Received: 21 July 2023 / Accepted: 08 December 2023 / Published online: 28 December 2023

DOI 10.34689/SH.2023.25.6.016

UDC 632.938:613.2

INFLUENCE OF THE COMPOSITION OF "VOLCANO MINERAL" PLANT AND ANIMAL RAW MATERIALS ON HUMORAL AND CELLULAR STRUCTURE OF THE IMMUNE SYSTEM

Zhanna U. Kozykenova[1], Aisulu E. Zhumabayeva[2], Askar A. Abenov[3], Asemgul O. Izgutenova[4], Nazgul A. Zhorgatayeva[4], Vladlena R. Sabitova[5], Aigerim M. Shapikhanova[6], Bakhytbek A. Apsalikov[3], Gulsym K. Koshpessova[4], Meruyert R. Massabayeva[4]

NCJSC «Semey Medical University», Semey, Republic of Kazakhstan.
[1] Department of Physiological Disciplines named after T.A. Nazarova;
[2] Fourth-year student, Faculty of General Medicine; [3] Department of General Medical Practice;
[4] Central Scientific Research Laboratory; [5] Research Department;
[6] Epidemiology and Biostatistics Department.

Abstract

Objective. To study the influence of the composition of "Volcano mineral" plant and animal raw materials on the immune system of research animals

Materials and Methods: The study was conducted at the Center of the Research Laboratory of the NC JSC "SMU". To assess cellular and humoral immunity, research animals were divided into 4 groups of 10 rats in each group. During the experiment, rats were exposed to acute (7 days) and chronic (21 days) smoke exposure for 5 minutes with "Volcano-mineral" burning at a dose of 10 mg, 20 mg, and 30 mg.

Results: exposure to plant and animal raw materials known as "Volcano mineral" was shown to cause both acute and chronic increases in the quantity of circulating immune complexes. T-lymphocytes and T-suppressors were increased at acute and decreased at chronic exposure to the "Volcano-mineral" substance at a dose of 10 mg. There was observed a decrease in phagocytic activity during exposure to "Volcano-mineral" in doses of 20 and 30 mg, an increase in the indicators of T-helper in the dose of 20 mg, leukocytes and B-lymphocytes in the dose of 30 mg. A significant increase in the level of immunoglobulin A was found in acute and chronic exposure to "Volcano-mineral" at a dose of 20 mg and an increase in acute exposure at a dose of 30 mg. At chronic exposure to smoke from the "Volcano-mineral" substance at a dose of 30 mg a significant decrease in immunoglobulin G was observed.

Conclusion. Acute exposure to the "Volcano mineral" substance's smoke causes a shift in the body's cellular immune response, which in turn causes a protective immunological response. Higher doses over time have been shown to have an immunosuppressive impact.

Key words: *volcano mineral, cellular and humoral immunity, research animals.*

Резюме

ВЛИЯНИЕ КОМПОЗИЦИИ ИЗ РАСТИТЕЛЬНОГО И ЖИВОТНОГО СЫРЬЯ «ВУЛКАН МИНЕРАЛ» НА ГУМОРАЛЬНУЮ И КЛЕТОЧНУЮ СТРУКТУРУ ИММУННОЙ СИСТЕМЫ

Жанна У. Козыкенова[1], Айсулу Е. Жумабаева[2], Аскар А. Абенов[3], Асемгуль О. Изгутенова [4], Назгуль А. Жоргатаева[4], Владлена Р. Сабитова[5], Айгерим М. Шапиханова [6], Бакытбек А. Апсаликов[3], Гульсым К. Кошпесова [4], Меруерт Р. Масабаева[4]

НАО «Медицинский университет Семей», г. Семей, Республика Казахстан.
[1] Кафедра физиологических дисциплин имени Т. А. Назаровой;
[2] 4 курс, факультет общая медицина; [3] Кафедра общей врачебной практики
[4] Центр научно-исследовательской лаборатории; [5] Научно-исследовательский отдел;
[6] Кафедра эпидемиологии и биостатистики.

Цель. Изучить влияние композиции из растительного и животного сырья Вулкан-минерал на иммунную систему у исследуемых животных.

Материалы методы: Исследование проводилось на базе центра научно-исследовательской лаборатории НАО «МУС». Для оценки клеточного и гуморального иммунитета экспериментальные животные были разделены на 4 группы по 10 крыс в каждой группе. Во время опыта крысы, подвергались острому (7 дней) и хроническому (21 день) воздействию дыма в течении 5 минут при сжигании вещества «Вулкан-минерал» в дозе 10 мг, 20 мг, и 30 мг.

