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Epidemiology and Control of Mange on Goat in Rajshahi District

Rahman, Shaziea

University of Rajshahi

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A DISSERTATION
SUBMITTED TO THE UNIVERSITY OF RAJSHAHI IN FULFILMENT OF THE REQUIREMENT FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

BY
SHAZIEA RAHMAN
Doctor of Veterinary Medicine (DVM)
M.S. in Pathology

DEPARTMEENT OF ZOOLOGY
UNIVERSITY OF RAJSHAHI
RAJSHAHI-6205, BANGLADESH

JULY, 2014

Ph. D.
Thesis

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DEDICATED

TO

MY DEAR HUSBAND
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DECLARATION

I, hereby declare that the entire work presented in this thesis as submitted to the University of Rajshahi, Bangladesh for the degree of Doctor of Philosophy, is based on my original investigation.

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CERTIFICATE

This is to certify that Shaziea Rahman, Assistant Professor, Department of Animal Husbandry and Veterinary Science, University of Rajshahi, Bangladesh has been working under our supervision since July, 2009. We are pleased to forward her dissertation entitled "Epidemiology and Control of Mange on Goat in Rajshahi District" for the degree of Doctor of Philosophy in the Department of Zoology, University of Rajshahi, Bangladesh.

She has fulfilled all the requirements of the regulations relating to the nature and prescribed period of research to submit the present dissertation for the award of degree of Doctor of Philosophy of the University of Rajshahi.

Dr. Bidhan Chandra Das
Supervisor

Dr. Richard Wall
Co-Supervisor

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The author

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ACRONYMS AND ABBREVIATION

BBS	Bangladesh Bureau of Statistics
BHA	Butylated hydroxyl anisole
b.w/BW	Body weight
cm.	Centimeter
DPX	Distrene, Plasticiser, Xylene
df	Degree of freedom
et al.	Association (L. *Et Alia*)
FAO	Food and Agriculture Organization
Fig.	Figure
g.	Gram
GABA	Gama amino Butyric acid
GDP	Gross Domestic Product
HCL	Hydrochloric acid
Hb	Hemoglobin
hr.	Hour
Kg.	Killogram
NA	Not applicable
min.	Minute
ml.	Milliliter
mm	Millimeter

n	Number
OR	Odd Ratio
P	Pearson Chi-squire Test
PCV	Packed cell Volume
Rpm	Rotation per Minutes
S/C	Subcutaneos
SD	Standard deviation
SGOT	Serum glutamatic oxaloacetic transaminase
SGPT	Serum glutamatic pyruvic transaminase
sp.	Species
TEC	Total Erythrocytes Count
Tk.	Taka
TLC	Total Leukocytes Count
UV	Ultra violet
%	Percentage
ºC	Degree Celcius

Abstract

The parasitism is an important limiting factor to rear goats in Bangladesh as the climatic condition of the country favors the development and survival of various parasites. In parasitic problems, mange infestation is common in goats which directly or indirectly reduce their health and productivity. The objectives of this study are to determine the prevalence of mange mite on goat, assess the risk factors and health of goat in Rajshahi in relation to mange infestation and evaluate the economic impact of mange and to find out the alternative measures of mange control especially with herbal products. The study was carried out through questionnaire survey, clinical examination and the experiment of mange control in goats in the study areas of five Upazila namely Boalia, Puthia, Poba, Gudagari and Baghmara of Rajshahi district. In the prevalence study, the relevant data were collected from randomly selected a total of 129 goat rearing farms which consists a total of 1277 goats during the period from July'2010 to June'2011. In the experimental study of mange control, fifteen affected goats of both sexes aged between 10 and 30 months which were divided into five groups randomly and 3 goats were considered in each group. The treatments were considered with control (A), Neem ointment (B), Ata ointment (C), Mehedi ointment (D) and Ivermectin (E). The control experiment was conducted during November'2012 to December'2012. The collected experimental data were analyzed using SPSS Version-15. Association between prevalence and explanatory variables was found using chi-squire (P) test. A descriptive statistical analysis and ANOVA were used for the results of clinical parameters (skin lesion and bodyweight), certain hematological parameters (Hb, TEC, PCV and TLC) and biochemical parameters (SGOT and SGPT). The significant difference was set as ($P<0.05$) and ($P<0.10$) in the prevalence and experimental study, respectively in the analyses. The overall prevalence of mange mite was 5.95 per cent in goats in the study. The highest and the lowest percentages of mange mite prevalence were observed in large farm (9.04%) and small farm (4.13%), poor feeding (8.25%) and good feeding (3.61%), Black Bengal (6.93%) and crossbreed (3.09%), age 3 years and above (8.47%)

and age below 01 year (3.60%), female (6.78%) and male (3.87%), winter season (10.74%) and summer season (2.09%), low land (8.81%) and high land (3.09%), conventional housing system (6.51%) and semi-intensive housing system (2.34%), poor housing condition (8.97%) and good housing condition (3.50%), poor health condition (25.32%) and good health condition (2.03%), temperature below 21^{0}C (8.47%) and temperature 29^{0}C & above (2.76%), rainfall below 50 mm (8.24%) and 50 mm to < 200 mm (3.73%) and humidity below 65% (8.93%) and humidity 65% to < 85% (3.64%), respectively and the prevalence of mange mite was significantly different in each risk factor (P<0.05). The mange mites were the highest frequency on the head region and the lowest were on tail, leg and whole body. The maximum economic loss was incurred in large farm and it was the lowest in small farm. Only one species *Sarcoptes scabiei* was identified through the preparation of permanent slide. The recovery of skin lesion was statistically significant (P<0.10) in all treatment groups except control group (P>0.10). The bodyweight was increased in all treatment groups and it was decreased in control group which was significant (P>0.10). After treatment, Total Erythrocytes Count (TEC million/ cu.mm), Hemoglobin content (Hb gm %), Packed Cell Volume (PCV %) and Total Leukocytes Count (TLC thousand/ cu.mm) of blood was increased in all treatment groups except control group which were significant (P<0.10) and the SGOT and SGPT of blood were decreased in all treatment groups except control group which were significant (P<0.10). From the prevalence study, it may be concluded that this study quantifies the level of mange mite infestation in goats corresponding to the different risk factors which demands immediate control program and more epidemiological study for detail information of the constraints of goat health and production. In the herbal ointments, Neem *(Azadirachta indica*) was more effective for control of mange in goats than Mehidi (*Lawsonia inermis*) and Ata (*Annona reticulata*). The patent drug Ivermectin was very much successful in mange mite infestation than the herbal ointments. Further studies are required to clarify the efficacy of the ethnoveterinary and anthelmintics widely used in agro ecologies, animal species and livestock management system in Bangladesh.

Chapter 1

1 Introduction

Agriculture is one of the main sectors in the economy of Bangladesh. Seventy-five percent of the world's poor people are rural, most are involved in farming, and agriculture remains fundamental in the 21st century for poverty reduction, economic growth, and environmental sustainability (World Bank, 2013). Bangladesh is mainly an agro-based country with an area of 147570 square kilometers accommodating a population of about 140 million people. Bangladesh ranks among the smallest in surface area, eighth in population and one of the highest in population density. The economy of Bangladesh is basically based on agriculture, industry and services. The agriculture sector contributes a major share in GDP, which is about 20.6 per cent and employs about 48.10 per cent of the working force. Services sector is also an important sector in the economy of the country; about 49.67 per cent of the GDP is generated through this sector and the rest by industrial sector (29.73 per cent) (both the sectors engage 37.35 per cent and 14.55 per cent of the work force respectively (BBS, 2009). Again, among the sub-sectoral contributions of agricultural are dominated by crops (56.07 per cent), followed by fisheries (22.18 per cent) and livestock (13.25 per cent) and the rest by forest and related services (8.50 per cent) (BBS, 2010).

Statistics show that about 2.9% of national GDP is covered by the livestock sector, and its annual rate of growth is 5.5%. About 20% of the population of Bangladesh earns their livelihood through work associated with raising cattle and poultry. Livestock population in Bangladesh is currently estimated to comprise 25.7 million cattle, 0.83 million buffaloes, 14.8 million goats, 1.9 million sheep, 118.7 million chicken and 34.1 million ducks (Hefazuddin and Alam, 2014**).**

The goat is a mammal in the genus *Capra*, which consists of several species. Goats are bovid (member of the family Bovidae) and Caprius (sub- family Caprinae). A total of 94 per cent goat population is found in the developing countries. The largest populations are found in Asia and the Pacific and Africa. The goat is mainly important for production of good quality meat, milk, fiber and skin. Presently, the demand for goat meat is in excess of supply, and this has resulted in very high prices for the meat. Generally, goat meat is the highest priced relative to all other meats sold in the market. Goats as suppliers of milk serve a most useful function in producing valuable animal proteins for the rural community. Goat milk and its products are known for its properties regarding the health benefits. A calculation of the nutritional adequacy of goat milk for human infants demonstrated that the supply of protein, calcium. Phosphorus, vitamins A, thiamin, riboflavin and pantothenate are in excess and deficient in iron, vitamin B_{12} and vitamin C. Goat milk also contains a satisfactory balance of essential amino acids and three special attributes of goat milk are worthy of mention. The fat and protein contents are more easily digestible, tubercle bacillus infection is rare and goat milk can be replaced for persons allergic to other milk. The skin of the Black Bengal goat in particular is unique throughout the world. It is highly sought after in the lather trade and tannery industry. The skin is also an important by-product which is a contributing source to the export income. Goats play an important role in complex agricultural system especially by which small farmers earn supplementary income and accumulate capital, create employment particularly for landless peasants, contribute to soil fertility by returning dung and urine to the soil, to local handicraft industries in which their fibers and skin are used extensively (Samad, 2008). More than 90% of goats in Bangladesh are kept by rural people and 10% are kept through urban other folks. Goats are the most adaptable geographically popular farm animal's species rearing from the top altitude of the Himalayas to the deserts of Rajasthan and humid coastal spaces of India. Archaeological evidence indicates that the goat used to be one of the most first animals to be domesticated through humans around 10000 years ago at the down of the Neolithic duration in the Fertile Crescent (Porter, 1996; Pringle, 1998). It has been suggested that at least two wild species of the genus *Capra* have contributed to the gene pool of domestic goats (Joshi *et al.,* 2003). While studies have suggested that an independent domestication in Pakistan government rise to the cashmere breeds (Porter, 1996; Meadow, 1996).

However the origin of the domestic goat remains uncertain and controversial despite the archaeological evidence. Goats rear as a popular ruminant species for household income due to its prolificacy character and higher market value for meat and skin. Chevon (Goat meat) is most popular meat of ruminant species and is accepted by all communities in Bangladesh. According to FAO (2006), the country possesses 35 million goats and produced 182,000 tons of chevon in 2005. Chevon is obtained from goats of different genotypes like Black Bengal, exotic breeds (mainly Sirohi and Beetal) and crossbred goats (cross between Black Bengal and exotic breeds) in Bangladesh (Devendra and Owen, 1983; Das *et al.,* 2001; Moniruzzaman *et al.,* 2002). Goat has been recently recognized as a tool of poverty alleviation. But their production is not sufficient and that is why a few private farmers are initiated cross breeding between the exotic buck (Beetal, Sirohi and Jamunapari) and doe of Black Bengal (Sarder, 2012).

1.1 Variety of Goat

Most of the goats belong to indigenous Black Bengal variety and the rest are crosses of Jamunapari in Bangladesh. Black Bengal is a predominant goat in the country and is famous for its prolificacy, meat and skin quality. Bucks of exotic breeds are being imported privately from India and used for crossbreeding, especially in the western part of the country. The real number of crossbreed goat population is not known; but mostly found in Rajshahi, Pabna, Kustia, Chuadanga, Jinaidah and Jessore district (Faruque and Khandokar, 2007). The crossbred goat is becoming more and more popular to the western part of the country due to their larger body size, more carcass yield and more market prices as compared to Black Bengal goat (Amin *et al.,* 2000). The goat is a prolific animal; twins or triplets are common in kidding. The cheese is worldwide recognized according to its quality (Banerjee, 1980).

1.1.1 Black Bengal Goats

The Black Bengal goats are more than 90% of 35 million goats in Bangladesh which is famous for meat and skin in the world. It is a breed of goats which is found in West Bengal, Bihar, and Orissa regions of northeastern India and throughout Bangladesh. The predominant Black Bengal goat colour is black, brown, gray, tan, but white colour is also found. The goat hair is short soft and lustrous. The back is straight; legs are short, ears (11-15 cm) in size. Both sexes have horns (5.8-11.5 cm), directed upward or sometimes backward. The adult buck's weight ranges from 18-20 kg and that of a doe 14-16 kg. Black Bengal can efficiently survive on available shrubs and trees in adverse harsh environment in low fertility land (Shariarbd.com, 2011). Black Bengal goat is a dwarf animal produces about 6.0 kg carcasses (Abedin *et al.,* 2005). Black Bengal goat is a great source of income for the poor people of Bangladesh. Goat farming has a very important role in reducing unemployment and poverty, increasing meat production and achieving currency from foreign country. The Black Bengal goat breed is very suitable for meat, milk and skin production (Banerjee, 1980).

Fig. 1. Black Bengal Goat

1.1.2 Crossbreed

The Jamunapari is known as the best dairy goat in India. It is also the tallest breed and commonly known as the "Pari" in its area of origin the "home tract" because of its majestic appearance. Its home tract and natural habitat is the Chakarnagar area of the Etowah district in the State of Uttar Pradesh, along the delta of the Jamuna and Chambal rivers, and the Bhind district of the state of Madhya Pradesh along the Kowari river, east of New Dehli and not far from the famous Taj Mahal at Agra. The Jamunapari is well adapted to the unique ravines of this area with its dense bush and shrub vegetation. The Jamunapari seems to have evolved specifically in this environment, as the breed is not found naturally in adjacent areas outside of their home tract (Rout *et al.,* 1999.). This breed has been extensively utilized to upgrade indigenous breed for milk and meat and has been reported to neighboring countries such as Bangladesh, Nepal, Pakistan and Sri Lanka for the same purpose. Pure stock is found in Etowah districts of Uttar province and they are white, brown and gray in colour. Body hair is small and soft but in the back site (hind leg) long hair is present. Ear is longer in size (17-21 cm) and hanging downward. Buck up to 60 kg and doe 40 kg and its yield 1.5-2 litres milk per day. Hybrids are derived from crosses among Jamunapari and Black Bengal. It is smaller than Jamunapari and its colour is black, grey white and tan and hair is small and cushy horn in both sexes. Ear and mouth are longer than Black Bengal. Buck up to 35 kg and Doe 25-30 kg (Shariarbd.com, 2011). However, the main problem to achieve maximum output from this sector is that goats suffer from a number of diseases which ultimate reduce their potentiality.

Fig. 2. Crossbreed goats

1.2 Parasitic Diseases in Livestock

The health of an animal may be affected due to infection by bacteria, virus, mycoplasma, or a parasite. Poor reproductive performances are often associated with failure in conception, infertility, embryonic deaths and abortion, and other gynaecological disorders. A bacterial or viral disease normally kills an animal, whereas parasites are mainly associated with debility and loss of production, although there are ample examples of a parasite killing an animal. Parasitic diseases of major economic importance in livestock include fascioliasis, paramphistomiasis, schistosomiasis, hydatidosis, ascariasis, stephanofilariasis, haemonchosis, oesophagostomiasis and babesiosis. In addition, a number of arthropods, including flies, ticks and mites have economic importance mainly because of their role in the transmission of various disease producing agents, and because they may affect the general health of livestock resources. Pests and parasites of livestock include arthropods, helminths and protozoans, which exploit animals for their nutrition and multiplication. The tropical climate of Bangladesh and poor husbandry methods provide suitable ecological conditions for rapid multiplication and dissemination of a wide variety of pests and parasites. 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). Commonly occurring mites are *Sarcoptes scabiei* De Geer, 1778 and *Psoroptes ovis* Hering, 1838 in sheep, goat and cattle; incidence is moderate, around 10 per cent; more frequent in winter, and are prevalent all over the country (Rahman, 2014). 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 are 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. Ectoparasitic infestations reduce the quality and market value of valuable skin. Besides, ectoparasites transmit various types of deadly pathogens of animals (Soulsby, 1982).

1.3 Mange

Mites are microscopic external parasites that cause mild to chronic skin disease known as “Mange” in a wide range of hosts including domestic, farm and wild animals (Pence and Ueckermann, 2002). The ectoparasitic mites of mammals and birds inhabit the skin, where they feed on blood, skin debris or sebaceous secretions, which they ingest by puncturing the skin, scavenging from the skin surface or imbibe from epidermal lesions. Most ectoparasitic mites spend their entire lives in intimate contact with the host. Infestation by mites is called acariasis and can result in severe dermatitis, known as mange. Mange is a widespread and most important ectoparasitic disease of animals, which may cause significant welfare problems and economic losses (Wall and Shearer, 1997). The transmission of mange mite from host to host is primarily by physical contact and all the three stages: the larvae, the nymph and the adult are capable of migrating and inert materials such as bedding and grooming tools can act as a carrier. Adult mites do not usually survive more than two weeks away from the host, but in optimum conditions, they may remain alive for up to three weeks (Radostits *et al*., 1994).

The major species that cause mange in small ruminants belongs to the four genera of mite, namely *Sarcoptes, Psoroptes, Chorioptes* and *Demodex.* These are described in below.

1.3.1 Sarcoptic Mange

Sarcoptic mange occurs in all species of animal and is caused by mite *S. scabiei* that has a number of host adapted sub species, distinguished by presence or absence of patches of dorsal or ventral spine, that affect different hosts but this host specificity is not complete and transference from one host species to another can occur (Radostits *et al*., 1994). This very contagious disease is spread by direct contact or indirectly by fomites. The causative mite, *Sarcoptes scabiei* var *bovis,* can be transmitted to humans and is a reportable disease. Lesions start on the head, neck, and shoulders and can spread to other parts of the body; pruritis is intense. Papules develop into crusts, and the skin thickens and forms large folds. Sarcoptes may be transmitted to unusual host in which it might borrow in to the skin and set up a typical mange lesion. Sarcoptes mites are economically the most important cause of mange in goats but rare in sheep. Sarcoptic mange in sheep and goats is caused by *Sarcoptic scabei* var *ovis* and *Sarcoptes scabei* var *capri* respectively (Okoh and Gandame, 1992). The life cycle from egg to egg lying female may take 10-14 days (Radostits *et al*., 1994). Sarcoptes mange usually starts on relatively hairless part of the skin and may latter generalize (Bowman and Lynn, 1999). Sarcoptic mange is highly contagious and the spread of *S. scabiei* is usually by close physical contact. As a result single cases are rarely seen in groups of animals kept together. Infestation may also occur by indirect transfer, since the mites have been shown to be capable of surviving off the host for short periods. The length of time that *S. scabiei* can survive off the host depends on environmental conditions but may be between 2 and 3 weeks (Wall and Shearer, 1997). Sarcoptic mange was noticed throughout the year but the incidence was higher during the wet cold months where the moistness and temperature is optimum condition for mite's development (Olubunmi, 1995).

1.3.2 Psoroptic Mange

Psoroptic mang***e***, known as sheep scab, is highly contagious disease of sheep and goats. It is caused by the mite, *P. ovis* in sheep and *Psoroptes cuniculi* Delafond, 1859 in goats. The mite migrates to all part of the skin and prefers areas covered by wool or hair. The whole life cycle is completed in 3 weeks (Soulsby, 1982). Infestation by these mites is always superficial on the epidermis, but the piercing of the skin by the mites lead to exudation and exfoliation, causing scabs to form (Sewell and Brockesby, 1990). In goats, lesions can vary from a dry crusty scab on the external ear canal with no clinical signs to severe lesions covering much part of the body and causing death (Jackson, 1991). Mites are usually more active in winter and the oviposition rate is higher at lower temperatures. The short life cycle can contribute to a very rapid buildup of *P. ovis* populations. Scab mites are spread by direct contact and can survive for a period of up to 10 – 14 days off their hosts (depending on the environmental conditions), allowing clean animals to become infested from contaminated housing (Wall and Shearer, 1997).

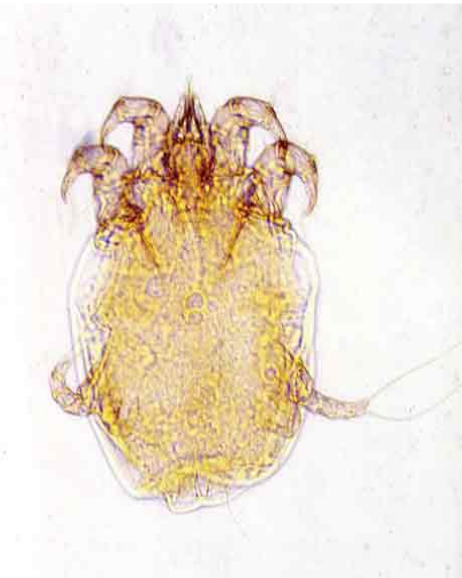


Fig. 3. *Psoroptes cuniculi*

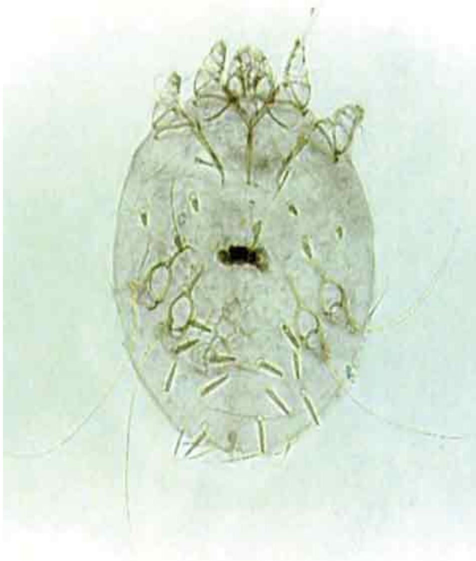


Fig. 4. *Sarcoptes scabiei*

1.3.3 Chorioptic Mange

Chorioptic mange (tail, leg, scrotum mange) those on cattle, horse, and goats and sheep are now considered to be one species; C*horioptic bovis* Hering, 1845 (Radostits *et al*., 1994). The life cycle of *C. bovis* is similar to that of *Psoroptes* sp. and is completed in 3 weeks and transmission is by direct contact and contaminated materials, but *Chorioptes* sp. does not survive of the host for more than a few days (Peter, 1995). In goats, lesions of these conditions are usually confined to lower part of the leg and crusty lesions may be found behind fetlock of all four limbs (Jackson, 1991).

1.3.4 Demodectic Mange

Demodectic mange mites of demodex species infest hair follicles of all species of domestic animals. Demodex live as commensals, embedded head down hair follicle, sebaceous and meibomian glands of the skin where they spend their entire lives. For the most part they are nonpathogenic and form a normal part of the skin fauna. Species of demodex are unable to survive off their hosts (Wall and Shearer, 1997). The disease may also be severe in goats. The important signs of the disease in goats are the appearance of small nodules and pustules which may develop into larger abscesses from which large number of demodex mites may be expressed (Jackson, 1991). The disease spreads slowly and transfer of mite is through contact probably early in life (Radostits *et al*., 1994). Demodectic mange caused by the *Demodex* sp. has been identified from Bangladesh (Rahman, 2006). Most types of mange are forms of allergic dermatitis, characterized by encrustation, alopecia, and purities, initiated and maintained by a number of mite species. All the major mange mite species are contained within the orders Astigmata and Prostigmata. The Astigmata are a well-defined group of slow-moving, weakly sclerotised mites, including the medical or veterinary important families Sarcoptidae and Psoroptidae. The Prostigmata include the Trombiculidae (harvest mites), parasitic as larvae but free-living predators in the nymphal and adult stages, and the true mange mite families Cheletoidea (*Psorobia* , *Psorergates* sp.), Demodicidae (*Demodex* sp.) and Cheyletiellidae (*Cheyletiella* sp.).

Fig. 5. *Chorioptes bovis*

Fig. 6. *Demodex caprae*

1.4 Mange in domestic animals

Mites are the common and pivotal cause of skin diseases in the domestic animal. They can transmit various diseases and can cause hypersensitivity disorders in animals. They may also cause life threatening anemia in young and/or debilitated animals (Araujo *et al.,* 1998).

1.4.1 Mange in Goats

Goats can be infested by several species of mites but the species that are more commonly found on goats are: goat follicle mite (*Demodex caprae*), scabies mite (*S. scabiei*), psoroptic ear mite (*P. cuniculi*), and chorioptic scab mite (*C. bovis*). The goat follicle mite causes dermal papules and nodules and this resulting condition is known as demodectic mange in goats. These papules or nodules are the result of hair follicles or gland ducts becoming obstructed and producing these swellings, trapping the mites within these lesions. These continue to enlarge as the mites multiply, sometimes reaching several thousand mites per lesion. Cases of demodectic mange occur most commonly in young animals, pregnant does, and dairy goats. Papules usually appear on the face, neck, axillary region, or udder. Transmission of the goat follicle mite to newborn goats typically occurs within the first day following birth. Other possible means of transfer are licking and close contact during mingling or mating. Scabies mite burrows into the skin of their hosts causing varying degrees of dermatitis a condition known as sarcoptic mange. Although cases of sarcoptic mange in goats often resolve themselves without developing severe signs, heavily infested goats may exhibit crusty lesions and extensive hair loss around the muzzle, eyes, and ears; lesions on the inner thighs extending to the hocks, brisket, underside, and auxiliary region; dermal thickening and wrinkling on the scrotum and ears; and dry, scaly skin on all parts of the body, especially in areas of hair loss. The psoroptic ear mite or ear mange mite causes lesion on or in the ear of the host animal. These lesions cause crust formation, foul odor discharges in the external ear canal, and behavioral responses such as scratching the ears, head shaking, loss of equilibrium, and spasmodic contractions of neck muscles.

1.5 Justification of the Study

Livestock has an important contribution in economic growth of Bangladesh. It provides draft power, manure, fuel, meat, milk, skin and hides, wools, eggs etc., which meet up the human needs as well as earn the foreign currency. Goat rearing is an integral part of many farming systems in Bangladesh. It provides one of the main sources of income for the farmers of Bangladesh. Meat and skin of goats are valuable wealth of Bangladesh. A part from meeting the internal demand, these also earn foreign exchanges. But the skin is infected and damaged by different viral, bacterial, fungal, parasitic diseases and some non-infectious skin diseases. Parasitic skin diseases of small ruminants are widely distributed in different agro-climatic areas, causing serious economic loss to the farming community, tanning and leather industry at large, seriously hampering the income generation and foreign currency flow to the country. The extent of the problem has increased continuously during the past few years, threatening the small ruminant population, health, production and reproduction that warrant cost effective control measures. However, the main drawback to have maximum output is that goats suffer from a number of diseases which ultimate reduce their potentiality. The common skin parasites of small ruminants are ticks, mange mites, lice and ked. Mange is one of the ectoparasitic skin disease is characterized by hair loss, itching and scabby eruptions in most affected goats. In some cases, humans can also become affected. The mange mites are notorious external parasites of sheep/goats and are responsible for great economic losses due to damaged skin and wool, anemia, poor physical condition, reduced milk and meat production and suboptimal lambing/kidding and growth rates (Fthenakis *et al.,* 2001). In many species of animals, the prevalence of scabies is very high and often causes death if left untreated (Kemp *et al.,* 2002). Scabies may occur in farm animals of any age, especially those kept under poor management. Mites spread through direct contact between goats or from goat to kid while suckling (Schmidt, 1994). It mostly infests goats during winter. As they are highly contagious, heavy infestations can be fatal. Animals can die from dehydration, toxic reactions, secondary infections, or hypothermia due to excessive hair loss (Baniecki and Dabaan, 2000). Sarcoptic scabies not only causes direct economic loss to the farmer through animal mortality and poor growth and reproduction, the skin of mange-infested animals often must be downgraded or rejected at the tannery. This leads to economic losses to the tannery industry and ultimately the country (Mekonnen *et al.,* 1999). Some research studies were done on endoparasites, however, information on ectaparasitic especially mange epidemiology and control in Bangladesh is still poor. In the past there are some research works on endoparasites, however, information on ectoparasites especially mange epidemiology and control in Bangladesh is an infant stage. That's why information on ectoparasites is still poor. Although considerable works have been done in various parts of the world and a very few works on mange prevalence had been conducted in limited parts of Bangladesh (Paul *et al.,* 2012; Rony *et al*., 2010; Barmon *et al.,* 2010; Sarkar *et al.,* 2010; Hassan *et al.,* 2011; Ali *et al.,* 2011; Rahman *et al.,* 2009; Tarafder and Samad, 2010). Unfortunately, little attention was paid to the epidemiological factors influencing the prevalence of mange infestation in goats and the pathological changes produced by the parasites in Bangladesh. But no work has been done on goat mange in Rajshahi district of Bangladesh. Keeping in view the importance of mange, the present study was designed to know the prevalence of mange mite in goats and the relationship between the risk factors (farm size, age, housing condition, sex, breed, season, topography, etc.) of goats and mange along with the gross and histopathological changes produced by mange infestations in goats as well as to evaluate the economic impact of mange and to find out some alternative measures (Neem, Ata, Mehidi and Ivermectin) to control mange and to diagnose mange and isolate the species of mites that cause mange in goats. Accordingly, this study will be helpful for goat management more efficiently in Bangladesh and contributes significant role in the country's development process. The information achieved from this study would certainly increase our present state of knowledge to protect mange mite effectively in Bangladesh.

1.6 Objectives of the Study

The specific objectives of the study are:

i. To find out the prevalence of mange in Rajshahi.
ii. To assess the risk factors and health of goats in relation to mange infestation in Rajshahi.
iii. To evaluate the economic impact of mange.
iv. To find out an alternative measures of mange control especially with herbal products.

Chapter 2

2. Literature Review

This chapter aims at presenting some reviews of literature that is related to the objectives and scope of the present study. Some relevant researches are briefly reviewed in this chapter.

2.1 Review of Studies Related to Epidemiology

2.1.1 Overall Prevalance of Ectoparasites in Livestocks and Other Animals in the World

Aatish *et al.* (2007) studied the prevalence of mange mite infestation of sheep mange. They recorded the prevalence of mange in sheep as 6% and only one species *Sarcoptes scabiei* var. *ovis* was found in India. Sreedevi and Rani (2012) reported that the chorioptic mange in domestic animals, especially in cattle, sheep, horse and rarely in goats Andhra Pradesh of India. Sreedevi *et al.* (2010) reported on infestation with *Psoroptes natalensis* Hirst, 1919 in buffaloes in India. Aziz *et al.* (2013) conducted a study on the prevalence of *Sarcoptes scabiei* var. *caprae* in goats in and around Samina Sadat village of Dera Ghazi Khan District of Punjab province. They divided 300 goats (72 males and 228 females) into four groups depending upon age *viz,* 3-23 (n=128), 22-44 (n=121), 45-65 (n=40) and 66-86 (n=11) months and all goats were examined and 84 goats were infested with *S. scabiei* var. *caprae* showing an overall prevalence of 28%. Kagira *et al.* (2013) carried out a study on the prevalence of ectoparasites and possible risk factors in free-range pig's from135 farms of Busia District, Kenya. In their study, the occurrence of the infestations was associated with age, being highest in sows (*S. scabiei*) and finishers (ticks and *H. suis*). They also reported that male pigs had highest prevalence of *H. suis* and ticks, while female pigs had highest prevalence of *S. scabiei*.

Onu *et al.* (2013) investigated the prevalence and type of ectoparasitic fauna and associated host-related risk factors in cattle in Bench Maji Zone, Southwestern, Ethiopia. They revealed that cattle were infested with single (24.5%) and multiple (2.8%) ectoparasites with an overall prevalence of 27.3%. They identified the seven species of ectoparasites which belong to tick (16.0%), lice (10.4%) and mite (0.9%). *P. bovis* (0.9%) was the only mite species recorded in their study and the prevalence difference was not significant ($p>0.05$). Salifou *et al.* (2013) examined a total of 1,807 small ruminant and found the overall prevalence of scabies 28.33% and 9.5% in animals and smallholders (human cases) respectively and infestations were significantly ($p< 0.001$) more frequent in goats (39.6%) than in sheep. In their study, the very high predictive value of human scabies in infected farms (83.67%) and a very high odds ratio (OR = 2,019.25) indicated that small ruminant scabies were transmitted to smallholders by their animals. Zangana *et al*. (2013) investigated the prevalence of ectoparasites in goats in Iraq. They examined a total of 954 goats in 110 flocks from 80 villages and found that 753 (78.9%) goats were infested with one or more species of ectoparasites. They identified five types of ectoparasites *viz.,* ticks (34.9%), lice (33.8%), mites (0.1%), fleas (7.75%) and ked (4.5%) in goats. Only one goat was infested (0.1%) with *S. scabiei* in their study. Abd-Elrahman and Tanekhy (2012) examined clinically a total of 341 Egyptian buffaloes, aged from 2 to 10 years old to identify the incidence rate, clinical finding, age susceptibility of chorioptic mange besides measuring cell mediated immune response of chorioptic mite infested buffaloes. Al-Shebani *et al.* (2012) conducted a study to investigate the percentages of infestation of mange mites in sheep in different regions of Al-Diwaniyah province and they found the effects of age, sex of animals on the prevalence of the disease. They found the overall percentage of infestation as 3.65%. They recorded mange mites in sheep as *S. scabiei*, *P. ovis*, *Chorioptes* sp. and *Chirodiscoides caviae* (fur mite) with rates 31.18%, 52.15%, 8.06%, 2.15% respectively. Statistically there were no significant differences ($P>0.05$) according to the age and sex of animals, but the differences in percentages of infestation were significant ($p< 0.05$) according to different regions of study.Fentahun *et al.* (2012) conducted a cross sectional study to determine the prevalence and to identify ectoparasites on small ruminants. They considered a total of 384 small ruminants; sheep (n=273) and goats (n=111) in the study and found the overall ectoparasite prevalence as 301 (78.38%) in small ruminants which were infested by single or mixed ectoparasites. They also found that the most common ectoparasites encountered in order of their predominance were lice (54.6%), flea (35.7), tick (20%), sheep ked (10.6%) and mite (7%). They found no statistical significant difference ($P>0.05$) between the species of small ruminants and ectoparasites infestations.

Gakuya *et al.* (2012) carried out a 2-year cross-sectional study of the epidemiology in Kenya and discussed its interaction with sympatric wild (lion, wildebeest and Thomson's gazelle) and domestic (dog, cattle and sheep) animals. They observed that *S. scabiei* was isolated from cheetahs, Thomson's gazelles, wildebeests, lions, cattle, goats and dogs. *Psoroptes ovis,* on the other hand, was only isolated from sheep. The prevalence study revealed the infection rate 4·7% in dogs, 0·8% in sheep, 0·09% in cattle, and 0·09% in goats. Megersa *et al.* (2012) conducted a cross-sectional study on selected camel herds in Borana lowland of southern Ethiopia. They examined a total of 560 camels and found 97.7% and 25.9% infestation with ticks of various species and *Sarcoptes* species respectively. They identified tick species as *Rhipicephalus pulchellus* Gerstäcker, 1873 (69.6%), *Amblyomma gemma* Dönitz, 1909 (12.4%), *Hyalomma dromedarii* Koch, 1844 (10.8%), *Boophilus decoloratus* Koch, 1844 (4.2%), *Amblyomma variegatum* Fabricius, 1794 (2.6%) and *Amblyomma lepidum* Donitz, 1909 (0.4%). Sarcoptes species was the only mange mites observed in their study.

