Research Article

AL- ANBAR JOURNAL OF VETERINARY SCIENCES

Vol. 17 Issue:2, (2024) ISSN: P-1999:6527 E-2707:0603

A Comparative Prevalence of Lice Infesting Ruminants in Mosul City, Iraq

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Doi: https://doi.org/10.37940/AJVS.2024.17.2.

Received: 1/8/2023 Accepted:14/1/2024

Abstract

Lice infestation is one of the important ectoparasitic diseases infesting ruminants worldwide. A total of 1170 of sheep, 470 of goats, 545 of cows and 1060 of buffaloes were examined for the period from January - December 2022. Total infestation rates higher in goats 57.02% and in buffaloes 54.06% with no significant differences followed by sheep 50.43% and the lowest rate was recorded in cattle 40.37% with significant differences. The highest infestation rate in winter was 60% in sheep, 56% in cattle and 79% in buffaloes while the lowest infestation rates 40%, 22.22% and 43.64% for the same animals respectively in summer compared with goats recorded the highest rate 65% at $p \leq 0.05$. Sheep and cattle recorded no significant infestation rates between age groups compared with goats and buffaloes which recorded higher infestation rates in age group more than 3 years old 71.76% and 64.09% respectively. Results of sheep, goats and buffaloes recorded that females were more infested than males 68.97%, 76.60% and 61% respectively compared with cattle 66.66% in males. Higher infestation rate 55.71% indoor feeding system in sheep compared with goats which recorded 69.16% in outdoor feeding system. The highest infestation rate was in Al-Shura 55% and the lowest in Nineveh Plain 40%; in goats the highest infestation was in Bazwaya 88.33% and the lowest was 47.3% in Gojjali 47.3%, in cattle the highest infestation rate was in Izhilila 50% and the lowest in Orta Kharab 25%, while in buffaloes the highest infestation rate was recorded in Hawy Al maslagh 80% and the lowest was 36% in Hammam Al-Alil (Tomb of the slave). The study identified two lice species in sheep *Linognathus* spp. and *Damalina ovis*, while in goats; *Linognathus* spp. and *Damalina capri*. Lice species *Damalina bovis* was recorded in cattle while *Haematopinus tuberculatus* was recorded in buffalo.

Keywords: Ruminants, Prevalence, Lice, Damalina, Linognathus.

مقارنة انتشار الاصابة بقمل المجترات في مدينة الموصل، العراق

الإصابة بالقمل هي واحدة من اهم الأصابات الطفيلية الخارجية والتي تصيب المجترات في جميع أنحاء العالم. تم فحص 1170من الاغنام و 470 من الماعز و 545 من الابقار و 1060 من الجاموس للفترة من كانون الثاني حتى كانون الاول 2022. كانت نسب الإصابة الكلية في المجترات أعلى في الماعز 57.02٪ وفي الجاموس 54.06٪ تلتها الأغنام 50.43٪ وأقلها في الابقار 40.37٪. سجلت أعلى نسبة إصابة في فصل الشتاء 60٪ و56٪ و79٪ في الاغنام الأبقار والجاموس على التوالي بينما سجلت اقل معدلات الإصابة 40٪ و22.22٪ و43.64٪ في نفس الحيوانات على التوالي في الصيف مقارنة بالماعز حيث سجلت أعلى نسبة اصابة 65٪ في الصيف عند $p \leq 0.05$. لا توجد فروق معنوية في الأغنام والابقار بين الفئات العمرية مقارنة بالماعز والجاموس التي سجلت معدلات إصابة أعلى في الفئة العمرية أكثر من 3 سنوات 71.76٪ و64.09٪ على التوالي. سجلت نتائج الأغنام والماعز والجاموس أن الإناث كانت أكثر عرضة للإصابة من الذكور بنسبة 68.97٪ و76.60٪ و61٪ على التوالي مقارنة بالأبقار 66.66٪ في الذكور. ارتفاع نسب الإصابة 55.71٪ في نظام التغذية الداخلية في الأغنام مقارنة مع الماعز الذي سجل 69.16٪ في نظام التغذية الخارجية. وكانت أعلى نسبة إصابة في منطقة الشورة 55٪ وأقلها في سهل نينوى 40٪؛ وفي الماعز كانت أعلى نسبة إصابة في بازوايا 88.33٪ وأقلها 47.3٪ في كوكجلي 47.3٪، وفي الابقار كان أعلى نسبة إصابة في إزهليلا 50٪ وأقل نسبة إصابة في أورتا خراب 25٪، بينما في الجاموس سجلت أعلى نسبة إصابة في حاوي المسلخ 80٪ وأقلها 36٪ في حمام العليل (قبر العبد). حددت الدراسة نوعين من القمل في الأغنام *Linognathus* spp. و *Damalina ovis* ، وفي الماعز *Damalina capri* *Linognathus* spp. . وتم تسجيل نوع واحد في الابقار والجاموس *Damalina bovis* و *Haematopinus tuberculatus* على التوالي.

