Helminthic Infections of Gastrointestinal Tract of Sheep and Goat in and around Patna District

THESIS

SUBMITTED TO THE

RAJENDRA AGRICULTURAL UNIVERSITY

(FACULTY OF POST - GRADUATE STUDIES)

PUSA (SAMASTIPUR) BIHAR

In partial fulfilment of the requirements

FOR THE DEGREE OF

Master of Veterinary Science

(PARASITOLOGY)

By

Dr. Suchita Kumari

Registration No. - M/V. Para/28/2005-2006

Department of Veterinary Parasitology

BIHAR VETERINARY COLLEGE

PATNA - 800 014

2007

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P A T N A – 800 014

2007

Dedicated

to my

Adorable

Parents

Dedicated

to my

Adorable

Parents

DEPARTMENT OF VETERINARY PARASITOLOGY
BIHAR VETERINARY COLLEGE, PATNA- 14
RAJENDRA AGRICULTURAL UNIVERSITY, PUSA
(SAMASTIPUR), BIHAR.

CERTIFICATE-I

This is to certify that the thesis entitled ***"Helminthic infections of gastrointestinal tract of sheep and goat in and around Patna district"*** submitted in partial fulfilment of the requirements for the award of Master of Veterinary Science **(Veterinary Parasitology)** of the faculty of post-graduate studies, Rajendra Agricultural University, PUSA, Samastipur, Bihar is the record of bonafide research work carried out by **Dr. Suchita Kumari, Registration No.- M/V. Para/28/2005-2006,** under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.

It is further certified that the assistance and help received during the course of this investigation and preparation of the thesis have been fully acknowledged.

(S.R.P. Sinha)
Major Advisor

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CERTIFICATE –II

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Date : 25-05-07

Place : Patna

Suchita Kumari

(Suchita Kumari)

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CHAPTER - I

INTRODUCTION


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INTRODUCTION

Sheep and goats are important livestock population in India, and presently we have formidable 20% small ruminant population of the world, being largest with respect to goat population and fifth in sheep. Sheep and goats farming play a vital role as the source of milk, meat and wool including skin and hides. Due to the identical management practices, collective farming of sheep and goats has been employed by most of the states of India, which is not only confined to small holders but also widely popular in large-scale producer. In arid, semi-arid and mountainous regions these small ruminants are more important livestock and play significant role in poverty alleviation programme. Farmers of these regions are producing best stock of sheep and goats thus achieved high level of prosperity by contributing raw materials like meat, milk, wool, hides, leather, to various industries. Even sheep and goats are used in the production of drug/medicine, sera and vaccine.

In Bihar, sheep and goats farming always remain in the hand of unorganized farming community specially sheep rearing is mostly allied with some migratory community of the society. Sheep and goats meats are consumed locally and there is no dirth of marketing the products. Therefore, there is tremendous scope for improvement of sheep and goats and its contribution to socio-economic development programme. In

Bihar, with good management, the sheep and goats husbandry may become a great source of employment and better livelihood for weaker section of society, particularly landless labourer, small and marginal farmers. Sheep and goats farming provide great opportunity for self-employment. Though sheep and goats farming is low costing but their grazing habit in plain green field, low lying marshy land, river and harvesting beds, made them prone to various gastrointestinal infection caused by micro-organism including bacteria, viruses and parasites etc.

Gastrointestinal parasitism is one of the important causes of recurring losses in productivity as they are widely prevalent and mostly soil transmitted infections. These are the common problem in small ruminants worldwide. The harmful effect and incidence of these parasites and their developmental stages tend to depend upon broad ecological situation determined by climatic condition and directly influenced by rainfall, atmospheric temperature and humidity. The vegetation exerted through the soil also affects the distribution and prevalence of these helminthic parasites. Unfortunately all these conditions are favourable in our country for wide distribution of G.I. parasites.

The maintenance of the parasitic population depends upon the continuous cycle of infection between host and pasture. In rainy season the occurrence of disease transmitting vector population increases which simultaneously

propagate the parasitic infection in new hosts. Gastrointestinal trematodes, the common parasites of sheep and goats are usually present in rumen and reticulum. Paramphistomiosis is transmitted by snail in sheep and goats and clinically characterized by intestinal disturbance, anaemia, and loss of body weight, anorexia, hypoproteinemia, oedema and emaciation. The mortality has also been common due to profuse fluid diarrhoea and recumbence. Cestodes widely influence the clinical manifestation in sheep and goats but monieziosis has little pathogenic significance. However, problem of taeniosis considerably affect the general condition of sheep and goats due to gid and staggering gait.

Gastrointestinal nematodiosis is one of the most serious and common problems to sheep and goats. Most of the nematodes are transmitted through soil contamination. Nematodiosis in sheep and goats is related with anorexia, rapid weight loss and osteoporosis in growing lambs. In severe condition animal may die due to fluid loss by diarrhoea and dehydration.

Among various intestinal diseases, infection of haemonchosis is the major problem of sheep and goats. It is caused by *Haemonchus* spp., which popularly known as wireworm or stomach worm. It has been reported that each *H. contortus* worm may suck about 0.07 ml of blood per day (Malviya *et al.*, 1979). This disease is the cause of wasting and decreased productivity through loss of blood and plasma

protein, alteration of protein metabolism, decreased activity of certain enzymes and low levels of minerals.

In acute condition animal may show anaemia, stunted growth, weight loss and thus decreased meat, milk, and wool production. Mortality is also common in acute cases. In chronic cases, anaemia associated with oedematous swelling popularly known as "bottle jaw" or "watery pock" associated with weakness and emaciation.

Recent reports and literatures indicate that G.I. parasitism in sheep and goats is most generalize throughout the world and researches on prevalence, pathogenesis, immunology, control and prophylactic aspects on nematodiosis are going on, even some centers are claiming to produce vaccine against haemonchosis. But in Bihar, existence of organised sheep and goats farming is still in primitive stage.

However, cattle population is having positive growth and in terms of production we have achieved a respectable position. But structure of predominant sheep farming in Bihar is almost negligible, however, it is a demand of the situation as the choice of sheep and goats husbandry may also be widely practiced in those areas where agriculture could not be the main vocation. To achieve the targeted production necessary proper management practices including feeding and disease free population are the basic requirement. Parasitism in sheep and goats is known to cause lowered resistance, loss of production and even mortality. The prevalence of various

gastroenteric parasites of sheep and goats has been reported by many workers (Pandit *et al.* (2003), Thangathurai *et al.* (2003) in all over India), however, the information pertaining to the prevalence of G.I. parasites in sheep in Bihar is completely lacking though some information regarding goat parasitism is available. Therefore, this preliminary study has been taken with the following objectives:

(1) A study on the incidence of gastrointestinal helminth parasites of sheep and goats in and around Patna district, with special reference to *Haemonchus* spp.

(2) Study the effect of haemonchosis on haematological and biochemical values in sheep and goats.

(3) Studies on histopathological changes during haemonchosis in sheep and goats.

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CHAPTER - II

REVIEW OF LITERATURE


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PREVALENCE OF HELMINTHIC PARASITES :

Juarez and Quiroz (1972) recorded that 69.9% prevalence of *Haemonchus contortus* in sheep from May to August with a sex ratio of 1:1.4 male to female.

Mckenna *et al.* (1973) reported 20% infection of *Haemonchus* spp. during abomasal examination of sheep in New Zealand.

Ansari and Singh (1981) conducted examination of intestine and noted that 9.2% and 18.8% prevalence of *Gaigeria pachyscelis* in goats and sheep respectively in Bareilly district, Uttar Pradesh, India and highest infection rate was recorded in the post monsoon period and winter. *Haemonchus contortus, Bunostomum trigonocephalum, Oesophagostomum columbianum, Trichostrongylus colubriformis* and *Trichuris ovis* were also observed.

Biggs and Anthonissen (1982) observed the incidence of helminths in sheep in Namibia and reported that *Haemonchus contortus* (49.7 to 96.3%) was prevalent from March to early July. A spring rise in faecal egg counts of sheep in October. Whereas *Oesophagostomum columbianum* was prevalent in December and March and *Moniezia* spp. were present from November to early July.

Specht (1982) recorded the *H. contortus*, *Oesophagostomum columbianum* were most prevalent *helminthic* spp., *Strongyloides* spp., *Moniezia* spp., *Paramphistomum* spp. were also common gastrointestinal helminth parasites in grazing sheep and goats of Mozambique.

Chopra (1985) examined the alimentary canal of sheep in Lucknow, India and revealed that peak infection of most prevalent parasites viz. *Haemonchus contortus* (89.23%), *Bunostomum trigonocephalum* (75.38%), *Oesophagostomum columbianum* (95.38%) and *Trichuris ovis* (100%) were in September whereas minimum rate of infection occurred in May. There was inverse relationship between temperature and prevalence while positive relationship recorded between both humidity, rainfall and prevalence. Significant humidity was directly related with infection of *Oesophagostomum columbianum* and *T. ovis* whereas rainfall for *B. trigonocephalum* in sheep.

Nicolas *et al.* (1985) conducted an epidemiological survey on the internal parasites of sheep in Haute vienne. Faecal culture of the larvae revealed maximum intensity of *H. contortus* (50%) between June and December, where as *Ostertagia circumcincta* (30%) and *Trichostrongylus axei* (20%) were present throughout the year and peak prevalence was recorded in June, 2-8% infection recorded for *Oesophagostomum venulosum.*

Trichostrongylus colubriformis (6.26% and 6.84%) were in goats and sheep respectively where as *Gongylonema pulchrum* (28.35%) and *Gaigeria pachyscelis* (8.66%) in goats and *T. axei* (41.02%), *Ostertagia circumcincta* (34.18%), *Nematodirus filicollis* (40.17%), *Capillaria brevipes* (6.84%) were also common prevalent gastrointestinal parasites of sheep.

Njau (1987) conducted necroscopy and faecal examination of lambs in northern Tanzania and revealed that *Haemonchus contortus, Oesophagostomum columbianum, Trichostrongylus colubriformis, Trichuris ovis* were the prevalent parasites.

Asanji (1988) recorded maximum prevalence of haemonchosis between October to January and minimum infection rate was observed between March to May. The rate of incidence was slightly higher side in females than those of males. Further prevalence rate was significantly higher in young hosts than older animals and showed two peaks period of occurrence (August to December and April to June) in young hosts whereas old host exhibited an irregular seasonal pattern.

Morales (1988) reported that parasitic communities of sheep and goat were similar and *Trichostrongylus colubriformis* was the most abundant, prevalent and dominant spp. in both hosts. The nematode parasites were over dispersed in both host population and chemotherapy was most effective when given to all hosts, as examined in arid zones of Lara state, Venezuela.

Javed *et al.* (1992) noted prevalence of haemonchosis in Faisalabad, Pakistan in sheep and goats was 12.7% and 10.9% respectively. The female sheep (28.7%) having higher infection rate than males (17.1%) whereas non-significant difference was noted between female (11.8%) and (10.3%) male goats.

Lloyd (1994) stated that gastrointestinal nematodal infection increased with stocking density in sheep population and it can be avoided by extensive husbandry with browsing rotation of grazing and zero grazing in deep litter houses.

Singla (1995) noted overall prevalence of gastrointestinal parasitism (89.90%) in small ruminant population in Ludhiana, Punjab state. The rate of prevalence was 89.70% and 90.01% in sheep and goat respectively. In sheep 34.20% infection was of mixed type while 55.55% infection was due to strongyles alone, whereas mixed infection included strongyle with *Fasciola* (14.58%), with *Amphistome* (11.11%). In case of goats single infection of strongyle was recorded 70.40% than that of mixed type was 19.69%. The high rate of infection was greatly varied due to climatic condition, grazing behaviour of the hosts, overstocking of host, warm and humid climate provided favourable conditions for multiplication and dissemination of the parasite of the livestock. Further he suggested the lesser food requirement resulted into malnutrition thus lowered the

immunity of the host leading to higher incidence of parasitic infection.

Alam *et al.* (1996) reported that small ruminants in Bangladesh were mostly suffer from haemonchosis and fascioliosis and maximum incidence was observed during summer and monsoon seasons.

Khan *et al.* (1996) observed that fascioliosis, haemonchosis, trichostrongyliosis, ostertagiosis, nematodirosis, trichuriosis and coccidiosis were the major parasitic diseases of small ruminants in Pakistan and also reported that almost 100% of grazing sheep and goats harbour light to medium levels of parasitic infection.

Mazhar *et al.* (1996) noted 65.2% and 47.1% prevalence of *Haemonchus contortus* infection in sheep and goat respectively in Faisalabad abattoir, Pakistan and prevalence was highest in female (74.6%) than male (59.1%) in sheep. There was non-significant difference in the prevalence between male and female goats. The prevalence of haemonchosis was higher in both sheep and goats below 2 year of age (67.1%, 47.8%) compared with those of above 2 years (40.4%, 33.3%).

Mostofa *et al.* (1996) studied epidemiology of gastrointestinal helminth parasites in small ruminant in Bangladesh and identified 10 species of helminths of which 7 were nematodes, one cestode and two trematodes. Helminthic infection ranges from 1-24% and also revealed highest infection

of *Haemonchus contortus* (20-24%) followed by *Fasciola gigantica* (12-15%).

Saithanoo *et al.* (1996) stated that gastrointestinal nematodes particularly *Haemonchus contortus* were common and a major constraint to goat production in villages of southern Thailand, where the climate was humid and tropical. Transmission of parasite occur throughout the year.

Maqbool *et al.* (1997) studied the prevalence of haemonchosis in slaughtered and live goats in Faisalabad, Pakistan and found overall prevalence was 17.54 and 18.18% respectively. The maximum occurrence of disease was recorded in slaughtered goat in March (28.57%) and in live goats in April (28.20%) while the lowest infection was observed in slaughtered goat in July (7.69%) and in live animal in August (12.43%). Spring season was the most strongyle associated with the occurrence of the disease 24.56% and 24.81% in both slaughtered and live animals respectively, followed by winter (16.76%), summer (15.33%) and autumn (14.18%) in slaughtered goats while in live animals it was recorded (17.02%), (16.96%) and (16.72%) in summer, autumn and winter seasons respectively.

Swarnkar *et al.* (1997) observed that the survival of *Haemonchus contortus* eggs deposited on pasture under semi-arid condition in Rajasthan may remain over period of one year

and development to the effective larvae and their survival recovered maximum no. in monsoon. The survival time of infective larvae varied from one months (January) to nine months (September).

Gatongi *et al.* (1998) carried out an epidemiological study in flocks sheep and goats in Kenya and observed that prevalence of *Haemonchus contortus* was over 90% in both sheep and goats and contributed about 80% of total worm burden. Higher prevalence of hypobiotic larvae were recorded during dry month than wet month.

Katoch *et al.* (1999) studied the outbreak of *Haemonchus contortus* infection in sheep in Himachal Pradesh and reported a maximum incidence of *H. contortus* (97 ± 0.56%) followed by *Strongyloides* spp. (2.20 ± 0.51%) and *Trichostrongylus* spp. (0.8 ± 0.25%) were also prevalent.

Rizvi *et al.* (1999) reported the occurrence of haemonchosis in goat was 18.81% in Faisalabad, Pakistan and rate of prevalence was higher in kids (53%) than adult animals (47%), also higher occurrence of disease was noted in the spring (24.81%) in comparison to summer (17.02%) and autumn (16.96%) seasons.

Boubas and Theodoridis (2000) examined digestive tracts of local breed of male and female goats aged between 2-8 years in Greece and found 97% goats were infected with L_3, various

parasite located in different parts of digestive tracts. Location of *Gongylonema pulchrum* (20%) was in oesophagus, *Haemonchus contortus* (85.38%), *Teladorsagia circumcincta* (66.77%) and *Trichostrongylus axei* (0.77%) were found in abomasum, *T. colubriformis* (19.23%), *Cooperia curticei* (3.85%), *Nematodirus filicollis* (36.92%), *N. helvetianus* (2.31%), *N. spathiger* (10.0%) and *Bunostomum trigonocephalum* (7.69%) were observed in small intestine and common parasites of large intestine were *Chabertia ovina* (44.6%), *Trichuris ovis* (3.07%) and *Skirjabinema ovis* (13.06%). Incidence of mix infection was 84.6% whereas only 15.4% had simple infection. *Haemonchus contortus*, *Trichostrongylus colubriformis*, *Nematodirus filicollis* and *Chabertia ovina* were commonly found throughout the study period.

Chaudhri *et al.* (2000) studied the helminth parasites most affecting sheep and goats in Haryana were *Haemonchus* spp., *Trichostrongylus* spp., *Paramphistomes spp., Fasciola gigantica, Moniezia* spp., *Thysaniezia giardi, Avitellina* spp. and *Stilesia* spp.

Farhat *et al.* (2000) observed 54.77% prevalence of *Haemonchus contortus* in sheep from Punjab and the infection rate was highest between July (89.55%) to August (87.13%) where as lowest prevalence was noted during February (20.02%) and March (29%).

Katoch *et al.* (2000) recorded highest incidence of gastrointestinal nematodes of goats of Mathura region during rainy season, when mean temperature and relative humidity were appriceably high. However, coproculture studies revealed that *Haemonchus, Oesophagostomum, Trichostrongylus, Strongyloides* were prevalent throughout the year.

Rajapakse *et al.* (2000) studied month wise prevalence of gastrointestinal nematodes of goats in the dry zone of Sri Lanka, that 99% of the animals were infected with one or more spp. of nematodes. *Oesophagostomum columbianum* (88%), *Haemonchus contortus* (81%), *Trichostrongylus* spp. and *Trichuris* spp. were the major nematodes present in the abomasum and intestine during G.I. tract examination.

Tchoumboue *et al.* (2000) conducted a survey in the west African dwarf sheep and goats of the Western Highlands of Cameroon and found that *Haemonchus, Oesophagostomum, Trichostrongylus* and *Strongyloides* were most prevalent nematodes.

Dhanalakshmi *et al.* (2001) carried out faecal examination, faecal culture and estimated egg count in per gram of faeces in 10 sheep farms of Karnataka and reported that most common infection was due to strongyle (82.8%) in all farms followed by mixed infection of strongyle and *Eimeria* spp. (2.8%), strongyle and *Moniezia* infection (2.3%). Further faecal culture showed

Haemonchus spp. was most prevalent parasite and *Oesophagostomum, Trichostrongylus, Cooperia* and *Nematodirus* spp. were also common in all farms.

Lindqvist *et al.* (2001) conducted a survey on prevalence and impact of nematodes infection on sheep flock in Sweden and recorded that prevalence of nematodes was higher in flocks of sheep. Most prevalent parasites were *Haemonchus contortus* (37%) followed by *Teladorsagia circumcincta, Trichostrongylus axei, T. colubriformis, Nematodirus battus* and *Chabertia ovina.* These parasites were progressively increased during summer in lambs grazing on permanent pasture of Sweden. Severity of parasitic infection in lambs was highly dependent on egg output from the ewes and grazing lambs had higher nematode EPG in permanent pasture that those grazed on pasture which had not carried sheep in the previous year.

Morales *et al.* (2001) evaluated the effect of seasonal rainfall extremes on the prevalence of gastrointestinal nematodes in naturally infected ewes in the State of Falcon, Venezuela. Necropsy was performed during rainfall period and dry period which revealed that most prevalent parasites were *Haemonchus contortus, Trichostrongylus axei, T. colubriformis, Cooperia fuelleborni, C. pectinata, C. curtecei, C. punctata, Trichuris ovis, Oesophagostomum columbianum, Skirjabinema ovis* and *Bunostomum trigonocephalum.*

Rehman and Ali (2001) studied monthwise prevalence of gastrointestinal trematodes, cestodes and nematodes infecting damani sheep and goats in district Dera Ismile Khan, Pakistan and denoted the maximum infection of trematodes in June and July and highest cestodal infection in sheep and goat were recorded in June and August respectively. The lowest recorded nematodal infection in sheep was observed in June which increased maximum in August and also similar trend was observed in goats.

Yildiz and Aydenizoz (2001) noted 66.31% prevalence of helminthic infection in sheep flocks in Turkey and indicated that prevalence of parasites belonging to family Trichostrongyloidae was 38.65% with common incidence of *Haemonchus* spp., *Ostertagia* spp. and *Nematodirus* spp. followed by *Trichuris* spp. (27.79%), *Dicrocoelium dendriticum* (19.16%), *Strongyloides papillosus* (5.43%), *Fasciola* spp. (3.51%).

Arunachalam *et al.* (2002) conducted a survey to find out the sheep farming structure and its income in Tamilnadu. They concluded that large number of farmers prefers sheep farming structure, in combination with poultry or buffalo or bullock or cattle or goat considering the profitability.

Barry *et al.* (2002) conducted an epidemiological study of gastrointestinal helminths in Djallonke goats in Central Guinea. Autopsy was carried out every month for one year which revealed

that most prevalent parasites were *Haemonchus contortus* (94%) followed by *Trichostrongylus colubriformis* (84%), *Oesophagostomum columbianum* (75%), *Taenia hydatigena* (71%), *T. axei* (70%), *Cooperia* spp. (55%), *Trichuris ovis* (55%) whereas *Moniezia* spp. (39%), *Gaigeria pachyscelis* (39%), *Strongyloides papillosus* (25%) and *Paramphistomum* spp. (12%) were also commonly found. Gastrointestinal nematodes count was peak in rainy season between July to October. Heavier parasite burden was mostly found in goats aged above 30 months or in lactating one.

Bhojane *et al.* (2002) noted 70% prevalence of helminthic infection in goats in Nagpur, India and revealed that simple infection of *Strongylus* (16.57%) and *Haemonchus* spp. (12.23%) were significantly higher than mixed infection. *Oesophagostomum* spp., *Fasciola hepatica* and *Amphistomes* were also accounted. Sex, season and year had a significant effect on parasitaemia.

Etana-Debela (2002) observed the prevalence of gastrointestinal helminths in Rift-Valley goats in Ethiopia, and revealed that most prevalent parasite were *Haemonchus contortus* (66.5%) followed by *Strongyloides papillosus* (30.19%), *Trichostrongylus* spp. (30.4%), *Moniezia expansa* (32.2%). Mixed infestation was also common to goats, and female and young ones were most affected group. Highest infection was observed in big rainy season followed by short rainy season. The egg output

in July was significantly different than other months except in June.

Achi *et al.* (2003) recorded prevalence of G.I. parasitism in sheep and goats in Cote d'Ivoire and reported that all sheep and goats were carrying atleast one parasite. The most prevalent nematodes were *Trichostrongylus colubriformis* (88% in sheep and 96% in goat), *Haemonchus* spp. (66% and 82%), *Strongyloides papillosus* (63% and 31%), *Trichostrongylus axei* (62% and 46%), *Oesophagostomum columbianum* (43% and 54%), *Gaigeria pachyscelis* (42% and 17%) in sheep and goats respectively. *Trichuris* spp. (29%) *Cooperia curticei* (10%) were observed only in goat. Whereas *Paramphistome* spp., *Fasciola gigantica, Dicrocoelium hospes, Moniezia expansa, M. benedeni, Stilesia* spp., *Avitellina* spp., *Cysticercus tenuicollis*, and *Echinococcus granulosus* were also reported from sheep. Only *T. axei* increased significantly with increase of age. Peak infection was found in end of rainy season and above one year goats carried the highest parasitic burden.

Arora *et al.* (2003) noted 49.46% prevalence of gastrointestinal parasitism in goats in Mathura, Uttar Pradesh (India). This study revealed that bursate worm (*Haemonchus contortus*) was most prevalent parasite.

Garg *et al.* (2003) conducted epidemiology of *Haemonchus contortus* infection in goats in semi arid region of India by

examination of faecal sample, abomasii and coproculture. Overall incidence was noted 56.38% which was lower in summer season as compared to winter and rainy season. Abomasal examination of slaughtered goats showed 71.03% incidence of *H. contortus* worms with a range of 4-4.111 worm. Abomasal worm and faecal egg count were positively correlated and the correlation was significant. Female worms were more common than males with an average of 1.447 female/male ratio.

La *et al.* (2003) studied the infestation of gastrointestinal nematodes in a goat herd in Cuba and observed the goats were mostly infected with *Strongyloides, Haemonchus, Oesophagostomum, Trichostrongylus* and *Bunostomum* parasites. The EPG increased in the dry season as compared to rainy season. Pasture infestation was generally low due to high biomass production in the areas with higher tree density.

Pandit *et al.* (2003) reported the overall prevalence of nematodal infection in sheep of farm and field managed group were 75.92% and 88.39% respectively. Coproculture and gut studies indicated that *Haemonchus, Trichostrongylus, Nematodirus, Marshallagia, Bunostomum, Chabertia, Ostertagia, Oesophagostomum, Strongyloides* and *Trichuris* were the main worms among local sheep farms of Kashmir Valley.

Epizootiological studies on gastrointestinal nematode in Greek dairy breed of sheep and goat was carried out by

Papadopoulos *et al.* (2003). The study revealed that parasitic burden in sheep was significantly higher than those in goat. *Teladorsagia, Haemonchus, Trichostrongylus* and *Chabertia* were the most prevalent nematode parasite in both sheep and goats. There was also a significant interaction between months of year and area of study.

Tsotetsi and Mbati (2003) studied the incidence of helminth parasites in sheep and goats in the north eastern South Africa. Analysis of faecal sample using McMaster, Visser Sieve technique and faecal culture revealed that *Haemonchus* and *Oesophagostomum* spp. were the common prevalent parasites.

Tariq *et al.* (2003) recorded 38% prevalence of haemonchosis in sheep in Mansehra district, Pakistan, and highest prevalence was recorded in sheep below one year (44.0%) in comparison to sheep aged 1 year (32.0%) and above. Rate of incidence varied non-significantly between male and female sheep.

Thangathurai *et al.* (2003) noted 47.2% prevalence of enteric parasitism in sheep and goats in and around Bidar, Karnataka. The common parasites encountered were *O. columbianum*, hookworm, *Oesophagostomum, Trichuris, Stilesia hepatica* among a local population of sheep and goat.

Shahiduzzaman *et al.* (2003) studied seasonal influence on the occurrence of *H. contortus* in slaughtered black bengal goats

in Bangladesh and recorded significant higher infection rate in females than males. Significant higher rate of infection was recorded in rainy season as compared to summer and winter season. The overall infection was 65.63%, and an average (maximum) no. of parasite per abomasum was recorded 41.25% in July and minimum in March (5.52%). In case of sex ratio of parasite, always female were found to be dominated over males worms.

Ismail *et al.* (2004) concluded that *Haemonchus contortus* was fairly prevalent in the local goats of south Darfur state of Sudan and male and female ratio was (0:9) in January while highest (2 : 72) was found in March.

Nasreen *et al.* (2005) studied an epidemiology of gastrointestinal nematodes in sheep of Kashmir valley and *Strongylus, Trichostrongylus* spp., *Haemonchus* spp., *Nematodirus* spp. and *Marshallagia* spp. were identified. The seasonal prevalence of infections indicated that the nematode infection (overall) was highest in summer (67.14%) and lowest in winter (44.31%).

Singh *et al.* (2005) noted 78% prevalence of helminthic infections in sheep in Ludhiana, Punjab and revealed *Strongylus, Trichuris, Strongyloides, Moniezia* and *Paramphistomum,* strongyle infection were most commonly encountered during pre and post rainy seasons. Fortnightly mean eggs per gram (epg)

and climatic factors (rainfall and temperature) were found to be positively correlated. Only 11.52% cases were found positive for mixed helminthic infection out of which the most common cases of mixed infection were of strongyles and *Moniezia* spp.

Sreedevi and Murthy (2005) noted overall 37.6% of gastrointestinal parasites in sheep at Andhra Pradesh. The prevalence was more in summer and lowest in monsoon. Seasonal and age wise prevalence revealed maximum in sheep during summer (47.5%) whereas, in lambs, monsoon was more favourable (46.1%) for parasitism. The prevalent parasite were strongyles and *Moniezia* spp.

Kumar *et al.* (2006) studied the rate of incidence of parasitic diseases in migratory Nallore sheep flocks and it was noted that amphistomiosis was significantly higher in migratory sheep than non-migratory flocks. Monieziosis was very common among both flocks however fascioliosis and strongyle infection were high in migratory flocks. The major problem during migration was identified that common water sources which perceives maximum no. of contamination, infection and outbreaks. Further it was demonstrated that under normal condition also, sheep flocks possessed certain degree of intestinal parasitism with or without clinical symptoms but worm burden reached to pathogenic level during the migratory phase mostly because of grazing during

early hours in a day which facilitates higher incidence of parasitism.

HAEMATOLOGICAL AND BIOCHEMICAL STUDIES :

Barowicz and Petryszak (1970) recorded fall in haemoglobin and eosinophilia in lambs experimentally infected with gastrointestinal nematodes such as *Haemonchus contortus*.

Dargie *et al.* (1974) reported a dramatic reduction in PCV and very low serum iron concentration and signal of exhaustion of the hosts synthetic machinery due to deficiencies of iron and possibly available protein during final stages of ovine haemonchosis.

Gretillat (1976) presented G.I. parasitic fauna of goats and revealed that *Bunostomum* (55%), *Coccidia* (70%), *Trichostrongylus* spp. (20%), *Strongyloides* spp. (27%), *Oesophagostomum* spp. (20%) and *Haemonchus contortus* (20%) were the prevalent parasites in goats and observed monocytosis (37%), neutrophilia and lymphopenia (13%) during severe nematodiosis.

Anosa (1977) evaluated haematology of unweaned lambs and their dams naturally infected with *Haemonchus* spp. and reported low packed cell volumes (PCV), low red cell counts and depressed haemoglobin concentrations in lambs which were showing the signs of severe infection including stunted growth

and severe normocytic normochromic anaemia was associated with a high reticulocyte response during acute haemonchosis.

Grzebla *et al.* (1978) studied that sheep infected with gastrointestinal nematodes predominating *Haemonchus contortus* in Poland showed decreased erythrocyte counts, related to chronic post haemorrhagic anaemia. No significant changes in the white cell counts were observed.

Bezubik *et al.* (1980) observed a reduction in haemoglobin and PCV levels in sheep during experimental haemonchosis and also revealed that percentage of the different kinds of leucocytes in infected animals did not significantly differ from those in uninfected controls.

Albers and Lejambre (1983) conducted haematological study in sheep infected with *Haemonchus contortus* and revealed, significant decrease in packed cell volume which was inversely related with faecal egg excretion. There was significant decrease in serum iron level and increase in serum transferin level. The erythrocyte potassium concentration was significantly correlated with erythropoiesis.

Bennett (1983) identified that *Haemonchus contortus, Fasciola hepatica, Fascioloides magna, Bunostomum trigonocephalum, Cooperia, Trichostrongylus* and *Nematodirus* were important causes of anaemia and hypoproteinemia in sheep and goats.

Abbott *et al.* (1984) demonstrated that a low level of infection with *H. contortus* in lambs on a poor plane of nutrition caused normochromic normocytic anaemia which was associated with a modest but significant increase in abomasal blood loss, slightly elevated erythropoiesis and hypoproteinemia.

Barger and Dash (1987) evaluated lower PCV values throughout the infection of *Haemonchus contortus* in sheep.

Falca *et al.* (1987) observed decrease in Hb and erythrocyte concentration in lambs infected with *H. contortus* and their gastrointestinal nematodes and also reported anaemia was normocytic and normochromic which later become microcytic and hypochromic.

Khan *et al.* (1988) reported that the degree of anaemia due to haemonchosis has positively correlated with the number of egg/gm. of faeces in sheep in Islamabad, Pakistan.

Ahmad and Ansari (1989) observed effects of haemonchosis on haematology in sheep and goats in Aligarh (UP) and recorded depletions in RBC counts, further PCV and Hb values also decreased significantly in animals with high burdens of eggs of *Haemonchus contortus*. Whereas changes in WBC counts were inconsistent but had a declining tendency during the study period.

Albers *et al.* (1990) studied the effect of *Haemonchus contortus* infection on haematological parameters in sheep and

revealed haematocrits value (PCV) were found to be reduced during infection whereas erythrocyte potassium levels were increased and serum iron concentrations were reduced as compared to controls.

Brar *et al.* (1991) studied a biochemical alteration in sheep with natural infection of *Haemonchus contortus* and recorded decrease in total serum protein (16.6%) and marked fall in AST or SGOT (76.3%) and ALT or SGPT (24.9%) levels. However, an increase was observed in blood glucose (22.6%) level during acute haemonchosis.

Ghulam *et al.* (1995) studied haematological disturbances associated with haemonchosis in sheep in Faisalabad, Pakistan and recorded significant reduction in total erythrocyte counts, pack cell volume, haemoglobin percentage and lymphocyte counts. Whereas erythrocyte sedimentation rate, total leucocyte counts, neutrophil and eosinophil counts were increased significantly during haemonchosis. However, values of basophils and monocytes remained constant during severity of infection.

Watson *et al.* (1995) evaluated that haematological changes, such as eosinophils and total white cell counts which were significantly higher in low faecal egg count in ewes than high faecal egg count ewes naturally infected with *H. contortus* and *O. circumcincta.*

Hayat *et al.* (1996) observed that values of erythrocyte counts, haemoglobin, packed cell volume and body weight were significantly reduced and the erythrocyte sedimentation rate was increased in lambs experimentally infected with *Haemonchus contortus* and *Trichostrongylus colubriformis* in comparison to uninfected lambs.

Woolaston *et al.* (1996) evaluated higher values of circulating eosinophil counts but the difference were not significant during haemonchosis.

Paranagama *et al.* (1997) studied that blood sucking nematodes like *H. contortus* and its chronic form of infection in goats causes changes in systemic red blood cell parameter and not in the protein which also lost during the infection. High worm burden demonstrated a weak negative correlation with PCV, moderate worm burden causes a weak negative correlation with Hb%, however, low worm burden was no correlated with haematological parameters. Worm burden was not correlated with levels of total protein or albumin.

Moskwa *et al.* (1998) studied a relationship between faecal egg counts and haematological parameters in sheep naturally infected with gastrointestinal nematodes. There were no significant changes in TLC or in lymphocyte and neutrophil percentages whereas marked differences observed in the value of eosinophil percentages which was negatively correlated with

faecal egg counts, further lowest level of haematocrit (PCV) correlated negatively with faecal egg counts when the highest percentage of *H. contortus* L_3 were found in the faecal culture.

Nwaogu (1998) observed lower serum protein value during higher worm burden of *Haemonchus* spp. (70%). In yearlings total serum protein was found higher than lambs because younger lambs had significantly higher worm burdens than yearlings.

Moskwa *et al.* (1999) reported that PCV was negatively correlated with epgs alongwith significant difference in the values of white blood cells such as lymphocytes, neutrophils and eosinophils in sheep naturally infected with *Haemonchus contortus.*

Costa *et al.* (2000) studied haematological changes during *Haemonchus contortus* infection in yearling female goats in Brazil and revealed a negative correlation between egg counts and blood values. Further there was drops in Hb and PCV values.

Sharma *et al.* (2000) observed significant decline in packed cell volume, Hb and total erythrocyte count during haemonchosis in goats in Mathura, Uttar Pradesh.

Swarnkar *et al.* (2000) observed that mean pack cell volume, haemoglobin concentration, erythrocyte count decreased significantly in experimentally infected lambs with *Haemonchus contortus*, where as worm burden and faecal egg count were negatively correlated with Hb%, PCV, TEC and body weight.

Arora *et al.* (2001) recorded significant decrease in total protein, albumin and blood glucose during bursate worm infection in sheep and goats.

Sharma *et al.* (2001) evaluated some biochemical parameters during experimental *Haemonchus contortus* infection in goats and observed significant increase in level of SGPT and SGOT, while significant decrease in total serum protein level as compared to control group of animals.

Rajguru *et al.* (2002) studied a haematobiochemical alteration in goats naturally infected with *Haemonchus* spp., *Strongylus* spp. and *Trichuris* spp. and observed significant decrease in Hb%, PCV%, total erythrocyte count, total serum protein and blood glucose in anaemic goats.