Результаты: было установлено повышение уровня циркулирующих иммунных комплексов как при остром, так и при хроническом воздействии растительного и животного сырья «Вулкан-минерал». Т-лимфоциты и Т-супрессоры повышались при остром и снижались при хроническом воздействии вещества «Вулкан-минерал» в дозе 10 мг. Отмечено снижение фагоцитарной активности при воздействии Вулкан-минерала в дозах 20 и 30 мг, повышение показателей Т-хелпер в дозе 20 мг, лейкоцитов и В-лимфоцитов в дозе 30 мг. Обнаружено значительное повышение уровня иммуноглобулина А при остром и хроническом воздействии вещества «Вулкан минерал» в дозе 20 мг и повышение при остром воздействии в дозе 30 мг. При хроническом воздействии дыма от вещества «Вулкан минерал» в дозе 30 мг наблюдается значительное снижение иммуноглобулина G.

Вывод. Острое воздействие дыма вещества «Вулкан-минерал» запускает защитную иммунную реакцию организма, которая обуславливается изменением клеточного иммунного ответа. При хроническом воздействии более высоких доз наблюдается иммуносупрессивное действие.

Ключевые слова: *вулкан-минерал, клеточный и гуморальный иммунитет, экспериментальные животные.*

Түйіндеме

«ВУЛКАН МИНЕРАЛ» ӨСІМДІК ЖӘНЕ ЖАНУАР ТЕКТІ ШИКІЗАТТАР ҚҰРАМЫНЫҢ ИММУНДЫҚ ЖҮЙЕНІҢ ГУМОРАЛДЫҚ ЖӘНЕ ЖАСУШАЛЫҚ ҚҰРЫЛЫМЫНА ӘСЕРІ

Жанна У. Козыкенова[1], Айсулу Е. Жумабаева[2], Аскар А. Абенов[3], Асемгуль О. Изгутенова [4], Назгуль А. Жоргатаева[4], Владлена Р.Сабитова[5], Айгерим М. Шапиханова [6], Бакытбек А. Апсаликов[3], Гульсым К. Кошпесова [4], Меруерт Р. Масабаева[4]

«Семей медицина университеті» КеАҚ, Семей қ., Қазақстан Республикасы.
[1] Т.А. Назарова атындағы физиологиялық пәндер кафедрасы;
[2] 4 курс, жалпы медицина факультеті; [3] Жалпы дәрігерлік тәжірибе кафедрасы;
[4] Ғылыми-зерттеу зертханалық орталығы; [5] Ғылыми-зерттеу бөлімі;
[6] Эпидемиология және биостатистика кафедрасы.

Мақсаты. Зерттелетін жануарлардың иммундық жүйесіне Вулкан-минералды өсімдік және жануар шикізаты құрамының әсерін зерттеу.

Материалдар мен әдістер: Зерттеу «СМУ» КеАҚ ғылыми-зерттеу зертханасының орталығында жүргізілді. Жасушалық және гуморальдық иммунитетті бағалау үшін эксперименталды жануарларды әр топта 10 егеуқұйрықтан тұратын 4 топқа бөлді. Тәжірибе барысында егеуқұйрықтар 10 мг, 20 мг және 30 мг дозада «Вулкан-минерал» затын жағу кезінде 5 минут ішінде өткір (7 күн) және созылмалы (21 күн) түтіннің әсеріне ұшырады.

Нәтижелер: «Вулкан минерал» өсімдік және жануар текті шикізатының жедел және созылмалы әсерінен айналмалы иммундық кешен деңгейінің жоғарылауы анықталды. Т-лимфоциттер мен Т-супрессорлар 10 мг дозада «Вулкан-минерал» затының жедел әсер ету кезінде жоғарылады және созылмалы әсер ету кезінде азайды. Вулкан-минералды 20 және 30 мг дозада қолданғанда фагоцитарлық белсенділіктің төмендеуі, 20 мг дозада Т-хелпер жасушаларының, 30 мг дозада лейкоциттер мен В-лимфоциттердің жоғарылауы байқалды. Иммуноглобулин А деңгейінің айтарлықтай жоғарылауы «Вулкан минерал» затының 20 мг дозасында жедел және созылмалы әсер ету кезінде және 30 мг дозада жедел әсер ету кезінде анықталды. 30 мг дозада «Вулкан-минерал» затының түтінінің созылмалы әсерінен G иммуноглобулинінің айтарлықтай төмендеуі байқалады.

Қорытынды. «Вулкан минерал» затының түтінінің өткір әсері жасушалық иммундық жауаптың өзгеруіне байланысты ағзаның қорғаныш иммундық реакциясын тудырады. Жоғары дозалардың созылмалы әсерінен иммуносупрессиялық әсерлер байқалады.

