



## Evaluation of the Therapeutic Effectiveness of an *Artemisia Lerchiana*-Based Preparation in the Treatment of Purulent Wounds in Dogs

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### ABSTRACT

This study examined the healing of purulent wounds in dogs using ointments containing *Artemisia lerchiana* at various concentrations. The animals were divided into four groups, including two experimental groups (10% and 20% ointment), one control group without treatment, and one group with the traditional Vishnevsky liniment application. The active ingredient in the ointments was *Artemisia lerchiana* essential oil, and the formative substance was petroleum jelly. Four days after the wounds were made, all animals developed a purulent process, accompanied by an increase in body temperature to 39.5°C, a 22.8% increase in pulse rate, and a 24% increase in respiratory rate. In the control group, the indicators normalized by the seventh day, whereas in the treatment group, recovery occurred by the third day. By the fourteenth day, the wound area decreased by 73.4% with 10% ointment and 74.6% with 20% ointment, whereas in the control group, the decrease was only 56.3%. Leukocytosis in the experimental groups normalized by the tenth day, while in the control group it persisted until the end of the study, exceeding the norm by 39.1%. By the seventh day, the bactericidal activity of blood serum increased by 9-10% in the experimental groups and by 16.4% in the control group, after which it gradually returned to its initial values. The persistent increase in bactericidal activity in the control group reflects the ongoing infection and intensity of the inflammatory process, while the decrease in this indicator to baseline levels in the experimental groups correlates with effective treatment and wound healing. *Artemisia lerchiana*-based ointments were well tolerated and contributed to the normalization of clinical indicators. The 20% ointment demonstrated the most excellent effectiveness and can be recommended for veterinary use in the treatment of purulent wounds.

**Keywords:** *Artemisia lerchiana*, Infusion, Essential oil, Dogs, Biochemistry, Bactericidal activity.

### INTRODUCTION

Currently, one of the urgent problems in surgery is wound healing, which is directly related to the spread of ulcers of various etiologies, frequent purulent complications and significant treatment costs (Belous 2017; Yin 2018; Kalnins et al. 2021; Faccin et al. 2023; Laptev et al. 2023). There are many methods of wound healing, including new ones that are being developed and implemented in line with modern medical advances. However, it should be noted that excessive use of

antibacterial drugs leads to the emergence of microorganisms with reduced sensitivity or even resistance to these drugs (Koehler et al. 2018; Negut et al. 2018; Masson-Meyers et al. 2020; Ousey and Sussman 2021; Caneschi et al. 2023).

In such cases, the use of antimicrobial medicinal plants, considered an alternative to traditional antibiotics, is of great interest. Particular attention has been paid genus *Artemisia* (wormwood), many of which possess pronounced wound-healing activity. In recent years, studies on the antibacterial, antiviral, anti-inflammatory,

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nematicidal, and fungicidal properties of essential oils and wormwood extracts have garnered considerable interest (Pashteki and Nevkryta 2018; Liu et al. 2023; Tepe et al. 2024; Yertleuova et al. 2024a).

Among the secondary metabolites of wormwood species, terpenoids are the most studied. One promising approach to treating inflammatory diseases is the local application of plant essential oils (Boudjelal et al. 2020; Mohammed et al. 2022; Nikolova et al. 2023; Yertleuova et al. 2024b). Some components of *Artemisia lerchiana* essential oil (1, 8-cineol, borneol,  $\alpha$ -tuion, bornyl acetate) exhibit pronounced fungicidal and bactericidal activity. In particular, cineole and borneol are active compounds responsible for antimicrobial properties.

Studies on the antimicrobial activity of wormwood infusions, including *Artemisia absinthium* and *Artemisia lerchiana*, have demonstrated significant inhibitory effects against *Staphylococcus aureus*, *Streptococcus* spp., and *Escherichia coli* (Nametov et al. 2023; Karmaliev et al. 2024; Mumtaz et al. 2025). Among the leading representatives of conditionally pathogenic microflora in dogs are *S. aureus* and *S. albus*, pyogenic and epidermal streptococci, and, less frequently, Coliform bacteria. In our studies, *Staphylococcus* spp. were found in 83% of Gram-positive isolates from dog wounds, and *Escherichia coli* accounted for 50% of Gram-negative isolates (Kakishev and Ertleuova 2019).

