EPIDEMIOLOGICAL SURVEILLANCE, CLINICO-PATHOLOGY, DIAGNOSTIC AND TECHNO-ECONOMIC ASPECTS OF HELMINTHS IN GOATS

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BY
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2001

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DEDICATED TO MY BELOVED PARENTS
ABSTRACT
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EPIDEMIOLOGICAL SURVEILLANCE, CLINICO-PATHOLOGY, DIAGNOSTIC AND TECHNO-ECONOMIC ASPECTS OF HELMINTHS IN GOATS

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2001

In present study, systems were structured for surveillance in rural household for epidemiology and techno economic aspect of helminth infection in goats. The present study comprised of examination of each and every individual surveyed using field tests for helmithiasis coupled with detailed inquires of the farmers door step for retrospective and prospective studies on rural goats. Further the data generated was analyzed on surveillance and epidemiology on disease, incidence in relation to physiological status, meteorological factors, housing, nutritional status, body condition score, hygienic condition were analyzed. The pathophysiology of the helminth infection, haematological and biochemical changes, immunodiagnosis, histopathological findings and economic losses were also studied.

The epidemiological study was undertaken in and around Anand for the period of one year i.e. from July 2000 to June 2001 and a total number of 1783 goats were included in the study. These were divided in three major groups. Group I - survey group (1135 goats), group II - organized farm group (288 goats) and group III included slaughter goats (360 goats). Door to door visit for surveillance programme were made at farmer’s doorsteps in each village on a
regular basis at monthly interval. Total twelve visits per animal in a year were made.

The percent of infection was lowest 50.0% in Farm and highest 96.90% in Survey group. The highest incidence of helminth infection was observed throughout the year in Survey and Slaughter groups (94.62 and 94.16% respectively) while in farm group the incidence was comparatively low (53.82%). No faecal sample was found positive for the fascioliasis under the study period. The incidence of various parasites observed as Moniezia spp., Trichostrongylus spp., Coccidia spp., Trichuris spp. and mixed infection were as 23 (2.02%), 324 (28.54%), 369 (32.51%), 166 (14.62%) and 192 (16.91%) respectively. The mixed infection of Trichuris + Ampistome, Trichuris spp. + Coccidial oocyst, Trichostrongylus spp. + Coccidia oocyst, Trichostrongylus spp. + Trichuris spp. + Coccidial oocysts and Trichostrongylus spp. + Moniezia spp., were recorded as (0.08%), 46 (4.05%), 59 (5.19%), 52 (4.58%) and 7 (0.61%) respectively. While in Farm group the incidence of infection was ranged from 50.0% to 62.50%. A total number of 155 goats were found positive for ova of different helminths indicating 53.82% overall incidence.

The incidence of helminth infection with the age of goats has been established under the study. The highest incidence 308 (91.66%) was observed in kids followed by 397 (87.44%) and 863 (83.15%) in hogget / doeling and adult respectively, indicating that the kids are more prone to helminth infection.

The seasonal incidence of helminth infection was recorded during the period of study. The overall incidence of helminth infection in survey group was 1074 (94.26%). In monsoon season a total number of 391 faecal samples were examined with highest incidence of 375 (95.90%), followed by 343 (94.23%) in summer and, the lowest incidence 356 (93.68%) in winter.

The correlation between incidence of helminth infection and various meteorological parameters were established group wise. A positive correlation (P<0.05) revealed between the disease incidence and minimum temperature, while a positive but nonsignificant correlation was observed between incidence of helminth infection and maximum and mean temperature morning and
evening humidity, rainfall and pan evaporation rate. A negative but nonsignificant correlation was observed between the incidence on helminth infection and bright sunshine.

The suffering goats were found to be weak and debilitated. Heavily infected goats showed diarrhoea with marked reduction in body weight and dehydration. Some of goats were emaciated and mostly found in cachetic condition. The visible mucous membranes were pale and the skin of affected goats was rough, dry and doughy.

The faecal sample examination is used as a routine examination for the presence of ova of helminth parasites in all species of animals. Under the research study sedimentation technique was used to detect the presence of helminthic eggs and McMaster and Stoll’s method for the quantitative examination.

For Immunodiagnosis tests a total number of 97 infected and 30 non-infected control serum samples were used. For conducting the Agar Gel Diffusion Test (AGPT) the antigen of specific helminths, viz Trichostrongylus spp and Trichuris spp. were used against the serum of affected goats. The immunoelectrophoresis test was conducted against the serum of two helminth parasites viz. Trichostrongylus spp and Trichuris spp.

In infected goats the average total protein and mean albumin levels were reordered significantly low with values of 5.13±0.03 to 3.36±0.03 and 2.89±0.03 to 1.30±0.01 g/dl respectively in noninfected control and infected goats. The mean A:G ratio was also reduced from 1.29±0.05 to 0.63±0.24 in control and infected animals. The mean values of LDH, SGPT and SGOT were observed significantly high with 319.33±0.05 to 468.07±0.16, 73.36±0.07 to 94.35±0.08 and 258.09±0.15 to 322.22±0.09 IU/L respectively in non-infected control and infected goats. Average serum glucose level was found significantly low from 78.85±0.22 to 39.55±0.23 mg/dl in control and infected animals. The mean total bilirubin level was observed nonsignificantly increased from 0.46±0.01 to 0.57±0.02 mg/dl in healthy and infected goats respectively a similar trend of observations were recorded in all the infected goats of three groups.
The gross pathological changes observed were congestion, catarrhal enteritis, oedema and few nodules were present in *Trichostrongylus* spp. and *Trichuris* spp. The microscopic changes observed in *Trichostrongylus* spp., *Trichuris* spp. *Moniezia* spp. and *Coccidia* were thickness of intestinal wall and oedematus folds, infiltration of eosinophils, moderate, chronic inflammatory cellular reactions with mucoid degeneration, necrosis of tips of villi and desquamation of epithelial lining and cells. The dark brown to black color parasitic excreta was found in the superficial villus mucosa.

The quantification of monetary losses was calculated on 434 goats infected with helminth infection. A total loss of Rs. 90321/- was calculated under the study period. These losses were calculated on the basis of losses due to (a) milk loss (Rs. 2538/-), cost of treatment (Rs.31248/-) and culling of goats (Rs. 56535/-).

Few villages of the Anand taluka were selected for the present study but the population of goats is distributed all over the Gujarat and hence, similar helminthic problems and its impact may be presented everywhere. The results of the study will be act as guidelines for the veterinarians to control of helminth infection in goats to uplift the socioeconomic status of poor farmers and nomadic tribes.
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C E R T I F I C A T E

This is to certify that the thesis entitled "EPIDEMIOLOGICAL SURVEILLANCE, CLINICO-PATHOLOGY, DIAGNOSTIC AND TECHNO-ECONOMIC ASPECTS OF HELMINTHS IN GOATS" submitted by Shri Mehta Hemant Kumar (Registration No. 4-4212-98) in partial fulfillment of the requirements for the award of degree of DOCTOR OF PHILOSOPHY in the subject of Veterinary Medicine of Gujarat Agricultural University is a record of bonafide research work carried out by him under my guidance and supervision and the thesis has not previously formed the basis for the award of any degree, diploma or other similar title.

Place : ANAND
Date : 26-11-2001

(P. R. PATEL )
Major Advisor
CERTIFICATE

This is to certify that, I have no objection for supplying to any scientist only one copy of any part of this thesis at a time through reprographic process, if necessary, for rendering reference services in a library or documentation center.

Place: ANAND

Date: 26-11-2001

(MEHTA HEMANT KUMAR)
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<tr>
<td>AKP</td>
<td>Alkaline Phosphatase</td>
</tr>
<tr>
<td>Av.</td>
<td>Average</td>
</tr>
<tr>
<td>°C</td>
<td>Degree Centigrade</td>
</tr>
<tr>
<td>Cm</td>
<td>Centimetre</td>
</tr>
<tr>
<td>dl</td>
<td>Decalitre</td>
</tr>
<tr>
<td>DLC</td>
<td>Differential Leucocyte Count</td>
</tr>
<tr>
<td>e.g.</td>
<td>As for example</td>
</tr>
<tr>
<td>E.P.G.</td>
<td>Egg per gram of faeces</td>
</tr>
<tr>
<td>etc</td>
<td>Et cetera</td>
</tr>
<tr>
<td>°F</td>
<td>Degree Fahrenheit</td>
</tr>
<tr>
<td>g</td>
<td>Gram</td>
</tr>
<tr>
<td>Hb</td>
<td>Haemoglobin</td>
</tr>
<tr>
<td>IU</td>
<td>International Unit</td>
</tr>
<tr>
<td>Kg</td>
<td>Kilogram</td>
</tr>
<tr>
<td>Lit</td>
<td>Litre</td>
</tr>
<tr>
<td>LDH</td>
<td>Lactate Dehydrogenase</td>
</tr>
<tr>
<td>mg</td>
<td>Milligram</td>
</tr>
<tr>
<td>ml</td>
<td>Millilitre</td>
</tr>
<tr>
<td>μg</td>
<td>Microgram</td>
</tr>
<tr>
<td>No.</td>
<td>Number</td>
</tr>
<tr>
<td>PCV</td>
<td>Pack cell volume</td>
</tr>
<tr>
<td>pi</td>
<td>Post infection</td>
</tr>
<tr>
<td>SGOT</td>
<td>Serum Glutamate Oxaloacetate Transaminase</td>
</tr>
<tr>
<td>SGPT</td>
<td>Serum Glutamate Pyruvate Transaminase</td>
</tr>
<tr>
<td>Spp.</td>
<td>Species</td>
</tr>
<tr>
<td>RBC</td>
<td>Red blood cells</td>
</tr>
<tr>
<td>Rs</td>
<td>Rupees</td>
</tr>
<tr>
<td>WBC</td>
<td>White blood cells</td>
</tr>
<tr>
<td>$</td>
<td>Dollar</td>
</tr>
<tr>
<td>£</td>
<td>Pound</td>
</tr>
<tr>
<td>&gt;</td>
<td>Greater than</td>
</tr>
<tr>
<td>&lt;</td>
<td>Less than</td>
</tr>
<tr>
<td>%</td>
<td>Per cent</td>
</tr>
<tr>
<td>Ag</td>
<td>Antigen</td>
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<td>Ab</td>
<td>Antibody</td>
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INTRODUCTION
CHAPTER I
INTRODUCTION

Goat has been associated with human science history. It was probably the first animal to be domesticated (around 9000-7000 BC). The present domestic goat (Capra hircus) is result of natural and man made selection over last 10000 years. India is having the highest goat population (12 crores) in the world, accounting 17.15 % of the world and 26.0 % of the Asian goat population, annually 4.58 crores of goats are slaughtered in India to produce 4.58 lakh tones of meat which is higher by 171 % in sheep slaughter and 126 % mutton produced respectively. Contribution of goats in total meat production in India comes to 10.06 %. The meat production potential of goat in India, Asia and world is 458, 2776 and 3701 thousand metric tones respectively (FAO, 1997).

The contribution of Asia and India in world goat meat production is 75 % and 12.3 % respectively, over and above goats in India produces 21.6 lakh of milk and 1.26 tones of skin. The goat population of India has increased at a growth rate of 3.25% per year which is much more higher than growth rate of buffaloe (2.0%) and cattle (0.8%). The projected population by 2000 A.D. will be 132 million. Goats prefer drier areas with an annual rainfall of about 250-400 mm and light to sandy soil (Wadhwani, et al. 2000).

Goat is a multifunctional animal and plays a significant role in the economy and nutrition of landless, small and marginal farmers in the country goat rearing is an enterprise, which has been practiced by a large section of population in the India. Goat can efficiently survive on available shrubs and trees in adverse harsh environment in the fertility lands where no other crop can grow. In pastoral and agricultural subsistence societies in India, goats are kept as a source of additional income and as an insurance against disaster. Goats are also used in ceremonial feasting and for the payment of social dues. In addition to this, goat has religious and ritualistic importance in many societies (Patil 2000).

Goat is numerically a very important livestock species in the state, especially under arid, semi-arid and hilly areas. Goats contribute to the
subsistence of professional breeders, small landholders and landless rural poor by supplying meat, fibre, skin, hair and manure. Goats have an important role in income generation, capital investment, employment generation and improving household nutrition. Being small in size, the meat can be consumed by the family and would not need refrigeration. Throughout Asia including Gujarat goat meat is preferred over the other meat (Patel 2000).

The wide distribution of goats in the tropics and subtropics reflects their ability to adapt to a variety of environments. However, the preferred environment is on the lighter sandy soil in the drier Tropics and sub-Tropics rather than in the wet humid climate. The inherent characteristics of goats such resistance to dehydration, preference for browse and wide ranging feeding habits, enable them to thrive in region less than 750 mm of rainfall. They have high dry matter and fibre digestibility and thus can subsist on poor woody vegetation, which no other species will consume. It is the last species to leave ecology where virtually no food is available. There is much less risk in goat farming especially in the draught prone areas where large mortality occurs due to frequent draughts. This is because of their feeding habit, high prolificacy and capacity to recover flock size.

In spite of the neglect of goat by development planners, primarily due to misconception of the role in ecological degradation, their number has increased relatively more than other species, specially in Asia. The role of goat in causing ecological degradation and is highly exaggerated and is more due to misconception. The goat in fact acts as seeding machine of trees, especially hard coated seeds, which would not germinate unless acid treated. Goats are also utilized as biological control for brush and undesirable forbs. The browsing, if controlled, accelerates vegetation, growth of trees, shrubs and surface vegetation (Patel 2000).

Parasitic diseases of goat are considered to be the major cause of considerable economic losses, which arise primarily from the failure of parasitised animals to grow or perform satisfactorily. Several species of parasites are involved, and the relative importance of species in a particular region varies
with its agroclimatic and animal husbandry practices. Research on the incidence of parasitic diseases of goat of various regions indicates that *Haemonchus contortus*, *Trichostronglus colubriformis*, *Dictyocaulus fiaira*, *Trichuris* spp.*Oesophagostomum* spp. *Fasciola gigantica* and *Paramphistomes* are the most common and important parasite responsible for morbidity and mortality. Studies on the epidemiology revealed that the severity of these parasites is influenced by the weather conditions to a large extent.

No data is available on the economical losses at national level, caused by the helminths, however research studies have showed that even the sub clinical parasitism causes economical losses as the parasitized goats have poor body weight gain, induced a decrease in body condition scoring, causes decreased fertility and led to persistent decrease in milk yield, ranging between 13.0 to 25.1 %, and was associated with the decrease in fat content. The higher-producer goats have less resistance and resilience to infection associated with more severe consequences on milk production (Hostle and Chartier 1993).

In the parasitic phase the parasite lives in the host and its development, survival, pathogenecity, population dynamic etc. is regulated by the age, sex, physiology, and immune status of the host. In the free-living phase, its survival, translation and transmission is governed by the weather and animal husbandry practices. It should be realised that the free-living stages of parasites are very small and they share their habitat with other microbes. The temperature, humidity, oxygen in the immediate vicinity of these microbes, called microclimate, is quite different from the general climate. The optimum conditions required by free-living stages of different parasites vary. Accordingly, the incidence of parasites differs as per the agroclimatic conditions (Yadav 2000).

As very little is known about rural ecology and economic significance of helminth infection in rural goats. The veterinary profession is concerned how best to treat and at what cost. Thus, necessity for generation of information at rural household level cannot be overlooked. Epidemiological studies are complex being influenced by a number of factors e.g. local climate, animal husbandry practices, pasture management, soil type, herbage etc. Therefore these
studies should be carried out in an area where they are to be applied. Seasonal fluctuations in worm burden and their genetic composition are dictated by the availability of infective larvae on the pasture (Gupta et al. 1988).

Keeping in view the facts it is planned to undertake the studies on “Epidemiological Surveillance, Clinico-Pathology, Diagnostic And Techno-Economic Aspects Of Helminths In Goats” with the following objectives,

- To study the epidemiology of helminths in goats from different villages of Anand district of Gujarat state.
- To correlate the clinico-pathological changes with various haematological and biochemical parameters.
- To study the symptomatology of major helminths in goats under field condition.
- To investigate the economic aspect of major helminths with reference to production loss, morbidity, mortality, and treatment cost.

The purpose of this study has therefore been to generate reliable data on prevalence and incidence of helminth infection among goats in rural households, intelligible enough to be analyzed for identification of priority areas for the expansion of work and to initiate epidemiology and economy of helminthiasis in goats in few villages of rural Gujarat.
REVIEW OF LITERATURE
CHAPTER II
REVIEW OF LITERATURE

2.1 EPIDEMIOLOGY

Several species of helminth parasites are involved, and the relative importance of species in a particular region varies with its agro climate and animal husbandry practices. The temperature, humidity, oxygen in the immediate vicinity of microbes called microclimate, is quite different from the general climate. The optimum conditions required by free-living stages of different parasites vary and accordingly the incidence of parasites differs as per the agroclimatic conditions (Yadav, 2000).

Lumbers (1973) reported that goats carried much higher level of infestation than sheep. The biggest difference occurred with small brown stomach worm, the goats averaged 1800 worms per weather compared with just six in the sheep. The goats were also highly susceptible to the black scour worms. Level of infection of this parasite averaged 12000 worms / goat, which compared rather unfavorably with the levels in sheep. Large and small worms were also common in goats. December samples showed a drop in worm eggs to that found in the sheep, but in subsequent months number rose rapidly. By the end of January the worms in the goats were producing more eggs.

LeRhiche et al. (1973) carried out helminthic survey of sheep and goats in Cyprus. They examined 889 guts from sheep and goats of all ages. 48% of the guts were from sheep and rest were from goats. They also examined 326 faecal samples, 70% of these were from sheep and 30% from goats. They reported Ostertagia spp. 70% in spring and autumn and spring, Trichostrongylus spp. 62% in spring and autumn, Trichuris ovis was 55% (no seasonal pattern), Chabertia ovis 38% in autumn and spring, Haemonchus contortus 23%, Oesophagostomum venulosum 12%. Bunostomum trigonocephalum 6%, Moniezia expansa 17%, Avitellina centripunctata 4.1%, Stilesia globipunctata 1.3%.
Further in 1973 LeRiche et al. reported severity of the infection and their association with the age of the animals. They examined 889 guts from sheep and goats. *Ostertagia* spp. and *Trichostrongylus* spp. were most common, affecting sheep and goats in Cyprus. *Haemonchus contortus* and *Bunostomum trigonocephalum* was not very much important and *Chabertia ovina* was present in 38 % of the guts. *Moniezia* spp. and *Trichuris ovis* was seen in young animals. Adult sheep had higher infection than goats.

Boag and Thomas (1977) carried out the monthly postmortem and recorded *Ostertagia* spp. and *Nematodirus* spp. in June, *Haemonchus contortus* in July, *Trichostrongylus* spp. in August, *T. axei, T. colubriformis* and *Cooperia curtice* in September in goats.

Tarazona et al. (1982 b) carried out examinations of worms burden in goats from 14 outbreaks of gastro-intestinal parasitism and derived a provisional epidemiological pattern peak were observed in May-June due to Trichostrongyllosis and in November- December due to Trichostrongylosis, while in January and February outbreaks of Trichostrongylosis and Ostertagiasis type II were seen.

Bundy et al. (1983) carried out survey of Fascioliasis in Jamaica from November 1979 to April 1980 and revealed the presence of *F. hepatica* in 22.2 % of 520 cattle, 17.2 % of 514 goats and 0.72 % of sheep.

Gupta et al. (1985) examined 29631 sheep and goats faecal sample during 1977-82 in Haryana, India. Amongst this 2808 (9.5 % were positive for amphistomes eggs peaking between May and September. Post mortem examination of 1086 sheep and goats during 1977-81 revealed 28.4 % positive for mature amphistomes with the highest incidence from November to February.

Varma et al. (1987) studied the incidence of Paramphistome infection in buffaloes, sheep and goats by examining infected rumen of animals from local abattoirs and also faecal samples collected from animals of endemic biotopes. Out of 7166 animals examined, 2329 (32.50%) were found harbouring Paramphistomes. The incidence of buffaloes, goats and sheep was found to be 59.85 %, 8.90 % and 8.13 % respectively. In sheep and goats the incidence of
Paramphistomes infection was lowest in summer (3.64 % and 3.15 %). In other season the incidence varied from 8.09 % to 12.50 %.

Upadhyay and Bhatia (1987) studied the epidemiology of helminthic infection of sheep and goats in Tarai region of U.P. 109 out of 65 goats (92.68 %) and 69 out of 74 sheep (93.24%) revealed mixed infection of helminths in different seasons. 34.73 % of goats had trematode infection (F. gigantica, Amphistome spp. and S. indicum) with peak during September. 37.89 % had cestode infection (Moniezia expansa, M. benedeni and Stilesia globipunctata, Cysticercus tenuicollis and hydatid cysts) and 87.36 % had nematode infection (10 species) out of which stomach worm (H. contortus) was most prevalent (74.09 %) and O. columbianum (43.37 %).

McCraw and Menzies (1988) examined the 179 does over a 12 months period at Ontario, Canada, 98 (54.7%) were found to have passed first stage larvae of Muellerius capillaris. There was a significant difference in the seasonal prevalence; with the highest proportion of does (74.3%) passing larvae between April and June. All 98 infected does were given ivermectine at 300 mg/kg body weight subcutaneous once in the left axilla. Passage of larvae into the faeces ceased after treatment, but resumed later in 25 animals. Of these 6 animals began to shed larvae under the prepatent period of 39 to 43 days. The proportion of does resuming passage of larvae after treatment was higher in older animals (>3 years old), consistent with the accumulation of inhibited larvae as a result of reported infection as animals become older.

Pachavari et al. (1988) undertook the epidemiological studies between January and December 1985 to know the influence of season, species, age, and physiological status of host on the occurrence of Fascioliasis in slaughtered goats in Tarai region of U.P. The overall infection rate was 14.73 % affecting more females (26.79 %) than males (8.47 %). The monthly incidence of the disease was noticed highest during August (27.37 %) and nil during June (1984 and 1986) reported fascioliasis as more severe and infective to goats than sheep.
Patel (1989) studied the seasonal incidence of various gastrointestinal parasites in goats in Gujarat state. In faecal sample examination in field and slaughtered goats and sheep he observed, *Fasciola gigantica, Amphistomes, Trichostrongylid* spp., *Trichuris* spp., *Moniezia* spp. ova in faeces, oocyst of *Coccidia*, cysts of ciliates, *Avitellina centripunctata, Thysaniezia giardi, Stilesia globipunctata, Haemonchus contortus, Trichostrongylus axei, Trichostrongylus colubriformis, Oesophagostomum columbianum, Bunostomum trigonocephalum* and *Trichuris ovis*. Mostly mixed infection were observed with marked variation in faecal egg count within as well as between various collections. The incidence of parasitic load was higher during monsoon as compared to winter and summer seasons. The total parasitic burden of goats based on faecal sample examination under field conditions was higher during monsoon with 85 %, followed by 71% in winter and 58.33% in summer. Under farm condition the rate of infection was comparatively lower than under field condition and it was 54.16 % in monsoon, 50.83 % in winter and 48.33 % in summer.

Amrosi (1989) investigated over three consecutive years in a mutton flock and in milk flock, heavily infected with strongylus, revealed that the spring lactation rise was more prolonged than the autumn lactation rise. The autumn rise was more extensive in the milking flock than in the mutton flock. Important influential factor were air temperature, rainfall and daily evaporation rate.

Connor et al. (1990) reported the epidemiology and control of gastrointestinal nematode infection of goats in a southern Tanzania. The mean egg count fell in July after the onset of the dry season and remained below 500 eggs per gram faeces until December when the wet season began. The highest faecal egg counts were recorded in February. *Haemonchus* and *Oesophagostomum* 3rd larvae were observed in all faecal cultures and a few Strongyloides larvae were also seen.

Duwel (1990) observed the faecal egg counts and worm burdens of ruminants recorded over almost 20 years in Germany. The evaluation included ruminants experimentally or naturally infected with nematodes and was made up of 4056 sheep and 2638 cattle. In sheep under one-year-old, egg output correlated
with worm burden for about 3 months after experimental infection. In experimentally infected sheep more than one-year old however, egg output and worm burden correlated for only a few weeks post infection in the majority (about 60%) of the animals.

El-Azazy (1990) studied the 96 abomas of sheep and goats at Sharkia Province of Egypt during the 4-climetic seasons from April to March, for the prevalence of adults and larval nematodes. Adults of *Trichostrongylus axei* were most numerous, followed by adult *Haemonchus contortus*. Adult *Ostertagia* spp. and *Parabronema skrjabini* were less prevalent. There was no significant difference between sheep and goats in infection rates, but worm burdens of the nematodes other than goats. The animals were uniformly infected with these parasites throughout the year, as there was no significant difference in the incidence or intensity of infection between the 4 seasons. The numbers of larvae recovered from the wall of the abomasum were small in relation to the total worm population throughout the year with a slight increase during the summer.

Fakae (1990a) noticed the prevalence of endemic parasitic gastroenteritis in the Savanna area of eastern Nigeria and was indicated by the high prevalence of the helminths irrespective of the season of the year. The overall trend in the helminthosis in the goats and sheep was that of an escalates worm burden during the period of confinement (April-October) and a low worm burden when animals were allowed free range (November-March), these periods corresponding to the cropping and harvest seasons respectively. A strong positive correlation was obtained between the mean strongyle worm burden and the egg per gram of faeces.

Fakae (1990b) reported the high incidence of *Haemonchus* infection (77.8-100%) with no definite seasonal distinction. There was however, clear seasonal trend in the worm burden of animals, higher burdens were evident during the rainy rather than dry season. There was no hypobiosis. *H. contortus* survived in the host during the unfavorable dry season (November to March) as adults.
Richard et al. (1990) studied the non-genetically determined parameters such as age or reproductive status, had any effect on the susceptibility of dairy goats to helminth infection (Muellerius capillaris and the intestinal strongyles Teladorsagia, Trichostrongylus, Haemonchus, Oesophagostomum and Chabertia), the study was undertaken in the spring season (using 263 goats from 8 farms) and autumn (165 goats from 5 farms). The farms were selected because they breed French Alpine and Saanen goats within the same flock, in spring all goats were lactating while in autumn most were in their 3rd month of pregnancy. The faecal output of strongyle eggs was significantly related to breed, polledness, presence of wattles and age. The faecal output of first stage larvae of M. capillaries was correlated with breed, age and pregnancy.

Wamae and Ihiga (1990) noticed that the worms species parasitizing the goats were Haemonchus Oesophagostomum, Trichostrongylus, Nematodirus, Strongyloides and Moniezia. It was established that faecal egg counts for strongyles peaked during the dry months while those of Strongyloides peaked during the wet and warm weather. It is suggested that deforming should be done just before the rains in order to reduce pasture contamination during wet weather.

Jacquiet et al. (1992) examined faecal samples of goats before, during and after the rainy season at three locations in Southwest Mauritania (Trarza). Haemonchus contortus was the most prevalent helminth, infection by digestive tract strongylus and Strongyloides papillosus was very light (<20%). Animals under 1 year of age were not infected by digestive-tract strongylus. It was thought that young small ruminants become infected during the rainy season and that the parasites so acquires are inhibited in their development and survive nearly one year as adults.

Rajkhowa et al. (1992) collected samples of lungs, liver, mesentery, and faeces and were screened for the presence of schistosomes in 185 cattle, 25 buffaloes and 110 goats. Schistosoma indicum, S. spindale and S. mansalis were identified, it was noticed that the incidence of all 3 species was highest in the areas where the intermediate host snail Indoplanorbis exustus was abundant.
Chartire and Reche (1992) indicated 15 species of helminths from 81 dairy goat farms in 6 sub regions of Western France. The most frequent were *Muellerius capillaris*, *Trichostrongylus colubriformis* and *Teladorsagia circumcincta* with prevalence more than 90%. Other prevalent species were *Haemonchus contortus*, *Strongyloides papillosus*, *Trichuris* spp., *Moniezia* spp. and *Dicrocoelium lanceolatum*. It was concluded that no area of particular risk was defined for the other helminth infections, probably because of the relative homogeneity in climatic and topographic conditions of the 6 agricultural regions.

Kanyari (1993) reported the prevalent species of *Eimeria* and level of infection with strongyle egg/g (EPG) indifferent geographical parts of Kenya. A significant difference was found in the EPG levels between various farms but not in the oocysts/g (OPG) levels, this was attributed to the relative susceptibility of various pre-parasitic stages of helminths to adverse climatic conditions, especially desiccation, compared with coccidian oocysts. There was a negative correlation between OPG levels and the age of animals as a result of acquired immunity. Sheep were found to shed significant more oocysts and helminth eggs than goats; this could be related to the differences in their mode of feeding, i.e. grazing and browsing respectively. Young age (under 1 year) and confinement were found to contribute to high prevalence of oocysts in faecal samples. In goat samples, 8 species were identified, the commonest being *E. arloingi* (37.5%) and *E. ninakohlyakimovae* (32.2%).

Maingi et al. (1993) examined 341 goats and reported, 83% of 150 kids, 93% of immature goats and 93% of 108 adult goats infected with nematodes. Geometric mean faecal strongyle egg counts were 1119, 1375 and 1225 for kids, immature and adult goats respectively. The strongyle egg frequency of occurrence within age group of the animals best fitted negative binomial distributions. Nematode genera identified were *Haemonchus*, *Trichostrongylus*, *Cooperia Oesophagostomum*, *Nematodirus* and *Strongyloides* in the order of prevalence. *Trichuris* eggs were found in only 2% of the goats examined on the farms in Nairobi and Kajiado and were absent from goats on the other farms. Tapeworm eggs were found in 7% of goats in Nairobi, 5.5% in
Kajiado and 10% in Murang’a. Coccidian oocysts were found in Kiambu, 60% in Nairobi, 31% in Kajiado and 50% in Murang’a.

Nwosu and Sarivastava (1993) carried out a survey of cattle, sheep and goats of local breeds slaughtered in 1 year in Nigeria, the prevalence rates of 42.7% and 5.7% were recorded for *Fasciola gigantica* and *Dicrocoelium hospes* eggs, respectively. The prevalence of egg secretion in sheep and goats was 28(3.9%) and 13 (1.8%) for *F. gigantica* and *F. hospes* respectively.

Cabaret and Gasnier (1994) studied the 16 dairy goat farms in the center-west of France for the nematode infection. The most common species were *Teladorsagia* and *Trichostrongylus*. *T. vitrinus* and *Oesophagostomum venulosum* were present in significant numbers on only one farm of 16. The importance of *Haemonchus contortus* varied from farm to farm. The historical and breeding management factors that influenced the proportions of the most common species were the age of farm, size of flock, percentage of Alpine breed, duration of kidding period, age of goats and number of farm of origin.

Pandey *et al.* (1994) reported that the 4 dominant species, *Haemonchus contortus*, *Trichostrongylus axei*, *T. colubriformis* and *Oesophagostomum columbianum*, were present in 88-97% of the animals. Three other nematodes, *Strongyloides papillosus*, *Bunostomum* spp. and *Trichuris* spp. occurred respectively in 9%, 3% and 21% of the goats. The total nematode burden was lowest at the end of the dry season in November and increased gradually through the rainy season to reach a peak after the end of the rains in April. The population of *H. contortus* followed the same trend as that of the total worm burden. *Trichostrongylus colubriformis* showed a peak in April and *T. axei* peaked in June. The 4th stage larvae (L4) of *H. Contortus* accounted for 6-6.8% of the total population during most of the year except in August, when they comprised 46.1% of the burden. It can be concluded that there is a direct relationship between rainfall and intensity of infection with gastrointestinal nematodes.

Dorny *et al.* (1995) used the faecal egg counts to study the pattern of trichostrongyline infection in sheep and goats according to season, age,
pregnancy and lactation on traditional farm in West Malaysia. *Haemonchus contortus* and *Trichostrongylus* spp. were the most important strongyles in sheep and goats; *Haemonchus contortus, Trichostrongylus* spp. and *Oesophagostomum* spp. were most prevalent. The faecal egg counts of sheep and goats were apparently not influenced by the small seasonal climatic variations. Strongyle infections were acquired at an earlier age in sheep than in goats. Mean faecal egg counts decreased from the age of periparturient rise in strongyle egg counts was observed in both animal species. *Haemonchus contortus* was mainly responsible for this rise in faecal egg counts.

Jacquiet et al. (1995) studied a total of 647 faecal egg counts and 53 necropsies of sheep and goats originating from 5 sites of a Sahelian region of Mauritania. *Haemonchus contortus, Oesophagostomum columbianum* and *Stilesia globipunctata* were most prevalent species. Long survival of adults and high percentage of arrested 4th stage larvae characterized the seasonal pattern in the dry season, suggesting that 2 different strategies were used to survive from one rainy season to next.

Ndao et al. (1995) reported the epidemiological survey on gastrointestinal helminths in 51 goats in the tree cropping pasture region in Senegal. All the examined animals were infected with at least one helminth species. Three nematodes (*Fasciola gigantica, Schistosoma bovis, amphistomatidis*), 2 cestodes (*Moniezia expansa, Cysticercus tenuicollis*) and 9 nematodes (*Haemonchus contortus, Trichostrongylus axei, Trichostrongylus colubriformis, Cooperia curticei, Geigeria pachyscelis, Strongyloides papillosus, Oesophagostomum columbianum, Trichuris ovis* and *Skrjubinem*) were identified. There was a negative correlation between haematocrit level, number of worms and number of eggs per gram of faeces during the rainy season. The gastrointestinal nematode burden is high during the rainy season. During the dry season (9 months) nutritional problems are aggravated by adult worms and residual larvae.

Nishikawa et al. (1995) noticed the *Marshallagia marshalli* and *Nematodirus* spp. infections were higher in the driest areas; infections by
Dictyocalus filaria and small lung-worm (Cystcaulus ocreatus and Mullerius capillaris) were higher in the rainy areas. A long transhumance distance limited lung worm infection, which were higher in flocks using wet night shelters.

Berrag and Urquhart (1996) carried out a survey on lungworm infection in goats and identified 5 species Dictyocalus filaria, Protostrongylus rufescens, Cystocalus ocreatus, Muellerius capillaris and Neostrongylus linearis. from Middle Atlas and Rabat areas of Morocco. The infection rate was almost 100% in both kids and adult goats from both areas with average worm burden of 77.03 parasites per adult goat and 44.16 per kid in Rabat area, and 51.48 parasites per adult goat and 34.06 parasites per kid in the middle Atlas region. High risk of small lungworm infections was recorded in autumn, early winter and late spring/early summer. However, heaviest infection by adult worms and highest larval excretion were observed in late autumn and winter when molluscan intermediate host were heavily infected. The perparturient period seemed to exert a positive influence on prostrongylid larval production. First stage lungworm larvae (L1) output was significantly higher in goats compared with sheep. Suggesting that goats may play a greater role in pasture contamination.

Mazhar et al. (1996) recorded the prevalence of Haemonchus contortus infection in animals slaughtered at Faisalabad abattoir, Pakistan was 65.2 and 47.2% in sheep and goats, respectively. The distribution in different breeds revealed non-significant differences in the prevalence between different breeds of sheep and goats. The rate of infection was higher (74.6%) in female than in male (59.1%) sheep, whereas there was no difference in the prevalence between male and female goats. The prevalence of haemonchosis was higher in both sheep and goats less than 2 years of age (67.1% and 47.8%) compared with those of above 2 years (40.4% and 33.3%). Worm burden was higher in sheep compared with the goats.

Talukdar (1996) obtained the epidemiological survey of helminth infections in goats in Assam, 17 species of Cestodes were recorded. The examination of 630 faecal samples indicated prevalence rate of 8.15, 3.98 and 15.27 % for nematodes, digeneans and Cestodes respectively in young goats, and
corresponding rate of 19.25, 14.20 and 12.56% in adult goats. Autopsy finding revealed 1.09, 1.22 and 2.28% infection in young and 7.88, 10.08 and 8.82% infection in adult goats by nematodes, digeneans and Cestodes respectively. The rate of infection was highest (35.34%) in summer and lowest (13.95%) in winter. The most frequent species (>50% prevalence) were *Haemonchus contortus*, *Trichuris ovis*, *Paramphistomum cervi*, *Bunostomum trignonofcephalum*, *Moniezia expansa*, *Gastrothylax crumenifer* and *Trichostrongylus colubriformis*.

Cabaret *et al.* (1998) indicated that the fertility of worms depended on density (10 to 50% of variance), and presence of *Haemonchus contortus* to a lesser extent. For sheep and goats from several temperate and steppe areas, a good relationship between egg counts and worm burden was established ($r=0.62$). It was much improved when the percentage of *H. contortus*, the most profile species, was incorporated in the model.

Chartier *et al.* (1998) reported that the mean faecal egg counts were significantly higher in pregnant goats during the 2 weeks before (668 versus 242 epg, $p<0.05$) and the 2 weeks after (962 versus 279 epg, $p<0.01$) parturition, compared with nonpregnant lactating doe goats. No significant difference was seen in the composition of larval cultures between the 2 groups of goats, with *Oesophagostomum* infective larvae being found predominantly, particularly at the time of parturition. Pepsinogen and phosphate concentrations as well as blood eosinophil counts were similar between the 2 groups throughout the survey and indicated a moderate larval challenge. The mean prolectin concentration measured in pregnant goats was significantly higher ($p<0.01$) at the time of parturition (298 versus 130 ng/ml) and 4 week after parturition (387 versus 193 ng/ml) than that determined in pregnant goats. Further, a significant correlation ($r=0.03$, df = 79; $p<0.01$) between faecal egg counts and prolectin concentrations was recorded for the pregnant goats during the 4-week period around parturition.

Jithendran (1998) conducted a study of migratory sheep ($n=335$) and goats ($n=158$) of Himachal Pradesh from January to December 1990 showed that 94% were infected with gastrointestinal nematodes. Monthly mean faecal egg counts showed a high intensity of infection in July-September. Overall faecal
egg counts ranged from 236 to 3400 in sheep and 325 to 590 in goats. The main species found (in decreasing order of prevalence) were *Strongyloides*, *Trichostrongylus*, *Haemonchus*, *Bunostomum*, *Oesophagostomum* and *Chabertia*.