Introduction

Ruminants are the primary source for meat and dairy products (1,2), when exposed to infestation with ectoparasites, they will be affected directly or indirectly (3,4). Lice are external parasites belonging to the Phthiraptera order which contains the suborder Ischnocera (chewing or mandibulate lice) and Anoplura suborder (blood sucking lice) infesting only mammalian hosts (5,6). The suborder: Anoplura consists of numerous families, two of which are of medical interest to vets; the family Haematopinidae such as Haematopinus tuberculatrus (buffalo louse) and family: Linognathidae such as Linognathus ovillus (long-nosed sheep louse) and Linognathus stenopsis (goat sucking louse). While suborder Ischnocera includes many families, Bovicolidae family contains the Bovicola genus (previously Damalinia) on cattle, sheep, deer and horses such as Bovicola bovis (Damalina bovis) and Bovicola ovis (7).

Lice infestations or pediculosis is a serious problem in ruminant flocks especially during winter months and decreases significantly as summer begins because of strong increase of lice in winter due to denser coat, crowding and promiscuousness of the host under the effect of cold bad conditions or different pressures (8). Infestation is fundamentally direct or indirectly due to the environmental conditions (9).

There were many studies in Iraq that have documented the prevalence lice infestation in ruminants, but were insufficient for covering all ruminant species. In Mosul studies were carried on occurrence of lice in sheep and goat (10) other study about buffalo (11). The study aimed to evaluate prevalence of lice infestation in ruminants associated with season, age, sex, location, breed and feeding system and identifying species of lice affecting sheep, goats, cattle and buffaloes based on morphological characteristics using a dissecting microscope.

Materials and Methods

Sample collection

The study was carried from January to December 2022. A total of: 1170, 470, 545 and 1060 of sheep, goat, cattle and buffalo were examined respectively. Collection of lice was carried by brushing with lice-comb (12). Post collection, samples preserved in 70% ethyl Alcohol and then brought to laboratory of College of Veterinary Medicine - University of Mosul.

Collection of samples from ruminants are from different locations in Mosul city as shown in (Figure 1). Sheep lice samples were collected from herds located in Al-Mahlabiya (Sitta), Qayyarah, Bazwaya, Gojjali, Nineveh Plain, Al-Shura, Tubzawa, Tuwaitla, Tirawa, Al-Dawanem, Local Market and the Teaching Hospital in the same college. For the breeds they were local , Turkey and Iran. The animals are feeding on concentrated food (in door), also some herds feeding out door in grazing yards. Goat lice samples were collected from herds located in: Gojjali, Bazwaya, Local Market and the Teaching Hospital in University of Mosul/College of Veterinary Medicine. As for the breeds and species, they were local types, Afghanistan and Shami. Cattle lice samples were collected from herds located in: Gojjali, Orta Kharab, Bazwaya, Izhilila, Local Market and the Teaching Hospital - College of Veterinary Medicine. As for cattle breeds, they were local breed and from Georgia, Turkey, Iran, Brazil and Armenia. All types of animals are feeding on concentrated food (in door). Buffalo lice samples were collected from herds located in: Hawy Al maslagh (right side (,

Hammam Al-Alil (right side) included the following areas: (Quneitra), (Tomb of the slave), (Jamasah), (Quneitra Arabs) Badoush Jamasa (right side) Damerchy Al sagher, Local market and the Teaching Hospital. Concerning breed, it was collected from local Iraqi water buffalo feeding on concentrated food (in door). The information about months, sex, age, breed and feeding system were obtained and documented from owners in special data forms.