Given the high prevalence of these bacteria on wound surfaces, the investigators investigated the antibacterial effect of the infusion and essential oil derived from *Artemisia lerchiana*. The results showed that both the infusion and essential oil exhibited potent antibacterial activity (Nametov et al. 2023). Therefore, the primary objective of our study was to assess the wound-healing efficacy of an ointment prepared from *Artemisia lerchiana* at various concentrations in the treatment of purulent wounds in dogs.

## MATERIALS AND METHODS

### Animals

For scientific research, 20 dogs (both sexes) weighing 20-22kg, aged 3-5 years, were used, kept in conditions at the University Veterinary Clinic that meet sanitary and hygienic standards and requirements.

The dogs were kept in a specially equipped experimental room at the university's veterinary clinic. Each dog had at least 2 m<sup>2</sup> of space. Their diet consisted of balanced food appropriate for their age and weight, with free access to drinking water. The room was lit by natural and artificial light with a 12-hour light/12-hour dark cycle. The room temperature was maintained at 20–22°C, with a relative humidity of 50–60%. The maintenance conditions complied with the sanitary and hygienic standards and requirements for experimental animals.

### Procedure

To study the healing of purulent wounds, animals were divided into four groups of 5 heads each. The first group received 10% *Artemisia lerchiana* ointment, the second group received 20% *Artemisia lerchiana* ointment, the third group received Vishnevsky liniment (traditional method), and the fourth group was left untreated (control group). A

10% and 20% ointment sample was tested with *Artemisia lerchiana* essential oil as the active ingredient and vaseline oil as the mould-forming agent. The technology for preparing the ointment was developed in accordance with generally accepted pharmacological principles.

The wound size was measured using the planimetric method described by Popova (1942). Blood tests in animals were performed on the Mindray BC-2800 vet hematological analyzer. Clinical trials were conducted using generally accepted methods. Humoral factors of immunity were studied by the method of Emelyanenko (1980), who determined bactericidal activity in blood serum. The method was determined using a photoelectrocolorimeter device, which measures a change in the optical density of a mixture of blood serum and a test microbe. Studies on the photoelectrocolorimeter were conducted using a red-light filter at 490nm in 10mm cuvettes. The study was conducted on healthy and infected animals at 1, 3, 5, 7, 10, 14, and 21 days.

Before the start of the experiments, a complete clinical examination and blood tests were performed on all animals. Clinically healthy animals were taken for the experiment. In all groups of animals, the size of the experimental wounds was approximately 14cm<sup>2</sup>. Subsequently, the purulent process was formed by the method proposed by Abdulla (2008). Before starting the experiments, a clinical examination of the animals was carried out; in particular, they showed generalized anxiety, limping of the leg from which the wound was made, increased body temperature, increased heart rate and respiratory rate, decreased appetite, and decreased mobility.

### Statistical Analysis

The data points were analyzed using Microsoft Excel 2016 (Microsoft Corporation, USA). Mean values and standard deviations were calculated. To compare the groups, one-way analysis of variance (ANOVA) was used, followed by Tukey's post hoc test to identify significant differences.

## RESULTS

As a result of studies conducted to determine the effect of *Artemisia lerchiana*-based and traditional drugs on purulent wounds in dogs, the following results were obtained. In case of purulent wounds, in addition to the formation of a purulent process in the animals of the entire group taken for study, the main clinical manifestations of pathology in the form of an increase in body temperature, an increase in heart rate, and an increase in breathing were characterized (Fig. 1).

The results of the study showed that both the experimental and control groups developed a tendency toward suppuration 4 days after the wound was created. After the formation of a tendency to suppuration in the wound, there was a sharp deterioration in the condition of animals of all groups, a decrease in appetite for food, the appearance of severe pain symptoms in the areas where the wound appeared, and lameness in the legs where the wound was made in animals. At the same time, the average increase in body temperature in animals of all groups to 39.5°C, that is, compared to the indicators of primary healthy animals, increased by 2.9%, the pulse rate by 22.8%, and the respiratory movement by 24%.