Uttah *et al. (*2012) studied the prevalence and geometric mean intensities of ectoparasites of indigenous goats from Cross River State of Nigeria. They categorized ectoparasites into four major groups, namely, mites, lice, ticks and fleas, identified species as *Rhipicephalus evertsi* Neumann, 1897, *Amblyomma variegatum, Psoroptes communis* Alan R Walker, 2006, *Lignognathus* sp, *Bovicola* sp and *Ctenocephalides felis* Bouché, 1835.

Zeryehun and Mengesha (2012) conducted a study on the prevalence of mange mite of goats, their species composition and associated risk factors in and around Kombolcha, Northeastern Ethiopia. They reported the overall infestation rate of mange mites as 11.7% (41 of 350) and it was 5.1% and 6.6% in and around Kombolcha, respectively which was insignificant difference (P>0.05) in the two study areas. *Sarcoptes* sp. and *Psoroptes* sp. were identified in percentage of 11.78% and 8.57%, respectively, with overall percentage of 20.35%. Infestation by sarcoptic mange mites (57.89%) was recorded to be the most frequent in the examined cases, followed by *Psoroptes* sp. mites (42.10%). They found a significant relationship between prevalence of mange mite infesting buffaloes and season, age, housing management as well as regular or irregular using acaricides.

Asghar *et al.* (2011) inspected a total of 2220 sheep and goats for scabies infection during Hajj season in Saudi Arabia. They found the scabies infection 6.5% in goats the identified species of mite as *S. scabiei*. Eo and Kwon (2010) examined the two male domestic rabbits and identified '*Psoroptes cuniculi'* the ear mite of domestic rabbits in Korea. Kumilachew *et al.* (2010) observed an overall infection rate with mange mites 29.4% and the mites *Sarcoptes* (28%) and *Demodex* (1.42%) were identified. Ahmed *et al.* (2009) conducted a study on (250) Mountain goats (*Capra aegagrus* Erxleben, 1777) in South Baghdad. They found one hundred and fifty goats (60%) infestated with mange. Two genera of mites *Sarcoptes* and *Psoroptes* were identified in the skin scrapings with infestation rates of 38%, 26.7% respectively. Faccini *et al.* (2008) examined the ear cannals of 145 domestic goats for the presence of ear mites in Brazil. They found that the prevalence of *Raillietia caprae* Quintero, Bassols & Acevedo, 1980 was higher than *Psoroptes ovis* Hering, 1838 in their study and it was 62% (90/145) and 4% (6/145) respectively. Nematollahi *et al.* (2007) reported the infestation with *Chorioptes bovis* Hering, 1845 of Holstein cattle in Tabriz of Iran. Tasawar *et al.* (2007) examined a total of 200 sheep (49 males and 151 females) to identify the prevalence of *P. ovis* infection in sheep in Multan of Pakistan. They found 28 sheep infested with *P. ovis* and the overall prevalence as 14%. Yakhchali and Hosseine (2006) carried out a study on ectoparasites of sheep and goats in Iran. They examined a total of 1200 goats and 1200 sheep and found that ticks were the most frequent ectoparasites which belonged to the *Rhipicephalus bursa* Canestrini and Fanzago 1878 (90.7% of sheep and 88.8% of goats), followed by *R. sanguineus* Latreille, 1806 (6.9%), *Boophilus annulatus* Say, 1821 (2.4%), plus *Ornithodoros lahorensis* Lahor kenesi (2.6%). They also observed that all goats were infested with two species, including *R.bursa* (88.8%) and *R. sanguineus* (11.4%).

Sheferaw *et al.* (2010) examined a total of 352 sheep and 376 goats for mange mites infestation in three selected agro-ecological zones of Southern Ethiopia and found positive 7 (1.98%) and 22 (5.85%) in sheep and goats respectively. They identified the genuses of mange mites as *Demodex* (1.23%) and *Sarcoptes* (2.61%) and among these the genus *Sarcoptes* was more prevalent in the study area. The prevalence of mange mites was significantly higher in goats than in sheep (F=7.141, P=0.008) in their study. Iqbal *et al.* (2004) reported an overview of the occurrence of various types of parasites in cattle, buffaloes, sheep, goats and poultry in Pakistan. Rajah *et al.* (2001) carried out a study on buffalo calf infested with Psoroptic and Sarcoptic mites. Demissie *et al.* (2000) determine the extent of mange problems in sheep and goats so as to propose a disease control option. Their findings showed that 87% of sheep and goat mange cases were associated with *S. scabies*, Pangui (1994) said that some forms of mange such as demodectic mange, was the result of underlying diseases or immune suppression.

2.1.2 Prevalance of Endoparasites in Goats in Bangladesh

Hassan *et al.* (2011) studied the prevalence of ectopatasites and endopatasites in semi scavenging black Bengal goat (*Capra hircus* Linnaeus, 1758) in Chittagong district of Bangladesh and observed the overall prevalence of gastrointestinal helminthes in goats as 63.41% (N=317) in which s*trongyloides* sp. (51.74%) was more prevalent and *moniezia* sp. and *capillaria* sp. were least prevalent (n=201). Sultana *et al*. (2013) observed 54.75% the prevalence of natural gastrointestinal nematodes in cattle in Rajshahi district. Khalid *et al.* (2004) studied the overall prevalence of gastro-intestinal nematodes in sheep as 58.18% in Mymensingh.

2.1.3 Overall Prevalence and Population Density of Ectoparasites in Domestic Livestock and Other Animals in Bangladesh

Paul *et al.* (2012) examined a total of 125 goats for the prevalence of ectoparasites in goat in Gaibandha district of Bangladesh and found 72.8% infestation in goats with one or more species of ectoparasites. They identified six species of ectoparasites as *Heamaphysalis bispinosa* Neumann, 1897 (34.4%), *Rhipicephalus sanguineus (*7.2%), *Boophilus microplus* Canestrini, 1888 (27.2%), *Darmalinia caprae* Gurlt, 1843 (20.8%), *Linognathus stenopsis* Burmeister, 1838 (18.4%) and *P. cuniculi* Delafond, 1859 *(*5.6%). Rahman *et al.* (2012) studied a total of 1241 clinical cases (793 cattle and 448 goats) at Patuakhali of Bangladesh. They depicted that the medicinal cases constituted the highest percentage in cattle 84.1% and in goats 81.0%. In case of goats, they recorded the highest cases with digestive disorders (22.9%), followed by parasitic diseases (20.4%) and respiratory disorders (16.8%). Other medicinal cases in goats were eye diseases (13.5%), infectious diseases (11.8%), general systemic states (9.6%), musculo-skeletal disorder (3.3%), skin diseases (0.8%) and nutritional deficiency diseases (0.8%). Ali *et al.* (2011) determine the prevalence and distribution of animal diseases in ruminants in Khagrachari Hill tract of Bangladesh. They commonly found various diseases, in which the percentages of mange were 3.2%. Ali *et al.* (2011) investigate the prevalence and pathology of mite infestation in street dogs at Dinajpur of Bangladesh. They examined a total of 48 street dogs (27 male and 21 female), among them 30 (62.5%) were infested with one or more species of mites and identified the two species of mites as *Sarcoptes scabiei* var. *canis* and *D. canis*. Barmon *et al.* (2010) studied the prevalence of ectoparasites of sheep in Gaibandha district of Bangladesh and examined a total of 120 sheep and among them 95 (79.2%) were infested with five species of ectoparasites in which 3 species were arachnids, such as *Heamaphysalis bispinosa* (16.7%), *Boophilus microplus* (12.5%) and *P. ovis* (5.8%) and 2 species belonged to the class insecta such as *Damalinia ovis* Schrank, 1781 (64.2%), *Linognathus pedalis* Osborn, 1896 (15.8%).

Rony *et al.* (2010) studied the prevalence of ectoparasitic infestation in goat at Gazipur district of Bangladesh. They examined 165 Black Bengal goats as sample and among these, 114 (69.09%) were infested with several species of ticks, lice and flea and observed the prevalence rate higher in *Boophilus microplus* (45.45%) followed by *Rhipicephalus sanguineus* (31.51%), *Linognathus vituli* Linnaeus, 1758 (25.45%), *Heamaphysalis bispinosa* (20%), *Haematopinus eurysternus* Leach, 1815 (15.75%), *Damalinia caprae* (8.48%) and *Ctenocephalides canis* Curtis, 1826 (4.84%). Sarkar *et al.* (2010) studied the epidemiology and pathology of ectoparasitic infestations in Black Bengal goats in Mymensingh and Gaibandha districts of Bangladesh considering a total of 125 Black Bengal goats as sample. They examined all the sample goats and found 91 (72.8%) infested with one or more species of ectoparasites of which four species were arachnids, namely *Heamaphysalis 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 *Damalinia caprae* (20.8%) and *Linognathus stenopsis* (18.4%).

Tarafder and Samad (2010) conducted a study to ascertain the prevalence of clinical diseases of pet dogs presented to the Central Veterinary Hospital (CVH) in Dhaka. They observed the mange prevalence (3.76%) in dog. Rahman *et al.,* (2009) carried out a study on 36 domestic and stray cats (*Felis catus*) of Bangladesh to determine the prevalence and pathology of potential arthropods. They found that the overall 32 (88.89 %) cats had arthropod infestation and the rate of infestation was 86% (31 out of 36), 11% (4 out of 36) and 14 % (5 out of 36) with *Ctenocephalides felis felis* Bouche, 1835, *Demodex cati* and *Linguatula serrata* Fröhlich, 1789 respectively. Slightly higher rate of *Ct. felis felis* infestation was found in kittens (90%) followed by adults (84.61%). Shanta *et al.* (2006) conducted a study on prevalence and clinico-pathological effects of ectoparasites in Patuakhali district and recorded nine species as *Menacanthus stramineus, Menopon gallinae, Lipeurus caponis, Cuclotogaster heterographus, Goniodes gigas and Goniocotes gallinae, Dermanyssus gallinae, Knemidocoptes mutans* and *Simulium* sp. in which *Menacanthus stramineus* was the most common in Bangladesh.

Islam *et al.* (2006) observed the distribution, host preference, and population density of five species *viz., B. microplus, H. bispinosa, R. sanguineus, H. anatolicum, Amblyomma testudinarium* Koch, 1844 in flood plains, hills and steppe Barind in Bangladesh. Nooruddin *et al.* (1987) investigated the occurrence of skin diseases in goats at the Mymensingh, Jessore, Narshingdi and Tangail districts of Bangladesh. They reported that out of 5073 goats, 1361 (26.8%) were affected with either one (89.9%), 2 (8.6%), 3 (1.3%) or 4 (0.1%) types of skin disease that included dermatophilosis (3.8% prevalence), dermatophytosis (2.8%), contagious ecthyma (1.2%), goat pox (0.4%), *seborrhea sicca* (2.1%), sternal alopecia (5.1%), and *Demodex* sp. (0.5%), *S. scabiei* (1.0-%), *P. ovis* (0.2%), *Chorioptes* sp. (2.8%), trombiculid mite (5.7%), tick (1.4%) and lice (2.6%) infestations.

2.1.4 Different Species of Mite Specially Identified in Goats in Bangladesh

One species of mite was identified as *P. cuniculi (*5.6%) Paul *et al.* (2012). Sarkar *et al.* (2010) identified the species of mites in Black Bengal goats as *P. cuniculi* (5.6%). Nooruddin *et al.* (1987) identified the species in goats as *Demodex* (0.5%), *S. scabiei* (1.0-%), *P. ovis* (0.2%), *Chorioptes* (2.8%), trombiculid mite (5.7%).

2.1.5 Different Species of Mites Identified in Other Animals in Bangladesh

Rahman *et al.* (2009) found that the overall 32 (88.89 %) cats had arthropod infestation. The rate of infestation was *D. cati,* 11% (4 out of 36). They examined the sample goats and found 72.8% infested with one or more species of ectoparasites. Barmon *et al.* (2010) examined the prevalence of ectoparasites in sheep and found 95 (79.2%) infested with five species of ectoparasites as *P. ovis* was (5.8%). Sarkar *et al.* (2010) identified the species of mites as *P. cuniculi* (5.6%) in Black Bengal goats in Mymensingh and Gaibandha districts of Bangladesh. Nooruddin *et al.* (1987) reported the occurrence of skin diseases in goats caused by *Demodex* (0.5%), *S. scabiei* (1.0-%), *P. ovis* (0.2%), *Chorioptes* (2.8%), trombiculid mite (5.7%). Ali *et al.* (2011) identified the two species of mites as *Sarcoptes scabiei* var.*canis* and *D. canis* in street dogs.

2.1.6 Effects of Age on the Prevalence of Mange Mite in Goats

The prevalence of *Sarcoptes scabiei* var. *caprae* in goats was highest (54.54%) in age group of 66-86 months and lowest (21.09%) in age groups of 3-23 months and the prevalence difference was statistically significant (P<0.05) (Aziz *et al.*, 2013). . The prevalence of mange infestation was highest in sheep more than two years old (3.74%) and the lowest in sheep with age less than two years old (3.40%) (Al-Shebani *et al.,* 2012). Zeryehun and Mengesha (2012) observed no statistically significant difference (P> 0.05) between the different age and sex groups of goats in mange infestation. The ectoparasitic infestation was higher in case of young (87.3%) and older (73.3%) than in kid (71.4%) in sheep (Barmon *et al.,* 2010).

Rony *et al.* (2010) found that young goats aged ≤ 6 months (75.86%) were more susceptible than adults aged > 6-24 months (65.51%) and older goats > 24 months (59.32%). The ectoparasitic infestation was higher in case of kids (82%) and older goats (79.55%) than that of young (51.61%) goats (Sarkar *et al.,* 2010). Sheferaw *et al.* (2010) also found that the prevalence of mange mites was significantly higher in goats than in sheep (F=7.141, P=0.008) and age ($X2$ =0.108, P=0.743) and sex ($X2$ =0.007, P=0.79) of the host animals had not affected the prevalence of mange mite. Ahmed *et al.* (2009) found that one hundred and fifty goats (60%) were infested with mange and the highest rate of infestation was (58%) in the age of less than 1-2 years old, whereas the lowest rate was 42% in 3-6 years old. The prevalence of mange in sheep as 6% and *Sarcoptes scabiei* var. *ovis* was found higher prevalence in younger animals aging less than six month old (6.9%) (Aatish *et al.,* 2007). Tasawar *et al.* (2007) showed that the prevalence was highest (19.71%) in age group of 1-15 months and lowest (8.33% in age group of 16-30 months and the difference in the prevalence between the two groups was statistically insignificant (P>0.05). The disease affects all age groups and runs a more chronic course in adults than younger animals (Pangui, 1994).

2.1.7 Effects of Sex on Prevalance of Mange Mite in Goats

The prevalence of *S. scabiei* var *caprae* in female hosts was 30.26% versus 20.83% in males and the difference was statistically significant (P<0.05) (Aziz *et al.,* 2013). Al-Shebani *et al.* (2012) observed that the prevalence of mange mites in male sheep was 3.93% versus 3.59% in females. Paul *et al.* (2012) also found that the prevalence of ectoparasites was higher in female (77.6%) than in male (65.3%) goats. Zeryehun and Mengesha (2012) observed the highest level of infestation in female adult goats (9.1 %) than in male adult goats (2.6%). Barmon *et al.* (2010) found the female sheep (88.6%) more susceptible than male (66%) to ectoparasitic infestation. Kumilachew *et al.* (2010) established that the prevalence of mange mites (*Sarcoptes* 28% and *Demodex* 1.42%) were higher in female (31.1%) than male (25.5%) goats. The prevalence of ectoparasitic infestation in goat was higher in female significantly ($p < 0.05$) than male (Rony *et al.,* 2010). Sarkar *et al*. (2010) found that the female goats (77.63%) were more susceptible than male (65.31%) to ectoparasitic infestation in Black Bengal goat in Bangladesh. Sheferaw *et al.* (2010) also observed that the prevalence of mange mites was significantly higher in goats than in sheep (F=7.141, P=0.008) and sex (*X*2 =0.007, P=0.79) of the host animals had not affected the prevalence of mange mite. Tasawar *et al.* (2007) observed that 28 sheep were infested with *P. ovis* and the overall prevalence was 14% in which the prevalence of *P. ovis* in male hosts was 20.4% and 11.92% in female and the difference was statistically insignificant (P>0.05).

2.1.8 Effects of Breed on Prevalance of Mange Mite in Goats

Aziz *et al.* (2013) conducted a study on the prevalence of *Sarcoptes scabiei* var. *caprae* in goats in Dera Ghazi Khan District of Punjab province in Pakistan. Among the three breeds (Nachi, Teddy and Beetle), the highest prevalence (35.48%) was recorded in Nachi while the lowest prevalence (21.55%) was recorded in Teddy and the prevalence difference was statistically insignificant (P>0.05).

2.1.9 Prevalence of Mange Mite in Goats due to Nutritional Status and Housing System

Zeryehun and Mengesha (2012) found that the prevalence of mange mites in poor body conditioned goat (7.4%) was significantly higher than (P<0.05) those of the good body condition (3.1%). Kumilachew *et al.* (2010) observed an overall infection rate of 29.4% of mange mites and the prevalence of mange mites in poor body condition goats was 48% (P<0.05) as compared to moderate body condition (15.5%) goats. Rony *et al.* (2010) also found that animal with poor health was found to be significantly more vulnerable to such parasitic infestation than normal healthy animals. Prevalence of ectoparasites was significantly (p<0.05) higher in animals, reared under free-range system than that of semi-intensive system. Pangui (1994) established that problems with mite infestations and dramatic increases in mite populations occur more commonly in animals in poor condition.

2.1.10 Clinical Signs Produced by Mange Mites in Goats

Ahmed *et al.* (2009) conducted a study on Mountain goats (*Capra aegagrus*) and the clinical signs varied from irregular red spots, scattered in different parts of body to active dermatitis characterized by rough, thick and Keratinzed skin, covered by scales and crusts. They also found the disease intense pruritis with focal alopecia, papules and vesicular which were abundant over the back region. Pangui (1994) reported that the clinical signs of erythema, pruritus and scale or crust formation were due to the inflammatory response of the skin and resulting excoriation.

Demodectic mange in calf was presented with a history of hair fall and reddened skin color and clinical examination revealed scaly, wrinkled, thickened skin, hair fall and a change in skin colour from its normal color to red, and bruises on the face and hind limb (Ravikumar *et al.,* 2009). Goats of 2–3 years of age clinically infested with *C. bovis*. exhibited signs of alopecia, pruritis, crusts, ulcers and chewing at limb region (Sreedevi and Rani, 2012)

2.1.11 Pathological Lesions Produced by Mites in Goats

The pathological lesions produced by ectoparasites and found alopecia, rough, dry and leathery skin in *P. cuniculi* in Black Bengal goats and microscopically characterized *P. cuniculi* infestation as hyperkeratinization, ulceration, acanthosis and eosinophilic infiltration (Sarkar *et al*., 2010). The predominant gross pathologic lesions were crusts and scabs, which mostly occurred because of either degeneration or traumatization as a consequence of an earlier primary lesion or lesions. The lesions were found histopathologically, various epidermal reactions, ranging from hyperkeratosis, parakeratosis, lichenified stratum corneum and acanthosis (Gbolagunte *et al.,* 2009). Giadinis *et al*., 2011 diagnosed the typical of a chronic and generalized-diffuse sarcoptic mange affected goats and demonstrated mites by histopathological examination. Tarigan (2003) studied to compare the histopathological changes in immature and sensitized goats caused by *S. scabiei* infestation. Lesions in the immature goats developed progressively characterized by thick parakeratotic crusts honeycombed with tunnels containing large number of mites and in sensitized goats, which were characterized by copious amount of serocellular exudates in and on the surface of the epidermis, and marked edema and cell infiltrations in the dermis. Dermal infiltration by eosinophils, which was rare in immature goats, was apparently an important feature in the sensitized goats and lesions developed in the sensitized goats were interpreted to be the manifestation of cutaneous anaphylaxis.

2.1.12 Diagnosis of Mange by Means of Skin Scraping Examination

The calf was severe, distinct dermatitis involving the perineal region; elbows and neck were infested with psoroptic and sarcoptic mites which acted upon skin scraping examination (Rajah *et al.,* 2001). The infestation with *C. bovis* of Holstein cattle and the lesions were present around the base of the tail, on the neck and below the knee and they recovered eggs, larvae, nymphs and adult mites by the skin scrapings examination (Nematollahi *et al.,* 2007). One hundred and fifty goats (60%) were found infested with mange in the skin scrapings examinations Ahmed *et al.* (2009). Mange in domestic animals, especially in cattle, sheep, and horse and rarely in goats diagnosed through microscopic examination of skin scraping samples revealed numerous mites of all developmental stages of *C. bovis* in infested goats (Sreedevi and Rani, 2012).

Giadinis *et al*. (2011) identified the typical of a chronic and generalized-diffuse sarcoptic mange in lesions of the affected goats and demonstrated many mites by skin scrapings. Sreedevi *et al.* (2010) reported on infestation with *P. natalensis* Hirst, 1919 in buffaloes in which, skin scrapings were examined and eggs, larva, nymphs and adult mites were recovered. The case was tentatively diagnosed as demodectic mange and was confirmed by finding the mite during microscopic examination of deep skin scrapings of the affected area in calf (Ravikumar *et al.,* 2009)

2.1.13 Prevalance of Ectoparasites in Goats in Different Seasons and Geographical Locations

There were relatively higher infestations with ectoparasites in goats in Gaibandha district of Bangladesh. The study revealed higher infestation with ectoparasites in goats in rainy season (90%), followed by winter (82.6%) and summer (53.1%) Paul *et al.* (2012). Significantly ($p<0.01$) higher prevalence of ectoparasites in sheep in the rainy season (87.9%), followed by winter (80%), and summer (71.4%), Barmon *et al.* (2010). The prevalence of ectoparasitic infestation in goat was the highest ($p<0.05$) in the summer (81.35%) followed by winter (62.96%) and rainy seasons (59.26%) Rony *et al.* (2010). Sarkar *et al.* (2010) observed significantly ($p<0.01$) higher prevalence of ectoparasites in Black Bengal goats in the rainy season (90%), followed by winter (82.61%), and summer (53.06%). Pangui (1994) reported that high temperature, humidity and sunlight favored mange mite infestations. Problems with mite infestations and dramatic increases in mite populations occurred commonly in animals more often seen at the end of winter or in early spring. Sheferaw *et al.* (2010) conducted an epidemiological study of small ruminant mange mites in three selected agro-ecological zones of Southern Ethiopia and found the higher infestation of mange mites in small ruminant in the lowland area ($F=7.463$, $P=0.006$).

2.1.14 Distribution of Mange Mite in Different Anatomical Sites of Goats

Asghar *et al.* (2011) identified the *S. scabiei* as the most common mite species in sheep and goats and it was diagnosed from 34 (54 %), 10 (15.9 %) and 12 (19 %) of examined nostril, ear and nostril and ear of all infested animals, respectively. In their study, *P. communis* and *P. ovis* mites were extracted from 7.9 % of the examined back lesions, while *P. ovis* only were extracted from 3.2 % of the tail lesions of the affected animals.

Mites of *Sarcoptes* (28%) and *Demodex* (1.42%) were identified in goats and detected at highest frequency from head region determined by Kumilachew *et al.* (2010). Ahmed *et al.* (2009) observed the skin lesions clearly in the head, ear neck, tail and back regions. Nematollahi *et al.* (2007) reported the infestation with *C. bovis* in Holstein cattle and the lesions were present around the base of the tail, on the neck and below the knee. Rajah *et al.* (2001) carried out a study on buffalo calf infested with psoroptic and sarcoptic mites and found that the affected calf was severe, distinct dermatitis involving the perineal region, elbows and neck. Sreedevi *et al.* (2010) reported infestation with *P. natalensis* in buffaloes and lesions and it was confined to the neck, shoulders and rump.

2.1.15 Economic Loss in Tannery Industry

Parasitic skin diseases caused by ectoparasites such as mange mites was the threats in serious economic loss of tanning industry and the country as a whole. In their study, tanneries reported 56 per cent of goats' skin was rejected due to external parasites and out of the reject groups of the processed skin, about 80 to 90 per cent defects were believed to be due to external parasites (Tolossa, 2014).

The pathological and leather quality of the skins of goats and sheep with skin diseases, goats and sheep with normal looking skins as controls, were examined after gross assessment and the chrome tanned leathers from the flayed skins were subjected to surface examination for aesthetics and grade. They found the different diseases downgraded leather quality in various manners and marred their aesthetic appeals *viz.* mange (Gbolagunte *et al.,* 2009). An overview of the occurrence of various types of parasites in cattle, buffaloes, sheep, goats and poultry was led in Pakistan. The study revealed that parasitic diseases were responsible for heavy economic losses to livestock industry particularly due to lowered productivity of the affected animals (Iqbal *et al.,* 2004).

2.2 Review of Studies Related to Control Experiment

2.2.1 Herbal Medicine Used for the Control of Mange in Livestock

The traditional treatment of animal diseases was found to be a common practice particularly herbal treatment for a number of diseases and non-inflammatory conditions with herbal Tar (Gutran), Aradaib *(Tamarindus mdica)*, Garad *(Acacia nilotica)* and cauterization (Kai). The trial of treating natural mange infection in donkeys showed that treatment by veterinary drugs (combined drug- mangezal, cypermethrine and ivermectin paste) was most superior followed by the traditional treatment with tar (Gutran) which was considered to be the best alternative for treating mange in animals (Basheir *et al.,* 2012).

There is a documentation of ethno-veterinary practices (EVPs) on parasitic ailments in animals to identify the traditional veterinary healers (n=200) among the local farmers in Pakistan. A total of 35 plants representing 23 families were documented for the treatment of different parasitic diseases. The top 10 most frequently used plants were: *Eruca vesicaria* (n=69), *Azadirachta indica* (n=47), *Citrullus colocynthis* (n=32), *Brassica rapa* (n=25), *Ocimum basilicum* (n=22), *Ferula asafetida* (n=15), *Nicotiana tabacum* (n=13), *Allium cepa* (n=8), *Withania coagulans* (n=8) and *Aloe vera* (n=6).The most frequently reported prescriptions were for the treatment of mange (n=111) followed by helminthiasis (n=63), tick infestation (n=57) and fly infestation (n=39) and the findings indicated richness of the indigenous knowledge and its effective use in treating parasitic diseases prevalent in the area by the local farming communities (Sindhu *et al.,* 2012).

The affected a group of sheep with ear mange was treated with preparation containing 50ml *Azadirachta indica* oil, 50ml *Pogamia pinnata* oil, 25gm Camphor, 50gm Sulphur powder and 500ml coconut oil applied on the affected skin twice a day for 15 days and the another group of sheep was treated with preparation having 50gm of Curcuma longa rhizome and 25gm of *Azadirachta indica* oil applied once a day for 15 days. The first preparation may be found highly effective against ear mange in sheep (Hagawane *et al.,* 2010). The efficacy of SCAVON VET (The Himalaya Drug Company,Bangalore, India,) spray, a polyherbal formulation used in the treatment of demodectic mange in three months old Holstein Freshen calf. This formulation was very effective in treating demodectic mange in calf and very convenient for use in field conditions (Ravikumar *et al.*, 2009). The application of Himalayan cedar wood oil (*Cedrus* *deodara*) in rabbits naturally infested with *P. cuniculi* mites. The mean lesion score in the *Cedrus deodara* oil treated group was significantly lower than the untreated group in the post treatment period and comparable to benzyl benzoate emulsion treated group on day 14 and 21 post treatment (Deepali and Devina, 2012).

2.2.2 Herbal Medicine Used for Ectoparasitic Diseases in Livestock

The treatment of 30 animals with topical herbal gel for maggoted wound of laceration myiasis, FMD myiasis, surgical wound , otitis, incision, dog bite, abscess, pustule, mandible edema, mange and foot rot in clinical cases of cattle of India. Examined of the biochemical profile and bacteriology before and after treatment with gel and the result found that all maggoted wounds due to mange were cleared of maggots (Debnath *et al.,* 2013). The crude extracts of Arand, yellow Kaner and Pudina have adulticidal activity of in natural tick infestation. *In vivo* adulticidal activity on tick population and *in vitro* results revealed that the mortality percentage was higher as the concentration of extract increased and the time internal progresses. The mortality was significantly different ($p<0.5$) at 4 and 24 hrs interval in case of crude extract of Arand, yellow Kaner and Pudina (Kumar *et al.,* 2011).

The efficacy of Ivermectin and Neem plants against ectoparasites in calves was found. The indigenous medicinal plant, Neem leaves shown the efficacy of 68% at day 28. All the calves after Ivermectin injection and Neem spray remained healthy, no adverse effect and calves appetite increased, growth and coat color improved rapidly (Rahman *et al.,* 2009). Another study revealed the effect of indigenous medicinal plant namely Ata (*A. reticulata*) leaves extract upon ectoparasites activity in calves. A significantly high efficacy was recorded in 3% aqueous extract of Ata leaves. So, active ingredients against ectoparasites are more concentrated in Ata leaves (Razu *et al.,* 2010). A lot of allopathic medicines are available for treatment of skin diseases in animals (scabies, bacterial and fungal infection, ulcers, bruises, and sprains, inflammations burns, sore feet, ringworm, eczema, skin eruption, urticaria and infestation of tick, mite, lice and maggots). Herbal formulations are preferred for the safety of both animal and owner of the animal (Sharma and Joshi, 2004).

2.2.3 Herbal Medicine Used for Mange and Other Ectoparasitic Diseases in Goats and Livestock

A study revealed that 70% of the respondents used both modern and traditional medicine, 16.67 % used modern medicine only 10 % used traditional remedies and 3.33% used no medication on their goats in Botswana as ethnoveterinary medicine practice. 13 plant species and other non-plant remedies were commonly used in the treatment of diseases and the control of intestinal parasites in goats and used to treat diarrhea, cough and mange (Setlalekgomo and Setlalekgomo, 2013).

The methanolic extract of *Tecomella undulata G. Don.* with concentrations of 10% and 20% was applied topically on the skin of mange affected camels, buffalos, goats, dogs and people. They found that the topical application of *Tecomella undulata* extract (10 and 20%), Ivermectin (reference compound) and 100% methyl alcohol (control) on scabies affected goats 58%, 73%, 81% and 5% protection respectively after five weeks. The effect of *Tecomella undulata* extract with three different concentrations (i.e. 10%, 20%, and 30%) to know the duration to be taken to kill *S. scabiei* using *in vitro* laboratory test and findings revealed that 10%, 20% and 30% concentrations of *Tecomella undulata* extract caused 45%, 65%, and 80% mortality of the *S. scabiei* mites, respectively (Khan *et al.,* 2013).

Another study revealed the comparative efficacy of indigenous medicinal plants, dadmardan (*Cassia alata*) and neem (*A. indica*) against skin lesions (ringworm, scabies, humpsore, wounds) in calves and goats. The calves and goats were treated with dadmardan ointment cured at 30th days of treatment in calves and at 27th days of treatment in goats and the rate of healing was 99.80% & 99.88% respectively and those were treated with combined ointments of dadmardan and neem leaves cured at 27th days of treatment in calves and at 24th day of treatment in goats and the rate of healing was 99.94% and 99.35% respectively (Rahman *et al.,* 2009). The value of Neem as anthelmentics for ecto as well as endoparasites of goats and sheep, which were exposed to high occurrence of helminthic diseases, protozoan diseases (e.g. coccidiosis etc.), mange, pediculosis and tick infestations. The Neem and its products can prove to be efficacious and economical in controlling parasitic infestations (Tiwary and Pandey, 2010).

2.2.4 Herbal Medicine Used for Control of Other Parasitic Diseases

The ethanol extracts of 10 indigenous plants (Neem, custard apple, betel leaf, pineapple, jute, garlic, papaya pomegranate, bitter gourd, and chaste tree) showed potential in vitro activities gastrointestinal nematodes in cattle. Out of 10 plant extracts, 2 plants (Neem and bitter gourd) showed 100% efficacy against adult worms, 5 plants (papaya, garlic, pineapple, betel leaf and chaste tree) showed 90% and others (pomegranate, jute and custard apple) showed below 90% (Sultana *et al*., 2013). Evaluation of the *in-vitro* anthelmintic activity of methanolic extract of Neem plant against third-stage *Haemonchus contortus* larvae from goats indicated that Neem extract was effective in killing larvae. It was recorded that 4 mg/ml extract gave 40% mortality, the highest percentage of mortalities among all used concentrations after 24 hr treatment (Rahman *et al.,* 2011).

The biologically active ingredients of Neem plant have diverse applications and useful traditional medicinal plant in India. These compounds belong to the natural products called triterpenoids (Limonoids). Several animals and plant pathogenic fungi, bacteria, viral, protozoan and helminthes are sensitive to Neem preparations, with antiseptic properties (Kumar *et al.,* 2010).

An investigation exposed the possible anthelmintic effects of crude aqueous and hydroalcoholic extracts of the leaves *Lawsonia inermis* on eggs and adult *Haemonchus contortus*. The effect of *L. inermis* was not dose-dependent and did not inhibit the hatching of eggs of *H. contortus,* significantly, and have shown statistically significant ($P<0.05$) effect on the survival of adult parasites at all tested concentrations and the few mortality cases recorded were not dose-dependent (Eguale *et al.,* 2009**)**. The ethanol extracts of indigenous medicinal plants have anthelminthic properties *in vitro* and *in vivo* against the gastro-instestinal nematodes in goat. Ethanol extract of Labanga, Neem, Karolla and Pineapple at the dose of 100mg/kg showed a significant and potent antinematodal effect and ethanol extracts of korolla also showed significant efficacy. The adult gastrointestinal nematodes were more vulnerable to selected indigenous plants (Sujon *et al.,* 2008).

The previous and current status of herbal remedies in animal parasitic diseases provides background information on the rationale behind ethno veterinary research in general especially as it relates to the developing nations where cost of drugs majorly limit the full use of modern medicine. It presents in quantifiable terms the degree of efficacy of whole or plant parts and their extracts in percentages of efficacy (Fajimi and Taiwo, 2005). An observation showed the effect of extracts from Neem (*Azadirachta indica*), wormwood (*Artemisia absinthium*) and Tobacco (*Nicotiana tabacum*) with added copper sulfate on female Boer goats infected with gastrointestinal parasites (GIN). The results showed that the plant extracts at the tested concentration were not effective anthelmintics (Worku *et al.,* 2009).