Vatta *et al.* (2002) conducted clinical evaluation of anaemia caused by *Haemonchus* spp. infection in sheep and revealed lower haematocrit (PCV) values and higher incidence of anaemic conjunctival mucous membranes during the period of higher *Haemonchus* eggs counts.

Arora *et al.* (2003) demonstrated that total blood protein, blood sugar were negatively correlated with epg of bursate worm and concluded that epg values influence these parameters in sheep and goats infected with *Haemonchus contortus*. They further observed negative correlation between epg and Hb value and positive correlation between epg and TLC in both species.

The eosinophils count initially decline during infection and gradually increase in both animals.

Abdel-Salam and Mahran (2004) studied some biochemical changes in goats infested with internal parasite like *Haemonchus* spp. and revealed hypoalbuminemia which resulted in hypoproteinemia in all investigated goats.

Vanimisetti *et al.* (2004) studied inheritance of faecal egg count and pack cell volume and their relationship with production trait in sheep artificially infected with *Haemonchus contortus* and revealed that PCV was positively correlated with body weight and negatively correlated with faecal egg counts in both ewes and lambs.

Padmaja *et al.* (2006) demonstrated anaemia, neutrophilia, eosinophilia, hypoproteinemia, hypoalbuminemia, hyponatremia, hypokalemia and hypochloremia in endoparasitic infested sheep and attributed with their loss in gastrointestinal tract due to hyper secretion of mucus and protein leakage which would be due to inflammation of intestinal epithelium. The low profile of haematobiochemical values could also be due to blood sucking nature of helminths.

Lakra *et al.* (2007) estimated different biochemical constitute in goats naturally infected with common G.I. nematodes (*Haemonchus, Trichuris, Oesophagostomum, Ostertagia, Bunostomum* and others) and noted significant

reduction in Hb, PCV, TEC, serum calcium, inorganic phosphorous, Cu and Zn values during infection and suggested that decreased biochemical profile might have occurred due to blood loss caused by blood sucking nematodes. Hypoprotienemia, hypoalbuminemia, hypoglycemia and serum phosphorous level got decreased due to reduced feed intake and absorption and due to alteration in carbohydrates metabolism.

HISTOPATHOLOGICAL STUDIES :

Chermette (1982) revealed that plasma IgG and IgA were developed in the abomasal mucosa during *Haemonchus contortus* infection in sheep. Self cure appears to be related to the release of IgE, eosinophils and mastocytes on reinfection.

Akulin *et al.* (1984) studied a abomasal changes histologically in sheep infected and superinfected with *Haemonchus* spp. The abomasal cell reaction was most marked during self cure and there was intense infiltration of the mucosa by neutrophils, eosinophils, lymphocytes and plasma cells. Infiltration of numerous globular leucocytes were also observed in the surface layer of the abomasal mucosa.

Salman and Duncan (1984) conducted abomasal histology in sheep infected with *H. contortus* and found increased in the number of mast cells, globule leucocytes, eosinophils, IgA plasma cells in the mucosa.

Salman and Duncan (1985) studied abomasal pathology of immunized and non-immunised sheep infected with *Haemonchus contortus* and revealed cellular changes in the abomasal mucosa were less marked in the non-immunised groups than in the immunized animals. Thus the number of mast cells and eosinophils were increased in the immunized sheep. In immunized sheep marked lymphoid cells aggregated at the base of the mucosa and in submucosa. However, both immunized and non-immunised ewes showed rise in the numbers of IgA plasma cells.

Blanchard *et al.* (1986) revealed mild changes in the abomasal mucosa including dialated glands, focal accumulations of lymphocytes, significant increases in number of mucus containing cells, eosinophils and globule leucocytes and increased mucosal thickness, when *Haemonchus contortus* infection superimposed to *O. circumcincta* in lambs. The abomasal mucosa were observed more roughened and hyperaemic in lambs infected only with *H. contortus* than lambs having combined infections, but contained few dilated glands and globule leucocytes.

Al-Zubaidy *et al.* (1987) studied gross pathology and histopathology of haemonchosis in sheep and goats in Iraq and revealed more severe pathological changes in the abomasums and regional lymphoid tissue of infected goats than in sheep. The

lesions were mostly concentrated in the fundus of infected sheep whereas lesion mainly in the gastric folds and cardiac regions in goats. In origin the cellular responses in goats were immunological.

Nicholls (1988) conducted a fibreoptic endoscopy and biopsy of the abomasum in lambs and sheep inoculated with *Haemonchus contortus* which revealed structural changes, increase of endocrine cells, degeneration of mucus cells and increases in pH, enzymes etc. during infection.

Rahman and Collins (1991) conducted PM examination (abomasums) of infected goats with *Haemonchus contortus* and *T. Colubriformis* and revealed thickened walls and oedematous folds in abomasal lining. Mean pH of abomasum was increased. There was an initial infiltration of eosinophils and some neutrophils which had tendency to increase with age of infection.

Abd-Rabo *et al.* (1993) recorded *Trichostrongylus papillosus, T. axei, H. contortus, Ostertagia trifurcata, Parabronema skrjabini, Nematodirus* spp. were the prevalent spp. of nematodes in sheep population of Egypt. The pathological changes associated with degeneration of mucosa, focal areas of cellular reactions in the mucosa and submucosa, congestion of blood vessels with oedema in lamina propria in abomasum and adult worms were usually seen between the abomasal villi.

Shwakat *et al.* (1994) observed various pathological changes in sheep infected with *Haemonchus contortus* and other nematodes. Histology revealed destruction of parietal cells, dilatation of gastric glands and infiltration of the mucosa with mainly eosinophils, mononuclear cells. The abomasa showed degenerative and necrotic changes in the epithelial lining and occasional ulcer formation.

Singh *et al.* (1998) investigated immunological, histopathological responses in sheep due to *Haemonchus contortus* infection associated with moderate infiltration of mononuclear cells in abomasum and skin.

Scott *et al.* (1999) observed generalized hyperplasia characterized by increased numbers of mucopeptic cells and least reduction in parietal cell numbers. Zymogen granules content of chief cells was reduced in sheep infected with *H. contortus.*

Balic *et al.* (2000) estimated cellular profiles in the abomasal mucosa and lymph node during primary infection with *Haemonchus contortus* in sheep. It resulted rapid and selective increase in T-cells in abomasal lymphnode and weight of lymphnode increased two folds. Increased number of eosinophils, T and B cells were found in abomasal tissue during post infection of adult *Haemonchus* spp. Any increase in cell population was not visible in adult infected group but in contrast level of both

lamina propria and intraepithelial mast cell observed in abomasal mucosa was highest in sheep having adult nematodes. The infection was able to generate an early immune response with *Haemonchus* larvae characterized by activation of T-cell and B-cell, recruitment of eosinophils and gammadelta TCR in larval infected tissues. However, these changes didnot seems to be maintained during infection with the adult parasite, where increase in mast cell numbers dominate the local response, indicating that different parasitic stages may induce distinct and possibly counteractive immune responses.

Howlader *et al.* (2001) observed various pathological changes in liver like dilated hepatic sinusoids, intense eosinophilia of the hepatic cytoplasm, coursly granulated hepatic cytoplasms and karyorrhexis, pyknotic hepatic nuclei in goats artificially infected with *H. contortus,* on the other hand the lymphnode showed massive proliferation of lymphoid cells that were intermixed with considerable numbers of red blood cells, some of which were lysed.

Perez *et al.* (2001) studied histopathological and immunohistochemical changes in the abomasums and abomasal lymphnodes of goats, experimentally infected with *Haemonchus contortus* and revealed that granulomas were present in the abomasal mucosa. There was marked increase in the secretion of mucus by mucous cells together with an abundant infiltration of

eosinophils, mast cells, T lymphocytes, B cells, IgG + plasma cells and globule leucocytes in the abomasal mucosa. The abomasal lymphnodes showed marked hyperplasia, particularly of B cells and IgG + plasma cells in all infected goats.

Marin (2002) recorded severe anaemia and gross pathological lesion during advanced gastroenteritis with abundant nematode at necroscopy of the goats. Severe anaemia also observed in goats associated with heavy load of *Haemonchus* spp.

Perez *et al.* (2003) studied an effect of single and multiple infections in the host response during experimental haemonchosis in goats. It was observed that infiltration of abomasal mucosa with eosinophils, mast cells, T lymphocyte, B cells and IgG + plasma cells were dramatically increased at 10 day post infection whereas globular leucocytosis was observed only during chronic infection. Abomasal infiltration of globule leucocytes, T lymphocytes, B cells and IgG + plasma cells were significantly higher in reinfected than in primarily infected goats. In the abomasal lymphnodes, marked hyperplasia of lymphoid follicles and medullary cords with increase in T lymphocytes, B cells and IgG + plasma cells were recorded.

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CHAPTER - III

MATERIALS AND METHODS


CHAPTER - III

MATERIALS AND METHODS

MATERIALS AND METHODS

Parasites of gastrointestinal tract of sheep and goats are serious threat to small scale producer as these parasites are widely prevalent and mostly soil transmitted infections, causes irreversible damages to small ruminants associated with economic losses, reduced production and performance by affecting normal function of gastrointestinal system causing many clinical disorders in various organs viz. abomasum, intestine etc.

Therefore, the present study was undertaken to find out the prevalence of common gastrointestinal helminths in sheep and goats within the Patna district and its surrounding areas. Sheep and goats, positive for haemonchosis were identified and various haematological, biochemical and histopathological changes were analysed during infection. The period of investigation was carried out between April, 2006 to March, 2007.

COLLECTION OF MATERIAL :

Collection of faecal samples :

In order to find out the incidence and intensity of helminthic infection of sheep and goats in and around Patna, a total of 580 faecal samples and 112 intestinal scrapings were examined.

Faecal samples were collected from sheep flock kept at Govt. cattle farm, Patna, B.V.C. complex, clinics of Bihar veterinary college, Patna, Gaunpura, Bihta, Sirman, Bhabhua, Kaimur, private owners of sheep and goats of Patna and its surrounding areas, and gastrointestinal tracts was procured from local abattoir of sheep and goats at Sabjibagh, Rajabazar, Asiananagar, Phulwarisharif, Jagdevpath, Danapur, Shahpur (Arrah) and other surrounding areas of Patna during the period of April, 2006 to March, 2007. The records of season in which samples were collected, sex, age and habitat pattern were also maintained. Out of 580 faecal samples a total of 200 and 380 faecal samples were collected from sheep and goats respectively. Faecal sample of both sheep and goats in habitating semi-intensive or free ranged pattern were obtained either when freshly passed or directly from the rectum. Special emphasis was given to find out the prevalence of haemonchosis in sheep and goats in different season, sex, age and habitat pattern.

Effect of seasons :

To study the effect of seasonal variation on the prevalence of helminthic parasites in sheep and goats was carried out. According to regional weather condition, the period undertaken for study was divided into monsoon (July to October), winter (November to February) and summer (March to June) and accordingly depicted in Table-I.

Table – III

Age	Sheep	Goat
0-12 month	62	135
12-24 month	98	158
>24 month	40	87
Total	**200**	**380**

Effect of habitat pattern :

The total samples collected were divided in two groups according to their habitat pattern viz. semi-intensive system and free range system as depicted in Table-IV.

Table – IV

Habitat pattern	Sheep	Goat
Semi-intensive system	85	175
Free range system	115	205
Total	**200**	**380**

Collection of gastrointestinal tracts :

One hundred twelve gastrointestinal tracts of sheep and goats were procured randomly from local slaughter houses of Patna district and its surrounding areas to the study of incidence of gastrointestinal parasites of sheep and goats. The records of sample collected under different season, sex, age and habitat pattern are presented in Table-V.

Table – V : Records of collected gastrointestinal tracts of sheep and goats in and around Patna district according to season, sex, age and habitat pattern.

Factor		No. of faecal sample examined in sheep	No. of faecal sample examined in goats.
Season	Monsoon	9	38
	Winter	7	27
	Summer	6	25
	Total	**22**	**90**
Sex	Male	10	48
	Female	12	42
	Total	**22**	**90**
Age	0-12 month	8	43
	12-24 month	8	28
	>24 month	6	19
	Total	**22**	**90**
Habitat pattern	Semi-intensive system	9	38
	Free-range system	13	52
	Total	**22**	**90**

Collection of blood for haematological and biochemical study during haemonchosis in sheep and goats :

Blood samples from each 5 naturally infected sheep and goats with *Haemonchus* spp. were collected. Similarly blood samples of apparently 5 healthy goats and 5 healthy sheep, whose dung samples were found negative for any helminthic ova or cyst were also collected to serve them as control.

Blood :

For collection of blood the puncturing site was prepared by removal of hair and proper sterlizing the surface with 70% alcohal. Then 15 ml. of blood was collected aseptically from jugular veins of each sheep and goats with the help of separate sterilized disposable syringe. Out of 15 ml. blood, 8 ml. of blood was kept in sterilized screw caped vials containing anticoagulant disodium salt of ethylene diamine tetra acetic acid (EDTA) @ 1-1.5 mg/ml. of blood. To study the differential leucocyte count, thin and uniform smears were prepared on clean and grease free slides. Smear were dried in air and properly labeled.

Serum :

Out of 15 ml. blood, serum was separated from 7 ml. of blood. Blood was kept in each dry, clean and sterilized serum separating test tube without anticoagulant. The tubes containing blood were kept in slant position on the table for 6-8 hours at room temperature and then supernatant fluid was pour out and

centrifused at 2000 r.p.m. for 10-15 minutes to obtain the clear serum. The serum samples were stored in sterilized glass vial at 4°C in refrigerator and then various biochemical parameters were conducted.

Collection of organs for histopathological studies :

Tissues portions of affected parts of gastrointestinal tract of infested sheep and goats with *Haemonchus* spp. were collected and preserved in separate jar containing 10% formalin. Same tissue segments from healthy animals were also collected and preserved in 10% formalin in separate vials for histopathological studies.

EXAMINATION OF COLLECTED MATERIAL :

Examination of faecal samples :

Faecal samples collected from sheep and goats were kept in separate sterile plastic vial and properly labeled by showing sample no., age, sex, place and season in which samples were collected. If there was any delay in processing of collected samples, a few drops of 10% formalin was added in the samples to preserve the morphological characteristics of helminthic ova.

The collected faecal samples, were examined by the direct and indirect techniques and coproculture as described by Soulsby (1982).

Examination of gastrointestinal tracts :

Gastrointestinal tracts of sheep and goats were collected from local slaughter houses of Patna and its surrounding areas. Then intestinal samples were incised throughout the length by placing on the metal tray and the contents were placed in a separate tray. Intestinal contents were thoroughly examined for presence of parasites. Mucosal linings of different parts were also minutely observed for presence of parasites. Affected parts were preserved to carry out histopathological studies and gross pathological changes were accounted.

The content and washing were examined carefully by decanting method as described by Hendrix (1998). The parasites were collected and placed in petridish containing normal saline.

Processing for clearing and identification of parasites :

After collection of nematode worms were identified on the basis of their characteristic morphological feature after clearing them in lactophenol as described by Soulsby (1982), Urquhart *et al.* (1996) and Bhatia *et al.* (2006). Nematodes were fixed in warm 70% alcohal.

The trematodes were identified after clearing them in normal saline as described by Soulsby (1982), then these flukes were fixed by pressing them gently between two glass slides and preserved in 5% formalin solution. Then specimen were removed after 24 hours and preserved in 70% alcohal, whereas cestodes

were directly collected and preserved in 10% formalin after identification by viewing its segments characteristics, length and breadth of the parasites (Soulsby, 1982).

HAEMATOLOGICAL STUDIES :

Various haematological parameters were estimated immediately after collection of blood from healthy and infected animals. Following studies were carried as per method given below.

Haemoglobin percentage (Hb %) :

The haemoglobin values was estimated by Sahli's haemoglobinometer as per method described by Schalm *et al.* (1975).

Packed cell volume (PCV%) :

PCV was determined by wintrobe method for estimation of PCV, wintrobe haematocrit tube was filled with blood upto 100 mark using long needle or fine pasteur pipette then it was centrifused at 3000 r.p.m. for 30 minutes and reading of height of red cell column was noted as method described by Schalm *et al.* (1975).

Erythrocyte sedimentation rate (ESR) :

ESR per hours of healthy goats and sheep and naturally infected animals with haemonchosis were estimated. The blood was filled with a pasteur pipette in the wintrobe ESR haematocrit tube from bottom upward upto zero mark and then the tube was

kept in a special ESR stand vertically and level of sedimentation was recorded at 24 hours. The average sedimentation rate per day was calculated for each sample (Sinha, 1998).

Total erythrocyte count (TEC) :

The collected blood was draw upto 0.5 mark in the RBC diluting pipette of haemocytometer and then diluted with RBC diluting fluid upto 101 marks. The content was mixed by rotating the pipette between fingers. Then first 2-3 drops of fluid was discarded and Neubauer's counting chamber was charged by touching the tip of pipette at the junction of chamber and coverglass. All the cells including touching all the side of the wall of 5 big squares (4 corner and 1 central) or 80 small squares for counting cells of RBC were counted and the total no. of erythrocyte count per cubic mm. was calculated.

Total leucocyte count (TLC) :

Blood was taken upto 0.5 mark in WBC pipette and was diluted with the WBC diluting fluid upto 11 mark taking care that no air bubbles was included. Mix the content by rotating the pipette, than the Neubauer's counting chambers was charged as described for RBC counting method. The white cells were counted in the four large corner squares of the chamber and the total number of leucocyte count per cubic mm. was calculated.

Differential leucocyte count (DLC) :

For DLC, a thin and uniform smear of blood was prepared on a clean grease free slide and dried in the air. The smear was stained with Leishman's stain. The stained blood film was seen under low power objective of the microscope to see weather the film was homogeneously stained or not and then examined under oil immersion objective of microscope by placing a drop of cedar wood oil in well separated film. After that at least 100 leucocytes were counted by Battlement method and the percentages of different leucocytic cells were recorded (Schalm *et al.*, 1975).

BIOCHEMICAL STUDIES :

Various biochemical parameters were studied in 5 control and infected sheep (5) and goats (5) as per method described below :

Blood glucose :

To estimate the blood glucose level in healthy and infected groups of sheep and goats samples were processed as per method described by Folin-Wu (1920).

Total serum protein :

Values of total serum protein were determined by Biuret's method as described by Coles (1974).

Bilirubin :

Serum bilirubin level during haemonchosis was estimated by the method described by Malloy and Evelyn (1937).

Serum glutamate oxaloacetate transaminase (SGOT) or Aspartate transaminase (AST) and Serum glutamate pyruvate transaminase (SGPT) or Alanine transaminase (ALT) :

Changes in the values of SGOT and SGPT during infection of *Haemonchus contortus* in sheep and goats were estimated by the method described by Reitman and Frankel (1970).

HISTOPATHOLOGICAL STUDIES :

For histopathological examination, 0.5 cm. thick tissue pieces of abomasum of naturally infected sheep and goats with *Haemonchus* spp. parasite were collected and preserved in 10% formalin solution.

Preparation of histopathological sections of tissues :

Histopathological studies included various processes like fixing, embedding, section cutting, staining and mounting of the sections.

Firstly, the affected portion of abomasum (0.5 to 1 cm. thick) were fixed and preserved in 10% formalin and kept for 12-24 hours to prevent autolysis of tissues and also to give hardening effect to the pieces of abomasums.

After proper fixation of tissues in formalin, fixed tissues were thoroughly washed for 12 hours or overnight in running tap water. After proper washing these tissues were dehydrated in ascending grades of 70% and 90% ethyl alcohal and then absolute alcohal I and II for 30 minutes in each. Then tissues

were cleared in xylol and finally passed in another pot for paraffin embedding (Paraffin wax having melting point 58°C to 60°C). Hence, for perfect infiltration of paraffin into the tissues, the temperature of paraffin wax was maintained at 60°C.

Blocks were prepared by infiltration of paraffin wax into the tissues with the help of L-mold. Then tissue sections were cut at 5-6 microns in thickness using rotary microtome. After that tissue sections were put on clean slides, which were smeared with Mayer's glycerine egg albumin previously, and passed in electric drier to remove water and fix the sections over the slides. Then staining of these slides were carried out by haematoxylin and eosin (H & E) stain.

Prior to staining of tissue section with H & E stain, sections were deparaffinised by passing it in two changes of xylol and brought to water level by passing it into descending grades of alcohal and finally into the distilled water.

Then staining of section were done with Mayer's haematoxylin and counter stained by 1% alcohalic solution of eosin as a routine stain.

STATISTICAL ANALYSIS :

The data thus collected, recorded, tabulated and statistically analysed as per method described by Snedecor and Cochran (1967).

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CHAPTER - IV

RESULTS


CHAPTER - IV

RESULTS

RESULTS

INCIDENCE OF GASTROINTESTINAL HELMINTH PARASITES IN SHEEP :

In present investigation an extensive study on epidemiology of gastrointestinal helminth parasites in sheep of Patna district and its surrounding areas was carried out. Altogether 200 faecal samples and 22 gastrointestinal tracts of sheep were examined. The prevalence of gastrointestinal helminths of sheep in and around Patna is depicted in Table-1 and Fig.-1. It revealed that 178 and 20 samples were found positive for the presence of various gastrointestinal helminths through faecal samples and gastrointestinal tracts examination respectively and the respective percentages were 89 and 90.9%. The chi-square test revealed non-significant difference on the incidence of gastro-intestinal helminth parasites in sheep obtained from faecal samples and gastrointestinal tracts as mentioned above.

INCIDENCE OF GASTROINTESTINAL HELMINTH PARASITES IN GOATS :

In the present investigation, an attempt was made to study the prevalence of helminth parasites in goats in and around Patna district. A total of 380 faecal samples and 90 gastrointestinal tracts of goats were examined. The prevalence of various gastrointestinal helminths of goats in and around Patna

and 86.58% in males. However, the difference was non-significant indicating that sex had no effect on the incidence of gastrointestinal helminth parasites in sheep.

The effect of age on the prevalence of gastrointestinal helminths was found to be highly significant ($P<0.01$). The highest incidence of parasites was obtained in the age group of sheep upto 12 months (95.16%). While the lowest infection rate was observed in the age group of 24 months and above (70%). The incidence of gastrointestinal helminth parasites within the age group of 12-24 months was 92.85%.

The influence of habitat pattern on the incidence of gastrointestinal helminths was found to be non-significant and percentage of infection under free range system was observed to be more (75.65%) as compared to the semi-intensive system (67.05%).

Through examination of gastrointestinal tracts :

The effects of season, sex, age and habitat pattern on the incidence of gastrointestinal parasites in sheep recorded from 22 intestinal scrapings has been presented in Table-4 and Fig.-4.

Studies on seasonal incidence revealed that the gastrointestinal helminth parasitism was found to be highest in monsoon followed by winter and summer season. The rate of infection was noted to be 100%, 85.71% and 83.33% for respective seasons. The influence between different season on the

incidence of parasitic infections was found statistically non-significant.

The incidence of gastrointestinal parasitism in sheep was found to be slightly higher in females (91.66%) than in males (90%). However, the difference in frequency of occurrence was statistically found non-significant indicating that sex had no effect on the incidence of gastrointestinal helminthic parasitism in sheep.

Chi-square test revealed non-significant effect of age on the incidence of gastrointestinal helminths through examination of gastrointestinal tract. The percentage of infection was observed to be maximum (100%) in sheep upto 12 months of age group and was also same within the 12-24 months age group (100%), where as minimum rate (66.66%) of infection was observed in group of sheep aged 2 years and above.

The overall influence of habitat pattern was found to be non-significant for incidence of helminthic parasites through gastrointestinal tract examination. It was slightly higher in sheep maintained under free range system (92.30%) than the sheep maintained under semi-intensive pattern of habitat (88.88%).

INFLUENCE OF VARIOUS FACTORS ON THE PREVALENCE OF GASTROINTESTINAL HELMINTH PARASITES IN GOATS :

Through faecal samples examination :

The effects of season, sex, age and habitat pattern on the incidence of gastrointestinal helminth parasites in 380 faecal samples of goats collected from Patna district and its surrounding areas have been depicted in Table-5 and Fig.-5.

Influence of seasons on the prevalence of gastrointestinal helminthic infection in goats was found to be highly significant ($P<0.01$) through faecal sample examination. The occurrence of parasites was recorded highest (89.88%) in monsoon season followed by winter (78.81%) and lowest in the season of summer (62.76%).

Present study further indicated that sex had non-significant influence on the incidence of gastrointestinal helminths in goats. However, the occurrence was higher (81.93%) in females in comparison to males (78.22%).

The effect on the prevalence of gastrointestinal helminths within the various age group of goats was observed to be significant ($P<0.05$). Maximum occurrence on incidence was noted to be in goats upto 12 months of age group (85.18%) followed by 12-24 months age group (80.37%) and least frequency of (70.11%) incidence was observed in goats aged 2 years and above.

Incidence of gastrointestinal helminthic parasites significantly ($P<0.01$) influenced by rearing practices of goats. Maximum frequency of parasitism observed in population of goats managed under free range system (86.34%) as compared to the semi-intensive system (72.0%).

Through examination of gastrointestinal tracts :

The effects of season, sex, age and habitat pattern on the prevalence of gastrointestinal parasites in goats recorded from 90 gastrointestinal tracts have been depicted in Table-6 and Fig.-6.

The influence of seasons on the prevalence of gastrointestinal helminths was recorded to be significant ($P<0.05$) during gastrointestinal tracts examination and ascending trends were noted as 80%, 88.88% and 100% in summer, winter and monsoon seasons respectively.

The data recorded in respect to the influence of sex revealed that gastrointestinal helminthic parasitism was more commonly seen in female goats in comparison to male goats, as the rate of infection was noted to be 92.85% and 89.58% in females and males respectively. However, statistical analysis indicated that sex had non-significant effect on the incidence of gastrointestinal helminth parasites in goats.

Higher incidence of gastrointestinal helminth parasites was mostly observed in goats upto 12 months of age (97.67%) followed by 12-24 months age group (92.85%) and it was lowest

(73.68%) in old goats of more than 24 months age group. The influence of age on the incidence of gastrointestinal helminthic parasites was highly significant ($P<0.01$) in the present study.

Prevalence of gastrointestinal helminthic parasites in goats was recorded to be non-significant and the rate of prevalence was higher (94.23%) in free ranged population of goats as compared to semi-intensive pattern of habitat (86.84%).

INCIDENCE OF VARIOUS GASTROINTESTINAL HELMINTHS IN SHEEP :

Faecal samples :

The incidence of different species of helminths in sheep detected through examination of faecal samples (200) are summarized in the Table-7 and Fig.-7. Among the nematodes, incidence of *Haemonchus* spp. was noted to be highest (92.13%) followed by *Trichostrongylus* spp. (84.26%), *Trichuris* spp. (19.10%), *Strongyloides* spp. (15.16%) and *Oesophagostomum* spp. (15.16%). Ova of cestodes were accounted from *Moniezia expansa* (2.24%), *Moniezia benedeni* (1.12%) and *Stilesia hepatica* (1.12%). Among trematodes, *Cotylophoron* spp. (11.23%) and *Fasciola* spp. (8.98%) were commonly recorded through faecal samples examination.

Gastrointestinal tracts :

A total of 6 different species of helminth parasites, identified through gastrointestinal tract (22) examination, have been

presented in the Table-8 and Fig.-8, along with their percentage of infection. Altogether three species of nematodes viz. *Haemonchus* spp. (90%), *Trichostrongylus* spp. (80%) and *Trichuris* spp. (75%), only one species of cestodes, *Moniezia expansa* (5%), and two species of trematodes, *Cotylophoron* spp. (55%) and *Fasciola* spp. (5%) were accounted during present study.

INCIDENCE OF VARIOUS GASTROINTESTINAL HELMINTHS IN GOATS :

Faecal samples :

Various ova of gastrointestinal helminth parasites in goats recorded through 380 faecal sample examination have been presented in the Table-9 and Fig.-9, alongwith their percentage of infection. Among the common nematodes, the highest (89.76%) and lowest (3.96%) incidence was noted in *Haemonchus* spp. and *Bunostomum* spp. respectively. The incidence of other nematodes along with their rate of infection in the goats of Patna were *Trichostrongylus* spp. (84.81%), *Strongyloides* spp. (62.04%), *Oesophagostomum* spp. (49.17%) and *Trichuris* spp. (12.21%). Among cestodes *Moniezia expansa* (1.98%) and *Moniezia benedeni* (1.98%) were observed. Faecal samples examination also revealed the incidence of trematodes viz. *Cotylophoron* spp. (33.99%) and *Fasciola* spp. (12.87%).

Gastrointestinal tracts :

The incidence of different species of helminths in goats detected through examination of gastrointestinal tracts (90) has been shown in Table-10 and Fig.-10. The most prevalent nematodes were *Haemonchus* spp. (84.14%) followed by *Trichostrongylus* spp. (67.07%), *Trichuris* spp. (35.36%) and *Nematodirus* spp. (18.29%). Among the cestodes, *Moniezia expansa* (1.12%) and among trematodes, *Cotylophoron* spp. (47.56%), and *Fasciola* spp. (10.97%) were recorded from goats.

INCIDENCE OF *HAEMONCHUS* SPP. IN SHEEP :

Through faecal samples examination :-

The overall prevalence and the effect of season, sex, age and habitat pattern on the incidence of *Haemonchus* spp. in sheep through faecal samples examination are depicted in Table-11 and Fig.-11.

Higher incidence of *Haemonchus* spp. was recorded during monsoon (96.87%) followed by winter (89.83%) and occurrence of this stomach worm was minimum (40%) in summer season. However, the effect of seasonal distribution was found to be highly significant ($P<0.01$).

The influence of sex was noted to be non-significant through faecal samples examination. However, the frequency of incidence of *Haemonchus* spp. was slightly higher (83.05%) in females than in males (80.48%).

Chi-square test revealed non-significant effect of age on the incidence of *Haemonchus* spp. through examination of faecal samples, however, rate of infection was observed to be maximum (87.09%) in young one, of 0-12 months age group followed by the group aged upto 12-24 months (82.65%) and minimum (72.5%) in above 24 months age group of sheep.

The effect of habitat pattern revealed non-significant influence on the incidence of *Haemonchus* spp. The higher (82.6%) incidence was recorded in free-range system as compared to semi-intensive system (81.17%).

Through examination of gastrointestinal tracts :

Table-12 and Fig.-12 revealed the result pertaining to season, sex, age and habitat pattern on the incidence of *Haemonchus* spp. through examination of gastrointestinal tracts of sheep.

Seasonal influence on the incidence of *Haemonchus* spp. was found to be significant ($P<0.05$) through examination of gastrointestinal tracts and increasing trends were noted as 50, 85.71 and 100% in summer, winter and monsoon seasons respectively.

The effect of sex on the prevalence of *Haemonchus* spp. was found to be non-significant and the frequency of infection was found to be more (83.33%) in females than in males (80%).

Out of 22 gastrointestinal tracts screened out and statistical analysis revealed non-significant difference among the various age groups of sheep in respect to incidence of haemonchosis. The rate of infection was observed to be same in both 0-12 months (87.5%) and 12-24 months age group (87.5%) of sheep whereas least (66.66%) infection was found in above 24 months age groups.

Chi-square test revealed that habitat pattern had non-significant influence on the incidence of *Haemonchus* spp. in gastrointestinal tracts. However, the rate of infection was recorded higher (84.61%) under free range system in comparison to semi-intensive system (77.77%).

INCIDENCE OF *HAEMONCHUS* SPP. IN GOATS :

Through faecal samples examination :

The prevalence of *Haemonchus* spp. was observed during faecal sample examination and data pertaining to season, sex, age and habitat pattern on its incidence has been presented in Table-13 and Fig.-13.

The influence of season on the prevalence of *Haemonchus* spp. in goats was found to be highly significant ($P<0.01$) through faecal sample examination and maximum (86.9%) incidence was noted in monsoon followed by winter (80.5%) and minimum (32.97%) in summer season.

Chi-square test revealed that impact of sex had non-significant influence on the incidence of haemonchosis during faecal sample examination. However frequency of infection was slightly in higher side in females (73.54%) in comparison to males (70.22%).

The influence of age on the prevalence of *Haemonchus* spp. in goats examined through faecal samples was observed to be highly significant ($P<0.01$). The incidence was found to be highest (80.74%) in goats upto 12 months age group followed by 12-24 months age group (69.62%) and lesser (60.91%) infection rate was observed in above 24 months age group.

In present study, the higher incidence of *Haemonchus* spp. was recorded (73.65%) in goats managed under free range system, whereas goats maintained in semi-intensive system harbouring 69.14% *Haemonchus* parasites.

Through examination of gastrointestinal tracts :

Incidence of *Haemonchus* spp. was recorded in gastrointestinal tracts and the influence of season, sex, age and habitat pattern has been depicted in Table-14 and Fig.-14.

Qualitative examination of gastrointestinal tracts revealed highly significant ($P<0.01$) effect of seasons on the incidence of *Haemonchus* spp. and rate of infection was observed to be highest (92.10%) in monsoon and lowest (48%) in summer

whereas higher incidence was also observed in winter (81.48%) season.

The effect of sex was found to be non-signficant on the prevalence of wire worm, however, prevalence of haemonchosis was found to be more (78.57%) in females in comparison to males (75%).

Similarly the influence of age on the incidence of *Haemonchus* spp. was also found non-significant. The incidence was observed to be highest (86.04%) in goats of 0-12 months age group followed by 12-24 months age group (71.42%) and lowest (63.15%) in goats aged more than 24 months.

Influence of habitat pattern on the prevalence of *Haemonchus* spp. in goats was found to be non-significant. However, the percentage of infection was found to be higher (78.84%) under free range system as compared to the semi-intensive system (73.68%).

HAEMATOLOGICAL CHANGES IN SHEEP DURING HAEMONCHOSIS :

The means alongwith their standard error (S.E.) and C.V.% of haemoglobin, packed cell volume, erythrocyte sedimentation rate, total erythrocyte count and total leucocyte count of control and infected sheep are presented in Table-15 and Fig.-15.

(i) **Haemoglobin percentage (Hb%) :** Mean value of haemoglobin % in infected sheep (6.29gm. %) was found

to be significantly ($P<0.05$) lower by 5.49 gm% from control group (11.78gm. %).

(ii) **Packed cell volume (PCV) :** It is evident from Table-15 that difference of mean values of PCV in control (38.00%) and infected sheep (19.59%) was found to be 18.41% and it was significantly ($P<0.05$) decreased in infected sheep.

(iii) **Erythrocyte sedimentation rate (ESR) :** It was observed that the mean ESR value of infected sheep (3.10mm/hr.) was significantly ($P<0.05$) higher by 3.10 mm/hr. than the average ESR value of control (0.00mm/hr.) group.

(iv) **Total erythrocyte count (TEC) :** The mean of TEC of infected animal ($7.73 \times 10^6/mm^3$) was found to be decreased significantly ($P<0.05$) by $2.41 \times 10^6/mm^3$ than the healthy animal ($10.14 \times 10^6/mm^3$).

(v) **Total leucocyte count (TLC) :** The mean value of sheep infected with *Haemonchus* spp. was observed to be $15.54 \times 10^3/mm^3$ and significantly ($P<0.05$) higher ($8.17 \times 10^3/mm^3$) than the mean value of control ($7.37 \times 10^3/mm^3$).

(vi) **Differential leucocyte count (DLC) :** The differntial leucocytic changes in sheep suffered from haemonchosis have been presented in Table-16 and Fig.-16. Mean percentages of lymphocytes, neutrophils, eosinophils,

and monocytes in the infected animals were found to be 20%, 58%, 20.6% and 1.4% respectively. The average percentage of lymphocytes of the infected animals was found to be decreased significantly ($P<0.05$) by 38% than the control (58%), whereas the average percentages of neutrophils (37.2%) and eosinophils (3.6%) in healthy animals were observed to be increased significantly ($P<0.05$) by 20.8 and 17% respectively in infected animals, however the difference was non-significant in case of monocytes.

