

EPIDEMIOLOGY AND PATHOLOGY OF ECTOPARASITIC INFESTATIONS IN BLACK BENGAL GOATS IN GAIBANDHA AND MYMENSINGH DISTRICTS OF BANGLADESH

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ABSTRACT

Epidemiology and pathology of ectoparasitic infestations in Black Bengal goats were studied in different areas of Mymensingh and Gaibandha districts, Bangladesh from December, 2006 to November, 2007. A total of 125 Black Bengal goats were examined. Among them 91 (72.8%) were infested with one or more species of ectoparasites. Six species of ectoparasites were identified, of which four species were arachnids, namely *Haemaphysalis bispinosa* (34.4%), *Boophilus microplus* (27.2%), *Rhipicephalus sanguineus* (7.2%), and *Psoroptes cuniculi* (5.6%) and two species belonged to the class Insecta namely *Damalinea caprae* (20.8%) and *Linognathus stenopsis* (18.4%). Overall mean parasitic burden was 2.36±1.49 per square inch of affected area. The highest parasitic burden was recorded in case of *L. stenopsis* (3.93±2.219), followed by *D. caprae* (3.00±2.424), *H. bispinosa* (2.32±1.278), *P. cuniculi* (2.00±1.414), *B. microplus* (1.59±1.098), and *R. sanguineus* (1.33±0.516). Significantly ($p < 0.01$) higher prevalence of ectoparasites was recorded in the rainy season (90%), followed by winter (82.61%), and summer (53.06%). The ectoparasitic infestation was higher in case of kids (82%) and older goats (79.55%) than that of young (51.61%) goats. The female goats (77.63%) were more susceptible than male (65.31%) to ectoparasitic infestation. The prevalence of ectoparasites was higher in Mymensingh (87.5%) than that of Gaibandha region (57.38%). In the present study, pathological lesions produced by ectoparasites were also studied. In *P. cuniculi* infestation, alopecia, rough, dry and leathery skin was found. Microscopically, it was characterized by hyperkeratinization, ulceration, acanthosis and eosinophilic infiltration. In tick infestation, rough, reddened skin and loss of hair were observed. In lice infestation, the skin was red and slightly elevated. The ectoparasites produced pathological lesions on the skin which reduces the value and quality of skin.

Key words: Epidemiology, pathology, ectoparasitic infestation, black bengal goat

INTRODUCTION

There are about 34.5 million goats in Bangladesh (Anon, 2003). Next to Africa (41.3%), the Indian subcontinent has the largest (31.4%) goat population (Anon, 1979). The Black Bengal goat occupies the second position in livestock population and it plays an important role in the rural economy and export trades of Bangladesh. About 97.90% of goats are distributed in rural areas and 2.10% in urban areas (Anon, 1986). Most of these goats belong to indigenous Black Bengal breed. But goat rearing is hindered by various problems, among them parasitism is an important limiting factor in Bangladesh as the climatic condition of the country favors the development and survival of various parasites. Of the parasitic problems, ectoparasitic infestations are commonly seen in goats.

Common ectoparasites of animals are ticks, lice and mites (Nooruddin and Mondal, 1996; Nooruddin and Dey, 1989; Rahman and Mondal, 1985; Huq and Mollah, 1972; Kader and Huq, 1973). They are annoying pests because of their movement over the skin. The damage done by the ectoparasites cause considerable amount of blood loss, irritation and annoyance. As a result, feeding and digestion is hampered that may lead to retarded growth, loss of weight and reduced milk and meat production. The infested goats bite and rub the affected area so that the affected skin becomes abraded. Ultimately myiasis and other infections may occur which might lead to death of the animals (Soulsby, 1982). Ectoparasitic infestations reduce the quality and market value of valuable skin. Besides, ectoparasites transmit various types of deadly pathogens of animals (Soulsby, 1982).

