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## NEMATODIROSIS IN LAMBS: CLINICAL, PATHOLOGICAL, AND HISTOLOGICAL FEATURES

### ANNOTATION

The aim of this study was to investigate the epizootiological situation of nematodiosis in lambs under pasture conditions in the West Kazakhstan region using a combination of morphological, coprological, and histological methods.

Nematodiosis is one of the most significant parasitic diseases causing considerable damage to sheep farming, especially among young animals, leading to reduced productivity, stunted growth, diarrhea, and mortality.

The study was conducted in 2024 in the Zhanibek district on the farms “Moldir” and “Nurbergen.” The study focused on lambs aged 1.5-3 months. A total of 50 animals were examined. In 21 of them (32.8%), eggs of *Nematodirus spathiger* were detected by coprological analysis using the Fulleborn method. Cases of combined infections with coccidia of the genus *Eimeria* were also noted.

Clinically, infected animals showed symptoms of watery diarrhea, depression, growth retardation, and dehydration. Death occurred within 2-3 days without treatment. Pathological autopsy using the Shore method revealed inflammatory changes in the proximal small intestine, edema and hyperemia of the mucous membrane, as well as the presence of a large number of nematodes in the lumen. A complete helminthological autopsy according to K.I.Sryabin allowed quantitative confirmation of the invasion.

Histological analysis showed shortening and destruction of villi, infiltration of the lamina propria with lymphocytes and eosinophils, as well as degenerative changes in epithelial cells. Reduced activity of brush enzymes (alkaline phosphatase, maltase) was detected, indicating the development of malabsorption syndrome.

The data obtained emphasize the need for systematic monitoring and prevention of nematode infections in young sheep under pasture conditions, with mandatory consideration of mixed infections and age susceptibility of animals.

**Keywords:** *Nematodiosis, lambs, helminthological autopsy, intestinal histology, coprological diagnosis.*

**Introduction.** *Nematodirus spathiger* is a significant gastrointestinal nematode that primarily affects sheep, causing substantial health issues and economic losses in the sheep farming industry. The prevalence of *N. spathiger* infection can be alarmingly high; studies indicate infection rates can range from 12% to as high as 98%, with some regions reporting dominance of this particular species in infected sheep population [1]. *N. spathiger* infections often lead to nematodiosis, characterized by symptoms such as weight loss, diarrhea, and in severe cases, death, particularly in young lambs [2].

The life cycle of *N. spathiger* is intricately linked to environmental conditions, with the nematode displaying an ability to overwinter in cold climates. This adaptation enables the larvae to survive harsh conditions until favorable weather arrives, which can lead to significant infection loads in spring when lambs are exposed to pastures that harbor the eggs [3]. Understanding the epidemiological patterns of *N. spathiger*, including seasonal prevalence and environmental factors influencing its lifecycle, is crucial for effective management and control strategies on farms. Surveys from regions like New Zealand show high prevalence of *N. spathiger* and *N. filicollis*, requiring targeted helminth control approaches [4].

In Kazakhstan, data on species-specific gastrointestinal parasitism in sheep remain limited. However, several studies confirm the presence of *Nematodirus* spp. in domestic and wild ruminants, including sheep and saiga antelopes, in the western regions. The semi-arid, pasture-based husbandry systems in West Kazakhstan create favorable conditions for the seasonal transmission of these nematodes.

Histopathological changes due to *N. spathiger* have been well documented, including mucosal villus shortening, infiltration with eosinophils and lymphocytes, and degenerative changes in enterocytes, which lead to malabsorption syndrome [5]. In addition, resistance to benzimidazoles and lower efficacy of anthelmintics like monepantel have been reported [6,7].

Molecular studies, including mitochondrial genome sequencing, have improved the understanding of genetic diversity within *Nematodirus* species and offer promising tools for accurate diagnosis and epidemiological surveillance [8].

This study aims to investigate the prevalence, clinical manifestations, and histopathological changes associated with *Nematodirus spathiger* infections in lambs under pasture conditions in the West Kazakhstan region, contributing to regional data on this neglected but economically important parasitic disease.

