

Original Research Article

## Influence of Short-Term Inhalations of High-Concentrated Oxygen Adding of Chamomile Oil to the State of Local Immunity at Sore Throat in Adults

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**Abstract:** The article considers the efficacy of use short-term inhalations of high-concentrated oxygen with the addition of chamomile oil on the state of local immunity in adults with sore throat. **Materials and methods:** The study involved 35 patients aged 25 to 40 years (mean -  $34.5 \pm 5.71$  years, 20 women, and 15 men) with a diagnosis sore throat. Observed were randomized into 2 groups: in group 1 the inhalations with high concentrated oxygen (n=18) were used, in group 2 is treated by inhalations of high concentrated oxygen with Chamomile oil (n=17). Inhalation was conducted with 3 breathing per minute three times (totally 3 minutes) twice per day. The efficacy of therapy was determined by the period of the decrease in severity clinical manifestations and their complete disappearance. **The results of the study:** The reason for the treatment in all patients was an increase in body temperature to  $37.5-38.9^{\circ}\text{C}$ , the presence of symptoms of intoxication, varying severity of sore throat, a feeling of dryness/sore throat and dry cough. Patients were self-evaluated the severity of sore throat at the period of treatment, at  $3.8 \pm 0.78$  points in group 1 and  $3.9 \pm 0.86$  points in group 2, difficulty in nasal breathing - at  $4.1 \pm 0.96$  points and  $4.2 \pm 0.85$  points, respectively; the severity of hyperemia - by  $4.9 \pm 0.30$  points and  $4.8 \pm 0.46$  points; an increase in tonsils - by  $2.4 \pm 0.40$  and  $2.3 \pm 0.53$  points in groups 1 and 2. In 17.6% people of the 2-nd group, already on the 3rd day, the pharyngoscopic picture completely normalized, while in the 1-st group this result was not attained. By the 4th day of observation, pharyngoscopic signs were absent in 41.2% of patients of the 2nd group and only in 16.7% of people of the 1st group. On the 5th day during the oropharyngeal examination, 55.6% of the 1-st group examined retained mild hyperemia of the mucous membranes of the palatine arches and small tongue, while in the 2nd group this symptom was recorded only in 17.6% of cases. According to the scoring, until the end of the observation period (5-7 days) in both groups - with the Oxygen Breathing Mixture Natural and Oxygen Breathing Mixture Sea Minerals Chamomile inhalations, hyperemia in the oropharynx significantly decreased. The effectiveness of the Oxygen Breathing Mixture Sea Minerals Chamomile inhalations was significantly reduced and the symptoms exceeded the effectiveness of Oxygen Breathing Mixture Natural by 3.5 times ( $p < 0.05$ ). The severity of pain in the follow-up dynamics decreased to  $1.7 \pm 0.18$  points in the 1st group and  $1.3 \pm 0.15$  in the 2nd group ( $p < 0.05$ ). The therapeutic effectiveness of Oxygen Breathing Mixture Sea Minerals Chamomile exceeded the efficiency of Oxygen Breathing Mixture Natural by 30.8%. A significant improvement in nasal breathing was observed on the 5th day of observation - up to  $1.7 \pm 0.43$  points in group 2 versus  $2.8 \pm 0.51$  points in group 1 ( $p < 0.05$ ), with the effectiveness of Oxygen Breathing Mixture Sea Minerals Chamomile-64.7%. Symptoms of intoxication and pharyngoscopic signs of the inflammatory process in patients of the 2-nd group stopped on average 1.5 days faster compared with patients of the 1st group. The level of sIgA in saliva tended to normalize (from  $0.18 \pm 0.08$  to  $0.21 \pm 0.09$  g / l,  $p > 0.05$ ) in the group 1. The normalization of the content in the group 2 was observed saliva secretion of an initially low level of sIgA (from  $0.16 \pm 0.03$  to  $0.34 \pm 0.06$  g / l,  $p < 0.05$ ). The total duration of acute respiratory viral infections in patients receiving Oxygen Breathing Mixture Sea Minerals Chamomile was on average 3 days shorter than in patients of the 1st group.