Swarnkar et al. (1998) found no significant difference in egg counts on pooled faecal samples from 44 bred and 24 non-bred ewes of 3 breeds (Malpura, Avikalin and Bharat Merino), and there was no appreciable rise in counts made in the perparturient period. Slightly higher egg counts were found from the second week after lambing, with a peak after weaning. It is suggested that the customary periparturient drench could be omitted in these breeds and substituted with appropriate treatment when required, thus providing an adequate, but more economical control programme. Examination and culture of the faeces showed that 18-74% of the parasite present were *Haemonchus contortus*, 14-79% *Strongyloides papillosus*, 3-11% *Oesophagostomum* spp. and 0-6% *Trichostrongylus*.

Arosemena et al. (1999) noticed the prevalence of gastrointestinal nematodes was 95.9% in goats and 83.3% in Sheep. *Haemonchus contortus* and *Trichostrongylus axei* were the predominant species. Other nematodes found included *Trichostrongylus colubriformis*, *Oesophagostomum columbianum*, *Trichuris* spp., *Cooperia* spp., *Strongyloides papillosus* and *Bunostomum trigonocephalum*. The seasonal dynamics of the worm burdens differed between sheep and goats, but the prevalence was low in both species at beginning of the wet season (January, February, March.).

Borecka and Gawor (1999) observed the highest faecal egg counts in the months of September (3120.0 in adults and 4223.1 in kids). The 7 genera recorded were *Trichostrongylus*, *Teladorsagia*, *Haemonchus*, *Nematodirus*, *Cooperia*, *Chabertia* and *Oesophagostomum*. *Mullerius capillaris* were the only lungworm species found. The highest prevalence (100%) and intensity (larvae/g 11.2) of lungworm in adult goats were recorded in May. In kids, peak prevalence (80%) and intensity (LPG 45.6) of lungworm were detected in July.

Gawor and Borecka (1999) indicated that during the grazing season (except July) the prevalence and number of larvae was higher in adults (75-100%;
3.5-18.6 eggs/g faeces) than in kids (0-80%; 0-2.8 eggs/g faeces). In July the prevalence and intensity of infection in adults and kids was 68.8 and 71.4%, and 6.3 and 109.2 eggs/ faeces, respectively. The lower infection of kids was attributed to this being their first grazing season.

Kusina et al. (1999) reported that the infection by helminths showed a distinct seasonal pattern; high during the rainy season and low during the dry season. The trichostrongylid species predominant were *Haemorchus contortus*, *Trichostrongylus*, *Oesophagostomum*, *Bunostomum* and *Cooperia* species respectively. *Fasciola gigantica* and amphistomes egg were also detected, but did not follow a seasonal pattern.

Oge et al. (1999) recorded the prevalence hydatid cyst (*Echinococcus granulosus, Taenia hydatigena* and *Taenia saginata*) as 33.9%, 29.5% and 9.8% in sheep, goats and cattle respectively. *T. hydatigena* had the highest prevalence (27.9%) followed by *E. granulosus* (1.6%) and *T. saginata* in goats. Mixed infections were seen in sheep and cattle but not in goats.

Valcarcel and Garcia (1999) observed a large spectrum of nematodes, *Teladorsagia circumcincta* and *T. trifurcata* being the most prevalent species, followed by *Trichostrongylus vitrinus* and *Nematodirus filicollis*. *Trichostrongylus capricola* recorded a high level of infection despite low prevalence. The total digestive tract community worm number was always > 1000 and was seasonal. The lowest level of infection was found in the winter and rose progressively until the autumn. Females were more frequently infected than males.

2.2 INCIDENCE

Bhattacharjee (1937) listed a checklist of nematode parasite in domesticated animals in Burma. He encountered *Neoascaris vitulorum, Trichuris ovis, Bunostomum sangeri, Dictyocaulus viviparous, D. filaria, Oesophagostomum* spp. *Haemonchus contortus, Mecistocirrus digitatus,*
Nematodirus filicollis, Trichostrongylus colubriformis, Onchocerca spp. Setaria digitata and Thelazia rhodesii in ruminants

Liakos (1955) carried out an epidemiological survey of parasitoses of sheep and goats. Examination of faecal samples from 677 sheep and goats in 114 flocks in Thessaly showed gastrointestinal strongylus in 100 %, Lungworm in 37.5 % and Coccidia in 100 % of the animals. Gastrointestinal Strongyles and Coccidia were present in all flocks, D. dendriticum in 82 %, Lungworm in 51.7 %, Cestodes in 50.9 % and F. hepatica in 7 %.

Endrejat (1964) studied helminths and helminthic diseases in Assam and observed Haemonchus contortus, Oesophagostomum columbianum, Trichostrongylus spp. and Moniezia spp. as common parasites in sheep and goats.

Hiregaudar (1972) encountered Haemonchus contortus, Ostertagia spp., Trichostrongylus axei, T. colubriformis, Cooperia spp., Nematodirus spp. and Bunostomum trigonocephalum from Russian Merino sheep at Nalia (Kutch) in Gujarat state.

Tongson et al. (1981) carried out studies on parasitic fauna of goats in Philippines and described helminths, ectoparasites and protozoa of 1230 goats. Amongst these, 90% were infected with Trichostrongylus spp. 87 % with Haemonchus spp. 85 % with Oesophagostomum spp., 47 % with Strongyloides and 8.7 % Moniezia spp. Postmortem examination of 39 animal also revealed small numbers of Cooperia, Bunostomum and Trichuris ova, Fasciola gigantica, Carmyerius synethes and Faschoederius cobboldi 80 % of 1127 faecal samples were positive for Coccidia, the most common being Eimeria ahsata, E. crandallis and E. granulosa. Blood parasites were not found in 1308 goats examined of 1305 goats 54.7 % were infected with ectoparasites.

Tarazona et al. (1982a) reported the species present in goats and a comparison of their occurrence in goats and sheep. They examined 53 goats, received for diagnostic purpose over a period of 4 years from various Spanish provinces. Gastro-intestinal parasitism was seen in 50 (94.3 %) animals. The prevalence of various genera and species of Trichostrongylus in the different parts of alimentary tract was also tabulated and compared with data from sheep. O.
circumcincta, T. axei, T. capricola, T. vitrinus and T. colubriformis were numerically prominent and T. capricola appeared more numerous in goats than sheep.

Yadav (1983) reported the incidence of helminth parasites in dairy goats by examination of 593 faecal samples and showed that Strongyloides spp. were present in 13%, Trichuris in 11%, Moniezia in 7%, Strongyloides in 4%, Amphistome in 0.67% and Dictyocaulus filaria in 0.44%.

Muslih et al. (1986) carried out clinical survey to work out the incidence of various diseases of sheep and goats. During six years of the study (1979-85) among various diseases highest incidence was recorded for internal parasites (62.28%) which included gastrointestinal parasites with lungworm (17.26%), Lungworm (11.32%), Moniezia (2.84%) and Fasciola (0.72%) followed by protozoal infection (7.53%).

Dhar et al. (1988) while studying the prevalence of Fascioliasis in various species of domesticated animals in different parts of Kashmir Valley indicated that sheep, goats and cattle were all found infected. Cattle showed highest prevalence, goats the lowest and sheep occupied an intermediate position.

Toparlak and Guly (1988) found liver flukes in 248 (62.6%) of the 396 goats examined in an 8-month period (November, 1987-June 1988). Dicrocoelium dendriticum in 197 and Fasciola hepatica in 72, with some animals infected by both.

Irshadullh et al. (1989) reported the incidence of Echinococcus granulosus in different animals in Alighar, Uttar Pradesh. A total number of 20 (2%) of 1208 goats and 6 (6%) of 109 sheep were found to be infected with E. granulosus metacestodes. The frequency distribution of the hydatid cyst in each intermediate host species was over-dispersed and in buffalo, cyst fertility increasing cyst size. Of 2171, 95 and 4 buffaloes, goat and camel cyst examined, 327 (15%), 2 (2%) and 3 cysts respectively were fertile.

Gusbi et al. (1990) inspected locally bred goats for cyst of Echinococcus granulosus. Of 2295 goats, 35 adults (1.5%) had cyst, no kids were
infected. Thirty-one adult goats had infected livers, 28 had lung infections, 4 each had cyst in their kidneys and spleens.

Alvarado et al. (1990) collected faecal samples from 5 goats farms in different parts of Costa Rica. The culture examination revealed 6 helminth genera. *Haemonchus, Cooperia, Strongyloides, Trichuris Moniezia* and *Skrjabinema*. Also identified as *Eimeria ahsata, E. ninakohyakimovae* and *E. crandallis*. Although no diarrhoea was seen, on some farms the animals were in poor condition.

Chartier et al. (1990) reported 17 species of helminths by examination of carcasses of goats in Ituri, Zaire. The most frequent species were *Haemonchus contortus, Trichostrongylus colubriformis* and *Oesophagostomum columbianum*, present in 100, 76.9 and 86.7% respectively. Cestodes (*Taenia tenuicollis* metacestodes, *Stilesia hepatica, Moniezia expansa* and *Thysaniezia giardi*) were present, but hydatid were not found.

Amin Babjee et al. (1990) had examined 66 freshly slaughtered clinically healthy adult indigenous adult goats and reported 16 species of helminth from digestive tract, *Haemonchus contortus, Trichostrongylus axei, T. colubriformis, Oesophagostomum* spp. and *Strongyloides papillosus* being the most common. The animals harbored substantial number of the worms with exception of *Oesophagostomum* spp. The rumen fluke *Paramphistomum* spp., the pancreatic fluke, *Eurytrema pancreaticum* and *Cooperia cruticei* were next most common.

Fakae (1990a) observed the incidence of helminths in sheep and goats in savanna area of eastern Nigeria, *Haemonchus contortus* (87.1%), *Trichostrongylus* spp. (63.8%), metacestodes of *Taenia hydatigena* (30.2%), *Oesophagostomum colubriformis* (22.4%), *Strongyloides* spp. (18.8%), *Cooperia* spp. (17.2%), *Moniezia expansa* (6.0%), *Bunostomum* spp. (4.3%), *Trichuris ovis* (3.5%) *Capillaria* spp. (0.9%) and Paramphistomes (0.9%), mixed infection were most prevalent.

Louw and Reinecke (1991) noticed that the lambs were infected before the age of 8 weeks and harboured large burdens of nematodes before the
age of 14 weeks. The nematodes detected were *Teladorsagia* spp. *Nematodirus* spp. and *Trichostrongylus* spp. *Oestrus ovis* infections were present in 96% of the ewes and 92% of the lambs above the age of 3 weeks.

Szelaagiewicz et al. (1991) examined 2 flocks of goats, first consisted of 13 adult goats and 19 kids 506 months old that grazed on pastures in summer whereas second one consisted of 14 adult goats kept exclusively indoors. Faecal examination showed that all the animals were infected in the first flock and 42.8% in second one. In goats of group 1 the parasites viz *Eimeria* spp. (69.2%), *Fasciola hepatica* (38.4%) *Oesophagostomum* spp. (15.3%), *Bunostomum* spp. (100%) *Trichostrongylus* spp. (23.0%), *Nematodirus* spp. (30.7%) and *Trichocephalus* spp. (38.4%) and in kids *Eimeria* spp. (89.4%) *Fasciola hepatica* (15.7%), *Moniezia* spp. (5.2%) and following nematodes- *Strongyloides* spp., *Oesophagostomum* spp., *Trichocephalus* spp. (5.2%) and *Bunostomum* spp. (15.7%). In-group II *Eimeria* spp. (28.5%), *Trichostrongylus* spp. (35.7%) and *Trichocephalus* spp. (7.1%) were found.

Pal and Qayyum (1992) examined the gastrointestinal tract of 53 Kaghan goats in Swat valley, Pakistan for helminths at abattoirs in Rawalpini. *Moniezia expansa* and *Avitellina centripunctata* were recovered from the small intestine with prevalence of 9.43% and 3.17%, respectively.*Haemonchus contortus* (9.43%) *Ostertagia ostertagi* 81.13%), *O.circumcincta* (66.03%) and *Trichostrongylus axei* (50.95%) were recorded from the abomasae, *T. columbiformis* (73.58%) from the small intestine and *Oesophagostomum venulosum* (22.64%), *Trichuris ovis* (39.62%) and *T. globulosa* (11.32%) from the large intestine.

Pangui and Salla (1992) reported the hydatidosis in goats in Niger. 83 of 4221 goats were infected with Echinococcus granulosus . The main sites of infection were the liver and lungs.

Cantoray et al. (1992) concluded that all the 170 goats killed in abattoirs of Konya region, Turkey. The 28 species recorded with localization and prevalence of infection included 22 species of nematodes, 4 species of Cestodes and 2 digenean species.
Anwar et al. (1993) recorded the prevalence and fertility ratio of hydatidosis at Faislabad abattoir, Pakistan. The prevalence of hydatidosis in goats was 0.55% (115 of 20891) and 0.21% (10 of 4867) for male and female, respectively. None of 3207 kids were infected. The overall prevalence ratio was 0.98%.

Shanmugan et al. (1993) examined 614 goat carcasses and viscera and reported the presence of hydatid cysts, 238 (38.76%). The most commonly affected organs by the cyst were lungs, liver and abdominal cavity. The majority of cysts were fertile, multiple and unilocular.

Hasslinger et al. (1993) coproscopically investigated 70 flocks of sheep and goats. 838 of 882 small ruminants (95.01%) harboured endoparasites. The most common were Dictyocaulus filaria (11.8%), small lung worms (Protstronglids, 58%), Marshillagia (42.7%), Nematodirus (18%), Trichostrongylids (32.2%), Moniezia (6%) and Eimeria (73.5%). No apparent difference between sheep and goats was observed.

Joshi (1994) reported an outbreak of parasitic gastroenteritis in a herd of 25 goats under a sedentary management system in a low hill village in the Kaski district of west Nepal. The major parasites recovered from affected herd were Haemonchus contortus (49.4%), Trichostrongylus spp. (43.5%) followed by Oesophagostomum venulosum (4.2%), Ostertagia circumcincta (2.5%) and Bunostomum trigonocephalum (0.4%).

Malik et al. (1995) collected 10000 faecal samples from sheep and goats from all districts of Punjab and examined coccidial cysts and cultured for the presence and identification helminth larvae. All animals were positive for various endoparasites. 6800 samples were positive for Eimeria spp. The following helminths were detected in >50% of the samples. Dictyocaulus filaria, Haemonchus contortus, Ostertagia ostertagi, Oesophagostomum columbianum, Trichostrongylus axei, Fasciola gigantica and Moniezia expansa.

Anderson and Roberson (1996) examined gastrointestinal and respiratory tracts of 70 adult goats slaughtered at an abattoir in Georgia for helminths and protozoa. All animals had naturally occurring infection with one or
more species of gastrointestinal nematodes. *Haemonchus, Trichostrongylus,* and *Oesophagostomum* were the most prevalent genera (90, 81, and 81%, respectively). *Ostertagia circumcincta* (*Teladorsagia circumcincta*) was recovered from 14% of the goats. Other helminths detected were *Strongyloides papillosus* (43%), *Trichuris ovis* (40%), *Moniezia* spp. (7%), and *Cooperia curticei* and *C. oncophora* (1.4%). Larvae of the lung worm, *Muellerius capillaris,* were detected in the faeces of 68% of the goats, but gross lung lesions were seen in only 47% of these animals. *Eimeria* oocysts were recovered from faeces of 94% of the goats.

Jithendran (1996) observed 335 sheep and 437 goats at a slaughter house in the Kangra Valley, Himachal Pradesh, India, During 1989 and 1990, 28.4 and 19.5%, respectively, were found to harbour liver flukes and/or hydatid cysts. The overall infection rate was 23.3%. *Fasciola gigantica, Dicrocoelium dendriticum, Gigantocotyle explanatum, Echinococcus metacestodes* and mixed infections were found in 7.4, 7.0, 1.9, 4.4 and 2.6% of the animals, respectively. Seasonal variations suggest that transhumance is a factor affecting the prevalence of infection, and it is recommended that animals should be given anthelmintics during their annual migrations.

Nwosu *et al.* (1996) collected gastro-intestinal tracts of 120 (41 young and 79 adult, 10/month) Red Sokoto (maradi) goats and rectal faecal samples from 960 goats (80/month) slaughtered at Ibadan, Nigeria, between May 1991 and April 1992 were examined to assess the prevalence and seasonal changes in the gastro-intestinal helminth parasites Egg types recorded in the faecal samples were those of strongyle. *Strongyloides, Trichuris, Skrjabinema, Dicrocoelium* and *Moniezia* (in 93, 83, 44, 0.9, 2.3 and 31% of the faecal samples, respectively).

Molina *et al.* (1997) reported the prevalence of abomasal nematodes in 151 goats at Grand Canary Island between October 1994 and March 1995. Nematodes were isolated from 56% of the goats, with a mean burden of 691 worms per animal. No significant differences in; prevalence and intensity were found in 4 isoclimatic areas of the island (dry-desert, dry-steppe, temperate-mild,
temperate-cold). The commonest species were *Teladorsagia circumcincta* (65.8% of goats) and *Trichostrongylus axei* (51.9%). *T. circumcincta* predominated in the coastal areas.

Rafique et al. (1997) studied the faecal samples obtained from the rectum of sheep and goats in Baluchistan, Pakistan, for helminth eggs. Fifty of 57 (87.7%) animals were infected with helminths. Overall, *Nematodirus spathiger* was the most frequent parasite (72.7% Prevalence at Kalat but only 6.3% at Quetta), followed by *Trichuris globulosa* (27.3 and 37.5% at Kalat and Quetta, respectively). *Marshallagia marshalli* (6.3%) and *Strongyloides papillosa* (6.3%) were only present at Quetta. Most animals had mixed infections. The average number of eggs per gram of faeces ranged from 291561. Infected animals were generally in poor condition.

Akkaya (1998) observed 100 mohair goats slaughtered in Istanbul, Turkey, for *Trichostrongylidae*. Sixteen species from 5 genera were present in the abomasum: 58% *Trichostrongylus capricola*, 62% *T. vitrinus*, 73% *T. axei*, 11% *T. colubriformis*, 100% *Ostertagia circumcincta* [*Teladorsagia circumcincta*], 84% *O. trifurcata* [*Teladorsagia trifurcata*], 13% *O. occidentalis*, 9% *O. ostertagi*, 2% *O. podjapolskyi*, 1% *O. aegagri*, 4% *O. leptospicularis*, 53% *Marshallagia marshalli*, 22% *M. orientalis*, 18% *Haemonchus contortus*, 5% *Nematodirus abnormalis* and 1% *N. filicollis*. Fifteen species and 4 genera were found in the small intestine: 98% *Trichostrongylus capricola*, 90% *T. vitrinus*, 6% *T. axei*, 25% *T. colubriformis*, 1% *T. retortaeformis*, 1% *T. brevis*, 44% *O. circumcincta*, 3% *O. trifurcata*, 2% *O. occidentalis*, 3% *O. leptospicularis*, 4% *M. marshalli*, 79% *N. abnormalis*, 60% *N. spathiger* and 26% *N. filicollis*. Overall parasite Prevalence was: 99% *T. capricola*, 98% *T. vitrinus*, 77% *T. axei*, 28% *T. colubriformis*, 1% *T. retortaeformis*, 1% *T. brevis*, 100% *O. circumcincta*, 84% *O. trifurcata*, 14% *O. occidentalis*, 10% *O. ostertagi*, 2% *O. podjapolskyi*, 1% *O. aegagri*, 4% *O. leptospicularis*, 55% *M. marshalli*, 22% *M. orientalis*, 18% *H. contortus*, 80% *N. abnormalis*, 60% *N. spathiger* and 26% *N. filicollis*. *T. retortaeformis*, *T. brevis*, *O. leptospicularis*, *O. aegagri* and *M. orientalis* are reported from goats in Turkey for the first time.
Deka and Gaur (1998) examined goats, sheep and pigs slaughtered at abattoirs in 4 towns in Uttar Pradesh, India throughout the year for the presence of hydatid cysts in the viscera. The overall prevalence was highest in sheep (9 of 312), lowest in pigs (27 of 2980) and intermediate in goats (39 of 2710). The fertility rate of hydatidosis was about 80%, being highest in sheep and lowest in goats. No marked seasonal variation in the occurrence of hydatidosis was observed.

Katoch et al. (1998) reported incidence of gastrointestinal parasites in goat and sheep farm in Himachal Pradesh, about 40 sheep died sporadically during January. Faecal samples were collected from 25 adults and 5 lambs that were showing signs of illness. Strongyle infection was found in 24 of adults, but not in lambs. *Haemonchus* larvae in 75.8± 2.29% of the samples, *Strongyloides* in 19.2± 1.53 and *Trichostrongylus* in 5.0± 1.30%. The epg in the faeces ranged from 0-4300, with an average of 1544.

Lannoy et al. (1998) obtained faecal samples from 731 sheep and 524 goats in the 6 districts of Jenin in the Palestinian territories and were examined for gastrointestinal parasites and lungworms. Animals under 6 months of age had fewer parasites (with the exception of those infected with coccidia). Parasitoses were more prevalent on goats than in sheep. The prevalence of infection in the different districts are compared. Most animals were from the district of Nablus, where the infecting lungworm species in increasing order of prevalence were *Dictyocaulus, Protostrongylus* and *Muellerius*. Other Strongyles found included *Marshallagia, Nematodirus* and other Trichostrongylidae. Tapeworms of the genus *Moniezia* were also present.

Rehbein et al. (1998) examined the gastrointestinal tracts of 25 German improved white goats from Saxony, Upper Bavaria and Württemberg, together with lungs and liver from 6 goats from Württemberg. A table shows the occurrence and numbers of 29 species of helminths. The commonest gastrointestinal nematodes were *Ottertail circumcincta, O.trifurcata, Chabertia ovina* and *Oesophagostomum venulosum*. The abomasal worm burden ranged from 140 to 16490, and the duodenal worm burden from 10 to 15520.
Bandyopadhyay (1999) conducted the Coproscopic examination of sheep and goats at Salboni, West Bengal, India, and revealed the occurrence of eggs of *Haemonchus* spp., *Bunostomum* sp., *Trichuris* spp., *Strongyloides* spp., and amphistomes, and coccidial oocysts. Most animals were infected with more than one species. 38 of 50 sheep examined (76%) and 31 of 50 goats (62%) harboured parasitic infections.

Boulanger et al. (1999) evaluated the infectivity of *Schistosoma bovis* cercariae administered orally in Sahelian goats from Niger. Compared to the percutaneous route, a single massive oral dose of 2000 cercariae resulted in a 50% reduction in worm burden and faecal egg count. The tissue egg counts were increased by more than 4-fold. Fecundity of individual female *S. bovis* was, therefore, markedly increased. When cercariae were administered weekly by trickle infection for 20 weeks (100 cercariae/dose), both worm and egg burden were doubled without modification of individual worm pair fecundity. Repeated oral infections appeared to induce an acquired tolerance toward parasite antigens. The results confirm the epidemiological relevance of the oral route in a host species, which has contact with infected dunking water.

Do Dug Dien et al. (1999) studied the 1250 faecal samples and PM examinations of 34 goats from 7 villages in the Kim Bang district for the prevalence of intestinal helminths. Twelve helminth species were identified including 2 species of cestodes, 4 species of trematodes and 6 species of nematodes. Commonest isolates were *Moniezia expansa*, *Fasciola hepatica*, *F. gigantica*, *Haemonchus contortus*, *Mecistocirrus digitatus* and *Trichostrongylus axei*. The prevalence of *Paramphistomum* spp. was 88% and the prevalence of *Fasciola* spp., was 22%. Treatment with CuSO4 ((0.5% solution) at 1 ml/10 kg showed an efficacy of 75% against tape worms while treatment with levamisole at 10 mg/kg had an efficacy of 80-92% against round worms.

Hoste et al. (1999) reported the information on the epidemiology of trichostrongylosis of the digestive tract in dairy goats. Parasite infection was not influenced by the mode of pasture grazing (rotational vs. continuous); several host factors were identified which modulated the development of parasitism. In the
first grazing season, goats, and particularly those in first lactation, excreted more nematode eggs and hence contributed largely to pasture contamination. In addition, the goats within the flock with the highest level of milk production were more severely infected. They were also more susceptible to the impact of parasitism on milk yield. The relevancy of the identification of these animals within a flock as a major epidemiological risk for nematode infection is discussed in relation to a possible targeted application of anthelmintics treatments.

Mandial et al. (1999) indicated that the Haemonchus contortus predominated among the larvae obtained by culture of the faecal samples (51.5%) and in the intestine (172 adult worms), followed by Bunostomum trigonocephalum (45.5% and 36 adults) and Trichostrongylus colubriformis (3% and 23 adults), respectively. The epg of the samples ranged from 1200 to 1400. Lung tissue contained an average of 1.5 worms/g faeces.

2.3 BIOECOLOGY

Barnes et al. (1988) carried out a long-term study at New South Wales, Australia, to investigate the ecology of the free-living stages of Trichostrongylus colubriformis. Results included weekly estimates of the number of the infective larvae on the pasture arising from single applications of contaminated faeces. These were used to construct a mathematical model to predict larval availability on pasture from standard meteorological measurements. The model has 3 components predict from meteorological variables -p, the probability that an egg develops to infective larval stage and migrates to the herbage (X1), the average time that the egg takes to develop to infective larval stage and migrate to the herbage, and E (X2) the average lifetime of an infective larvae on the herbage. The metrological variables used to predict p were evaporation and rainfall in the first 2 days after the eggs were deposited on the pasture, and the lengths of time until an effective fall of rain. E (X1) was described by a function of the average temperature in the first week after eggs were deposited on the pasture and length of time until an effective fall of rain. E
(X2) was predicted by the rainfall and average temperature in weeks 7-10 after the eggs were deposited on the pasture. A value of $R^2 = 0.39$ was obtained over a set of 39 plot. The optimal value for this set of data is $R^2 = 0.76$. The model was adjusted to simulate the pattern of larval availability on pasture arising from continual contamination by grazing sheep with naturally acquired infections.

Amount and Gruner (1989) reported that there was a marked depressive effect by the dry season on eggs hatching and L3 development, with some arrested egg hatching in *Trichostrongylus*. The climatic events and the amount of dry matter on pastures during the grazing period appeared to be the main factor which could interfere with the overall evolution of the L3 population size and there was no preferential direction of L3 migration from faeces to herbage.

Chiejina *et al.* (1989) indicated that during February and May, two cultures of goat faeces (infected with predominantly with *Haemonchus contortus* and *Trichostrongylus* spp.) were incubated in the laboratory at 25-30° C or at a constant temperature of 50° C and free-living development was monitored. L3 development very readily in faeces cultured at 25-30° C and in those spread on a grass plot in October (at the end of wet season), but developed less quickly on the plot contaminated in May (at the start of wet season). Worm eggs in faeces deposited on plots during the hot dry season (December to April) or incubated at 50° C died and disintegrated after 24-48 h exposure. It is indicated that it is unlikely that gastro-intestinal nematodes of goats can develop or survive on open pasture during the dry season in the Nigerian derived Savanna zone.

Rahaman and Collins (1990) studied the levels of nematode egg production in goats and the availability of infective larvae (L3) on pasture, were investigated on a dairy unit in New South Wales, Australia. The output of eggs by adult goats was always above 3000epg. The profile of the graph of larval availability in the herbage paralleled those for temperature and rainfall, suggesting that larval peaks occurred when the temperature and availability of moisture were optimal. A large proportion of *Haemonchus* larvae in the cultures of faeces were collected during summer months.
Fakae (1990a) described the prevalence of endemic gastroenteritis in the savanna area of eastern Nigeria was indicated by the high prevalence of helminths irrespective of the season of the year. The overall trend in helminthosis in the sheep and goats was that of an escalating worm burden during the period of confinement (April-October) and a low worm burden when animals were allowed for range (November-March), these periods corresponding to the cropping and harvest seasons respectively. A strong positive correlation was obtained between the mean strongyle worm burden and the eggs per gram of faeces.

Banks et al. (1990) conducted the experiment on the pasture plots artificially contaminated with known proportion of *Haemonchus contortus* and *Trichostrongylus colubriformis* eggs. The pasture was sampled at regular interval after contamination and infective larvae identified and counted. Larvae of both species developed throughout the year in the wet zone but development was more sporadic in the dry zone. The larval counts generally decline to below levels within 9 weeks of contamination between September and March but longevity increased during the cooler weather from April to August. The comparatively short larval survival time noted in this experiment may present opportunities for manipulation of parasite population dynamics in the wet tropics.

Onyali et al. (1990) indicated the survival and development of infective larvae of *Haemonchus contortus* on pasture throughout the year except during the dry season months December to April in Nigeria. More infective larvae were recorded from herbage in June, July and August than in other months. The survival time of the infective larvae ranged from 2 weeks in October to 10 weeks in June, July and August. Rainfall was the most important epizootiological factor affecting the development and survival of the infective larvae. Temperature was not a limiting factor.

Khallaayoune and El-Hari (1991) assessed the infection of *Fasciola hepatica* in correlation with the dynamics of *Lymnaea truncatula* population. The infective rate was high in winter (23.8% in January) and summer (17.1% in August), and relatively low in spring and at the beginning of autumn. Infected animals had a fluke burden range of 1-48; a mean of 13 was recorded in July.
Lymnaeid snails were observed in their habit throughout the year, but were more abundant during the hot months (July and August). Snails infected with *F. hepatica* were found in February, June, July and August; their infection rate did not exceed 3%. The main periods for transmission of Fascioliasis appeared to be spring and autumn.

Jelenova (1991) the survival of *Moniezia expansa* eggs in the faeces from 6-month-old lambs was investigated at various temperatures under laboratory conditions and test plots outdoors by experimental infection. At the optimum temperature (5° C) in the laboratory 10% of the eggs survived at least 161 days, while at 12, 10 25 and 35° C about 20% survived 28, 105 28 and 49 days, respectively. On grass plots outdoors July and August, with an average air temperature of 15.7-18.2° C and a relative humidity of 67.7-74.3 %, they survived 21-35 days, while in September and October (5.8-14.6° C, RH 65.3-76.7%) they survived 49-91 days, and in November up to 175 days.

Rahaman (1992) observed the faecal egg count pattern followed that of total rainfall. The humid tropical environment was favorable for the development of various species of trichostrongylid nematodes, namely *Haemonchus contortus, Trichostrongylus* spp., *Oesophagostomum* spp. *Cooperia* spp. Generally, *H. contortus* was observed to be the prominent species, more so in the monsoon months of the year.

Chartier *et al.* (1992) studied 57 kid does, taken from their mothers at birth, were raised in a new goat-houses until weaning and anticoccidial treatment at 2 months. When 85 days old, the animals were separated, group 1 was placed on lucern pasture and group 2 was kept in the goat-house, both groups were managed in a common, first in a fold and then on pasture. Coccidian infection was low (<1000 oocysts/g faeces) during the first 3 months, due to almost total absence of environment contamination. Infection intensity rose gradually and peaked in group 1 at 170-200 days; it was significantly higher on day 154 and 183 in-group 1 than in-group 2. The profiles of *Eimeria, E. ninakohlyakimovae* and *E. parva* oocysts for the entire experimental period are
presented. *Trichuris* spp. ova appeared at the age of 112-139 days and remained moderate (≤ 100 epg) during the study period.

Diez-Banos *et al.* (1993) carried out the experiment on goat faeces infected with *Mullerius capillaris* and *Neostrongylus linearis*, were deposited on 3 plots covered with ryegrass, short cut lucern, or tall lucern. The desiccation of faeces and survival of larvae were determined at 1, 7, 14 and 21-day intervals. Survival of *M. capillaries* was much greater than that of *N. linearis* in all plots. The lower desiccations were observed in the 2 other plots. The type of vegetation where faeces are deposited may thus play a part in the parasitic risk presented by a pasture.

Besier and Dunsmore (1993a) investigated the seasonal pattern of development of *Haemonchus contortus* eggs to infective larvae in Western Australia in sheep. The maximum recoveries occurred in late autumn and in late spring, when adequate moisture coincided with warm temperature. Larval development was low and sporadic over the hot and dry summer period, and dressed during winter, although most egg deposition in winter yielded L3 at same time. The proportion of L3 recovered was related to temperature and moisture parameters, and the major constraint appeared to be the availability of conditions for the development of *H. contortus* was the proportion of green pasture material present, based on a visual assessment.

Besier and Dunsmore (1993b) noticed that during hot and dry summer, when the pasture was completely dry, L3 often failed to develop or were recovered on only a single occasion and the mean larval survival period on positive plots was less than 5 weeks. In contrast L3 deposited on green perennial pasture plots in summer were recovered for up to 4 months in faecal pellets and on pasture. The longest periods of larval survival were associated with the lowest temperature and highest rainfall recordings, and with the greatest quantity of green plant material in the pasture. It is suggested that the poor survival of L3 during the dry summer period could be used in a strategic treatment programme to
sufficiently moist microclimate to permit the survival of *H. contortus* L3 despite otherwise unfavorable environmental conditions.

Douch and Morum (1993) indicated that sheep aged 16-28 months are no more able to resist short-term primary nematode (*Haemonchus contortus Trichostrongylus axei, cooperia* spp. *Nematodirus* spp.) challenge than lambs, but more rapidly express a mucosal globule leukocytes / mucosal mast cells (GL / MMC) response and suppress nematode count in their faeces.

Gurner and Suryahadi (1993) demonstrated that the development of *Teladorsagia circumcincta, Trichostrongylus vitrinus* and *Chabertia ovina* were very low in spring and summer in dry plots but proportional to the duration of submersion I the irrigated plots. *T. circumcincta* was mainly favored in spring, *T. vitrinus* in summer, but higher rates were observed in autumn. The action of water had more effect on freshly deposited faeces. In laboratory experiments on *T. circumcincta, T. vitrinus* and *Haemonchus contortus*, the submersion of cultures was unfavorable to egg development but favored L1 development. Cultures with different faecal water contents (FW simulating submersion (for 7-16 hr.), alternate spraying and dehydration. Or contents of 60 and 50% led to the conclusion that high FWC favored the development of *T. vitrinus*, had some negative effects on *T. circumcincta*, while *H. contortus* was more susceptible to variations of FWC. The FWC had an effect on the size of L3 obtained at low FWC was decreased. These findings could explain the absence of *H. contortus*, as well as the abundance of *T. vitrinus* on the pastures studied.

Jallow et al. (1994) noticed that the number of larvae per kg. of green grass were lower than on green clover, the most heavily contaminated portion of the pasture was the mat of dead herbage on the ground. The diet selected by the goats contained more green grass and dead herbage and less clover that of sheep. Goats ingested 643 infective trichostrongyloid larvae per kg dry
interrupt the transmission cycle of *H. contortus* in winter rainfall climates. However, areas of green pasture, which persist in summer, may provide a sufficiently moist microclimate to permit the survival of *H. contortus* L3 despite otherwise unfavorable environmental conditions.

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matter intake (DMI) versus 274 per kg DMI for sheep in autumn, increasing to 1892 versus 1143 in early winter. The heavier trichostrongylic burden of goats compared with sheep, when grazed together, are due in part to greater rates of infection consequent on different grazing pattern as well as greater susceptibility to infection.

Amarante and Barbosa (1995) reported the *Haemonchus* and *Trichostrongylus* were found most frequently, *Haemonchus* larvae counts on the pasture peaked in June or July. The highest counts for *Trichostrongylus* larvae also occurred in the autumn and winter while the lowest counts were observed in the hot and rainy months. The highest incidence of helminthiasis occurred during September and October. When the highest faecal egg counts in ewes were recorded.

Paciejewski (1995a) incubated the faecal samples from naturally infected sheep in rotation every 12 hr, between 17-24°C 4°C or 24°C and −10°C for 54 days. The first larvae of *Haemonchus contortus* and *Ostertagia circumcinta* were seen in 4 and 24°C samples after 33 days and the highest number of larvae occurred on day 42-45 and accounted for 19% of larvae incubated in control samples at 24°C. In samples incubated alternatively at 24°C and −10°C first larvae of *H. contortus* and *O. circumcincta* were observed after 48 days and accounted for 3% of larvae in control samples. The invasive larvae of *O. circumcincta* (410-456), 4°C and −10°C survived 35, 85 and 180 days respectively.

Further in 1995(b) Paciejewski collected the grass from experimental fields in Poland on which gastrointestinal nematodes were cultivated and dried at room temperature (16-26°C). In one sample of grass 254 invasive larvae were present. They were identified as *Haemonchus contortus* (64%), *Ostertagia ovina* (10%), and *Oesophagostomum venulosum* (2%). After 6 days of the experiment the grass was dry and contained only 16.5% of viable larvae. Approximately 47.2% of the viable larvae were found on the bottom of the dish. After 12 days of the
experiment viable larvae were completely absent on the grass and after 18 days of drying no viable larvae could be found on the bottom of the dish.

El-Azazy (1995) noticed that the overall worm counts and infection rates were lowest in the winter. Larval inhibition plays an important role in Marshallagia life cycle, since this parasite survives the dry season as arrested larvae. By the contrast, Inhibition of Haemonchus was pronounced and the parasite survived the same season as adults and larvae. Although the phenomenon of hybiosis was observed, the number of inhibited larvae was too small to be expected to induce clinical symptoms after resumption of development.

Thamsoborg et al. (1996) concluded that the level of ovine nematode infection, especially Trichostrongylus spp. in weaned lambs increased with increasing stocking rate even though pasture production was enhanced by increased rates of fertilizer application.

Luzon et al. (1997) reported that the highest prevalence was detected in pasture irrigated by the Esla canal (90% of flocks, 58% of animals) and by the Benares canal (75% of flocks, 35% of animals) and in sheep grazing in areas near to the Duero river (78% of flocks, 23% of animals). Prevalence was high in sheep grazing mountain pastures (60% of flocks, 9% of the animals). Lower prevalence (17-33% of flocks) were detected in sheep grazing in wet highland areas and in cereal-growing areas in spite of the presence of rivers or irrigation canals.

