Original article

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HELMINTH FAUNA OF CAMELS UNDER PASTURE CONDITIONS

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ABSTRACT

The aim of this study was to investigate the composition and intensity of helminthiasis, in particular the detection of cestodes, in dromedary camels (*Camelus dromedarius*) kept on pasture. A total of 68 faecal samples (52 from adult animals and 16 from young camels) were examined using the Fülleborn flotation method and light microscopy. Overall, 63.2% (95% CI: 50.7-74.6) of the camels were infected with *Eimeria* spp., 67.6% (95% CI: 55.2-78.5) with *Strongyloides* spp. and 60.3% (95% CI: 47.7-72.0) with *Trichostrongylidae* spp., with no significant differences between these dominant taxa ($p < 0.0001$). Infections with *Nematodirus* spp. (16.2%, 95% CI: 8.4-27.1) and *Trichuris* sp. (4.4%, 95% CI: 0.9-12.3) were less common but still present. The highest mean intensity was observed for *Eimeria* spp. (7.1 ± 0.81 eggs per gram, EPG), followed by *Strongyloides* spp. (6.6 ± 1.12 EPG) and *Nematodirus* spp. (5.5 ± 0.50 EPG), while Trichostrongylidae sp. (3.5 ± 0.50 EPG) and *Trichuris* sp. (1.3 ± 0.47 EPG) showed lower values. These results confirm the high prevalence and significant intensity of gastrointestinal parasite infestation in camels, reflecting the constant risk of reinfestation in pastoral conditions. The results highlight the need for regular diagnostic monitoring, deworming programs and improved management practices to reduce parasite load and prevent economic losses in the camel industry.

Keywords: *camels, parasites, helminths, flotation, microscopy.*

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1 INTRODUCTION

Helminth infections in camels represent a serious constraint for livestock production in regions characterized by arid and semi-arid climates. Gastrointestinal parasites reduce feed conversion efficiency, impair growth and reproductive performance, and can predispose animals to secondary infections. Moreover, certain camel parasites are of zoonotic significance, creating risks for human health in pastoral communities.

Gastrointestinal helminth infections in camels (*Camelus dromedarius*) represent a significant veterinary and economic problem in countries with arid and semi-arid climates. The most commonly identified parasites in these animals are nematodes (*Strongyle* spp., *Trichostrongylus* spp., *Haemonchus* spp., *Strongyloides* spp., *Nematodirus* spp., *Trichuris* spp.), as well as cestodes (*Moniezia expansa*, *Thysaniezia ovilla*) and protozoa of the genus *Eimeria*. These parasites reduce camel productivity, impair feed conversion efficiency, and can lead to severe gastrointestinal disorders, particularly in young animals [1].

Seietkamzina et al. (2023) reported the results of a survey of the parasite fauna of 460 camels in farms of the Kyzylorda and Mangystau regions of Kazakhstan. The most common parasites were *Trichostrongylidae* spp., with a prevalence rate (PR) of 47.6% and infection intensity (II) of 27–94 specimens. *Eimeria* spp. (PR 26.9%) and *Fasciola* spp. (PR 14.3%) were also detected. In addition, a significant proportion of camels were infested with *Ixodidae* ticks (PR 58.7%) and lice *Microthoracius cameli* (PR 56.1%) [2].

Studies conducted in Saudi Arabia demonstrated that gastrointestinal parasites were detected in more than 40% of the examined camels, with cestodes identified as *Moniezia expansa* in 6.7% of the animal [3]. Another unique case was reported by Omer and Al-Sagair (2005), who documented, for the first time, the occurrence of the fringed tapeworm *Thysanosoma actinioides* in a Najdi camel, a parasite previously

considered restricted to New World ruminants [4]. These findings confirm that the spectrum of cestodes in camels is broader than previously assumed.