**Keywords:** Oxygen administration, chamomile oil, tonsillitis, pharyngitis, sore throat, local immunity.

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## ACTUALITY

Redox reactions constantly occur in all human and animal cells. According to this work, all processes in the body provided with the necessary energy. Molecular oxygen is necessary for the complete extraction of chemical energy [10].

In plants, at present, a sufficiently large number of flavonoids - antioxidants with a wide range of healing effects, have been found. They have vasoligating, antitumor, anti-inflammatory, bactericidal, immunostimulant and anti-allergic properties. In herbal extracts, bioactive ingredients are in a free state, are not associated with cellular structures, so they are more easily absorbed by the body [17].

Also among the scientifically proven advantages of herbal medicines which are presented with low toxicity, the absence of side effects even with prolonged use, many pharmacological properties due to which herbal preparations act on several body systems at once. Each medicinal plant contains a whole complex of substances, which not only eliminates the cause of the disease, but also has a beneficial effect on the whole organism [4].

*Chamomilla recutita* (L.) Rauschert chamomile flowers are used in medicine as anti-inflammatory, antispasmodic and weak antiseptic agents. The main types of pharmacological activity of the antispasmodic and anti-inflammatory effects of chamomile flowers depends on the presence of flavonoids and coumarins. The expand the range of medicines is based on chamomile flowers possibly with hydrophobic extractants, for example vegetable oils. The Chamomile (*Matricaria perforatae*) contains essential oil (0.2–0.8%), with special blue color depending on chamazulene. In addition, flavonoids, coumarins, triterpene alcohols, ascorbic acid, carotene and other components are present. Currently, essential oil and phenolic compounds of chamomile studied deeply. More than 30 flavonoids were found in various organs of the chamomile pharmacy, including apigenin, quercetin, isoramnetin, luteolin 7-glucoside, apigenin 7-glucoside and chrysozriol. Moreover, their total content reaches 1.2% [11, 12]. The anti-inflammatory effect of chamomile extracts, according to available literature, is due to the substances that make up the essential oil, as well as spiro esters [13, 16]. Antispasmodic, anti-inflammatory and sedative actions have been established for the apigenin flavonoid [15]. Oxycoumarins umbelliferone (the content reaches 0.016%) and its methyl ester gerniarin (content is up to 0.039%), found in chamomile flowers, also have antispasmodic activity [7, 8].

The possibilities of creating new drugs based on chamomile pharmacy are far from exhausted. First, this concerns the use of hydrophobic extractants to obtain lipophilic complexes of chamomile pharmacy, in which a different ratio of hydrophilic and hydrophobic biologically active compounds is observed. As a hydrophobic extractant, various vegetable oils can be used [9, 14].

Oil extract of chamomile flowers pharmacy (CML) is a promising object for the creation of new drugs and products based on it. It contains essential oils - levomenol, bisabolol oxide A, bisabolol oxide B, camazulene, spatulenol. It has an antispasmodic, anti-inflammatory, antimicrobial effect, improves tissue regeneration processes. It has a deodorizing and antipruritic effect [1-3].

Flavonoids with high antioxidant potential - derivatives of quercetin, luteolin, apigenin in many experiments turned out to be the most effective antioxidants: the presence of the O-dihydroxyl structure in the B-ring provides a high level of stability of flavonoid phenoxyl radicals involved in electronic delocalization and, thus, making a large contribution into the antioxidant defense system [5, 6].

The study of inhalation of highly concentrated oxygen with the addition of chamomile essential oil to the local immunity system in patients, who often suffer from acute respiratory diseases, is relevant.

The purpose of the study was to set the efficacy of short-term inhalations with concentrated oxygen and Chamomile oil on wellbeing, local pharyngeal state and local immunity status in people with recurrent respiratory infections.

## MATERIAL AND METHODS

The study involved 35 patients aged 25 to 40 years (mean age -  $34.5 \pm 5.71$  years), including 20 women, 15 men with a diagnosis acute respiratory viral infections with sore throat (tonsillitis and pharyngitis).