Swarnkar et al. (1997) studied the seasonal pattern of development and survival of Haemonchus contortus eggs to infective larvae on pasture was investigated in a semi-arid region of Rajasthan. Sheep faeces containing H. contortus eggs were deposited on the pasture plots over a period of 1 year. Development to infective larvae and their survival took place between July and October, with the maximum number of infective larvae being recovered during the monsoon. The survival time of the infective larvae varied from 1 (January) to weeks (September). Development of eggs to infective larvae took place when the mean daily rainfall was <4.50 mm.
Gatongi et al. (1998) found statistically, a higher proportion of hypobiotic larvae was found during the dry months than during the wet months, an indication that hypobiosis was an important feature in the survival of *Haemonchus contortus* during the dry months. Negligible worm burdens were acquired by the tracers during the short rains, suggesting that few *H. contortus* larvae survived on pasture in this season. The effectiveness of strategic control using ivermectin varied according to the timing in relation to the wet season. Treatment did not influence the seasonal pattern of hypobiosis but the treatment administered before the onset of the rains significantly reduced the number of both hypobiotic larvae and the adults worms. Treatment during the rains conferred a temporary relief of adult worm burden but had no impact on hypobiotic larvae.

Moskwa et al. (1998a) reported that the ewes were drenched with oxfendazole (systamex, 5 mg/kg) in May 1996 but not in 1995. The epg were estimated by the modified McMaster method and were transformed by log (epg+1) prior to analysis. Meteorological data were collected to evaluate the influence of rainfall and temperature on the faecal egg counts. There was substantial variation among individuals in their epg. Several nematode species were present but *Haemonchus contortus* and *Trichostrongylus* spp. were dominant. The mean count and comparison of the nematode population was influenced by the weather conditions. *H. contortus* was the main egg producer during the period of high mean counts when the temperature and rainfall were highest. The correlations between epg in successive samples were positive and almost always significant.

Silva et al. (1998) noticed the most prevalent nematodes in decreasing order were *Trichostrongylus colubriformis, Haemonchus contortus* and *Oesophagostomum columbianum*. Age of the goats did not appear to be a factor in resistance to infection. Worm burdens of 11-to 12-month-old animals were significantly higher (P<0.05) than those of other age groups.
Yilma and Malone (1998) examined the monthly *Fasciola* risk indices of 4 climatic regions in Ethiopia and transmission patterns of *F. Hepatica* could be identified. In the humid west, cercariae shedding were predicted to occur from May to October. In the south it occurred from April to May and September to October, depending on the annual abundance of rain. In the north-central and central regions, risk was highest during heavy summer rains and pasture contamination with metacercariae was predicted to occur during August-September, except in wet years, when it could start as early as July and extend up October. *F. gigantica* risk was present in the western, south and north-central regions of the country at altitudes of 1440-2560 m. However, a transmission cycle could be completed in a single year only at elevations below 1700 m. The greatest risk of *F. gigantica* infection was in the humid western regional strategic chemotherapy schemes of 2 or 3 treatments per year were developed.

Almeria and Uriarte (1999) studied the pasture contamination with larvae of gastrointestinal nematodes over 4 years in a herd of 200 beef cattle (Alpine and Pyrenean) grazing at altitudes between 800 and 2100 m north of Jaca in the Spanish Pyrenees. Seasonal variation was affected by altitude, with maximum faecal and pasture larval counts occurring in October (20 larvae/kg faeces) and February (7.5 larvae/kg herbage) in lower pastures and in December (7 larvae/kg faeces) and February (12 larvae/kg herbage) in high meadows, respectively.

Claxton et al. (1999) reported that the *Lymnaea viatrix* snail development at a rate dependent on environmental temperature, but development at least as well under conditions of varying temperature as at same mean constant temperature. *Fasciola hepatica* eggs held at constant or varying temperatures, developed at a rate comparable to other reports. However, eggs developing at varying temperatures appeared to have reduced hatchability. Parasite development in side the snail was slow, though within limits calculated from the literature and
varying temperature did not appear to reduce development compared to constant temperature.

Giudici et al. (1999) estimated the species diversity by Shannon diversity index (main species or all species). It was higher in the mixed grazing group than in lambs that grazed alone. Diversity increased in successive controls. This was due in part to infection with *Cooperia* spp. of cattle origin. The increased in diversity in the mixed grazing lambs corresponding to the lowered faecal egg excretion and better weight gains recorded previously in that group. There seemed to be no cross-transmission of *Haemonchus similis* in heifers and *H. contortus* harboured by lambs. The latter species was not morphologically or genetically different in the lambs grazed alone or with heifers, indicating that the presence of cattle did not modify quantitatively the transmission of *Haemonchus contortus*.

Raman *et al.* (1999) examined the pasture samples from 4 villages in the Madras region for *Strongylus* larvae. The highest larval burden was detected between October and January ranging from 28.09 to 100.43 larvae per kilogram of forage on dry matter basis with the peak in November and December. Larval burden decreased between February and April and further decreased in May and September. No larvae were detected in August. It is concluded that the maximum larval burden coincided with increased rainfall (300-480mm) and lower temperature (20.8-29.3° C).

2.4 CLINICAL OBSERVATIONS:

Nascimento *et al.* (1988) reported that the hookworm, *Gaigeria pachyscelis*, probably reached Brazil in goats from Asia or Africa. An average number of 70 adult worms can kill a sheep, but only 17 were needed to kill a goat. Anorexia develops 4 to 5 weeks after experimental infection. Anaemia occurs from the 4th week after infection with 2400 larvae and 15 weeks after infection
with 150 larvae. The worm causes severe lesions at point of attachment to the intestinal wall, where chronic necrotic enteritis develops.

Alvarado et al. (1990) collected faecal samples from 5 goats farms in different parts of Costa Rica. The culture examination revealed 6 helminth genera. *Haemonchus, Cooperia, Strongyloides, Trichuris, Moniezia* and *Skrjabinema*. Also identified as *Eimeria ahsata, E. ninakohlyakimovae* and *E. crandallis*. Although no diarrhoea was seen, on some farms the animals were in poor condition.

Gogi et al. (1992) cyst location and symptoms were correlated in 9 goats from India with *Coenurus cerebralis (Taenia multiceps)* infection. Cysts located in the cerebrum correlated with depression, tilting of the head either right or left, head pressing, feet stamping or walking in a straight line. Hyperexcitability with a broad based stance was noticed when the cyst was involved with the cerebellum. Cysts were mostly located in the cerebral cortex and particularly in the cerebellum of the brain. Cysts were not found caudally beyond the cerebellum.

Joshi (1994) reported the major signs in parasitic gastroenteritis in goats were diarrhoea, bottle jaw (maxillary oedema), loss of appetite and inability to move. Five adult and two young out of 25 were died. Examination of 12 representative faecal samples from the affected herd showed heavy infection of gastrointestinal nematode parasites.

Handeland and Skorping (1993) reported the Clinical observations of 17 goat kids inoculated with 100-1000 infective larvae of *E. rangiferi* and killed 21-154 days post inoculation (p.i.). Pruritus was common in the period 4 to 10 weeks p.i. Six animals showed neurological signs starting 35 to 94 days p.i. The most frequent sign was posterior paresis. Other signs included cranial nerve paresis, ataxia, lameness, scoliosis, reduced vision, abnormal behaviour, depression and mental confusion.
Larsen et al. (1995a) indicated that the syndromes of diarrhoea “winter scours” which affects Merino sheep in Australia during winter and spring is compared with the syndrome of diarrhoea in UK which is unresponsive to anthelmintics drenches. It is suggested that the selection of resistant lines of sheep (usually on the basis of low faecal counts) may inadequately select sheep that suffer significantly more diarrhoea because of an increased hypersensitivity response to nematode larvae.

Taylor and Kenny (1995) described that the chronic mild diarrhoea syndrome that is caused by chronic larval nematode infections, which occurs at the end of the summer in relatively overstocked upland farms producing store lambs.

Brito et al. (1996) demonstrated the clinical signs in Oesophagostomum colubriformis infected goats. The signs were apathy, anorexia, pale mucosa, intermittent diarrhoea, moderate hypothermia and small weight gain or weight loss. The result showed that the strains used in the experiment were pathogenic to goats during the prepatent period, and that the infective dose used was adequate for the production of moderate clinical disease.

Magzoub et al. (1998) demonstrated the experimental infection of 14 Neime lambs with the camel parasite Haemonchus longistipes resulted in a transient anaemia in the 5th week, when blood urea levels and egg numbers in faeces reached their peaks. The lambs were killed 10 weeks after infection, and postmortem examination revealed worms (reduced size) in the abomasum, there were haemorrhages and inflammatory changes at the site of attachment of the worms.

Pienaar et al. (1999) observed the clinical signs included transient diarrhoea, misshapen, elongated faeces pellets terminally, dehydration, anorexia, cachexia, gnashing of teeth, foaming at the mouth, anaemia and nervous signs such as ataxia a wide-based stance. A pushing syndrome was seen in 22% of animals.
Demiaszkiecz et al. (1999) recorded the clinical symptoms of *Elaphostrongylus cervi* (*Nematoda Prostostrongylidae*). The goats showed an increasing paresis and paralysis of extremities. The goats infected with higher doses developed mucosal rhinorrhea, coughing and breathlessness and died 18 days after infection. The goats infected with lower dose developed a chronic form of the disease and died 117 days after infection.

### 2.5 Faecal Egg Counts

Spedding (1952) reported considerable variation in faecal egg counts in samples taken at different intervals throughout the day from sheep. He suggested that where attempts are being made to detect slight difference in infection counts should be made on sample drawn from well-mixed daily faecal output of the animal. Brambell (1963) found no significant variation in faecal egg counts as a result of collection at different times and reported a negative correlation of egg concentration and daily faecal output. There was however, no significant correlation between egg concentration and dry matter content of the faeces. Day to day variation was found to be much less, when total daily output of eggs was used, then with egg per gram of faeces. Attempts were also made to apply correlation for Variation in egg counts resulting from differences in faecal consistency.

Southcott (1955) gave the factors as normal faeces 1, soft pellets 1.5, unformed 2.0, and soft and diarrheic 3-4 in the faecal sample of sheep and goats.

Morgan et al. (1957) showed evidence of the part played by an increased fecundity of existing female worms as circumstantial, thus the nematode faecal egg counts of ewes were higher if they were subjected to excessive stress such as extremes of weather and poor nutrition.
Powere et al. (1960) reported that eggs shed during one year survived the winter and embryonated in spring and early summer.

Muller (1962) conducted survey in the winter rainfall region of the Cape Province and showed definite trends and patterns in e.p.g. with a quiescent period over summer months.

Seasonal variation in Trichuris ovis infections has been reported by Schmid (1933-34). There was an increase in egg production during summer. In Wisconsin 45 percent of lambs were found to be infected in June, 97 per cent in September and 11 per cent in the month of May of the following year.

Levine and Clark (1965) found variation in the dry matter contents of samples, which appeared to have about the same consistency.

McManus and Arnold (1965) observed that the faecal egg counts of young sheep from July were substantially higher (2000 e.p.g. and above) and 1900 e.p.g. in faeces were recorded in the spring season of the same year. The count declined in early summer.

Nunns et al. (1965) recorded a steady increase in mean egg count in untreated lambs reaching 620 e.p.g. in September, 1963; while the same was about 10 in May, 1963.

Kingsbury (1965) made a comparison between faecal egg counts and worm burdens in 148, 5 to 12 months old sheep. The minimal significant Trichostrongylus egg count was 500 e.p.g. counts of 550-2000 e.p.g. signified all levels of worm infestation. 41% of cases were associated with more than 4000 worms. Some heavy worm infestation was found in sheep with egg counts of only 550-1000 e.p.g., 80% of egg counts in excess of 200 e.p.g. indicated the presence of more than 400 worms and out of 23 sheep with e.p.g. of 3000 or more were infected with Haemonchus contortus.

Brunsdon (1967) conducted a trial to obtain further information on the seasonal fluctuations in the faecal egg counts of breeding ewes and also to
ewes had significantly higher egg counts of *Haemonchus contortus*, *Trichostrongylus* spp. and *Ostertagia* spp. than the non-pregnant ewes. There were more *Ostertagia* spp. and *T. colubriformis* and fewer *H. contortus*.

Boag and Thomas (1971) reported the pattern of infection with gastro-intestinal nematodes in ewes and lambs on clean and autumn contaminated pasture; the study followed by faecal egg counts and pasture larval counts, lamb weight gain and post-mortem worm counts.

Tassi and Widenborn (1973) studied the seasonal variation in the faecal egg counts of gastro-intestinal strongyles in sheep in Central Southern Italy, Sicily and Sandinia. The 3 years survey involved 505 flocks totaling 1,63,798 sheep of which 4.4% underwent individual faecal examination. There was uniform infection rate of 76% faecal egg count, which peaked in February, March and August-September and was minimum in January and July.

Jambre and Royal (1976) reported that the Angora goats did not develop the same degree of resistance as sheep and appeared to be little or no difference in the initial faecal egg counts of the 15-month-old goats and sheep. As the experiment progressed, the sheep became resistant whereas the goats continued to show increasing faecal egg counts.

Loyd and Soulsby (1978) carried out the survey to study the prevalence and intensity of parasitic infection in goats. Faecal samples were examined from 336 goats in South-Eastern Pennsylvania and Northern Maryland. On the basis of faecal egg, oocysts and larval counts the cimerian oocysts were found in 100% of the faecal samples and the greatest faecal oocysts counts were found in goats less than 6 months of age. Strongyle eggs and Strongyloides eggs were present in 76% and 20% respectively and *Moniezia* eggs in 9%, *Trichuris* eggs in 4% and *Nematodirus* eggs were seen in 1% of the samples.

Roberts and Swan (1981) studied the relationship on faecal eggs and adult worms in the abomasum. These were counted and differentiated in 61 sheep
selected from a flock infected with \textit{Haemonchus contortus}. Faecal egg counts were highly correlated with the total number of adult worms.

Dhar et al. (1982) conducted post-mortem examination of 62 sheep of Karnal breed for a period of 1 year, at Handwara, Northwest of Kashmir valley. In abomasum and intestinal tract the infestation rate in adult sheep ranged from 85-100 \%. The species found were \textit{H. contortus}, \textit{T. axei}, \textit{Nematodirus spathiger}, \textit{Skerjabinema ovis} and \textit{Trichuris ovis}. Infection rate of \textit{T. axei} was 57.2\% and \textit{T. colubriformis} was 40.2\%.

Nicoles \textit{et al.} (1985) indicated that the \textit{Haemonchus contortus} accounted for half the larvae cultured from faeces between June and December and \textit{Ostertagia circumcincta} for 30\%. \textit{Trichostrongylus axei} was present throughout the year, peaked in June at 20\% and \textit{Oesophagostomum venulosum} was accounted for 2.89 \%.

Benjamin (1988) reported the helminth in Nigerian sheep and goats. For all groups faecal egg count was below 500 e.p.g. in April, there after it rose gradually reaching mean peak value of 140, 715 and 650 for animals in groups A, B and C respectively as against 2700 observed for the control group D (p<0.01). Egg counts fluctuated in groups and peaked again in November. PCV were lower for animals in group C until the month of December. PCV for A and B were similar.

In their work, Gupta \textit{et al.} (1988) indicated post-mortem worm counts at low infection with \textit{Haemonchus contortus} occurring throughout the year except in June, however 25 or more \textit{H. contortus} per lamb, were recorded in January, April, May and August. \textit{Trichostrongylus colubriformis} infection was detected throughout the year and 150 or more worms per lamb were recorded during January to May and in the month of August. Low infection with \textit{Oesophagostomum columbianum} and \textit{Trichuris ovis} were observed. The faecal egg count from the permanent flock with which the tracer lambs were grazed revealed heavy to mild worm burden throughout the year. Negligible infection
with *O. columbianum*, *Bunostomum trigonocephalum*, *Gaigeria pachyscelis* and *Dictyocaulus filaria* was also observed.

Vercruysse (1988) examined 2545 sheep faecal samples (including 162 with diarrhoea) for gastrointestinal parasites. The mean intensity of infection with strongylides (*Haemonchus contortus* and *Oesophagostomum*) was 2400 and 1200 epg in sheep with and without diarrhoea, respectively; corresponding values for *Strongyloides papillousus* and *Eimeria* were 850 epg, and 14000 e.p.g respectively.

Cabaret *et al.* (1989). Observed the output of eggs in faeces was positively related to the presence of *Haemonchus*, predominance of the Alpine breed, use of benzimidazoles, and number of hectares of pasture/goat. Larval output of *Mullerius capillaries* was positively related to age of goat, number of hectares of pastures/goat, presence of unimproved pasture and predominance of the Alpine breed. Occurrence of Moniezia was found to be related to any variable. Milk production was negatively correlated with *Mullerius* infection and the number of kids/goat was negatively correlated with the use of benzimidazoles and with strongyle infection.

Nicholls and Obendorf (1994) observed the nematode egg count from a simple composite faecal counting equal amount of sample from 10 sheep were compared statistically against the arithmetic mean of the same 10 samples prepared by a conventional egg count method. Forty separate data set were analyzed in an untransformed bivariate plot and after natural logarithmic transformation. A sign test analysis indicated a high degree of similarity between the 2 data sets. A confidence interval for the composite count (n=10) was calculated to give a result between 5 eggs more and 15 eggs less than the arithmetic mean count of the 10 samples. When multiple faecal samples are to be examined, the composite method has significant advantage in time saving and increased throughout whilst still providing an accurate result. This technique has
been used to monitor gastrointestinal helminthosis and for faecal egg count reduction testing to assess anthelmintics efficacy.

Le Jambre (1995) indicated that the relationship of the log blood loss to log worm number, to log biomass of infection in each sheep and to log total egg production in the parental species was linear. Biomass was no better an estimator of blood loss than was worm number. There was no improvement in the estimation of blood loss by regressing the male and female worms separately. In all of the analyses, there was no improvement by regression Haemonchus contortus and H. placei or their hybrids separately. It is concluded that egg production was not a major factor in the requirement for blood by Haemonchus.

The size of individual female worm was negatively correlated with the number of worms in the infection. The linear nature of the relationship of blood loss to worm number, worm biomass and worm egg production indicated that sheep have very little control of blood loss and that the limitation of the pathology of Haemonchus infections is likely to be exerted at the establishment stage of the infection.

Israf et al. (1996a) used the correlation analysis to assess the validity of the faecal egg count (FEC) technique in determining worm burden in caprine gastrointestinal helminthiasis. Faecal egg counts prior to natural death and total worm count of the entire gastrointestinal tract of 17 kid goats that had been submitted for necropsy were performed. The worm species present included Haemonchus contortus and Trichostrongylus colubriformis. Among 8 kids of <6 months old there was a significant positive correlation between FEC and worm burden (p=0.0001) and the total pathogenic index (TPI, a point system where number of worms are weighted according to their relative pathogenicity) (p=0.001). Among 9 kids >6 months old, a significant positive correlation existed between FEC and H. contortus populations (p=0.01) and the TPI (p=0.01). However there was no correlation between FEC and T. colubriformis burdens.

Almeida and Clemente (1996) sampled twelve sheep from natural pastures in Madeira for faeces in the spring. The samples from each sheep were
divided into 4 to 8 portions of 3 g and analysed by the McMaster method for faecal egg burdens. Altogether 61 analyses for Strongyloid eggs and 39 for coccidial egg were performed. 53 samples from sheep with experimental nematode infections were also analysed by the McMaster and Willis methods and parasite culture for Strongyloid and Coccidial eggs. 62 and 56 % of the faeces samples from the 12 sheep were positive for strongyloid and coccidial eggs, respectively, by the McMaster method. An analysis of the results showed, however, that 52% of both results had the same probability of being negative. A further statistical analysis also showed that the McMaster results did not display binominal distribution but were strongly biased to the, with large interval variations and 0 as the model value. Of 53 sheep, 46 and 34 were positive for strongyloid eggs and 23 and 12 for coccidial eggs by the Willis and McMaster methods, respectively.

Aguirre et al. (1998) compared the sensitivity and efficacy of 3 techniques for Fasciola hepatica diagnosis in faecal samples of cattle (n=30) and sheep (n=24) raised in fascioliasis endemic areas in Argentina. The samples were assessed by 2-sedimentation techniques and by a combined filtration, sedimentation and potassium mercuri-iodide flotation method (McMaster technique). These 3 techniques detected 24(80%), 27 (90%) and 30(100%) infected cattle (p<0.05) and 17(70.8%), 20 (83.3%) and 22 (91.7%) infected sheep (p>0.05), respectively. The mean number (± S.D.) of F. hepatica eggs counted by each technique was 10.9± 13.10, 33.3± 51.50 and 33.2± 47.82 for sheep(p<0.05), respectively. The minimum time to detect F. hepatica eggs was significantly lower with the McMaster technique (p<0.05) for both cattle and sheep samples.

2.6 IMMUNODIAGNOSIS

Arriaga et al. (1989) showed that (either) crude somatic antigen and a metabolic antigen of adult Fasciola hepatica was suitable, the most reliable tests
being the intradermal test (990-93% sensitivity, 97%) specificity and the thin layer immunoassay (80-83% sensitivity, 97-100 % specificity).

Banerjee and Singh (1991) conducted immunodiagnosis pf 6-9 month old lambs, experimentally infected with 200 Fasciola gigantica metacercariae , using double diffusion (DD) , capillary tube agglutination ( CAT ) and indirect haemagglutination (IHA) tests, was attempted. Sera from lambs 5 weeks post infection, showed a single precipitin line in DD test and remained positive up until week 12 (limit of observation). Sera from lambs treated with Fasinex and Zanil ( Oxyclonanidw ) gave negative results. A positive CAT reaction was also observed from 2 week post infection until week 12, although the test become positive after 4 8 h. Treated lambs showed negative reactions. A positive IHA titre 1:80 was detected at 2 weeks post infection and the test remained positive until 12 weeks . After 5 weeks infection, the IHA titre was 1:32. Again, no treated lamb gave a positive reaction.

Georgieva (1991) evaluated the diagnostic value of 4 immunological techniques in lambs infected with 4000(1), 10000 (2) and 20000(3) Taenia ovis ova at intervals from 10 to 2000 days after infection, as well as in lambs with natural infections. Haemagglutination and CIEP were more sensitive and specific than IEP or immunodiffusion. The percentage of positive reactions was dependent on infection intensity and duration. In-group 1, CIEP and haemagglutination reached a maximum (62.5%) of positive results on day 60-70 and 40-50 respectively. In-group 2 and 3, CIEP reached a maximum of 75 % on the day 69-90 and of 100% on the day 80-90 respectively and haemagglutination reached maximal of 75% on days 50-60 and 87.5% on day 40-50 respectively. The use of both tests is recommended.

Pathak and Gaur (1992) used single radial immunodiffusion tests (SRDT) was used to detect antibodies to porcine cysticercosis in relation to its cross reaction with infections involving the cystic phase of infection by Taenia hydatigena and Echinococcus granulosus. The test was performed using crude
scolex antigens of *C. cellulosae*. Antibodies were demonstrable in rabbit hyperimmune serum and sera from experimentally infected pigs with *C. cellulosae*. Detectable zones were formed by antibodies containing pig serum after 24 h of incubation. No zone appeared with pig serum containing *T. hydatigena* or *E. granulosus*. Zone diameter increased up to 8 h, but only slightly thereafter. A liner relationship between the zone surface and antibody concn was found.

Ambrosi et al. (1993) used coprological examinations by McMaster, Baermann and larval culture techniques on 760 herds (25392 sheep). The anthelmintics programme involved 3 treatments a year. The parasites present were *Moniezia, Fasciola, Dicrocoelium, Trichostrongylus, Ostertagia, Chabertia, Nematodirus, Bunostomum, Cooperia, Oesophagostomum, Strongyloides, Trichuris, Dictyocaulus, Mullerius, Cystocaulus and Protostrongylus*. Prevalence of most helminths decreased over the monitoring period. It is concluded that coprological examination is a useful guide to the level of helminth infections in flocks of sheep.

Cutillas et al. (1995) indicated that lactate dehydrogenase (LDH) is considered to be an important diagnostic tool for differentiating between species of *Dictyocaulus*. The LDH isoenzymatic pattern in *P. rufescens* was identical in both male and females, appearing as a single cathodic band.

Satya and Kalita (1999) compared the results of disc electrophoresis of serum and cyst samples from 6 adult goats with clinical sings of *Taenia multiceps* cysts in the brain were compared before and after surgical removal of the cyst and with serum samples from 6 healthy controls. An extra protein band below the β2- globulin band was detected in the serum of the affected sheep before surgery. It was not present 30 days after cyst removal or in the controls.

2.7 HAEMATOLOGY:
Robert and Swan (1981) reported the quantitative aspect of ovine Haemonchosis and relationship between total worm counts of *H. contortus*, haemoglobin values and body weight. They observed that, when haemoglobin levels become moderately depressed (10.5 g %) or severely depressed (8.0 g %) than the number of worms associated with these haemoglobin levels varied with the body weight of the sheep.

Cameron (1957) reported that blood picture in haemonchosis in sheep and goats resembled those of pernicious anaemia of human beings.

Clark *et al.* (1962) indicated that each specimen of *Haemonchus contortus* caused an average blood loss of 0.049 ml per day.

Soulsby (1965) reported that in animals with heavy infections, fresh blood may be seen in the faeces and there may be general jaundice associated with hypochromic microcytic anaemia. He opined that the traumatic action of the embedded parasite caused irritation, resulting in an inflammatory response, sometime with haemorrhages.

Georgi and Whitlock (1967) reported that the anaemia is one of the clinical signs commonly associated with haemonchosis in sheep and found positive correlation between exposure to *H. contortus* infection and onset of erythrocyte loss in sheep, supporting the assumption that blood loss leading to anaemia was caused by *H. contortus*.

Bratanov (1968) reported in experimental *T. ovis* infections in lambs, described erythrocnenia, leukophilia, leucocytosis and low haemoglobin content.

Mishra and Ruprah (1968) reported the haematology of infected and control lambs to determine the degree and type of anaemia caused by *H. contortus* infection; because this parasite is known to be the virulent bloodsucker.

Ogunsusi (1978) reported the blood values of sheep suffering from acute and chronic helminthiasis. He observed that acute infection with *Haemonchus* and *Trichostrongylus* was characterized by a rapid increase in helminth egg output coupled with rapid decline in the values of packed cell
volume (PCV), haemoglobin (Hb) and red blood cell (RBCs). Fluctuations were observed in the leukocyte count.

Bhargava (1980) reported the haematological studies in goats. Blood samples were collected from 50 goats and values obtained were erythrocytes 8.5 - 12.5 million/mm³, Haemoglobin (10.09 g/ml), Neutrophils (39 %), Lymphocytes (57.7 %), Monocytes (2.12 %), Eosinophils (1.12 %) and Basophils (0.04 %).

Tarazona et al. (1982b) studied in detail clinical, haematological and biochemical characters of 14 goats received from the field for diagnosis together with faecal egg counts and gastro-intestinal worm counts. Parasitism due to Trichostrongyles appeared to be of some importance in goats, which were not treated with anthelmintics. High egg counts and worm counts were recorded in the animals examined and anaemia, low serum albumin and high values of gamma globulin were noted. Ostertagia spp. and Trichostrongylus spp. were predominant and goats appeared to be a very sensitive to ostertagiasis type II.

Momin (1984) reported the haematological study indicating that during the monsoon season the parasitic load was high and value of the Hb, RBCs, WBCs, and PCV was low.

Palacio et al. (1985) studied the relation between leukocyte formula and gastro-intestinal parasites of goats. They collected blood and faecal samples from 115 pirenaica goats, aged 1-5 years in various herds in Leojn province in which all had intestinal parasites. These were Moniezia, Skrabinema, Haemonchus, Trichostrongylus, Cooperia, Trichuris, Capillaria and Coccidia were found in 84 %. The leukocyte formula revealed neutrophilia with right shift in 40 %, eosinophilia in 67 %, and lymphopenia in 72 % and monocytosis in 9 %. Most of the animals had mixed infections.

Haron et al. (1986) reported the haematological changes in 214 sheep naturally infected with Fasciola gigantica in an endemic area in Sudan together with 82 uninfected controls. Infected animals showed reduced values of Hb concentration PCV and RBCs counts.
Chaudhri et al. (1988) reported the haemoglobin content, packed cell volume, total erythrocyte count, total serum protein, iron, phosphorus and calcium content of the blood of 98 bufaloes naturally infected with *F. hepatica* were significantly reduced compared with uninfected buffaloes.

Bhat et al. (1989) experimentally investigated pathogenesis of *Dictyocaulus filaria* induced anaemia in lambs. The infection caused an increase in erythrocyte sedimentation rate and total leukocyte count. However, a decrease in PCV, Hb, total erythrocyte count (TEC) and blood pH was observed in acute infection. The shape and size of the erythrocytes, serum bilirubin level, mean corpuscular volume, mean corpuscular haemoglobin and mean corpuscular haemoglobin concentration remained unaffected. In carriers, the values of these parameters, except for TEC, return to near normal levels. The analysis of the results suggested that the infected animals developed a normocytic normochromic anaemia, which persisted during the later stage of infection.

Mali and Gaur (1990) reported the haematological values in golden hamsters experimentally infected with 10 cysticerci of *T. solium*. The blood values were recorded at regular intervals from day 10 until day 70 pi. Erythrocytopenia, hypohaemoglobinemia, leukocytosis and reduced packed cell volume (PCV) were most pronounced features by day 30 post infection PCV was as low as 37% as compared to control values of 52.8%. The differential leukocyte count revealed an increase in the number of lymphocytes on day 30pi. The neutrophil count on the other hand was slightly decreased. Monocyte, eosinophil and basophilic counts remained more or less unchanged. Mean corpuscular haemoglobin concentration (MCHC) was, however, slightly increased but the values of mean corpuscular volume (MCV) and mean corpuscular haemoglobin (MCH) revealed no significant changes at any of these intervals.

Rahman and Colling (1990a) experimented the two groups of goats which were dosed with 20,000 and 40000 sheep-derived strain (SDS) larvae of *T. colubriformis* respectively over a period of 42 days, goats dosed with 40000
larvae lost more weight than goats dosed with 20000 larvae. Anaemia was not observed in infected goats, but total serum proteins, albumins and phosphorus fall with infection.

Ayrsha Siddiqua *et al.* (1990) reported haematological observations of 64 Black Bengal goats naturally infested with intestinal parasites showed a decrease in haemoglobin, haematocrit and significant increase in Eosinophil count. However, the decrease in total iron content was significant. Only in goats infested with *Fasciola* and *Haemonchus* spp.

Rahman and Collins (1990b) studied the two groups of goats which were dosed with 10000 and 20000 sheep-derived strain (SDS) larvae of *H. contortus* respectively. Over a period of 42 days goats dosed with 20000 larvae lost more weight than those dosed with 10000 larvae. Anaemia developed in infected goats from about 2 weeks after infection together with reduced levels of total serum proteins and albumins.

Mugambi *et al.* (1990) reported the changes in blood cell counts, packed cell volume (PCV) and haemoglobin (Hb) concentrations were monitored for 19 weeks following experimental infection of calves with *F. gigantica*. There were no falls in PCV, Hb concentrations and red blood counts, contrary to reports of falls in *F. hepatica* infected sheep. The slight falls observed occurred during the migratory phase. A moderate increase in Eosinophil counts was observed from the 10th week after infection, in contrast to the reported increases during the migratory phase in *F. hepatica* in sheep and rabbits.

Bekele *et al.* (1991) recorded the monthly measurements of packed cell volume (PCV) and nematode and trematode faecal egg counts (EPG) in Ethiopian highland sheep at Debre Berhan, Dejen, Deneba, Tulu Meko and Wereilu from June 1988 to December 1989. High frequencies of low PCV, high nematode EPG were found at Tulu Meko. Among the productivity traits examined, body condition score and live-weight were significantly associated with differences in PCV and nematodes and trematode EPG levels at most sites.
Monthly repeatability of PCV, body weight and body condition scores were $0.44 \pm 0.01$, $0.71 \pm 0.01$ and $0.35 \pm 0.01$, respectively, while those of nematode ($0.09 \pm 0.01$) and trematode EPGs ($0.20 \pm 0.02$) were much lower. The high repeatability for PCV indicates that it was less affected by the variable factors influencing egg output, and hence it could be utilized in conjugation with nematode and trematode EPG levels for endoparasite monitoring. The most commonly nematodes identified were *Trichostrongylus colubriformis*, and there were smaller numbers of *Haemonchus contortus*, *T. axei*, *Oesophagostomum columbianum*, *Bunostomum trigonocephalum* and *Trichuris skrjabini*. *Dictyocaulus filaria* and *Moniezia* were also frequently found.

Abdel (1991) reported that the presence of normocytic normochromic anaemia associated with eosinophilia in naturally infected sheep, with highly significant decreases in the circulating levels of zinc, copper, manganese and iron.

Mottelib et al. (1992) studied the 2150 sheep and 760 goats for gastrointestinal parasites. 460 (21.4%) sheep and 120 (15.5%) goats were diagnosed with protozoal infections and helminthoses. The isolates included *Eimeria* spp [94 (20.4%) sheep; 26 (21.7%) goats], *Trichostrongylus* [85 (18.5%); 20 (16.6%)], *Haemonchus* [73 (15.9%); 12 (10.0%)], *Ostertagia* [42 (9.1%); 16 (13.3%)], *Oesophagostomum columbianum* [26 (5.7%); 7 (5.9%)] and *Trichuris ovis* [60 (13.0%); 14 (11.7%)]. Clinical signs included anaemia, emaciation, weight loss and diarrhoea. Haematological findings were decreased red blood cell counts, haemoglobin and packed cell volumes, and lymphocytosis.

Garcia et al. (1994) concluded that the faecal egg counts were significantly higher in the dry than in the wet season and haemoglobin, haematocrit, albumin, total protein, urea, phosphate and magnesium level were significantly lower in the dry season. The most frequent genera were *Haemonchus* (94 and 98% of the eggs in the dry and wet seasons respectively) (*Oesophagostomum, Bunostomum and Trichostrongylus*) in breeding ewes.
Ghulam Rasool et al. (1995) recorded the effect of *Haemonchus contortus* infection on haematological parameters in sheep. Blood samples from the infected and uninfected controls were collected on day 1, 7, 14, 21, 35 and 50 after infection and examined for various haematological parameters. Total erythrocyte count, packed cell volume, mean corpuscular volume, haemoglobin, and lymphocyte counts decreased significantly with increasing severity of infection, whereas, a significant increase in mean corpuscular haemoglobin, erythrocyte sedimentation rate, total leukocyte neutrophil counts was observed in infected animals. The values of basophils and monocytes remained constant with the severity of infection.

Howlander et al. (1996) reported the effect of experimentally *Haemonchus contortus* infection on haemoglobin concentration and packed cell volume in goats. The infected animals showed significantly lower haemoglobin and packed cell volume than the control animals. The haemoglobin concentration did not differ significantly between the animals in infected groups.

Hayat et al. (1996) reported the values of erythrocyte count, haemoglobin and packed cell volume were significantly reduced and erythrocyte sedimentation rate was increased in 12 experimentally infected with *Haemonchus contortus* and *Trichostrongylus colubriformis* in lambs.

Nguyen et al. (1996) *Fasciola gigantica* infection in buffaloes was studied by examining the physiological blood index of healthy and diseased buffaloes and calves from naturally infected animals in Vietnam. The result demonstrated that in the affected animals the number of red blood cells and haemoglobin decreased, and number of white blood cells, especially eosinophils, increased, characteristic of parasitic disease.

Woolaston et al. (1996) conducted study in Merino sheep bred either increased or decreased resistance to *Haemonchus contortus*, faecal egg count (FEC) were lower in the resistant line (6831 vs 17645 epg), and circulating eosinophils (EOS) were higher, but not significantly so (3.40×10⁶/ ml). Another
flock was experimentally infected with *Trichostrongylus colubriformis* and significant genetic variation was found in both FEC (heritability $0.40 \pm 0.11$) and EOS ($0.19 \pm 0.08$).

Howlander and Huq (1997) concluded that the PCV of *F. giagentica* infected goats (26.6%) were significantly lower than the noninfected goats (32.6%). The Hb values of infected animals (9.127g/dl) were significantly lower than the non-infected animals (10.51g/dl). There was no age and season on the values of PCV and Hb of infected and non-infected animals.

Howlander *et al.* (1997a) reported the effect of *Haemonchus contortus* on red blood and white blood cells in goats. The erythrocyte counts in infected groups were significantly lower ($9.70 \times 10^{12}$/litre) and ($9.12 \times 10^{12}$/litre) than noninfected control goats. *H. contortus* infection did not significantly affect the total leukocyte counts.

Hohenhaus *et al.* (1998) indicated the hypothesis that behaviour in sheep is influenced by resistance to infections with *Trichostrongylus colubriformis* and *Haemonchus contortus*. High eosinophilia correlated with low faecal egg counts for the infected sheep, which identified sheep that were resistant to parasites. It indicated that resistant sheep were more at ease with the environment of the test than the sheep with low Eosinophil count and behaviour is suggested that retention of normal levels of circulating eosinophils is associated with resistance to stress.

Moskwa *et al.* (1998) reported relationship between faecal egg counts and haematological parameters with *Trichostrongylus* spp. and *Haemonchus contortus* infection in Polish breed of sheep. High repeatability of faecal egg counts, PCV and peripheral eosinophil counts were observed. There was no significant change in total white blood cells, or in percentage of lymphocytes and Neutrophils in blood smears. Marked differences in percentage of eosinophils in blood smears were confirmed in peripheral Eosinophil counts.
Also, the eosinophil counts in most sampling data correlated negatively with faecal egg counts.

Maiti \textit{et al.} (1999) reported that the faecal samples contained \textit{Trichostrongylus} spp. and \textit{Cooperia} spp. and post mortem examination showed the presence of large numbers of immature \textit{Paramphistomum cervi} and \textit{Cotylophoron cotylophorum} in the abomasums and duodenum. Examination of blood samples from affected sheep showed significantly low total erythrocyte counts, haemoglobin, lymphocyte count and total protein levels, and high eosinophil counts.

