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ECTOPARASITE INFESTATION OF GOATS (CAPRA HIRCUS) IN NORTHERN IRAQ: PREVALENCE AND SPECIES IDENTIFICATION

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ABSTRACT

The study was carried out for eight months from May to December 2020 to identify the main ectoparasite species that infest goats; for this purpose, a total of 150 local goats (Capra hircus) were thoroughly examined for the investigation of ectoparasites from ten small ruminant flocks belonging to five districts of the Sulaymaniyah governorate in northern Iraq. The goats included in the study were determined for preimaginal and adult ectoparasite stages. The observed ectoparasites were collected and preserved separately in containers with 70% ethanol and then brought to the laboratory for identification. The ectoparasite collection was done from the following regions: the ear, shoulder, neck, back, flank, thigh, and groin region. The overall prevalence rate of ectoparasite infestation was 57.33% counting 86 animals. Three different types of ectoparasites including ticks (n = 42; 48.84%), lice (n = 37; 43.02%), and fleas (n = 7; 8.14%), were identified. The higher infestation rate was due to hard ticks (Ixodidae). The identified ticks belonged to five species and Rhipicephalus spp. were widely distributed with the highest reported numbers as follows: Rhipicephalus sanguinaus 14 (16.28%), R. turanicus 11 (12.79%), R. bursa 7 (8.14%), Rhipicephalus (Boophilus) annulatus 4 (4.65%), and Hyalomma anatolicum 6 (6.98%). Two species of lice belonging to sucking lice, Linognathus stenopsis 22 (25.58%) and chewing lice of Bovicola caprae 15 (17.44%), were reported. The only identified flea species from the study was Ctenocephalides canis which was reported in 7 (8.14%). Recognized ectoparasites affect the health status and productivity of goats.

Keywords: - goat, tick, lice, flea, Sulaimani

INTRODUCTION

Ectoparasites cause a significant decline in growth rate and production resulting in reduced income from livestock rearing (Milne *et al.,* 2008). Ectoparasitism is one of the most common problems among livestock; however, it was underestimated in goat farming (Cornall and Wall, 2015). The phylum Arthropoda comprises over 80% of known animal species and exists in almost all habitats. As a consequence of their activity, ecto-parasites may have a variety of direct and indirect effects on their hosts (Wall and Shearer, 2001).

Among the ectoparasites of terrestrial vertebrates, ticks, mites, lice and fleas are more abundant with greater veterinary and zoonotic significance (Durden, 2006, Yakhchali and Hosseine, 2006).

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Phthirapterosis (lice infestation) in goats is a precise entomosis. Lice are considered ~~as~~ permanent ectoparasites with great specificity towards the host. They can be sucking or biting. (Nizamov and Prelezov, 2019). Substantial infestations among goat herds with lice species have been reported from various parts of the world, predominantly during the winter months (Iqbal *et al.,* 2014). Itching and alopecia are the main consequences related to the clinical lice infestation as a result of hypersensitivity reaction of the skin (Ajith *et al.,* 2019). Numerous factors enhance the flaring up of lice infestation in animals, increased herd density, lack of hygiene, low temperature, and high humid weather were among the important factors (Taylor *et al.,* 2007). Moreover, they become vectors, and are capable of transmitting several pathogens, such as viruses, bacteria, protozoa, and fungi to susceptible hosts (Otter *et al.,* 2003).

Fleas (Siphonaptera) are another type of blood-sucking arthropods that infest different hosts including mammals, poultry, reptiles as well as humans (Halos *et al.,* 2014).

Various species of fleas have been stated infesting goats including C*tenocephalides canis, C. felis, C. felis orientis, C. felis strongylus* and *Pulex irritants* (Soundararajan *et al.,* 2018).

