

MINISTRY OF AGRICULTURE OF THE REPUBLIC OF KAZAKHSTAN



ZHANGIR KHAN
UNIVERSITY

Zhangir khan West Kazakhstan
agrarian-technical university

B.O. Yertleuova

The efficacy of a formulation derived from *Artemisia lerchiana* in the treatment of wounds in animals

MONOGRAPH



Oral
2025

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MONOGRAPH

Uralsk
2025

UDC 619:615.454.1:633.8

LBC 48.752

Y45

**APPROVED AND RECOMMENDED FOR PUBLICATION BY
SCIENTIFIC COUNCIL OF ZHANGIR KHAN WKATU**

(27.06.2025, № 12 minutes)

Peer reviewers: **S. G. Kanatbayev**, doctor of biological sciences, professor, head of the West Kazakhstan research veterinary station, a branch of the «Kazakh research veterinary institute» LLP
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Y45 The efficacy of a formulation derived from *Artemisia lerchiana* in the treatment of wounds in animals: monograph/ B.O. Yertleuova. - Uralsk : Zhangir khan West Kazakhstan agrarian-technical university, 2025.-111 p.

ISBN 978-601-319-630-5

The monograph examines the safety of the wormwood (*Artemisia lerchiana*) plant for the organism, its therapeutic effectiveness in veterinary medicine and human healthcare, and its accessibility in both market conditions and everyday household use. For the first time in the West Kazakhstan region, the antimicrobial effect of the endemic *Artemisia lerchiana* species-commonly found in this area-has been identified and its pharmacotoxicological safety has been confirmed. A new effective medicinal preparation for treating common surgical wounds among animals in veterinary surgery is proposed.

This monograph is recommended for veterinary professionals in the field, as well as for master's and doctoral students to apply in their practical work. Additionally, it is suggested as a resource for students studying the subjects of «Veterinary surgery» and «Pharmacology and toxicology» within the 6B09100 – «Veterinary medicine» educational program.

UDC 619:615.454.1:633.8

LBC 48.752

ISBN 978-601-319-630-5

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TERMS AND DEFINITIONS

Injury -	The term "τραύμα", derived from Greek, translates as "wound". In veterinary and biomedical contexts, it denotes a disruption of the anatomical integrity and physiological function of tissues and organs in an animal's body resulting from external environmental influences.
Phytopreparation -	are medicinal products derived from plant materials, including herbs, whole plants, or their extracts. They are used for the treatment of diseases and as preventive agents.
Sensitization -	(from Latin <i>sensibilis</i> – "sensitive") is the ability of an animal or human organism (or certain individual organs or sensory systems) to exhibit heightened sensitivity in response to external stimuli.
Essential oil -	are oily, water-insoluble liquids containing volatile biochemical compounds derived from aromatic and flavorful plants. These compounds are produced by plants and represent secondary metabolites involved in various ecological and physiological functions.
Hydrodistillation -	is a technological method of extracting essential oils from raw plant materials by using water extraction and steam distillation from diluted aqueous solutions containing essential oils.
Infusion -	(from Latin <i>infusum</i>) is an undosed liquid medicinal form prepared by extracting biologically active substances from medicinal plant materials using water. It is intended for internal or external use.
<i>Artemisia</i> -	<i>Asteraceae</i> is a large family of herbaceous or shrubby plants belonging to the family commonly known as the daisy or composite family.
Acute toxicity -	is the harmful effect of a substance that occurs after a single administration or multiple administrations within a short period (usually within 24 hours) to determine the transferable toxic and lethal doses and the causes of animal mortality.
Allergic response -	is a type of immune reaction that occurs due to a dysfunction of the immune system. According to the speed of development, allergic reactions are classified into two types: immediate and delayed responses. The initial symptoms appear within minutes after contact with the allergen.

INTRODUCTION

One of the important issues raised in the Address of the President of the Republic of Kazakhstan, Kassym-Jomart Tokayev, to the people of Kazakhstan is the development of agriculture, including livestock farming. This direction is considered one of the main mechanisms for ensuring the country's economic stability and food security.

Currently, the overall state of agriculture directly affects the country's food security. Several pilot projects aimed at increasing production volumes and improving the quality of domestic products are being implemented in this sector. The results of these projects demonstrate the efficiency of agricultural cooperatives: productivity has doubled, while livestock numbers have increased by approximately 25%.

To maintain and further develop such positive results, one of the key tasks is to ensure animal health. This is a primary priority in the field of veterinary medicine because the health of livestock is the main condition for producing high-quality and safe products.

From this perspective, preventing complications arising from injuries in animals and timely effective treatment is one of the urgent issues of modern veterinary surgery. In industrial farms, the main factors causing frequent injuries to animals include hypodynamia, stress, high concentration of animals in a confined space, violations of technological regimes, and non-compliance with veterinary and sanitary requirements. In such situations, the occurrence of wound infection is a process that follows certain patterns in the damage of animal tissues and leads to significant economic losses in livestock farming [1].

Today, veterinary specialists use various methods and tools to treat wounds. In local wound treatment, chemical ointments are considered one of the most widely used methods. Nevertheless, treatment in this area remains a relevant and pressing issue [2].

Each of the currently proposed treatment methods and drugs has its own limitations: they may be difficult to apply, expensive, or insufficiently effective against microbial flora. This creates the need to search for accessible, effective, and affordable medicinal products and pathogenetic therapy methods. One of the most urgent problems is the development of microbial resistance to antibiotics and antiseptics [3].

Therefore, one of the current tasks in veterinary medicine is to find new locally acting medicinal products that are both effective and safe. A global trend in recent years has been the use of natural compounds in veterinary and human medicine, as well as in the production of cosmetics and perfumes, as raw materials for medicinal products. Natural substances, having co-evolved with biological systems, are generally well tolerated by the body and tend to have fewer side effects compared to synthetic alternatives — this is one of their main advantages [4].

Among medicinal products applied to the skin for therapeutic purposes, ointments and gel-based preparations are widely used. These formulations offer several benefits: they allow effective drainage and ensure that the affected area is not further damaged during application, while the active medicinal components provide a positive therapeutic effect.

Currently, medicinal products used in practice are expected to have a complex effect: they must exhibit antimicrobial activity, possess high dehydrating capacity, and simultaneously stimulate tissue regeneration [5].

Research findings indicate that in treating wounds in animals, the development of plant-based preparations with antibacterial and anti-inflammatory properties, as well as the ability to stimulate tissue repair, is of particular importance.

In recent years, both domestic and international practices have increasingly used the *Artemisia* (wormwood) plant for medicinal purposes-especially in wound treatment, inflammation suppression, and antimicrobial applications [6,7].

Plants belonging to the *Artemisia* genus are characterized by their rich content of biologically active substances. Scientific interest in this plant stems from the wide range of its therapeutic applications. Specifically, its hemostatic, antimicrobial, and wound-healing properties highlight the broad pharmacological potential of *Artemisia*.

Given the plant's safety profile, its therapeutic properties in veterinary and human medicine, its availability in the market, and its widespread use in daily life, a new approach is proposed in veterinary surgery for treating commonly occurring surgical wounds in animals. This study aims to determine the antimicrobial activity and scientifically prove the pharmacological and toxicological safety of *Artemisia lerchiana*, an endemic species widely found in the West Kazakhstan region. As a result, the possibility of developing a new highly effective medicinal product is being considered for the first time.

1. TREATMENT OF WOUNDS WITH PHYTOPREPARATIONS AND A MODERN EXPLANATION OF THE HEALING PROCESS

1.1 Prevalence, etiology and pathogenesis of open wounds in animals

Injuries in animals are among the most frequently encountered non-contagious conditions. Injury rates reach 37,8% in cattle, 26,5% in three-year-old animals, and range from 12% to 30% in young bulls kept in feedlots. Among sheep, injuries occur in 44,6% during the grazing season and up to 7.3% in the winter. The incidence is 28,4% in pigs and 26,4% in horses. Under farm conditions, trauma-related injuries include wound processes (30,0%), bruises (19,4%), tendon and ligament sprains (12,9%), bone fractures (1,3%), lymphoextravasates and hematomas (0,9%), fissures (0,8%), and abscesses (0,5%).

Due to injuries, animals may experience a 30–50% reduction in weight gain, and breeding bulls may exhibit reduced semen production. In injured animals, milk yield decreases by up to 50%, and offspring rates are 15–20% lower compared to healthy animals. These factors cause significant economic losses to agricultural enterprises.

Timely detection and proper treatment of wounds can prevent many losses in livestock farming. Early-stage treatment of injuries helps minimize the risk of substantial economic damage [6].

Surgical diseases cause major economic losses both in industrial-scale and small-scale livestock operations.

The animal body is a complex self-regulating system of structures and functions. Therefore, its defense mechanisms must be considered as an integrated system of biological reactions.

Due to this complexity, injuries in animals affect not only the local tissue but also lead to systemic disturbances, such as impairments in vital functions, metabolic changes, and manifestations of neurotrophic, endocrine, and stress-related responses [7].

Gradually developing complications often result from surgical infections. Both local and systemic responses in the body can cause significant functional and systemic disturbances. There are various factors that may contribute to the development of these complications.

The progression of a wound in an animal's body depends on several factors: the force of the trauma, the duration of exposure to the injurious agent, the anatomical and physiological characteristics of the affected organs and tissues, the functional state of the nervous system, species-specific traits, and the individual resistance of the animal [8].

Non-infectious diseases account for over 80% of illnesses in animals. The main contributing factors to their development include non-compliance with zoo-hygienic standards, excessive exploitation of animals, improper feeding systems, and aggressive interactions with other animals, all of which lead to injury

formation. As a result of these factors, metabolic processes in the body are disrupted, dystrophic changes begin to develop, and organ function disorders (dystonia) occur. Additionally, the ability of cells to resist harmful agents diminishes, creating favorable conditions for the progression of wounds.

Acute non-infectious diseases tend to be more severe and frequent. If appropriate and timely treatment is not provided, the condition can ultimately result in death.

Among non-infectious diseases in livestock, surgical disorders are the most commonly observed. Frequent mechanical injuries include bruises, wounds, ligament sprains, joint dislocations, and bone fractures.

Traumatic injuries, such as incised or torn wounds of the chest and shoulder-blade area, or injuries caused by cereal plants, are often associated with long-lasting purulent processes and are slow to heal.

Therefore, the physiological condition of the animal's body—specifically, the viability of cells in each part of the body—is directly related to the overall functional state of the organism [9].

1.2 Biology of wounds in animals (clinic)

The animal organism consists mainly of self-regulating organ systems and functional systems. Therefore, the organism's defensive ability should be considered as a complex of its biological response capabilities [10].

Disruption of the integrity of organs and tissues in an animal's body poses a significant threat to the organism. Damage to vital organs can lead to hemorrhage, collapse, shock, as well as the development of surgical infections, ultimately resulting in complications such as anaerobic infections, tetanus, and sepsis [11].

The concept of a wound (*Vulnus*) is defined as an open mechanical injury to the skin, mucous membranes, and deeper tissues and organs, accompanied by pain, gaping, bleeding, and in some cases, functional impairment [12].

Pain response during trauma is associated with damage to sensitive nerve endings, ligaments, and nerve trunks. In animals, the most pain-sensitive areas include the skin surface, bone surfaces, abdominal region, and the hoof's skin. The duration and intensity of the pain response depend on the wound's location, nature of the injury, and the species-specific and individual resistance of the animal.

The gaping of a wound—i.e., the separation of its edges and walls—depends on the elasticity and mobility of the damaged tissue, as well as the size, depth, and direction of the wound. Gaping is more noticeable in skin wounds than in mucosal injuries. It is especially pronounced in highly mobile areas of the body (e.g., joint extension areas or the dorsal prominence of the withers) and when incisions run across elastic fibers.

Bleeding in wounds occurs due to mechanical damage to blood vessels. It may be capillary, venous, arterial, parenchymatous, or mixed, and may be external or internal. External bleeding is easier to detect, while internal bleeding involves

blood accumulation within tissues or anatomical cavities. Accordingly, it is classified as intramuscular or intra-abdominal bleeding. Signs of internal bleeding include weakness, rapid pulse, pale visible mucous membranes, general fatigue, and increased respiration. Over time, bleeding is categorized as primary or secondary.

Primary bleeding occurs immediately or within minutes to hours after the wound is inflicted. Secondary bleeding, or re-bleeding, happens several hours or even days later after initial bleeding has stopped. A wound is a traumatic defect characterized by mechanical injury to the covering and deeper tissues and is considered a strong irritant. The resulting reflexive and endocrine responses of the organism are anatomically local but physiologically generalized [13].

The organism's response to a wound is both direct and reversible. Therefore, the wound process should not be viewed as a purely local phenomenon; it also involves other systemic functions of the body.

Local and systemic infections resulting from wounds can impair various physiological systems. Disruptions in metabolism, blood circulation, and microcirculation, along with impaired liver function and altered biochemical indicators, directly influence the clinical condition of the sick animal. Hyperthermia leads to dehydration, renal dysfunction, and often results in hypochromic anemia. Circulatory disorders may cause capillary adhesion in the skin, brain, and kidneys, and external respiration may be impaired. Acute and chronic inflammatory processes can hinder adrenal gland function, worsening the disease and disturbing metabolic processes [14].

There is no unified classification of the wound healing process among scientists. Some base it on clinical studies of wounds, while others focus on histological and biochemical changes during healing. N.I. Pirogov was the first to highlight the characteristics of wound healing, proposing the following stages: the initial traumatic stage (infiltration of serous fluid into tissues), followed by suppuration and removal of necrotic tissues (days 4–14), and finally granulation and epithelialization of the wound [15].

These stages are not strictly demarcated, and the boundaries between them are not clearly defined.

From a biochemical perspective, wound healing progresses through three phases: the open wound gap phase, followed by the dissimulation phase, and finally the assimilation phase [16].

Based on the contraction force of the wound, healing is also divided into three stages: the latent stage, also referred to as stagnation or dormancy, which typically occurs between days 4 and 6; the fibroplasia stage, which begins around days 10 to 14 and is characterized by increased wound contraction; and the final stage, which involves maturation and scarring [17].

E.E. Peacock (1973) supported this classification but noted that an inflammatory reaction develops during the latent phase and highlighted the importance of removing necrotic tissue for effective wound healing.

Another classification approach identifies three primary stages: the preparatory or inflammatory stage, during which complex biochemical and pathophysiological processes occur to prepare the wound for healing; the regeneration stage, in which the wound cavity becomes filled with newly formed tissue; and the scarring stage, which marks the final structural restoration of the tissue. This system is considered to offer a more clinically grounded perspective on wound healing [18].

Considering cytological and pathological changes, M.F. Kamaev proposed three corresponding stages. The early stage occurs within the first 12 hours and is marked by initial signs of inflammation and microbial contamination. This is followed by the degenerative-inflammatory stage, and then the regenerative stage, which involves the removal of necrotic tissue, the formation of granulation tissue, and the subsequent normalization and scarring of the wound.

A similar classification was suggested by S.S. Grigolav and R. Ross, who also identified three main phases: inflammation, proliferation, and scarring. The first two stages are associated with the development of granulation tissue, while the final stage is characterized by the formation of the scar.

1.3 Phytopreparations used in wound treatment

Under industrial livestock farming technologies, non-infectious diseases are widespread, accounting for 94–97% of all animal diseases. Furthermore, surgical pathologies make up approximately 40% of the total number of non-infectious diseases. Significant losses in livestock farming are directly linked to injuries resulting from errors in animal handling, feeding, usage, and transportation. Injuries are most often characterized by open wounds, which are frequently complicated by wound infections. A number of researchers have noted in their studies that open injuries are among the most common types of surgical diseases and cause considerable economic damage in the field of livestock breeding. They report that such injuries account for 64.2% of all animal traumas [11].

The formation and progression of injuries in animals have been thoroughly studied and extensively documented in the scientific works of many domestic and foreign researchers. Among the various types of injuries in animals, open wounds—also referred to as lacerations—are the most prevalent.

Based on their etiology, wounds are classified as either surgical or accidental. Depending on the type of injuring agent, wounds can be categorized as incised, chopped, sliced, bitten, contused, crushed, torn, gunshot wounds, burns, or mixed types. According to microbial contamination and frequency of occurrence, wounds are further classified as aseptic, contaminated with microbes, or purulent [12,13].

Nevertheless, regardless of the circumstances of their formation, general principles of treatment are applied to all wounds. The main difference lies only in the timing of the healing process, as the wound healing sequence represents a

comprehensive set of vital bodily responses aimed at repairing tissue damage. During wound development, both destructive and regenerative changes occur in connective, epithelial, nervous, and muscle tissues. From a pathological perspective, the wound process is considered a specific form of inflammation characterized by localized disturbances [14–16].

Damage to the integrity of animal tissues and organs poses a significant threat due to the potential impairment of vital organs, bleeding, collapse, shock, and the risk of developing surgical infections, which may lead to anaerobic infections, tetanus, or sepsis.

N.I. Pirogov was the first to draw attention to the nature of wound formation. He identified several stages in the development of the wound process. The initial stage, referred to as the "first traumatic response," involves the serous infiltration of tissues. This is followed by a "purulent phase," occurring between days 4 and 14, associated with the cleansing of the wound from necrotic tissue. He also noted that the inflammation-induced swelling represents a localized response. After the necrotic tissues are removed, the wound enters the granulation phase, which concludes with epithelialization [17,18].

The division of the wound healing process into phases is a naturally established principle, as there are no clear boundaries between the stages of wound healing. According to the classification by W. Gaza, based on biological and chemical processes, wound healing is divided into three phases: the initial phase—open wounds; the second phase—the dissimulation phase; and the final phase—the assimilation phase [19].

E.L. Bezruk, focusing on the dynamics of cellular and pathological deviations, categorized the wound process into phases and stages. The initial stage, occurring within the first 12 hours, is characterized by the onset of inflammation and initial microbial contamination. This is followed by the degenerative-inflammatory stage. The final stage is the regenerative phase, which is directed at cleansing the wound of necrotic tissue and is followed by the development of granulation tissue, epithelialization, and the restoration of the wound's condition [20].

In animals, wound healing occurs through primary healing, secondary healing, or scab formation. The classification of wound healing as primary or secondary is not based on qualitative characteristics, but rather on quantitative indicators. This is because, in all cases, the same cellular elements—responsible for inflammation, proliferation, and epithelialization—participate, ensuring a similar dynamic in the wound healing process [21,22].

Secondary wound healing occurs in cases where the wound edges are not in close contact and there is tissue deficiency. A mandatory component of this type of healing is wound suppuration and granulation. In such cases, the wound is infected and contains a large amount of necrotic tissue [23].

In the first phase, the general bodily response develops in an effort to enhance vital activity. This is characterized by an increase in body temperature, a

rise in basal metabolism, weight loss, and an intensification of protein, fat, and carbohydrate breakdown. These disturbances are associated with increased adrenaline secretion, which mobilizes glycogen stores and accelerates its breakdown. Glycolysis is stimulated, blood viscosity and coagulation increase, and subsequently, thrombosis forms. Within 4 to 6 hours after the injury, leukocytes begin to develop a cellular reaction and infiltrate the damaged tissue. Neutrophilic leukocytes immediately act in the affected area and encounter the damaging agent. These neutrophils form a leukocyte complex, which helps prevent the proliferation of harmful microflora.

R. Bizikola, K.E. Lindner, and T. Olivkov (2014) demonstrated that the phenomenon of phagocytosis forms the basis of the inflammatory process and serves as the body's primary defense mechanism against microbes [24]. Neutrophils are considered highly specialized phagocytic cells [25].

In the secondary phase, body weight increases, and protein metabolism and regeneration processes begin to develop [26]. The restoration of connective tissue plays a crucial role in wound healing and in eliminating structural and functional impairments. In healing wounds, the regenerating connective tissue contains fibrous structures, cellular elements, intercellular substance, branches of blood and lymph vessels, as well as nerve endings and receptors [27, 28].

The regenerative capacity of connective tissue is exceptionally high. The regeneration of connective tissue occurs through the mobilization and division of fibrocytes. Fibroblasts, which are derived from dividing fibrocytes, are responsible for producing fibers. Elastic fibers regenerate simultaneously with collagen fibers. Granulation tissue gradually fills the defect and is eventually replaced by mature fibrous connective tissue. After this, the wound surface undergoes epithelialization. The closure of the wound with skin signifies the completion of the healing process [29–31].

Thus, when studying mechanical skin injuries—specifically wounds and wound healing processes—it is important to recognize that restoring the integrity of damaged body surfaces is a complex biological process. To choose the appropriate treatment method, it is essential to consider the stages of the wound process, the healing phases, and the species-specific characteristics of wound treatment in different animals.

The biology of the wound healing process is directly related to the living conditions of animals. Accordingly, in different animal species, the cleansing of wounds from necrotic tissues and contaminants develops in one of three main forms: purulent-fermentative, purulent-sequestrative, and sequestrative. The purulent-fermentative type is characterized by enzymatic decomposition of necrotic tissue accompanied by purulent exudate. The purulent-sequestrative type involves the separation and elimination of necrotic tissue (sequestra) in combination with purulent inflammation. The sequestrative type is defined by the isolation and gradual removal of dead tissue without significant purulent discharge.

The purulent-fermentative type of wound cleansing is observed in meat-producing animals and cloven-hoofed animals such as horses. It is characterized by purulent-exudative changes that occur during intense moisture accumulation in the form of inflammatory swelling. In this case, a purulent-fermentative process develops, involving enzymatic liquefaction of necrotic tissues, reduction of microbial load, and the removal of unwanted substances or other materials through purulent fluid [32]. This type of wound cleansing occurs over a short period and, compared to the other two types, causes less impairment to the animal's mobility.

Purulent sequestration is the primary mode of wound cleansing in animals such as cattle and pigs when wounds cover a large damaged area (Komanov A.V., 2012). Initially, the wound accumulates a large volume of fibrinous fluid, which together with necrotic tissues forms a fibrinous-tissue mass. This mass becomes dehydrated due to fibrin contraction, resulting in a dense consistency. Acting as a biological barrier, it protects the wound area from recurrent microbial contamination and other foreign substances. Contaminants entering the wound become trapped within the fibrin fibers, thus preventing microbial substances from penetrating healthy tissues [33–35].

Sequestration of wounds is typically observed during secondary healing, mainly in rodents and birds. In cloven-hoofed animals such as cattle and pigs, it occurs relatively less frequently, while in horses and dogs, it is more commonly seen in skin wounds [36, 37].

Wound treatment is generally comprehensive and includes surgical and conservative methods as well as the use of medications aimed at suppressing and eliminating pathogenic agents, detoxifying and correcting disruptions in the body's homeostasis, stimulating overall body function, and enhancing immunity [38–40].

A major drawback of many well-known drugs is their high cost and insufficient antibacterial activity. In such cases, pathogens causing wound infections often develop resistance to antibacterial agents, leading to disruption of the wound's microecology [39].

Depending on the severity of the wounds and the toxicity of microorganisms that cause wound complications, it is necessary to clarify the physical factors influencing treatment to ensure the effectiveness of the medications used [41,42].

In veterinary medicine, the study of wound processes and wound treatment has been extensively covered over the past twenty years by domestic scientists such as A.M. Nametov, K.A. Orynkhanov, A.A. Abdulla, as well as foreign researchers including A.V. Tarasov, E.V. Markina, V.N. Krechetova, and others [43–47].

Methods for treating wounds are continually being improved in line with the latest research innovations. Changes in the physiological state of the macroorganism, alterations in microbial flora, and increased variability of these

microorganisms affect the course and characteristics of the wound healing process. Consequently, new techniques and approaches for wound treatment emerge alongside advances in medical and veterinary sciences. It is well known that wound treatment begins with surgical intervention, followed by care and therapy adjustments based on the specific features of the wound healing process [48].

Depending on the cause and nature of the wound, treatment stages apply appropriate methods and tools that promote active reparative regeneration. Currently, alongside traditional wound treatment methods, several advanced techniques are widely used.

1) One such method is vacuum therapy, which is effective in actively removing excess wound exudate, increasing blood flow, normalizing the pH of the wound environment, stimulating aerobic glycolysis, providing energy support during the wound healing process, and facilitating rapid wound decontamination [49–51].

2) Local ozone therapy has antimicrobial and fungicidal effects and is based on stimulating metabolism and reducing inflammation.

3) Laser treatment of wounds using high-intensity laser radiation limits necrosis, kills bacteria, and reduces inflammation, shortening healing times in early stages; however, this method is not applied to anatomically critical areas [52].

4) Pulsed antiseptic flow therapy is used for complex and extensive wounds; antiseptic solution is applied to the wound surface under alternating pressure, effectively cleansing the wound from bacteria and necrotic tissue.

5) Ultrasonic treatment involves pouring an antiseptic solution onto the wound while delivering ultrasound waves via a generator; the cavitation effect produced in the fluid leads to bacterial death and removal of necrotic tissue.

6) Cryotherapy causes peeling through exposure to very low temperatures, which promotes epithelialization beneath the peeled area or thorough cleansing of the wound after necrosis rejection.

7) The use of composite dressings allows removal of exudate and toxins, direct application of antiseptics to the wound area, and control of moisture levels within wounds [50, p. 58].

Despite the advances in modern veterinary medicine and the emergence of new antibacterial agents, the effectiveness of wound treatment across various etiologies remains at a similar level. This is partly due to animal owners' failure to fully comply with veterinary recommendations, but more often it is associated with the development of antibiotic-resistant strains of microorganisms [53–57].

Many researchers consider antiseptics as the primary agents for local wound treatment and infection prevention [58, p. 163]. In his studies, A.A. Stekolnikov (1995) argued that when selecting antiseptics, preference should be given to bacteriostatic drugs that inhibit microbial activity without impairing the regenerative capacity of cells.

Currently, plant-based preparations are widely used in wound treatment. One such preparation is the Zalevsky balm, which contains spirulina microalgae and Siberian pine oil. A.A. Alekseev and A.E. Bobrovnikov (2012) investigated the microbiological efficacy of Zalevsky balm and found it effective against the main pathogens of burn infections [59].

As an alternative to traditional treatments, phytopreparations for wound healing have increasingly been introduced into practice. According to their pharmacological effects, these agents are not inferior to existing wound and wound infection treatments and often even surpass them [60].

Phytopreparations are medicinal plants containing biologically active plant-based substances (BAPS). They are used for the treatment and prevention of diseases in animals, poultry, and humans. Biologically active plant substances include alkaloids, glycosides, saponins, organic acids, bitter tannins, essential oils, resins, and vitamins—compounds that possess pharmacological properties.

Thanks to comprehensive professional selection, biologically active substances found in medicinal plants can be obtained, providing clear pharmacological effects not only in treating the primary disease but also in addressing concomitant conditions. Compared to synthetic drugs, phytopreparations have very few contraindications and do not lead to the development of microbial resistance [61].

Wounds in various animal species remain one of the persistent challenges in veterinary medicine. Despite the abundance of proposed treatment options, the development of methods and techniques that ensure rapid wound healing continues to be highly relevant today.

In wound treatment, drugs with antibacterial, bacteriostatic, antiseptic, and necrolytic properties are used, along with stimulative agents that enhance the body's defenses and restore processes occurring in the wound. Among these, products containing components derived from medicinal plant raw materials play an important role. Phytopreparations are characterized by high therapeutic efficacy, polyvalent effects (complex influence on the organism), safety during use, and the possibility of long-term application (for months or even years). The use of whole-plant-based medicinal forms defines their key advantages.

Medicinal plants have a chemical composition advantage over synthetic drugs because the animal body is biologically closer to the plant kingdom than to chemical substances. Plants as medicinal agents tend to cause fewer complications in animals.

For a long time, medicinal plants containing complexes of chemical compounds with multifaceted effects on the organism have been used in wound treatment. Compounds found in plants—alkaloids, glycosides, essential oils, phenolic compounds, vitamins, microelements, polysaccharides—serve as sources for developing new drugs with high therapeutic efficiency. Preparations based on medicinal plants are more affordable, accessible to animal owners, and allow long-term use without side effects [62].

The importance of medicinal plants in modern medicine is very significant. Research institutes dedicated to medicinal plants established in various countries have enabled the extraction of new valuable plant substances—such as alkaloids, cardiac glycosides, saponins, terpenes, flavonoids, and furocoumarins—from many previously unknown plant species. Despite considerable advances in the synthesis of valuable synthetic medicinal drugs, plant-based preparations continue to hold a prominent place in contemporary medicine, and the balance between the two is considered stable.

About one-third of the drugs available on the market are based on medicinal plants. Medicinal plant-derived substances possess distinctive features and complex, diverse chemical compositions. The species composition of medicinal plants, as well as their growing environment, harvesting, drying, and storage methods and durations, directly affect their properties. Approximately 40% of the pharmaceuticals used in medical and veterinary practice are plant-based.

In recent years, despite advances in chemical synthesis of drugs, there has been a growing trend toward the widespread use of natural substances in medicine. Medicinal plants and their preparations are becoming increasingly popular. However, the demand for medicinal plant raw materials is still not fully satisfied, creating a need to increase the production of these preparations.

The growing demand for medicinal plant raw materials necessitates the efficient utilization and implementation of new technologies for complex processing of raw materials as a source of new medicinal substances. It also requires in-depth chemical research of the composition and physicochemical properties of biologically active substances in the raw materials, as well as improvements in quality assessment methods. This remains a critical and relevant issue in chemical and pharmaceutical science and practice [63].

Studies by both foreign and domestic scientists report that essential oils found in plants possess antioxidant [64], antiseptic [65], antibacterial [66], radical-scavenging [67], antiparasitic, anthelmintic, antifungal [68], insecticidal [69], and anxiolytic [70] activities. Additionally, they exhibit anti-inflammatory [71], regenerative [72], neuroprotective, hepatoprotective, anticonvulsant, antidepressant [73], and sedative [74,75] properties.

Today, many researchers focus on the use of phytopreparations in clinical veterinary medicine. Some study results are described below. Research on the use of medicinal plants in veterinary practice has been conducted at the Orlov State Agrarian University named after N.V. Parakhin [76]. It was found that biologically active substances exert a certain physiological effect on the organism even when introduced in minimal amounts. Typically, these substances accumulate only in specific parts of the plant, and their quantity can significantly vary depending on hydrothermal climate conditions, soil composition, and several other factors. Plant harvesting must be carried out only during certain stages of vegetation, as plant raw materials collected at other times have a weaker physiological effect on the organism.

There are several groups of active substances in plants:

- Alkaloids have a therapeutic effect in small amounts. For example, plants of the poppy family are rich in alkaloids, while coniferous trees do not contain them.
- Cardiac glycosides are complex nitrogen-free organic compounds that have a therapeutic effect on the heart muscle. Examples include field hawthorn and bark of buckthorn.
- Saponins (a type of glycosides) are used in veterinary practice for expectorant, diuretic, choleretic effects, and they positively influence the cardiovascular system.
- Flavonoids strengthen capillary walls, participate in oxidation processes, promote wound healing, and are used for liver and kidney diseases. They are abundant in plants like beans, celery, and plants of the buttercup family.
- Organic acids participate in metabolism, increase secretory acids, stimulate the activity of salivary glands, and enhance the secretion of bile and pancreatic juice. They have digestive, bactericidal, and other properties. Organic acids are found free or in salt form in seeds, fruits, berries, roots, leaves, and stems.

The results of many studies provide a systematic basis for selecting essential oils and medicinal plants both when developing phytopreparations and when directly using plant raw materials for animal feeding, disease prevention, and treatment. This contributes to preserving livestock and further improving the efficiency of animal husbandry.

Common wormwood contains up to 0.6% essential oil with anti-inflammatory properties and is distinguished from other species by the absence of a bitter taste. The essential oil of sage leaves includes cineole, thujone, solvents, borneol, camphor, alkaloids, flavonoids, tannins, and bitter substances used to treat gastrointestinal diseases. Research has proven that the raw materials of these plant species have anti-inflammatory effects and stimulate the growth of ovarian follicles.

Dozens of medicinal plants, such as chamomile, plantain, yarrow, wormwood, birch buds, safflower, aloe, and others, have shown to accelerate the healing process when used to treat wounds and abrasions. Additionally, they help stop bleeding and reduce swelling caused by bruising and toxic effects [77].

A topical ointment was prepared from the phytoextract of round-leaved wintergreen (*Pyrola rotundifolia*) and applied to laboratory animals with skin-muscle wounds. The treatment showed a significant positive effect on wound healing. The reduction in wound size was relatively greater compared to the Vishnevsky liniment. The healing process involved secondary contraction, meaning the wound surface was covered with granular tissue, marking the formation of the epithelialization stage. On the 10th day, the wound contraction was 56.4% with Vishnevsky ointment, whereas with the round-leaved

wintergreen ointment, the wound surface was reduced by 23%, indicating that the healing process was twice as fast compared to the Vishnevsky ointment [78].

To monitor the healing of skin-muscle wounds in laboratory animals, a collagen gel with 1%, 2.5%, and 5% extracts of tuberous *Phlomis tuberosa* (tuberous mullein) was used and compared to the effect of the Solcoseryl preparation. The healing process lasted up to 28-30 days. From the 25th day onwards, a reduction in wound size was observed. The gel prepared with the tuberous mullein extract demonstrated a healing period that was 5-7 days shorter compared to the control group [79].

The use of essential oil blends from oregano, bay leaf, sage leaves, myrtle leaves, and dill seeds has demonstrated positive effects as alternatives to antibiotics [80-82].

According to a review of literature sources, the essential oil of winter savory (*Satureja montana*) exhibits antifungal, antibacterial, antiviral, immune-boosting, analgesic, and tonic effects [83,84].

V.A. Ermolaev (2010) applied an ointment for treating wounds in animals, whose main base component was a concentrated fraction of birch fungus (chaga). The biologically active substances in chaga give the ointment antimicrobial, anti-inflammatory, and reparative properties [85].

The ointment "Repalen," prepared on the basis of essential oils from medicinal plants, demonstrated high therapeutic efficacy in morphological studies during preclinical investigations of standardized thermal burns. Preclinical studies were conducted using an experimental model of thermal burns meeting Good Laboratory Practice standards. Due to the complex action of biologically active substances in essential oils, "Repalen," containing common yarrow (*Achillea millefolium* L.), Pontic wormwood (*Artemisia pontica* L.), pharmaceutical chamomile (*Matricaria chamomilla* L.), and tansy (*Tanacetum annuum* L.), shows a broad spectrum of effects against I-III degree skin burns (anti-inflammatory, wound healing, antimicrobial), reducing treatment duration by up to 3 weeks [86].

In veterinary practice, yarrow leaves are used as an anti-inflammatory agent for gastrointestinal diseases (gastritis, especially anacid gastritis, gastroenteritis, and colitis). The herbal dose for sheep and pigs is 3-10 g, and for dogs – 1-3 g. Yarrow tincture is administered to calves at a dose of 20,0 ml three to four times a day, one hour before feeding; for sheep and pigs – 10,0–15,0 ml; for dogs – 5,0–8,0 ml. Due to the presence of phytoncides, yarrow leaf tincture exhibits pronounced antimicrobial properties and is an effective remedy for treating purulent wounds and ulcers. An aqueous tincture (1:20) promotes rapid healing of infected wounds and can be used for their initial treatment [87].

Infusions of yarrow and tansy plants at concentrations of 5%, 10%, and 30% showed antimicrobial activity. Infusions at 5% and 10% concentrations did not exhibit sufficient antimicrobial effects, while the 30% concentration

demonstrated clear antimicrobial activity against pathogenic strains such as *Staphylococcus aureus*, *Escherichia coli*, and *Proteus vulgaris* [88].

In Tibetan medicine, the medicinal plant tuberous phlomidoides (*Phlomidoides tuberosa* (L.) Moench) is widely used as an anti-inflammatory and wound-healing agent.