Doligalska \textit{et al.} (1999) reported the relationship between faecal nematode egg counts, peripheral eosinophilia and peroxidase activity. Animals with higher concentration of interleukin-5 had greater peripheral eosinophilia and those animals with higher number of eosinophils had lower faecal egg counts. These associations were statistically significant but weak.

\textbf{2.8 BIOCHEMICAL ASPECTS:}

Studies on serum protein changes have been reported in case of parasitized lambs (Turner and Wilson, 1960, 1962; Kuttler and Marble, 1960), parasitized sheep and goats (Wilson and Turner, 1965), sheep and adult goats infected with \textit{Haemonchus contortus} and \textit{Trichostrongylus colubriformis} (Fitzsimmon \textit{et al.}, 1968, Shastry and Ahluwalia 1972) estimated the changes in total serum protein, albumin and globulin. They observed significant drop in total serum protein, albumin and globulin/albumin ratio, while globulin % increased. The total serum protein % dropped gradually in all the infected kids unto 10 weeks. In kids infected with 5000 larvae, the drop was from 7.85 to 5.0 per cent with 1000 larvae from 6.9 to 4.5 per cent with 2000 larvae; from 7.75 to 4.9 per cent with 40,000 larvae from 6.85 to 4.0 per cent by 10 weeks. In control kids the percentage increased from 6.6 to 7.6 per cent.
Dobson (1967) demonstrated the relationship between size of infesting dose and multiple infestation and the total serum proteins. During primary infestation with the low and medium sized doses of infective larvae, the total serum protein fell. After multiple infestation the large larval doses the total serum protein was increased. Hypoalbuminaemia could be demonstrated after both primary and secondary infestations also the animals given secondary infestation had failed to regain the level of albumin present before primary infestation.

Infection with *Trichostrongylus* spp. results in a protein loosing gastro-enteropathy and hypoalbuminaemia develops. In experimental infection, protein loss commenced from day 10 and rate of loss was directly related to larval dose Baker, (1973b). Coop *et al.* (1976) have reported low plasma phosphorus and calcium was decreased Symons and Steel (1978) and hypophosphatamia was reported in an infected sheep Coop (1981).

Gastro-intestinal parasitism induces disorder in mineral/ metabolism. Reduces calcium and phosphorus and magnesium absorption was reported by Reveron *et al.*, 1974 and Skyes *et al.*, 1975.

Skyes and Russel (1979) collected the blood samples from 414 Scottish Blackface ewes in 3 folds at two sites in Scottland during 3 successive years and analyzed for total protein, albumin, globulin and urea. The minimum mean plasma albumin concentration of 15.5, 20.7 and 23.5 g/lit. was recorded in the winter from 3 flocks. Albumin concentration in the serum was generally below the normal concentration of 25 mg/bgl. and was associated with hyperglobunaemia.

Chaudhri *et al.* (1988) reported that the levels of serum Aspartate aminotransferase and Alanine aminotransferase were significantly elevated in *Fasciola hepatica* infected animals.

Khan *et al.* (1989) conducted the study to determine the effect of natural Fascioliasis on the total serum bilirubin and glutamic oxaloacetic
transaminase (SGOT) in sheep. Sera were collected from 100 infected (group A, 64 sheep, 300-600 epg and group B, 36 sheep, confirmed by direct smear and zinc sulphate flotation technique). Serum total bilirubin and SGOT values were estimated by spectrophotometry and both were significantly different between groups, and were directly proportional to egg count.

Patel (1989) conducted the biochemical study of goats and sheep under field and farm conditions indicated that during monsoon when the parasitic load was higher, decreased in the value of serum calcium, serum phosphorus and total serum protein was seen and higher values were during winter and summer, when there was lower parasitic burden.

Siddiqua et al. (1989) reported that the goats naturally infected with *Fasciola, Paramphistomum* or *Haemonchus* spp. had lower serum total protein and albumin values than controls not infected with these parasites, and higher globulin, AST and ALT values. The greatest difference from controls was for ALT values in *Fasciola* infection.

Theodridis et al. (1989) thirty healthy adult female goats were infected experimentally with 300 *F. hepatica* metacercariae and treated with triclabendazole. The animals of treated group showed great improvements in blood total proteins, albumin, immunoglobulins, and packed cell volume over the 3-month observation period in comparison with the untreated control group.

Prache and Galtier (1990) conducted studies in lambs experimentally infected with 150 *F. hepatica* metacercariae, plasma y-glutamyltransferase activity rose from week 6 post infection (as the young flukes reach the liver) to a maximum of 77.4 IU/litre on week 10, after which it declined the bile ducts and obstructed them) to reach a peak of 4.5 mg/litre on week 26. It is considered that excess bilirubin may cause yellow discoloration of the fat and lead to devaluation of carcasses.

Ahmad et al. (1990) studied the four groups, each of four 4-to 6-month-old Lohi lambs, were given O, 4, and 12 thousand third stage infective
larvae of *Haemonchus contortus* orally. There was a marked decrease in albumin, and a slight reduction in α- and β-globulins, but γ-globulins were increased at the peak of the infection. As a result, both total serum proteins and the albumin/globulin ratio showed a corresponding and proportionate decrease.

Donat *et al.* (1990) indicated the significant change in biochemical and haematological values in *Fasciola hepatica* infection in ponies. There was decreased in white blood cells, (in week one), cholesterol (week 2), calcium (week 9 and 10), albumin (week 10), alpha 1 globulins (weeks 7 and 10) and beta 2 globulins (week 7), and increases for aspartate aminotransferase (week 7). Lactate dehydrogenase (week 2,3 and 7), a and glutamate dehydrogenase (week 9).

Bhattarai *et al.* (1993) reported that the *Fasciola* infection in cattle and buffaloes significantly decreased the levels of total serum protein, serum albumin and serum copper and increased the levels of serum globulin. However, the effect of Fascioliasis on the serum levels of calcium, magnesium and inorganic phosphorus was insignificant.

Kouider and Kolb (1994) concluded that the *Haemonchus contortus* parasitized sheep had increased activities of ALT and AST transaminases. Blood glucose was low in sheep harbouring gastrointestinal nematodes.

Qian *et al.* (1998) reported that the experimental fluke infection caused no clinical signs of *Fasciola hepatica* but provoked an increase in plasma level of IgG directed against *F. hepatica* from 4-week pi. There was a significant increase in plasma AST from 6-week pi (<0.05). Maximal values were reached at 14 weeks and remained significantly elevated by 23 weeks. Plasma GLDH was significantly elevated from 6 to 21 week pi (p<0.05). Significant increases in plasma GGT occurred from 8 to 26 weeks pi (p<0.05), reaching maximal values 15 weeks.

Oryan *et al.* (1999) investigated the biochemical parameters and serum proteins in the blood of 24 cattle infected with *Cysticercus bovis* (*Taenia saginata*). The activity of serum CK and LDH in both experimentally (n=16) and
naturally (n=8) infected animals increased significantly compared with controls (P<0.05). Other parameters (various serum protections, minerals and a few enzymes) were almost unaltered by infection.

Prasanthi, et al. (1999) reported the levels of glucose, total proteins and albumin, and aspartate aminotransferase were measured in serum samples from 144 ewes with clinical signs of strongyle infection (epg 800-1800) before and after treatment with anthelmintics. The most significant findings were the high levels of aspartate aminotransferase (up to 130.18± 11.24 units/ml) before treatment; these levels returned to normal within 21 days of the commencement of treatment.

Waweru et al. (1999) concluded that following the establishment of F. gigantica infection, albumin levels declined in infected animals without any significant difference between breeds. Serum bilirubin and gamma glutamyl transferase in infected sheep were elevated significantly more in the Dorper than in the Red Masai breed.

2.9 PATHOLOGY:

Panjoo et al. (1988) change observed in sheep and goats infected with Gastrothylax crumenifer. Enteritis was marked; cell infiltration was observed in the lamina propria of the mucosa. The main lesions were localized in the first meter of the intestine and the pyloric end of the abomasum; the superficial layers of the tunica were destroyed and parasites at various stages of development were present in the mucosa; desquamated cellular element were found in the mouth of immature flukes; cell inflammation surrounded the parasites; haemorrhages were occasionally present.

Burroughs et al. (1991) recorded the prevalence of Taenia. ovis cysticerci and origin of infected animals for a period of 39 days at Port Elizabeth abattoir, South Africa. 239 sheep and 9 Angora goats were found to have
muscular cysticercosis during this period. The cysticerci were found in the semimembranous, semitendinous, adductor, biceps femoris, rectus femoris and gracilis groups of muscles of the hind limb.

Vyas et al. (1991) studied a total number of 968 specimens collected from 3045 goats slaughtered at abattoirs in Bikaner, India. Fasciola infection was observed in 13 of the 968 livers examined. Seven of these livers showed occasional whitish nodules of 0.5-1.0 cm in size and dilated thickened bile ducts containing flukes. One liver showed a nodule of 4.0x2.9 cm and a bile duct containing 20 flukes. Two livers showed considerable hypertrophy and 3 showed atrophy of left lobe and hypertrophy of other lobes. Few parenchymal lesions were observed. Portal lesions were most frequently present in the medium size portal tracts.

Gogoi et al. (1991) reported the histopathological lesions developed in 18 goats infected with coenuriasis (Taenia). These lesions were categorized as being due to Meningoencephalitis. Common features of the lesions included congestion, focal haemorrhages, demyelination, satellitosis, perivascular cuffing, neuronophagia, focal liquefactive necrosis and gliosis leading to formation of macroglial nodules.

Wiedosari et al. (1991) indicated the pathological changes in the liver induced by Fasciola hepatica and Gigantocotyle explanatum were readily distinguishable from each other. Lesions associated with the migration of immature flukes through the parenchyma were a prominent feature of infection with F. gigantica, whereas lesions induced by G. explanatum were confined to the large bile ducts. The size of the hepatic lesions increased during the course of infection with F. gigantica and was associated with the formation of progressively larger areas of scar tissue in the parenchymal migration tracts as the flukes grew. This was also as a result of the progressively increasing cellular infiltration, of bile ducts and fibrosis, which occurred in adjacent portal triads and interlobular septa. The absence of signs of migration through the hepatic parenchyma by G.
*explanatum,* was regarded as evidence that these flukes gain entry to the bile ducts from the intestine via the common bile duct. In bile ducts infected with *F. gigentica* there was more extensive desquamation of the epithelium, more intense mucosa infiltration with lymphoid cell and fewer eosinophils, less severe glandular hyperplasia, more free blood in the lumen and a thicker duct wall than in bile ducts infected with *G. explanatum.*

Rahman and Collins (1991) reported the histopathological changes in experimentally induced *Haemonchus contortus* and *Trichostrongylus colubriformis* infection in goats. At postmortem examination abomasum from infected goats had thickened wall and oedematus folds, there was an initial infiltration of eosinophils and some Neutrophils which tend to increase with age of infection.

Valero et al. (1992) reported that the 41% of the lungs had lesions consistent with infection by *Muellerius capillaris,* 33% with *Dictyocaulus filaria* and 8% with both species. The prevalence of parasitic lesions increased with age. Nematode larvae were seen in the bronchial lumina of 3 of them. The microscopic appearance varied from a moderate dilatation of occluded bronchi, which retained an intact epithelium, to large foreign-body granulomas where the remaining bronchial outlines were barely discernible. Multiple very discrete, fibrous pleural plaques were found on the caudal lobes in 2 cases. Plaques of this morphology have not been described previously in the veterinary literature. Pleural adhesions were found in 350 cases (8.2%).

Green et al. (1994) observed the nodules typical of *Cysticercus ovis* in the heart (4.7%), diaphragmatic muscle (2.87%) and carcasses (0.6%) of the lamb from one flock. Liver lesions thought to be due to *C. tenuicollis* were seen in 1.5% to 3.0% of the lamb from 3 flocks.

Rolfe et al. (1994) reported the pathological changes occurred in *Paramphistomum ichikawai* in experimentally induced infection in lambs. These changes varied, according to the number of flukes present, from a localized
enteritis and villous atrophy in the duodenum, the light infections to sever
destruction of the mucosa extending into most of the jejunum in the heavy
infections. As the infection progressed changes were characterized by the
extensive thickening and fibroplasma in the mucosa and submucosa. Sever
damage to the mucosa of the rumen was also observed in heavy infections. Heavy
infections were associated with increased infiltration with eosinophils. Mast cells
were generally depleted and leukocytes only appeared after the flukes had small
intestine.

Lindberg et al. (1993) reported the histopathological changes in the
affected organs of Schistosoma bovis infected goats. The eosinophilic-rich hepatic
fibrotic inflammatory foci and liver granuloma with a large number of giant cells
and least hepatic portal fibrosis observed.

Berrag et al. (1996) examined the intestines of freshly slaughtered
goats to study the pathological changes caused by different species of helminths
(Stilesia, Moniezia, Bunostomum, Gaigeria, Trichuris and Oesophagostomum).
Common macroscopic changes were catarrhal enteritis, oedema and congestion.
Nodule formation in the intestinal wall was a diagnostic feature in
Oesophagostomum infection. Microscopically there were moderate, chronic
inflammatory cellular reactions and mucoid degeneration. In some cases necrosis
of the tips of villi and desquamation of the lining epithelial cells were observed.

Wang Kai Gong et al. (1996) reported the number of mucosal mast
cells in bile duct sections of 5 cattle with and 5 cattle without Fascioliasis were
431 ± 103 and 191 ± 66/mm², respectively. In groups of 5 sheep these figures
were 702± 300 and 75 ± 13/mm².

Howlader and Hou (1997) confirmed the presence of flukes
surrounded by fibrous capsule in the liver. All the animals were suffering from
chronic F. gigantica infections. The blood vessels in most of the liver tissue were
thickened due to proliferation of surrounding fibrous tissue. Focal infiltration of
lymphocytes in the lobules, patches of focal accumulation of Neutrophils and
eosinophils were found in all the liver tissue. Proliferations of new bile ductules in the hepatic trinity around the bile ducts were clogged by the flukes in most tissue sections.

Winter et al. (1997) studied the sections of small intestine taken at post-mortem from the area of adult worm establishment over the course of *Nematodirus battus* infection in lambs showed a significant increase in mucosal eosinophil and mast cell numbers during the period of adult worm rejection, when compared with uninfected controls. The results show that young lambs develop significant increases in the numbers of cells associated with an inflammatory reaction in the intestine during the development of a partially protective immune response to this parasitic nematode.

Berrag and Cabaret (1997) reported the diaphragmatic lobes were the preferred sites for protostrongylids. The average number of nodules (mostly *Muellerius capillaries*) and lobular lesions (mostly *Protostrongylus rufescens* and *Cystocaulus ocreatus*) was 174 and 9 per pair of lungs, respectively. 19.9% of kids and 34.2% of adult goats had heavy nodular infections (more than 200 nodules per pair of lungs) and 61% of kids and adult goats, respectively, had heavy lobular infections (more than 4 lobular lesions per pair of lungs). The overall proportion of lung surface occupied by protostrongylid lesions was 35.1% in kids and 23.5% in adult goats.

Sharma et al. (1997) conducted the examination of 1208 goats and 542 sheep at Bareilly and Delhi slaughterhouses, and revealed parasitic lesions in the alimentary tracts. *Sarcocystis* was found in lips and tongues of 35 goats and 7 sheep and also in the esophagus of 45 goats and 11 sheep. Mature amphistomes (one was identified as *Paramphistomum epiclitum*) were present in the rumen of 110 goats and 75 sheep. *Haemonchus contortus* was seen in 27 goats and 17 sheep and *Globidium* cysts were found in the abomasum of 8 goats and 3 sheep. Intestinal lesions due to helminths (*Oesophagostomum, Trichuris, Moniezia,*)
Avitellina, Stilesia globipunctata) were seen in 297 goats and 120 sheep. Eimeria was seen in 15 goats and 5 sheep.

Rehbein et al. (1997) investigated the distribution of Chabertia ovina, Oesophagostomum venulosum and Trichuris spp. within the large intestine of 136 naturally infected slaughtered sheep in Bavaria, Germany. The large intestine was divided into 4 sections. More than 75% of C. ovina were found within the ‘disk-like’ section of the ascending colon. O. venulosum and Trichuris spp. preferred the caecum and the first section of the colon up to the beginning of the ‘disk-like’ section. For both species, the proportion of worms recovered from the first section of the colon increased with higher worm counts. The simultaneous presence of O. venulosum and Trichuris spp. had significantly negative effect on the number of Trichuris spp. isolated from the caecum.

Dwivedi et al. (1997) Lambs and kids (6 of each) were each experimentally infected per os with 3500 metacercariae of Paramphistomum epiclitum. Infected animals developed the clinical form of the disease in 2–4 weeks pi and showed the characteristic signs of weakness, diarrhoea, anorexia and weight loss. The disease was more severe in lambs than in kids. Clinical signs continued for 6 weeks post infection and then declined.

Sharma et al. (1998) studied the prevalence of coenurosis (infection by Taenia gaigeri metacestodes), between 1986 and 1994 on 2 organized semi-intensive goat farms at the Central Institute for Research on Goats, Makhdoom-Farah, India. Cysts were found mainly in the central nervous system, with typical neurological symptoms, but some were recorded in the abdominal cavity or subcutaneous and muscular tissues in the thigh and cervical region; cysts in these locations caused few obvious symptoms. Histopathological studies of 10 goats showed acute and chronic inflammatory changes including cellular infiltration, haemorrhages, demyelination, perivascular cuffing, neuronophagia, liquifactive necrosis and formation of microglial nodules.
Utpal Das and Das (1998) examined the carcasses of 5414 cattle, 4212 buffaloes, 230 sheep, 410 goats and 105 pigs for hydatid cysts in and around Calcutta and 45, 48, 9, 5, and 8% were found positive. In all the species the most common sites were the liver and lungs, but cyst were also found in the spleen of 4 and the kidneys of 3 animals. The cysts were sterile in 95% of the cattle and 88% of the buffaloes, but most of those in the other species were fertile.

Achenef et al. (1999) examined 37 diseased sheep at post-mortem and 183 apparently healthy sheep for the presence of cystic larvae of *Taenia multiceps*, of which 37 and 5 respectively, contained 1 to 8 coenuruses cysts. The cysts were located in the cerebral hemisphere in 96% of the cases (43% and 57% for left and right hemisphere, respectively), and in the cerebellum in the 4% of the cases. Prediction cyst locations based on the direction of circling and head deviation had 62% success rate.

Satyavir Singh et al. (1998) reported the histopathological changes in purebred Nali sheep and their Russian Merino/ Corriedale cross, experimentally infected with *Haemonchus contortus*. Histopathological examination of skin and abomasum of purebred and 50% Nali lambs revealed moderate infiltration of mononuclear cell, with less such infiltration in the 37.55 Nali crosses.

Oge et al. (1999) observed the maximum intensity of *Taenia hydatigena* in sheep and goats was in the mesenteries and omentum. Hydatid cysts were found mostly in the liver and lungs and *T. saginata* in the heart and skeletal muscles.

Martinez et al. (1999) reported the relationship between immune response and pathogenesis in goats with primary and secondary experimental infections of *Fasciola hepatica*. The hepatic damage was much more severe in secondary infections. Primary infection progressed to chronic fasciolosis, which did not induce resistance, since goats were highly susceptible to secondary
infection, and showed severe acute and chronic hepatic lesions that led to death of some of animals.

Pienaar et al. (1999) described the pathological changes occurred in goats infected with *Strongyloides papillosus*. The pathological changes described included enteritis, status spongious in the brain, hepatosis leading to rupture of the liver, nephrosis, pulmonary oedema, interstitial pneumonia. About 6% goats died acutely from fatal hepatic rupture.

Bokaie et al. (1999) examined 1627 sheep carcasses at Lavasan abattoire, Iran. Lesions were observed in 336 sheep. Parasitic lesions were commonest (76%) followed by hydatid cysts (5.85%), liver worm (3.69%). The prevalence of non-parasitic lesions was, 1%. The lesions were more frequent in females than males with the exception of hydatid cysts which were observed in lambs of 6 months of age or less.

2.10 ECONOMIC LOSSES

Clarkson (1989) reported the cost of a control scheme based on prevention of snail infection by *Fasciola hepatica* by treating 1800 ewes grazed on fluke-infested riverine land with 4 treatments /ewe of tricalbendazole is compared with the cost of leaving the sheep untreated. It is estimated that if sheep were not treated there would be a total loss of £8272 per annum due to reduction in lamb carcass and fleece weights (this is a conservative estimate as mortality, liver condemnation and the effect of immature flukes are ignored), whereas treating the sheep would cost only £864 per annum.

Singh et al. (1990) studied 800 goat intestines collected from slaughterhouses in the Patna area, parasitic infestation was present in 80.42% in monsoon, 73.73% in winter and 69% in summer. *Oesophagostomum, Bunostomum, Trichuris, Trichostrongylus, Moniezia, Stilesia* and also *Coccidia* were identified. The intestines were for use as casings (raw material for the
production of gut products, membranes, etc), and a large-scale control programme was proposed to reduce this high level of infestation, thus improving the quality of casing whose value is reduced by the presence of perforations and nodules of parasitic origin.

Abbot and McFarland (1991) following a period of grazing with untreated cattle, 4 out breaks of *Trichostrongylus axei* infection in sheep in South Australia are described in which the parasites was the principal cause of diarrhoea, weight loss and death. In second outbreak 240 pregnant, 2-year-old ewes were affected. Lambing commenced on June and in mid-June the owner noticed that some of the ewes were scouring. Over the next 2 weeks 12 ewes died and many others lost condition rapidly. On 29 June it was apparent that 30 to 40 % of the ewes were in very poor condition, were scouring and their lambs were undernourished. One ewe that had lambed 1 to 2 days earlier harboured 144000 *T. axei*. They indicated that *T.axei* could be a serious threat to sheep health and production when young sheep or lambing ewes are run on pastures previously grazed by untreated cattle.

Meana *et al.* (1991) carried out experiment on the lambs grazed on the pasture contaminated with *Haemonchus contortus, Ostertagia circumcincta* and *Trichostrongylus colubriformis* in a central zone of Spain. Overall body weight gain decreased as the total worm population increased. There was a close relationship between the *O. circumcincta* population and the body weight. The most important reduced live weight period was between the 3rd and 4th week after infection.

Redl (1991) conducted field experiment on cattle infected naturally with (*Cooperia, Ostertagia, Trichostrongylus, Haemonchus, Bunostomum, Oesophagostomum, Strongyloides*). The body weight gain was higher in treated animals (1.3 to 17.0 kg) and daily weight gain by 12-152g compared with the untreated controls.
Valero et al. (1992) reported the carcasses of goats with more than 10 nodular *Muellerius capillaries* lesions were 0.75 Kg lighter than those without the lesions. Twelve sets of lungs had lesions of chronic bronchiectasis.

Crempien et al. (1993) conducted faecal sample examination for helminth eggs was carried out every fortnight and the weight of the sheep recorded. Wool production was recorded at the time of shearing. No difference in body weight or wool production was recorded in 1976 when the lowest faecal egg counts were observed in untreated animals. Live weights were significantly higher in treated animals. Wool production was significantly greater in the treated group.

Hostle and Chartier (1993) indicated that the presence of strongyle egg count in faeces of dairy goats, increases in pepsinogen values, and reduction in RBC count, PCV, and serum inorganic phosphate concentration indicated sub clinical infection. This sub clinical parasitism induced a decrease in body condition scoring and led to persistent decrease in milk yield, ranging from 2.5 to 10 % reduction from control values. Changing in fat and protein content were not detected. However, the consequences of infection were more severe in the goats with the highest milk production at the start of the study. Decrease in the milk output ranged between 13.0 to 25.1 %, and was associated with the decrease in fat content. The higher-producer goats have less resistance and resilience to infection associated with more severe consequences on milk production.

Bekele et al. (1993) reported that *Trichostrongylus colubriformis* was predominant gastrointestinal nematode, with *T. axei, Haemonchus contortus, Oesophagostomum columbianum, Bunostomum trigonocephalum* and *Trichuris skrjabini* also present. *Dictyocaulus filaria* was the main lungworm. Mean litter size, lambing interval, annual reproductive rate and abortion rate were 1.04 to 1.33, 216 to 263 day, 1.7 to 2.1 and 1.3 to 6.5% respectively. Lambing interval and endoparasitism were significantly at different sites, but there was no significant correlation between two factors. Difference in the level of endoparasitism affected body weights and body condition scores of breeding
ewes. Nursing ewes had more nematode and trematode EPG, low PCV, low body weight and at lambing. This lactation-rise in EPG was attributed to a reduction in resistance due to the stress of suckling.

Joshi (1994) reported an outbreak of parasitic gastroenteritis in a heard of 25 goats under a sedentary management system in a low hill village in the Kaski district of west Nepal. The studies showed that the parasitic gastroenteritis is one of the major causes of productivity in goats in Nepal.

Niezen et al. (1994) conducted experiment on 140 Polled Dorest lambs that were randomly allocated to graze one of 7 herbage and ether trickle dosed with a total of 108 000 third stage gastrointestinal nematode larvae (50% Trichostrongylus colubriformis and 50% Ostertagia circumcincta) over 6 weeks or undosed (n=8) and allowed to ingest any nematode larvae on pasture. After 28 days on the trial, lambs dosed with larvae had higher faecal egg counts (FEC's) than undosed lambs but after 42 days egg counts did not differ between dosed undosed groups. Dosing with larvae did not significantly alter the live weight gain.

Williamson et al. (1994) concluded that while the large difference in faecal egg counts between lines overestimates the difference in total worm burden, fleece weight sheep to carry significantly more worms of the abomasal species Haemonchus contortus and Ostertagia circumcincta than in control sheep.

Larsen et al. (1995b) indicated the productivity of Merino ewes treated with ivermectine and controlled-release capsule containing albendazole was compared with untreated ewes grazing the same pasture. Treated breeding ewes had significantly increased greasy fleece weights (GFW, 6.5% and 7.1%) compared with untreated breeding ewes. Other benefits of treatment on all farms were a significant in body weight gain (from 1.7 to 3.7 kg) and a significant decrease in the weight of dag removed at crutching (from 42 to 622g). These benefits occurred despite the presence on each farm of worm resistance to benzimidazoles. One disadvantage of treatment was an increase in mean fibre
diameter of wool from treated ewes from 0.12 to 0.41 μm. This increase reduces the value of the wool. Partial budgets indicate a net loss of from 8 to 62 cents per ewe for treatment.

Williamson et al. (1995) conducted experiments on male sheep aged 15 months from a Massey University flock selected for increase fleece weight (FW13 sheep) and unselected controls (C, sheep), were infected with larvae of *Haemonchus contortus* (4000 larvae), *Ostertagia circumcincta* (22750) and *Trichostrongylus colubriformis* (25000). Some FW sheep (7) and C sheep (5) had previously been treated with an albendazole controlled release capsule (CRC), at 6 months of age. Faecal egg count were higher in FW than C sheep (4204 vs eggs/g, p<0.0001), as were the numbers of adults *Haemonchus contortus* (1151 vs. 249, p<0.01), when the sheep were slaughtered at day 28. Numbers of *T. colubriformis* (5838 vs. 5266 eggs/g) did not differ between lines but were higher in previously CRC-treated sheep than in untreated sheep (corrected live weight was higher in FW than in C sheep) p<0.01 and lower in CRC-treated than in untreated sheep (p<0.01)

Hayat et al. (1996) noticed that there was a significant reduction in body weight, wool growth, fleece weight, staple length and fiber diameter in *Haemonchus contortus* and *Trichostrongylus colubriformis* infected sheep.

Howlander et al. (1996) carried out experiment to compare the body weight changes of adult female goats experimentally infected with 15000 and 30000 larvae of *Haemonchus contortus* (group 2 and 3 respectively) and uninfected control groups (group 1) was made using weekly weight data over 35 weeks. Animals in-group 2 weighed significantly less than in group 1 (control) Does in group 3 had significantly lighter body weight than control does from week 13 pi. The animals in control group gained an average of 0.75 kg, whereas animals in infected groups 2 and 3 lost an average of 3.90 and 4.13 kg. Respectively. Animals in-group 2 and 3 also had significantly power pre-slaughter and hot carcass weight than the controls.
Howlander et al. (1997b) showed that the *Haemonchus contortus* infected goats has a significant (<0.01) interaction between the infection and duration of infection on the body weight. The infected groups weighed significantly (p<0.05) less than the control from week 18 to 21 pi. The control group gained an average of 2.85 kg with 18.75 g average daily gain in 152 days, and this was significantly higher than in the infected groups. It was also indicted that *Haemonchus contortus* has a significant effect in the pre-slaughter weight of goats.

Ankers et al. (1998) carried out study to assess the impact on productivity and profitability of prophylactic biannual anthelmintics treatment. The 2 productivity traits that were significantly improved by the treatment scheme tested were the number of lambs per lambing which increased from 1.11± 0.31 (mean ± s.d.) to 1.19± 0.53 to 1.22± 0.47. The mortality and weight at 12 months were not significantly affected by treatment. Monitoring of sheep sale in the flocks and on surrounding markets allowed the calculation of a rate of return to the treatment scheme studied is recommended as over 90% of the adopting farmers would yield positive returns to their investment.

Bishop and Stear (1999) observed the genetic and epidemiological relationships between productivity and resistance to gastrointestinal parasites in young lambs was explored by means of simulation. The reduction in growth rate was calculated from cumulative larval challenge and cumulative worm mass in the lamb. Genetic parameters were then estimated for the output traits of observed live weight at 6 months of age, growth rate reduction and faecal egg count. The severity or epidemiology of the disease greatly influenced the results- the genetic correlation between observed live weight and egg count strengthened from -0.02 to- 0.46 as the disease severity changed from mild to sever. Selection for reduced faecal egg count resulted in large correlated increases in live weight gain, more than twice that predicted by quantitative genetic theory, due to the reductions in growth rate loses as the disease challenge to the animals decreased.
Blackburn et al. (1991) experimented on weaned weather goats (n=144) approximately 6 months of age were placed in a 2x3 factorial design for 5 months to test the main effects and interaction of 2 levels of nutrition (growth + maintenance, NUT1; twice growth + maintenance, NUT2) and 3 levels of Haemonchus contortus burden (0.500 and 2000 larvae administered every 2 weeks: W0, W500 and W2000, respectively) on weight, feed intake, level of infection and packed cell volume (PCV). Goats on NUT2, after an initial period, showed little difference in body weight, irrespective of worm burden. Within the NUT1 level, W0 kids weighed more than W500 or W2000 kids throughout the study. Although not statistically significant, this constitutes a trend towards an interaction between nutrition and worm burden. In both nutrition levels, there were no body weight differences between W500 and W2000 until the last 14 days. Feed intake was depressed in the first 3 months of the experiment for infected animals, but was subsequently followed by a compensatory reaction. Lower establishment rates, based on actual worm counts, were observed for the higher infection levels, but in both infection levels establishment rates tended to decrease with time. Nutrition was found to be more important to counteract the consequences of a parasitic infection than to counteract the establishment of the same infection.

Brown et al. (1991) concluded that a major limiting factor in efficient food utilization in animals with gastrointestinal nematode infections is a parasite-induced protein rather than energy deficiency, possibly the result of increased endogenous protein losses into the gastrointestinal tract. Increasing duodenal protein supply could markedly reduce the debilitating effect of internal parasites.

Blackburn et al. (1992) indicated a significant nutritional effect associated with all the variables except leukocytes. Nutrition by worm load interactions was found for PCV and leukocytes. The neutrophil/lymphocyte ratio
was higher in the infected animals given growth + maintenance feed, leading to the nutrition by worm load interaction for leukocytes.

Suttle et al. (1992a) suggested that the molybdenum (Mo) either increased the inflammatory response which preceded worm rejection or that it enhanced the response by reducing the effectiveness of copper dependent, anti-inflammatory enzymes in the gastrointestinal mucosa.

Suttle et al. (1992b) concluded that molybdenum (Mo) may have direct effects on nematode metabolism, reducing growth and viability and may enhance immunity against parasite infection by modulating the inflammatory response.

Houtert et al. (1995) concluded that supplementary feeding with FM substantially reduced the production losses attributable to infection with *Trichostrongylus colubriformis* and was associated with enhanced expulsion of the parasite burden.

Kochapakdee et al. (1995) concluded that drenching of anthelmintics (levamisole @ 5mg.kg) did not result in increased body weight gain, except when the nutritional status was also improved in Thai Native and Anglo-Nubian goats.

Scales et al. (1995) recorded significantly lower faecal egg counts from lambs grazing chicory or Lucerne (320epg) than from lambs grazing grasses (1100epg). In experiment 1, control lambs grew faster on chicory (311g/day) than Lucerne (222g/day) or grasses (169-195g/day). In experiment 2, growth rates on chicory and Lucerne were similar (250g/day) and faster growth rates on grasses (120-148g/day). It was calculated that the use of chicory can reduce the effects of parasitism of the growth of grazing lambs relative to grasses, but responses to Lucerne were more variable.

Wallace et al. (1995) indicated that the mean worm burdens were similar, the lambs given the basal diet had higher faecal egg counts, lower packed red cell volumes and lower concentrations of total plasma protein and plasma
albumin than the lambs given the supplemental diet. It is concluded that the
dietary supplementation also improved the carcase composition of the lambs.

Israf et al. (1996a) carried out experiment on 2 groups of 7 and 2
groups of 6 lambs were fed either a complete basal ruminant diet (13.2% crude
protein) (group 2 and 4) or the same diet supplemented with fish meal (18.3%CP)
(group 1 and 3). Group 1 and 2 were infected daily for 7 weeks with Nematodirus
battus larvae (L3) and group 3 and 4 served as uninfected challenge controls All
the groups treated with anthelmintics in the 8th week, challenged with a single
dose of 30000 N. battus L3. Although protein supplementation tended to improve
the regulation of the population of N. battus in the lambs, which had been infected
continuously, the effect was not statistically significant. The worms burdens in
both the groups of previously infected lambs were significantly reduced both in
number and size (p<0.001) and they had a lower proportion of male worms than
the uninfected challenged controls.

Wallace et al. (1996) conducted experiment on 19 Scottish blackface
lambs were given either a basal diet (BD) or a diet supplemented with soybean
meal (SD) to give an additional 80 g crude protein/ kg dry matter. Six BD and 5
SD lambs were given an initial loading dose of 100 Haemonchus contortus 3rd
stage (L3) larvae at 32 week of age fallowed by tickle infection of 200 L3, 3 times
a week for 10 weeks. Four BD and 4 SD lambs were uninfected controls. The
weight gains of lambs given the supplemented diet were greater and their
carcasses were leaner, irrespective of infection status. Infected animals on basal
diet were more anemic and hypoalbuminaemic than animals receiving the
supplemented diet, although there was no statistically significant difference in
mean worm burden or faecal egg counts.

Anindo et al. (1997) reported that the urea-molasses feed supplement
blocks (MUB) is a suitable method for supplementing the nutrition of grazing
sheep in Ethiopia, and that MUB feeding can help alleviate the effect of
endoparasitism.
Saretzke (1997) reported that in sheep with a secondary copper deficiency the *Haemonchus contortus* egg hatch rate was <90%. Following the feeding of a high copper diet over 10 days the egg hatch rate increased to >90%, but the low egg output was not affected. A reduction in the egg hatch rate of *Nippostrongylus brasiliensis* was seen in rats fed a diet with high copper content. The egg production by the worms was low, and only a few adults developed in the small intestine. After the addition of cadmium to the diet (as a copper antagonist), the egg hatch rate, the number of eggs and the number of adults returned to normal.

Datta *et al.* (1998) reported as diets were formulated to be isoenergetic (9.0 MJ of calculated metabolisable energy per kg dry matter) with 5 levels of protein (10, 13, 16, 19 and 22% crude protein). These diets were based on oaten chaff, with barley, cottonseed meal, urea and mineral mix (except for the 22% crude protein diet which did not contain barley). Dietary crude protein content increased live-weight gain, feed intake, rumen fluid ammonia-N, packed cell volume, eosinophil decreased faecal worm egg counts significantly (P<0.01). Infection did not significantly affect packed cell volume of animals in diets with 16, 19 and 22% crude protein content. It is concluded that extra dietary protein can prevent the adverse effects of H. contortus infection on animal production.

Donaldson *et al.* (1998) indicated the importance of protein and energy supply and larval intake on the ability of per parturient sheep to maintain resistance to parasitic infection was infection was investigated. Resistance was significantly less in ewes bearing and suckling twin lambs than those with singles. Differences in larval intakes spanning the range likely to be experienced in practice did not appear to be important. In dual infections with *Teladorsagia circumcincta* and *Trichostrongylus colubriformis*, the breakdown of resistance occurred almost exclusively with *T. circumcincta* confirming previous evidence of parasite species specificity in the per parturient breakdown of resistance.
Israf et al. (1998) noticed that the lambs on the supplemented diet that were trickle infected showed a significant reduction on egg output. Supplementation and previous infection did not affect growth rate, worm burden, worm development or haematological parameters. There was a trend for enhanced growth among supplemented non-infected lambs in comparison to lambs which received the basal ration.

Miller et al. (1998) concluded that fleece weight (FW) sheep are more susceptible to internal parasites and cysteine may influence certain aspects of immunocompetence in sheep.

Theodoropoulos et al. (1998) observed that the mean faecal counts for strongyle-type eggs were higher in the low protein-no anthelmintics treatment (LP -NT) group than all the other groups and higher in the low protein than the high protein (HP) groups indicating that faecal egg before turnout. This effect was intensified in the absence of anthelmintics treatment.

Wallace et al. (1998) carried out experiment on supplementation with urea had no discernible effect on resistance to infection; faecal egg counts, worm burdens, worm lengths and mean number of eggs per adult female worm did not differ between the 2 groups. However, lambs on the supplemented diet showed better resilience; they had greater packed red cell volumes, higher plasma albumin concentrations and increased live weight gain compared to lambs on the basal diet (P<0.05). The loss of appetite following infection was less in lambs fed the urea-supplemented diet. The observed effect of urea supplementation was seemingly due to greater food consumption as well as the better diet.