HAEMATOLOGICAL CHANGES IN GOATS DURING HAEMONCHOSIS :

The means along with standard error (S.E.) and C.V.% of haemoglobin, packed cell volume, erythrocyte sedimentation rate, total erythrocyte count and total leucocyte count of healthy and infected goats have been depicted in Table-17 and Fig.-17.

(i) **Haemoglobin percentage (Hb%) :** The mean value of haemoglobin % in infected goats was observed to be 6.24 gm% whereas in control group this value was recorded to be 11.08gm. %. Analysis of data revealed that the decrease in haemoglobin % (4.84gm%) in infected group was statistically significant ($P<0.05$).

(ii) **Packed cell volume (PCV) :** The mean value of PCV in control group was found to be 35.43% whereas in the

infected group accompanied with haemonchosis was 18.86%. This decreased value of PCV (16.57%) in infected group was found to be significant ($P<0.05$) as per t-test analysis.

(iii) **Erythrocyte sedimentation rate (ESR) :** The mean value of ESR of infected goats was estimated to be 3.20 mm/hr. Statistically this increased by 3.20 mm./hr. in the value of ESR in infected group was found to be significant ($P<0.05$).

(iv) **Total erythrocyte count (TEC) :** It is evident from the table that mean value of TEC in infected goats (7.17 x $10^6/mm^3$) was decreased by $3.61x10^6/mm^3$ from control group (10.78 x $10^6/mm^3$) which was found statistically significant ($P<0.05$).

(v) **Total leucocyte count (TLC) :** The mean value of TLC in goats having infection of *Haemonchus* spp. was recorded $16.88x10^3/mm^3$, whereas in control group the value was 7.09 x $10^3/mm^3$. It was found that the TLC value of infected goats was increased by 9.79 $x10^3/mm^3$ and it is found to be significant ($P<0.05$).

(vi) **Differential leucocyte count (DLC) :** The differential leucocytic changes in goats infected with *Haemonchus* spp. have been depicted in Table-18 and Fig.-18. Mean percentages of lymphocytes, neutrophils, eosinophils and

monocytes in the goats during natural infection of *Haemonchus* spp. were observed to be 30.2, 50.8, 17.8 and 1.2% respectively. Statistical analysis revealed that percentage of lymphocytes decreased in infected group by 36.2% and this decrease was found to be significant ($P<0.05$). Whereas average percentages of neutrophils and eosinophils were observed to be increased significantly ($P<0.05$) by 21.6 and 14.4% respectively in goats during haemonchosis. However, in case of monocytes difference was found to be non-significant.

BIOCHEMICAL CHANGES IN SHEEP DURING HAEMONCHOSIS :

Means along with standard errors of the values and C.V. % of blood glucose, total serum protein, bilirubin, SGOT and SGPT of sheep infected with *Haemonchus* spp. and healthy animal have been depicted in Table-19 and Fig. -19.

Blood glucose : -

The mean value of blood glucose of infected sheep was estimated to be 32.32mg/ml, whereas in healthy animals this value was found to be 56.28 mg/ml. Statistically decreased in value by 23.96 mg/ml of blood glucose in infected group was found to be significant ($P<0.05$).

Total serum protein :

It was observed that mean of total serum protein of infected group (4.85 gm/dl) was found to be significantly ($P<0.05$) lower than the mean value of control group (6.94 gm/dl).

Bilirubin :

The average mean of bilirubin in infected and control group were found to be 1.08 mg/100ml and 0.35 mg/100ml respectively. However, analysis of these data indicated significant ($P<0.05$) difference between the value of control and infected group during haemonchosis.

Serum glutamate oxaloacetate transaminase (SGOT) or Aspartate transaminase (AST) :

There was significant ($P<0.05$) increase in SGOT mean value (147.63 IU/L) in the group of sheep infected with *Haemonchus* spp. than the control group (72.30 IU/L) of animal.

Serum glutamate pyruvate transaminase (SGPT) or Alanine transaminase (ALT) :

The mean values of SGPT in sheep having infection of *Haemonchus* spp. was found to be 42.26 IU/L whereas in control group the corresponding value was 24.66 IU/L. It was found that the SGPT/ALT value of infected sheep was significantly ($P<0.05$) increased by 17.60 IU/L than the control.

BIOCHEMICAL CHANGES IN GOATS DURING HAEMONCHOSIS :

Mean ± S.E. and C.V.% of the value of blood glucose, total serum protein, bilirubin, SGOT and SGPT of control and infected goats have been presented in Table-20 and Fig.- 20.

Blood glucose :

The mean value of blood glucose in control group was found to be 57.45 mg/ml, whereas in infected group the value was 36.53 mg/ml. Statistical analysis reflected that blood glucose level was decreased significantly ($P<0.05$).

Total serum protein :

The mean values of total serum protein in goats having infection of *Haemonchus* spp. were recorded to be 4.99 gm/dl whereas in control group the value was 6.95 gm/dl. It was found that the total serum protein value of infected goats was decreased significantly ($P<0.05$) than the control by 1.96 gm/dl.

Bilirubin :

The mean value of bilirubin in goats infected with *Haemonchus* spp. was found to be significantly ($P<0.05$) higher (0.71 mg/100ml) than the mean value of control (0.16mg/100ml).

Serum glutamate oxaloacetate transaminase (SGOT) or Aspartate transaminase (AST) :

Mean values of SGOT in healthy and infected goats were estimated to be 21.36 IU/L and 100.39 IU/L respectively (Table-20). Analysis of data revealed that mean SGOT in infected animals increased by 79.03 IU/L than the healthy which was statistically highly significant ($P<0.05$).

Serum glutamate pyruvate transaminase (SGPT) or Alanine transaminase (ALT) :

There was significant ($P<0.05$) increase in mean values of SGPT level in goats (42.12 IU/L) infected with *Haemonchus* parasite, where as mean values of SGPT in healthy goats was found to be 21.15 IU/L.

HISTOPATHOLOGICAL STUDIES OF HAEMONCHOSIS IN SHEEP AND GOATS (ABOMASUM) :

Gross changes :

- Abomasal fluid was brown and filled with numerous worms.
- Thin consistency of blood was observed and mucous membrane was pale in colour.
- When fluid was cleared many worms were found attached to internal abomasal wall.
- Numerous necrotic and haemorrhagic spots at the site of attachments were also found in the abomasal mucosa.

Histopathological changes :

- Histological examination revealed immunopathological changes in abomasum and regional lymphnodes.
- The abomasal mucosa showed degeneration and necrotic changes in epithelial lining and occasional ulcer formation (Fig.- XVII). It also revealed destruction of parietal cells, dialation of gastric glands.
- There was generalised hyperplasia (Fig.- XVIII), resulting in increased no. of peptic cells and mucosal cells, along with reduction in parietal cells. Zymogen granule content of chief cells were reduced.
- There was infiltration of mucosa with mainly eosinophils, mononuclear cells.
- In general all over changes in infected organs were hypersensitive types with increase in leucocytes, eosinophils in the mucosa.

****

Table – 1 : Prevalence of gastrointestinal helminths of sheep in and around Patna district.

Factor	Total sample examined	Total sample found positive	Percentage of infection (%)	χ^2_{1df}
Faecal sample	200	178	89.00	0.08^{NS}
Gastrointestinal tract	22	20	90.90	

NS= Non-significant

Table – 2 : Prevalence of gastrointestinal helminths of goats in and around Patna district.

Factor	Total sample examined	Total sample found positive	Percentage of infection (%)	χ^2_{1df}
Faecal sample	380	303	79.73	6.36*
Gastrointestinal tract	90	82	91.11	

* = Significant at P<0.05

Fig.-1 : **Histogram showing prevalence of gastrointestinal helminths of sheep in and around Patna district.**

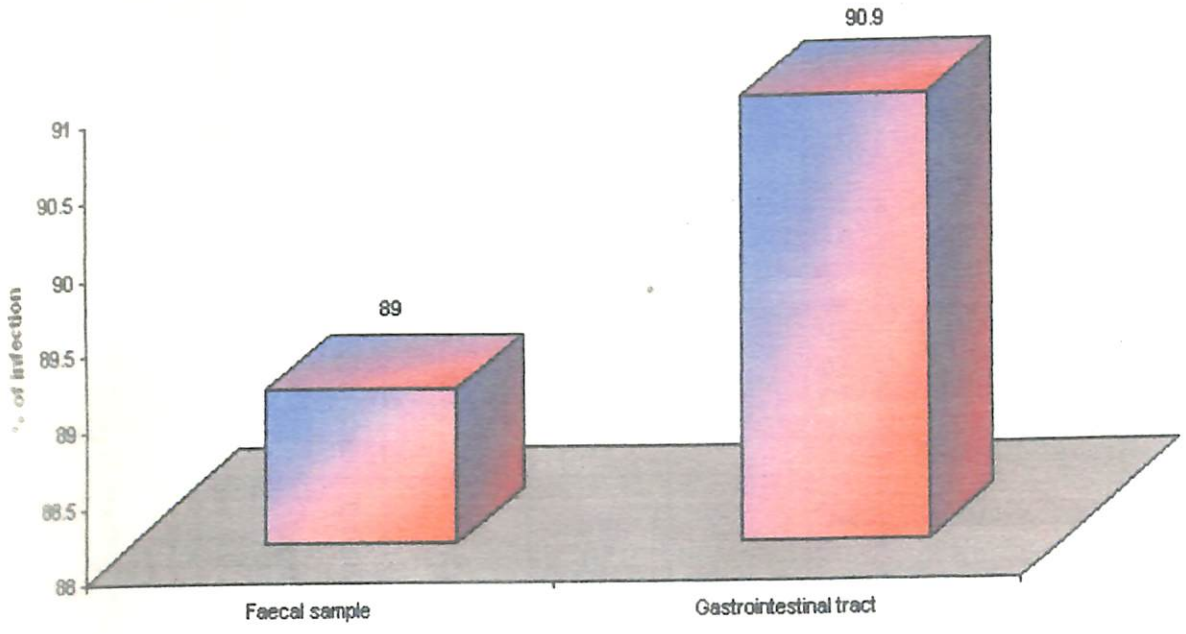


Fig.-2 : **Histogram showing prevalence of gastrointestinal helminths of goats in and around Patna district.**

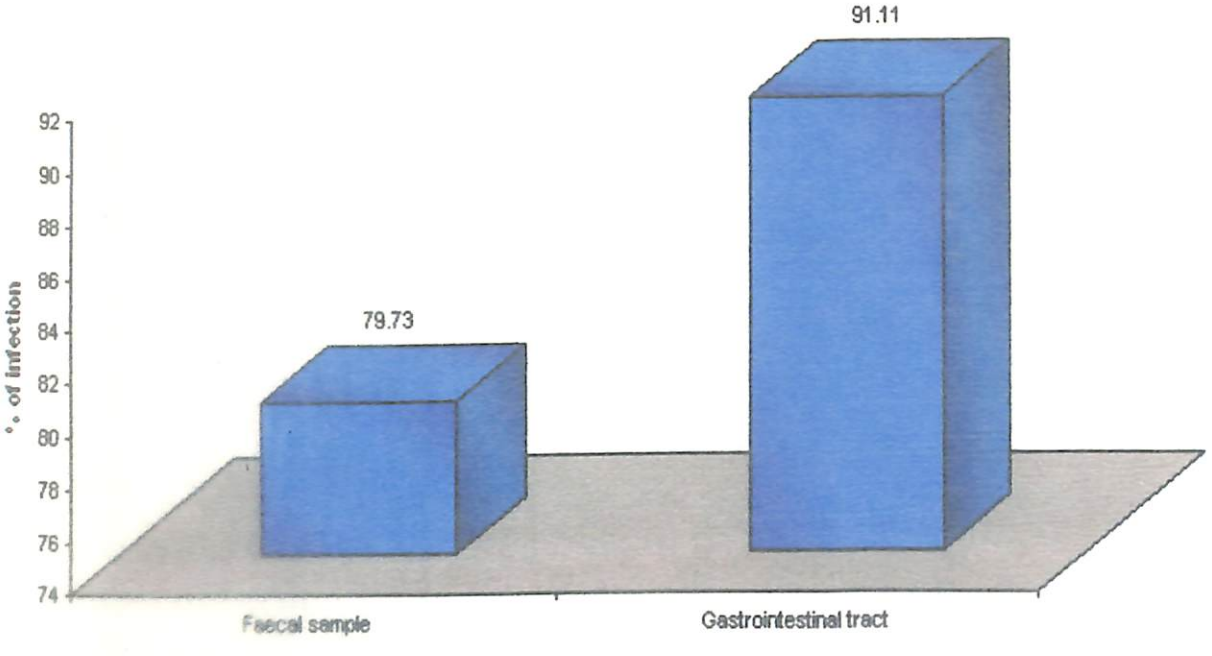


Fig.-1 : Histogram showing prevalence of gastrointestinal helminths of sheep in and around Patna district.

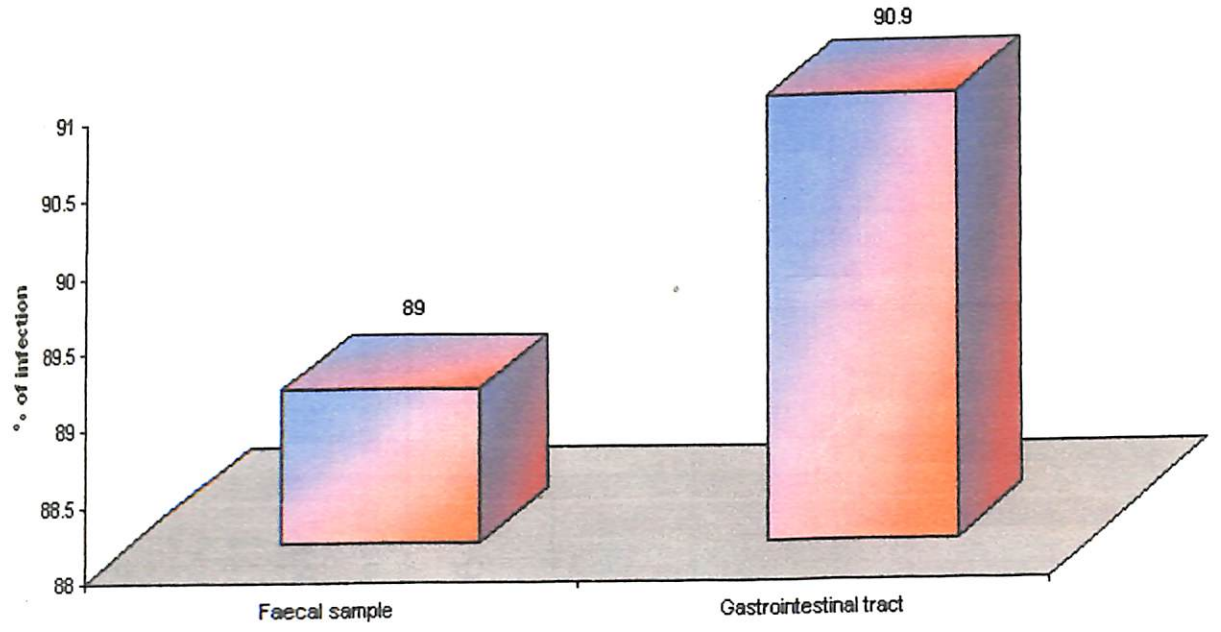


Fig.-2 : Histogram showing prevalence of gastrointestinal helminths of goats in and around Patna district.

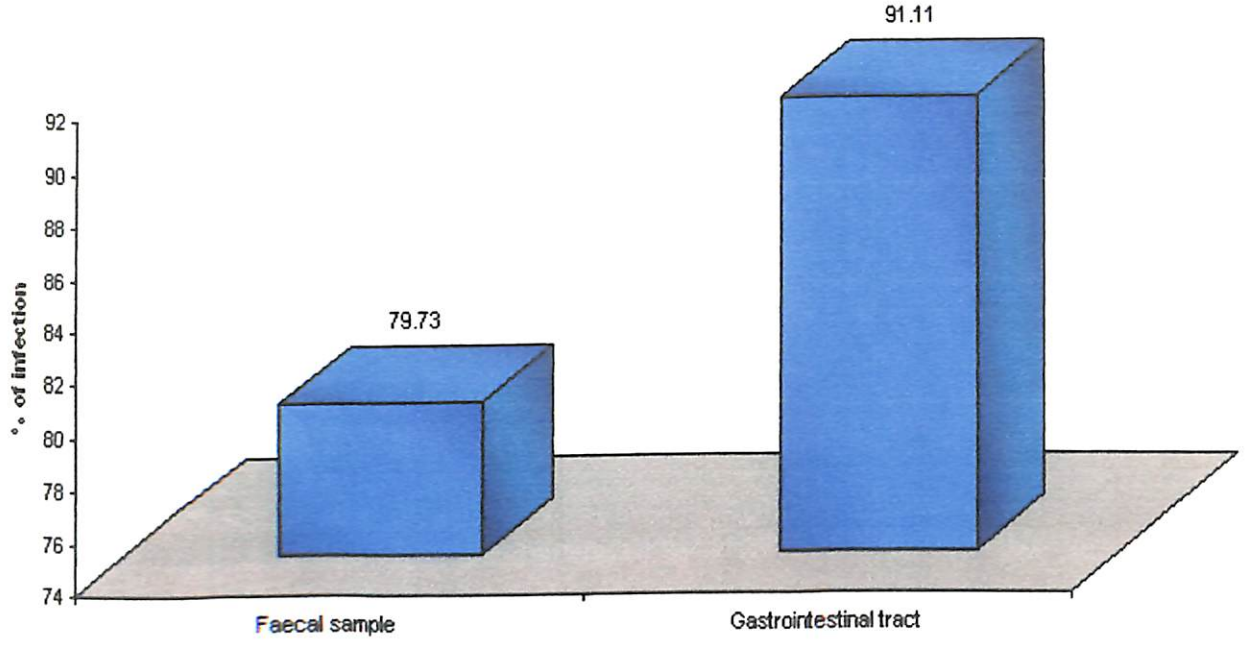
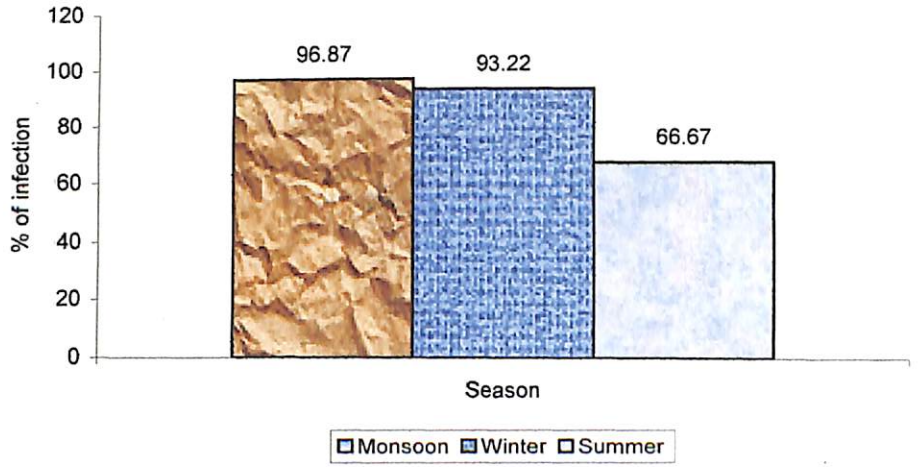


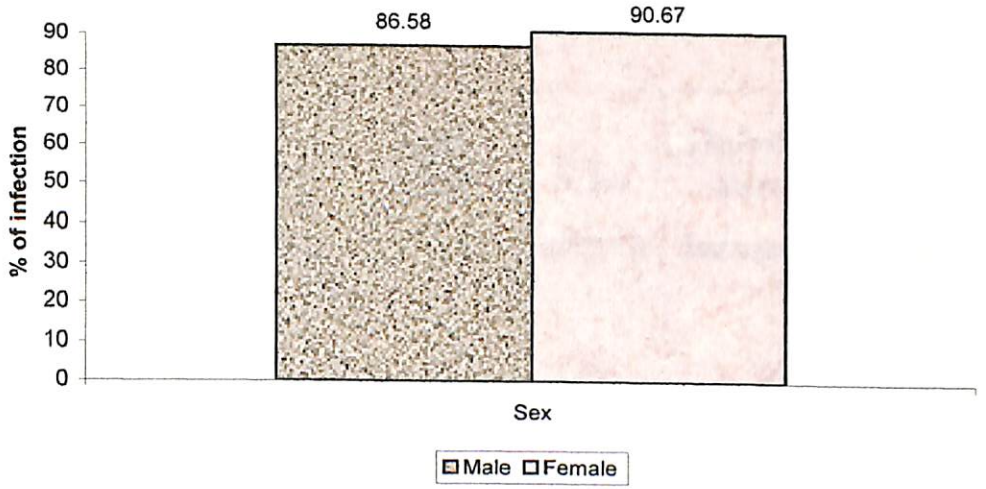
Table - 3 : Effect of season, sex, age and habitat pattern on the prevalence of gastrointestinal helminths through examination of faecal sample collected from sheep.

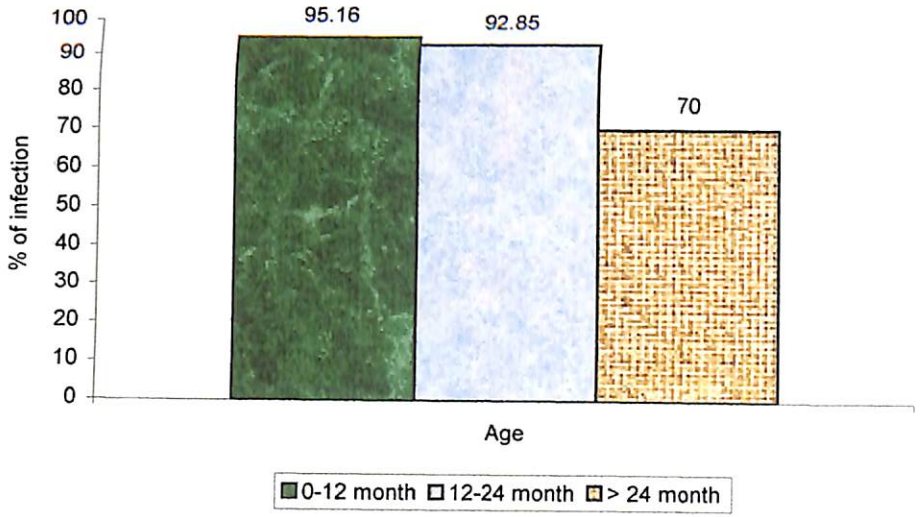
Faecal Sample	Season			Sex		Age			Habitat pattern	
	Monsoon	Winter	Summer	Male	Female	0-12 month	12-24 month	> 24 month	Semi-intensive	Free range
Total examined (200)	96	59	45	82	118	62	98	40	85	115
Total positive (178)	93	55	30	71	107	59	91	28	57	87
% age of infection (89.00)	96.87	93.22	66.67	86.58	90.67	95.16	92.85	70.00	67.05	75.65
	$\chi^2_{2df} = 38.22^{**}$			$\chi^2_{1df} = 0.83^{NS}$		$\chi^2_{2df} = 18.64^{**}$			$\chi^2_{1df} = 1.79^{NS}$	

NS = Non-significant, ** = Significant at P<0.01

Fig.-3 : Histogram showing effect of season, sex, age and habitat pattern on the prevalence of gastrointestinal helminths through examination of faecal sample collected from sheep.







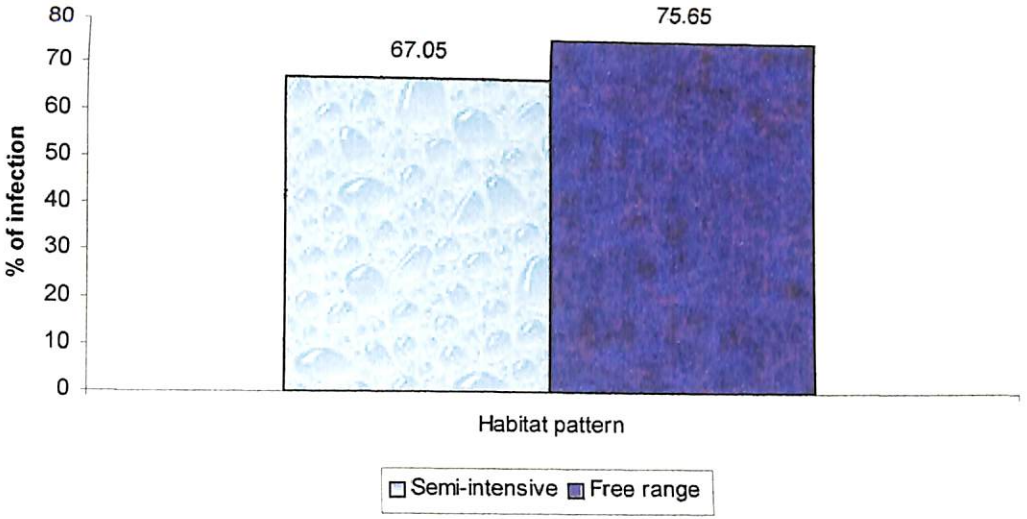
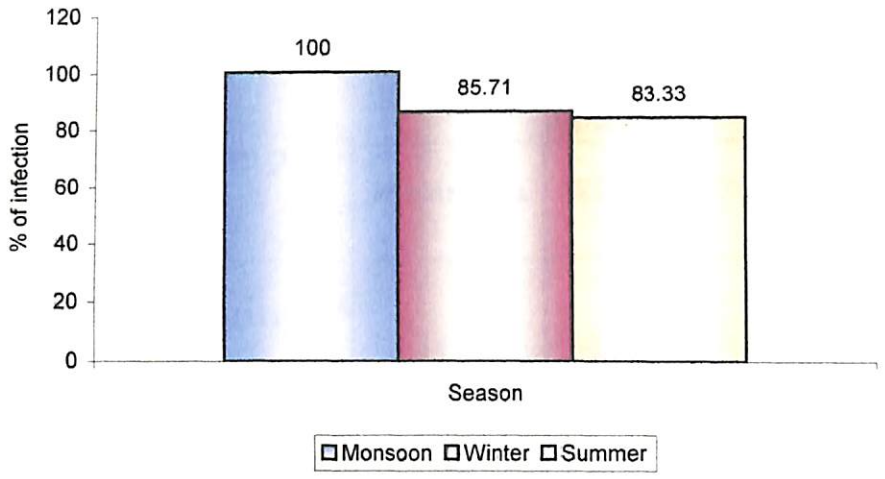


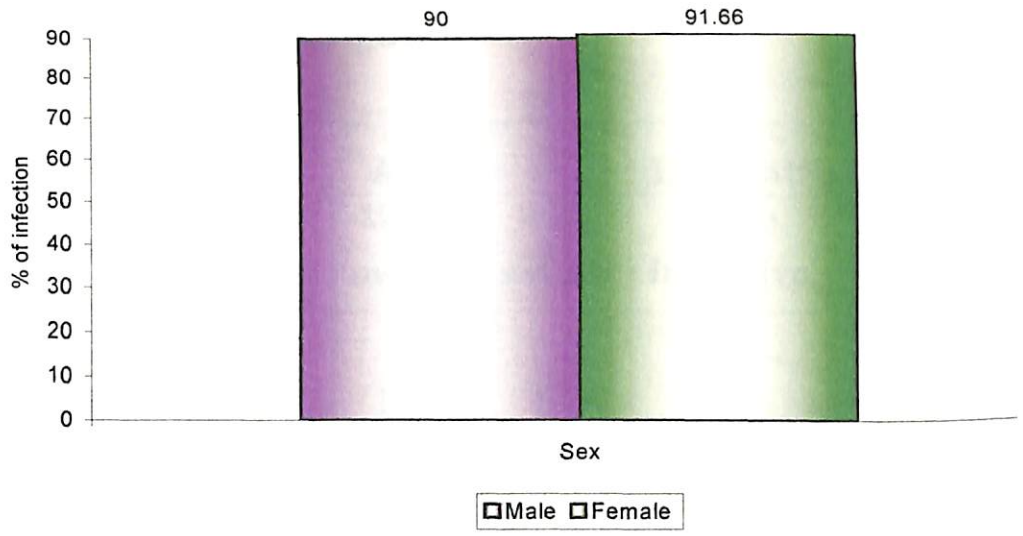
Table - 4 : Effect of season, sex, age and habitat pattern on the prevalence of gastrointestinal helminths in sheep through examination of gastrointestinal tract.

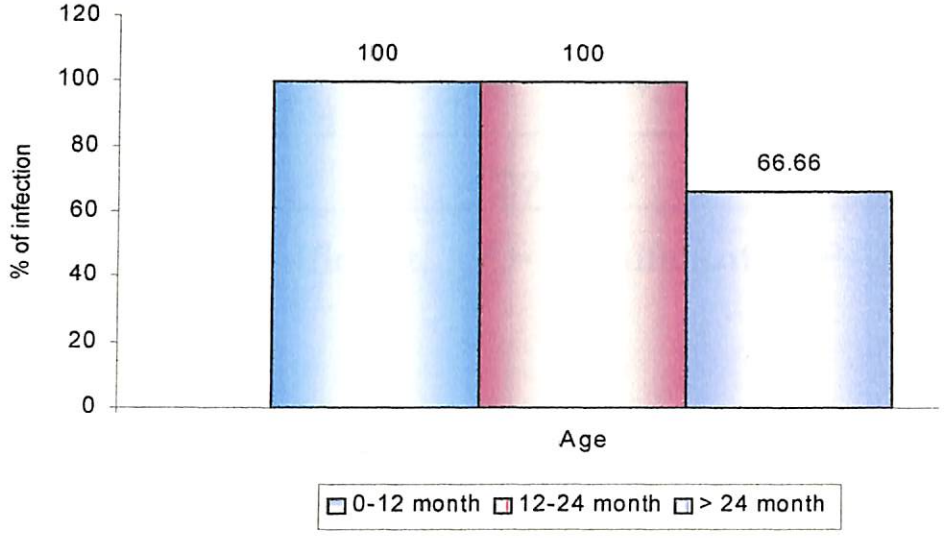
Gastrointestinal tract	Season			Sex		Age			Habitat pattern	
	Monsoon	Winter	Summer	Male	Female	0-12 month	12-24 month	> 24 month	Semi-intensive	Free range
Total examined (22)	9	7	6	10	12	8	8	6	9	13
Total positive (20)	9	6	5	9	11	8	8	4	8	12
%age of infection (90.90)	100.00	85.71	83.33	90.00	91.66	100.00	100.00	66.66	88.88	92.30
	$\chi^2_{2df} = 1.544^{NS}$			$\chi^2_{1df} = 0.018^{NS}$		$\chi^2_{2df} = 5.92^{NS}$			$\chi^2_{1df} = 0.69^{NS}$	

NS = Non-significant

Fig.-4 : Histogram showing effect of season, sex, age and habitat pattern on the prevalence of gastrointestinal helminths in sheep through examination of gastrointestinal tract.







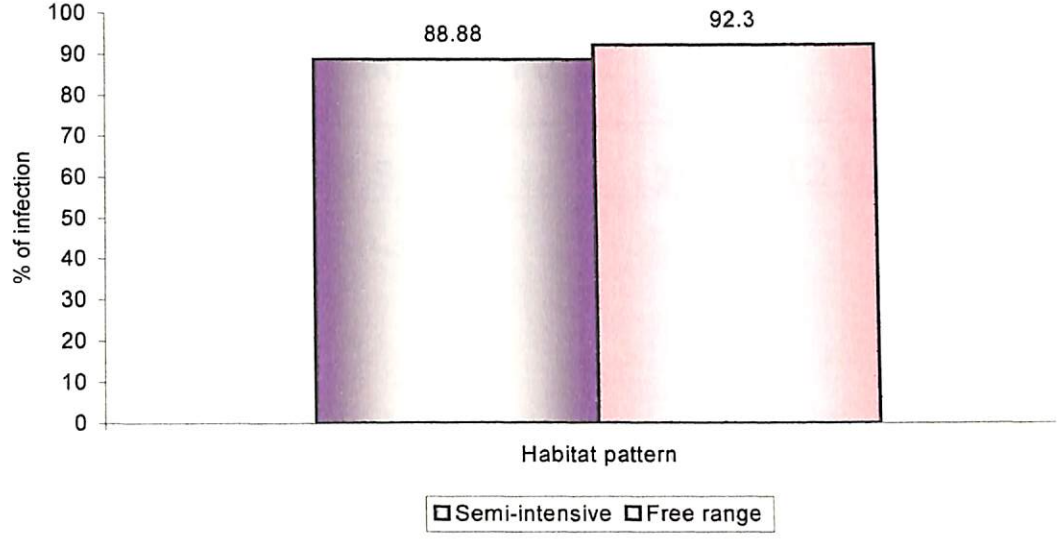
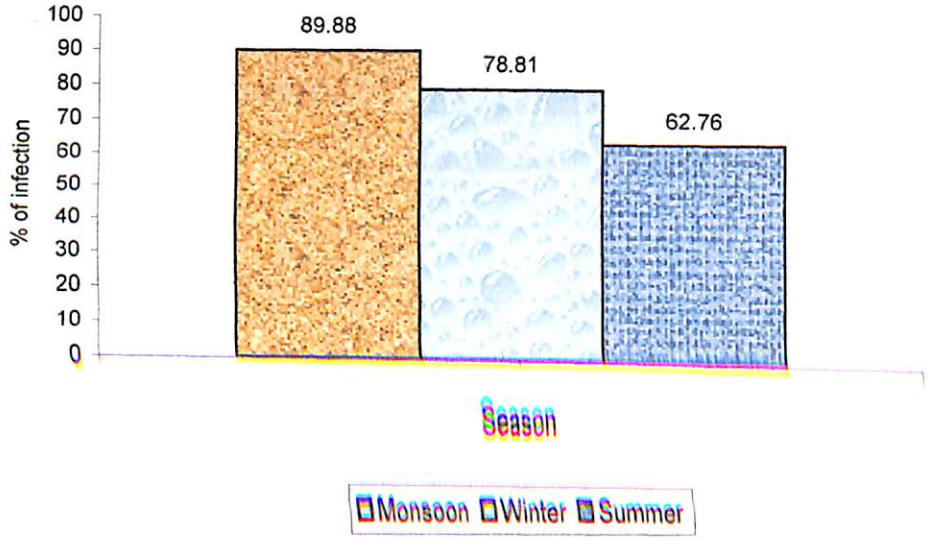


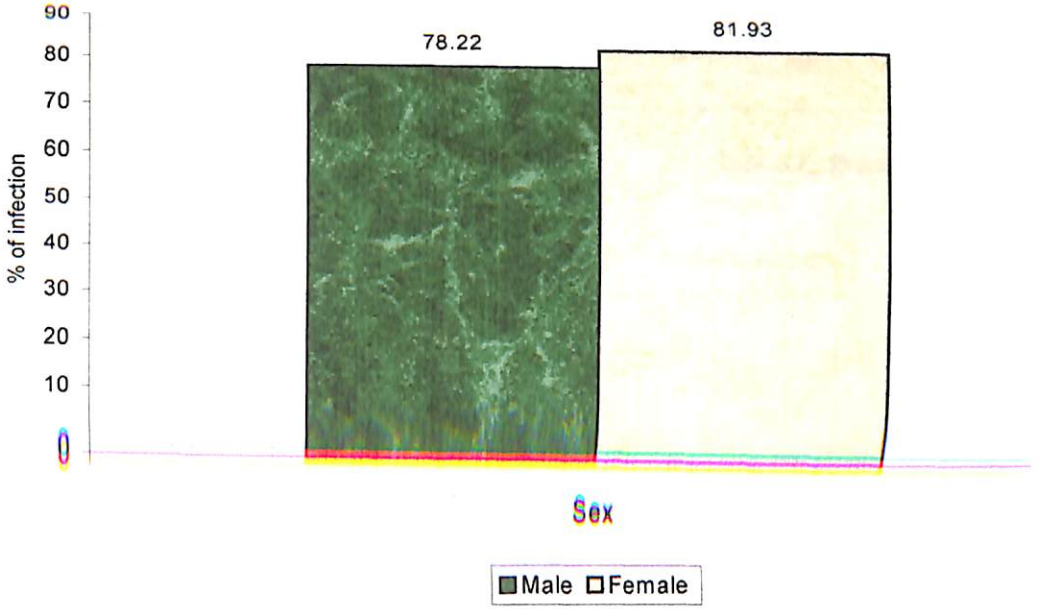
Table - 5 : Effect of season, sex, age and habitat pattern on the prevalence of gastrointestinal helminths through examination of faecal sample collected from goats.

