Open Access

Int. J. Trop. Vet. Biomed. Res.
Vol. 8 (2): 1-10; November 2023

www.jurnal.usk.ac.id/IJTVBR
E-ISSN : 2503-4715

A Study on major ectoparasites and associated skin diseases of ruminants in and around Bishoftu Town, Central Ethiopia

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Abstract

A cross-sectional study was conducted from November 2018 to April 2019 to evaluate the occurrence of ectoparasites and associated skin diseases in ruminants in and around Bishoftu town, central Ethiopia. A total of 437 ruminants (216 cattle, 141 sheep, and 80 goats) brought to the open-air Veterinary Teaching Hospital (VTH) of the College of Veterinary Medicine, Addis Ababa University, were sampled using simple random sampling. Accordingly, the occurrence of ectoparasites and associated skin diseases was found to be 59% (258), and out of these animals, 195 (44.6%) were infected with ectoparasites, of which 111 (25.4%) were bovine, 27 (6.2%) were caprine, and 57 (13%) were ovine. The major ectoparasite species identified were *Amblyomma variegatum* (13%), *A. gemma* (0.7%), *A. cohaerens* (1.8%), *A. nymph* (3.2%), *H. truncatum* (2.7%), *Boophilus decoloratus* (6.2%), *Rhipicephalus pulchellus* (1.8%), *R. eversi* (0.7%), *Damalinia ovis* (3%), *Linognatus vituli* (5.5%), P*soroptes* (0.7%), *Demodex bovis* (0.5%), *Ctenocephalides canis* (0.7%) and *Ct. felis* (5.03). On the other hand, the associated skin diseases infesting animals were: 63 (14.4%), lumpy skin disease (0.9%), sheep pox (5.5%), goat pox (5%), dermatophilosis (0.2%), contagious ecthyma in caprine (2.1%), and contagious ecthyma in ovine (0.7%). The findings of the present study suggest that ectoparasites and associated skin diseases in and around Bishoftu are still widespread and economically important constraints for the productivity and use of ruminants. Hence, stringent adherence to the control of ectoparasites and associated skin diseases is required as a responsibility of the concerned government body based on professional research results in the study area.

Keywords: Associated skin diseases, Ectoparasite, Prevalence, Ruminants, Bishoftu, Ethiopia

Citation: Amanuel, S & Getahun, T.K. (2023). A Study on major ectoparasites and associated skin diseases of ruminants in and around Bishoftu Town, Central Ethiopia. *The International Journal of Tropical Veterinary and Biomedical Research*, 8(2), 1-10.

Introduction

Ethiopia is fundamentally an agrarian country whose livelihood depends on plant cultivation and animal husbandry. It has a numerous livestock population with an estimated 70 million herds of cattle, 30.7 million sheep, 30.2 million goats, and 56.53 million poultry (CSA, 2021). This sector provides various functions in Ethiopia as sources of meat, milk, manure, fertilizer, drought power, and employment (Solomon and Authority, 2003). In addition, it contributes 19% of the GDP and 16–19% of the foreign exchange earnings of the country (Alemnesh et al., 2018). Livestock is also a major source of foreign currency through the export of chilled meat, live animals, hides, and skins (Sheferaw et al., 2010). Because of this huge potential, Ethiopia is capable of supplying 16–18 million skins and hides per year for the tanneries within the country (Kabir et al., 2011).

Ectoparasites cause serious economic loss in ruminants through the mortality of animals, decreased production, downgrading, and rejection of skin and hide (Tiki and Addis, 2011; Fentahun et al., 2012). Moreover, they are the most important vectors of protozoan, bacterial, viral, and rickettsial diseases (Radostits et al., 2007). Ectoparasite diseases such as sarcoptic and psoroptic mange, tick, flea, and louse infestation have frequently been reported in Ethiopia, and these are among the threats that result in serious economic loss to the tanning industry and the country as a whole (Yacob, 2014).

Among the ectoparasites infesting cattle, sheep, and goats, ticks are very significant and harmful because of their blood-sucking habits and direct debilitating effect (Taylor et al., 2015). In Ethiopia, there are 47 species of ticks found on livestock, and most of them are important as vectors and disease-causing agents and also have a mechanical damaging (tick bite) effect on skin and hide production (Kassa, 2005).

