

HEPATOPROTECTIVE EFFECT OF PREPARATIONS PRODUCED FROM *CHLOROPHYTUM COMOSUM* (L.) AT EXPERIMENTAL TOXIC DAMAGE IN WISTAR RATS

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Abstract

Researches of age-dependent changes of liver functions and their correction with the use of various biologically active substances are an important issue of modern biomedicine. Investigation of the influence of the enzymatic hydrolyzate and DMSO extract of *Chlorophytum comosum* (L.) on the liver of rats at the age of 18 months at its experimental toxic damage showed that the substrate has expressed a pronounced hepatoprotective effect. Under its influence morphological changes in the rat liver induced by CCl₄ are much less pronounced than in the controls. There are also less significant deviations from normal levels of Alanine transaminase (ALT), Alanine transaminase (AST) and Total Bilirubin in blood plasma. Information analysis of the state of the organ indicates that the level of adaptation and regeneration opportunities of the liver of rats treated with an enzymatic hydrolyzate of *Chlorophytum comosum* (L.) is significantly higher than at the liver of rats with experimental toxic liver damage without the use of studied substrate. Histopathological analysis confirmed the alleviation of liver damage in connection with use of enzymatic hydrolyzate of *Chlorophytum comosum* (L.)

Keywords: Liver, Hydrolyzate, DMSO extract, Hepatotoxicity, Hepatocyte, *Chlorophytum comosum* (L.).

Introduction

Liver disease is one of the most pressing public health problems around the world, because the liver is one of the central organs to ensure homeostasis. Hepatic injury is associated with distortion of various metabolic functions [1-4]. Researches of age-dependent changes of liver functions and their correction with the use of various biologically active substances are an important issue of modern biomedicine. Aging of liver is characterized by alterations of liver biology and by a reduction of many functions which are important for the maintenance of body homeostasis. The main dysfunctions include appearance of enlarged hepatocytes, violation of liver regeneration, development of hepatic steatosis, alterations in the hepatic sinusoid [5-10]. The elderly are predisposed to a variety of diseases, which contribute to a marked increase in morbidity in this subpopulation. The incidence of liver disease increases in the elderly, but the cellular and subcellular perturbations that underlie this suspected predisposition to pathology remain unresolved. Several age-related changes have been documented, including a decline of liver volume, an increase in the hepatic dense body compartment (lipofuscin), moderate declines in the Phase I metabolism of certain drugs, shifts in the expression of a variety of proteins and diminished hepatobiliary functions [11]. In modern scientific literature there are few reports about the healing properties of the plant *Chlorophytum comosum* (L.). It is shown that the leaves of this plant have a high sorption characteristics with respect to formaldehyde, carbonmonoxide, benzene, trichloroethylene, phenols and other compounds [12,13]. Dimethylsulphoxide [(CH₃)₂S; DMSO] is the organic aprotic solvent which is widely used for dissolution of small hydrophobic molecules of medicines at the expense of its amphipathic nature. [14]. This solvent possessing amphiphilic properties [15], is successfully used for extraction of photosynthesizing components from tissues of the higher plants [16,17]. Use of DMSO has advantages in comparison with other solvent extraction agents (methanol, ethanol and acetone). Extraction with DMSO due to its diffuseness doesn't demand grinding of substrate and centrifugation that allows to analyze a large number of samples in rather short terms [18]. Stability of DMSO-extracts of photosynthesizing components is above than stability of acetone extracts [19]. DMSO is an intracellular cryoprotectant and is used at sublimation dehydration.

Use of DMSO at production of lyophilic plant extracts allow to keep cells and organelles without changes and, as a result, to preserve properties of the proteins and other biologically active agents which are not steady against action of low temperatures.