An investigation exposed the anthelmintic efficacy of the aqueous extracts of Neem leaf and stem and root barks against the hatching of eggs and the survival of larvae of nematode parasites of small ruminants. The results of the in vitro egg hatch assay showed that the aqueous extracts of the leaf and stem bark produced significant anthelmintic effect through reduction in nematode egg hatch. The reduction in egg hatch was concentration dependent being highest (51% and 50% for the leaf and stem bark extracts respectively) at the highest concentration (100 mg/ml) of the extracts (Okwudiri *et al.,* 2006). The aqueous extract of *Azadirachta indica* leaves for anthelmintic activity used for earthworms (*Pheretima posthuma*), tapeworms (*Raillietina spiralis*) and roundworms (*Ascaridia galli*). Determination of paralysis time and death time of the worms were recorded. Extract exhibited significant anthelmintic activity at the concentration of 40 mg/ml (Rabiu and Subhasish, 2011).

The anthelmintic activity of the *Annona squamosa* leaf extract used for adult earthworm, *Peritima posthuma*. The hexane, ethylacetate, ethanolic extracts of the crude drug at concentrations of 100mg/ml, 200mg/ml, were tested which involve determination of paralysis time and death time. Annona reticulata leaf extracts showed dose dependent activity *viz.* ethyl acetate extract at a dose of 200mg/ml was shown very high significant action (Satyanarayana *et al*., 2013). *Lawsonia inermis* contains carbohydrates, proteins, flavonoids, tannins and phenolic compounds, alkaloids, terpenoids, quinones, coumarins, xanthones and fatty acids. The plant was reported to have analgesic, hypoglycemic, hepatoprotective, immunostimulant, anti-inflammatory, antibacterial, antimicrobial, antifungal, antiviral, antiparasitic, antitrypanosomal, antidermatophytic, antioxidant, antifertility, tuberculostatic and anticancer properties (Chaudhary *et al.,* 2010).

2.2.5 Ivermectin Medicine Used for Control of Parasitic Diseases

The study revealed the comparative efficacy of modern anthelmintics like albendazole, Ivermectin and Fenbendazole against gastrointestinal nematodiasis in goats (Akanda *et al.,* 2012). Another investigtion showed the efficacy of Ivermectin, Fenbendazole and Albendazole against gastrointestinal nematodes in naturally infected goats of government goat development farm (Aktaruzzaman *et al.,* 2012). Black Bengal goats were treated with CEVAMEC®-1% (Ivermectin, ENDEX®-1500 (Triclabendazole along with Levamisole), and a placebo. Both of the drugs were equally significant against endoparasitic infections of goats (P<

0.05; t-test) (Hassan *et al.,* 2012). The chorioptic mange infested goats were treated at weekly intervals with 0.005% amitraz spray as topical application for consecutive 3 weeks. The animals recovered from skin lesions and scrapings were negative for mites after 3 days of the last spray (Sreedevi and Rani, 2012). The *sarcoptic* mange affected goats were treated with injectable moxidectin solution 1% (CYDECTIN-Fort Dodge) at the dose of 0.2 mg/kg, applied every 15 days for four times, subcutaneously and found that although pruritus had decreased soon after the first treatment, a satisfactory healing of cutaneous lesions was witnessed 6 weeks after the beginning of moxidectin trial (Giadinis *et al*., 2011). The high efficacy was recorded in ivermec® pour on upon ectoparasites activity in calves (Razu *et al.,* 2010). Four graded Murrah buffaloes of 3-5 years aged were infested with *P. natalensis* in buffaloes and they were separated from others and treated twice at a weekly interval with flumethrin in the prescribed dose of 1ml/10 kg body weight as a pour-on application. Signs of improvement were observed after the treatment (Sreedevi *et al.,* 2010).

The three acaricides, doramectin (Dectomax®, Pfizer) using at a single dose of 300 µg/kg b.w. in sheep given intramuscularly showed a high efficacy (95%) against *P. ovis.* In naturally infected sheep and the all doramectin treated animals were clinically normal. All skin scrapings were negative for mites 50 days after treatment (Vasile *et al.,* 2010). Ivermectin was used against skin lesions in calves and goats and found that the calves and goats were treated with Ivermectin and got almost cured within 18 days and the rate of healing was 98.36% and 99.03% respectively (Rahman *et al.,* 2009).

The therapeutic efficacy of Ivermectin was 100% against ectoparasites in calves on day 7, 14, 21 and 28 after the treatment. All the calves after Ivermectin injection remained healthy, no adverse effect and calves appetite increased, growth and coat color improved rapidly (Rahman *et al.,* 2009). Gastro-intestinal nematodes in sheep were treated with Vermic® (Ivermectin) @ 0.23 mg kg^{-1} body weight. A significant ($p<0.01$) reduction of EPG count was found on 7th, 14th, 21st and 28th day of Vermic® (90.51, 89.85, 87.91 and 86.38%) in treated sheep. Vermic® may be used as a broad spectrum anthelmintic against gastro-intestinal nematodiasis in sheep (Khalid *et al.,* 2004).

The affected animals in the third phase of mange treated with a high dose (0.4 mg/kg BW) of Ivermectin were completely cured and the same result was achieved after 4 weeks of treatment in those animals in phase 3 of mange when 0.2 mg/kg bodyweight was used. The therapeutic effectiveness when it was administered through subcutaneous injection, to sick animals in the consolidation stage of mange (third phase), and with double injections to chronically affected animals (fourth phase) at a dosage of 0.2 or 0.4 mg/kg body weight (BW). The second experiment consisted on the animals were treated first topically with foxim (500 mg/l) and subcutaneously with Ivermectin (0.4 mg/kg bw). The implemented sanitation was fully effective in curing the affliction of Spanish ibex affected by *S. scabiei* (Vizcaı´no *et al.,* 2001).

2.2.6 Effects of Herbal and Ivermectin Medicines on Clinical Parameter (Skin Lesion and Body Weight)

An investigation showed the comperative efficacy of modern anthelmintics like Albendazole, Ivermectin and Fenbendazole against gastrointestinal nematodiasis in goats regarding their effects on body weight. The body weight was increased significantly ($p<0.01$) in all treated goat (Akanda *et al.,* 2012). The infested goats were treated at weekly intervals with 0.005% amitraz spray as topical application for consecutive 3 weeks. The animals recovered from skin lesions and scrapings were negative for mites after 3 days of the last spray (Sreedevi and Rani, 2012). Lesions were confined to the neck, shoulders and rump due to infestation with *P. natalensis* in buffaloes. The infested animals were separated from others and treated twice at a weekly interval with flumethrin in the prescribed dose of 1ml/10 kg body weight as a pour-on application. Signs of improvement were observed after the treatment (Sreedevi *et al.,* 2010). The therapeutic efficacy of Ivermectin, Fenbendazole and Albendazole against gastrointestinal nematodes in naturally infected goats was evaluated through body weight gain/loss. The results showed that the efficacy of Ivermectin was 100%, followed by fenbendazole 95.33% and albendazole 90.11%. The body weight of the treated animals were slightly increased which were significant ($p<0.05$) (Aktaruzzaman *et al.,* 2012). Goats were treated with CEVAMEC®-1% (Ivermectin, ENDEX®-1500 (Triclabendazole along with Levamisole), and a placebo as a selective anthelmintics against ecto and endoparasites of Black Bengal goats and their treatment effects on body-weight gains. Both of the drugs were equally significant against endoparasitic infections of goats and in all treated goats. The body weight was increased significantly ($P<0.05$; t-test) (Hassan *et al.,* 2012).

One indigenous medicinal plant namely *Annona reticulata* leaves extract and Ivermec® pour were applied on ectoparasites activity in calves. A significantly high efficacy was recorded in 3% aqueous extract of Ata leaves and Ivermec® pour on clinical body weight. The results showed that the body weight was increased in calves after treatment (Razu *et al.,* 2010). Another investigation showed the efficacy of Ivermectin and Neem plants against ectoparasites in calves. Leaves of Neem showed the efficacy of 68% at day 28 and body weight of Ivermectin and Neem treated calves also increased. All the calves after Ivermectin injection and Neem spray remained healthy, calves appetite was increased, growth and coat colour were improved rapidly (Rahman *et al.,* 2009). A study was conducted with the treatment Vermic® (Ivermectin) @ 0.23 mg kg^{-1} body weight in sheep against gastro-intestinal nematodes. The body weight was decreased in untreated control group. Vermic® may be used as a broad spectrum anthelmintic against gastro-intestinal nematodiasis in sheep (Khalid *et al.,* 2004).

2.2.7 Effects of Herbal and Ivermectin Medicines on Hematological Parameters (PCV, Hb and TEC, TLC)

The modern anthelmintics like Albendazole, Ivermectin and Fenbendazole were used against gastrointestinal nematodiasis in goats regarding haematological indices. After treatment with Albendazole, Ivermectin and Fenbendazole, Total Erythrocyte Count (TEC), Hemoglobin (Hb) content and Packed Cell Volume (PCV) were increased significantly ($p>0.05$ and $p<0.01$) in goats but decreased significantly ($p<0.01$) in untreated control goats, Erythrocyte Sedimentation Rate (ESR) were increased significantly ($p>0.05$) in untreated control group and decreased in treated group. Total Leukocyte Count (TLC) was decreased in all treated goat (Akanda *et al.,* 2012). The value of Ivermectin, Fenbendazole and Albendazole against gastrointestinal nematodes in naturally infected goats was evaluated. TEC, Hb and PCV values were lower on day 0 but turned to increase ($p<0.01$) on day 28 of the study. On the other hand, ESR and TLC were higher before treatment (day 0) but decreased significantly ($p<0.01$) on day 28 (Aktaruzzaman *et al.,* 2012).

Goats were treated with CEVAMEC®-1% (Ivermectin, ENDEX®-1500 (Triclabendazole along with Levamisole), and a placebo. Packed Cell Volume and Hemoglobin levels were increased significantly ($P<0.05$) in both of the treated groups, which was indicative of effective treatments of those trial drugs (Hassan *et al.,* 2012). The hemato-biochemical changes observed in the mange infested Surti buffaloes and buffalo calves. Hematological analyses of blood samples were done to evaluate changes in Hb, PCV, TEC, TLC and DLC counts. Infestation caused anaemia, increased TLC with eosinophilia. There was decrease in total protein as well as zinc concentration in serum in infested buffaloes (Vishe *et al.,* 2012). The experimental tick infected group showed lower values of Hb, PCV, TEC, neutrophil and MCHC in day 21 when compare to naturally infested group. The first three treatment weeks showed no significant difference in eosinophil, basophil and MCV values between naturally infested village flock and non-infected control group (Kumar *et al.,* 2010).

A significantly high efficacy was recorded in 3% aqueous extract of Ata leaves and Ivermec® pour on hematological parameters (TEC, Hb, PCV and ESR) and post mortem findings. The results showed that the increased values of TEC and PVC were observed, but Hb increased and slightly decreased in calves after treatment. Whereas ESR and TLC values were slightly decreased and increased respectively in all treated groups. But ESR and TLC were slightly increased and decreased respectively in control group (Razu *et al.,* 2010). An investigation was carried out on buffalo calf infested with psoroptic and sarcoptic mites at the Veterinary College Hospital, Namakkal. In the haematological profile, marked neutropenia and oesinophilia were present (Rajah *et al.,* 2001). After treatment with Vermic® against gastro-intestinal nematodes in sheep, the Total Erythrocyte Count (TEC), Hemoglobin (Hb) content and Packed Cell Volume (PCV) were increased significantly ($p<0.01$ and $p<0.05$) in sheep. Total Leukocyte Count (TLC) was decreased significantly ($p<0.01$ and $p<0.05$) in all treated sheep (Khalid *et al.,* 2004).

2.2.8 Effects of Herbal and Ivermectin Medicines on Biochemical Parameters (SGOT and SGPT)

Black Bengal goats were treated with CEVAMEC®-1% (Ivermectin, ENDEX®-1500 (Triclabendazole along with Levamisole), and a placebo. The level of Serum Glutamate Pyruvate Transaminase (SGPT) and Serum Glutamate Oxaloacetate Transaminase (SGOT) declined significantly ($P<0.05$) in both of the treated groups (Hassan *et al*., 2012). Biochemical changes were observed in the mange infested Surti buffaloes and buffalo calves. Biochemical analyses of serum samples were done to determine the concentrations of total protein, albumin, globulin, A:G ratio and serum zinc levels by Atomic Absorption Spectrophotometer (AAS). There was decrease in total protein as well as zinc concentration in serum in infested buffaloes (Vishe *et al.,* 2012). In the serum biochemical profile, lowered total protein value (5.89 g/dl), hypoalbunminemia and hyperglobulihnemia were present in buffalo calf infested with psoroptic and sarcoptic mites (Rajah *et al.,* 2001). The outcome of ectoparasite on biochemical parameters of goats was analyzed and compared with normal (control) animals. The experimental tick infected group showed the biochemical parameters like total protein and globulin were found higher on day 21 in experimental tick infected goats but albumin, A/G ratio, glucose, bilirubin and AST were considerably lower during 7 and day 21 in the experimental group when compared to naturally infested goats (Kumar *et al*., 2010).

Chapter 3

3 Materials and Methods

Researcher followed a set of tools and techniques in order to fulfill the aims and objectives of the study. Researcher also tried to find out unbiased results of his studies within the limited scope of time, money and personnel. With the above background, a survey method was used for data collection.

3.1 Study Area

The five Thana of Rajshahi district, namely Boalia, Puthia, Poba, Gudagari and Baghmara were selected as study area for convenience of the works. The study areas cover high land, medium land and low land as land topography.

3.2 Field Survey and Data Collection

The survey schedule/questionnaire of the study was prepared in accordance with objectives of the study. The goat rearing families in the study area were grouped into three categories such as small farm (having number of goat up to 8), medium farm (having goat 9 to15) and large farm (having goat above 15). A total of 129 goat rearing farms were selected randomly and proportionately from the three categories of farm. The relevant data were collected from a total of 1277 goats of all selected goat rearing farms by directly face to face interview and with the help of register book.

Fig. 7. Map showing the study areas of Rajshahi district

The investigation was carried out in three seasons *viz*, rainy season, winter season and summer season, during the period from July'2010 to June'2011. The selected goat rearing farms and their belonging number of goats in different category of farms are shown in Table 1.

Table 1. The selected goat rearing farms and their belonging number of goats in different category of farms

Farm size	Total goat rearing farm in each category	5% of total goat rearing farm in each category	Total number of goat in each category of farm
Small farm (up to 8 goats)	1080	54	315
Medium farm (9 to 15 goats)	1320	66	796
Large farm (above 15 goats)	180	9	166
Total	2580	129	1277

Source: Field survey, 2010-2011

3.3 Data Analysis

The collected data were analyzed using SPSS Version-15. Association between prevalence and explanatory variables such as farm size, feeding, breed, age, sex, season, land topography, housing system, housing condition, body condition, temperature, rainfall and humidity were carried out by using chi-squire (P^2) test. Among all variables, only farm size, feeding, breed, age, sex, season and land topography were considered in logistic regression analysis. The significant difference was set as $P<0.05$ in the prevalence study.

3.3.1 Logistic Regression Model

As in multiple regression analysis, there are two important stages in the analysis of data. First, estimates for the parameters in the model must be obtained and, second, some determination must be made of how well the model actually fits the observed data. In multiple regression analysis, the parameter estimates are obtained using the least-squares principle and assessment of fit is based on significance tests for the regression coefficients as well as on interpreting the multiple correlation coefficients. The process is analogous for logistic regression analysis, although specific details of these stages of analysis are somewhat different as outlined here.

The parameters that must be estimated from the available data are the constant, α, and the logistic regression coefficients, β_j. Because of the nature of the model, estimation is based on the maximum likelihood principle rather than on the least-squares principle. In the context of logistic regression analysis, maximum likelihood estimation (MLE) involves the following. First, we define the likelihood, L, of the sample data as the product, across all sampled cases, of the probabilities for success or for failure:

$$L = \prod_{i=1}^{n} P(Y_i \mid X_{i1},\ldots,X_{ip}) = \prod_{i=1}^{n}\left[\left(\frac{e^{\alpha+\sum_{j=1}^{p}\beta_j X_j}}{1+e^{\alpha+\sum_{j=1}^{p}\beta_j X_j}}\right)^{Y_j} \times \left(\frac{1}{1+e^{\alpha+\sum_{j=1}^{p}\beta_j X_j}}\right)^{1-Y_j}\right] \quad (1)$$

Note that Y is the 0/1 outcome for the ith case and, $X_{i1},\ldots,X_{ip}$ are the values of the predictor variables for the ith case based on a sample of n cases. The use of Y_i and 1-Y_i as exponents in the equation above includes in the likelihood the appropriate probability term dependent upon whether Y_i =1 or Y_i =0 (note that F^0=1 for any expression, F). Using the methods of calculus, a set of values for and the β_j can be calculated that maximize$L$ and these resulting values are known as maximum likelihood estimates (MLE's). This maximization process is somewhat more complicated than the corresponding minimization procedure in multiple regression analysis for finding least-square estimates. However, the general approach involves establishing initial guesses for the unknown parameters and then continuously adjusting these estimates until the maximum value of L is found. This iterative solution procedure is available in popular statistical procedures such as those found in SPSS (statistical software). To distinguish them from parameters, we denote the MLE's as a andb_j. Given that these estimates have been calculated for a real data set, tests of significance for individual logistic regression coefficients can be set up as in multiple regression analysis. That is, for the hypothesis, H: $\beta_j = 0$, a statistic of the form $z = b_j/S_j$ can be calculated based on the estimated standard error, S_j, for b_j (SPSS report $\chi_1^2 = z^2$and label these values as Wald statistics).

Similarly, the usefulness of the model as a whole can be assessed by testing the hypothesis that, simultaneously, all of the partial logistic regression coefficients are 0; i.e., H: $\beta_j = 0$ for all$j$. In effect, we can compare the general model given above with the restricted model $Log_e\left(\pi/(1-\pi)\right) = \alpha$. This test, that is equivalent to testing the significance of the multiple R in multiple regression analysis, is based on a chi-squared statistic (Statistical Package SPSS labels this value as "Model Chi-Square").

Finally, different logistic regression models fitted to the same set of data can be compared statistically in a simple manner if the models are hierarchical. The hierarchy principle requires that the model with the larger number of predictors include among its predictors all of the predictors from the simpler model (e.g., predictors X_1 and X_2 in the simpler model and predictors X_1, X_2 , X_3 and X_4 in the more complex model). Given this condition, the difference in model chi-squared values is (approximately) distributed as chi-squared with degrees of freedom equal to the difference in degrees of freedom for the two models (e.g., for the above example, the degrees of freedom would be 2). In effect, this procedure tests a conditional null hypothesis that, for the example, would be: $H\colon \beta_3 = \beta_4 = 0 \mid \beta_1, \beta_2$. That is, the values of the logistic regression coefficients associated with X_1 and X_2 are unrestricted, but the logistic regression coefficients associated with X_3 and X_4 are assumed by hypothesis to be 0. If the models are specified in a series of "blocks" in SPSS, an "Improvement" chi-square value is computed for each successive model and this can be used to test whether or not the additional predictors result in significantly better fit of the model to the data.

3.3.2 Interpreting the Fitted Logistic Regression Model

The results may be interpreted from a logistic regression analysis at three different levels. First, each term in the equation represents contributions to estimated log-odds. Thus, for each one unit increase (decrease) in X_j, there is predicted to be an increase (decrease) of b_j units in the log-odds in favor of $Y = 1$. Also, if all predictors are set equal to 0, the predicted log-odds in favor of $Y = 1$ would be the constant term, a. Second, since most people do not find it natural to think in terms of log-odds, the logistic regression equation can be transformed to odds by exponentiation:

$$\frac{\pi}{1-\pi} = e^{a+b_1X_1+\ldots+b_pX_p} = e^{a} \times e^{b_1X_1} \times \ldots \times e^{b_pX_p} \qquad (2)$$

$$P(Y=1 \mid X_1,\ldots,X_p) = \frac{e^{a+\sum_{j=1}^{p} b_jX_j}}{1+e^{a+\sum_{j=1}^{p} b_jX_j}} \qquad (3)$$

With respect to odds, the influence of each predictor is multiplicative. Thus, for each one unit increase in X_j, the predicted odds are increased by a factor of $exp(b_j)$. If X is decreased by one unit, the multiplicative factor is $exp(-b_j)$. Note that $exp(c)=e^c$. Similarly, if all predictors are set equal to 0, the predicted odds are $exp(a)$. Finally, the results can be expressed in terms of probabilities by use of the logistic function. With estimates substituted the equation above becomes:

$$P(Y=1\mid X_1,\ldots,X_p)=\frac{e^{a+\sum_{j=1}^{p} b_j X_j}}{1+e^{a+\sum_{j=1}^{p} b_j X_j}} \qquad (4)$$

Although this form of the model may seem simplest because it results in predicted probabilities for Y = 1, there is no simple interpretation for the logistic regression coefficients in this form.

3.4 Diagnosis of Mange

3.4.1 Diagnosis by Physical Examination of Goats

The examination of goat for mite identification was conducted at Raja Bari goat farm in Rajshahi, Narikalbaria veterinary clinic of the University of Rajshahi and some selected farmers of five Upozila of Rajshahi district namely Boalia, Puthia, Poba, Gudagari and Baghmara. The examination of each goat was conducted by visual inspection and palpation of skin lesions and by the eventual identification of ectoparasites. The direct physical inspection of each 10.16-cm2 region of neck and loin per goat was performed to screen ectoparasites in this study. This technique was previously applied (Hannan *et al.*, 2003).

3.4.2 Diagnosis by Skin Scraping Test

3.4.2.1 Collection and Preservation of Deep Skin Scraping

The selected goats were clinically inspected for presence of mange mite. From goat showing signs of scales, crusts, alopecia itching, a skin scraping was taken by the following procedure. A drop of mineral oil was put on a clean glass slide, dip a clean scalpel in the drop and then scrape the edge of the affected area until blood oozed. The collected scrape samples were preserved in 70% ethanol containing few drops of glycerin and dispatched to laboratory for further confirmatory examination.

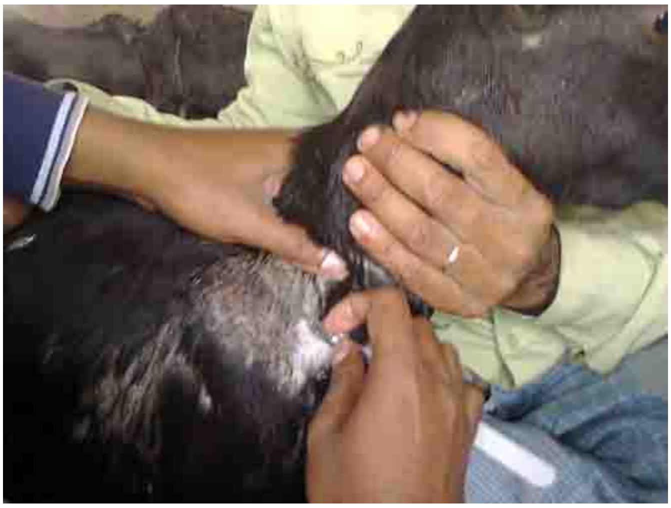


Fig. 8. Collection of deep skin scraping

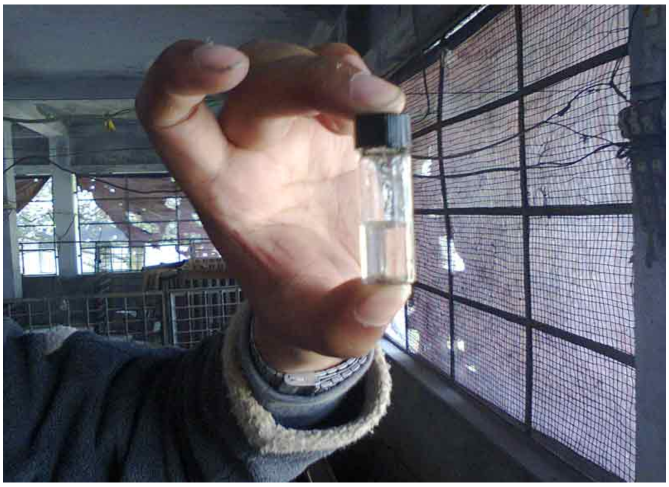


Fig. 9. Preservation of deep skin scraping

3.4.2.2 Examination of Deep Skin Scraping

Laboratory examination of the samples (skin scraping) is diagnosed for mange by identification of mites through directly with the help of stereoscope and boiling with 5 to 10 percent potassium hydroxide solution for 5 to 10 Minutes. The boiling in caustic potash is carried to clear the material of debris which usually dissolves in this solution. The material is then centrifuged a little and the sediment is then examined on a glass slide under the micro scope.

3.4.3 Diagnosis of Mange by Skin Biopsy Method

Diagnosis of mange was also done by skin biopsy method or histopathology from collected sample like skin of the affected live animals in the laboratory of department of Animal Husbandry and Veterinary Science, the laboratory of Genetic Engineering of the department of Zoology and the laboratory of department of Genetic Engineering and Biotechnology of the University of Rajshahi.

3.4.3.1 Collection of Tissues for Pathological Studies

Goats were examined carefully and gross pathological changes were recorded, if any. Biopsy materials from the affected part of the skin were collected and fixed in 10% buffered neutral formalin solution for histopathological studies.

Fig. 10. Skin collection for histopathology

Fig. 11. Collected skin preservation

Formalin- fixed samples of the skin were processed for paraffin embedding, sectioned and stained with haematoxylin and eosin according to standard method of (Luna, 1968) for histopathological study. Buffered neutral formalin fixed tissues were dehydrated in graded alcohol, cleared in chloroform and impregnated and then embedded in paraffin. Tissues were sectioned at five to six micron thickness and stained with Hematoxylin and Eosin. The stained tissues sections were studied under low and high power of objectives under the microscope. Micrographs of the tissues having characteristics pathological changes were taken. Formalin- fixed samples of the skin were processed for paraffin embedding, sectioned and stained with hematoxylin and eosin according to standard method of (Luna, 1968) for histopathological study. Details of tissue processing, sectioning and staining are given below.

Processing of tissues and sectioning:

- The tissues were properly trimmed to obtain a good cross section of skin.
- The tissues were washed under running tap water for overnight to remove the fixative.
- The tissues were dehydrated in ascending grades of alcohol using 50%, 70%, 80%, 90% alcohol, and three changes in absolute alcohol, for 1 hr in each.
- The tissues were cleared in two changes in chloroform, 1.5 hrs in each.
- The tissues were embedded with molten paraffin wax at 56^0c for two changes, 1.5 hr in each.
- The tissues were sectioned with a microtome at 5 µm thickness, which were allowed to spread on warm water bath (45^0C) containing small

amount of gelatin and taken on oil and grease-free glass slides. The slides were air dried and kept in cool place until staining.

Staining procedure:

- **Preparation of Harri's Haematoxylin solution**

Haematoxylin crystals	5.0g
Alcohol (100%)	50.0 ml
Ammonium or potassium alum	100g
Distilled water	1000.0ml
Mercuric oxide (red)	2.5g

Hematoxylin was dissolved in alcohol and alum in water by heat. The two solutions were thoroughly mixed and boiled as rapidly as possible. After removing from heat, mercuric oxide was added to the solution slowly. The solution was reheated to a simmer until it became dark purple, and then the vessel was removed from heat and immediately plunged in to basin of cold water until it became cool. 2-4 ml glacial acetic acid was added per 100 ml of solution to increase the precision of the nuclear stain. Before use, the prepared solution was filtered.

- **Preparation of Eosin solution:**

1% stock alcoholic solution

Eosin Y, water soluble	1g
Distilled water	20ml
95% alcohol	80ml

Eosin was dissolved in water and then 80 ml of 95% alcohol was added.

- **Working Eosin solution**

  Eosin stock solution 1 parts

  Alcohol, 80% 3 parts

  0.5 ml of glacial acetic acid was added to 100 ml of working eosin solution just before use.

- **Staining protocol**

- Deparaffinization of the sectioned tissues was done by 3 changes in xylene (3 min in each).
- Rehydration of the sectioned tissues was done through descending grades of alcohol (3 changes in absolute alcohol, 3 min in each; 95% alcohol for 2 min; 80% alcohol for 2 min; 70% alcohol for 2 min) and distilled water for 5 min.
- The tissues were stained with Harri's hematoxylin for 15 min.
- The sections were washed in running tap water for 10-15 min.
- Then the staining was differentiated in acid alcohol (1 parts HCl and 99 parts 70% alcohol), 2-4 dips.
- The tissue sections were then washed in tap water for 5 min and dipped in ammonia water (2-4 times) until sections became bright blue.
- The sections were stained with eosin for 1 min and then differentiated and dehydrated in alcohol (95% alcohol, 3 changes, 2-4 dips in each; absolute alcohol 3 changes, 2-3 min in each).
- The stained sections were then cleaned by 3 changes in xylene, 5 min in each and finally the sections were mounted with cover slip using DPX.

3.5 Detection of Mange Mite

The mites were detected by physical examination of goats. The selected goats were thoroughly investigated by close inspection, palpation, parting the hairs against their natural direction and other methods for the detection of clinical manifestations relevant to ectoparasitic infestation such as dandruff, thickening of skin, desquamation, ulceration, alopecia etc. The skin scrapings were done in the affected areas of goats to collect mites using the standard techniques (Bush, 1975). 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). Morphology of mites was studied in the laboratory with the help of dissecting (x4) microscope. The mites were identified according to the keys and descriptions given by Soulsby (1982) by preparing permanent slides following the procedures described by Cable (1957).

3.5.1 Identification of Mange Mite

Skin scrapings were taken from the suspected animals which suffered from mite infestations or mange. The technique involved for demonstrating the mites was the examination of skin scraping as stated subsequently. The mites infested lesions were selected and hairs over the edge of the lesion were clipped. The scalpel blade and the rim of the Petri plate were coated first with liquid paraffin. Then the skin was scraped over the edge gently and took the materials in the Petri plate. This process was continued till a slight amount of blood oozed out. This was done in order to contain the deep-seated mites. The collected scraped skin in

Petri plate was brought in the laboratory for examination. The skin scrapings were examined by the following methods.

3.5.1.1 Direct Examination

A small amount of skin scrapings was taken on a glass slide and poured 2-3 drops of liquid paraffin over it and covered it with cover slip and examined under suitable magnification of microscope.

3.5.1.2 Examination after Boiling

The skin scrapings were boiled in 5-10% of potassium hydroxide solution (caustic potash) for 5-10 minutes. Then the materials were centrifuged a little and the sediments were then examined on a glass slide under the microscope.

3.5.1.3 Examination after Mounting in Permanent Slide Preparation

The mites in the materials were mounted on slides permanently. The materials were cleared of debris by boiling in caustic potash solution. Then the sediments were washed by water for 2-3 times to remove caustic potash. Afterwards the sediments were to be dehydrated in ascending grades of ethyl alcohol i.e. 70%, 80%, 90%, 95% and absolute and these were left for 20-30 minutes in each grade. Then they were cleaned in a clearing agent i.e. xylene. The sediments were immersed in xylene for a few hours till they become transparent and clear. Since the mites were microscopic in size, so the centrifugation was carried out at each stage. Finally from the clearing agent the sediments containing the mites were mounted in a suitable mountant i.e. Hoyer's medium. Then the few drops of sediments were taken on glass slide and examined them under dissecting light microscope to confirm the presence of mites. The identified mites were transferred in to glass slide containing Hoyer's medium and it was covered with a suitable sized cover slip. The slides were dried and the medium on outside of the cover slip was removed and then ringed.

3.6 Control of Mange Using Patent Medicine and Herbal Products

The research was conducted to study the efficacy of herbal products and patent drug for mange control in goats in veterinary practice. The patent drug Ivermectin and locally available medicinal plant (Neem, Ata and Mehedi) were selected with the aim for comparative investigation of the efficacy of anthelmentic activity on mange and on some clinical, hematological and biochemical parameters in goats.

3.6.1 Collection of Medicine and Herbal Products

The leaves of Neem (*Azadirachta indica* A.Juss., 1830), Ata (*Annona reticulata* Linnaeus, 1758) and Mehedi (*Lawsonia inermis* Linnaeus, 1758) were collected from local villages of Motihar Upazila in Rajshahi district. The required chemicals to prepare ointments were Vaseline and Butylated hydroxyl anisole (Loba Chemie Pvt. Ltd., Mumbai, India) and these were purchased from the local market. Vaseline was used as vehicle in the herbal ointment and Butylated hydroxyl anisole was used as preservative in the ointment. The different solutions for blood examination like salt solution, normal saline (0.9%), anticoagulant (sodium citrate 3.8%), Hayem's solution, 0.14% hydrochloric acid solution were prepared in the laboratory of the Department of Animal Husbandry and Veterinary Science of Rajshahi University. The Ivermectin injection was purchased from the local market of Rajshahi.

Fig. 12. Neem (*Azadirachta indica*)

Fig. 13. Mehedi Plant (*Lawsonia inermis*)

Fig. 14. Ata (*Annona reticulata*)

3.6.2 Preparation of Herbal Ointment

The required materials (appliances and instruments) for preparation of ointment were leaves of Neem, Ata and Mehedi and Vaseline, Butylated hydroxyl anisole (BHA), hot air oven, grinder, slab, spatula, plastic tube, sieve, measuring balance, cotton, paper and spoon. The procedure of ointment preparation was followed systematically. At first the leaves of Neem, Ata and Mehedi were wiped with cotton and these were kept in separate steel tray in hot air oven. The temperature in the oven was maintained at 37^0C and then it was gradually increased at 40^0C, 50^0C and 60^0C. The relative humidity was maintained as 60 per cent. In this way the leaves were dried within 5 days. Then the dried leaves were grinded separately by grinder. The grinding of leaves was done three times for making fine particles.

Then the fine particles of leaves were sieved separately by a sieve. These were weighted by using measuring balance separately. In the preparation of 100 gm ointment of Neem, Ata and Mehedi, 20 gm of each leave, 79.5 gm of Vaseline and 0.5 gm of Butylated hydroxyl anisole (BHA) were mixed smoothly on a slab with a spatula. Then the prepared ointments were kept in plastic containers separately. Then the ointments were taken in small plastic tubes for applying convenience.

3.6.3 Selection of Goat and Experimental Schedule

Fifteen affected goats of both sexes aged between 10 and 30 months were selected for treatments from different areas of Rajshahi district. The experiment of control was conducted at Dalal Para of Katakhali in Rajshahi district during the period from November'2012 to December'2012. All of the experimental goats were divided into 5 groups randomly and 3 goats were considered in each group. The sample size for each group was statistically sufficient. Specific treatment groups were selected by tossing a coin. The experimental groups were named as A, B, C, D and E. All groups were considered under different treatments as control (A), Neem ointment (B), Ata ointment (C), Mehedi ointment (D) and Ivermectin (E).

The goats affected by ectoparasites were considered for the selective herbal preparations and Ivermectin experiment. The collected samples for ectoparasites (mites) from different body regions of the goats were examined as per the protocol referred to earlier in order to assess skin lesion on day 0 (before the start of the treatment) and days 7, 14, 21, and 28 (during the treatments). Body weight (BW) and blood samples were taken from each goat following the same schedule mentioned above for ectoparasite assessment. The digital balance was used to measure bodyweight. Approximately 5 ml of blood per goat was drawn from the jugular vein each time. A portion of the blood from each sample was used to evaluate routine hematological indices such as total erythrocyte count (TEC), hemoglobin (Hb), packed cell volume (PCV) and total leukocyte count (TLC). Serum samples were then separated by centrifugation at 1500 rpm for 10 minutes. These samples were evaluated for biochemical parameters such as SGOT, and SGPT. The detailed herbal and anthelmintic treatment schedules are presented in Table 2.

