Research Article

AL- ANBAR JOURNAL OF VETERINARY SCIENCES

Vol. 16 Issue:2, (2023) ISSN: P-1999:6527 E-2707:0603

Prevalence of Gastrointestinal Nematode of Sheep in Mosul and Erbil City

W. K. Khalaf*[1], M.T. Jarjees[2] and M.H. Hasan[1]

[1]Department of Microbiology, College of Veterinary Medicine, University of Mosul, Iraq.
[2]Department of Veterinary Public Health, College of Veterinary Medicine, University of Mosul, Iraq

*Corresponding Author: waadkhalid@uomosul.edu.iq

Doi: https://doi.org/10.37940/AJVS.2023.16.2.5

Received:2 /8/2023 Accepted:13/11 /2023

Abstract

This study was designed to explore and assess the status of nematode infection of sheep based on the prevalence, identification genera and species of detected eggs, age and sex of infected sheep, type of infection (single, double, mixed), type of sheep breeding (outdoor/indoor husbandry) and intensity of infection (light, moderate, heavy). One hundred and eighty-five fecal samples were microscopically examined which were randomly collected from different locations of Mosul and Erbil cities. The sheep of the study were of different ages and both sexes and were carried out during the period from January until the December 2020. Conventional helminthic examination methods were applied including the examination and description of genera and species of the egg worms. The findings indicated that the total infection rate was 46.49%. In all sheep of both areas, the highest infection rates were observed in adults and older sheep (2-3 years and >3 years). There was no significant difference between infection rates of males and females. It was found that "light" type of intensity of infection (50-800) egg/g was the most predominant in both sheep representing 63.6% and 59.5% of Mosul and Erbil cities, respectively. It can be conducted that the infection with a single type of nematodes was generally prevalent in the examined sheep of the two cities .According to the degree of infection concomitant to the management of housing, indoor type of breeding is better that outdoor type of Mosul sheep, while the outdoor type of had the worse influence in Erbil sheep city. Although, the predominant type of intensity of infection was light (50-800 egg/g) among all sheep investigated, those sheep need to be regularly and continuously administered with effective and suitable anthelmintics.

Keywards: Infection, Intensity, Nematode, Prevalence, Sheep

انتشار الديدان الاسطوانية للمعدة والامعاء في اغنام مدينتي الموصل وأربيل

الخلاصة

صُممت هذه الدراسة لاستكشاف وتقييم حالة الإصابة بالديدان الاسطوانية في الأغنام بناءً على انتشار وتحديد أجناس وأنواع البيوض المفحوصة، عمر وجنس الأغنام المصابة ، نوع الاصابة (مفردة ، مزدوجة ، مختلطة) بالديدان الاسطوانية ، نوع التربية للضأن (التربية الخارجية / الداخلية) وشدة الاصابة (خفيفة ، متوسطة ، شديدة). تم فحص مائة وخمسة وثمانين عينة براز مجهرياً، تم جمعها عشوائياً من مناطق مختلفة في مدينتي الموصل وأربيل. كانت أغنام الدراسة من مختلف الأعمار ومن كلا الجنسين وأجريت الدراسة من شهركانون الثاني الى كانون الاول عام 2020 . تم تطبيق طرق الفحص التقليدية للديدان الطفيلية بما في ذلك فحص ووصف أجناس وأنواع بيوض الديدان. أشارت النتائج إلى أن معدل الإصابة الكلي بلغ 46.49٪. لوحظت أعلى معدلات الإصابة في الأغنام البالغة والأغنام المسنة (2-3 سنوات والاكبرمن 3 سنوات). لم يكن هناك فرق معنوي بين معدلات الإصابة بين الذكور والإناث. وجد أن النوع "الخفيف" من شدة الإصابة (50-800) بيضة/غم و كان الأكثر انتشارا في كلا المدينتين بنسبة 63.6٪ و 59.5٪ في مدينتي الموصل واربيل على التوالي. أن الإصابة بنوع واحد من الديدان الاسطوانية كانت منتشرة بشكل عام في الأغنام التي تم فحصها في المدينتين. وبحسب درجة الإصابة المصاحبة لتربية الحيوانات، فإن التربية الداخلية كانت أفضل من التربية الخارجية في أغنام الموصل ، بينما التربية الخارجية كان لها التأثير الأسوأ على أغنام أربيل. على الرغم من أن النوع السائد في شدة الاصابة كانت الاصابة الخفيفة (50-800) بيضة/غم، بين جميع الأغنام التي تم فحصها ، إلا أن هذه الأغنام تحتاج إلى تناول مضادات الديدان المناسبة والفعالة بانتظام وباستمرار.