Түйінді сөздер: *вулкан-минерал, жасушалық және гуморалдық иммунитет, тәжірибелік жануарлар.*

Bibliographic citation:

Kozykenova Zh.U., Zhumabayeva A.E., Abenov A.A., Izgutenova A.O., Zhorgatayeva N.A., Sabitova V.R., Shapikhanova A.M., Apsalikov B.A., Koshpessova G.K., Massabayeva M.R. Influence of the composition of “Volcano mineral” plant and animal raw materials on humoral and cellular structure of the immune system // *Nauka i Zdravookhranenie* [Science & Healthcare]. 2023, (Vol.25) 6, pp. 133-139. *doi 10.34689/SH.2023.25.6.016*

Козыкенова Ж.У., Жумабаева А.Е., Абенов А.А., Изгутенова А.О., Жоргатаева Н.А., Сабитова В.Р., Шапиханова А.М., Апсаликов Б.А., Кошпесова Г.К., Масабаева М.Р. Влияние композиции из растительного и животного сырья «Вулкан минерал» на гуморальную и клеточную структуру иммунной системы // Наука и Здравоохранение. 2023. 6(Т.25). С. 133-139. *doi 10.34689/SH.2023.25.6.016*

Козыкенова Ж.У., Жумабаева А.Е., Абенов А.А., Изгутенова А.О., Жоргатаева Н.А., Сабитова В.Р., Шапиханова А.М., Апсаликов Б.А., Кошпесова Г.К., Масабаева М.Р. «Вулкан минерал» өсімдік және жануар текті шикізаттар құрамының иммундық жүйенің гуморалдық және жасушалық құрылымына әсері // Ғылым және Денсаулық сақтау. 2023. 6 (Т.25). Б.133-139. *doi 10.34689/SH.2023.25.6.016*

Introduction

Since civilization has advanced, humans have had to deal with issues including stress, sadness, poor eating habits, and a variety of harmful influences. As a result, health issues like obesity, chronic illnesses, and disorders of the respiratory, cardiovascular, and neurological systems are not unusual. One of the promising directions of development of medicine of the future is the search for new methods of actualization of mechanisms of self-regulation of the organism, expansion of its functional capabilities. The use of aromatic substances as a non-medicamentous means of correction of disturbed physiological functions of the human body and increasing its functional capabilities is becoming more widespread. Plant aromatic substances have a positive effect on the cardiovascular system, reduce the risk of ischemic heart disease, heart rhythm disorders, and improve the supply of oxygen and glucose to the heart muscles [1,6,10].

Special attention was paid to the immunomodulatory and antioxidant properties of essential oils. Aromatoprophylaxis expands human adaptive capabilities [4], is one of the ways to improve health and increase the resistance of the organism to adverse environmental factors. The effect of aromatherapy on the body directly depends on the method of application of essential oils, as well as individual tolerance of the patient.

Consequently, the analysis of literature data indicates the possibility of changing various characteristics of the organism under the influence of aromatic substances. At the same time, physiological effects and mechanisms of influence of odors on the morphofunctional state of organs are poorly studied, in the application of aromatherapy still lack scientific justification of the choice of the type of aromatic substance, its concentration, duration and purposes of exposure, and taking into account the characteristics of biological individuality of a person.

Objective. To study the influence of the composition of "Volcano mineral" plant and animal raw materials on the immune system of research animals

Study Materials and Methods

Determination of the composition of plant and animal raw materials "Volcano mineral" was carried out at the Scientific center "Radioecological Research" of Shakarim University, Semey. Moisture content analysis was carried out using gravimetry (drying oven, 100 °C); the content of organic substances and ash was determined by gravimetry (muffle furnace, 800 °C); the acid-insoluble residue was determined by gravimetry (filtration); the content of cadmium, lead and mercury was studied using stripping voltammetry; The dose rate of gamma cures was measured using dosimetry, MKS-AT6130. Electron microscopy of the "Volcano mineral" substance was carried out on a scanning electron microscope JSM-6390LV from Jeol (maximum magnification up to 300,000, operating modes - high and low vacuum for the analysis of biological objects).

The experimental study was carried out at the Center of the Research Laboratory (CRL) of NC JSC "SMU". The experiment was carried out in several stages, with the experimental animals being divided into 4 groups of 10 rats in each group. The use of animals was carried out in compliance with the rules and regulations regulated by the legislation of the Republic of Kazakhstan and the international recommendations of the European Convention for the Protection of Vertebrate Animals used for experiments for scientific or other purposes. During the experiment, all animals were in the same, standard vivarium conditions. During the experiment, animals exposed to smoke poisoning were exposed to conditions of 5 minutes in the priming chamber. The control group are intact animals, stayed in the priming chamber with no priming smoke for 5 minutes daily.