Table 2. The anthelmintic schedule for the experimental goats affected with mites

Treatment groups	Drug details				
	Scientific /generic name	Trade name	Company name	Doses	Route of administration
A(Control)	N/A	N/A	N/A	No drugs given	N/A
B (Neem ointment)	Neem ointment	N/A	Self-made	5gm paste once daily for 28 days	Applied topically in affected area
C (Ata ointment)	Ata ointment	N/A	Self-made	5gm paste once daily for 28 days	Applied topically in affected area
D (Mehedi ointment)	Mehedi ointment	N/A	Self-made	5gm paste once daily for 28 days	Applied topically in affected area
E (Ivermectin)	Ivermectin	CEVAMEC ®-1%	ACI Animal Health Ltd.	0.2 mg/kg bodyweight for day 0 and 14	Inject subcutaneously

N/A: Not applicable

3.6.4 Data Entry and Statistical Analysis for Control Experiment

The obtained data were analyzed by using Microsoft Excel program. A descriptive statistical analysis was carried out for the results of clinical parameters (skin lesion and bodyweight), certain hematological parameters (Hb, TEC, PCV and TLC) and biochemical parameters (SGOT and SGPT). The results were expressed as the mean ± standard error and percentage mean reduction and increment of the mentioned parameters during different time points of the herbal preparation and anthelmintic treatments. One way ANOVA was used to compare the effects of different treatments on some selected clinical, hematological and biochemical of experimental goats. The efficacy of the drugs in terms of reduction and increment status of parasitic orientation in goats between the treatment groups at different time points was tested for significance. Significant difference was set as $P<0.10$ in expermental study in analyses.

3.7 Clinical Parameters

3.7.1 Severity of Infestation

The severity of infestation of mite was observed by the skin lesion of individual goat. The skin lesions were studied on the basis of gross pathological changes which were observed at pretreatment (0 day) and (7^{th}, 14^{th}, 21th, 28^{th}) treatment period by visual examination of the goats.

3.7.2 Feeding

Feeding efficacy of treated and untreated (infected control) groups was compared at pretreatment (0day) and (7^{th}, 14^{th}, 21th, 28^{th}) post treatment period. The experimental goats were fed with the following constituent of feed:

- Cereal straws and leaves of trees
- Concentrates –feeding concentrates at the amount of 0.25 kg-1.75kg/goats once daily. The concentrate mixtures were made by the following feed-stuff available in local market:
  - Wheat bran-100gm
  - Mustered oil cake-50gm
  - Crushed maize-100gm to make 250gm of feed for supply each experimental goat.

3.7.3 Hair Coat

Hair coat of each affected goat of different treatment groups as well as non-treatment groups (control groups) was physically examined by visual examination on day 0 (pre-treatment) and days 7^{th}, 14^{th}, 21^{st} and 28^{th} (post-treatment) following the earlier mentioned schedule.

3.7.4 Body Weight

The effects of Ivermectin and herbal preparations on bodyweight were observed following a standard schedule. The parameter body weight of each goats of different treatment groups and non-treatment groups was taken on day 0 (before starting the treatment that was considered as control group) and days 7, 14, 21, and 28 (during the post-treatment period). It was measured by using the digital balance.

3.8 Hematological Parameters

Blood samples were collected from jugular vein of the goats of treated and control group in vials containing anticoagulant (Sodium Citrate 3.8%) at day 0, 7, 14, 21, 28 of treatment period to determine the effects of Ivermectin and herbal preparation on the following hematological parameter.

3.8.1 Total Erythrocyte Count (TEC)

Thoma's red blood cell pipette was used. The pipette was filled up to 0.5 marks with blood and diluting fluid (Hayem's solution) was then drawn till it reached the 101 mark. The contents were thoroughly mixed for 2 minutes. The diluting or the contents was 1:200. The neubauer counting chamber and cover slip were cleaned and dried properly. The cover slip was placed on the chamber in proper position. The content of the pipette was again shaken and 2or 3 drops of the fluid were expelled. The chamber was then filled with the contents of the pipette at an angle of about 40^0 to the chamber so that the fluid was flown under the cover slip by capillary action. The ruled area at the chamber was filled completely, taking care that excess did not run in to the troughs and no air bubble appeared under the cover slip. The counting chamber was then placed under microscope and examined first with a low power objective (10x) to ensured that there was and even distribution of the cells. The cells were then counted with the aid of high power objectives (100x). The central squares of the counting were counted in the far corner squares and one central square of the chamber. The counting and calculation of red blood cells were performed as per methods indicated by Coffin (1955). The number of RBC was calculated as follows:

Number of RBC=No. of cell counted x 10,000 and the result was expressed in million/cu.mm

3.8.2 Total Leukocyte Count (TLC)

The TLC was determined in a counting chamber with a special type pipette (white cell pipette). The pipette was filled with one parts of whole blood to 20 parts of diluting fluid (1/10 normal HCL in distilled water, to which 1% aqueous solution of gentian violet would be added). Through mixing of the contents of the pipette, the free- fluid were expelled and the solution was introduced in to the counting chamber (Neubaurer type). The counting chamber was covered with a cover glass. The counting chamber was then placed under microscope and examined first with a low power objective (10x) to ensured that there was and even distribution of the cells. The cells were then counted with the aid of high power objectives (100x) and counting the leukocytes within the four large squares. Multiplication of the counted leukocytes by 50 gives the total leukocytes count/$mm^3$of blood. The counting and calculation of white blood cells were performed as per methods indicated by Coffin (1955). The number of WBC was calculated as follows:

Number of WBC=No. of cell counted x 50 and the result was expressed in number of WBC/cu.mm of blood.

3.8.3 Determination of Hemoglobin (gm %)

The hemoglobin estimation was performed by the acid Hematin method with the Hellige Hemometer (Coffin, 1955) Hydrochloric acid (N/10) solution was taken in the special graduated tube up to its 2 mark. The special Sahli pipette was filled with well mixed oxalated blood up to 20 marks and blood on the side of the pipette was wiped out by cotton. The content of the Sahli pipette was expelled into the special graduated diluting tube and thoroughly mixed. The tube was then allowed to stand for 10 minutes for development of acid hematin. Distilled water was then add drop by drop and each time mixed with the solution with the help of stirring rod until the color of the solution matched with the standard color of the comparator. The result was read as per method described by Coffin (1955).

3.8.4 Packed Cell Volume (PVC)

The PCV was determined as per method described by Coffin (1955). The wintrobe Haematocrit tube was filled up with well-mixed blood by special loading pipette up to 10 marks. Then the tube was centrifuged at 3000 rpm for half an hour and reading was taken.

3.8.5 Determination of Biochemical Parameters (SGOT and SGPT)

The following biochemical parameters were studied:

- Serum glutamate oxaloacetate transaminase (SGOT)
- Serum glutamate pyruvate transaminase (SGPT)

3.8.5.1 Determination of SGOT

For studding biochemical parameters blood was collected on 0, 7th, 14th, 21th, 28th without giving anticoagulant and serum was obtained for studied biochemical parameters. The experiment was performed by UV method using IFCC used Humalyzer 2000- Human type Germany.

Test principle

$$\alpha - \text{Oxoglutarate} + \text{L} - \text{Aspertate} \xrightarrow{\text{AST}} \text{L} - \text{Glutamate} + \text{Oxaloacetate}$$

$$\text{Oxaloacetate} + \text{NADH} + \text{H}^{+} \xrightarrow{\text{MDH}} \text{L} - \text{Malate} + \text{NAD}^{+}$$

Sample-Serum

Reagents

Contents	**Concentration in the test**
Buffer/substrate	
Tris buffer	84 m mol/l p^H 7.5
L-aspartate	260 mol/l
Enzyme/co-enzyme/ α-oxoglutarate	
α - Oxoglutarate	12 m mol /l
MDH	≥420 U/ml
LD	≥ 1.2 U/ml
NADH	0.18 m mol/l

Brief procedure

0.1 ml of serum was mixed with 1.0 ml kit solution 2 Enzyme/co-enzyme/ α-oxoglutarate AL 1205. The wave length was set at 340 mm Hg, 1 cm light path cuvette was used and analysis was done at 37 ^{0}C. After mixing the cuvette was placed in the Humalyzer 2000. Initial absorbance was read after 1 minute.The final record was done at 1, 2 and 3 minutes after initial reading. Absorbance was recorded each time (0.11 and 0.16 at 340 nm/ Hg 340 mm). First two values for the first 2 minutes are used for the calculation.

Calculation

SGOT concentration: 1746 x absorbance U/L

3.8.5.2 Determination of SGPT

The experiment was performed by UV method using IFCC used Humalyzer 2000-Human type Germany.

Test principle

$$\alpha \text{ – Oxoglutarate + L - Alanine} \xrightarrow{\text{ALT}} \text{L - Glutamate + Pyruvate}$$

$$\text{Pyruvate + NADH + H}^{+} \xrightarrow{\text{LD}} \text{L – Lactate + NAD}^{+}$$

Sample-Serum

Reagents

Contents	**Concentration in the test**
Buffer/substrate	
Tris buffer	100 m mol/l p^H 7.5
L-alanine	0.6 mol/l
Enzyme/co-enzyme/ α-oxoglutarate	
α-oxoglutarate	15 m mol /l
LD	≥ 1.2 U/ml
NADH	0.14 m mol/l

Brief procedure

0.1 ml of serum was mixed with 1.0 ml kit solution 2 Enzyme/co-enzyme/ α-oxoglutarate AL 1205. The wave length was set at 340 mm Hg, 1 cm light path cuvette was used and analysis was done at 37 ^{0}C. After mixing the cuvette was placed in the Humalyzer 2000. Initial absorbance was read after 1 minute.The final record was done at 1, 2 and 3 minutes after initial reading. Absorbance was recorded each time (0.11 and 0.16 at 340 nm/ Hg 340 mm). First two values for the first 2 minutes are used for the calculation.

Calculation

SGPT concentration: 1746 xabsorbance U/L

Chapter 4

4 Results

This chapter embodies the effects of mange prevalence in goats caused by the different risk factors *viz.* farm size, age, housing condition, housing system, feed, sex, breed, season, land topography, health condition, temperature, rainfall and humidity as well as to evaluate the economic impact of mange. This chapter is also concerned to the different treatment experiments of goat with herbal products like Neem (*Azadirachta indica*), Ata (*Annona reticulata*) and Mehedi (*Lawsonia inermis)* and Ivermectin medicine as well as to estimate the effects of different drugs on clinical parameters (hair coat, skin lesion, bodyweight and adverse effects), certain hematological parameters (TEC, Hb, PCV and TLC) and biochemical parameters (SGOT and SGPT).

4.1 Epidemiological Study

The effect of different risk factors such as farm size, feeding, breed, age, sex, season, land topography, housing system, housing condition, body condition, temperature, rainfall and humidity on the prevalence of mange mite in goat was detected in the study. Logistic regression analysis was done to show the comparative effects of some selected variables such as farm size, feeding, breed, age, sex, and season and land topography on the prevalence of mange in goats.

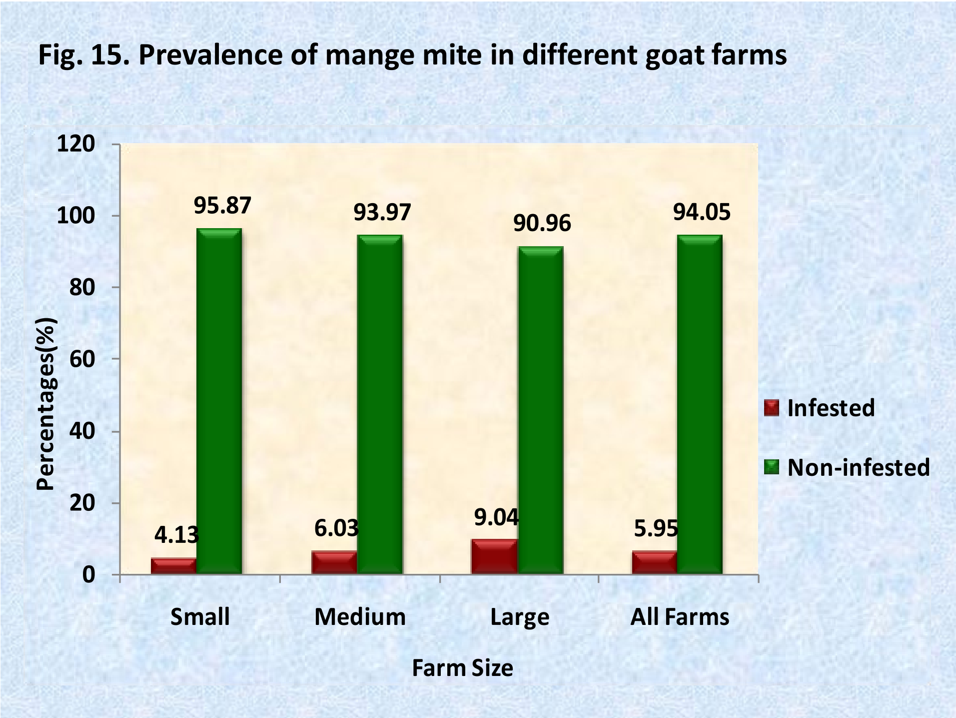
4.1.1 Prevalence of Mange Mite by Farm Size

In the present study goats were found to be infested by mange mite. Farm size specific prevalence of mange identified on goats is shown in Table 3. The different levels of mange mite affection were found in small, medium and large farms which were 4.13 per cent, 6.03 per cent and 9.04 per cent of each farm, respectively. The large farms were more affected than the medium and small farms. The overall prevalence of mange mite was computed at 1.02 per cent, 3.76 per cent, 1.17 per cent and 5.95 per cent in small, medium, large and all farms, respectively. It was found that the prevalence of mange mite was significantly (P = 0.033) different among the farm groups (Table 3).

Table 3. Prevalence of mange mite in different goat farms

Farm size	Number of goats	Mange mite			
		Affected	Non-affected	Overall Prevalence per cent (%)	P value
Small	315	13 (4.13)	302 (95.87)	1.02	0.033
Medium	796	48 (6.03)	748 (93.97)	3.76	
Large	166	15 (9.04)	151 (90.96)	1.17	
All farms	1277	76 (5.95)	1201 (94.05)	5.95	

Note: Figures within parentheses indicate percentages.



Logistic regression analysis of the effect of farm size after adjusting for feeding, breed, age, sex, season and land topography indicated the significant difference in prevalence of mange mite infestations between small farm and medium farm (Odds Ratio=0.402, P=0.026) and between small farm and large farm (Odds Ratio=0.618, P=0.082) (Table 4). It can be said that the prevalence of mange mite infestation was observed to be higher 40.2 per cent and 61.8 per cent in medium farm and large farm respectively, than small farm.

Table 4. Adjusted multivariate logistic regression, odds ratio and P values of farm size, feeding, breed, age, sex, season and land topography for mange mite of goats

Variables		Co-efficient (β)	P value	Odds Ratio
Farm size	Small (R)	--	--	1
	Medium	-0.911	0.026	0.402
	Large	-0.481	0.082	0.618
Feeding	Good (R)	--	--	1
	Moderate	0.095	0.112	1.02
	Poor	0.020	0.049	1.10
Breed	Cross (R)	--	--	1
	Black Bengal	-0.173	0.046	0.841
Age	<1 year (R)	--	--	1
	1 to <3 years	-0.955	0.003	0.385
	3 years and above	-0.393	0.012	0.675
Sex	Male (R)	--	--	1
	Female	-0.397	0.031	0.672
Season	Summer (R)	--	--	1
	Rainy	-3.014	0.003	0.049
	Winter	-2.370	0.001	0.094
Land topography	Low land (R)	--	--	1
	Medium land	0.308	0.814	1.360
	High land	-1.682	0.045	0.186
Constant		0.621	0.594	1.860

4.1.2 Prevalence of Mange Mite by Feeding

The mange mite infestations were found in different feeding conditions. It was found in good, moderate and poor level of feeding condition which was 3.61 per cent, 6.03 per cent and 8.25 per cent of each level of feeding condition, respectively. The highest prevalence of mange mite infestation was observed in poor feeding condition and it was lowest in good feeding condition. The overall prevalence of mange mite infestation was computed at 0.94 per cent, 2.97 per cent, 2.04 per cent and 5.95 per cent for good feeding, moderate feeding, poor feeding and overall feeding, respectively. The difference of mange mite prevalence among different feeding conditions was statistically significant (P=0.044).

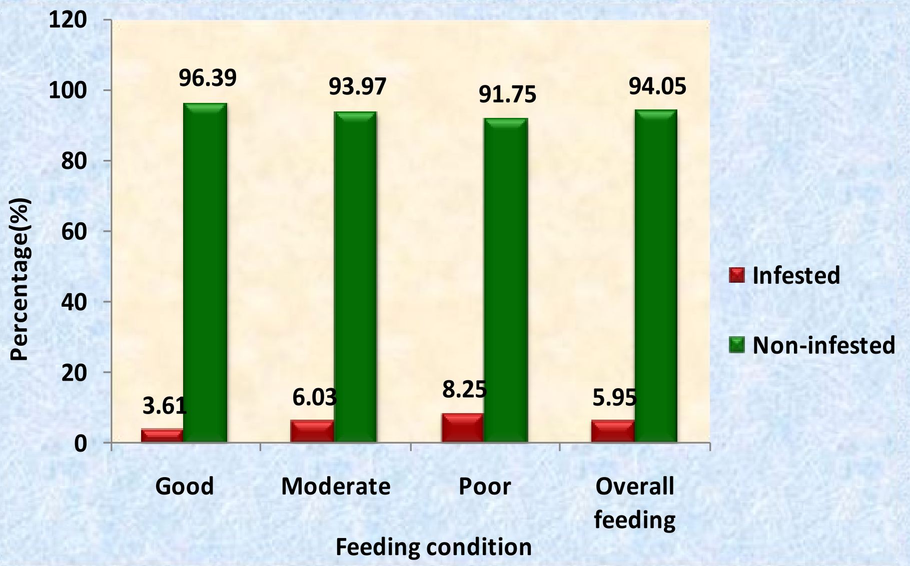
Logistic regression analysis of the effect of feeding after adjusting for farm size, breed, age, sex, season and land topography (Table 4) indicated the insignificant difference in prevalence of mange mite infestations between good feeding and moderate feeding (Odds Ratio=1.02, P=0.112) and it was the significant difference between good feeding and poor feeding (Odds Ratio=1.10, P=0.049). It can be interpreted that the prevalence of mange mite infestation was 1.02 times higher in moderate feeding than good feeding and it was 1.10 times higher in poor feeding than good feeding.

Table 5. Prevalence of mange mite in goat for feeding

Feeding	No. of goats	Mange mite			
		Affected	Non-affected	Overall prevalence per cent (%)	P value
Good	332 (100)	12 (3.61)	320 (96.39)	0.94	0.044
Moderate	630 (100)	38 (6.03)	592 (93.97)	2.97	
Poor	315 (100)	26 (8.25)	289 (91.75)	2.04	
Total	1277 (100)	76 (5.95)	1201 (94.05)	5.95	

Note: Figures within parentheses indicate percentages.

Fig. 16. Prevalence of mange mite in goat for feeding condition



4.1.3 Prevalence of Mange Mite by Breed

Black Bengal and cross breed were considered in the study. The different levels of mange infestation were detected in Black Bengal and cross breed which were 6.93 per cent and 3.09 per cent of individual breed, respectively. The study revealed that the highest prevalence of mange mite infestation was observed in Black Bengal breed and it was the lowest in cross breed. The overall prevalence of mange mite infestation was estimated at 0.78 per cent, 5.17 per cent and 5.95 per cent for cross breed and Black Bengal and all breed, respectively. It was found that the prevalence of mange mite was significantly (P= 0.012) different between cross breed and Black Bengal.

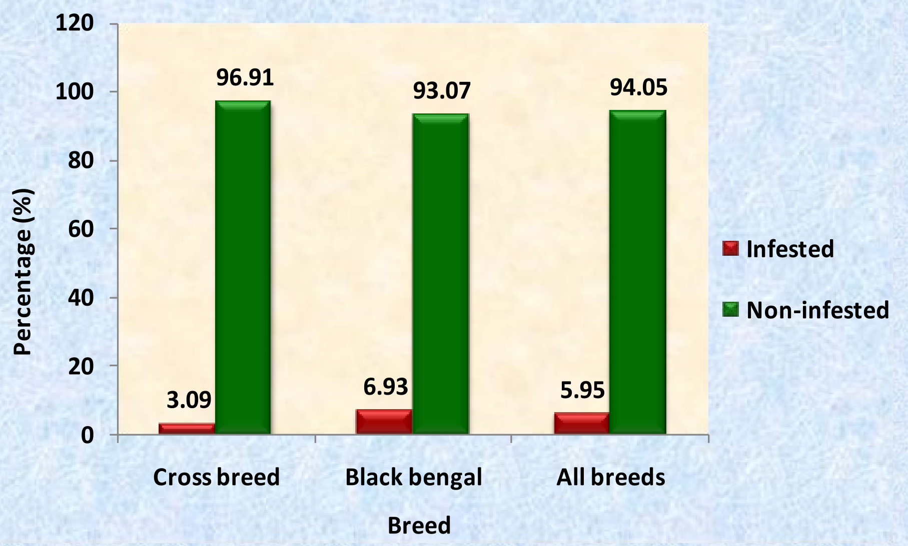
Logistic regression analysis of the effect of breed after adjusting for farm size, feeding, age, sex, season and land topography indicated the significant difference in prevalence of mange mite infestations between cross breed and Black Bengal (Odds Ratio=0.841, P=0.049) (Table 4). It can be explained that the prevalence of mange mite infestation was found to be higher 84.1 per cent in Black Bengal than cross breed.

Table 6. Prevalence of mange mite in goat for breed

Breed	No. of goats	Mange mite			
		Affected	Non-affected	Overall prevalence percent (%)	P-value
Cross breed	324 (100)	10 (3.09)	314 (96.91)	0.78	0.012
Black Bengal	953 (100)	66 (6.93)	887 (93.07)	5.17	
All breed	1277 (100)	76 (5.95)	1201 (94.05)	5.95	

Note: Figures within parentheses indicate percentages.

Fig. 17. Prevalence of mange mite in goat for breed



4.1.4 Prevalence of Mange Mite by Age

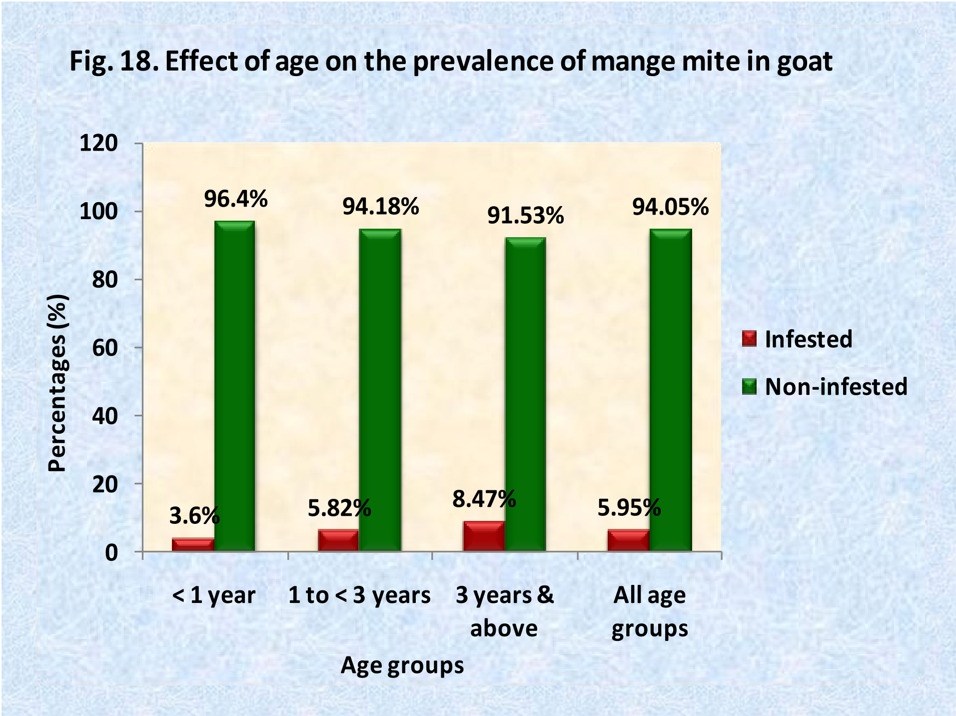
The prevalence of mange mite in goats was 3.60 per cent, 5.82 per cent and 8.47 per cent in age groups '< 1 year', '1 < 3 years' and '3 years and above', respectively. The results showed that the highest prevalence of mange mite was detected in the age group of 3 years and above and the lowest prevalence of mange mite was found in the age group of below 1 year (<1year). The overall prevalence percent of mange mite was calculated at 1.17 per cent, 2.04 per cent, 2.74 per cent and 5.95 percent for the age group of '< 1 year', '1 < 3 years' '3 years and above' and 'all age groups', respectively. It was observed that the prevalence of mange mite was significantly (P=0.012) different among the different age groups.

Table 7. Effect of age on the prevalence of mange mite in goat

Age group	Number of goats	Mange mite			
		Affected	Non-affected	Overall Prevalence per cent (%)	P value
< 1 year	417 (100)	15 (3.60)	402 (96.40)	1.17	0.012
1 < 3 years	447 (100)	26 (5.82)	421 (94.18)	2.04	
3 years and above	413 (100)	35 (8.47)	378 (91.53)	2.74	
All age groups	1277 (100)	76 (5.95)	1201 (94.05)	5.95	

Note: Figures within parentheses indicate percentages.

Logistic regression analysis of the effect of age after adjusting for farm size, feeding, breed, sex, season and land topography indicated the highly significant difference in prevalence of mange mite infestations between the age group of '< 1 year' and '1 < 3 years' (Odds Ratio=0.385, P=0.003) and between the age group of '< 1 year' and '3 years and above' (Odds Ratio=0.675, P=0.012) (Table 4). It can be interpreted that the prevalence of mange mite infestation was found to be higher 38.5 per cent and 67.5 per cent in the age group '1 < 3 years' and '3 years and above' than the age group '< 1 year', respectively.



4.1.5 Prevalence of Mange Mite by Sex

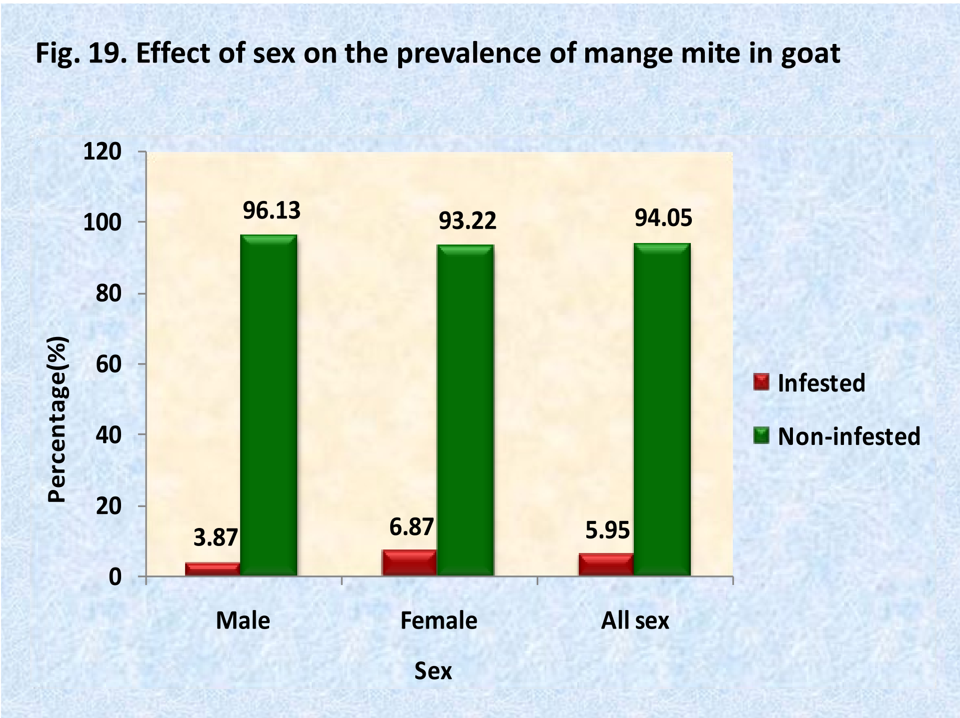
The prevalence of mange mite was found in goats considering sex which was estimated at 3.87 per cent in male and 6.78 per cent in female. The highest prevalence of mange mite was observed in female goats and it was the lowest in male goats. The overall prevalence of mange mite was computed at 1.09 per cent, 4.86 per cent and 5.95 per cent in the sex group of male, female and all (both sex), respectively. The difference between the mange mite prevalence of the different sex group was statistically significant (P=0.048).

Logistic regression analysis of the effect of sex after adjusting for farm size, feeding, breed, age, season and land topography indicated the significant difference in prevalence of mange mite infestations between male and female (Odds Ratio=0.672, P=0.031) (Table 4). It can be said that the prevalence of mange mite infestation was observed to be higher 32.8 {(1-0.672) x 100} per cent in female than male.

Table 8. Effect of sex on the prevalence of mange mite in goat

Sex	No. of goats	Mange mite			
		Affected	Non-affected	Overall prevalence percent (%)	P-value
Male	362 (100)	14 (3.87)	348 (96.13)	1.09	0.048
Female	915 (100)	62 (6.78)	853 (93.22)	4.86	
All (both sex)	1277 (100)	76 (5.95)	1201 (94.05)	5.95	

Note: Figures within parentheses indicate percentages.



4.1.6 Prevalence of Mange Mite by Season

The different levels of prevalence of mange mite in goat were found in different seasons of rainy, winter and summer which were 5.14 per cent, 10.74 per cent and

2.09 per cent of each season, respectively. The mange prevalence was observed to be higher in winter season and it was lower in summer season. The overall prevalence was estimated at 1.72 per cent, 3.52 per cent, 0.71 per cent and 5.95 per cent in rainy season, winter season, summer season and all season, respectively. The prevalence difference among the seasons was statistically highly significant (P=0.000).

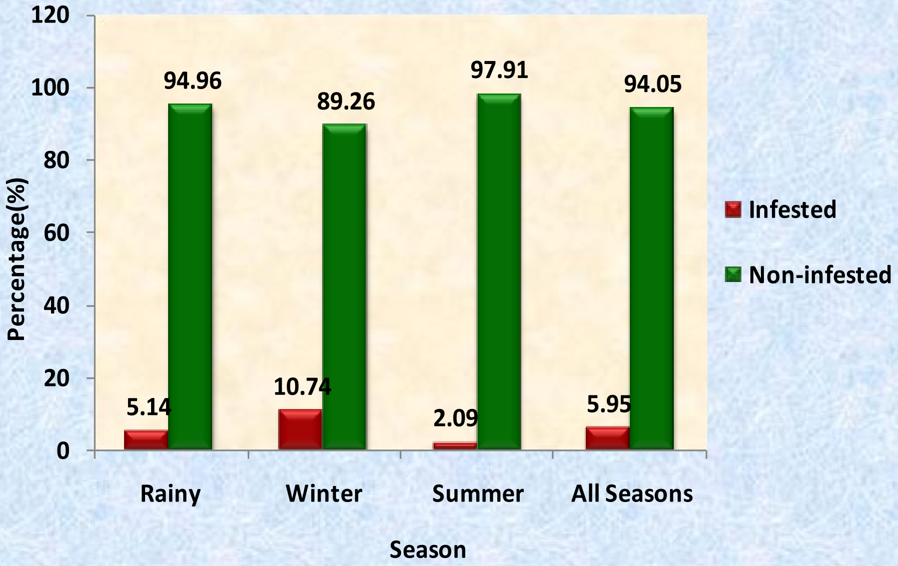
Logistic regression analysis of the effect of season after adjusting for farm size, feeding, breed, age, sex and land topography (Table 4) indicated the highly significant difference in prevalence of mange infestations between summer season and rainy season (Odds Ratio=0.049, P=0.003) and between summer season and winter season (Odds Ratio=0.094, P=0.001). It can be interpreted that the prevalence of mange mite infestation was observed to be lower 95.1 per cent and 90.6 per cent in summer season than rainy season and winter season respectively.

Table 9. Prevalence of mange mite on goat in different seasons

Seasons	No. of goats	Mange mite			
		Affected	Non-affected	Overall Prevalence percent (%)	P value
Rainy	428 (100)	22 (5.14)	406 (94.96)	1.72	0.000
Winter	419 (100)	45 (10.74)	374 (89.26)	3.52	
Summer	430 (100)	9 (2.09)	421 (97.91)	0.71	
All Seasons	1277 (100)	76 (5.95)	1201 (94.05)	5.95	

Note: Figures within parentheses indicate percentages.

Fig. 20. Prevalence of mange mite on goat in different seasons



4.1.7 Prevalence of Mange Mite by Land Topography

The prevalence of mange mite was found in goat for different types of land topography in the study area. It was computed to be at 8.81 per cent, 5.94 per cent and 3.09 per cent for low land, medium land and high land, respectively. The results show that the highest prevalence of mange mite was detected in low land and it was the lowest in high land. The overall prevalence was estimated to be at 1.80 per cent, 3.52 per cent, 0.63 per cent and 5.95 per cent in low land, medium land, high land and all land topography, respectively. It was observed that the prevalence of mange mite was significantly (P= 0.022) different among the different land topography.

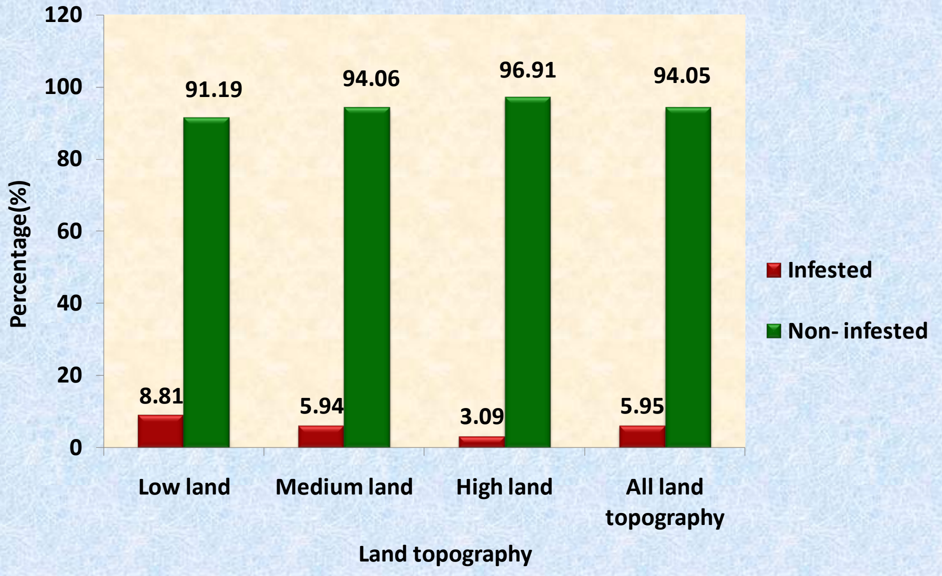
Logistic regression analysis of the effect of land topography after adjusting for farm size, feeding, breed, age, sex and season (Table 4) indicated the insignificant (Odds Ratio=1.36, P=0.814) and it was the significant difference in prevalence of mange mite infestations between low land and high land (Odds Ratio=0.186, P=0.045). It can be interpreted that the prevalence of mange mite infestation was 1.36 times lower in medium land than low land and it was found to be lower 81.4 per cent {(1-0.186) X 100} in high land than low land.

