the corrective effect of MW with increased content of organic substances on separate parts of pathogenesis is established, although it is not carried out completely, but is stable.

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