To simulate smoke, a plastic chamber with a volume of 0.3 m3 was used (Figure 1). The chamber was smoked by burning the composite in powder form in a special holding device. As the powder burned, they were replaced, thereby ensuring a constant flow of smoke into the seed chamber. We place 5 in the priming chamber. Smoke was carried out for 5 minutes by burning 10 mg, 20 mg, and 30 mg of the medicinal composite from plant and animal raw materials "Volcano mineral". Experimental rats underwent the procedure once a day. After the end of each 5-minute session, the animals were removed from the priming chamber and were kept in the sanitary conditions of the vivarium. The entire experiment was carried out over 7 and 21 days.

The animals were divided into 4 groups:

1. The first control group (10 rats) were not exposed to smoke when burning a medicinal composite from plant and animal raw materials for 7 and 21 days.
2. The second group (10 rats) were exposed to chronic smoke when burning a medicinal composite from plant and animal raw materials at a dose of 10 mg for 21 days.
3. The third group (10 rats) were exposed to chronic smoke when burning a medicinal composite from plant and animal raw materials at a dose of 20 mg for 21 days.
4. The fourth group (10 rats) was exposed to chronic smoke when burning a medicinal composite from plant and animal raw materials at a dose of 30 mg for 21 days.

After the end of the experiments, the rats were killed by decapitation.

Next, a study of metabolic processes in the body was carried out on the accumulation of toxic and potentially toxic elements subjected to chronic and acute inoculation with a medicinal composite from plant and animal raw materials "Volcano mineral" in various doses with increasing concentrations.

Laboratory tests were carried out to assess the immune status of the body of experimental and control animals. Immunoglobulins (IgA, IgM, IgG) were assessed using the enzyme immunoassay (ELISA) method . Using a manual method, the number of leukocytes, lymphocytes, T-helpers, T-suppressors, T-lymphocytes, B-lymphocytes, phagocytic number and phagocytic index were determined to assess the indicators of nonspecific immunity, determination of circulating immune complexes (CIC) in blood serum, inhibition reaction migration of leukocytes (IRML), as well as to study the phagocytic link of immunity, a nitroblue tetrazolium (NBT) reduction test was performed.

The study was approved by the Local Ethical Commission of NJSC Semey Medical University, protocol No. 2 dated 10/07/2022. During the project, all ethical and legal standards required for experimental research conducted on the territory of the Republic of Kazakhstan were observed.

Statistical data processing was carried out using IBM SPSS Statistics Version 21 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean (standard deviation). Of the nonparametric tests, the Kruskil-Walliss H test was used. The differences between the samples are statistically significant at $p < 0.05$.

Figure 1. Preparatory stage of the experiment.

Results

Based on the results of the obtained analyses, it was determined that the plant and animal raw materials of "Volcano mineral" consist of 84% organic substances, 13% ash and 3% moisture. The substance does not contain major toxic metals that can cause damage to many organs [9], such as cadmium, mercury and lead. It was also found that the dose rate of gamma radiation does not exceed the normal value (Table 1).

Table 1.

Chemical composition of plant and animal raw materials "Volcano mineral".

Parameter	Meaning	Determination method
Moisture contents, %	2.97±0.21	Gravimetry, oven, 100 °C
Content of organic substances, %	83.72±0.48	Gravimetry, muffle furnace, 800 °C
Ash content,%	13.31±0.26	Gravimetry, muffle furnace, 800 °C
Acid-insoluble residue, %	9.23±0.18	Gravimetry, filtration
Cadmium content in aqueous ash solution, mg/g	Not detected	Stripping voltammetry
Lead content in aqueous ash solution, mg/g	Not detected	Stripping voltammetry
Mercury content in aqueous ash solution, mg/g	Not detected	Stripping voltammetry
Gamma radiation dose rate, μSv/hour	0.090±0.018 (norm 0.25 μSv/hour)	Dosimetry, MKS-AT6130

It is worth noting that the composition of the "Volcano mineral" substance includes volcanic rock, snake extract, licorice root, and Chinese copperhead.

We also carried out electron microscopy of the "Volcano mineral" substance on a scanning electron microscope JSM-6390LV from Jeol (maximum magnification up to 300,000, operating modes - high and low vacuum for the analysis of biological objects) (Figure 2).

The results of immunological studies in rats were analyzed before exposure to smoke, after acute exposure to smoke when burning plant and animal raw materials "Volcano mineral" for 7 days and chronic for 21 days in doses of 10, 20 and 30 mg.

Table 2 presents the results of analyzes of cellular and humoral immunity before and after exposure to smoke in rats when burning 10 mg of the "Volcano mineral" substance for 7 days (acute exposure) and 21 days (chronic exposure). There is an increase in the number of leucites and lymphocytes in the blood of rats after acute exposure to smoke, and a decrease in these indicators during chronic exposure, but these data did not reach statistical significance ($p \geq 0.1$). There is also a statistically significant increase in T-suppressors by almost 2 times and T-lymphocytes after acute exposure to smoke in rats, and a decrease in this indicator during chronic exposure ($p = 0.029$ and $p = 0.001$, respectively). T-helper cells also slightly increased after acute exposure to "Volcano mineral" and decreased with chronic exposure to a dose of 10 mg ($p = 0.303$). There is a slight inhibition of B-lymphocyte production ($p = 0.255$). A slight decrease in phagocytic parameters, such as the phagocytic index and phagocytic number ($p \geq 0.6$), was found, which may indirectly indicate immunodeficiency.