Datta et al. (1999) indicated that during the grazing period, animals that previously received the higher protein diets consistently showed higher live-weight gain and wool production, higher antibody responses to both H. contortus and Trichostrongylus colubriformis antigenic challenge in vitro, and lower faecal nematode egg counts than did lambs previously offered the lower protein diets. It
was concluded that short periods of enhanced post-weaning nutrition could have long-term and perhaps life-long effects on production.

Etter et al. (1999) examined per parturient relaxation in immunity (PPRI) to nematode infection in ewes is associated with a rise in faecal egg counts during the perparturient period. To assess an eventual relationship between the PPRI and the nutritional status of periparturient females, a 2-year study was carried out in a dairy goat flock in western France. In year 1, 21 pregnant does were fed at 26% below their energy requirements and 5% above their protein requirements during the last 3 weeks before parturition (week 0) and an increase in nematode egg counts occurred from week-2 to week+4 with a predominance of Oesophagostomum larvae in coprocultures. In year 2, 2 groups of 20 pregnant goats were fed at about 100% energy requirements and 28 and 44% above the protein requirements, respectively, during the same period. No nematode egg count increase occurred in either group; Teladorsagia and Trichostrongylus were the prevalent larval genera in coprocultures. The implication of several factors related to host physiology, parasite epidemiology and host nutrition are discussed.

Knox and Steel (1999) concluded that supplementation with urea can increase resilience to parasitism thereby improving production and also enhance resistance mechanisms against worms in young sheep on low quality roughage diets. These responses can be partly attributed to stimulation of feed intake, presumably due to enhanced ruminal digestion, but also to elevated rumen NH3-N levels which would be expected to have increased rumen microbial protein synthesis and availability to the intestines.

2.12 TREATMENT

Kerboeuf et al. (1988) assessed the resistance by the helminths, in sheep and goats, chiefly to benzimidazole derivatives, was made by faecal egg counts, performed before and after treatment. Helminths suspected of being
resistant were then tested in vitro, by the egg hatching test for benzimidazoles (thiabendazole, albendazole and fenbendazole), and by the larval paralysis test for levamisole and pyrantel tartrate. Resistant strains of Haemonchus, Osteriagia and Trichostrongylus were found in 20% of the 26 sheep and goat flocks tested. Goats showed more resistant strains than sheep. Monospecific strains were developed in experimental animals.

Sahoo et al. (1988) experimented on groups of 4 goats aged 4-6 months were infected with 2 doses of 2000 Haemonchus contortus larvae 15 days apart. Group I was treated with panacur [fenbendazole] at 5 mg/kg, and Group II animals received thiophanate at 4 ml/animal (500g wettable powder dissolved in 2 litres of water), on day 25 after initial infection. Faecal egg counts were zero on day 5 after treatment in group I, and had fallen to an average of 15 epg by day 7 in group II. An average of 7.5 worms/animal were recovered from group II animals at post mortem on day 32 post infection.

Coles et al. (1989) indicated anthelmintic efficacy of levamisole against induced infections with 7 and 21 day-old Haemonchus contortus, Ostertagia circumcincta, Trichostrongylus axei, and T. colubriformis was evaluated as an oral drench in goats. Group 1 (n=8) was not treated, group 2 (n=8) was given 3.96 mg of levamisole/kg of body weight, group 3 (n=8) was give 7.92 mg of levamisole/kg, and group 4 (n=7) was given 11.88 mg of levamisole/kg. Efficacy against all worms was low in goats given 3.96 mg of levamisole/kg, but was high against adult H. contortus (99%) and adult T. colubriformis (99.7%) in goats given 7.97mg of levamisole/kg. Although efficacy against adults of all species was high in goats given 11.88 mg of levamisole/kg, some immature worms of all species remained in the abomasa of goats.

Gupta et al. (1989) reported that the triclabendazole was found to be highly effective in sheep, goats and rabbits, confirming the results of other workers, it was ineffective in ten buffalo calves at doses of 10,12 or 20mg/kg, even when three doses were given 7-15 weeks apart.
Mishra et al. (1989) Of 12 calves and 12 kids with heavy natural *Moniezia* infections, half received albendazole at 7.5 mg/kg (calves) or 5 mg/kg (kids). After expulsion of worms and scoleces, the faeces of treated animals remained negative for the 50-day observation period. There were no side effects.

Scherrer et al. (1989) reported a survey of anthelmintics resistance on ten goat farms was carried out. The criterion for resistance was a faecal egg count reduction (FECR) of <90% based on arithmetic means of 11 to 19 goats per group. It was found that nine of the ten farms harboured nematodes resistant to oxfendazole when used at 5mg/kg although on two of these, the FECR’s were 89.2% and 89.8%. Post treatment larval cultures indicated *Haemonchus*, *Ostertagia* and *Trichostrongylus* were the resistant genera involved. On none of the ten farms was resistance to oral ivermectin at 0.2 mg/kg detected.

Shastri (1989) assessed ivermectin at 10 mg subcutaneously in 40 goats with strongyles (*Haemonchus contortus*, *Trichostrongylius colubriformis* and *T. axei*). Only one passed ova after treatment (97.5% efficacy). *Trichuris* (*T. globulosa*, *T. discolor*) ova were detected in 26 of these goats, but in only two after treatment (92.3% efficacy).

Srivastava et al. (1989) noticed the 60 naturally infected goats, 38 (60%) had diarrhoea in the form of pasty faeces with a fetid smell, and only 58% had immature amphistomes in the faeces. Differences in lesion score were highly significant between the group treated with morantel and the control group. The treated group had a highly significant reduction in PM immature worm count.

Craig and Miller (1990) showed that the goats in the control group had an increase in the number of eggs per gram of feces (epg). Comparison of the geometric mean percentage reduction in epg showed that *H. contortus* was resistant to ivermectin orally, and subcutaneous and oxfendazole but not to levamisole. Results of a simplified faecal egg count reduction test on the group treated with double the ivermectin dose confirmed that resistance to ivermectin had developed.
Mckenna et al. (1990) indicated resistance by faecal egg count reduction tests and larval cultures, of 2 cases of multiple anthelmintics resistance in goats and 2 in sheep on properties on North Island, New Zealand is reported. The former cases appeared to involve resistance to all 3 broad-spectrum drench groups (benzimidazole, levamisole, ivermectin) by mainly Ostertagia spp., the latter resistance to 2 of them (benzimidazole, levamisole) by Trichostrongylus spp.

Menezes et al. (1990) used a dose of 4000 infective larvae, partially resistant of a strain of Haemonchus spp. to benzimidazoles was given to each of 24 goats and 24 sheep, aged 6-12 months, previously freed from nematodes with an anthelminitic. After 36 days 8 goats and 8 sheep were treated with 0.2 mg/kg ivermectin and 8 goats and 8 sheep with 20 mg/kg netobimin, while the remainder were controls. Faecal egg counts and larval cultures showed practically 100% efficiency of the two anthelmintics in both goats and sheep.

Watson and Hosking (1990) reported resistance for the first time by Teladorsagia (Ostertagia) spp. to members of the three broad-spectrum families of anthelmintics. Worm counts in a controlled slaughter trial demonstrated multiple anthelmintics resistance in a mixed population of Teladorsagia (T. circumcincta and Trifurcata) and Trichostrongylus spp. The efficacies of oxfendazole, morantel citrate and ivermectin in reducing the Teladorsagia population were 43.8%, 75.6% and 93.1%, respectively. Ivermectin removed more than 99% of the small intestinal Trichostrongylus spp. but oxfendazole and morantel were less effective, removing 37.9% and 87.7%, respectively. Only treatment with ivermectin totally eliminated faecal nematode egg count 8 days after treatment. The lack of agreement between faecal nematode egg depressions and worm counts in lambs given ivermectin suggests that the drug may have affected the fecundity of the surviving nematode population or the assay lacked the sensitivity required. These data suggest that the sole use of faecal egg
depression would be inappropriate for accurate assessment of anthelmintics effectiveness.

Goraish et al. (1991) noticed that the goats previously infected with 100 viable *F. gigantica* metacercariae and treated with rafoxanide (Ranide, 7.5 mg/kg) at week 4 were not protected against subsequent homologous challenge with 250 metacercaria given 6 weeks later. Reinfection resulted in more severe hepatic lesions and a higher percentage of flukes recovered than in primarily infected controls. However, the size of flukes originating from the second (challenge) infection was considerably reduced. Plasma enzyme activities of aspartate aminotransferase, glutamate dehydrogenase and sorbitol dehydrogenase increased to a similar extent with primary and challenge infections. However, the plasma antibody response to *F. gigantica* was less pronounced in reinfeeted goats.

Hubert et al. (1991) invested the 20 sheep flocks and one goat herd with cases of gastrointestinal strongylosis detected benzimidazole resistance or tolerance with 16 instances. Four genera — *Haemonchus contortus*, *Trichostrongylus colubriformis*, *Teladorsagia circumcincta* and *T. trifurcata* and *Cooperia curticei* were involved. Most farmers used several anthelmintics, mainly benzimidazoles, sheep being treated 3 or 4 times a year, and lambs monthly, through the number of treatments did not seem to be related to resistance was more frequent in flocks kept on the range than in flocks kept in semi-confinement.

Jackson et al. (1991) surveyed the fibre-producing goat farms in Scotland with 81 to 900 goats (mean 226) carried out in the summer of 1990 showed evidence of resistance of resistance to drugs within the benzimidazole family on 5 farms. The faecal egg count reduction test using arithmetic means showed an average (5 farms) efficacy of 89.1% for ivermectin compared to only 36.3% (range 28.2-47.0%) for fenbendazole. Post-treatment egg hatch assays showed a mean hatch of 57.3% (range 22.7 to 88.5%) in 0.3 ppm thiabendazole. Specific faecal egg counts after anthelmintics treatment showed *Ostertagia*
*cercineta* to be the predominant species of 4 of the 5 farms where resistance was detected; *Haemonchus contortus* predominated on the fifth farm.

Sundlof et al. (1991) experimented on the goats 2-4 months of age and were infected with 250 infective metacercariae of *F. hepatica* orally in a gelatin capsule and 14 weeks later were treated orally with clorsulon (Curatrem) at 3.5, 7, 11 or 15 mg/kg body weight. A fifth group of controls was infected but not treated with clorsulon. PM examination of goats 3 weeks after treatment revealed mean reductions in numbers of flukes of 83, 98, 99 and 100%, respectively, and reductions in faecal egg counts of 82, 98, 100 and 100%, respectively. In 24 goats not infected with *F. hepatica* and given clorsulon at doses of 7, 21 and 35 mg/kg every other day for a total of 3 dose/goat, no abnormal signs or lesions that could be attributed to the drug were found at PM examination at 14 days after dosing.

Pomroy et al. (1992) used faecal egg count reduction tests to identify a strain of *Ostertagia* ([Teladorsagia] *cercineta* trifurcata) complex in goats which was resistant to ivermectin (at 0.2 mg/kg and 0.4 mg/kg orally), oxendazole (at 5 mg/kg orally), levamisole (at 12 mg/kg orally) and fenbendazole (at 5 mg/kg orally) combined with levamisole (at 9.4 mg/kg orally). The percentage reductions achieved in these faecal egg count reduction tests were respectively 27%, 83%, 82%, 79% and 82%. Moxidectin (at 0.2 mg/kg by subcutaneous injection), fenbendazole (at 10 mg/kg orally) combined with levamisole (at 18.8 mg/kg orally) combined with oxendazole (at 10 mg/kg orally) and ivermectin (at 0.4 mg/kg orally) combined with levamisole (at 12 mg/kg orally) were effective in removing these nematodes in goats as determined by faecal egg count reduction tests. These drenches achieved reductions of 100%, 100%, 98% and 100% respectively.

Uppal et al. (1992) reported that when treatment with fenbendazole failed to alleviate diarrhea in a flock of 500 goats on a farm where a levamisole-resistant strain of *Haemonchus contortus* had been detected, a trial was
undertaken with several anthelmintics. The *Haemonchus* strain resistant to levamisole was also found to be resistant to morantel, fenbendazole, mebendazole and thiophanate, but not to ivermectin or closantel.

Corba *et al.* (1993) were found *Ostertagia* and *Trichostrongyulus* spp. resistant to thiabendazole, albendazole, levamisole and ivermectin in 650 Cashmere and Angora goats imported from New Zealand. After the simultaneous administration of anthelmintics at double or 3 times the recommended dosage (ivermectin s.c. at 0.4 mg/kg, levamisole orally at 30 mg/kg and albendazole orally at 20 mg/kg) faecal examinations for eggs were negative 8 and 21 days later, but examination of goats 7 and 8 months after treatment again showed the presence of multiple resistant nematodes.

Mohamed and Radhakrishnan (1993) conducted a trial, which involved 42 sheep and 27 goats naturally infected with intestinal nematodes including *Haemonchus* spp., *Trichostrongyulus* spp. and *Oesophagostomum* spp., 26 sheep and 14 goats were treated with an albendazole suspension at 2.5% w/v at 1.5 ml/5 kg body weight; the other animals were untreated controls. The treatment was 100% effective, with the mean epg of faeces before treatment being 1260 and dropping to zero 7 days after treatment. At this time the epg count of the controls was 1290.

Barger *et al.* (1994) indicated that a rotational grazing system consisting of 10 paddocks grazed in sequence for 3.5 weeks at a time may permit a reduction in the frequency of anthelmintics treatment of goats grazed on infected pasture plots with eggs of *Haemonchus contortus*, *Trichostrongyulus colubriformis* and *Oesophagostomum columbianum*. In comparison with an adjacent set-stocked flock which required treatment on 3 occasions during the year when mean flock egg counts exceeded 2000 egg per gram (EPG) rotationally grazed goats generally maintained mean egg counts of less than 1000 EPG. Anthelmintics treatment was only given to rotationally grazed goats individually as they kidded, and there were indications that even this precaution was unnecessary. Because of frequent anthelmintics treatment and the resulting
selection of strain of anthelmintics resistant nematodes, rotational grazing of small ruminants through fencing tethering or herding deserves further investigation as a nematode control option in wet tropical environments.
MATERIALS AND METHODS
CHAPTER III
MATERIALS AND METHODS

The present research work on the “Epidemiological Surveillance, Clinico-pathology, Diagnostic and Techno-economic aspects of Helminths in Goats” conducted in and around Anand for the period of one year i.e. from July 2000 to June 2001 under the guidance of Department of Medicine and collaboration with Department of Parasitology, Department of Pathology, Department of Livestock and production and Department of Physiology and Biochemistry.

3.1. LOCATIONS AND PROCURMENT OF MATERIALS

The Anand district is situated at 22° 35’ north latitude and 72° 55’ east longitude and 45.1 m. (A-M.S.L) altitude, which come under middle Gujarat Agro climatic zone, in Gujarat State of Western India. According to the biogeographical classification based on climatic and geographic condition, Anand district is classified in semi-arid region that is more favorable area for goat farming. The materials required for the present research were collected from five randomly selected villages (viz Chikhodara, Lamvehal, Hadgud, Jitodia, and Samarkha) of Anand taluka, Instructional Farm unit, Veterinary College Anand and nearby slaughterhouses of Anand.

A total number of 1783 goats were included for the study. These were divided in three major groups. Group I - survey group (1135 goats), group II - organized farm group (288 goats) and group III included slaughter goats (360 goats).

To record the incidence of the Helminths infection, visiting the local abattoir of Anand at monthly interval during the period from July 2000 to Jun 2001 carried out slaughterhouse survey. In the slaughter group a total number of 360 goats included for the study. The faecal samples, blood, serum and affected organs were collected for further study. Visit record were maintained to furnish
information about the data of visit, number of total animals slaughtered number of
positive for the presence of internal worms and age of such infected goats.

3.2. THE COMPONENT OF RURAL HERD HEALTH PROGRAMME

3.2.1 Frequency Of Visits

Door to door visit for surveillance programme were made at farmer’s
doorsteps in each village on a regular basis at monthly interval. Total twelve visits
per animal in a year were made and during each visit the following activities were
carried out.

3.2.2 Activities During Visit

(A) Epidemiology

Prevalence of helminths was recorded according to the age, body
condition score, nutritional status, housing pattern and hygienic condition in all
the three groups. Information regarding milk production, number of kidding
management practices and age group as indicated in the proforma were recorded.
The goats were divided into 3 major groups according to the age and these were
as follow

- Kid --- up to 6 months of age.
- Hogget /Doeling --- 6 months to 1 year of age.
- Adult --- above 1 year of age.

(B) Production Performance

Information regarding the effect of helminth on the milk production
was recorded.

(B) Nutritional status

Information regarding feed and fodder were inquired from the owner
and recorded in the format and the goats were classified into three groups as per
nutritional status i.e. Good / Fair / Poor.
(C) Body Condition Score

The animals were examined for body condition and classified into three groups as per standard score card method. Vide page No.100.

(D) Housing

Housing pattern for the goat keeping was examined and classified into three groups i.e. Pakka housing/ Kacha housing / Open yard.

(E) Hygienic condition

Each and every animal was examined closely in relation to hygienic condition and were classified into three groups i.e. Good / Fair / Poor.

3.3. METEOROLOGICAL DATA

Day to day information for maximum and minimum temperature, relative humidity, average rainfall, bright sunshine and pan evaporation were collected from the record of metrological department of Gujarat Agricultural University, Anand.

The correlation of infection rate with various meteorological parameters was established. The seasonal incidence of parasitic infection was also observed and was correlated with three seasons viz. Monsoon, Winter and Summer. The 12 months were divided into three seasons as follow.

- Monsoon -- July to October.
- Winter -- November to February.
- Summer -- March to June.

3.4. COLLECTION OF SAMPLES

3.4.1 Faecal samples

3.4.1.1 Qualitative examination of faecal sample

The faecal samples were collected from individual animal and were examined for the presence of ova of Helminths parasites. The faecal samples were examined by sedimentation techniques as per the standard procedure described by
Soulsby (1982). The ova of various helminths identified on the basis of morphological details.

3.4.1.2. Quantitative examination

In quantitative examination, faecal egg counts were given as egg per gram of faeces (EPG) and were done by using McMaster and Stoll’s techniques.

3.4.2. BLOOD AND SERUM

For haematological, biochemical purpose blood was collected from jugular vein into a clean vials with and without Ethylene Diamine Tetra Acetic Acid di-sodium salt (EDTA) as an anticoagulant.

Serum was harvested from blood after being allowed to clot in cold (about 10°C) for approximately 1 hour. After centrifugation in universal centrifuge at 800-1000 rpm for 5 minutes, serum was transferred in clean vials. For biochemical estimation sera were stored at -20°C till used.

A total number of 912 blood and serum samples were collected from all the three groups. In survey group 250 samples from infected and 50 from noninfected goats were collected. Similarly from slaughter group 339 samples from infected and 21 from noninfected goats were collected. In organized farms group 156 samples from infected and 96 from noninfected goats were collected.

Out of these, a total number of 205 blood and serum samples from infected goats and 50 samples from noninfected goats were used for the haematological and biochemical studies.

3.4.3. TISSUE SPECIMEN

Tissue pieces of intestine, liver from infected and noninfected goats were collected and fixed in 10 % formalin for histopathological study.

3.5. HAEMATOLOGY

The following haematological estimations were carried out on the day of sample collection.
3.5.1. Haemoglobin estimation (Hb)

The haemoglobin was estimated as oxyhaemoglobin using 0.1 HCL as per procedure described by Jain (1986). The values were expressed in g/dl of blood.

3.5.2. Total Erythrocyte Count (TEC)

Total erythrocyte count was made on an improved Neubaure’s counting chamber using tryline pipette corrected up to 1 per cent error. Physiological saline solution was used as diluting fluid and cells were counted as suggested by Jain (1986). The results were expressed as million/cmm of blood.

3.5.3. Total Leukocyte Count (TLC)

Using 0.1 HCL diluting fluid TLC was performed as described by Jain (1986). The values were expressed as cells $10^9$/cmm.

3.5.4. Differential Leukocyte Count (DLC)

Smear was prepared immediately after blood collection and were fixed and stained by standard technique. The different leukocytes like neutrophil, lymphocyte, eosinophil, monocyte and basophil were determined by the method indicated by Jain (1986).

3.6. BIOCHEMICAL ESTIMATION

In survey and slaughter groups, 205 serum samples from infected animals and 50 samples from healthy animals were used for the following biochemical estimates.

3.6.1. Total Protein

Total protein from the serum samples was analyzed by Biuret and Bromocresol green (BCG) method using reagents supplied by Monozyme India Limited. The values were expressed as g/dl.
3.6.2. Albumin, Globulin and A/G ratio

Albumin and globulin from the serum sample were calculated from total protein values analyzed by Biuret and Bromocresol green (BCG) method. The values were expressed g/dl. A/G ratio was calculated from albumin and globulin values.

3.6.3. Total Bilirubin

Total bilirubin was estimated by Jendrassik and Grof end point colorimetry method using Span Diagnostic Kit (Udhana, Gujarat). The values were expressed as mg/dl.

3.6.4. Alkaline Phosphates (AKP)

The enzyme AKP from the serum sample was determined by PNPP, Kinetic, Spectrophotometry, Single reagent chemistry method employing Span Diagnostic Kit (Udhana, Gujarat) in semi automated analyzer. The activity was expressed in IU/L.

3.6.5. Serum Glutamic Pyruvate Transminase (SGPT)

SGPT enzyme from the serum sample was estimated by Modified – IFCC recommended UV-Kinetic, Inverse Spectrophotometry Single Step Chemistry method using Span Diagnostic Kit (Udhana, Gujarat). The results were denoted as IU/L of serum.

3.6.6. Serum Glutamic Oxalo Transminase (SGOT)

SGOT enzyme activity from the serum sample was determined by IFCC recommended UV-Kinetic, Inverse Spectrophotometry Single Reagent Chemistry using Span Diagnostic Kit (Udhana, Gujarat) and the activity was expressed as IU/L of serum.
3.6.7. Serum Glucose

Serum glucose in the serum sample was estimated by GOD POD method using gold span diagnostic reagent Kit (Udhana, Gujarat) and the values were expressed as mg/dl of serum.

3.6.8. Lactate Dehydrogenase (LDH)

LDH from the serum sample was estimated by Optimized DGKC UV Decreasing Reaction method, employing Liquid Gold, Span diagnostic Kit. The results were denoted as IU/L of serum.

3.7. IMMUNODIAGNOSIS

The immunodiagnosis tests were carried out only in the slaughter group of goats. In all 97 serum samples and 30 control samples were used.

3.7.1. Preparation of antigens

The worms which were collected from slaughter animals were identified and weighted after blotting dry on filter paper and macerated in saline (20% w/v), which was cooled in crushed ice. The macerate was allowed to stand overnight at 4°C and then centrifuged at 15,000rpm for 30 minutes at 4°C. The supernatant was collected and stored in small volume at -20°C. The protein concentration of the whole worm soluble antigen was estimated as per the method described by Lowry et al. (1951).

3.7.2. Agar Gel Diffusion Test

3.7.2.1. Materials

Veronal (Barbitone) buffer (0.2 M, pH 7.6)

Solution A
Sodium barbital : 4.12 gm
Distilled water : 100 ml

Solution B
Hydrochloric and (11 N) : 1.80 ml
Distilled water : 98.20 ml
27.50 ml of solution of B was added to 50 ml of solution A and the volume was made to 200 ml using triple distilled water.

**Composition of Gel:**
- Veronal buffer : 100 ml
- Agarose : 1 gm
- Thiomersal : 0.01 gm

The mixture was steamed for 10 minutes, distributed in 10 ml aliquots and stored at 4 °C until further use.

**Coomassic brilliant blue stain**
- Coomassic brilliant blue (R-250) : 0.50 gm
- Ethanol (96 per cent) : 45.00 ml
- Glacial acetic acid : 10.00 ml
- Distilled water : 45.00 ml

The above stains were prepared by dissolving the powder in acid-alcohol mixture, distilled water and diluted to volume and filtered using Whatman filter paper No.1.

**Destaining solution**
- Ethanol (96 per cent) : 45.00 ml
- Glacial acetic acid : 100 ml
- Distilled water : 450 ml

3.7.2.2. Method

The petridish was first coated with gel and dried. Fifty ml of molten agarose was carefully poured on each petridish and allowed to solidify on a horizontal plane. A pattern was created consisting of central well surround by 4 wells of 3 mm diameter. The distance between the central well to the peripheral well was 6 mm.
The central well was charged with antigen (Ag) and peripheral well with sera (Ab) from naturally infested goats. Petridish was kept at 4 °C for incubation and regular observations were made up to 72 hours.

3.7.3. Immunoelectrophoresis

3.7.3.1. Materials

Veronal (barbiton) buffer (0.2ml pH 7.6) as per 3.8.2.1 A.
Composition of gel as per 3.8.2.1 B
Coomassie brilliant blue stain as per 3.8.2.1 C
Destaining solution as per 3.8.2.1 D.

3.7.3.2. Methods

Immunoelectrophoresis was carried out according to procedure of Varela Diaz et al. (1975) with slight modification. One per cent agarose in Veronal buffer (pH 7.6) was poured over clean dry glass slide (75 x 25 mm) and allowed to solidify at room temperature and kept in humid chamber at 4 °C for 30 minutes. The slides were removed from the refrigerator and circular wells were punched for antigen and trough for naturally infected goat serum were out in the gel. The circular portion of gel was removed carefully and filled with antigen. The slides containing the antigen were placed in the electrophoretic tray. Filter paper strips having the same width as the slide were soaked in the veronal buffer and placed at each end of the slide to establish electrophoresis was carried out for two hours at 2.5 mA per slide. Following the electrophoresis, the gel in the trough was removed and filled with serum from the naturally infected goat with helminths.

The slides were then placed in humid chamber at 4 °C for 48 hours. The slides were stained with coomassie brilliant stain.

3.8. HISTOPATHLOGICAL PROCESING

Tissue pieces of affected organs i.e. intestine and liver pieces as well as from healthy goats were collected and fixed in 10 % formalin for histopathological study. After fixation, they were processed by paraffin embedding
method. Section of 5\(\mu\) thicknesses were cut and stained by Harri’s Haematoxylin and Eosin staining method (Humason, 1962).

3.9. ECONOMIC PARAMETERS FOR QUANTIFICATION OF MONETARY LOSSES

Several factors both direct and indirect are found to contribute towards economic losses. Since it was difficult to quantify the indirect lose for want of reliable data (e.g. impairment of breeding efficiency, slow body weight gain, kid mortality). Only significant financially accountable components were taken into consideration (Patel, 1981). These were (a) treatment cost (b) Milk loss (c) culling loss (other then mortality) (d) losses due to mortality

(a) Treatment cost

Total number of goats affected with helmithosis, number of treatment requires and average cost of each treatment was calculated. Above information were collected by inquiry and considering present market price of drugs with Veterinary charges. Following formula derived the total cost of treatment for disease.

\[
\text{Total cost of Treatment (Rs.)} = \text{No of animals affected} \times \text{No of treatments} \times \text{Av. Cost of treatment}
\]

(b) Milk loss

Information of milk loss due to helmithosis was calculated by calculating the average loss and then monetary loss by using following formula.

\[
\text{Monetary Loss} = \text{No of milch goat affected} \times \text{Av. Milk loss/goat} \times \text{Market value of milk/Lit. (Rs.)}
\]
(c) Culling losses

Loss due to culling was calculated by considering present market value of goat.

Culling loss = value of normal healthy goat – sale value of culled goat.

(d) Losses due to mortality

The market value of each goat was used to calculate the monetary loss.

(e) Economic parameters:

The present market value of goats and products is presented as below. The present market value of goat and products

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Type of Goat / products</th>
<th>Av. market value (Rs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Kid</td>
<td>320=00</td>
</tr>
<tr>
<td>2</td>
<td>Doeling</td>
<td>900=00</td>
</tr>
<tr>
<td>3</td>
<td>Hogget</td>
<td>1000=00</td>
</tr>
<tr>
<td>4</td>
<td>Adult male</td>
<td>1500=00</td>
</tr>
<tr>
<td>5</td>
<td>Adult Female</td>
<td>1400=00</td>
</tr>
<tr>
<td>6</td>
<td>Aged Male</td>
<td>1200=00</td>
</tr>
<tr>
<td>7</td>
<td>Aged Female</td>
<td>1100=00</td>
</tr>
<tr>
<td>8</td>
<td>Chaveon</td>
<td>90 / Kg</td>
</tr>
<tr>
<td>9</td>
<td>Milk</td>
<td>6 / Lit.</td>
</tr>
</tbody>
</table>
THE PROFORMA FOR EPIDEMIOLOGICAL SURVEILLANCE, CLINICO-PATHOLOGY, DIAGNOSTIC AND TECHNOECONOMIC ASPECT OF HELMITHS IN GOATS.

Computer Code No.--------

A  Epidemiology

Name of the Village :---------------------Date---------------------
Owner's Name :---------------------------------------------
Address :---------------------------------------------
Goat : Age------- Sex:------- Breed------- Species-------
Season : Winter / Summer /Monsoon
Temperature :--------- Relative Humidity ------- Rainfall------
Location of river, pond /cannels ------------------------
Grazing pattern :---------------------------------------------

B. Reproduction Status

Total No. of kidding---------------------------------------------
No. Of kid born during---------------------------------------------
Study period.---------------------------------------------
Abortion/ still birth---------------------------------------------
Present reproduction status (P/NP/INF)---------------------------------------------

C. Production Performance

Age of animal sold (months)---------------------------------------------
Weight of animal sold (Kg.)---------------------------------------------
Income (Rs.)---------------------------------------------
Fleece (Kg.)---------------------------------------------
Income (Rs.)---------------------------------------------
Milk production (Lit.)---------------------------------------------
Income (Rs.)---------------------------------------------
Source of drinking water for goats :---------------------------------------------
Disposal of animal dung :---------------------------------------------
Production performance (Milk yield) :---------------------------------------------
Before treatment: __________________ After treatment: ________________

Nutritional status: Good / Fair / Poor
Body condition score: Good / Fair / Poor
Hygienic condition: Good / Fair / Poor
Housing: Pakka / Kachha / Open yards

D. Clinical observation of animal: ________________________________

E. Faecal sample:
Qualitative examination: ________________________________
Quantitative examination: ________________________________

F. Haematology:
Hb: __________________
TEC: __________________
TLC: __________________
DLC: N: L: E: M: B: __________________

G. Biochemical analysis:
Total protein: AKP: __________________
Albumin: ACP: __________________
Globulin: SGPT: __________________
A/G ratio: SGPT: __________________
Total bilirubin: __________________

H. Immunological aspect: __________________
AGPT: __________________
Immunoelectrophresis: __________________

I. Economic parameter: __________________
Treatment cost: __________________
Veterinary cost: __________________
Duration: __________________
Mortality: __________________
Loss due to culling: __________________
Loss of milk yield: __________________
CHAPTER IV
RESULTS

4.1 LOCATIONS AND PROCURMENT OF MATERIALS

The present study on “Epidemiological Surveillance, Clinico-pathology, Diagnostic and Techno-economic aspects of Helminths in Goats” was conducted in and around Anand. A total number of 1783 goats were included for the study. These were divided into three groups.

A total number of 1135 goats in Survey Group, 288 goats in Farm group and 360 goats in Slaughter group were studied for the helminth infection. The informations were collected in a proforma.

4.2 THE COMPONENT OF RURAL HERD HEALTH PROGRAMME

Very little is known about rural ecology and economic significance of helminth infection in rural goats. The veterinary profession is concerned how best to treat and at what cost. Thus, necessity for generation of information at rural household level cannot be overlooked.

The purpose of this study was therefore to generate reliable data on prevalence and incidence of helminth infection among goats in rural households, intelligible enough to be analyzed for identification of priority areas for the expansion of work and to initiate epidemiology and economic of helminthosis in goats in few village of rural Gujarat.

In advance nations, system for herd health programmers have been devised bearing in view the economic aspects, collection of data from individual animals on continued basis is considered important. Development of systems for assessment of progress of eradication of specific disease like brucellosis, mastitis has been attempted. Systems for national level disease monitoring have been propounded. Computer application for complicate analysis, storage and retrieval of data whenever wanted. Computer forecasting modeling
techniques for disease control are becoming increasingly popular. India is attempting to toe in line with international trend to streamline system suited for generation of data in rural ecologies and economics analysis of specific problems.

In present study, systems were structured for surveillance in rural household for epidemiology and techno economic aspect of helminth infection in goats. The present study comprised of examination of each and every individual surveyed using field tests for helmithiasis coupled with detailed inquires of the farmers door step for retrospective and prospective studies on rural goats. Further the data generated was analyzed on surveillance and epidemiology of disease, clinico - pathology, diagnostic test, mortality and economic aspects of helminthes in goats and are presented in the related tables.

4.2.1 EPIDEMIOLOGY

The occurrence of helminthic infestations in an area is influenced by multifactorial system with host, parasitic agent, and transmission process and environment effects. The complex and dynamic relationship between host, parasite and environment is an unstable and changes the balance frequently. This complex is influenced by ecological properties of Anand region, which is determined by geography, meteorological conditions, quality of herbage, and environmental factors. The managerial practices adopted by farmer for maximum economic output is also an influencing factor.

The monthly and seasonal incidence of the various helminth parasites was recorded and correlated with the age, body condition, nutritional status, housing pattern and hygienic condition in all the three groups.

4.2.2 INCIDENCE

The monthly incidence of various helminth infections in three groups was recorded and is presented in Table 1. The percent of infection was lowest 50.0% in Farm and highest 96.90 % in Survey group. The high incidence of helminth infection was observed throughout the year in Survey and Slaughter
groups (94.62 and 94.16 % respectively) while in farm group the incidence was comparatively low (53.82 %).

4.2.2.1 SURVEY GROUP

The incidence of helminth infection in survey group is indicated in Table 2. Under the survey group high incidence through the year was recorded. The infection range was observed from 93.54 to 96.90 %. A total number 1135 goats were examined for the presence of helminth infection, out of which 1074 goats were found positive indicating average incidence of 94.62 %. The incidence of various parasites observed as *Coccidia* spp. 369 (32.51%), *Trichostrongylus* spp. 324 (28.54%), *Trichuris* spp. 166 (14.62 %), mixed infection 192 (16.91) and *Moniezia* spp. 23 (2.02%). The mixed infection of *Trichuris* + *Ampistome*, *Trichuris* spp. + *Coccidial oocyst*, *Trichostrongylus* spp. + *Coccidia oocyst*, *Trichostrongylus* spp. + *Trichuris* spp. + *Coccidial oocysts* and *Trichostrongylus* spp. + *Moniezia* spp., were recorded as (0.08%), 46 (4.05%), 59 (5.19%), 52 (4.58%) and 7 (0.61%) respectively. (Table 3)

4.2.2.2 FARM GROUP

The results of faecal sample examination of this group are depicted in Table 4. In the farm group a total number of 288 faecal samples were examined under the study period. The infection rate in this group was found lowest amongst the three groups. The incidence of infection was ranged from 50.0 % to 62.50 %. A total number of 155 goats were found positive for ova of different helminths indicating 53.82 % overall incidence. The goats of this group were found positive for the ova of, *Trichostrongylus* spp. 80 (27.77%), mixed infection 38 (13.19%) *Trichuris* spp. 35(12.15%) and *Moniezia* spp. 2(0.96%). The goats of this group were found negative for *Coccidial* oocysts. In mixed infection, *Moniezia* spp. + *Trichuris* spp., *Trichostrongylus* spp. + *Trichuris* spp. and *Trichostrongylus* spp. + *Moniezia* spp. + *Trichuris* spp. were recorded with incidence of 9 (3.12%), 23 (7.98%) and 6 (2.08%) respectively as presented in Table 5.
4.2.2.3 SLAUGHTER GROUP

In slaughter group of animals the average distribution of helminth infection was observed constantly high all around the year as depicted in Table 6. In all 339 (94.16%) faecal samples out of 360 were found to be positive for different helminth parasites, ranging from 90.0% to 96.66%. The incidence of various helminth parasites *Trichostrongylus* spp. 104 (28.88%), mixed infection 85 (23.61%), Coocidial oocyst 81 (22.50%) *Trichuris* spp. 58 (16.11%), and *Moniezia* spp. 11 (3.05%). The mixed infection of *Trichostrongylus* spp. + *Trichuris* spp., *Trichostrongylus* spp. + *Trichuris* spp. + Amphistomes, *Trichuris* spp. + *Moniezia* spp., *Trichuris* spp. + Coocidial oocyst and *Trichostrongylus* spp. + Coocidial oocyst were recorded with incidence of 32(8.88%), 1(0.27%), 3(0.83%) 13(3.61%) and 36 (10.0%) respectively. (Table 7)

4.3 DISTRIBUTION OF HELMINTH INFECTION IN RELATION TO AGE

The incidence of helmith infection with the age of goats has been established under the study. The result indicated that the younger goats are more susceptible to helminth infection and as the age progresses the animals got resistance as the percent of infection decreases with age increases.

The overall incidence of helminth infection in relation to age of goats was recorded and is presented in Table 8. In all 1783 goats were observed under the present study period. The highest incidence 308 (91.66%) was observed in kids followed by 397(87.44%) and 863 (83.15%) in hogget / doeling and adult respectively, indicating that the kids are more prone to helminth infection. The group wise incidence was also recorded and is presented as below.

4.3.1. SURVEY GROUP

A total number of 1135 faecal samples were examined for the presence of helminth ova. The overall infection rate in this group was 1074 (94.62%) while in kids 281(96.56%), hogget / doeling 231 (96.65%) and in adults 562 (92.89 %) incidence was recorded, indicating a high incidence in all the three age groups as depicted in Table 9.
Table 1. Incidence of Helminth infection in survey, farm and slaughter groups on the basis of faecal sample examination

<table>
<thead>
<tr>
<th>Months</th>
<th>Survey group</th>
<th>Farm group</th>
<th>Slaughter group</th>
<th>Total Incidence</th>
</tr>
</thead>
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<tr>
<td></td>
<td>No.of animals Observed</td>
<td>No.of animals Positive</td>
<td>Incidence Per cent</td>
<td>No.of animals Observed</td>
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<td>95</td>
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</tr>
<tr>
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<td>94</td>
<td>95.91</td>
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</tr>
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<td>94</td>
<td>96.90</td>
<td>24</td>
</tr>
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<td>92</td>
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<td>93.54</td>
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<td>May 2001</td>
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<td>86</td>
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<td>June 2001</td>
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<td>84</td>
<td>94.38</td>
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<tr>
<td>Total</td>
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<td>1074</td>
<td>94.62</td>
<td>288</td>
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</table>
Plate 1: Gross photograph of grazing area showing green herbage which remain throughout the year.