Introduction

Endo-parasitism is an unhealthy and harmful condition caused by the infection of gastro helminths of the host *i.e* small ruminants of farm animals. However, it embraces not only the understanding of the biology of the parasite but also the pathogenic effects and control measures against them (1). Apart from blood sucking activities of some nematodes *e.g*., *Bunostomum* spp. and *Haemonchus* spp., the parasites produce severe ill health or even death of the host , Contextually the internal parasites may compete with the host for food with an indirect decrease in food utilization, conversion and intake (2). The extent of parasitism depends on severity of the parasitic invasion. In Iraq, local studies showed that the infection rates of gastro-intestinal parasites ranged between (21.2-100%) (3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14). In neighboring and other countries, the moderate infection intensity rates of gastrointestinal parasites in sheep in Spring were 88.5% in Iran (15), and in Central Alberta/ Canada (16) which unfortunately reflects the broad spread of the parasites and the great importance of the disease, *Ovis aries* are the domesticated sheep which differ from other farm animals in their great numbers. In consequence such huge flocks require more care, close attention and watchful keeping.

The current study was planned to investigate the prevalence and the obtained genera of gastrointestinal nematodes with relation to age, sex and breed of the Mosul and Erbil cities.

Materials and methods

A total of 185 fresh fecal samples from sheep (135 samples from Mosul and 50 samples from Erbil)were randomly and directly obtained from the recta of sheep (about 10 gm) put in a plastic container transferred to the parasitology laboratory/ College of Veterinary Medicine/University of Mosul. The samples were collected from different local sheep farms Mosul and Erbil cities during the whole year of 2020. The area is lactated 36.21-° 36.35°N and 43.09°-43.15° E.

Sheep management is traditional *i.e*., extensive and semi-intensive rearing systems are followed in sheep husbandry. A form was prepared including age and sex of the examined sheep. All sheep were healthy and of local Breed. Detection of parasites: Fecal samples were examined for gastrointestinal eggs applied using mentioned flotation and sedimentation techniques and Mac master method as mentioned by (2). Description and identification keys of the nematode eggs were carried out on basis of information (2, 17).

Data interpretation:

The data were analyzed with Chi square test using SPSS software V.25. The values of probability below 0.05 were deemed statistically important.

Results and discussion

Nematoda is a class of worms characterized by an elongated, unsegmented, cylindrical or round body. Although nematode is derived from a Greek word that before means a thread or spin, it has a harmful effect on the parasitized host. According to (18), these helminths have more adverse impacts on sheep than cattle, This higher prevalence in ovine than caprine and bovine could be due to the grazing habit of the sheep where they might be grazing on contaminated pasture while goats are usually natural browsers. In the current work Out of total 185 fecal samples examined; 86 Samples were positive for nematode eggs with a mean percentage of 46.49% Figure (2). It was found that sheep Erbil area had higher infection rate (84%) than those of Mosul's sheep city (32.6%) Figure (2). Figure (1) shows some of the eggs of the obtained genera of nematodes. It revealed that *Trichostrongylus* spp. and *Marshallagia* spp. were the most prevalent genera in Mosul and Erbil sheep regions respectively. In all over Iraq, the infection rates range between 74.5-86.71% with different types, genera and species of various nematode percentages (3, 7, 8, 10, 11, 19, 20, 21, 22). In Nineveh governorate, the infection rate of ovine nematodes was 42.85% (5), and 30.73% (12). All these helminthic were elsewhere and collectively reported locally, in the neighboring countries and all over the globe with different percentages. Interestingly, (2)