The "Veterinary Balm" for local therapy — prepared based on pine resin, chlorophyll carotene paste, and birch resin — shows high therapeutic efficacy in treating skin diseases in animals, including dermatitis [89].

A plant-based preparation for wound treatment contains an active ingredient in the form of an alcoholic extract obtained from the entire *Melittis melissophyllum* plant, emulsified or suspended in an organic medium. This preparation includes a specific amount of alcoholic plant extract, ethyl alcohol, and an organic medium. The mentioned preparation accelerates the regeneration processes during wound healing [90].

The extract of coltsfoot oil has demonstrated high efficacy in treating purulent wounds in cattle and domestic animals. During studies of this preparation, no deviations in the physiological condition of the animals were observed [91].

Many plants are widely known for their medicinal properties, particularly their antiseptic qualities. Previous studies have confirmed the antiseptic properties of plant extracts such as chamomile, potentilla (cinquefoil), and thyme [92,93].

Aloe preparations are frequently used for wound treatment due to their anti-inflammatory, antibacterial, and wound-healing effects. They can enhance immune reactivity and the body's defense functions while stimulating regenerative processes in damaged tissues. Aloe juice has been shown to have a bacteriostatic effect on many groups of microorganisms [94].

A literature review indicates that the essential oil of mountain savory (*Satureja montana*) possesses fungicidal, antibacterial, antiviral, immunostimulatory, analgesic, and tonic effects [95].

Components of essential oils, specifically thymol and carvacrol, have been found to exhibit synergy with penicillins against *Escherichia coli* and *Salmonella typhimurium*. Carvacrol also demonstrates a synergistic effect with ampicillin and nitrofurantoin against *Klebsiella oxytoca* [96].

*Sanguisorba officinalis** L. (great burnet) is a perennial herbaceous plant with thick rhizomes and small flowers gathered in dark red clusters. It is commonly found in meadows, shrubs, and grassy slopes. It is used as a mucilaginous agent in gastrointestinal diseases, enterocolitis, poisoning, and diarrhea; as a hemostatic during uterine bleeding; and for oral rinsing and antimicrobial purposes.

Great plantain (*Plantago major* L.) has a broad spectrum of action; its extract possesses calming, hemostatic, and bacteriostatic effects [97].

The results of many studies enable a proper approach to selecting essential oils and medicinal plants when developing phytopreparations. The direct use of

plant raw materials for disease treatment contributes to the preservation and further development of livestock, supporting systematic advancement in animal husbandry.

In conclusion, the trend in wound treatment in medicine and veterinary practice is shifting over time from chemical drugs toward natural substances, as evidenced by scientific research. Since plant-based compounds are biologically closer to animal organisms and their nutrition systems, their safety in inhibiting pathological processes in animals has been clearly demonstrated. The next section of the study analyzes scientific literature to determine the importance of various species of wormwood (*Artemisia*) in medicine and veterinary science.

1.4 The use of plants belonging to the *Artemisia* genus in medicine and veterinary practice

The number of plant species growing in the territory of Kazakhstan exceeds six thousand, of which approximately 1,300 possess medicinal properties. More than 500 of these medicinal plants are endemic, meaning they are unique to Kazakhstan. The flora of Kazakhstan includes over 80 species of the *Artemisia* (wormwood) genus, which is highly valued as a large-scale source of raw material in the country. Such a rich resource base offers the opportunity for targeted and efficient use of wormwood. The high concentration of biologically active substances in wormwood makes it especially suitable for medicinal purposes.

The scientific and practical interest of many researchers in this plant is due to its wide range of therapeutic activities. In traditional medicine around the world, wormwood species are used for treating wounds, reducing body temperature (antipyretic effects), reducing sputum, combating intestinal parasites, stopping bleeding (hemostatic effect), and promoting blood coagulation. Among the *Artemisia* species, the most extensively studied is *Artemisia annua* L., which has been a primary therapeutic agent in combating malaria in distant foreign countries. However, many wormwood species found in Kazakhstan remain insufficiently studied [98].

The floral composition of Kazakhstan is distinguished by a wide variety of medicinal plant raw materials, which can be fully utilized on an industrial scale. One of the most widely distributed medicinal plants across Kazakhstan's vast territory is wormwood, belonging to the genus *Artemisia*. This plant is among the leading species in the country's vegetation cover, notable for its medicinal properties. It belongs to the complex and systematically diverse group of dicotyledons in the family *Asteraceae* (*Compositae*). The botanical Latin name *Artemisia* resonates with the meaning “healthy” or “well-being.”

Artemisia includes herbaceous plants and shrubs that are resilient to natural environmental conditions. Wormwood is characterized by medicinal substances distinguished by complex chemical components based on essential oils.

Artemisia species are widely distributed across the globe, found in various geographic regions: temperate zones of Eurasia, Africa, Europe, the Middle East, Afghanistan, Pakistan, China, Korea, Japan, and the Indian (Himalayan) region. The greatest species diversity is found in Russia (over 180 species), including the geographic zones of Yakutia (22 species), Siberia (over 70 species), Buryatia (more than 46 species), and China (over 200 species). In Kazakhstan, there are more than 80 species, with over 30 species growing in the central regions and more than 10 species recorded in the western regions, including local and rare plants that remain incompletely studied [99].

Essential oils and extracts derived from *Artemisia* have recently been extensively studied and have attracted significant interest due to their antibacterial, antiviral, anti-inflammatory, anti-helminthic, and antifungal properties [100].

Among the classes of metabolites found in wormwood species, terpenoids have been the most thoroughly researched. One promising area for treating inflammatory diseases is the topical application of plant essential oils.

Essential oils and their components have been identified in various medicinal substances, demonstrating a broad spectrum of activities—including analgesic, irritant, antimicrobial, immunomodulatory effects—as well as antioxidant properties involved in metabolic processes in the body [101-103].

Identifying the antimicrobial components that form the chemical basis of these essential oils determines the primary direction for their effective therapeutic use [104].

The active essential oil components with antimicrobial properties against harmful microorganisms include the following:

1. Phenols:

- 1.1. Thymol – found in essential oils of fragrant ajowan *Trachyspermum ammi* (L.) Sprague ex Turrel. (Apiaceae), savory *Satureja* L. (Lamiaceae), monarda (Lamiaceae), thyme *Thymus* L. (Lamiaceae);

- 1.2. Carvacrol – in oregano essential oils *Origanum* L. (Lamiaceae), monarda, savory thyme;

- 1.3. Eugenols – found in essential oils of patchouli, clove, citronella.

2. Terpene alcohols:

- 2.1. Linalool – in coriander essential oils *Coriandrum sativum* L. (Apiaceae), narrow-leaf lavender *Lavandula angustifolia* Mill. (Lamiaceae), clary sage *Salvia sclarea* L. (Lamiaceae), mint *Mentha* L. (Lamiaceae);

- 2.2. Geraniol – in rose essential oils *Rosa* L. (Rosaceae), medicinal lemon balm *Melissa officinalis* L. (Lamiaceae);

- 2.3. Menthol – in mint essential oil;

3. Ketones:

- 3.1. Thujone – in essential oils of some *Artemisia* species: wormwood *Artemisia absinthium* L. (Asteraceae), common mugwort *A. vulgaris* L., Crimean

mugwort *A. taurica* Willd., as well as medicinal sage *Salvia officinalis* L. (*Lamiaceae*), common tansy *Tanacetum vulgare* L. (*Asteraceae*);

4. Camphor – in essential oils of medicinal sage and *Artemisia*;

4.1. Menthone – in mint essential oil;

5. Esters:

5.1. Anethole – in essential oils of common anise *Pimpinella anisum* L. (*Apiaceae*), common dill;

5.2. Estragole (methyl chavicol) – in essential oils of tarragon *Artemisia dracunculus* L. (*Asteraceae*), common dill, and common anise [105].

Essential oils with a high content of non-phenolic components exhibit antimicrobial and antibacterial activity. A study of the effects of essential oils from some wild Siberian plants on several strains of conditional pathogenic microorganisms revealed that peppermint and lemon essential oils possess the strongest bactericidal properties against all tested bacteria. For Gram-positive bacteria (*Staphylococcus aureus*, methicillin-resistant *Staphylococcus aureus* MRSA, *S. aureus* 209), peppermint essential oils (whose main component is menthol) and common juniper *Juniperus communis* L. (family *Cupressaceae*) showed significant activity [106].

According to scientific research, over 250 species of the *Artemisia* genus have been studied, and the scientific conclusions indicate that they contain many secondary metabolite classes, which are pharmacologically active metabolites and complex chemical compounds. The main biologically active component of wormwood is essential oils (EOs), while additional substances include organic acids, fatty acids, and phenolic compounds (tannins). Among the components of the essential oils, pinene, cadinene, phellandrene, and other biologically active substances have also been identified [107].

Currently, the most studied species of wormwood in terms of chemical composition and therapeutic scope are: *Artemisia vulgaris* (common mugwort), *Artemisia pontica* (Pontic wormwood), *Artemisia annua* (annual wormwood), *Artemisia absinthium* (bitter wormwood), *Artemisia selengensis* (Selenga wormwood), *Artemisia gmelini* (Gmelin's wormwood), *Artemisia frígida* (cold wormwood), *Artemisia mongolica* (Mongolian wormwood), *Artemisia jacutica* (Yakut wormwood), *Artemisia argyi* (argyi wormwood), *Artemisia austriaca* (Austrian wormwood), *Artemisia abrotanum* (southernwood), *Artemisia arctica* (Arctic wormwood), *Artemisia glabella* (sea wormwood), *Artemisia sieversiana* (Sievers' wormwood).

Essential oils are the main components of various substances, and it is more difficult to determine exactly how they act; they act through synergy or modulation by other minor molecules obtained through extraction. Essential oils have been found to exhibit anti-inflammatory and reparative properties as well as antimicrobial and fungicidal activity [98, p. 60].

One of the topical directions is the selection of wormwood species with essential oils that effectively inhibit microbial growth and reduce resistance

properties. Dela Croix was the first to evaluate the antibacterial properties of essential oils in 1881. The data on the antimicrobial effect and prevention of organism acidification by the essential oils of *A. annua* grown in Bosnia was confirmed by Caviar Sanja. Besides antimalarial properties, *A. annua* has been found to possess anti-inflammatory, antipyretic, antifungal, antiparasitic, and cytotoxic properties. Variability in the composition of wormwood essential oils is directly related to its growth region and developmental stage [108-112].

The therapeutic properties of medicinal plants depend on the active substances in their composition. Initially, essential oils constitute 33-35%, alkaloid-containing plants 18-20%, plants with flavonoids 13-15%, and plants containing carotene and saponins make up 7-10%. Phenolic compounds, essential oils, flavonoids, tannins, coumarins, lectins, and polypeptides are rich in microorganisms; these substances are found in most parts of the plant body. Accordingly, a comparative study of the local *A. lerchiana* plant tincture, which frequently contains terpenoid biologically active substances, with tinctures of other antimicrobial medicinal plants showed that the alcoholic tincture based on *A. lerchiana* had 35-37% greater effect against *Staphylococcus* and 21-22% greater effect against *E. coli* compared to other medicinal plants [113].

According to the concept of synergism, it is considered more important to study the whole essential oil composition of various *Artemisia* species rather than focusing on individual components. The essential oil of *Artemisia santonicum* inhibits the growth of many microorganisms, whereas *Artemisia vulgaris* only stops the proliferation of certain bacterial strains (such as *Staphylococcus aureus*, *Staphylococcus epidermidis*, *Enterococcus faecalis*). Among the tested bacteria, *Staphylococcus aureus* was the most sensitive to all essential oils. The essential oils of *Artemisia santonicum* and *Artemisia scoparia* showed inhibition zones against *Candida albicans* that were comparable to the antifungal drug ketoconazole. Methanol extracts of the plants showed preferential activity only against *Pseudomonas aeruginosa* and *Escherichia coli*. The most active extracts against *P. aeruginosa* were those of *Artemisia vulgaris*, *Artemisia arborescens*, and *Artemisia santonicum*, exhibiting clear lysis zones (ranging from 20 to 23 mm), similar to the synthetic antibiotic ceftazidime. The extracts showed weak activity against *E. coli* strains. The most active against *E. coli* (ATCC strain 29998) was *Artemisia absinthium* [114].

The essential oils of various species of the genus *Artemisia* L. possess antibacterial effects. Experiments have shown activity against *Staphylococcus epidermidis*, *S. aureus*, and *E. coli* bacteria [115].

Another promising anti-inflammatory medicinal plant is wormwood (*Artemisia absinthium*) — a perennial herbaceous plant and a typical species of the genus *Artemisia* in the family *Asteraceae*. Its antibacterial, antifungal, anti-inflammatory, analgesic, and antioxidant biological activities have been confirmed by many scientific studies [116].

Research has shown that wormwood and its extracts exhibit anti-inflammatory effects, which may be related to sesquiterpene compounds and flavonoids. These compounds demonstrate anti-inflammatory activity by inhibiting inflammation regulators such as histamine, bradykinin, serotonin, and prostaglandins [117,118].

According to study results, the aerial part of common wormwood contains vitamin C (5.43 mg/%), vitamin B1 (1.03 mg/%), as well as flavonoids and tannins. The alkaloid content is very high, reaching 0.5% [119].

Many species of *Artemisia* L. (wormwood) plants have been used for many years in both official and traditional medicine. The pharmacological properties of wormwood are related to the large amount of biologically active compounds they contain. These include essential oils, coumarins, alkaloids, phenolic compounds, organic acids, and others, based on which various medicinal preparations are obtained. For example, “Guaiazulene” and “Santonin” are extracts obtained from the leaves of *Artemisia cina* and *A. absinthium*.

Usually, the pharmacological properties of *Artemisia* species are associated with their essential oils. The yield of essential oil in dry plant material ranges from 0.18% to 0.33%. The common components found in all samples are 1,8-cineole, camphor, and germacrene. However, the composition of essential oils in plants varies quantitatively. For example, the camphor content in the essential oil of *A. lerchiana* is approximately 30%, while in *A. santonica* it is only 0.3%.

1,8-cineole constitutes 14.5% of all essential oil components in *A. pauciflora*, twice less in *A. lerchiana*, and only 0.3% in *A. santonica* [120].

Extracts of *Artemisia gmelinii* Weber ex Stechm have demonstrated a broad spectrum of antifungal and antibacterial activity. Identifying the potential compounds of this plant allows for the development of antibacterial and antifungal drugs [121].

Research results showed that the antimicrobial activity of various *Artemisia* species differed against microorganisms such as *Staphylococcus aureus*, *Staphylococcus epidermidis*, *Escherichia coli*, and *Candida albicans*. The study used more than 10 species of *Artemisia*. The researchers found that all tested species possessed bactericidal properties.

Nine species of *Artemisia* exhibited bactericidal activity against *S. epidermidis*, six species against *S. aureus*, and eleven species affected *E. coli*. Nearly all species of *Artemisia* tested showed the ability to inhibit the growth of the microorganisms [122].

Recently, not only have agents with antimicrobial activity been developed, but drugs capable of withstanding the persistent potential of toxic organisms have also attracted major scientific interest. Recent studies have revealed that the formation of biofilms resistant to antibiotics, phagocytosis, and other components of the immune system by microorganisms has led to the discovery of many derivative compounds such as monoterpenes, sesquiterpenes, flavonoids, and coumarins [123–126].

Some components of the essential oil obtained from *Artemisia lerchiana* (1,8-cineole, borneol, α -thujone, bornyl acetate, α -thujone) have been found by L.P. Tsedenova and other authors (1999) to possess fungicidal and bactericidal activity while protecting the organism from pathogens [127]. Methanol and acetone extracts of *A. lerchiana* showed bacteriostatic activity against *Pseudomonas aeruginosa* 1390, and bactericidal activity against two other strains (*Escherichia coli* K16 and *Bacillus subtilis* 168) [128]. As a result of studying the antimicrobial activity of tinctures of the wormwood plant, two species of wormwood (*Artemisia absinthium*, *Artemisia lerchiana*) showed high antimicrobial activity against test microbes such as *Staphylococcus aureus*, *Streptococcus*, and *Escherichia coli* grown in EPS and EPA [129]. Experimental studies on the antifungal effect of *Artemisia* species growing as meadow flora in various regions of Romania (*A. santonica*, *A. pontica*, *A. annua*, *A. austriaca*, *A. lerchiana*, *A. vulgaris*, *A. scoparia*), as well as cultivated species (*A. abrotanum*, *A. dracunculus*, *A. dracunculus* var. *pilosa*), on the fungal pathogen *Sclerotinia sclerotiorum* were evaluated in vitro using essential oils obtained by hydrodistillation. The results showed that *A. santonica*, *A. pontica*, *A. annua*, *A. austriaca*, *A. dracunculus*, *A. lerchiana*, and *A. vulgaris* had a minimum inhibitory concentration (MIC) of 2400 $\mu\text{L L}^{-1}$, while *A. abrotanum* had an MIC of 1200 $\mu\text{L L}^{-1}$ [130].

In scientific studies conducted by several researchers from the Republic of Moldova, among 68 species belonging to the Asteraceae family, the following species of wormwood (*Artemisia campestris* L., *A. annua* L., *A. absinthium* L., *A. lerchiana* Web Stechm., *Anthemis arvensis* L.) were identified to have anthelmintic effects. These species require further research for various medicinal purposes. The biologically active substances identified in these medicinal species indicate a high potential for future studies [131].

In conclusion, it has been determined that among the medicinal plants growing in the territory of the Republic of Kazakhstan, research has been conducted only on some species of wormwood. Considering the wide range of plants belonging to the genus *Artemisia* growing in our country, the study of the biologically active substances of *A. lerchiana* — regarded as an endemic species growing in the West Kazakhstan region — to determine its antibacterial and anti-inflammatory properties highlights the importance of this research.

1.5 Description of the plant *Artemisia lerchiana*, its chemical and biologically active composition

Artemisia lerchiana, belonging to the genus *Seriphidium* of the family Asteraceae (or Compositae), is a wild, semi-shrubby plant. This species is widely distributed as one of the leading dominants in the Caspian-Kazakhstan desert communities of Eastern and Western Kazakhstan [132–136]. In the Lower Volga region, the species composition of plant communities often experiences soil salinization due to moisture and mineral nutrient deficiency, high

temperatures, and excessive insolation. The predominant vegetation type in the Lower Volga region is steppe. Within the plant cover of the desert steppe, wormwoods of the genus *Seriphidium* (Bess) play a dominant role. Its main representative is *Artemisia lerchiana* (Web.) (known as white wormwood or Lerch's wormwood). This species is part of various natural complexes and phytocenoses within its geographical range [137].

Artemisia lerchiana is found from the Lower Don and Volga regions to the borders of Central Kazakhstan, typically inhabiting plakor-like spaces with saline light-chestnut soils. This plant is a dominant species in communities widespread in dry steppe areas, while in the semi-desert steppe subzone, Lerch's wormwood (lercha cenoses) forms predominant complexes [138].

Lerch's wormwood, or white wormwood (*Artemisia lerchiana* Web.), is a perennial shrub-like plant of the Asteraceae family, growing 16–50 cm tall. It is a valuable forage plant. Initially, the entire plant is covered with dense grayish hairs, later becoming partly bare. The shrub consists of perennial, strongly shortened shoots and short annual leafy stems. It has high seed viability and is branched in the upper part of the plant.

This species is distributed in the steppe, southern forest-steppe, and semi-desert regions of the European part of the Russian Federation, as well as in Kazakhstan. It grows on highly saline black earth, black chestnut, chestnut, light chestnut, and brown soils, including saline soils. The presence of white wormwood in the plant cover is an indicator of soil salinity [139].

It begins to grow in April–May, flowers in August–September, and fruits in October and even in early November. It usually spreads by seeds, although in some cases lateral branches take root. Seedlings appear in the fall and under favorable weather conditions. During winter, they reach a height of 3–5 cm. Most young plants die during the winter. Vegetative propagation occurs in the first year, and fruiting begins in the second or third year.

Steppe communities in the West Kazakhstan region, particularly in the Bokeyorda area, are notable for their floristic diversity. These communities form phytocenoses consisting of typical local steppe plant species. Additionally, there are other distinctive features of the flora in this region. Here, herbaceous cereal crops such as *Stipa sarentana*, *Festuca valesiaca*, *Agropyron desertorum* dominate, and shrub species including *Artemisia lerchiana*, *Artemisia pauciflora*, and *Kochia prostrata* are frequently found [140].

Shrubs are the dominant life form in desert areas. However, in the steppe zone, shrubby communities are typical but mainly develop on rocky, gravelly, and saline soils. Among shrubs distributed in steppe and desert zones, desert species can be distinguished; these occur only in desert areas and are absent in the considered region. There are steppe species such as *Artemisia lessingiana* Bess., which fully belong to the steppe zone (rarely entering the desert zone). Steppe-desert shrubs reach their phytocenotic optimum in the desert zone but form communities in the steppe zone. These include *Artemisia lerchiana* Web. ex

Stechm., *Anabasis salsa*, and *Halocnemum strobilaceum*. Desert-steppe species reach their phytocenotic optimum in the steppe zone but play an important role in the vegetation cover of the desert zone. These include *Artemisia pauciflora* Web., *Artemisia santonica* L., and *Atriplex cana* [141].

Artemisia lerchiana is a haloxerophyte and exhibits high tolerance to water scarcity and soil salinization.

The leaves of *A. lerchiana* are characterized by xeromorphic traits (dense pubescence, well-developed cuticle, small-celled epidermis, etc.). Under conditions of severe salinization, they acquire succulent features manifested by an increase in the number of cellular layers in the protective tissue of conductive bundles, as well as an increase in the volume of protective cells and mesophyll, which contribute to water retention in the leaves.

Under conditions of low soil water potential (drought, salinity), the water absorption capacity of wormwood is ensured by the accumulation of inorganic ions — K^+ , Na^+ — and organic osmolytes — mono-, di-, and trisaccharides, as well as glycerol — in cells. The upward movement of water in wormwood plants is largely associated with the creation of a water potential gradient in the soil-root-shoot system, facilitated by the gradient distribution of K^+ and monosaccharides and glycerol.

Plants of *A. lerchiana* in the steppe zone are characterized by two growth phases corresponding to precipitation periods (spring-summer and autumn). The middle of the growing season (August) corresponds to a dormancy period when stress factors peak. This phase is characterized by growth cessation, a decrease in vegetative and generative biomass, and their submersion in water. This allows wormwood to endure the dry period and complete the growing season with fruiting in favorable hydrothermal conditions in autumn.

Protection of the photosynthetic apparatus of wormwood from excessive insolation is ensured not only by the morphological and anatomical features of the leaf (hairy, insulated mesophyll) but also by the relatively stable content of carotenoids per unit leaf surface during the growing season, the increase in the share of carotenoids in the pigment complex during the peak of stress factors, and an efficient transition in the state of chloroplasts.

During the dormancy period in the middle of the growing season, maintenance of wormwood's life activity is associated with the preservation of photosynthetic activity in the leaves, which is ensured by the relatively high pigment content per unit leaf area and the low sensitivity of the photosynthetic apparatus to drought and salinity [142].

Representatives of wormwood (*Artemisia*) play an important role for humans. In some regions, they serve as a primary forage base for large livestock. They are also used in the food industry and as essential oil crops. Some species of wormwood are used for medicinal purposes. Pharmacognostic studies have been conducted in Russia and worldwide on various species of the *Artemisia* genus, such as *A. annua*, *A. sieversiana*, and *A. vulgaris*. These studies aim to develop

phytopreparations based on these species for potential future use in medical practice [143].

Research on the composition of the essential oil of *A. lerchiana*, as well as the seasonal dynamics of its formation in plants from the Volgograd and Ilovlya cenopopulations, showed that the essential oil is synthesized and accumulated in secretory structures—glandular trichomes—on the aerial parts of the plant. Long-term studies of their compositional dynamics revealed that maximum essential oil production usually occurs during the active growth period in spring and summer. High essential oil yields were also observed mid-vegetation season during the peak of stress factors.

Analysis of the chemical composition of the essential oils identified about 58-60 individual components. The main components of the essential oil were mono- and bicyclic monoterpenes and their derivatives: 1,8-cineole, camphor, borneol, bornyl acetate, and camphene. These components accounted for 88-89% of the total essential oil composition. Thus, *A. lerchiana* can be classified as a camphor-type wormwood. Minor components included monoterpenes and their derivatives, as well as mono-, bi-, and tricyclic sesquiterpenes and their derivatives. Studies of component composition in plants from various cenopopulations showed that edaphic factors have little effect on the overall composition of the main essential oil components but do influence their relative proportions. Weather conditions also affect the ratios of the oil components [144-146].

Components of *A. lerchiana* essential oil such as camphor, camphene, pinene, 1,8-cineole, myrtenol, and eucarbon may have allelopathic effects on other plant species [144-146]. Some components of the essential oil, including 1,8-cineole, borneol, α -thujone, borneol, and bornyl acetate, exhibit fungicidal and bactericidal activity and protect against pathogens [147-152]. Additionally, some substances found in the essential oil, like germacrene D and α -pinene, have antioxidant activity [153], which is crucial for this species growing under drought, salinity, high temperature, and excess solar radiation conditions.

Studies on the biologically active compounds in three *Artemisia* species—*A. santonica*, *A. pauciflora*, and *A. lerchiana*—included low molecular weight carbohydrates, proteins, amino acids, carotenoids, phenolic compounds, and the qualitative and quantitative composition of essential oils. All species showed a high level of proline in their amino acid composition. Among these, *A. lerchiana* essential oil was found to be dominated by camphor [120, p.34].

A. lerchiana produces significant amounts of essential oil throughout the growing season (0.5–1.5% of dry weight). Approximately 60 terpenoid compounds were identified in the oil, some of which play protective roles such as allelopathic, fungicidal, bactericidal, and antioxidant effects. The main components of the essential oil—camphor, 1,8-cineole, borneol, bornyl acetate, and camphene—constitute about 90% of all detected components, and their relative proportions vary depending on weather and edaphic conditions.

A. lerchiana exhibits the highest antioxidant activity and has elevated levels of proline, monosaccharides, as well as manganese (Mn) and boron (B) [154].

In Bulgaria, methanol and acetone extracts of *Achillea clypeolata*, *Artemisia annua*, *A. campestris*, *A. santonica*, *A. lerchiana*, *Micromeria dalmatica*, *Origanum vulgare* subsp. *hitrum*, *Salvia sclarea*, *Salvia officinalis*, *Tanacetum parthenium*, and *Thymus yankee* were tested for antibacterial activity against *Pseudomonas aeruginosa*, *Escherichia coli*, and *Bacillus subtilis*. Results showed that both methanol and acetone extracts predominantly exhibited bactericidal activity.

The methanol and acetone extracts of *A. lerchiana* demonstrated bacteriostatic effects against *P. aeruginosa*. The study revealed that both extracts have a complex multi-component composition. Common constituents in both methanol and acetone extracts include terpenes, polyols, and phenolic acids, each of which, individually or combined, contribute to their antimicrobial activity [128, p.50].

In conclusion, research based on scientific literature has shown that many species of the *Artemisia* genus are studied not only for their active medicinal compounds against microorganisms but also for their properties that modify the effects of toxic microbes. These studies pave the way for a comprehensive understanding of the plants' potential and their effective therapeutic use. Analyzing the data presented in this section highlights the importance of studying wormwood essential oils as both base and adjuvant substances in the development of new medicinal products aimed at treating infectious and inflammatory diseases associated with microorganisms.

2. RESEARCH MATERIALS AND METHODS

Scientific research was conducted from 2018 to 2024 at the «Microbiology» laboratory of the Institute of Veterinary Medicine and Animal Husbandry at Zhangir Khan West Kazakhstan Agrarian-Technological University and at the «Zhardem-Vet» educational-scientific-industrial center, with industrial practices carried out at the «Akzhayik» Production Practice Center located in the Taskala district of the West Kazakhstan region.

The main object of the study was Lerch's wormwood (*Artemisia lerchiana*). The research material consisted of above-ground parts of *Artemisia lerchiana* — leaves and stems — collected during the mass vegetation period (June–July) from plants growing in the West Kazakhstan region between 2018 and 2021. Identification of the wormwood species (species composition differentiation) was carried out at the “Natural and Humanitarian Sciences” laboratory of M. Otemisov West Kazakhstan University.

The antibacterial activity of *Artemisia lerchiana* was tested in vitro against gram-positive bacteria (*Staphylococcus aureus*, *Streptococcus*) and gram-negative bacteria (*Escherichia coli*), while some toxicological properties were studied in vivo.

In microbiological experiments, the plant was used according to generally accepted pharmacological guidelines in the form of a infusion (1:10) and essential oil obtained by hydrodistillation.

To evaluate the antibacterial effects of various plant infusions (*Artemisia absinthium*, *Calendula officinalis* L., *Chamomilla recutita* L.) on test microbes, specific antibacterial activity assays were applied. In this method, test microbes prepared according to the McFarland standard (500 million CFU, 1 billion CFU, 2 billion CFU) in a volume of 0.3 ml were added to prepared nutrient broth (5 ml) in special test tubes. Then, infusions prepared from the studied plants were added in volumes of 0.5 ml, 1 ml, and 2 ml. The test tubes were incubated at 37°C for 24 hours, after which the results were analyzed.

Photocolorimetric studies using a KFK device were carried out with a red light filter at a wavelength of 490 nm in 10 mm cuvettes.

To assess the antibacterial activity of essential oils from different plants, the disk diffusion method on nutrient agar (MPA) in Petri dishes was used. One test microbe (*Staphylococcus aureus*, *Streptococcus*, or *E. coli*) was cultured on the nutrient agar in Petri dishes. Then, disks impregnated with essential oil-based preparations — including *Abies sibirica*, *Eucalyptus*, *Lemon*, *Bergamot*, *Melaleuca alternifolia*, *Artemisia absinthium*, *Lavandula*, *Artemisia lerchiana* essential oils, and Septarius antiseptic — were placed on the agar. The Petri dishes were incubated in a thermostat for 24 hours. The results were evaluated by measuring the zone of lysis around each disk in millimeters [155].

The research was carried out in two stages. At the first stage, the antibacterial effect of *Artemisia lerchiana* essential oil at different concentrations

(100%, 50%, 25%, 12.5%, 6.25%) was determined. At the second stage, the antibacterial activity of essential oils from various plants was evaluated. The antibacterial effects of different plant preparations and the chemically-based antiseptic «Septarius» were analyzed comparatively.

The acute toxic, allergic, and local irritant properties of *Artemisia lerchiana* infusion and essential oil were studied on both male and female white mice weighing 19–24 g, and rabbits of the «White Giant» breed weighing 2–2.5 kg. The studies were carried out according to the methodological guidelines of professor R.U. Khabriev on the «Toxicological and ecological evaluation of medicinal substances used in veterinary medicine», as well as the «Guidelines for preclinical (experimental) studies of new pharmacological substances», and A.N. Mironov's «Guidelines for conducting preclinical studies of medicinal products». Additionally, the rules outlined in the «European convention for the protection of vertebrate animals used for experimental and other scientific purposes» were followed during the research [156-158].

The acute toxic effect of *Artemisia lerchiana* infusion was assessed by orally administering various volumes (0,3; 0,5; 0,7 and 0,9 ml) to 25 white mice. The allergic effect was evaluated in 10 rabbits via conjunctival testing, and the local irritant effect of the essential oil was studied by applying it to the skin of 10 rabbits.

For experimental purposes, *Artemisia lerchiana* infusion was used as a wound treatment agent, and an ointment was prepared from *Artemisia lerchiana* essential oil to promote wound healing.

The ointment contained *Artemisia lerchiana* essential oil as the active ingredient and petrolatum as the base, in 10% and 20% formulations. The ointment preparation technology was developed according to generally accepted pharmacological principles. As comparative controls, furacillin solution and Vishnevsky liniment were used as traditional treatments.

The experimental research was conducted on domestic animals, including dogs aged 3-5 years weighing 20-22 kg, and farm animals such as sheep aged 1-1.5 years. The animals were divided into groups according to the principle of analogs.

Experimental aseptic and purulent wounds were created on animals following methods recommended by A. Abdulla and other authors [159].

Wounds on dogs were created on the thigh area of the hind leg using a stencil measuring 14.0 ± 1.0 cm². Local anesthesia was performed by administering 0.5% novocaine, and wounds were created with a scalpel (Figure 1).



Figure 1 – Appearance of the experimental wound on dogs

Experimental wounds on sheep were also made on the thigh area of the hind leg, using a stencil of the same size as for dogs, measuring $14.0 \pm 1.0 \text{ cm}^2$ (see Figure 2).



Figure 2 – Appearance of the experimental wound on sheep

Aseptic wounds were created following strict aseptic rules; after bleeding stopped, treatment procedures were carried out, and the wound surface was covered with a sterile white gauze pad fixed to the skin.

For the formation of purulent wounds, aseptic and antiseptic rules were not followed; a gauze moistened with feces was applied to the wound area and fixed to the skin. Treatment of aseptic wounds began immediately after bleeding stopped, whereas purulent wound treatment started on the 4th day after infection when purulent exudate appeared.

For animals with aseptic wounds, ointment was applied once daily, and gauze was fixed to the wound surface. For purulent wounds, starting from the 4th day, *Artemisia lerchiana* infusion and 10% and 20% ointments were applied to

the first two experimental groups, while the third group received Vishnevsky liniment, and animals in the control group remained untreated during the initial stages of the study.

Before starting clinical studies, animals underwent clinical examination according to generally accepted procedures.

For hematological and biochemical analyses, blood samples were taken from the animals. Hematological parameters (leukocytes, erythrocytes, thrombocytes, hemoglobin, hematocrit, thrombocrit) were studied using the Mindray BC-2800 Vet semi-automatic analyzer, and biochemical tests (total protein, albumins, α , β , γ -globulins) were conducted using the BioChem SA semi-automatic analyzer.

Clinical studies were performed according to standard methodologies. Changes in wound size were assessed by planimetric analysis following the method of L.N. Popov [160]. The method involves covering the microbially contaminated wound with cellophane, tracing the wound edges onto it, then transferring the tracing to graph paper to calculate the wound area. The percentage reduction in wound surface area per day relative to the initial measurement was calculated.

Humoral immune factors were determined by the method proposed by P.A. Emelyanenko and co-authors [161]. Bactericidal activity of blood serum was measured based on changes in optical density during growth of *E. coli* (non-pathogenic strain) on slanted agar, with and without addition of test serum (using a daily culture standardized to 2.5 billion microbial cells per ml according to the McFarland turbidity standard). Measurements were conducted before treatment and on days 1, 3, 5, 7, 10, 14, and 21 after treatment began.

Production studies were carried out at our university's «Akzhayik» Production Practice Center and in sheep farms located in the Taskala district of West Kazakhstan region, focusing on spontaneous wounds in sheep.

3. TECHNOLOGY FOR PREPARING A MEDICINAL PRODUCT BASED ON ARTEMISIA LERCHIANA

The main object of the research was Lercha wormwood (*Artemisia lerchiana*). The study focused on the above-ground parts of *Artemisia lerchiana*—namely, its leaves and stems—collected during the peak vegetative period (June to July) from plants growing in the West Kazakhstan region between 2018 and 2021. The identification of the wormwood species (species composition differentiation) was carried out at the “Natural and Humanitarian Sciences” laboratory of West Kazakhstan University named after M. Otemisov.

3.1 Preparation of an infusion from *Artemisia lerchiana* plant

In accordance with generally accepted pharmacological guidelines, a infusion was prepared from *Artemisia lerchiana*. The dried *Artemisia lerchiana* plant was ground using a Vyuga grinding apparatus. After that, the infusion preparation technology was carried out as follows (Figure 3, a, b).