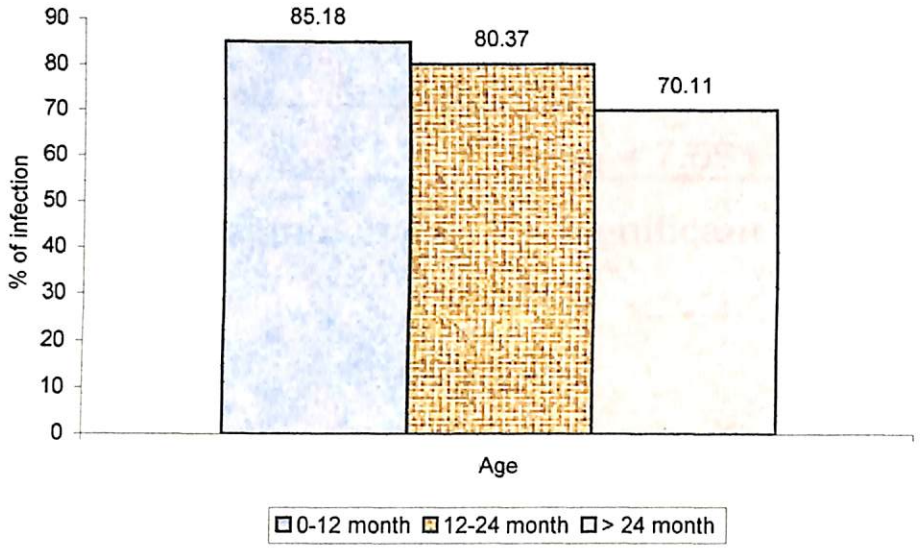
Faecal sample	Season			Sex		Age			Habitat pattern	
	Monsoon	Winter	Summer	Male	Female	0-12 month	12-24 month	> 24 month	Semi-intensive	Free range
Total examined (380)	168	118	94	225	155	135	158	87	175	205
Total positive (303)	151	93	59	176	127	115	127	61	126	177
% age of infection (79.73)	89.88	78.81	62.76	78.22	81.93	85.18	80.37	70.11	72.00	86.34
	$\chi^2_{2df} = 27.53^{**}$			$\chi^2_{1df} = 0.784^{NS}$		$\chi^2_{2df} = 7.51^{*}$			$\chi^2_{1df} = 12.02^{**}$	

NS = Non-significant, * = Significant at P<0.05, ** = Significant at P<0.01

Fig.-5 : ***Histogram showing effect of season, sex, age and habitat pattern on the prevalence of gastrointestinal helminths through examination of faecal sample collected from goats.***







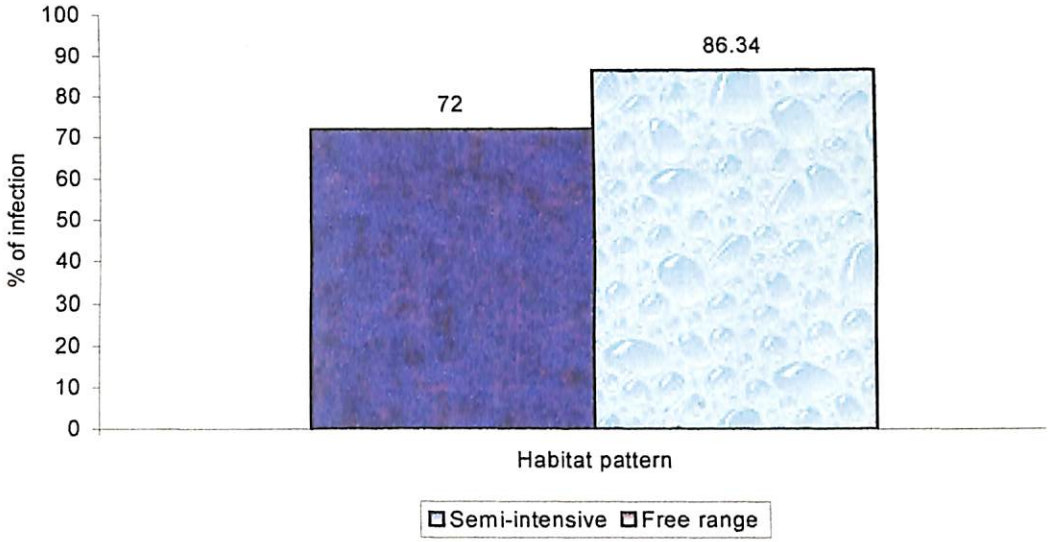
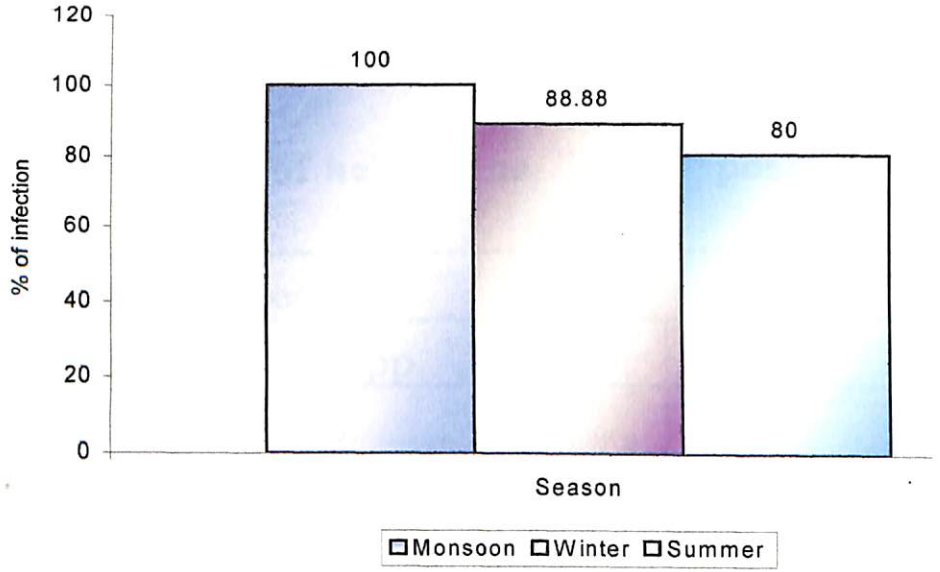


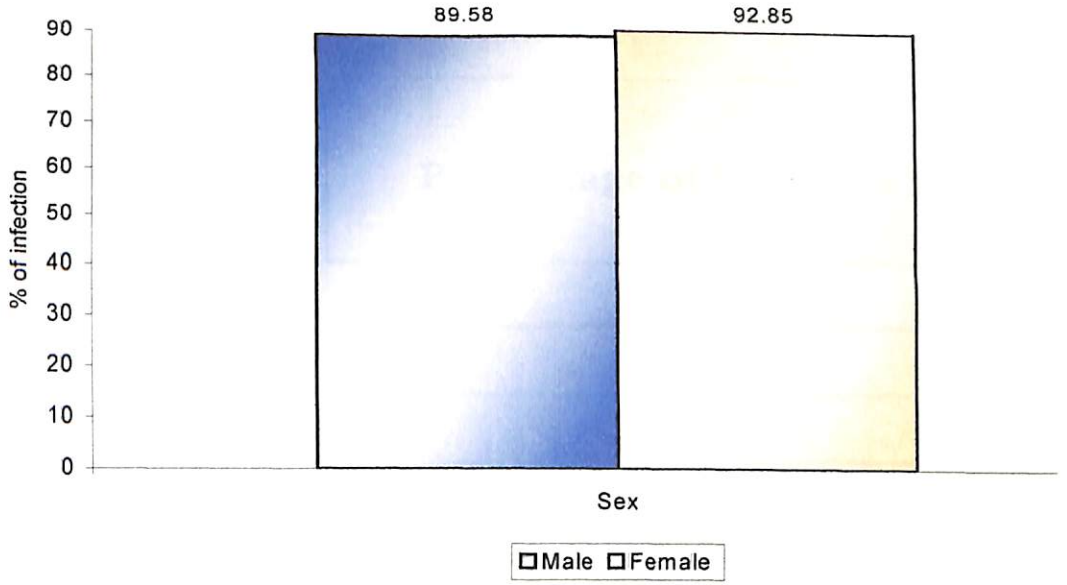
Table - 6 : Effect of season, sex, age and habitat pattern on the prevalence of gastrointestinal helminths in goats through examination of gastrointestinal tract.

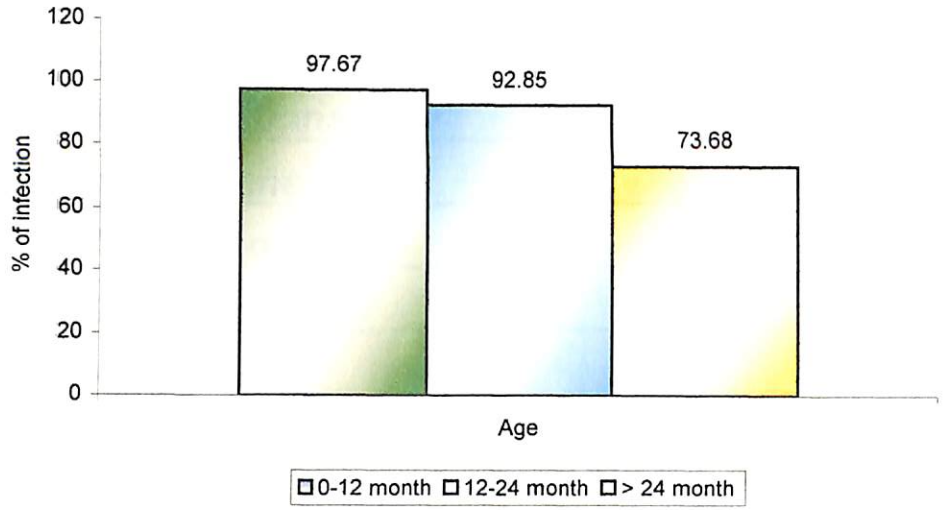
Gastrointestinal tract	Season			Sex		Age			Habitat pattern	
	Monsoon	Winter	Summer	Male	Female	0-12 month	12-24 month	> 24 month	Semi-intensive	Free range
Total examined (90)	38	27	25	48	42	43	28	19	38	52
Total positive (82)	38	24	20	43	39	42	26	14	33	49
%age of infection (91.11)	100.00	88.88	80.00	89.58	92.85	97.67	92.85	73.68	86.84	94.23
	$\chi^2_{2df} = 7.69^{*}$			$\chi^2_{1df} = 0.297^{NS}$		$\chi^2_{2df} = 9.58^{**}$			$\chi^2_{1df} = 1.474^{NS}$	

NS = Non-significant, * = Significant at P<0.05, ** = Significant at P<0.01

Fig.-6 : Histogram showing effect of season, sex, age and habitat pattern on the prevalence of gastrointestinal helminths in goats through examination of gastrointestinal tract.







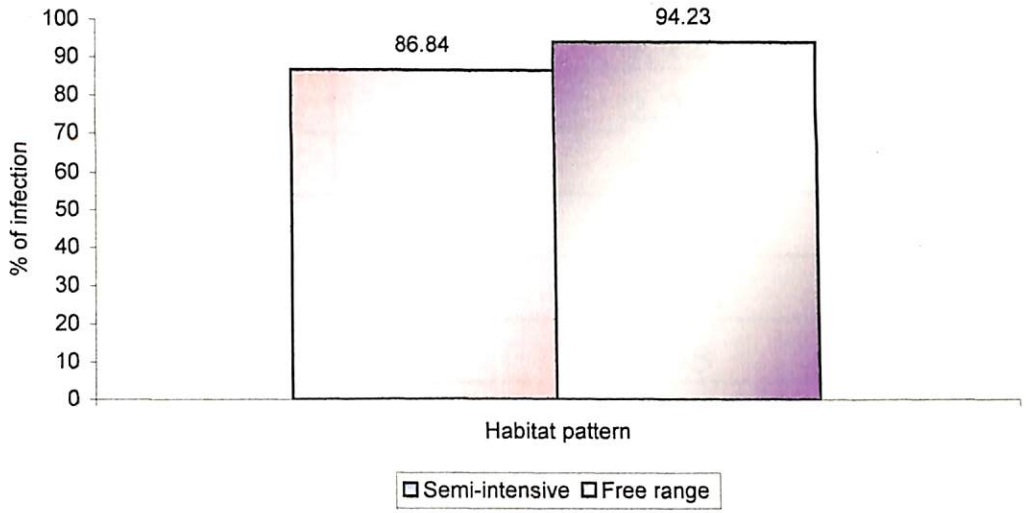


Table – 7 : Percentage of infection with different helminths in sheep through examination of faecal samples.

Name of helminths	No. of faecal sample found positive out of 178 positive samples	Percentage of infection
(A) Nematodes		
Trichostrongylus spp.	150	84.26
Haemonchus spp.	164	92.13
Trichuris spp.	34	19.10
Strongyloides spp.	27	15.16
Oesophagostomum spp.	27	15.16
(B) Cestodes		
Stilesia hepatica	2	1.12
Moniezia expansa	4	2.24
Moniezia benedeni	2	1.12
(C) Trematodes		
Cotylophoron spp.	20	11.23
Fasciola spp.	16	8.98

Fig. - 7 : Histogram showing percentage of infection with different helminths in sheep through examination of faecal samples.

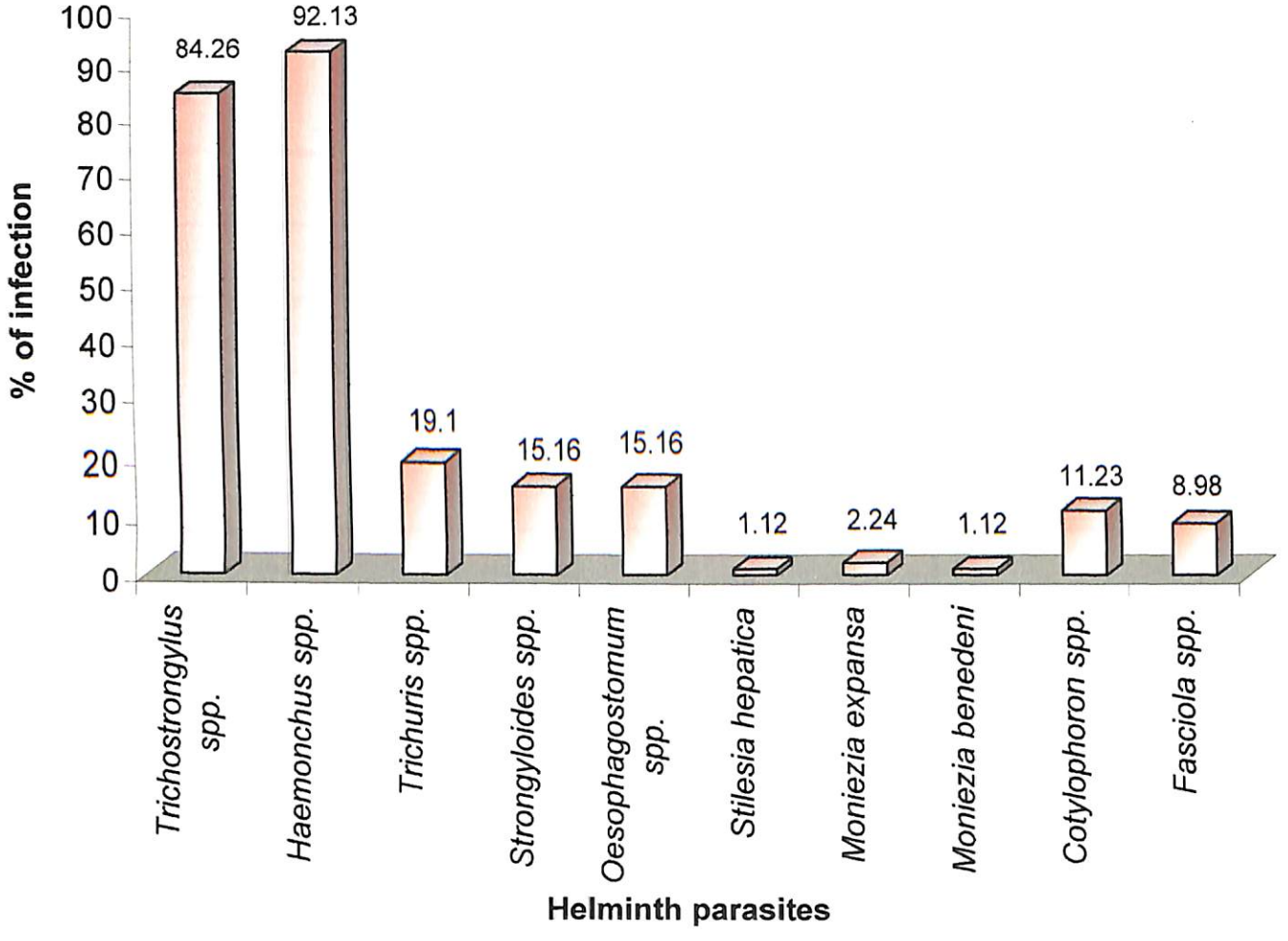


Table – 8 : Percentage of infection with different helminths in sheep through examination of gastrointestinal tracts.

Name of helminths	No. of animal found positive out of 20 infected animals	Percentage of infection
(A) Nematodes		
(1)*Trichostrongylus* spp.	16	80.00
(2) *Haemonchus* spp.	18	90.00
(3) *Trichuris* spp.	15	75.00
(B) Cestodes		
(1) *Moniezia expansa*	1	5.00
(C) Trematodes		
(1) *Cotylophoron* spp.	11	55.00
(2) *Fasciola* spp.	1	5.00

Fig. - 8 : Histogram showing percentage of infection with different helminths in sheep through examination of gastrointestinal tracts.

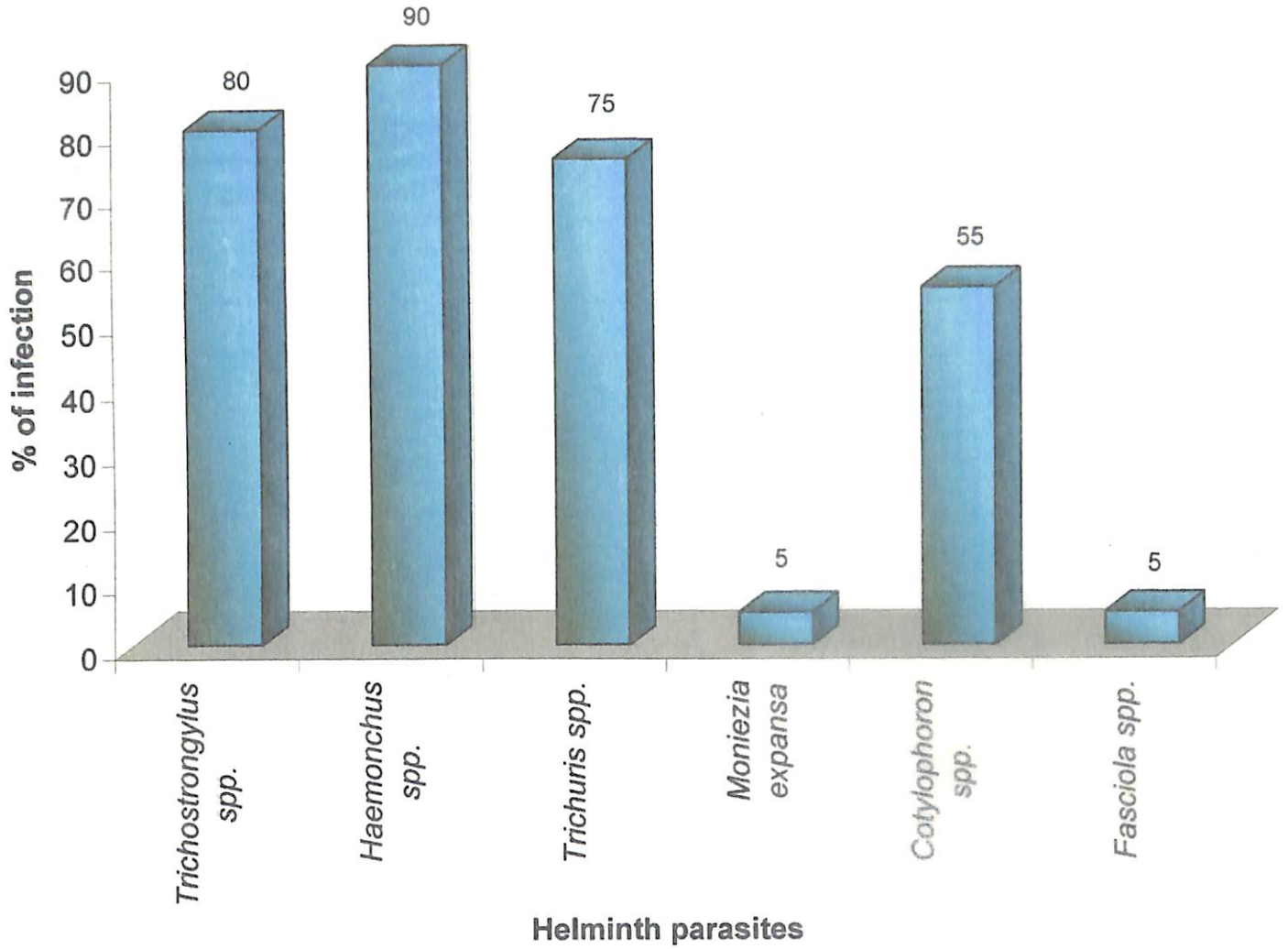


Fig. - 8 : Histogram showing percentage of infection with different helminths in sheep through examination of gastrointestinal tracts.

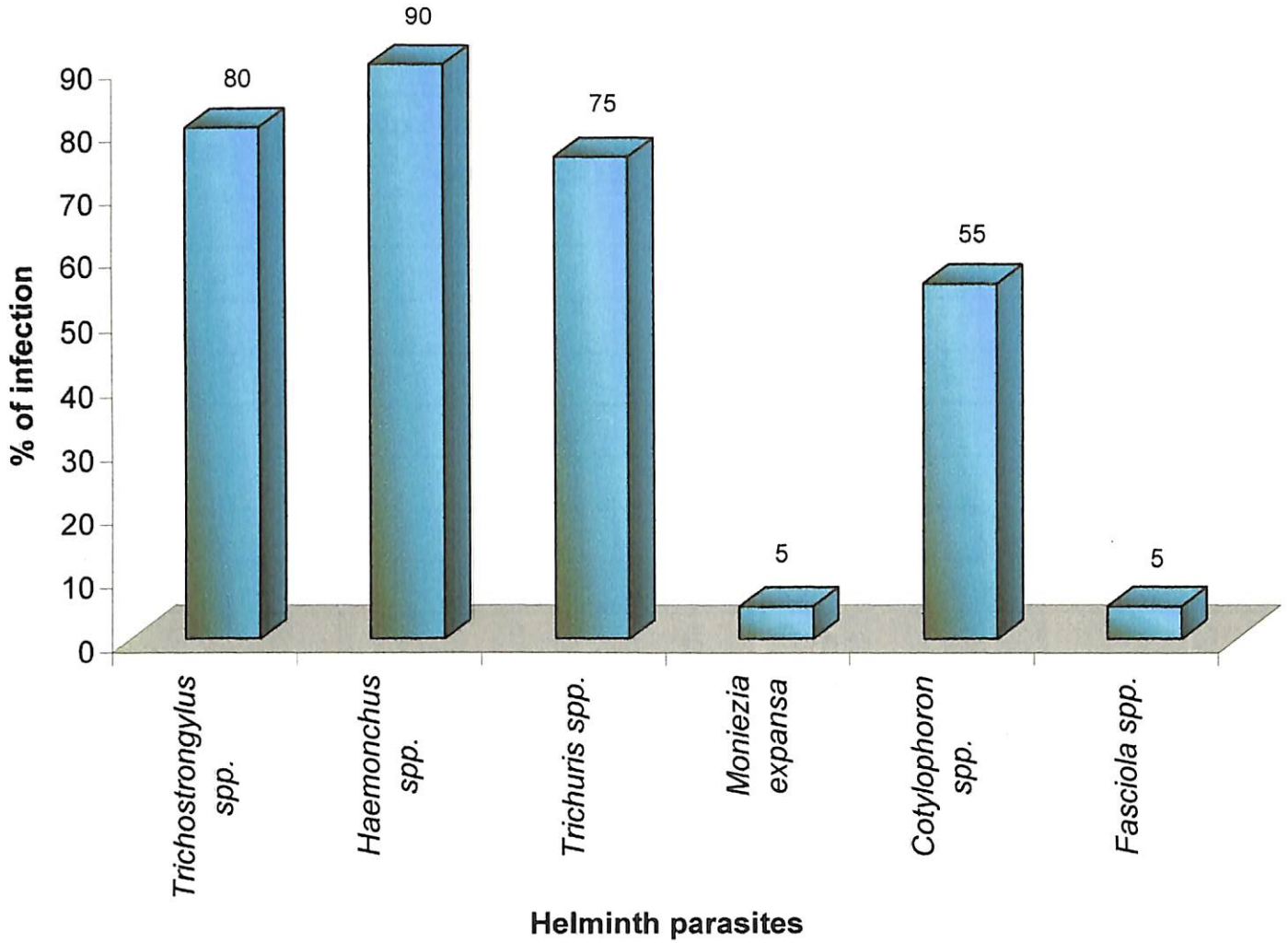


Table – 9 : Percentage of infection with different helminths in goats through examination of faecal samples.

Name of helminths	No. of faecal sample found positive out of 303 positive samples	Percentage of infection
(A) Nematodes		
(1) *Trichostrongylus* spp.	257	84.81
(2) *Haemonchus* spp.	272	89.76
(3) *Trichuris* spp.	37	12.21
(4) *Strongyloides* spp.	188	62.04
(5) *Oesophagostomum* spp.	149	49.17
(6) *Bunostomum* spp.	12	3.96
(B) Cestodes		
(1) *Moniezia expansa*	6	1.98
(2) *Moniezia benedeni*	6	1.98
(C) Trematodes		
(1) *Cotylophoron* spp.	103	33.99
(2) *Fasciola* spp.	39	12.87

Fig. - 9 : Histogram showing percentage of infection with different helminths in goats through examination of faecal samples.

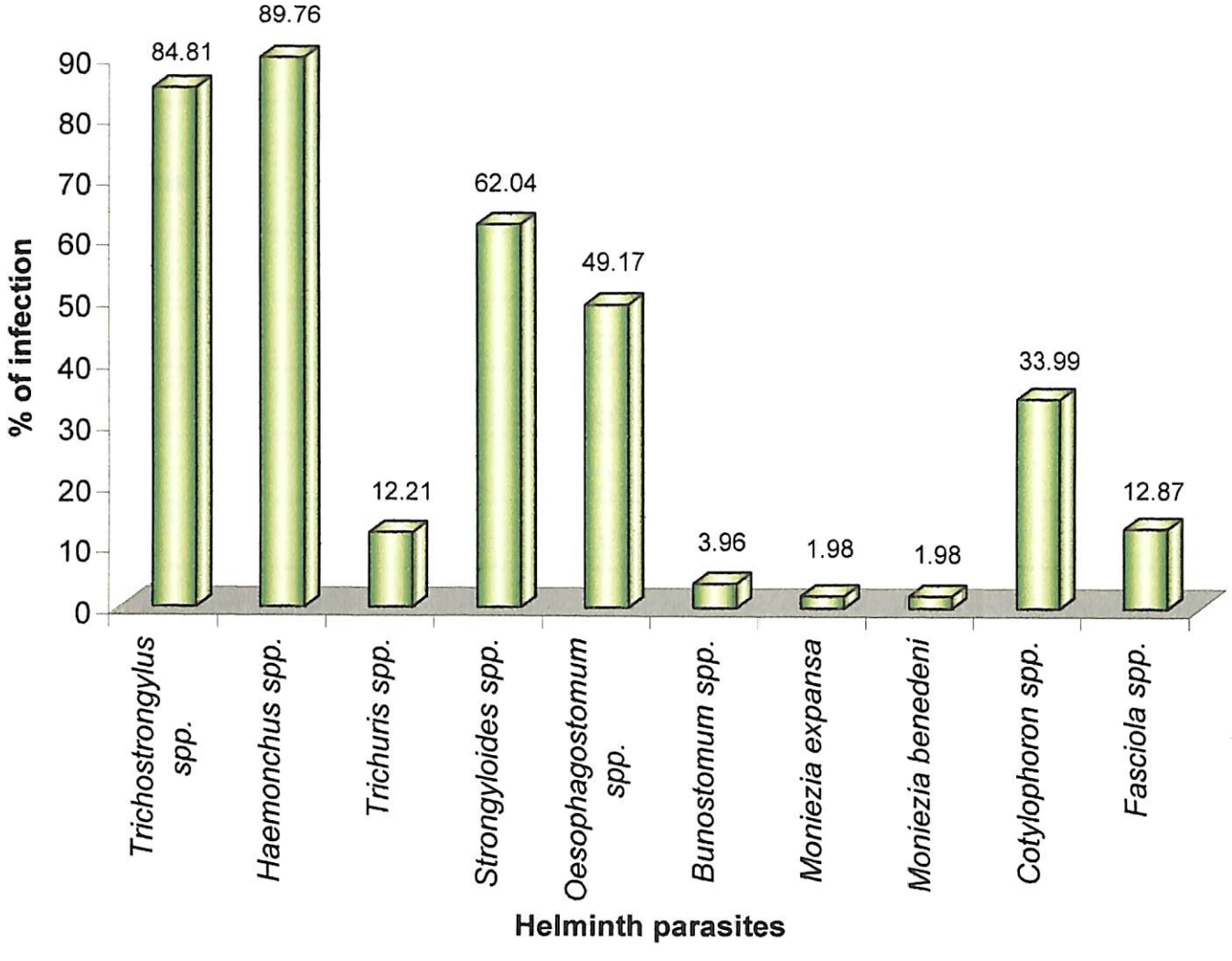


Table – 10 : Percentage of infection with different helminths in goats through examination of gastrointestinal tracts.

Name of helminths	No. of animal found positive out of 82 infected animals	Percentage of infection
(A) Nematodes		
(1) *Trichostrongylus* spp.	55	67.07
(2) *Haemonchus* spp.	69	84.14
(3) *Trichuris* spp.	29	35.36
(4) *Nematodirus* spp.	15	18.29
(B) Cestodes		
(1)Moniezia expansa	1	1.12
(C) Trematodes		
(1) *Cotylophoron* spp.	39	47.56
(2) *Fasciola* spp.	9	10.97

Fig. - 10 : Histogram showing percentage of infection with different helminths in goats through examination of gastrointestinal tracts.

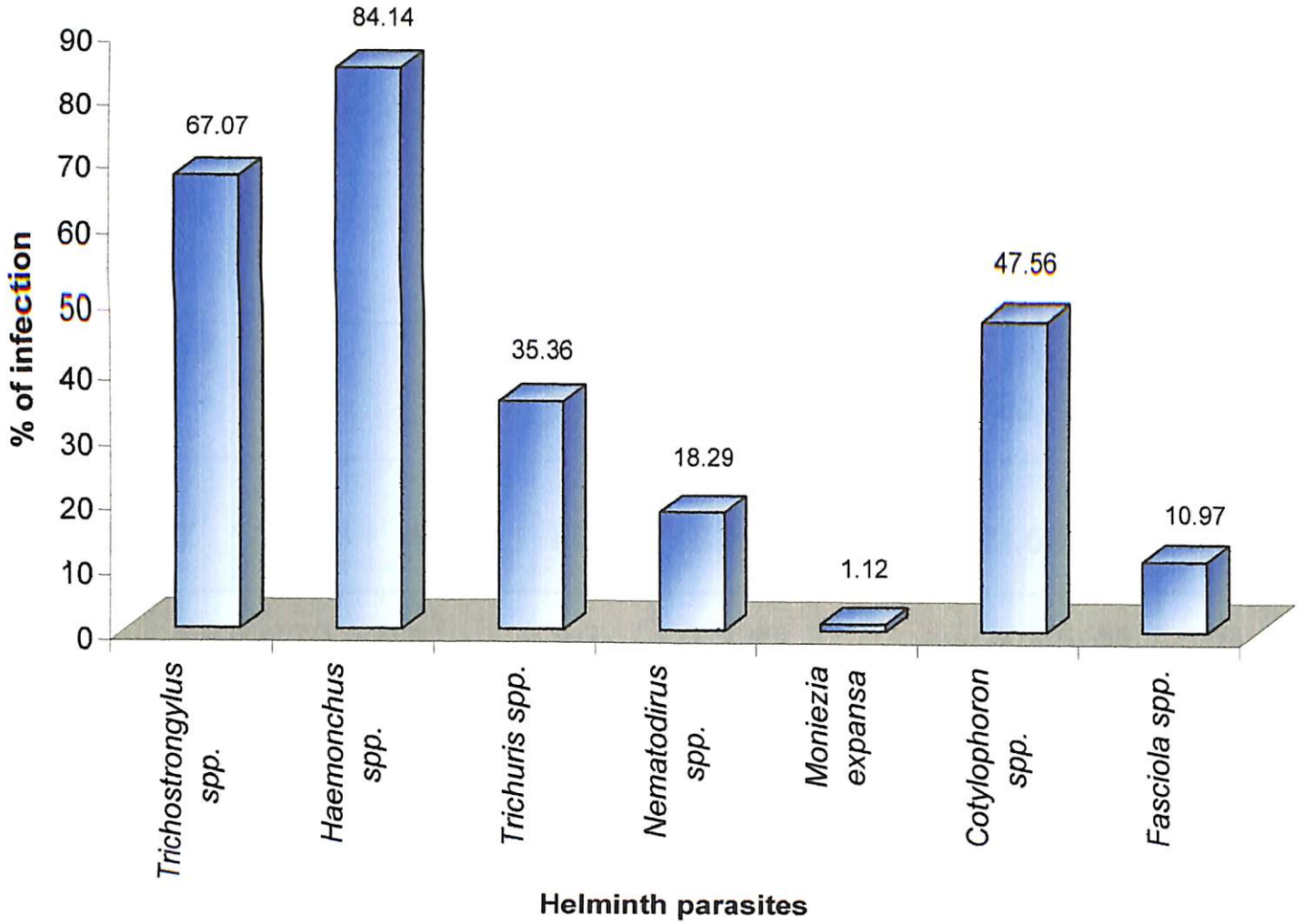
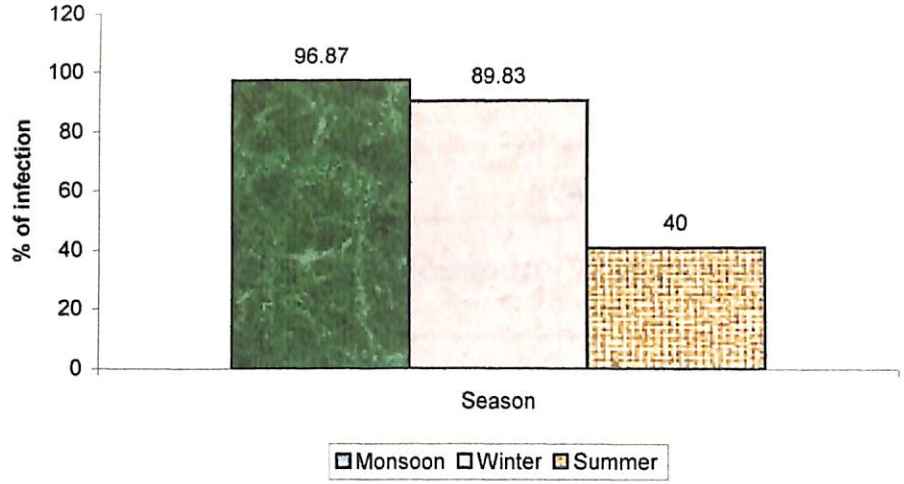


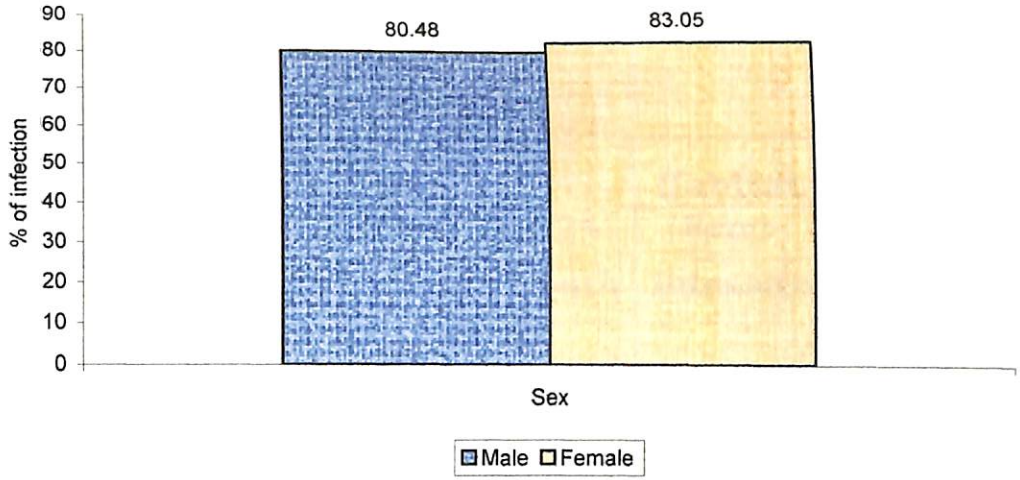
Table - 11 : Prevalence of *Haemonchus* spp. in sheep through faecal sample examination.