The observed patients were randomized into 2 groups. In addition to the basic therapy in group 1 inhalations with high concentrated oxygen (Tesla's Secret by Eco Medical Europe Ltd Oxygen Breathing Mixture, Natural, n=18) were used, and in group 2 the inhalations of high concentrated oxygen with Chamomilla oil (Tesla's Secret by Eco Medical Europe Ltd Oxygen Breathing Mixture Sea Minerals Chamomile, group 2, n=17) were administered. Both

groups are formed by equal representation in age, gender and initial clinical manifestations, which allows a comparative assessment of the results of observation and determines the reliability of the results. The sample size was sufficient to set conclusions.

The examination was carried out daily until recovery and included the collection and analysis of the medical history, the patient's subjective assessment of the severity of symptoms (perspiration, sore throat, cough frequency), an objective assessment by a doctor of the presence and severity of symptoms (pharyngoscopy, sizes of tonsillar lymph nodes). The severity of symptoms was assessed using a 4-point scale, where 0 is no symptom, 1 - mild symptom, 2 belongs to moderate symptom, 3 - severe symptom. All patients were prescribed to use warm alkaline drink, according to indications - antipyretic drugs (paracetamol or ibuprofen).

The effectiveness of therapy was determined by the terms of reducing the severity and complete disappearance of clinical manifestations, the presence and severity of complications of acute respiratory viral infections. Throughout the observation, adverse events were monitored, in the event of which the use of drugs could be discontinued.

Each of the tests was carried out initially and after the course of inhalations with high concentrated oxygen for 5-7 days ( $5.9 \pm 2.31$  days). Inhalation was conducted with 3 breathing per minute three times (totally 3 minutes) twice per day. The results of each study were set into database. All people subscribed informed agreement form before including in the study.

For statistical analysis results, we used Statistica for Windows Version 10.0 (Stat Soft inc., USA). Parameters are presented in the form  $M \pm m$ , where  $M$  is the mean,  $m$  is standard deviation. At the case of  $p < 0.05$ , differences were set as statistically significant.

## RESULTS AND DISCUSSION

The reason for the treatment in all patients was an increase in body temperature to  $37.5-38.9^\circ\text{C}$ , the presence of intoxication symptoms (general malaise, loss of appetite, headache), varying severity of sore throat (85.7%, 30 people) feeling of dryness / sore throat (74.3%, 26 people) and dry cough (51.4%, 18 people).

Moreover, moderate forms of acute respiratory viral infections were observed in half of the cases, and their average duration was  $7.8 \pm 1.2$  days.

During pharyngoscopy, all patients showed varying degrees of severity of symptoms of typical tonsillitis or pharyngitis: 100% hyperemia of the tonsils, arches and small tongue, 54.2% (19 people) with loosening of the mucous membrane of the oropharynx; an increase in tonsils in 71.4% (25 people) of cases, including 40.0% (14 people) depending on edema; granularity of the posterior pharyngeal wall was detected in 23.3% of patients.

Most of the patients have gone to the clinic on the 2nd day of the disease (77.1%, 27 people). At the initial examination, the frequency and severity of the initial clinical manifestations did not statistically differ in both groups. So the severity of sore throat at the time of treatment, patients of both groups were evaluated on average by  $3.8 \pm 0.78$  points and  $3.9 \pm 0.86$  points, respectively; nasal breathing difficulty by  $4.1 \pm 0.96$  points and  $4.2 \pm 0.85$  points, respectively. Similar results were obtained with pharyngoscopy, the severity of hyperemia averaged  $4.9 \pm 0.30$  points and  $4.8 \pm 0.46$  points, and palatine tonsils were increased to  $2.4 \pm 0.40$  degrees and  $2.3 \pm 0.53$  degrees, respectively ( $p > 0.05$ ).

Thus, at the starting point of treatment, the groups were comparable not only in basic demographic, but also in clinical characteristics.