**Methods and materials.** Parasitological and helminthological studies were conducted in 2024 in the West Kazakhstan region. The study focused on sheep kept in pasture conditions. A total of 50 animals were examined, from which fecal samples were taken, and pathological and histological studies were conducted.

Pathological autopsies were performed using the Shore method, which involves sequential autopsy of the chest, abdominal cavities, and head to identify macroscopic pathological changes and locate parasites [9].

Particular attention was paid to the condition of the mucous membranes, lungs, liver, intestines, and lymph nodes.

The Fulleborn method is a qualitative coprological diagnostic method based on the flotation of helminth eggs in a saturated solution of table salt. During the analysis, a small amount of fresh feces (3–5 g) is thoroughly mixed with a saturated salt solution (NaCl) until a homogeneous suspension is obtained. The mixture is left to stand for 15–20 minutes, after which a cover glass is placed on the surface of the solution where the parasite eggs accumulate. After the required time, the glass is transferred to a microscope slide and examined under a microscope. The method allows the detection of helminth eggs with a density lower than that of the solution, such as nematodes and cestodes. It is simple, quick, and highly sensitive for mild to moderate degrees of infestation. However, it is not very effective in detecting heavy eggs, such as those of trematodes, and can cause distortion of the shape of the eggs during prolonged contact with the solution. The Fulleborn method is widely used in veterinary and medical parasitology as an affordable and informative means of primary diagnosis of helminthiasis [10].



Figure 1 – Fecal sediment after filtration and preparation of a suspension using the Fulleborn method for detecting helminth eggs.

The Darling method [11] is a modified flotation technique used to detect coccidian oocysts in animal feces. It is based on the use of a high-density sucrose solution (density 1.20–1.27 g/cm<sup>3</sup>), which allows even small and light oocysts to float to the surface. Feces (about 1–2 g) are mixed with a small amount of water, filtered, and then centrifuged with a sugar solution. After centrifugation for 5 minutes, the cover glass placed on the edge of the test tube is carefully removed and transferred to a microscope slide for microscopic analysis. The Darling method is highly sensitive and widely used in veterinary parasitology, especially in the diagnosis of eimeriosis in small ruminants and poultry. Its main advantage is its ability to detect oocysts at an early stage of infection, even at low parasite concentrations.

The method of complete helminthological autopsy, developed by K.I. Sryabin, is a comprehensive technique aimed at identifying all forms and types of helminths in an animal's body. It involves the systematic autopsy and examination of all internal organs, primarily the gastrointestinal tract, liver, lungs, genitourinary system, and, if necessary, muscles, central nervous system, and eyes. Each organ is removed, cut open, and washed with saline solution, followed by settling and microscopic examination of the sediment. Scarification, filtration, and decantation methods are used to extract parasites. The detected helminths are fixed, stained if necessary, and identified by morphological characteristics using taxonomic identifiers. The method allows for accurate determination of the species, location, stage of development, intensity, and extent of the infestation. Due to its versatility and high diagnostic accuracy, it is widely used in veterinary practice to study the helminth fauna of domestic and wild animals, including in cases of mass or hidden infestations [12].

For microscopic analysis of tissues affected by parasites, samples were taken from the liver, intestines, lungs, and lymph nodes. The samples were fixed in 10% neutral formalin, then dehydrated in alcohols of increasing concentration, poured into paraffin, and cut into 5-micron-thick sections using a microtome. Staining was performed with hematoxylin and eosin [13].

**Results.** The climate of the Zhanibek district of West Kazakhstan region, in particular the village of Uzynkol, is characterized by a sharply continental type with cold winters and hot, dry summers. The average annual air temperature is about +4.7°C, with the average temperature in January reaching –14.2°C and in July rising to +21.5°C. Absolute minimums in winter can drop below –30 °C, and in summer the temperature sometimes exceeds +40 °C, creating sharp daily and seasonal fluctuations. Annual precipitation is low, around 355–370 mm, with most of it falling in the spring and summer (May to July), which coincides with the grazing season. Such climatic conditions contribute to the seasonal activation of invasive helminth species, in particular *Nematodirus spathiger*, whose eggs can successfully overwinter in the soil and massively invade lambs in the spring when they are put out to pasture. A sharp

warming in April–May creates favorable conditions for the completion of their life cycle and epizootic outbreaks among young animals.