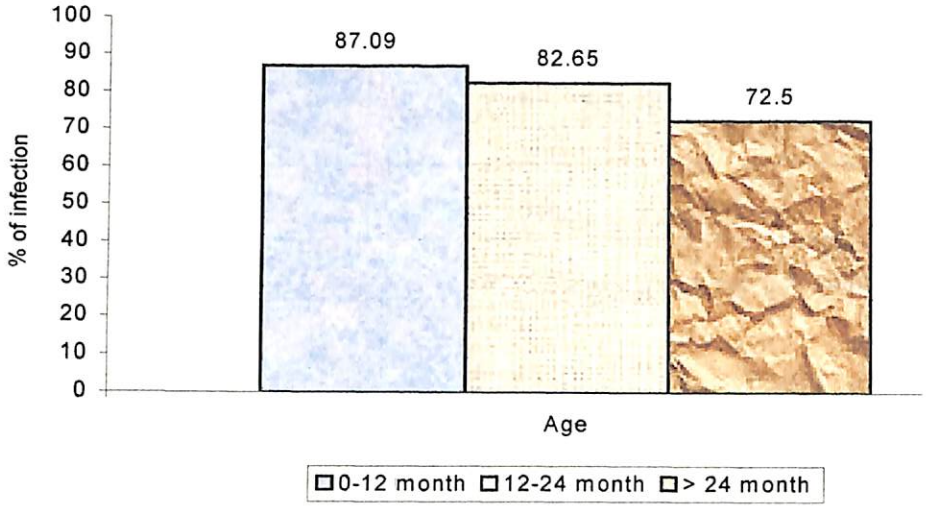
Faecal sample	Season			Sex		Age			Habitat pattern	
	Monsoon	Winter	Summer	Male	Female	0-12 month	12-24 month	> 24 month	Semi-intensive	Free range
No. of sample examined (200)	96	59	45	82	118	62	98	40	85	115
No. of sample positive (164)	93	53	18	66	98	54	81	29	69	95
%age of infection (82.00)	96.87	89.83	40.00	80.48	83.05	87.09	82.65	72.50	81.17	82.60
	$\chi^2_{2df} = 70.62^{**}$			$\chi^2_{1df} = 0.22^{NS}$		$\chi^2_{2df} = 3.56^{NS}$			$\chi^2_{1df} = 0.069^{NS}$	

NS = Non-significant, ** = Significant at P<0.01

Fig.-11 : Histogram showing prevalence of *Haemonchus* spp. in sheep through faecal sample examination.







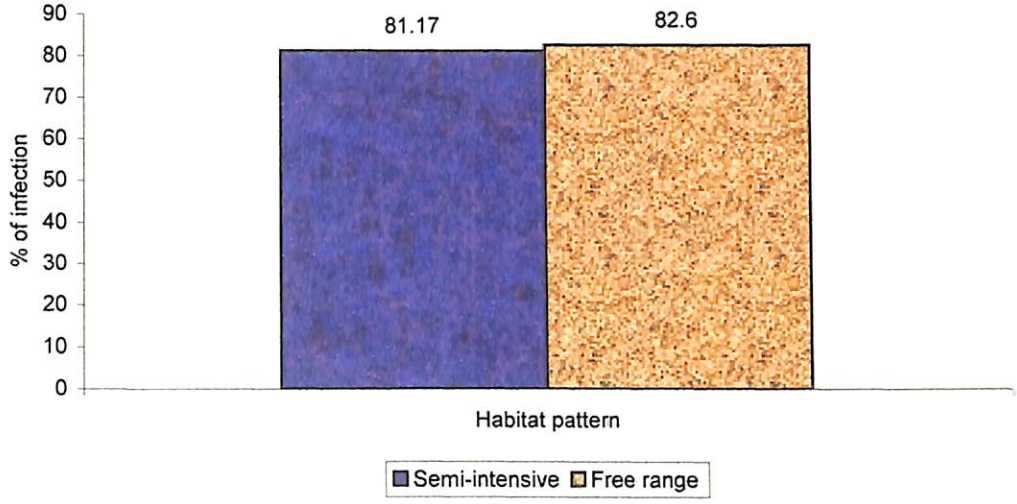
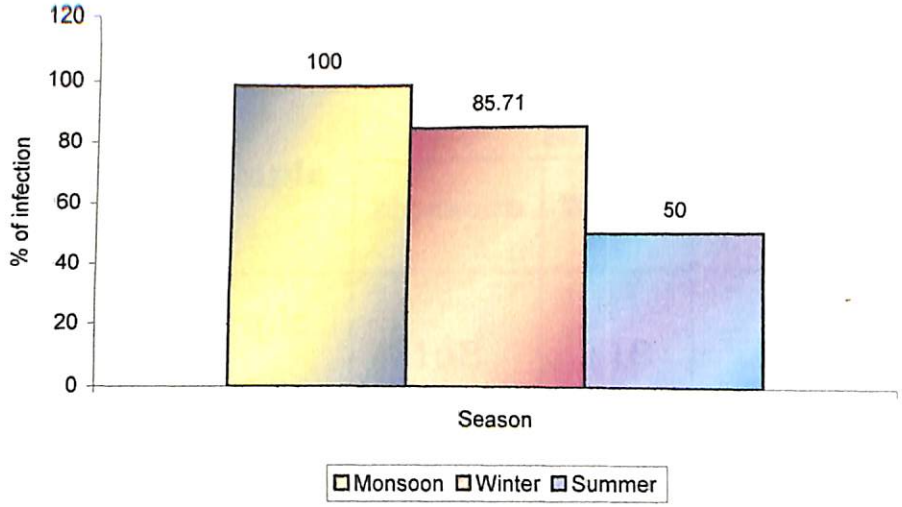
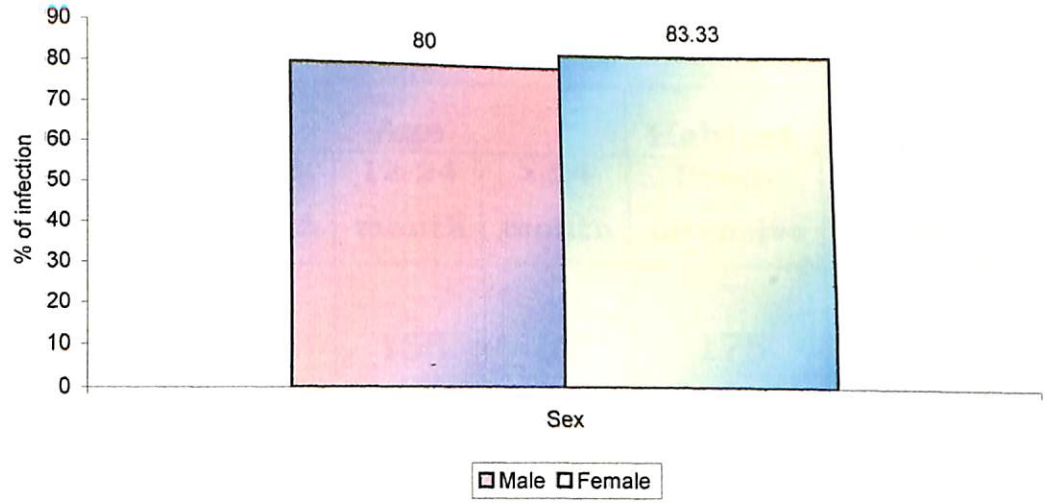
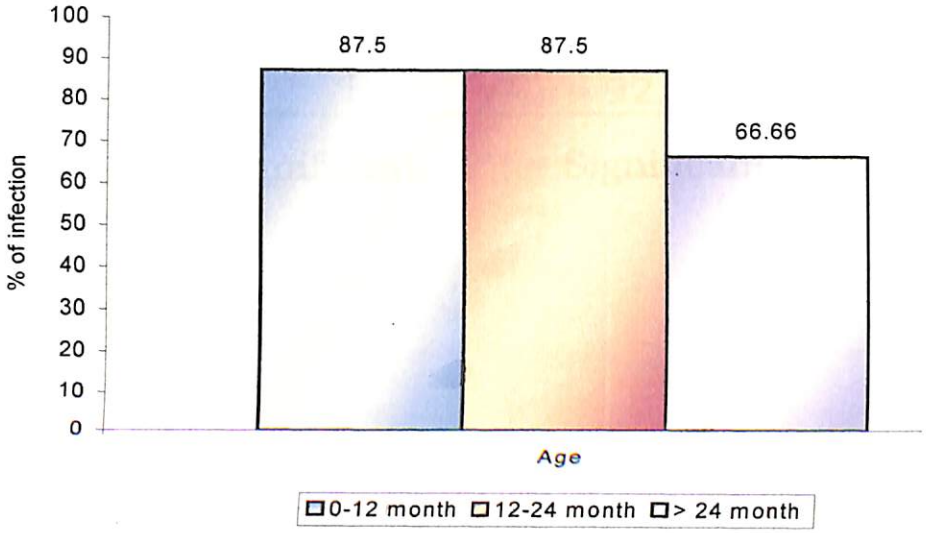


Fig.-12 : Histogram showing prevalence of *Haemonchus* spp. in sheep through gastrointestinal tract examination.







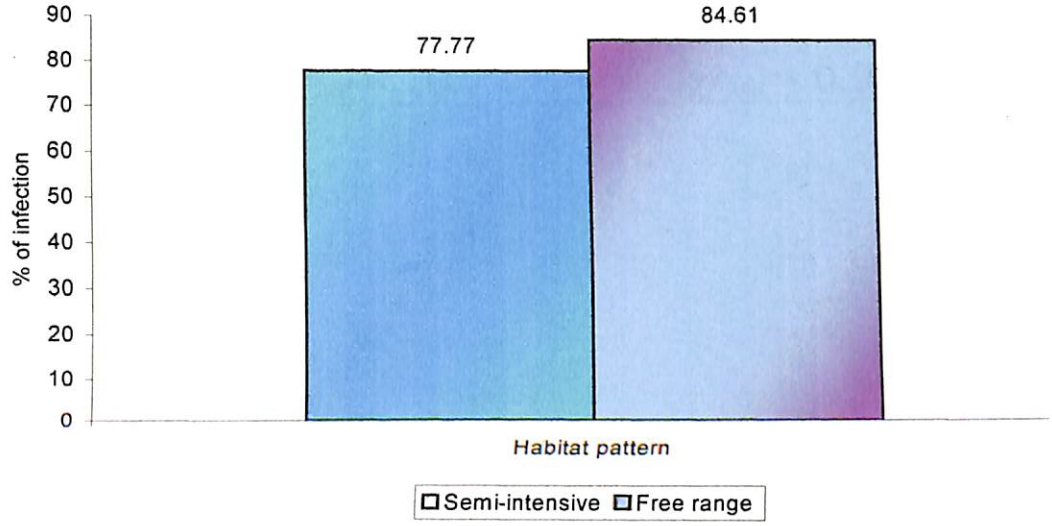
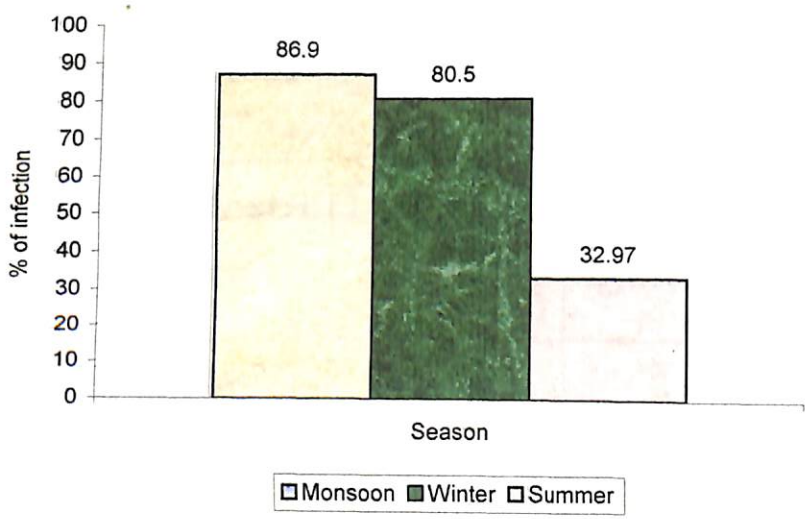


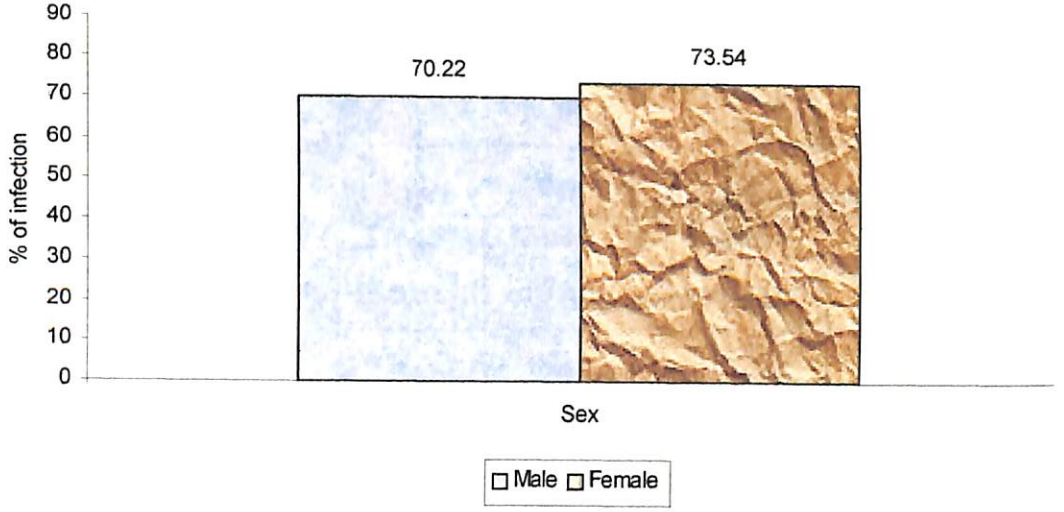
Table - 13 : Prevalence of *Haemonchus* spp. in goats through faecal sample examination.

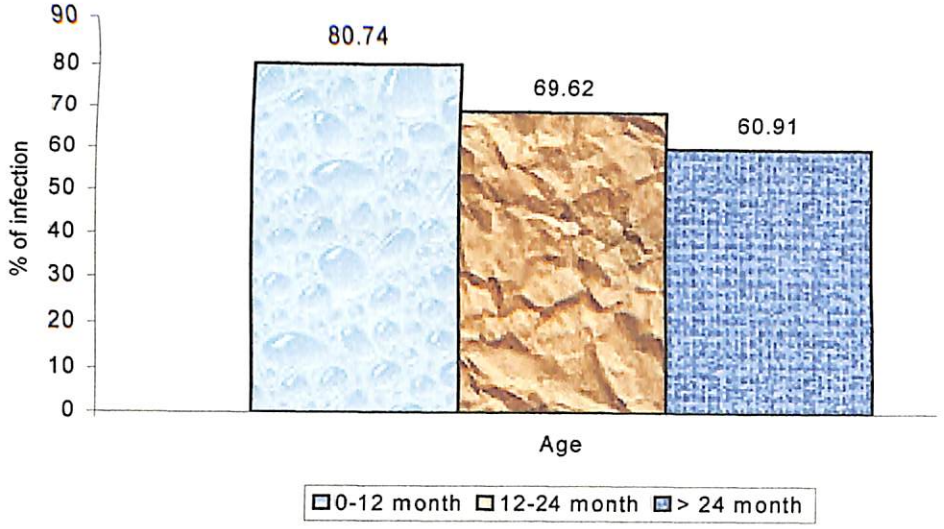
Faecal sample	Season			Sex		Age			Habitat pattern	
	Monsoon	Winter	Summer	Male	Female	0-12 month	12-24 month	> 24 month	Semi-intensive	Free range
No. of sample examined (380)	168	118	94	225	155	135	158	87	175	205
No. of sample positive (272)	146	95	31	158	114	109	110	53	121	151
%age of infection (71.57)	86.90	80.50	32.97	70.22	73.54	80.74	69.62	60.91	69.14	73.65
	$\chi^2_{2df} = 92.84^{**}$			$\chi^2_{1df} = 0.50^{NS}$		$\chi^2_{2df} = 10.72^{**}$			$\chi^2_{1df} = 0.95^{NS}$	

NS = Non-significant, ** = Significant at P<0.01

Fig.-13 : Histogram showing prevalence of *Haemonchus* spp. in goats through faecal sample examination.







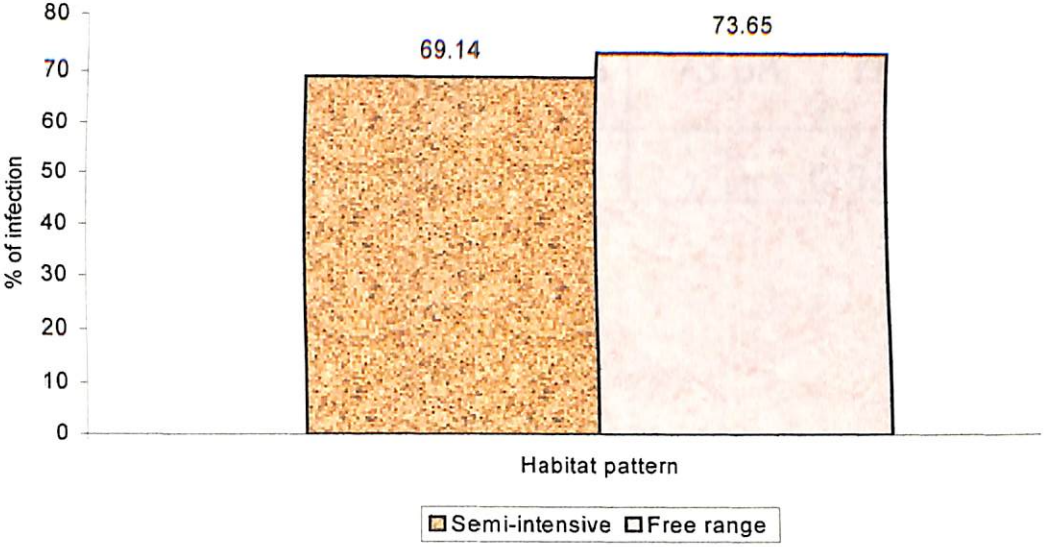
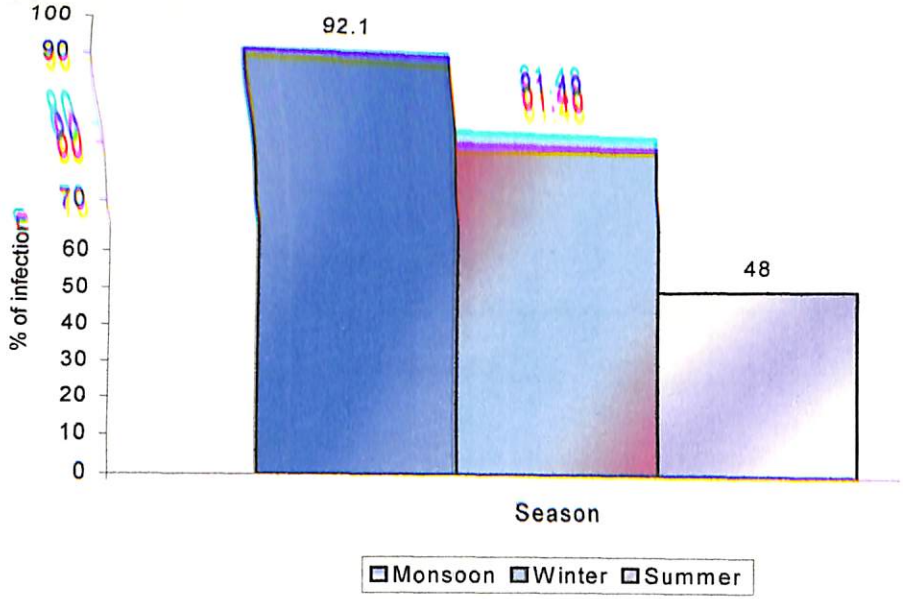


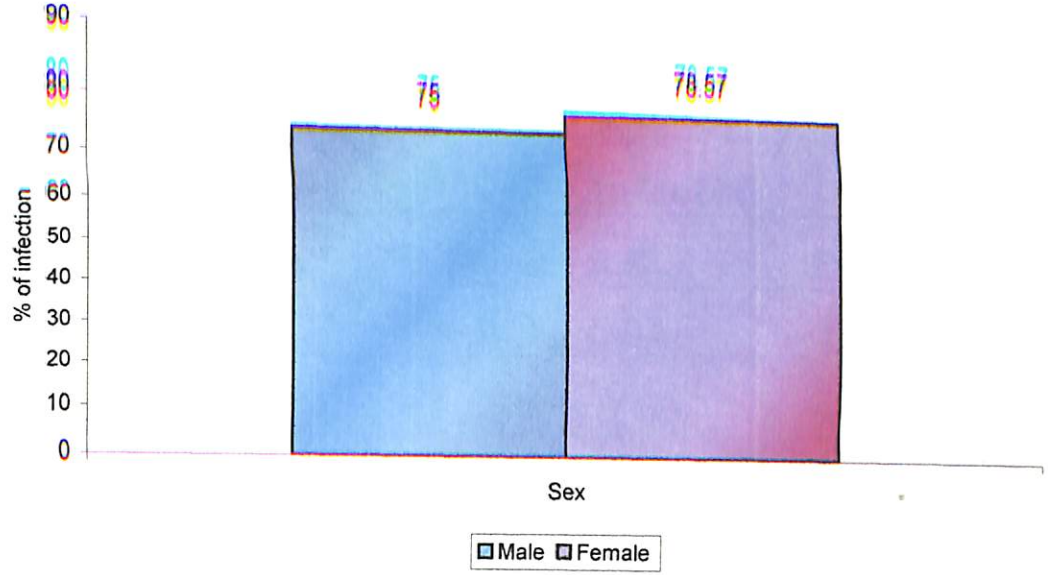
Table - 14 : Prevalence of *Haemonchus* spp. in goats through gastrointestinal tract examination.

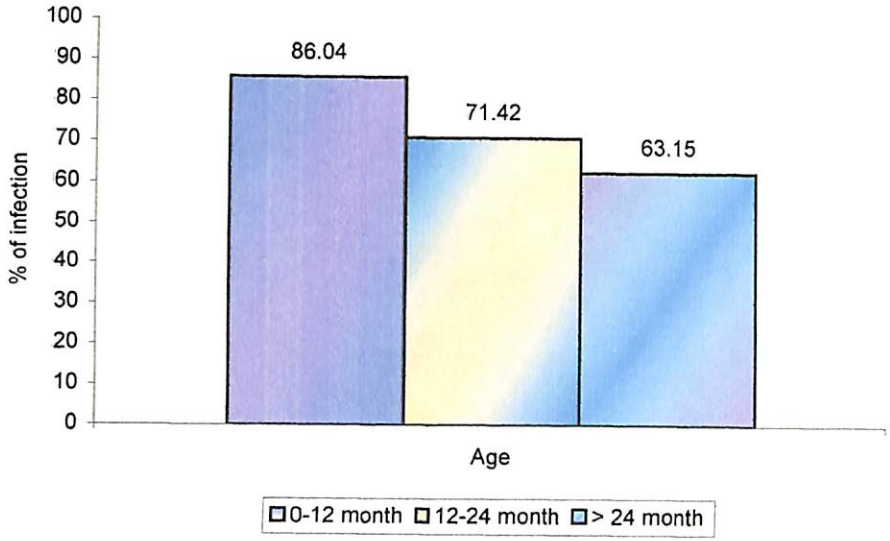
Gastrointestinal tract	Season			Sex		Age			Habitat pattern	
	Monsoon	Winter	Summer	Male	Female	0-12 month	12-24 month	> 24 month	Semi-intensive	Free range
No. of sample examined (90)	38	27	25	48	42	43	28	19	38	52
No. of sample positive (69)	35	22	12	36	33	37	20	12	28	41
%age of infection (76.66)	92.10	81.48	48.00	75.00	78.57	86.04	71.42	63.15	73.68	78.84
	$\chi^2_{2df} = 16.92^{**}$			$\chi^2_{1df} = 0.16^{NS}$		$\chi^2_{2df} = 4.49^{NS}$			$\chi^2_{1df} = 0.33^{NS}$	

NS = Non-significant, ** = Significant at P<0.01

Fig.-14 : Histogram showing prevalence of *Haemonchus* spp. in goats through gastrointestinal tract examination.







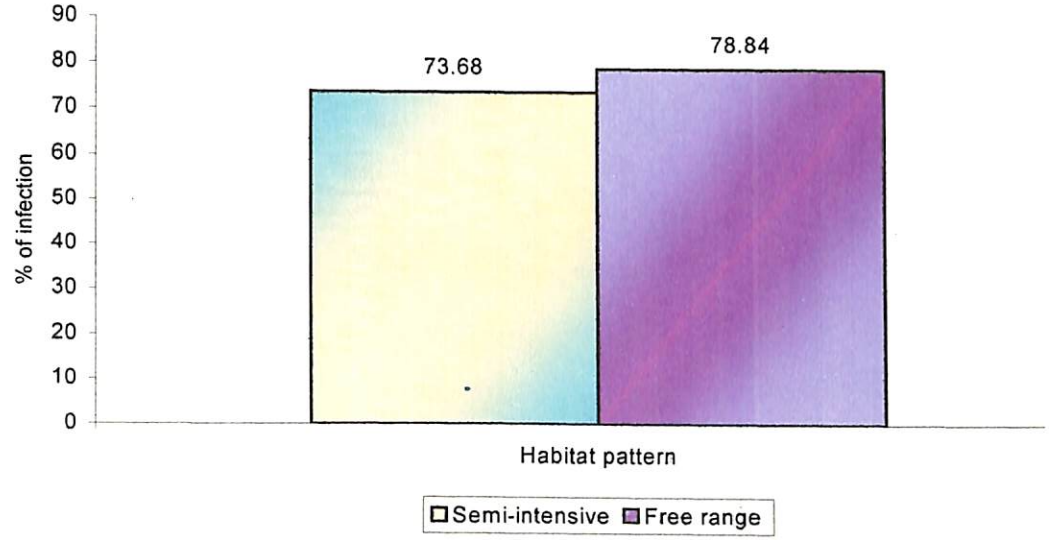


Table – 15 : Mean ± S.E. and C.V. % of haematological changes in sheep during haemonchosis.

Parameters	Control		Infected	
	Mean ± S.E.	C.V.%	Mean± S.E.	C.V.%
Haemoglobin percentage (gm %)	$11.78^{a} \pm 0.45$	9.28	$6.29^{b} \pm 0.31$	11.19
Packed cell volume (%)	$38.00^{a} \pm 1.07$	7.06	$19.59^{b} \pm 0.59$	6.75
Erythrocyte sedimentation rate (mm/hrs.)	$0.00^{a} \pm 0.00$	0.00	$3.10^{b} \pm 0.26$	18.55
Total erythrocyte count (10^{6}/mm^{3})	$10.14^{a} \pm 0.29$	6.57	$7.73^{b} \pm 0.23$	6.66
Total leucocyte count (10^{3}/mm^{3})	$7.37^{a} \pm 0.31$	9.32	$15.54^{b} \pm 0.54$	7.78

Means having different superscripts (row-wise) differ significantly ($P<0.05$).

Fig. - 15 : Histogram showing means of different haematological changes in sheep during haemonchosis.

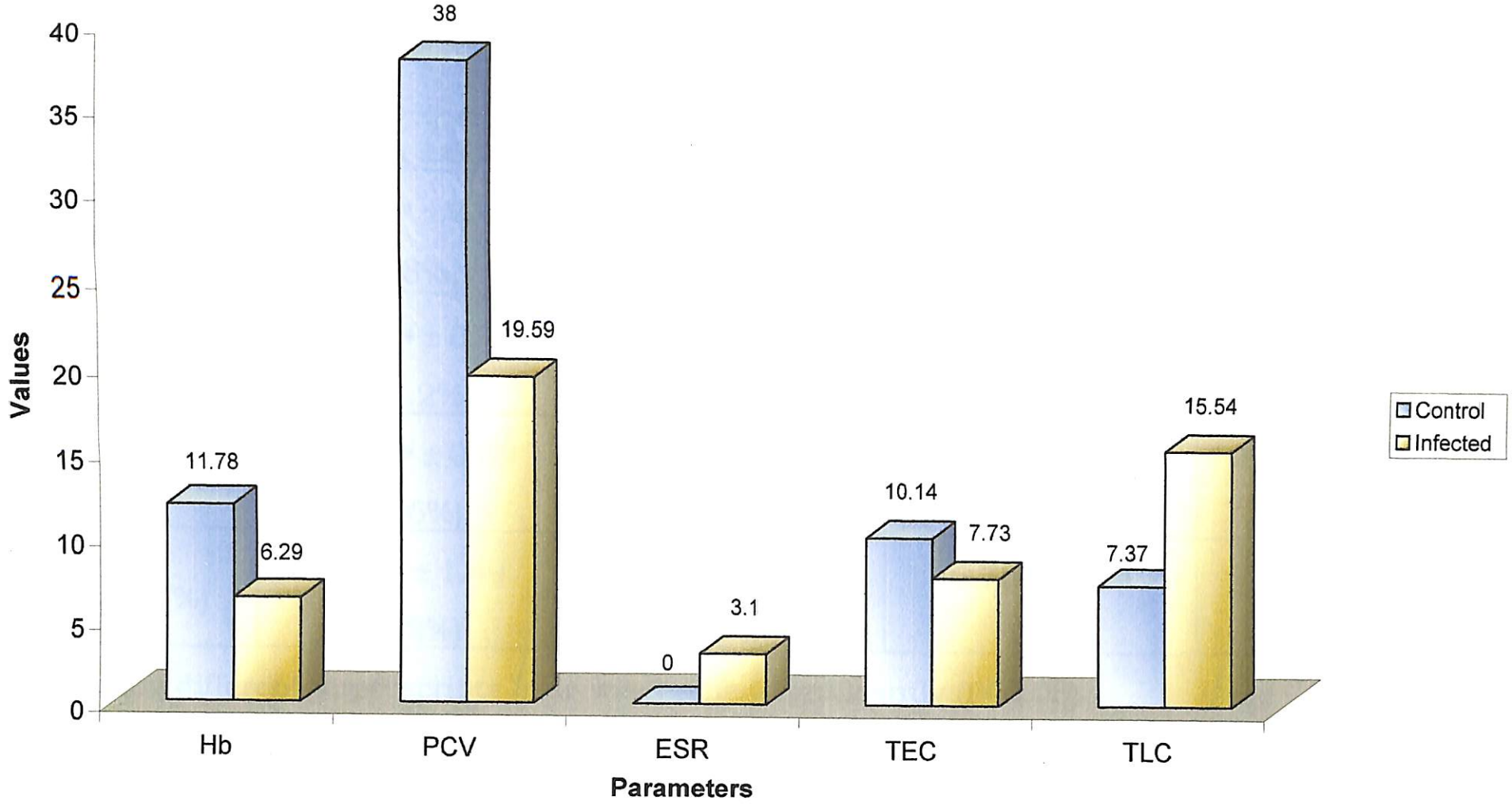


Table – 16 : Mean ± S.E. and C.V. % of differential leucocytic changes in sheep during haemonchosis.

Parameters	Control		Infected	
	Mean ± S.E.	C.V.%	Mean ± S.E.	C.V.%
Lymphocytes (%)	$49.60^{a} \pm 0.76$ (58%)	3.42	$26.53^{b} \pm 0.83$ (20%)	7.03
Neutrophils (%)	$37.57^{a} \pm 0.74$ (37.2%)	4.41	$49.60^{b} \pm 0.52$ (58%)	2.34
Eosinophils (%)	$10.88^{a} \pm 0.59$ (3.6%)	12.19	$26.97^{b} \pm 0.66$ (20.6%)	5.48
Monocytes (%)	$5.55^{a} \pm 1.49$ (1.2%)	59.89	$6.70^{a} \pm 0.59$ (1.4%)	19.55

Means having different superscripts (row-wise) differ significantly ($P<0.05$).

Figure in parenthesis indicates percentages of original values before Arcsin transformation.

Fig. - 16 : Histogram showing means of differential leucocytic changes in sheep during haemonchosis.