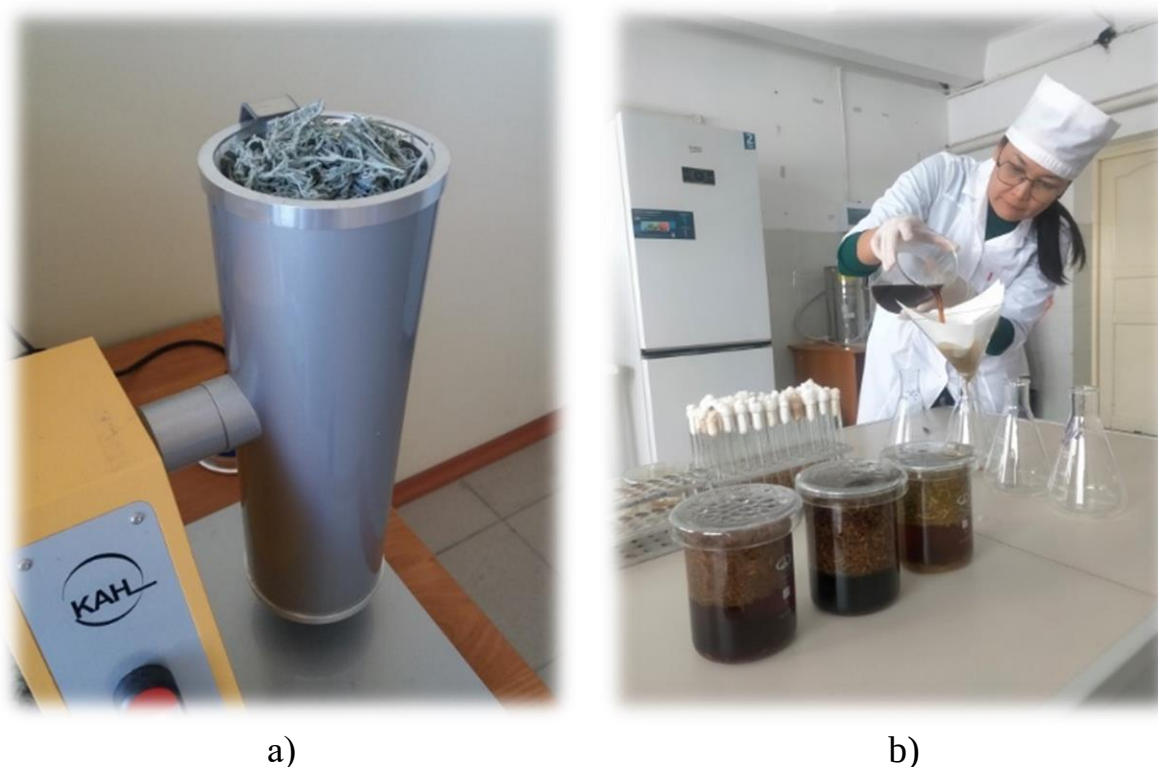


Figure 3 – Preparation of infusion from *Artemisia lerchiana*

- a) Grinding *Artemisia lerchiana* using the Vyuga grinding apparatus (5–7 mm),
b) Preparation of infusion from *Artemisia lerchiana*.

To prepare the infusion, a ratio of 1:10 was used — that is, one part of the plant material to ten parts of distilled water (taking into account the raw material's water absorption coefficient). Dried, ground (5–7 mm) *Artemisia lerchiana* was

placed into a preheated infusion container in a boiling water bath, and the required volume of distilled water at room temperature was added. The infusion time in the boiling water bath was 15 minutes. Afterward, the infusion was removed from the water bath and allowed to cool at room temperature, thus continuing the extraction of active substances. The cooling time lasted 45 minutes.

During infusion preparation, it was considered that a large amount of water is absorbed by the medicinal plant raw material. Therefore, taking the water absorption coefficient into account, more water was used than indicated in the recipe. This coefficient defines how many milliliters of water 1 gram of raw material holds after infusion and squeezing. The water absorption capacity of *Artemisia lerchiana* during infusion preparation was determined to be 2.1 g/ml.

After cooling, the infusion was filtered several times through two layers of gauze, with the final filtration carried out using laboratory filter paper. The prepared infusions were protected from sunlight, poured into glass containers, and stored in a refrigerator.

3.2 Extraction of essential oil from *Artemisia lerchiana* plant

To extract the essential oil, *Artemisia lerchiana* was processed using the hydrodistillation method. For this purpose, a schematic of the simplest hydrodistillation apparatus was used. The equipment consisted of a flask, a vertical condenser, and a receiving device. Tubing was connected to the condenser to supply cold running water, with the water flow directed from bottom to top. The flask and the condenser were connected using a wide flat ground glass joint with a diameter of at least 30 mm.

As the receiving device, a Ginsberg receiver was used — a simple glass tube whose upper part is widened and the lower part narrows into a thin bent tube. The volume of the receiver ranged from 4 to 5 ml, with a diameter of approximately 5 to 8 mm (Figure 4).



Figure 4 – Extraction of essential oil from *Artemisia lerchiana* plant

100 grams of moderately ground *Artemisia lerchiana* plant material (particle size 2–4 mm) was placed into a 1-liter flask, and water was added to fully cover the plant material. The flask was placed on an electric hot plate, and the condenser was fixed on a stand with cooling water continuously supplied from the tap.

During the boiling process, the steam carried small droplets of essential oil upward, which condensed in the condenser into a liquid mixture of water and tiny droplets of essential oil. This mixture was collected in the Ginsberg receiver.

The boiling intensity was adjusted so that the condenser dripped 1–2 drops per second. As a result, 0,2–1 ml of essential oil was obtained from 100 grams of plant material.

3.3 Preparation of the composition of ointment based on *Artemisia lerchiana*

Currently, various antimicrobial drugs and methods are widely used to treat wounds and infectious processes in animals. However, each newly proposed method or drug presents certain challenges and limitations during application. Specifically, issues such as the long duration of treatment protocols, high cost of drugs, limited effect on some microflora in wounds, adverse effects on the animal's body, and the potential for weakening immune status highlight the need to find cost-effective, production-friendly, and therapeutically efficient medicinal substances [162–168].

A significant concern is the allergic reactions caused by currently used synthetic antibiotics and antiseptics in animals, as well as the development of microbial resistance within wounds.

Today, the search for new plant-based local-acting drugs remains a pressing issue in veterinary medicine.

In recent years, both domestic and international practices have increasingly adopted the medicinal use of *Artemisia* (wormwood) plants for their antimicrobial and anti-inflammatory properties, as well as for treating animal wounds [123, p. 6; 124, p., 106].

Plants of the *Artemisia* genus, rich in biologically active compounds, are notable for their diverse therapeutic properties. Researchers' interest in this plant is primarily due to its wide spectrum of therapeutic effects. In particular, wormwood is recognized for its abilities to stop bleeding, provide antimicrobial action, and accelerate wound healing, underscoring its medicinal value.

One of the main objectives of this research was to develop a new antimicrobial drug with high therapeutic efficacy from *Artemisia lerchiana*, which contains biologically active compounds such as alkaloids, glycosides, essential oils, phenolic compounds, vitamins, microelements, and polysaccharides. Such a plant-based drug is characterized by affordability, low toxicity, and the absence of side effects, providing animal owners with a safe and

long-term treatment option. To this end, the development of an environmentally friendly drug based on wormwood extracts was planned.

The processes of preparing the infusion and extracting essential oils from *Artemisia lerchiana* were carried out at the “Zhardem-Vet” educational-scientific-production center of the West Kazakhstan Agrarian-Technical University named after Zhangir Khan, in accordance with generally accepted pharmacological standards.

To evaluate the effectiveness and safety of the *Artemisia lerchiana* essential oil in wound healing, topical dosage forms — ointments — were prepared for use in animals (dogs and sheep). Considering the nature and location of the wounds, the use of essential oil in a soft topical ointment form was considered the optimal solution. Taking into account the hydrophobic properties of the essential oil and pharmacoeconomic advantages, a classical vaseline base was selected for ointment preparation. This base is distinguished by its chemical inertness, standardized composition, stability, maintenance of physicochemical properties during long-term storage, and industrial availability.

Ointments based on *Artemisia lerchiana* essential oil were prepared at concentrations of 10% and 20%, adapted for use on various animal species and wound types. During ointment preparation, the concentration of the pharmacologically active substance and physicochemical properties were taken into account, following general pharmaceutical principles [169].

Since the ointment was intended for direct application to open wounds, pure vaseline, additional materials, and special packaging were used in its preparation, with all technological stages carried out under aseptic conditions.

The main goal of the ointment technology was to ensure maximum dispersion and uniform distribution of the essential oil. The resulting product had a consistency typical of ointments, a homogeneous structure, a characteristic aroma of wormwood, and a bright yellow color.

The qualitative characteristics and standard parameters of the ointment prepared with *Artemisia lerchiana* essential oil are presented in Table 1, based on the pharmacopoeia of the Eurasian Economic Union. These quality indicators were taken as the main criteria determining the shelf life of the ointment.

Table 1 – List of main quality indicators of the ointment prepared from *Artemisia lerchiana* essential oil, their limit values, and evaluation methods

№	Quality indicators	Normal values of quality indicators	Evaluation methods. Considerations
1	2	3	4
1	Properties	A homogenous ointment with a bright yellow color characteristic of fragrant wormwood	Homogeneity is determined by visual inspection

1	2	3	4
2	Genuine	Positive qualitative reaction to camphor	In accordance with the draft regulatory document
3	Quantitative content of the active substance..	Essential oil concentration is 10% or 20%.	In accordance with the draft regulatory documentation of the prepared product
4	pH	Within the range of 6,0–7,0.	Determined in accordance with FS 2.1.2.5. «Determination of pH by potentiometry»
5	Purity	Must comply with the requirements for ointment purity.	Tests are carried out according to FS 2.1.6.1. «Purity of ointments»
6	Weight indicated on the packaging, g	25, 30, 50, or 100	Determined according to FS 2.1.9.17. «Volume in packaging»

The shelf life of the ointment containing *Artemisia lerchiana* essential oil was determined based on the stability of quality indicators and key criteria during storage. Analyses were conducted every three months during the first year of storage, and then every six months in subsequent periods. The preparation was stored under natural conditions in tightly sealed glass containers with screw-type polymer lids.

The *Artemisia lerchiana* - based ointment has a dense consistency, a light yellow color, and a characteristic wormwood aroma. It is intended for external use on animals. It is recommended to store the ointment in glass containers in a cool place.

4. STUDY OF THE ANTIBACTERIAL AND SOME TOXICOLOGICAL PROPERTIES OF *ARTEMISIA LERCHIANA*

4.1 Study of the antibacterial effect of *Artemisia lerchiana*

Currently, one of the pressing issues in veterinary medicine is the search for new, highly effective plant-based drugs that have no side effects.

To address this, substances with antimicrobial activity must meet the following criteria:

- They must possess a broad spectrum of antimicrobial action, effectively eliminating bacteria, mycobacteria, viruses, fungi, and spores regardless of the duration and frequency of use. These agents should also contain properties that prevent the development of microbial resistance.
- The substances must be safe for humans and animals not only during production and use but also after their intended application. That includes during the stages of degradation caused by environmental factors or biodegradation processes in the human body. In other words, antimicrobial agents and their natural or synthetic degradation products must not act as xenobiotic compounds.
- Antimicrobial substances should cause minimal damage to various materials and, ideally, be simple in composition and relatively cost-effective.

In modern veterinary medicine, increasing attention is being paid to plant-based and natural remedies. Given their abundance on the market, selecting the most effective ones can be challenging. However, in recent years, medicinal plants from the *Artemisia* genus have attracted significant interest.

In this regard, the present scientific study analyzed the antibacterial activity of *Artemisia lerchiana* in comparison with other plant-based preparations. The antibacterial effect of *Artemisia lerchiana* was studied *in vitro* against Gram-positive test microorganisms such as *Staphylococcus aureus* and *Streptococcus*, as well as the Gram-negative *E. coli*. In addition, certain toxicological properties were assessed *in vivo*.

For microbiological studies, *Artemisia lerchiana* was used in the form of a infusion (in a 1:10 ratio), prepared according to generally accepted pharmacological standards, as well as in the form of essential oil obtained by hydrodistillation.

To determine the antimicrobial effects of various plant infusions (*Artemisia absinthium*, *Calendula officinalis* L., *Chamomilla recutita* L.) on the test microorganisms, standard methods for assessing antibacterial activity were employed. Specifically, 0,3 ml of test microorganisms, prepared in accordance with the McFarland standard (500 million CFU, 1 billion CFU, 2 billion CFU), were added to 5 ml of prepared nutrient broth (EPS) in sterile test tubes. Then, infusions derived from the plants under study were added in volumes of 0,5 ml, 1 ml, and 2 ml.

The test tubes were incubated in a thermostat at 37°C for 24 hours, after which the results were evaluated.

The studies using a photoelectric colorimeter (PEC) were carried out in 10 mm cuvettes with red light filters at a wavelength of 490 nm. To determine the antibacterial activity of essential oils from various plants, the disk diffusion method on nutrient agar (NA) in Petri dishes was employed.

For this method, a single test microorganism (*Staphylococcus aureus*, *Streptococcus*, or *E. coli*) was inoculated onto the nutrient agar in each Petri dish. Discs impregnated with essential oil-based preparations—including *Abies sibirica*, *Eucalyptus*, *Lemon*, *Bergamot*, *Melaleuca alternifolia*, *Artemisia absinthium*, *Lavandula*, *Artemisia lerchiana*, as well as the antiseptic *Septarius*—were then placed on the agar surface. The prepared Petri dishes were incubated in a thermostat for 24 hours. Antibacterial activity was evaluated by measuring the diameter of the lysis (inhibition) zones around the discs in millimeters [155].

The research was conducted in two stages. In the first stage, the antibacterial activity of *A. lerchiana* essential oil at various concentrations (100%, 50%, 25%, 12.5%, and 6.25%) was assessed. In the second stage, the antibacterial effects of essential oils from various plants were evaluated. The results of the comparative analysis between different plant-based preparations and the chemically based antiseptic *Septarius* were obtained.

To achieve the study's objectives, both infusion and essential oil extracts of *Artemisia lerchiana* were used. For comparative purposes, infusions of *Artemisia absinthium*, *Calendula officinalis* L., and *Chamomilla recutita* L., as well as essential oil-based preparations including *Abies sibirica*, *Eucalyptus*, *Lemon*, *Bergamot*, *Melaleuca alternifolia*, *Artemisia absinthium*, and *Lavandula* were also used. All preparations were made according to generally accepted pharmacological procedures.

To study the antibacterial properties of the infusions obtained from different plants, standard methods for determining antimicrobial activity were applied.

For reliability, all experiments were repeated five times. To study the antibacterial properties of infusions obtained from various plants, methods for determining the antimicrobial activity of the preparations were used.

The microbiological research was conducted in the "Microbiology" laboratory of our university. The local *Artemisia lerchiana* plant was used in the form of an infusion and essential oil obtained by hydrodistillation.

In studying the effectiveness of *A. lerchiana* against *Staphylococcus* (Table 2), it was shown that the preparation exhibited high activity against microorganisms at a concentration of 500 million CFU regardless of the volume of the preparation. At a microbial load of 1 billion CFU, the preparation's activity remained high at larger volumes (1 ml and 2 ml), whereas a significant decrease in activity by 1 point was observed at the smaller volume of 0,5 ml.

Table 2 – Antibacterial activity of medicinal plant infusions against *Staphylococcus aureus*

Name of infusion	Volume of tested preparations (ml)											
	0,5	1,0	2,0	C	0,5	1,0	2,0	C	0,5	1,0	2,0	C
	Growth of <i>Staphylococcus aureus</i>											
	500 million CFU				1 billion CFU				2 billion CFU			
Infusion of <i>Artemisia absinthum</i>	+	-	-	++ +	++	+	+	++ +	++	++	++	++ +
Infusion of <i>Calendula officinalis</i> L.	++	+	+	++ +	++	++	++	++ +	++	++	++	++ +
Infusion of <i>Chamomilla recutita</i> L.	++	+	+	++ +	++	+	+	++ +	++	++	++	++ +
Infusion of <i>Artemisia lerchiana</i>	-	-	-	++ +	+	-	-	++ +	++	+	+	++ +
Septarius antiseptic	-	-	-	++ +	+	-	-	++ +	++	+	+	++ +
Note :– Control group; CFU – Colony-Forming Unit; The symbols “+” and “–” indicate the rate of microbial growth. “–” means low growth rate (clear nutrient broth); “+” means satisfactory growth rate; “++” means good growth rate; “+++” means turbid, dense growth.												

At a microbial dose of 2 billion *Staphylococcus aureus*, the tested preparation showed 50% activity at volumes of 1 ml and 2 ml, but only 25% activity at a volume of 0,5 ml.

The antibacterial activity of other plant-based infusions was effective at 50% for microbial loads of 500 million CFU and 1 billion CFU, but no antibacterial effect was observed at 2 billion CFU. In this case, the infusion of *Calendula officinalis* exhibited the lowest antibacterial activity.

The antibacterial activity of the chemical antiseptic, *Septarius*, was similar to that of the *Artemisia lerchiana* preparation.

Regarding *Streptococcus*, the study of *Artemisia lerchiana* (see Table 3) demonstrated high activity at a microbial dose of 500 million CFU, as well as at volumes of 1 ml and 2 ml for a microbial dose of 1 billion CFU.

Table 3 – Antibacterial activity of medicinal plant infusions against *Streptococcus*

Name of infusion	Volume of tested preparations (ml)											
	0,5	1,0	2,0	C	0,5	1,0	2,0	C	0,5	1,0	2,0	C
	Growth of <i>Streptococcus</i>											
	500 million CFU				1 billion CFU				2 billion CFU			
Infusion of <i>Artemisia absinthum</i>	+	-	-	+++	++	+	+	+++	++	++	++	+++
Infusion of <i>Calendula officinalis</i> L.	++	+	+	+++	++	++	++	+++	++	++	++	+++
Infusion of <i>Chamomilla recutita</i> L.	++	+	+	+++	++	+	+	+++	++	++	++	+++
Infusion of <i>Artemisia lerchiana</i>	-	-	-	+++	+	-	-	+++	++	+	+	+++
Septarius antiseptic	-	-	-	+++	+	-	-	+++	++	+	+	+++
Note :- Control group; CFU – Colony-Forming Unit; The symbols “+” and “-” indicate the rate of microbial growth. “-” means low growth rate (clear nutrient broth); “+” means satisfactory growth rate; “++” means good growth rate; “+++” means turbid, dense growth.												

A decrease in the activity of *Artemisia lerchiana* (50%) was observed at volumes of 1 ml and 2 ml with a microbial dose of 2 billion CFU. At the 2 billion CFU microbial dose, the effect of the preparation at a volume of 0.5 ml was practically ineffective.

The antibacterial activity of *Artemisia lerchiana* at the 2 billion CFU microbial dose was higher compared to the chemical antiseptic *Septarius*.

According to the study results, the antibacterial activity of infusions of *Artemisia absinthum* and *Chamomilla recutita* was low at microbial doses of 500 million CFU and 1 billion CFU. In both tested preparations, no antibacterial effect was observed at a microbial dose of 2 billion CFU.

The infusion of *Calendula officinalis* L. was ineffective against microbes at 1 billion and 2 billion CFU and showed only 50% effectiveness at a microbial dose of 500 million CFU.

Regarding *E. coli*, the antibacterial activity of *Artemisia lerchiana* (see Table 4) was high at volumes of 1 ml and 2 ml at a microbial dose of 500 million CFU. A 50% activity was observed at a microbial dose of 1 billion CFU with a 0.5 ml volume, while at 1 ml and 2 ml volumes, *Artemisia lerchiana* showed no antibacterial effect against *E. coli* at the 2 billion CFU dose.

Table 4 – Antibacterial activity of medicinal plant infusions against *E. coli*

Name of infusion	Volume of tested preparations (ml)											
	0,5	1,0	2,0	Б	0,5	1,0	2,0	Б	0,5	1,0	2,0	Б
	Growth of <i>E. coli</i>											
	500 million CFU				1 billion CFU				2 billion CFU			
Infusion of <i>Artemisia absinthum</i>	++	++	+	++ +	+	++	+	+++	++	+++	+++	+++
Infusion of <i>Calendula officinalis</i> L.	++	++	++	++ +	++	++	++	+++	++	+++	+++	+++
Infusion of <i>Chamomilla recutita</i> L.	+	+	+	++ +	++	++	++	+++	++	+++	+++	+++
Infusion of <i>Artemisia lerchiana</i>	+	-	-	++ +	+	+	+	+++	++	++	++	+++
Septarius antiseptic	-	-	-	++ +	+	-	-	+++	+	+	+	+++
Note :– Control group; CFU – Colony-Forming Unit; The symbols “+” and “–” indicate the rate of microbial growth. “–” means low growth rate (clear nutrient broth); “+” means satisfactory growth rate; “++” means good growth rate; “+++” means turbid, dense growth.												

The chemical antiseptic *Septarius* showed high antibacterial activity at microbial doses of 500 million CFU and 1 billion CFU at volumes of 1 ml and 2 ml, while in other tests it exhibited 50% effectiveness.

The infusion of *Chamomilla recutita* demonstrated 50% antibacterial activity at a microbial dose of 500 million CFU but was ineffective under other conditions.

The infusions of *Artemisia absinthium* and *Calendula officinalis* L. were also ineffective against *Escherichia coli*.

All experiments in the control group showed intensive microbial growth, confirming the high activity of the test microbes.

Thus, the results indicate that at a microbial dose of 500 million CFU, the infusion of *Artemisia lerchiana* was effective against *Staphylococcus aureus*, *Streptococcus*, and *E. coli*. The comparison of this preparation with the standard antiseptic *Septarius* showed concordance for *Staphylococcus aureus* and *Streptococcus*, while the effectiveness of *Artemisia lerchiana* infusion against *E. coli* was lower than that of *Septarius*.

A comparative analysis of *Artemisia lerchiana* infusion with other plant-based infusions showed high antibacterial activity of the tested preparation against both Gram-positive (*Staphylococcus aureus*, *Streptococcus*) and Gram-negative (*E. coli*) test microbes. The infusion of *Calendula officinalis* showed very low antibacterial activity, whereas infusions of *Abies sibirica* and *Chamomilla recutita* showed 50% effectiveness.

The study results allow us to conclude a direct correlation between preparation volume and antibacterial activity, and an inverse correlation between microbial dose and antibacterial activity.

Next, studies were conducted to determine the antibacterial activity of essential oils from *Artemisia lerchiana* and other widely used veterinary plant-based preparations. The chemical antiseptic *Septarius* was used as the test standard.

The disk diffusion method on nutrient agar (EPA) was used to determine antibacterial activity in vitro. Test microbes included *Staphylococcus aureus*, *Streptococcus*, and *E. coli* at doses of 500 million CFU and 2 billion CFU.

In the first part of the experiment, we studied the antibacterial activity of *Artemisia lerchiana* at various concentrations (100%, 50%, 25%, 12.5%, 6.25%) against *Staphylococcus aureus*, *Streptococcus*, and *E. coli* at a microbial dose of 500 million CFU (Figure 5).

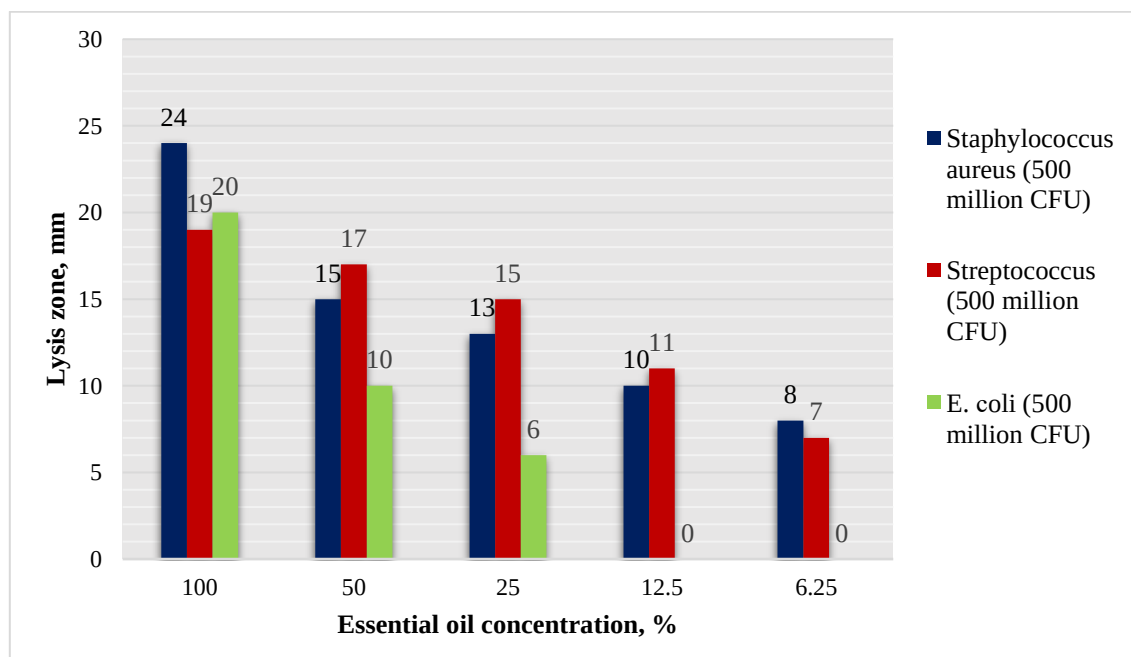


Figure 5 – Diagram of *Artemisia lerchiana*'s activity against various test microbes

The experimental results showed that the high concentration of *Artemisia lerchiana* essential oil was effective against all test microbes, particularly *Staphylococcus aureus*. A reduction in concentration to 50% and 25% led to a decrease in antibacterial activity against *Staphylococcus* and *Streptococcus* from 20 mm to 13–17 mm (a reduction of 35–50%). At concentrations of 12,5% and 6,25%, antibacterial effects against *Staphylococcus* and *Streptococcus* were observed at 30–40% effectiveness.

The reduction in the concentration of *Artemisia lerchiana* essential oil led to a sharp decrease in antibacterial activity against *E. coli*—to 45% at 50% concentration and to 30% at 25%. No antibacterial effect was observed at 12,5% concentration and below.

Thus, *Artemisia lerchiana* maintains antibacterial activity against Gram-positive microbes (*Staphylococcus* and *Streptococcus*) even at lower concentrations. However, at lower concentrations, its effect on *E. coli* was ineffective. This demonstrates a direct correlation between the concentration of *Artemisia lerchiana* and its antibacterial activity across all microbial cultures.

In the second part of the experiment, we conducted a comparative analysis of the antibacterial activity of *Artemisia lerchiana* and other plant-based preparations against three types of microbial cultures. The chemical antiseptic *Septarius* was used as the control standard (Figure 6).

According to the results, *Artemisia lerchiana* showed the highest antibacterial activity against *Staphylococcus* (24 mm at 500 million CFU, 20 mm at 1 billion CFU). *Septarius* showed an activity zone of 17 mm at 500 million CFU and 14 mm at 1 billion CFU. All other preparations showed activity zones below 13 mm.

In terms of activity against *Streptococcus*, the highest efficacy was again observed for *Artemisia lerchiana* (19 mm at 500 million CFU, 15 mm at 1 billion CFU). *Septarius* showed relatively high activity (16 mm at 500 million CFU, 13 mm at 1 billion CFU). The remaining preparations showed inhibition zones below 12 mm.

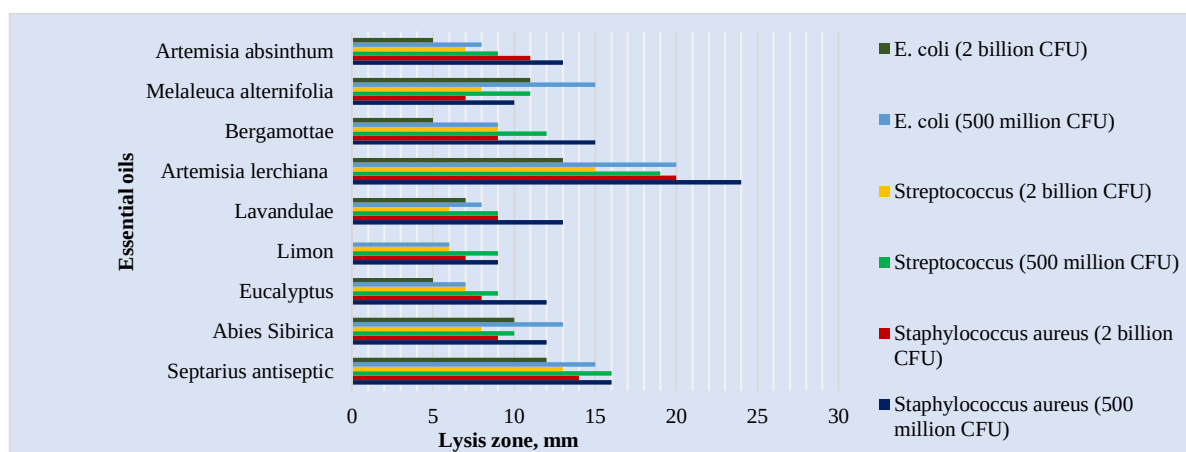


Figure 6 – Diagram of antibacterial activity of various plant essential oils against test microbes on agar

All tested preparations showed low antibacterial activity against *E. coli*. Only *Artemisia lerchiana* showed an inhibition zone ranging from 20 mm to 13 mm, while *Melaleuca alternifolia* and *Septarius* ranged from 15 mm to 11 mm.

Thus, based on the experimental results, *Artemisia lerchiana* demonstrated high antibacterial activity against *Staphylococcus* and *Streptococcus*, whereas the essential oils of other medicinal plants showed lower antibacterial activity. Additionally, against *E. coli*, the antibacterial activity of the essential oils from *Artemisia lerchiana*, *Abies sibirica*, *Melaleuca alternifolia*, and *Septarius* was higher (above 11 mm) compared to the other medicinal plant preparations.

4.2 Study of the acute toxic, allergic, and local irritant effects of *Artemisia lerchiana*

Many chemical agents with antimicrobial effects are not always effective or reliable. Some are used as disinfectants, others as antiseptics for the skin, and some are applied to prevent infectious diseases in animals. However, many of them tend to accumulate in organs and tissues and may cause allergic and toxic side effects.

In modern veterinary medicine, increasing attention is being paid to plant-based and natural preparations. Given the abundance of such products on the market, it is challenging to select the most effective one. In this regard, medicinal plants of the genus *Artemisia* have recently garnered growing interest [170].

As the requirements for the quality and safety of pharmaceuticals increase, one of the key focuses of pharmaceutical science is the development of medicinal products that are both therapeutically effective and characterized by low toxicity, low allergenicity, and minimal irritant effects.

Adverse reactions that may occur during the use of medicinal products are often associated with the development of hypersensitivity to any component of the formulation [171]. The general program for evaluating the safety of new drugs also includes assessing their potential to cause allergic reactions [172].

Ensuring the safety of plant raw materials and medicinal products becomes possible only after completing the necessary stages of research during the development of a new product. In this context, studying the acute toxicity, local irritant effect, and allergenic potential of various dosage forms of *Artemisia lerchiana* has been one of the main objectives of our research work [173].

The experimental studies involving laboratory animals were conducted under the supervision of the Local Bioethics Committee of Zhangir Khan West Kazakhstan Agrarian-Technical University.

Toxicological studies of *Artemisia lerchiana* were carried out in accordance with the methodological recommendations by Professor R.U. Khabriev on the “Toxicological and ecological evaluation of veterinary medicinal products,” as well as the “Guidelines for Preclinical (Experimental) Study of New Pharmacological Substances” by A.N. Mironov, and in compliance with the

provisions of the “European Convention for the Protection of Vertebrate Animals Used for Experimental and Other Scientific Purposes” [156–158].

As research material, an infusion prepared from the dried form of *Artemisia lerchiana* collected in the West Kazakhstan region and its essential oil obtained through hydrodistillation were used. The acute toxicity, local irritant, and allergic effects of the *Artemisia lerchiana* infusion and essential oil on laboratory animals (white mice and rabbits) were studied at the vivarium of the “Zhardem-Vet” Educational, Scientific, and Industrial Center of Zhangir Khan West Kazakhstan Agrarian-Technical University. The study involved white mice of both sexes weighing 19–24 g (n=25) and rabbits of the “White and Gray Giant” breed weighing 2–2.5 kg (n=20). Laboratory animals were kept in vivarium conditions with a temperature of 20–22°C and a humidity level of 60–62%.

Acute toxic effect of Artemisia lerchiana infusion

Acute toxicity refers to the harmful effect of a drug that occurs after a single dose or repeated administration over a short time (within a day), aimed at identifying transportable, toxic, and lethal doses and the causes of death in animals.

In the first stage of the study, the acute toxic effect of *Artemisia lerchiana* infusion was determined. Based on the principle of analogy, clinically healthy white mice under identical feeding and housing conditions were selected. Experimental and control groups, each consisting of 5 animals, were formed. A total of 25 mice received the infusion orally in different doses. The mice in the experimental groups received 0.3, 0.5, 0.7, and 0.9 ml of *Artemisia lerchiana* infusion orally, while the control group received 0.9 ml of distilled water. No food was provided for 2 hours before and after administration. The administration methodology for the infusion is described in Table 5 below.

Table 5 – Scheme of the experimental study on the acute toxicity of *Artemisia lerchiana* infusion in laboratory white mice (n=5)

Groups	Administration method	Dosage and volume of administration
1st experimental group	Peroral	0,3 ml once a day for 3 consecutive days
2nd experimental group		0,5 ml once a day for 3 consecutive days
3rd experimental group		0,7 ml once a day for 3 consecutive days
4th experimental group		0,9 ml once a day for 3 consecutive days
Control group		0,9 ml of distilled water once a day for 3 consecutive days

On the following days of the study, there were no restrictions on food and water. The clinical condition of the white rats was evaluated daily for 14 days

after the last administration of the infusion to detect any toxic signs. On the first day, observations were conducted every hour, then every 8 hours during the first three days post-intoxication. On the remaining days, the condition of the white rats was assessed every 24 hours.

During this period, the survival rate, the nature of the toxic effects of *Artemisia lerchiana* infusion, behavioral activity, and tactile sensitivity were evaluated. Feeding and physiological functions, skin reflexes, and changes in body weight were also monitored.

The results of the study are described in Table 6.

Table 6 – Acute toxic effects of *Artemisia lerchiana* infusion on white rats

Groups	Average weight, g	Dose, ml	Substance administered	Study results
1st experimental group	21,0±0,79	0,3	<i>Artemisia lerchiana</i> infusion	No visible toxic reactions were observed after administering the infusion. Throughout the entire study period, no deviations were detected in the animals' behavior or general condition. Appetite and water consumption were normal. No animal deaths were recorded.
2nd experimental group	22,0±0,93	0,5		
3rd experimental group	21,2±0,74	0,7		
4th experimental group	20,8±0,82	0,9		Due to the performed manipulations, the rats exhibited short-term changes in respiration (up to 5 minutes); however, no behavioral abnormalities were observed during the subsequent days of the experimental period. No animal deaths were recorded.
Control group	22,2±0,89	0,9	<i>Aqua destillata</i>	The animals were in good condition, active, with a clear appetite. Reflexes were intact, and no signs of intoxication were observed.

According to the study results, administering *Artemisia lerchiana* infusion once daily for 3 consecutive days did not cause death or acute toxic effects in the laboratory animals. The infusion did not adversely affect the general condition or behavior of the laboratory animals. In the 4th experimental group, changes in

respiration were observed only within 5 minutes after administration due to the threshold dose, which was related to the manipulation itself.

During the subsequent observation period, no clinical or physiological differences were found between the animals in all experimental groups and the control group across all studied parameters. The experimental animals were actively moving in their cages and showed interest in water and food. A similar clinical picture was observed in the control group as well.

No significant differences in respiratory rate or body temperature were found between all experimental rats (regardless of group) and the control group. The skin and mucous membranes were pale pink, with no wounds or ulcers.