Plate 2: Photograph showing a week and emaciated doeling suffering from helminth infection.
Table 2. Incidence of different parasitic infection in goats of survey group

<table>
<thead>
<tr>
<th>Months</th>
<th>Total F/S Examined</th>
<th>Total +ve animals</th>
<th>% Of infection</th>
<th>Liver fluke</th>
<th>Amphi stome</th>
<th>Moniezia</th>
<th>Tricho Strongy lids</th>
<th>Oocyst Of Coccidia</th>
<th>Mixed</th>
<th>Trichuris</th>
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<td>-</td>
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<td>-</td>
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<td>-</td>
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<td>26 (26.80)</td>
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<td>-</td>
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<td>13 (13.54)</td>
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<td>23 (2.02)</td>
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<td>369 (32.51)</td>
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<td>192 (16.91)</td>
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</table>

Figures in parenthesis indicate percent of infection
Graph 2 Incidence of various helminth infection in survey group

% of infection

July August Sept Oct Nov Dec Jan Feb March April May June

- Moni
- Tricho
- Cocci
- Trichu
- Mixed
Table 3. Incidence of mixed helminth infection in goats of Survey Group

<table>
<thead>
<tr>
<th>Months</th>
<th>No. of F/S examined</th>
<th>No. of sample positive for ova</th>
<th>Trichuris + Amphistomes</th>
<th>Trichuris + Coccid</th>
<th>Tricho+Cocci</th>
<th>Trichuris + Amoeba</th>
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<td>59 (5.19)</td>
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</table>

Figures in parenthesis indicate percent of infection
Table 4. Incidence of different parasitic infection in goats of farm group

<table>
<thead>
<tr>
<th>Months</th>
<th>Total F/S Examined</th>
<th>Total +ve animals</th>
<th>% Of infection</th>
<th>Moniezia spp</th>
<th>Tricho Strongy Lid spp</th>
<th>Oocyst Of Coccidia</th>
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Figures in parenthesis indicate percent of infection
Graph 3 Incidence of various helminth infection in farm group
Plate: 3 Microscopic photograph showing ova of *Trichuris* spp. (10x40).

Plate: 4 Ova of *Trichostrongylus* spp. showing larvae (10x40).
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Figures in parenthesis indicate percent of infection
Table 6. Incidence of different parasitic infection in goats of slaughter group

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<td>81 (22.50)</td>
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</table>

Figures in parenthesis indicate percent of infection
Graph 4 Incidence of different helminth infection in slaughter group
Plate 5 Oocyst of coccidia showing distinct sporozoites. (10x40).

Plate 6 Microscopic photograph showing ova of Moniezia spp. (10x40).
Plate: 7 The ova of Amphistomes showing indistinct operculum and embryonated mass and transparent eggshell.

Plate: 8 A photograph from mixed infection showing ova of *Trichostrongulus spp.* and coccidial oocyst.
Table 7. Incidence of mixed infection in goats of slaughter group

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<th>Months</th>
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<th>Total +ve animals</th>
<th>% Of infection</th>
<th>No of animals positive for Mixed infection</th>
<th>Trichostongyloid+ Trichuris+ Amphiloscope</th>
<th>Trichostongyloid+ Trichuris+ Moniezia+</th>
<th>Trichuris+ Coccidia</th>
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<td>1 (3.33)</td>
<td>2 (6.66)</td>
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<td>29</td>
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<td>1 (3.33)</td>
<td>2 (6.66)</td>
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<tr>
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<td>93.33</td>
<td>7 (23.33)</td>
<td>2 (6.66)</td>
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<td>2 (6.66)</td>
<td>3 (10.0)</td>
</tr>
<tr>
<td>Total</td>
<td>360</td>
<td>339</td>
<td>94.16</td>
<td>85(23.61)</td>
<td>32(8.88)</td>
<td>1 (0.27)</td>
<td>3 (0.83)</td>
<td>13 (3.61)</td>
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</table>

Figures in parenthesis indicate percent of infection.
4.3.2. FARM GROUP

The average distribution of helminth infection in relation to age of goats is presented in Table 10. In this group 288 faecal samples were observed for the presence of helminth infection. The overall infection rate in this group was 155 (53.83%). The highest incidence 27 (56.25%) was recorded in kids followed by 53 (55.28%), and 75 (52.82%) in doeling/hogget and adult respectively.

4.3.3. SLAUGHTER GROUP

The overall incidence of helminth infection was recorded high in hogget/doeling and adult groups of goats. In kid group there was no animal appeared for slaughter. A total 360 goats were observed under survey group indicating 339 (94.16%) incidence. In hogget/doeling and adult goats the average distribution of helminth infection was recorded constantly high as 113 (94.95%) and 226 (93.77%) respectively. (Table 11)

4.4. INCIDENCE OF HELMINTH INFECTION IN RELATION NUTRITIONAL STATUS, BODY CONDITION, HOUSING AND HYGIENIC CONDITION.

4.4.1. SURVEY GROUP

The distribution of helminthic infection was studied in relation to the nutritional status, body condition, housing and hygienic condition adopted by the goat owner. It has been observed that the incidence was influenced by these factors and is presented in Table 12. A total number of 1135 observations were recorded under the survey group.

4.4.1.1. NUTRITIONAL STATUS

Out of 1135 observed goats, a total number of 225 and 910 observations categorized under Fair and Poor nutritional status respectively. Comparatively low incidence of infection was recorded in the animals of Fair
Nutritional Status. The incidence recorded in Fair and Poor Nutritional status was 179 (79.55 %) and 884 (97.14 %) respectively.

4.4.1.2 BODY CONDITION SCORE

The relation of body condition a total number of 94 and 1041 observations were recorded under Fair and poor classes respectively. The incidence of infection was observed as 59 (62.76%) and 1013 (97.31 %) in Fair and Poor class respectively, indicating that under the poor body condition the incidence was comparatively higher.

4.4.1.3. HOUSING

The overall housing system was divided into three classes viz Pakka, Kaccha and Open yard, under which 154, 514 and 467 observations were classified respectively. A highest percent of infection 483 (93.96 %) was observed in Kaccha housing followed by 427 (91.43 %) and 109 (70.77 %) in Open yards and Pakka housing system respectively.

4.4.1.4 HYGIENIC CONDITION

A total number of 1135 observation were divided into three class viz Good, Fair and Poor hygienic condition, under which 107, 372 and 656 number of observations were recorded respectively. The highest percent 632 (96.34 %) of infection was observed in Poor hygienic condition while the lowest incidence 79 (73.83 %) was recorded under Good hygienic condition. Under the Fair hygienic condition the average rate of distribution of helminth infection was 281 (75.53 %).

4.4.2. FARM GROUP

Under this group a total number of 288 observations were recorded during the study period to study the relation of helminth infection with nutritional status, body condition, housing and hygienic condition and the results are depicted in Table 13. The parameter wise results are indicated as below.
4.4.2.1. NUTRITIONAL STATUS

The incidence of helminth infection in relation to the nutritional status of animals was studied. It has been observed that good nutrition has an inverse effect on the infection rate as it was recorded in three groups. In goats of the “Farm Group” the percent of infection was observed lowest among all the three groups of goats. All the observations (288) of this group fall under the category of “Good Nutrition Status”. The lowest incidence 155 (53.82%) was recorded under this class. No animals were found under Fair and Poor classes.

4.4.2.2. BODY CONDITION SCORE

The percent of infection according to the body condition was studied under the good and fair classes. A low infection rate 109(50.46%) in the good body condition and 51 (70.83 %) in fair body condition was recorded. No animal was found under the poor body condition category.

4.4.2.3. HOUSING

All the animals studied under this class were belonging from pakka housing made up of cement and concrete. In all 288 observations were included for the present study and a low 155 (53.82 %) infection rate was observed. Under the class of Kaccha and Open yard no animals were found for the observation.

4.4.2.4. HYGIENIC CONDITION

In all 288 goats samples were observed for the presence of helminth parasites under the class of good hygienic condition. A total of 155 (53.82 %) incidence was record under this class. No goats were found for the study under the category of Fair and Poor conditions.

4.4.3. SLAUGHTER GROUP

Under this group the observation on nutritional status, housing and hygienic conditions were not taken because of unknown source of goats. The body condition score was the only parameter, which could be studied under this group.
Table 24. Accuracy of agar gel precipitation test against helminth infection in slaughter group.

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<td>6 months to 1 year</td>
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<td>No. of goats found positive at P.M. examination.</td>
<td>Nil</td>
<td>48</td>
</tr>
<tr>
<td>No. of animals positive by AGPT.</td>
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<td>46</td>
</tr>
<tr>
<td>Percent of accuracy by AGPT.</td>
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Table 8. Average distribution of helminthes infection in relation to age

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<td>upto 6 months</td>
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<td>2</td>
<td>No. of Animals Positive On faecal Examination</td>
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Table 9: Average distribution of helminthes infection in relation to age in goats of Survey Group.

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<td>No. of animals Positive on faecal Examination</td>
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<td>Rate of infection (Per cent)</td>
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<td>96.65</td>
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Graph 6 Incidence of helminth infection in relation to age in survey group

% of infection

Below 6 Months  6 months to 1 yr.  Above 1 yr.
Age of goats
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<td>1 year</td>
</tr>
<tr>
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<td>96</td>
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<td>4.</td>
<td>No. of Positive faecal sample</td>
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<td>53</td>
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<td>5.</td>
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<td>155</td>
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Table 11: Average distribution of helminthes infection in relation to age in goats of Slaughter Group.

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<td>6 months 1 year</td>
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</tr>
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<td>Rate of infection (Per cent)</td>
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Graph 8 Incidence of helminth infection in relation to age in slaughter group
Table 12. Incidence of Helminths in Survey group (Group I) according to nutritional status, body condition score, housing and hygienic condition

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### Nutritional Status

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<th>No of</th>
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<td>-</td>
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<tr>
<td>b</td>
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<td>19</td>
<td>225</td>
<td>179</td>
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<tr>
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### Body condition Score

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<td>-</td>
<td>-</td>
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<tr>
<td>b</td>
<td>Fair</td>
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### Housing

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<td>Kaccha</td>
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### Hygienic condition

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<tr>
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<td>107</td>
<td>79</td>
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<td>b</td>
<td>Fair</td>
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<td>372</td>
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Table 13. Incidence of Helminths in Farm group (Group II) according to Nutritional status, body condition score, housing and hygienic condition

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Parameters</th>
<th>No of Animal Examined</th>
<th>No of observations for 12 M period</th>
<th>No of Animals affected in 12 M period</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<tr>
<td></td>
<td></td>
<td>24</td>
<td>288</td>
<td>155</td>
<td>53.82</td>
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</tbody>
</table>

**Nutritional Status**

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</thead>
<tbody>
<tr>
<td>a</td>
<td>Good</td>
<td>24</td>
<td>288</td>
<td>155</td>
<td>53.82</td>
</tr>
<tr>
<td>b</td>
<td>Fair</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>c</td>
<td>Poor</td>
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</table>

**Body condition Score**

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<tbody>
<tr>
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**Housing**

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</thead>
<tbody>
<tr>
<td>a</td>
<td>Pakka</td>
<td>24</td>
<td>288</td>
<td>155</td>
<td>53.82</td>
</tr>
<tr>
<td>b</td>
<td>Kaccha</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>c</td>
<td>Open yards</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**Hygienic condition**

<p>| | | | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>a</td>
<td>Good</td>
<td>24</td>
<td>288</td>
<td>155</td>
<td>53.82</td>
</tr>
<tr>
<td>b</td>
<td>Fair</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>c</td>
<td>Poor</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
A total no of 360 observations were taken out of which 3 (27.27 %), 180 (95.23 %) and 156 (97.50%) incidence was recorded under the Good, Fair and Poor body conditions respectively.

4.5. QUANTITATIVE EXAMINATION OF FAECAL SAMPLE

The quantitative examination of faeces was carried out for *Trichostrongylus* spp. and *Trichuris* spp. The egg per gram of faeces (e.p.g.) was recorded monthly and a correlation was observed with seasonal variations. In *Trichostrongylus* spp. the highest egg count were observed in winter season, followed by monsoon and lowest in summer while in *Trichuris* spp. the highest egg count was observed in monsoon followed by summer and lowest in winter. The group wise results of quantitative examination are presented in Table 14, 15 and 16.

4.5.1. SURVEY GROUP

The average egg count of *Trichostrongylus* spp. in this group was recorded as 1258 e.p.g. In the month wise egg count the average e.p.g. during monsoon was 1225. The egg count of *Trichostrongylus* spp. found constant (1200) in the months of July to September, while in the month of October the average egg count was raised up to 1300. The average egg count in the winter season was found highest (1350) ranged from 1300-1400, while in the summer season the egg count was found to be lowest among the three seasons, with an average egg count of 1200 ranged from 1100 in the month of June to 1300 in the month of February.

Average e.p.g. of *Trichuris* spp. was observed to be 283 e.p.g. In monsoon season it was found to be highest with 350 e.p.g. In the month of August and September the average e.p.g was 400 while in the months of July and October it was found 300. In winter and summer seasons, the average egg count was found almost constant with 250 e.p.g. The average e.p.g. ranged from 200 to 300 in both the seasons. (Table 14)
4.5.2. FARM GROUP

The observations of this group are presented in Table 15. The result of the study showed that the average egg count of *Trichostrongylus* spp. ranged from 1100 to 1300 e.p.g. with an average of 1191. In winter season the average egg count was found highest (1250) followed by monsoon and summer, 1200 and 1125 e.p.g. respectively. In the monsoon season the monthly average egg count ranged from 1100 in the month of July to 1300 in the month of October with an average of 1200 e.p.g. The average egg count in winter season was ranged from 1200 in the month of January / February while 1300 e.p.g. in the month of November / December. The average egg count of summer season was found lowest among the three season as it ranged from 1100 in the month of May / June while in the month of March / April, 1200 e.p.g recorded.

The average egg count of *Trichuris* spp. was ranged from 200 to 300 e.p.g. with an average of 250. In monsoon and summer seasons the average egg count were found highest (275) among the three seasons, ranged from 200 to 300, while in winter (months of November to February), it was recorded constantly 200 e.p.g.

4.5.3. SLAUGHTER GROUP

The results of quantitative examination of faecal samples of goats of slaughter group are presented in Table 16. The average egg count of *Trichostrongylus* spp., ranged from 1200 to 1400 e.p.g., with an annual average of 1267. In egg count of Trichostrongylus spp. a seasonal variation was observed with highest in winter followed by monsoon and summer. In monsoon season the average egg count ranged from 1200 to 1300 with an average of 1224 e.p.g., while in winter, the egg count ranged from 1300 to 1400 with an average of 1375 which was found to be highest among the three seasons. In summer the e.p.g was found 1200 constantly throughout the season.

The egg count of *Trichuris* spp. was ranged from 200 to 400 with an average of 342. In monsoon season the e.p.g ranged from 300 to 500 with an
Table 14. Quantitative examination of faecal sample of goats (Survey group).

<table>
<thead>
<tr>
<th>Months</th>
<th>Total F/S Examined</th>
<th>Total +ve animals</th>
<th>Number of animals positive with E.P.G.*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Tricho Strongy lid</td>
</tr>
<tr>
<td>July 2000</td>
<td>100</td>
<td>95</td>
<td>24(1200)</td>
</tr>
<tr>
<td>Aug.2000</td>
<td>98</td>
<td>94</td>
<td>25(1200)</td>
</tr>
<tr>
<td>Sept.2000</td>
<td>97</td>
<td>94</td>
<td>26(1200)</td>
</tr>
<tr>
<td>Oct.2000</td>
<td>96</td>
<td>92</td>
<td>25(1300)</td>
</tr>
<tr>
<td>Nov.2000</td>
<td>96</td>
<td>90</td>
<td>27(1400)</td>
</tr>
<tr>
<td>Dec.2000</td>
<td>96</td>
<td>90</td>
<td>28(1400)</td>
</tr>
<tr>
<td>Jan.2001</td>
<td>95</td>
<td>89</td>
<td>28(1300)</td>
</tr>
<tr>
<td>Feb.2001</td>
<td>93</td>
<td>87</td>
<td>29(1300)</td>
</tr>
<tr>
<td>March 2001</td>
<td>93</td>
<td>87</td>
<td>28(1300)</td>
</tr>
<tr>
<td>April 2001</td>
<td>91</td>
<td>86</td>
<td>28(1200)</td>
</tr>
<tr>
<td>May 2001</td>
<td>91</td>
<td>86</td>
<td>29(1200)</td>
</tr>
<tr>
<td>June 2001</td>
<td>89</td>
<td>84</td>
<td>27(1100)</td>
</tr>
<tr>
<td>Total</td>
<td>1135</td>
<td>1074</td>
<td>324</td>
</tr>
</tbody>
</table>

* Figure in parentheses indicate average E.P.G.
* E.P.G. of mixed infection is not included.
Table 15. Quantitative examination of faecal sample of goats (Farm group).

<table>
<thead>
<tr>
<th>Months</th>
<th>Total F/S Examined</th>
<th>Total +ve animals</th>
<th>Tricho Strongy lid</th>
<th>Seasonal Average E.P.G.</th>
<th>Trichuris</th>
<th>Seasonal Average E.P.G.</th>
<th>Oocyst Of Coccidia</th>
<th>Moniezia</th>
</tr>
</thead>
<tbody>
<tr>
<td>July 2000</td>
<td>24</td>
<td>13</td>
<td>7(1100)</td>
<td>1200</td>
<td>3(200)</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Aug.2000</td>
<td>24</td>
<td>14</td>
<td>7(1200)</td>
<td>1200</td>
<td>3(300)</td>
<td>-</td>
<td>-</td>
<td>1(++)</td>
</tr>
<tr>
<td>Sept.2000</td>
<td>24</td>
<td>15</td>
<td>8(1200)</td>
<td>1250</td>
<td>4(300)</td>
<td>275</td>
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<td>-</td>
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<tr>
<td>Oct.2000</td>
<td>24</td>
<td>13</td>
<td>7(1300)</td>
<td>1250</td>
<td>2(300)</td>
<td>-</td>
<td>-</td>
<td>1(++)</td>
</tr>
<tr>
<td>Nov.2000</td>
<td>24</td>
<td>13</td>
<td>7(1300)</td>
<td>1250</td>
<td>3(200)</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Dec.2000</td>
<td>24</td>
<td>12</td>
<td>6(1300)</td>
<td>1250</td>
<td>3(200)</td>
<td>200</td>
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<tr>
<td>Jan.2001</td>
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<td>1125</td>
<td>3(200)</td>
<td>275</td>
<td>-</td>
<td>1(+++)</td>
</tr>
<tr>
<td>Feb.2001</td>
<td>24</td>
<td>12</td>
<td>6(1200)</td>
<td>1125</td>
<td>3(200)</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>March 2001</td>
<td>24</td>
<td>12</td>
<td>6(1200)</td>
<td>1125</td>
<td>2(300)</td>
<td>275</td>
<td>-</td>
<td>1(+++)</td>
</tr>
<tr>
<td>April 2001</td>
<td>24</td>
<td>12</td>
<td>6(1100)</td>
<td>1125</td>
<td>3(300)</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>May 2001</td>
<td>24</td>
<td>13</td>
<td>7(1100)</td>
<td>1125</td>
<td>3(300)</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>June 2001</td>
<td>24</td>
<td>13</td>
<td>6(1100)</td>
<td>1125</td>
<td>3(200)</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>288</td>
<td>155</td>
<td>80</td>
<td>35</td>
<td>35</td>
<td>2</td>
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<td>-</td>
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</tbody>
</table>

Figure in parentheses indicate average E.P.G.

* E.P.G. of mixed infection is not included.
Table 16. Quantitative examination of faecal sample of goats (Slaughter group).  

<table>
<thead>
<tr>
<th>Months</th>
<th>Total +ve animals</th>
<th>Percent Of infection</th>
<th>Number of animals positive with E.P.G.*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Tricho Strongy lid</td>
</tr>
<tr>
<td>July 2000</td>
<td>28</td>
<td>93.33</td>
<td>6(1200)</td>
</tr>
<tr>
<td>Aug.2000</td>
<td>29</td>
<td>96.66</td>
<td>7(1200)</td>
</tr>
<tr>
<td>Sept.2000</td>
<td>29</td>
<td>96.66</td>
<td>9(1200)</td>
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<tr>
<td>Oct.2000</td>
<td>29</td>
<td>96.66</td>
<td>9(1300)</td>
</tr>
<tr>
<td>Nov.2000</td>
<td>28</td>
<td>93.33</td>
<td>8(1400)</td>
</tr>
<tr>
<td>Dec.2000</td>
<td>27</td>
<td>90.00</td>
<td>9(1400)</td>
</tr>
<tr>
<td>Jan.2001</td>
<td>27</td>
<td>90.00</td>
<td>9(1400)</td>
</tr>
<tr>
<td>Feb.2001</td>
<td>28</td>
<td>93.33</td>
<td>9(1300)</td>
</tr>
<tr>
<td>March 2001</td>
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<td>9(1200)</td>
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<td>April 2001</td>
<td>29</td>
<td>93.33</td>
<td>10(1200)</td>
</tr>
<tr>
<td>May 2001</td>
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<td>93.33</td>
<td>10(1200)</td>
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<tr>
<td>June 2001</td>
<td>28</td>
<td>93.33</td>
<td>9(1200)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>339</strong></td>
<td><strong>94.16</strong></td>
<td><strong>104</strong></td>
</tr>
</tbody>
</table>

Figure in parentheses indicate average E.P.G.  
* E.P.G. of mixed infection is not included.
average of 425, which was found to be highest among the three seasons, followed by 350 e.p.g in summer, ranged from 300 to 400, while in winter it was ranged from 200 to 300 with an average of 250 e.p.g which was found lowest among three seasons.

4.6. SEASONAL DISTRIBUTION

The seasonal incidence of helminth infection was recorded during the period of study and results are depicted in Table 18 and 19. The meteorological data of Anand region was used for the establishment of correlation with rate of infection of various helminthes. The meteorological information of Anand region are presented in Table 17. The results of study showed that the percent of infection in all the three groups did not influenced much with seasons.

4.6.1. SURVEY GROUP

The incidence of helminth infection in this group was found high throughout the study period. The overall incidence of helminth infection in this group was 1074 (94.26 %). In monsoon season a total number of 391 faecal samples were examined with highest incidence of 375 (95.90%), followed by 343 (94.23 %) in summer and, the lowest incidence 356 (93.68%) in winter. The season wise incidences of various helminth infections are given in Table 19.

The overall incidence of Trichostrongylus spp., Moniezia spp., Trichuris spp. Coocidial oocyst and Mixed infection were recorded as 324 (28.54%), 23 (2.02%), 192 (16.91 %), 369 (32.51 %) and 166 (13.54 %) respectively.

The seasonal distribution of Trichostrongylus spp. recorded as 100 (25.57%), 112 (29.47%) and 112 (30.76%) in monsoon, winter and summer respectively. While the incidence of Moniezia spp. were recorded comparatively low as 16 (4.09%), 5 (1.31%) and 2 (0.54%) in monsoon, winter and summer respectively. The highest incidence of Coocidial oocyst was recorded as 135 (35.52%) in monsoon followed by 125 (32.89%) and 109 (29.94%) in winter and summer respectively. The incidence of Trichuris spp. in monsoon season was
recorded as 68 (17.39%) followed by 65 (17.10%) and 59 (16.20%) in winter and summer respectively while incidence of mixed infection was observed as 56 (914.32%), 49 (12.89%) and 61 (16.75%) in monsoon winter and summer seasons respectively.

4.6.2. FARM GROUP

A total number of 288 faecal samples were examined under the study period with overall incidence of 155 (53.82%) under this group. The highest seasonal incidence 55(57.29 %) was recorded in monsoon followed by 50 (52.08%) in winter and summer.

The incidence of Trichostrongylus spp., was observed highest in monsoon with 29(30.20 %) followed by 26 (27.08%) and 25 (26004%) in winter and summer respectively. The seasonal incidences of Trichuris spp. in monsoon and winter were found equal as 12 (12.50%) while in summer, the incidence was comparatively low as 11 (11.45%). No faecal sample was found positive for Coocidial oocyst in the Farm group. The incidence of Moniezia spp. was found lowest as 1 (1.04%) in monsoon and summer seasons while in winter no sample was found positive. The seasonal incidence of mixed infection was 13 (13.54%) in monsoon and summer while 12 (12.50%) in winter season.

4.6.3. SLAUGHTER GROUP

A total number of 120 faecal samples were examined in each season under this group. The highest incidence of 115 (95.83%) was recorded in monsoon followed by 114 (95.0%) in summer and lowest in 110 (91.66%) in winter season.

The seasonal incidence of Trichostrongylus spp. was found highest 38 (31.66%) in summer fallowed by 35(29.16%) in winter and lowest 31 (25.83%) in monsoon. The seasonal incidence of Trichuris spp. observed with highest 24(20.0%) in monsoon, Followed by 18 (15.0%) in summer and lowest 16 (13.33%) in winter season. As in other groups the infection rate of Moniezia spp.
<table>
<thead>
<tr>
<th>Months</th>
<th>Temperature (°C)</th>
<th>Relative humidity (%)</th>
<th>Rainfall (cm/month)</th>
<th>Pan Evaporation (mm/24hrsIST)</th>
<th>Bright Sunshine (Hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Maximum</td>
<td>Minimum</td>
<td>Mean</td>
<td>Morning</td>
<td>Evening</td>
</tr>
<tr>
<td>July 2000</td>
<td>32.02</td>
<td>25.69</td>
<td>28.86</td>
<td>89.42</td>
<td>68.21</td>
</tr>
<tr>
<td>Aug.2000</td>
<td>32.88</td>
<td>25.50</td>
<td>29.19</td>
<td>89.08</td>
<td>67.31</td>
</tr>
<tr>
<td>Sept.2000</td>
<td>34.23</td>
<td>24.25</td>
<td>29.24</td>
<td>86.98</td>
<td>50.77</td>
</tr>
<tr>
<td>Oct.2000</td>
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<td>29.18</td>
<td>85.52</td>
<td>32.73</td>
</tr>
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<td>25.11</td>
<td>77.21</td>
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</tr>
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<td>Jan.2001</td>
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<td>68.78</td>
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</tr>
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<td>April 2001</td>
<td>39.16</td>
<td>21.00</td>
<td>30.08</td>
<td>61.32</td>
<td>19.18</td>
</tr>
<tr>
<td>May 2001</td>
<td>38.56</td>
<td>25.89</td>
<td>32.23</td>
<td>77.57</td>
<td>39.20</td>
</tr>
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<td>June 2001</td>
<td>34.62</td>
<td>26.60</td>
<td>30.61</td>
<td>85.80</td>
<td>60.29</td>
</tr>
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</table>
Table 18. Seasonal incidence of helminth infection in different groups

<table>
<thead>
<tr>
<th>Season</th>
<th>Survey Group</th>
<th></th>
<th></th>
<th>Farm Group</th>
<th></th>
<th></th>
<th>Slaughter Group</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No. of F/S</td>
<td>No. of</td>
<td>Percent</td>
<td>No. of F/S</td>
<td>No. of</td>
<td>Percent</td>
<td>No. of F/S</td>
<td>No. of</td>
<td>Percent</td>
</tr>
<tr>
<td></td>
<td>Examined</td>
<td>Positive</td>
<td>infection</td>
<td>Examined</td>
<td>Positive</td>
<td>infection</td>
<td>Examined</td>
<td>Positive</td>
<td>infection</td>
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<tr>
<td>Monsoon</td>
<td>391</td>
<td>375</td>
<td>95.90</td>
<td>96</td>
<td>55</td>
<td>57.29</td>
<td>120</td>
<td>115</td>
<td>95.83</td>
</tr>
<tr>
<td>Winter</td>
<td>380</td>
<td>356</td>
<td>93.68</td>
<td>96</td>
<td>50</td>
<td>52.08</td>
<td>120</td>
<td>140</td>
<td>91.66</td>
</tr>
<tr>
<td>Summer</td>
<td>364</td>
<td>343</td>
<td>94.23</td>
<td>96</td>
<td>50</td>
<td>52.08</td>
<td>120</td>
<td>114</td>
<td>95.00</td>
</tr>
<tr>
<td>Total</td>
<td>1135</td>
<td>1074</td>
<td>94.62</td>
<td>288</td>
<td>155</td>
<td>53.82</td>
<td>360</td>
<td>339</td>
<td>94.16</td>
</tr>
</tbody>
</table>
Graph 9: Seasonal Incidence of helminth infection in different groups

% of infection

- Survey
- Farm
- Slaughter

Monsoon Winter Summer
Table 19. Seasonal incidence of various helminth infections in different groups

<table>
<thead>
<tr>
<th>Seasons</th>
<th>Total F/S Examined</th>
<th>Total +ve animals</th>
<th>% Of infection</th>
<th>Liver fluke</th>
<th>Amphistome</th>
<th>Moniezia</th>
<th>Tricho Strongy lides</th>
<th>Oocyst Of Coccidia</th>
<th>Trichuris</th>
<th>Mixed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SURVEY GROUP</td>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monsoon</td>
<td>391</td>
<td>375</td>
<td>95.90</td>
<td>-</td>
<td>-</td>
<td>16 (4.09)</td>
<td>100(25.57)</td>
<td>135(34.52)</td>
<td>68(17.39)</td>
<td>56(14.32)</td>
</tr>
<tr>
<td>Winter</td>
<td>380</td>
<td>356</td>
<td>93.68</td>
<td>-</td>
<td>-</td>
<td>05 (1.31)</td>
<td>112(29.47)</td>
<td>125(32.89)</td>
<td>65(17.10)</td>
<td>49(12.89)</td>
</tr>
<tr>
<td>Summer</td>
<td>364</td>
<td>343</td>
<td>94.23</td>
<td>-</td>
<td>-</td>
<td>02 (0.54)</td>
<td>112(30.76)</td>
<td>109(29.94)</td>
<td>59(16.20)</td>
<td>61(16.75)</td>
</tr>
<tr>
<td>Total</td>
<td>1135</td>
<td>1074</td>
<td>94.62</td>
<td>-</td>
<td>-</td>
<td>23 (2.02)</td>
<td>324(28.54)</td>
<td>369(32.51)</td>
<td>192(16.91)</td>
<td>166(14.62)</td>
</tr>
<tr>
<td></td>
<td>FARM GROUP</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monsoon</td>
<td>96</td>
<td>55</td>
<td>57.29</td>
<td>-</td>
<td>-</td>
<td>1(1.04)</td>
<td>29(30.20)</td>
<td>-</td>
<td>12(12.50)</td>
<td>13(13.54)</td>
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<tr>
<td>Winter</td>
<td>96</td>
<td>50</td>
<td>52.08</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>26(27.08)</td>
<td>-</td>
<td>12(12.50)</td>
<td>12(12.50)</td>
</tr>
<tr>
<td>Summer</td>
<td>96</td>
<td>50</td>
<td>52.08</td>
<td>-</td>
<td>-</td>
<td>1(1.04)</td>
<td>25(26.04)</td>
<td>-</td>
<td>11(11.45)</td>
<td>13(13.54)</td>
</tr>
<tr>
<td>Total</td>
<td>288</td>
<td>155</td>
<td>53.82</td>
<td>-</td>
<td>-</td>
<td>2(0.69)</td>
<td>80(27.77)</td>
<td>-</td>
<td>35(12.15)</td>
<td>38(13.19)</td>
</tr>
<tr>
<td></td>
<td>SLAUGHTER GROUP</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monsoon</td>
<td>120</td>
<td>116</td>
<td>96.66</td>
<td>-</td>
<td>-</td>
<td>4(3.33)</td>
<td>31(25.83)</td>
<td>31(25.83)</td>
<td>24(20.00)</td>
<td>26(21.66)</td>
</tr>
<tr>
<td>Winter</td>
<td>120</td>
<td>109</td>
<td>90.8</td>
<td>-</td>
<td>-</td>
<td>3(2.50)</td>
<td>35(29.16)</td>
<td>23(19.16)</td>
<td>16(13.33)</td>
<td>32(26.66)</td>
</tr>
<tr>
<td>Summer</td>
<td>120</td>
<td>114</td>
<td>95.00</td>
<td>-</td>
<td>-</td>
<td>4(3.33)</td>
<td>38(31.66)</td>
<td>27(22.50)</td>
<td>18(15.00)</td>
<td>27(22.50)</td>
</tr>
<tr>
<td>Total</td>
<td>360</td>
<td>339</td>
<td>94.16</td>
<td>-</td>
<td>-</td>
<td>11(3.05)</td>
<td>104(28.88)</td>
<td>81(22.50)</td>
<td>58(16.11)</td>
<td>85(23.61)</td>
</tr>
</tbody>
</table>

Figures in parenthesis indicate per cent of infection
Seasonal incidence of helminth infection in survey group

- Moni: 4.09%
- Tricho: 25.3%
- Cocci: 34.5%
- Trichu: 12.89%
- Mixed: 17.1%

- Summer: 30.76%
- Winter: 29.94%
- Monsoon: 0.84%

% infection
Graph 12: Seasonal incidence of helminth infection in farm group

% infection

Moni  Tricho  Cocci  Trichu  Mixed

Summer  Winter  Monsoon

26.04

27.00

0.00

0.00

6.00

10.00

10.00
Graph 13 Seasonal incidence of helminth infection in slaughter group
was found low with 4 (3.33%) in monsoon and summer followed by 3 (2.50) in winter. The incidence of Coccidial oocyst was observed highest 31 (25.83%) in monsoon followed by 27 (22.50) and 23 (19.16%) in summer and winter respectively. A highest incidence of 32 (26.66%) in winter followed by 27 (22.50%) in summer and lowest 26 (21.66%) in monsoon was recorded for the mixed infection.

4.7. CORRELATION BETWEEN INCIDENCE OF HELMINTH AND METEOROLOGICAL PARAMETERS

The meteorological data of Anand region for the period between July 2000 to June 2001 has been depicted in Table 17. The average maximum temperature was recorded in the month of May (32.23°C) while average minimum temperature was recorded in January (19.09°C). The average maximum humidity percent was higher in July (78.82) and August (78.19) as rains started in the month of July 2000. The highest rainfall recorded under the study period in the month of July 2000 (222.20 cm) while lowest in May 2001 (120cm). The pan evaporation rate was the highest in the month of May (8.92 mm/ 24 IST) and in the same month the bright sunshine was highest (10.36 hrs).

The correlation between incidence of heminth infection and various meteorological parameters were established group wise and are presented as below.

4.7.1. SURVEY GROUP

The correlation between incidence of parasitic infection of survey group and various meteorological parameters were recorded and are depicted in Table 20. A positive correlation of disease incidence between survey group and slaughter group has been recorded. Statistical analysis revealed significant correlation (P<0.1) between both the groups. A positive correlation (P<0.05) also revealed between the disease incidence and minimum temperature, while a positive but nonsignificant correlation was observed between incidence of helminth infection and maximum and mean temperature morning and evening humidity,
rainfall and pan evaporation rate. A negative but nonsignificant correlation was observed between the incidence on helminth infection and bright sunshine.

4.7.2. FARM GROUP

A positive correlation between incidence of helminth infection of farm and slaughter and survey groups has been recorded. Statistical analysis revealed significant correlation (P<0.01) between both groups. A positive correlation has been observed between incidence of helminth infection and morning, evening and mean humidity was observed. The statistical analysis revealed significant correlation (P<0.5) between these parameters. While a positive but nonsignificant correlation was observed between incidence of helminth infection and minimum and mean temperature and rainfall. Negative but nonsignificant correlation was observed between incidence and maximum temperature, bright sunshine and pan evaporation rate Table 21.

4.7.3. SLAUGHTER GROUP

The correlation between incidence of helminth infection and meteorological parameters are depicted in Table 22. A positive and significant correlation has been observed between incidence of infection of this group and minimum and mean temperature and statistical analysis revealed significance level at P<0.05. While a positive but nonsignificant correlation was observed between disease incidence and maximum temperature, morning evening and mean humidity, rainfall and pan evaporation rate. A negative but nonsignificant correlation was observed between incidence of infection and bright sunshine.

4.8. CLINICAL OBSERVATION

The goats suffering from helminth infection were divided into two classes. In class one the goats which had positive faecal samples for the presence of helminth ova / oocyst of Coccidia but were not showing the symptoms. In such animals the haematological, biochemical and other values were not differ significantly than the normal noninfected goats. In such goat a low level of egg
count was recorded. In other class of goats, symptoms were appeared. The suffering goats were found to be weak and debilitated. Heavily infected goats showed diarrhoea with marked reduction in body weight and dehydration. Some of goats were emaciated and mostly found in cachetic condition. The visible mucous membranes were pale and the skin of affected goats was rough, dry and doughy. The clinical observations recorded during the study period revealed no significant variation in rectal temperature of infected and normal control goats in all the three groups viz Survey, Farm and Slaughter (Table 23)

4.8.1 SURVEY GROUP

The clinical observations of infected and control goats of survey group are presented in Table 23. The mean rectal temperature of infected and noninfected control goats of survey group was 102.27°F±0.05 and 102.81°F±0.03 respectively. The mean heart rate of goats of infected and noninfected groups were recorded as 68.03±0.08 and 64.57±0.02 per minute respectively. A significant increase (27.10±0.05 per minute) in mean respiration rate in was observed in the goats of infected groups as compare to control animals (18.05±0.05 per minute) The mean ruminal and intestinal movement in infected goats were found to increased significantly (5.61±0.03 per 5 minutes) as compared with noninfected control (3.83±0.05 per minutes). The heavily infected goats showed diarrhoea.