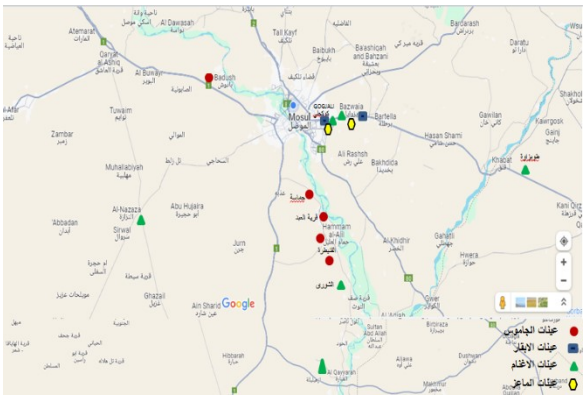

Figure (1): Areas covered to obtain the louse samples from different types of ruminants in city of Mosul

Macroscopical examination

Cross examination was carried by naked eye to detect of lice infestation in sheep, goat, buffalo and cattle manually using special lice comb from head across the trunk and other areas of the body. Samples examined using a dissecting microscope and lice images were taken using a digital Canon camera. Morphometrical identification of lice was carried depending on the identification keys by (7, 13).

Statistical analysis

Descriptive of statistics analyzed data by using (IBM, SPSS v27, UK) data has been confirmed normally distributed using Shapiro-Wilks test, differences of infestation ratio among groups demonstrated with Chi- square (cross tabulation) and followed with Bonferroni correction to estimate differences within groups, all test were performed at significant level of $P \leq 0.01$ (14).

Results and Discussion

Clinical gross examination of skin of ruminants revealed the presence of lice and eggs in the skin of buffaloes and calves suffering from heavy lice infestation (Figure 2 and 3). Lice lay the eggs on hair and can be seen clearly especially in heavy infestation when lice take pieces of hair for nesting the eggs that cause notable hair and skin damage (15, 16).

Figure (2): Calf of buffalo suffering from lice infestation.

Figure-3: Eggs of Haimatopinus tubercalatus (sucking lice of buffalo).

Table (1): Total infestation rate of lice in ruminants.

Animal species	Number of examined animals	No. of infested animals	Percentage
Sheep	1170	590	50.43% a
Goat	470	268	57.02% b
Cattle	545	220	40.37% c
Buffalo	1060	573	54.06% b

The different letters between groups mean there is significant difference at p≤ 0.05

The study results revealed total infestation rates in ruminants were higher in goats 57.02% and in buffaloes 54.06% with no significant differences followed by sheep 50.43% and the lowest rate was recorded in cattle 40.37% with significant differences (Table 1). These infestation rates are somewhat high and significant, and this indicates that there is a real problem, especially in goats and buffaloes, followed by sheep and cattle compared to the study of (17) who recorded cattle 27%, sheep 24% and goats 30% in the Guelma area, and in another study in north-east of Tunisia, researchers reported an infestation rate of 14.3% in cattle (18), but are parallel to the findings of Ouarti et al., (15) who recorded in cattle 71.41%, in sheep 63.63%, and in goats 66.66%. The differences similarities in the infestation rates can be attributed to different causes such as health of animals, diet quality and breeding. The ruminant industry is still facing several health problems. Veterinary authorities, veterinarians and farmers pay more attention to diseases with high morbidity and lethality such as foot and mouth disease, brucellosis or tuberculosis (13). On the other hand, endemic parasitic diseases such as external parasites, GIT and blood parasite infections, which induce lower losses but may concern a high percentage of the population and may last for several years sometimes the whole life of the animal are often neglected. For instance, animals infested by ectoparasites are not considered sick and they do not therefore receive specific health care (15).