A significant increase in circulating immune complexes is observed both after acute exposure to smoke and during chronic exposure to plant and animal raw materials "Volcano mineral" in all compared groups: 10 mg, 20 mg and 30 mg of the substance ($p \leq 0.001$) (Table 2, 3.4).

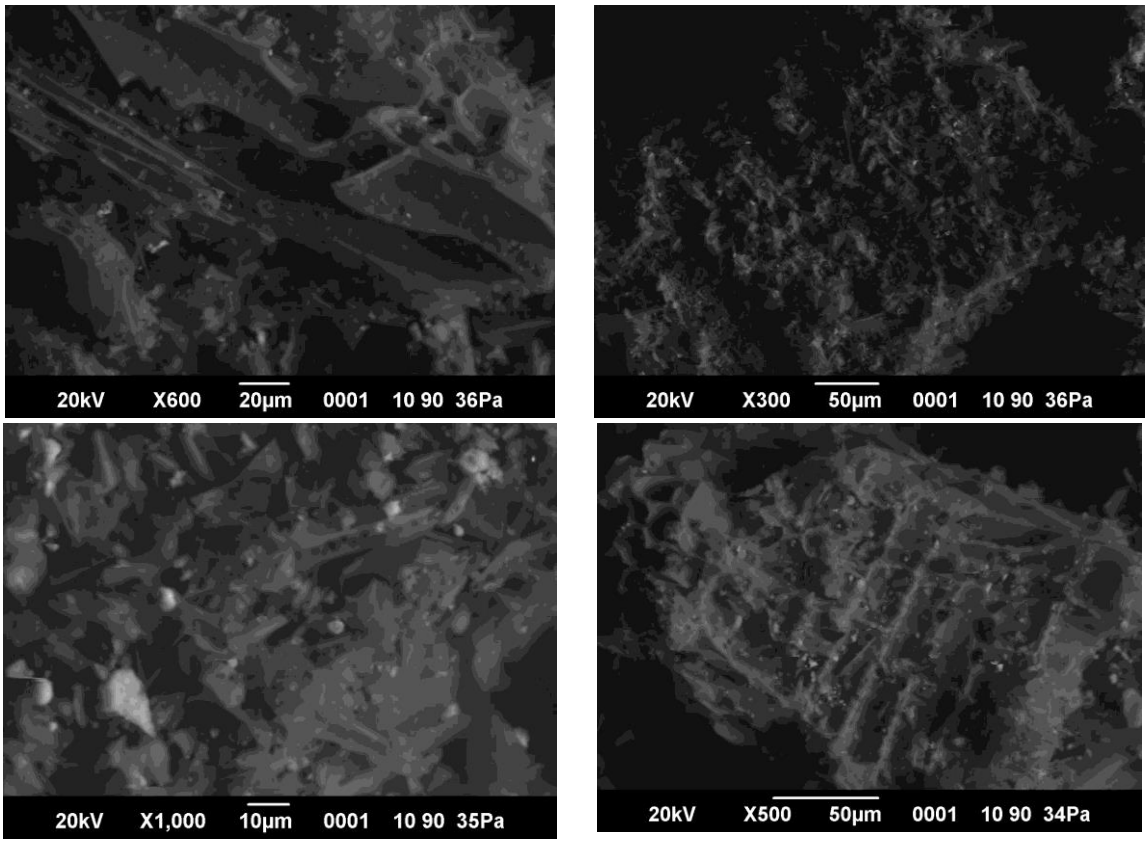

Figure 2. Structure of the "Volcano mineral" substance under an electron microscope.

Table 2.

Comparative analysis of indicators of cellular and humoral immunity in rats after exposure to smoke when burning the "Volcano mineral" substance at a dose of 10 mg.