Lice are one of the common parasites of domestic ruminants. The most common and clinically significant type of lice is the chewing louse. Chewing lice may cause less individual damage than sucking lice, but because they are present in greater numbers, they can cause extremely severe damage. Poor control may be associated with a failure to detect or identify lice infestation in its initial stages, and by the time clinical diagnosis is achieved, the entire herd may be infested (Milnes and Green, 1999).

Mites are an important ectoparasite of livestock with great veterinary and medical significance. Due to their behavior, mites may have a direct or indirect effect on their host. These could be direct (blood loss, skin inflammation, purities, etc.) or indirect (cause disturbance and self-wounding) when present in high density (Taylor et al., 2015). The mites damage the skin, which is usually accompanied by irritation, rubbing, and scratching. On a larger scale, mite infections have a great impact on the local and international trade of animals (Maxie et al., 2007).

Fleas are the most common ectoparasite-causing dermatitis in livestock. The feeding activity of this ectoparasite results in significant blood loss, secondary infestation, pruritus, excoriation, and, in some cases, premature death. A heavy infestation in young animals may cause severe anemia and death (Taylor et al., 2015; Agarwal and Gupta, 2010). From the flea species, *Ctenocephalides felis*, and *Ctenocephalides canis* are frequently recognized in ruminants (Yeruham et al., 1997).

Various skin diseases affecting ruminants are frequently reported from different parts of Ethiopia. These different skin diseases are liable for considerable economic losses, especially to the skin and hide export industry, due to various defects, 65% of which occur in the pre-slaughter conditions and are most directly related to the skin and hide rejection because of inferior quality. Apart from quality degradation, skin and hide diseases induce associated economic losses due to reduction of wool quality, meat and milk yield, losses as a result of culling and occasional mortalities, and related costs of treatment and prevention of the diseases. Namely, dermatophilosis, dermatophytosis, photosensitization, lumpy skin disease, contagious ecthyma, and sheep and goat pox have been frequently reported in Ethiopia, which is badly affecting the product, health, and economy of the country (Woldemeskel, 2000; Yacob et al., 2008). Even though several studies have been conducted in the study area, ectoparasites are still a serious problem that causes significant economic losses. Therefore, this study aimed to identify the major ectoparasite prevailing in and around Bishoftu, Ethiopia, and to evaluate the prevalence of ectoparasites and associated skin diseases in ruminants.

Materials and Method

Study Area

The study was carried out in and around Bishoftu. Bishoftu is a town in Adea district, in the east Shoa zone of the Oromia regional state, in central Ethiopia. It is located 47 kilometers south of Addis Abeba on the declivity of Ethiopia's Great Rift Valley. It is situated at 9^{o} N latitude and 40^{o} S longitude, at an altitude of about 1850 meters above sea level. The area receives an average annual rainfall of 600mm (400–800mm). The rainy season is bimodal, with the short rainy season occurring from March to May and the long rainy season beginning from June to September. In addition, the dry season extends from October to February. The mean annual minimum and maximum temperatures are 10.91^{o}C and 29.45^{o}C, respectively (NMSA, 2013). The livestock production system in the area is both intensive and extensive.

Study Animals

The animals used in this study were domestic ruminants: cattle, sheep, and goats. Local and cross-bred animals of both sexes, as well as young and adult age groups, are among those included. According to Aiello and Mays, (1998), lambs and children aged 6 months and under were considered young, while those aged 6 months and older were considered adults. In addition, body condition scores were grouped into poor, medium, and good according to Nicholson and Butterworth, (1986). All the above-mentioned animals were presented to the open-air veterinary teaching hospital (VTH) of the Addis Ababa University College of Veterinary Medicine, which is found in Bishoftu town. The animals presented either with clinical illness seeking medication or for various related services, including pregnancy diagnosis, vaccination, and castration.

Study Design

The study design implemented was cross-sectional. A total of 437 ruminants (216 cattle, 141 sheep, and 80 goats) were examined during the study period from November 2018 to April 2019 to identify the major ectoparasites prevailing in the study area and associated skin diseases. Cattle, sheep and goats presented each day in VTH were sampled using simple random sampling.