A study in Mosul by Al-Farwachi and Alobaidii (10) recorded infestation rates 11.8% and 7.6% in goat and sheep respectively which is too far lower than this study 57.2% and 50.43% in goats and sheep respectively. High infestation rate in goats compared to sheep is similar to (19 , 20) in Kurdistan region. Contrary to Mustafa (21) a study in Sulaymaniyah who has recorded a higher infestation rate in sheep compared to goats. This diversity in infestation could be contributed to geographical climate changes in the studied areas, add to this is the willingness of farmers to treat their infested ruminant with anti-parasitic and preferring sheep more than goats in raring is apparently another reason for diversity of infestation (12).

According to the season that the highest infestation rate in winter was 60%, 56%and 79% recorded in sheep, cattle and buffaloes respectively while the lowest infestation rates recoded 40%, 22.22% and 43.64% respectively in summer, compared with goats recorded the highest rate 65% at p≤ 0.05 (Table 2). Lice infestation rates recorded higher in winter months January, February and March 79%, 60%, 56% in buffalo's sheep and cattle respectively contrary to goats higher 65% in summer and lower in sheep due to shearing,

solar radiation and thunderstorms in sheep and goat (22). Pediculosis is heavier during winter where intense reproduction occurs may be due to denser coat, stress, malnutrition, and indirectly through transporting the tufts of wool by birds (7, 8) in addition to low hygiene practices due to the high number of animals, abiotic factor (hygrometry and temperature) (23). Well-fed healthy cattle do not develop heavy lice infestation and lice present do not affect performance seriously. Also, heavy pediculosis occurs in poor cattle conditions, particularly if they are infected with chronic disease. These high susceptible animals to lice infestation called "louse carriers" (24). Greasiness of the hair coat in various cattle breeds is also considered another important factor which increased susceptibility to infection. However, lice burdens differences differ according to many reasons like immune, nutrition and health state between animal individuals, breed, rearing system and healthier condition are the major risks affecting the incidence and spreading of lice among goats (18, 25 and 26).

Table (2): Lice infestation rates in ruminants according to seasons.

Seasons	sheep	goats	cattle	buffaloes
	Infested / Examined%	Infested / Examined%	Infested / Examined%	Infested / Examined%
winter	(180/300) 60% [a]	(53/90) 58.89% [a]	(70/125) 56% [a]	(158/200) 79% [a]
spring	(190/350) 54.3% [b]	(90/180) 50% [b]	(55/140)39.29% [b]	(170/300) 56.67% [b]
summer	(100/250) 40% [c]	(65/100) 65% [c]	(40/180) 22.22% [c]	(120/275) 43.64% [c]
autumn	(120/270) 44.4% [c]	(60/100) 60% [a]	(55/100) 55% [a]	(125/285) 43.86% [c]
Total	(590/1170) 50.43%	(268/470) 57.02%	(220/545) 40.37%	(573/1060) 54.06%

different letters mean significant differences among groups at p≤ 0.05

Our study revealed no significant differences between age groups in cattle and sheep less than 3 years 42%, 49.62% and more than 3 years 38.98, 51.46% respectively while in buffaloes and goats revealed that age groups more than 3 years recorded lice higher infestation rates 64.09% and 71.76% compared to less than 3 years 37.5% and 39.53% respectively (Table 3). Our results agree with (27) who recorded 40.8% in adult sheep and the lowest 22.6% in young age. Contrary to our results (28) recorded the highest infestation in small ruminants 50.5% while in adults 39%; in addition to a study by (29) who recorded higher infestation rate 28% in calves more than adult cows 2%. The researcher (30) mentioned that young ruminants are 2.1 times more than older ruminants. These differences in our study and other study may be associated to different factors such as crowding for certain ages, clipping and acquired immunity (29).

Table (3): Lice infestation rates in ruminants according to age.

Ages / year	sheep	goats	cattle	buffaloes
	Infested / Examined%	Infested / Examined%	Infested / Examined%	Infested / Examined%
Less than 3	(325/655) 49.62%	(85/215) 39.53%	(105/250) 42%	(150/400) 37.5%
More than 3	(265/515) 51.46%	(183/255) 71.76% *	(115/295) 38.98%	(423/660) 64.09% *
Total	(590/1170) 50.43%	(268/470) 57.02%	(220/545) 40.37%	(573/1060) 54.06%

star means there is significant difference between groups

As for sex, the study results of sheep, goats and buffaloes recorded that females were more infested than males were recorded 68.97%, 76.60% and 61% respectively compared with cattle which recorded 66.66% in males with significant differences at p≤0.05 (Table4). This result may be contributed to the number of

animals reared and keeping females for meat and milk production contrary to cattle which is bred for meat production. These results do not match with (27) who recorded 38.2% and 33.8% in males and females of sheep respectively. While similar results are found (24) reported 16.9% in male and 20.5% in female sheep.