Unfortunately, little attention was paid to the epidemiological factors influencing the prevalence of ectoparasitic infestation in Black Bengal goats and the pathological changes produced by the parasites in Bangladesh. Therefore, the present research work was planned to study the overall prevalence of ectoparasites and the effect of age, sex, seasons and geographic variations on ectoparasitism in Black Bengal goats along with the gross and histopathological changes produced by ectoparasitic infestations in Black Bengal goats.

MATERIALS AND METHODS

Study area

One hundred and twenty five (125) goats were selected randomly from different areas of Gaibandha and Mymensingh districts, Bangladesh during the period of December 2006 to November 2007. Their ages ranged from 15 days to 3.5 years.

Examination of goats

For the collection of ectoparasites and detection of clinical manifestations (dandruff, thickening of skin, abnormal pigmentation, desquamation, ulceration and alopecia) relevant to ectoparasitic infestation, the selected goats were thoroughly investigated by close inspection, digital palpation and parting the hairs. Ectoparasites were counted in per square inches of areas.

Collection, preservation and identification of ectoparasites

Ticks and lice were collected from different parts of the body of the goats by hand picking and by using tools. When required, small camel hair brush dipped in ethanol was used for the collection of ticks and fine black comb was used for the collection of lice. The point of attachment was smeared with ethanol. Adequate precautions were taken to preserve the mouth parts and appendages of the ectoparasites during collection. To collect mites, skin scrapings from the affected areas were collected and the skin scrapings were examined by adding 10% potassium hydroxide (Hendrix and Robinson, 2006). Ticks and lice were preserved in 70% alcohol in clean, well-stopper glass vials. Permanent slides were prepared by following the procedures described by Cable (1957). Ectoparasites were identified according to the keys and descriptions given by Ferris (1951), Roberts (1952), Hoogstraal (1956) and Soulsby (1982).

Study of pathological changes due to ectoparasitic infestations

The goats were examined carefully to detect gross pathological changes, if any. Biopsy materials of the skin were collected from the affected part and fixed in 10% buffered neutral formalin solution for histopathological studies. The well-fixed tissues were processed and stained following the procedure of Luna (1968).

Statistical analysis

Statistical analyses were carried out by using Statistical Package for Social Sciences (SPSS). To determine the susceptibility of different groups of goats to ectoparasitic infestation, odds ratio was calculated according to the formula given by Scesselman 1982.

RESULTS

Among 125 examined goats, 91 (72.8%) (Table 2) were infested with one or more species of ectoparasites. A total of 6 species of ectoparasites were identified, of them 3 were ticks namely *Haemaphysalis bispinosa* (34.4%), *Boophilus microplus* (27.2%), *Rhipicephalus sanguineus* (7.2%), and one was mite, *Psoroptes cuniculi* (5.6%) and 2 were lice such as *Damalinea caprae* (20.8%) and *Linognathus stenopsis* (18.4%) (Table 1, 2). Mean parasitic burden was almost equal in case of *L. stenopsis* (3.93 ± 2.219) and *D. caprae* (3.00 ± 2.424). Relatively low parasitic burden was found in case of *R. sanguineus* (1.33 ± 0.516) infestation.

Prevalence of ectoparasites was lower (51.61%) in young animals (>6 months to 1 year) than that of kids (≤ 6 months), (82%); and older animals (> 1 year), (79.55%). Calculated odds ratio implied that kids were 4.27 times more susceptible to ectoparasitic infestation than young goats. But the older animals were 3.65 times more susceptible than young animals. Results also implies that kids and older animals are almost equally (odd ratio 1.17) susceptible to ectoparasitic infestation. *P. cuniculi* infestation was found only in kids (10%) and young (6.45%) goats but not in adults. *B. microplus* and *H. bispinosa* infestation found more in adult goats than kids and young ones (Table 3).

In this study, prevalence of ectoparasites was slightly higher in females, (77.63%) than males, (65.31%) resulted in 1.84 times more susceptibility of female to ectoparasitic infestations than males. In male goats, prevalence was higher in case of *D. caprae* (30.61%), followed by *L. stenopsis* (24.49%). In female goats, prevalence was higher in case of *H. bispinosa* (42.11%) followed by *B. microplus* (34.21%) (Table 4).