DMSO easily permeates through skin integuments and mucous membranes of humans and animals, providing the strengthened delivery of many chemicals through biological membranes that can influence ionic balance in an organism [20]. Basing on the assumption that preparations made of *Chlorophytum comosum* contain a certain set of biological active agents, studying of potential hepatoprotective properties of these preparations at experimental toxic injury of a liver seems important. To test the hypothesis about the effectiveness of biostimulation, we carried out a study which purpose was to examine the severity of liver damage while taking CCl₄, enzymatic hydrolyzate of *Chlorophytum comosum* (L.) and DMSO extract of *Chlorophytum comosum* (L.).

Materials and methods

Collecting of Plant Material

The fresh aerial parts of the *Chlorophytum comosum* (L.) plant were collected in Moscow State regional university botanical garden. The collected plant samples were washed thoroughly with running tap water and were used to prepare an enzymatic hydrolyzate and DMSO extract.

Preparation of Enzymatic Hydrolyzate

The starting substance in an amount of 0,333 kg was washed thoroughly under running tap water (previously placing in gauze). The washed raw material was placed in a glass container with 1.0 liter (1:3) of tap water heated to a temperature of (45 ±1)°C. Na₂CO₃ was added to the mixture to pH 8,2-8,3 (pH was defined with phenolphthalein). Then were added 0.15 kg of crushed pancreas of cattle. Then container was tightly covered by cotton-gauze pad with parchment and placed in a thermostat at (45 ±1)°C. Kept for 10 days, shaking during the first day every 15 minutes to 5 minutes, and in the following days every two hours to 5 minutes. The dynamics of the enzymatic process was defined on the increase of the content of amino nitrogen. At the ninth or tenth day increase stops and hydrolyzate is left for the night in the switched-off thermostat. Then the hydrolyzate was filtered through a filter paper. In the filtrate was added chloroform in the ratio 2% to the total amount, the substance was placed in a glass flask with the rubber stopper and was stored at a temperature from 2 to 8°C.

By chemical analysis of the enzymatic hydrolyzate of *Chlorophytum comosum* (L.) in its composition was found DL-ornithine monohydrochloride, having desintoxication and hepatoprotective action [21-26].

Preparation of DMSO extract.

Plants for research were grown at botanical garden of Moscow State regional university. For preparation of extract the clean intact leaves and shoots of a plant were selected. Leaves and shoots of a plant were packed into a plastic bag and placed in the refrigerator at a temperature of 2-8° for 10 days (according to technology of producing of biogenous stimulators in conditions of low temperature and darkness). Then the plant materials were washed out under flowing water, processed with ultraviolet irradiation within 30 minutes at distance 0,5 meters and grinded. The grinded plant material was placed in the low-temperature refrigerator at a temperature minus 40°C for 24 hours. Further material was subjected to a liofilization at a sublimator temperature making minus 45-50°C and at pressure of 60 Pa within 20 hours. Humidity of the produced sublimate made 4%. Further 10 g of the sublimate were weighed out on electronic scales and filled in 500 ml of pure DMSO at careful stirring. The produced mixture was exposed to autoclaving at 121°C within 30 min. The mixture after autoclaving was placed in a shaker thermostat for stirring at 50°C within 24 hours. The produced substratum was filtered through the wadding-gauze filter, diluted with the distilled water in the ratio 1:10 and homogenized fourfold with use of a high-pressure homogenizer at 1000 bar. Produced homogenate was subjected to an ultramicrofiltration through the Vivaflow 50 module (membrane material – polyethersulfone (PES), the pore size 0,2 microns) then was exposed to a fivefold tindalization on a heating bath at the 50° C. The preparation is checked for sterility by the standard methods.

Animals

Male Wistar Albino rats of body weights ranging from 200 to 220 g were used in the study. Age of the animals was 18 months old. The animals were fed with standard pellet diet and water ad libitum. They were maintained in controlled environment (12:12 h light/dark cycle) and temperature (30±2°C). All the animal experiments were performed according to the compliance with the EC Directive 86/609/EEC and with the Russian law regulating experiments on animals.