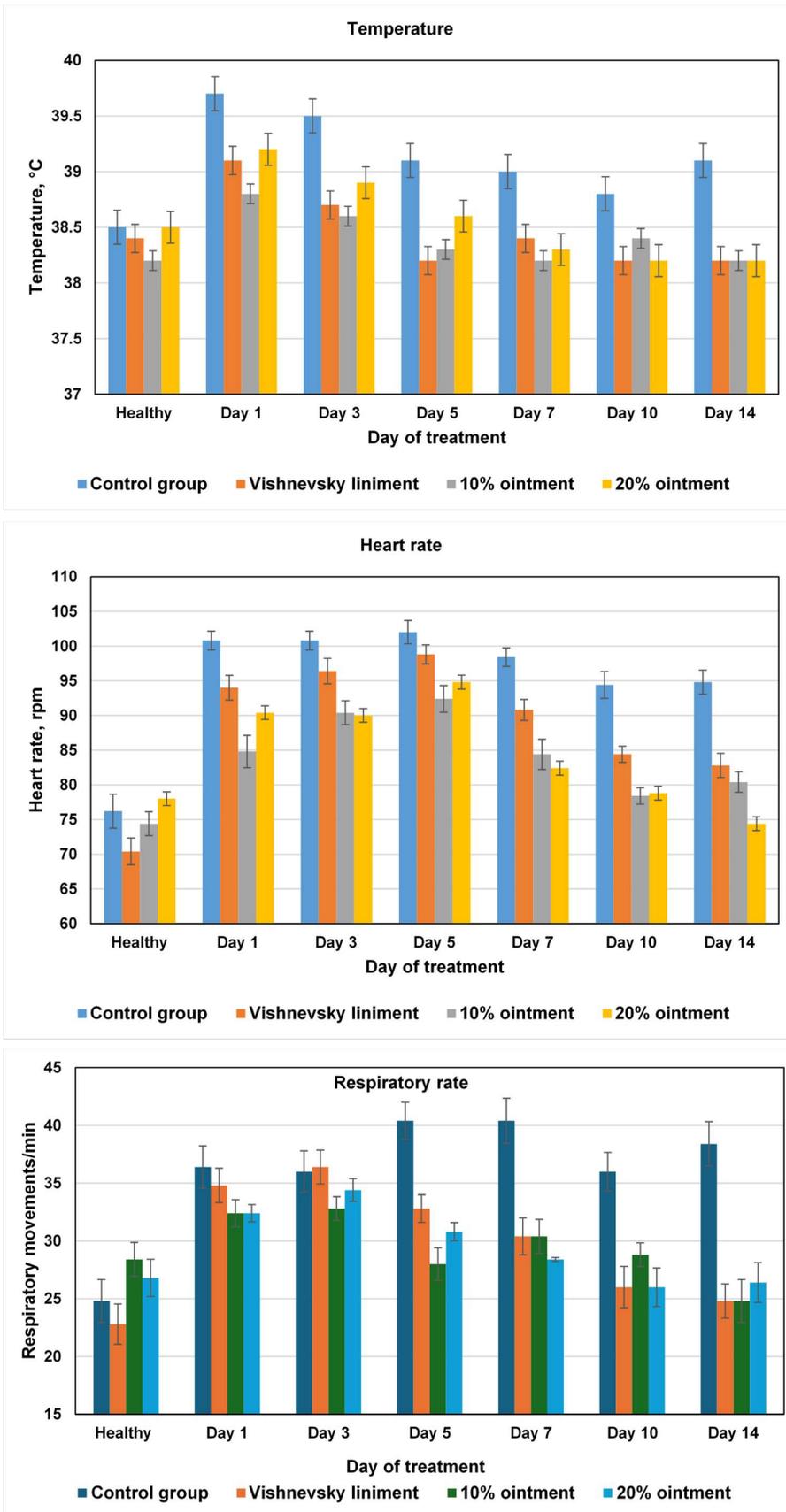


Fig. 1: Dynamics of clinical parameters in healthy animals and animals during the treatment of purulent wounds in dogs.

In the control group, body temperature remained elevated above the normal range for up to 7 days after

treatment. In the experimental groups (I, II, III), these indicators remained within the normal range for 3 days of

treatment and remained elevated until the end of treatment. Breathing and pulse rates remained above normal thresholds in the control group throughout the study.

According to the results of the research, in the experimental groups (I, II, III groups), a clear manifestation of the beginning of the initial state of the animals was observed between the 5th and 10th days. In the control group, even on the 14th day of the study, the initial indicators remained above the threshold.