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Table 1. Ectoparasites affecting Black Bengal goats in Bangladesh

Name of parasites	Distribution on host	Gross lesions	Histopathological Lesions
<i>Haemaphysalis bispinosa</i> Neumann, 1897 (Fig. 1) <i>Boophilus microplus</i> Canestrini, 1887 (Fig. 2) <i>Rhipicephalus sanguineus</i> Latreille, 1806 (Fig. 3)	Ear, base of the horn, neck, tail, near the coronary band, interdigital space.	Rough and reddened skin, loss of hair, slightly elevated and skin damage due to rubbing.	No significant changes were observed.
<i>Psoroptes cuniculi</i> Delafond, 1859 (Fig. 4)	Ear, face, neck, hind quarter, ventral abdomen, hindlegs, costal area.	Dermatitis with rough, dry, and lathery skin, alopecia, thickening of skin, in some cases corrugation and presence of dandruff was common.	Hyperkeratosis, acanthosis, eosinophilic infiltration and necrotic lesions.
<i>Damalinea caprae</i> Gurlt, 1843 (Fig. 5) <i>Linognathus stenopsis</i> Burmeister, 1838 (Fig. 6)	Ear, neck, abdominal region, hind quarter, tail of goats.	Red and slightly elevated skin.	No significant changes were observed.

Table 2. Overall prevalence and population density of ectoparasites in Black Bengal goats in Bangladesh

Name of parasites	No. of animals affected (%) N= 125	Parasitic burden	
		Range	Mean±SD
<i>H. bispinosa</i>	43 (34.4%)	1-5	2.32±1.278
<i>R. sanguineus</i>	9 (7.2%)	1-2	1.33±0.516
<i>B. microplus</i>	34 (27.2%)	1-5	1.59±1.098
<i>D. caprae</i>	26 (20.8%)	1-8	3.00 ±2.424
<i>L. stenopsis</i>	23 (18.4%)	1-9	3.93±2.219
<i>P. cuniculi</i>	7(5.6%)	1-4	2.00 ±1.414
Total	*91 (72.8%)	1-9	2.36±1.492

N = Total number of animals examined

Table 3. Effect of age on the prevalence of ectoparasites of goats in Bangladesh

Age of animals	Name of parasites recovered	No. of animals affected (%)	Parasitic burden		Odds ratio
			Range	Mean±SD	
Kids (≤6 months) n=50	<i>H. bispinosa</i>	16 (32%)	1-5	2.5±1.433	Kids vs Young =4.27
	<i>R. sanguineus</i>	4 (8%)	1-2	1.33±0.577	
	<i>B. microplus</i>	13 (26%)	1-5	2.25±1.581	
	<i>D. caprae</i>	11 (22%)	1-8	4.00±3.00	
	<i>L. stenopsis</i>	10 (20%)	2-9	4.71±2.289	
	<i>P. cuniculi</i>	5 (10%)	1-4	2.33±1.528	
	Sub total	*41 (82%)	1-9	2.86±1.73	
Young (>6 months -1 year) n=31	<i>H. bispinosa</i>	6 (19.35%)	1-5	2.5±1.915	Older vs Young =3.65
	<i>R. sanguineus</i>	2 (6.45%)	2	2.00±0.00	
	<i>B. microplus</i>	3 (9.67%)	1	1.00±0.00	
	<i>D. caprae</i>	7 (22.58%)	1-6	2.4±2.074	
	<i>L. stenopsis</i>	5 (16.13%)	1-6	3.00±2.646	
	<i>P. cuniculi</i>	2 (6.45%)	2	2.00±0.00	
	Sub total	16 (51.61%)	1-6	2.15±1.659	
Older (> 1 year) n=44	<i>H. bispinosa</i>	21 (47.73%)	1-4	2.14±1.027	Kids vs Older =1.17
	<i>R. sanguineus</i>	3 (6.82%)	1-1	1.00±0.00	
	<i>B. microplus</i>	18 (40.91%)	1-2	1.25±0.452	
	<i>D. caprae</i>	8 (18.18%)	1-5	2.2±1.643	
	<i>L. stenopsis</i>	8 (18.18%)	1-6	3.4±1.949	
	Sub total	*35 (79.55%)	1-6	2.02±1.012	