Sample Collection and Examination

Sample collection was carried out after the animal was physically restrained, followed by visual inspection and palpation of the head, neck, dewlap, brisket, axillae, belly, prepuce, scrotum, udder, groins, and tail regions. These were performed to search for ectoparasites and lesions on the external body of the animal. Then, a detailed history of the animal, such as address, species, sex, age, body condition, site collection, and laboratory results, was written on a special field registration format prepared for this study.

The ectoparasites encountered during the study period (ticks, lice, and fleas) were collected manually from their sites of attachment. The removal of ticks was performed with great care with the aid of forceps so as to avoid detaching the mouth parts of the ticks, which helps to identify the genus easily. Coat brushing techniques were used for lice collection. Fleas were collected from the infested body parts using saturated gauze soaked in 70% ethanol. Identification of their genus or species was made based on differentiating structures that included the width and length of the head and the combs and spines on the head or legs. The removed ectoparasite from the animal's body was dropped into a labeled universal bottle containing 70 % ethanol for later identification. Forceps were used to remove the collected ectoparasites from the bottle and place them in a Petri dish. Meanwhile, the Petri dish was placed under a stereomicroscope and examined according to the morphological descriptions given by Soulsby, (1982) and (Urquhart et al., 1996).

For the suspected mange mite infestations, skin scrapings were taken by clipping the hair around the periphery of active lesions in the affected area with a scalpel blade (Urquhart et al., 1996). The skin was squeezed firmly and scraped deeply until blood was drawn. The scrapped materials were transferred to Petri dish and taken for laboratory examination. A few drops of 10% potassium hydroxide were added to the specimen, which was allowed to stand for 30 minutes before being appreciated under a light microscope at 40 x magnifications. By using this method, the mange mites were identified following the procedure outlined by Beyecha et al., (2014).

For the suspected cases of dermatophilosis, scabs, pus, and exudates were collected, and Gram stain smears were made according to the procedures described by Carter and Cole Jr, (2012). Diagnoses of contagious ecthyma and sheep and goat pox are made based on flock history and clinical signs such as lesions around the oral cavity, body, and tail region (Aiello and Mays, 1998).

Sample Size Determination

As previous studies on species identification of ectoparasites in the study

area had not been conducted, the expected prevalence was assumed to be 50%. Therefore, the sample size was calculated at a 50% prevalence rate with a desired precision of 5% and a 95% confidence interval. The desired sample size for the study was calculated using the formula given by Thrusfield, (2005).

$$n = \frac{1.962Pexp\ (1 - Pexp)}{d^2}$$

Noted: Pexp = expected prevalence; d= absolute precision; n=sample size.

Accordingly, a total of 384 cattle, sheep, and goats needed to be sampled. However, the sample size was raised to 437 cattle, sheep, and goats to increase the precision of the study.

Data Analysis

The entire collection of raw data was entered into a Microsoft Excel spreadsheet and coded. For statistical analyses, R version 4.01 software packages were used. A percentage was used to calculate the prevalence. Additionally, chi-square was used to measure the degree of association between risk factors and the prevalence of ectoparasites and associated skin diseases. In the analysis, a difference was taken as significant at a p-value less than 0.05, and the confidence level was held at 95%.

Results and Discussion

The Occurrence of Ectoparasite

Out of 384 animals sampled, 258 (59%) were infested by ectoparasites and skin diseases. From 216 bovine, 80 caprine, and 141 ovines, 116 (26.5%), 58 (13.3%), and 84 (19.2%) were infected, respectively. From the total infected animals, 195 (44.6%) were infected with ectoparasites, of which 111 (25.4%) bovine, 27 (6.2%) caprine, and 57 (13%) ovine were infested with ectoparasites. Bovine was highly infested with ticks, and local breeds were the most affected with ectoparasites (Table 1).

Species of Ectoparasite

Amblyomma variegatum, Linognatus vituli, Psoroptes, and *Ctenocephalides felis* were the frequently occurring problems of tick, louse, mite and flea species with respective prevalences of 13%, 5.5%, 0.7%, and 5.03% (Table 2).

Overall Prevalence of Associated Skin Diseases

According to our study, 63 (14.4%) cases were caused by associated skin diseases. The result showed that sheep pox was the most common, with a prevalence of 5.5%, and dermatophilosis (0.2%) was the least prevalent problem in the study animals (Table 3).