No disturbances were noted in digestive and urinary functions: fecal output was normal in amount, brown in color, and of typical consistency; no changes in urine color or pathological discharges from natural openings were observed.

In accordance with bioethical principles, after 7 days of observation, 2 animals from each study group were euthanized using diethyl ether for pathological autopsy. Macroscopic examination of internal organs was conducted during autopsy (Figure 7).

No macroscopic changes were observed in the internal organs and tissues of the experimental and control group rats during pathological autopsy. The anatomical positioning of internal organs was normal.

The mucous membranes of the digestive system were pink. No visible swelling or inflammation was observed in the parenchymal organs. Blood vessels were fully filled with blood.



Figure 7 – Appearance of internal organs during pathological autopsy of the animals

Thus, the study of the acute toxicity of *Artemisia lerchiana* infusion showed that its oral administration at various doses does not have adverse effects on white rats and does not cause functional disorders in different organ systems of the animals.

Allergic reaction to Artemisia lerchiana infusion

An allergic reaction is a type of immune response that occurs due to a dysfunction of the immune system. Based on the speed of development, allergic reactions are divided into two types: immediate and delayed. The initial symptoms appear within minutes after contact with the allergen.

In the second phase of the study, the allergic effect of *Artemisia lerchiana* infusion was evaluated in rabbits using a conjunctival test. The administration protocol of the infusion is described in Table 7.

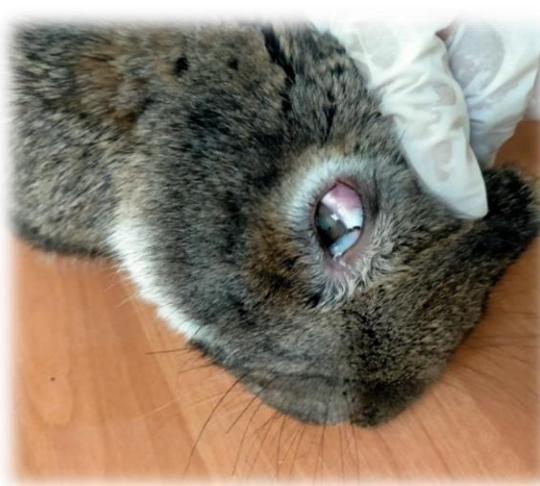
Table 7 – Administration Schedule of *Artemisia lerchiana* infusion

Schedule	
Number of subjects in the study, n	10
Frequency of administration	Single dose
Route of administration	By instillation into the eye
Dosage administered to the animal	From 1 drop

Ten rabbits were used in the study. To assess the allergic effect, an experimental sample of *Artemisia lerchiana* infusion was instilled into the conjunctiva of the right eye of the rabbits, while distilled water was instilled into the conjunctiva of the left eye as a control (Figure 8, a, b).



a)



b)

Figure 8 – Conducting an allergy test on the eye of a laboratory animal

The effects on the rabbits' eyes after instillation of the infusion were evaluated at 5 minutes, 15 minutes, 2 hours, 24 hours, and after 7 consecutive days based on the following parameters: condition of the sclera, conjunctiva, and

cornea; hyperemia of blood vessels in the sclera and cornea; and secretions from the lacrimal glands. The study results were assessed using a scoring system (Table 8).

Table 8 – Allergic Effects of *Artemisia lerchiana* infusion (n=10)

Severity of irritant effect	Assessment of the animal's eye condition
Experimental group	
Severity of irritant effect	—
Marked irritant effect	—
Moderate irritant effect	—
Mild irritant effect	+/-1
No irritant effect	—
Control group	
Severity of irritant effect	—
Marked irritant effect	—
Moderate irritant effect	—
Mild irritant effect	—
No irritant effect	—

From the results in Table 8, it can be seen that the eye blinking reflex was observed immediately after the administration of *Artemisia lerchiana* infusion in one experimental rabbit, with tearing lasting approximately 1 minute. However, in subsequent observations, no redness (hyperemia) or swelling of the conjunctiva was detected. The overall condition of the animals remained good, with no side effects observed.

Local irritant effect of Artemisia lerchiana essential oil

In the third phase of the study, 10 rabbits weighing 2–2.5 kg were used to assess the local irritant effect of *Artemisia lerchiana* essential oil (at concentrations of 10%, 15%, and 20%) on the skin. Vaseline was used as the base substance to evaluate the effects of different concentrations of the essential oil. The administration of *Artemisia lerchiana* essential oil at various concentrations is described in Table 9.

Table 9 – Administration schedule of *Artemisia lerchiana* essential oil at various concentrations

Schedule	
1	2
Number of subjects in the study, n	10
Frequency of administration	Multiple times per day
Route of administration	Topical application to the skin

1	2
Dosage administered to the animal	At concentrations of 10%, 15%, and 20% (<i>Artemisia lerchiana</i> essential oil + vaseline)

The study was conducted by applying the ointment to the shaved area of the animal's body and observing the effects. One day before the application, a 5 × 5 cm area was shaved on both lateral sides of the rabbits to remove fur. After one day, the essential oil-based ointment of *Artemisia lerchiana* was applied with a spatula to the shaved, degreased skin: 10% and 15% concentrations on the right side, and 20% concentration and vaseline on the left side of the animal's body (Figure 7, a, b).

The pharmacological treatments were applied twice daily for 5 consecutive days. The exposure reaction was monitored immediately after application, at 30 minutes, then 1, 2, 6 hours, and up to 24 hours afterward. All animals were kept in separate cages during the observation period.

Throughout the study period, swelling, hyperemia, itching, pain on palpation, the appearance of cracks and scales, and localized temperature increases were observed and recorded.

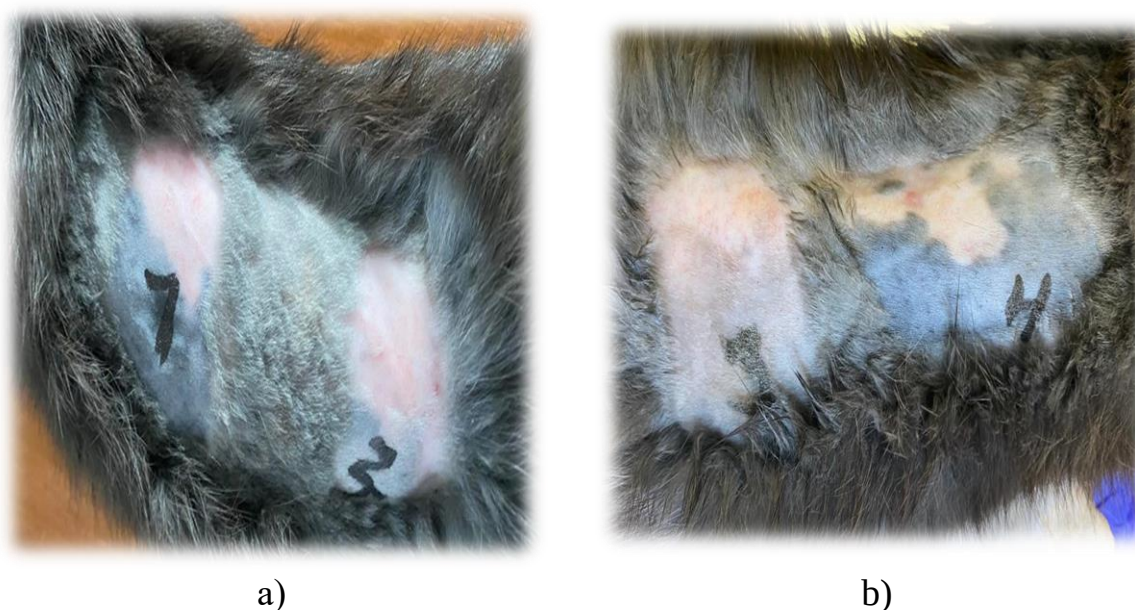


Figure 9 – Local irritant effect of *Artemisia lerchiana* essential oil

a) Right lateral side – 10% and 15% ointment; b) Left lateral side – 20% ointment and vaseline.

Evaluation of the irritant effect of ointments at different concentrations on the skin was conducted (Table 10).

Table 10 – Local irritant effect of *Artemisia lerchiana* essential oil

Level of irritant effect manifestation	Number of animals showing local irritant effect			
	10%	15%	20%	Vaseline
Severity of irritant effect	-	-	-	-
Marked irritant effect	-	-	-	-
Moderate irritant effect	-	-	-	-
Mild irritant effect	-	-	-	-
No irritant effect	-	-	-	-

Analyzing the data in Table 10, slight redness was observed at the edge of the application area in one rabbit during the initial 30-minute observation after applying the 20% *Artemisia lerchiana* essential oil ointment, which resolved spontaneously within 1 hour. No such changes were noted during subsequent applications in the study. None of the animals developed swelling on the surface of the skin throughout the study [173].

5. EFFECT OF A PREPARATION BASED ON ARTEMISIA LERCHIANA ON ASEPTIC AND PURULENT WOUNDS IN DOGS

Experimental study on the use of *Artemisia lerchiana* infusion and essential oil ointment for wound treatment.

For the purpose of experimental research, *Artemisia lerchiana* infusion was used as a substance for wound surface treatment, and an ointment based on *Artemisia lerchiana* essential oil was prepared to promote the wound healing process.

The ointment samples contained *Artemisia lerchiana* essential oil as the active ingredient and vaseline as the base-forming agent at concentrations of 10% and 20%. The ointment preparation technology complied with generally accepted pharmacological standards. As a comparative basis in the study, traditional treatment methods using furacilin solution and Vishnevsky liniment were applied.

Experimental studies were conducted on domestic animals including dogs aged 3–5 years weighing 20–22 kg, and agricultural animals including sheep aged 1–1,5 years. Animals were divided into groups according to the principle of analogs.

Experimental aseptic and purulent wounds were created on animals according to the methods proposed by A. Abdulla and other authors [159]. In dogs, experimental wounds measuring $14,0 \pm 1,0$ cm² were made on the thigh area of the hind leg using a stencil. The wounds were inflicted with a scalpel under local anesthesia (0,5% novocaine).

Before starting the clinical study, the animals underwent a clinical examination following generally accepted protocols.

To determine hematological and biochemical parameters, blood samples were collected from the animals. Hematological parameters (leukocytes, erythrocytes, platelets, hemoglobin, hematocrit, thrombocrit) were analyzed using the Mindray BC-2800 Vet semi-automatic analyzer. Biochemical tests (total protein, albumins, α -, β -, γ -globulins) were performed using the BioChem SA semi-automatic analyzer.

Clinical investigations were carried out using standard methods. The wound size change was measured by planimetric study according to the method by L.N. Popov [160]. This method involves placing cellophane over the microbially infected wound and tracing the wound edges onto it. The tracing is then transferred onto graph paper to calculate the wound area. The daily percentage reduction of the wound area relative to the initial measurement was calculated.

Humoral immune factors were determined according to the method described by P.A. Emelyanenko and co-authors [161]. The bactericidal activity of blood serum was measured using the optical density changes of test microbes grown on slanted agar. A non-pathogenic strain of *E. coli* was used as the test microbe, standardized to 2,5 billion microbial cells per ml according to McFarland turbidity standards. Measurements were taken before treatment and on days 1, 3, 5, 7, 10, 14, and 21 after treatment initiation.

Statistical analysis of the obtained data was performed using digital technologies.

5.1 Clinical, hematological, biochemical indicators and the effect on humoral factors of a preparation based on *Artemisia lerchiana* in the treatment of aseptic wounds in dogs

The main representatives of conditional pathogenic microflora in dogs are considered to be yellow and white staphylococci, pyogenic and epidermal streptococci, and less commonly coliform bacteria. In our studies, among the smears taken from dog wounds, Gram-positive bacteria of the genus *Staphylococcus* constituted 83%, while Gram-negative bacteria of the genus *Escherichia coli* constituted 50% [174].

Noting the high frequency of these bacteria on wound surfaces, the antibacterial effect of infusion and essential oil based on *Artemisia lerchiana* was studied specifically against these microbes. The results of the study showed that the infusion and essential oil based on *Artemisia lerchiana* had a strong antibacterial effect against these bacteria.

Accordingly, to determine the relevance of our research, an ointment was prepared from *Artemisia lerchiana* essential oil, and to comparatively evaluate its therapeutic effect against a traditional medicine, dogs were taken as research subjects. They were divided according to analogous principles, and experimental aseptic and purulent wounds were made [175].

Before starting the experiments, all animals underwent a complete clinical examination and blood tests. Clinically healthy animals were selected for the experiment.

In the first experiment, we studied the comparative effect of infusion and ointment made from *Artemisia lerchiana* wormwood in the treatment of aseptic wounds in animals versus the traditional treatment method (using Vishnevsky liniment).

The wound size in all groups of animals was approximately 14 cm². After the wound was made, animals exhibited restlessness, limping of the wounded leg, and clinical indicators (temperature, pulse, respiration) remained within normal limits. Local reactions (in the wound area) were characterized by signs of inflammation and increased sensitivity.

After examining the aseptic wound, a treatment strategy was determined (treatment of the wound area and treatment with medicinal preparations, dressing).

Animals in experimental groups I and II were treated with *Artemisia lerchiana* wormwood preparations (10% and 20% ointments), animals in experimental group III were treated with Vishnevsky liniment, and group IV (control) was left untreated.

One day after the wound was made, all groups of animals showed restlessness, a slight increase in body temperature, and pulse and respiratory rates increased but remained within normal limits (Figures 10-12).

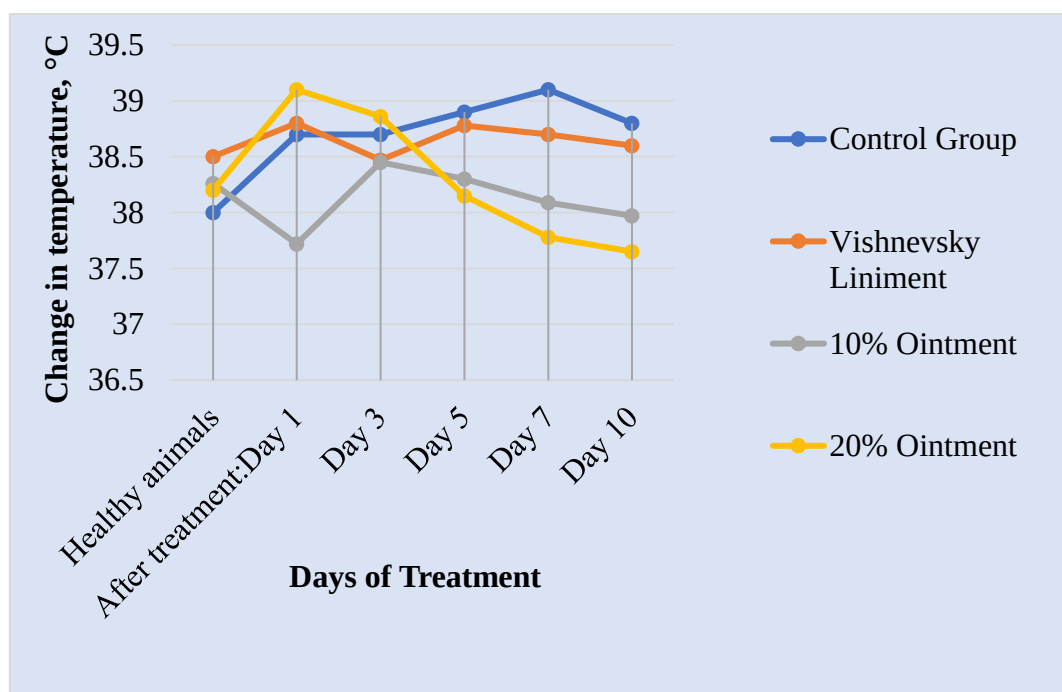


Figure 10 – Changes in body temperature during the treatment of aseptic wounds in dogs

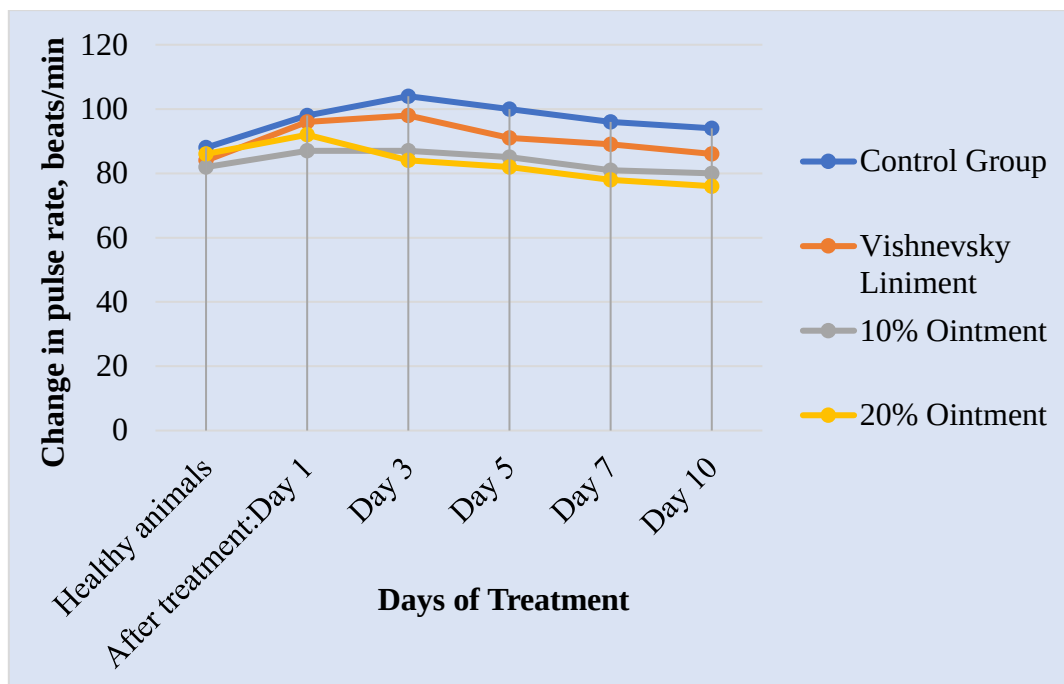


Figure 11 – Changes in pulse rate during the treatment of aseptic wounds in dogs

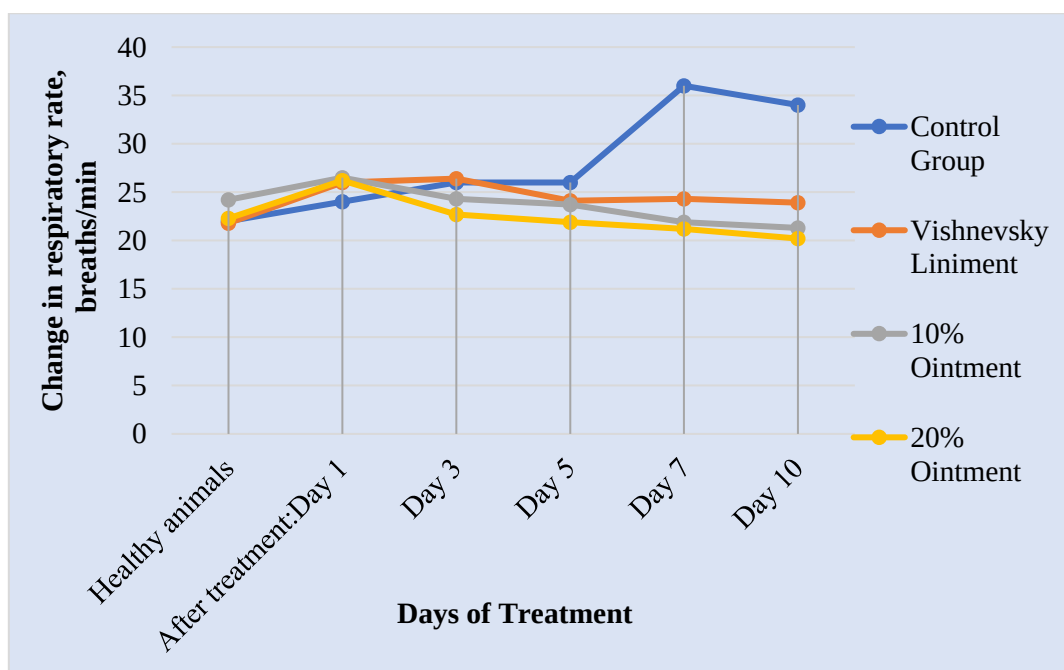


Figure 12 – Changes in respiratory rate during the treatment of aseptic wounds in dogs

On the 3rd and 5th days of the study, the pulse rate in animals of the control group was at the upper limit of normal values, while the body temperature and respiratory rate indicators on the 7th day were at the higher end of the normal range compared to the baseline values. In the experimental groups, clinical indicators returned to baseline levels by the 10th day of the study. Throughout all

stages of the study, clinical parameters in all animals of the study groups remained within normal limits.

Treatment of aseptic wounds in animals began on the day the wound was inflicted. On the 1st day after wounding, mild inflammatory edema appeared at the edges of the wound area in all study groups; the skin maintained its mobility, animals exhibited a clearly noticeable level of pain, and a small amount of fibrinous tissue coating formed on the wound surfaces (Figure 13).

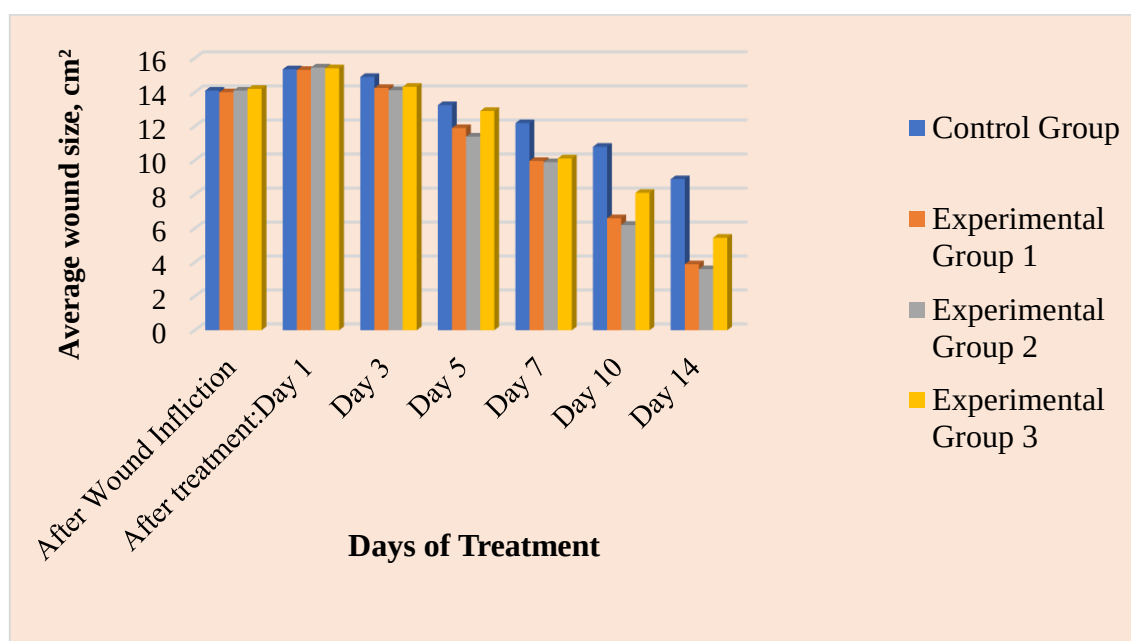


Figure 13 – Changes in the size of aseptic wounds in dogs

In animals of the control group, edema in the wound area persisted during the initial days, and a reduction in wound size to baseline values was only observed on the 5th day, with the wound size decreasing by 6.02% compared to the initial measurement. In the experimental groups, the wound size on the same day decreased by 15.0% and 19.14% in the 1st and 2nd experimental groups treated with 10% and 20% *Artemisia lerchiana* ointment, respectively, while in the 3rd experimental group treated with Vishnevsky liniment, the wound size decreased by 9.15%.

On the 7th day of the study, purulent-fibrinous exudate accumulation was observed on the wound surfaces of animals in the control group. Additionally, signs of pain in the wound area persisted. In contrast, in the experimental groups, the swelling of the wound surface was completely resolved, and the wound was filling in and smoothing to the level of the skin surface.

Significant changes in wound size, i.e., healing, were noted on the 14th day in the 1st and 2nd experimental groups, where the wound size decreased by 72.2% and 74.4%, respectively, compared to baseline values. In the 3rd experimental group, this figure was 61.6%. Meanwhile, in the control group, the wound size reduction was 36.9% compared to baseline.

These results indicate accelerated healing in dogs treated with *Artemisia lerchiana*-based ointment, whereas the healing process in control group dogs was slower. Dogs treated with Vishnevsky liniment showed slightly slower regeneration compared to the 1st and 2nd experimental groups, but treatment outcomes were still clearly better than those in the control group. After the 14th day, the formation of purulent-fibrinous changes increased in the control group animals, resulting in slowed wound healing and the onset of complications, at which point further treatment was administered to these animals. In the 1st and 2nd experimental groups, complete wound healing occurred 1–2 days earlier than in the 3rd experimental group.

During the study, alongside clinical parameters, changes in hematological indicators of the animals were also determined. Hematological parameters measured included erythrocytes, leukocytes, hemoglobin, platelets, monocytes, eosinophils, and lymphocytes (Table 11).

Table 11 – Dynamics of hematological parameters in blood during the treatment of aseptic wounds in dogs

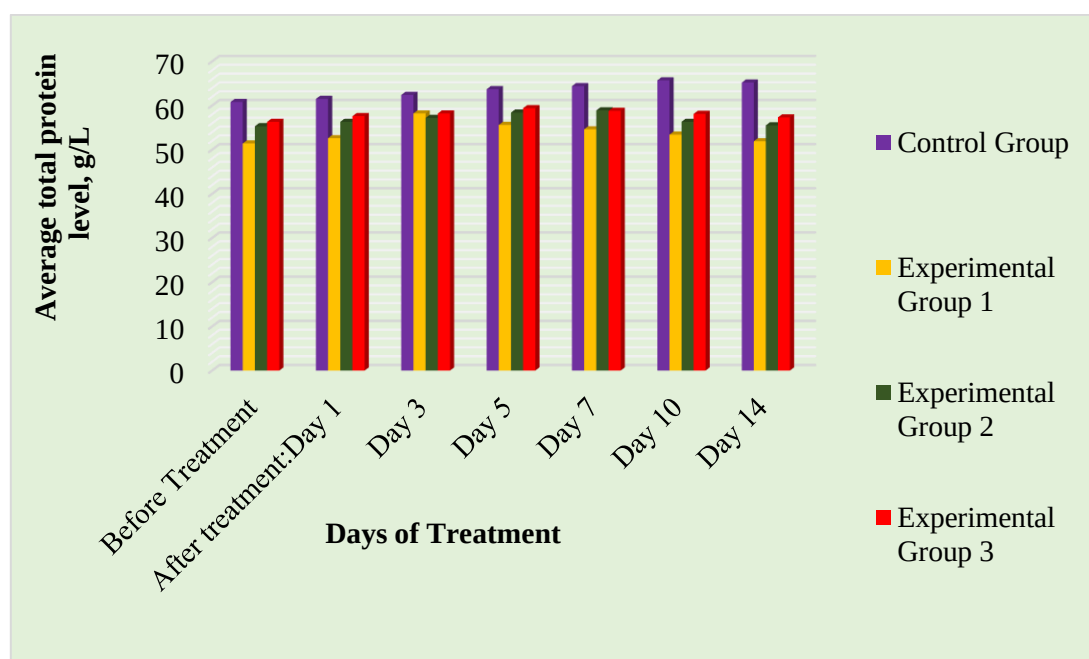
Parameters	Study duration (days)						
	Healthy animals	After treatment: 1 day	3	5	7	10	14
1	2	3	4	5	6	7	8
Control group							
Leukocytes, $10^9/L$	8,7±0,32	9,80±3,23	18,3±5,36	20,1±4,32	17,85±3,36	14,5±2,25	13,8±4,15
Erythrocytes, $10^{12}/L$	6,01±1,36	5,83±2,98	5,24±1,05	5,34±0,89	5,31±1,12	5,38±0,77	5,57±1,26
Hemoglobin, g/L	141,8±3,8	138,5±3,41	127,57±4,52	128,8±4,25	131,4±3,09	132,8±6,25	135,1±5,28
Platelets, $10^9/L$	210,5±4,41	180,8±8,36	119,12±7,58	235,5±7,47	400,41±9,28	394,37±8,85	298,8±6,58
Experimental group 1							
Leukocytes, $10^9/L$	8,56±2,41	9,5±1,29	16,8±2,29	15,4±1,45	10,8±2,27	9,59±2,21	8,7±1,28
Erythrocytes, $10^{12}/L$	6,07±2,05	5,95±1,15	5,88±1,28	6,05±2,14	6,18±1,6	6,25±1,38	6,19±1,74
Hemoglobin, g/L	132,8±2,89	129,2±4,56	139,8±4,7	135,45±5,63	142,2±4,06	140,1±4,61	141,9±4,88
Platelets, $10^9/L$	301,8±4,96	317,5±6,5	333,86±6,36	325,3±7,27	408,4±8,28	395,45±4,09	298,12±4,05
Experimental group 2							
Leukocytes, $10^9/L$	7,89±2,02	8,85±2,15	17,2±1,89	15,45±2,74	12,1±2,09	9,4±1,89	8,8±1,2
Erythrocytes, $10^{12}/L$	5,75±1,15	5,61±1,08	5,81±2,05	6,1±2,36	6,21±1,9	6,34±2,77	6,32±2,37
Hemoglobin, g/L	132,5±4,45	125,25±3,98	128,4±4,5	141,4±4,85	148,8±4,56	142,89±3,69	139,1±2,98
Platelets, $10^9/L$	236,6±2,52	267,5±6,38	272,54±5,92	344,12±5,63	350,36±5,87	309,01±7,16	311,25±6,56

Experimental group 3							
Leukocytes, 10 ⁹ /L	8,5±1,28	9,1±1,85	18,1±2,05	18,84±2,95	16,6±3,35	11,89±3,06	9,7±2,27
Erythrocytes, 10 ¹² /L	6,25±1,28	6,03±2,04	5,97±2,28	5,98±2,36	6,02±2,11	6,16±1,41	6,31±1,29
Hemoglobin, g/L	130,1±5,41	124,14±6,38	121,23±5,28	131,5±5,4	136,4±4,58	138,5±7,28	135,5±4,59
Platelets, 10 ⁹ /L	325,1±8,4	323,5±7,48	325,14±9,87	457,5±9,4	581,89±7,85	461,1±7,45	297,4±7,39

Indicators of erythrocytes, platelets, and hemoglobin in the blood showed changes within normal physiological ranges from the beginning of the study to day 14, when blood samples were taken. The main indicator clearly reflecting the changes in the wound process was the dynamics of leukocytes, which varied among the different groups.

In the control group, leukocyte levels remained above normal from day 3 to day 7, and even on day 14 of the study, the leukocyte count was 58,6% higher compared to baseline values. In contrast, in the experimental groups, fluctuations within the normal range were observed on days 3 and 5. The elevated leukocyte levels in the control group indicate the progression of a purulent process, while the levels within the normal range in the experimental groups are explained by timely treatment.

Analysis of the biochemical parameters of blood serum (total protein, albumins, α -, β -, and γ -globulins) during the study showed no significant changes in any of the groups of dogs. All values remained within physiological norms (Figures 14, 15).