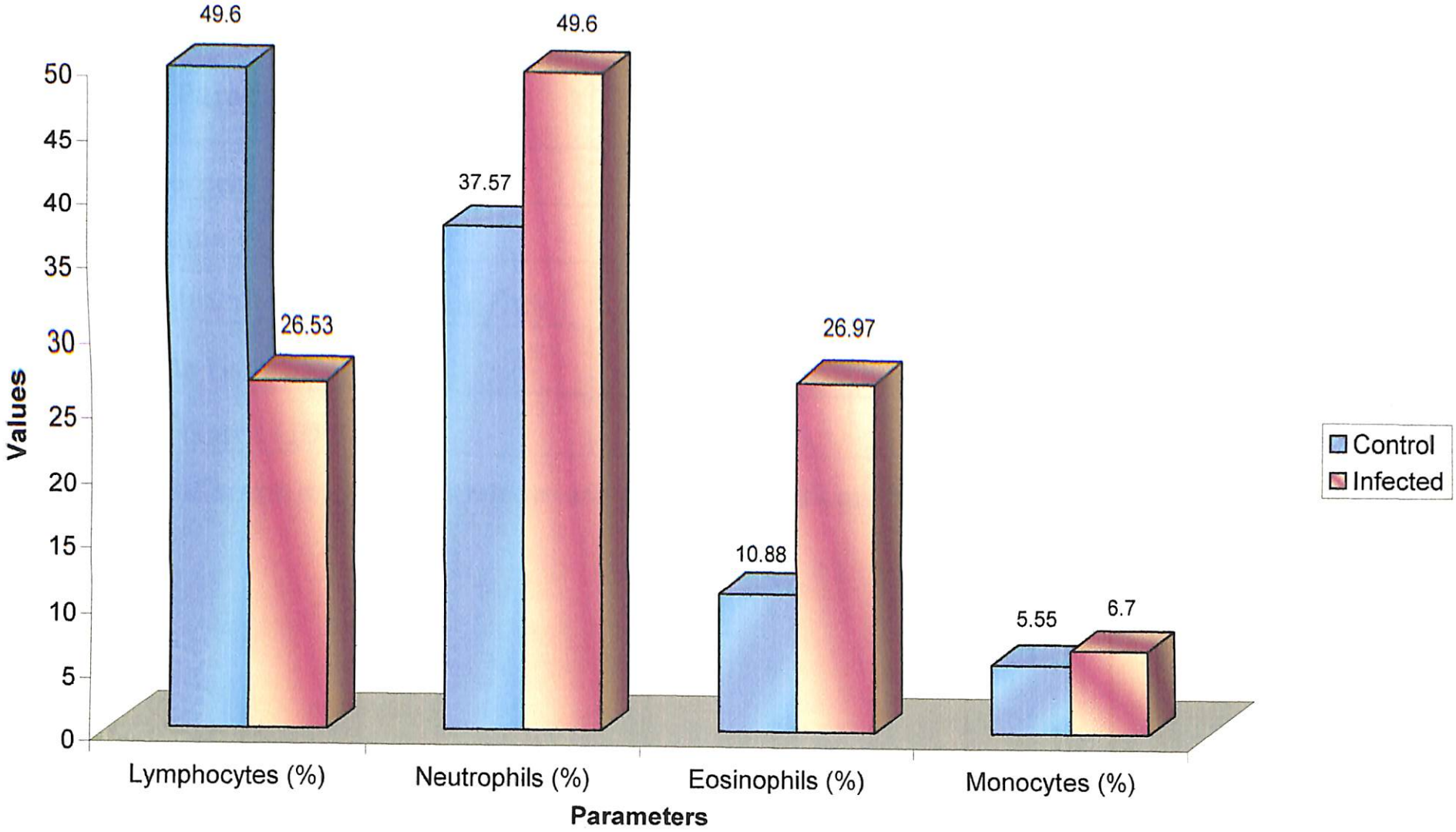


Table – 17 : Mean ± S.E. and C.V. % of haematological changes in goats during haemonchosis.

Parameters	Control		Infected	
	Mean ± S.E.	C.V.%	Mean ± S.E.	C.V.%
Haemoglobin percentage (gm%)	$11.08^{a} \pm 0.25$	6.10	$6.24^{b} \pm 0.36$	12.92
Packed cell volume (%)	$35.43^{a} \pm 1.17$	8.34	$18.86^{b} \pm 0.88$	10.50
Erythrocyte sedimentation rate (mm/hrs.)	$0.00^{a} \pm 0.00$	0.00	$3.20^{b} \pm 0.21$	15.00
Total erythrocyte count (10^6/mm^3)	$10.78^{a} \pm 0.06$	1.39	$7.17^{b} \pm 0.25$	7.81
Total leucocyte count (10^3/mm^3)	$7.09^{a} \pm 0.28$	8.89	$16.88^{b} \pm 0.55$	7.26

Means having different superscripts (row-wise) differ significantly ($P<0.05$).

Fig. - 17 : Histogram showing means of different haematological changes in goats during haemonchosis.

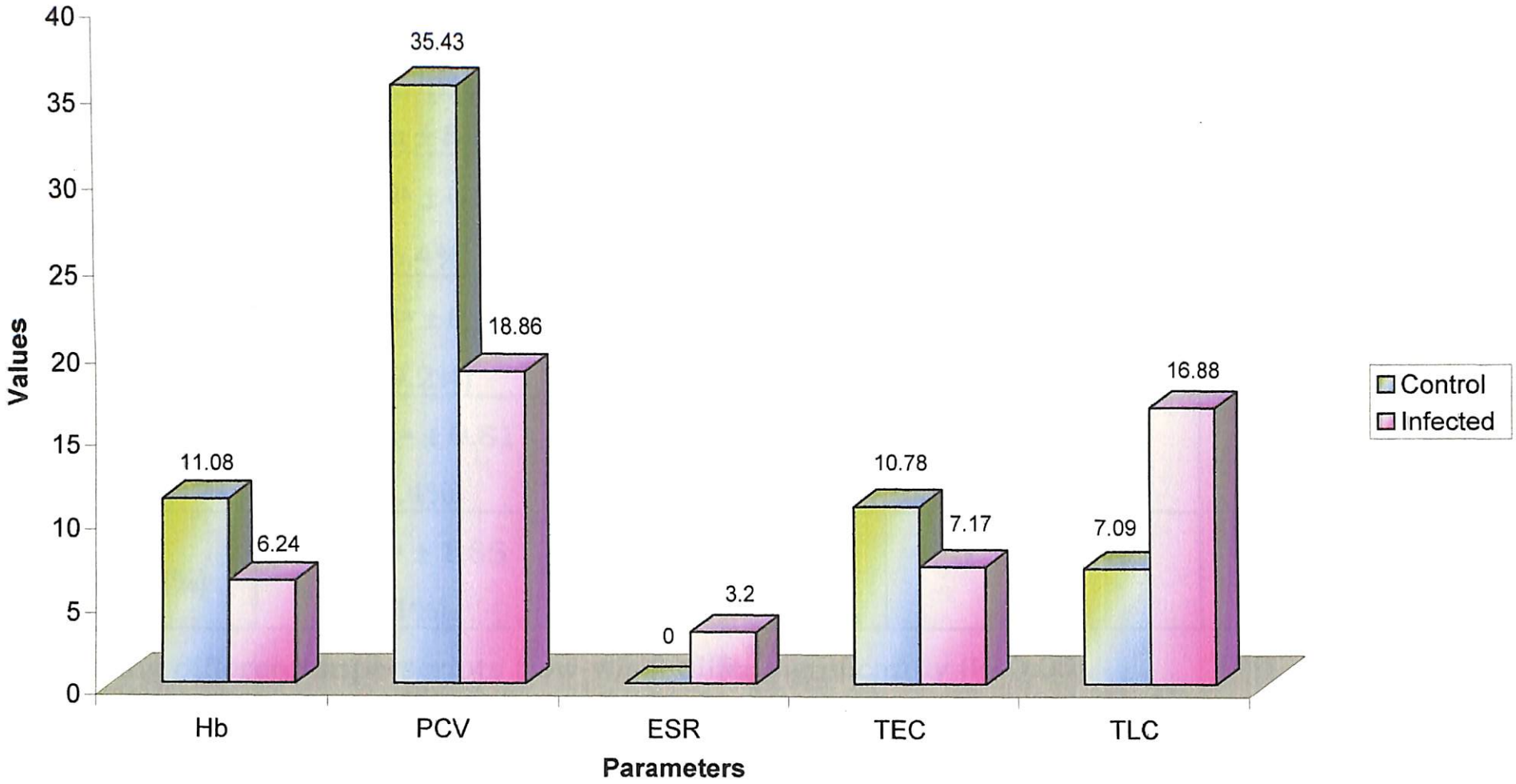


Table – 18 : Mean ± S.E. and C.V. % of differential leucocytic changes in goats during haemonchosis.

Parameters	Control		Infected	
	Mean ± S.E.	C.V.%	Mean ± S.E.	C.V.%
Lymphocytes (%)	$54.59^{a} \pm 0.68$ (66.4%)	2.80	$33.32^{b} \pm 0.67$ (30.2%)	4.47
Neutrophils (%)	$32.68^{a} \pm 0.95$ (29.2%)	6.46	$45.46^{b} \pm 0.49$ (50.8%)	2.43
Eosinophils (%)	$10.51^{a} \pm 0.81$ (3.4%)	17.22	$24.93^{b} \pm 0.65$ (17.8%)	5.82
Monocytes (%)	$4.40^{a} \pm 1.85$ (1%)	93.95	$5.55^{a} \pm 1.49$ (1.2%)	59.89

Means having different superscripts (row-wise) differ significantly ($P<0.05$).

Figure in parenthesis indicates percentages of original values before Arcsin transformation.

Fig. - 18 : Histogram showing means of differential leucocytic changes in goats during haemonchosis.

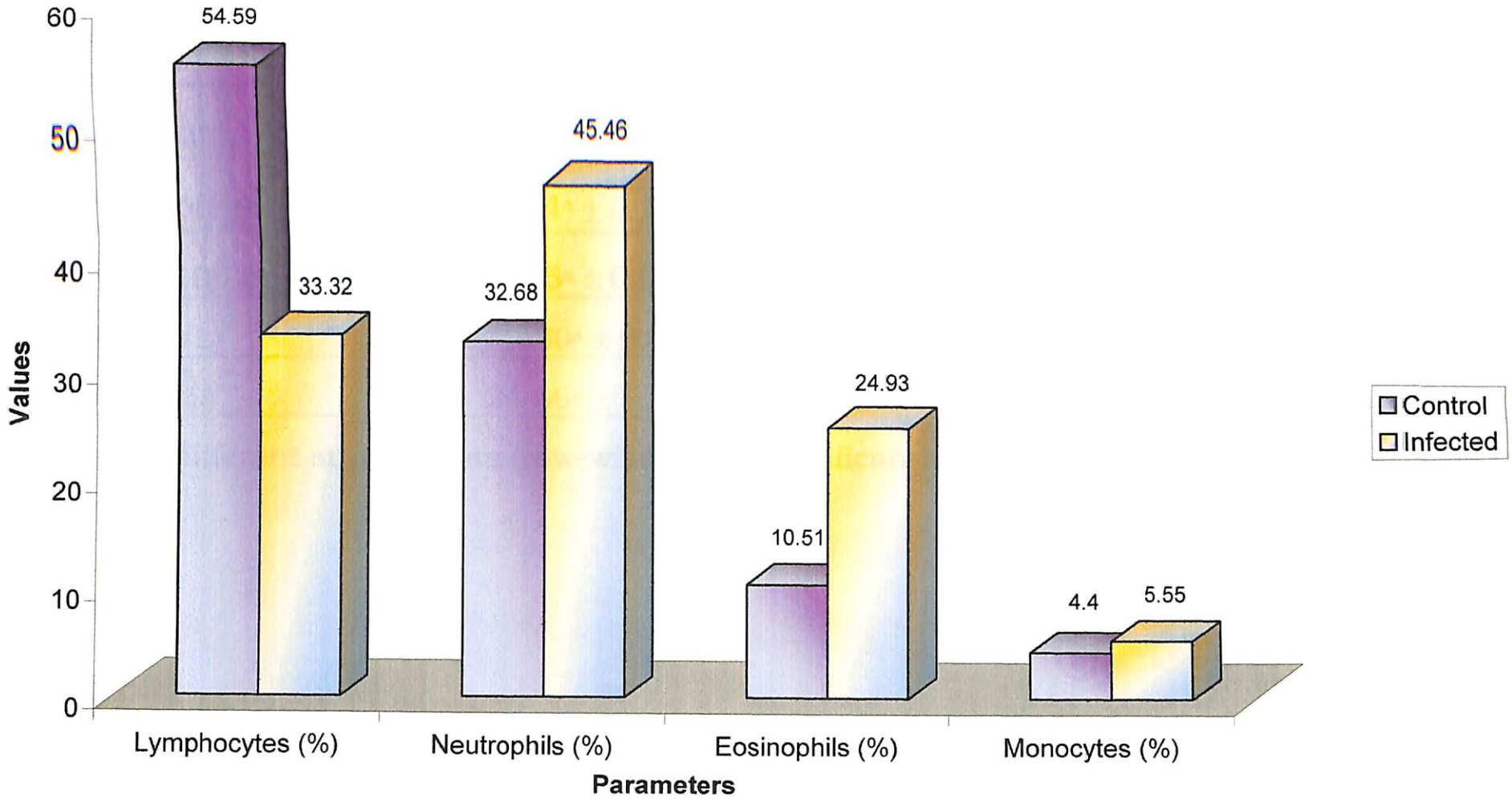


Table – 19 : Mean ± S.E. and C.V. % of biochemical changes in sheep during haemonchosis.

Biochemical parameters	Control		Infected	
	Mean ± S.E.	C.V.%	Mean ± S.E.	C.V.%
Blood glucose (mg/ml)	$56.28^{a} \pm 1.49$	5.92	$32.32^{b} \pm 2.05$	14.23
Total serum protein (gm/dl)	$6.94^{a} \pm 0.19$	6.00	$4.85^{b} \pm 0.29$	13.48
Bilirubin (mg/100 ml)	$0.35^{a} \pm 0.05$	31.29	$1.08^{b} \pm 0.15$	29.63
SGOT/AST (IU/L)	$72.30^{a} \pm 2.84$	8.78	$147.63^{b} \pm 5.34$	8.08
SGPT/ALT (IU/L)	$24.66^{a} \pm 1.17$	10.58	$42.26^{b} \pm 2.55$	13.51

Means having different superscripts (row-wise) differ significantly ($P<0.05$).

showing biochemical changes in sheep during haemonchosis.

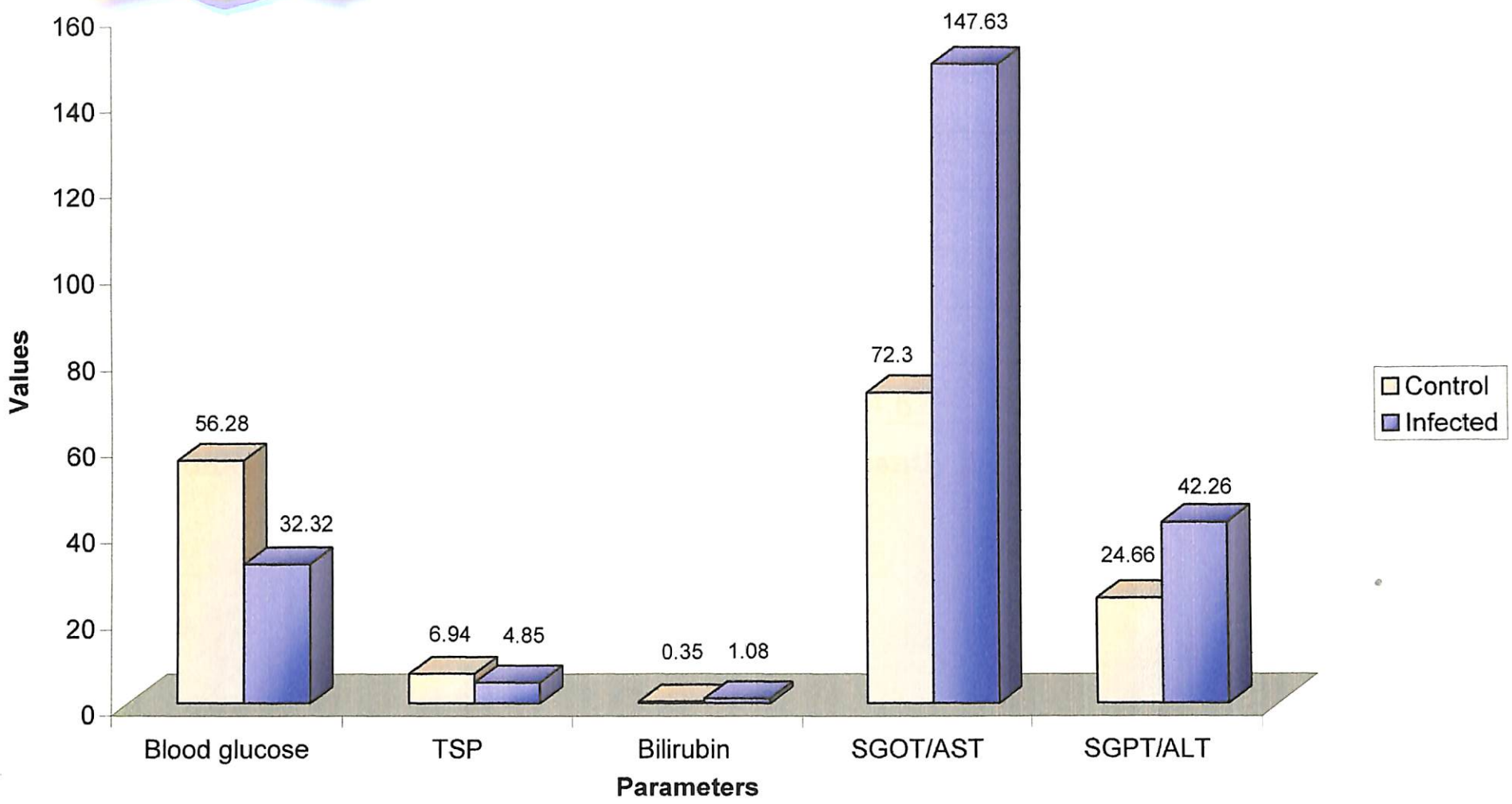
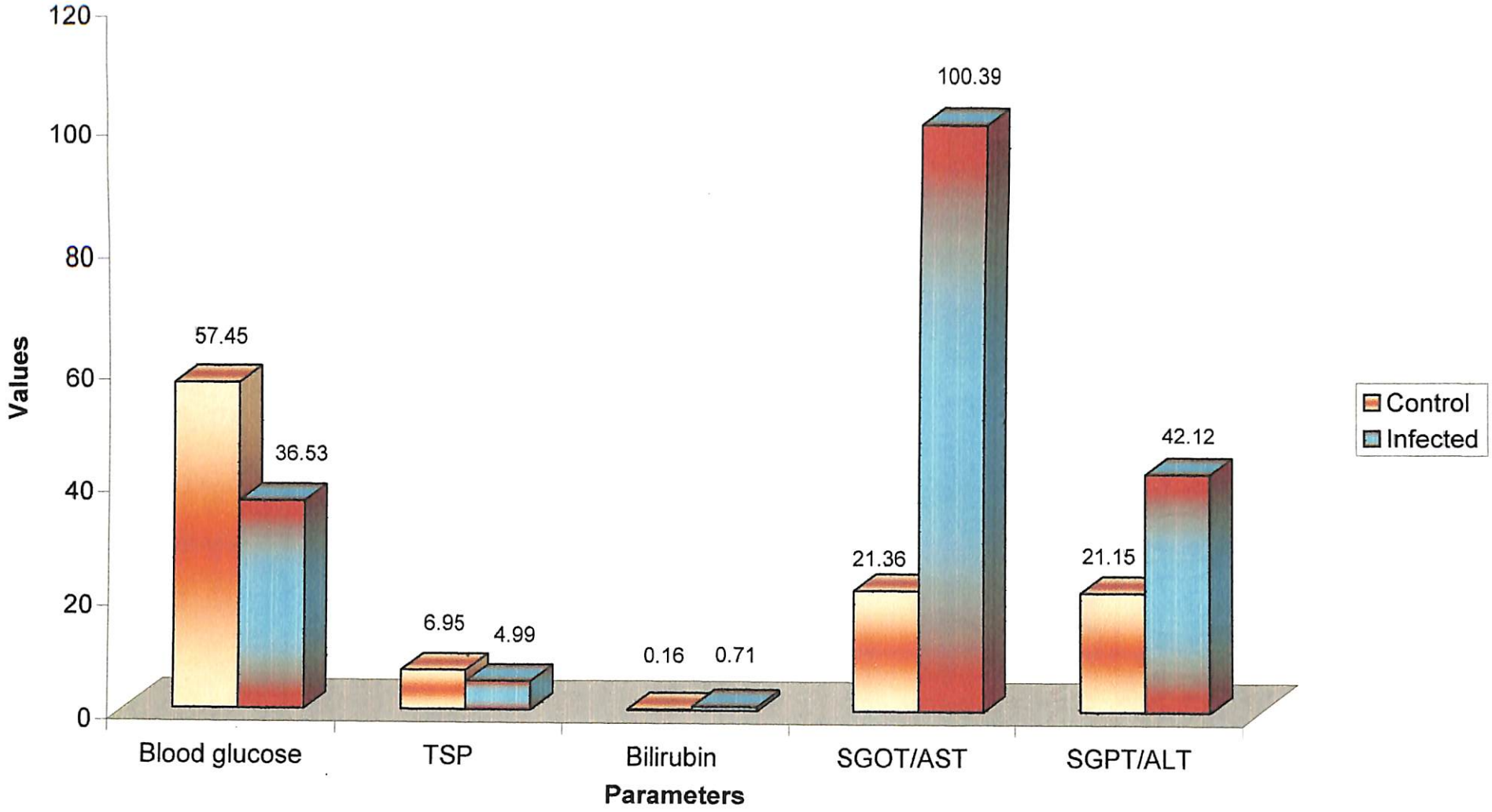


Table – 20 : Mean ± S.E. and C.V. % of biochemical changes in goats during haemonchosis.

Biochemical parameters	Control		Infected	
	Mean ± S.E.	C.V.%	Mean ± S.E.	C.V.%
Blood glucose (mg/ml)	$57.45^{a} \pm 1.25$	4.87	$36.53^{b} \pm 1.50$	9.20
Total serum protein (gm/dl)	$6.95^{a} \pm 0.20$	6.47	$4.99^{b} \pm 0.27$	12.21
Bilirubin (mg/100ml)	$0.16^{a} \pm 0.01$	18.60	$0.71^{b} \pm 0.15$	45.52
SGOT/AST (IU/L)	$21.36^{a} \pm 1.10$	11.52	$100.39^{b} \pm 4.07$	9.06
SGPT/ALT (IU/L)	$21.15^{a} \pm 1.39$	14.67	$42.12^{b} \pm 2.42$	12.87

Means having different superscripts (row-wise) differ significantly ($P<0.05$).

Fig. - 20 : Histogram showing biochemical changes in goats during haemonchosis.




CHAPTER - V

DISCUSSION

DISCUSSION

The geographical and agro-ecological conditions of Bihar, hot and humid climate with multiple river banks, less urbanization and large agricultural land, are very congenial for propagation of helminth parasites in livestock, although, limited informations are available on the occurrence of helminths in small ruminants such as sheep and goats. The epidemiological picture of the gastrointestinal parasites of sheep and goats is not clear so far. Both of these animals have almost identical husbandry practices and harbours alike parasitic fauna as previously reported (Soulsby, 1982 and Bhatia *et al.*, 2006). Further *Haemonchus* spp. surpass all gastrointestinal helminths in producing various clinical implications, morbidity and mortality in population of sheep and goats which are mostly belong to small scale and poor producers.

Therefore, this preliminary study **"Helminthic infections of gastrointestinal tract of sheep and goat in and around Patna district"** was undertaken to have a better knowledge on epidemiology of gastrointestinal helminthosis specially various haematological, biochemical and histopathological changes during natural haemonchosis in sheep and goats of Patna, Bihar.

OVERALL INCIDENCE OF GASTROINTESTINAL HELMINTH PARASITES IN SHEEP AND GOATS :

It was observed that overall prevalence of gastrointestinal helminthic infection in sheep population in Patna was ranged between 89 to 90.9% through examination of faecal samples and gastrointestinal tracts respectively (Table-1). Similarly 79.73 and 91.11% infection (Table-2) was observed in respective samples of goats in and around Patna district. The study revealed higher occurrence of gastrointestinal helminthic infection in sheep and goats in and around Patna. Various degree of gastrointestinal helminthic parasitism in sheep and goats have been reported by many workers throughout the world. The finding of Maqbool *et al.* (1997) in Pakistan corroborates with the results of the present study. Singla (1995) observed 89.07% and 90.01% G.I. helminthic infection in sheep and goat respectively at Ludhiana; Al-Hadethi and Al-Saffar (1988) observed 68.4% G.I. helminthosis in sheep in Iraq ; Fakae (1990) recorded 77.8 to 100% prevalence in sheep and goat respectively in Nigeria ; Bhojane *et al.* (2002) recorded overall 70% helminthic infections in goats in Nagpur. The present finding also simulate with the reports of Juarez and Quiroz (1972), Sani *et al.* (1986), Okafor (1987), Boubas and Theodoridis (2000), Yildiz and Aydenizoz (2001), Arora *et al.* (2003), Garg *et al.* (2003), Shreedevi and Murthy (2005), Singh *et al.* (2005). Thus it can be said that the problem of G.I. helminthosis distributed throughout the world.

IMPACT OF SEASON, SEX, AGE AND HABITAT PATTERN ON THE PREVALENCE OF GASTROINTESTINAL HELMINTH PARASITES IN SHEEP (TABLES - 3 AND 4):

Dynamics of prevalence and impact of various helminthic infections in local population of sheep in Patna and its surrounding areas surveyed by collection of faecal samples (200) and gastrointestinal tracts (22). The aim of this study was to determine the prevalence and intensity of overall gastrointestinal helminthosis in respect to establish relationship between seasonal distribution, their sex, various age groups and sheep management practices. The table-3 and 4 revealed that nearly 89 to 91% population of local sheep harbouring various gastrointestinal parasites which is highly alarming situation and definitely responsible for reducing the efficiency and productivity. Statistical analysis of data pertaining to different seasons indicated that occurrence of G.I. helminthosis greatly influenced by warm and humid climatic condition as magnitude of incidence was found to be maximum in monsoon season (96.87 to 100%) through faecal and G.I. tract examinations respectively. Similarly in winter season hypobiotic larvae and post parturient rise might be responsible to cause severe disease outbreak conditions as data revealed 85.71 to 93.22% incidence in winter season. Survival of larvae, conducive migration means and magnitude of egg output adversely affected in hot climate, therefore minimum prevalence was recorded (66.67 to 83.33%) in

summer season. The present finding simulate with the reports of Specht (1982), Chopra (1985), Singla (1995), Morales *et al.* (2001), Achi *et al.* (2003) and Singh *et al.* (2005), suggested that high rate of infection in sheep may be due to varied climatic conditions in tropical warm and humid atmosphere provide favourable conditions for multiplication, dissemination and development of ova and free living stages of parasites. Ansari and Singh (1981) also observed higher incidence of G.I. helminthosis in sheep in post monsoon and winter season. Out of G.I. tracts screened out in present study it was analysed that distribution of season has non-significant effect on the incidence of the G.I. Parasites. Mckenna *et al.* (1973) also found that variation of seasons does not influence the occurrence of G.I. parasitism in sheep, El-Azazy (1990) observed the intensity of infection non-significantly effective between four seasons. Contrary to the finding of the present study, Maqbool *et al.* (1997) reported higher percent of parasitism in spring in Pakistan, Alam *et al.* (1996) found higher incidence of parasites in summer and monsoon season, Nasreen *et al.* (2005) noted highest prevalence in summer and lowest in winter in sheep of Kashmir valley. Lindqvist *et al.* (2001) found peak of parasitism during summer (autumn) season, Al-Hadethi and Al-Saffar (1988) reported higher incidence of helminthic infection in summer and low in winter, Sreedevi and Murthy (2005) noted more prevalence of gastrointestinal parasites in summer and lowest in monsoon.

The influence of sex on the occurrence of gastrointestinal parasitism through examination of faecal samples and gastrointestinal tracts revealed non-significant difference, however, the rate of prevalence was slightly higher towards female sheep. Similar finding observed by Asanji (1988) who also recorded slightly higher incidence in female sheep in comparison to males whereas Mazhar *et al.* (1996) found significant influence of sex on the incidence of G.I. parasitism, Similar reports have also been presented by Morales *et al.* (2001) as maximum incidence of G.I. parasitism recorded in ewes.

In the present study, maximum incidence of G.I. parasitism (95.16 to 100%) was mainly observed within the age group of 0-12 months through faecal sample and intestinal scraping examination, similarly incidence was also higher in sheep aged up to 1-2 years (92.85 to 100%). The abundance of parasites was also seen in sheep of the age group of 2 years and above but it was lower (66.66 to 70%) as compared to previous age groups. The influence of age was highly significant through faecal sample examination, however, it was statistically found non-significant during study of gastrointestinal tract. This could presumably be due to lower immunotolerence in young lambs and susceptibility to infection as age advanced due to repeated exposure of mild to heavy infection. The present study also confirmed with the findings of Asanji (1988), Mazhar *et al.* (1996), Rizvi *et al.*

(1999), Lindqvist *et al.* (2001), Achi *et al.* (2003) and Tariq *et al.* (2003).

Pooled faecal samples and gastrointestinal tracts from semi-intensive and free ranged sheep flocks revealed non-significant influences between these two pattern of sheep managements but higher prevalence accounted in free ranged sheep flocks. Incidence of parasitism and pattern of disease outbreak related with common water sources and repeated grazing in common pasture become the major source of infection for grazing and migratory sheep flocks. Whereas stocking density of sheep population in semi-intensive management induces the chances of contamination for the other healthy sheep stocks, which might to be facilitate the higher incidence of parasitism in semi-intensive managed sheep. Singla (1995), however, suggested that degree of parasitism or worm burden greatly depend upon the managemental and hygienic conditions of the area. Thangathurai *et al.* (2003) reported higher prevalence rate due to improper management of enteric parasitism in sheep. However, present finding in agreement with the reports of Pandit *et al.* (2003) who observed higher incidence of G.I. parasitism in sheep managed in field as compared to farm sheep flocks and findings are also in accordance with the reports of Kumar *et al.* (2006) who also noted higher prevalence in free grazing migratory sheep whereas Lloyd (1994) observed higher incidence in stock sheep. In Bihar, the

condition of either free grazing or semi-intensive sheep farming is presently in very initial stage and mostly carried out by poor and illiterate farmer and some migratory community of the society. They hardly provide proper nourishment or anthelminthic schedule to their sheep flock and never apply any hygiene management, thus directly responsible for high degree of parasitism in sheep flocks.

IMPACT OF SEASON, SEX, AGE AND HABITAT PATTERN ON THE PREVALENCE OF GASTROINTESTINAL HELMINTH PARASITES IN GOATS (TABLE-5 AND 6) :

Foregoing discussions further revealed as per the anlaysed data depicted in Table- 5 and 6, that out of total 380 faecal samples and 90 gastrointestinal tracts 79.73 and 91.11% respectively goats found positive for various gastrointestinal infection. Parasitic gastroenteritis greatly influenced by variation of seasons as nearly 89.88 to 100% respective samples were found positive in monsoon season because hot and humid tropical climate always supposed to be very favourable for development, survival and transmission of preparasitic stages of nematodes, cestodes and trematodes. However, infective larvae, development stages, intermediate host and metacestodes always remain available in the pasture throughout the year which also reflects in the present finding as 78.81 to 88.88% infection rate observed in winter and 62.76 to 80% in summer season. Corresponding to current findings Etana- Debela (2002) also reported maximum egg out put in

big rainy season followed by short rainy season. Similarly Bhojane *et al.* (2002) found impact of season to be significant on G.I. parasitism. Further Prasad and Singh (1982), Ahmad and Ansari (1987), Mollah (1996), Katoch *et al.* (2000), Barry *et al.* (2002) and Achi *et al.* (2003), also noted peak prevalence of G.I. helminthosis in rainy season, Specht (1982) and Rehman and Ali (2001) ALSO observed high frequency of helminths and heavy egg load during rainy season, Ansari and Singh (1981) recorded maximum incidence in post monsoon followed by winter which is also confirmed the finding of present study. But El-Azazy (1990) observed non-significant difference in intensity of infection between four seasons. Vice-versa La *et al.* (2003) recorded peak epg count in dry season followed by rainy season. Similar to previous reports, Alam *et al.* (1996) and Maqbool *et al.* (1997) noted maximum incidence during summer season followed by monsoon season in Bangladesh and Pakistan respectively. However, Gupta *et al.* (1987) demonstrated peak prevalence of various gastrointestinal nematodes in different seasons.

The infection rate of gastrointestinal helminths in goats found non-significant in both faecal samples and gastrointestinal tracts examination, while occurrence was slightly higher in female population. Barry *et al.* (2002) also suggested that lactating female goats possess heavy egg load and worm burden due to hypobiosis. Confirmation to present finding Etana-Debela (2002) also demonstrated that female

harboured higher relative density of nematodes than male. However, Bhojane *et al.* (2002) described significant effect of sex on G.I. parasitosis in their report.

The effect of different age groups had significant influence on the prevalence of G.I. helminthosis both during faecal samples and G.I. tracts examinations. The statistical analysis further revealed that rate of incidence decreases with the advancement of age. In present finding maximum rate of occurrence was noted in goats aged below one year followed by 1-2 years than 2 years and above. The results were in accordance with the findings of Achi *et al.* (2003) who observed maximum parasitic burden in population of goats aged less than one year. The infection rate in present studies were similar to the reports of Etana-Debela (2002) as he recorded higher density of worm burden in young hosts as compared to adult ones. However, Barry *et al.* (2002) reported lesser rate of incidence iin animals aged below 30 months.

Examiination of faecal samples and gastrointestinal tracts of goats showed that incidence of G.I. parasitism significantly influenced by managemental strategies during faecal sample examiatiion, whereas it was found non-significant in later case. Probaibly pasture land for free ranged and semi-intensive system of amiimal rearing plays an important role for increasing the frequency of incidence basically most of the animal farming done on thee agricultural land and it is compulsion to allow grazing along with stall feeding. Probability of reinfection by

parasites in this pattern increased in many folds. Frequent contacts between parasites and host often change in the parasite ecological behaviour for its survival. Repeated grazing in same pasture, faecal output further increase the chances of infection.

Arora *et al.* (2003) studied that under semi-intensive pattern of goats farming nematodiosis was more prevalent. Tchoumboue *et al.* (2000) recorded the significant role of management pattern for the incidence of parasites in the goats farming. La *et al.* (2003) noticed grazing area considerably influenced the gastrointestinal nematodiosis in goats. Saithanoo *et al.* (1996) observed that goat farming in small scale structure in villages mainly affected by impact of gastrointestinal parasitism.

Similar to findings of the present investigation, Khan *et al.* (1996) observed almost 100% of grazing goats harboured light to medium levels of parasitic infection. Alam *et al.* (1996) suggested that prevalence of parasites increases by continuous grazing in same field and control of parasites can be done by grazing management in discriminate areas.

PREVALENCE OF DIFFERENT SPECIES OF HELMINTHS IN SHEEP THROUGH EXAMINATION OF FAECAL SAMPLES AND GASTROINTESTINAL TRACTS :

A total of 200 faecal samples and 22 intestinal scrapings of sheep were examined (Table – 3 and 4). Among them *Haemonchus* spp. (90 and 92.13%) was predominant in

respective samples followed by *Trichostrongylus* spp. (80 to 84.26%). Other common nematodal infection were trichuriosis (19.10%), strongyloidiosis (15.16%) and oesophagostomosis (15.16%) (Table- 7 and 8) were accounted only during faecal sample observation, whereas 75% intestinal scraping were harbouring *Trichuris* spp. in sheep. Various workers in India and abroad have reported higher incidence of haemonchosis in sheep. Gatongi *et al.* (1998) and Katoch *et al.* (1999) observed 90 and 97% haemonchosis respectively in population of sheep in Kenya and Himachal Pradesh (India) respectively. Present findings are in close agreement with reports of Nicolas *et al.* (1985), Njau (1987) and Katoch *et al.* (1999) as they also detected *Haemonchus contortus*, *Strongyloides* spp., *Trichostrongylus* spp., *Trichuris* spp. and *Oesophagostomum* spp. in their studies. Similarly Sani *et al.* (1986) and Papadopoulos *et al.* (2003) found *Haemonchus* spp., *Trichostrongylus* spp., *Oesophagostomum* spp., *Trichuris* spp. as predominant nematode species in sheep population of West Malaysia and Greece respectively. However, *Cooperia*, *Teladorsagia* and *Chabertia* were also recorded in their findings. Similar finding also reported by Dhanalakshmi *et al.* (2001) in Karnataka as they recorded *Haemonchus* spp., *Oesophagostomum* spp. and *Trichostrongylus* spp. along with *Cooperia* spp. and *Nematodirus* spp. as common strongyle species. Present findings also in accordance with the reports of Tchoumboue *et al.* (2000) and Yildiz and Aydenizoz (2001)

during examination of faecal samples and G.I. tract respectively in Cameroon and Turkey.