Table 10. Effect of land topography on the prevalence of mange mite in goat

Land topography	No. of goats	Mange mite			
		Affected	Non-affected	Overall prevalence percent (%)	P-value
Low land	261	23 (8.81)	238 (91.19)	1.80	0.022
Medium land	757	45 (5.94)	712 (94.06)	3.52	
High land	259	8 (3.09)	251 (96.91)	0.63	
All land topography	1277	76 (5.95)	1201 (94.05)	5.95	

Note: Figures within parentheses indicate percentages.

Fig. 21. Effect of land topography on the prevalence of mange mite in goat



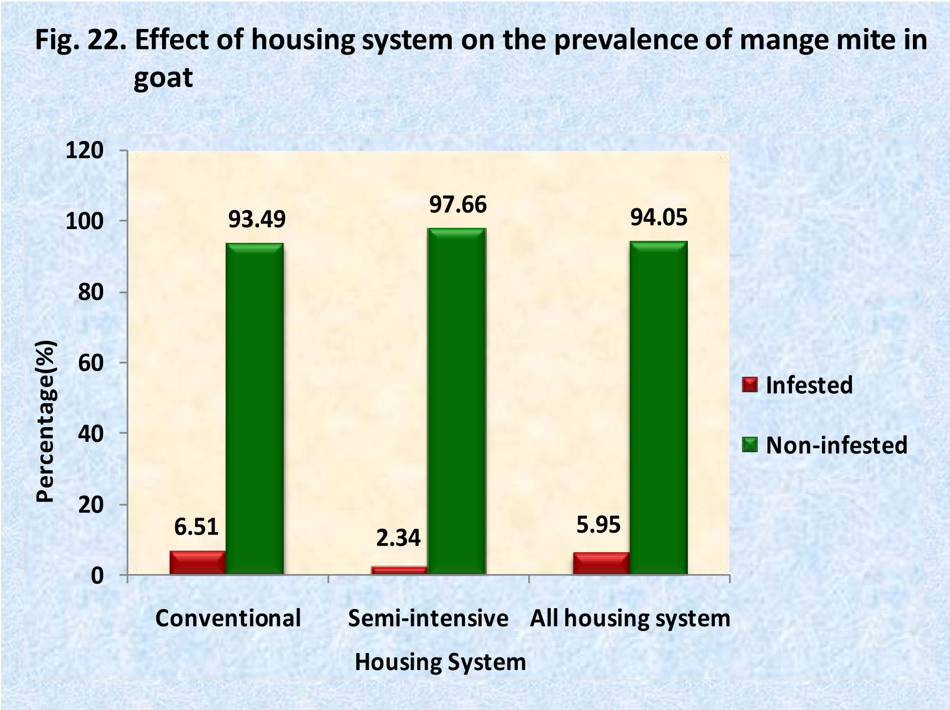
4.1.8 Prevalence of Mange Mite by Housing System

The different levels of mange mite infestation were detected in conventional and semi-intensive housing systems which were 6.51 per cent and 2.34 per cent of each housing system, respectively. The highest prevalence of mange mite was found in conventional housing system and it was the lowest in semi-intensive housing system. The overall prevalence was computed at 5.64 per cent, 0.31 per cent and 5.95 per cent for conventional housing system, semi-intensive housing system and all (both housing system). The difference between mange mite prevalence of different housing system was statistically significant (P=0.032).

Table 11. Effect of housing system on the prevalence of mange mite in goat

Housing system	Number of goats	Mange mite			
		Affected	Non-affected	Overall prevalence percent (%)	P value
Conventional	1106 (100)	72 (6.51)	1034 (93.49)	5.64	0.032
Semi-intensive	171 (100)	4 (2.34)	167 (97.66)	0.31	
All housing system	1277 (100)	76 (5.95)	1201 (94.05)	5.95	

Note: Figures within parentheses indicate percentages.



4.1.9 Prevalence of Mange Mite by Housing Condition

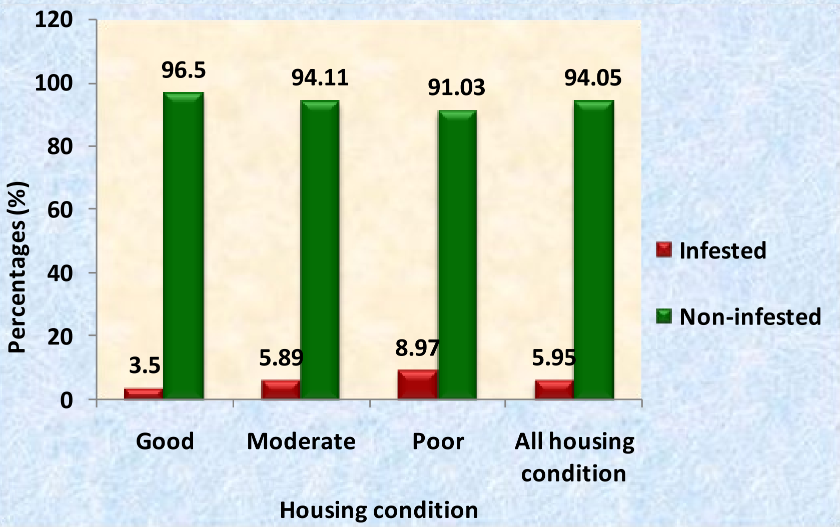
The different levels of mange mite infestation were detected in different housing conditions. The prevalence of mange infestation was found to be 3.5 per cent, 5.89 per cent and 8.97 per cent in good, moderate and poor level of housing conditions, respectively. The highest prevalence of mange mite infestation was detected in poor housing condition and it was the lowest in good housing condition. The overall prevalence was computed at 1.02 per cent, 2.74 per cent, 2.19 and 5.95 per cent for good housing, moderate housing, poor housing and all housing condition, respectively. The difference between the prevalence was statistically significant (P=0.011).

Table 12. Effect of housing condition on the prevalence of mange mite in goats

Housing condition	Number of goats	Mange			
		Affected	Non-affected	Overall prevalence percent (%)	P value
Good	371 (100)	13 (3.50)	358 (96.50)	1.02	0.011
Moderate	594 (100)	35 (5.89)	559 (94.11)	2.74	
Poor	312 (100)	28 (8.97)	284 (91.03)	2.19	
All housing condition	1277 (100)	76 (5.95)	1201 (94.05)	5.95	

Note: Figures within parentheses indicate percentages.

Fig. 23. Effect of housing condition on the prevalence of mange mite in goat



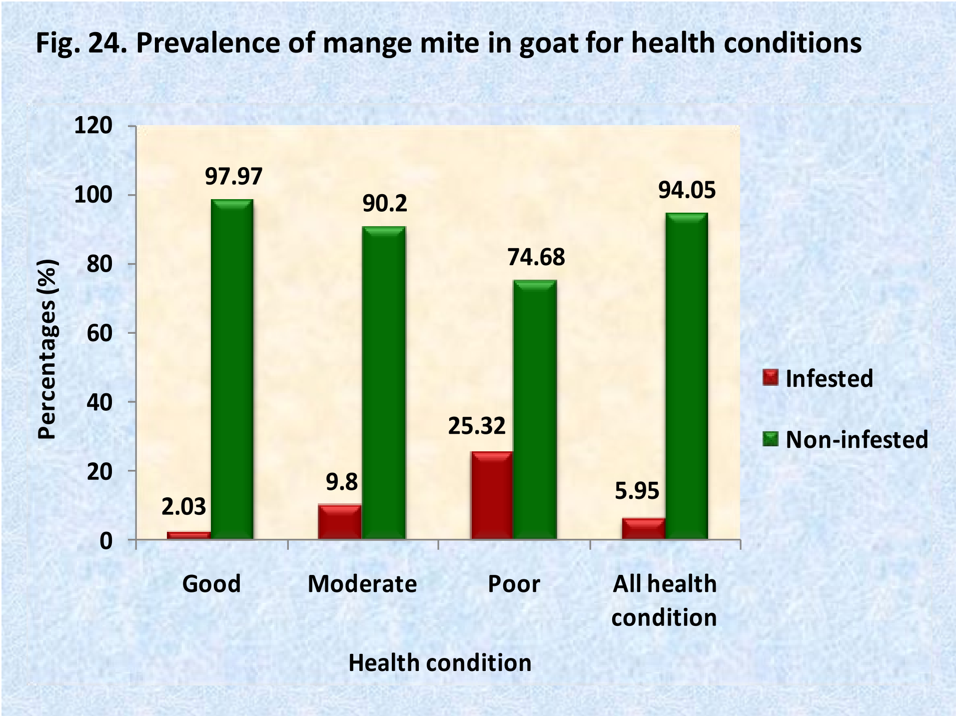
4.1.10 Prevalence of Mange Mite by Health Condition

The different levels of mange mite infestations were found in various health conditions. The prevalence of mange infestation was found to be 2.03 per cent, 9.80 per cent and 25.32 per cent in good health, moderate health and poor health condition, respectively. The study revealed that the highest prevalence of mange mite infestation was found in poor health and it was the lowest in good health condition. The overall prevalence of mange mite infestation was computed at 1.25 per cent, 3.13 per cent, 1.57 per cent and 5.95 per cent for good health, moderate health, poor health and all health condition, respectively. The Chi-Square (P-value) is 0.000. So, the difference between the prevalence was statistically highly significant.

Table 13. Prevalence of mange mite in goats for different health conditions

Health condition	Number of goats	Mange mite			
		Affected	Non-affected	Overall prevalence percent (%)	P value
Good	790 (100)	16 (2.03)	774 (97.97)	1.25	0.000
Moderate	408 (100)	40 (9.80)	368 (90.20)	3.13	
Poor	79 (100)	20 (25.32)	59 (74.68)	1.57	
Overall condition	1277 (100)	76 (5.95)	1201 (94.05)	5.95	

Note: Figures within parentheses indicate percentages.



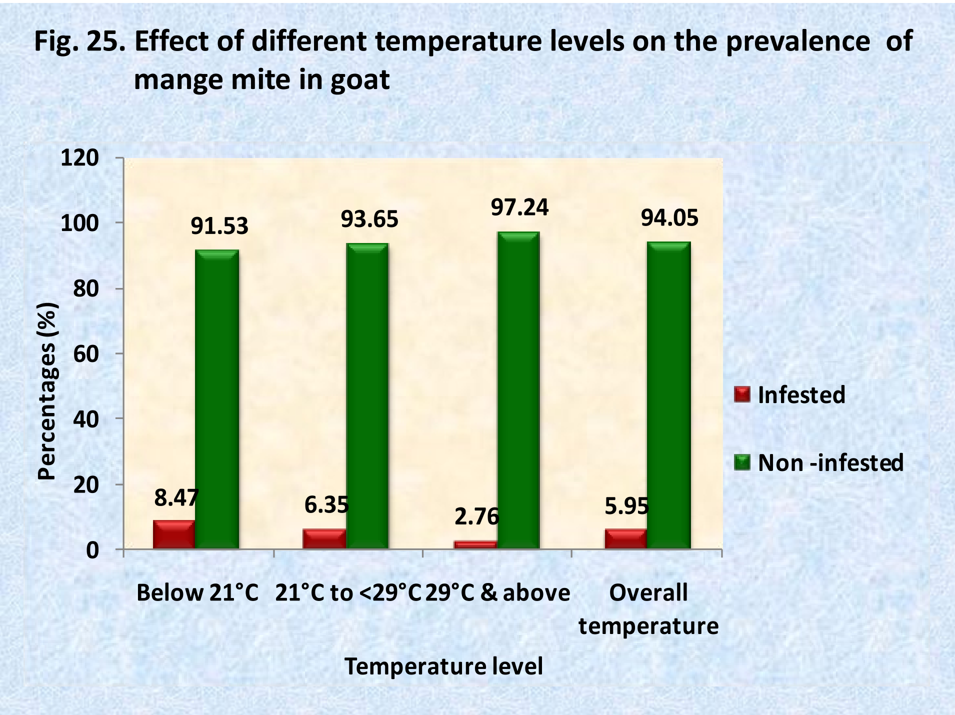
4.1.11 Prevalence of Mange Mite by Temperature

The prevalence of mange mite in goat was observed in different ranges of temperature. It was estimated at 8.47 per cent, 6.35 per cent and 2.76 per cent in the temperature range of 'below 21^0C', '21^0C to <29^0C' and '29^0C & above', respectively. The prevalence of mange mite infestation was found to be the highest in the temperature range of 'below 21^0C' and it was the lowest in the temperature range '29^0C & above'. The overall prevalence of mange mite infestation was compute at 2.90 percent, 2.19 percent, 0.86 percent and 5.95 percent for the temperature range of 'below 21^0C', '21^0C to < 29^0C', '29^0C & above' and overall temperature, respectively. The difference between the mange mite prevalence of different temperature ranges was statistically significant (P=0.002).

Table 14. Effect of different temperature levels on the prevalence of mange mite in goats

Temperature level	Number of goats	Mange mite			
		Affected	Non-affected	Overall prevalence percent (%)	P value
Below 21^{0}C	437 (100)	37 (8.47)	400 (91.53)	2.90	0.002
21^{0}C to <29^{0}C	441 (100)	28 (6.35)	413 (93.65)	2.19	
29^{0}C & above	399 (100)	11 (2.76)	388 (97.24)	0.86	
Overall temperature	1277 (100)	76 (5.95)	1201 (94.05)	5.95	

Note: Figures within parentheses indicate percentages.



4.1.12 Prevalence of Mange Mite by Rainfall

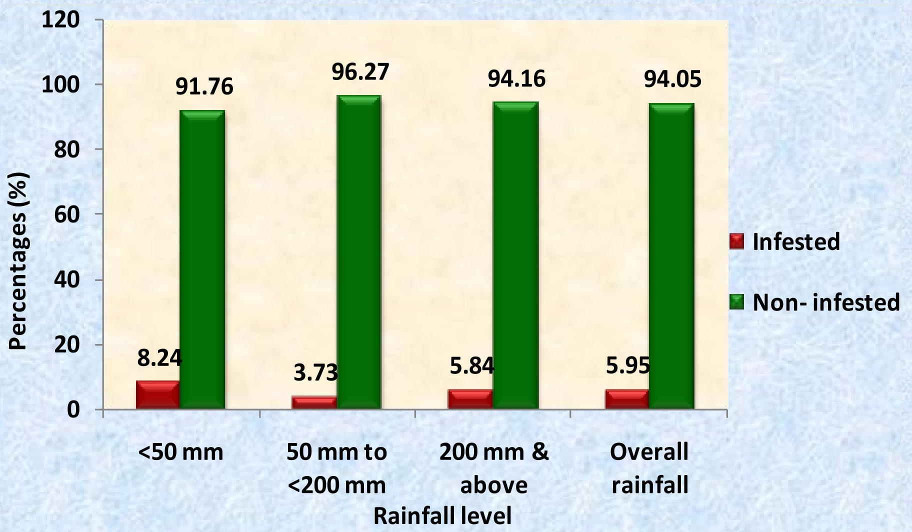
The different levels of prevalence of mange mite in goat were detected in different ranges of rainfall in the study area. The prevalence of mange mite infestation was estimated at 8.24 per cent, 3.73 per cent and 5.84 per cent for the rainfall range of 'below 50 mm', '50 mm to < 200 mm' and '200 mm & above' respectively. The highest prevalence of mange mite infestation was observed in the rainfall range 'below 50 mm' and it was the lowest in the rainfall range '50 mm to <200 mm'. The overall prevalence was computed at 2.82 per cent, 1.25 per cent, 1.88 per cent and 5.95 per cent in the rainfall range 'below 50 mm', '50 mm to <200 mm', '200 mm & above' and overall rainfall, respectively. The difference between the prevalence was statistically significant (P=0.019).

Table 15. Effect of different rainfall levels on the prevalence of mange mite in goats

Rainfall level	Number of goats	Mange mite			
		Affected	Non-affected	Overall prevalence percent (%)	P-value
Below 50 mm	437 (100)	36 (8.24)	401 (91.76)	2.82	0.019
50 mm to < 200 mm	429 (100)	16 (3.73)	413 (96.27)	1.25	
200 mm & above	411 (100)	24 (5.84)	387 (94.16)	1.88	
Overall rainfall	1277 (100)	76 (5.95)	1201 (94.05)	5.95	

Note: Figures within parentheses indicate percentages.

Fig. 26. Effect of different rainfall levels on the prevalence of mange mite in goat



4.1.13 Prevalence of Mange Mite by Humidity

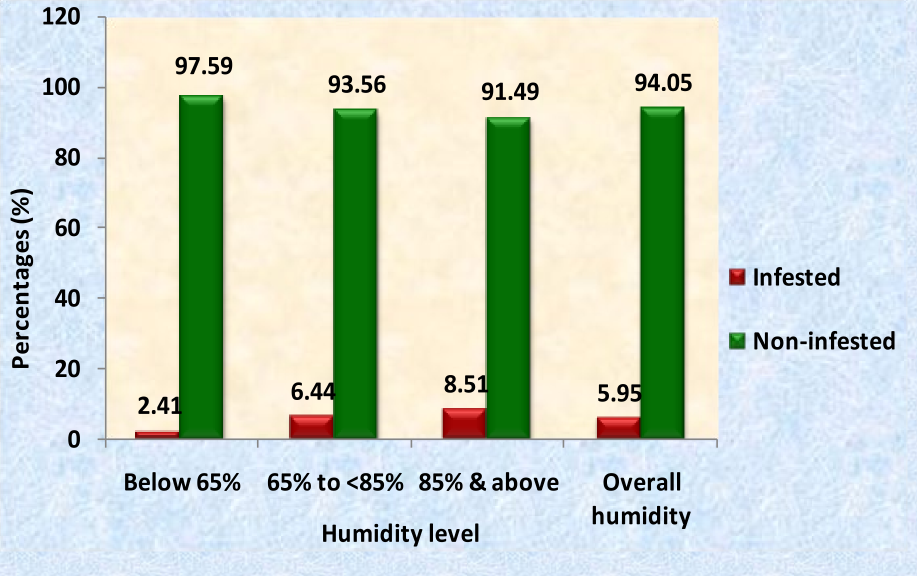
The different levels of prevalence of mange mite in goat were observed in different ranges of humidity. The prevalence of mange mite infestation was calculated at 8.93 per cent, 3.64 per cent and 5.52 per cent corresponding to the humidity range 'below 65%', '65% to < 85%' and '85% & above', respectively. The prevalence of mange mite infestation was observed to be the highest in the humidity range 'below 65%' and it was the lowest in the humidity range '65% to < 85%'. The overall prevalence was computed at 2.82 per cent, 1.25 per cent, 1.88 per cent and 5.95 per cent corresponding to the humidity range 'below 65%', '65% to < 85%', '85% & above' and overall humidity respectively. The difference between the prevalence was statistically significant (P=0.001).

Table 16. Effect of different humidity levels on the prevalence of mange mite in goats

Humidity level	Number of goats	Mange mite			
		Affected	Non-affected	Overall prevalence percent (%)	P-value
Below 65%	403 (100)	36 (8.93)	367 (91.07)	2.82	0.001
65% to < 85%	454 (100)	16 (3.64)	423 (96.36)	1.25	
85% & above	420 (100)	24 (5.52)	411 (94.48)	1.88	
Overall humidity	1277 (100)	76 (5.95)	1201 (94.05)	5.95	

Note: Figures within parentheses indicate percentages.

Fig. 27. Effect of different humidity levels on the prevalence of mange mite in goat

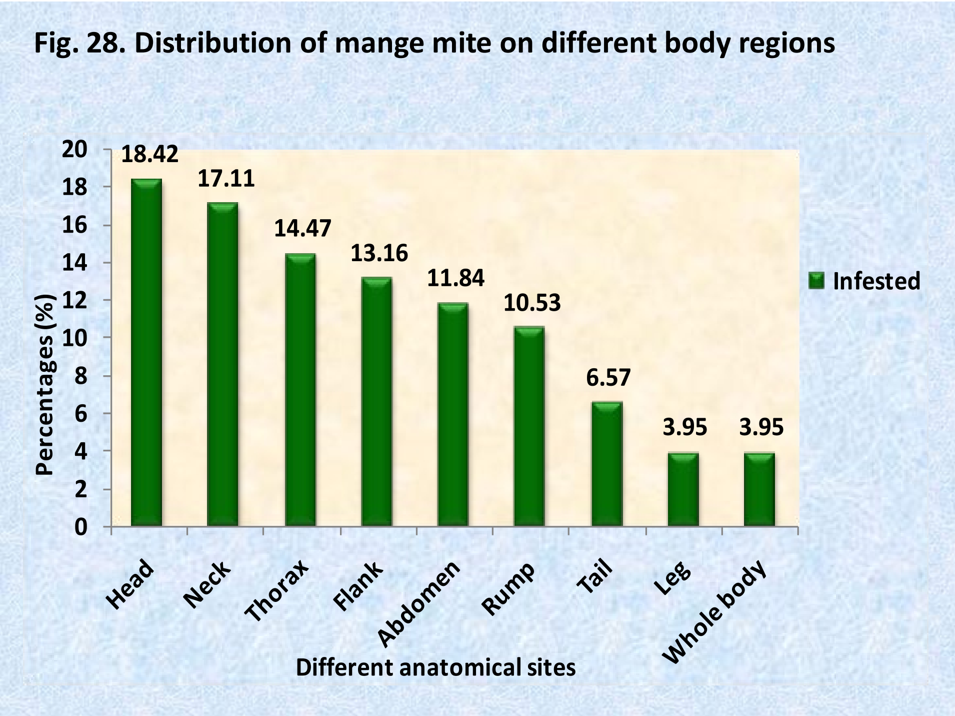


4.1.14 Distribution of Mange Mite

The distribution of mange mite in different anatomical sites of goats was also identified. It was studied on nine anatomical sites. Mange mites were detected at the highest frequency from the head region 18.42 (14 of 76) per cent followed by the neck region 17.11 per cent (13 of 76) and the region of the thorax 14.47 per cent (11 of 76), flank region 13.16 per cent (10 of 76), abdomen region 11.84 per cent (9 of 76), rump region 10.53 per cent (8 of 76), tail region 6.57 per cent (5 of 76), leg region 3.95 per cent (3 of 76) and whole body 3.95 percent (3 of 76). The mange mites were detected at highest frequency on the head region and at lowest frequency on the regions of the tail, leg and whole body. The distributions of mange mite in different anatomical sites are presented in Table 17.

Table 17. Distribution of mange mite on different anatomical sites in goats

Affected region	Head	Neck	Thorax	Flank	Abdomen	Rump	Tail	Leg	Whole body	Total Affected
Affected goat (no.)	14	13	11	10	9	8	5	3	3	76
Prevalence (%)	18.42	17.11	14.47	13.16	11.84	10.53	6.57	3.95	3.95	100



4.1.15 Economic Impact of Mange Mite

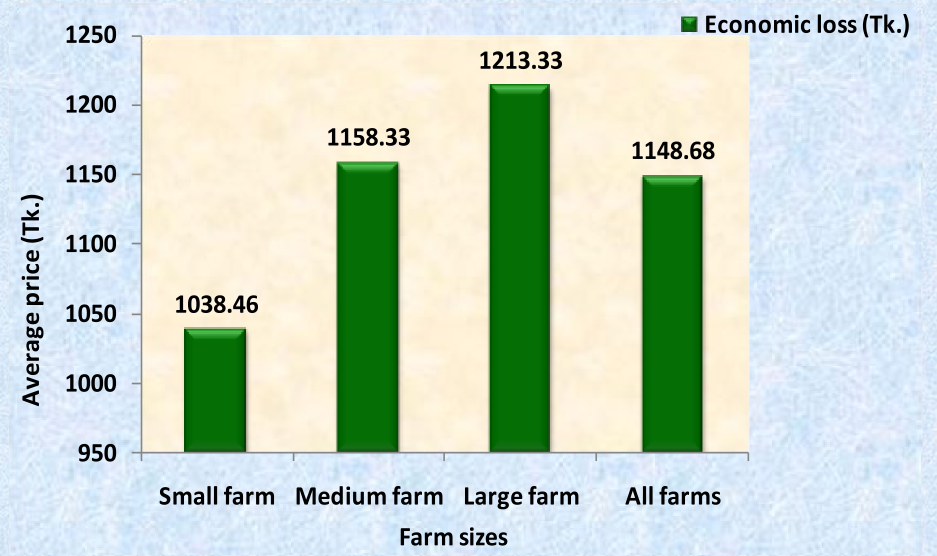
There is no study on economic impact of mange disease of goats in Bangladesh due to insufficient information. This impact must be certainly high that causes a considerable economic loss to the different goat rearing farms. The average economic loss was incurred at Tk.1038.46, Tk.1158.33, Tk.1213.33 and Tk.1148.68 in small, medium, large and all farms, respectively in the study area. The highest economic loss was incurred in large farm and it was the lowest in small farm.

Table 18. Yearly economic impact of goat rearing farms due to mange mite

Farm size	Average value of non-affected goat (Tk)	Average value of affected goats (Tk)	Economic loss due to mange affection (Tk)
Small farm	4015.39	2976.92	1038.46
Medium farm	4364.58	3206.25	1158.33
Large farm	4413.33	3200.00	1213.33
All farms	4314.47	3165.79	1148.68

Source: Field survey, 2010-2011

Fig. 29. Yearly economic impact of goat rearing farms due to mange infestation



4.2 Clinical Diagnosis of Mange

The mange was identified by the following ways:

4.2.1 Examination of Goat

The selected goats were thoroughly investigated by close inspection, palpation and parting the hairs. The pathological lesions produced by the mites were mostly found on the ear, face, neck, thorax, flank, rump, abdomen, tail and leg. The skin lesions were characterized by rough, dry and leathery conditions with loss of hair (alopecia). In some cases, skin was thick and mild to moderate corrugation was present. Dandruff was found in each affected animal. {Fig. 30 (a) and Fig. 30 (b)}.

Fig. 30(a). Mange infested goat

Fig. 30(b). Mange infested goat

4.2.2 Examination of Deep Skin Scraping

The mange was positive in collected deep skin scraping from the affected goats examined under the light microscope. Only species of mite, *Sarcoptes scabiei* was identified through the preparation of permanent slide. The whole procedures of deep skin scraping and preparation of permanent slide are shown in {Fig. 31 (a) & Fig. 31 (b)}.

Fig. 31(a). *Sarcoptes Scabiei* (Dorsal view)

Fig. 31(b). *Sarcoptes Scabiei* (Ventral view)

4.2.3 Skin Biopsy Method or Histopathology

Histopathologically the lesions were characterized by hyperkeratosis, eosinophilic infiltration, acanthosis and superficially by the loss of cornified layer associated with aggregation of necrotic cellular debris {Fig. 32 (a) and Fig. 32 (b)}.

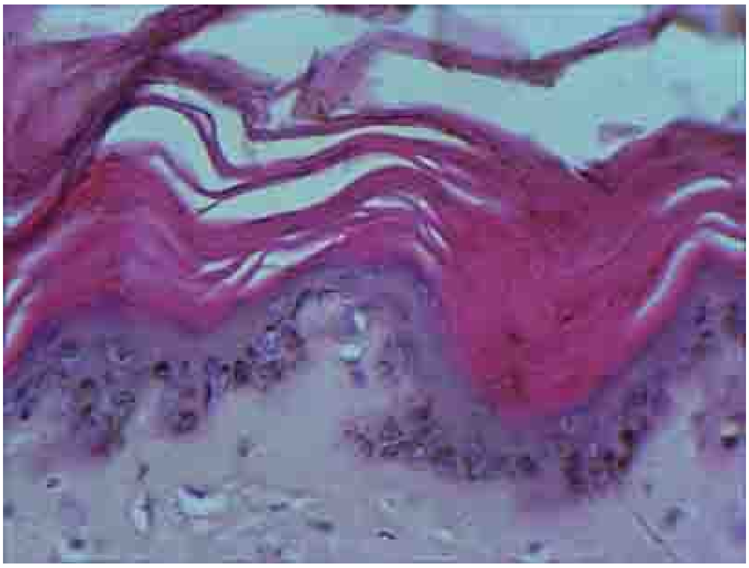


Fig. 32(a). Mite infestation in goat characterized by acanthosis, hyperkeratosis and infiltration of inflammatory cells (lower magnification)

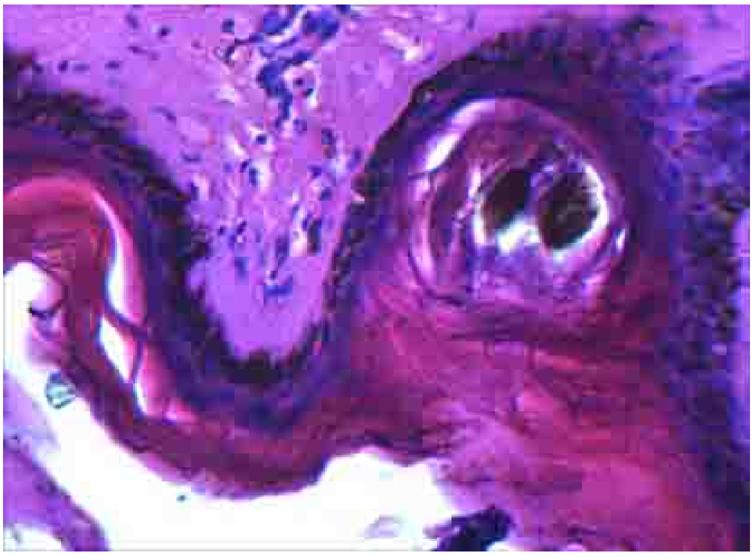


Fig. 32(b). Aggregation of necrotic cellular debris in mite infestation in goat (higher magnification)

4.3 Experimental Study for Mange Control in Goats

An experiment with different treatments was conducted to control mange in selected goats. The Ivermectin medicine and herbal products like Neem (*Azadirachta indica*), Ata (*Annona reticulata*) and Mehedi (*Lawsonia inermis)* were used as drug for treatment to control mange in goats. The results of clinical parameters (hair coat, skin lesion, bodyweight and adverse effects), certain hematological parameters (TEC, Hb, PCV and TLC) and biochemical parameters (SGOT and SGPT) are discussed subsequently below.

4.3.1 Clinical Parameters

4.3.1.1 Hair Coat

Hair coat of each affected goat of different treatment groups (B, C, D and E) as well as non-treatment groups (control groups A) was rough with discoloured wool on day 0 (pre-treatment). It was observed that the hair coat of goats started to become smooth and shiny gradually after giving the treatment with Neem, Ata, Mehidi and Ivermectin in the group of B, C, D and E, respectively. The hair coat of the infected control group A became more and discolored. The patent drug Ivermectin showed better results than the herbal drugs in the experiment.

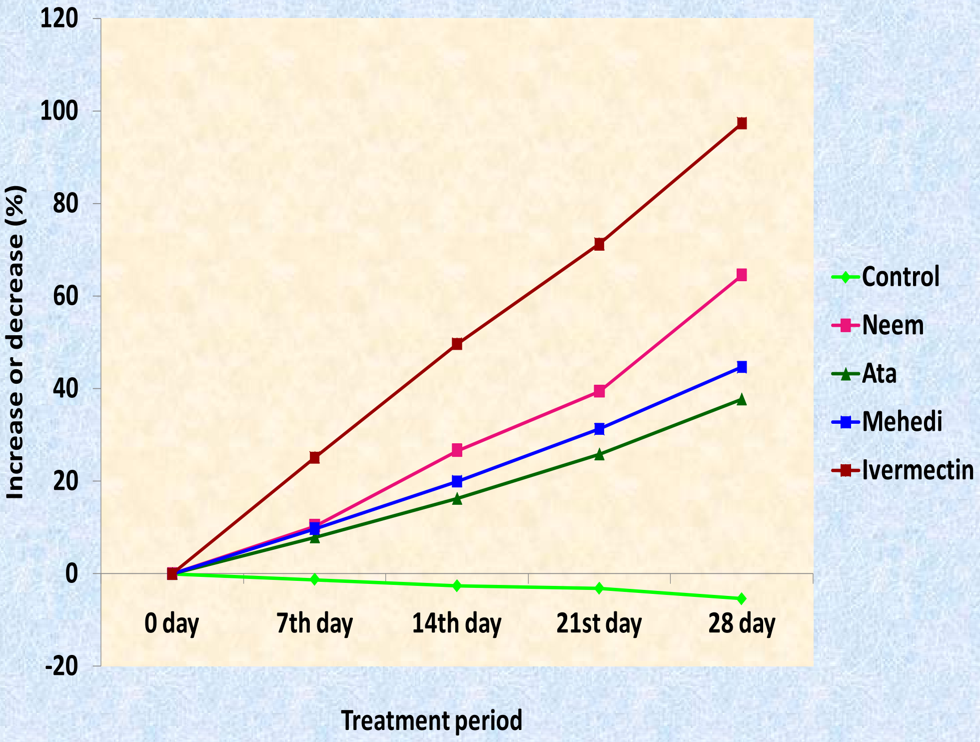
4.3.1.2 Skin Lesion

The skin lesion caused by mange was examined in individual goat. The condition of skin lesions was observed at pretreatment (0 day) and treatment period (7^{th}, 14^{th}, 21th, 28^{th}). The efficacy of three herbal and one patent drug against mange infestation in goats is presented in the Table 19. In the control group A, it was found that the wound per skin lesion area was gradually increased at 1.23 per cent, 2.63 per cent, 3.16 per cent and 5.44 per cent on the treatment days of 7^{th}, 14^{th}, 21^{st} and 28^{th}, respectively. On the other hand, the group of B, C, D and E were treated with Neem, Ata, Mehedi and Ivermectin, respectively. In the group B, it was found that the wound per lesion area was decreased at 10.33 per cent, 26.68 per cent, 39.40 per cent and 64.57 per cent on the treatment days of 7^{th}, 14^{th}, 21^{st} and 28^{th}, respectively.