Table (4): Lice infestation rates in ruminants according to sex.

Sex	sheep	goats	cattle	buffaloes
	Infested / Examined%	Infested / Examined%	Infested / Examined%	Infested / Examined%
Male	(190/590) 32.2%	(88/235) 37.45%	(180/270) 66.66% *	(237/550) 43.09%
Female	(400/580) 68.97%*	(180/235) 76.60% *	(40/275) 14.54%	(336/550) 61% *
Total	**(590/1170) 50.43%**	**(268/470) 57.02%**	**(220/545) 40.36%**	**(573/1060) 54.06%**

Star means there is significant difference between groups

According to the feeding system (Table 5) in sheep and goat, our study showed that the infestation rate differs. In sheep, indoor feeding recorded higher infestation rate 55.71% compared with sheep following outdoor feeding 42.55%. This may be due to close contact between animals specially in winter and crowded barns (23). While in goat, outdoor feeding recorded higher infestation rate 69.16% compared with 52.5% with indoor feeding with significant differences at $p \leq 0.05$. This may be due to physiological behavior and type of hair and fleece of animals. The researcher (9) considered goat pediculosis as a main insect problem in goats kept under feeding system, especially during winter months.

Table (5): Lice infestation rates in ruminants according to the feeding system.

System of feeding	sheep	goats
	Infested / Examined%	Infested / Examined%
Indoor	(390/700)55.71%*	(185/350)52.5%
Outdoor	(200/470)42.55%	(83/129)69.16% *
Total	**(590/1170)50.43%**	**(268/470)57.02%**

Star means there is significant difference between groups

Breed revealed that all breeds of sheep are exposed to lice infestation foreign or local, while local goats are highly susceptible to infestation 64% compared with foreign breed; whereas cattle Gregorian breed recorded higher infestation rate 45.28 (Table 6). Results of breed recorded no significant differences between local and foreign breeds while in goat recorded 64% higher in local breed compared with Afghani and Shami breeds 54.16% and 50% respectively, while in cattle higher infestation rate in Georgian breed was 45.28%. This may be resulted from the differences in number of specimens and preference of farmers to specific breeds (Table 6). The study results of (30) proved that the susceptibility of different sheep breeds was due to many factors affected by poor feeding, poor management, body condition and climatic factor (31).

Table (6): Lice infestation rates in ruminants according to breed.

Host Type	Breed	No. examined	No. infested	Infestation rate %	Total
Sheep	Local	665	335	50.5% a	(590/1170) 50.43%
	Turkish	300	150	50% a	
	Iranian	205	105	51.21% a	
Goat	Local	200	128	64% a	(268/470) 57.02%
	Afghani	120	65	54.16% b	
	Shami	150	75	50% b	
Cattle	Local	170	60	35.2%a	(220/545) 40.37%
	Turkish	110	40	36.36%a	
	Georgian	265	120	45.28%b	

According to the location, the study revealed that in sheep, the highest infestation rate was in Al-Shura 55% and the lowest in Nineveh Plain 40%; in goats was in Bazwaya 88.33% and the lowest was 47.3% in Gojjali 47.3%, in cattle the highest infestation rate was in Izhilila 50% and the lowest in Orta Kharab 25%, while in buffaloes the highest infestation rate was recorded in Hawy Al maslagh (right side) 80% and the lowest was 36% in Hammam Al-Alil (Tomb of the slave) as shown in (Table 7). The infestation rate as shown in this study reported significant difference in different areas inside and outside Mosul city depending on the geographical distribution, number and type of animal, environmental and type of management. These differences in rates with different areas in the same animal type due to management and environmental conditions (23).

Table (7): Lice infestation rates in ruminants according to location.