Indicators	Intact animals	Smoke exposure for 7 days	Smoke exposure for 21 days	P value
	Me (Q1-Q3)			
Leukocytes	7.400 (6.200-8.300)	8.800 (8.600-9.100)	6.400 (6.200-6.800)	0.162
Lymphocytes	45 (41-47)	48 (47-48)	44 (41-44)	0.425
T-Suppressors	0.37 (0.32-0.73)	0.67 (0.56-0.71)	0.30 (0.28-0.33)	0.029*
T lymphocytes	1.24 (1.11-1.33)	1.60 (1.55-1.68)	1.09 (0.99-1.20)	0.002*
T-Helpers	0.665 (0.540-0.800)	1.010 (0.940-1.040)	0.710 (0.700-0.820)	0.303
B-lymphocytes	0.575 (0.500-0.700)	0.460 (0.420-0.530)	0.470 (0.440-0.480)	0.255
Phagocytic number	3.05 (2.0-4.0)	2.90 (2.8-4.2)	2.8 (2.4-3.2)	0.649
Phagocytic index	49 (44-62)	48 (41-53)	48 (44-52)	0.519
CIC	54.4 (47.3-56.6)	89.5 (87.6-91.7)	83.7 (78.3-98.8)	0.001*
IRML	22 (18-24)	26 (22-26)	22 (22-26)	0.592
NBT	7 (5-8)	7 (7-8)	8 (7-8)	0.494
IgA	1.860 (1.628-3.721)	2.325 (1.395-2.790)	0.697 (0.465-3.023)	0.656
IgM	2.346 (1.811-6.481)	3.211 (2.305-3.458)	2.882 (1.564-6.481)	0.974
IgG	7.469 (6.463-11.219)	7.012 (6.463-7.560)	5.914 (3.809-6.280)	0.255
Note: *statistical significance level $p < 0.05$.				

In a comparative analysis of the immunological status before and after exposure to smoke when burning the "Volcano mineral" substance at a dose of 20 mg, significant changes in T-helper levels ($p = 0.023$), phagocytic index ($p = 0.026$) and an increase in the titer of IgA antibodies ($p = 0.032$). Immunoglobulin A was increased twofold after acute and chronic exposure to smoke at a dose of 20 mg (Table 3).

When inhaling smoke from the combustion of the "Volcano mineral" substance at a maximum dose of 30 mg, leukocytosis ($p = 0.03$) and an increase in the level of B-lymphocytes ($p = 0.04$) were observed in rats. A decrease in the level of IgG ($p = 0.003$) with chronic exposure and an increase in the level of IgA ($p = 0.04$) with acute exposure to the "Volcano mineral" were also determined (Table 4).

To summarize, we can note an increase in the level of circulating immune complexes under both acute and chronic exposure to plant and animal raw materials "Volcano mineral". T-lymphocytes and T-suppressors increase with acute and decrease with chronic exposure to the "Volcano mineral" substance at a dose of 10 mg. A decrease in phagocytic activity was found when exposed to "Volcano mineral" in doses of 20 and 30 mg, an increase in T-helper cells in a dose of 20 mg, leukocytes and B-lymphocytes in a dose of 30 mg.

Table 3.

Comparative analysis of indicators of cellular and humoral immunity in rats after exposure to smoke when burning the "Volcano mineral" substance at a dose of 20 mg.

Indicators	Intact animals	Smoke exposure for 7 days	Smoke exposure for 21 days	P value
	Me (Q1-Q3)			
Leukocytes	7.4 (6.2-8.3)	7.9 (7.8-9.3)	7.2 (6.9-7.4)	0.166
Lymphocytes	45 (41-47)	43 (41-44)	46 (40-47)	0.470
T-Suppressors	0.37 (0.32-0.73)	0.74 (0.58-0.74)	0.44 (0.43-0.64)	0.230
T lymphocytes	1.24 (1.11-1.33)	1.48 (1.25-1.60)	1.15 (1.09-1.21)	0.087
T-Helpers	0.665 (0.540-0.800)	0.860 (0.860-1.150)	0.730 (0.720-0.750)	0.023
B-lymphocytes	0.575 (0.500-0.700)	0.600 (0.540-0.610)	0.530 (0.530-0.650)	0.885
Phagocytic number	3.05 (2-4)	2.2 (2.1-2.2)	1.9 (1.7-2.2)	0.187
Phagocytic index	49 (44-62)	43 (42-44)	41 (39-42)	0.026*
CIC	54.4 (47.3-56.6)	90.8 (89.6-95.9)	72.4 (68.0-76.3)	0.0001*
IRML	22 (18-24)	19 (18-22)	24 (20-26)	0.258
NBT	7 (5-8)	10 (8-10)	7 (7-7)	0.051
IgA	1.860 (1.628-3.721)	4.186 (2.093-5.349)	5.349 (4.186-5.581)	0.032*
IgM	2.346 (1.811-6.481)	1.729 (1.647-2.964)	3.705 (2.553-6.392)	0.205
IgG	7.469 (6.463-11.219)	6.280 (6.097-9.390)	6.829 (5.914-8.292)	0.612

Table 4.

Comparative analysis of indicators of cellular and humoral immunity in rats after exposure to smoke when burning the "Volcano mineral" substance at a dose of 30 mg.