Table 19. Comparative efficacy of herbal preparations and Ivermectin on skin lesions in goats

Experi-mental days	Area (cm^2) of skin lesion in group A (control) (mean ±SD)	% of wound/ lesion area increased	Area (cm^2) of skin lesion in group B (Neem) (mean ±SD)	% of wound/ lesion area decreased	Area (cm^2) of skin lesion in group C (Ata) (mean ±SD)	% of wound/ lesion area decrease d	Area (cm^2) of skin lesion in group D (Mehedi) (mean ±SD)	% of wound/ lesion area decreased	Area (cm^2) of skin lesion in group E Ivermectin) (mean ±SD)	% of wound/ lesion area decreased
0	9.50±0.50		10.58±0.38		9.08±0.63		8.95±0.85		11.90±0.61	
7	9.62±0.60	1.23	9.49±0.65	10.33	8.36±0.29	7.93	8.07±0.77	9.76	8.92±0.38	25.07
14	9.75±0.51	2.63	7.76±0.28	26.68	7.61±0.24	16.26	7.16±0.73	19.97	5.98±0.64	49.72
21	9.80±0.43	3.16	6.41±0.33	39.40	6.73±0.21	25.87	6.15±0.29	31.22	3.42±0.26	71.26
28	10.02±0.38	5.44	3.75±0.25	64.57	5.65±0.27	37.76	4.96±0.55	44.60	0.31±0.17	97.37

Fig. 33. Line diagram showing the effects of herbal preparations and Ivermectin on efficacy of skin lesions in goats



In the group C, the wound per lesion area was decreased at 7.93 per cent, 16.26 per cent, 25.87 per cent and 37.76 per cent on the treatment days of 7th, 14th, 21st and 28th, respectively. It was found in the group D that the wound per lesion area was decreased at 9.76 per cent, 19.97 per cent, 31.22 per cent and 44.60 per cent on the treatment days of 7th, 14th, 21st and 28th, respectively and it was decreased at 25.07 per cent, 49.72 per cent, 71.26 per cent and 97.37 per cent on the treatment days of 7th, 14th, 21st and 28th, respectively in the group E.

Table 20. Comparative effects of different treatments on skin lesions in experimental groups of goats by using ANOVA

Treatment Groups		Sum of Squares	df	Mean Square	F	P value
Group A (Control)	Between groups	2.320	2	1.160	26.417	0.384
	Within groups	0.527	12	0.043		
	Total	2.847	14			
Group B (Neem)	Between Groups	0.677	2	0.338	0.047	0.059
	Within Groups	87.146	12	7.262		
	Total	87.822	14			
Group C (Ata)	Between Groups	0.466	2	0.233	0.123	0.085
	Within Groups	22.636	12	1.886		
	Total	23.102	14			
Group D (Mehidi)	Between Groups	3.609	2	1.804	0.712	0.079
	Within Groups	30.403	12	2.534		
	Total	34.012	14			
Group E (Ivermectin)	Between Groups	1.199	2	0.599	0.029	0.041
	Within Groups	247.607	12	20.634		
	Total	248.805	14			

Table 19 shows that the maximum recovery of skin lesion was occurred in group E with the treatment of Ivermectin that was significant (P=0.04) (Table 20). The recovery of skin lesion was found to be significant in group B, C and D with the treatment of Neem (P=0.059), Ata (P=0.085) and Mehedi (P=0.079), respectively. On the other hand, the skin lesion was expanded in the control group A with the treatment of no drugs that was insignificant (P=0.384) (Table 20).

4.3.1.3 Bodyweight

The average bodyweights of the experimental goats on 0 day (pre-treatment) were 14.02 kg, 17.58 kg, 15.27 kg, 12.76 kg and 12.50 kg for the group of A, B, C, D and E, respectively and after treatment it was estimated on 28th day (post-treatment) at 13.06 Kg, 18.77 Kg, 15.99 Kg, 14.09 Kg and 13.22 Kg in the treatment group A, B, C, D and E, respectively. In the control group A, it was observed that the bodyweight was decreased at 6.85 percent on 28th day from the 0 day which was significant (P=0.077). Table 21 showed that the bodyweights of goats were increased with the treatment of Neem, Ata, Mehedi and Ivermectin at 6.73 per cent, 4.74 per cent, 10.40 per cent and 5.73 per cent, respectively to the post-treatment (28th day) from the pre-treatment (0 day).

Table 21. Effect of different herbal and Ivermectin drugs on bodyweight of goats

Name of the groups and drugs	Pre-treatment	Post-treatment			
	0 day	7th day	14th day	21st day	28th day
Group A (Control)	14.02±0.35	13.82±0.33 (1.45^{b})	14.04±0.34 (0.12^{a})	13.55±0.27 (3.38^{b})	13.06±0.35 (6.85^{b})
Group B (Neem)	17.58±0.38	17.81±0.33 (1.29^{a})	18.09±0.37 (2.90^{a})	18.42±0.37 (4.78^{a})	18.77±0.48 (6.73^{a})
Group C (Ata)	15.27±0.48	15.52±0.31 (1.64^{a})	15.47±0.26 (1.31^{a})	15.72±0.49 (2.95^{a})	15.99±0.28 (4.74^{a})
Group D (Mehedi)	12.76±0.65	12.98±0.59 (1.72^{a})	13.32±0.63 (4.39^{a})	13.62±0.76 (6.74^{a})	14.09±0.72 (10.40^{a})
Group E (Ivermectin)	12.50±0.50	12.83±0.55 (2.67^{a})	12.97±0.35 (3.73^{a})	13.03±0.51 (4.27^{a})	13.22±0.33 (5.73^{a})

'a' and 'b' indicate the increase and decrease percentages, respectively.

The maximum increase of bodyweight (10.40 per cent) was depicted in the treatment group D (Mehedi) and the minimum increase (4.74 per cent) was observed in the treatment group C. The effect of Ata (P=0.078) was significant and Neem (P=0.007), Mehedi (P=0.006) and Ivermectin (P=0.001) showed the highly significant effects (Table 22).

Fig. 34. Line diagram showing the effects of herbal and Ivermectin drugs on bodyweight of goats

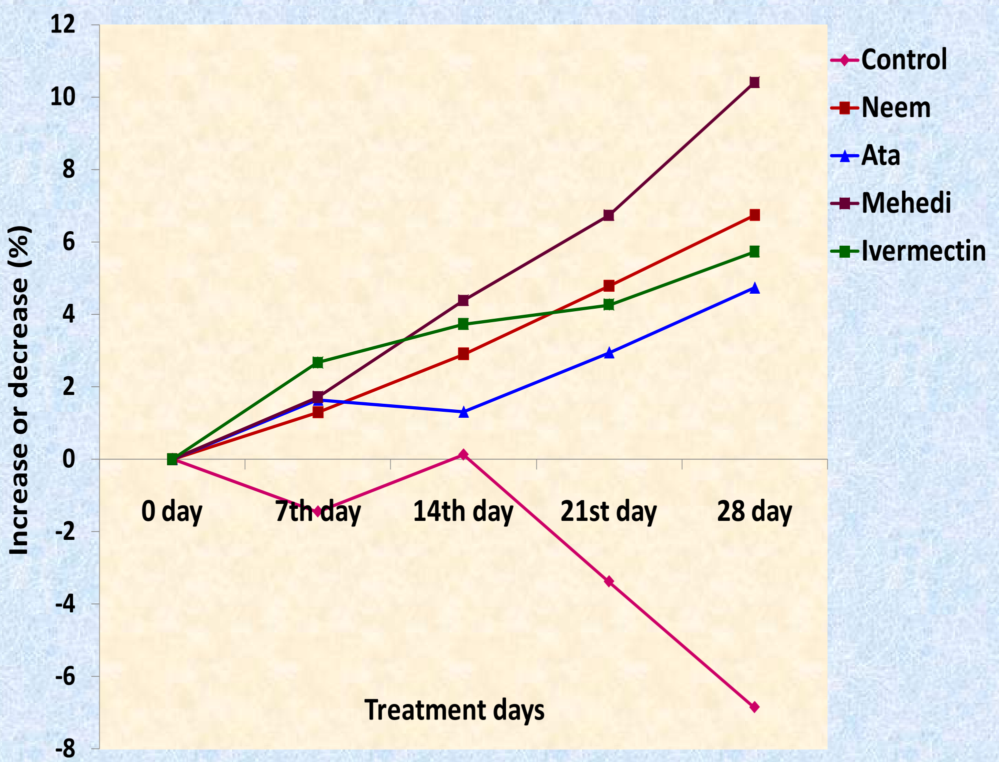


Table 22. Comparative effects of different treatments on bodyweight of experimental goats by using ANOVA

Treatment Groups		Sum of Squares	df	Mean Square	F	P value
Group A (Control)	Between Groups	1.067	2	0.534	3.204	0.077
	Within Groups	1.998	12	0.167		
	Total	3.065	14			
Group B (Neem)	Between Groups	1.067	2	0.534	3.204	0.007
	Within Groups	1.998	12	0.167		
	Total	3.065	14			
Group C (Ata)	Between Groups	1.453	2	0.727	3.183	0.078
	Within Groups	2.739	12	0.228		
	Total	4.193	14			
Group D (Mehidi)	Between Groups	1.294	2	0.647	7.692	0.006
	Within Groups	1.010	12	0.084		
	Total	2.304	14			
Group E (Ivermectin)	Between Groups	4.472	2	2.236	8.017	0.001
	Within Groups	3.347	12	0.279		
	Total	7.819	14			

4.3.1.4 Adverse Effects

There was an attempt to see the adverse effects of herbal and Ivermectin drugs during the treatment period of the experimental goats. But, no visible effects of the different drugs were observed in the four experimental groups of goats.

4.3.2 Hematological Parameters

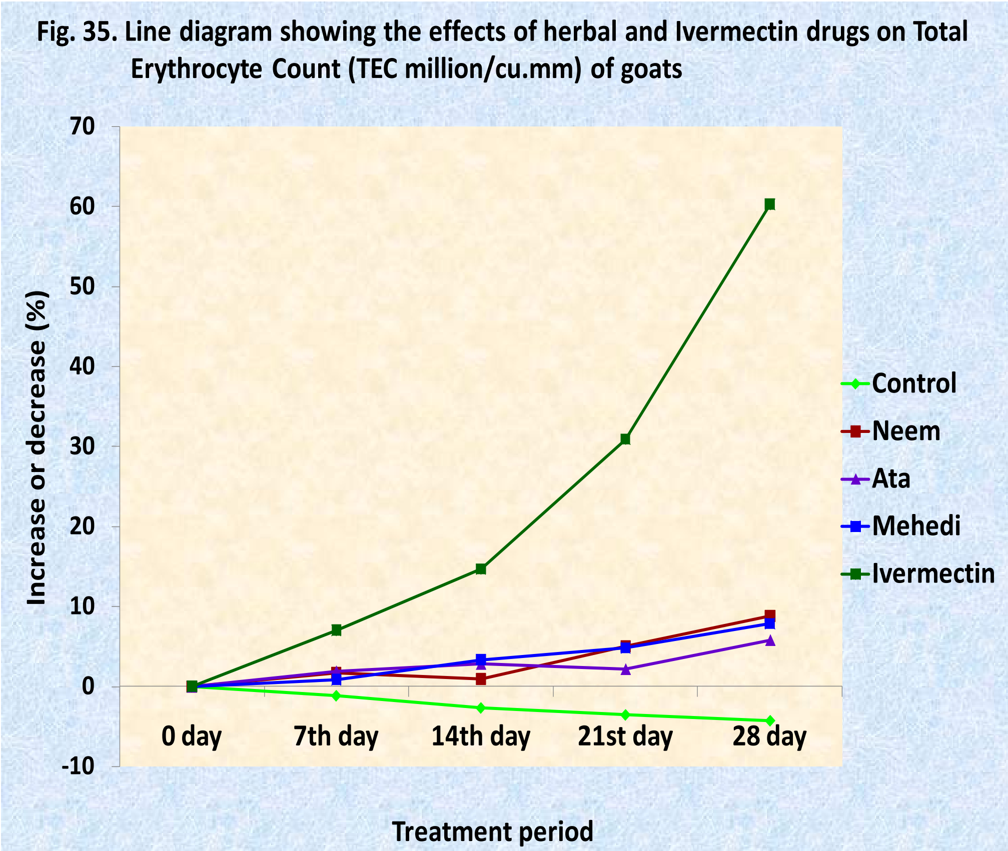
4.3.2.1 Total Erythrocyte Count (TEC Million/Cu.Mm)

On an average Total Erythrocyte Count (TEC million/cu.mm) of blood in the experimental goats groups A, B, C, D and E were assessed on 0 day (pre-treatment) at 8.38 million/cu.mm, 7.84 million/cu.mm, 7.26 million/cu.mm, 7.52 million/cu.mm and 6.50 million/cu.mm, respectively and after treatment the TEC of blood were estimated on 28th day (post-treatment) at 8.02 million/cu.mm, 8.33 million/cu.mm, 7.68 million/cu.mm, 8.12 million/cu.mm and 10.42 million/cu.mm in the treatment group A, B, C, D and E, respectively (Table 23).

Table 23. Effect of different herbal and Ivermectin drugs on Total Erythrocyte Count (TEC million/cu.mm) of goats

Name of groups and drugs	Pre-treatment	Post-treatment			
	0 day	7th day	14th day	21st day	28th day
A (Control)	8.38±0.55	8.28±0.43 (1.19[b])	8.15±0.56 (2.71[b])	8.08±0.56 (3.58[b])	8.02±0.58 (4.31[b])
B (Neem)	7.84±0.58	7.98±0.63 (1.70[a])	7.92±0.55 (0.98[a])	8.24±0.50 (5.01[a])	8.33±0.37 (8.80[a])
C (Ata)	7.26±0.47	7.40±0.44 (1.93[a])	7.47±0.29 (2.85[a])	7.42±0.40 (2.20[a])	7.68±0.35 (5.83[a])
D (Mehedi)	7.52±0.60	7.59±0.39 (0.89[a])	7.78±0.41 (3.37[a])	7.89±0.39 (4.87[a])	8.12±0.28 (7.89[a])
E (Ivermectin)	6.50±0.39	6.96±0.51 (7.02[a])	7.46±0.32 (14.70[a])	8.51±0.48 (30.90[a])	10.42±0.62 (60.30[a])

‘a’ and ‘b’ indicate the increase and decrease percentages, respectively.



In the control group A it was found that the TEC of blood was decreased at 4.31 percent on 28th day from the 0 day which was significant (P=0.049). Table 23 displayed that the TEC of blood were increased with the treatment of Neem, Ata, Mehedi and Ivermectin at 8.80 per cent, 5.83 per cent, 7.89 per cent and 60.30 per cent, respectively to the post-treatment (28th day) from the pre-treatment (0 day). The highest increase of TEC of blood was depicted in the treatment group E (Ivermectin) which was 60.30 per cent and the lowest increase of TEC of blood was found to be 7.64 per cent in the treatment group C. The effects of Neem (P=0.001), Ata (P=0.008), Mehedi (P=0.001) and Ivermectin (P=0.000) were highly significant (Table 24).

Table 24 . Comparative effects of different treatments on Total Erythrocyte Count (TEC million/cu.mm) in experimental goats by using ANOVA

Treatment Groups		Sum of Squares	df	Mean Square	F	P value
Group A (Control)	Between Groups	2.858	2	1.429	57.541	0.049
	Within Groups	0.298	12	0.025		
	Total	3.156	14			
Group B (Neem)	Between Groups	2.693	2	1.346	15.032	0.001
	Within Groups	1.075	12	0.089		
	Total	3.768	14			
Group C (Ata)	Between Groups	1.523	2	0.761	27.437	0.008
	Within Groups	0.333	12	0.028		
	Total	1.856	14			
Group D (Mehedi)	Between Groups	1.682	2	0.841	12.650	0.001
	Within Groups	0.798	12	0.067		
	Total	2.480	14			
Group E (Ivermectin)	Between Groups	2.116	2	1.058	0.433	0.000
	Within Groups	29.354	12	2.446		
	Total	31.470	14			

4.3.2.2 Hemoglobin Content (Hb) %

The average Hemoglobin gram percentages of blood in the experimental goats of the groups A, B, C, D and E were measured on 0 day (pre-treatment) at 7.26 gm%, 8.03 gm%, 7.72 gm%, 7.69 gm% and 6.91 gm%, respectively and after treatment the Hemoglobin gram percentages of blood were estimated on 28th day (post-treatment) at 6.66 gm%, 8.96 gm%, 8.31 gm%, 8.40 gm% and 11.36 gm% in the treatment group A, B, C, D and E, respectively (Table 25). In the control group A, it was observed that the Hemoglobin gm% of blood was decreased at 8.31 per cent on 28th day from the 0 day which was highly significant (P=0.002).

Table 25. Effect of different herbal and Ivermectin drugs on Hemoglobin content (Hb gm %) of goats

Name of groups and drugs	Pre-treatment	Post-treatment			
	0 day	7th day	14th day	21st day	28th day
A (Control)	7.26±0.50	7.15±0.46 (1.52[b])	7.03±0.38 (3.12[b])	6.88±0.42 (5.19[b])	6.66±0.49 (8.31[b])
B (Neem)	8.03±0.38	8.01±0.51 (0.17[b])	8.30±0.37 (3.32[a])	8.59±0.27 (7.02[a])	8.96±0.29 (11.60[a])
C (Ata)	7.72±0.29	7.71±0.28 (0.22[b])	7.95±0.42 (2.93[a])	8.14±0.39 (5.35[a])	8.31±0.51 (7.64[a])
D (Mehedi)	7.69±0.71	7.67±0.69 (0.26[b])	7.93±0.54 (3.03[a])	8.08±0.56 (5.07[a])	8.40±0.73 (9.19[a])
E (Ivermectin)	6.91±0.52	8.04±0.62 (16.60[a])	9.20±0.70 (33.40[a])	10.68±0.67 (54.80[a])	11.36±0.86 (64.70[a])

'a' and 'b' indicate the increase and decrease percentages, respectively.

Fig. 36. Line diagram showing the effects of herbal and Ivermectin drugs on Hemoglobin content (Hb gm %) of goats

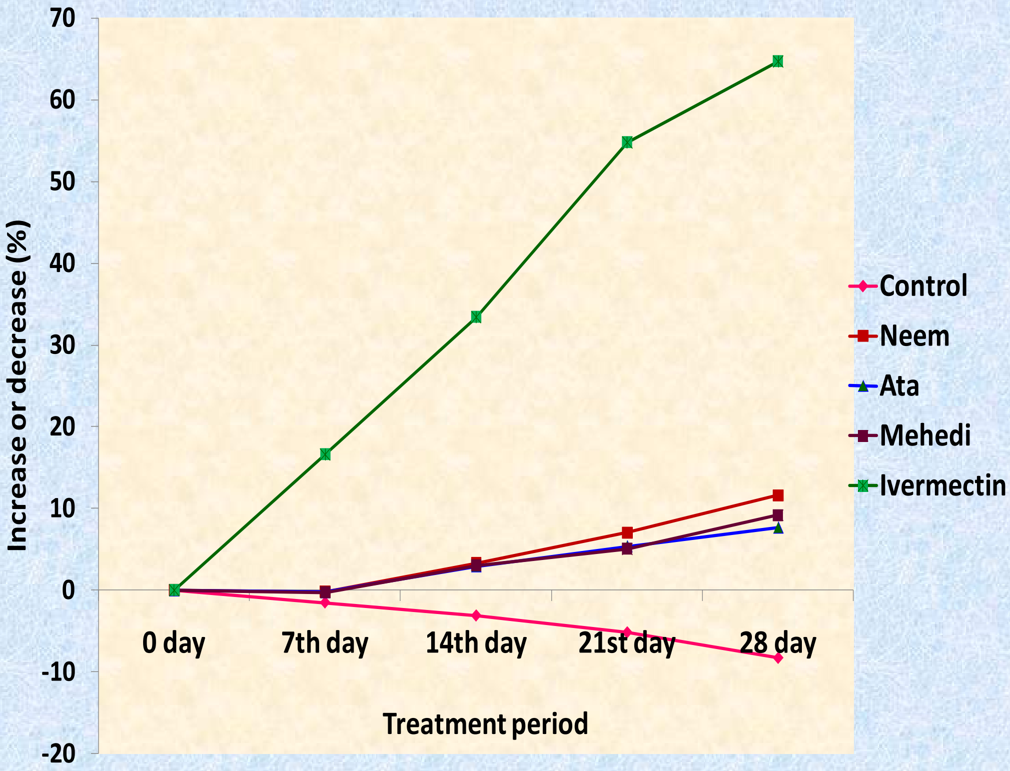


Table 25 demonstrated that the Hemoglobin gm% of blood were increased with the treatment of Neem, Ata, Mehedi and Ivermectin at 11.60 per cent, 7.64 per cent, 9.19 per cent and 64.70 per cent, respectively to the post-treatment (28th day) from the pre-treatment (0 day). The highest increase of Hemoglobin gm% of blood (64.70 per cent) was depicted in the treatment group E (Ivermectin) and the lowest increase of Hemoglobin gm% of blood (7.64 per cent) was found in the treatment group C. The effect of Ata (P=0.044) was significant and Neem (P=0.000), Mehidi (P=0.009) and Ivermectin (P=0.000) showed the highly significant effects (Table 26).

Table 26. Comparative effects of different treatments on Hemoglobin content (Hb) % of experimental goats by using ANOVA

Treatment Groups		Sum of Squares	df	Mean Square	F	P value
Group A (Control)	Between Groups	2.009	2	1.005	17.288	0.002
	Within Groups	0.697	12	0.058		
	Total	2.706	14			
Group B (Neem)	Between Groups	1.273	2	0.637	3.717	0.000
	Within Groups	2.055	12	0.171		
	Total	3.328	14			
Group C (Ata)	Between Groups	1.415	2	0.708	9.372	0.044
	Within Groups	0.906	12	0.075		
	Total	2.321	14			
Group D (Mehedi)	Between Groups	4.013	2	2.006	18.367	0.009
	Within Groups	1.311	12	0.109		
	Total	5.324	14			
Group E (Ivermectin)	Between Groups	4.510	2	2.255	0.667	0.000
	Within Groups	40.579	12	3.382		
	Total	45.089	14			

4.3.2.3 Packed Cell Volume (PCV %)

Table 27 demonstrates that on an average Packed Cell Volume (PCV %) of blood in the experimental goats groups A, B, C, D and E were computed on 0 day (pre-treatment) at 28.45 per cent, 30.08 per cent, 30.55 per cent, 29.85 per cent and 29.60 per cent, respectively and after treatment the PCV percentages of blood were estimated on 28th day (post-treatment) at 27.13 per cent, 32.72 per cent, 32.52 per cent, 32.22 per cent and 30.86 per cent in the treatment group A, B, C, D and E, respectively.

Table 27. Effect of different herbal and Ivermectin drugs on Packed Cell Volume (PCV %) of goats

Name of groups and drugs	Pre-treatment	Post-treatment			
	0 day	7th day	14th day	21st day	28th day
A (Control)	28.45±0.27	27.99±0.34 (1.62[b])	27.62±0.27 (2.91[b])	27.37±0.31 (3.80[b])	27.13±0.32 (4.65[b])
B (Neem)	30.08±0.38	30.37±0.21 (0.95[a])	30.70±0.29 (2.06[a])	31.94±0.34 (6.17[a])	32.72±0.47 (8.74[a])
C (Ata)	30.55±0.27	30.92±0.35 (1.21[a])	31.29±0.47 (2.41[a])	32.13±0.50 (5.16[a])	32.52±0.45 (6.42[a])
D (Mehedi)	29.85±0.56	30.24±0.61 (1.32[a])	30.88±0.57 (3.47[a])	31.74±0.55 (6.35[a])	32.22±0.42 (7.95[a])
E (Ivermectin)	29.60±0.27	29.73±0.38 (0.45[a])	30.27±0.43 (2.27[a])	30.59±0.36 (3.34[a])	30.86±0.46 (4.25[a])

'a' and 'b' indicate the increase and decrease percentages, respectively.

In the control group A it was found that the PVC percent of blood was decreased at 4.65 per cent on 28th day from the 0 day which was insignificant (P=0.246) (Table 28).

Fig. 37. Line diagram showing the effects of herbal and Ivermectin drugs on Packed Cell Volume (PCV %) of goats

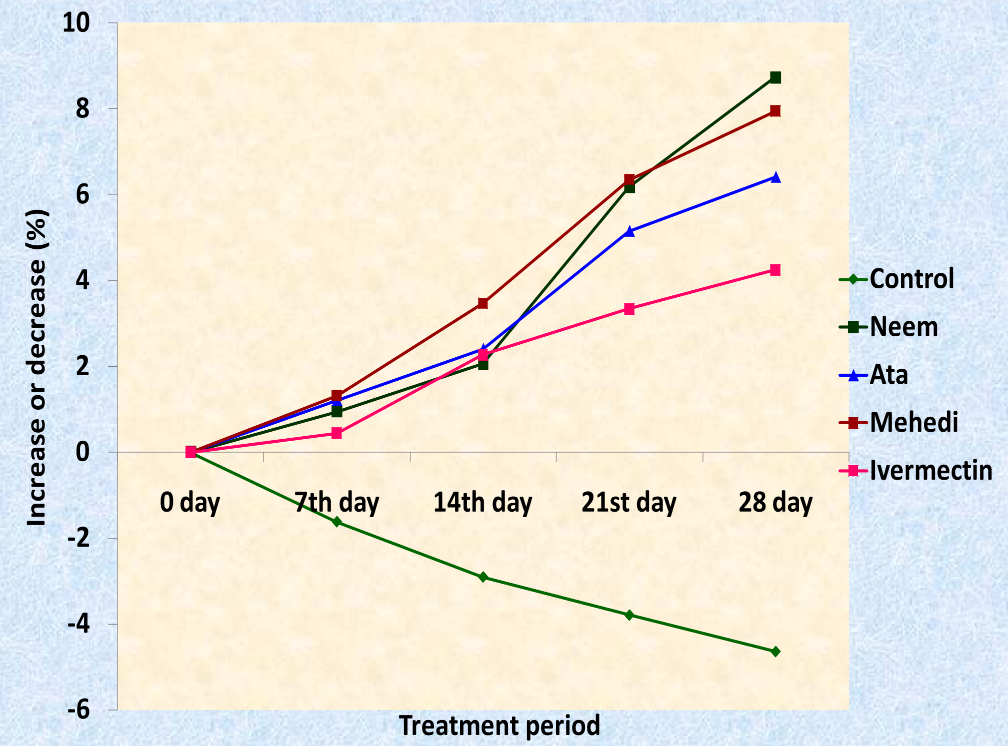


Table 27 displays that the PVC percent of blood were increased with the treatment of Neem, Ata, Mehedi and Ivermectin at 8.74 per cent, 6.42 per cent, 7.95 per cent and 4.25 per cent, respectively to the post-treatment on 28th day from the pre-treatment on 0 day. The maximum increase of PVC percent of blood was presented in the treatment group B (Neem) which was 8.74 per cent and the minimum increase of PVC percent of blood was found to be 4.25 per cent in the treatment group E (Ivermectin). The effects of Neem (P=0.062) and Mehedi (P=0.071) were significant and Ata (P=0.367) and Ivermectin (P=0.138) showed the insignificant effects (Table 28).

Table 28. Comparative effects of different treatments on Packed Cell Volume (PCV %) in experimental goats

Treatment Groups		Sum of Squares	df	Mean Square	F	P value
Group A (Control)	Between Groups	0.872	2	0.436	1.581	0.246
	Within Groups	3.309	12	0.276		
	Total	4.181	14			
Group B (Neem)	Between Groups	1.043	2	0.522	0.411	0.062
	Within Groups	15.220	12	1.268		
	Total	16.263	14			
Group C (Ata)	Between Groups	1.507	2	0.753	1.090	0.367
	Within Groups	8.292	12	0.691		
	Total	9.799	14			
Group D (Mehidi)	Between Groups	2.906	2	1.453	1.458	0.071
	Within Groups	11.959	12	0.997		
	Total	14.865	14			
Group E (Ivermectin)	Between Groups	1.404	2	0.702	2.347	0.138
	Within Groups	3.589	12	0.299		
	Total	4.992	14			

4.3.2.4 Total Leukocyte Count (TLC thousand/cu.mm)

From the Table 29 it was observed that on an average Total Leukocyte Count (TLC thousand/cu.mm) of blood in the experimental goats groups A, B, C, D and E were calculated on 0 day (pre-treatment) at 7.25 thousand/cu.mm, 8.13 thousand/cu.mm, 7.46 thousand/cu.mm, 8.35 thousand/cu.mm and 7.67 thousand/cu.mm, respectively and after treatment the TLC of blood were computed on 28th day (post-treatment) at 6.97 thousand/cu.mm, 8.72

thousand/cu.mm, 7.77 thousand/cu.mm, 8.93 thousand/cu.mm and 9.45 thousand/cu.mm in the treatment group A, B, C, D and E, respectively.

Table 29. Effect of different herbal and Ivermectin drugs on Total Leukocyte Count (TLC thousand/cu.mm) of goats

Name of groups and drugs	Pre-treatment	Post-treatment			
	0 day	7th day	14th day	21st day	28th day
A (Control)	7.25±0.09	7.27±0.12 (0.32[a])	7.09±0.05 (2.16[b])	7.01±0.07 (3.31[b])	6.97±0.06 (3.86[b])
B (Neem)	8.13±0.12	8.36±0.03 (2.87[a])	8.35±0.13 (2.71[a])	8.48±0.17 (4.31[a])	8.72±0.08 (7.26[a])
C (Ata)	7.46±0.11	7.57±0.13 (1.48[a])	7.67±0.13 (2.82[a])	7.63±0.13 (2.32[a])	7.77±0.16 (4.16[a])
D (Mehedi)	8.35±0.35	8.33±0.36 (0.28[b])	8.57±0.26 (2.67[a])	8.77±0.30 (4.99[a])	8.93±0.34 (6.95[a])
E (Ivermectin)	7.67±0.10	8.05±0.08 (5.14[a])	8.34±0.09 (8.97[a])	8.95±0.05 (16.90[a])	9.45±0.08 (23.40[a])

'a' and 'b' indicate the increase and decrease percentages, respectively.

Fig. 38. Line diagram showing the effects of herbal and Ivermectin on Total Leukocyte Count (TLC thousand/cu.mm)of goats

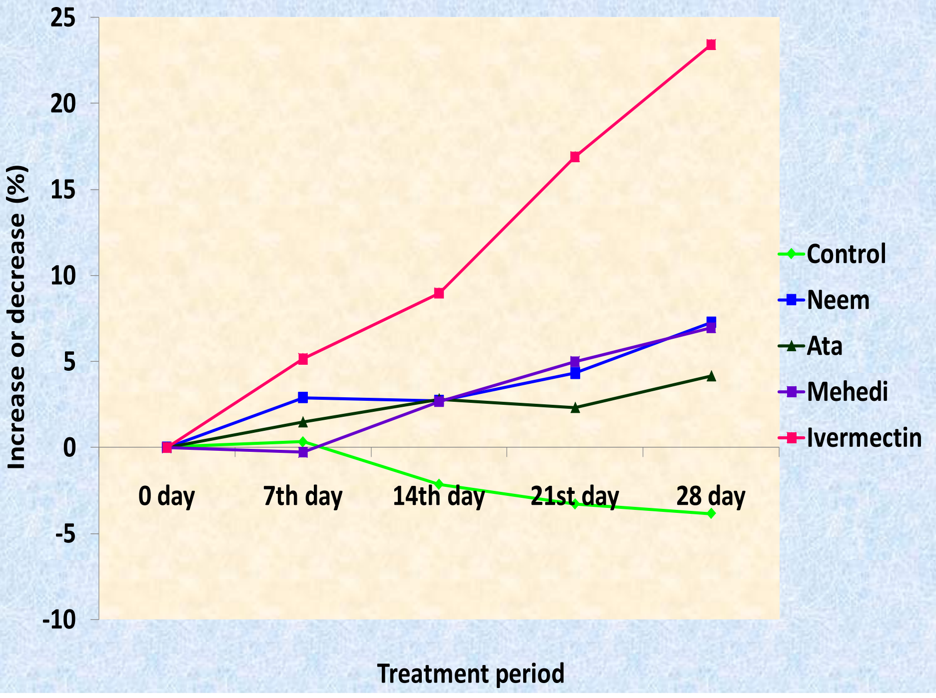


Table 30. Comparative effects of different treatments on Total Leukocyte Count (TLC thousand/cu.mm) in experimental goats by using ANOVA

Treatment Groups		Sum of Squares	df	Mean Square	F	P value
Group A (Control)	Between Groups	0.046	2	0.023	1.123	0.357
	Within Groups	0.245	12	0.02		
	Total	0.290	14			
Group B (Neem)	Between Groups	0.102	2	0.051	1.043	0.032
	Within Groups	0.587	12	0.049		
	Total	0.689	14			
Group C (Ata)	Between Groups	0.163	2	0.082	5.611	0.046
	Within Groups	0.175	12	0.015		
	Total	0.338	14			
Group D (Mehedi)	Between Groups	1.018	2	.509	7.234	0.003
	Within Groups	0.845	12	0.07		
	Total	1.863	14			
Group E (Ivermectin)	Between Groups	0.053	2	0.026	0.051	0.005
	Within Groups	6.142	12	0.512		
	Total	6.194	14			

In the control group A it was observed that the TLC of blood was decreased at 3.86 percent on 28th day from the 0 day which was insignificant (P=0.357) (Table 29 and Table 30). The TLC of blood were increased on 28th day (post-treatment) from 0 day (pre-treatment) at 7.26 per cent, 4.16 per cent, 6.95 per cent and 23.40 per cent with the treatment of Neem, Ata, Mehedi and Ivermectin, respectively. The highest increase of TLC of blood was observed in the treatment group E (Ivermectin) which was 23.40 per cent and the lowest increase of TLC of blood was found to be 4.16 per cent in the treatment group C (Ata). The effects of Neem (P=0.032) and Ata (P=0.046) were significant and Mehedi (P=0.003) and Ivermectin (P=0.005) showed the highly significant effects (Table 30).

4.3.3 Biochemical Parameters

4.3.3.1 Serum Glutamic-Oxaloacetic Transaminase (SGOT)

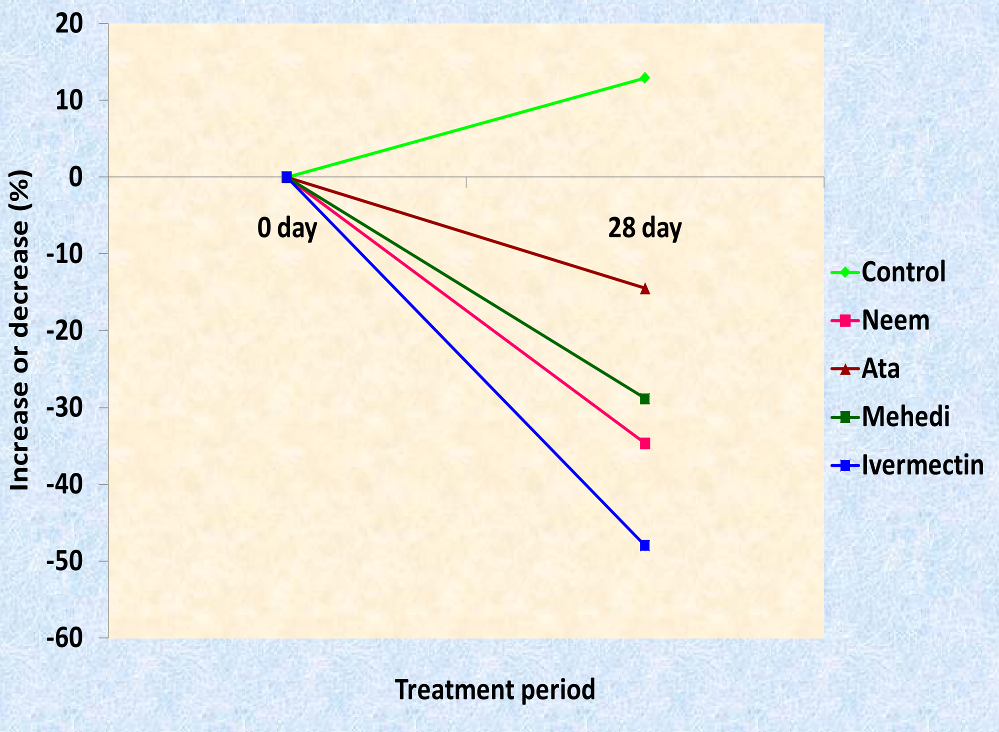
From the Table 31 it was observed that on an average Serum Glutamic-Oxaloacetic Transaminase (SGOT) of blood in the experimental goats groups A, B, C, D and E were computed on 0 day (pre-treatment) at 17.69, 20.52, 19.49, 19.61 and 18.80, respectively and after treatment the SGOT of blood were estimated on 28th day (post-treatment) at 19.97, 13.41, 16.68, 13.96 and 9.79 in the treatment group A, B, C, D and E, respectively.