4.8.2 FARM GROUP

The clinical observations of goats of farm group are presented in Table 23. There was no significant difference in mean body temperature of goats of both groups were observed. A nonsignificant increase in mean heart rate of infected goats (69.82±0.01 per minute) as compared with the noninfected control (63.03±0.03 per minute). The mean respiration rate and ruminal movements of infected goats were found to be significantly increased, 26.87±0.05 per minute and 5.90±0.009 per 5 minutes respectively as compared to noninfected goats 19.03±0.03 per minute and 3.01±0.08 per 5 minutes respectively.
4.8.3. SLAUGHTER GROUP
The clinical observations of this group are depicted in Table 23. The clinical changes were found similar to those of infected goats of farm and survey groups. The mean body temperature of infected goats was 102.81±0.05 °F as compared to the noninfected animals 102.23±0.03 °F. The respiration and ruminal movements in infected goats were significantly increased as 28.46±0.02 per minute and 5.03±0.03 per 5 minutes, respectively, as compared to noninfected control goats, 17.38±0.05 per minute and 3.96±0.02 per 5 minute respectively.

4.9. FAECAL SAMPLE EXAMINATION
The faecal sample examination is used as a routine examination for the presence of ova of helminth parasites in all species of animals. Under the research study sedimentation technique was used to detect the presence of helminthic eggs. In all 1783 faecal samples were examined during the period of study. A total number of 1568 faecal samples were found positive for the presence of egg of various helminths.

4.10. IMMUNODIAGNOSIS
For Immunodiagnosis tests a total number of 97 infected and 30 non-infected control serum samples were used.

4.10.1. AGAR GEL DIFFUSION TEST
For conducting the Agar Gel Diffusion Test (AGPT) the antigen of specific helminths, viz *Trichostrongylus* spp and *Trichuris* spp. were used against the serum of affected goats. The results of the tests in both the cases showed a sharp and a faint line of precipitation between the antigen and sera after 48 hrs of inoculation. In negative cases no such lines were recorded between the antigen and sera in both the cases. The results of AGPT is presented in Table 24. Out of 102 goats harboring the helminth parasites (on p.m. examination), A total number of 97
Plate: 13 Photograph showing positive reaction in *Trichuris* spp. with two precipitin bands
Table 20. Correlation between incidence of helminth infection with relation to survey group of animals and meteorological parameter

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Correlation Factors</th>
<th>Coefficient Of Correlation</th>
<th>Type of Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Between incidence of helminth infection in survey and slaughter group of animals in different months.</td>
<td>0.9524 **</td>
<td>Positive</td>
</tr>
<tr>
<td>2.</td>
<td>Helminth infection and maximum temperature.</td>
<td>0.2792</td>
<td>Positive</td>
</tr>
<tr>
<td>3.</td>
<td>Helminth infection and minimum temperature.</td>
<td>0.6642 *</td>
<td>Positive</td>
</tr>
<tr>
<td>4.</td>
<td>Helminth infection and mean temperature</td>
<td>0.5915</td>
<td>Positive</td>
</tr>
<tr>
<td>5.</td>
<td>Helminth infection and morning humidity.</td>
<td>0.5604</td>
<td>Positive</td>
</tr>
<tr>
<td>6.</td>
<td>Helminth infection and evening humidity.</td>
<td>0.5582</td>
<td>Positive</td>
</tr>
<tr>
<td>7.</td>
<td>Helminth infection and Average humidity.</td>
<td>0.5536</td>
<td>Positive</td>
</tr>
<tr>
<td>8.</td>
<td>Helminth infection and rainfall.</td>
<td>0.1870</td>
<td>Positive</td>
</tr>
<tr>
<td>9.</td>
<td>Helminth infection and bright sunlight.</td>
<td>-0.5871</td>
<td>Negative</td>
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<tr>
<td>10.</td>
<td>Helminth infection and pan evaporation rate.</td>
<td>0.0428</td>
<td>Positive</td>
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</table>

* Values differ significantly at P<0.05
** Values differ significantly at P<0.01
Table 21. Correlation between incidence of helminth infection with relation to farm group of animals and meteorological parameter

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Correlation Factors</th>
<th>Coefficient Of Correlation</th>
<th>Type of Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Between incidence of helminth infection in farm and survey group of animals in different months.</td>
<td>0.8331**</td>
<td>Positive</td>
</tr>
<tr>
<td>2.</td>
<td>Helminth infection and maximum temperature.</td>
<td>-0.0267</td>
<td>Negative</td>
</tr>
<tr>
<td>3.</td>
<td>Helminth infection and minimum temperature.</td>
<td>0.5303</td>
<td>Positive</td>
</tr>
<tr>
<td>4.</td>
<td>Helminth infection and mean temperature</td>
<td>0.3765</td>
<td>Positive</td>
</tr>
<tr>
<td>5.</td>
<td>Helminth infection and morning humidity.</td>
<td>0.6141 *</td>
<td>Positive</td>
</tr>
<tr>
<td>6.</td>
<td>Helminth infection and evening humidity.</td>
<td>0.6276 *</td>
<td>Positive</td>
</tr>
<tr>
<td>7.</td>
<td>Helminth infection and Average humidity.</td>
<td>0.6679 *</td>
<td>Positive</td>
</tr>
<tr>
<td>8.</td>
<td>Helminth infection and rainfall.</td>
<td>0.1924</td>
<td>Positive</td>
</tr>
<tr>
<td>9.</td>
<td>Helminth infection and bright sunlight.</td>
<td>-0.4556</td>
<td>Negative</td>
</tr>
<tr>
<td>10.</td>
<td>Helminth infection and pan evaporation rate.</td>
<td>-0.1653</td>
<td>Negative</td>
</tr>
</tbody>
</table>

* Values differ significantly at P<0.05
** Values differ significantly at P<0.01
Table 22. Correlation between incidence of helminth infection with relation to slaughter group of animals and meteorological parameter

<table>
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<tr>
<th>S.No.</th>
<th>Correlation Factors</th>
<th>Coefficient Of Correlation</th>
<th>Type of Correlation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Between incidence of helminth infection in slaughter and farm group of animals in different months.</td>
<td>0.8262**</td>
<td>Positive</td>
</tr>
<tr>
<td>2.</td>
<td>Helminth infection and maximum temperature.</td>
<td>0.4758</td>
<td>Positive</td>
</tr>
<tr>
<td>3.</td>
<td>Helminth infection and minimum temperature.</td>
<td>0.6436 *</td>
<td>Positive</td>
</tr>
<tr>
<td>4.</td>
<td>Helminth infection and mean temperature.</td>
<td>0.6516 *</td>
<td>Positive</td>
</tr>
<tr>
<td>5.</td>
<td>Helminth infection and morning humidity.</td>
<td>0.4527</td>
<td>Positive</td>
</tr>
<tr>
<td>6.</td>
<td>Helminth infection and evening humidity.</td>
<td>0.3863</td>
<td>Positive</td>
</tr>
<tr>
<td>7.</td>
<td>Helminth infection and Average humidity.</td>
<td>0.3540</td>
<td>Positive</td>
</tr>
<tr>
<td>8.</td>
<td>Helminth infection and rainfall.</td>
<td>0.1918</td>
<td>Positive</td>
</tr>
<tr>
<td>9.</td>
<td>Helminth infection and bright sunlight.</td>
<td>-0.4967</td>
<td>Negative</td>
</tr>
<tr>
<td>10.</td>
<td>Helminth infection and pan evaporation rate.</td>
<td>0.2262</td>
<td>Positive</td>
</tr>
</tbody>
</table>

* Values differ significantly at P<0.05
** Values differ significantly at P<0.01
Table 23  Body temperature, heart rate, respiration rate ruminal movement in helminth infected and noninfected goats of different Groups.

<table>
<thead>
<tr>
<th>Physiological parameters</th>
<th>SURVRY GROUPS</th>
<th>FARM GROUPS</th>
<th>SLAUGHTER GROUPS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Infected (n=250)</td>
<td>Control (n=50)</td>
<td>Infected (n=156)</td>
</tr>
<tr>
<td>Body temperature (°F)</td>
<td>102.27 (±0.05)</td>
<td>102.81 (±0.03)</td>
<td>102.81 (±0.05)</td>
</tr>
<tr>
<td>Heart rate (per minute)</td>
<td>68.03 (±0.08)</td>
<td>64.57 (±0.02)</td>
<td>69.82 (±0.01)</td>
</tr>
<tr>
<td>Respiration Rate (per minute)</td>
<td>27.10* (±0.05)</td>
<td>18.05 (±0.05)</td>
<td>26.87* (±0.05)</td>
</tr>
<tr>
<td>Ruminal movement (per 5 minute)</td>
<td>5.61* (±0.03)</td>
<td>3.83 (±0.05)</td>
<td>5.90* (±0.09)</td>
</tr>
</tbody>
</table>

*Values differ at 5 per cent level
goats were showing positive AGPT indicating 95.09 percent accuracy. In control group there was no precipitation line observed.

4.10.2 IMMUNO ELECTROPHORESIS

The immuno electrophoresis test was conducted against the serum of two helminth parasites viz. *Trichostrongylus* spp and *Trichuris* spp. A total number of 38 serum collected from goats, found positive during the post mortem examination were used for the test. Out of 38 samples, 28 (73.68%) in *Trichostrongylus* spp and 26 (68.42%) in *Trichuris* spp. gave the positive reaction showing two strong precipitin bands. The whole worm antigens were used for the study.

4.11. HAEMATOLOGY

The helminth parasite affects the haematological values of host animal. The haematological parameters viz. Hb., T.E.C., T.L.C., P.C.V., and D.L.C. were studied in infected (*Moniezia* spp., *Trichostrongylus* spp, *Coccidia* spp., *Trichuris* spp. and mixed infection) and noninfected control goats in all the three groups and are presented in Table 25. The group wise results are presented as below.

4.11.1. SURVEY GROUP

In this group a total number of 50 and 250 blood samples from noninfected control and infected goats were collected and studied for haematological parameters. The infected goats of this group showed a significant reduction in average Hb, T.L.C. and P.C.V. values, as the mean Hb value was found significantly reduced from 12.10±0.02 to 8.97±0.01 g/dl, while the value of mean T.E.C. was also observed significantly reduced from 15.05±0.01 to 9.17±0.01 million / cmm. The values of average T.L.C and P.C.V. were also recorded significantly powered from 12.10±0.09 to 7.59±0.03 x10^3 / cmm and 34.66±0.11 to 23.61±0.09 percent respectively. The eosinophil count was observed raised significantly from 2.10±0.04 to 8.46±0.05 % indicating eosinophilia in infected goats while the neutrophil count was reduced from 33.60±0.01 to 24.24±0.06 %.
4.11.2. FARM GROUP

A total 96 and 156 blood samples from noninfected and helminth infected goats were studied for haematological changes. In farm group, the haematological values were observed significantly differ between infected and noninfected goats in average Hb., T.E.C., T.L.C., P.C.V. and D.L.C. The values of T.E.C., T.L.C. and P.C.V. values were found significantly reduced from 15.25± to 9.21±0.02 million/cmm, 12.11±0.01 to 7.44±0.02 x 10^9/cmm and 36.06±0.04 % to, 28.36±0.05 % in infected goats respectively. The value of mean Hb. was observed nonsignificantly reduced from 12.90±0.01 g/dl to 11.09±0.04 g/dl in infected goats of this group. The mean eosinophil count was recorded significantly higher from 2.38±0.02 to 8.24±0.05 percent in infected goats while average Neutrophil count was observed significantly reduced from 29.54±0.04 to 19.36±0.03 percent in infected animals.

4.11.3. SLAUGHTER GROUP

The blood samples of this group included 21 and 339 samples from control and infected goats respectively. The values of Hb., T.E.C., T.L.C., P.C.V., and D.L.C. were recorded significantly differ in noninfected and infected animals of this group. The mean Hb., T.E.C. and P.C.V. values was found significantly reduced from 11.71±0.03 to 9.30±0.05 g/ dl, 15.14±0.05 to 8.94±0.05 million / cmm. and 34.98±0.05 to 23.00±0.05 percent in infected animals respectively. The average T.L.C was also observed significantly reduced from 11.42±0.02 to 7.60±0.01 x 10^9/cmm. The eosinophil count was recorded significantly increased from 2.16±0.02 to 8.56±0.03 percent while neutrophil count was significantly reduced from 32.14±0.05 to 19.08±0.02 percent in infected goats.

4.12. BIOCHEMICAL PROFILE

A total number of 50 and 250 serum samples from healthy and infected goats were studied under survey group, while 96 and 156 serum samples
Table 25 Haematological values of infected, noninfected goats in survey, farm and slaughter Groups.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Parameters</th>
<th>Survey group</th>
<th>Farm group</th>
<th>Slaughter group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Non infected (n= 50)</td>
<td>Infected (n= 250)</td>
<td>Non infected (n=96)</td>
</tr>
<tr>
<td>1.</td>
<td>Haemoglobin (g/dl)</td>
<td>12.10 (±0.02)</td>
<td>8.97* (±0.01)</td>
<td>12.90 (±0.01)</td>
</tr>
<tr>
<td>2.</td>
<td>Total erythrocyte Count (million/cmm)</td>
<td>15.05 (±0.01)</td>
<td>9.17* (±0.01)</td>
<td>15.28 (±0.02)</td>
</tr>
<tr>
<td>3.</td>
<td>Total Leucocyte count (10^9 /cmm)</td>
<td>12.10 (±0.09)</td>
<td>7.59* (±0.03)</td>
<td>12.11 (±0.01)</td>
</tr>
<tr>
<td>4.</td>
<td>P.C.V. %</td>
<td>34.66 (±0.11)</td>
<td>23.61* (±0.09)</td>
<td>36.06 (±0.04)</td>
</tr>
<tr>
<td>5.</td>
<td>Different leucocyte count</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(a) Lymphocyte (%)</td>
<td>62.10 (±0.01)</td>
<td>65.09 (±0.06)</td>
<td>66.00 (±0.01)</td>
</tr>
<tr>
<td></td>
<td>(b) Neutrophil (%)</td>
<td>33.60 (±0.01)</td>
<td>24.24* (±0.06)</td>
<td>29.54 (±0.04)</td>
</tr>
<tr>
<td></td>
<td>(c) Eosinophil (%)</td>
<td>2.10 (±0.04)</td>
<td>8.46* (±0.05)</td>
<td>2.38 (±0.02)</td>
</tr>
<tr>
<td></td>
<td>(d) Monocyte (%)</td>
<td>1.40 (±0.02)</td>
<td>1.38 (±0.02)</td>
<td>1.36 (±0.02)</td>
</tr>
<tr>
<td></td>
<td>(e) Basophile (%)</td>
<td>0.80 (±0.03)</td>
<td>0.83 (±0.02)</td>
<td>0.72 (±0.01)</td>
</tr>
</tbody>
</table>

* Means differ significantly at 1 percent level
<table>
<thead>
<tr>
<th>S.No.</th>
<th>Parameters</th>
<th>Unit</th>
<th>Survey group</th>
<th>Farm group</th>
<th>Slaughter group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Non infected (n=50)</td>
<td>Infected (n=250)</td>
<td>Non infected (n=96)</td>
</tr>
<tr>
<td>1.</td>
<td>Total protein</td>
<td>g/dl</td>
<td>5.81 (±0.01)</td>
<td>2.90* (±0.01)</td>
<td>5.13 (±0.03)</td>
</tr>
<tr>
<td>2.</td>
<td>Albumin</td>
<td>g/dl</td>
<td>3.77 (±0.01)</td>
<td>1.39* (±0.01)</td>
<td>2.89 (±0.03)</td>
</tr>
<tr>
<td>3.</td>
<td>Globulin</td>
<td>g/dl</td>
<td>2.04 (±0.01)</td>
<td>1.51 (±0.02)</td>
<td>2.24 (±0.01)</td>
</tr>
<tr>
<td>4.</td>
<td>A:G ratio</td>
<td>---</td>
<td>1.84 (±0.05)</td>
<td>0.92* (±0.12)</td>
<td>1.29 (±0.05)</td>
</tr>
<tr>
<td>5.</td>
<td>Total bilirubin</td>
<td>mg/dl</td>
<td>0.46 (±0.00)</td>
<td>0.53 (±0.02)</td>
<td>0.46 (±0.01)</td>
</tr>
<tr>
<td>6.</td>
<td>Glucose</td>
<td>mg/dl</td>
<td>60.53 (±0.03)</td>
<td>34.73* (±0.06)</td>
<td>78.85 (±0.22)</td>
</tr>
<tr>
<td>7.</td>
<td>AKP</td>
<td>IU/L</td>
<td>236.49 (±0.11)</td>
<td>271.08 (±0.60)</td>
<td>254.00 (±0.24)</td>
</tr>
<tr>
<td>8.</td>
<td>LDH</td>
<td>IU/L</td>
<td>329.25 (±0.05)</td>
<td>493.76* (±0.15)</td>
<td>319.33 (±0.05)</td>
</tr>
<tr>
<td>9.</td>
<td>SGPT</td>
<td>IU/L</td>
<td>66.13 (±0.07)</td>
<td>90.34* (±0.90)</td>
<td>73.36 (±0.07)</td>
</tr>
<tr>
<td>10.</td>
<td>SGOT</td>
<td>IU/L</td>
<td>291.75 (±0.10)</td>
<td>355.19* (±0.24)</td>
<td>258.09 (±0.15)</td>
</tr>
</tbody>
</table>

* Means differ significantly at 1 percent level.
from noninfected and infected goats in farm group, and 21 and 339 serum samples from control and infected animals were collected and studied under slaughter group. The biochemical profile included Total protein, Albumin, Globulin, A:G ratio, Total bilirubin, serum glucose, AKP, LDH, SGPT and SGOT levels of infected and non infected control animals and the results are presented in Table 26.

4.12.1. SURVEY GROUP

The infected goats of this group showed hyoproteinemia, with significant reduction in mean total protein from 5.80±0.01-to 2.90±0.01-g/ dl in control and infected goats respectively. The average albumin level was recorded significantly reduced from 3077±0.01 to 1.39±0.01 g/dl in control and infected goats respectively. The average A:G ratio was also significantly reduced from 1084±0.05 to 0.92±0.12 in healthy and infected animals respectively. The hypoglycemic condition was also recorded in the infected goats of this group with average serum glucose level decreased from 60.53±0.03 to 34.73±0.06 mg/dl in control and infected goats respectively. The result indicated a significant increase in mean LDH level from 329.25±0.05 to 493±0.15 IU/L of serum in control and infected goats respectively. The average values of SGPT and SGOT were also recorded significantly elevated as 66.13±0.07 to 90.34±0.90 and 291.75±0.10 to 355.19±0.24 respectively. The mean total bilirubin and AKP values were found nonsignificantly raised in noninfected control and infected goats. Table 26.

4.12.2. FARM GROUP

In infected goats of farm group the average total protein and mean albumin levels were reordered significantly low with values of 5.13±0.03 to3.36±0.03 and 2.89±0.03 to 1.30±0.01 g/dl respectively in noninfected control and infected goats. The mean A:G ratio was also reduced from 1.29±0.05 to 0.63±0.24 in control and infected animals. The mean values of LDH, SGPT and SGOT were observed significantly high with 319.33±0.05 to 468.07±0.16, 73.36±0.07 to 94.35±0.08 and 258.09±0.15 to 322.22±0.09 IU/L respectively in non-infected control and infected goats. Average serum glucose level was found
significantly low from 78.85±0.22 to 39.55±0.23 mg/dl in control and infected animals. The mean total bilirubin level was observed nonsignificantly increased from 0.46±0.01 to 0.57±0.02 mg/dl in health and infected goats respectively.

4.12.3. SLAUGHTER GROUP

The result of biochemical profile indicated that a significant hypoproteinemia with hypoalbuminemia were recorded in infected goats of this group with mean values of total protein and albumin decreased from 5.07±0.02 to 3.02±0.01 g/dl and 2.99±0.01 to 1.06±0.05 g/dl respectively in control and infected goats. A significant reduction was observed in A:G ratio with average values from 1.43±0.03 to 0.54±0.02 in infected goats. The mean values of LDH, SGPT and SGOT were recorded significantly high as 322.06±0.05 to 445.30±0.05, 79.0±0.01 to 93.09±0.02 and 260.62±0.04 to 337.04±0.67 IU/L of serum respectively in healthy and control goats. The mean serum glucose value was found significantly low as 73.17±0.08 to 37.50±0.04 g/dl of serum in infected goats.

4.13. PATHOLOGY

The pathological changes in various helminth infections in goats were observed in the slaughter groups of animals. In all 360 goats were examined for the pathological changes. The entire digestive system was examined for the lesions caused by helminths.

The gross pathological changes observed were congestion, catarrhal enteritis, oedema and few nodules were present in *Trichostrongylus* spp. and *Trichuris* spp. While in *Coccidia* there were few petechial haemorrhages with oedema and inflammatory reactions were observed.

The microscopic changes observed in *Trichostrongylus* spp., *Trichuris* spp. *Moniezia* spp. and *Coccidia* were thickness of intestinal wall and oedematous folds, infiltration of eosinophils, moderate, chronic inflammatory cellular reactions with mucoid degeneration, necrosis of tips of villi and desquamation of epithelial lining and cells. The dark brown to black colour parasitic excreta was found in the superficial villus mucosa. Lumen contains degenerated cellular debris
Plate 9: Intestinal section from Trichostrongylus spp. infected goat showing dark brown to black colour parasitic excreta. (H&E, 10 x100).

Plate 10: Intestinal section from Trichuris spp. infected goat showing necrosis of tips of villi and desquamation of epithelial lining and cells. (H&E, 10 x 40).
Plate : 11 Section of intestine from *Trichostrongylus* spp. infected goat showing oedematous folds with moderate to heavy cellular infiltration. (*H&E, 10 x100*).

Plate : 12 Section of intestine showing moderate to heavy cellular infiltration in mucosa and submucosa with moderate infiltration of eosinophils. (*H&E, 10 x100*).
and excreta of parasites. Oedema showing mild and acute enteritis, Cystic dilatation of mucosa and submucosa.

In coccidian infected intestine the microscopic lesions were, coccidial schizonts with moderate to heavy cellular infiltration in mucosa and submucosa with moderate infiltration of eosinophils along with coccidial oocysts.

MONETARY LOSSES

The estimation of economic losses caused by the helminth infection is a complex process. Several factors both direct and indirect are found to contribute towards economic losses. Since it was difficult to quantify the indirect lose for want of reliable data (e.g. impairment of breeding efficiency, slow body weight gain). Only significant financially accountable components were taken into consideration. These were (a) treatment cost (b) Milk loss (c) culling loss (other then mortality) (d) losses due to mortality. No mortality was observed due to helminth infection under the study period

Generally certain other factors like increase in rearing cost, lowered fertility level, immediately depression in production, cumulative life span losses, decrease in value of animals and progenies lost due to fertility problems, etc. were not considered. In this study as it was not possible to have specific information on these aspects also the technique of discounting to compensate identical events that occur in a population during the same period is not adopted.

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Monetary loss caused due to</th>
<th>Loss (Rs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Treatment cost</td>
<td>31248=00</td>
</tr>
<tr>
<td>2</td>
<td>Culling of infected goats</td>
<td>56535=00</td>
</tr>
<tr>
<td>3</td>
<td>Milk loss</td>
<td>2538=00</td>
</tr>
<tr>
<td>G. Total</td>
<td></td>
<td>90321=00</td>
</tr>
</tbody>
</table>

The quantification of monetary losses was calculated on 434 goats infected with helminth infection. A total loss of Rs. 90321/- was calculated under
the study period. These losses were calculated on the basis of losses due to (a) milk loss (Rs. 2538/-), cost of treatment (Rs. 31248/-) and culling of goats (Rs. 56535/-).

The milk loss occurred due to helminth infection was calculated (Rs. 2538/-) as, a total number of 282 female milking goats affected with the helminth infection had an average 100 ml of milk loss (decreased milk production) for 15 days. The average cost of milk of goats was Rs 6 /- per litre.

The cost of treatment for the 434 affected goats was recorded (Rs. 31248/-). The average cost of Rs. 24 was calculated for the treatment of a helminth infected goat with three treatment required in a year.

Table 28 Monetary losses occurred due to culling of goats

<table>
<thead>
<tr>
<th>Type of goat</th>
<th>Av. Value of normal goat</th>
<th>Av. Value of culled goat</th>
<th>Av. Loss (Rs.)</th>
<th>No. of culled goats</th>
<th>Total losses due to culling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adult male goat</td>
<td>1500=00</td>
<td>1300=00</td>
<td>200=00</td>
<td>71</td>
<td>14200=00</td>
</tr>
<tr>
<td>Adult female goat</td>
<td>1400=00</td>
<td>1275=00</td>
<td>125=00</td>
<td>125</td>
<td>35375=00</td>
</tr>
<tr>
<td>Hogget</td>
<td>1000=00</td>
<td>880=00</td>
<td>120=00</td>
<td>120</td>
<td>1680=00</td>
</tr>
<tr>
<td>Doeling</td>
<td>900=00</td>
<td>820=00</td>
<td>80=00</td>
<td>80</td>
<td>5280=00</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td>434</td>
<td>56535=00</td>
</tr>
</tbody>
</table>

The loss (Rs. 56535/-) occurred due to the culling of helminth-infected goats was calculated as per Table 27. The monetary loss due to culling was calculated on the basis of type of goat. The loss recorded due to culling of 71 adult male goats was Rs. 14200/-, while loss due to culling of 125 adult female was observed as Rs. 35375/- . Total losses of Rs. 1680/- and 5280/- were observed due to culling of 120 hogget and 80 doeling respectively.
DISCUSSION
CHAPTER V
DISCUSSION

5.1. RURAL HERD HEALTH PROGRAMME AND ANIMAL HEALTH INFORMATION

The reporting system and format structured for generation of data were useful in documentation diverse in formations that could be analyzed with ease. Despite the fact that there has been a major thrust towards the improvement and moderation of animal production system, the animal health care activity has been woeful inadequate (Adinarayanan and Menon. 1981). In the days begone our ancestors did have adequate knowledge on animal health care (Rajgopalachari, 1968). The concept and mechanisms somehow did not perpetuate. The Britisher left a system, which did not grow any better with the passage of time. The animal health intelligence through a framework does exist but has not percolated to desired extent in India. The economic concept of disease control among animal is an emerging theme both in developed and developing countries (Morris and Blood, 1969 and Adinarayanan and Menon 1981).

Very little is known about rural ecology and economic significance of helminth infection in rural goats. The veterinary profession is concerned how best to treat and at what cost. Thus, necessity for generation of information at rural household level cannot be overlooked.

The purpose of this study has therefore been to generate reliable data on prevalence and incidence of helminth infection among goats in rural households, intelligible enough to be analyzed for identification of priority areas for the expansion of work and to initiate epidemiology and economy of helminthosis in goats in few village of rural Gujarat.

In advance nations, system for herd health programmers have been devised bearing in view the economic aspects (Morris and Blood, 1969 and Safiullah et al. 1997) collection of data from individual animals on continued basis.
is considered important. Development of systems for assessment of progress of eradication of specific disease like brucellosis, mastitis has been attempted. Systems for national level disease monitoring have been propounded. Computer application for complicate analysis, storage and retrieval of data whenever wanted, Computer forecasting modeling techniques for disease control are becoming increasingly popular (Goodal et al. 1992). India is attempting to toe in line with international trend to streamline system suited for generation of data in rural ecologies and economics analysis of specific problems (Mathur and Sharma 1974).

In present study, systems were structured for surveillance in rural household for epidemiology and techno economic aspect of helminth infection in goats. The present study comprised of examination of each and every individual surveyed using field tests for helmithiasis coupled with detailed inquires of the farmers door step for retrospective and prospective studies on rural goats. Further the data generated was discussed on surveillance and epidemiology of disease, clinico - pathology, diagnostic test, and economic aspects of helminths in goats.

5.1.1. EPIDEMIOLOGY

The free-living stages of helminth parasites are vulnerable to a degree, which varies with parasites and its stage of development to dessication, high, and some time very low temperature. In final host, the survival and proliferation of parasites may be greatly influenced by nutritional, physiological and immunological status of the host. In natural foci of the helmithiasis, the parasite and their intermediate and final host form an association of potential epidemiological danger and it is important that the existence and localization of such association should be recognized before hand so that they can be brought under control.

5.1.1.2. INCIDENCE

The percent of infection was lowest 50.0% in Farm and highest 96.90 % in Survey group. The high incidence of helminth infection was observed
throughout the year in Survey and Slaughter groups (94.62 and 94.16 % respectively) while in farm group the incidence was comparatively low (53.82 %). No faecal sample was found positive for the fascioliasis under the study period.

Under the survey group high incidence through the year was recorded. The infection range observed from 93.54 to 96.90 %. The incidence of various parasitids observed as Moniezia spp., Trichostrongylus spp., Coccidia spp., Trichuris spp. and mixed infection, as 23 (2.02%), 324 (28.54%), 369 (32.51%), 166 (14.62 %) and 192 (16.91%) respectively. The mixed infection of Trichuris + Ampistome, Trichuris spp. + Coccidial oocyst, Trichostrongylus spp. + Coccidia oocyst, Trichostrongylus spp. + Trichuris spp. + Coccidial oocyst and Trichostrongylus spp. + Moniezia spp., were recorded as (0.08%), 46 (4.05%), 59 (5.19%), 52 (4.58%) and 7 (0.61%) respectively.

In slaughter group of animals the average distribution of helminth infection was observed constantly high all around the year. In all 339 (94.16 %) faecal samples out of 360 were found to be positive for different helminth parasites, ranging from 90.0% to 96.66%. The incidence of various helminth parasites Moniezia spp., Trichostrongylus spp., Trichuris spp., Coccidial oocyst and mixed infection were observed as 11 (3.05%), 104 (28.88%), 58 (16.11%), 81 (22.50%) and 85 (23.61%) respectively.

A high incidence of helminth parasites were also observed by Jithendran (1998) in Himachal Pradesh he reported 94 % animals were infected with gastrointestinal nematodes in January to December 1990. While Maingi et al. (1993) examined 341 goats and reported, 83% of 150 kids, 93% of immature goats and 93% of 108 adult goats infected with nematodes. Hasslinger et al. (1993) indicated that small ruminants (95.01%) harboured endoparasites. The most common were Dictyocalus filaria (11.8%), small lung worms (Protstronglids, 58%), Marshillagia (42.7%), Nematodirus (18%), Trichostrongylids (32.2%), Moniezia (6%) and Eimeria (73.5%) while Patel (1989) reported the seasonal incidence of various gastro intestinal parasites in goats in Gujarai state. In faecal sample examination in field and slaughtered goats and sheep he observed, Fasciola
gigantica, Amphistomes, Trichostrongylid spp., Trichuris spp., Moniezia spp. ova in faeces, oocyst of Coccidia, cysts of ciliates, Avitellina centripunctata, Thysaniezia giardi, Stilesia globipunctata, Haemonchus contortus, Trichostrongylus axei, Trichostrongylus colubriformis, Oesophagostomum columbianum, Bunostomum trigonocephalum and Trichuris ovis. Mostly mixed infection was observed with marked variation in faecal egg count within as well as between various collections. The total parasitic burden of goats based on faecal sample examination under field conditions was higher during monsoon with 85%, followed by 71% in winter and 58.33% in summer. Pandey et al. (1994) reported that the 4 dominant species, Haemonchus contortus, Trichostrongylus axei, T. colubriformis and Oesophagostomum columbianum, were present in 88-97% of the animals. Three other nematodes, Strongyloides papillosus, Bunostomum spp. and Trichuris spp. occurred respectively in 9%, 3% and 21% of the goats. Akkaya (1998) reported overall parasite prevalence: 99% T. capricola, 98% T. vitrinus, 77% T. axei, 28% T. colubriformis, 1% T. retortaeformis, 1% T. brevis, 100% O. circumcincta, 84% O. trifurcata, 14% O. occidentalis, 10% O. ostertagi, 2% O. podjapolskyi, 1% O. aegagri, 4% O. leptospicularis, 55% M. marshalli, 22% M. orientalis, 18% H. contortus, 80% N. abnormalis, 60% N. pathiger and 26% N. filicollis. T. retortaeformis, T. brevis, O. leptospicularis, O. aegagri and M. orientalis are reported from goats in Turkey for the first time. Arosemena et al. (1999) noticed the prevalence of gastrointestinal nematodes was 95.9% in goats and 83.3% in sheep.

The infection rate in survey and slaughter groups were found constantly higher all around the year, it is probably due to the high moisture content of the soil of the villages as the farmers irrigate their fields throughout the year through the cannel which create a favorable microclimate for the free living stage of helminth parasite

In farm group the infection rate was found lowest amongst the three groups. The incidence of infection was ranged from 50.0% to 62.50%. A total number of 155 goats were found positive for ova of different helminthes
indicating 53.82 % overall incidence. The goats of this group were found positive for the ova of *Moniezia* spp., *Trichostrongylus* spp., *Trichuris* spp., and Mixed infection with incidence of 2(0.96%), 80 (27.77%), 35(12.15%) and 38 (13.19%) respectively.

Patel (1989) reported that under farm condition the rate of infection was comparatively lower than under field condition and it was 54.16 % in monsoon, 50.83 % in winter and 48.33 % in summer.

A low helminth infection rate in goats of Farm group were probably due to regular deworming of individual goat, even than a mild to moderate incidence of helminth infection recorded, it is thought that regular deworming caused a resistance of helminth against athelmintics as indicated by so many workers Watson *et al.* (1990), Mckenna *et al.* (1990) and Corba *et al.* (1993) reported resistance in *Ostertagia* and *Trichostrongylus* against thiabendazole, albendazole benzimidazole, levamisole and ivermectin. While Uppal *et al.* (1992) reported that when treatment with fenbendazole failed to alleviate diarrhoea in a flock of 500 goats on a farm where a levamisole-resistant strain of *Haemonchus contortus* had been detected, a trial was undertaken with several anthelmintics. The *Haemonchus* strain resistant to levamisole was also found to be resistant to morantel, fenbendazole, mebendazole and thiophanate, but not to ivermectin or closantel.

### 5.2. DISTRIBUTION OF HELMINTH INFECTION IN RELATION TO AGE

The incidence of helmith infection with the age of goats has been established under the study. The result indicated that the younger goats were more susceptible to helminth infection and as the age progresses the animals achieve resistance as the percent of infection decreases with age increases. The highest incidence 308 (91.66%) was observed in kids followed by 397(87.44%) and 863 (83.15%) in hogget / doeling and adult respectively, indicating that the kids are more prone to helminth infection. While in survey group overall infection rate was 1074 (94.62%) while in kids, hogget /doeling and in adults the incidence was
recorded as 281 (96.56%), 231 (96.65%) and 562 (92.89%) respectively, in goats of farm group the highest incidence 27 (56.25%) was recorded in kids followed by 53 (55.28 %), and 75 (52.82 %) in doeling/hogget and adult respectively.

Maangi et al. (1993) examined 341 goats and reported, 83% of 150 kids, 93% of immature goats and 93% of 108 adult goats infected with nematodes. Geometric mean faecal strongyle egg counts were 1119, 1375 and 1225 for kids, immature and adult goats respectively. While Silva et al. (1998) noticed that the age of goat did not appear to be a factor in resistance to infection. Worm burdens of 11-to 12-month-old animals were significantly higher (P<0.05) than those of other age groups.

5.3. INCIDENCE OF HELMINTH INFECTION IN RELATION NUTRITIONAL STATUS, BODY CONDITION, HOUSING AND HYGINIC CONDITION.

5.3.1. NUTRITIONAL STATUS

It is indicated that the helminth infection was observed higher in poorly fed goat as compared to good fed animals. The quality of feed certainly effect the progression of helminth in host body. The incidence recorded in Fair and Poor Nutritional status was 179 (79.55 %) and 884 (97.14 %) respectively. No animals were found under the Good Nutritional Status category in survey group while in farm group all the goats (288) fall under the category of “Good Nutrition Status”. The lowest incidence 155 (53.82%) was recorded under this class. No animals were found under Fair and Poor classes.

. Nutrition was found to be more important to counteract the consequences of a parasitic infection than to counteract the establishment of the same infection. The major limiting factor in efficient food utilization in animals with gastrointestinal nematode infections is a parasite-induced protein rather than energy deficiency, possibly the result of increased endogenous protein losses into the gastrointestinal tract. Increasing duodenal protein supply could markedly reduce
the debilitating effect of internal parasites. Nutrition by worm load interactions was found for PCV and leukocytes. The neutrophil / lymphocyte ratio was higher in the infected animals given growth + maintenance feed, leading to the nutrition by worm load interaction for leukocytes (Blackburn et al. 1991, Brown et al. 1991 and Blackburn et al. 1992).

Kochapakdee et al. (1995) concluded that drenching of anthelmintics (levamisole @ 5mg.kg) did not result in increased body weight gain, except when the nutritional status was also improved in Thai Native and Anglo-Nubian goats while Wallace et al. (1995) indicated that the mean worm burdens were similar, the lambs given the basal diet had higher faecal egg counts, lower packed red cell volumes and lower concentrations of total plasma protein and plasma albumin than the lambs given the supplemental diet. Anindo et al. (1997) reported that the urea-molasses feed supplement blocks (MUB) is a suitable method for supplementing the nutrition of grazing sheep in Ethiopia, and that MUB feeding can help alleviate the effect of endoparasitism.

Wallace et al. (1998) carried out experiment on supplementation with urea had no discernible effect on resistance to infection; faecal egg counts, worm burdens, worm lengths and mean number of eggs per adult female worm did not differ between the 2 groups. While Knox and Steel (1999) concluded that supplementation with urea can increase resilience to parasitism thereby improving production and also enhance resistance mechanisms against worms in young sheep on low quality roughage diets. Wallace et al. (1996) indicated that the infected animals on basal diet were more anemic and hypoalbuminaemic than animals receiving the supplemented diet, although there was no statistically significant difference in mean worm burden or faecal egg counts.

Datta et al. (1999) concluded that short periods of enhanced post-weaning nutrition could have long-term and perhaps life-long effects on production.