A local reaction (near a purulent wound) is characterized by signs of purulent inflammation, including hypersensitivity, purulent exudate, redness of the tissues around the wound, and increased local temperature.

After examining the purulent wound, a treatment strategy was determined within the study's purpose (wound treatment, drug treatment, dressing).

Experimental animals in groups I and II were treated with preparations made from *Artemisia lerchiana* wormwood (10% and 20% ointments), Group III animals were treated with Vishnevsky liniment (traditional method for comparison), and Group IV animals were left untreated (control). The healing process began immediately after diagnosis and the determination of the treatment strategy, and changes in wound size and clinical characteristics during the course of treatment were documented (Fig. 2, 3, and 4).

According to the study's results, normalization of the animals' general condition was observed from the third day of treatment in the experimental groups (I, II, and III). On the wound surface, fibrin deposition and the initial development of scabs were also observed at this stage. Compared with the initial indicators, the wound size decreased by 13.8% in the first experimental group (*Artemisia lerchiana* ointment 10%), by 13.55% in the second experimental group (*Artemisia lerchiana* ointment 20%), by 11.42% in the third experimental group (Vishnevsky liniment), whereas in the control group the reduction was only 2.14% on the fourth day.

After these days, in the experimental groups, there is clear normalization of appetite, a decrease in edema driven by inflammation and a decrease in pain on palpation of the wound area. In the animals of the control group, anxiety persisted, local temperature and pain were observed, and it was obvious that purulent processes in the wound area persisted.

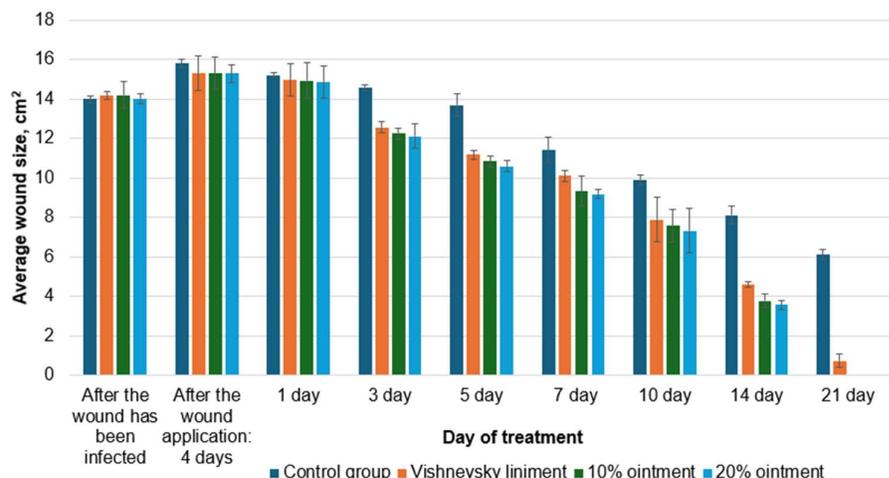
By the 14th day, complete exfoliation and wound

surface regeneration were observed in the experimental groups. The wound size decreased significantly compared to the initial measurements: by 73.38% in the first experimental group, 74.61% in the second, and 67.7% in the third. The wound surface was closed entirely 4-5 days earlier in the 1st and 2nd experimental groups than in the 3rd experimental group. In the control group, on the 21st day of the study, the wound size decreased by 56.29% compared to the initial measurements. Due to the slow healing process in the control group animals, given complications with secondary infection, it was recommended to treat the wound after the 21st day. During monitoring of the healing of purulent wounds in dogs for experimental purposes, an additional study of the morphological composition of blood (leukocytes, erythrocytes, hemoglobin) was conducted (Table 1).

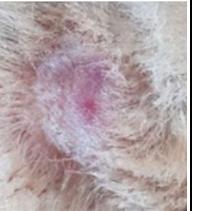
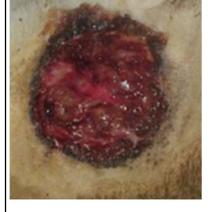
All groups show pronounced leukocytosis ( $12-13 \times 10^9/L$ ) after infection. In the control group, the increase in leukocyte count persists until the end of the experiment, decreasing only to  $9.85 \times 10^9/L$  by day 21. In experimental groups I and II, a more rapid recovery is observed: by days 14-21, the indicator returns to the physiological norm ( $7.01-7.11 \times 10^9/L$ ). In group III, the decrease is slower, and by day 21, leukocytes remain above the baseline level ( $8.57 \times 10^9/L$ ).