Table 31. Effect of different herbal and Ivermectin drugs on Serum Glutamic-Oxaloacetic Transaminase (SGOT) of goats

Name of groups and drugs	Pre-treatment	Post-treatment
	0 day	28th day
A (Control)	17.69±1.59	19.97±1.43 (12.90^{a})
B (Neem)	20.52±0.94	13.41±0.98 (34.65^{b})
C (Ata)	19.49±1.10	16.68±2.09 (14.43^{b})
D (Mehedi)	19.61±0.83	13.96±0.62 (28.79^{b})
E (Ivermectin)	18.80±1.40	9.79±1.48 (47.95^{b})

'a' and 'b' indicate the increase and decrease percentages, respectively.

Fig. 39. Line diagram showing the effects of herbal and Ivermectin drugs on Serum Glutamic-Oxaloacetic Transaminase (SGOT) of goats



In the control group A it was observed that the SGOT of blood was increased at 12.90 per cent on 28th day from the 0 day which was insignificant (P=0.194) (Table 31 and Table 32). The SGOT of blood were decreased on 28th day (post-treatment) from 0 day (pre-treatment) at 34.65 per cent, 14.43 per cent, 28.79 per cent and 47.95 per cent with the treatment of Neem, Ata, Mehedi and Ivermectin, respectively. The highest decrease of SGOT of blood was observed in the treatment group E (Ivermectin) which was 47.95 per cent and the lowest increase of SGOT of blood was found to be 14.43 per cent in the treatment group C (Ata). The effects of Neem (P=0.085), Ata (0.099), Mehedi (P=0.087) and Ivermectin (P=0.066) were significant (Table 32).

Table 32. Comparative effects of different treatments on Serum Glutamic Oxaloacetic Transaminase (SGOT) in experimental goats by using ANOVA

Treatment Groups		Sum of Squares	df	Mean Square	F	P value
Group A (Control)	Between Groups	8.943	2	4.472	1.682	0.194
	Within Groups	7.977	3	2.659		
	Total	16.920	5			
Group B (Neem)	Between Groups	2.405	2	1.203	0.047	0.085
	Within Groups	77.103	3	25.701		
	Total	79.508	5			
Group C (Ata)	Between Groups	10.220	2	5.110	1.192	0.099
	Within Groups	12.861	3	4.287		
	Total	23.081	5			
Group D (Mehidi)	Between Groups	2.097	2	1.048	0.066	0.087
	Within Groups	47.888	3	15.963		
	Total	49.985	5			
Group E (Ivermectin)	Between Groups	8.171	2	4.086	0.100	0.066
	Within Groups	122.057	3	40.686		
	Total	130.229	5			

4.3.3.2 Serum Glutamic-Pyruvic Transaminase (SGPT)

From the Table 33 it was observed that on an average Serum Glutamic-Pyruvic Transaminase (SGPT) of blood in the experimental goats groups A, B, C, D and E were measured on 0 day (pre-treatment) at 32.29, 35.83, 36.96, 33.23 and 31.79, respectively and after treatment the SGPT of blood were computed on 28th day (post-treatment) at 36.76, 16.72, 24.68, 18.43 and 9.37 in the treatment group A, B, C, D and E, respectively. In the control group A it was found that the SGPT of blood was increased at 13.80 per cent on 28th day from the 0 day which was insignificant (Table 34).

Table 33. Effect of different herbal and Ivermectin drugs on Serum Glutamic-Pyruvic Transaminase (SGPT) of goats

Name of groups and drugs	Pre-treatment	Post-treatment
	0 day	28th day
A (Control)	32.29±3.61	36.76±2.04 (13.80[a])
B (Neem)	35.83±3.58	16.72±0.69 (53.32[b])
C (Ata)	36.96±3.06	24.68±2.49 (33.23[b])
D (Mehedi)	33.23±3.00	18.43±1.31 (44.55[b])
E (Ivermectin)	31.79±3.15	9.37±0.50 (70.54[b])

'a' and 'b' indicate the increase and decrease percentages, respectively.

Fig. 40. Line diagram showing the effects of herbal and Ivermectin drugs on Serum Glutamic-Pyruvic Transaminase (SGPT) of goats

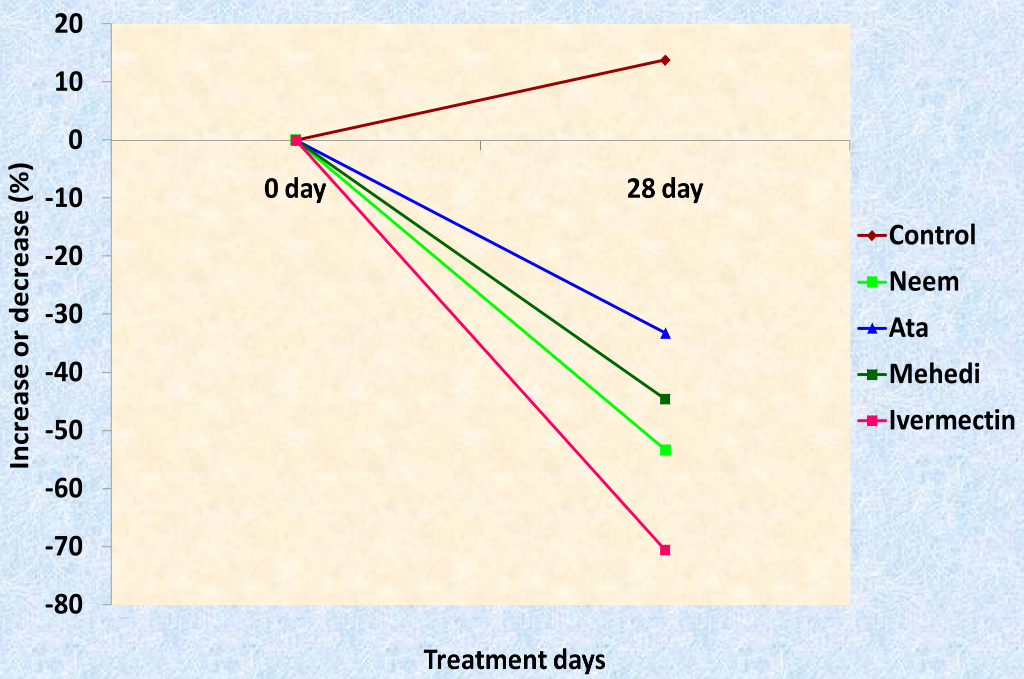


Table 34. Comparative effects of different treatments on Serum Glutamic-Pyruvic Transaminase (SGPT) in experimental goats by using ANOVA

Treatment Groups		Sum of Squares	df	Mean Square	F	P value
Group A (Control)	Between Groups	31.915	2	15.957	1.479	0.207
	Within Groups	32.370	3	10.790		
	Total	64.285	5			
Group B (Neem)	Between Groups	18.176	2	9.088	0.049	0.095
	Within Groups	555.829	3	185.276		
	Total	574.005	5			
Group C (Ata)	Between Groups	30.751	2	15.375	0.204	0.082
	Within Groups	226.540	3	75.513		
	Total	257.291	5			
Group D (Mehedi)	Between Groups	15.650	2	7.825	0.070	0.093
	Within Groups	334.631	3	111.544		
	Total	350.281	5			
Group E (Ivermectin)	Between Groups	13.312	2	6.656	0.026	0.097
	Within Groups	761.414	3	253.805		
	Total	774.726	5			

The SGPT of blood were decreased on 28th day (post-treatment) from 0 day (pre-treatment) at 53.32 per cent, 33.23 per cent, 44.55 per cent and 70.54 per cent with the treatment of Neem, Ata, Mehedi and Ivermectin, respectively. The highest decrease of SGPT of blood was observed in the treatment group E (Ivermectin) which was 70.54 per cent and the lowest increase of SGPT of blood was found to be 33.23 per cent in the treatment group C (Ata). The effects of Neem (P=0.095), Ata (P=0.082), Mehedi (P=0.093) and Ivermectin (P=0.097) were found to be significant (Table 34).

Chapter 5

5 Discussion

The purpose of this chapter is mainly concerned with the comparison of the effects of mange prevalence in goats caused by the different risk factors like farm size, age, housing condition, housing system, feed, sex, breed, season, topography, health condition, temperature, rainfall and humidity as well as the economic impact of mange in goats and to compare the effects of herbal products like Neem (*Azadirachta indica*), Ata (*Annona reticulata*) and Mehedi (*Lawsonia inermis)* and Ivermectin medicine in different experimental treatment groups as well as to compare the effects of different drugs on clinical parameters (hair coat, skin lesion, bodyweight and adverse effects), selected hematological parameters (TEC, Hb, PCV and TLC) and biochemical parameters (SGOT and SGPT).

5.1 Epidemiological Study

The effect of different risk factors such as farm size, feeding, breed, age, sex, season, land topography, housing system, housing condition, body condition, temperature, rainfall and humidity on the prevalence of mange mite in goat was discussed subsequently. The results of logistic regression analysis for some selected variables such as farm size, feeding, breed, age, sex, season and land topography on the prevalence of mange in goat, were also discussed.

5.1.1 Overall Prevalence of Mange in the Study Area

The overall prevalence of mange mite in goats was observed to be 5.95 per cent in the study area which was shown in each table of risk factors in the chapter 4. The overall prevalence in the all farms obtained in the study is more consistent with the findings of Desta (2004), Sarkar *et al.* (2010), Shiferaw *et al.* (2010), Zeryehun and Tadesse (2012). Desta (2004) showed 5.85 per cent of mange mite prevalence in tigray region of northern Ethiopia. Sarkar *et al.* (2010) reported the overall prevalence of mange in goat 5.6 per cent. Asghar *et al.* (2011) reported 6.5 per cent prevalence in native goats during the Hajj season in Makkah of Sauddi Arabia. The prevalence of mange mite in goats was registered in Shiferaw *et al.* (2010) at 5.85 per cent in Southern Ethiopia. Zeryehun and Tadesse (2012) reported the mange with prevalence of 5.43 per cent from their study in Northwest Ethiopia. In contrast, Kassaye and Kebede (2010) in tigray region of northern Ethiopia showed the prevalence of mange mite 8.11 per cent in their study. Parija *et al*., (1995) observed that 2.22 % goats were infested with *Psoroptes* sp. in India. Dalapati and Bhowmik (1995) reported goats' infestation with *Psoroptes cuniculi* (16.3%). Chakrabarti (1994) observed 13.4% *Psoroptes* sp. infestation in goats in India. The overall prevalence of 9.25% in goats Zeryehun and Tadesse (2012) in East Wollega Zone of Northwest Ethiopia. But, the finding of the current study was lower than the prevalence reported in the Southern range land of Oromia 16.45% in goats (Molu Nura, 2002).

The differences among the results of present and earlier study might be due to variation in the geographical locations, climatic conditions of the experimental area, methods of study, selection of sample in different areas, breed of goats etc.

5.1.2 Prevalence of Mange by Farm Size

Table 3 of chapter 4 shows the different levels of mange mite infestation in small, medium and large farms which were 4.13 per cent, 6.03 per cent and 9.04 per cent of each farm, respectively and it was the significantly (P=0.033) different among the farm groups. In logistic regression analysis, the effect of farm size indicated the significant difference in prevalence of mange infestations between small farm and medium farm (Odds Ratio=0.402, P=0.026) and between small farm and large farm (Odds Ratio=0.618, P=0.082) (Table 4 in the chapter 4). It can be said that the prevalence of mange infestation was observed to be higher 40.2 per cent and 61.8 per cent in medium farm and large farm respectively than small farm. The large farms were more affected than the medium and small farms, which was in agreement with Hassan *et al.* (2011). This is due to direct contact, overcrowding and unhygienic condition of the goat farm. Sometime the intensive care of individual goat in large farm is not possible due to rearing the many number of goats. The sufficient feed supply and veterinary services for goats in large farm are sometimes hampered for lack of money. The maintaining of the proper biosecurity is difficult in case of large farm. As mange is a contagious disease, so another cause of higher infestation of mange in large farm is that the frequent contact of non-infested goats with the infested goats is easily occurred. The small farm was found to be low affected among all farms in this study. The cause of low mange affection in small farm is that the owner of small farm can take care of individual goat simply from different essential corners like maintaining of proper biosecurity of farm, sufficient feed supply, and disease contamination possibilities, due to small number of goats.

5.1.3 Prevalence of Mange by Feeding

Table 5 in the chapter 4 represented the mange mite prevalence in goats 3.61 per cent, 6.03 per cent and 8.25 per cent in good feeding, moderate feeding and poor feeding, respectively. In this study the highest prevalence of mange infestation was seen in poor feeding condition and it was lowest in good feeding condition and the prevalence difference was statistically significant (P=0.044). In agreement with this finding, Radostitis *et al.* (2000) described that sarcoptic mange mite often-go hand in hand with poor feeding and general mismanagement. In logistic regression analysis, the effect of feeding was insignificant difference in prevalence of mange infestations between good feeding and moderate feeding (Odds Ratio=1.02, P=0.112) and it was significant difference between good feeding and poor feeding (Odds Ratio=1.10, P=0.049) (Table 4 in the chapter 4). The results of logistic regression indicated that the prevalence of mange infestation was 1.02 times and 1.10 times higher in moderate and poor feeding than good feeding, respectively. This finding cannot be compared because of the non-availability of related literature.

The argument behind the highest infestation of mange in poor feeding condition is that the most of the goats are suffered from malnutrition due to insufficient nutrients which are required to grow body resistance. If the nutritional deficiency exists, the immune system of the body does not work properly. The poor feeding is one of the causes of weak health of goats which may be one of the predisposing factors to be infested by mange mite.

5.1.4 Prevalence of Mange by Breed

Black Bengal and cross breed carried the mange infestation 6.93 per cent and 3.09 per cent of individual breed, respectively. The highest and the lowest prevalence of mange infestation were observed in Black Bengal and cross breed, respectively and it was the significantly (P= 0.012) different between cross breed and Black Bengal. The study revealed the overall prevalence of mange infestation 0.78 per cent, 5.17 per cent and 5.95 per cent for cross breed and Black Bengal and all breed, respectively (Table 6 in the chapter 4). Paul *et al.* (2012) in Bangladesh reported that the Black Bengal goats were infested with *P. cuniculi* (5.6%) which was more consistent with the finding of overall prevalence of mange in goats in the present study. Tadesse *et al.*, 2011 also found the significant breed differences in susceptibility to *S. scabiei* var. *caprae* infection in Northestern Ethiopia which is in conformity with the finding of the present study. The results are also supported by Asghar *et al.*, 2011, who found that the breeds of host showed difference in parasitic infection. The possible causes of the highest infestation of mange in Black Bengal are that the Black Bengal goats are physically small in size, thin and small hair, smooth and light skin and comparatively weak than the cross breed. The immune system of the body of Black Bengal may be comparatively weak than the cross breed. On the other hand the cross breed is found to be physically strong, high body resistance, large and course hair and thick skin and for these qualities the cross breed may be comparatively low infested by mange. In logistic regression analysis, the effect of farm size revealed the significant difference in prevalence of mange infestations between cross breed and Black Bengal (Odds Ratio=0.841, P=0.049) (Table 4 in the chapter 4). The result of logistic regression analysis indicated that the prevalence of mange infestation was higher 84.1 per cent in Black Bengal than cross breed. This finding cannot be compared because of the non-availability of related literature.

5.1.5 Prevalence of Mange by Age

In the chapter 4, the Table 7 shows the prevalence of mange mite 3.60 per cent, 5.82 per cent and 8.47 per cent in the age group of '< 1 year', '1 < 3 years' '3 years and above' and 'all age groups', respectively. The highest prevalence of mange was found in the age group of 3 years and above and it was the lowest in the age group of below 1 year (<1year). The prevalence of mange mite was significantly (P=0.012) different among the different age groups which is in agreement with Kassaye and Kebede (2010). The results of the present study are supported by Hassan *et al.* (2011) and Paul *et al.* (2012) in Bangladesh, Yeruham *et al.* (1999) in Israel, Mahran and Saleh (2004) in Shalatin city and Gonzalez-Candela *et al.* (2004). The immunity in the older hosts may be lowered due to various stresses, e.g. pregnancy, poor nutrition and reduced ovulation. Chakrabarti (1994) found that prevalence of *Psoroptes* sp. was higher in young goats in India. Aatish *et al.* (2007) in Dera Ghazi Khan of Pakistan reported the mange mite prevalence 6.9 per cent and 5.8 per cent in young and older small ruminants respectively. It is very difficult to explain exactly the frequent occurrence of ectoparasitic infestation in kids and older animals (Barmon *et al.*, 2010). 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 (Barmon *et al*., 2010). The higher prevalence of mange in young small ruminants as compared to older small ruminants may be due to keeping young and adult animals together thus getting infection through direct contact.

In the logistic regression analysis, the effect of age was the highly significant difference in prevalence of mange infestations between the age group of '< 1 year' and '1 < 3 years' (Odds Ratio=0.385, P=0.003) and between the age group of '< 1 year' and '3 years and above' (Odds Ratio=0.675, P=0.012) (Table 4 in the chapter 4). The results of logistic regression analysis indicated that the prevalence of mange infestation was found to be higher 38.5 per cent and 67.5 per cent in the age group '1 < 3 years' and '3 years and above' than the age group '< 1 year', respectively which are supported by Hassan *et al.* (2011) in Chittagong of Bangladesh.

5.1.6 Prevalence of Mange by Sex

From the Table 8 in chapter 4 it was seen that the prevalence of mange mite in male and female was 3.87 per cent and 6.78 per cent respectively and the difference between the mange prevalence of the sex groups was statistically significant (P=0.048). The highest prevalence of mange mite was found in female goats and it was the lowest male goats. The findings are in agreement with the study of Sarkar *et al.* (2010) in Bangladesh (Chakrabarti, 1994) in India, Aziz *et al.* (2013) in Dera Ghazi Khan of Panjab. The higher prevalence in female goats as compared to male goats has also been reported earlier (Leon-Vizcayno *et al.,* 1999). Although the exact cause of higher prevalence of ectoparasitic infestation in female goats cannot be explained but it can be assumed that some hormonal influences may be associated with this phenomenon. Alexander and Stinson (1988) reported that female animals were more prone to infection with protozoan parasites than males. There are various other factors which may break down the immunity in females e.g., changes in sex associated hormones, environmental factors, age, nutrition and pregnancy (Craig *et al.*, 2001, Gonzalez-Candela *et al.,* 2004). In fact, higher level of prolactin and progesterone hormones could make the females more susceptible to any infection (Lloyd, 1983). However higher prevalence in female also due to estrogens, have a stimulatory effect on immune responses, while androgens may have an opposite effect (Bilbo and Nelson, 2001). Moreover, stress of production, such as, pregnancy and lactation could have made the female animals more susceptible to infection. On the contrary, Tasawar *et al*. (2007) in Multan of Pakistan reported that the prevalence of Psoroptes spp. in male hosts was 20.4 per cent, while in female hosts it was 11.92 per cent. Yacob *et al*. (2008) and Kasaye and Kebede (2010) have reported that sex has no significant effect on the prevalence mange mites.

In logistic regression analysis, the effect of sex indicated the significant difference in prevalence of mange infestations between male and female (Odds Ratio=0.672, P=0.031) that indicated mange prevalence 32.8 {(1-0.672) x 100} per cent higher in female than male (Table 4 in the chapter 4). This finding cannot be compared because of the non-availability of related literature.

5.1.7. Prevalence of Mange by Season

Table 9 in the chapter 4 represents the prevalence of mange mite in goat 5.14 per cent, 10.74 per cent and 2.09 per cent in rainy season, winter season and summer season respectively. The mange mite prevalence was higher in winter season and it was lower in summer season and the prevalence difference was highly significant (P=0.000) among the seasons. Similarly, the mange mite infestation was higher in winter season in goats of India (Parija *et al.,* 1995; Chakrabarti, 1994; Mittal and Mathur, 1988; Dalapati and Bhowmik, 1995). The close contact between goats in winter and rainy seasons may be a determining factor in transmission of mange to other non-infected goats. In contrast, a relatively higher infestation with ectoparasites was observed in rainy season, followed by winter and summer in Bangladesh (Sarkar *et al.,* 2010). Prevalence of ectoparasites was higher in rainy season in Brazil (Brito *et al.,* 2005). 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 is less than three or above three seasons in a year. So, the different division of seasons could have made some overlapping of months and seasons and could have created some contradiction. However, the highest prevalence in winter and rainy seasons may be due to the cool and dry weather, high humidity and heavy rainfall and in these conditions, the goats are kept in close contact which increases the possibility of contamination.

In logistic regression analysis, the effect of season was the highly significant difference in prevalence of mange mite infestations between summer season and rainy season (Odds Ratio=0.049, P=0.003) and between summer season and winter season (Odds Ratio=0.094, P=0.001) (Table 4 in the chapter 4). These findings indicated that the prevalence of mange infestation was lower at 95.1 per cent and 90.6 per cent in summer season than rainy season and winter season, respectively. The findings are in acceptance of Kassaye and Kebede (2010) in tigray region of northern Ethiopia.

5.1.8 Prevalence of Mange Mite by Land Topography

The present study showed 8.81 per cent, 5.94 per cent and 3.09 per cent of mange mite prevalence in goats in low land, medium land and high land, respectively. The highest prevalence of mange mite observed in low land and it was the lowest in high land and the difference of mange mite prevalence in the three categories of land was significant (P= 0.022). The findings of the present study are supported by Kassaye and Kebede (2010) in tigray region of northern Ethiopoa. In their study they reported that the prevalence of mange mite was higher (5.50 per cent) in low land and it was lower (2.17 per cent) in highland and the difference was statistically significant (P< 0.05).

In logistic regression analysis, the effect of land topography (Table 4) indicated the insignificant (Odds Ratio=1.36, P=0.814) and it was the significant difference in prevalence of mange infestations between low land and high land (Odds Ratio=0.186, P=0.045). The prevalence of mange infestation was 1.36 times lower in medium land than low land and it was 81.4 per cent lower in high land than low land. In agreement with the findings many researchers reported the same results (Kassaye and Kebede, 2010, Desta, 2004 and Pangui, 1994). The high prevalence of the mange mite in the lowland may be associated with the ideal micro climate environment in these areas which favors the breeding and multiplication of mange mite eggs to their developmental stages (Pangui, 1994). High temperature, humidity and sunlight in the lowland favor mange infestation which account for the difference in the prevalence.

5.1.9 Prevalence of Mange Mite by Housing System

Table 11 in the chapter 4 presents the prevalence of mange mite in goats 6.51 per cent and 2.34 per cent in conventional and semi-intensive housing systems respectively and the conventional housing system contained the highest prevalence of mange mite and it was the lowest in semi-intensive housing system and the difference between the prevalences was statistically significant (P=0.032) which are in agreement with Hassan *et al.* (2011) in Chittagong of Bangladesh, Rony *et al.* (2010) in Bangladesh and Jugessur *et al.* (1998) in India. Baroi (2009) hypothesized that animals reared intensively get the advantage of their conscious owner who used to take regular hygienic management of barns, acaricidal treatment and other supportive cares (bath, grooming etc.) for their animals and this help them to overcome ectoparasitic infestation. The possible reasons for such high prevalence of ectoparasites in conventional housing system are poor management, poor sanitation, and rearing in free range which provide the scope of mixing with infested and other species of goats which contribute for transmission and maintenance of ectoparasites.

5.1.10 Prevalence of Mange Mite by Housing Condition

Table 12 in the chapter 4 displays the prevalence of mange mite infestation in goats 3.5 per cent, 5.89 per cent and 8.97 per cent in good, moderate and poor level of housing conditions, respectively and it was the highest in poor housing condition and the lowest in good housing condition and the prevalence difference was statistically significant (P=0.011). Poor management and poor level of awareness of most of the small ruminant owners on the effect of ectoparasites are strongly believed to have contributed to the widespread occurrence of the infestation (Mulugeta *et al*., 2010). The highest prevalence of mange mite in goats in poor housing condition can be explained that the poor housing conditions have some characteristics which are not facilitated to rear goats in safe from mange mite. The poor housing condition like low and damp housing floor, ill ventilation, insufficient light and air, uncontrolled temperature and moisture, cold and rain water and insanitation and unclean environments may enhance mange mite infestation in goats.

5.1.11 Prevalence of Mange Mite by Health Condition

Table 13 in the chapter 4 shows the prevalence of mange mite in goats 2.03 per cent, 9.80 per cent and 25.32 per cent in good health, moderate health and poor health condition, respectively and the highest prevalence of mange mite in poor health and it was the lowest in good health condition and the prevalence difference was statistically highly significant (P=0.000). These findings are in agreement with Rony *et al.* (2010) in Bangladesh, Kumar *et al.* (1994) in Uttara Pradesh of India, Baroi (2009) in Bangladesh, Desta (2004) in Ethiopia, Mulugeta *et al.* (2010) in Tigery of Ethiopia and Lapage (1962) in UK. It can be explained that malnourished goats are more susceptible to mange mite infection as they are immune compromised. The observation from Manan *et al.* (2007) indicated that bony conditioned animals are least resistance to ectoparasite infestation and lacking enough body potential to build resistance with age advancement whereas over-conditioned animals showed reasonable combat to the infestation. It appears that malnutrition in goats increases their susceptibility to ectoparasitic infestation.

5.1.12 Prevalence of Mange Mite by Temperature

Table 14 in the chapter 4 presents mange mite prevalence in goats 8.47 per cent, 6.35 per cent and 2.76 per cent in below 21^0C, 21^0C to <29^0C and 29^0C & above, respectively and the highest prevalence of mange mite in below 21^0C and the lowest in 29^0C & above and the prevalence difference was statistically significant (P=0.002). The findings of the present study are similar with the different scientists as Parija *et al.* (1995) detected higher mange mite infestation in Black Bengal goats in winter in India, Dalapati and Bhowmik (1995) observed highest prevalence of acariasis in winter in goats, Chakrabarti (1994) reported that mange infection was higher in the winter season (33.2 per cent) in goats in India and Mittal and Mathur (1988) found higher mange (*S. scabiei*) infestation in goat in winter, followed by spring, autumn and summer. The low temperature has a significant effect on the biological activity and survival rate of the mange mite which becomes more active during the cold season (Smith *et al.,* 1999). The similarity in between the present and earlier findings can be explained by the fact of low temperature prevailed in winter season that is more facilitated to enhance mange mite infestation in goats.

5.1.13 Prevalence of Mange Mite by Rainfall

Table 15 in the chapter 4 represents mange mite prevalence 8.24 per cent, 3.73 per cent and 5.84 per cent in rainfall range below 50 mm, 50 mm to below 200 mm and 200 mm & above, respectively and the prevalence of mange infestation was higher in below 50 mm rainfall and it was lower in 50 mm to < 200 mm rainfal and the difference between the prevalence was statistically significant (P=0.019). The similar findings as the present study were not found. The higher mange mite prevalence in goats in low rainfall may be the reason of low rainfall happening in winter season in Bangladesh. In contrast, Paul *et al.* (2012) in Bangladesh, Barmon *et al.* (2010) in Bangladesh, Latha *et al.* (2004) and Brito *et al.* (2005) in Brazil found that ectoparasites infestation was higher during rainy season in goats. The contrast in between the present and earlier findings can be explained that the low temperature has a significant effect on the biological activity and survival rate of the mange mite which becomes more active during the cold season (Smith *et al.* 1999).

5.1.14 Prevalence of Mange Mite by Humidity

Table 16 in the chapter 4 represents the prevalence of mange mite infestation in goats 8.93 per cent, 3.64 per cent and 5.52 per cent in humidity range ‘below 65%’, ‘65% to < 85%’ and ‘85% & above’, respectively and it was the highest in the humidity range ‘below 65%’ and the lowest in ‘65% to < 85%’ and the prevalence difference significant (P=0.001). In behalf of higher prevalence of mange mite in low humidity can be given the argument in such way that the low humidity prevails during the winter season in Bangladesh. Smith *et al.* (1999) found in their study a significant effect on the biological activity and survival rate of the mange mite which become more active during the cold season. Paul *et al.* (2012) in Bangladesh observed the significant (P< 0.01) effect in Seasonal fluctuation of ectoparasitic infestation. Parija *et al.* (1995), Chakrabarti (1994), Mittal and Mathur (1998) and Dalapati and Bhowmik (1995) reported that the prevalence of mange mite infestation was higher in witer season while low humidity was prevailed. In contrast Sarkar *et al.* (2010) in Bangladesh and Brito, *et al.* (2005) in Brazil prevalence of ectoparasites was higher in goats during the rainy season. 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 different seasons.

5.1.15 Distribution of Mange Mite

Table 17 in the chapter 4 shows the mange mite distribution in different anatomical sites of goats as the highest frequency on head region 18.42 per cent followed by the neck region 17.11 per cent and the region of the thorax 14.47 per cent, flank region 13.16 per cent, abdomen region 11.84 per cent, rump region 10.53 per cent, tail region 6.57 per cent, leg region 3.95 per cent and whole body 3.95 percent. Talley and Sparks (2009) in Ethiopia and Salifou *et al.* (2013) in southern Benin, Asghar *et al.* (2011) in Makkah, Mitra *et al.* (1993) in India, Rahbari *et al*. (2009) in Iran, Kaufman *et al.* (1993) and Welsh and Bunch (1983) have an agreement with the findings of the present study. According to them papules due to mange mite usually appear on the head region, neck, or axillary region. This might be associated with the frequency of contact with infected animals and with contaminated inanimate objects. The region of the head has more chance to come in contact with during sniffing, fighting and licking each other.

5.1.16 Economic Impact of Mange Mite

The economic impact of mange disease of goats in Bangladesh has not yet been studied. The findings of the present study indicate a considerable economic loss in the different goat rearing farms (Tk.1038.46, Tk.1158.33, Tk.1213.33 and Tk.1148.68 in small, medium, large and overall farms, respectively) due to the low market price of mange mite infested goats. Desta (2004) found the economic impact of skin disease like mange on tannery industry which was not well documented in Ethiopia. The burrowing and feeding activities of mange cause intense itching, inflammation, hair loss and formation of crusts of exudates, loss of condition and death (Olubunmi, 1995). It results in huge economic loss to tanneries and the country at large since the damage is realized only after cost is incurred on processing after which the damaged skins have to be discarded or downgraded (ESGPIP, 2009). Kassaye and Kebede (2010) explained that the economic impact of these external parasites is not only confined in downgrading the value of skins and hides, but also brings about significant body weight loss. For this reason, the owner of goats gets the lower price in the meat market. Tolossa (2014) reported that parasitic skin diseases caused by ectoparasites such as mange mites, lice, keds and ticks were the threats in serious economic loss to the tanning industry and the country as a whole. In their study, tanneries reported 56% of goat's skin was rejected due to external parasites and out of the reject groups of the processed skin, about 80 to 90% defects were believed to be due to external parasites. They estimated economic loss due to drop in quality of sheep and goat skin is around USD 25.8 million per year. Therefore the economic impact of mange must be certainly high, judging from damage of the skin, cost of the treatment and death.

It can be said that the mange mite prevalent in Bangladesh and the risk factors like farm size, age, housing condition, housing system, feed, sex, breed, season, topography, health condition, temperature, rainfall and humidity have substantial influence on the prevalence of mange mite in goats. Since mange mite infestation is associated with production loss, pathological lesions and destruction of valuable skin, further detailed epidemiological investigation is needed to prevent and control the mange mite in goats.

5.2 Clinical Diagnosis of Mange

5.2.1 Pathology Produced by Mange Mite

The pathological lesions produced by the mites were mostly found on the ear, face, neck, thorax, flank, rump, abdomen, tail and leg. Grossly the *S. scabiei* infestation was characterized by rough, dry and leathery conditions with loss of hair (alopecia). In this study dandruff was found in each affected goat. Pathological changes in mite infestation in goats were also described by some other scientists. The similar findings were found by Sarkar *et al.* (2010), Ahmed *et al.* (2009) in Iraq, Prasad (1984) in India, Kandil (2000) in Egypt, Williams and Williams (1978) and Cook (1981). The affected animals were suffered from intense purities, due to the bites on the affected parts (Davies *et al.,* 1993 and Sanders *et al*., 2000). They mentioned that animals became sensitized to mites excremate this sensitivity as a result of an allergic reaction. In some cases, skin was thick and mild to moderate corrugation was present. It also caused irritation; head shaking and scratching as a result the lesions were produced.

5.2.2 Skin Biopsy or Histopathology

Histopathologically skin lesions were characterized by hyperkeratosis, eosinophilic infiltration, and acanthosis and superficially by the loss of cornified layer associated with aggregation of necrotic cellular debris. The findings of this study are in agreement with Sarkar *et al.* (2010) in Bangladesh, Tarigan (2003) in Indonesia, Gbolagunte *et al.* (2009) in Nigeria and Giadinis *et al.* (2011) in

Greece. The reaction of sensitized goats against the mite was initiated by acantholysis which often developed into sub corneal vesicles and subsequent vesicopustules or micro abscesses. The abscesses were often filled with such a large number of inflammatory cells that burst and their content condensed and dried on the skin surface. The dermis contained a large number of eosinophils and mononuclear cells. These epidermal and dermal changes, which were compatible with spongiotic psoriasiform is a feature of an allergic dermatitis (Stromberg and Fisher, 1986). The lesions caused by *S. scabiei* may be due to the penetration of skin by the parasites resulting local inflammation and exudation of serum.