Indicators	Intact animals	Smoke exposure for 7 days	Smoke exposure for 21 days	P value
	Me (Q1-Q3)			
Leukocytes	7.4 (6.2-8.3)	8.6 (8.4-9.1)	8.3 (7.8-8.6)	0.03*
Lymphocytes	45 (41-47)	41 (39-43)	40 (39-40)	0.128
T-Suppressors	0.37 (0.32-0.73)	0.46 (0.46-0.56)	0.39 (0.37-0.49)	0.687
T lymphocytes	1.24 (1.11-1.33)	1.32 (1.29-1.36)	1.27 (1.19-1.58)	0.772
T-Helpers	0.665 (0.540-0.800)	0.630 (0.630-0.730)	0.700 (0.600-0.790)	0.863
B-lymphocytes	0.575 (0.500-0.700)	0.840 (0.800-0.880)	0.770 (0.740-0.820)	0.042*
Phagocytic number	3.05 (2-4)	2.6 (2.4-3.0)	2.2 (2.2-2.8)	0.603
Phagocytic index	49 (44-62)	40 (39-42)	40 (40-41)	0.006*
CIC	54.4 (47.3-56.6)	77.1 (58.7-92.3)	86.8 (80.3-88.7)	0.001*
IRML	22 (18-24)	22 (21-23)	22 (20-23)	0.991
NBT	7 (5-8)	3 (3-7)	4 (2-6)	0.244
IgA	1,860 (1.628-3.721)	3,721 (2.093-4.883)	1.395 (0.930-1.860)	0.044*
IgM	2.346 (1.811-6.481)	2.035 (1.564-7.097)	2.470 (1.894-7.090)	0.888
IgG	7.469 (6.463-11.219)	6.200 (6.097-7.012)	1.666 (1.666-3.098)	0.003*

A significant increase in the level of immunoglobulin A was found during acute and chronic exposure to the "Volcano mineral" substance at a dose of 20 mg and an increase during acute exposure at a dose of 30 mg. With chronic exposure to smoke from the "Volcano mineral" substance at a dose of 30 mg, a significant decrease in immunoglobulin G is observed.

Discussion

The immune system serves as the body's main line of defense against illnesses and infections. This kind of reaction has been split into two main branches over the ages: innate immunity and adaptive immunity. [2]. The innate immune system represents the first barrier, that aims to limit the ability of pathogens to spread throughout our body [8]. The acquired or adaptive immune response, as it is also called, corresponds to the second barrier of the immune system. Unlike the innate system, the adaptive response is antigen-specific and provides long-lasting protection, mainly mediated by T and B lymphocytes [2].

The human immune system is divided into two main parts: humoral and cellular immunity. The cells of the immune system are directly responsible for cellular immunity. Protective reactions occur in the cells of the lymphoid system and are provided by T-lymphocytes. Phagocytosis is of primary importance in suppressing infectious agents. The phagocytic reaction is the process of capturing, killing and digesting microbial cells, viruses and the body's own cells by white blood cells - phagocytes. The process of phagocytosis can be divided into several main stages, one of which is the oxidative burst - intracellular destruction using oxygen-dependent mechanisms. In our study, in general, an increase in the number of T- and B-lymphocytes and a decrease in the phagocytic index were noted. T lymphocytes are involved in providing a cellular immune response and control the work of B lymphocytes responsible for the formation of antibodies, i.e., for the humoral immune response. Decreased phagocytosis leads to increased susceptibility to infections and indicates some suppression of immune defense.

The quantity of immunoglobulins generated in response to B cell activation serves as a proxy for the humoral component of immunity. The amount of immunoglobulins of different

classes is measured in the blood. Immunoglobulins (Ig) or antibodies are a special type of proteins that are produced under the influence of antigens and have the ability to specifically bind to them.

The state of the humoral immunity is determined by the level of immunoglobulins (IgM, IgG, IgA) and their ability to respond to antigens and mitogens. Immunoglobulins recognize self and foreign antigens and are an important component of the first line of defense against invading pathogens, but also play a homeostatic role in regulating the clearance of intracellular molecules or modified cell surface structures of necrotic or apoptotic cells [5,7]. An increase in immunoglobulin class A is often associated with the launch of some pathological process in the body, most often this can be a consequence of damage to internal organs and skin. A decrease in immunoglobulin A levels represents activation of the complement system and elimination of toxins. In our study, immunoglobulin A increased with exposure to "Volcano mineral" at a dose of 20 mg and decreased with chronic exposure at a dose of 30 mg. In the case of a decrease in the level of IgA in rats, in response to inhalation of smoke during the combustion of the "Volcano mineral" substance at a maximum dose of 30 mg, that shows the relative insufficiency of local and general immunity.