Toxity Studies

Based on previous studies [21,22] the doses of enzymatic hydrolyzate and DMSO extract of *Chlorophytum comosum* (L.) at the concentration of 6 mg/kg.bw was chosen for the experiments.

Treatment Design

180 animals (Male Wistar Albino rats) were randomized and divided into six groups on 30 animals in each group. First group served as intact control. Animals in second group were inhaled by carbon tetrachloride to 2 min. per day for 6 days (control group).

1. Intact group
2. Control group
3. I group - enzymatic hydrolyzate of *Chlorophytum comosum* (L.)
4. II group - enzymatic hydrolyzate of *Chlorophytum comosum* (L.) + CCl₄
5. III group - DMSO extract of *Chlorophytum comosum* (L.)
6. IV group - DMSO extract of *Chlorophytum comosum* (L.) + CCl₄

Animals of I group were treated by drinking with drinking of enzymatic hydrolyzate of *Chlorophytum comosum* (L.) at the concentration of 6 mg/kg.bw, animals of III group received with drinking DMSO extract of *Chlorophytum comosum* (L.) at the same concentration. Rats in II group and IV group were inhaled with carbon tetrachloride to 2 min a day for 6 days, but at the same time were treated with drinking of enzymatic hydrolyzate of *Chlorophytum comosum* (L.) and DMSO extract of *Chlorophytum comosum* (L.) accordingly at the concentration of 6 mg/kg.bw.

Selection of carbon tetrachloride (CCl₄) as an agent acting on the liver is caused by the fact that this substance is a direct liver poison, widely used in experimental medicine and biology. Selecting of the liver-toxic and exposure method is determined by the fact that the use of carbon tetrachloride under this scheme provides the appearance and development of reversible changes in liver at tissue and organ level. Selection of carbon tetrachloride as an hepatotoxic agent is caused by the fact that this substance is a direct liver poison, widely used in experimental medicine and biology. Selecting of the liver-toxic and exposure method is determined by the fact that the use of carbon tetrachloride under this scheme provides the appearance and development of reversible changes in liver at tissue and organ level. Carbon tetrachloride (CCl₄), or tetrachloromethane, is toxic substance traditionally used as a model to study hepatotoxic effects.

This halogenated alkane causes toxic damage of liver through a number of mechanisms. First of all, CCl_4 can induce liver damage through the formation of reactive free radicals that can bind covalently to cellular macromolecules (nucleic acids, proteins, lipids), initiating lipid peroxidation, forming nucleic acid, protein and lipid adducts and impairing critical cellular processes, including lipid metabolism, potentially leading to fatty degeneration (steatosis). CCl_4 can also affect hepatocellular calcium homeostasis that results in the loss of cellular calcium sequestration. The induction of hypomethylated ribosomal RNA caused by use of carbon tetrachloride results in inhibition of protein synthesis in hepatocytes. As a whole, treatment with carbon tetrachloride can result in centrilobular steatosis, inflammation, cancer initiation, apoptosis and necrosis. If the volume of tissue damage exceeds the repair capacity of the liver, the organ will progress to fibrosis and cirrhosis [27-30].

Assessment of Hepatoprotective Activity Biochemical Examinations

For the 7th day of experiment, blood samples were collected by direct cardiac puncture using light ether anesthesia. Blood was separated by centrifuging at 2500 rpm for 20 min and used for analysis of AST, ALT, Total Bilirubin and Total protein by means of the biochemical StatFax3300 analyzer (USA) with sets of Spinreact firm (Spain).

Histopathological Analysis

A small portion of liver was taken and fixed in to 10% formaldehyde. After several treatments for dehydration in alcohol, sections having 5 μm thickness were cut and stained with hematoxylin and eosin and histopathological analysis was carried. To detect apoptotic cells semi-thin sections (3 μm) were stained with methylene blue-azure II with afterstain by fuchsin. All stained sections were embedded in balsam.