Alike nematodal fauna was also recorded by Morales *et al.* (2001) and Achi *et al.* (2003) in sheep population of Venezuela and France respectively as *Haemonchus, Trichostrongylus, Cooperia, Trichuris, Oesophagostomum, Strongyloides* spp. were commonly accounted during gastrointestinal tract examination. However, Chaudhri *et al.* (2000) and Tsotetsi and Mbati (2003) recorded only *Haemonchus* spp. and *Oesophagostomum* spp. as prevalent nematodes of sheep population of Haryana (India) and South Africa respectively. Pandit *et al.* (2003) and Nasreen *et al.* (2005) noted various species of *Strongyloides, Trichuris, Haemonchus, Nematodirus, Marshallgia, Bunostomum* and *Chabertia* as prevalent nematodes of Kashmir valley. Present finding also in accordance with the reports of Ansari and Singh (1981), Chopra (1985), Gupta *et al.* (1987), Singh *et al.* (2005) who recovered *H. contortus* as most prevalent strongyle infection along with other nematodes in sheep population of Bareilly, Lucknow, Haryana and Ludhiana respectively. Considering to our neighbouring countries Khan *et al.* (1996) and Mostofa *et al.* (1996) reported *Haemonchus, Trichostrongylus, Ostertagia, Nematodirus, Trichuris* were prevalent nematodes of sheep of Pakistan and Bangladesh respectively, this finding also simulate with the present results.

The present findings are also in accordance with the reports of Biggs and Anthonissen (1982), Specht (1982), Okafor (1987), Al-Hadethi and Al-saffar (1988) and El-Azazy (1990) in respect to the description given about prevalent nematodes of sheep population in Namibia, Mozambique Nigeria, Iraq and Egypt, respectively.

It can be suggested on the basis of present study and earlier investigation reports that a wide range of nematodal parasites at single or mixed infection are prevalent in the world wide population of sheep. The problem of sheep nematodiosis and pasture contamination is ubiquitous.

The occurrence of cestodes ova was less common during faecal sample examination and 1.12%, 2.24% and 1.12% samples found positive for *Stilesia hepatica*, *Moniezia expansa* and *M. benedeni* respectively while only *Moniezia expansa* (5%) detected during G.I. tract examination. Prevalence of cestodes in sheep have been well documented and present report is in accordance with the finding of Singh *et al.* (2005) who detected eggs of *Moniezia* during faecal sample examination of sheep in Ludhiana. The communications of Specht (1982) and Sani *et al.* (1986) reveal the prevalence of *M. benedeni* and *M. expansa* in gastrointestinal tract of sheep in Mozambique and Malaysia respectively, are alike to present study. However, Chaudhri *et al.* (2000) and Achi *et al.* (2003), observed incidence of *M. benedeni*, *M. expansa*, *Stilesia*, *Avitellina*, *Thysaniezia* and *Cysticercus tennuicollis* in sheep flocks of Haryana and France

respectively which also partially fulfill the present findings. Biggs and Anthonissen (1982) also recorded eggs of *Moniezia* spp. in sheep of Namibia.

The fluke recovery was 5% (*Fasciola* spp.) and 55% (*Cotylophoron cotylophorum*) in bile duct and rumen areas respectively in G.I. tracts of Sheep. Ova of *Fasciola* spp. (8.98%) and *Cotylophoron* spp. (11.23%) were detected through faecal samples examination. Present result corroborates with the finding of Al-Hadethi and Al-Saffar (1988). Supporting observation also reported by Singh *et al.* (2005) in Ludhiana, *Paramphistome* was the most prevalent rumen parasites of sheep. Similarly Mostofa *et al.* (1996) recorded that 12-15% population of sheep harbouring infection of fasciolosis in Bangladesh. Yildiz and Aydenizoz (2001) and Achi *et al.* (2003) recorded *Fasciola* spp. and *Dicrocoelium* spp. as the common infection of liver and bile ducts of sheep. Present result highly corresponds with reports of Chaudhri *et al.* (2000) who detected *Fasciola* and *Paramphistome* spp. in sheep of Haryana. Khan *et al.* (1996) also recorded prevalence of *Fasciola* spp. in sheep of Pakistan.

PREVALENCE OF DIFFERENT SPECIES OF HELMINTHS IN GOATS THROUGH EXAMINATION OF FAECAL SAMPLES AND GASTROINTESTINAL TRACTS :

The rate of infection of different species of helminth parasites in goats through examination of faecal samples (380) and gastrointestinal tracts (90) has been presented in Table-9

and 10. The present study revealed that the most prevalent parasite was *Haemonchus* spp. (84.14 to 89.76%) followed by *Trichostrongylus* spp. (67.07 to 84.81%). The other prevalent nematodes were *Trichuris* spp. (12.21%), *Strongyloides* spp. (62.04%), *Oesophagostomum* spp. (49.17%) and *Bunostomum* spp. (3.96%) observed during faecal samples examination. However, 35.36 and 18.29% intestinal scrapings were positive for *Trichuris* spp. and *Nematodirus* spp. respectively in goats. Higher prevalence of *Haemonchus* spp. in goats has been reported by various workers in the country and abroad. Boubas and Theodoridis (2000), Rajapakse *et al.* (2000), Barry *et al.* (2002) and Achi *et al.* (2003) observed 85.38, 81, 94 and 82% haemonchosis in local goat population in Greece, Sri-Lanka, Central Guinea and Cote d'Ivoire respectively along with *Trichostrongylus colubriformis, Oesophagostomum* spp., *T. axei, Cooperia* spp., *Trichuris ovis, Gaigeria pachyscelis, Strongyloides papillosus, Gongylonema* spp. *Teladorsagia* spp., *Nematodirus* spp., *Bunostomum* spp. and *Chabertia ovina* were also recorded. Similar finding also reported by Gupta *et al.* (1987) in Haryana as they recorded *Haemonchus* spp. and *Trichostrongylus* spp. were predominated throughout the observation period and accounted for >80% of total worm burden, apart from *Bunostomum trigonocephalum, Gaigeria* spp., *Oesophagostomum* and *Trichuris* spp. Present finding also corroborates with the respects of Njau (1987) and Katoch *et al.* (2000) as they detected *Haemonchus* spp., *Oesophagostomum*

spp., *Trichostrongylus* spp., *Trichuris* spp. and *Strongyloides* spp. as predominant nematode species in goats population of Tanzania and Mathura region (India) respectively. The findings of the present study are also simulates with the reports of Craig (1986), Saithanoo *et al.* (1996), Alam *et al.* (1996) and Mostofa *et al.* (1996), who recovered *Haemonchus contortus* as most prevalent strongyles in goats population of Southern USA, Thailand, Pakistan and Bangladesh respectively. Alike nematodal fauna was also recorded by Tchoumboue *et al.* (2000) and Etana-Debela (2002), La *et al.* (2003) in goats population of Cameroon, Ethiopia and Cuba respectively as *Haemonchus* spp., *Trichostrongylus* spp., *Oesophagostomum* spp., *Strongyloides* spp. and *Bunostomum* spp. were commonly observed during their studies. The results of the present study also in accordance with the reports of Okafor (1987). Similarly Chaudhri *et al.* (2000) and Bhojane *et al.* (2002) found *Haemonchus* spp., *Trichostrongylus* spp. and *Oesophagostomum* spp. as prevalent nematodes in goats population of Haryana and Nagpur respectively. Tsotetsi and Mbati (2003) also observed *Haemonchus* spp. and *Oesophagostomum* spp. as the predominant nematodes which simulate with the findings of the present investigation. The present findings are also in accordance with reports of Ansari and Singh (1981), El-Azazy (1990), Khan *et al.* (1996) and Papadopoulos *et al.* (2003) in respect to description given

about prevalent nematodes of goats population in Bareilly (India), Egypt, Pakistan and Greece respectively.

Among cestodes, *Moniezia expansa* (1.98%), *Moniezia benedeni* (1.98%) were found during faecal samples examination, however, only *Moniezia expansa* (1.12%) detected through gastrointestinal tracts examination. Prevalence of cestodes in goats have been well documented and present report has close resemblance with finding of Etana-Debela (2002) as *Moniezia expansa* eggs were detected during faecal samples examination of goats in Ethiopia. Present findings are in close agreement with Specht *et al.* (1982) who also detected *Moniezia* spp. during faecal samples examination of goats in South Mozambique. However, Chaudhri *et al.* (2000) found incidence of *Moniezia* spp., *Thysaniezia giardi, Avitellina* spp., *Stilesia* spp., *Anoplocephala* spp. in local population of goats of Haryana which also supports the present finding. Barry *et al.* (2002) also recorded worm of *Moniezia* spp. and *Taenia hydatigena* during gastrointestinal tracts examination of goats in Central Guinea.

Observation on occurrence of trematodes, *Fasciola* spp. and *Cotylophoron* spp. were prevalent during faecal samples examination. However, *Fasciola* spp. (10.97%) and *Cotylophoron* spp. (47.56%) were detected through gastrointestinal tracts examination. The present finding are in close agreement with the reports of Chaudhri *et al.* (2000) and Bhojane *et al.* (2002) as they found high prevalence of *Fasciola*

and *Paramphistome* spp. in local goats population of Haryana and Nagpur respectively. Considering to our neighbouring countries Khan *et al.* (1996), Alam *et al.* (1996) and Mostofa *et al.* (1996) also reported *Fasciola* spp. was the prevalent trematode of goats in both Pakistan and Bangladesh. Present results corroborates with the findings of Specht (1982) and Barry *et al.* (2002) as they observed paramphistomosis was the most prevalent infection of goats in South Mozambique and Central Guinea respectively.

INCIDENCE OF *HAEMONCHUS* SPP. IN SHEEP :

Haemonchosis is considered to be one of the major causes of impaired productivity in small ruminants resulting in heavy economic losses to animal husbandry. Though information is available on the prevalence of haemonchosis in sheep and goats in different parts of India and abroad but reports are not available on the prevalence of *Haemonchus* spp. in local population of sheep and goats in Bihar. The present study therefore, conducted to record the prevalence of *Haemonchus* spp. and factors influencing its occurrence in indigenous sheep and goats maintained in Patna and its surrounding areas through faecal samples and intestinal scraping, examination.

The overall incidence of *Haemonchus* spp. infection in local population of sheep was 82% through faecal samples examination and 81.81% through observation of gastrointestinal tracts examination (Table-11 and 12). The

findings of the present study is in agreement with the observation of Gupta *et al.* (1987) and Achi *et al.* (2003) as they identified more than 80% and 66% population of sheep were found infective with this wire worm in Haryana (India) and France respectively. Lindqvist *et al.* (2001) surveyed 37% haemonchosis in Sweedish sheep population. Gatongi *et al.* (1998) investigated hypobiotic *Haemonchus contortus* in 90% naturally infected sheep in semi-arid area of Kenya.

Farhat *et al.* (2000) recorded over all 54.77% of haemonchosis in sheep in an epidemiological survey in Punjab, Pakistan. Prevalence of haemonchosis in Jaba sheep farm was only 38% as observed by Tariq *et al.* (2003). The present findings are also alike with the reports of the Chopra (1985) who observed 89.23% of haemonchosis in sheep of Lucknow (India). Incidence and abundence of *Haemonchus contortus* in killed sheep was found to be 69.6%, by Juarez and Quiroz (1972) in Mexico city abattoir.

Seasonal distribution of *Haemonchus* parasite showed the prevalence was significantly higher in monsoon season (96.87 to 100%) and lowest (40 to 50%) in summer. The frequency of prevalence in winter season was also higher, 89.83 to 85.71% samples found positive during faecal samples and gastrointestinal tracts examination. Heavy rain fall and high relative humidity lowers the resistance of animals and favours the propagation and development of larval stages. Further higher incidence in winter season observed in present study

could be attributed to onset of hypobiotic larvae and post parturient rise. The pattern of seasonal incidence corroborates with the findings of Chopra (1985), Gupta *et al.* (1987), Fakae (1990) and Swarnkar *et al.* (1997). However, Gatongi *et al.* (1998) observed high prevalence of hypobiotic larvae in dry months than wet months where as Alam *et al.* (1996) observed higher prevalence of haemonchosis during summer and monsoon, both of these finding also partially alike the present finding. The observations of present investigation are also in line of finding recorded by Nicolas *et al.* (1985) as 50% of haemonchosis observed between June to December in France. Farhat *et al.* (2000) also noted highest prevalence in July and August and lowest in February and March in sheep flocks of Punjab, (Pakistan). However, Asanji (1988) noted peak prevalence of haemonchosis in dry months (October to January) and lower between March to May. Whereas, Juarez and Quiroz (1972), observed peak incidence of haemonchosis between May to August and similarly Biggs and Anthonissen (1982) recorded peak prevalence of haemonchosis between March to early July.

Present study indicated that influence of sex was non-significant, however, impact of haemonchosis observed more in female sheep. Mazhar *et al.* (1996) also found higher prevalence of haemonchosis in female as compared to male. Javed *et al.* (1992) also recorded G.I. nematodiosis higher in ewes than rams. Juarez and Quiroz (1972) analysed that sex

ratio on prevalence of haemonchosis was higher in female as compared to male. The present finding also simulate with reports of Asanji (1988) who observed slightly higher prevalence of haemonchosis in female than male.

Several factors that have been reported to the influence the course of *Haemonchus* spp. infection, out of them impact of age was found non-significant both in case of faecal samples and intestinal scrapings examination in present investigation. Bhatia *et al.* (2006) demonstrated that acute form of haemonchosis occurs in animals of all ages harbouring 1000-10000 worms. However, in present study the frequency of haemonchosis was higher in lower age group (0-12 months) followed by sheep aged between 1-2 year. Occurrence of haemonchosis ranged between 66.66% to 72.5% in sheep aged above 2 years during faecal samples and gastrointestinal tracts examination. Similar finding has been reported by Tariq *et al.* (2003) as observed maximum prevalence of this abomasal nematode in sheep aged below 1 year than over 1 year. Present finding also corresponds with the reports of Asanji (1988) and Mazhar *et al.* (1996) as higher prevalence was observed in young flocks than old animals.

The pattern of habitat had non-significant influence on the prevalence of haemonchosis under semi-intensive and free range system. However, higher prevalence accounted in free ranged sheep flocks. Incidence of parasitism and chronicity or acuteness of disease related with common water sources,

pasture of grazing, non practice of anthelmintics, poor hygiene of stocking places for grazing and migratory sheep flocks, whereas, stocking density of sheep population in semi-intensive management induces chances of contamination for rest healthy sheep stocks which might facilitate the higher incidence of parasitism. Singla (1995), however suggested that degree of parasitism or worm burden greatly depend on the managemental and hygienic conditions of the area. Thangathurai *et al.* (2003) reported higher prevalence rate due to improper management enteric parasitism in sheep. Present finding in agreement with the reports of Pandit *et al.* (2003) who observed higher incidence of haemonchosis in sheep managed in field as compared to farm sheep flocks and findings are also in accordance with the reports of Kumar *et al.* (2006) who noted higher prevalence in free grazing migratory sheep whereas Lloyd (1994) observed higher incidence rate in stock sheep flocks.

INCIDENCE OF *HAEMONCHUS* SPP. IN GOATS :

Goat rearing is mainly confined to the small holder farming system which plays a vital role as source of protein (meat and milk) and the tool of poverty eleviation in Bihar. A total of 380 faecal samples and 90 gastrointestinal tracts were collected from Patna and its surrounding areas and accordingly effect of season, sex, age and habitat pattern on the occurrence of stomach worm was studied during one year period for April, 2006 to March, 2007 (Table-13 and 14). The

season wise infection rate of *H. contortus* in goats was recorded maximum in monsoon followed by winter season, however, the prevalence was least noted in summer season both during faecal sample and G.I. tract examination. The climatic variation depending upon season had significant impact on prevalence of haemonchosis in goats. Similar findings were reported by Shahiduzzaman *et al.* (2003) and Garg *et al.* (2003) who recorded higher incidence of *Haemonchus contortus* in rainy and winter and lower in summer season. The higher incidence of infection in rainy and winter seasons has been related with survival, embryonation, transmission of parasitic ova and its pre-infective larval stages and subsequent development to infective stages in pasture because of high ambient temperature and moisture content. Moreover, the hypobiotic phenomenon of larval development in the host body because of conducive environment in winter (as it happens in tropical country) may also play important role. Identical findings were also reported by Gupta *et al.* (1987), Fakae (1990) and Katoch *et al.* (2000). Whereas Saithanoo *et al.* (1996) observed infection rate of haemonchosis was common in goats throughout the year. Unlike to the findings of present study, Maqbool *et al.* (1997) and Rizvi *et al.* (1999) recorded maximum incidence of haemonchosis in goats in spring season followed by winter, summer and autumn both in live animal as well as in slaughtered goats. However, Asanji (1988) and

Gatongi *et al.* (1998) reported higher incidence of hypobiotic larvae in dry months than in wet season.

Results further revealed that the effect of sex had non-significant effect on prevalence of haemonchosis in the present study. However, it was recorded that females were dominant in harbouring this parasitic infestation over males. Shahiduzzaman *et al.* (2003) also recorded significantly higher prevalence of haemonchosis in females as compared to males and suggested that females are in stress during the pregnancy and lactation which provides chances for establishment of infection by the parasites (Soulsby, 1982, Urquhart *et al.*, 1996). Since females need more nutrients for the nourishment of their kids, susceptibility towards acquisition of infective larvae than the bucks. Javed *et al.* (1992), Mazhar *et al.* (1996) also reported non-significant difference on the prevalence of haemonchosis between female and male, while all the above three mentioned workers including Asanji (1988) recorded slightly higher prevalence of *Haemonchus* parasite in females than males.

The influence of age on the occurrence of *Haemonchus contortus* was found to be significant ($P<0.01$) in faecal samples and (Non-significant) G.I. tracts examination, however, infection rate of *Haemonchus* spp. was maximum in kids aged upto one year in both the cases followed by age group between 1-2 years and minimum was recorded in adult goats aged 2 years and above. Present finding corroborates with the reports

of Asanji (1988), Mazhar *et al.* (1996) and Rizvi *et al.* (1999) as density of infection were slightly higher in young host and were low in old host which might be attributed that host immunity increases with the advancement of age.

Rate of incidence of haemonchosis in goats was almost common both in semi-intensive and free ranged condition was almost similar as non-significant influences of managemental pattern observed both during faecal samples and gastrointestinal tracts examination.

Arora *et al.* (2003) reported that under semi-intensive pattern of goat farming, haemonchosis was more prevalent. However, Tchoumboue *et al.* (2000) recorded significant role of various management pattern for the incidence of parasite in the goats farming. La *et al.* (2003) noticed grazing area considerebally influences haemonchosis in goats. Saithanoo *et al.* (1996) observed that goats farming in small scale structure in villages mainly affected by impact of gastrointestinal parasitism.

Similar to present finding, Khan *et al.* (1996) observed almost 100% of grazing goats harbour light to medium levels of simple or mix parasitic infection.

HAEMATOLOGICAL CHANGES IN SHEEP DURING HAEMONCHOSIS :

Author has already been discussed that haemonchosis is the most common and serious endoparasitic infestation of sheep throughout the world. *Haemonchus* species is voracious

blood suckers and disease is often characterized clinically by anaemia, hypoproteinemia, emaciation, oedema and digestive disturbances. Hence, the present study was conducted to find out pathological implications in sheep naturally infested with *Haemonchus* spp. In present study alteration of blood haematological profiles under diseased condition were compared with healthy animals to carry out significant characteristic features and alteration of blood haematological profiles during natural infestation of haemonchosis in sheep (Table-15 and 16). From the table it is clearly visualised that there was significant ($P<0.05$) decline in mean haematological parameters, viz., Hb%, PCV%, TEC and lymphocyte% of infected sheep in comparison to the mean values of healthy control group. Whereas, there was significant ($P<0.05$) increase in ESR, TLC, neutrophil and eosinophil counts of infested sheep than healthy control. However, value of monocyte % was slightly higher in infected group of sheep but the difference was found statistically non-significant. The present findings are in agreement with the findings of Ghulam *et al.* (1995) who observed association of haematological disturbances with haemonchosis where there was significant decrease in TEC, PCV, Hb% and lymphocyte counts and significant increase in the values were observed in ESR, TLC, neutrophils and eosinophils. Further, estimates of basophil and monocyte percentage remained constant with advancement in severity of infection. Khan *et al.* (1988), found that the degree of anaemia

positively correlated with acuteness of haemonchosis. Ahmad and Ansari (1989) also observed depletion in RBC counts in sheep infected with haemonchosis alongwith marked decrease in the pack cell volume and haemoglobin during heavy worm burden, however, changes in WBC counts were inconsistent and showed tendency to decrease. Bennett (1983) identified the important cause of anaemia in sheep is haemonchosis. Albers and Lejambre (1983) found reflection of anaemia with a significant decrease in PCV during haemonchosis. Bezubik *et al.* (1980) observed decrease in the haemoglobin and haematocrit levels, where as percentages of the different kinds of leucocytes in infected animals did not significantly differ from those in uninfected controls, which partially fulfill the present finding. Barowicz and Petryszak (1970) and Grzebla *et al.* (1978) documented similar finding in sheep infested with gastrointestinal nematodes. Anosa (1977) suggested that severe anaemia was associated with high reticulocyte response in dams infected naturally with *Haemonchus* spp. Dargie *et al.* (1974) and Albers *et al.* (1990) also reviewed that anaemia, dramatic fall in PCV, deficiency of normal serum iron concentration and increased in erythrocyte potassium levels, which are directly attributable to the blood sucking activities of 5th stage larvae, young and adult parasites and also to a delay in host erythropoitic response. Marked differences in the percentages of eosinophil, low PCV and insignificant changes in TLC, lymphocytes and neutrophils values were observed by

Moskwa *et al.* (1998) during predominant natural infection of *Haemonchus contortus*. Resembling with the present findings Barger and Dash (1987), Woolaston *et al.* (1996), Moskwa *et al.* (1999), Swarnkar *et al.* (2000) and Vanimisetti *et al.* (2004) reported negative correlation of PCV with worm and egg burden and level of circulating eosinophils were high during haemonchosis in sheep. Hayat *et al.* (1996) also confirmed the present findings as they found effective reduction in TEC, Hb% and PCV values and increased in ESR level. Watson *et al.* (1995) also concluded that total eosinophils and white cell counts significantly increases in lambs challenged with eggs of *Haemonchus contortus*. Abbott *et al.* (1984) demonstrated that a low level of infection with *H. contortus* in lambs on a poor plane of nutrition caused the development of a normochromic normocytic anaemia which was associated with a modest but significant increase in abomasal blood loss and slightly delayed erythropoiesis. Similar findings were recorded by Falca *et al.* (1987) in lambs infected with gastrointestinal parasites associated with fall in Hb% and erythrocyte concentration. Anaemia was usually normocytic, normochromic in acute cases, and microcytic and hypochromic in chronic cases. The findings of the present study also simulate with reports of Padmaja *et al.* (2006) as they observed decrease level of TEC, Hb and PCV, however, TLC, eosinophils and neutrophils counts were recorded increased during endoparasitic infestation in sheep of Hydrabad (India).

HAEMATOLOGICAL CHANGES IN GOATS DURING HAEMONCHOSIS :

Variation in the blood picture of the goats suffering from haemonchosis has been presented in Tables-17 and 18. Haematological examination of goats suffering from haemonchosis revealed significant decrease in haemoglobin percentages, packed cell volume, total erythrocyte counts, whereas significant increase were observed in the values of erythrocytes sedimentation rate and leucocytes. Infection with *Haemonchus* parasites further caused lymphopenia, neutrophilia, eosinophilia as significant differences in comparison to control group. However, slight monocytosis also observed during haemonchosis in goats but this changes was non-significant. The results on haematological observations showed similar trend as per variation of haematology in sheep during haemonchosis. Present findings are in close resemblance with the reports of Sharma *et al.* (2000), Rajguru *et al.* (2002) and Lakra *et al.* (2007) who also studied significant decline in Hb%, PCV% and TEC in experimental haemonchosis in Barbari goats of Mathura (India). The findings of Ahmad and Ansari (1989) corroborate with the results of present investigation as depletion in RBC counts, TEC and Hb values was marked during experimental haemonchosis in goats of Aligarh (India). Gretillat (1976) also observed severe neutrophilia, lymphopenia, monocytosis along with anaemia during gastrointestinal parasitism in Maradi

goats of Nigeria. Costa *et al.* (2000) reported the epg rise concided with the drop in Hb% and PCV%. Bennett *et al.* (1983) also identified haemonchosis is one of the important causes of anaemia. Arora *et al.* (2003) found negative corelation between epg and haemoglobin and positive correlation between epg and TLC during experimental haemonchosis. Further they observed decrease in TEC only when epg was higher than 1200 eggs. Eosinophil counts initially found to be decreased then gradually increased. However, the results of the present study disagree with the reports of Paranagama *et al.* (1997) as no correlation observed between worm burden and haematology during haemonchosis in goats.

BIOCHEMICAL CHANGES IN SHEEP AND GOATS DURING HAEMONCHOSIS :

Biochemical changes due to *Haemonchus contortus* infection were studied in five sheep and five goats and compared with similar number of healthy animals (Table-19 and 20). There were considerable and significant changes in blood glucose, total serum protein, serum bilirubin, SGOT and SGPT levels during haemonchosis in both sheep and goats under natural infestation of *Haemonchus* spp. Arora *et al.* (2003) suggested that recurring losses in productivity are due to the wide prevalence of parasitic infection is a common problem. Helminthic infection of gastrointestinal tract, particularly with *Haemonchus contortus* is the major cause of

wasting and decreased productivity through loss of blood and plasma proteins in gastrointestinal tract, alteration in protein metabolism and decreased activity of certain enzymes because magnitude of infection is responsible for drastic changes in blood constituent.

Reduction in food intake and reduced absorption through injured gut might be responsible for fall in blood glucose level in the present study. Hypoglycemia during haemonchosis in small ruminants confirms the reports of Arora *et al.* (2001) and Rajguru *et al.* (2002) due to rapid consumption of sugar by parasites when they develop and exhaustion of the glycogen reserves of the body may be responsible for decreased blood sugar level. However, contradictory to present finding, Brar *et al.* (1991) observed increase in blood sugar during haemonchosis.

In the present study the decline in total serum protein level was significant both in case of sheep and goat during natural *Haemonchus* spp. infection. Brar *et al.* (1991) also observed decrease in total serum protein in clinical haemonchosis in sheep of Ludhiana (India). Abdel-Salam and Mahran (2004) reported hypoproteinemia in nematode infested goats. Nwaogu (1998) recorded higher total serum protein, albumin and gamma globulin in yearlings than lambs which is dissimilar to present observations. Rajguru *et al.* (2002) also observed significant decrease in total serum protein level in parasitized goat with nematodes. Arora *et al.* (2001) reported

fall in total protein and resulted hypoproteinemia in clinical cases of bursate worm infection in sheep and goats. While Paranagama *et al.* (1997) demonstrated that worm burden was not correlated with total protein level. However, Bennett (1983), Abbott *et al.* (1984), Padmaja *et al.* (2006) and Lakra *et al.* (2007) attributed hypoproteinemia during endoparasitic infestation in sheep and goats.

Changes in the level of serum enzymes viz., serum glutamate oxaloacetate transaminase, serum glutamate pyruvate transaminase and bilirubin during haemonchosis in sheep and goats were significantly increased during haemonchosis in sheep and goats. It may be attributed that infestation of parasites usually creat necrosis in the abomasal area during their blood sucking activity and may be responsible for release of some toxin due to degeneration and necrosis of cells. The effect of toxaemia may be possible reason for disfunction of liver cells. Sharma *et al.* (2001) also analysed significant increase in SGOT and SGPT in Barbari goats during haemonchosis. However, level of both enzymes were noted to be decreased during acute haemonchosis in sheep recorded by Brar *et al.* (1991).

HISTOPATHOLOGICAL CHANGES IN SHEEP AND GOATS DURING HAEMONCHOSIS :

Gross and histopathological observation were made in present study of abomasal tissues of sheep and goats naturally infected with *Haemonchus* spp. Gross changes revealed

brownish abomasal fluid filled with numerous worms along with various necrotic haemorrhagic spots at the attachment sites of the worm in abomasal mucosa. All these observations are in agreement with the reports of Al-Zubaidy *et al.* (1987), Shwakat *et al.* (1994), Marin (2002) and Bhatia *et al.* (2006).

The cellular changes in the abomasal mucosa showed degeneration and necrosis in epithelial lining, infiltration of mucosa with eosinophils and lymphoid cells along with generalized hyperplasia. The general changes in abomasum were hypersensitive type similar changes were described by Akulin *et al.* (1984) and Perez *et al.* (2001) who also observed massive proliferation of lymphoid cells and marked increase in the secretion of mucous cells together with abundant infiltration of eosinophils and lymphocytes. Accordance to present findings Salman and Duncan (1985), Perez *et al.* (2003) described hyperplasia in abomasal lymphnode and hypersensitive changes in abomasums. Nicholls (1988) revealed identical structural changes and degeneration in mucous cells in abomasums of infected lambs with nematodes. Blanchard *et al.* (1986) also recorded roughened abomasal mucosa in lambs during infectivity of *H. contortus*. Chermette (1982) investigated the pathogenesis of digestive disorders due to *H. contortus* mostly by penetration of larvae into abomasal mucosa, this also signifies the findings of the present study. Infiltration of eosinophils and neutrophils was also characterized during haemonchosis in goats by Rahman and

Collins (1991). Simulating to present observation Abd-Rabo *et al.* (1993), Singh *et al.* (1998), Scott *et al.* (1999) and Balic *et al.* (2000) reported almost alike findings during histology of abomasums of infected sheep and goats with haemonchosis.

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CHAPTER - VI

SUMMARY AND CONCLUSION

SUMMARY AND CONCLUSION

SUMMARY

High incidence of gastrointestinal parasitic infections is associated with semi-intensive and free ranged rearing of sheep and goats under conditions of over crowding, poor sanitation, contaminated pasture, food and feed sources. Haemonchosis is generally considered to be the most common cause of anaemia, odema and death in small ruminants.

In Bihar, sheep rearing is in very immature stage and mostly done by some migratory community and goats rearing is considered as symbol of poverty in local population. The masses of people who keep sheep or goats belong to weaker section of society. Illiteracy and lack of knowledge regarding animal nutrition, anthelminthic administration and unhealthy practices of management, increase the chances and susceptibility towards G.I. helminthosis in several folds.

Very few systematic studies on the incidence of gastro intestinal helminthosis in small ruminants has actually been carried out in Bihar. Therefore, this preliminary investigation on **"Helminthic infections of gastrointestinal tract of sheep and goat in and around Patna district"** was carried out to evaluate unacceptable high level of productive losses in respect to

helminthic infections. Emphasis was given to occurrence of haemonchosis and various haematological, biochemical and histopathological changes observed during natural infection of *Haemonchus* spp.

The study on epidemiology of G.I. helminth parasites in sheep and goats was carried out by screering of 200 faecal samples and 22 gastrointestinal tracts of sheep while 380 and 90 respective samples examined from local population of goats in Patna and its surrounding areas. The incidence of various gastrointestinal helminths were found to be ranged from 89 to 90.9% in sheep, whereas it ranged from 79.73 to 91.11% in goats during both the samples examination.

It was observed that through faecal samples and intestinal scrapings examination, the incidence of G.I. helminth infections in sheep was found to be the highest (96.87 and 100%) in monsoon season followed by winter (93.22 and 85.71%) and the lowest (66.67 and 83.33%) during summer season. Similar trend of influence on seasonal distribution was also observed in goats and frequency was maximum (89.88 and 100%) in monsoon followed by winter (78.81 and 88.88%) and summer (62.76 and 80%) seasons in respective samples examination of goats.

On the basis of chi-square test it was revealed that impact of sex was non-significant on the prevalence of various G.I.

helminths both in sheep and goats but prevalence of infestation was more in females in comparison to males.

Studies further revealed that frequency of infection decreased with the advancement of age both in sheep and goats. Through examination of faecal samples and intestinal scrapings, 95.16 to 100% population of sheep aged below 1 year were found to be host of harbouring various G.I. parasites. The corresponding values in goats below 1 year was 85.18 to 97.67%. The infection rate was 92.85 to 100% in sheep aged between 1 to 2 year, while it ranged from 80.37 to 92.85% in similar age group of goats. The frequency of incidence ranged minimum in sheep (66.66 to 70.00%) and goats (70.11 to 73.68%) aged above two years.

Incidence of gastrointestinal helminthic parasites usually non-significantly influenced by rearing practices of sheep and goats during various studies except faecal samples examination in goats. But major frequency of parasitism always associated with population of sheep (75.65 to 92.30%) and goats (86.34 to 94.23%)) managed under free range system as compared to those sheep ((67.05 to 88.88%) and goats (72.00 to 86.84%) managed under semi-intensive rearing system.

A total of 10 different parasites were identified during faecal samples and G.I. tracts examination of sheep. The frequency of incidence of nematodes was maximum for *Haemonchus* spp.

(92.13 and 90%) and was the predominant parasite followed by *Trichostrongylus* spp. (84.26 and 80%), *Trichuris* spp. (19.10 and 75%), whereas *Moniezia expansa* (2.24 and 5%), *Cotylophoron* spp. (11.23 and 55%) and *Fasciola* spp. (8.98 and 5%) during faecal and intestinal scraping examination. While ova of *Moniezia benedeni* (1.12%), *Stilesia hepatica* (1.12%), *Strongyloides* spp. (15.16%) and *Oesophagostomum* spp. (15.16%) were also detected through faecal samples of sheep. The parasitic fauna of goats were identical to sheep population in Patna as prevalent nematodes were *Haemonchus* spp. (89.76%), *Trichostrongylus* spp. (84.81%), *Strongyloides* spp. (62.04%), *Oesophagostomum* spp. (49.17%), *Trichuris* spp. (12.21%) and *Bunostomum* spp. (3.96%). *M. expansa* (1.98%) and *M. benedeni* (1.98%) were common cestodes, while ova of trematodes viz. *Cotylophoron* spp. (33.99%) and *Fasciola* spp. (12.87%) were also detected in faecal samples of goats. Through G.I. tracts examination most prevalent nematodes was *Haemonchus* spp. (84.14%), followed by *Trichostrongylus* spp. (67.07%), *Trichuris* spp. (35.36%) and *Nematodirus* spp. (18.29%), whereas common cestode was *Moniezia expansa* (1.12%) and trematodes *Cotylophoron* spp. (47.56%) and *Fasciola* spp. (10.97%) in goats.

Special emphasis provided to incidence of haemonchosis in sheep and goats in local population of Patna and its surrounding

areas during examination of faecal samples and gastrointestinal tracts.

In the present study incidence of haemonchosis was found mostly during monsoon (96.87 and 100%) followed by winter (89.83 and 85.71%) and occurrence of this wire worm was minimum (40 and 50%) in summer during faecal samples and intestinal scrapings examination of sheep. Similarly in goats maximum incidence was also recorded in monsoon (86.90 and 92.10%) followed by winter (80.50 and 81.48%) and summer (32.97 and 48%) in respective samples.

Effect of sex was found to be non-significant on the prevalence of this helminths and incidence of haemonchosis was more in females as compared to males both in sheep and goats.