emphasized the type of nematode and their counts rather than other attributes or traits. It is thought that the easy liberating of the larvae from the small crushed fecal pellets of sheep harboring the eggs may lead to wide distribution of the infective stage with subsequent contamination of the paddock(3). In our study,figure (3) refers to the genera of nematodes in sheep feces of Mosul city with their percentages. It was noticed that out of 44 samples, the highest and the lowest occurrence of nematode's genera were 20(45.5%) for *Trichostrongylus* spp. and one Sample (2.3%) for *Chabertia ovina* and *Toxocara vitulorum*, respectively Similarly, Figure (4) refers to the genera of nematodes in sheep feces of Erbil city with their percentages. Some additional genera of nematode eggs were detected in these sheep which were not found in Mosul sheep *areas Viz*., *Ostertagia* spp. (64.3%) and *Strongyloides* spp. (81%). The highest and the lowest presence of the detected genera of nematodes were *Marshallagia* spp. (83.3%) and *Toxocara vitulorun* (2.4%) in the sheep feces of Erbil city. Table (1) shows the prevalence rates of nematode eggs in Mosul and Erbil sheep regions to their ages regions. It is clear that the prevalence rate was the highest among the older sheep (2-3 years and more than 3 years), Also, the lowest percentage was found in young group of sheep (6 mouth -1 year) in both sheep areas which were 15% and 33.3% in Mosul and Erbil sheep areas respectively. These findings were in contrast to (14, 11) results who mentioned that younger sheep are more prone to infection, (7) recorded Maximum parasite infection in age group (1-6 months) (91.66%). Long ago, (2) in his early publication referred to this biological phenomenon. However, other studies corroborated the contrast.

Table (2) declares the prevalence of sheep in two regions according to their sex. There were no significant differences ($P<0.05$) between males and females in sheep of Mosul area (25.7%), (41%) respectively. However, there is resemblance between males, females and total infection rates in groups of Erbil distinct which were 83.3%,84.2% and 84%, respectively. These results are in agreement with previous studies, (23) indicated that there was no significant difference between males and females of sheep infected in Iran. While the outcomes were in inconsistent with those of (5, 7, and 3) who found higher percentages with males than females. while AL-Dahar& AL-Amery (24) noted higher percentages with females than males. The previous authors described that the females may be subjected to certain stress factors in their reproductive life *i.e.,* pregnancy and labor causing immunodeficiency due to disturbance of sexual hormone secretions and inadequate feed requirements in comparison to higher essential need with suppression of resistance (25) .Heavy infection with nematodes in female sheep could be attributed to the increased feed requirements Known as "higher biological activity" reflected by gestation and lactation which impose some pressure on the female leading to more feeding, grassing and pasturing with subsequent increased opportunities for further infection. It should be borne in mind that females are usually kept on the farm for longer time, being older than males and lambs, which are slaughtered early in their lives for lamb and mutton production. The prolonged periods in their life span of the ewes make these animals acquire additional exposure for further parasitic infections as compared to males.

Table (3) shows types of infection in sheep of Mosul and Erbil regions, The highest percentages of infection rates were detected with single infection in Mosul sheep and mixed infection in Erbil sheep which were 56.8% and 71.4%, respectively. Reviewing the available literature denotes the great discrepancies in determination the type of infection. On the one hand, (3. 26, 27) found that the mixed infection

was more prevalent than the single type. On the other hand (10) recorded the reverse *i.e.*, the single infection and mixed types of infection were 67.84% and 31.27%, respectively. These in accordance's are questionable and such cases cannot be interpreted. The above conditions depend upon the probable availability of the different causative agents in the pasture and environment surrounding sheep rearing areas which determine type of infection.

The total types of infection with nematodes in both categories of sheep were 44% and 42% in Mosul and Erbil sheep, respectively. Table (4) illustrates the prevalence rates in Mosul and Erbil sheep according to the type of breeding. There was no significant difference ($P<0.05$) between indoor and outdoor types of sheep breading of Mosul rearing. However, Outdoor type of breeding of Erbil sheep had significant more infection (84%) than that of Mosul outdoor Sheep area (28.1%) indicating that the outdoor type of breeding is better in Mosul while it is worse in Erbil. Sheep enclosures housing and type of raising are poorly studied all over Iraq in their association with animal parasitism with the possible exception of (20). In the current study, nematodiasis was investigated related to outdoor type of breeding "extensive management" which is most common in Erbil and indoor type "intensive management" which is famous in Mosul. The former regime includes farm-grazing and Paddock rearing of lactating and breeding ewes with their newly parturient lambs and young suckling lambs. In this system, such animals room and feed themselves automatically in the open posture and come back to their barns at night based on the availability of grass and their chances of getting the infection are little versus the indoor system as seen in Mosul sheep region. It is believed that sheep bred by intensive system have the greater opportunity to be infected by various parasites due to their close gathering and tethering in small spaces following few and common feeders and troughs enhancing and promoting the possibility of infection which is observed in Mosul sheep in "closed flocks" as mentioned by (20).It is well-known that Mosul is the main center of "intensive sheep rearing" for fattening which typically represent "feed-lot sheep" especially in "Kokjali" suburb a distinct in the vicinity of Mosul. Contextually, Erbil city is famous for outdoor rearing and these sheep are pasture grazers consisting mainly of dams and lactating females. The occurrence of outdoor infection may be accounted to the contaminated pasture and absence or ineffective drenching of sheep with anthelmintic with high loading of the pasture by infected sheep. The infection rates in sheep could be attributed to the fact that the samples were collected in the grazing season where larval counts are the peak in this period. The temperature and relative humidity of the pasture during this season were optimal for settlement growth, development and perpetuation of nematodes (9).