Flea infestation is associated with extreme annoyance, irritation, loss of hair, and loss of body weight. As a result, the infested animals become weak and debilitated, with rough coats and lusterless skin. In heavy infestation conditions, there was discoloration of the hairs which become dark brown or reddish colour as a result of blood oozing from the flea's bite injuries (Christodoulopoulos *et al.,* 2006). The consequence was severe anemia and even death in children (Soundararajan *et al.,* 2018). Additionally, sings of restlessness, rubbing, chewing, cutting hairs, excoriations, and lichenification have also been observed (Kaal *et al.,* 2006).

Ticks are the further most nonpermanent ectoparasites (Durden, 2006; Yakhchali and Hosseine, 2006). Hard ticks are a group of arthropods that have a harmful effect on domesticated animals, as well as they transmit some pathogenic agents of serious zoonotic diseases (Kumar *et al.,* 2013).
The premature and adult stages of ticks attack different animal hosts. They feed on their blood and interstitial fluids (Davari *et al.,* 2017), resulting in direct injuries due to their feeding behavior (Ghashghaei *et al.,* 2016). In spite of this, about 10% of the currently known tick species ~~are~~ act as vectors for pathogens of animals and humans (De la Fuente *et al.,* 2008). Since ticks have one or more hosts during their life cycle, they may transmit infections from wild to domestic hosts during their feeding, as they remain infected for their lifetime and transfer the infection through trans-ovarial or trans-stadial transmission (Davari *et al.,*2017). As a result, they considered as a serious threat to animal and public health in several parts of the world (De la Fuente *et al.,* 2008).

Ixodidae family is one of the largest families of parasitic ticks that infest domestic ruminants. At least 13 genera and 650 species of Ixodidae ticks have been identified and reported (Horak *et al.,* 2002).

Deficient prophylactic and therapeutic programms for controling of ectoparasitic invasions, low skill, and bad awareness from the owners of the animals have led to the wide spread of the ectoparasitic infestation among livestock in some regions (Nizamov and Prelezov, 2019). Furthermore, control of ticks and tick-borne diseases is important to protect livestock health and their products (Mullen and Durden, 2009).

Ectoparasite infestations have been reported from different parts of Iraq affecting the health, condition of farm animals and production, while periodic investigations of ectoparasite prevalence and associated risk factors are required, so the study was aimed to find out and identify different types

of ectoparasites infesting goats in Sulaymaniyah governorate northern Iraq.

MATERIALS AND METHODES

Study areas and sampling

The study was conducted from May to December 2020 to identify the main ectoparasite species infesting goats. A total of 150 adult local breed goats (*Capra hircus*) of both sexes were randomly selected from ten small flocks of ruminants belonging to five districts of the Sulaymaniyah governorate, and thoroughly examined for infestation of ectoparasites. The goats included in the study were determined for preimaginal and adult ectoparasite stages.

Ectoparasites Collection and Identification

The lice, fleas and ticks that were found, collected individually with forceps, preserved in containers with 70% ethanol (Urquhart *et al.,* 1996), and brought to the laboratory for identification. Ectoparasite collection was performed from the following regions: ears, shoulder, neck, back, flank, thigh, and groin region.

Species differentiation and identification of collected ectoparasites was conducted microscopically based on the morphological traits for each parasite as described by (Joseph, 1981; Walker *et al.,* 2003) for ticks, (Soulsby, 1982; Wall and Shearer, 2001) for fleas and lice. Based on reference identification keys, ectoparasites were identified to the genus, species, and gender.

RESULTS

The overall prevalence rate of ectoparasite infestation was 57.33% (n= 86) cases. The encountered ectoparasites infesting goats belonged to three different types, including: ticks, lice, and fleas. Among the reported ectoparasites, hard ticks (Ixodidae) were found as the predominant one, and recovered in 42 (48.84%), compared to lice 37 (43.02%) and fleas 7 (8.14%).