The number of red blood cells decreases in all groups after infection, but in the control group, recovery is minimal, and the indicator only reaches the initial level by day 21 ( $6.01 \times 10^{12}/L$ ). In the treatment group, a gradual increase is observed, and the most pronounced recovery is seen in group II, where, by the end of the observation period, the red blood cell count significantly exceeds the initial level ( $6.93 \times 10^{12}/L$ ). In group III, the increase in the indicator is moderate.

The hemoglobin level in the control group decreases and recovers slowly, remaining below normal (91.24 g/L) by day 21. In the experimental groups, recovery is faster: in group I, hemoglobin exceeds the initial level (94.18 g/L) by day 21, and in group II, it reaches the maximum values among all groups (97.36 g/L). In group III, a moderate increase is observed (92.98 g/L). Thus, the table shows that the most pronounced positive effect of treatment is observed in experimental group II, where recovery of all hematological parameters is faster and more complete than in other groups.



**Fig. 2:** Changes in the size of purulent wounds in dogs Control vs. Vishnevsky liniment:  $t = 0.533, P = 0.609$  Control vs. 10% *A. lerchiana* ointment:  $t = 0.702, P = 0.503$  Control vs. 20% *A. lerchiana* ointment:  $t = 0.864, P = 0.413$  As described in Fig. 2, changes in the size of the wound after the formation of a purulent process (after the 4th day) in dogs of the entire study group, the size of the wound increased by 13.31% compared to the initial indicators.

Group	After the wound has been inflicted	After wound application: 4 day	Treatment: 1 days	3 days	7 days	10 days	14 days	21 days
Experimental group 1 <i>Artemisia lerchiana</i> wormwood (10% ointment)								
Experimental group 2 <i>Artemisia lerchiana</i> wormwood (20% ointment)								
Experimental group 3 (Vishnevsky liniment)								
Group 4 (Control group)								

**Fig. 3:** Clinical characteristics of purulent wound healing in dogs.

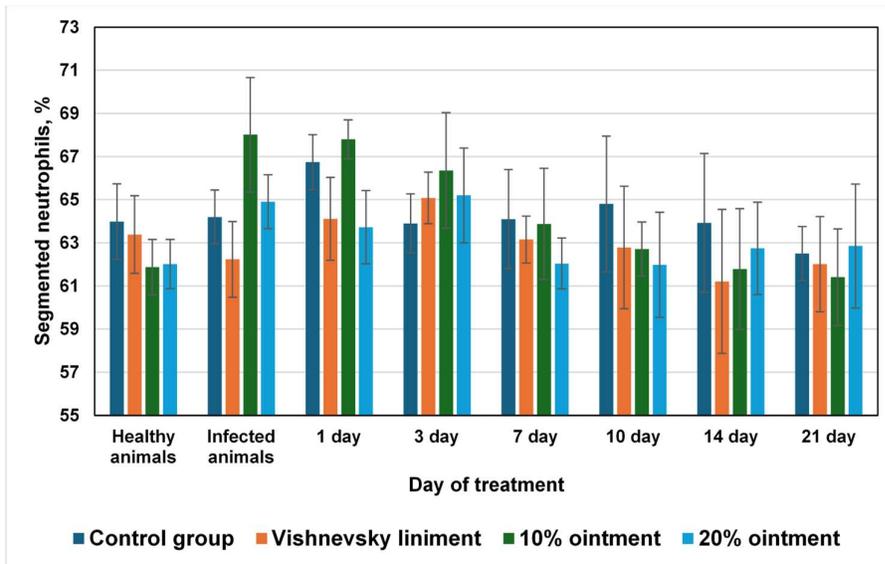


Fig. 4: Dynamics of neutrophils in the blood in purulent wounds in dogs; the segment is nucleated; b) the young and rod are nucleated.