n = Total animals examined

SD = Standard deviation

Table 4. Effect of sex on the prevalence of ectoparasites of goats in Bangladesh

Parameters	Name of parasites	No. of animals affected (%)	Parasitic burden		Odds ratio
			Range	Mean \pm SD	
Male N=49	<i>H. bispinosa</i>	11 (22.45%)	1-5	2.71 \pm 1.70	Female vs Male =1.84
	<i>R. sanguineus</i>	3 (6.12%)	1	1.00 \pm 0.00	
	<i>B. microplus</i>	8 (16.33%)	1-4	1.6 \pm 1.342	
	<i>D. caprae</i>	15 (30.61%)	1-8	3.6 \pm 2.57	
	<i>L. stenopsis</i>	12 (24.49%)	1-9	4.38 \pm 2.559	
	<i>P. cuniculi</i>	2 (4.08%)	2	2.00 \pm 0.00	
	Sub total	*32 (65.31%)	1-9	2.55 \pm 1.673	
Female N=76	<i>H. bispinosa</i>	32 (42.11%)	1-4	2.19 \pm 1.123	
	<i>R. sanguineus</i>	6 (7.89%)	1-2	1.5 \pm 0.577	
	<i>B. microplus</i>	26 (34.21%)	1-5	1.59 \pm 1.064	
	<i>D. caprae</i>	11 (14.47%)	1-5	2.14 \pm 1.68	
	<i>L. stenopsis</i>	11 (14.47%)	1-6	3.43 \pm 1.813	
	<i>P. cuniculi</i>	5 (6.58%)	1-4	2.33 \pm 1.528	
	Sub total	*59 (77.63%)	1-6	2.19 \pm 1.297	

N = Total animals examined

Prevalence of ectoparasites was the highest in rainy season (90%) followed by winter (82.61%) and summer (53.06%) seasons (Figure 3). In this study, it was also revealed that goats were 7.96 times more susceptible to ectoparasitic infestations in the rainy season than that of summer season. But in winter season, goats were 4.20 times more vulnerable to ectoparasitic infestations than summer season. On the other hand, in the rainy season goats were 1.89 times more prone to ectoparasitic infestations than in winter season.

In Mymensingh district 87.5% goats were infested with ectoparasites whereas in Gaibandha district the infestation was 57.38%. Goats reared in Mymensingh region were 5.2 times more vulnerable to ectoparasitic infestation than Gaibandha region. Surprisingly, no louse was detected in the goats of Mymensingh district and no tick was detected in the goats of Gaibandha district (Table 5).

Pathological lesions produced by different external parasites

P. cuniculi infestation

The mites were mostly found on the ear, face, hind quarter and abdomen. Affected skin was rough, dry and leathery with loss of hair (alopecia). In some cases, skin was thick with mild to moderate corrugation. Dandruff was common (Figure 7, 8). Histopathological lesions were characterized by hyperkeratosis, eosinophilic infiltration, acanthosis and superficially by the loss of cornified layer associated with aggregation of necrotic cellular debris (Figure 11, 12) (Table 1).

Tick infestation (*H. bispinosa*, *R. sanguineus*, *B. microplus*)

Ticks were found mostly on the external ears on both sides. However, they were also detected on the base of horn, neck, tail and on the interdigital spaces at the level of coronary band. Skin of the affected areas became rough and reddened. Loss of hair (alopecia) was seen in the heavily infested area. The site of attachment was slightly elevated. Sloughing of skin was also observed as a result of rubbing (Figure 9, 10).