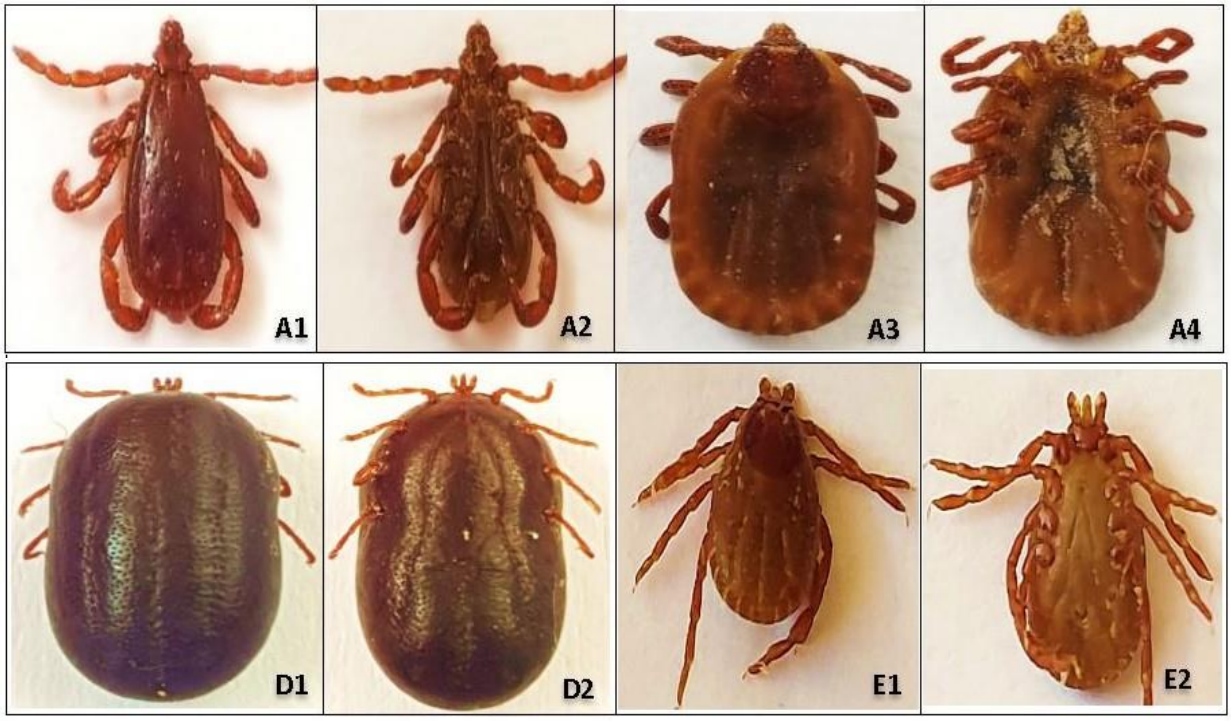
The identified hard ticks belonged to five species. The highest number of recognized and widely distributed tick species were *Rhipicephalus* spp., including: *R. sanguinaus* (14; 16.28%), *R. turanicus* (11; 12.79%), *R. bursa* (7; 8.14%) and *R. (Boophilus) annulatus* (4; 4.65%). Furthermore, *Hyalomma anatolicum* was recovered in (6; 6.98%).