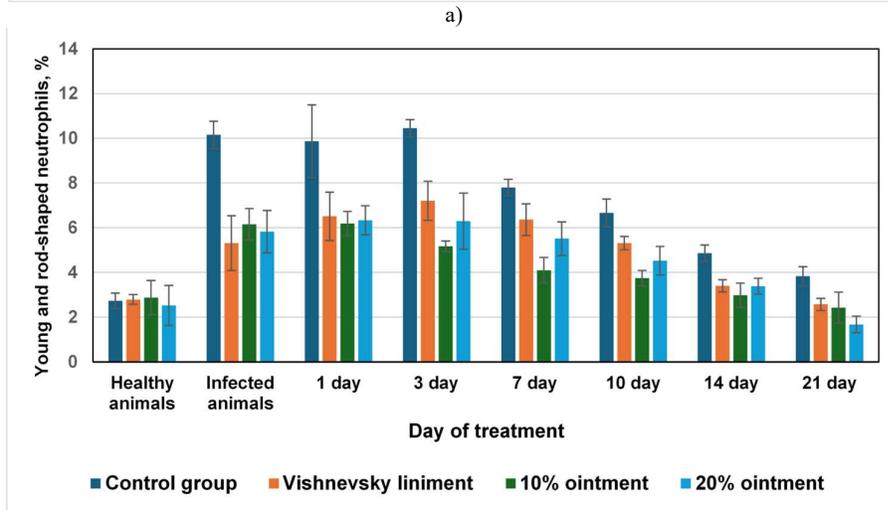
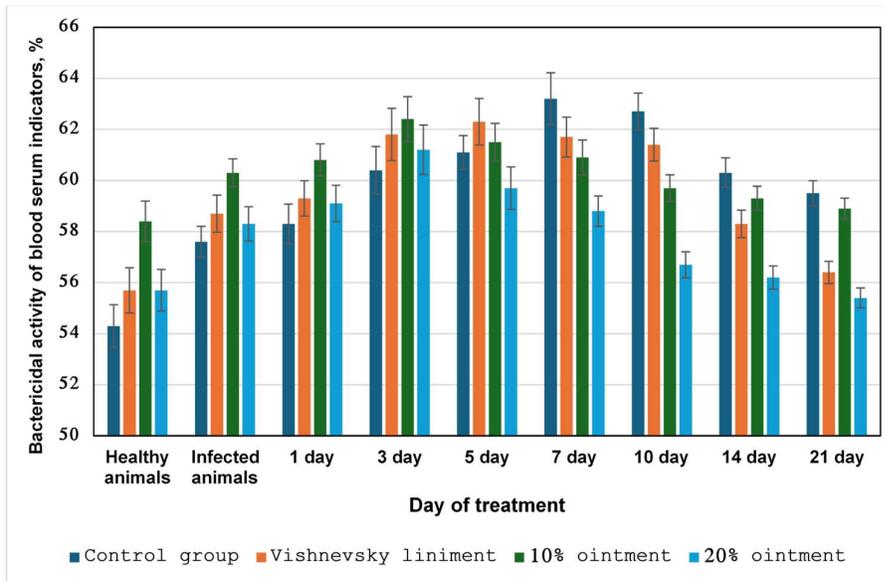


Table 1: Changes in the morphological composition of dogs' blood in the process of healing purulent wounds

Indications	Research time (day)							
	Healthy animals	Infected animals in 4 days	After treatment					
			1	3	7	10	14	21
Control group								
Leukocytes, 10 <sup>9</sup> /L	7.08±1.28	12.98±3.55	13.06±3.84	12.88±2.36	12.74±3.54	12.05±3.21	11.25±2.47	9.85±2.47
Erythrocytes, 10 <sup>12</sup> /L	6.08±0.89	5.64±2.74	5.62±1.25	5.07±1.87	5.96±1.2	5.89±1.47	5.95±1.24	6.01±1.12
Hemoglobin, g/L	93.87±2.72	90.75±3.82	89.45±3.24	85.89±3.24	87.23±3.24	88.19±4.01	89.41±3.56	91.24±2.74
Experimental group I								
Leukocytes, 10 <sup>9</sup> /L	7.57±2.47	12.45±0.98	12.38±2.2	11.54±1.89	10.25±2.25	8.89±2.87	7.08±1.8	7.01±2.04
Erythrocytes, 10 <sup>12</sup> /L	6.07±2.05	5.54±1.24	5.64±1.07	5.98±2.87	6.11±1.56	6.17±1.52	6.21±1.45	6.39±1.2
Hemoglobin, g/L	93.87±2.14	90.12±4.57	89.18±4.25	91.25±3.28	92.82±4.24	96.12±4.57	95.89±4.52	94.18±3.89
Experimental group II								
Leukocytes, 10 <sup>9</sup> /L	7.15±2.24	12.95±2.15	12.68±2.21	11.44±2.27	10.18±2.24	8.04±2.05	7.78±1.72	7.11±2.25
Erythrocytes, 10 <sup>12</sup> /L	6.11±1.78	5.86±1.08	5.81±2.05	5.91±2.76	6.18±1.25	6.24±3.87	6.38±2.1	6.93±1.75
Hemoglobin, g/L	92.15±1.28	89.25±3.98	88.14±3.85	91.4±2.05	93.18±3.14	96.74±3.24	96.25±2.17	97.36±2.15
Experimental group III								
Leukocytes, 10 <sup>9</sup> /L	8.15±2.28	13.1±1.85	12.95±2.47	12.84±2.95	11.16±2.89	10.25±4.06	8.70±2.70	8.57±1.35
Erythrocytes, 10 <sup>12</sup> /L	5.95±1.5	5.58±2.52	5.67±2.25	5.85±2.16	5.87±2.24	6.04±1.72	6.21±1.29	6.18±1.71
Hemoglobin, g/L	91.8±2.41	88.54±3.13	86.25±3.21	91.75±3.38	93.74±4.77	93.45±3.27	93.58±3.38	92.98±2.77