Determination of Mitotic, Apoptotic and Necrotic Index

At hematoxylin and eosin stained sections were determined mitotic and necrotic cells. At sections stained by methylene blue-azure II with afterstain by fuchsin were determined apoptotic cells. Visualization was performed using a microscope Nikon 500L at 900 \times magnification. Studied was made for 5 fields of view on each section.

Apoptotic index was calculated by the formula [31]:

$$AI = N_a / N,$$

where N_a - the number of apoptotic cells; N - total number of cells in the test population.

The mitotic index was calculated by the formula:

$$MI = N_m / N,$$

where N_m - number of mitosis; N - total number of cells in the test population.

Necrotizing index calculated by the formula:

$$NI = N_n / N,$$

where N_n - of necrotic cells; N - total number of cells in the test population.

Morphometric Studies

Volume of the nuclei of hepatocytes was measured by image analyzer "Videotest" at hematoxylin and eosin stained sections.

Weight Measurements

All rats were weighed in grams. Weighing was made at the beginning and at the end of research in each group. At the end of experiment it was measured absolute (in grams) and relative mass of a liver of rats.

Studies of the Information Condition of the System of the Liver

We carried out a breakdown of the aggregate of the measured volumes of hepatocyte nuclei into classes. Based on the concept of information in a tissue system as the displaying of the diversity of morphology and function of the process for assessing the information status of organs and tissues have been proposed and tested the such indicators - information morphological capacity (H_{\max}), information morphological entropy (H), information morphological organization (S), the relative morphological entropy (h) and redundancy (R) [32,33]. In this case, the baseline characteristics, which were used to calculate these parameters, can vary widely (the linear dimensions of the structures, their number, etc.). In our study was defined the volume of the nuclei of hepatocytes.

Information morphological capacity H_{\max} , which means the maximum structural diversity, calculated

by formula [32,33]:

$$H_{\max} = \log_2 n,$$

where n - number of classes.

Next, we made the calculation of the real structural diversity H. Real structural diversity is the parameter that clearly illustrates the degree of determinism of morphofunctional system in time and space [31,32]. The calculation was made using the formula:

$$H = -\sum P_i \log_2 P_i,$$

where $\sum P_i$ is the sum of probabilities of stay of the measured parameter of cells in a one of existing classes; $\log_2 P_i$ - logarithm of the probability of staying in one of the possible classes. In this case, the value of P_i is defined as the classical probability [32,33].

Knowing the maximum and actual structural diversity, we can calculate the organization of the system (S), the difference between the maximum possible and the real structural diversity (implemented structural diversity). This parameter, in our opinion, displays the state of the system adaptability to date. To determine the value of this parameter is used the formula [32,33]:

$$S = H_{\max} - H.$$

It is necessary to consider that when $H = H_{\max}$, the system is deterministic, but such relation to the vast majority of permissible is possible only in theory.

Then we determined the coefficient of relative entropy of the system, or (the coefficient of compression of information) h by formula [32,33]:

$$h = H/H_{\max}.$$

High levels of relative morphological entropy provide evidence of the disorder of the system and significantly reducing of its structural integrity [32,33].

The coefficient of the relative organization of the system (redundancy factor) R is given by [5]:

$$R = (S/H_{\max}) \times 100\%.$$

With these data, the researcher has the opportunity to calculate the equivocation of the system (the value of reliability) e [32,33]:

$$e = (H_p - H_n)/H_{\max},$$

where H_n - real structural diversity in normal, H_p - real structural diversity in pathology.

Statistical Analysis

Values are expressed as mean (\pm SD). The statistical analysis was performed using one-way analysis of variance (ANOVA). The statistical difference determined using repeated measures analysis of variance or paired Student t-tests. A p value of < 0.05 was considered statistically significant.