Species Wise Occurrence of Ectoparasites and Associated Skin Diseases

Ectoparasite species *A. gemma, A. cohaerens, R. eversi, Psoroptes, D. bovis, and C. canis* were isolated only from bovines. Bovine species were not infested with *Damalina ovis.* Caprine species examined for ectoparasites were infested with *A. variegatum, A. nymphs, B. decoloratus, R. pulchellus, Ct. felis, and L. vituli*. Ovine ectoparasites identified were: *A. variegatum, A. nymph, H. truncatum, B. decoloratus, R. pulchellus, R. eversi, D. ovis,* and *Ct. felis* (Table 4).

Occurrence of Ectoparasites and Associated Skin Diseases according to body condition

Most ecto-parasites and other skin diseases were commonly identified from animals with poor body conditions (Table 5).

Discussion

The study revealed that skin diseases caused by ectoparasites in and around Bishoftu town were causing serious problems in the area. Ticks, lice, fleas, psoroptic mange, and demodectic mange were the most common ectoparasites, while dermatophytosis and viral diseases such as lumpy skin disease, contagious ecthyma, and sheep and goat pox skin diseases were encountered in the study area.

The occurrence of ectoparasites in cattle, sheep, and goats was 25.4%, 13%, and 6.2%, respectively. This finding was lower than the findings of Abebayehu et al., (2011), who reported 73.3%, Yacob et al., (2008), who reported 40.2%, and Onu and Shiferaw, (2013), who reported 27.3%, while slightly higher than the findings reported by Yacob et al., (2008b), who reported 15.41%. This difference may be due to the agro-climatic conditions, the health care of the animals, or a lack of regular deworming habits.

On the other hand, in the present study, 13% of the sheep were infested with one or more ectoparasites, which was lower than the prevalence reported by different authors from other regions of Ethiopia: 55.7% by Yacob et al., (2008), 81.5% by Chanie et al., (2010), 99.38% by Abebe et al., (2011) and 78.4% by Fentahun et al., (2012). Variations in geographical locations, seasons, and management practices in the different study areas might have contributed to the disparity in prevalence.

In this study, the major ectoparasites identified were ticks, lice, mites, and fleas, with an overall prevalence of 30.1%, 8.5%, 1.2%, and 0.9%, respectively. It was found that tick infestation (30.1%) was the outstanding ectoparasite in cattle, and the genera identified were Boophilus (6.2%), Rhipicephalus (2.5%), Ambylomma (18.7%), and Hyalomma (2.7%). The genera found were similar to those found by Yacob et al., (2008a) and Abebayehu et al., (2011). The dominance of tick infestation among others is in agreement with the work of Onu and Shiferaw, (2013). The relatively higher prevalence of tick infestation in this study might be due to the humidity and tropical climate that favor the survival and reproduction of ticks.

In the present study, the identified genera of ticks in cattle, goats, and sheep were Amblyomma (56.5%), Boophilus (118.6%), Hyalomma (8.3%), and Rhepicephalus (7.6%). Of these, a higher proportion of Amblyomma (56.5%) and Boophilus (18.6%) were observed in cattle. Moreover, two genera of lice; Linognathus and Damalina, were identified in cattle and sheep, respectively. *Ct. felis* in cattle, sheep, and goats and *Ct. canis* in cattle were also identified. Similar genera of ticks, lice, and mites were identified in different locations of the country by different authors (Yacob et al., 2008; Dawit et al., (2012).

The overall prevalence of major skin diseases in ruminants encountered in the current study was 14.4%. This is comparable with the report of Yacob et al., (2008a), which found 15.41%. According to Woldemeskel and Taye, (2002), dermatophilosis is a treat for livestock production in Ethiopia; 0.2% of cattle were obtained in the study area. The finding was lower than the findings of Kassaye et al., (2003), who reported 5.22%, and Awad et al., (2008), who reported 8.7%. The low prevalence of dermatophillosis may be attributed to agro-climate changes, the season of the study conducted, and the management system of the animal, but in small ruminants' no prevalence was registered in the study period.

Lumpy skin disease was only found in cattle, accounting for 0.9% of the prevalence in the presented study area, which was lower than the previous study of 0.68% conducted at the Adama veterinary clinic by Yacob et al., (2008) and also lower than the study conducted in Wolliso (South West Oromia) by Beshahwured, (1991), which showed a prevalence rate of 27.91%. This is assumed to be a result of the study period, which was not the season of multiplication of flies, which act as mechanical vectors for the virus. Because, in the Ethiopian context, the availability of flies during the spring season exacerbates the viral infection rate of lumpy skin disease as a mechanical vector.