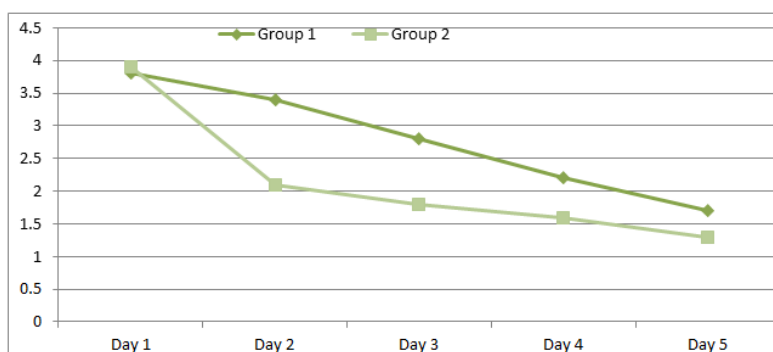
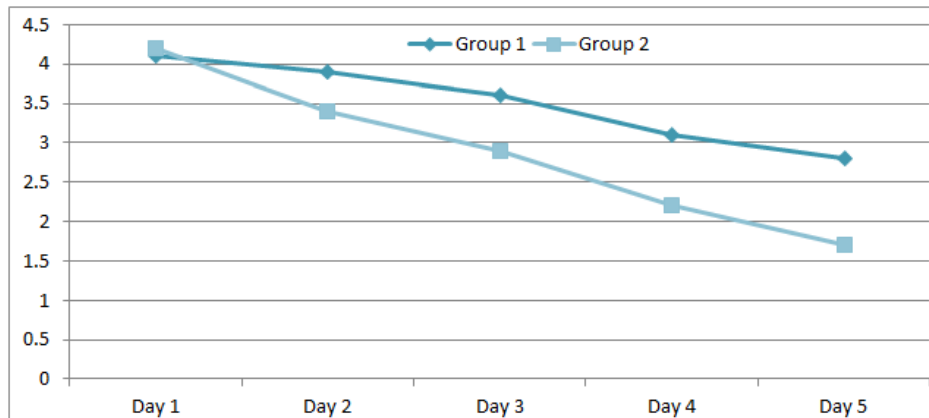


Fig-1: Dynamics of throat pain after inhalations with high concentrated oxygen (group 1) and high concentrated oxygen with chamomilla oil (group 2)

Upon repeated examination after 1 day from the start of therapy, a significant decrease in body temperature was set in patients of both groups (on average, to  $37.2 \pm 0.47^\circ\text{C}$  in the 1st group and  $37.0 \pm 0.42^\circ\text{C}$  in the 2nd).



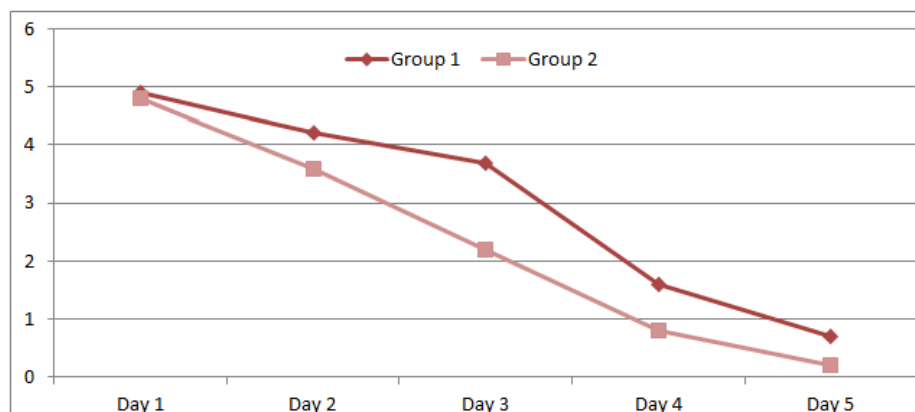
**Fig-2: Discomfort of nasal breathing and its dynamics after inhalations with high concentrated oxygen (group 1) and high concentrated oxygen with chamomilla oil (group 2)**

Subsequently, all patients showed a decrease in symptoms of intoxication, pain and discomfort in the throat, a significant improvement in the pharyngoscopic picture.

On the 3rd day in both groups, the number of patients with symptoms of tonsillopharyngitis decreased by half. It should be noted that in 3 patients (17.6%) of the 2nd group, the pharyngoscopic picture was completely normalized (in the 1st group there was no such result), the rest restored the relief of the tonsils (in the 1st group in 7 patients their swelling still persisted).