The table shows the dynamics of hematological parameters—white blood cell count, red blood cell count, and hemoglobin level—in healthy animals, infected animals, and animals from three experimental groups over 1–21 days after infection and subsequent treatment.

In the analysis of blood leukograms in dogs with purulent ulcers, after the 4th day of purulent process formation, there is a sharp increase in neutrophil counts across all research groups (Fig. 4a, b).



**Fig. 5:** Bactericidal activity of blood serum in purulent wounds of dogs.

Subsequently, a decrease in the percentage of neutrophils in animals in the experimental groups was observed after the 10th day, and at the end of the observation period, it reached the initial level. In the control group, neutrophilia began after the formation of a purulent process, that is, from the 1st day of treatment, and persisted for up to 14 days.

The bactericidal activity of blood serum directly influences the main indicators of wound healing in animals. The results of determining the bactericidal activity of blood serum in the treatment of purulent wounds in dogs are shown in Fig. 5.

The study of bactericidal activity in blood serum in animals with purulent wounds showed a reliable increase in all groups on the 5th to 7th days of the study. In the control groups, this indicator increased by 16.4% from its initial value. In the 1st, 2nd, and 3rd experimental groups, this indicator averaged 9-10%. Subsequently, the level of this indicator gradually decreased in experimental groups, reaching the initial level at the end of the study (Day 21). Only in Group IV (control) was the level of bactericidal activity in the blood serum 9.6% higher than the initial level.

## DISCUSSION

Our study confirmed the effectiveness of ointments containing *Artemisia lerchiana* in treating purulent wounds in dogs. Our data show the advantages of herbal preparations over traditional remedies such as Vishnevsky liniment. This observation is consistent with current trends in veterinary medicine, which emphasize the potential of herbal remedies (Nametov et al. 2023; Karmaliev et al. 2024; Kerimov et al. 2024). According to a study by several authors, *Artemisia lerchiana* essential oil has pronounced antiseptic and wound-healing properties, which are confirmed by its component composition, including camphor, 1,8-cineole, isoborneol, and camphene, which have high antimicrobial, antiseptic and anti-inflammatory effects (Jenis et al. 2025; Neyaz et al. 2025; Yertleuova et al. 2025).

No side effects were observed in animals treated with ointments based on *Artemisia lerchiana*, confirming the high safety profile of herbal preparations. These results are consistent with data from several authors (Sushinskaya et al. 2024), who showed that *A. lerchiana* infusions have no irritating or sensitizing effects, further confirming their safety for use in veterinary practice. The use of ointments based on *Artemisia lerchiana* promotes accelerated healing of purulent wounds in dogs. Animals receiving 10% and 20% ointments showed faster recovery of clinical indicators compared to the control group and the group treated with Vishnevsky liniment. Thus, normalization of temperature, pulse rate, and respiration occurred by the third day in the experimental groups, while in the control group these indicators returned to normal only by the seventh day. The reduction in wound area in the experimental animals was more pronounced: by the 14th day, wounds decreased by 73.4% with 10% ointment and 74.6% with 20% ointment, whereas in the control group, they decreased by only 56.3%. These clinical results are confirmed by other studies (Yertleuova et al. 2025).