El-Dakhly et al. (2020) examined 626 fecal samples from camels in Egypt. The overall prevalence of parasites was 41.53%. A total of 15 species were identified, including *Trichuris* sp., *Trichostrongylus* spp., and *Haemonchus* spp.

Among protozoa, *Eimeria cameli* and *E. dromedarii* were noted. The highest infection intensity was observed during winter, while animal age significantly influenced the infection level [5].

A study by Bekele et al. (2022) in Ethiopia showed that 76% of the surveyed camels were infected with at least one parasite. The most common findings included *Strongyle* spp., *Trichostrongylus* spp., and *Haemonchus* spp. The main risk factors were animal age and geographical origin, with older animals being more frequently infected [6].

Anisimova et al. (2012) identified three nematode species in camels from Iraq: *Haemonchus longistipes*, *Camelostrongylus mentulatus*, and *Parabronema skrjabini*. The study was conducted at slaughterhouses in two provinces using Skrjabin's method. Nematodes were noted as the most common parasites in this area [7].

Al-Ani et al. (2019) investigated *Onchocerca fasciata* in 97 camels slaughtered in Jordan, reporting a prevalence of 8.24%. Adult animals were more frequently infected, with nodules caused by the parasite observed in subcutaneous tissue and ligaments [8].

Zhang et al. (2020) surveyed 362 camels in the pastoral areas of the Tianshan Mountains. The most common parasites were *Ostertagia* spp. (100%) and *Trichostrongylus* spp. (98.1%). Many camels had mixed infections involving 5-14 parasite species. The infection intensity was higher in adult animals compared to younger ones [9].

Sazmand et al. (2019) provided a review of zoonotic parasites, including *Echinococcus granulosus*, *Toxoplasma gondii*, and *Fasciola* spp. Infections with these parasites pose a significant public health risk, particularly in regions with low sanitation levels. Cases of *Trypanosoma evansi* transmission via insect bites were also reported [10].

Thus, the helminth fauna of camels is characterized by high diversity and is often represented by mixed infections, which complicates both diagnosis and control. The presence of cestodes, including *Moniezia* spp. and *Thysanosoma actinioides*, further illustrates the epizootic instability and underscores the need for continued research to better understand their epidemiology and impact on animal health and productivity.

All these studies emphasize the high prevalence of parasitic infections in camels and the urgent need for preventive measures. Parasites exert a significant impact not only on camel productivity but also on public health, highlighting the necessity of broader implementation of diagnostic and control strategies.

The aim of this study is to investigate and characterize the helminth fauna of camels (*Camelus dromedarius*), with a particular focus on the detection and identification of cestode eggs.

2. MATERIALS AND METHODS

Study material. A total of 68 fecal samples from camels (*Camelus dromedarius*) were collected in the Akmola region of Kazakhstan. Of these, 52 samples originated from adult animals and 16 from young individuals. Fresh feces were taken directly from the rectum or immediately after defecation to avoid environmental contamination. Samples were placed in sterile plastic containers, labeled with information on age group and location, stored at 4 °C, and transported to the laboratory for further analysis within 24 hours.

Fülleborn flotation method. To detect helminth eggs in fecal samples, the Fülleborn flotation method was employed. A small amount of fecal material (approximately 1-2 g) was mixed with a saturated sodium chloride solution and thoroughly homogenized until a uniform suspension was obtained. The suspension was filtered through a double layer of gauze into a test tube, which was then filled to the rim with the flotation solution. A coverslip was gently placed on the surface of the tube and left in position for 20-30 minutes to allow parasite eggs to float. After this period, the coverslip was carefully removed, and the adhering helminth eggs were transferred onto a clean microscope slide for subsequent examination.

Microscopy. Further analysis was conducted using light microscopy. Preparations obtained after flotation were examined under a compound microscope at magnifications of 10× and 40×. Species identification of helminths was performed based on the morphological characteristics of eggs, with the aid of specialized keys and atlases of parasites.