Contagious ecthyma (orf) had a prevalence of 0.7% in sheep and 2.1% in goats at the time of the study, while poxvirus disease had a prevalence of 5.5% in sheep and 5% in goats. These findings were lower than the findings of Yacob et al., (2008) who reported contagious ecthyma in 4.91% of sheep and 9.21% of goats and the poxvirus disease in 8.55% of goats and 8.87% of goats in the Adama veterinary clinic. Hence, the prevalence carried out at Bishoftu Veterinary Teaching Hospital was

less than that of the study conducted at Adama Veterinary Clinic. This may be due to the difference in the climatic conditions of the area. Since contagious ecthyma and sheep and goat pox occur mostly in drought periods.

Conclusion

The presented study concerning ectoparasites and associated skin diseases was undertaken on ruminants, namely, cattle, sheep, and goats. In the study area, ticks, lice, fleas, dermatophillosis, demodectic and psoroptic mange, and viral diseases such as lumpy skin disease, pox virus, and contagious ecthyma were discovered, resulting in the condemnation or downgrading of the quality of hides and skins in tanneries, a reduction in production and productivity, and, in some cases, death. Those resulted in the greatest economic losses to ruminant production and were also subject to secondary infection. The higher prevalence of ectoparasites in ruminants could be due to the government giving less attention to preventing the diseases in terms of campaign immunization before exposure if available and supporting the livestock sector in disease prevention. Unable to use effective acaricide, lack of proper management by the owner, insufficient awareness creation, and education of the owner by veterinarians paved the way for the problem to persist.

Based on the aforementioned idea, the following recommendations are suggested: 1) Continuous research must be conducted using scientifically sound data to determine the incidence and distribution of various ectoparasites and associated skin diseases to identify which species are veterinary significant in that area, and the responsible body should take immediate action; 2) Ruminant owners should receive education regarding how to dip with conventional acaricides, maintain a clean ruminant barn, and isolate an infected host; 3)To perform effectively, strict adherence to the control of ectoparasites and associated skin diseases is required as a responsibility of the concerned government body based on professional research results on the study area.

Authors' contributions

Samson Amanuel has recorded all the laboratory and survey data, and compiled and written the fwrite-upe up of the paper. Temesgen Kassa contributes through data analysis and edition.

Conflict of Interest

The authors declare that they have no conflict of interest.

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Tables

Table 1: Occurrence of Ectoparasite

Factors	Variables	Tick (%)	Fleas (%)	Lice (%)	Mite(%)	X^2-value	P-value
Species	Bovine	85(65.9)	2(8)	20(54.1)	4(100)	42.59	**0.000**
	Caprine	17(13.2)	6(24)	4(10.8)	0		
	Ovine	27(20.9)	17(68)	13(35.1)	0		
Sex	Male	100(77.5)	11(44)	14(37.8)	3(75)	32.81	**0.000**
	Female	29(22.5)	14(56)	23(62.2)	1(25)		
Breed	Cross	5(3.9)	0	0	0	2.5	**0.561**
	Local	124(96.1)	25(100)	37(100)	4(100)		
Age	Adult	114(88.4)	12(48)	18(48.6)	3(75)	41.06	**0.000**
	Young	15(11.6)	13(52)	19(54.5)	1(25)		
BCS	Good	23(17.8)	2(8)	1(2.7)	0	46.85	**0.000**
	Medium	71(55)	13()52	6(16.2)	2(50)		
	Poor	**35(27.1)**	**10(40)**	**30(81.1)**	**2(50)**		

Table 2: Species of Ectoparasite

Ectoparasite species	Number Positive	Prevalence (%)
Ticks		
Amblyomma variegatum	57	13
Amblyomma gemma	3	0.7
Amblyomma cohaerens	8	1.8
Amblyomma nymph	14	3.2
Hyalomma truncatum	12	2.7
Boophilus decoloratus	27	6.2
Rhipicephalu spulchellus	8	1.8
Rhipicephaluseversi	3	0.7
Lice		
Damalinia ovis	13	3
Linognatus vituli	24	5.5
Mites		
Psoroptes	3	0.7
Demodex bovis	2	0.5
Fleas		
Ctenocephalides canis	3	0.7
Ctenocephalides felis	22	5.03