Table (5) evidenced the intensity of egg nematodes according to their counts in fecal samples of sheep of Mosul and Erbil regions. The light (50-800) epg in the categorization of intensity predominant representing 63.6% and 59.5%, in all examined sheep of Mosul and Erbil cities, respectively. Earlier, (2) stated that in lambs 2000-6000 epg indicates an acute infestation and treatment is recommended when 1000 epg or more are detected. Locally (9) found that the infected sheep may shed an average of (1550 -3250) epg in Suleimani sheep district with means of 2640 epg. Later, in the same location, Dyary & Banaz (13) noticed mean epg was 535. In Mosul city, the mean epg of sheep nematodes was 3100 epg (6). Virtually, several factors influence egg counts such as consistency of faeces, the entire quantity of faeces voided per day individual variations amongst animals passing eggs at different times as well as immune states of the

host. The occurrence of "inhibited worms" in winter in some nematode genera plays an important role in these cases as well as the concurrence of resistant nematodes to certain anthelmintics (26,27). According to the above data, our findings were much less than those for mentioned reports. However, these findings in spite of being "slight" reflect unfavorable consequences. Such animals' manifest asymptomatic signs and may act as masked reservoir or hidden carriers of the parasites spreading the infection in several domains (28, 12). In light infection, it is proposed that a state of equilibrium between bowl worm burden and host immunity is often reached some researchers suggested that a farm with FEGs higher than 500 epg requires anthelmintic therapy (29, 30). Accordingly, all sheep of the study need to be administered with suitable vermifuges.

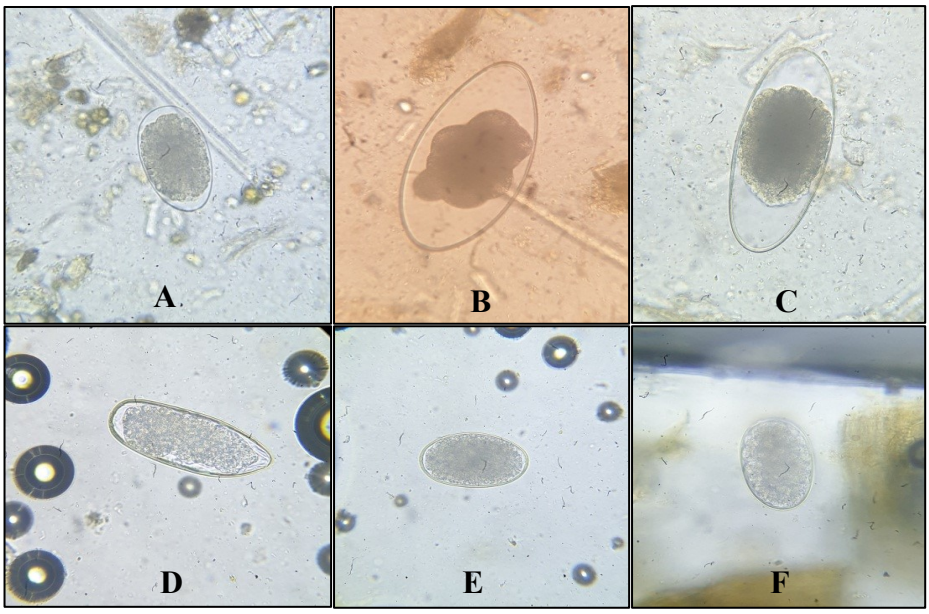

Figure (1) Eggs of Nematodes 40X

A- *Haemonchus* spp. B- *Nematodirus* spp. C- *Marshallagia* spp.