Statistical analysis. The apparent prevalence of faecal shedding of parasite stages and its 95% confidence interval (CI) were calculated. The observed mean intensity and abundance of each parasite species were calculated as described by Bush et al. [11].

3 RESULTS

A total of 68 fecal samples from dromedary camels (*Camelus dromedarius*) were examined for the presence of gastrointestinal helminths and protozoa using the Fülleborn flotation method followed by microscopic identification. The parasitological survey revealed a high overall prevalence of infection, with the majority of animals harboring more than one parasite species. Statistical analysis allowed estimation of prevalence rates, 95% confidence intervals (CI), and mean infection intensities expressed as eggs per gram (EPG) of feces. The results demonstrated clear differences in the distribution and intensity of individual parasite taxa, highlighting the predominance of nematodes of the *Strongyloides* and *Trichostrongylidae* groups, as well as coccidia of the genus *Eimeria*. Less frequent but still noteworthy were infections with *Nematodirus* spp. and *Trichuris* sp. The detailed prevalence and intensity data are summarized in Table 1.

Parasitological analysis of 68 dromedary camels (*Camelus dromedarius*) revealed, among identified parasites, *Strongyloides* spp. (67.6%, 95% CI: 55.2-78.5), *Eimeria* spp. (63.2%, 95% CI: 50.7-74.6) and *Trichostrongylidae* sp. (60.3%, 95% CI:47.7-72.0) were the most prevalent, with no statistically significant difference between them ($p < 0.0001$).

Infections with *Trichuris* sp. (4.4%, 95% CI: 0.9–12.3) and *Nematodirus* spp. (16.2%, 95% CI: 8.4–27.1) were sig-

Table 1 – Prevalence and intensity of parasites in camel (95% CI: 95% confidence interval; SD: standard deviation).

Host	N infected/N examined	% prevalence (95% CI)	*p*-value	eggs per gram (EPG)	Mean (SD) intensity	helminth species identified
			< 0.0001			
Camelus dromedarius	43/68	63.2 (50.7-74.6)		6-8	7.1 (0.81)	*Eimeria spp*
	46/68	67.6 (55.2-78.5)		5-6	6.6 (1.12)	*Strongyloides spp.*
	41/68	60.3 (47.7-72.0)		3-4	3.5 (0.50)	*Trichostrongylidae sp.*
	3/68	4.4 (0.9-12.3)		1-2	1.3 (0.47)	*Trichuris sp.*
	11/68	16.2 (8.4-27.1)		5-6	5.5 (0.50)	*Nematodirus spp.*

nificantly less frequent compared to the dominant parasites (*Eimeria* and *Strongyloides*) (all $p < 0.0001$). Mean intensity values varied across species. *Eimeria* spp. showed the highest mean intensity (7.1 ± 0.81 EPG), followed closely by *Strongyloides* spp. (6.6 ± 1.12 EPG). *Nematodirus* spp. displayed moderate intensity (5.5 ± 0.50 EPG), *Trichostrongylidae* sp. (3.5 ± 0.50 EPG), while *Trichuris* sp. exhibited the lowest (1.3 ± 0.47 EPG).

The flotation process was completed due to density differences between the solution and helminth eggs, resulting in the concentration of eggs in the upper layer of the liquid. The surface fraction enriched with helminth eggs was carefully collected and subjected to microscopic examination for morphological identification. The main morphological types of helminth eggs are presented in Figure 1.

Strongyloides spp. Eggs are small, oval in shape, measuring approximately 50-60×30-35 µm. The shell is thin and transparent. A rhabditiform larva usually develops inside, which explains why eggs are rarely detected in feces and quickly disintegrate; larvae are more frequently found.

Trichostrongylus sp. Eggs are elongated-oval, measuring 75-95×40-50 µm. The shell is thin, smooth, and transparent. The contents consist of a multinucleated embryo. Morphologically, they are very similar to other strongylids, with differentiation based mainly on size and biological traits.