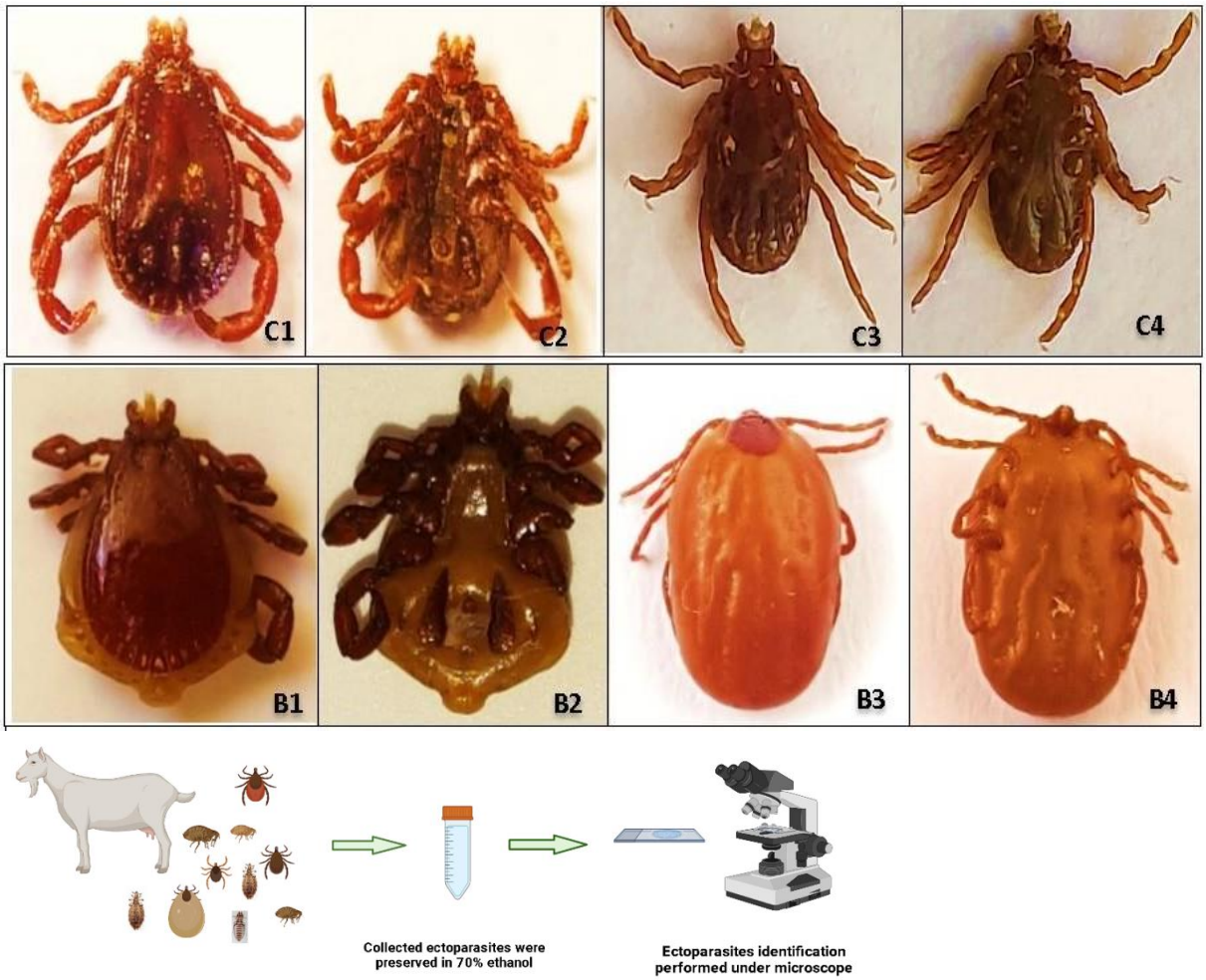
Two species of lice were reported, including sucking lice *Linognathus stenopsis* (22; 25.58%) and chewing lice *Bovicola caprae* (15; 17.44%), and also, a flea species *Ctenocephalides canis* was identified with a prevalence rate of (7; 8.14%) as shown in Table 1.

FIGURE LEGENDS

Figure 1. Photomicrographs of lice and flea species: *Linognathus stenopsis* female, (A) *Bovicola caprae* female (B), *Ctenocephalides canis* male (C) (40 X).

Figure 2. Photomicrographs of tick species *Rhipicephalus bursa* male (A1, A2), female (A3, A4), *Rhipicephalus turanicus* male (B1, B2), female (B3, B4), *Rhipicephalus sanguineus* male (C1, C2), female (C3, C4), *Rhipicephalus (Boophilus) microplus* female (D1, D2), *Hayaloma anatolicum* female (E1, E2) with dorsal and ventral view, respectively.