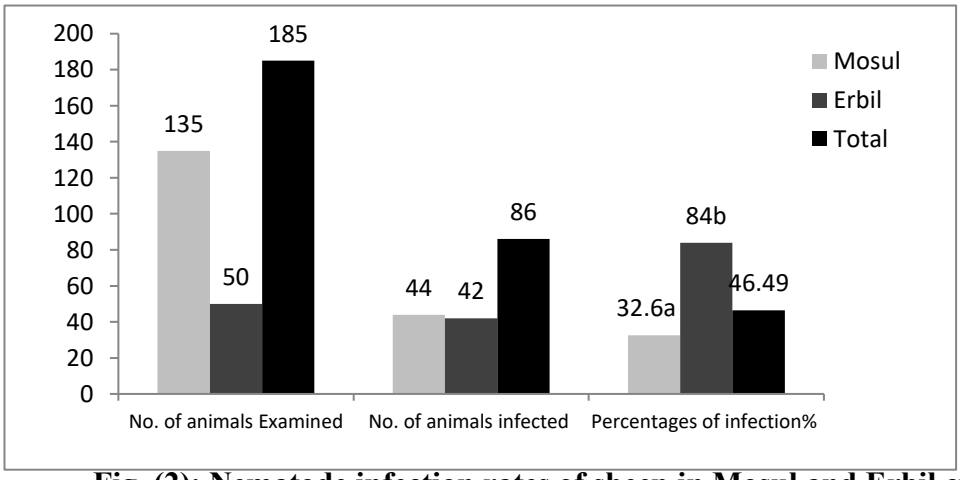

Fig. (2): Nematode infection rates of sheep in Mosul and Erbil cities

Vertically different letters indicate the presence of significant difference at level of significance (P<0.05).