Nematodirus spp. Eggs are significantly larger than other strongylids, reaching 150-230×70-100 µm. They are elongated and oval, with a thick, double-layered, well-visible shell. Inside are large blastomeres (4-8 cells). Their large size is the primary distinguishing feature.

Trichuris spp. Eggs have a barrel-shaped ("lemon-like") form, measuring about 50-55×22-23 µm. The shell is thick and smooth, with characteristic transparent polar plugs at both ends. These features allow easy differentiation from other nematodes.

Eimeria spp. Oocyst sizes vary by species (15-35 µm). They are round or oval, with a two-layered, smooth shell,

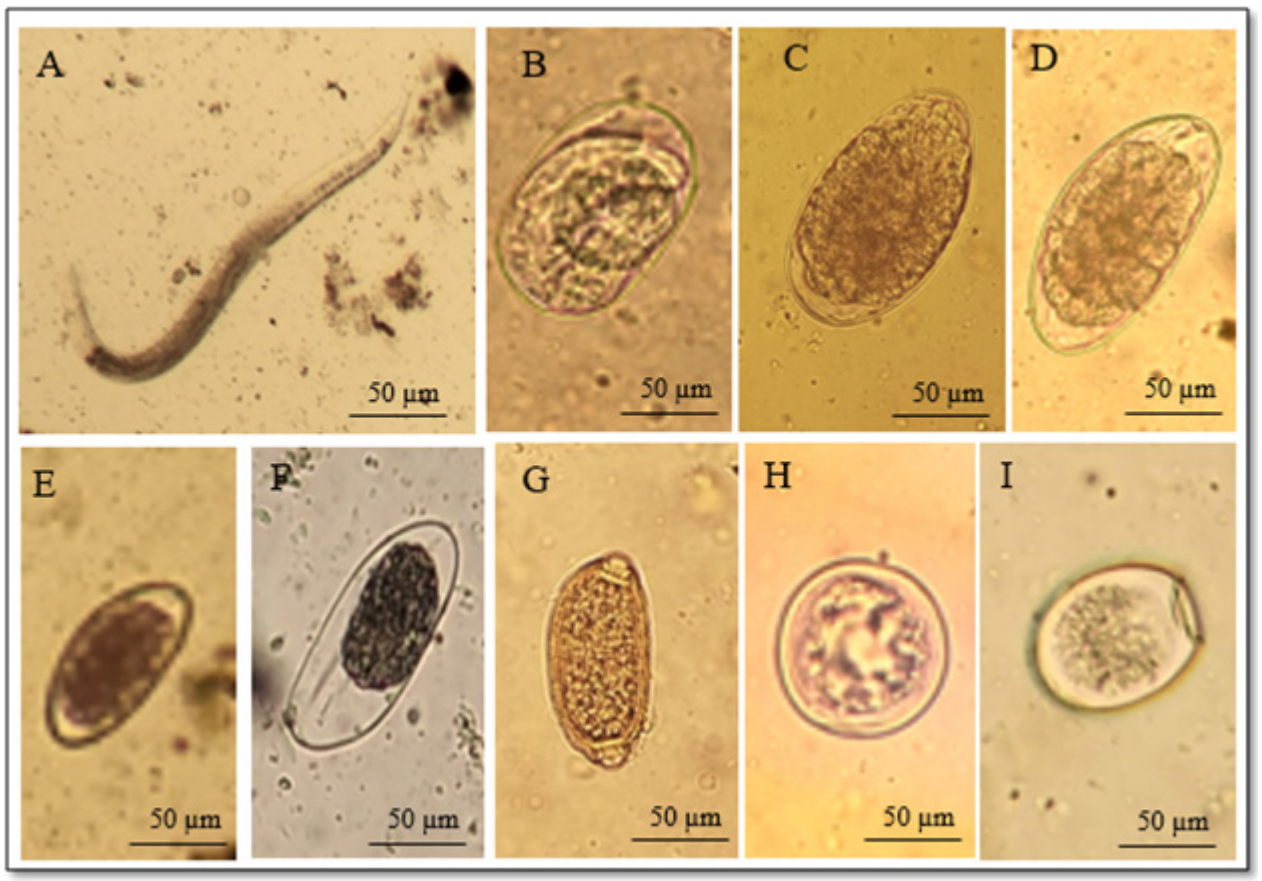

Figure 1 – Microscopy of helminth eggs from camel feces at ×40 magnification: A – *Strongiloides* spp. (larva); B – *Strongiloides* spp. (egg); C,D,E – *Trichostrongylidae* sp.; F – *Nematodirus* spp.; G – *Trichuris* spp.; H, I - *Eimeria spp*.

sometimes with a micropyle. A non-sporulated oocyst contains a single cell (sporont), which later divides into sporoblasts during sporulation. It is important to note that these are protozoa, not helminths, but their oocysts are frequently found together with nematode eggs.

Their high prevalence reflects the continuous presence of infective stages in the pasture environment and highlights an unfavorable epizootic situation. The findings confirm the need for systematic monitoring of parasitoses, routine deworming, and sanitary measures aimed at reducing parasitic burden and preventing economic losses in camel husbandry.

DISCUSSION

The present study demonstrates a high prevalence of gastrointestinal parasites in dromedary camels, with protozoan *Eimeria* spp. and nematodes *Strongyloides* spp., *Trichostrongylidae* sp. being the dominant infections. The high prevalence and relatively high mean intensity of *Eimeria* spp. (7.1 EPG) suggest that coccidiosis may represent a substantial subclinical burden in camels, affecting productivity even in the absence of overt clinical signs.