DISCUSSION

Diseases caused by ectoparasites are among the important aspects that influence the production and productivity of small ruminants (Zewdu *et al.*, 2015). The overall prevalence rate of goat ectoparasites in the study area was 57.33% (86/150). As compatible with the current study, higher ectoparasites infestation rates of 72.8% and 79.9% were reported by Puvarajan, (2017) and Tulu and Urge, (2018), respectively.

The ectoparasites encountered that infested goats were ticks, lice, and fleas. Among the various reported ectoparasites in the current study, ticks were found to be predominant as ecoparasites, which recovered in 42 (48.84%) compared to in lice 37 (43.02%) and in fleas 7(8.14%).

In accordance with the study findings by Iqbal *et al.*, (2014) in Pakistan, who reported a higher prevalence rate of ticks (33.58%) compared to lice (9.58%) and fleas (6.84%). The highest infestation rate of ectoparasites due to tick was also reported (37.8%), followed by fleas (34.4%) and lice (31.2%) by (Tulu and Urge, 2018) from Ethiopia. Furthermore, in another study (Monfared *et al.*, 2015) a higher tick infestation rate was (49.6 %). The ixodid tick species are the most abundant tick parasite that infest ruminants (Sajid *et al*., 2008).

The ectoparasites identified with Ixodidae from the current study belong to five species, including the following: *Rhipicephalus sanguinaus* (14, 16.28%), *R. turanicus* (11, 12.79%), *R. bursa* (7, 8.14%), Rhipicephalus *(Boophilus) microplus* (4, 4.65%) and *Hyalomma anatolicum* (6, 6.98%). Other authors have also identified similar species

of hard ticks in goats with various prevalence rates. In a previous study from northern Iraq, Mustafa, (2019) reported that *R. sanguineous* 28.63%, *R. turanicus* 15.96%, *Rhipicephalus (Boophilus)* spp. 14.16% and *Hy. anatolicum* 31.30%. Also, (Banafshi *et al.,* 2018) reported *R. sanguineus* 60.05%, *R. bursa* 0.08%, and *Hy. anatolicum* 12.33% from the borderline of Iran-Iraq. Furthermore, the common identified tick species reported by Davari *et al.,* (2017) were *R. sanguineus* 43.63.1%, *R. bursa* 28.1% and *R. annulatus* 0.18% from Iran. In agreement with our study, high prevalence rates of *R. sanguineus* 43.2 % and *R. bursa* 41.5 % from Iran were reported (Monfared *et al.,* 2015).

In agreement with our study, *Rhipicephalus* spp. was more prevalent than *Hyalomma* spp. in goats from the middle and southern borders of Iraq (Mohammad, 2016). Similar findings were also reported by (Shemshad *et al.,* 2012; Semu *et al.,* 2012) from Iran and Ethiopia, respectively. This can be attributed to the fact that this genus is considerably resistant to adverse climatic conditions (Shemshad *et al.,* 2012).

In accordance with the current study, both *R. sanguinaus* and *R. turanicus* were also reported with high prevalence rates of 39.93% and 49.54%, respectively compared to *Hy. anatolicun* 13.5% (Zangana *et al.,* 2013). While contrary to the current study findings, higher infestation rates were reported due to *Hy. anatolicum* 28.45% and 20.39% in Iran and Pakistan (Yakhchali *et al.,* 2012; Iqbal *et al.,* 2014), respectively. Moreover, in contrast to our study data, higher infestation rate due to *Boophilus microplus* 27.2% than *R. sanguineus* 7.2% was reported (Puvarajan, 2017).