Hematological indicators also confirm the effectiveness of the treatment: leukocytosis normalized by the tenth day in animals receiving the ointment, while in the control group, elevated levels persisted until the end of the experiment, exceeding the norm by 39.1%. The dynamics of the bactericidal activity of blood serum showed an increase of 9–10% in the experimental groups and 16.4% in the control group by the seventh day, after which the level in the experimental animals gradually decreased to baseline values, reflecting successful healing and effective treatment, while the control group remained at a high level, indicating ongoing infection and intense inflammation (Karmaliev et al. 2024).

The results obtained are consistent with recent studies on the use of herbal remedies in veterinary medicine, which emphasize the significant antiseptic, anti-inflammatory, and wound-healing effects of *Artemisia* essential oils and extracts (Romanteeva et al. 2023). In particular, the component composition of *A. lerchiana*, which includes camphor, 1,8-cineole, isoborneol, and

camphene, is effective in treating wounds in dogs (Romanteeva et al. 2023). In particular, the chemical composition of *A. lerchiana*, including camphor, 1,8-cineole, isoborneol, and camphene, exhibits pronounced antimicrobial activity and stimulates tissue regeneration (Zhigzhitzhapova et al. 2021; Zhanzhaksina et al. 2025). The absence of side effects in the experimental groups confirms the safety profile of preparations based on *A. lerchiana* and their advantage over traditional remedies, such as Vishnevsky liniment, which, when used for prolonged periods, can cause allergic reactions and reduce nonspecific immunity.

The effectiveness of the 20% ointment was slightly higher than that of the 10% ointment, as evidenced by shorter healing times and faster recovery of hematological parameters, consistent with research showing that increasing the concentration of active components in herbal preparations enhances their therapeutic effect. In addition, the observed normalization of blood serum bactericidal activity in experimental animals confirms that *A. lerchiana* can exert an immunomodulatory effect, stimulating both local and systemic defense mechanisms (Yertleuova et al. 2025).

Thus, the study's results indicate the high efficacy and safety of ointments containing *Artemisia lerchiana* for the treatment of purulent wounds in dogs. The use of these preparations accelerates the healing process, normalizes clinical and hematological parameters, and reduces the risk of secondary infectious complications. The 20% ointment demonstrated the highest effectiveness, making it the preferred choice for veterinary use in treating purulent wounds in animals.

## Conclusion

The study confirmed the therapeutic efficacy of *Artemisia lerchiana*-based preparations in alleviating disease symptoms. In the experimental groups, the animals' general condition improved from the third week, and their physiological parameters (temperature, pulse, and respiration) normalized. White blood cell counts significantly decreased by day 14, while leukocytosis persisted only in the control group. Hemoglobin levels stabilized by day 10 in treated animals and remained normal. The bactericidal activity of the wound was 5-7 times higher than in controls. These findings suggest that *A. lerchiana* preparations effectively reduce inflammation, accelerate healing, and restore hematological balance, making them a promising alternative therapy for severe cases. The treatment improved clinical outcomes and supports further investigation into *Artemisia*-based formulations.

## DECLARATIONS

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**Conflict of Interest:** There is no conflict of interest on the part of other organizations.

**Data Availability:** Data available upon request from the corresponding authors.

**Ethical approval:** The experiments were carried out following the bioethics adopted at the University and the provisions of the European Convention for the Protection of Vertebrates Used for Practical and Scientific Purposes. Experimental and clinical research was carried out as part of scientific endeavours at the Zhangir Khan West Kazakhstan Agrarian and Technical University (No: WKATU-12/2024, August 29, 2024).

**Author's Contribution:** Balaussa Yertleuova: data interpretation, critical revisions. Askar Nametov, Kanat Orynkanov: data analysis, statistical work. Aiman Ichshanova, Faruza Zakirova: data acquisition and data collection, interpretation of results. Aigerim Kozhayeva, Dosmukan Gabdullin, Nurzhan Sariyev: research design, technical support. Rinat Abdrakhmanov: methodological development. Bekzhassar Sidikhov: literature review, manuscript writing, overall study supervision. Sengaliyev Yerbol, Zhangelidi Ussenov, Yessen Tuyashev: conceptualization, research design.

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