5.3.2.BODY CONDITION SCORE
The helminth parasites, utilizes the nutrition from the host which is thought to be the cause of poor growth, low weight gain, low production and ultimately poor body condition. In relation to the body condition score a total number of 94 and 1041 observations were recorded under Fair and poor classes respectively. The incidence of infection was observed as 59 (62.76%) and 1013 (97.31%) in fair and poor classes respectively; indicating that under the poor body condition the incidence was comparatively higher.

Bekele et al. (1991) observed that among the productivity traits examined, body condition score and live-weight were significantly associated with differences in PCV and nematodes and trematode epg. levels at most sites. Monthly repeatability of PCV, body weight and body condition scores were 0.44± 0.01, 0.71± 0.01 and 0.35± 0.01, respectively, while those of nematode (0.09± 0.01) and trematode epgs (0.20± 0.02) were much lower.

Endoparasitism affected body weights and body condition scores of breeding ewes. Nursing ewes had more nematode and trematode EPG, low PCV, low body weight and at lambing. This lactation-rise in EPG was attributed to a reduction in resistance due to the stress of suckling as described by Bekele et al. (1993).

Our present observations on body condition score are in accordance with Valderrabano and Uriarte (1999) as conducted study on 66 pregnant ewes that were divided into groups showing good, medium and poor body condition. Each ewe was infected experimentally with 5000 infective nematode larvae (*Teladorsagia circumcincta, Trichostrongylus colubriformis, Haemonchus contortus*) between 5 weeks before lambing and 3 weeks afterwards. Faecal egg counts; eosinophil counts and serum pepsinogen were followed for 25 weeks after infection. As expected, ewes in poor condition developed more severe infections.

5.3.3. HOUSING

The overall housing system was divided into three classes viz Pakka, Kaccha and Open yard, under which 154, 514 and 467 observations were
classified respectively. A highest percent of infection 483 (93.96 %) was observed in Kaccha housing followed by 427 (91.43 %) and 109 (70.77 %) in Open yards and Pakka housing system respectively. In first two classes ie. Kaccha and open yard the rate of infection was found high as these conditions favors the transmission of helminth parasite.

5.3.4. HYGIENIC CONDITION

The highest percent 632 (96.34 %) of infection was observed in Poor hygienic condition while the lowest incidence 79 (73.83 %) was recorded under Good hygienic condition. Under the Fair hygienic condition the average rate of distribution of helminth infection was 281 (75.53 %).

5.4. QUANTITATIVE EXAMINATION OF FAECAL SAMPLE

The quantitative examination of faeces was carried out. The egg per gram of faeces (epg.) was recorded monthly and a correlation was observed with seasonal variations. In *Trichostrongylus* spp. the highest egg count were observed in winter season (1350) epg, followed by monsoon 1225epg. The egg count was found constant (1200) in the months of July to September, while in the month of October the average egg count was raised up to 1300 and lowest in summer while in *Trichuris* spp. the highest egg count was observed in monsoon 350 e.p.g. In the month of August and September the average e.p.g was 400 while in the months of July and October it was found 300 followed by summer and lowest in winter. In winter and summer seasons, the average egg count was found almost constant with 250 e.p.g. as the cooler climate is best suited for the propagation of *Trichostrongylus* spp. as observed under the study period (19.09 to 25.11° C) in winter season while the epg of *Trichuris* spp. was found highest during hot (28.18 to 29.24° C) and high humidity (78.82 %) as in monsoon. The observations are in support of Gordon (1953), Fakae (1990a), Amarante and Barbosa (1995), Talukdar (1996), and Yadav. (2000),
Ndao et al. (1995) found there was a negative correlation between haematocrit level, number of worms and number of eggs per gram of faeces during the rainy season. The gastrointestinal nematode burden is high during the rainy season. During the dry season (9 months) nutritional problems are aggravated by adult worms and residual larvae. Borecka and Gawor (1999) observed the highest faecal egg counts in the months of September (3120.0 in adults and 4223.1 in kids). The 7 genera recorded were Trichostrongylus, Teladorsagia, Haemonchus, Nematodirus, Cooperia, Chabertia and Oesophagostomum. Mullerius capillaris were the only lungworm species found.

Valcarcel and Garcia (1999) observed a large spectrum of nematodes, Teladorsagia circumcincta and T. trifurcata being the most prevalent spp followed by Trichostrongylus vitrinus and Nematodirus filicollis. Trichostrongylus capricola recorded a high level of infection despite low prevalence. The total digestive tract community worm number was always > 1000 and was seasonal. The lowest level of infection was found in the winter and rose progressively until the autumn. Katoch et al. (1998) reported that the Haemonchus larvae in 75.8± 2.29% of the samples, Strongyloides in 19.2± 1.53 and Trichostrongylus in 5.0± 1.30%. The epg in the faeces ranged from 0-4300, with an average of 1544.

Rahaman and Collins (1990) indicated that the output of eggs of Haemonchus by adult goats was always above 3000epg. The profile of the graph of larval availability in the herbage paralleled those for temperature and rainfall, suggesting that larval peaks occurred when the temperature and availability of moisture were optimal. Morgan et al. (1957) showed evidence of the part played by an increased fecundity of existing female worms as circumstantial, thus the nematode faecal egg counts of ewes were higher if they were subjected to excessive stress such as extremes of weather and poor nutrition.

McManus and Arnold (1965) observed that the faecal egg counts of young sheep from July were substantially higher (2000 e.p.g. and above) and 1900 e.p.g. in faeces were recorded in the spring season of the same year. The count declined in early summer. Kingsbury (1965) made a comparison between faecal egg
counts and worm burdens in 148, 5 to 12 months old sheep. The minimal significant
Trichostrongylus egg count was 500 e.p.g. counts of 550-2000 e.p.g. signified all
levels of worm infestation. 41% of cases were associated with more than 4000
worms. Some heavy worm infestation was found in sheep with egg counts of only
550-1000 e.p.g., 80% of egg counts in excess of 200 e.p.g. indicated the presence of
more than 400 worms and out of 23 sheep with e.p.g. of 3000 or more were infected
with Haemonchus contortus.

Trichostrongylus axei and T. colubriformis were only species
present in large number of sheep and they indicated that this was due to the
population of infective larvae on local pasture. There was little relationship between
e.p.g. in faeces and number of worms of sheep, Heath and Fowcett (1968).while
Vercruysse (1988) indicated the mean intensity of infection with strongylides
(Haemonchus contortus and Oesophagostomum) was 2400 and 1200 epg in sheep
with and without diarrhoea, respectively; corresponding values for Strongyloides
papillosus was 850 epg.

5.5. SEASONAL DISTRIBUTION

The incidence of helminth infection in this group was found high
throughout the study period. The over all incidence of helminth infection in this
group was 1074 (94.26 %). In monsoon season a total number of 391 faecal
samples were examined with highest incidence of 375 (95.90%), followed by 343
(94.23 %) in summer and, the lowest incidence 356 (93.68%) in winter. The
seasonal distribution of Trichostrongylus spp. recorded as 100 (25.57%), 112
(29.47%) and 112 (30.76%) in monsoon, winter and summer respectively. While
the incidence of Moniezia spp. were recorded comparatively low as 16 (4.09%), 5
(1.31%) and 2 (0.54%) in monsoon winter and summer respectively. The incidence
of Trichuris spp. in monsoon season was recorded as 68 (17.39%) fallowed by 65
(17.10%) and 59 (16.20%) in winter and summer respectively while incidence of
mixed infection was observed as 56 914.32%), 49 (12.89%0 and 61 (16.75%) in
monsoon winter and summer seasons respectively in survey group of goats.
The incidence of *Trichostrongylus* spp. was found highest in winter, as *Trichostrongylus* spp. prefer a low temperature (up to 25° C) to prorogate. The mean temperature of Anand region in winter season was ranged 19.09° to 25.11° C, which is best suited for the propogation of *Trichostrongylus* spp. While the incidence of *Trichuris* spp., *Moniezia* spp. and *Coccidia* was found higher in the monsoon season this could be probably due to the high moisture content of soil, herbage and high humidity (59.13 to 78.82 %) and a moderate temperature (28.86 to 29.24° C) which create a suitable microclimate for the translation and transmission of parasites of these species. The incidence of helmith infection was found constantly high throughout the year, it is thought that this could be because of continuous moisture of soil and herbage of the region as the farmers of the region used canal irrigation throughout the year. The uncultivable wasteland and the land along the roads, drain, canals and village ponds constituted grazing area for sheep, goat and other livestock. These areas are often flooded during rains seepage from drains and canals. As such enough moisture is invariably available for the free-living stage to develop and survives even during dry spell. The type of vegetation where faeces are deposited may thus play a part in the parasitic risk presented in a pasture.

The above observations are in support of Amarante and Barbosa (1995) indicated that the highest counts for *Trichostrongylus* larvae also occurred in the autumn and winter while the lowest counts were observed in the hot and rainy months. The highest incidence of helminthiasis occurred during September and October. When the highest faecal egg counts in ewes were recorded and Raman *et al.* (1999) also indicated the highest larval burden in villages of Madras region for *Strongylus* larvae was detected between October and January ranging from 28.09 to 100.43 larvae per kilogram of forage on dry matter basis with the peak in November and December. Larval burden decreased between February and April and further decreased in May and September. No larvae were detected in August. It is concluded that the maximum larval burden coincided with increased rainfall (300-480mm) and lower temperature (20.8-29.3° C).
The grazing pattern of goats with sheep and cattle of the region also played an important role in high incidence of helminth infection as the reports indicated by Jallow et al. (1994) that the heavier trichostrongylid burden of goats compared with sheep, when grazed together, are due in part to greater rates of infection consequent on different grazing pattern as well as greater susceptibility to infection.

The incidence of *Trichostrongylus* spp. was found highest in winter season as this could be attributed to the ability of free-living stages of *Trichostrongylus* spp. to survive desiccation and low temperatures during development to the infective stage. According to Gordon (1953) the preparasitic stages of *Trichostrongylus* spp. prefer temperate climates requiring mean monthly maximum temperature between 12.8°C to 18.3°C and a mean monthly rainfall of 50 mm or more for the optimum translation and transmission. It is therefore expected in areas where monthly maximum temperature is higher than 18.3°C, *Trichostrongylus* spp. would not pose any problem. However, different species of *Trichostrongylus* have different physiological requirements and although Gordon’s criteria may be correct of *T. vitrinus*, the predominant species in India are *T. colubriformis* and *T. axei* which are known to prefer warmer conditions and can retain some activity up 25°C (Yadav. 2000).

The rate of infection was highest (35.34%) in summer and lowest (13.95%) in winter. The most frequent species (>50% prevalence) were *Haemonchus contortus*, *Trichuris ovis*, *Paramphistomum cervi*, *Bunostomum trigonocephalum*, *Moniezia expansa*, *Gastrothylax crumenifer* and *Trichostrongylus colubriformis* (Talukdar 1996).

Further our observations analysed were on similar tract as described by Molina et al. (1997) observed no significant differences in; prevalence and intensity were found in 4 isoclimatic areas of the island (dry-desert, dry-steppe, temperate-mild, temperate-cold). The commonest species were *Teladorsagia circumcincta* (65.8% of goats) and *Trichostrongylus axei* (51.9%). *T.circumcincta* predominated in the coastal areas. Fakae (1990a) indicated the overall trend in
helminthosis in the sheep and goats was that of an escalating worm burden during the period of confinement (April-October) and a low worm burden when animals were allowed for range (November-March), these periods corresponding to the cropping and harvest seasons respectively.

More infective larvae were recorded from herbage in June, July and August than in other months. The survival time of the infective larvae ranged from 2 weeks in October to 10 weeks in June, July and August. Rainfall was the most important epizootiological factor affecting the development and survival of the infective larvae. Temperature was not a limiting factor, Onyali et al. (1990).

Jelenova (1991) reported that at the optimum temperature (5° C) in the laboratory 10% of the eggs of *Moniezia expansa* survived at least 161 days, while at 12, 10 25 and 35° C about 20% survived 28, 105 28 and 49 days, respectively. On grass plots outdoors July and August, with an average air temperature of 15.7-18.2° C and a relative humidity of 67.7-74.3 %, they survived 21-35 days, while in September and October (5.8-14.6° C, RH 65.3-76.7%) they survived 49-91 days, and in November up to 175 days.

### 5.6. CLINICAL OBSERVATION

The goats suffering from helminth infection were divided into two class. In class one the goats which had positive faecal samples for the presence of helminth ova / oocyst of Coccidia but were not showing the symptoms. In such animals the haematological, biochemical and other values were not differ significantly than the normal noninfected goats. In such goat a low level of egg count was recorded. In other class of goats, symptoms were appeared. The suffering goats were found to be weak and debilitated. Heavily infected goats showed diarrhoea with marked reduction in body weight and dehydration. Some of goats were emaciated and mostly found in cachetic condition. The visible mucous membranes were pale and the skin of affected goats was rough, dry and doughy. The clinical observations recorded during the study period revealed no significant variation in rectal temperature of infected and normal control goats.
The clinical signs like weakness, debilitation, pale mucous membrane, emaciation were caused due to the protein gastropathy, increased intestinal movements due to irritability leading to decreased absorption ultimately caused the sever weakness and associated symptoms. The observations are in support of Alvarado et al. (1990), Taylor and Kenny (1995), Brito et al. (1996) and Mottelib et al. (1992).

5.7. FAECAL SAMPLE EXAMINATION

The faecal sample examination is used as a routine examination for the presence of ova of helminth parasites in all species of animals. Under the research study sedimentation technique was used to detect the presence of helminthic eggs. In all 1783 faecal samples were examined during the period of study. A total number of 1568 faecal samples were found positive for the presence of egg of various helminthes viz. Coccidia spp., Trichostrongylus spp., Trichuris spp., Moniezia spp. mixed infection of Trichuris+ Ampistome, Trichuris spp. + Coccidial oocyst, Trichostrongylus spp. + Coccidial oocyst, Trichostrongylus spp. + Trichuris spp.+ Coccidial oocysts and Trichostrongylus spp. + Moniezia spp.

Ambrosi et al. (1993) used coprological examinations by McMaster, Baermann and larval culture techniques on 760 herds (25392 sheep). The anthelmintics programme involved 3 treatments a year. The parasites present were Moniezia, Fasciola, Dicrocoelium, Trichostrongylus, Ostertagia, Chabertia, Nematodirus, Bunostomum, Cooperia, Oesophagostomum, Strongyloides, Trichuris, Dictyocaulus, Mullerius, Cystocaulus and Protostrongylus. Prevalence of most helminths decreased over the monitoring period. It is concluded that coprological examination is a useful guide to the level of helminth infections in flocks of sheep.

Almeida et al. (1996) sampled twelve sheep from natural pastures in Madeira for faeces in the spring. The samples from each sheep were divided into 4 to 8 portions of 3 g and analysed by the McMaster method for faecal egg burdens.
Altogether 61 analyses for Strongyloid eggs and 39 for coccidial egg were performed. 53 samples from sheep with experimental nematode infections were also analysed by the McMaster and Willis methods and parasite culture for Strongyloid and Coccidial eggs. 62 and 56 % of the faeces samples from the 12 sheep were positive for strongyloid and coccidial eggs, respectively, by the McMaster method. An analysis of the results showed, however, that 52% of both results had the same probability of being negative. A further statistical analysis also showed that the McMaster results did not display binominal distribution but were strongly biased to the, with large interval variations and 0 as the model value. Of 53 sheep, 46 and 34 were positive for strongyloid eggs and 23 and 12 for coccidial eggs by the Willis and McMaster methods, respectively.

5.8. IMMUNODIAGNOSIS

5.8.1. AGAR GEL DIFFUSION TEST

For conducting the Agar Gel Diffusion Test (AGPT) the antigen of specific helmiths, viz *Trichostrongylyus* spp and *Trichuris* spp. were used against the serum of affected goats. The results of the tests in both the cases showed a sharp and a faint line of precipitation between the antigen and sera after 48 hrs of inoculation. In negative cases no such lines were recorded between the antigen and sera in both the cases. Out of 102 goats harboring the helminth parasites (on p.m. examination), A total number of 97 goats were showing positive AGPT indicating 95.09 percent accuracy. In control group there was no precipitation line observed.

Georgieva (1991) evaluated the diagnostic value of 4 immunological techniques in lambs infected with 4000(1), 10000 (2) and 20000(3) *Taenia ovis* ova at intervals from 10 to 2000 days after infection, as well as in lambs with natural infections. Haemagglutination and CIEP were more sensitive and specific than IEP or immunodiffusion. The percentage of positive reactions was dependent on infection intensity and duration. In-group 1, CIEP and haemagglutination reached a maximum (62.5%) of positive results on day 60-70 and 40-50 respectively. In-group 2 and 3, CIEP reached a maximum of 75 % on the
day 69-90 and of 100% on the day 80-90 respectively and haemagglutination reached maximal of 75% on days 50-60 and 87.5% on day 40-50 respectively. The use of both tests is recommended.

5.8.2. IMMUNO ELECTROPHORESIS

The immuno electrophoresis test was conducted against the serum of two helminth parasites viz. *Trichostrongylus* spp and *Trichuris* spp. A total number of 38 serum collected from goats, found positive during the post mortem examination were used for the test. Out 38 samples, 28 (73.68%) in *Trichostrongylus* spp. and 26 (68.42%) in *Trichuris* spp. gave the positive reaction showing two strong precipitin bands.

Satya *et al.* (1999) compared the results of disc electrophoresis of serum and cyst samples from 6 adult goats with clinical sings of *Taenia multiceps* cysts in the brain were compared before and after surgical removal of the cyst and with serum samples from 6 healthy controls. An extra protein band below the β2-globulin band was detected in the serum of the affected sheep before surgery. It was not present 30 days after cyst removal or in the controls.

5.9. HAEMATOLOGY

The helmith parasite affects the haematological values of host animal. The haematological parameters viz. Hb., T.E.C., T.L.C., P.C.V., and D.L.C. were studied in infected (*Moniezia* spp., *Trichostrongylus* spp., *Coccidia* spp., *Trichuris* spp. and mixed infection) and noninfected control goats in all the three groups. A significant reduction in average Hb, T.L.C. and P.C.V. values, as the mean Hb value was found significantly reduced from 12.10±0.02 to 8.97±0.01 g/dl, while the value of mean T.E.C. was also observed significantly reduced from 15.05±0.01 to 9.17±0.01 million / cmm. The values of average T.L.C and P.C.V. were also recorded significantly powered from 12.10±0.09 to 7.59±0.03 x10^3 / cmm and 34.66±0.11 to 23.61±0.09 percent respectively. The eosinophil count was observed raised significantly from 2.10±0.04 to 8.46±0.05 % indicating
eosinophilia in infected goats while the neutrophil count was reduced from 33.60±0.01 to 24.24±0.06 %.

The above observations are in accordance with the observations of Bratanov (1968), Ogunusi (1978), Tarazona et al. (1982), Momin (1984), Palacio et al. (1985), Bekele et al. (1991), Abdel et al. (1991), Hayat et al. (1996), Hohenhaus et al. (1998) and Maiti et al. (1999).

5.10. BIOCHEMICAL PROFILE

The infected (Moniezia spp., Trichostrongylus spp., Coccidia spp., Trichuris spp. and mixed infection) goats of this group showed hypoproteinemia, with significant reduction in mean total protein from 5.80±0.01 to 2.90±0.01 g/dl in control and infected goats respectively. The average albumin level was recorded significantly reduced from 3077±0.01 to 1.39±0.01 g/dl in control and infected goats respectively. The average A:G ratio was also significantly reduced from 1084±0.05 to 0.92±0.12 in healthy and infected animals respectively. The hypoglycemic condition was also recorded in the infected goats of this group with average serum glucose level decreased from 60.53±0.03 to 34.73±0.06 mg/dl in control and infected goats respectively. The result indicated a significant increase in mean LDH level from 329.25±0.05 to 493±0.15 IU/L of serum in control and infected goats respectively. The average values of SGPT and SGOT were also recorded significantly elevated as 66.13±0.07 to 90.34±0.90 and 291.75±0.10 to 355.19±0.24 respectively. The mean total bilirubin and AKP values were found nonsignificantly raised in noninfected control and infected goats.

Studies on serum protein changes have been reported in case of parasitized lambs (Turner and Wilson, 1960, 1962; Kuttler and Marble, 1960), parasitized sheep and goats (Wilson and Turner, 1965), sheep and adult goats infected with Haemonchus contortus and Trichostrongylus colubriformis (Fitzsimmon et al., 1968, Shastry and Ahluwalia 1972) estimated the changes in total serum protein, albumin and globulin. They observed significant drop in total serum protein, albumin and globulin/albumin ratio, while globulin % increased. The
total serum protein % dropped gradually in all the infected kids unto 10 weeks. In kids infected with 5000 larvae, the drop was from 7.85 to 5.0 per cent with 1000 larvae from 6.9 to 4.5 per cent with 2000 larvae; from 7.75 to 4.9 per cent with 40,000 larvae from 6.85 to 4.0 per cent by 10 weeks. In control kids the percentage increased from 6.6 to 7.6 per cent.

Infection with *Trichostrongylus* spp. results in a protein loosing gastro-enteropathy and hypoalbuminaemia develops. In experimental infection, protein loss commenced from day 10 and rate of loss was directly related to larval dose (Baker, 1973b). Coop *et al.* (1976) have reported low plasma phosphorus and calcium was decreased (Symons and Steel 1978) and hypophosphatamia was reported in an infected sheep (Coop 1981) and Khan *et al.* (1989).

Siddiqua *et al.* (1989) reported that the goats naturally infected with *Fasciola, Paramphistomum* or *Haemonchus* spp. had lower serum total protein and albumin values than controls not infected with these parasites, and higher globulin, AST and ALT values. The greatest difference from controls was for ALT values in *Fasciola* infection.

5.11. PATHOLOGY

The gross pathological changes observed were congestion; catarrhal enteritis oedema and few nodules were present in *Trichostrongylus* spp. and *Trichuris* spp. While in *Coccidia* there were few petechial haemorrhages with oedema and inflammatory reactions were observed. The observations are in accordance with Rehbein *et al.* (1997), Sharma *et al.* (1993) and Pienarr *et al.* (1999).

The microscopic changes observes in *Trichostrongylus* spp., *Trichuris* spp. *Moniezia* spp. and *Coccidia* were thickness of intestinal wall and oedematus folds, infiltration of eosinophils, moderate, chronic inflammatory cellular reactions with mucoid degeneration, necrosis of tips of villi and desquamation of lining epithelial lining and cells. The dark brown to black colour parasitic excreta was found in the superficial villus mucosa. Lumen contains degenerated cellular debris and excreta of parasites. Oedema showing mild and
acute enteritis, Cystic dilatation of mucosa and submucosa. These observations are in support of Rahman and Collins (1991), Rolfe et al. (1994), Berrag et al. (1996) and Sharma et al. (1997).

5.12. MONETARY LOSSES

In present study an attempt has been made to quantify the economic losses. Certain losses can be measured whereas few indirect losses are also the result of helminthosis. The technique employed to quantify the losses was similar to one developed by Patel (1981) and Dangaria (1994) comprised of generation of actual at rural area to know the extent and magnitude of prevalence. Identify various health problems and accounting for components contributory towards economic losses which were significant and recognizable. The estimation of economic losses caused by the helminth infection is a complex process. Several factors both direct and indirect are found to contribute towards economic losses. Since it was difficult to quantify the indirect losses for want of reliable data (e.g. impairment of breeding efficiency, slow body weight gain). Only significant financially accountable components were taken into consideration. These were (a) treatment cost (b) Milk loss (c) culling loss (other than mortality) (d) losses due to mortality. Generally certain other factors like increase in rearing cost, lowered fertility level, immediately depression in production, cumulative life span losses, decrease in value of animals and progenies lost due to fertility problems, etc. were not considered.

The quantification of monetary losses was calculated on 434 goats infected with helminth infection. A total loss of Rs. 9032/- was calculated under the study period. These losses were calculated on the basis of losses due to (a) milk loss (Rs. 2538/-), cost of treatment (Rs. 31248/-) and culling of goats (Rs. 56535/-).

The milk loss occurred due to helminth infection was calculated (Rs. 2538/-) while the cost of treatment for the 434 affected goats were recorded (Rs. 31248/-). The loss recorded due to culling of 71 adult male goats was Rs. 14200/-, while loss due to culling of 125 adult female was observed as Rs. 35375/-.
Total losses of Rs. 1680/- and 5280/- were observed due to culling of 120 hogget and 80 doeling respectively. No mortality was recorded due to helminth infection under the study period.


Macchi et al. (1999) indicated that the control of nematode parasites by using of effective anthelmintics provided the highest net returns yielding a margin over ineffectively treated lambs of Australian $114 per 100 lambs on average. Suppressive treatment based on the administration of 2 controlled-release capsules and monthly administration of moxidectin resulted in an average loss of A$131 per 100 lambs compared with animals treated with an ineffective anthelmintics.
SUMMARY AND CONCLUSIONS
CHAPTER VI

SUMMARY AND CONCLUSIONS

In advance nations, system for herd health programmers have been devised bearing in view the economic aspects, collection of data from individual animals on continued basis is considered important. Development of systems for assessment of progress for eradication of specific disease like brucellosis, mastitis has been attempted. Systems for national level disease monitoring have been propounded. Computer application for complicate analysis, storage and retrieval of data whenever wanted. Computer forecasting modeling techniques for disease control are becoming increasingly popular. India is attempting to toe in line with international trend to streamline system suited for generation of data in rural ecologies and economics analysis of specific problems.

A planned animal health and production programme is commonly known as herd health, is a combination of regularly scheduled veterinary activities and good herd management, designed to maintain optimal health and to achieve optimum production at least cost that will provide maximum economic return to the animal owner to increase profitability of farmer.

In present study, systems were structured for surveillance in rural household for epidemiology and techno economic aspect of helminth infection in goats. The present study comprised of examination of each and every individual surveyed using field tests for helmithiasis coupled with detailed inquires of the farmers door step for retrospective and prospective studies on rural goats. Further the data generated was analyzed on surveillance and epidemiology on disease, incidence in relation to physiological status, meteorological factors, housing, nutritional status, body condition score, hygienic condition were analyzed. The pathophysiology of the helminth infection, haematological and biochemical changes, immunodiagnosis, histopathological findings and economic losses were also studied.

The epidemiological study was undertaken in and around Anand for the period of one year i.e. from July 2000 to June 2001 and a total number of
1783 goats were included in the study. These were divided into three major groups. Group I - survey group (1135 goats), group II - organized farm group (288 goats) and group III included slaughter goats (360 goats). Door to door visit for surveillance programme were made at farmer's doorsteps in each village on a regular basis at monthly interval. Total twelve visits per animal in a year were made.

The percent of infection was lowest 50.0% in Farm and highest 96.90 % in Survey group. The high incidence of helminth infection was observed throughout the year in Survey and Slaughter groups (94.62 and 94.16 % respectively) while in farm group the incidence was comparatively low (53.82 %). No faecal sample was found positive for the fascioliasis under the study period. The incidence of various parasites observed as *Moniezia* spp., *Trichostrongylus* spp., *Coccidia* spp., *Trichuris* spp. and mixed infection were as 23 (2.02%), 324 (28.54%), 369 (32.51%), 166 (14.62 %) and 192 (16.91%) respectively. The mixed infection of *Trichuris* + *Ampistome*, *Trichuris* spp. + *Coccidial oocyst*, *Trichostrongylus* spp. + *Coccidia oocyst*, *Trichostrongylus* spp. + *Trichuris* spp. + *Coccidial oocysts* and *Trichostrongylus* spp. + *Moniezia* spp. , were recorded as ( 0.08%), 46 (4.05%), 59 (5.19%), 52 ( 4.58%) and 7 ( 0.61%) respectively. While in Farm group the incidence of infection was ranged from 50.0 % to 62.50 %. A total number of 155 goats were found positive for ova of different helminths indicating 53.82 % overall incidence.

The incidence of helminth infection with the age of goats has been established under the study. In all 1783 goats were observed under the present study period. The highest incidence 308 (91.66%) was observed in kids followed by 397(87.44%) and 863 (83.15%) in hogget / doeling and adult respectively, indicating that the kids are more prone to helminth infection.

The distribution of helminthic infection was studied in relation to the nutritional status, body condition, housing and hygienic condition adopted by the goat owner. In survey group the incidence recorded in Fair and Poor Nutritional status was 179 (79.55 %) and 884 (97.14 %) respectively. No animals were found under the Good Nutritional Status category. The incidence of infection was
observed as 59 (62.76%) and 1013 (97.31%) in Fair and Poor class respectively, indicating that under the poor body condition the incidence was comparatively higher. No animals were found under the Good Body condition score in the survey group. A highest percent of infection 483 (93.96%) was observed in Kaccha housing followed by 427 (91.43%) and 109 (70.77%) in Open yards and Pakka housing system respectively. The highest percent 632 (96.34%) of infection was observed in Poor hygienic condition while the lowest incidence 79 (73.83%) was recorded under Good hygienic condition. Under the Fair hygienic condition the average rate of distribution of helminth infection was 281 (75.53%).

In goats of the “Farm Group” the percent of infection was observed lowest among all the three groups of goats. All the observations (288) of this group fall under the category of “Good Nutrition Status”. The lowest incidence 155 (53.82%) was recorded under this class. No animals were found under Fair and Poor classes. A low infection rate 109 (50.46%) in the good body condition and 51 (70.83%) in fair body condition was recorded. No animal was found under the poor body condition category. In all 288 observations were included for the present study and a low 155 (53.82%) infection rate was observed. Under the class of Kaccha and Open yard no animals were found for the observation. A total of 155 (53.82%) incidence was record under good hygienic condition. No goats were found for the study under the category of Fair and Poor conditions.

The quantitative examination of faeces was carried out. The egg per gram of faeces (e.p.g.) was recorded monthly and a correlation was observed with seasonal variations. In *Trichostrongylus* spp. the highest egg count were observed in winter season, followed by monsoon and lowest in summer while in *Trichuris* spp. the highest egg count was observed in monsoon followed by summer and lowest in winter. The average egg count of *Trichostrongylus* spp. in the winter season in survey group was found highest (1350) ranged from 1300-1400, while in the summer season the egg count was found to be lowest among the three seasons, with an average egg count of 1200 ranged from 1100 in the month of June to 1300 in the month of February. In winter and summer seasons, the average egg count of *Trichuris* spp. was found almost constant with 250 e.p.g. The average e.p.g.
ranged from 200 to 300 in both the seasons. In farm group in winter season the average egg count of *Trichostrongylus* spp. was found highest (1250) followed by monsoon and summer, 1200 and 1125 e.p.g. respectively. While in *Trichuris* spp. in monsoon and summer seasons the average egg count were found highest (275) among the three seasons, ranged from 200 to 300, while in winter (months of November to February), it was recorded constantly 200 e.p.g.

The seasonal incidence of helminth infection was recorded during the period of study. The over all incidence of helminth infection in survey group was 1074 (94.26 %). In monsoon season a total number of 391 faecal samples were examined with highest incidence of 375 (95.90%), followed by 343 (94.23 %) in summer and, the lowest incidence 356 (93.68%) in winter. While in farm group a total number of 288 faecal samples were examined under the study period with overall incidence of 155 (53.82%). The highest seasonal incidence 55(57.29 %) was recorded in monsoon followed by 50 (52.08%) in winter and summer. In slaughter group a total number of 120 faecal samples were examined in each season under this group. The highest incidence of 115 (95.83%) was recorded in monsoon followed by 114 (95.0%) in summer and lowest in 110 (91.66%) in winter season.

The correlation between incidence of heminth infection and various meteorological parameters were established group wise. A positive correlation (P<0.05) revealed between the disease incidence and minimum temperature, while a positive but nonsignificant correlation was observed between incidence of helminth infection and maximum and mean temperature morning and evening humidity, rainfall and pan evaporation rate. A negative but nonsignificant correlation was observed between the incidence on helminth infection and bright sunshine.

The clinical observations recorded during the study period revealed no significant variation in rectal temperature of infected and normal control goats in all the three groups viz Survey, Farm and Slaughter. The goats suffering from helminth infection were divided into two classes. In class one the goats which had positive faecal samples for the presence of helminth ova / Oocyst of Coccidia but were not showing the symptoms. In such animals the haematological, biochemical
and other values did not differ significantly than the normal noninfected goats. In such goat a low level of egg count was recorded. In other class of goats, symptoms were appeared. The suffering goats were found to be weak and debilitated. Heavily infected goats showed diarrhoea with marked reduction in body weight and dehydration. Some of goats were emaciated and mostly found in cachetic condition. The visible mucous membranes were pale and the skin of affected goats was rough, dry and doughy.

The faecal sample examination is used as a routine examination for the presence of ova of helminth parasites in all species of animals. Under the research study sedimentation technique was used to detect the presence of helminthic eggs. In all 1783 faecal samples were examined during the period of study. A total number of 1568 faecal samples were found positive for the presence of egg of various helminths.

For Immunodiagnosis tests a total number of 97 infected and 30 non-infected control serum samples were used. For conducting the Agar Gel Diffusion Test (AGPT) the antigen of specific helminths, viz *Trichostrongylus* spp and *Trichuris* spp. were used against the serum of affected goats. The results of the tests in both the cases showed a sharp and a faint line of precipitation between the antigen and sera after 48 hrs of inoculation. In negative cases no such lines were recorded between the antigen and sera in both the cases.

The immunoelectrophoresis test was conducted against the serum of two helminth parasites viz. *Trichostrongylus* spp and *Trichuris* spp. A total number of 38 serum collected from goats, found positive during the post mortem examination were used for the test. Out of 38 samples, 28 (73.68%) in *Trichostrongylus* spp. and 26 (68.42%) in *Trichuris* spp. gave the positive reaction showing two strong precipitin bands.

The haematological parameters viz. Hb., T.E.C., T.L.C., P.C.V., and D.L.C. were studied in infected (*Moniezia* spp., *Trichostrongylus* spp., *Coccidia* spp., *Trichuris* spp. and mixed infection) and noninfected control goats in all the three groups. The infected goats showed a significant reduction in average Hb, T.L.C. and P.C.V. values, as the mean Hb value was found significantly
reduced from 12.10±0.02 to 8.97±0.01 g/dl, while the value of mean T.E.C. was also observed significantly reduced from 15.05±0.01 to 9.17±0.01 million / cmm. The values of average T.L.C and P.C.V. were also recorded significantly powered from 12.10±0.09 to 7.59±0.03 x10^3 / cmm and 34.66±0.11 to 23.61±0.09 percent respectively. The eosinophil count was observed raised significantly from 2.10±0.04 to 8.46±0.05 % indicating eosinophilia in infected goats while the neutrophil count was reduced from 33.60±0.01 to 24.24±0.06 % a similar trend was observed in all the infected groups.

The biochemical profile included Total protein, Albumin, Globulin, A:G ratio, Total bilirubin, serum glucose, AKP, LDH, SGPT and SGOT levels of infected and non-infected control animals. In infected goats the average total protein and mean albumin levels were reordered significantly low with values of 5.13±0.03 to 3.36±0.03 and 2.89±0.03 to 1.30±0.01 g/dl respectively in noninfected control and infected goats. The mean A:G ratio was also reduced from 1.29±0.05 to 0.63±0.24 in control and infected animals. The mean values of LDH, SGPT and SGOT were observed significantly high with 319.33±0.05 to 468.07±0.16, 73.36±0.07 to 94.35±0.08 and 258.09±0.15 to 322.22±0.09 IU/L respectively in non-infected control and infected goats. Average serum glucose level was found significantly low from 78.85±0.22 to 39.55±0.23 mg/dl in control and infected animals. The mean total bilirubin level was observed nonsignificantly increased from 0.46±0.01 to 0.57±0.02 mg/dl in healthy and infected goats respectively a similar trend of observations were recorded in all the infected goats of three groups.

The gross pathological changes observed were congestion, catarrhal enteritis, oedema and few nodules were present in Trichostrongyulus spp. and Trichuris spp. While in Coccidia there was few piteacheal haemorrhages with oedema and inflammatory reactions were observed. The microscopic changes observes in Trichostrongyulus spp., Trichuris spp. Moniezia spp. and Coccidia were thickness of intestinal wall and oedematus folds, infiltration of eosinophils, moderate, chronic inflammatory cellular reactions with mucoid degeneration, necrosis of tips of villi and desquamation of lining epithelial lining and cells. The
dark brown to black color parasitic excreta was found in the superficial villus mucosa. Lumen contains degenerated cellular debris and excreta of parasites. Oedema showing mild and acute enteritis, Cystic dilatation of mucosa and submucosa.

Patel (1981) established the base for economic analysis on that line monetary losses were calculated and presented. The quantification of monetary losses was calculated on 434 goats infected with helminth infection. A total loss of Rs. 90321/- was calculated under the study period. These losses were calculated on the basis of losses due to (a) milk loss (Rs. 2538/-), cost of treatment (Rs.31248/-) and culling of goats (Rs. 56535/-).

The milk loss occurred due to helminth infection was calculated (Rs. 2538/-) while the cost of treatment for the 434 affected goats were recorded (Rs.31248/-). The loss recorded due to culling of 71 adult male goats was Rs. 14200/-, while loss due to culling of 125 adult female was observed as Rs. 35375/-. Total losses of Rs. 1680/- and 5280/- were observed due to culling of 120 hogget and 80 doeling respectively. No mortality was recorded due to helminth infection under the study period.

The goat rearing is commonest animal husbandry among poor farmers and nomadic tribes. The studies on epidemiology, surveillance, clinico-pathology diagnostic, biochemical, histopathological and nutritional aspects suggest the veterinarians to judge the economic aspects of helminth infection, cost of treatment of, and the importance of helminth infection and gives a guideline to control the infection.

Few villages of the Anand taluka were selected for the present study but the population of goats is distributed all over the Gujarat and hence similar helminthic problems and its impact may be presented everywhere. The results of the study will be act as guidelines for the veterinarians to control of helminth infection in goats to uplift the socioeconomic status of poor farmers and nomadic tribes.
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