Rhipicephalus sanguineus is considered as a global tick and is capable of transmitting pathogens such as *Rickettsia rickettsii, Coxiella burnetii, Ehrlichia* spp. and *Anaplasma* spp. (Sarih *et al.,* 2005; Dantas-Torres, 2008), as its activities were extended all over the seasons, although the activity of *R. bursa* was confined during the autumn months (Davari *et al.,* 2017). The present results about identifying different tick species agree with previous reports that goats act as alternative hosts for cattle ticks (Nyangiwe and Horak, 2007; Puvarajan, 2017). Both *R. sanguineus* and *R. bursa*, were among the reported tick species that parasitized cows and goats (Shemshad *et al.,* 2012).

Variation in prevalence levels from different studies may be associated with difference in the study season, grazing system, method for appling of chemicals, and animal management, also age, sex, and flock type are considered risk factors (Leul *et al.,* 2020).

Lice were the second identified ectoparasites, which noted in 37 animals (43.02%). High prevalence rate of lice infestation 53% was also reported in Algeria (Meguini *et al.,* 2018). Both sucking lice *Linognathus stenopsis* and chewing lice *Bovicola capriae* were detected with prevalence rates of 22 (25.58%) and 15 (17.44%), respectively. *L. stenopsis* was also found to be the second most prevalent ectoparasite of 25.92% (Leul *et al.,* 2020).

Concerning lice infestation, in contrast to the study findings, higher prevalence rates of chewing lice than sucking lice were reported, including both *B. capriae* and *L. stenopsis*, 80.74% and 19.2% , respectively (Zangana *et al.,* 2013), and 10.97% and 6.22%, respectively, in Iraq (Mustafa, 2019). Similarly, higher prevalence rates of chewing lice than sucking lice were reported in many countries. Yakhchali and Hosseine, (2006) reported *B. capriae* in 71.4% and L. *stenopsis* in 36.1% in Iran. Sarkar *et al.,* (2010) identified *B. caprae* in 20.8% and *L. stenopsis* in 18.4% of infested goats in Bangladesh. As well as Prelezov and Nizamov, (2020) reported 46.6 % and 40% for sucking lice (*L. stenopsis*) and biting lice (*B. caprae*), respectively, in Bulgaria. Such variation in prevalence rates might attributed to various epidemiological risk factors.

Factors such as differences in chemical intervention, stress conditions, feeding and

housing conditions, and quarantine of newly introduced animals may contribute to the fluctuation of lice infestations (Shibeshi *et al.,* 2013). Intestinal parasitism and malnutrition were among the stress factors that enhancing the lice infestation (Pugh, 2002), poor body condtion was another predisposing risk factor (Tulu and Urge, 2018) reported that goats being at risk four times to be infested with ectoparasites compared to good bodycondition goats. Age and sex of infested animals also considered as another risk factor (Sarkar *et al.,* 2010).

Lice have been considered one of the responsible parasites for skin rejection in tanneries due to a skin defect as a result of itching leading to scratching and rubbing due to the feeding behavior of lice (Mulugeta *et al.,* 2010, Mersha, 2013).

Flea was another reported ectoparasite, *Ctenocephalides canis* was the only identified species with an infestation rate of 7 goats (8.14%). The study result represented a higher prevalence rate of lice 37 (43.02%) than fleas 7 (8.14%). A similar finding was also reported by (Zangana *et al.,* 2013), however, Semu *et al.,* (2012) noticed a higher prevalence rate of fleas 11.3% in comparison to lice 9.7%.

Previously, flea infestations were recognized, and a high abundance rate of 30.79% was reported by (Soundararajan *et al.,* 2018). Among the current study's inspected animals, only Ctenocepahlides *canis* was reported with a prevalence rate of 7 (8.14%). However, higher infestation rates of 47.2% and 18.52% for both flea species; *C. canis* and *C. felis* were reported by Zangana *et al.,* (2013) and Leul *et al.,* (2020) in Iraq and Ethiopia, respectively. However, both *C. felis* and *C. canis* were reported with low prevalence rates of 4.35% and 2.48%, respectively, in Pakistan (Iqbal *et al.,* 2014).