Results

Effect on body and liver mass

By results of the conducted research it is revealed that experimental toxic injury of a liver leads to decrease in body weight in control group of animals in comparison with intact rats. At the same time these animals have an increase in both absolute and relative mass of a liver. Reliable differences from parameters of intact animals aren't revealed in both experimental groups. At the same time, the body weight of animal of all these groups was higher, than in control, and the absolute and relative mass of a liver, conversely, is significantly lower, than in control. At the same time, differences between the studied parameters of I and II groups, and also between parameters of III and IV of group aren't revealed (Table 1).

Effects of Enzymatic Hydrolyzate of *Chlorophytum comosum* (L.) and DMSO extract of *Chlorophytum comosum* on Histopathology

The histologic pattern of a liver of rats from group of intact control complies to age norm. In a liver of the rats treated with enzymatic hydrolyzate and DMSO-extract of *Chlorophytum comosum* (L.) the pathomorphological analysis did not reveal any abnormalities. At the pathomorphological examination of the liver of rats exposed to carbon tetrachloride was found that organs of animals were red, sometimes with yellow or gray tint. About 29% of rat liver was spotty. The organs were loose, easily torn, the cut oozing blood. The histological study noted a pronounced discomplexation of hepatic beams. Hepatocytes were swollen and their cytoplasm was cloudy, the boundaries of the cells were not clear; the nuclei were also swollen, bright, with blurred outlines. In hepatocytes clearly observed clear vacuoles. In rat liver hepatocytes detached state granular dystrophy. The vessels of the liver in different parts of the cut were unevenly expanded and filled with blood, in the field

of triads were observed the signs of mild perivascular mesenchymal reaction. In a number of cases were observed the connective tissue layers, thickened and infiltrated by small cells, significant in the field of triads. Blood vessels (central vein capillaries) of liver are extended (hyperemia of blood vessels), the permeability of the walls of vessels for the blood cells was increased, the focal hemorrhage was observed. Among the cells is observed a large number of white blood cells and macrophages.

In hepatocytes there were large number of vacuoles, including lipid ones. Some cells were very large and in fact represented a continuum vacuole. In 85% of cases multiple foci of necrosis in different sizes were showed, in which the structural elements of the individual cells were not rendered, and the liver tissue represented a homogeneous unstructured mass. In 48% of cases extensive necroses were noted. The observed changes indicate the development of typical toxic liver disease at animal. However, at some rats were established characteristic of the micro-focal alterative inflammation.

A significant proportion of rats had typical signs of acute toxic hepatitis with high intensity of tissue damage (alterative hepatitis). Some animals had severe steatosis with defined necrotic component. At the use of the hydrolyzate of *Chlorophytum comosum* (L.) with the simultaneous inhalation by CCl_4 , pathological changes in the liver were much less severe. Thus, in the liver of all animals remain beams and lobular structure. In this case, a few pockets of malnutrition alternate with areas represented with dual-core and intact hepatocytes (signs of recovery) or hepatocytes in a condition of the initial stage of granular dystrophy, fatty degeneration occurs in 19%. Also, there were observed substantially less hepatocytes in a condition of a necrosis. It was noted the absence of focal hemorrhages, capillaries were moderately bloodshot, and there were no signs of swelling, and the permeability of vessels, which were registered in the group without the use of the hydrolyzate, reduced in group treated with enzymatic hydrolyzate. Vessels in the triads were moderately dilated. In this case, 28% of hepatocytes have small vacuoles. The similar picture was observed also in the liver of rats treated with DMSO extract of *Chlorophytum comosum* (L.) along with CCl_4 inhalation. Adipose degeneration in this case was observed in 22% of hepatocytes, and vacuolization – in 34%.