Lice infestation (*D. caprae*, *L. stenopsis*)

In lice infestation, the pathological changes were not so pronounced. The site of attachment of lice was red and slightly elevated (Table 1). In some cases, pinpoint hemorrhages were noticed.

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Table 5. Prevalence of ectoparasites in Black Bengal goats in different seasons and geographical locations of Bangladesh

Seasons	Name of parasites	No. of animals affected (%)	Parasitic burden		Odds ratio
			Range	Mean±SD	
Rainy n=30	<i>H. bispinosa</i>	8 (26.67%)	1-4	1.6±1.342	Rainy vs Winter =1.89
	<i>R. sanguineus</i>	3 (10%)	1-2	1.5±0.707	
	<i>B. microplus</i>	6 (20%)	1-3	1.75±0.957	
	<i>D. caprae</i>	8 (26.67%)	1-5	2.00±1.732	
	<i>L. stenopsis</i>	9 (30%)	2-6	4.17±1.835	
	<i>P. cuniculi</i>	5 (16.67%)	1-4	2.33±1.528	
	Sub total	*27 (90%)	1-6	2.23±1.350	
Winter n=46	<i>H. bispinosa</i>	33 (71.74%)	1-5	2.5±1.263	Winter vs Summer =4.20
	<i>R. sanguineus</i>	4 (8.69%)	1-2	1.33±0.577	
	<i>B. microplus</i>	25 (54.35%)	1-4	1.31±0.793	
	<i>P. cuniculi</i>	2 (4.35%)	2	2.00±0.00	
	Sub total	*38 (82.61%)	1-5	1.79±0.878	
Summer n=49	<i>H. bispinosa</i>	2 (4.08%)	2	2.00±0.00	Rainy vs Summer =7.96
	<i>R. sanguineus</i>	2 (4.08%)	1	1.00±0.00	
	<i>B. microplus</i>	3 (6.12%)	2-5	3.5±2.121	
	<i>D. caprae</i>	18 (36.73%)	1-8	3.42±2.609	
	<i>L. stenopsis</i>	14 (28.57%)	1-9	3.78±2.539	
	Sub total	*26 (53.06%)	1-9	2.74±2.423	
Mymensingh n=64	<i>H. bispinosa</i>	43 (67.19%)	1-5	2.32±1.278	Mymensingh vs Gaibandha =5.2
	<i>R. sanguineus</i>	9 (14.06%)	1-2	1.33±0.516	
	<i>B. microplus</i>	34 (53.13%)	1-5	1.59±1.098	
	<i>P. cuniculi</i>	5 (7.81%)	1-4	2.33±1.528	
	Sub total	56 (87.5%)	1-5	1.89±1.105	
Gaibandha n=61	<i>D. caprae</i>	26 (42.62%)	1-8	3.00±2.424	
	<i>L. stenopsis</i>	23 (37.70%)	1-9	3.93±2.219	
	<i>P. cuniculi</i>	2 (3.28%)	2	2.00±0.00	
	Sub total	35 (57.38%)	1-9	2.98±2.321	

n = Total animals examined



Figure 1. *Haemaphysalis bispinosa*, Figure 2. *Boophilus microplus*, Figure 3. *Rhipicephalus sanguineus*, Figure 4. *Psoroptes cuniculi*, Figure 5. *Damalinia caprae* and Figure 6. *Linognathus stenopsis*