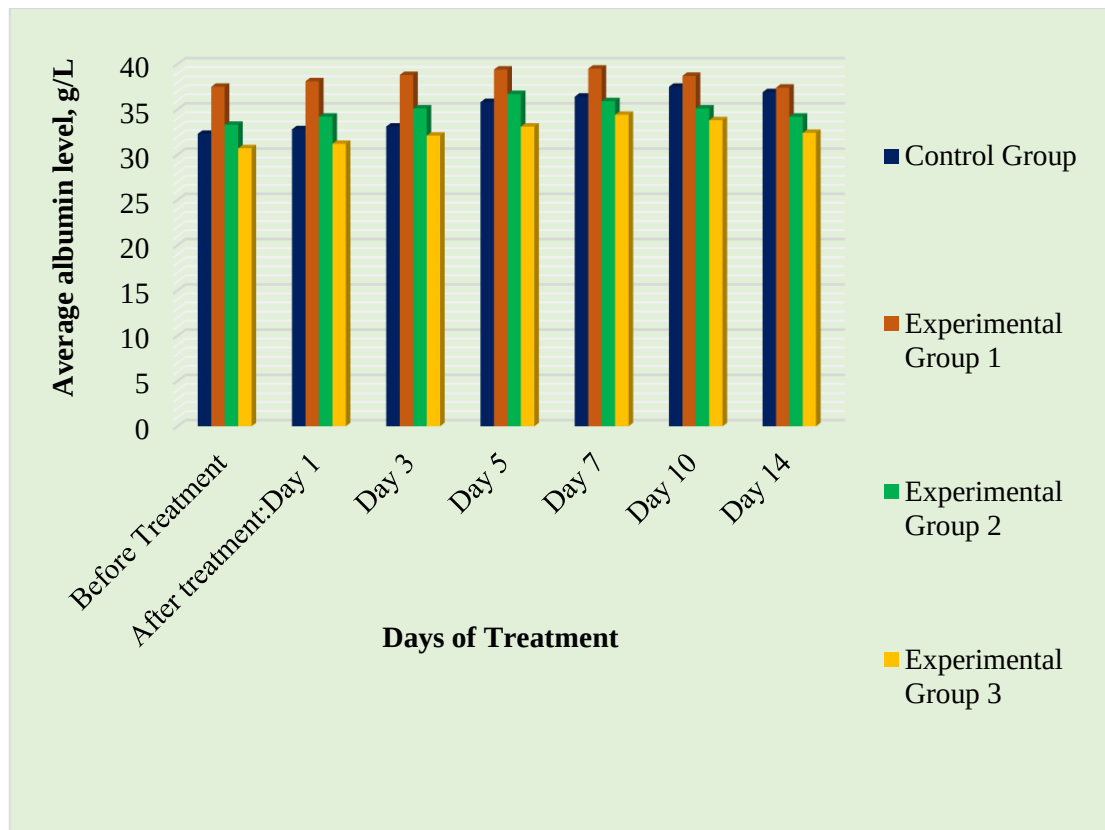
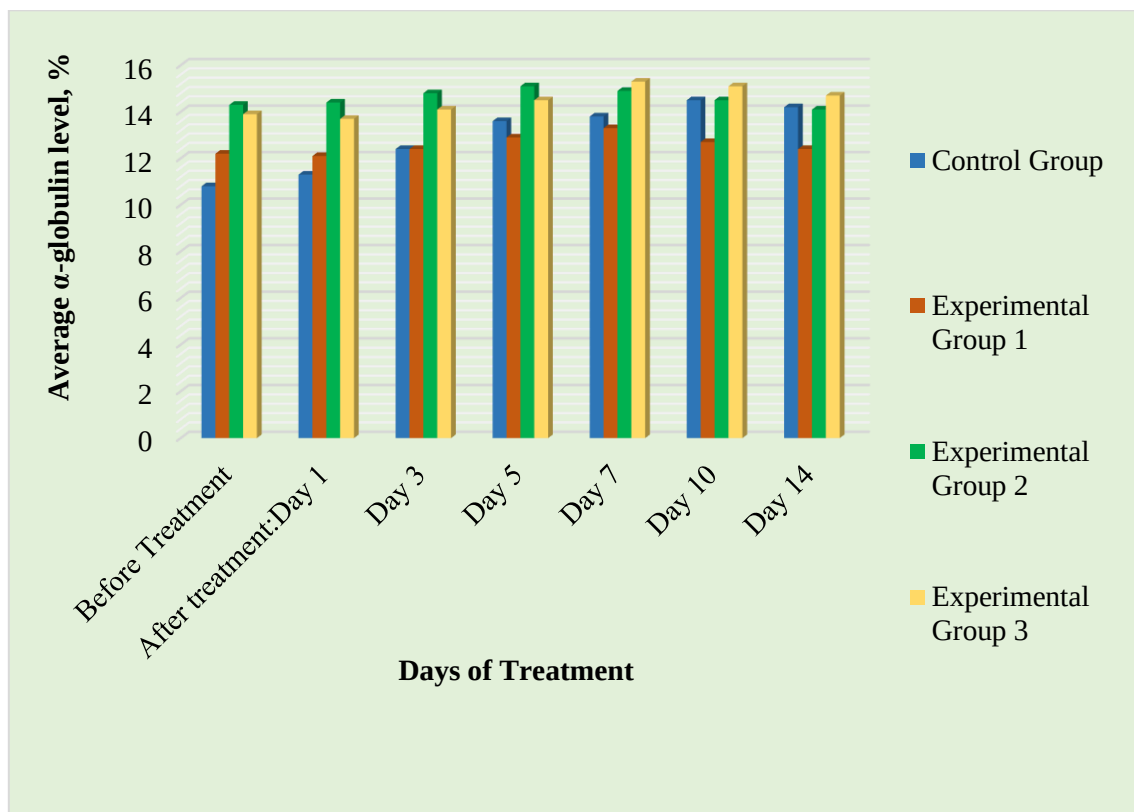


Figure 14 – Changes in total protein and albumin levels in the blood serum of dogs with aseptic wounds



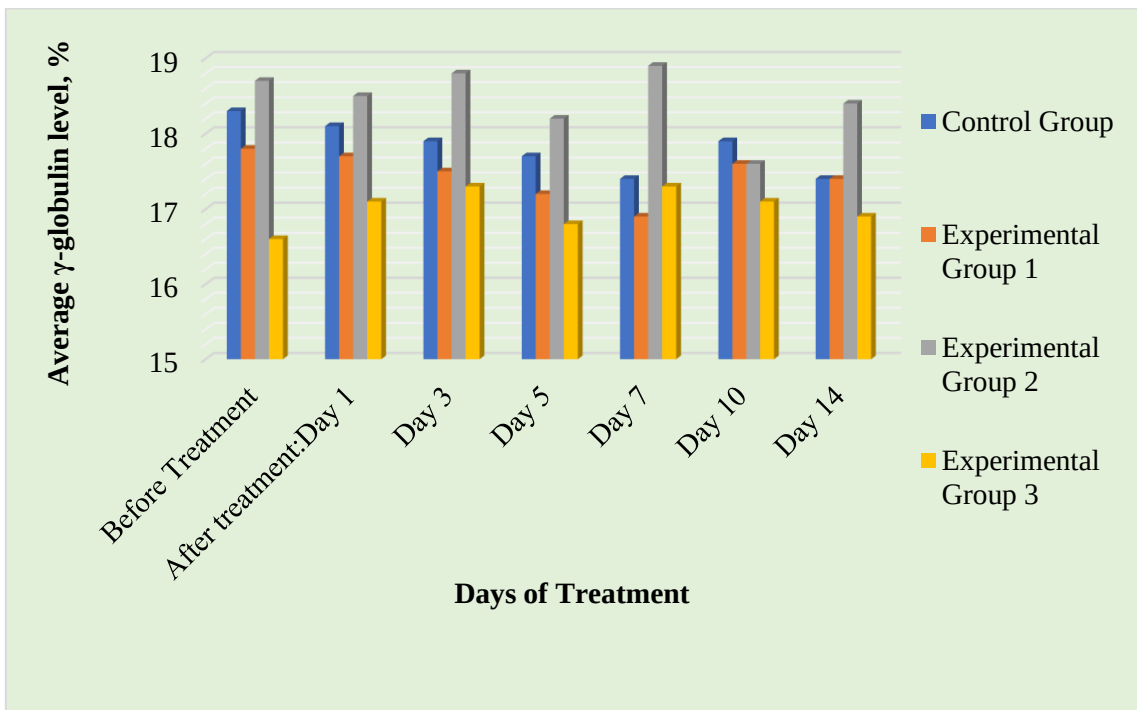
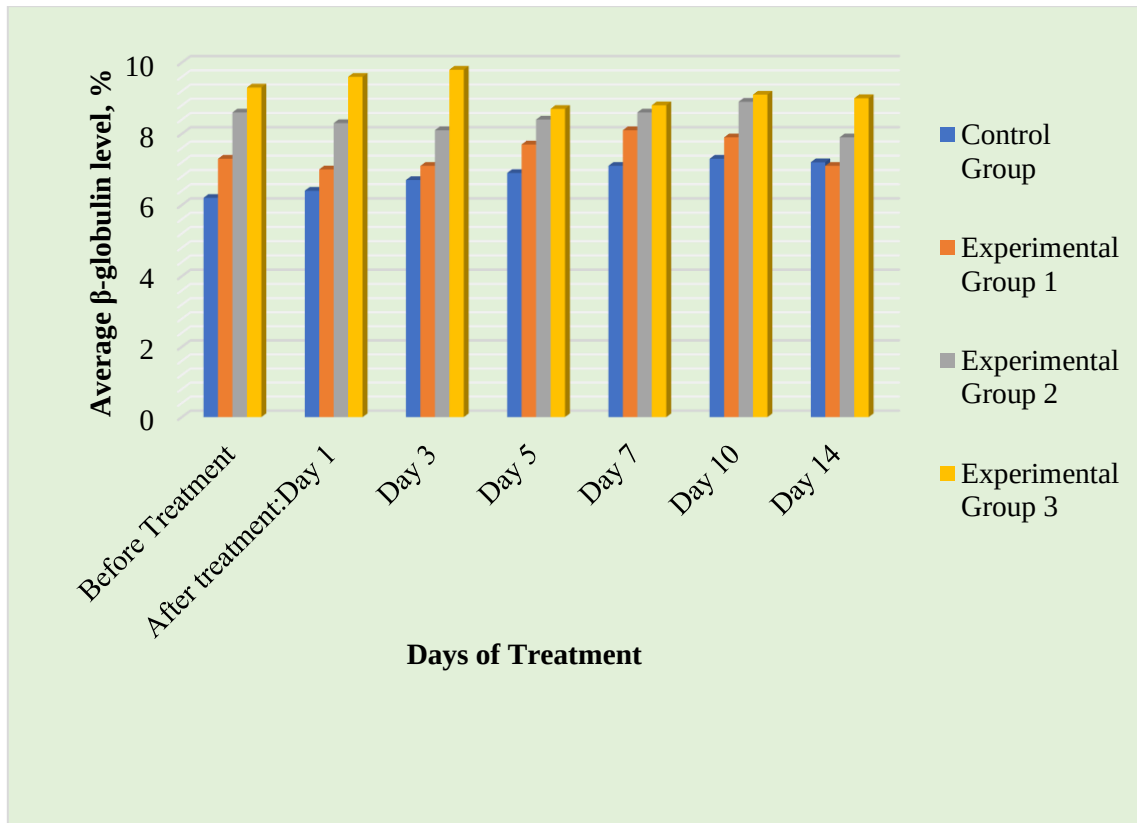
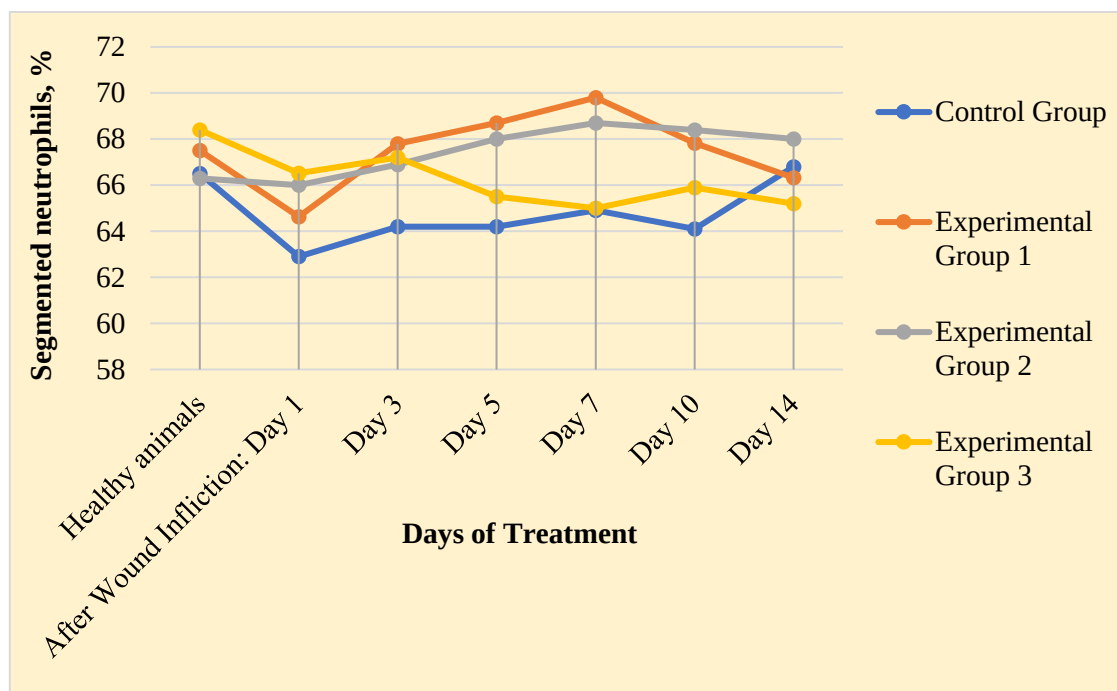


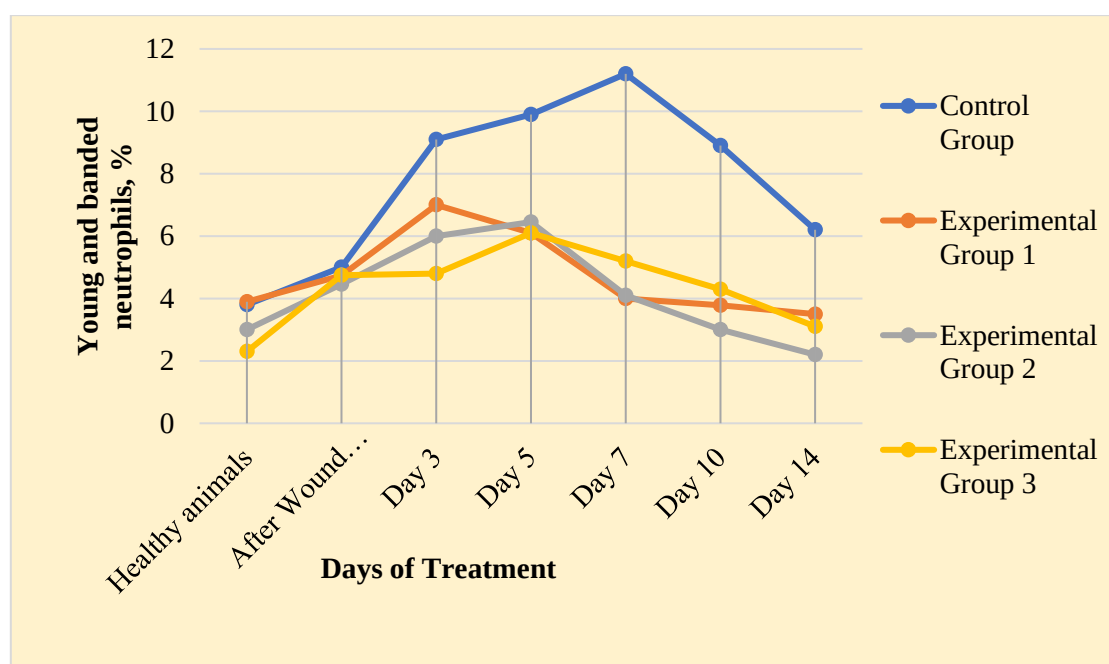
Figure 15 – Changes in α , β , and γ globulin levels in the blood serum of dogs with aseptic wounds

The leukogram of blood was performed as a key indicator in the healing process of aseptic wounds in dogs. Analysis of the leukogram parameters revealed

that the main changes occurred in neutrophils, specifically in young and band neutrophils as well as segmented neutrophils (Figure 16).



a)



b)

a) Segmented nucleus; b) Young and band (stab) nucleus

Figure 16 – Dynamics of neutrophils in the blood of dogs with aseptic wounds

On the 1st day after wound induction, a decrease in segmented neutrophils below the normal baseline levels was observed in all groups of animals, whereas the levels of young and band neutrophils increased in all groups on the 1st day. In the 1st and 2nd experimental groups, an increase in segmented neutrophils above baseline levels was observed on the 7th day, while in the 3rd experimental group, a decrease compared to baseline was noted. Additionally, young and band neutrophils in the 3rd experimental group remained elevated above baseline from that day onward.

In the control group, an increase in young and band neutrophils was observed from the time of wound induction up to the 7th day, while segmented neutrophil levels decreased compared to baseline. The increase in young and band neutrophils during this period indicates a slower healing process, reflecting the need for a higher number of these neutrophils in the blood to support wound healing.

By the 14th day, segmented neutrophil levels in the 1st, 2nd, and 3rd experimental groups returned to baseline, while young and band neutrophils decreased below baseline, indicating active wound healing in these animals. In contrast, young and band neutrophil levels in the control group remained elevated above baseline at this time.

Additionally, during the study, basophil, eosinophil, lymphocyte, and monocyte counts remained within normal physiological ranges across all groups.

The bactericidal activity of blood serum reflects the antimicrobial properties of humoral factors of natural resistance. The immunological parameters in the blood serum of the experimental dogs are presented in Figure 17.

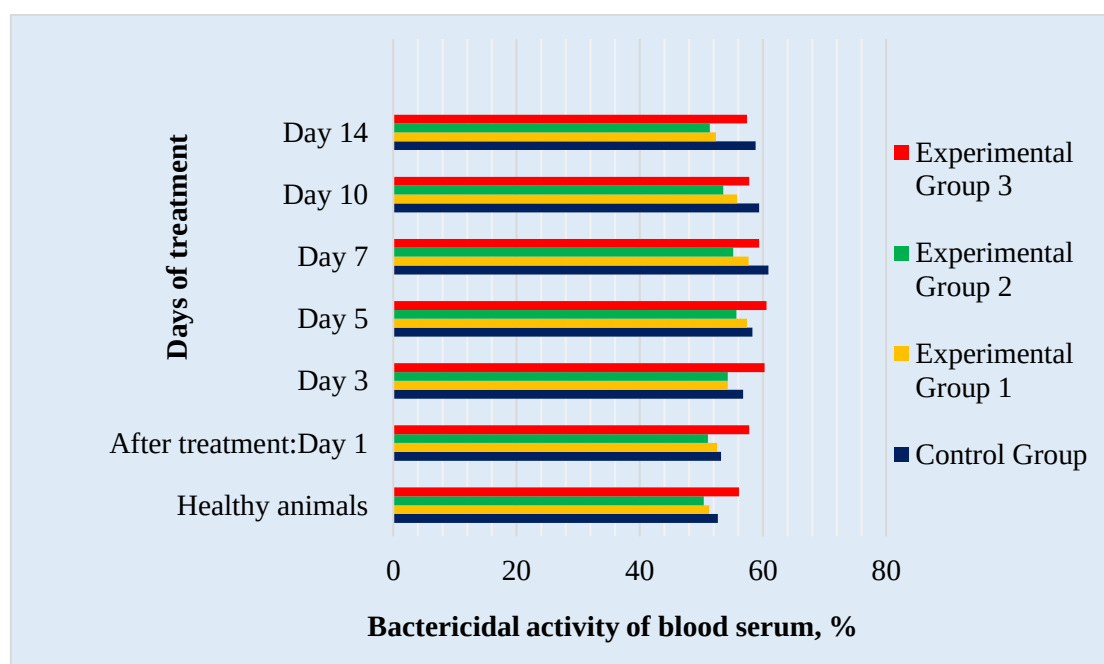


Figure 17 – Bactericidal activity of blood serum in dogs with aseptic wounds

The dynamics of bactericidal activity in the blood serum of dogs with aseptic wounds are shown. The study of bactericidal activity in the blood serum of animals with aseptic wounds demonstrated a significant increase in all groups after wound induction.

In the control group, the bactericidal activity of blood serum increased throughout the study, reaching its highest level on day 7, with a 15.56% increase compared to baseline. By day 14, this indicator was still elevated by 11.57% compared to the initial value.

In the 1st, 2nd, and 3rd experimental groups, the bactericidal activity showed a gradual increasing trend, with an average increase of 2-3% compared to baseline values [175].

5.2 Clinical, hematological, biochemical indicators and the effect on humoral factors of a preparation based on *Artemisia lerchiana* in the treatment of purulent wounds in dogs

As a result of studies conducted to determine the effects of *Artemisia lerchiana*-based and traditional preparations on purulent wounds in dogs, the following results were obtained. During purulent wounds, all groups of animals involved in the study exhibited the development of purulent processes, accompanied by the main clinical signs of pathology, such as increased body temperature, elevated heart rate, and accelerated respiration (Figures 18-20).

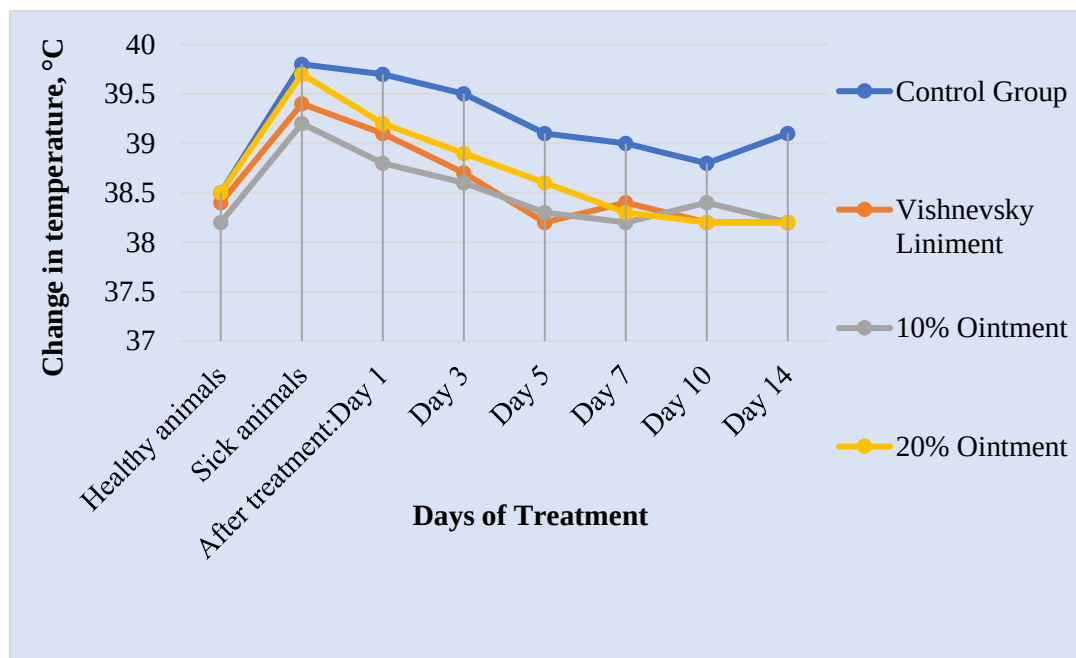


Figure 18 - Changes in body temperature during the treatment of dogs' purulent wounds

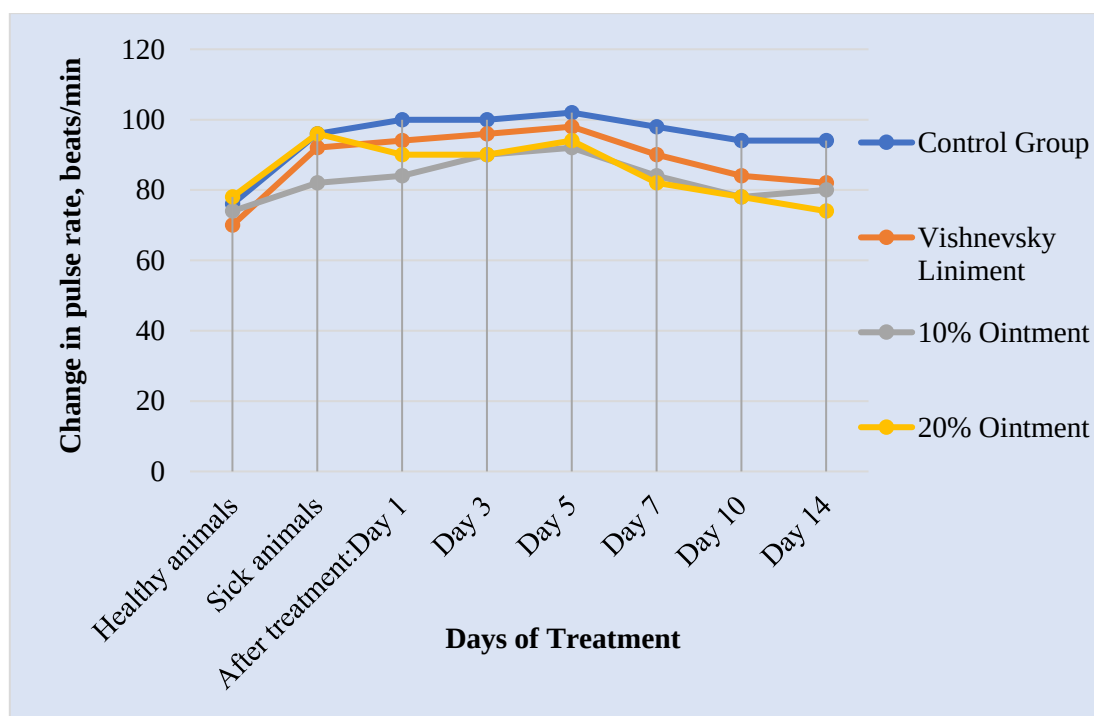


Figure 19 - Changes in pulse rate during the treatment of dogs' purulent wounds

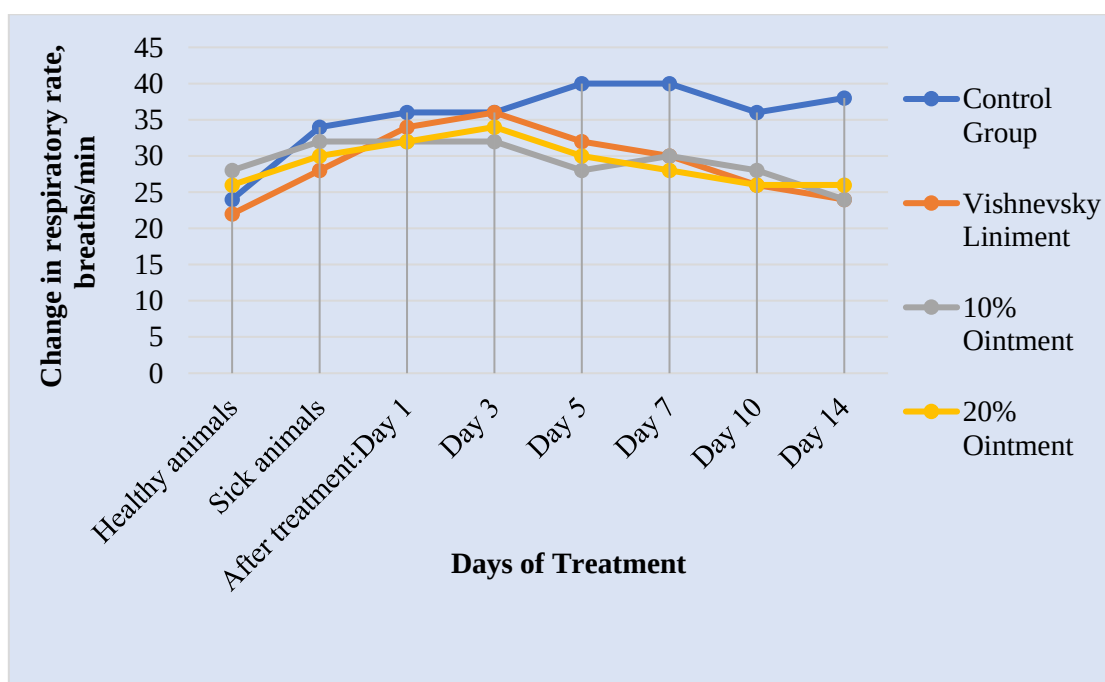


Figure 20 - Changes in respiratory rate during the treatment of dogs' purulent wounds

The research results showed that, in both the experimental and control groups, purulent inflammation developed 4 days after the wound was inflicted. After the purulent process formed in the wound, all animals in all groups exhibited a sharp deterioration in condition, decreased appetite, severe pain symptoms in the wound areas, and noticeable limping in the legs where the wounds were made.

At that time, the average body temperature in all groups rose to 39.5°C, which is 2.9% higher compared to the initial healthy animals, while pulse rate increased by 22.8%, and respiratory rate by 24%.

In the control group, body temperature remained above the normal range until the 7th day after treatment, whereas in the experimental groups (Groups I, II, III), these indicators were within the normal range by the 3rd day of treatment and stayed normal until the end of treatment. Respiratory and pulse rates in the control group remained elevated above the normal range until the end of the study.

According to the results of the study, the overall recovery of animals in the experimental groups (Groups I, II, III) was clearly observed between the 5th and 10th days, whereas in the control group, the indicators remained above the initial normal range even on the 14th day of the study.

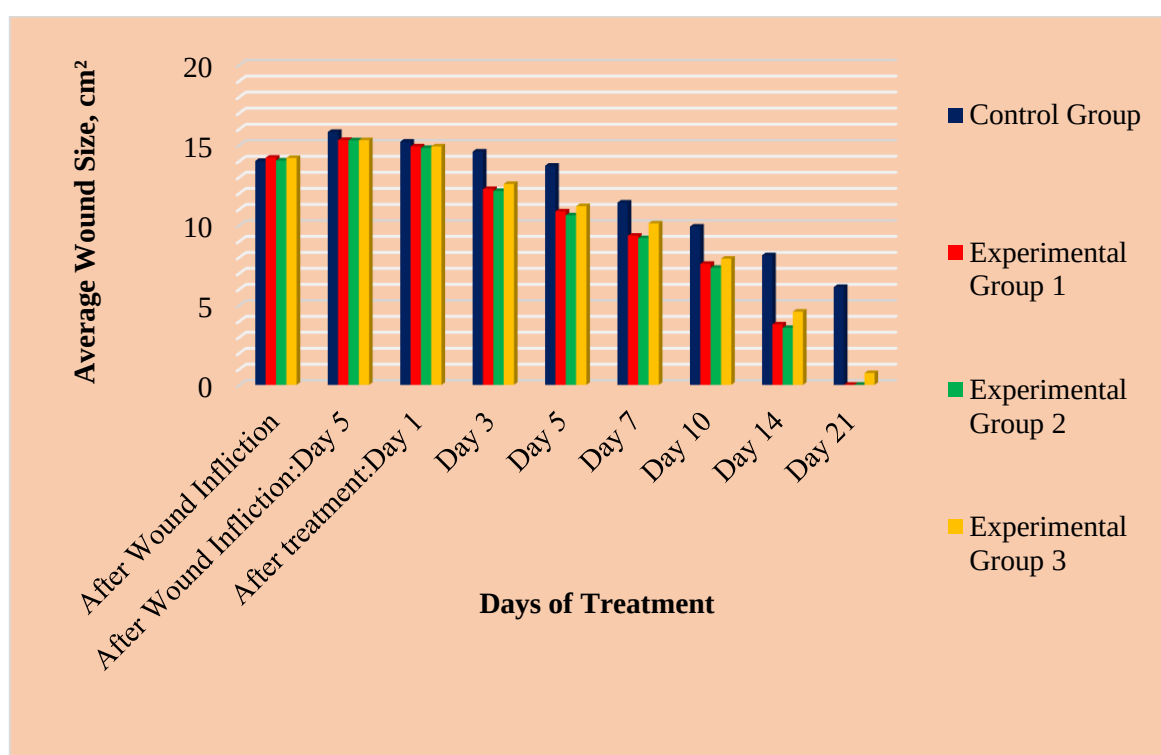


Figure 21 – Changes in the size of purulent wounds in dogs

The change in wound size, after the formation of the purulent process (from the 4th day onwards), showed an increase of 13.31% in all experimental groups compared to the initial measurements (Figure 21).

According to the study results, the general condition of the animals began to improve, fibrinous tissue changes appeared on the wound surface, and crust formation started from the 3rd day in the experimental groups (Groups I, II, and III). These indicators showed a reduction in wound size compared to the initial measurements by 13.8% in the first experimental group (10% *Artemisia lerchiana* ointment), 13.55% in the second experimental group (10% *Artemisia lerchiana* ointment), and 11.42% in the third experimental group (Vishnevsky liniment). In

contrast, the control group showed only a 2.14% reduction in wound size by the 5th day.

After these days, the experimental groups showed normalized appetite, decreased inflammation-related swelling, and noticeably reduced pain upon palpation of the wound area. In the control group, animals remained restless, with local temperature increases and pain sensations present, and purulent processes in the wound area were still clearly observed.

Complete crusting of the wound surface and regeneration processes in the experimental groups by the 14th day resulted in wound size changes compared to initial measurements as follows: 73.38% reduction in the first experimental group, 74.61% in the second experimental group, and 67.7% in the third experimental group. Complete wound closure occurred 4–5 days earlier in the first and second experimental groups compared to the third group. In the control group, by the 21st day, the wound size had decreased by only 56.29% compared to initial measurements. Due to the slower healing process in the control group and considering the risk of secondary infection complications, it was recommended to continue treatment after the 21st day.

During the observation of the healing process of purulent wounds in the experimental dogs, an additional study of the blood's morphological composition (leukocytes, erythrocytes, hemoglobin, platelets, hematocrit, thrombocrit) was conducted (Table 12).

Table 12 – Changes in the morphological composition of dogs' blood during the treatment of purulent wounds

Parameters	Study duration (days)							
	Healthy animals	Sick animals in 5 days	After treatment					
			1	3	7	10	14	21
1	2	3	4	5	6	7	8	9
Control group								
Leukocytes, $10^9/L$	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, $10^{12}/L$	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 1								
Leukocytes, $10^9/L$	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, $10^{12}/L$	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 2								
1	2	3	4	5	6	7	8	9
Leukocytes, 10 ⁹ /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 ¹² /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 3								
Leukocytes, 10 ⁹ /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 ¹² /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

During the monitoring of the morphological blood parameters in dogs during wound treatment, leukocytosis was observed in the experimental groups (Groups I, II, and III) from the 5th day after the purulent process developed until the 10th day of treatment. Afterward, their leukocyte count gradually decreased to the level of healthy animals by the end of the study period. In contrast, leukocytosis persisted throughout the study in the control group, and on the 21st day of blood tests, it was 39.12% higher compared to the baseline values of healthy animals.

Hemoglobin levels decreased somewhat from the 4th day after the purulent process developed, i.e., from the 1st day of treatment. Hemoglobin levels began to normalize by the 10th day in the experimental groups, while in the control group, on the 21st day of the study, hemoglobin remained 2.8% lower than the values of healthy animals. Erythrocyte, platelet, hematocrit, and thrombocrit levels remained within normal physiological ranges throughout the study in all groups.

The analysis of the biochemical parameters of blood serum (total protein, albumins, α , β , γ globulins) showed no significant changes in dogs across all groups during the study. All these indicators remained within physiological normal ranges (Figures 22 and 23).

