Journal of Chemistry of Goods and Traditional Medicine

J Chem Good Trad Med, Volume 4, Issue 6, 2025 Traditional Medicine

ANTI-INFLAMMATORY AND IMMUNOMODULATORY ACTIVITY OF "ASMURMAX" CAPSULES

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DOI: https://doi.org/10.55475/jcgtm/vol4.iss5.2025.564

Keywords:
воспаление, иммунитет, IL-6, DSS, иммуномодуляция, фитотерапия, биомаркеры воспаления, нейтрофил

Abstract

The article presents the results of a study on the anti-inflammatory and immunomodulatory activity of the phytocomplex ASMURMAX, which includes extracts of Ailanthus (Ailanthus altissima), honey locust (Gleditsia triacanthos), Orthilia (Orthilia secunda), Rhodiola (Rhodiola quadrifida), and hops (Humulus lupulus). The experiment was conducted using a DSS-induced inflammation model in mice. The formulation demonstrated a pronounced reduction in leukocyte levels, normalization of the neutrophil index, restoration of lymphocytic balance, and a significant (more than threefold) decrease in IL-6 concentration compared with the inflamed control. Considering the biological properties of the included plants—rich in polyphenols, saponins, phytoestrogens, phenolic acids, and adaptogens—the obtained results align with known mechanisms regulating pro-inflammatory cascades. ASMURMAX may be considered a promising complex for the correction of inflammatory and immune disorders.

How to Cite

Kirgizov, S. M., Muminov , M. M., & Turgunova, D. ANTI-INFLAMMATORY AND IMMUNOMODULATORY ACTIVITY OF "ASMURMAX" CAPSULES. Journal of Chemistry of Goods and Traditional Medicine, 4(6). https://doi.org/10.55475/jcgtm/vol4.iss6.2025.564

Introduction

Inflammation is a complex biological process associated with a wide range of pathological conditions, including inflammatory bowel diseases, autoimmune disorders, metabolic dysregulation, and chronic degenerative processes [1,2]. The key mediators of inflammation are cytokines such as IL-6, IL-1β, and TNF-α, which regulate neutrophil activity, T-lymphocyte differentiation, acute-phase protein production, and activation of transcription factors NF-κB and AP-1 [2]. Elevation of IL-6 is considered one of the most important markers of severe inflammation and impaired immune homeostasis.

Growing interest in plant-derived bioactive compounds is driven by their potential to modulate inflammatory responses, exert antioxidant effects, regulate immune activity, and offer a favorable safety profile [3,4]. *ASMURMAX* is a phytocomplex comprising extracts of plants known for their anti-inflammatory, immunomodulatory, and antioxidant activities. *Ailanthus altissima* contains phenolic acids,

quercetin, kaempferol, and the alkaloid ailanthone, all of which exhibit strong inhibitory effects on IL-6 and NF-κB activation [5,6]. *Gleditsia triacanthos* is rich in gleditsioside saponins capable of normalizing the Th1/Th2 balance and reducing neutrophil infiltration [7]. *Orthilia secunda* contains phytoestrogenic glycosides that provide anti-inflammatory and antioxidant effects [8]. *Rhodiola quadrifida* serves as a source of salidroside and tyrosol—well-known adaptogens that reduce the expression of pro-inflammatory cytokines and stabilize the neuroendocrine–immune axis [9]. *Humulus lupulus* contains xanthohumol and lupulones, which possess potent antioxidant and anti-inflammatory properties with demonstrated suppression of IL-6 and reactive oxygen species (ROS) [10].

Considering the biochemical characteristics of the included components, it was hypothesized that *ASMURMAX* would exert a multi-target anti-inflammatory and immunoregulatory effect. To objectively evaluate the efficacy of the formulation, a DSS-induced inflammation model widely used in experimental pharmacology was employed [11].

Materials and Methods

The experiment was conducted at the Central Asian Medical University and the ADU laboratory using 30 laboratory mice, which were randomly divided into three equal groups of 10 animals each. The first group served as the intact control without inflammation induction. The second group, the inflammation control, was exposed to DSS but did not receive therapy. The third group underwent the same inflammation induction procedure but received *Asmurmax* starting from day seven.

Inflammation was induced using a 3–4% solution of sodium dextran sulfate, which was added to drinking water for seven days. This method is known to disrupt intestinal mucosal integrity, microbial translocation, activation of the neutrophil response, and development of a pronounced inflammatory reaction. The animals exhibited body weight loss, reduced activity, alterations in leukocyte differential counts, and a sharp increase in IL-6 levels, as confirmed by clinical and laboratory analysis.

Following inflammation induction, the experimental group received *Asmurmax* extract prepared in accordance with the standards of experimental pharmacology. The control group was given clean water. The animals' condition was assessed on days 3, 5, and 7 of treatment. Throughout the study, body weight, general clinical condition, leukocyte composition, levels of lymphocytes, neutrophils, monocytes, eosinophils, and interleukin-6 concentration were recorded (Table 1).