Figure 2 – Map of West Kazakhstan Region with administrative districts.

A parasitological study conducted in 2024 in the Zhanibek district of West Kazakhstan region (Moldir and Nurbergen farms) revealed a high prevalence of nematodiosis among lambs aged 1.5–3 months.



Figure 3 – A flock of sheep grazing on pastureland on peasant farms in the West Kazakhstan region.

A total of 50 fecal samples were analyzed, of which 21 (32.8%) were found to contain *Nematodirus spathiger* eggs, indicating the circulation of these nematodes in the region's pastures.

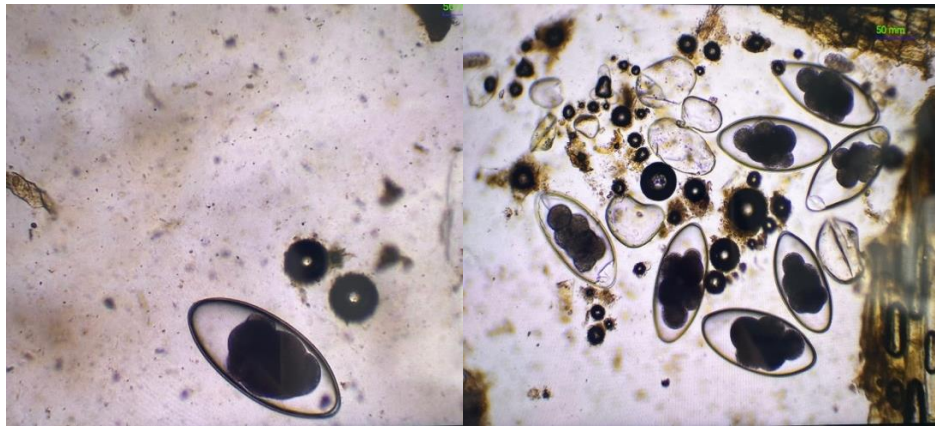


Figure 4 – Eggs of helminths of the genus *Nematodirus* detected in sheep feces using the Fulleborn method.

Macroscopically, some of the affected animals showed watery diarrhea, depression, loss of appetite, and dehydration. There were cases of death within 2–3 days of the onset of clinical signs in the absence of treatment.

Autopsy of the dead lambs revealed moderate inflammation in the proximal small intestine. The mucous membrane was edematous and hyperemic, and bundles of nematodes were observed in the intestinal lumen, numbering up to 15–20 thousand in severe cases. Microscopic examination of histological sections revealed shortening of the villi, infiltration of the lamina propria with lymphocytes and eosinophils, and degenerative changes in the epithelial cells.

Analysis of brush border enzyme levels (in particular, alkaline phosphatase and maltase) showed a decrease in clinically ill animals, indicating malabsorption syndrome. There was a clear correlation between the severity of clinical signs and the number of eggs per gram of feces.

Cases of mixed infestations with coccidia of the genus *Eimeria* were also recorded, which apparently exacerbated the severity of the clinical course.

Table 1 – Macroscopic and microscopic changes in nematodirosis in lambs

Type of changes	Characteristics	Level of damage
Macroscopic changes		
Diarrhea	Watery, foul-smelling, with a high content of undigested feed	Moderate to severe
Dehydration	Lethargy, sunken eyes, dry mucous membranes	Moderate to severe
Growth retardation	Significant weight loss compared to healthy peers	Moderate
Changes in the intestines at autopsy	Mucosal hyperemia, edema, presence of worm bundles in the lumen of the small intestine	Clearly expressed
Enlargement of mesenteric lymph nodes	Moderately enlarged, dense	Moderate
Microscopic changes		
Damage to villi	Shortening, deformation, partial destruction	Pronounced
Inflammatory infiltration	Lymphocytes, eosinophils in the lamina propria of the mucosa	Moderate – severe
Degeneration of enterocytes	Cytoplasmic vacuolization, nuclear swelling	Pronounced
Decrease in enzymatic activity	Alkaline phosphatase, maltase, leucine aminopeptidase – decreased activity	Moderate – pronounced
Presence of larvae in tissue	Detection of larvae in the mucous membrane on days 7-14 of infection	Frequent