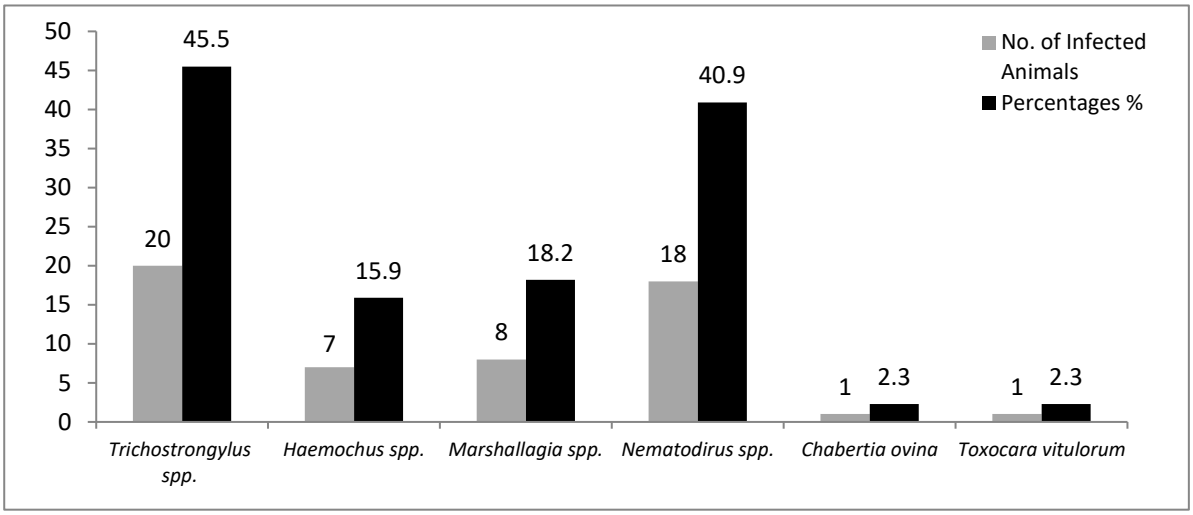

Fig. (3): Numbers of sheep infected with nematode parasites in Mosul city

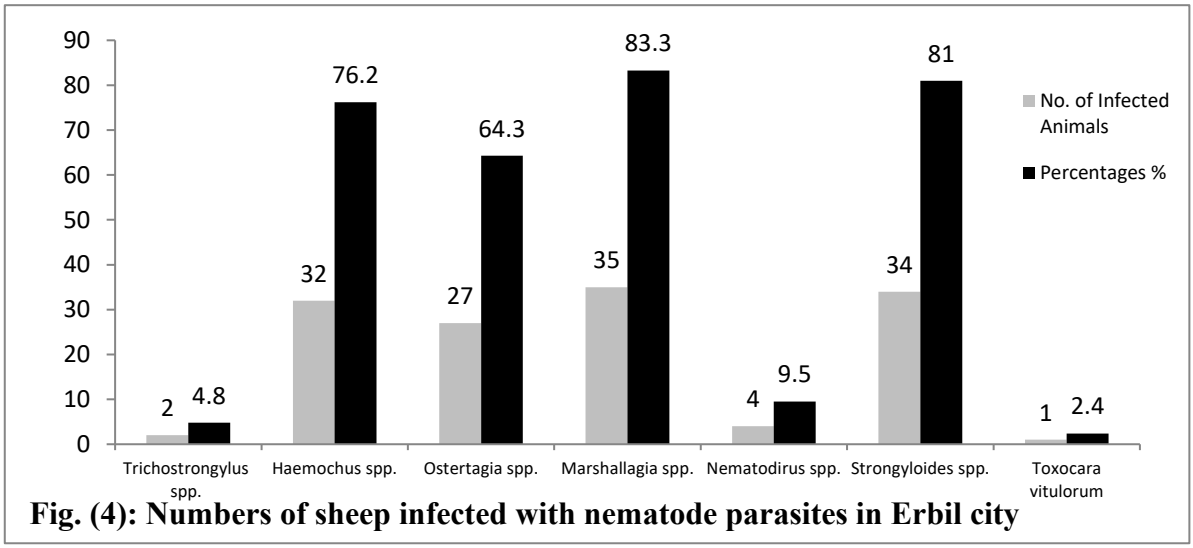

Fig. (4): Numbers of sheep infected with nematode parasites in Erbil city

Table 1- Prevalence of Nematodes in ages wise of sheep in Mosul and Erbil cities

City	Mosul city			Erbil city		
Age of animals	No of animals examined	No. of animals infected	Percentages of infection %	No of animals examined	No. of animals infected	Percentages of infection %
6months – 1 year	40	6	15[a]	6	2	33.3**a**
2-3years	35	18	51.4**b**	24	21	87.5**a**
>3 years	60	20	33.3**a, b**	20	19	95**a**
Total	135	44	32.6	50	42	84

Vertically different letters indicate the presence of significant difference at level of significance (P<0.05).

Table 2: - Prevalence of Nematodes of sheep in Mosul and Erbil cities according to sex

City	Mosul city			Erbil city		
Sex of animals	No. of animals examined	No. of animals infected	Percentages of infection %	No. of animals examined	No. of animals infected	Percentages of infection %
Males	74	19	25.7**a**	12	10	83.3**a**
Females	61	25	41**a**	38	32	84.2**a**
Total	135	44	32.6	50	42	84

Table 3: Types of infection with gastrointestinal nematodes in sheep in Mosul and Erbil cities

City	Mosul city		Erbil city	
Type of infection	No. of animals infected	Percentages of infection %	No. of animals infected	Percentages of infection %
Single	25	56.8**a**	3	7.1**a**
Double	14	31.8**a, b**	9	21.4**a**
Mixed	5	11.4**b**	30	71.4**b**
Total	44		42	

Vertically different letters indicate the presence of significant difference at level of significance ($P<0.05$).

Table 4: Prevalence of Nematodes in sheep according of type breeding in Mosul and Erbil cities

City	Mosul city			Erbil city		
Type breeding	No. of animals examined	No. of animals infected	Percentages of infection%	No. of animals examined	No. of animals infected	Percentages of infection%
Outdoor	64	18	28.1**a**	50	42	84b
Indoor	71	26	36.6**a**	-	-	-
Total	135	44	32.6	50	42	84

Horizontally different letters indicate the presence of significant difference at level of significance ($P<0.05$).

Table 5: Intensity of Nematodes infection according FEC in sheep in Mosul and Erbil cities

City	Mosul city		Erbil city	
Intensity of infection	No. of animals infected	Percentages of infection%	No. of animals infected	Percentages of infection%
Light (50-800)	28	63.6**a**	25	59.5**a**
Moderate (801-1200)	13	29.5**a**	12	28.6**a, b**
Heavy (>1200)	3	6.8**b**	5	11.9**b**
Total	44		42	

Vertically different letters indicate the presence of significant difference at level of significance (P<0.05).

Conclusions:

The highest infection rates with gastrointestinal nematodes were observed in adults and older sheep (2-3 years and >3 years) in both locations of Mosul and Erbil cities.