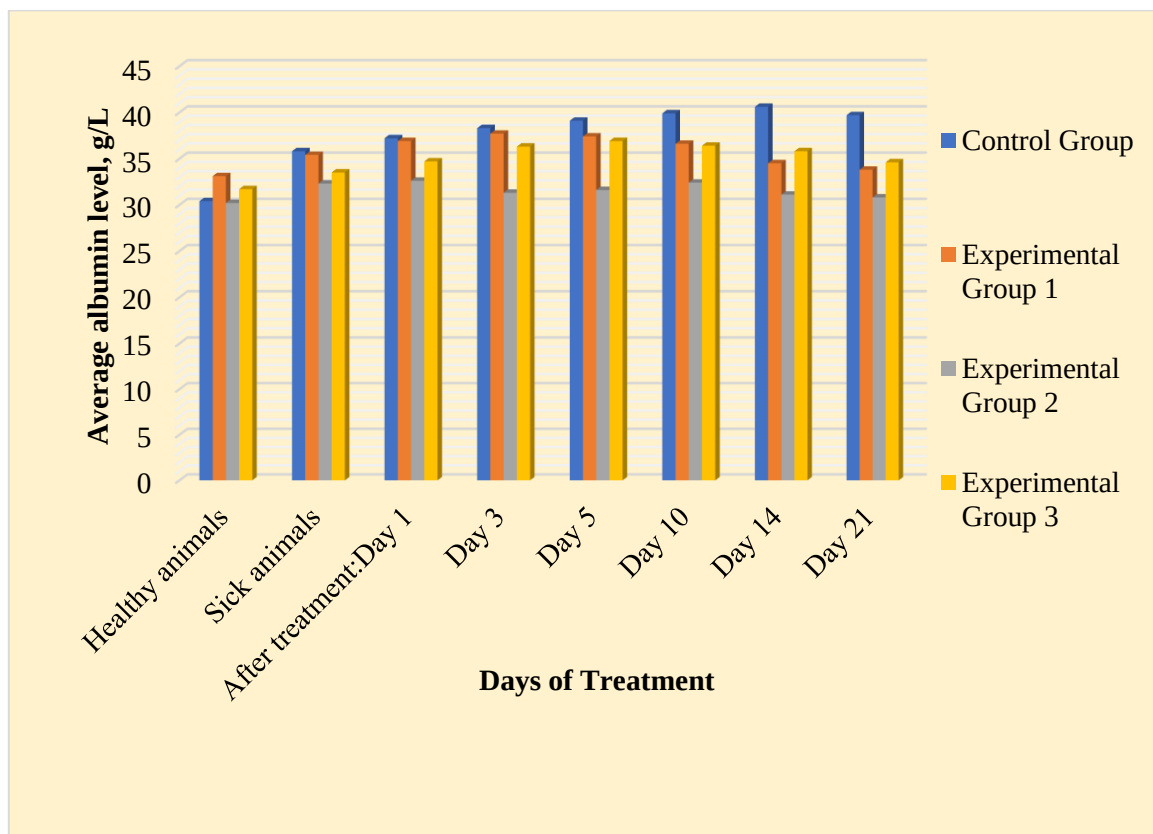
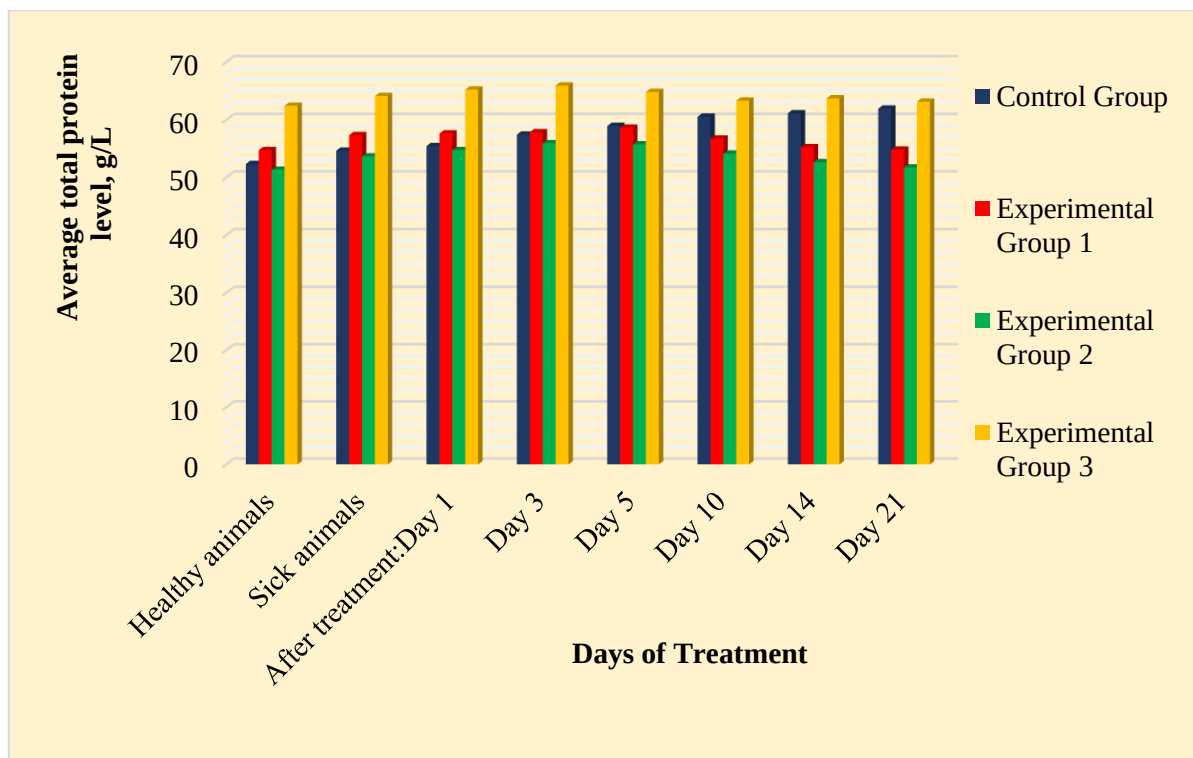
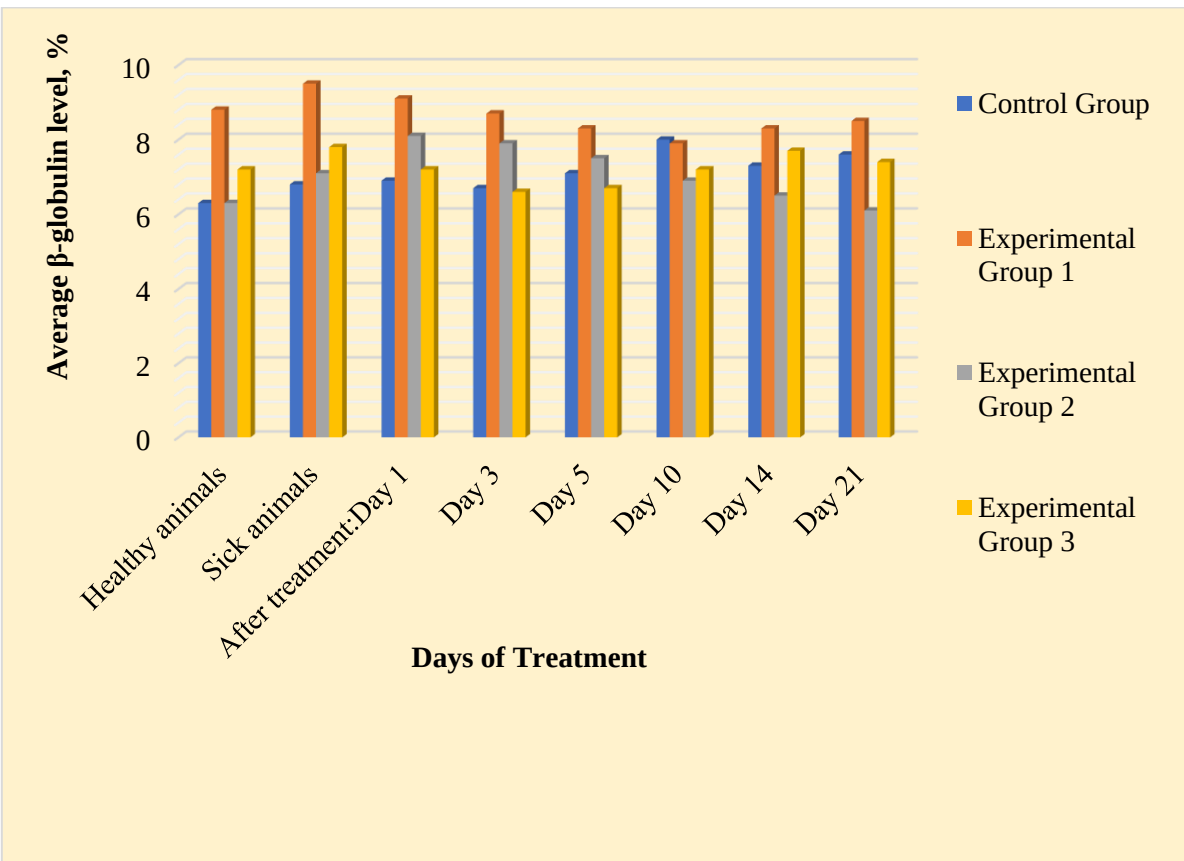
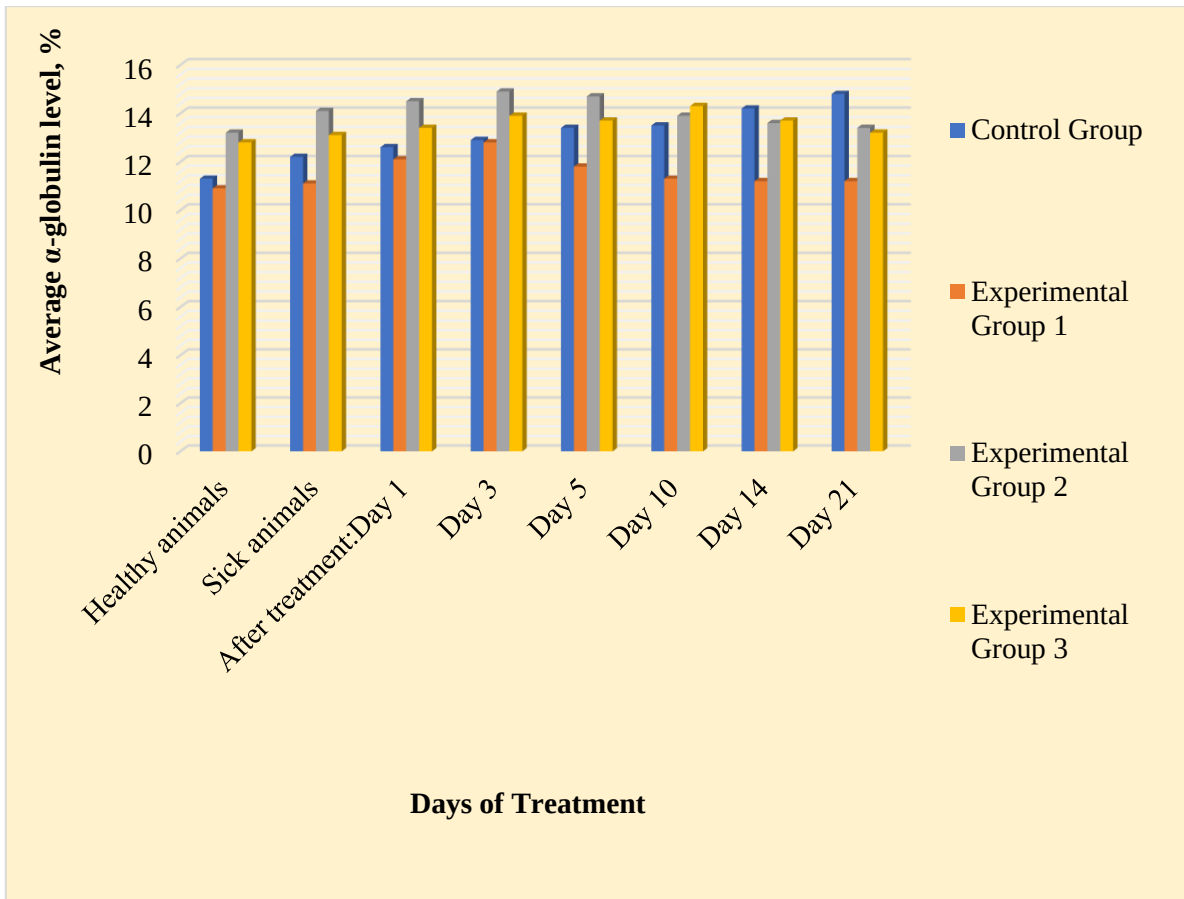


Figure 22 – Changes in total protein and albumin levels in the blood serum of dogs with purulent wounds



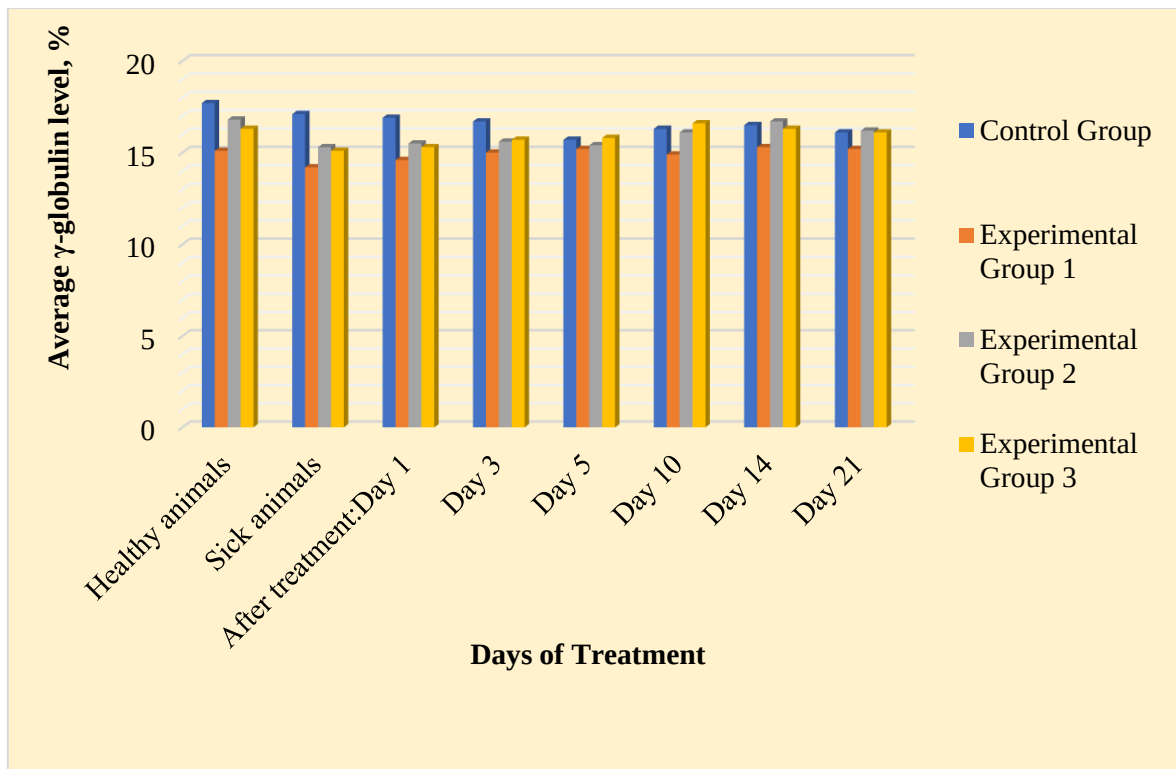
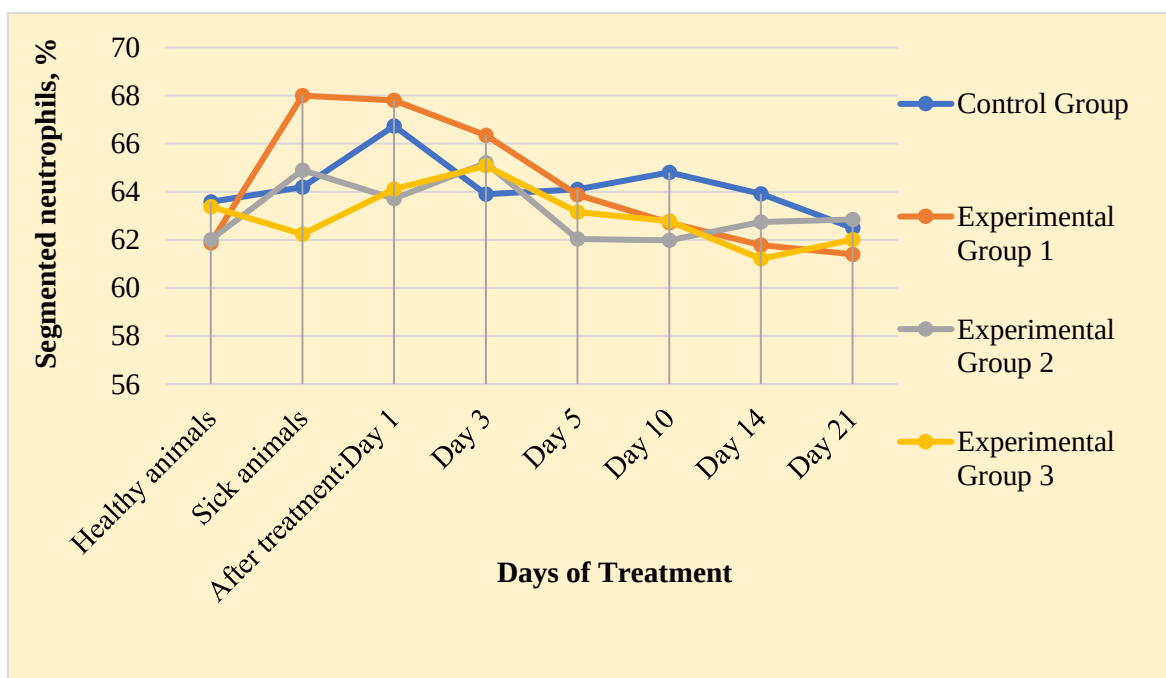
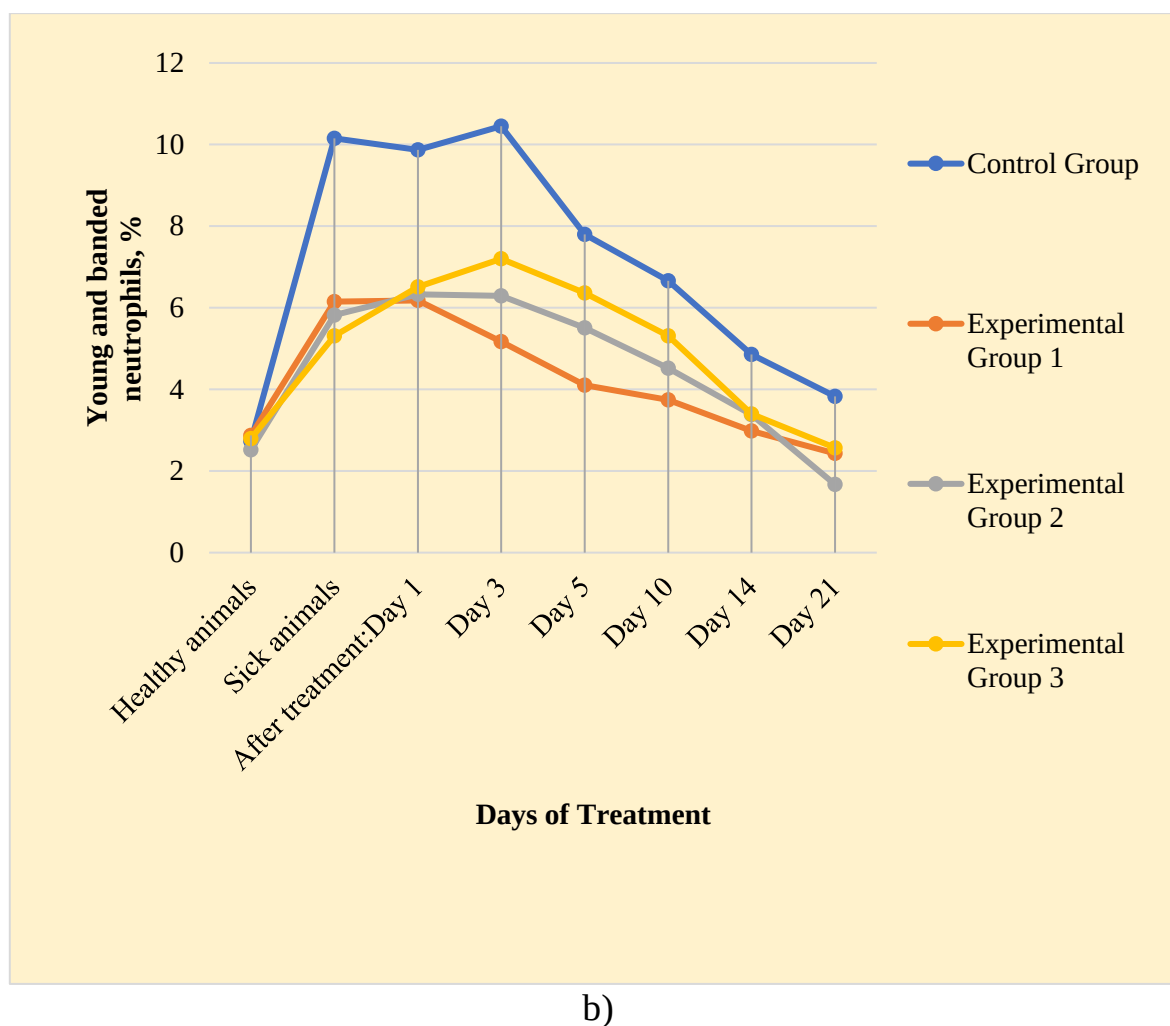


Figure 23 – Changes in α , β , γ globulin levels in the blood serum of dogs with purulent wounds

Analysis of the blood leukogram in dogs with purulent wounds showed a sharp increase in neutrophil count in all study groups after the formation of the purulent process on the 4th day. Correspondingly, the percentage of lymphocytes decreased in all groups (Figure 24, a, b).



a)



a) segmented nucleus; b) young and banded nucleus.

Figure 24 – Dynamics of neutrophils in the blood of dogs with purulent wounds

Subsequently, the percentage of neutrophils in the experimental groups decreased to within the baseline range after the 10th day and reached initial levels by the end of the observation period. In the control group, neutrophilia persisted from the 1st day of treatment after the purulent process developed and lasted until the 14th day. Basophil, eosinophil, and monocyte counts remained within normal ranges throughout the study in all groups.

The bactericidal activity of blood serum directly influences the primary indicators of wound healing in animals. The results of determining the bactericidal activity of blood serum during the treatment of purulent wounds in dogs are shown in Figure 25.

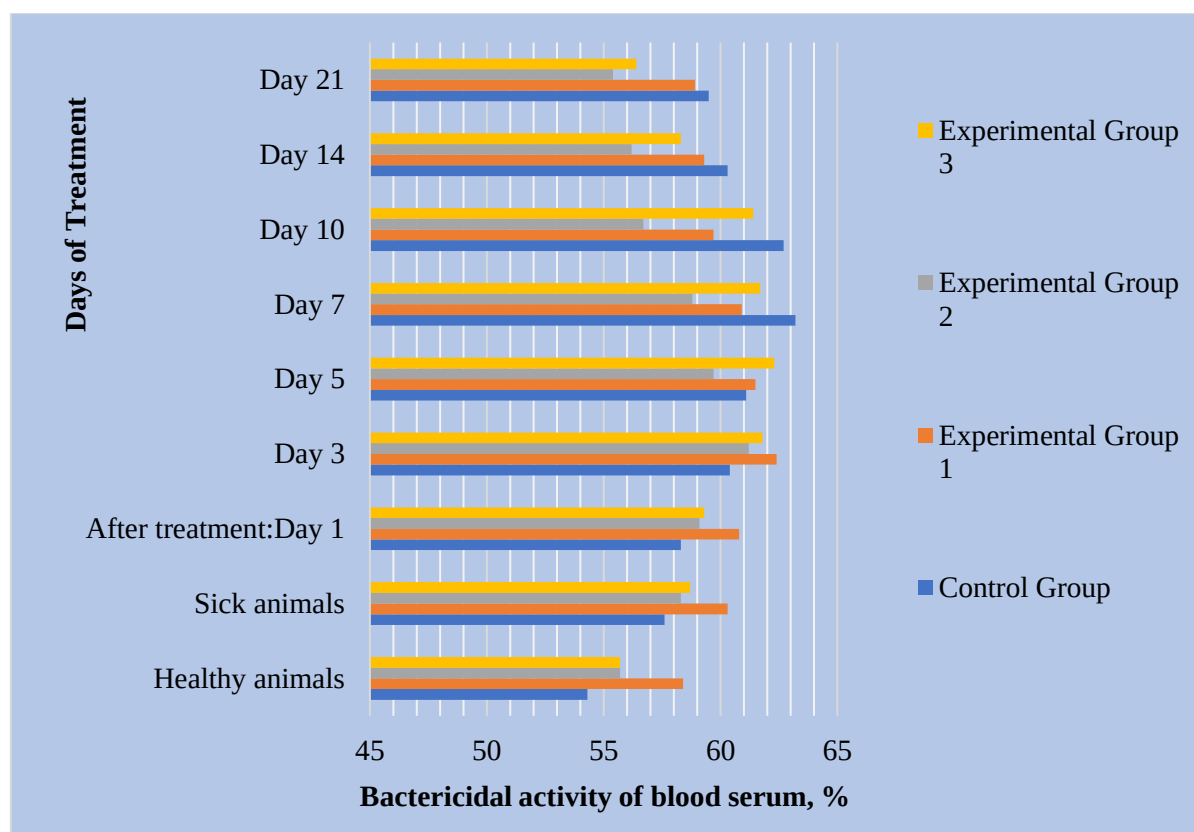


Figure 25 – Bactericidal activity of blood serum in dogs with purulent wounds

The study of bactericidal activity in the blood serum of animals with purulent wounds showed a significant increase in all groups between the 5th and 7th days of the study. In the control group, this indicator increased by 16.4% compared to baseline values, while in the 1st, 2nd, and 3rd experimental groups, the increase averaged between 9–10%. Subsequently, this level gradually decreased in the experimental groups, returning to baseline by the end of the study (21st day). Only in Group IV (control) did the bactericidal activity of blood serum remain 9.6% higher than the initial level.

6. EFFECT OF A PREPARATION BASED ON *ARTEMISIA LERCHIANA* ON ASEPTIC AND PURULENT WOUNDS IN SHEEP

Experimental wounds in sheep were also created in the thigh area of the hind leg, using a stencil, with the same size as those made in dogs – $14,0 \pm 1,0 \text{ cm}^2$ (Figure 26).

Before starting the experiments, all animals underwent a complete clinical examination and blood tests. Only clinically healthy animals were selected for the study.

In the first experiment, we studied the comparative effects of an infusion and ointment made from *Artemisia lerchiana* in the treatment of aseptic wounds

in animals, compared to the traditional treatment method (using Vishnevsky liniment).

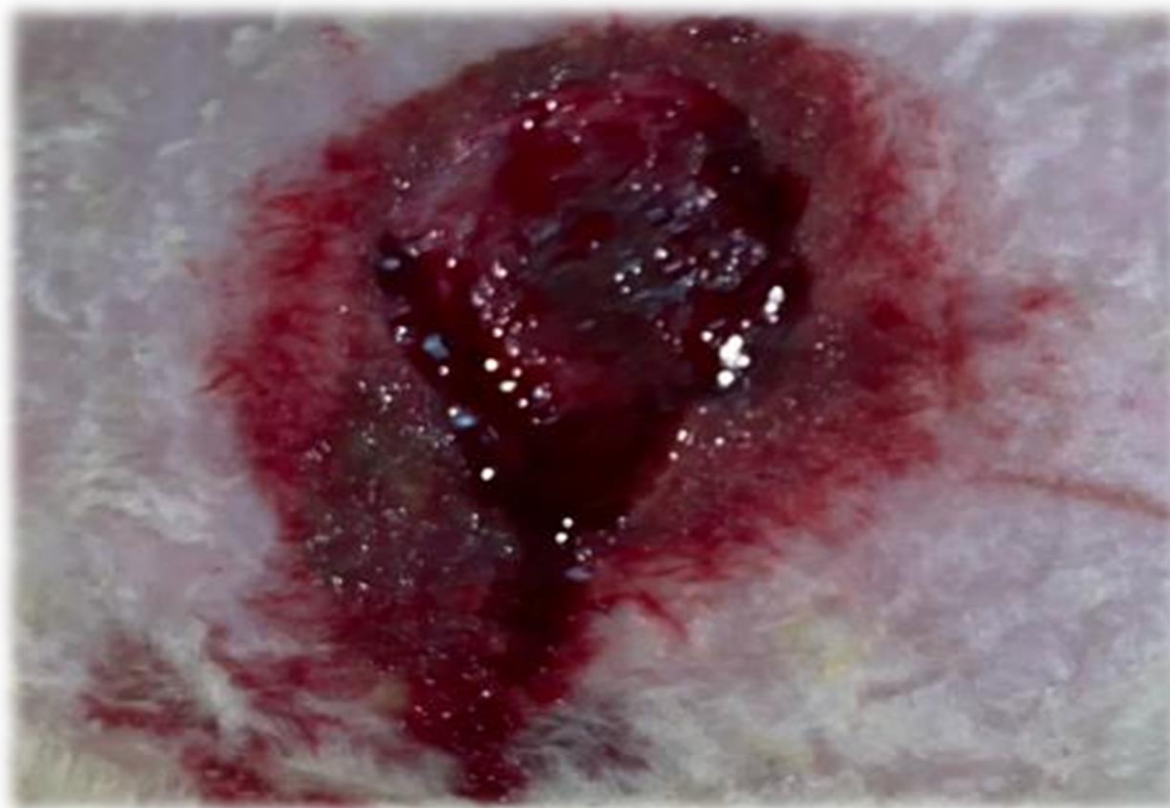


Figure 26 – Appearance of the experimental wound in sheep

6.1 Clinical, hematological, biochemical indicators and the effect on humoral factors of a preparation based on *Artemisia lerchiana* in the treatment of aseptic wounds in sheep

In all groups of animals, the size of the aseptic wounds was approximately 14 cm². After the wounds were inflicted, the animals showed signs of restlessness and limping in the affected limb, while clinical parameters (temperature, pulse, respiration) remained within normal limits. Local reaction (in the wound area) was characterized by signs of inflammation and increased sensitivity.

After visual inspection of the aseptic wounds, a treatment strategy was determined (wound area cleansing and application of medication, followed by dressing).

Animals in Groups I and II were treated with preparations made from *Artemisia lerchiana*, animals in Group III were treated with Vishnevsky liniment, and Group IV (control) received no treatment.

On the first day of observation, all groups of animals showed a slight increase in wound area due to skin tension, with a small difference between the groups (3–4%). The wound cavity was filled with blood clots, all signs of

inflammation were present, and the onset of the wound-cleansing process was clearly visible (Figure 27).

An increase in body temperature, respiratory rate, and heart rate was observed in all groups. This may have been caused by stress and the body's pain response. Overall, the animals' general condition remained stable, though slight limping was observed in the wounded limbs.

The tendency for wound area expansion was noted in all groups by day 3, but this trend was more pronounced in the control group. The inflammatory process in the wound area remained evident, and the cleansing process continued.

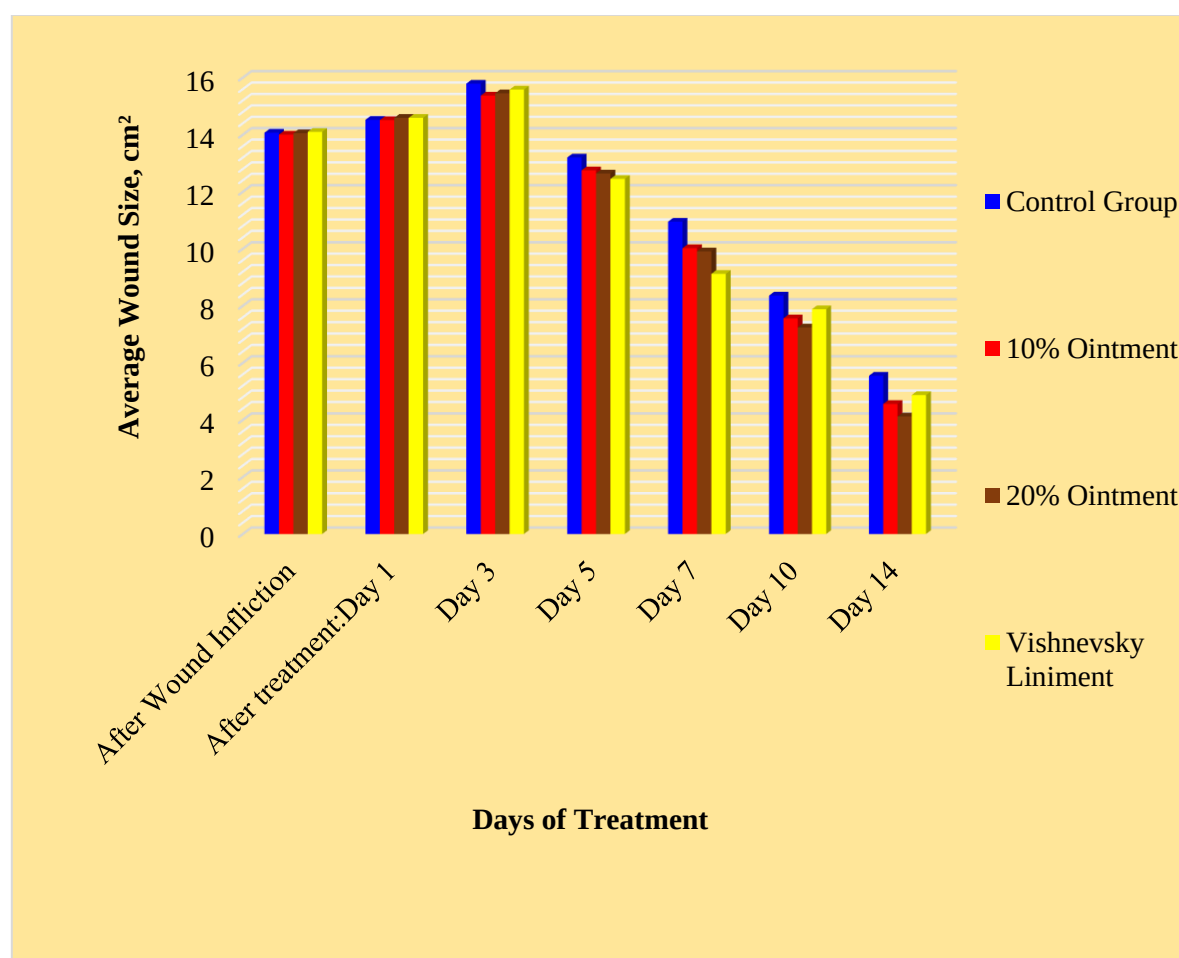


Figure 27 – Dynamics of wound size during the treatment of aseptic wounds in sheep

Clinical parameters (body temperature, heart rate, respiratory rate) showed a slight increase, but in all groups, the changes remained within normal ranges (Table 13).

Table 13 – Dynamics of clinical parameters in sheep during the treatment of aseptic wounds

search duration	Temperature (°C)				Pulse rate (beats/min)				Respiratory rate (breaths/min)			
	Control group	Vishnevsky liniment	10% A. Ierchiana ointment	20% A. Ierchiana ointment	Control group	Vishnevsky liniment	10% A. Ierchiana ointment	20% A. Ierchiana ointment	Control group	Vishnevsky liniment	10% A. Ierchiana ointment	20% A. Ierchiana ointment
Healthy animals	39,24±0,10	39,1±0,08	38,5±0,14	39,8±0,07	92,0±0,82	88,8±1,01	87,6±0,87	80,4±1,10	42,4±0,87	38,8±1,21	40,8±0,01	38,2±2,01
Treatment of sick animals: Day 1	39,3±0,09	39,5±0,06	39,6±0,08	39,4±0,21	112,8±1,21	98,2±1,06	94,8±1,01	100,0±1,94	42,6±0,56	42,8±0,37	50,8±1,21	48,6±0,65
Day 3	39,5±0,06	39,5±0,05	39,7±0,11	39,2±0,18	108,4±1,45	108,8±0,76	82,8±1,12	90,4±1,28	48,8±0,76	46,8±1,01	48,2±0,76	50,4±1,45
Day 5	39,5±0,09	39,8±0,11	39,2±0,12	39,5±0,21	98,6±1,26	90,8±1,01	88,0±1,62	98,4±1,19	44,8±0,76	48,6±0,65	48,2±0,89	46,4±1,10
Day 7	39,2±0,14	39,0±0,09	39,1±0,16	39,5±0,22	96,8±0,89	74,0±1,56	87,2±1,72	86,4±1,73	48,4±0,87	44,8±0,89	40,4±1,45	42,4±1,79
Day 10	39,4±0,07	39,1±0,09	38,7±0,19	39,2±0,18	96,6±0,80	84,8±1,01	90,4±0,99	90,0±0,94	42,8±0,55	52,0±1,25	56,2±1,64	44,4±1,28

By the 5th day of observation, the wound size significantly decreased in two experimental groups and the group treated with the traditional method. Signs of regenerative processes and a reduction in exudate were observed. In the control group, the wound-cleansing process continued, with the inflammatory process still present. Clinical parameters in all groups during days 5–7 of observation remained at the upper limits of normal ranges.

Differences in wound size changes and clinical parameters became noticeable starting from the 7th day of the study. In the control group sheep, general condition deteriorated, animals refused food, and did not bear weight on the injured limb during movement. The wound area was hyperemic, painful upon palpation, with tight and immobile skin.

Sheep in the experimental groups showed satisfactory general condition with only slight signs of limping. Overall clinical parameters decreased but remained within the upper limits of normal. Fibrinous tissue crusting began to form, and granular tissue was observed in areas of the wound not covered by crusts; the skin was movable. A statistically significant difference in wound size was observed between the third experimental group treated with Vishnevsky liniment and the control group.

The reduction in wound size in the first and second experimental groups was somewhat greater compared to the third experimental group. In these groups, crusting began to gradually peel off 2–3 days later.

In subsequent days of observation, accelerated wound healing was noted in sheep treated with 10–20% *Artemisia lerchiana* ointment. This effect was attributed to faster dehydration and granulation processes caused by the ointments. All clinical parameters in these groups returned to within normal limits. This trend continued until the end of the experiment: wounds in sheep from the first and second experimental groups fully healed by days 11–12, while wounds in the third group fully closed with scarring by day 14.

In animals of the control group, tissue regeneration progressed slowly during the 14-day observation period. Some animals developed purulent exudate, prompting termination of the experiment for this group and recommending treatment for these animals.

Clinical parameters during this period remained within normal limits.

During the study of blood morphological composition, the levels of leukocytes, erythrocytes, hemoglobin, platelets, hematocrit, and thrombocrit were recorded (Table 14).