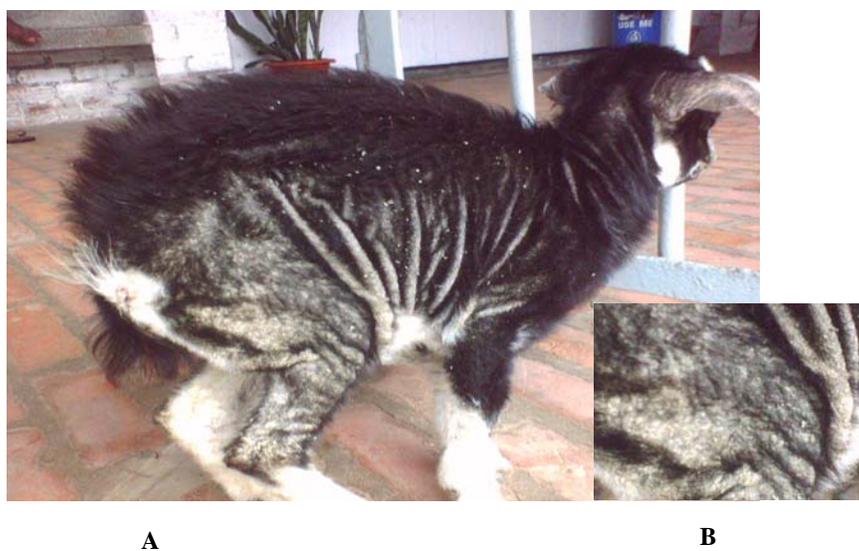


Figure 7(A). Severe infestation with *P. cuniculi* characterized by alopecia, dandruff, thickening and corrugation of skin, (B) higher magnification of the lesions of figure A



Figure 8(A). Ear of goat severely affected with *P. cuniculi*, (B) higher magnification of the lesions of figure A.



Figure 9. Tick affected ear, arrows indicate attachment of tick on the ear



Figure 10. Heavy infestation of ticks on the ear

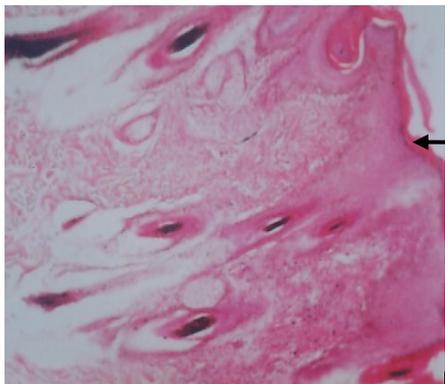


Figure 11. *Psoroptes cuniculi* infestation in the goat characterized by acanthosis and infiltration of inflammatory cells (330x)



Figure 12. Aggregation of necrotic cellular debris in *Psoroptes cuniculi* infestation in the goat (330x)

DISCUSSION

Epidemiological factors affecting the prevalence of ectoparasites in goats

The result of the research work indicates that the Black Bengal goats are very susceptible to ectoparasitic infestation. About 72.8% Black Bengal goats were found to be infested with ectoparasites, of them prevalence of *H. bispinosa* (34.4%), *B. microplus* (27.2%), *D. caprae* (20.8%), *L. stenopsis* (18.4%), *R. sanguineus* (7.2%) and *P. cuniculi* (5.6%) was recorded. Kamal *et al.* (1996) reported that 44.4 % goats were infested with ticks in the hilly area of Chittagong. Rahman and Mondal (1985) recorded *H. bispinosa* (74 %) and *B. microplus* (1.7%) in goats in Bangladesh. Huq and Mollah (1972) detected 36.2 % goats infested with *D. caprae* and *L. africanus*. Kader and Huq (1973) found that 76.3% goats were infested with *H. bispinosa* and *B. microplus* in Bangladesh. Parija *et al.* (1995) observed that 2.22% goats were infested with *Psoroptes* sp. in India. Dalapati and Bhowmik (1995) reported 16.3% infestation with *P. cuniculi* in goats. Kumer *et al.* (1994) recorded 38 % *L. africanus* infestation in goats in India. Chakrabarti (1994) observed 13.4 % *Psoroptes* sp. infestation in goats in India. Pratap *et al.* (1991) found *L. stenopsis* (68%), *B. microplus* (60%) and *R. haemaphysaloides* (52%) in goats in India. The differences among the results of present and earlier studies might be due to variation in the geographical locations, climatic conditions of the experimental area, methods of study and breed of goats.