**Discussion.** *Nematodirus spathiger* is recognized as a significant gastrointestinal nematode in sheep, contributing to both clinical issues and severe histopathological alterations within the host's intestine. The infection typically affects young lambs between 1.5 to 3 months of age, whose immune

systems are still underdeveloped, making them highly susceptible to nematodiosis. Clinical signs such as profuse watery diarrhea, anorexia, weight loss, dehydration, and in some cases, sudden death, have been repeatedly reported in both field and experimental settings [2, 3]. The severity of clinical manifestation is often proportional to the worm burden in the intestine [1].

Histopathological examinations of infected lambs revealed classical signs of nematodiosis: shortening and fusion of intestinal villi, inflammatory infiltration of the lamina propria predominantly by eosinophils and lymphocytes, and degenerative changes in epithelial cells [1, 5]. These structural changes interfere with digestive function and lead to malabsorption, as evidenced by reduced brush border enzyme activity—particularly alkaline phosphatase and maltase—observed in severe cases [14].

In some cases, mixed infections with coccidia (*Eimeria* spp.) intensify the clinical outcomes of nematodiosis. Polyparasitism exacerbates intestinal inflammation and further impairs the nutrient absorption, increasing the risk of weight loss and dehydration [3].

Molecular studies have advanced our understanding of *N. spathiger* biology. Mitochondrial genome analyses provide tools for species-level identification, phylogenetic analysis, and tracking of regional diversity [15]. Molecular diagnostics such as PCR offer more precise detection compared to classical morphological techniques, which is crucial for monitoring parasite distribution and identifying drug-resistant strains [16]. Resistance to common benzimidazole anthelmintics has been reported in several nematode species, including *Nematodirus*, which necessitates targeted surveillance [17, 18].

Furthermore, the epidemiology of *N. spathiger* is strongly influenced by climate. In temperate and continental regions like Kazakhstan, seasonal peaks in nematodiosis occur in spring when lambs graze for the first time on contaminated pastures. Eggs deposited in the previous season can overwinter and release infective larvae during warming, leading to synchronized outbreaks [19, 20].

To mitigate the impact of *N. spathiger* on animal health and productivity, a comprehensive approach is needed. This includes regular fecal egg counts, strategic anthelmintic use, pasture rotation, and incorporation of molecular diagnostics into surveillance programs. Research should also focus on local climatic influences and potential anthelmintic resistance patterns to inform region-specific control strategies.

**Conclusion.** A parasitological and helminthological study conducted among lambs kept in pasture conditions in the West Kazakhstan region confirmed a high degree of infection with nematodes of the genus *Nematodirus*, in particular *N. spathiger*, among animals in the younger age group (1.5-3 months). The frequency of egg detection in feces (32.8%) and the presence of clinically pronounced symptoms in some individuals indicate stable circulation of the pathogen in the studied pastures.

A comprehensive methodology, including pathological autopsy according to Shore, qualitative and quantitative coprological studies, helminthological autopsy according to Sryabin, and histological analysis, made it possible to establish both macro- and microscopic changes characteristic of nematodiosis. Morphological findings – shortening of villi, inflammatory infiltration of the mucosa, decreased activity of digestive enzymes – indicate impaired absorption (malabsorption) in the small intestine, which underlies the pathophysiology of this disease.

An additional aggravating factor in the clinical course of nematodiosis was the high frequency of combined invasions with coccidia of the genus *Eimeria*, which requires a comprehensive approach to diagnosis and therapy. The results obtained emphasize the need for regular epizootic monitoring and rational use of anthelmintic drugs, taking into account age and grazing load, especially in the spring and summer, when conditions are most favorable for the development of invasive forms of parasites.

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## ТҮЙІН

Зерттеудің жұмысының мақсаты – Батыс Қазақстан облысының жайылымдық жағдайындағы қозылар арасында нематодироздың эпизоотологиялық жағдайын морфологиялық, копрологиялық және гистологиялық әдістер кешенін қолдана отырып зерттеу болды. Нематодироз – өнімділіктің төмендеуіне, өсудің тежелуіне, диареяға және өлім-жітімге әкелетін қозылардың ең өзекті инвазиялық ауруларының бірі.