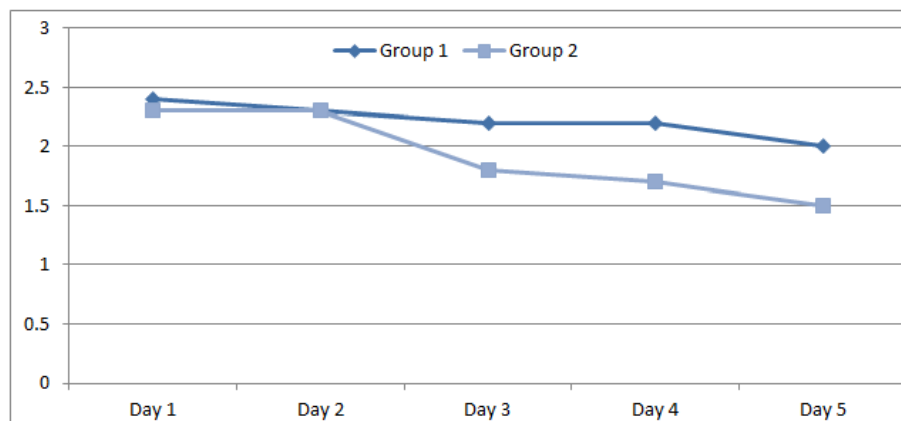
By the 4th day of observation, pharyngoscopic signs were already absent in 41.2% of patients of the 2nd group (7 people) and only 16.7% (3 people) of the 1st group. On the 5th day, complaints were practically absent in all patients.

However, when examining the oropharynx in 55.6% of the treated (10 people) of the 1st group, mild hyperemia of the mucous membranes of the palatine arches and small tongue remained (on average  $0.7 \pm 0.17$  points), while in the 2nd group, this symptom was set only in 17.6% of cases (3 people).



**Fig-3: Oropharyngeal surface hyperaemia and its dynamics after inhalations with high concentrated oxygen (group 1) and high concentrated oxygen with chamomilla oil (group 2)**

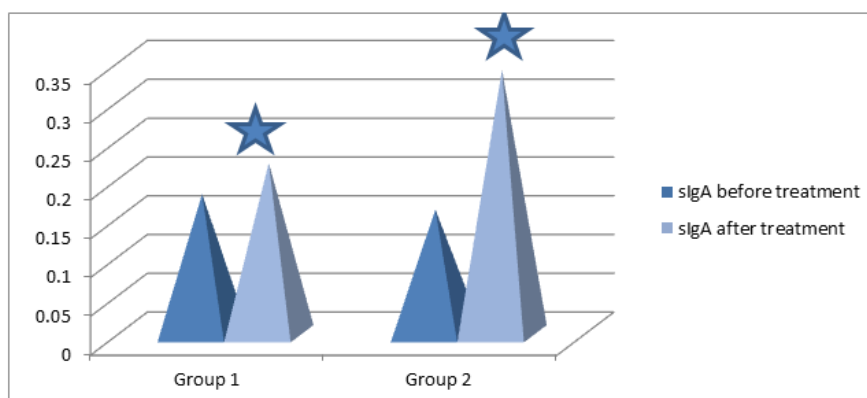
The hyperemia in the oropharynx significantly decreased (to  $0.7 \pm 0.01$  points in the 1st group and  $0.2 \pm 0.02$  in the 2nd, Fig. 1) and the severity of pain (up to  $1.7 \pm 0.18$  points in the 1st group and  $1.3 \pm 0.15$  in the 2nd, Fig. 2). The vast majority of patients felt a significant improvement in nasal breathing (on average, up to  $1.7 \pm 0.43$  points in group 2 versus  $2.8 \pm 0.51$  points in group 1, Fig. 3).



**Fig-4: Enlargement of tonsils after and its dynamics inhalations with high concentrated oxygen (group 1) and high concentrated oxygen with chamomilla oil (group 2)**

Analysis of the dynamics of clinical manifestations showed that the duration of fever is comparable in both groups ( $p > 0.05$ ). The dynamics of tonsil reduction is shown in Fig. 4 and amounted to  $2.0 \pm 0.05$  in the group 1,  $1.5 \pm 0.03$  in the group 2. Symptoms of intoxication and pharyngoscopic signs of the inflammatory process in patients of the 2-nd group stopped on average 1.5 days faster compared to patients of the 1-st group.