Effects of Enzymatic Hydrolyzate and DMSO extract of *Chlorophytum comosum* (L.) on MI, AI and NI

For the liver of intact rats we found the MI equal to $6.56 \pm 0.20\%$, AI – $1.72 \pm 0.09\%$, and NI was $0.41 \pm 0.05\%$. The value of MI in the liver of animals of the control group was $2.41 \pm 0.34\%$, AI – $0.70 \pm 0.09\%$, NI – $16.48 \pm 1.25\%$. In a liver of rats of the I group MI makes $7.0 \pm 0.33\%$, AI is equal to $1.52 \pm 0.11\%$, necrotic index makes $0.33 \pm 0.08\%$. At organs of animals of the III group MI was $6.89 \pm 0.34\%$, AI – $1.60 \pm 0.11\%$, NI made $0.39 \pm 0.06\%$. The described indexes of these groups of animals don't differ reliably from values of intact animals. Application of enzymatic hydrolyzate of *Chlorophytum comosum* (L.) at experimental toxic injury of the liver leads to the MI of $4.58 \pm 0.20\%$, AI – $2.45 \pm 0.17\%$, NI – $3.75 \pm 0.17\%$. Use of DMSO extract of *Chlorophytum comosum* (L.) at the same conditions leads to increase of MI up to $7.55 \pm 0.54\%$, AI makes $2.09 \pm 0.20\%$, and % NI makes 1.04 ± 0.13 .

Effects of Enzymatic Hydrolyzate and DMSO extract of *Chlorophytum Comosum* (L.) on AST, ALT, Total Bilirubin, Total Protein and Albumin Levels

Level of the studied metabolites in blood serum of intact animals complies to age norm. At rats of control group under the influence of CCl_4 the changes characteristic of acute toxic damage of a liver are noted. In particular, there is an essential increase of the AST and ALT levels, contents of other studied metabolites also considerably increases.

Biochemical parameters of blood serum of the animals treated with enzymatic hydrolyzate and DMSO-extract don't differ from parameters of intact rats. At the same time, in blood serum of animals of II and IV groups the studied parameters are slightly higher, than at intact rats, and also than at animal of I and III groups, but there are significantly lower, than in control.

Effect on Informational condition

At the analysis of the studied information parameters it is established that under the influence of CCl_4 in a liver of rats there is an increase in values of parameters H and h and, respectively, decrease in the values of S and R. As the arisen condition of a liver isn't norm, value of parameter e is also defined (Table 3). At the same time the information parameters characterizing a liver of rats of I and III groups don't differ from parameters of intact animals. Changes of the studied information parameters in a liver of rats of II and IV groups develop in the same direction, as parameters of control group, but differences from age norm are significantly less expressed.

The studied information parameters characterizing a liver of animals of the II and IV experimental group don't differ from parameters of intact animals, except for parameter e . In the analysis of parameters of these groups it is revealed that H and h increase in comparison with intact control, and S and R, on the contrary, decrease.

Discussion

The conducted research demonstrates that use of biologically active substances produced by processing of *Chlorophytum comosum* (L.) was effective on inhibiting the hepatotoxicity induced by CCl_4 in vivo models, most likely because of content of DL - ornithine monohydrochloride or specific constituents present in the studied preparations.

As a result of research it is established that the studied substances don't change a morphofunctional condition of a liver of intact animals. At the same time, changes of the information state serving as the indicator of level of adaptation and regenerator reserves of organ demonstrate their increase. Studies suggest that enzymatic hydrolyzate and DMSO extract of *Chlorophytum comosum* (L.) has significant hepatoprotective properties, reduces the intensity of the inflammatory process. Hydrolyzate and extract have pronounced positive effect on liver regeneration, as evidenced by differences in the mitotic, necrotic, apoptotic indexes and the proliferation rate in the experimental groups. The liver of rats treated with preparations of *Chlorophytum comosum* (L.) at toxic damage, based on analysis of the information state of organ, is characterized by a higher level of adaptation and regenerative capacity than the liver of rats of the first experimental group. The study showed that in contrast to the results obtained under analogous conditions on young rats, studied parameters of liver of rats after applying the enzymatic hydrolyzate and DMSO extract of *Chlorophytum comosum* (L.) though differ significantly from the indices of the control group of rats, as well is significantly different from the indices in intact animals. We planned to identify more precisely the main components responsible for hepatoprotective activity and to reveal the molecular mechanism of its therapeutic action.