5.2.3 Examination of Deep Skin Scraping

The mange was positive in collected deep skin scraping from the affected goats examined under the light microscope. The present study revealed that Sarcoptic scabiei was identified mite species isolated from different parts of infected goats. This result was in agreement with the view of some scientists who reported high incidence of sarcoptic mange in goats. The obtained results were in acceptance to findings reported by Mitra *et al.* (1993) in India, Borikar *et al*. (2005) in India, Neog *et al.* (1992) in India, Aziz *et al.* (2013) in Pakistan, Salifou *et al.* (2013) in southern Benin, Ahmed *et al.* (2009) in Iraq, Heath *et al.* (1983) in New Zealand, Kandil (2000) in Egypt, Dia and Diop (2005) and Zangana *et al.* (2013) in Iraq and Rahbari *et al.* (2009) in Iran. The mange mite (*S. scabiei*) is an important cosmopolitan parasite of many domestic mammals causing Sarcoptic mange (Arlian 1989, Strong and Halliday 1992 and Hopla *et al.,* 1994). In contrast, *P. cuniculi* was identified in goats in Mymensingh district of Bangladesh (Sarkar *et al.,* 2010) and Aatish *et al.* (2007) identified only *P. ovis* infesting in sheep in and around Tehsil Taunsa Shareef in Dera Ghazi Khan District of Pakistan. Kaufman *et al.* (1993) reported that the most common mange of goats and sheep was Psoroptic ear mite (*P. aniculi*). The difference in percentage of infection between the present study and the other described one may be related to the difference in the strain of goats as well as the atmospheric temperature difference between these areas.

Scabies research has been severely limited by the availability of parasites, and scabies remains a truly neglected infectious disease. It is a most needed tool for the further investigation of this important and widespread parasitic disease (Mounsey *et al.,* 2010).

5.3 Experimental Study for Mange Control in Goat

Here is an attempt to discuss the findings for the treatment of mange in goats with herbal products like Neem (*Azadirachta indica*), Ata (*Annona reticulata*) and Mehedi (*Lawsonia inermis)* and Ivermectin medicine. The results of clinical parameters (hair coat, skin lesion, bodyweight and adverse effects), certain hematological parameters (Hb, TEC, PCV and TLC) and biochemical parameters (SGOT and SGPT) are discussed subsequently below.

5.3.1 Clinical Parameters

5.3.1.1 Hair Coat

Hair coat of affected goats in different treatment groups (B, C, D and E) and control groups A was seen as rough with discolored wool on day 0 (pre-treatment). After treatment with Neem, Ata (custard apple), Mehedi and Ivermectin in the group of B, C, D and E, respectively, the hair coat of goats started to become smooth and shiny gradually. The hair coat of the infected control group A became more and discolored. This result was in agreement with the findings of Razu *et al.* (2010) and Hanif *et al.* (2005).

5.3.1.2 Skin Lesion

Table 19 in the chapter 4 shows the efficacy of three herbal and one patent drug against mange infestation in goat. The wound per skin lesion area in goats of the control group A was increased on the treatment days 28th that was insignificant (P=0.384). It was found that the wound per lesion area was decreased in the treatment group B, C, D and E with Neem, Ata, Mehedi and Ivermectin, respectively. The recovery of skin lesion was found to be significant in group B, C, D and E with the treatment of Neem (P=0.059), Ata (P=0.085), Mehidi (P=0.079) and Ivermectin (P=0.04), respectively (Table 20 in the chapter 4). The present findings of the treatment with herbal products were in well agreement with Rahman *et al.* (2009), Razu *et al.* (2009), Ghani (2003), Habluetzel *et al.* (2007), Ajose (2007) and Roy (2007) as they observed that the Neem, Ata and

Mehedi leaves act effectively against skin lesions, tick and mite infestations. The maximum recovery of skin lesion was occurred in group E with the treatment of Ivermectin medicine. This finding was agreed well with Hossain *et al.* (2002), Mannan *et al.* (1997) and Hossen and Mostofa (1999).

5.2.1.3 Bodyweight

The bodyweights of the experimental goats were taken in pre-treatment (0 day) post-treatment (28^{th} day). From Table 21 in the chapter 4, it was observed that in control group A the bodyweight was decreased at 6.85 per cent on 28^{th} day from the 0 day which was significant (P=0.077) and it was increased with the treatment of Neem, Ata, Mehedi and Ivermectin at 6.73 per cent, 4.74 per cent, 10.40 per cent and 5.73 per cent, respectively on 28^{th} day from 0 day. The effect of Ata was significant (P=0.078) and Neem (P=0.007), Mehedi (P=0.006) and Ivermectin (P=0.001) showed the highly significant effects (Table 22 in chapter 4). The present findings support the earlier observation of Roy (2007), Aktaruzzaman *et al.* (2012), Hanif *et al.* (2005), Khalid *et al.* (2004) and Razu *et al.* (2010). The results are in disagreement with the report of Hassan *et al.* (2012). The bodyweight was increased may be due to removal of parasitic load might have had facilitate the weight regain through proper digestion, absorption and metabolism of feed nutrients.

5.2.1.4 Adverse Effects

The adverse effects of herbal and Ivermectin drugs in experimental goats were not found during the treatment period. This observation was similar with the findings of Roy (2007) and Rahman *et al.* (2009).

5.2.2 Hematological Parameters

5.2.2.1 Total Erythrocyte Count (TEC million/cu.mm)

Total Erythrocyte Count (TEC million/cu.mm) of blood in the experimental goats groups A, B, C, D and E were accounted on pre-treatment (0 day) and on post-treatment (28^{th} day). Table 23 in the chapter 4 highlights that in the control group A, the TEC of blood was decreased at 4.31 per cent on 28^{th} day from the 0 day which was significant (P=0.049) and it was increased with the treatment of Neem, Ata, Mehidi and Ivermectin at 8.80 per cent, 5.83 per cent, 7.89 per cent and 60.30 per cent, respectively in post-treatment (28^{th} day) which were highly significant {Neem (P=0.001), Ata (P=0.008), Mehedi (P=0.001) and Ivermectin (P=0.000)} (Table 24 in the chapter 4). These results of the treatment with Neem are in agreement with the earlier researchers Rahman *et al.* (2009) and Roy (2007). In case of treatment with Ata, the results are in consistency with Razu *et al.* (2010) and the results of treatment with Mehedi are in compliance with the findings of Roy (2007). The similar findings have been stated due to Ivermectin treatment by some researchers like Hassan *et al.* (2012), Aktaruzzaman *et al.* (2012), Islam *et al.* (2003), Islam (1999) and Khalid *et al.* (2004).

5.2.2.2 Hemoglobin Content (Hb) %

The Hemoglobin gram percentages of blood in the experimental goats of the groups A, B, C, D and E were estimated on pre-treatment (0 day) and on post-treatment (28^{th} day). Table 25 in chapter 4 shows that in the control group A, the Hemoglobin gm% of blood was decreased at 8.31 per cent on 28^{th} day which was highly significant (P=0.002) and it was increased with the treatment of Neem, Ata, Mehidi and Ivermectin at 11.60 per cent, 7.64 per cent, 9.19 per cent and 64.70 per cent, respectively on the post-treatment (28^{th} day) in which the effect of Ata was significant (P=0.044) and Neem (P=0.000), Mehedi (P=0.009) and Ivermectin (P=0.000) were highly significant (Table 26 in chapter 4). These findings of the treatment with Neem are in conformity with the earlier researchers Rahman *et al.* (2009) and Roy (2007). In case of treatment with Ata, the results are in agreement with Razu *et al.* (2010) and the results of treatment with Mehedi are similar to the works of Roy (2007). The similar findings have been stated due to Ivermectin treatment by some researchers Hassan *et al.* (2012), Islam *et al.* (2003), Islam (1999), Khalid *et al.* (2004) and Kumar and Joshi (1992).

5.2.2.3 Packed Cell Volume (PCV %)

Table 27 in chapter 4 demonstrates that Packed Cell Volume (PCV %) of blood in the experimental goats groups A, B, C, D and E were computed on pre-treatment (0 day) and post-treatment (28^{th} day). In the control group A, the PVC per cent of blood was decreased at 4.65 per cent on 28^{th} day from the 0 day which was insignificant (P=0.246) and it was increased with the treatment of Neem, Ata, Mehedi and Ivermectin at 8.74 per cent, 6.42 per cent, 7.95 per cent and 4.25 per cent, respectively in post-treatment on 28th day in which the effects of Neem (P=0.062) and Mehedi (P=0.071) were significant and it was insignificant effects for Ata (P=0.367) and Ivermectin (P=0.138) (Table 28 in the chapter 4). The present findings of treatment with Ivermectin were in agreement of the works with Hassan *et al.* (2012), Aktaruzzaman *et al.* (2012), Islam *et al.* (2003), Islam (1999) and Khalid *et al.* (2004). These findings of the treatment with Neem are in agreement with the earlier researchers Rahman *et al.* (2009) and Roy (2007). In case of treatment with Ata, the results are in consistency with Razu *et al.* (2010) and the results of treatment with Mehedi are in compliance with the findings of Roy (2007).

5.2.2.4 Total Leukocyte Count (TLC thousand/cu.mm)

Table 29 in the chapter 4 shows the Total Leukocyte Count (TLC thousand/cu.mm) of blood in the experimental goats groups A, B, C, D and E on pre-treatment (0 day) and post-treatment (28th day). In the control group A, the TLC of blood was decreased at 3.86 per cent on 28th day which was insignificant (P=0.357) and it was increased on 28th day (post-treatment) at 7.26 per cent, 4.16 per cent, 6.95 per cent and 23.40 per cent with the treatment of Neem, Ata, Mehidi and Ivermectin, respectively in which the effects of Neem (P=0.032) and Ata (P=0.046) were significant and Mehedi (P=0.003) and Ivermectin (P=0.005) showed the highly significant effects (Table 30 in the chapter 4). These findings of the treatment with Neem are in agreement with the earlier researchers Rahman, *et al.* (2009) and Roy (2007). In case of treatment with Ata, the results are in consistency with Razu *et al.* (2010) and the results of treatment with Mehedi are in compliance with the findings of Roy (2007). The similar findings due to Ivermectin treatment are in conformity with Aktaruzzaman *et al.* (2012), Hassan *et al.* (2012), Khalid *et al.* (2004), Islam *et al.* (2003) and Islam (1999).

Blood parameters such as TEC, Hb, PCV, and TLC were improved significantly with the herbal products (Neem, Ata and Mehedi) and Ivermectin treatment, which could be due to the lack of blood-sucking mites. The rise in mean PCV after treatment might be associated with the increase of Hb%, as these parameters are closely interrelated with each other. The improvement of blood TEC, Hb, PCV, and TLC levels in the treated goats might be due to the elimination of mange mite, which was expected.

5.2.3 Biochemical Parameters

5.2.3.1 Serum Glutamic-Oxaloacetic Transaminase (SGOT)

Table 31 in the chapter 4 demonstrates the Serum Glutamic-Oxaloacetic Transaminase (SGOT) of blood in experimental goats groups A, B, C, D and E in pre-treatment (0 day) and post-treatment (28th day). In the control group A, the SGOT of blood was increased at 12.90 per cent on 28th day which was insignificant (P=0.194) and it was decreased on 28th day at 34.65 per cent, 14.43 per cent, 28.79 per cent and 47.95 per cent with the treatment of Neem, Ata, Mehedi and Ivermectin, respectively in which the effects of Neem (P=0.085), Ata (0.099), Mehedi (P=0.087) and Ivermectin (P=0.066) were significant (Table 32 in the chapter 4). The finding is consistent with the study of Hassan *et al.* (2012), Roy (2007), Chaudhary *et al.* (1988), Alam *et al.* (1994) and Ragab *et al.* (1981).

5.2.3.2 Serum Glutamic-Pyruvic Transaminase (SGPT)

Serum Glutamic-Pyruvic Transaminase (SGPT) of blood in the experimental goats groups A, B, C, D and E were counted in pre-treatment (0 day) and post-treatment (28^{th} day) which were found in Table 33 in the chapter 4. In the control group A, the SGPT of blood was increased at 13.80 per cent on 28^{th} day which was insignificant and it was decreased on 28^{th} day at 53.32 per cent, 33.23 per cent, 44.55 per cent and 70.54 per cent with the treatment of Neem, Ata, Mehidi and Ivermectin, respectively in which the effects of Neem (P=0.095), Ata (P=0.082), Mehedi (P=0.093) and Ivermectin (P=0.097) were significant (Table 34 in the chapter 4). These results are in conformity with earlier reports Hassan *et al.* (2012), Roy (2007), Chaudhury *et al.* (1988), Alam *et al.* (1994) and Ragab *et al.* (1981).

The levels of SGPT and SGOT in the herbal and Ivermectin treated groups are decreased, which suggest the removal of mange from the affected goats. The present findings suggest that the herbal products (Neem, Ata and Mehedi) and Ivermectin drugs have shown very satisfactory performances in terms of the removal of mange mite and the changing of healthy hematological and biochemical parameters.

The herbal products (Neem, Mehedi and Ata) contain some chemical contents like phenolics, terpenoids, polyphenols and alkaloids and polypeptide which have some medicinal values and these are frequently used for the treatment of mange, ticks, lice and flies (Iqbal *et al.*, 2012, Cowan 1999, and Satyanarayana *et al.,* 2013). Ivermectin stimulates the release of GABA (Gamma-Aminobutyric Acid) from nerve ending and enhance binding of GABA to special receptors at nerve junctions and decreasing nerve transmission. The hyperpolarization of neuronal membranes mediates a flaccid paralysis in parasites. Neem, Ata and Mehedi and Ivermectin were more or less effective against mange mite in the experimental goats. In the present study Mehedi showed the better performance to gain bodyweight and Ata was less effective than others. In the maximum increase of blood parameters TEC and HB%, Ivermectin showed the better performance followed by Neem, Mehedi and Ata. Neem showed the more effective performance to increase PCV of blood than Mehedi, Ata and Ivermectin. To increase TLC of blood, Ivermectin was more effective followed by Neem, mehidi and Ata. In biochemical parameters Ivermectin was more effective to reduce SGOT and SGPT followed by Neem, Mehedi and Ata.

Chapter 6

6.1 Summary

Bangladesh is mainly an agro-based country with an area of 147570 square kilometers accommodating a population of about 140 million people. The three sectors such as agriculture, industry and services contribute to the economy of Bangladesh in which the agriculture sector contributes to GDP 19.29 per cent. Among the sub-sectoral contributions of agricultural is dominated by crops (56.07 per cent), followed by fisheries (22.18 per cent) and livestock (13.25 per cent) and the rest by forest and related services (8.50 per cent) (BBS, 2010). Livestock sub-sectors are playing vital rule in the National economy of Bangladesh. Statistics show that about 2.9% of national GDP is covered by the livestock sector. Livestock population in Bangladesh is currently estimated to comprise 25.7 million cattle, 0.83 million buffaloes, 14.8 million goats, 1.9 million sheep, 118.7 million chicken and 34.1 million ducks (Banglapedia, 2014**)**.

The goat is a mammal in the genus *Capra*, which consists of several species. 94 per cent goat population is found in the developing countries. The main importance of goats is the production of meats, milk, fiber and skin. More than 90% of the goats in Bangladesh are kept by rural people and 10% are kept through urban other folks. Goats rear as a popular ruminant species for household income due to its prolificacy character and higher market value for meat and skin. Goat rearing has been recently recognized as a tool of poverty alleviation.

Most of the goats belong to indigenous Black Bengal variety and the rest are crosses of Jamunapari in Bangladesh. Black Bengal Goat comprises more than 90% of total goat population. Black Bengal is a predominant goat in the country and famous for its prolificacy, meat and skin quality. Bucks of exotic breeds are being imported privately from India and used for crossbreeding, especially in the western part of the country. The Jamunapari is known as the best dairy goat in India and it is also the tallest breed and commonly known as the "Pari" in its area of origin-the "home tract"-because of its majestic appearance. This breed has been extensively utilized to upgrade indigenous breed for milk and meat and has been reported to neighboring countries such as Bangladesh, Nepal, Pakistan and Sri Lanka for the same purpose. The real number of crossbreed goat population is not known; but mostly found in Rajshahi, Pabna, Kustia, Chuadanga, Jinaidah and Jessore district.

The health of an animal may be affected due to infection by the parasites. Parasites are mainly associated with debility and loss of production, although there are ample examples of a parasite killing an animal. The parasitism is an important limiting factor to rear goats in Bangladesh as the climatic condition of the country favors the development and survival of various parasites. In parasitic problems, ectoparasitic infestations are common in goats. Several ectoparasites affect the goats' health which is directly or indirectly reduce their productivity. Mites are the common and pivotal cause of skin diseases in goats.

Mites are microscopic external parasites that cause mild to chronic skin disease known as "Mange" in a wide range. The ectoparasitic mites of mammals and birds inhabit the skin, where they feed on blood, skin debris or sebaceous secretions, which they ingest by puncturing the skin, scavenging from the skin surface or imbibe from epidermal lesions. Infestation by mites is called acariasis and can result in severe dermatitis, known as mange. Mange is a widespread and most important ectoparasitic disease of animals, which may cause significant welfare problems and economic losses. The major species that cause mange in small ruminants belongs to the four genera of mite, namely *Sarcoptes, Psoroptes, Chorioptes* and *Demodex.*

Meat and skin of goats are valuable wealth of Bangladesh. But the skin is infected and damaged by mange mite, causing economic loss to the farming community, tanning and leather industry, hampering the income generation and foreign currency flow to the country. The extent of the problem is bieng increased continuously, threatening goat population, health, production and reproduction that warrant cost effective control measures. Keeping in view the importance of mange, the present study was designed to know the prevalence of mange mite in goats and the relationship between the risk factors (farm size, age, housing condition, housing system, feed, sex, breed, season, land topography, health condition, temperature, rainfall and humidity) of goats and mange along with the gross and histopathological changes produced by mange infestations in goats as well as to evaluate the economic impact of mange and to find out some alternative measures (Neem, Ata, Mehedi and Ivermectin) to control mange and to diagnose mange and isolate the species of mites that cause mange in goats.

The five Thana of Rajshahi district, namely Boalia, Puthia, Poba, Gudagari and Baghmara were selected as study area. The relevant data were collected from a total of 1277 goats which were selected randomly and proportionately from 129 goat rearing farms (small, medium and large farms) during the period from July’2010 to June’2011 considering the three seasons *viz,* rainy, winter and summer seasons. Raja Bari goat farm in Rajshahi, Narikalbaria veterinary clinic under the University of Rajshahi and some selected farmers of five Upozila of Rajshahi were considered for mite identification.

Diagnosis of mange was also done by skin biopsy method or histopathology from skin of the affected live goats. The collected scraped samples were diagnosed in laboratory for mange by identification of mites.

The herbal products such as Neem (*Azadirachta indica*), Ata (*Annona reticulata*), Mehedi (*Lawsonia inermis)* and Ivermectin medicine were used for conducting the control experiment of mange in goats. Fifteen affected goats of both sexes aged between 10 and 30 months were selected for experiment and it was divided into 5 groups such as A, B, C, D and E randomly considering 3 goats in each group and these groups were taken under different treatments as control, Neem ointment, Ata ointment, Mehedi ointment and Ivermectin, respectively. The control experiment was conducted during November’2012 to December’2012.

The collected samples for mites from different body regions of the goats were examined as per the protocol in order to assess skin lesion on 0 day (before the start of the treatment) and 7, 14, 21, and 28 days (during the treatments). Body weight (BW) and blood samples were taken from each goat following the same schedule. A portion of the blood from each sample was used to evaluate routine hematological indices such as total erythrocyte count (TEC), hemoglobin (Hb), packed cell volume (PCV) and total leukocyte count (TLC). Serum samples were then separated by centrifugation at 1500 rpm for 10 minutes. These samples were evaluated for biochemical parameters such as SGOT, and SGPT.

Data were analyzed using SPSS Version-15. Association between prevalence and explanatory variables such as farm size, feeding, breed, age, sex, season, land topography, housing system, housing condition, body condition, temperature, rainfall and humidity were found using chi-squire (P) test. Only farm size, feeding, breed, age, sex, season and land topography were considered in logistic regression analysis. A descriptive statistical analysis was also carried out for the results of clinical parameters (skin lesion and bodyweight), certain hematological parameters (Hb, TEC, PCV and TLC) and biochemical parameters (SGOT and SGPT). One way ANOVA was used to compare the effects of different treatments on some selected clinical, hematological and biochemical of experimental goats. The significant difference was considered as $P<0.05$ in the prevalence study and in the experimental study the significant difference was set as $P<0.10$ in the analyses.

The effects of mange prevalence in goats caused by the different risk factors like farm size, feeding, breed, age, sex, season, land topography, housing system, housing condition, body condition, temperature, rainfall and humidity were observed and the logistic regression analysis was done to show the comparative effects of some selected variables such as farm size, feeding, breed, age, sex, season and land topography on the prevalence of mange in goats.

The present study revealed that the overall prevalence of mange mite was 5.95 per cent in all farms. The prevalence of mange mite was identified in small, medium and large farms at 4.13 per cent, 6.03 per cent and 9.04 per cent respectively, which was statistically significant (P = 0.033). The large farms were more affected than the medium and small farms. Logistic regression analysis of the effect of farm size indicated the significant difference in prevalence of mange mite infestations between small farm and medium farm (Odds Ratio=0.402, P=0.026) and between small farm and large farm (Odds Ratio=0.618, P=0.082).

The present study revealed that mange mite infestation was found in good, moderate and poor level of feeding 3.61 per cent, 6.03 per cent and 8.25 per cent of each feeding condition, respectively, which was statistically significant (P=0.044). The highest prevalence of mange mite infestation was observed in poor feeding condition and it was lowest in good feeding condition. Logistic regression analysis of the effect of feeding indicated the insignificant difference in prevalence of mange mite infestations between good feeding and moderate feeding (Odds Ratio=1.02, P=0.112) and it was the significant difference between good feeding and poor feeding (Odds Ratio=1.10, P=0.049).

The prevalence of mange infestation were 6.93 per cent and 3.09 per cent in Black Bengal and cross breed, respectively which was statistically significant (P= 0.012). The highest prevalence of mange mite infestation was observed in Black Bengal. Logistic regression analysis of the effect of breeds indicated the significant difference in prevalence of mange mite infestations between cross breed and Black Bengal (Odds Ratio=0.841, P=0.049).

The prevalence of mange mite in goats was observed at 3.60 per cent, 5.82 per cent and 8.47 per cent in age groups '< 1 year', '1 < 3 years' and '3 years and above', respectively, which was statistically significant (P=0.012). The highest prevalence of mange mite was found in the age group '3 years and above' and it was the lowest in age group '< 1year'. Logistic regression analysis of the effect of age indicated the highly significant difference in prevalence of mange mite infestations between the age group of '< 1 year' and '1 < 3 years' (Odds Ratio=0.385, P=0.003) and between the age group of '< 1 year' and '3 years and above' (Odds Ratio=0.675, P=0.012).

The prevalence of mange mite was estimated at 3.87 per cent and 6.78 per cent in male and female goats respectively which was statistically significant (P=0.048). The highest and lowest prevalences of mange mite were observed in female and male goats respectively. Logistic regression analysis of the effect of sex indicated the significant difference in prevalence of mange mite infestations between male and female (Odds Ratio=0.672, P=0.031).

The prevalence of mange mite in goats was 5.14 per cent, 10.74 per cent and 2.09 per cent in rainy, winter and summer seasons, respectively which statistically significant (P=0.000). The mange prevalence was higher in winter season and it was lower in summer season. Logistic regression analysis of the effect of season indicated the highly significant difference in prevalence of mange infestations between summer season and rainy season (Odds Ratio=0.049, P=0.003) and between summer season and winter season (Odds Ratio=0.094, P=0.001).

The prevalence of mange mite in goats was 8.81 per cent, 5.94 per cent and 3.09 per cent in low land, medium land and high land, respectively which was statistically significant (P= 0.022). The highest and lowest prevalences of mange mite were observed in low land and high land respectively. Logistic regression analysis of the effect of land topography indicated the insignificant (Odds Ratio=1.36, P=0.814) and it was the significant difference in between low land and high land (Odds Ratio=0.186, P=0.045).

The mange mite infestation was estimated at 6.51 per cent and 2.34 per cent in conventional and semi-intensive housing systems, respectively which was statistically significant (P=0.032). The highest and lowest prevalencee of mange mite were observed in conventional and semi-intensive housing systems respectively.

The prevalence of mange infestation was 3.5 per cent, 5.89 per cent and 8.97 per cent in good, moderate and poor level of housing conditions, respectively which was statistically significant (P=0.011). The highest and the lowest prevalence of mange mite infestation were in poor and good housing conditions respectively.

The prevalence of mange infestation was 2.03 per cent, 9.80 per cent and 25.32 per cent in good, moderate and poor health conditions, respectively which was statistically highly significant (P=0.000). The highest and the lowest prevalence of mange mite infestation were observed in poor and good health conditions respectively.

The prevalence of mange mite in goats was 8.47 per cent, 6.35 per cent and 2.76 per cent in the temperature range of ‘below 21^{0}C’, ‘21^{0}C to <29^{0}C’ and ‘29^{0}C & above’, respectively which was statistically significant (P=0.002). The highest and the lowest prevalence of mange mite in the temperature range of ‘below 21^{0}C’ and ‘29^{0}C & above’, respectively.

The prevalence of mange mite infestation was found at 8.24 per cent, 3.73 per cent and 5.84 per cent in the rainfall range of ‘below 50 mm’, ‘50 mm to < 200 mm’ and ‘200 mm & above’ respectively which was statistically significant (P=0.019). The highest and the lowest prevalence of mange mite were observed in the rainfall range of ‘below 50 mm’ and ‘50 mm to <200 mm’, respectively.

The prevalence of mange mite was 8.93 per cent, 3.64 per cent and 5.52 per cent corresponding to the humidity range ‘below 65%’, ‘65% to < 85%’ and ‘85% & above’, respectively which was statistically significant (P=0.001). The highest and the lowest prevalence of mange mite were observed in the humidity range ‘below 65%’ and ‘65% to < 85%’ respectively.

The distribution of mange mite was identified in nine anatomical sites of goats. The study identified the highest frequency at head region 18.42 (14 of 76) per cent followed by the neck region 17.11 per cent (13 of 76) and the region of the thorax 14.47 per cent (11 of 76), flank region 13.16 per cent (10 of 76), abdomen region 11.84 per cent (9 of 76), rump region 10.53 per cent (8 of 76), tail region 6.57 per cent (5 of 76), leg region 3.95 per cent (3 of 76) and whole body 3.95 percent (3 of 76).

The economic impact of mange disease is an important aspect for goat rearing farms. The average economic loss was incurred at Tk.1038.46, Tk.1158.33, Tk.1213.33 and Tk.1148.68 in small, medium, large and all farms, respectively in the study area.

The pathological lesions produced by the mites were mostly found on the ear, face, neck, thorax, flank, rump, abdomen, tail and leg. The skin lesions were characterized by rough, dry and leathery conditions with loss of hair (alopecia). The skin was thick and mild to moderate corrugation was present in some cases.

The mange was positive in collected deep skin scraping from the affected goats examined under the light microscope. Only *S. scabiei* species of mite was identified through the preparation of permanent slide.

Histopathologically the lesions were characterized by hyperkeratosis, eosinophilic infiltration and acanthosis and superficially loss of cornified layer associated with aggregation of necrotic cellular debris.

The Ivermectin medicine and herbal products like Neem (*A. indica*), Ata (*A. reticulata*) and Mehedi (*L. inermis)* were used as drug for treatment to control mange in goats. The study revealed that the hair coat of goats started to become smooth and shiny gradually after giving the treatment with Neem, Ata, Mehedi and Ivermectin in the group of B, C, D and E, respectively. The hair coat of the infected control group A became more and discolored. The patent drug Ivermectin showed better results than the herbal drugs in the experiment.

The study revealed that the wound per skin lesion area was gradually increased at 5.44 per cent in control group A on 28th treatment day. With the treatment of Neem, Ata, Mehedi and Ivermectin, the wound per lesion area in treatment group B, C, D and E was decreased at 64.57 per cent, 37.76 per cent, 44.60 per cent and 97.37 per cent on 28th treatment day, respectively. The recovery of skin lesion was statistically significant in treatment group B, C, D and E with the treatment of Neem (P=0.059), Ata (P=0.085), Mehedi (P=0.079) and Ivermectin (P=0.04) respectively. In the control group A with the treatment of no drugs, the skin lession expansion was insignificant (P=0.384).

The average bodyweights of goats in treatment group B, C, D and E were increased on 28th day (post-treatment) with the treatment of Neem, Ata, Mehedi and Ivermectin at 6.73 per cent, 4.74 per cent, 10.40 per cent and 5.73 per cent, respectively and in the control group A, the bodyweight was decreased at 6.85 percent on 28th day which was significant (P=0.077). The effect of Ata (P=0.078) was significant and Neem (P=0.007), Mehedi (P=0.006) and Ivermectin (P=0.001) indicated the highly significant effects.

After treatment in the control group A, the TEC of blood was decreased at 4.31 percent on 28th day which was significant (P=0.049). The TEC of blood in treatment group B, C, D and E were increased with the treatment of Neem, Ata, Mehedi and Ivermectin at 8.80 per cent, 5.83 per cent, 7.89 per cent and 60.30 per cent on 28th day (post-treatment) respectively. The effects of Neem (P=0.001), Ata (P=0.008), Mehedi (P=0.001) and Ivermectin (P=0.000) were highly significant.

After treatment in the Hemoglobin gm% of blood was decreased at 8.31 per cent on 28th day in control group A which was highly significant (P=0.002). The Hemoglobin gm% of blood in treatment group B, C, D and E were increased with the treatment of Neem, Ata, Mehidi and Ivermectin at 11.60 per cent, 7.64 per cent, 9.19 per cent and 64.70 per cent on 28th day, respectively. The effect of Ata (P=0.044) was significant and Neem (P=0.000), Mehedi (P=0.009) and Ivermectin (P=0.000) showed the highly significant effects.

On an average Packed Cell Volume (PCV %) of blood in treatment group B, C, D and E were increased with the treatment of Neem, Ata, Mehedi and Ivermectin at 8.74 per cent, 6.42 per cent, 7.95 per cent and 4.25 per cent on 28th day (post-treatment), respectively. In the control group A, the PVC % of blood was decreased at 4.65 per cent on 28th day which was insignificant (P=0.246). The effects of Neem (P=0.062) and Mehidi (P=0.071) were significant and Ata (P=0.367) and Ivermectin (P=0.138) showed the insignificant effects.

The TLC of blood in treatment group B, C, D and E were increased on 28th day (post-treatment) at 7.26 per cent, 4.16 per cent, 6.95 per cent and 23.40 per cent with the treatment of Neem, Ata, Mehedi and Ivermectin, respectively. The effects of Neem (P=0.032) and Ata (P=0.046) were significant and Mehedi (P=0.003) and Ivermectin (P=0.005) showed the highly significant effects. In the control group A, the TLC of blood was decreased at 3.86 percent on 28th day which was insignificant (P=0.357).

The SGOT of blood in treatment group B, C, D and E were decreased on 28th day (post-treatment) at 34.65 per cent, 14.43 per cent, 28.79 per cent and 47.95 per cent with the treatment of Neem, Ata, Mehedi and Ivermectin, respectively. In the control group A, it was observed that the SGOT of blood was increased at 12.90 per cent on 28th day which was insignificant (P=0.194). The effects of Neem (P=0.085), Ata (0.099), Mehedi (P=0.087) and Ivermectin (P=0.066) were significant.

In the control group A, the SGPT of blood was increased at 13.80 per cent on 28th day which was insignificant. The SGPT of blood in treatment group B, C, D and E were decreased on 28th day (post-treatment) at 53.32 per cent, 33.23 per cent, 44.55 per cent and 70.54 per cent with the treatment of Neem, Ata, Mehedi and Ivermectin, respectively. The effects of Neem (P=0.095), Ata (P=0.082), Mehidi (P=0.093) and Ivermectin (P=0.097) were found to be significant.

6.2 Conclusion

A huge number of goat populations is reared and adapted to different seasons and environmental condition in Bangladesh. However, there is a contribution of goats as meat and skin to the national economy of country. Mange mite infestation is a major cause of the constraint for goat production and it deteriorates the export skin quality in Bangladesh. The different risk factors such as farm size, age, housing condition, housing system, feed, sex, breed, season, land topography, health condition, temperature, rainfall and humidity have the significant effects on the prevalence of mange mite in goats in the study area. Therefore, the overall prevalence of mange mite in goats caused by different risk factors causes to be economic loss through decreased production and productivity, deaths and skin damages in Bangladesh. This study quantifies the level of mange mite infestation in goats corresponding to the different risk factors which demands immediate control program and more epidemiological study for detail information of the constraints of goat health and production and will seek for remedies.

It may be concluded from the experimental study that the herbal ointments such as Neem, Ata and Mehidi and the patent drug Ivermectin were more or less suitable for controlling mange in goats. In the herbal ointments, Neem was more effective for control of mange in goats than Mehedi and Ata. The patent drug Ivermectin was very much successful in mange mite infestation than the herbal ointments. Ivermectin subcutaneous infection preparation is easy to administration to the goats without any risk that is associated with any other routes of administration and it is the safest and more effective for the treatment of mange. Besides, it can be said from the study that the herbal ointments (Neem, Mehedi and Ata) may be used for the treatment of mange in goats. Most of the farmers in Bangladesh cannot afford to buy modern medicine for the treatment of goats because of high price of the drug and poor economic condition of them. So, if the traditional system of herbal medicine can be developed in Bangladesh it will be highly beneficial for the farmers and for the overall improvement of the livestock. Recently much interest in the field of medicinal plants has been grown throughout the world. Many countries have already come to realize the medicinal plants as a potential means of therapeutic agent and also their availability and cost effectiveness.

Therefore, the following recommendations are forwarded.

- The farmers should be conscious about the effect of mange mite on production, productivity, deaths and skin damages by taking effective extension programs.
- The veterinary personnel and technician at the grassroots level need to be mobilized to implement mass treatment programs for urgent action which need to be repeated regularly with simultaneous awareness building to farmers.
- The goat farm owners have to be properly enlightened on various precautionary measures which ensure that mange mites are kept away as much as possible from non infested goats.
- A well biosecurity and neat and clean environment of the farm should be ensured from all sides at all times.
- The regular improvement of husbandry practices should be followed.
- Policy makers should formulate policies that would enhance the herbal treatment on small ruminants.

- Farmers association or cooperative should be formed in promoting the utilization of ethnoveterinary practices among them.
- Government need to encourange researchers to improve on the existing indigenous knowledge system through grants.
- A drug development program should be undertaken to develop modern drugs with the compounds isolated from Neem, Ata and Mehidi after extensive investigation of their bioactivity, mechanism of action, pharmacotherapeutics and toxicity.

The findings of the present study may help the researchers in future for conducting further epidemiological study for detail information of the constraints of goat health and reproduction and for seeking remedies. The findings may also help the researchers to explore the details bioactivity, mechanism of action, pharmacokinetic and toxic effects for wide therapeutic uses in Bangladesh for the treatment and control of parasitic infection in goats. Further studies are required to clarify the efficacy of the ethnoveterinary and anthelmintics widely used in agro ecologies, animal species and livestock management system in Bangladesh. From the findings of the present study the veterinary may use the specific herbal and anthelmintic for ectoparasitic infestation in goats.

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