Table 14 – Dynamics of the morphological composition of blood in sheep during the treatment of aseptic wounds

Parameters	Study duration (days)						
	Healthy animals	Day 1 of treatment	3	5	7	10	14
Control group							
Leukocytes, 10 ⁹ /L	7,72±1,52	9,97±3,47	15,23±4,12	15,52±4,32	12,28±3,34	11,85±2,07	10,58±2,1
Erythrocytes, 10 ¹² /L	7,84±1,36	7,84±2,88	7,82±1,05	7,94±1,25	7,91±1,12	8,01±0,45	7,97±1,04
Hemoglobin, g/L	91,8±2,25	90,5±3,21	85,89±4,72	86,8±2,28	91,4±3,4	92,89±4,58	95,41±3,35
Platelets, 10 ⁹ /L	483,8±2,85	457,6±2,34	486,0±2,88	546,4±3,08	521,6±3,04	498,6±2,11	501,2±1,98
Hematocrit, %	30,0 ±1,11	28,2±1,91	29,8±0,66	29,2±1,02	28,8±1,16	29,6±1,72	30,2±1,79
Thrombocrit, %	0,38±0,03	0,26±0,02	0,25±0,04	0,29±0,04	0,32±0,03	0,36±0,02	0,31±0,04
1st experimental group							
Leukocytes, 10 ⁹ /L	8,56±2,41	9,5±1,29	15,8±2,29	15,4±1,45	10,8±2,27	9,59±2,21	8,4±1,28
Erythrocytes, 10 ¹² /L	8,07±2,05	7,95±1,15	7,88±1,28	8,05±2,14	8,18±1,6	8,25±1,38	8,19±1,74
Hemoglobin, g/L	92,8±2,89	89,2±4,56	89,8±4,7	95,45±5,63	92,2±4,06	96,1±4,21	97,9±4,08
Platelets, 10 ⁹ /L	239,2±3,22	329,6±3,04	445,6±3,41	389,2±2,27	387,8±2,33	391,2±1,39	345,8±2,89
Hematocrit, %	40,4±1,47	42,4±1,83	44,4±1,94	39,2±1,36	40,2±1,49	41,4±1,40	40,8±1,20
Thrombocrit, %	0,35±0,02	0,26±0,03	0,28±0,04	0,26±0,03	0,29±0,03	0,31±0,03	0,34±0,02
2nd experimental group							
Leukocytes, 10 ⁹ /L	7,89±2,02	8,85±2,15	15,2±1,89	14,45±2,74	10,1±2,09	9,4±1,89	8,8±1,2
Erythrocytes, 10 ¹² /L	7,75±1,15	7,86±1,08	7,81±2,05	8,1±2,36	8,21±1,9	8,34±2,77	8,32±2,37
Hemoglobin, g/L	92,5±3,45	91,25±3,98	88,4±4,5	94,4±2,85	96,8±3,56	98,89±3,69	99,21±2,28
Platelets, 10 ⁹ /L	326,4±3,21	317,2±2,18	308,6±2,01	292,2±3,12	323,6±2,06	368,6±2,84	351,4±3,08
Hematocrit, %	30,6±1,72	30,8±2,08	29,8±2,33	28,6±2,27	29,4±2,18	28,6±2,09	29,8±1,85
Thrombocrit, %	0,32±0,03	0,34±0,02	0,33±0,03	0,37±0,03	0,35±0,04	0,32±0,02	0,35±0,02
3rd experimental group							
Leukocytes, 10 ⁹ /L	8,5±1,28	9,1±1,85	14,91±2,05	14,84±2,95	12,6±3,35	9,89±3,06	8,7±2,27
Erythrocytes, 10 ¹² /L	8,25±1,28	8,03±2,04	7,97±2,28	7,98±2,36	8,02±2,11	8,16±1,41	8,31±1,29
Hemoglobin, g/L	90,1±2,41	89,14±3,3	87,23±3,28	91,5±5,4	91,8±4,28	93,5±3,28	93,55±4,02
Platelets, 10 ⁹ /L	398,4±3,09	401,4±2,73	466,8±2,84	408,2±2,33	412,4±1,99	402,2±2,44	416,8±3,09
Hematocrit, %	31,8±2,15	32,8±2,08	33,4±1,54	30,6±1,59	32,6±1,72	34,8±1,74	33,2±1,32
Thrombocrit, %	0,27±0,03	0,26±0,03	0,25±0,02	0,26±0,03	0,27±0,03	0,28±0,04	0,30±0,03

Leukocytosis was observed on days 3-5 of observation in sheep with healed wounds (Groups I, II, and III). Subsequently, their numbers gradually decreased to the baseline levels of healthy animals. In the control group, leukocytosis was observed throughout the entire study period.

Hemoglobin levels in all groups slightly decreased on the 3rd day of observation. Afterwards, the levels increased but remained within normal ranges. During the study, analysis of erythrocyte, platelet, hematocrit, and thrombocrit counts showed no significant changes in any of the four research groups.

Analysis of the leukogram in sheep with aseptic wounds revealed neutrophilia with a left shift of the nucleus on days 3-5, along with a decreased percentage of lymphocytes in all groups (Table 15).

Table 15 – Changes in the blood leukogram during the treatment of aseptic wounds in sheep

Study duration	Neutrophils (%)			Basophils (%)	Eosinophil s (%)	Lymphocy tes (%)	Monocytes (%)
	Young	Rod- shaped	Segmented nucleus				
Control group							
Healthy animals	0,85±0,37	3,42±0,25	37,3±1,5	0,5±0,2	2,27±0,35	53,3±1,79	2,36±0,85
1 day after wound creation	1,25±0,27	4,35±1,8	41,25±1,41	0,54±0,12	2,81±0,63	43,67±1,52	2,45±0,15
Day 3	2,18±0,4	4,32±2,51	44,74±1,29	0,41±0,17	2,19±0,65	42,77±0,5	3,39±0,63
Day 5	2,2±0,35	5,1±1,12	42,20±1,30	0,24±0,16	3,17±0,66	44,11±1,77	2,98±0,89
Day 7	3,23±0,54	4,58±0,98	43,85±1,52	0,20±0,12	3,87±0,75	41,03±1,98	3,24±0,2
Day 10	2,96±0,62	3,51±0,74	42,25±2,89	0,42±0,6	3,85±0,32	43,89±0,98	3,12±0,5
Day 14	1,81±0,30	2,89±0,85	39,92±3,05	0,5±0,15	2,98±1,05	49,38±1,25	2,52±0,3
1st experimental group							
Healthy animals	0,70±0,39	3,05±1,45	37,50±1,87	0,5±0,1	2,20±0,41	52,2±1,83	2,85±0,15
1 day after wound creation	1,98±0,85	3,89±1, 2	41,63±1,85	0,6±0,12	2,42±0,55	47,05±1,84	2,43±1,05
Day 3	2,01±0,38	4,37±0,52	47,80±1,7	0,33±0,16	4,10±0,43	37,54±1,58	3,85±0,67
Day 5	2,84±0,31	3,87±1,4	41,2±2,25	0,60±0,24	4,15±0,25	43,47±1,85	3,87±0,98
Day 7	1,75±0,82	3,24±0,39	41,29±1,25	0,45±0,27	3,8±0,87	46,95±1,25	2,52±0,51
Day 10	1,52±1,1	3,05±0,33	39,89±2,28	0,4±0,21	3,87±0,65	48,69±1,2	2,58±0,44
Day 14	0,61±0,72	2,04±0,42	40,38±2,67	0,52±0,21	3,2±0,84	50,6±1,75	2,65±0,15
2nd experimental group							
Healthy animals	0,95±0,25	3,10±0,75	38,33±1,9	0,45±0,1	2,82±0,89	51,34±1,85	3,01±0,85
1 day after wound creation	1,85±0,8	3,8±0,87	38,2±1,25	0,6±0,15	2,95±1,58	49,1±1,28	3,5±0,74
Day 3	2,18±0,95	4,15±0,54	44,18±1,32	0,55±0,5	4,90±0,95	40,46±1,2	3,58±0,87
Day 5	2,15±0,33	3,86±0,6	41,75±1,28	0,42±0,26	4,18±0,7	44,26±1,5	3,38±0,48
Day 7	1,98±0,75	3,20±0,74	38,70±0,97	0,5±0,15	4,28±0,58	48,76±1,75	2,58±1,05
Day 10	1,45±0,2	2,90±0,87	38,45±1,25	0,45±0,18	4,15±0, 5	50,0±1,8	2,60±0,32
Day 14	0,98±0,42	2,76±0,47	38,94±2,65	0,51±0,36	4,52±0,33	49,24±1,98	3,05±0,53
3rd experimental group							
Healthy animals	0,95±0,32	3,2±0,53	36,50±1,60	0,45±0,2	2,20±0,31	54,2±1,05	2,50±0,65
1 day after wound creation	1,85±0,31	4,45±0,3	42,9±4,2	0,4±0,12	2,8±0,45	45,19±1,22	2,41±1,05
Day 3	2,80±0,32	4,30±0,55	44,2±1,42	0,40±0,17	2,95±0,48	42,14±0,95	3,21±0,53
Day 5	2,60±0,36	4,3±0,55	42,20±1,38	0,20±0,16	3,7±0,46	43,7±0,77	2,85±0,38
Day 7	3,3±0,39	5,2±0,42	43,9±1,37	0,20±0,14	4,10±0,55	40,1±0,98	3,2±0,36
Day 10	2,65±0,39	3,10±0,33	41,5±2,30	0,42±0,16	4,70±0,47	44,33±0,91	3,3±0,53
Day 14	0,91±0,39	1,10±0,85	38,58±3,35	0,5±0,16	3,8±0,47	51,91±0,91	3,2±0,3

Later, the percentage of neutrophils decreased and by the end of the observation period returned to the baseline levels. In the control group, neutrophilia with a left shift of the nucleus was observed between days 3 and 10, with a decrease in this indicator noted by day 14.

Similar changes were also observed in monocytes across all groups, while no clear trends were seen in the percentage changes of basophils and eosinophils.

Analysis of the biochemical parameters of blood serum (total protein, albumins, α , β , γ -globulins) during the study showed no significant changes in sheep across all groups. All indicators remained within normal reference ranges (Figures 28 and 29).

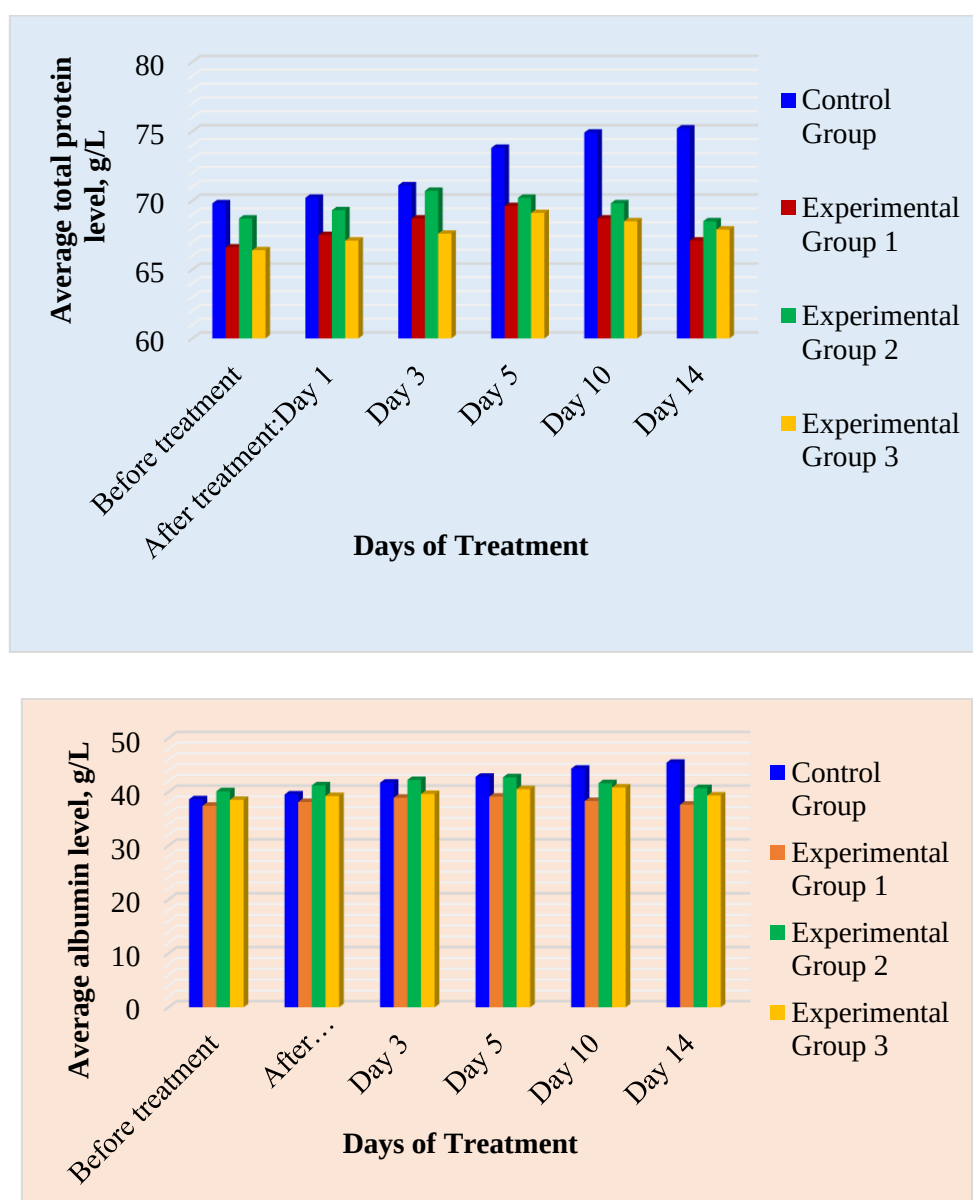
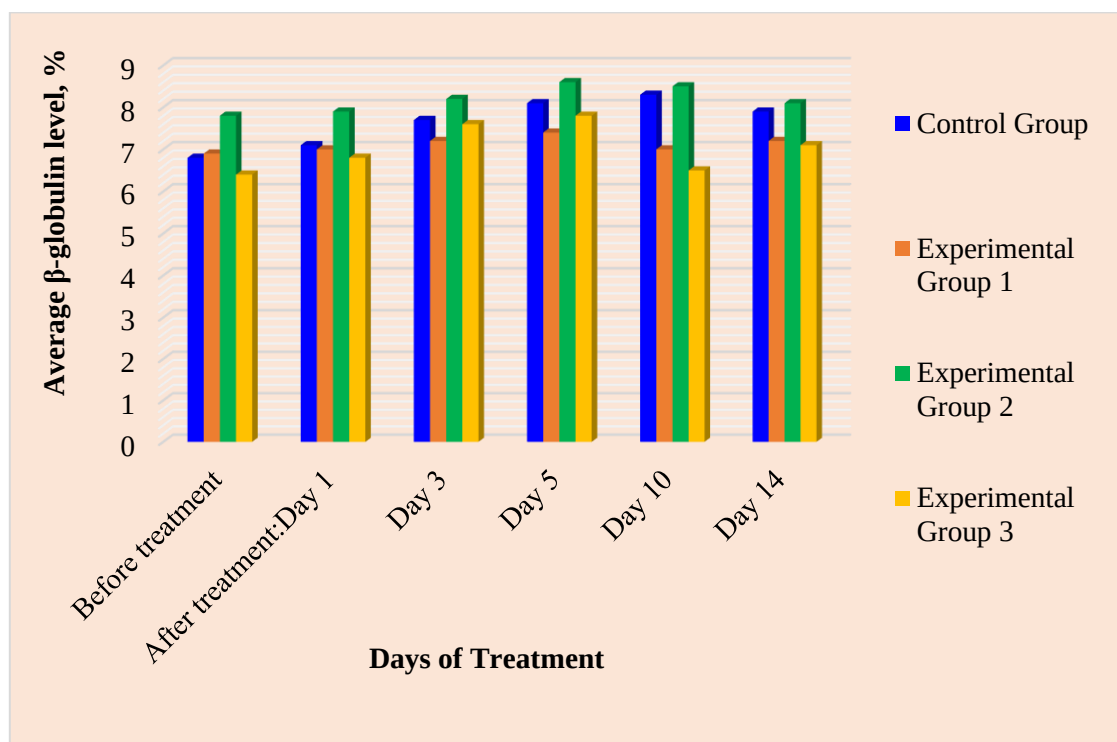
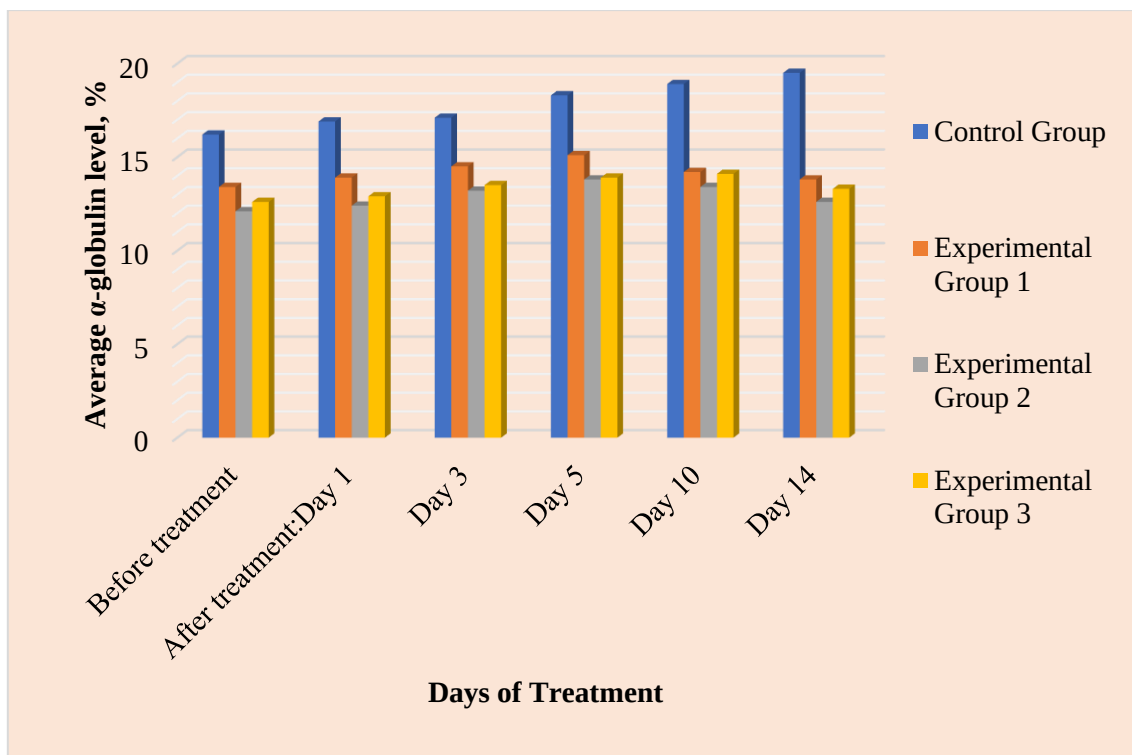


Figure 28 – Changes in total protein and albumin levels in the blood serum of sheep with aseptic wounds



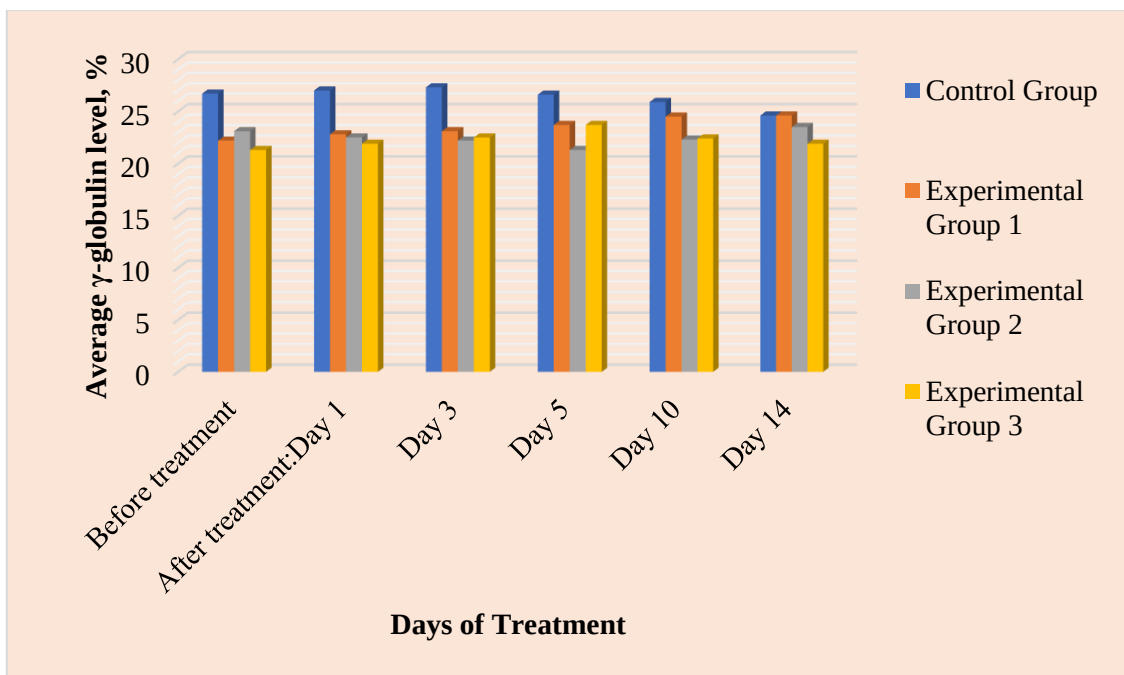


Figure 29 – Changes in α , β , and γ -globulin levels in the blood serum of sheep with aseptic wounds

The dynamics of bactericidal activity indicators in blood serum are shown in Figure 30.

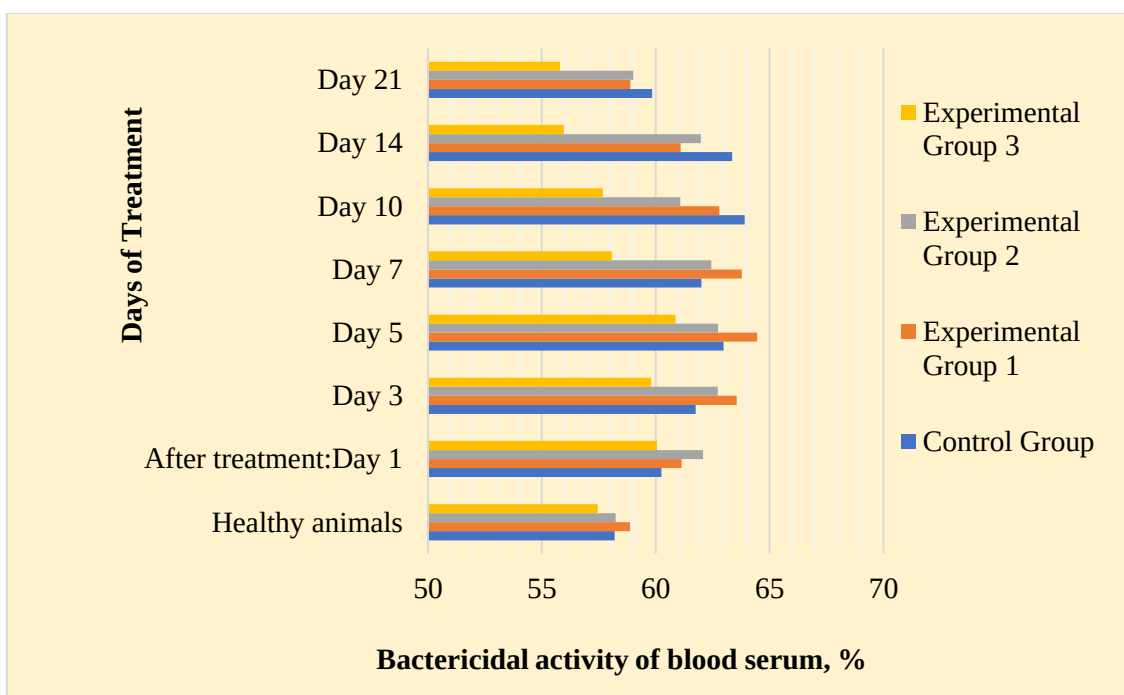


Figure 30 – Dynamics of bactericidal activity of blood serum (BABS) during the treatment of sheep with aseptic wounds

After wound induction, an increase in the bactericidal activity of blood

serum (BABS) was observed in all animals, averaging 4.62% on the first day. The maximum value was recorded in the control group on day 10, reaching 63.9 ± 1.27 , which was 9.79% higher than the baseline. In the experimental groups, the maximum values were observed on day 5 and were also higher than the initial levels—by 9.45%, 7.73%, and 5.95%, respectively—before gradually decreasing back to baseline. These data correlate with clinical indicators, the dynamics of blood composition changes, and the leukocyte formula.

6.2 Clinical, hematological, biochemical indicators and the effect on humoral factors of a preparation based on *Artemisia lerchiana* in the treatment of purulent wounds in sheep

In the second experiment, we studied the processes of treating purulent wounds using traditional methods (applying Vishnevsky liniment) and preparations made from *Artemisia lerchiana* (infusion and ointment).

In all animal groups, the experimental wounds had an approximate area of 14 cm². Subsequently, a purulent process was induced using the method proposed by A. Abdulla and co-authors. The animals were divided into four groups based on the same analogical principle used in the first experiment.

Prior to the start of the experiment, clinical examinations were conducted. The animals showed signs of general restlessness, lameness in the wounded limb, elevated body temperature, increased heart and respiratory rates, reduced appetite, and decreased physical activity.

The local reaction (around the purulent wound) was characterized by signs of purulent inflammation, including increased sensitivity, presence of purulent exudate, redness of the surrounding tissues, and elevated local temperature.

Once the purulent wound had formed, a treatment strategy was determined within the framework of the study's objective (wound margin cleaning, medicinal treatment, dressing application).

In the experimental Groups I and II, the wounds were treated with *Artemisia lerchiana*-based preparations (10% and 20% ointments, respectively). Group III animals received Vishnevsky liniment (used as a conventional treatment for comparison), while Group IV was left untreated (to observe the body's natural response). Treatment began immediately after diagnosis and the establishment of the treatment strategy.

During the first 1–3 days after the start of treatment, a slight reduction in wound size (2–3%) was observed in all animals. In the wound area, skin tension and firmness, tissue swelling, and sensitivity were noted. The wound surface was covered with a gray-brown fibrinous tissue crust, which in some areas had detached, revealing yellowish-green purulent discharge underneath (Figure 31).

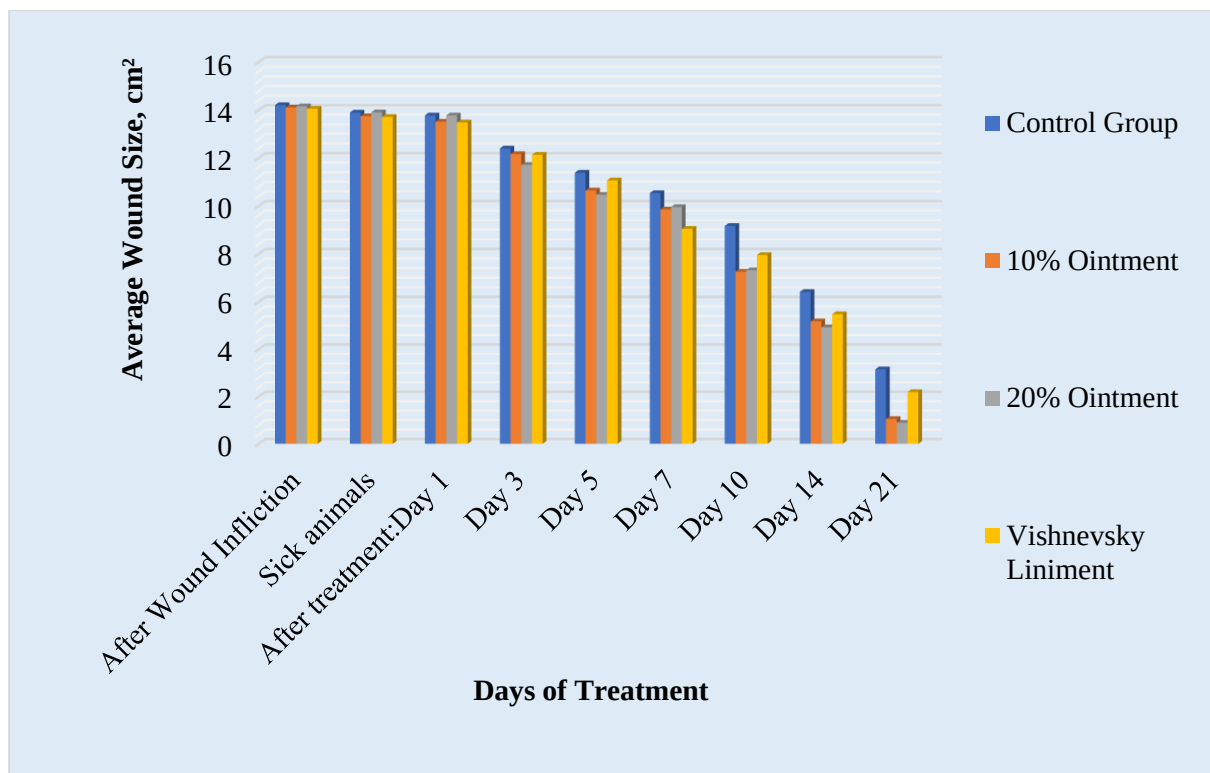


Figure 32 – Dynamics of wound area during the treatment of purulent wounds in sheep

Between days 5 and 7 after the start of treatment, a significant reduction in wound size was observed in animals of Groups I, II, and III, while the reduction in the control group was minimal. The wound area showed signs of purulent exudate and acute inflammation. Body temperature, heart rate, and respiratory rate in animals of Groups I, II, and III remained at the upper limit of normal values, whereas in Group IV (control), these parameters exceeded normal levels.

Between days 10 and 14 after treatment began, wound size decreased significantly in Groups I, II, and III. In Group IV, wound reduction occurred at a slower rate.

From days 14 to 21, tissue regeneration in the wound area progressed, function was restored, overall condition improved, and clinical parameters (body temperature, heart rate, and respiratory rate) were within normal ranges. Complete wound healing occurred on days 16–18 in Groups I and II, on days 19–21 in Group III (traditional treatment), while in Group IV (control), the healing process continued. Later, due to the slow healing rate in Group IV, additional treatment measures were prescribed to prevent secondary complications.

Body temperature, heart rate, and respiratory rate in the treated groups returned to baseline levels, while in the control group, they remained elevated compared to the initial values.

Table 16 – Dynamics of clinical indicators in sheep during the treatment of purulent wounds

Research duration	Temperature (°C)				Pulse rate (beats/min)				Respiratory rate (breaths/min)			
	Control group	Vishnevsky liniment	10% A. Ierchiana ointment	20% A. Ierchiana ointment	Control group	Vishnevsky liniment	10% A. Ierchiana ointment	20% A. Ierchiana ointment	Control group	Vishnevsky liniment	10% A. Ierchiana ointment	20% A. Ierchiana ointment
Healthy animals	38,6 ± 0,18	38,7 ± 0,14	38,8 ± 0,33	38,5 ± 0,27	82,4 ± 1,72	78,4 ± 1,83	80,8 ± 1,36	82,4 ± 1,47	32,8 ± 1,85	28,8 ± 1,74	22,4 ± 1,47	26,0 ± 1,41
Treatment of sick animals: Day 1	40,2 ± 0,13	39,9 ± 0,12	39,8 ± 0,18	39,7 ± 0,16	108,8 ± 1,62	88,0 ± 1,67	92,0 ± 1,67	90,8 ± 1,36	54,0 ± 1,79	44,4 ± 1,17	36,8 ± 1,85	40,4 ± 1,72
Day 3	40,5 ± 0,17	39,7 ± 0,17	39,9 ± 0,13	40,0 ± 1,72	114,8 ± 1,96	90,8 ± 1,02	88,2 ± 1,85	90,4 ± 1,60	60,4 ± 1,47	40,8 ± 1,36	36,4 ± 1,83	40,8 ± 1,50
Day 5	40,3 ± 0,14	39,2 ± 0,20	39,3 ± 0,17	39,7 ± 0,20	106,4 ± 1,94	86,8 ± 1,85	84,4 ± 1,47	86,4 ± 1,47	56,4 ± 1,59	38,4 ± 1,47	34,4 ± 1,47	38,4 ± 1,72
Day 7	39,9 ± 0,12	39,0 ± 0,12	38,7 ± 0,24	39,0 ± 0,27	100,8 ± 1,74	84,0 ± 1,90	78,4 ± 1,33	78,8 ± 1,36	50,8 ± 1,49	34,8 ± 1,62	36,0 ± 1,67	36,4 ± 1,72
Day 10	39,7 ± 0,17	38,7 ± 0,12	38,6 ± 0,22	38,7 ± 0,21	98,4 ± 1,33	84,4 ± 1,72	72,8 ± 1,74	76,8 ± 1,02	52,4 ± 1,17	32,4 ± 1,47	28,8 ± 2,06	32,4 ± 1,17

The morphological composition of the blood was studied using the same parameters as in the first experiment. The results of the study are presented in Table 17.

Table 17 – Dynamics of the morphological composition of blood in sheep during the treatment of purulent wounds

Parameters	Study duration (days)								
	Healthy animals	Sick animals	After treatment						
			1	3	5	7	10	14	21
Control group									
Leukocytes, 10 ⁹ /L	7,08± 1,28	19,89± 3,55	19,05 ± 3,84	17,58± 2,36	15,34± 0,12	13,74± 3,54	12,05± 3,21	11,25± 2,47	9,85± 2,47
Erythrocytes, 10 ¹² /L	6,08± 0,89	5,64± 2,74	5,62± 1,25	5,07± 1,87	5,30± 0,19	5,96± 1,20	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	86,4± 1,17	87,23± 3,24	88,19± 4,01	89,41± 3,56	91,24± 2,74
Platelets, 10 ⁹ /L	518,80 ± 2,06	485,60 ± 2,20	448,6 0± 2,28	403,80 ±1,94	414,20± 3,02	429,20± 1,62	435,00 ±2,41	486,40± 2,62	491,80± 3,12
Hematocrit, %	31,61± 1,17	30,83± 1,02	30,26 ± 0,49	29,44± 0,98	26,42± 2,02	27,66± 1,44	28,42± 1,60	30,24± 1,46	32,21± 1,36
Thrombocrit, %	0,39± 0,04	0,32± 0,03	0,28± 0,02	0,26± 0,03	0,23± 0,03	0,24± 0,03	0,27± 0,04	0,31± 0,03	0,32± 0,04

1st experimental group									
Leukocytes, 10 ⁹ /L	7,57± 2,47	19,45± 0,98	18,58 ± 2,2	15,54± 1,89	13,62± 0,19	11,25± 2,25	10,89± 2,87	8,08± 1,8	7,01± 2,04
Erythrocytes, 10 ¹² /L	6,07± 2,05	5,54± 1,24	5,64± 1,07	5,98± 2,87	6,06± 0,28	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	92,4± 1,33	92,82± 4,24	96,12± 4,57	95,89± 4,52	94,18± 3,89
Platelets, 10 ⁹ /L	511,40 ± 2,23	489,20 ±2,78	394,2 0±2,8 9	258,4± 3,17	359,60± 2,84	368,80± 2,85	375,6± 2,66	384,20± 3,22	391,80± 2,65
Hematocrit, %	41,6± 2,14	41,2± 2,06	41,6± 1,86	42,0± 2,21	39,0± 1,73	38,4± 2,06	37,6± 2,16	40,2± 2,15	42,2± 2,69
Thrombocrit, %	0,42± 0,03	0,38± 0,04	0,33± 0,02	0,28± 0,03	0,26± 0,02	0,29± 0,02	0,31± 0,03	0,34± 0,03	0,37± 0,05
2nd experimental group									
Leukocytes, 10 ⁹ /L	7,15± 2,24	20,05± 2,15	19,2± 2,219	17,84± 2,27	14,32± 0,20	11,87± 2,24	10,04± 2,05	8,78± 1,72	7,11± 2,25
Erythrocytes, 10 ¹² /L	6,11± 1,78	5,86± 1,08	5,81± 2,05	5,91± 2,76	6,08± 0,29	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	92,4± 2,23	93,18± 3,14	96,74± 3,24	96,25± 2,17	97,36± 2,15
Platelets, 10 ⁹ /L	512,60 ± 2,64	476,20 ± 3,22	415,8 0± 2,50	381,80 ± 2,01	476,20± 3,02	486,20± 2,89	494,20 ± 3,40	482,20± 2,33	493,20± 2,84
Hematocrit, %	41,4± 1,89	40,8± 1,39	40,2± 1,93	39,8± 1,93	42,2± 2,37	42,0± 2,76	41,8± 2,65	42,6± 2,64	42,8± 3,01
Thrombocrit, %	0,42± 0,03	0,41± 0,03	0,39± 0,03	0,38± 0,02	0,37± 0,02	0,32± 0,02	0,24± 0,03	0,38± 0,03	0,40± 0,03
3rd experimental group									
Leukocytes, 10 ⁹ /L	8,15± 2,28	19,1± 1,85	18,95 ± 2,47	16,84± 2,95	14,62± 0,24	12,16± 2,89	11,25± 4,06	9,7± 2,7	8,57± 1,35
Erythrocytes, 10 ¹² /L	5,95± 1,5	5,58± 2,52	5,67± 2,25	5,85± 2,16	5,64± 0,21	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	92,8± 2,42	93,74± 4,77	93,45± 3,27	93,58± 3,38	92,98± 2,77
Platelets, 10 ⁹ /L	506,60 ± 3,31	492,0± 3,52	475,8 ± 3,18	469,4± 2,87	435,4± 2,23	456,8± 2,71	475,4± 3,36	496,6± 1,57	492,4± 3,33
Hematocrit, %	35,6± 1,81	34,4± 1,44	32,2± 1,85	31,8± 1,74	30,8± 2,08	31,4± 2,11	31,8± 2,22	33,4± 1,86	37,2± 0,97
Thrombocrit, %	0,43± 0,03	0,42± 0,03	0,38± 0,03	0,39± 0,04	0,37± 0,04	0,40± 0,02	0,41± 0,03	0,40± 0,04	0,39± 0,03

In diseased animals, all groups showed leukocytosis and neutrophilia, along with decreases in erythrocyte, hemoglobin, thrombocyte, hematocrit, and thrombocrit levels compared to the pre-injury (healthy animals) state, indicating several changes.