Trichostrongylidae sp. (60.3%) and *Strongyloides* spp. (67.6%) also showed significant occurrence and comparable infection intensity. The lack of a significant difference between these species indicates that both taxa are major parasitic threats under local ecological conditions.

Conversely, *Nematodirus* sp. (16.2%) and Trichuris sp. (4.4%) were detected at significantly lower levels. Although their mean intensities (5.5 and 1.3 EPG, respectively) suggest limited pathogenic pressure, sporadic infections may still lead to clinical disease in immunocompromised or heavily burdened animals.

Studies have shown that among the gastrointestinal helminths of camels, representatives of the class *Cestoda* are also detected. An Iranian review covering the period from 1931 to 2017 reported four species of cestodes parasitizing the digestive tract of camels, including *Moniezia expansa* and *Thysaniezia ovilla* [9]. In China and Egypt, *Moniezia* spp. and *Thysaniezia* spp. have also been recorded in camels, with prevalence rates ranging between 2% and 5% of the population [12].

In Bangladesh, a survey of 55 camels revealed a lower occurrence of cestodes, with isolated cases of infection by *Hymenolepis* spp. (2%) and *Moniezia* spp. (2%) [13, 14].

Despite their relatively low prevalence, cestode infections in camels are of considerable importance: they can reduce feed digestibility, cause diarrhea, and lead to weight loss, particularly in young animals. Cases of mixed infections, where cestodes were found in combination with nematodes and protozoa (*Eimeria* spp.), have also been reported in zoo animals.

Parasitic burden in camels under pasture-based management is multifaceted, involving both nematodes and protozoa. Modern epidemiological studies confirm that *Camelus bactrianus* and *Camelus dromedarius* are frequently affected by mixed infections, for example with *Trichostrongylus* spp. and *Haemonchus contortus*. In Xinjiang, China, helminths were detected in 18.2% of camels, with most cases involving *Trichostrongylus* spp., *Haemonchus*, and *Chabertia ovina* in mixed infections [15, 16].