Table 3: Commonly occurring associated skin diseases

Skin problems	Positive animals	Prevalence (%)
Lumpy skin disease	4	0.9

Sheep pox	24	5.5
Goat pox	22	5
Dermatophilosis	1	0.2
Contagious ecthyma in ovine	3	0.7
Contagious ecthyma in caprine	9	2.1

Table 4: Occurrence of ectoparasites and associated skin diseases according to species

Ectoparasite species	**Total Positive**	**Animal Species**			**X^2 – Value**	**P-Value**
		Bovine (%)	**Caprine (%)**	**Ovine (%)**		
Ectoparasites						
A. variegatum	57	40(70.2)	1(1.8)	16(25.1)	15.876	**0.001**
A. gemma	3	3(100)	0	0	3.091	**0.251**
A. cohaerens	8	8(100)	0	0	8.338	**0.017**
A. nymph	14	8(57.1)	3(21.4)	3(21.4)	0.77	**0.723**
H. truncatum	12	9(75)	0	3(25)	4.093	**0.33**
B. decoloratus	27	12(44.4)	10(37)	5(18.5)	7.345	**0.024**
R. pulchellus	8	2(25)	3(37.5)	3(37.5)	2.693	**0.263**
R. eversi	3	3(100)	0	0	3.091	**0.251**
D. ovis	13	0	0	13(100)	28.128	**0.000**
L. vituli	24	20(83.3)	4(16.7)	0	14.137	**0.001**
Psoroptes	3	3(100)	0	0	3.091	**0.251**
D. bovis	2	2(100)	0	0	2.056	**0.515**
Ct. canis	3	3(100)	0	0	1.819	**0.459**
Ct. felis	22	1(5)	6(27)	15(68)	2.104	**0.508**
Associated skin diseases						
Lumpy skin disease	4	4(100)	0	0	4.13	**0.0146**
Sheep pox	24	-	-	24(100)	53.311	**0.000**
Goat pox	22	-	22(100)	-	103.37	**0.000**
Dermatophilosis	1	1(100)	0	0	1.025	**0.999**
Contagious ecthyma	**12**	**0**	**9(75)**	**3(25)**	**27.964**	**0.000**

Table 5: Occurrence of Ectoparasite and associated skin diseases according to body condition

Ectoparasite species	**Body condition**					
	No. positive	**Good**	**Medium**	**Poor**	**X^2 – value**	**P-Value**
		No. positive (%)	**No. positive (%)**	**No. positive (%)**		
Ectoparasites						
A. variegatum	57	18(31.6)	28 (49.1)	11(19.3)	27.24	**0.000**
A. gemma	3	0	3(100)	0	2.345	**0.294**
A. cohaerens	8	1(12.5)	4(50)	3(37.5)	0.135	**0.111**
A. nymph	14	0	9(64.3)	5(37.5)	1.972	**4.439**
H. truncatum	12	0	8(66.7)	4(33.3)	1.652	**0.562**
B. decoloratus	27	12(44.4)	10(37)	5(18)	7.345	**0.024**
R. pulchellus	8	2(25)	3(37.5)	3(37.5)	2.693	**0.263**
R. eversi	3	3(100)	0	0	3.091	**0.251**
D. ovis	13	0	12(15.4)	11(84.6)	16.68	**0.001**
L. vituli	24	1(4.2)	4(16.7)	19(79.2)	25.57	**0.000**
Psoroptes	3	0	2(66.7)	1(33.3)	0.40	**0.111**
D. bovis	2	0	1(50)	1(50)	0.44	**0.112**
Ct. canis	3	1(33.3)	0	2(66.7)	1.81	**0.045**
Ct. felis	22	2(9.1)	12(54.6)	8(36.36)	2.10	**0.005**
Associated skin diseases						

LSD	4	0	1(25)	3(75)	3.449	**0.179**
Sheep pox	24	0	7(29.2)	17(70.8)	17.93	**0.000**
Goat pox	22	0	1(25)	3(75)	6.698	**0.033**
Dermatophilosis	1	0	1(100)	0	0.778	**0.132**
Contagious ecthyma	12	0	5(41.7)	7(58.3)	4.479	**0.102**