Regardless to the period of the normalization of the clinical picture, in accordance with the standards for the management of patients with uncomplicated acute respiratory viral infections on an outpatient basis, all patients were discharged with recovery on the 7th day of observation.



**Fig-5: Salivary IgA after inhalations with high concentrated oxygen (group 1) and high concentrated oxygen with chamomilla oil (group 2)**

**Note:** - The reliability of the difference in indicators in dynamics ( $p < 0, 05$ );

The level of sIg a in saliva tended to normalize (from  $0.18 \pm 0.08$  to  $0.21 \pm 0.09$  g/l,  $p > 0.05$ ) with a statistically significant change in group 1 compared with the initial values, Fig. 5.

At the same time, as a result of treatment, the normalization of the secretion of initially low sIgA level (from  $0.16 \pm 0.03$  to  $0.34 \pm 0.06$  g/l,  $p < 0, 05$ , Fig. 5),

The duration of acute respiratory viral infections in patients receiving Oxygen Breathing Mixture Sea Minerals Chamomile was on average 3 days shorter than in patients of the 1-st group.

On the background of the therapy, none of the patients revealed adverse events. Thus, when using highly concentrated oxygen inhalations Oxygen Breathing Mixture, Natural, as well as Oxygen Breathing Mixture Sea Minerals Chamomile, a clear positive dynamics was observed in all patients: a decrease in symptoms of intoxication and pain in the throat, a significant improvement in nasal breathing and pharyngoscopic picture.

However, a more distinct clinical effect was observed in the group of patients who received Oxygen Breathing Mixture Sea Minerals Chamomile, which can be explained by the pronounced decongestant, anti-inflammatory and antimicrobial effects of the drug.



## CONCLUSIONS

1. The reason for the treatment in all patients was an increase in body temperature to 37.5-38.9 ° C, the presence of symptoms of intoxication, varying severity of sore throat, a feeling of dryness / sore throat and dry cough. During pharyngoscopy, all patients showed signs of typical tonsillopharyngitis: in 100% hyperemia of the tonsils, arches and small tongue, in 54.2% with loosening of the mucous membrane of the oropharynx, tonsil enlargement in 71.4% of cases, granularity of the posterior pharyngeal wall was detected in 23, 3%
2. The severity of sore throat at the period of treatment are based on the patients self-evaluation at  $3.8 \pm 0.78$  points in group 1 and  $3.9 \pm 0.86$  points in group 2; difficulty in nasal breathing at  $4.1 \pm 0.96$  points and  $4.2 \pm 0.85$  points, respectively; the severity of hyperemia - by  $4.9 \pm 0.30$  points and  $4.8 \pm 0.46$  points, an increase in tonsils - by  $2.4 \pm 0.40$  and  $2.3 \pm 0.53$  points in groups 1 and 2.
3. In the dynamics of treatment, as well as inhalation of Oxygen Breathing Mixture Natural and Oxygen Breathing Mixture Sea Minerals Chamomile, all patients showed a decrease in symptoms of intoxication, pain and discomfort in the throat, a significant improvement in the pharyngoscopic picture.
4. At 17.6% patients of the 2-nd group already on the 3rd day completely normalized laryngoscopy picture was set, while in the 1-st group, this result was not reached. On the 4-th day of observation laryngoscopy signs were absent in 41.2% of patients of the 2-nd group and only in 16.7% of the people 1-st group. On the 5th day during the inspection of the oropharynx 55,6% of patients of the 1-st group still remained slightly pronounced hyperemia of the mucous membranes of the palatal arches and uvula small, whereas in the 2-nd group, such symptoms were fixed only in 17.6% of cases.
5. According to the scoring, until the end of the observation period (5-7 days) in both groups - with the Oxygen Breathing Mixture Natural and Oxygen Breathing Mixture Sea Minerals Chamomile inhalations, hyperemia in the oropharynx significantly decreased, while the effectiveness of the Oxygen Breathing Mixture Sea Minerals Chamomile inhalations was significantly reduced exceeded the effectiveness of Oxygen Breathing Mixture Natural by 3.5 times ( $p < 0.05$ ).
6. The severity of pain in the follow-up dynamics decreased to  $1.7 \pm 0.18$  points in the 1-st group and  $1.3 \pm 0.15$  in the 2-nd group ( $p < 0.05$ ); the therapeutic effectiveness of Oxygen Breathing Mixture Sea Minerals Chamomile exceeded the efficiency of Oxygen Breathing Mixture Natural by 30.8%.
7. The vast majority of patients felt a significant improvement in nasal breathing on the 5-th day of observation - up to  $1.7 \pm 0.43$  points in group 2 versus  $2.8 \pm 0.51$  points in group 1 ( $p < 0.05$ ), with effectiveness of Oxygen Breathing Mixture Sea Minerals Chamomile - 64.7%. Symptoms of intoxication and pharyngoscopic signs of the inflammatory process in patients of the 2-nd group stopped on average 1.5 days faster compared with patients of the 1st group.
8. The level of sIgA in saliva tended to normalize (from  $0.18 \pm 0.08$  to  $0.21 \pm 0.09$  g/l,  $p > 0.05$ ) in the group 1. The normalization of the content in the group 2 was observed at saliva secretion of an initially low level of sIgA (from  $0.16 \pm 0.03$  to  $0.34 \pm 0.06$  g/l,  $p < 0.05$ ). The total duration of acute respiratory viral infections in patients receiving Oxygen Breathing Mixture Sea Minerals Chamomile was on average 3 days shorter than in patients of the 1-st group.