Simultaneous infections with nematodes and coccidia are also common. In one study, 17.0% of camels were infected with helminths, 17.0% with protozoa, and 7.5% had mixed infections [17]. Similar results were obtained in Iraq, where the overall prevalence of intestinal parasites reached 52%, including helminths (21.7%), protozoa (19.6%), and mixed cases (8.4%) [18].

Coccidia of the genus *Eimeria* are also highly prevalent, especially among young animals, and pose a significant economic threat. In Mongolia, three common species were identified in *Camelus bactrianus*: *E. cameli*, *E. rajasthani*, and *E. dromedarii*, with mixed infections detected in 24.8% of samples. In Saudi Arabia, the overall prevalence of *Eimeria* spp. in dromedaries reached 38%, with *E. pellerdyi* being recorded for the first time [19].

These findings highlight the presence of complex, multispecies parasitic communities in camels and the resilience of such infections under the extreme conditions of arid ecosystems. In many cases, infections remain latent, complicating early diagnosis and contributing to the accumulation of parasitic pressure on pastures. Clinically, these mixed infections lead to chronic digestive disorders, wasting, anemia, and reduced productivity. Young animals are particularly vulnerable, as confirmed by studies on *Eimeria* and helminth infections, where severe forms predominate among juveniles [20].

Adaptation of parasites to the arid climate of Central Asia exacerbates the problem: eggs and larvae can survive in soil for prolonged periods, maintaining a constant reservoir of infection. This fact necessitates a more comprehensive preventive approach, including monitoring of mobility and seasonality, strategic deworming, pasture rotation, and improved sanitary measures.

CONCLUSION

The conducted study demonstrated that camels raised under pasture conditions are exposed to a wide spectrum of helminthoses and protozoal infections, which remain a significant limiting factor for animal health and productivity. The parasitological survey revealed a high diversity of gastrointestinal nematodes, among which the most frequently recorded were *Strongyloides spp.*, representatives of the family Trichostrongylidae (*Trichostrongylus sp.*, *Nematodirus spp.*), and *Trichuris spp.* In addition, protozoa of the genus *Eimeria* were identified, with young animals being particularly susceptible to coccidial infection. Morphological identification of eggs confirmed both the high prevalence and considerable intensity of infection, reflecting the continuous reinvasion risk under traditional grazing systems.

It is noteworthy that, unlike in a number of reports from other camel-rearing regions where cestodes (*Moniezia spp.*, *Thysaniezia spp.*) are occasionally encountered, in the present investigation **e**ggs of cestodes were not detected. This may reflect both regional differences in parasite fauna and the influence of ecological and management factors on transmission dynamics.

AUTHORS CONTRIBUTIONS

Conceptualization, V.K. and A.S.; methodology, A.S. and R.U.; validation, A.S., V.K., R.U., L.L. and G.S.; formal

analysis, V.K., R.U., and A.S.; investigation, D.B., A.A. and R.U.; resources, V.K.; data curation, A.S.; writing–original draft preparation, A.S., R.U. and V.K.; writing-review and editing, V.K. and R.U.; visualization, A.S., L.L., G.S., D.B. and A.A.; project administration, A.S. and V.K.; funding acquisition, V.K. All authors have read and agreed to the publication of the final version of the manuscript.

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CONFLICT OF INTEREST

There are no conflicts of interest to declare.