The main function of immunoglobulin G is long-term humoral protection against the re-entry of a foreign antigen into the body, which prevents reinfection. IgG - makes up 75% of all serum immunoglobulins and plays a major role in the formation of long-term humoral immunity after infectious diseases. Thus, we can say that a decrease in IgG when exposed to "Volcano mineral" triggers the processes of neutralization of toxins, opsonizing antigens, enhancing their phagocytosis, and activating the complement system along the classical pathway. This class of antibodies is able to penetrate into the extravascular space and perform a protective function in tissues.

Many drugs have been described that do not initially contain immunosuppressive properties that modulate the humoral and cellular immune response in humans or animals [3]. "Volcano mineral" has an immunosuppressive effect. With acute exposure to smoke from the "Volcano mineral" substance, a protective immune reaction of the body is triggered, which is caused by a change in the cellular immune response, characterized by an increase in the number of T- and B-lymphocytes, T-suppressors and T-helpers and a decrease in phagocytic activity, further with chronic exposure At higher doses, an immunosuppressive effect is observed.

Conclusion. Thus, it can be concluded that the "Volcano mineral" substance consists of 84% organic matter, 13% ash and 3% moisture, including volcanic rock, snake extract, licorice root and Chinese copper head. The main toxic metals (cadmium, mercury and lead) were not found in the "Volcano mineral" substance, the dose rate of gamma radiation did not exceed normal values.

With acute exposure to smoke from the "Volcano mineral" substance on research rats, a protective immune reaction of the body is triggered caused by a change in the cellular immune response, characterized by an increase in the number of T- and B-lymphocytes, T-suppressors and T-helpers and a decrease in phagocytic activity. Subsequently with chronic exposure to higher doses, immunosuppressive effects are observed.

Funding. *Financing. Semey Medical University No. 447 dated November 7, 2022 funded this study as a startup project.*

Authors contributed. *All authors contributed equally.*

Conflict of Interest. *The authors declare no conflict of interest.*

Publication details: *This material has not been published in other publications and is not pending review by other publishers.*

Literatura:

1. *Abramovich S.G., Korovina E.O.* The use of therapeutic physical factors in elderly patients with hypertension // Siberian Medical Journal (Irkutsk). 2008. Vol. 78. No. 3. P. 21-25.

2. *Hato T., Dagher P.C.* How the Innate Immune System Senses Trouble and Causes Trouble // Clin J Am Soc Nephrol. 2015. 10:1459–69. doi: 10.2215/CJN.04680514

3. *Huemer H.P.* Possible immunosuppressive effects of drug exposure and environmental and nutritional effects on infection and vaccination // Mediators Inflamm. 2015. 2015:349176. doi:10.1155/2015/349176. Epub 2015 Apr 5. PMID: 25944981. PMCID: PMC4402171.

4. *Murgia V., Manti S., Licari A., De Filippo M., Ciprandi G., Marseglia G.L..* Upper Respiratory Tract Infection-Associated Acute Cough and the Urge to Cough: New Insights for Clinical Practice // Pediatr Allergy Immunol Pulmonol. 2020;33(1):3-11. doi:10.1089/ped.2019.1135

5. *Schwartz-Albiez R., Monteiro R.C., Rodriguez M., Binder C.J., Shoenfeld Y.* Natural antibodies, intravenous immunoglobulin and their role in autoimmunity, cancer and inflammation // Clin Exp Immunol. 2009 Dec.158 Suppl 1(Suppl 1):43-50. doi: 10.1111/j.1365-2249.2009.04026.x. PMID: 19883423. PMCID: PMC2801031.

6. *Shishko E.Yu. et al.* Features of physical therapy of patients with hypertension at the sanatorium-resort stage of rehabilitation // Crimean Journal of Experimental and Clinical Medicine. 2017. Vol. 7. No. 2. P. 127-136.

7. *Simon H.U., Späth P.J.* IVIG--mechanisms of action // Allergy. 2003. 58(7):543-552. doi:10.1034/j.1398-9995.2003.00239.x

8. *Sun L., Wang X., Saredy J., Yuan Z., Yang X., Wang H.* Innate-Adaptive Immunity Interplay and Redox Regulation in Immune Response // Redox Biol. 2020. 37:101759. doi: 10.1016/j.redox.2020.101759

9. *Titov A.F. et al.* The influence of lead on living things // Journal of General Biology. 2020. Vol. 81. No. 2. P. 147-160

10. *Zhao Q, Zhu L, Wang S, Gao Y, Jin F.* Molecular mechanism of the anti-inflammatory effects of plant essential oils: A systematic review // J Ethnopharmacol. 2023;301:115829. doi:10.1016/j.jep.2022.115829

Corresponding author:
Massabayeva Meruyert – PhD, NCJSC "Semey Medical University", Semey, Kazakhstan.
Postal address: Kazakhstan, 071400, Semey, Abay st., 103.
e-mail: meruyert.massabayeva@smu.edu.kz
Phone: +7 700 777 0230