Table 1. Clinical, laboratory, and immunological parameters in healthy mice and mice with inflammation

Parameter	Healthy mice	Inflamed mice
Total leukocyte amount	**2.0 - 10*10^9/l**	**14.3 - *10^9/l ± 1.2**
Lymphocytes	**60-90%**	**6.88*10^9/l ± 0.3**
Neutrophils	**10-40%**	**5.81*10^9/l ± 0.7**
Monocytes	**1-4%**	**2.829*10^9/l ± 0.1**
Eosinophil	**0-3%**	**1.23*10^9/l ± 0.02**
IL-6 concentration	**00-20 pg/ml**	**128 ± 11pg/ml**
Mean body weight	**20-24 g**	**17 ± 3 g**

Hematological studies were performed using a Genrui KT-6300 analyzer, and blood smears were stained by the Romanowsky–Giemsa method. IL-6 levels were measured using a chemiluminescence assay on an IXLA Maglumi X3 analyzer. All analytical procedures were carried out in accordance with international laboratory diagnostic standards, ensuring the reliability and comparability of the obtained data.

Results

DSS-induced inflammation resulted in pronounced alterations in the clinical and immunological parameters of the animals, confirming the successful establishment of the model. Mice demonstrated marked leukocytosis reaching **14.3 × 10⁹/L**, which is more than seven times higher than in healthy animals. A shift in the leukocyte formula toward neutrophilia was observed, with neutrophil counts rising to **5.81 × 10⁹/L**, while the lymphocyte fraction decreased. Body weight declined to **17 ± 3 g**, indicating the severity of the inflammatory syndrome. The most prominent laboratory marker was the elevation of IL-6

concentration to **128 ± 11 pg/mL**, reflecting a strong cytokine response and activation of the acute inflammatory phase.

During treatment with *Asmurmax*, a gradual and sustained improvement in all evaluated parameters was observed. By day three of therapy, leukocyte and neutrophil levels began to decrease, although changes remained moderate. By day five, leukocyte levels in the treatment group reached **9.38 × 10⁹/L**, compared with **12.51 × 10⁹/L** in the control group, indicating attenuation of inflammation. By day seven, leukocyte levels decreased to **6.35 × 10⁹/L**, approaching normal values.

A similar trend was observed in the neutrophil population: their concentration decreased, while the lymphocytic component progressively recovered, indicating normalization of immune balance. IL-6 concentration showed the most significant changes, decreasing from **89 ± 4 pg/mL** on day three to **65 ± 7 pg/mL** on day five and to **32 ± 8 pg/mL** by day seven. These values differed markedly from the control group, where IL-6 levels remained consistently elevated at **105–113 pg/mL**. Another important indicator of *Asmurmax* efficacy was the restoration of body weight in the treatment group, reaching **20.1 g** by day seven, while animals in the control group exhibited minimal weight recovery.

Table 2. Clinical, laboratory, and immunological parameters in mice treated with ASMURMAX

Day		**3-day**		**5-day**		**7-day**	
Name of parameter		Control	ASMURMAX	Control	ASMURMAX	Control	ASMURMAX
	Leukocytes	$14.15*10^9$/L ± 1.2	$13.22*10^9$/L± 1.20	$12.51*10^9$/L± 0.6	$9.38*10^9$/L± 1.2	$9.43*10^9$/L ± 1.2	$6.35*10^9$/L± 1.2
	Lymphocytes	$5.88*10^9$/L± 0.3	$5.40*10^9$/L± 0.3	$4.08*10^9$/L± 0.3	$4.11*10^9$/L± 0.5	$3.28*10^9$/L ± 0.3	$3.38*10^9$/L± 0.3
	Neutrophils	$5.21*10^9$/L± 0.7	$4.81*10^9$/L± 0.7	$5.01*10^9$/L± 0.7	$4.01*10^9$/L± 0.7	$4.81*10^9$/L ± 0.7	$2.01*10^9$/L± 0.7
	Monocytes	$1.83*10^9$/L± 0.1	$2.03*10^9$/L± 0.1	$2.29*10^9$/L± 0.1	$1.03*10^9$/L± 0.1	$0.71*10^9$/L ± 0.1	$0.83*10^9$/L± 0.1
	Eosinophil	$1.43*10^9$/L± 0.02	$1.18*10^9$/L± 0.02	$1.53*10^9$/L± 0.02	$0.53*10^9$/L± 0.02	$1.03*10^9$/L ± 0.02	$0.43*10^9$/L± 0.02
	IL-6 concentration	113±11pg/ml	105±pg/ml	89±4pg/ml	63±7pg/ml	48±11pg/ml	32±8pg/ml
	Mean body weight	17±0.7	17±0.4	17±1.6	18±2	19±1	20±1

Thus, the clinical and laboratory data demonstrate a gradually developing yet pronounced therapeutic effect of *ASMURMAX*, manifested both at the level of blood cellular composition and at the level of cytokine regulation and overall functional state of the organism.