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ГЕЛЬМИНТОФАУНА ВЕРБЛЮДОВ В УСЛОВИЯХ ПАСТБИЩНОГО СОДЕРЖАНИЯ

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АННОТАЦИЯ

Целью данного исследования было изучение состава и интенсивности гельминтозов, в частности выявление цестодозов, у одногорбых верблюдов (*Camelus dromedarius*) при пастбищном содержании. Всего было исследовано 68 образцов фекалий (52 от взрослых животных и 16 от молодых верблюдов) с использованием метода флотации по Фюллеборну и световой микроскопии. В целом, 63,2% (95% ДИ: 50,7-74,6) верблюдов были инфицированы *Eimeria* spp., 67,6% (95% ДИ: 55,2–78,5) – *Strongyloides* spp. и 60,3% (95% ДИ: 47,7-72,0) – *Trichostrongylidae* spp., без значимых различий между этими доминирующими таксонами ($p < 0,0001$). Инфицирование *Nematodirus* spp. (16,2%, 95% ДИ: 8,4-27,1) и *Trichuris* sp. (4,4%, 95% ДИ: 0,9-12,3) встречались реже, но всё ещё присутствовали. Наибольшая средняя интенсивность наблюдалась для *Eimeria* spp. (7,1 ± 0,81 яиц на грамм, EPG), за ними следовали *Strongyloides* spp. (6,6 ± 1,12 EPG) и *Nematodirus* spp. (5,5 ± 0,50 EPG), в то время как *Trichostrongylidae* sp. (3,5 ± 0,50 EPG) и *Trichuris* sp. (1,3 ± 0,47 EPG) показали более низкие значения. Эти результаты подтверждают высокую распространённость и значительную интенсивность заражения желудочно-кишечными паразитами у верблюдов, что отражает постоянный риск реинвазии в пастбищных условиях. Результаты подчеркивают необходимость регулярного диагностического мониторинга, программ дегельминтизации и совершенствования методов управления для снижения паразитарной нагрузки и предотвращения экономических потерь в верблюдоводстве**.**

Ключевые слова: *верблюды, паразиты, гельминты, флотация, микроскопия.*

ЖАЙЫЛЫМДЫҚ ЖАҒДАЙДА ӨСІРІЛЕТІН ТҮЙЕЛЕРДІҢ ГЕЛЬМИНТОФАУНАСЫ

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АННОТАЦИЯ

Бұл зерттеудің мақсаты жайылымда ұсталатын түйелердің (Camelus dromedarius) гельминтоздардың құрамы мен қарқындылығын, атап айтқанда цестодтардың анықталуын зерттеу болды. Барлығы 68 нәжіс үлгісі (52 ересек жануарлардан және 16 жас түйелерден) Фюллеборн флотациялық әдісі және жарық микроскопиясы арқылы зерттелді. Жалпы түйелердің 63,2% (95% CI: 50,7-74,6) *Eimeria* spp., 67,6% (95% CI: 55,2-78,5) *Strongyloides* spp. және 60,3% (95% CI: 47,7-72,0) *Trichostrongylidae* spp., осы басым таксондар арасында айтарлықтай айырмашылықтар жоқ ($p <0,0001$). *Nematodirus* spp. (16,2%, 95% CI: 8,4-27,1) және *Trichuris* sp. (4,4%, 95% CI: 0,9-12,3) сирек кездеседі, бірақ әлі де бар. Ең жоғары орташа қарқындылық *Eimeria* spp үшін байқалды. (грамына 7,1 ± 0,81 жұмыртқа, EPG), одан кейін *Strongyloides* spp. (6,6 ± 1,12 EPG) және *Nematodirus* spp. (5,5 ± 0,50 EPG), ал *Trichostrongylidae* sp. (3,5 ± 0,50 EPG) және *Trichuris* sp. (1,3 ± 0,47 EPG) төмен мәндерді көрсетті. Бұл нәтижелер түйелерде асқазан-ішек паразиттерінің инвазиясының жоғары таралуы мен айтарлықтай қарқындылығын растайды, бұл жайылымдық жағдайда қайта жұқтырудың тұрақты қаупін көрсетеді. Нәтижелер паразиттік жүктемені азайту және түйе шаруашылығында экономикалық ысыраптардың алдын алу үшін тұрақты диагностикалық мониторинг, дегельминтизация бағдарламалары мен жетілдірілген басқару тәжірибесінің қажеттілігін көрсетеді.

Түйін сөздер: *түйе, паразиттер, гельминттер, флотация, микроскопия.*