During the study, it was revealed that age of the goats had a significant ($P < 0.05$) effect on ectoparasitic infestation. Kids (82%) and older animals (79.55%) were more susceptible to ectoparasitic infestation. The prevalence of *Psoroptes* sp. was higher in young goats in India (Chakrabarti, 1994). *L. africanus* infestation was the highest on the kids during the first few months of their lives (Horak *et al.*, 2001). It is very difficult to explain exactly the frequent occurrence of ectoparasitic infestation in kids and older animals. But it may be assumed that the less developed immune system of the kids and exhausted immune system of the older animals may be responsible for the higher prevalence of ectoparasitic infestation in kids and older goats.

The prevalence of ectoparasites was higher in females (77.63%) than in males (65.31%). The prevalence of mange infestation was reported higher in females (29.4%) in India (Chakrabarti, 1994). The prevalence of *L. africanus* in female and male goats and the ratio of female to male was 23:5 in Brazil (Santos *et al.*, 2006). Although the exact cause of higher prevalence of ectoparasitic infestation in female goats can not be explained but it can be assumed that some hormonal influences may be associated with this phenomenon. In fact, higher level of prolactin and progesterone hormones could make the females more susceptible to any infection (Lloyd, 1983). Moreover, stress of production, such as, pregnancy and lactation could have made the female animals more susceptible to infection.

Seasonal fluctuation of the year had a significant ($P < 0.01$) effect on the prevalence of ectoparasitic infestation in Black Bengal goats. A relatively higher infestation with ectoparasites was observed in rainy season (90%), followed by winter (82.61%) and summer (53.06%). Similarly, overall prevalence of ectoparasites was higher in rainy season in Brazil (Brito *et al.*, 2005) and tick infestation was abundant in rainy season in India (Latha *et al.*, 2004) and Botswana (Mushi *et al.*, 1996). In contrast, mite infestation was higher in winter season in goats of India (Parija *et al.*, 1995; Chakrabarti, 1994; Mittal and Mathur, 1998). Overall prevalence of acariasis of goat was reported higher in winter in India (Dalapati and Bhowmik, 1995). The contrast between the present and earlier findings can be explained by the fact of variations in the geographical location of the experimental area, topography and composition of soil type, temperature and humidity. Moreover, in this study, a year was divided into three seasons. But in the other parts of the world, there are four seasons in a year. So, this difference in the division of seasons could have made some overlapping of months and seasons and could have created some contradiction. However, the highest prevalence in rainy season may be due to high humidity, heavy rainfall and keeping the goats in close contact which increase the possibility of contamination.

The ectoparasitic infestation was significantly ($p < 0.05$) higher in Mymensingh (87.5%), than that of Gaibandha (57.38%). This result could not be compared and contrasted due to lack of relevant literature. However, some geo-climatic condition may be associated with this variation.

Pathology produced by external parasites

P. cuniculi

Grossly the *P. cuniculi* infestation was characterized by rough, dry and leathery skin with loss of hair (alopecia). Pathological changes in mite infestation in goats were also described by some other scientists. Dunn (1982a) found psoroptic mange in the ear and the lesions were extended to the poll and to the legs. Wall and Shearer (1997) stated that *P. cuniculi* can cause ear mange in severe infestation and they can block the auditory canal with debris. It also caused irritation, head shaking and scratching as a result the lesions were produced.

Histopathologically the lesions were characterized by hyperkeratosis, acanthosis, eosinophilic infiltration and loss of cornified layer. The lesions caused by *P. cuniculi* may be due to the penetration of epidermis by the parasites resulting local inflammation and exudation of serum.

Ticks and lice

Grossly, the skin was rough, reddened, slightly elevated. There were loss of hair and damage due to rubbing. Similar finding was observed by Wall and Shearer (1997). They found dermatitis, intense irritation, pruritis, and alopecia. Ticks and lice bite animals, suck blood and cause mechanical irritation (Soulsby, 1982).

Ectoparasites are prevalent in Bangladesh and factors like season, age and sex have substantial influence on the prevalence of ectoparasites in goat. Since ectoparasite infestation is associated with production loss, pathological lesions and destruction of valuable skin, further detailed epidemiological investigation is needed to prevent and control the ectoparasites in goats.

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