Incompatibility in the prevalence rates of *Ctenocephalides* spp. reported by different authors may be due to differences in management, agroecological, and climatic conditions (Leul *et al.,* 2020). Variation in ectoparasitic prevalence rates depends on several environmental, host, and parasite-related factors like, climate, hygiene, age, sex, host immune status, parasite biology, etc. (Taylor *et al.,* 2007). Differences in the chemical application method, geographical differences, season, grazing system, and animal management were other related factors (Leul *et al.,* 2020). According to the reports of Madeira *et al.,* (2000) and Mulugeta *et al.,* (2010), the prevalence of ectoparasites was higher in large flock size than in small flock size, because in large flock sizes there is an overcrowding and constant contact between small ruminants for prolonged times which enhances ectoparasites' spread from infected to uninfected animals.

CONCLUSIONS

In view of the results of the present study, it has been confirmed that goats became infested with different ectoparasite species in spite of conducting the ectoparasite control programme under traditional husbandry practices. Ticks were the predominant ectoparasites affecting goats. *R. sanguinaus, R. turanicus, R. bursa, Rhipicephalus (Boophilus) microplus* and *Hy. anatolicum* were the important tick species identified in this study. lice belong to *L. stenopsis* and *B. capre* were the second most important reported ectoparasite, followed by *C. canis* flea.

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الإصابة بالطفيليات الخارجية للماعز (hircus Capra) في شمال العراق: الانتشار وتحديد الأنواع

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اجريت هذه الدراسة خلال ثمانية أشهر من مايس إلى كانون الاول ٢٠٢٠ لتحديد أنواع الطفيليات الخارجية الرئيسية التي تصيب الماعز ولهذا الغرض تم فحص ما مجموعه ١٥٠ ماعزًا محليًا (*Capra hircus*) بدقة للتحري عن الخمج بالطفيليات الخارجية في عشرة قطعان من المجترات الصغيرفة تنتمي إلى خمس مناطق من محافظة السليمانية شمال العراق. حيث تم تحديد الماعز المشمولة في الدراسة لمراحل الطفيليات الخارجية قبل البلوغ وللمراحل البالغة.كما تم جمع القمل والبراغيث والقراد التي تم العثور عليها بشكل فردي بالملقط وحفظت في عبوات تحتوي على ٧٠ % من الإيثانول وإحضرت إلى المختبر لتشخيصها . وقد تم جمع الطفيليات الخارجية من المناطق التالية : الأذن والكتف والرقبة والظهر والجناح والفخذ ومنطقة الفخذ. حيث كان معدل انتشار الخمج الكلي بالطفيليات الخارجية ٥٧,٣٣% ٨٦ حالة. و تم تحديد ثلاثة أنواع مختلفة من الطفيليات الخارجية بما في ذلك القراد ٤٢ (٤٨,٨٤%) والقمل ٣٧ (٤٣,٠٢%) والبراغيث ٧ (٨,١٤%).ووجد بان اعلى معدل للخمج كان بسبب القراد الصلب (Ixodidae).حيث كان القراد التي تم تشخيصها ينتمي إلى خمسة أنواع وكان نوع القراد *Rhipicephalus* أعلى الانواع المسجلة وعلى النحو التالي: 14(16.28%) *R. sanguinaus* و *turanicus* 11(12.79%) *R. bursa* (8.14%)7 و ٤ (٤,٦٥%) *Rhipicephalus (Boophilus) annulatus* و 6(6.98%) *Hyalomma anatolicum*. كما تم تسجيل نوعين من القمل بما في ذلك القمل الماص من نوع *Linognathus stenopsis*٢٢ (25.58%) وقمل المضغ *Bovicola caprae* 15(17.44%) . وكانت أنواع البراغيث المهيمنة في منطقة الدراسة هي *Ctenocephalides canis* وتم تسجيلها في ٧ (٨,١٤%) حيث تؤثر الطفيليات الخارجية المعروفة على الحالة الصحية وإنتاجية الماعز.