During the wound healing process in the animals, key indicators were determined by the blood leukogram. Changes in the main leukogram parameters are described in Table 18.

Table 18 – Changes in the blood leukogram during the treatment of purulent wounds in sheep

Study duration	Neutrophils (%)			Basop hils (%)	Eosin ophils (%)	Lymph ocytes (%)	Mono cytes (%)
	Young	Rod- shaped	Segm ented nucle us				
Control group							
Healthy animals	0,75± 0,41	3,1±0,33	38,37 ±1,5	0,55± 0,12	3,58± 0,28	50,21± 0,52	3,44± 0,87
1 day after wound creation	2,28± 0,54	4,84± 1,15	46,75 ±1,15	0,6± 0,12	4,95± 0,63	37,1± 1,2	3,48± 0,36
Day 3	2,18± 0,74	5,12± 2,25	46,74 ±1,29	0,41± 0,17	4,19± 0,65	36,97± 0,87	4,39± 0,63
Day 5	2,2± 0,35	4,91± 1,12	45,20 ±1,30	0,24± 0,16	4,17± 0,66	38,91± 0,98	4,37± 1,12
Day 7	2,28± 0,54	4,58± 0,98	45,85 ±1,52	0,20± 0,12	4,87± 0,75	37,41± 1,25	4,81± 0,72
Day 10	1,96± 0,62	3,51± 0,74	42,25 ±2,89	0,42± 0,26	4,85± 0,32	43,92± 1,28	3,09± 0,15
Day 14	1,81± 0,30	3,89± 0,85	41,92 ±3,05	0,5± 0,15	4,98± 1,05	44,03± 1,54	2,87± 0,45
Day 21	0,89± 0,23	3,75± 0,33	39,19 ±3,15	0,4± 0,2	4,58± 1,52	48,09± 1,85	3,1± 0,48
1st experimental group							
Healthy animals	0,82± 0,14	2,85±1,4	37,87 ±1,28	0,6±0, 25	3,72± 0,48	50,46± 1,71	3,68± 1,25
1 day after wound creation	2,62± 1,23	3,85± 1,62	47,3± 1,89	0,5±0, 12	3,68± 0,71	38,65± 1,18	3,4± 1,12
Day 3	2,61± 0,74	4,72± 0,67	45,82 ±1,17	0,3±0, 25	4,17± 1,02	38,85± 1,14	3,53± 0,62
Day 5	2,14± 0,23	4,87± 1,47	43,2± 2,28	0,30± 0,24	4,15± 0,25	39,99± 1,1	4,47± 0,45
Day 7	1,61± 0,82	4,24± 0,39	42,29 ±1,21	0,25± 0,17	4,8± 0,87	42,06± 1,85	4,75± 0,21
Day 10	1,54± 1,23	3,12± 0,25	39,11 ±2,72	0,4±0, 21	4,87± 0,65	46,78± 1,72	4,18± 1,05
Day 14	0,74± 0,25	2,24± 0,82	38,74 ±2,62	0,33± 0,21	3,82± 0,46	49,36± 1,52	4,77± 0,75
Day 21	0,62± 0,5	2,15± 0,56	38,07 ±2,37	0,42± 0,21	3,78± 0,84	50,99± 1,18	3,97± 1,12
2nd experimental group							
Healthy animals	0,76± 0,15	2,45± 1,74	37,81 ±1,12	0,4± 0,32	4,87± 0,41	50,03± 1,83	3,68± 1,28
1 day after wound creation	2,58± 1,27	4,14± 1,64	44,59 ±1,77	0,5± 0,24	4,75± 0,25	40,02± 1,14	3,42± 1,56
Day 3	2,21± 0,24	4,22± 0,75	46,12 ±1,17	0,33± 0,23	4,25± 1,23	39,66± 1,57	3,21± 1,25

Day 5	2,14± 0,23	4,17± 1,63	45,2± 2,28	0,39± 0,24	4,11± 0,85	39,95± 2,25	4,04± 0,65
Day 7	1,61± 0,82	4,04± 0,55	42,04 ±1,8	0,55± 0,28	4,21± 0,65	43,27± 1,78	4,28± 0,89
Day 10	1,54± 1,23	3,43± 1,12	39,98 ±2,15	0,42± 0,23	4,17± 0,41	46,35± 1,72	4,11± 1,08
Day 14	0,74± 0,25	2,12± 0,65	38,74 ±2,14	0,38± 0,26	3,25± 0,85	50,98± 1,75	3,79± 1,21
Day 21	0,62± 0,5	1,85± 0,28	40,17 ±2,24	0,4± 0,12	3,29± 0,35	49,96± 1,25	3,71± 1,75
3rd experimental group							
Healthy animals	0,68± 0,56	3,38± 0,33	38,78 ±1,28	0,35± 0,24	3,81± 0,18	49,64± 1,72	3,36± 0,77
1 day after wound creation	2,12± 0,75	4,87± 1,32	46,23 ±1,72	0,56± 0,13	4,83± 0,55	37,74± 1,88	3,65± 0,21
Day 3	2,25± 0,17	4,98± 2,05	46,11 ±1,97	0,44± 0,28	4,12± 0,36	37,33± 1,36	4,34± 0,27
Day 5	2,11± 0,28	4,87± 1,56	46,21 ±1,98	0,36± 0,12	4,27± 1,03	37,41± 1,87	4,77± 1,28
Day 7	2,18± 0,54	4,18± 0,15	43,15 ±1,28	0,40± 0,34	4,07± 0,56	41,62± 1,15	4,4±0, 45
Day 10	1,82± 0,25	4,05± 0,28	41,5± 2,17	0,47± 0,21	4,05± 0,26	44,26± 1,58	3,85± 0,28
Day 14	1,71± 0,56	3,29± 0,65	39,96 ±3,28	0,52± 0,32	3,98± 1,05	47,66± 1,93	2,88± 0,32
Day 21	0,68± 0,27	3,15± 0,33	38,18 ±2,42	0,42± 0,18	3,71± 1,58	50,65± 1,85	3,21± 0,57

During the following 1st to 5th days of the study, leukocytosis persisted in all animal groups, with neutrophilia observed. The percentages of young and band neutrophils increased by 2-3%, and lymphopenia was significantly noted. The percentages of basophils, eosinophils, and monocytes remained unchanged.

Subsequently, the numbers of leukocytes and neutrophils gradually decreased, while lymphocyte levels in the I, II, and III experimental groups rose back to their initial baseline levels. In the IV group (control), leukocyte counts remained at the upper limit of normal values, with neutrophilia and lymphopenia observed throughout the study.

Other hematological parameters remained within normal ranges across all animal groups during the study.

Analysis of the biochemical parameters in the blood serum of the sheep showed no significant changes during the study across all groups. Slight increases (about 1-2%) in total protein, albumins, and globulins were observed on days 5-7 in all groups but remained within normal limits (see Figures 33 and 34).

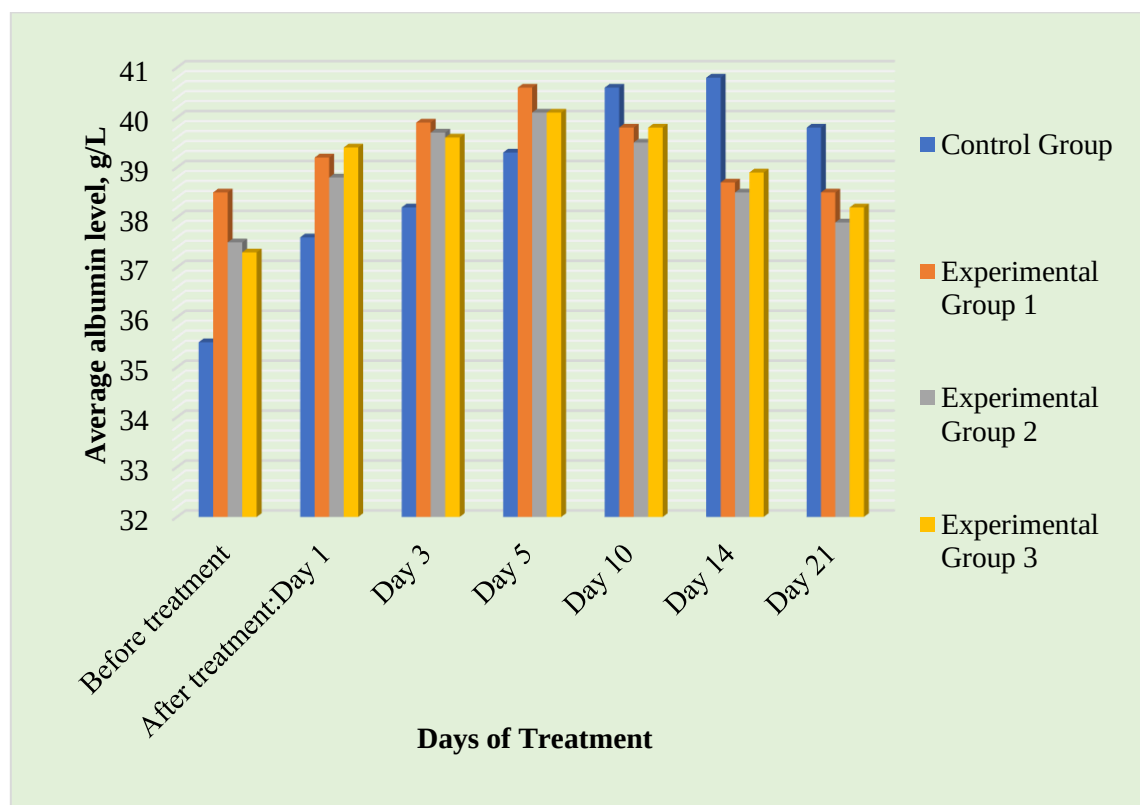
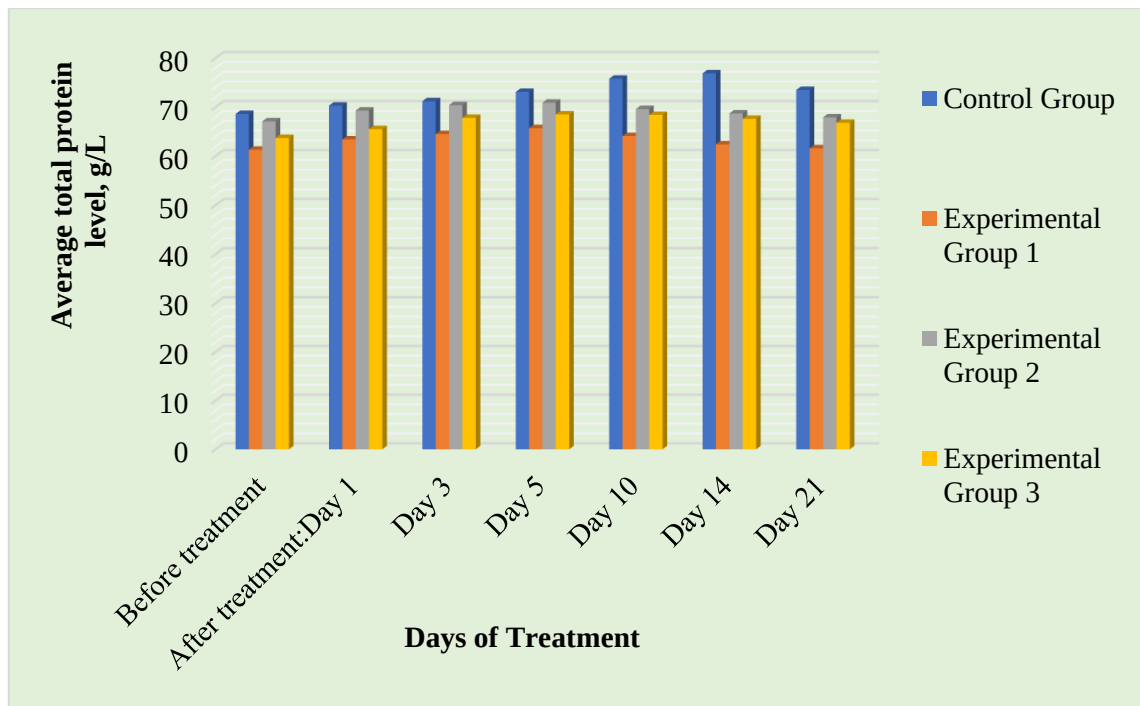
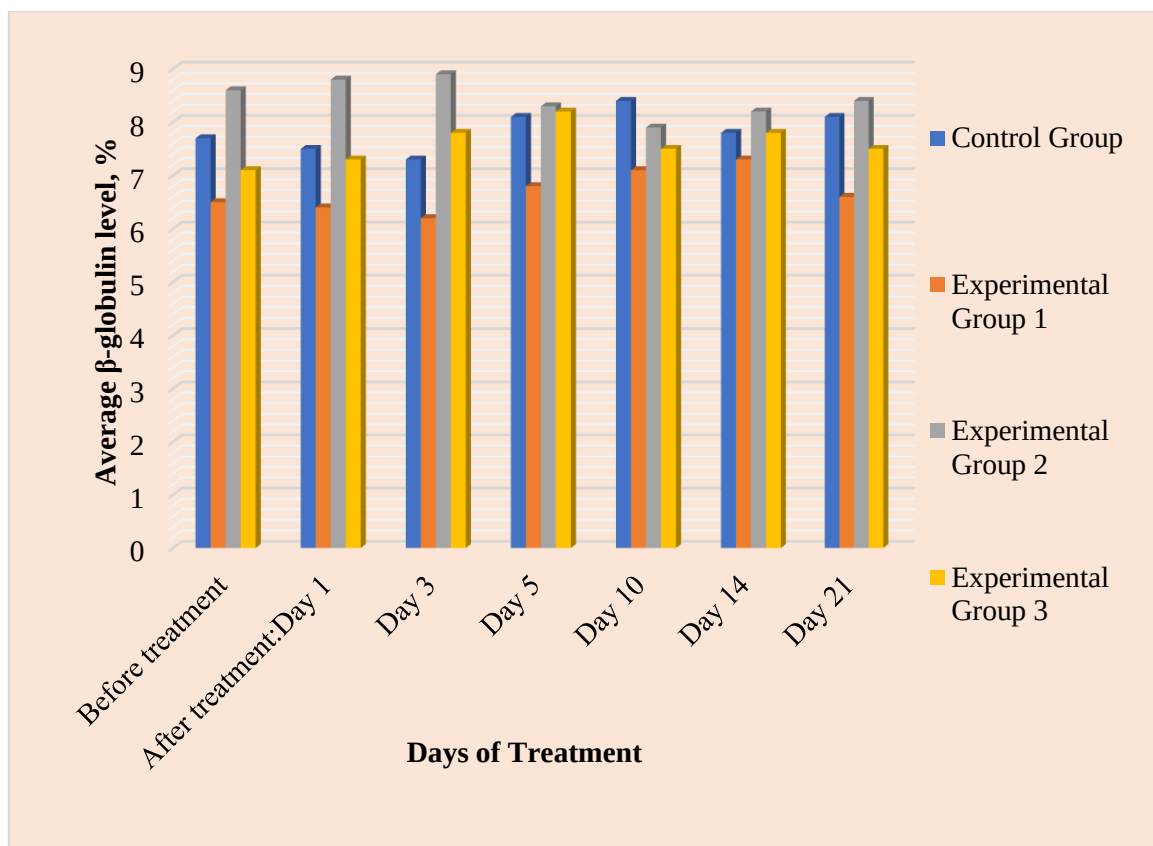
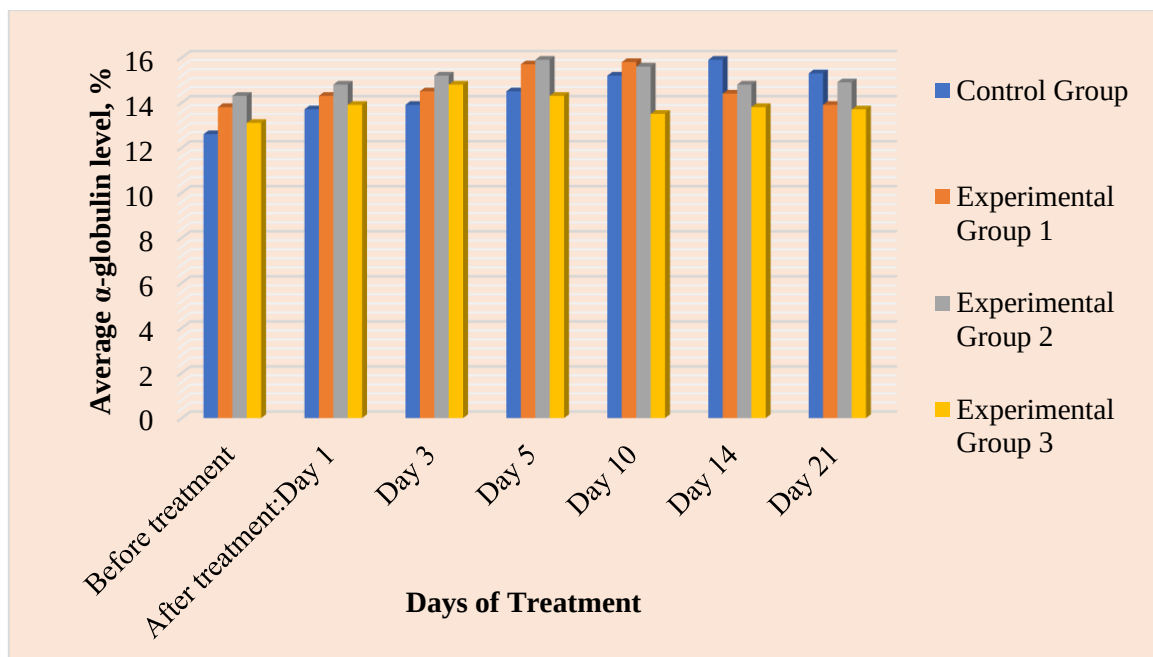


Figure 33 – Changes in total protein and albumin levels in the blood serum of sheep with purulent wounds



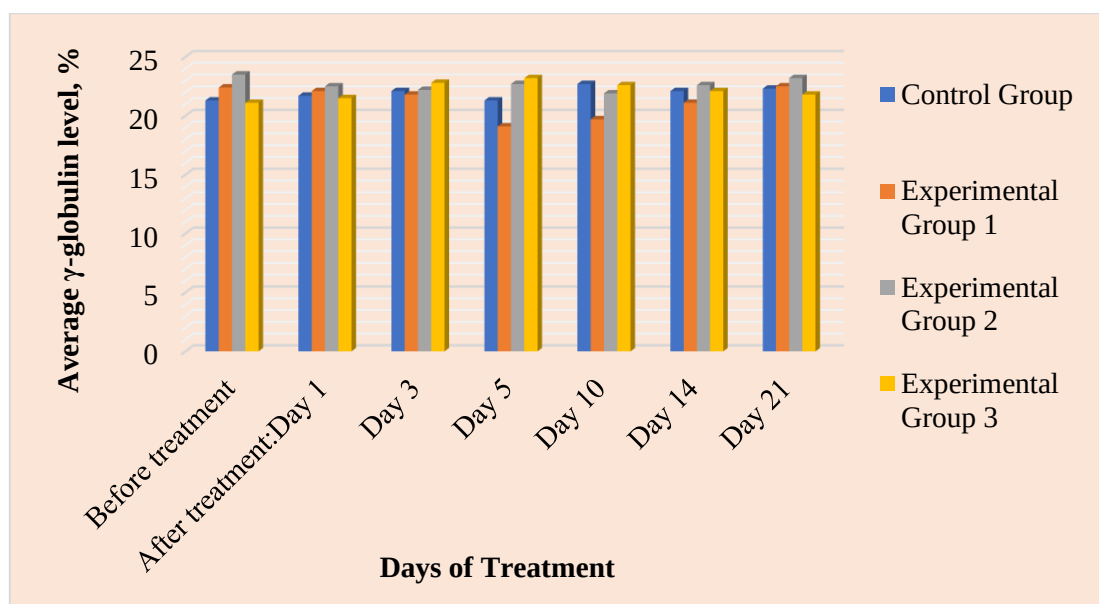


Figure 34 – Changes in α , β , γ globulins in the blood serum of sheep during purulent wounds

The study of bactericidal activity in the blood serum of animals with purulent wounds showed a significant increase on the 5th day of the study across all groups (17-19%) (Figure 35).

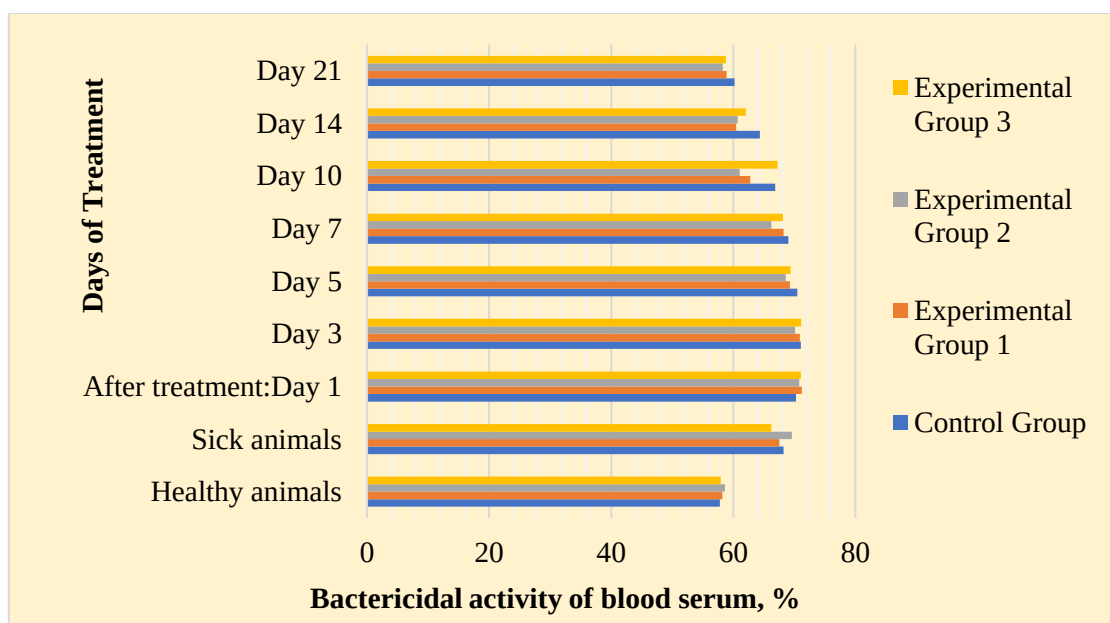


Figure 35 – Dynamics of bactericidal activity in blood serum during the treatment of experimental purulent wounds in sheep

Subsequently, the level of this indicator gradually decreased and returned to the initial level by the end of the study (day 21). Only in Group IV (control) did the bactericidal activity level in the blood serum remain higher than the initial level.

7. STUDY OF THE MEDICINAL PREPARATION BASED ON ARTEMISIA LERCHIANA UNDER PRODUCTION CONDITIONS

7.1 Study of the efficacy of a medicinal preparation based on *Artemisia lerchiana* in the treatment of wounds in sheep

Industrial studies were conducted on sheep with accidental wounds at our university's «Akzhaiyk» Experimental Training Farm and on farms in the Taskala district of the West Kazakhstan region.

Following the experimental work on sheep studying the effects of preparations made from *Artemisia lerchiana* essential oil, infusion and 10% and 20% ointments on aseptic and purulent wounds in dogs, industrial clinical trials were carried out on sheep with accidental wounds in various farms across the West Kazakhstan region.

The accidental wounds had various etiologies and types: cuts, bites, tears, and the time of wound detection varied. In some cases, the wounds were fresh, not exceeding 6-8 hours, while others were at the stage of purulent process development, and some were complicated by wohlfahrtiosis (presence of maggots in the wound). Wounds were found on different parts of the animal's body, but mostly on the legs (especially hooves and interdigital spaces), lateral chest wall and abdominal wall, hip (mostly bite wounds), neck, and other body parts.

First, the wound surroundings were cleaned: the hair around the wound was clipped, and the wound and its surface were carefully washed with warm water and soap. Then, depending on the animal group, the wounds were treated using various methods — traditional antiseptic (furacillin) and *Artemisia lerchiana* infusion, followed by the application of 10% and 20% ointments made from *Artemisia lerchiana* essential oil and Vishnevsky ointment.

Special dressings were also used to protect wounds from contamination and re-injury, with closed wound treatment (using dressings) often applied on distal leg wounds.

In cases of deep wounds with significant openings, sutures were often used to bring wound edges closer to accelerate healing.

During wound treatment in sheep, the following important aspects were emphasized:

- Pain management: During initial treatment, analgesics were used to relieve pain, especially for deep and large wounds. In our case, xylanit and rometar neuroleptics were administered at a dose of 0.1 ml per 10 kg of live weight.
- Removal of contaminants and necrotic tissue: Debridement and removal of crusts were performed as necessary to avoid negative effects on the wound's self-cleaning process.

If anaerobic infection was suspected (presence of gas bubbles), prognosis was often cautious. In such cases, animals were treated with broad-spectrum

antibiotics and open wound treatment without ointments. These animals were moved to a separate group.

In industrial conditions, animals were treated using three methods: initially, wounds were sanitized with furacillin solution for animals receiving Vishnevsky ointment, and with *Artemisia lerchiana* infusion for animals receiving *Artemisia lerchiana* ointment. Then, Vishnevsky liniment and experimental 10% and 20% essential oil ointments were applied.

Traditional treatment included short novocaine blockade, neuroleptics when needed, washing wounds with warm water and soap, processing with furacillin, sutures if necessary, and applying Vishnevsky liniment on the wound surface. When treating with experimental 10% and 20% ointments based on *Artemisia lerchiana* essential oil, short novocaine blockade was performed, and the ointments were applied on wound surfaces. All animals were treated before wound healing.

The number of animals with accidental wounds used in the study is shown in Table 19.

Diagnosis was made based on clinical examination and anamnesis data. Diseased sheep showed wound bleeding or purulent discharge, local temperature increase, pain, and inflammatory edges around the wound. Depending on the general condition, wound location, and stage of the process, some animals were restless, had decreased appetite, showed inactivity and lameness, though in some cases no obvious clinical signs were observed. Some animals with large purulent wounds showed increased temperature up to 40.0–41.0°C and respiratory rate up to 30–36 breaths per minute.

Table 19 – Number of sheep with various accidental wounds used in industrial trials

Types of accidental wounds	In traditional treatment		Treatment with 10% ointment based on <i>Artemisia lerchiana</i> essential oil		Treatment with 20% ointment based on <i>Artemisia lerchiana</i> essential oil	
	Total number of animals	Recovered animals	Total number of animals	Recovered animals	Total number of animals	Recovered animals
Torn	3	2	4	4	2	2
Bitten	3	2	2	1	2	2
Cut	4	4	4	4	5	5
Punctured (or Pierced)	1	0	2	2	2	1
Total	11	8	12	11	11	10

As seen from the table, cut wounds were most frequently identified, while punctured wounds were rare. However, compared to other wounds, punctured wounds showed a higher number of complications and unfavorable outcomes. Punctured wounds were complicated by anaerobic infection, and we removed the sheep with such complications from the trial and applied different treatment methods. Anaerobic infection was also observed in bitten wounds. Wounds caused by biting took longer to heal, and in our case, one sheep in the control group developed tetanus and was removed from the trial. It is also important to note that bitten wounds showed signs of tissue thinning and stretching, and in some cases, nerve damage was detected, which leads to impaired trophic conditions in the injured area.

According to the data on treatment outcomes in the table, out of 12 animals treated with *Artemisia lerchiana* infusion and 10% ointment, 11 recovered, resulting in a treatment efficacy of 91.67%. When using 20% ointment and infusion made from *Artemisia lerchiana* essential oil, 10 out of 11 sheep recovered, amounting to 90.91%. One animal with a punctured wound developed tetanus as a complication and was excluded from the industrial trial.

During traditional treatment, 8 out of 11 animals recovered, with a treatment efficacy of 72.7%. Secondary complications in the form of gangrene were observed in three animals: bitten wounds in some sheep, tetanus in one sheep with a punctured wound, and nerve damage in one sheep with a torn wound. All these animals were removed from the trial and the treatment method was changed.

7.2 Study of the efficacy of a medicinal preparation based on *Artemisia lerchiana* in the treatment of wounds in cattle

Determination of the efficacy of a medicinal preparation based on *Artemisia lerchiana* in the treatment of wounds in cattle

Treatment of accidental wounds was conducted on 13 heads of bulls and heifers (aged 15–17 months) under farm conditions. During the study, the cattle selected for treatment were divided into three groups. When grouping, factors such as age, sex, time of injury, nature of occurrence (etiology), wound localization, wound process characteristics, and type of inflammation were taken into account. The duration of wound formation in the animals ranged from 2 to 5 days.

The first group (n=4) was assigned *Artemisia lerchiana* infusion and 10% ointment; the second group (n=5) received *Artemisia lerchiana* infusion and 20% ointment; and the third group (n=4) was treated with furacillin solution (1:5000) and Vishnevsky liniment.

The dynamics of the wound healing process (transition from one stage to another) and the outcomes according to the treatment regimens are presented in Table 20.

According to the study results described in the table, the stages of wound healing in all groups varied in duration (in days). Overall, the healing process for accidental wounds in the animals ranged from 17 to 19 days. In the second experimental group treated with *Artemisia lerchiana* infusion and 20% ointment, complete healing was observed on day 17. In the first experimental group treated with *Artemisia lerchiana* infusion and 10% ointment, complete healing occurred on days 17–18. In the third experimental group, the healing process was completed on days 19–20.

The results obtained in the treatment of accidental wounds in bulls and heifers under farm conditions were fully confirmed by clinical studies.

Table 20 – Dynamics of wound healing process in cattle

Clinical parameters	Animal group		
	1st experimental group (<i>Artemisia lerchiana</i> infusion + 10% ointment)	2nd experimental group (<i>Artemisia lerchiana</i> infusion + 20% ointment)	3rd experimental group (furacillin solution + Vishnevsky liniment)
Complete wound cleansing, days	5,5±0,29	4,6±0,24	5,7±0,22
Granulation tissue formation, days	6,3±0,22	5,8±0,37	6,6±0,40
Start of epithelialization stage, days	10,0±0,37	8,2±0,20	11,2±0,43
Complete wound healing, days	18,3±0,43	17,6±0,24	19,5±0,26

Analyzing the results obtained during treatment, a high therapeutic effect of the treatment regimen used in the 2nd experimental group was observed. It is important to note that this is due to the positive effect of *Artemisia lerchiana* infusion and 20% ointment on wound cleansing during the first stage of the wound healing process. Their application promoted rapid wound cleansing and the transition to the regeneration phase of the wound process. It is worth mentioning that wound treatment in the experimental group animals concluded with the formation of mobile connective tissue, resulting in a good cosmetic outcome.

CONCLUSION

A technology for an ointment rich in biologically active substances with antibacterial properties and wound regeneration stimulation based on the *Artemisia lerchiana* plant was developed. During the study, infusion and essential oil forms of the plant were selected, and their activity against Gram-positive bacteria (*Staphylococcus* spp., *Streptococcus* spp.) and Gram-negative bacteria (*Escherichia coli*) was investigated. The results demonstrated that the essential oil exhibits high antimicrobial activity, showing a pronounced effect even at low concentrations. It was found that the essential oil based on *Artemisia lerchiana* surpasses some currently used phytopreparations in antibacterial activity.

Preclinical toxicological studies showed that topical application of the preparation did not cause toxic, allergic, or irritant effects in laboratory animals. When applied locally to the skin, the medicinal form exhibited complete biocompatibility and did not harm the animal organism.

The effect of the ointment on wound healing was studied in experimental models (dogs and sheep), and it was found to reduce healing time by 1 to 4 days compared to traditional treatment methods. Aseptic wounds healed 1–2 days earlier, and purulent wounds by 3–4 days, which is explained by the preparation's anti-inflammatory and antiseptic effects. It was experimentally proven that the essential oil reduces exudate on the wound surface, accelerates the formation of granulation tissue, and positively influences the regeneration process.

Flavonoids and terpenes in the preparation showed a synergistic effect, speeding up complete wound healing. Observational studies in animals confirmed the clinical efficacy and high safety of the new ointment. The results suggest that this phytopreparation can be used as a comprehensive treatment for injuries in agricultural animals.

Artemisia lerchiana, widely distributed in Kazakhstan, can serve as a stable, accessible, and environmentally friendly raw material source for this preparation. It was established that the biologically active compounds in the ointment directly affect the wound healing mechanism. Topical application of the ointment simplifies its use while achieving a high therapeutic effect.

Results obtained under production conditions demonstrated that the preparation is effective, affordable, and accessible for use in animal husbandry. The absence of synthetic components in the ointment's composition characterizes it as an environmentally safe product. The efficacy and safety of this medicinal form allow for its wide application in veterinary practice.

Overall, this new phytopreparation based on *Artemisia lerchiana* is an innovative product scientifically validated for its effectiveness and safety in wound treatment.

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Ғылыми басылым / Scientific publication

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The efficacy of a formulation derived from *Artemisia lerchiana* in the treatment of wounds in animals

Monograph

***Artemisia lerchiana* негізінде дайындалған препараттың жануарлардың жараларын емдеудегі тиімділігі**

Монография

Ағылшын тілінде

25.08.2025 ж. басуға қол қойылды

Пішімі 60x84 1/16 Офсетті қағаз 80 м/г

Көлемі 6,93 б.б. Тапсырыс №331

Таралымы 500 дана

***Дайын түпнұсқасының сапасына
толық сәйкестікте басылды***

«Жәңгір хан атындағы Батыс Қазақстан
аграрлық-техникалық университеті» КеАҚ
090009, Орал қ., Жәңгір хан көшесі, 51