Location of hosts	No. examined	No. infested	Infestation rate %	Total
Sheep				
Al-Mahlabiya (Sitta)	475	250	52.63% b	(590/1170) 50.43%
Bazwaya	130	60	46.15% a	
Gojjali	150	70	46.66% a	
Qayyarah	65	35	53.84% b	
Nineveh Plain	50	20	40% a	
Al-Shura	100	55	55% b	
Tubzawa	100	50	50% b	
Tirawa	50	25	50% b	
Tuwaitla	50	25	50% b	
Goats				
City centre	150	92	61.33% a	(268/470) 57.02%
Gojjali	260	123	47.3% b	
Bazwaya	60	53	88.33% c	
Cattle				
Gojjali	305	115	37.7% b	(220/545) 40.37%
Orta Kharab	40	10	25% c	
Bazwaya	140	65	46.42% a	
Izhilila	60	30	50% a	
Buffaloes				
Hawy Al maslagh (right side)	150	120	80% a	(573/1060) 54.06%
Hammam Al-Alil (Quneitra)	50	38	76% a	
Hammam Al-Alil (Jamasah)	115	70	60.86% b	
Hammam Al-Alil (Tomb of the slave)	250	90	36% c	
Hammam Al-Alil (Quneitra Arabs)	50	35	70% a	
Damerchy Al sagher	200	95	47.5% d	
Badoush Jamasa (right side)	245	125	51.02% d	

The results in (Table 8) showed two species of lice infesting sheep; sucking lice L. ovillus and biting lice D. ovis, while in goat there were 2 species of louse; sucking lice Linognathus spp. and biting lice Damalina capri; the biting lice species Damalina bovis is recorded in cattle while the sucking lice species Haematopinus tuberculatus is recorded in buffalo (Figures 4-7). In sheep the study identified both types of lice sucking lice Linognathus spp. and biting lice Damalina ovis, while in goat; sucking lice Linognathus spp. and biting lice Damalina capri. In Mosul similar findings were recorded

by researchers (10) in goats Linoganthus stenopsis, Damalinia caprae in goats, while in sheep Damalinia ovis. In a study Kurdistan-Iraq (19) recorded the sheep, the blue lice Linognathus africanus 35.58%, 24.11% with Damalina ovis. In goats, Damalinia caprae and Linognathus africanus. Another study (32) in Iraq has also reported five species of sheep lice in the Mosul of which Linognathus africanus and Damalina ovis; whereas other researchers (20) described presence of sheep infestation with Damalina ovis, Linognathus stenopsis while goats were infested with both species respectively. Also (20) reported two lice species in sheep namely Damalina ovis and Linognathus stenopsis, and two species of goat, Damalina caprae and Linognathus stenopsis. A morphological study of goat external parasites in Erbil - Iraq, the study of (33) diagnosed Damalina caprae and Linognathus africanus from goats. Lice species infesting cattle is only biting lice Damalina bovis, while the sucking lice species Haematopinus tuberculatus is recorded in buffalo.

Table (8): Species of lice detected in infested ruminants.

Animal species	Sucking lice	Biting lice
Sheep	*Linognathus* spp.	*Damalina ovis*
Goat	*Linognathus stenopsis*	*Damalina capri*
Cattle		*Damalina bovis*
Buffalo	*Haematopinus tuberculatus*	

Figure (4): Linognathus spp. infestation in sheep.

Figure (5): Damalina ovis infestation in sheep

Figure (6): Damalina bovis (Cattle biting lice)

Figure (7): Haematopinus tubercalatus (buffalo sucking lice) holding buffalo hair.

Conclusion

Lice infestation rate in ruminant is highly significant especially in goat, buffalo. Sheep were infested Linognathus spp. and Damalina ovis. Goats were infested with Linognathus spp. and Damalina capri. Cattle was infested with the Damalina bovis, while Haematopinus tuberculatus in buffalo. Highest infected rates were recorded in winter. Age more than three years recorded higher infestation rate.

Acknowledgement

The researchers would like to express their sincere gratitude to the Dean of College of Veterinary Medicine, University of Mosul and to staff of Department of Microbiology for their efforts and support to complete this research.

Conflict of interests

Researchers declare that they have no conflicts in interest regarding the publication of this research.

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