Acknowledgment:
I would like to thank the College of Veterinary Medicine for supporting, assisting, and providing space and facilities.

Conflict of interest
The authors declares that they have no conflict of interest with regards to the manuscript.

Ethical approve: This research was recorded in Mosul university / college of veterinary medicine / department of Microbiology in second session in 12-10-2021

References

1-Radostits OM, Gay CC, Blood DC, Hinchliff KW. Veterinary medicine; A textbook of the disease of cattle, sheep, pigs, goats and horses. 10th ed. Philadelphia: WB Saunders Company; 2007. 1499-1500.

2-Soulsby EJL. Helminths, Arthopods and Protozoa of Domesticated animals. 7th ed. Bailliere Tindall, London; 1982. 793.

3-Minnat TR. Detection of gastrointestinal parasite infection of sheep and goats in Diyala Province-Iraq. Al-Qadisiyah Journal of Veterinary Medicine Sciences. 2014; 13(2): 118-123. DOI: https://doi.org/10.29079/vol13iss2art312

4-Essa IM, Azzal GY. First record of nematode *Trichun's* spp. from sheep in Basrah city, Southern Iraq. European J. Molecular and Clinical Med. 2021; 8:355-366. https://ejmcm.com/

5-Sulaiman EG, Talib Q, Daham E, Arsalan SH. Study of some eggs and oocysts of internal parasites in sheep in Mosul. Iraqi J. Vet. Sci. 2005; 19:21-32. 10.33899/ijvs.2005.37275

6-Al-Farwachi MI, Mohamed EK. Evaluation the effect of albendazole against nematodes in sheep in Mosul,

Iraq. Iraqi Journal of Veterinary Sciences. 2008; 22(1): 5-7. 10.33899/ijvs.2008.5662

7-AL-Dabagh SMK, AL-Amery AMA, Al-Ani DAM. Prevalence study of gastro intestinal nematodes in goats in Baghdad province, Iraq. Al-Anbar J. Vet. Sci. 2014; 7:29-38. https://www.anbarjvs.edu.iq

8-Ahmed IA, Aziz KJ, Abdullah ShO. Prevalence of Gastrointestinal Nematodes Parasites from Sheep and Evaluation of Some Anthelminthic Resistance in Erbil Governorate, Bas. J. Vet. Res. 2015; 14(1): 1-11. https://basjvet.org/research/14

9-Dyary HO. Anthelmintic resistance of gastrointestinal nematodes in sheep in Piramagroon sub-district, Sulaymaniyah/Iraq.TropicalBiomedicine. 2018; 35(2): 373-382. https://msptm.org/files/Vol35No2/373-382-Dyary-HO.pdf

10-Gatie JA, Nejiban ZS. Prevalence of gastrointestinal parasites infestation in sheep of Thi-Qar Province, Iraq. Al-Qadisiyah Journal of Veterinary Medicine Sciences. 2019; 18(1): 123-128. www.qu.edu.iq/journalvm

11-Aziz ShJ, Mahmoud OI. Diagnosis of protozoa and nematodes in stomach and intestine of sheep in. Salah Al-Din governorate. Tikrit J. Pure Sci. 2020; 25: 10-15. http://www.tjps.tu.edu.iq/index.php/j/article/view/1061

12-Jwher DhM, Jarjees MT, Shareef AM. A study of the gastrointestinal parasites in Awssi sheep and surrounding environment. Iraqi J. Vet. Sci. 2021; 35(3): 561 567. 10.33899/ijvs.2020.127174.1478

13-Dyary HO, Banaz HQ. Multidrug resistance of sheep gastrointestinal nematodes. in Bakrajo district, north Iraq to albendazole, ivermectin and levamisole. Iraqi J. Agric. Sci. 2021; 52(4): 932-940. https://doi.org/10.36103/ijas.v52i4.1402

14-Hade BF, Al-Biatee ST, Al-Rubaie HM. Traditional and molecular diagnosis of *Haemonchus contortus* in sheep in Babylon province, Iraq. Iraqi Journal of Veterinary Sciences. 2022; 36(2): 479-481. DOI:10.33899/ijvs.2021.130533.1842

15-Salehi A, Razavi M, Nouri NV.Seasonal Prevalence of Helminthic Infections in the Gastrointestinal Tract of Sheep in Mazandaran Province, Northern Iran. Journal of Parasitology Research 2022: Article ID 7392801, 8 pages https://doi.org/10.1155/2022/7392801

16-Colwell DD, Goater CP, Jacobson KM. Prevalence and intensity of gastrointestinal nematodes in slaughter lambs from central Alberta. The Canadian Veterinary Journal. 2002; 43(10): 775-777. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC339609/

17-Van Wyk J., Cabaret J., Michael L. Morphological identification of nematode larvae of small ruminants and cattle simplified. *Veterinary Parasitology*. 2004;119(4):277–306. doi: 10.1016/j.vetpar.2003.11.012.