## REFERENCE

1. Зацепина, Е. Е., Оганова, Г. М., Круглая, А. А., Усманский, Ю. В., Савенко, И. А., Сергиенко, А. В., ... & Юркова, А. А. (2012). Характеристика репаративно-адаптивной активности жирных растительных масел в эксперименте. *Успехи современного естествознания*, (9), 10-11.
2. Zacepina, E. E., Oganova, G. M., Kruglaya, A. A., Usmanskiy, Y.U. V., Savenko, I. A., i dr.(2012). Charakteristika reparativno-adaptivnoj aktivnosti zhirnyh rastitel'nyh masel v eksperimente. *Uspekhi sovremennogo estestvoznaniya*, 9: 10–11.
3. Ивашев, М. Н., Круглая, А. А., Савенко, И. А., Усманский, Ю. В., Сергиенко, А. В., Лысенко, Т. А., ... & Ефремова, М. П. (2012). Биологическая активность соединений, полученных синтетическим путем. *Фундаментальные исследования*, (7-2), 441-444.
4. Ivashev, M. N. (2012). Biologicheskaya aktivnost' soedinenij, poluchennyh sinteticheskim putem. *Fundamental'nye issledovaniya*, 7(2): 441–444.
5. Локарев, А. В., Самуйленко, А. Я., Огай, М. А., Морозов, Ю. А., & Макиева, М. С. (2019). Качественное и количественное определение флавоноидов в разработанных мягких антиартритных и антиартрозных лекарственных формах. *Медико-фармацевтический журнал «Пульс»*, 21(11).
6. Lokarev, A. V., Samujlenko, A. Y.A., Ogaj, M. A., Morozov, Y. U. A., Makieva, M. S.(2019). Kachestvennoe i kolichestvennoe opredelenie flavonoidov v razrabotannyh myagkih antiartritnyh i antiartroznyh lekarstvennyh formah. *Medical & pharmaceutical journal "Pulse"*, 21(11): 27-34. - <https://clinicaljournal.ru>
7. Пахомова, Е. Е., Пахомова, А. Е., Пахомова, Ю. В., Карабинцева, Н. О., & Овсянко, Е. В. (2015). Оценка ранозаживляющего, антимикробного, противовоспалительного эффектов эфирных масел. *Journal of Siberian Medical Sciences*, (6).