Зерттеу 2025 жылы Жәнібек ауданындағы «Молдир» және «Нұрберген» шаруа қожалықтарында жүргізілді. Зерттеу нысаны ретінде 1,5-3 айлық қозылар таңдалды. Барлығы 50

бас қозылар зерттелді. Фюллеборн әдісімен жүргізілген копрологиялық талдаулар нәтижесінде 21 қозыдан (32,8%) *Nematodirus spathiger* түріне жататын жұмыртқалар анықталды. Сондай-ақ *Eimeria* туысына жататын кокцидиялармен аралас инвазия жағдайлары тіркелді.

Клиникалық белгілер ретінде диарея, әлсіздік, өсуінің кешеуілдеуі және сусыздану байқалды. Ем жүргізілмеген жағдайда клиникалық белгілер басталғаннан кейін 2-3 күн ішінде өлім – жітім орын алды. Шор әдісімен жүргізілген патологоанатомиялық жарып сою кезінде аш ішектің проксималды бөлімінде қабыну, кілегейлі қабықтың ісінуі мен гиперемиясы, сондай – ақ ішек қуысында көп мөлшердегі нематодтар анықталды. К. И. Срябиннің толық гельминтологиялық ашу әдісі инвазияны сандық тұрғыдан дәлелдеуге мүмкіндік берді.

Гистологиялық зерттеу нәтижесінде бүртіктердің қысқаруы мен бұзылуы, шырышты қабықтың меншікті тақашасында лимфоциттер мен эозинофилдердің инфильтрациясы, энтероциттердегі дегенеративтік өзгерістер анықталды. Шеткі жиек ферменттердің (сілтілік фосфатаза, мальтаза) белсенділігінің төмендеуі мальабсорбция синдромының дамуын көрсетті.

Алынған нәтижелер қозылар арасында жайылым жағдайында нематодоздардың таралуын жүйелі түрде бақылау және алдын алу шараларын ұйымдастырудың, сондай – ақ аралас инвазиялар мен жас ерекшелігін ескерудің маңыздылығын дәлелдейді.

### РЕЗЮМЕ

Целью настоящего исследования было изучение эпизоотологической ситуации по нематодозу ягнят в условиях пастбищного содержания в Западно-Казахстанской области с использованием комплекса морфологических, копрологических и гистологических методов. Нематодоз – одно из значимых паразитарных заболеваний, наносящее существенный ущерб овцеводству, особенно среди молодняка, вызывая снижение продуктивности, замедление роста, диарею и падёж.

Исследование проведено в 2025 году на территории Жанибекского района в крестьянских хозяйствах «Молдир» и «Нурберген». Объектом исследования стали ягнята в возрасте 1,5-3 месяцев. Всего было обследовано 50 животных. У 21 из них (32,8%) при копрологическом анализе методом Фюллеборна выявлены яйца *Nematodirus spathiger*. Также отмечены случаи сочетанных инвазий с кокцидиями рода *Eimeria*.

Клинически у заражённых животных наблюдались симптомы водянистой диареи, угнетённого состояния, отставания в росте и обезвоживания. Падёж наступал в течение 2–3 суток при отсутствии лечения. Патологоанатомическое вскрытие по методу Шора выявило воспалительные изменения в проксимальном отделе тонкого кишечника, отёчность и гиперемию слизистой оболочки, а также наличие большого количества нематод в просвете. Метод полного гельминтологического вскрытия по К. И. Срябину позволил количественно подтвердить инвазию.

Гистологический анализ показал укорочение и деструкцию ворсинок, инфильтрацию собственной пластинки лимфоцитами и эозинофилами, а также дегенеративные изменения эпителиальных клеток. Была выявлена сниженная активность щёточных ферментов (щелочная фосфатаза, мальтаза), что указывает на развитие синдрома мальабсорбции.

Полученные данные подчёркивают необходимость систематического мониторинга и профилактики нематодозов у молодняка овец в условиях пастбищного содержания, с обязательным учётом смешанных инвазий и возрастной восприимчивости животных.