Acknowledgements

Financial support of research was carried out by Moscow State Regional University and by the Ministry of Education and Science of the Russian Federation, within performance of a basic unit of

the state task (2014/2016). The study was conducted under Task number 2014/2016 on the implementation of public works in the field of scientific activities of the base portion of the state task of the Ministry of Education and Science of the Russian Federation.

Conflict of interest

The authors declare that there is no conflict of interests regarding the publication of this paper.

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Table 1. Effect of enzymatic hydrolyzate and DMSO extract of *Chlorophytum comosum* (L.) on weight parameters of rats.

Groups	Body weight, g	Absolute mass of liver, g	Relative mass of liver, %
Intact control group, (n=30)	205.28±7.15	7.94±0.32	3.87±0.30
Control group, (n=30)	178.52±9.90**	10.57±0.51**	5.91±0.41**
I group, (n=30)	207.60±8.40▲	7.78±0.41▲	3.73±0.32▲
II group, (n=30)	201.67±6.88▲	8.44±0.35▲	4.19±0.44▲
III group, (n=30)	210.48±7.41▲	7.90±0.52▲	3.76±0.31▲
IV group, (n=30)	202.71±8.31▲	8.61±0.29▲	4.25±0.27▲

Hereinafter: Intact control group – intact animals; Control group – animals subjected to inhalation with CCl_4 ; I group – animals, treated with drinking with enzymatic hydrolyzate of *Chlorophytum comosum* (L.), II group – animals, subjected to inhalation with CCl_4 and at the same time treated with enzymatic hydrolyzate of *Chlorophytum comosum* (L.), III group – animals, treated with drinking with DMSO extract of *Chlorophytum comosum* (L.); IV- XX animals, subjected to inhalation with CCl_4 and at the same time treated with DMSO of *Chlorophytum comosum* (L.)

* $P \leq 0,05$ – in comparison with intact control, ▲ $P \leq 0,05$ – differences from control, ● - $P \leq 0,05$ – differences of parameters of the II group from the I group; ○ - differences of parameters of the IV group from the III group.