8. Pahomova, E. E., Pahomova, A. E., Pahomova, Y.U.V., Karabinceva, N. O., Ovsyanko, E. V.(2015). Ocenka ranozazhivlyayushchego, antimikrobnogo, protivovospalitel'nogo effektivov efirnyh masel. *Medicina i obrazovanie v Sibiri*, 6: 70.
9. Коновалов, Д. А., Коновалова, О. А., & Челомбитько, В. А. (1992). Спектрофотометрический метод количественного определения капиллина в эфирном масле *Artemisia scoraria Waldst. et Kit.* *Химико-фармацевтический журнал*, 26(3), 73-75.
10. Pimenov, A. I., Stankevich, N. M., Makarov, V. E., Zenkevich, I. E. (2001). Spektrofotometricheskij metod kolichestvennogo opredeleniya flavonoidov v maslyanyh ekstraktah (na primere maslyanogo ekstrakta list'ev krapivy). Aktual'nye problemy sozdaniya novyh lekarstvennyh preparatov prirodnoho proiskhozhdeniya: materialy V mezhdun. S"ezda. SPb, 354-356.
11. Фурман, Ю. В., Хвостовой, В. В., Быканова, А. М. (2018). Окислительная активность экстрактов лекарственных трав. *Российская наука и образование сегодня: проблемы и перспективы*, 6(25): 80-85.
12. Furman, Y.U. V., Hvostovoj, V. V., Bykanova A. M. (2018). Okislitel'naya aktivnost' ekstraktov lekarstvennyh trav. *Rossijskaya nauka i obrazovanie segodnya: problemy i perspektivy*, 6(25): 80-85.
13. Шиков, А. Н., Макаров, В. Г., Рыженков, В. Е. Растительные масла и масляные экстракты: технология, стандартизация, свойства. М., 2004: 264 с.
14. Shikov, A. N., Makarov, V. G., Ryzhenkov, V. E.(2004). Rastitel'nye masla i maslyanye ekstrakty: tekhnologiya, standartizaciya, svojstva. M. 264 s.
15. Avallone, R., Zanoli, P., Puia, G., Kleinschnitz, M., Schreier, P., Baraldi, M. (2000). Pharmacological profile of apigenin, a flavonoid isolated from *Matricaria chamomilla*. *Biochem Pharmacol*, 59(11): 1387-1394.
16. Gupta, V., Mittal, P., Bansal, P., Khokra, S.L., Kaushik, D.(2010). Pharmacological Potential of *Matricaria recutita*. A Review. *Int J Pharm Sci Drug Research*, 2(1): 12-16.
17. Hagi, G., Hatami, A., Safaeil, A., Mehran, M. (2014). Analysis of phenolic compounds in *Matricaria chamomilla* and its extracts by UPLC-UV. *Research in Pharmaceutical Sciences*, 9(1): 31-37.
18. McKay, D.L., Blumberg, J.B.(2006). A Review of the Bioactivity and Potential Health Benefits of Chamomile Tea (*Matricaria recutita* L.). *Phytother Res*, 20: 519-530.
19. Ompal, S., Zakia, K., Neelam, M., Manoj, K.S. (2011). Chamomile (*Matricaria chamomilla* L.): An overview. *Pharmacogn Rev*, 5(9): 82-95.
20. Shikov, A. N., Laakso, I., Pozharitskaya, O. N., Dorman, H. J. D., Makarov, V. G., Tikhonov, V. P., & Hiltunen, R. (2006). Identification of spiroketal polyacetylenes as the main components of an oil extract of chamomile (*Chamomilla recutita* L. Rausch.) flowers. *Planta Medica*, 72(11), P\_146.
21. Shikov, A.N., Pozharitskaya, O.N., Makarov, V.G., Kvetnaya, A.S.(2008). Antibacterial activity of *Chamomilla recutita* oil extract against *Helicobacter pylori*. *Phytother Res*, 22(2): 252-253.
22. Shikov, A.N., Pozharitskaya, O.N., Makarov, V.G., Wagner, H., Verpoorte, R., Heinrich, M.(2014). Medicinal plants of the Russian Pharmacopoeia; their history and applications. *J Ethnopharmacol*, 154(3): 481-536.