Similarly, influence of age on the incidence of haemonchosis was highly significant ($P<0.01$) in case of faecal samples examination of goats and non-significant through faecal samples and intestinal scrapings examination of sheep. The incidence was maximum in sheep aged upto 0-12 months (87.09 and 87.50%) and minimum in sheep aged 2 years and above (72.50 and 66.66%). Similar trend of age-wise incidence in goats was observed in the present study.

Influence to habitat pattern on the prevalence of *Haemonchus* species was found to be non-significant and higher incidence was recorded in free range system of sheep and goats

in comparison to small ruminants managed under semi-intensive system.

Varied clinical manifestation in sheep and goats due to haemonchosis in sheep and goats was observed. There was significant decrease in haemoglobin percentage, total erythrocyte count, PCV, lymphocyte percentage, blood glucose and total protein values of naturally infected sheep and goats with *Haemonchus* spp., however, ESR, TLC, neutrophil and eosinophil percentage was increased significantly both in case of sheep and goats. The significant rise in the estimated values of ALT, AST and total bilirubin were indicative of liver involvement due to short term intoxication as because of necrosis in different organs caused by *Haemonchus* parasites.

Abomasum of sheep and goats naturally infected with *Haemonchus* parasites revealed structural changes in gross observations. Generally blood was thin in appearance, mucous membrane and skin was pale in colour. The abomasal fluid was filled with numerous worms. There were various necrotic and haemorrhagic spots found at the site of attachment of parasites in abomasal mucosa.

Histopathological examination revealed immunopathological changes in abomasal mucosa alongwith degeneration and necrotic changes in epithelial lining and occasional ulcer

formation. It also revealed destruction of parietal cells, dilation of gastric cells and infiltration of eosinophils and lymphocytes.

The studies concluded that the incidence of gastrointestinal parasites prevailing at alarming level in sheep and goats population of Patna and surrounding areas. The situation demands systematic anthelminthic administration throughout the year specially before onset of monsoon and from post-monsoon to winter months. Healthy management of sheep and goats required, in view to avoid pasture, water and feed borne contaminations. Haemonchosis is the most prevalent parasitosis among local population of small ruminants which not only responsible for degenerative changes and necrosis in abomasum but also responsible for many serious clinical manifestations along with severe anaemia, retarded growth and may be related to productive losses.

CONCLUSION

The present study indicated that over all prevalence of gastrointestinal helminthic parasites, is 89.19% and 81.91% in local population of sheep and goats respectively.

Fauna of G.I. parasites were almost common in sheep and goats. *Trichostrongylus* spp., *Haemonchus* spp., *Trichuris* spp., *Strongyloides* spp., *Oesophagostomum* spp., *Bunostomum* spp., *Moniezia expansa*, *Moniezia benedeni*, *Cotylophoron. cotylophorum* and *Fasciola* spp. were commonly detected through faecal samples examination in both sheep and goats, however, maximum occurrence was recorded for *Haemonchus* spp. followed by *Trichostrongylus* spp. and *Strongyloides* spp.

Similarly, during gastrointestinal tracts examination prevalence of *Trichostrongylus* spp. (small intestine), *Haemonchus* spp. (abomasum) and *Trichuris* spp. (caecum) was most commonly observed. Infestation of *Cotylophoron* spp. was also very frequent in rumen and reticulum areas of sheep and goats.

Infestation of gastrointestinal parasites was recorded to be maximum in monsoon season followed by winter and summer. However, influence of sex was found to be non-significant but incidence of these parasites were maximum in lambs and kids up to age of 24 months.

CONCLUSION

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of G.I. parasites were almost common in sheep and nostrongylus spp., *Haemonchus* spp., *Trichuris* spp., es spp., *Oesophagostomum* spp., *Bunostomum* spp., *expansa*, *Moniezzia benedeni*, *Cotylophoron*. m and *Fasciola* spp. were commonly detected through ples examination in both sheep and goats, however, occurrence was recorded for *Haemonchus* spp. *Trichostrongylus* spp. and *Strongyloides* spp.

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ation of gastrointestinal parasites was recorded to be in monsoon season followed by winter and summer. nfluence of sex was found to be non-significant but of these parasites were maximum in lambs and kids up 4 months.

Prevalence of these parasites were commonly occurred both in semi-intensive and free ranged animals but present study indicated that pattern of habitat in free range system certainly carrying higher degree of chances of getting infection.

The trend of season, age, sex and habitat pattern wise prevalence of haemonchosis was also similar to above observations.

Haematological studies revealed marked anaemia, leucocytosis, lymphocytopenia, neutrophilia and eosinophilia during infection of *Haemonchus* spp. both in sheep and goats.

During haemonchosis significant reduction in blood glucose level and total serum protein was observed. Whereas significant increase in level of bilirubin, SGOT and SGPT enzymes indicated certain pathological changes in affected animals.

Histopathological studies revealed that haemonchosis was responsible for necrosis and haemorrhagic lesions in abomasal areas. Microscopical changes in abomasal tissues were hypersensitive type with leucocytic and eosinophilic infiltrations.

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CHAPTER - VII

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APPENDIX

Fig. I : Showing *Haemonchus* spp. collected from abomasum of sheep.

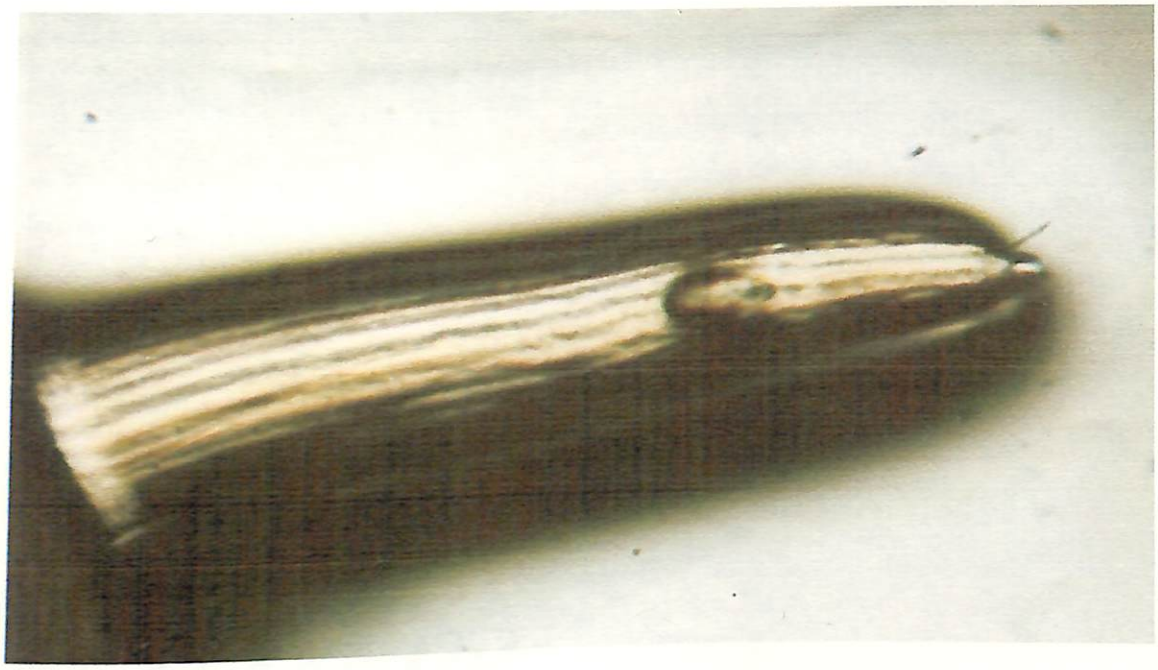
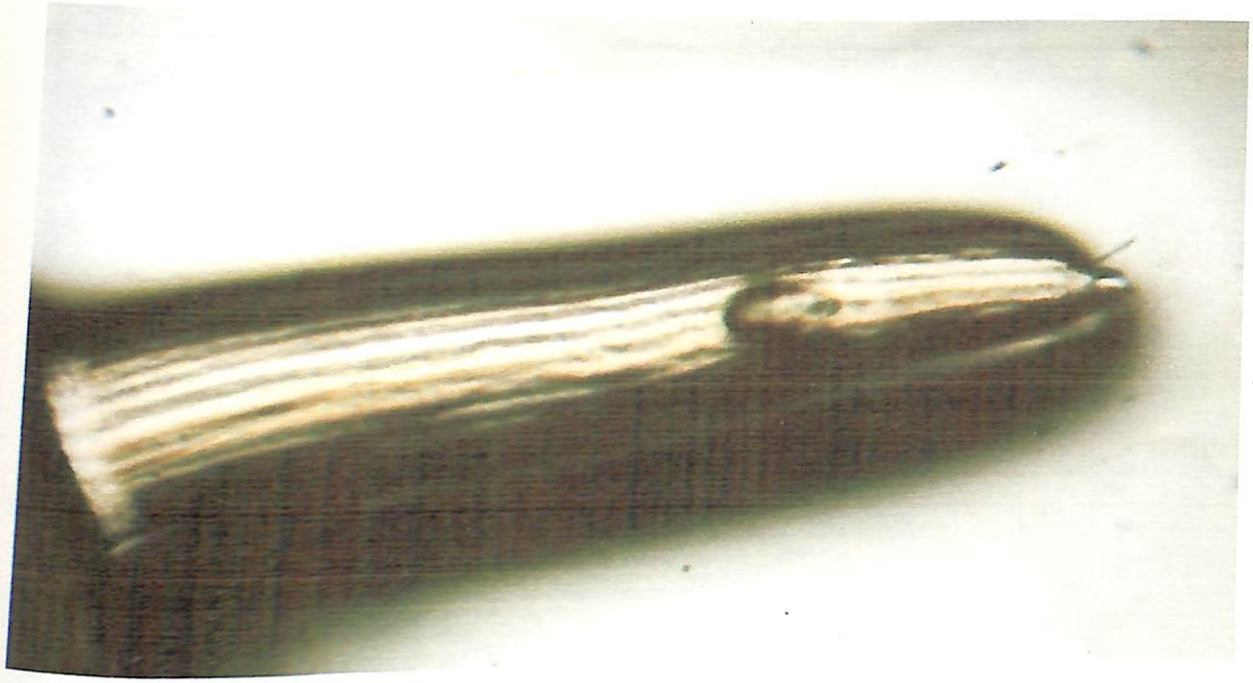


Fig. II : Showing buccal lancet and prominent cervical papillae of *Haemonchus* parasite (x 100).

Fig. I : Showing *Haemonchus* spp. collected from abomasum of sheep.



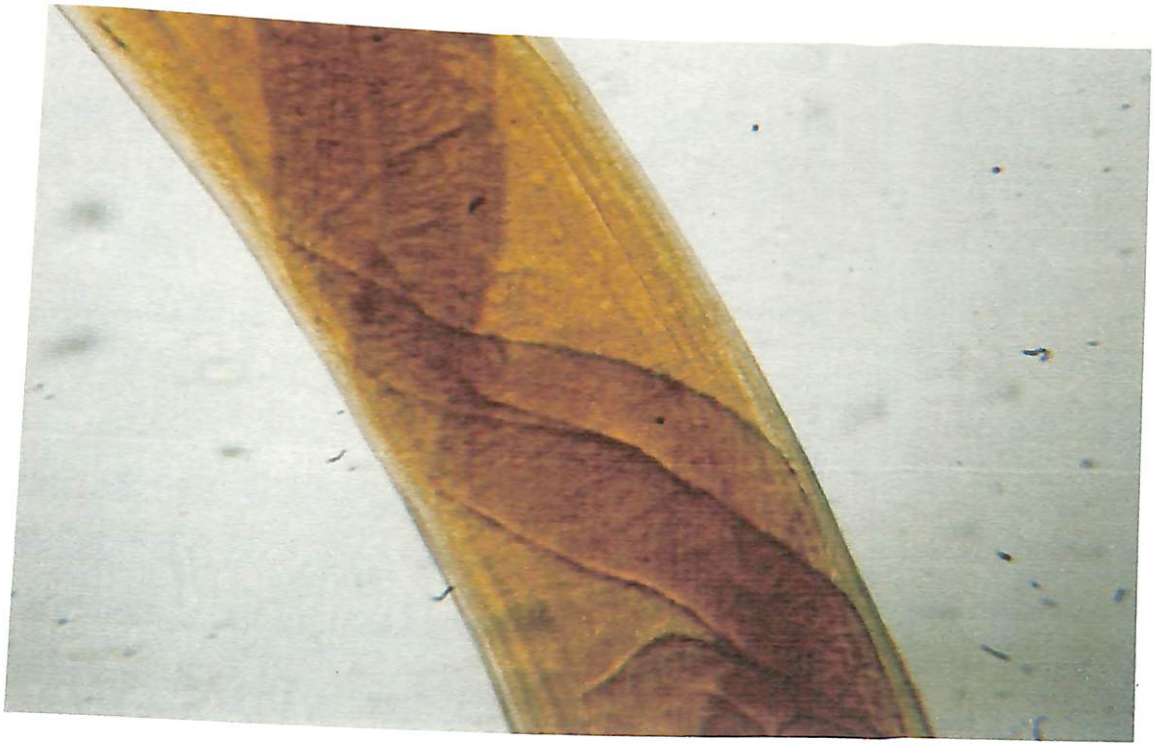


Fig. III : Showing intestine of *Haemonchus* spp. (x100).

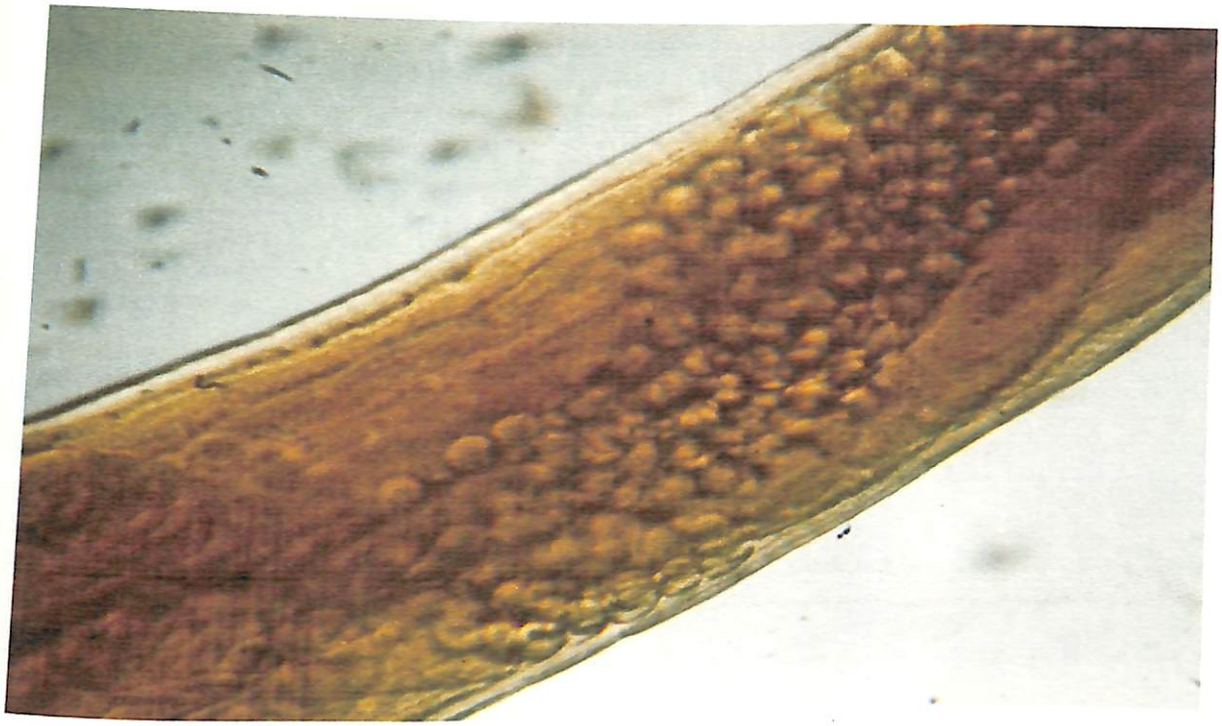


Fig. IV : Showing white ovaries spirally wound around the red intestine (x100).

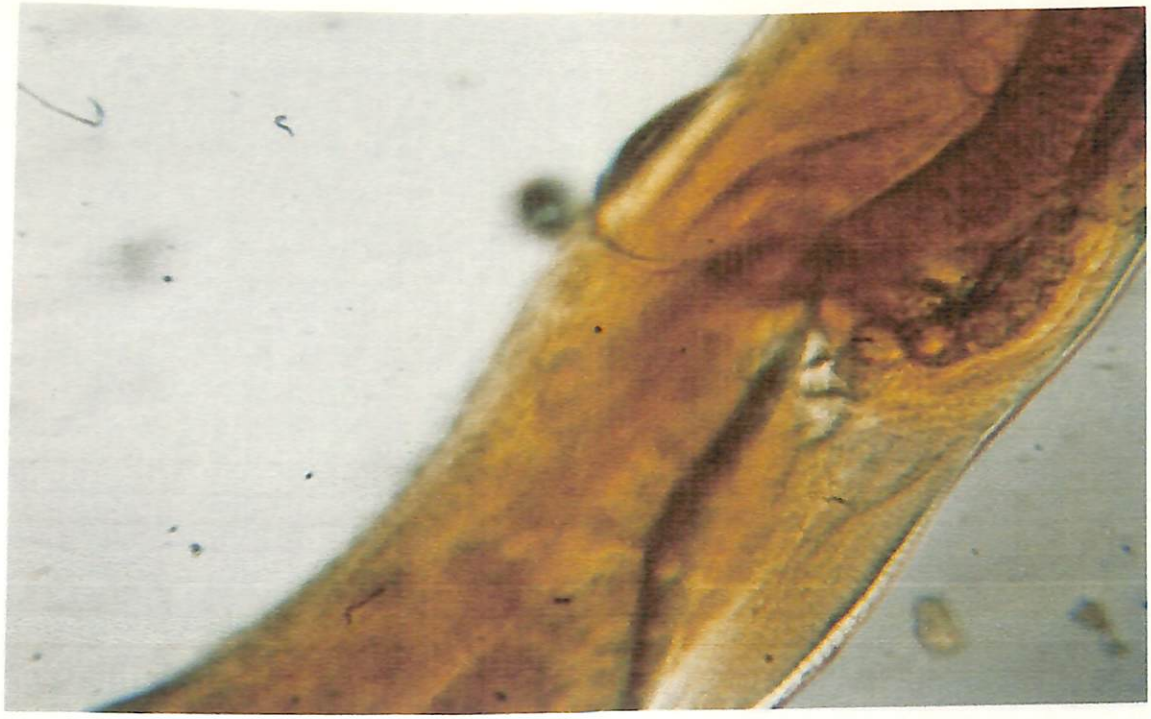


Fig. V : Showing vulvar flap of female worm (x100).

Fig. VI : Showing tail end of female worm (x100).

Fig. VII : Showing egg of *Haemonchus* spp. in faecal sample (x400).

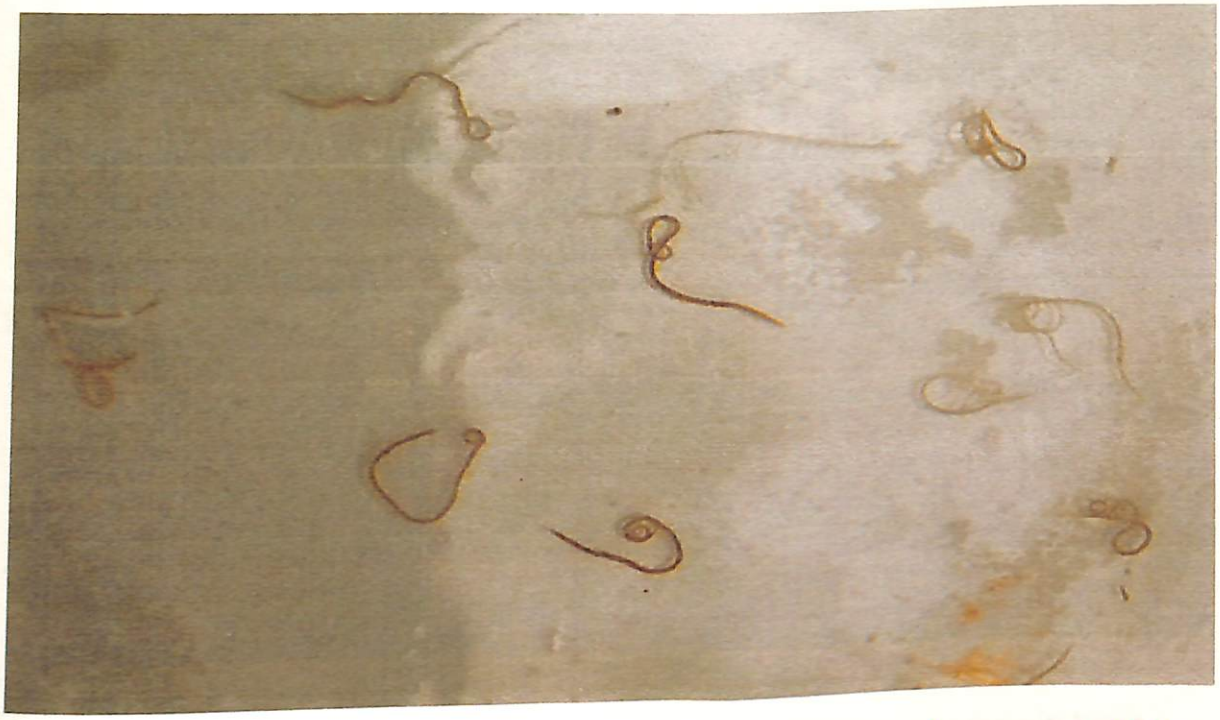


Fig. VIII : Showing *Haemonchus* parasites collected from abomasum of sheep.

Fig. IX : Showing egg of *Trichuris* spp. in faecal sample (x400).

Fig. X : Showing egg of *Trichostrongylus* spp. in faecal sample (x400).

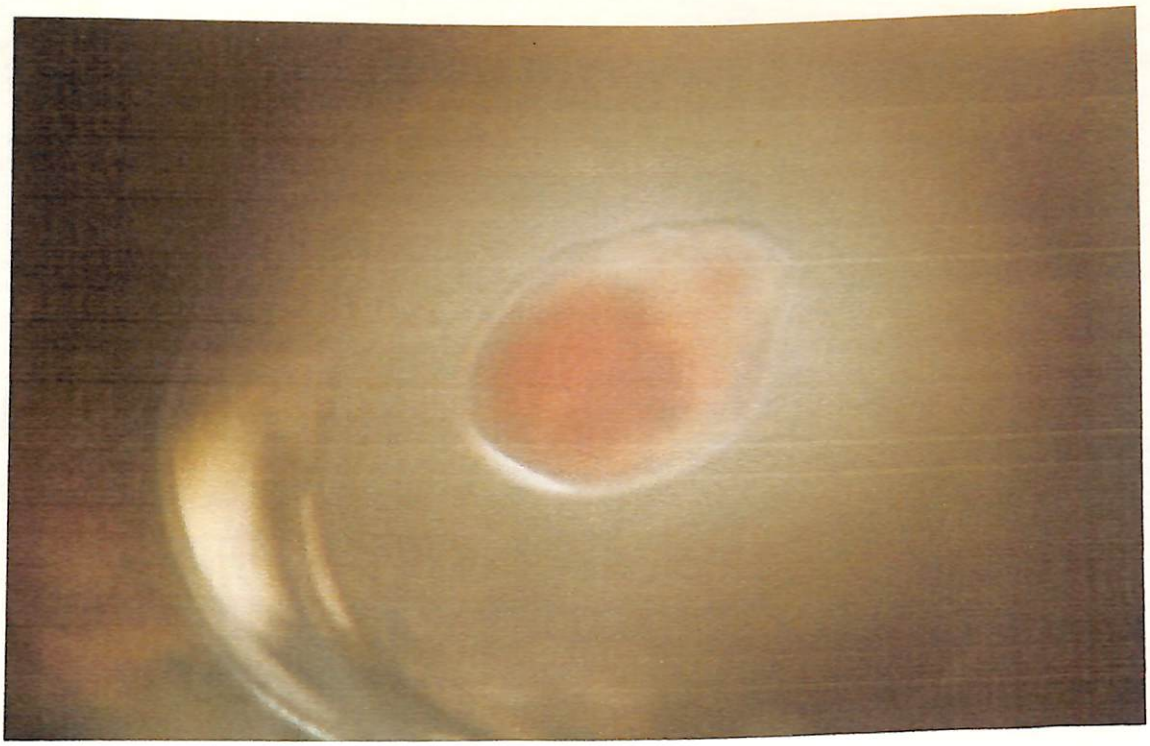


Fig. X I: Showing *Cotylophoron cotylophorum* collected from rumen of goat.

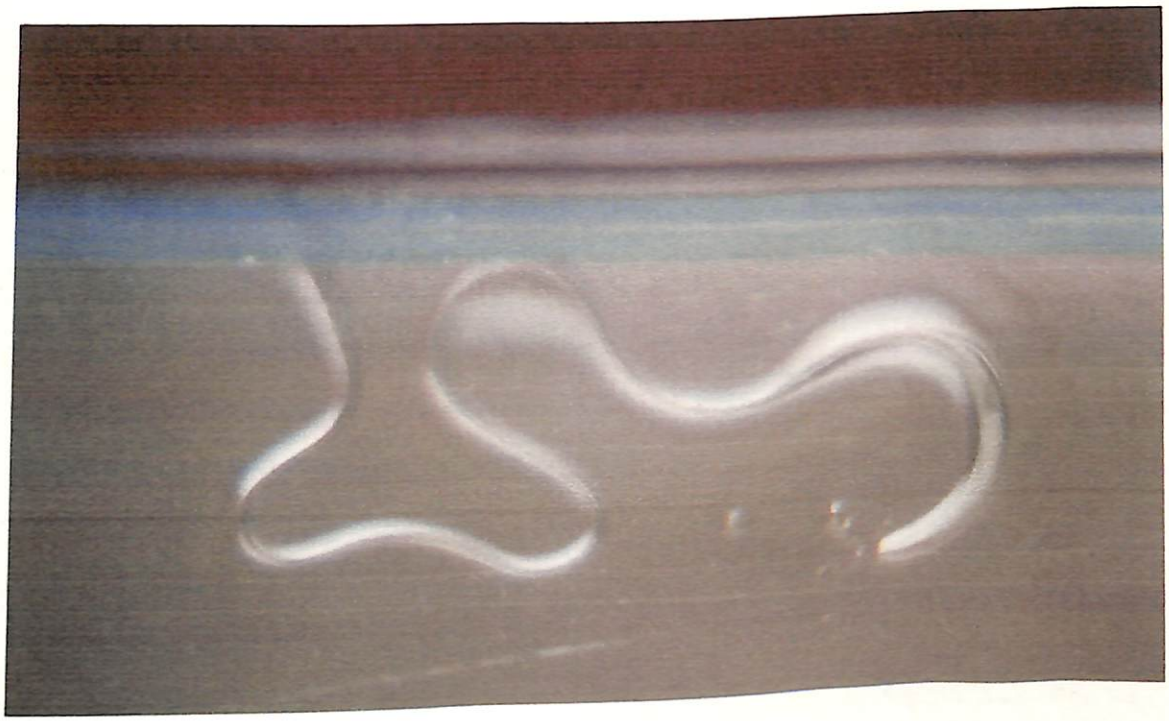


Fig. XII : Showing *Trichuris ovis* collected from caecum of sheep.

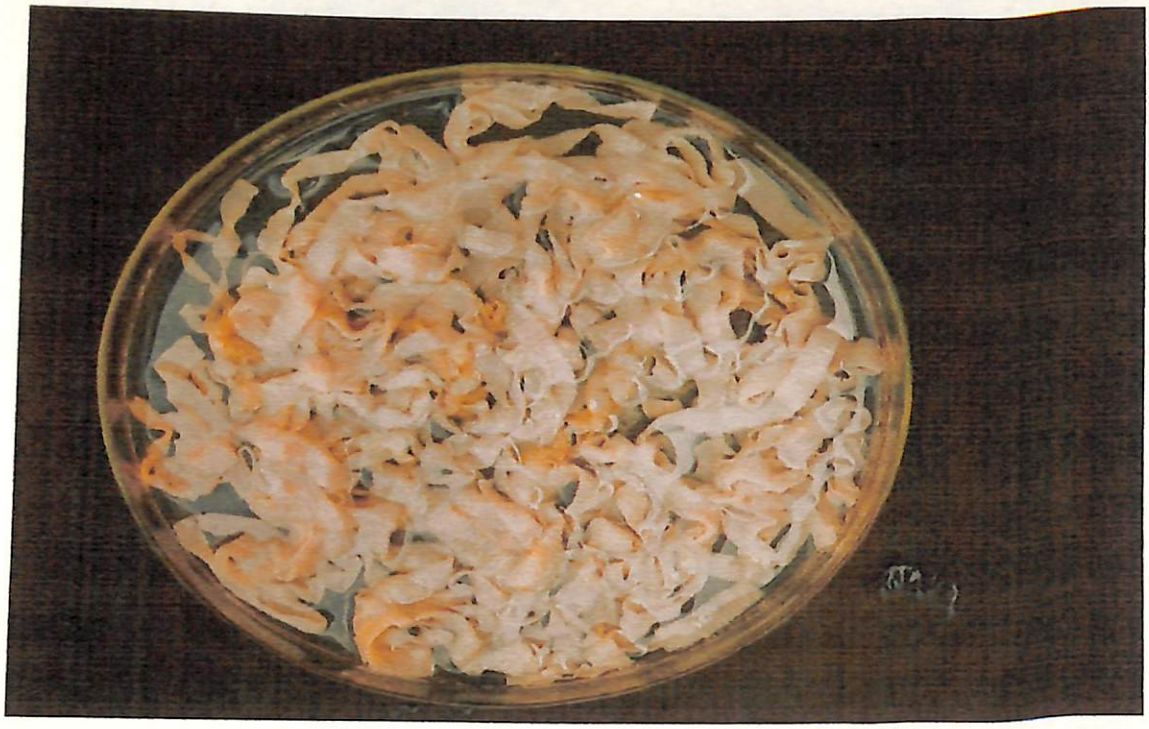


Fig. XV : Showing *Moniezia* spp. collected from large intestine of goat.

Fig. XVI : Showing segment of *Moniezia* spp. attached to large intestine.

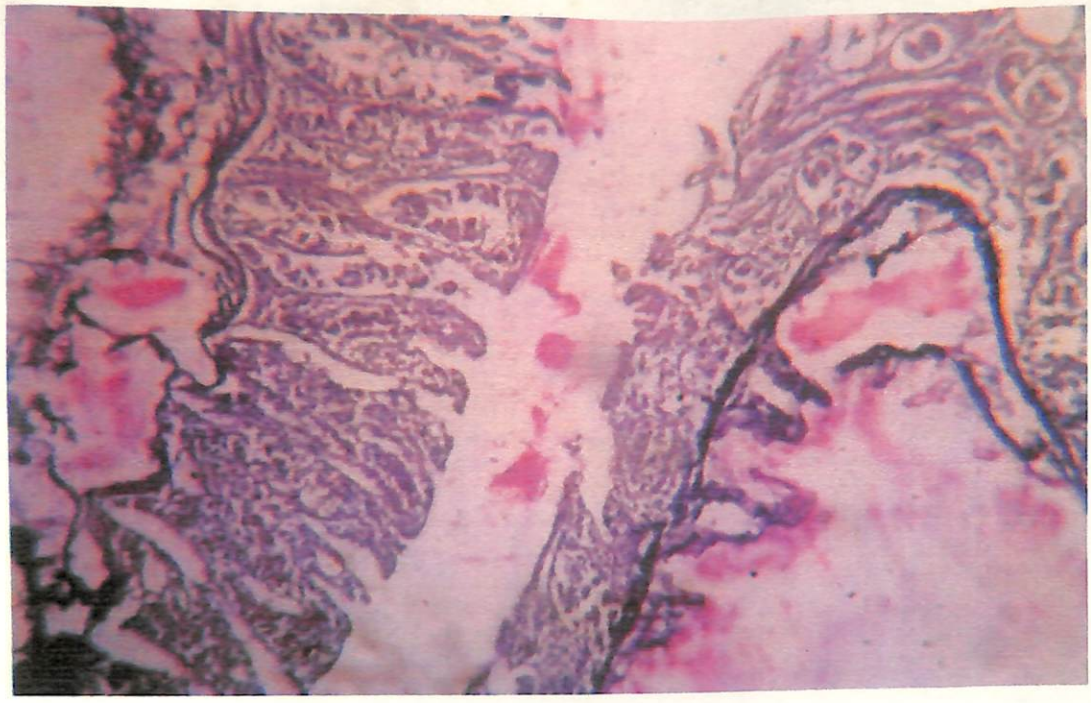


Fig. XVII : Section of abomasum of goat showing the changes of degeneration and necrosis of epithelial lining of abomasum (H & E x 100).

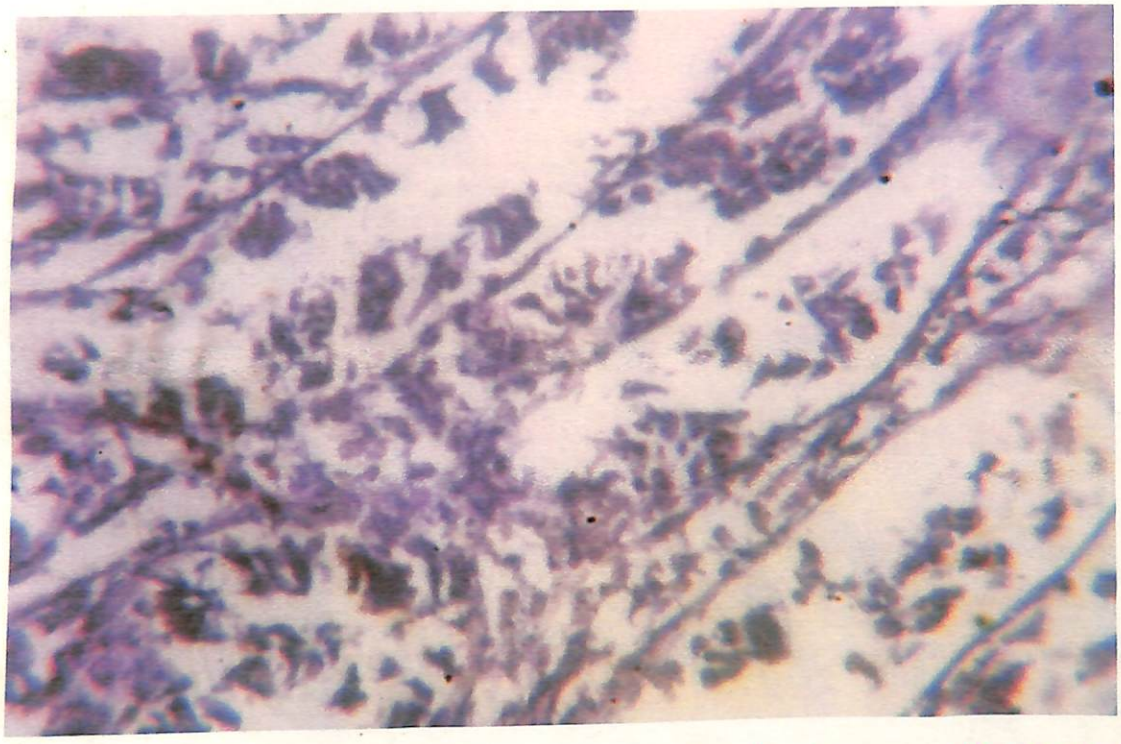


Fig. XVIII : Section of abomasum of goat showing the changes of hyperplasia of epithelial cells of lining of abomasum (H & E x 400).