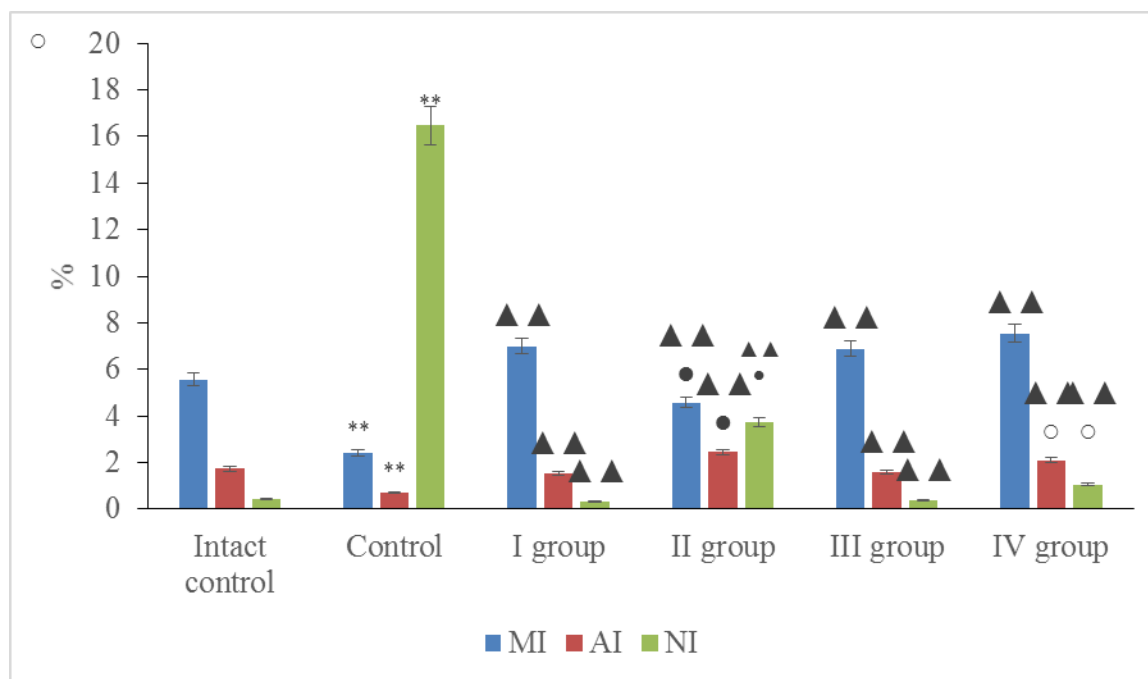


Figure 1. Effect of enzymatic hydrolyzate and DMSO extract of *Chlorophytum comosum* (L.) on AI, MI, NI of liver of rats.

Table 2. Effect of enzymatic hydrolyzate and DMSO extract of *Chlorophytum comosum* (L.) on biochemical parameters of blood serum.

Groups	AST, u/l	ALT, u/l	Total bilirubin, g/l	Total protein, g/l	Albumin, g/l
Intact control group, (n=30)	163.80±12.62	132.83±8.67	1.32±0.10	80.61±3.88	34.47±1.61
Control group, (n=30)	329.08±18.50**	504.20±48.55**	1.92±0.18*	93.48±5.71	28.15±2.22*
I group, (n=30)	148.27±10.94 ▲	148.11±10.58 ▲	1.43±0.12 ▲	82.70±4.08 ▲	33.92±2.0 ▲
II group, (n=30)	191.24±19.58 ▲	164.90±14.58 ▲	1.48±0.16 ▲	84.66±4.90 ▲	32.61±2.85 ▲
III group (n=30)	151.31±11.2 ▲	138.10±9.40 ▲	1.38±0.20 ▲	84.0±5.11 ▲	32.82±2.77 ▲
IV group (n=30)	185.55±15.12 ▲	151.31±10.59 ▲	1.46±0.21 ▲	86.38±5.19 ▲	32.92±3.72

Table 3. Informational parameters of liver of rats at an assessment of biological activity of enzymatic hydrolyzate and DMSO extract of *Chlorophytum comosum* (L.).

Group	H _{max} (bit)	H (bit)	S (bit)
Intact control group, (n=30)	3.32±0.002	2.52±0.023	0.8018±0.023
Control group, (n=30)	3.32±0.002	2.82±0.025*	0.50±0.025*
I group, (n=30)	3.32±0.002	2.55±0.020 ▲	0.77±0.20 ▲
II group, (n=30)	3.32±0.002	2.60±0.027* ▲	0.72±0.027* ▲
III group (n=30)	3.32±0.002	2.57±0.24 ▲	0.75±0.24 ▲
IV group (n=30)	3.32±0.002	2.62±0.19* ▲	0.70±0.19* ▲
	h (bit)	R (%)	e (bit)
Intact control group, (n=30)	0.7585±0.007	24.15±0.71	-
Control group, (n=30)	0.8494±0.012*	15.06±1.20*	0.302±0.026*
I group, (n=30)	0.7680±0.010 ▲	23.19±1.27 ▲	0.032±0.005 ▲
II group, (n=30)	0.7831±0.009* ▲	21.69±1.0* ▲	0.080±0.009* ▲
III group (n=30)	0.7740±0.011 ▲	22.59±1.54 ▲	0.050±0.004 ▲
IV group (n=30)	0.7891±0.009* ▲	21.08±1.66* ▲	0.090±0.005* ▲