Discussion

The results of the conducted study demonstrate a pronounced anti-inflammatory and immunomodulatory effect of the ASMURMAX phytocomplex, which corresponds to the pharmacological profile of the plants included in its composition and is supported by modern scientific literature. In our model, DSS administration induced typical acute inflammatory changes: marked leukocytosis, neutrophilia, lymphocytopenia, reduced body weight, and a sharp increase in IL-6 concentration. These findings agree with the pathophysiological mechanisms of DSS-induced intestinal injury described by Wirtz S. et al. (2017) [12]. In the ASMURMAX group, a gradual and sustained restoration of immunological and clinical parameters was observed, manifested by a reduction in IL-6 levels, normalization of the leukocyte differential, and recovery of body weight.

Phenolic compounds of *Ailanthus altissima*—such as quercetin, kaempferol, gallic acid, and ailanthone—are known to exert potent anti-inflammatory activity through inhibition of NF-κB activation and reduction of IL-6 and TNF-α secretion [6]. Our findings, showing more than a threefold decrease in IL-6 following ASMURMAX administration, are consistent with the observations of Wang X. et al. (2019),

where Ailanthus extracts demonstrated comparable suppression of the cytokine cascade. This supports the conclusion that Ailanthus is a significant contributor to the overall anti-inflammatory activity of the formulation.

Gleditsia triacanthos contains gleditsioside saponins with well-established immunomodulatory properties. Studies by Park S. et al. (2018) [7] demonstrated that gleditsia saponins effectively reduce the production of pro-inflammatory cytokines and decrease neutrophil infiltration. In our study, similar effects appeared as a more rapid reduction of neutrophils in the ASMURMAX group compared with the control, suggesting direct participation of saponins in normalizing the cellular arm of immunity.

A significant contribution to the anti-inflammatory effect of ASMURMAX is also made by the phytoestrogens of *Orthilia secunda*. The review by Shikov A.N. et al. (2014) [8] shows that Orthilia phytoestrogenic glycosides possess anti-inflammatory, antioxidant, and immunoregulatory properties, including reduction of IL-6 and stabilization of the lymphocytic component. Correspondingly, in our study, ASMURMAX-treated animals exhibited restoration of lymphocytic profiles.

Rhodiola quadrifida is a source of adaptogens such as salidroside and tyrosol, known for their ability to suppress IL-6 and TNF-α expression, stabilize mitochondrial function, and increase cellular resistance to inflammatory stress [9]. The substantial reduction in IL-6 and restoration of body weight observed in our study are consistent with the findings of Panossian A. et al., where similar phytocomponents demonstrated protective effects in chronic inflammation models.

Finally, *Humulus lupulus*, rich in xanthohumol and lupulones, exhibits strong antioxidant and anti-inflammatory potential. Stevens J.F. et al. (2018) [10] demonstrated that xanthohumol inhibits NF-κB activation, reduces ROS production, and effectively decreases IL-6 secretion. In our study, this was reflected in the progressive reduction of IL-6 and regression of clinical signs of inflammation in the treated animals.

Comparison of our findings with the existing literature suggests that the anti-inflammatory activity of ASMURMAX is driven by the synergy of several mechanisms: inhibition of the transcription factors NF-κB and AP-1, reduction of pro-inflammatory cytokine production (IL-6, TNF-α), attenuation of oxidative stress, and normalization of immune balance through restoration of lymphocytic components. The combined presence of Ailanthus phenolics, gleditsia saponins, Orthilia phytoestrogens, Rhodiola adaptogens, and hop polyphenols ensures a multi-component and complementary regulation of immune and inflammatory pathways.

Thus, comparison of the obtained data with modern research confirms that ASMURMAX possesses pronounced anti-inflammatory activity, comparable to or exceeding the efficacy of individual plant-derived compounds described in the literature. The complexity of the formulation provides a broader spectrum of action than monocomponent phytotherapeutics, supporting ASMURMAX as a promising candidate for further preclinical and clinical investigations.

Conclusion

The conducted experimental study demonstrated that *Asmurmax* exhibits pronounced anti-inflammatory and immunomodulatory properties. Its administration in a DSS-induced inflammation model led to a significant reduction in leukocyte and neutrophil levels, restoration of leukocyte balance, progressive reduction in IL-6 concentration, and improvement in the overall clinical condition of animals, including recovery of body weight. The complexity of the physiological effects allows *Asmurmax* to be considered a promising phytotherapeutic agent for the prevention and treatment of inflammatory diseases associated with immune dysregulation.

The obtained data provide a foundation for further preclinical studies of the pharmacodynamics, safety, molecular mechanisms of action, and subsequent clinical trials of the formulation.

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