18- Belina D., Giri A., Mengistu S.and Eshetu A. Associated Risk Factors and Anthelmintic Utilization Practices in Selected Districts of East and Western Hararghe, Ethiopia. J. Vet. Sci. Technol 2017, 8:2 DOI: 10.4262/2157-7579.1000433

.

19-Nassrullah AJ. Prevalence of gastrointestinal parasites in sheep in Sulamani province. Al Anbar J. Vet. Sci. 2011; 4(2): 34-36. https://www.anbarjvs.edu.iq/volume-4-issue-2-2011

20-Jwher DMT, Jarjees MT. Husain MA. Assessment of parasitic contamination to the environment in Mosul city / Iraq. J. Adv. Biomed. And Pathol. Res. 2012; 2: 45- 50. http://www.sign-ific-ance.co.uk/

21- Mohammedameen MG. Prevalence of gastrointestinal helminthes in sheep from Bardarash district, Duhok province. Zanco J. Pure and Applied Sci. 2017; 28(6): 166-173. https://doi.org/10.21271/zjpas.v28i6.528

22-Hussein ES. Comparison of different techniques for diagnosis of nematodes in sheep in Ninevah governorate [master's thesis]. Mosul: College of Veterinary Medicine; 2019.

23-Salehi A., Razavi M, and Nouri NV. Seasonal Prevalence of Helminthic Infections in the Gastrointestinal Tract of Sheep in Mazandaran Province, Northern Iran. Journal of Parasitology Research. Volume 2022, Article ID 7392801, 8 pages. https://doi.org/10.1155/2022/7392801

24- AL-Dahar AH, AL-Amery AMA. A Prevalence of abomasal worms in sheep in AL-Kut province abattoir. The Iraqi Journal of Veterinary Medicine. 2015; 39 (2): 38-41. https://doi.org/10.30539/iraqijvm.v39i2.175

25-Vieira V.D, Feitosa T.F., Vilela V.L.R., Azevedo S.S, de Almeida Neto D.F. João Leite de Morais, A.R.C. Ribeiro A.R.C., Athayde A.C.R. Prevalence and risk factors associated with goat gastrointestinal helminthiasis in the sertão region of paraíba state, Brazil.Trop. Anim. Health Prod., 2014; 46 (2) (2014), pp. 355-361 DOI: 10.1007/s11250-013-0496-y

26-Saikia D. Relationship between gastrointestinal (GI) nematode infection and immune response in dairy cows. Thesis Degree of Master of Agricultural Science. Lincoln University, New Zealanda,2013. https://researcharchive.lincoln.ac.nz/server/api/core/bitstreams/43358a16-ca3f-4176-8433-855cfc6f9bf8/content

27- Morgan RE, Lanusse C, Rinaldi L, Charlier J and Vercruysse J. Confounding factors affecting faecal egg count reduction as a measure of anthelmintic efficacy. Parasite.,2022; (29) 20 :13. https://doi.org/10.1051/parasite/2022017

28- Hussein ES, Aghwan SS. Uses of direct and indirect immuno-fluorescent techniques for demonstration of nematodes infection in sheep in Nineveh government. Iraqi J. Vet. Sci. 2020; 34(1): 17-22. https://www.vetmedmosul.com/article_163565_49a9f4d256d4c16c4d63aa63ccc666db.pdf

29- Morgan ER, Cavill L, Curry GE, Wood RM, Mitchell ESE. Effects of aggregation and sample size on composite faecal egg counts in sheep. Veterinary parasitology. 2005; 131(1-2):79-87. https://doi.org/10.1016/j.vetpar.2005.04.021

30- Singh R, Bal M S, Singla L D, and Kaur P. Detection of anthelmintic resistance in sheep and goat against fenbendazole by faecal egg count reduction test. J Parasit Dis 2017; 41(2):463–466. DOI 10.1007/s12639-016-0828-8