Studies on Bovine Coccidiosis With Special Reference to Chemoprophylaxis

THESIS

SUBMITTED TO THE

RAJENDRA AGRICULTURAL UNIVERSITY

(FACULTY OF POST - GRADUATE STUDIES)

PUSA (SAMASTIPUR) BIHAR

In partial fulfiiment of the requirements

FOR THE DEGREE OF

Master of Veterinary Science

(PARASITOLOGY)

By

Dr. Priti Manya

Registration No. - M/V Para/28/2004-2005

Department of Veterinary Parasitology

BIHAR VETERINARY COLLEGE

PATNA - 800 014

2006

Studies on Bovine Coccidiosis With Special Reference to Chemoprophylaxis

THESIS

SUBMITTED TO THE

RAJENDRA AGRICULTURAL UNIVERSITY

(FACULTY OF POST - GRADUATE STUDIES)

PUSA (SAMASTIPUR) BIHAR

In partial fulfilment of the requirements

FOR THE DEGREE OF

Master of Veterinary Science

(PARASITOLOGY)

By

Dr. Priti Manya

Registration No. - M/V Para/28/2004-2005

Department of Veterinary Parasitology

BIHAR VETERINARY COLLEGE

PATNA - 800 014

2006

"STUDIES ON BOVINE COCCIDIOSIS WITH SPECIAL REFERENCE TO CHEMOPROPHYLAXIS"

THESIS

SUBMITTED TO THE

RAJENDRA AGRICULTURAL UNIVERSITY

(FACULTY OF POST-GRADUATE STUDIES)

PUSA (SAMASTIPUR), B I H A R

In Partial fulfilment of the requirements

FOR THE DEGREE OF

Master of Veterinary Science
(Parasitology)

By

Priti Manya

Registration No. - M/V. Para/28/2004-2005.

DEPARTMENT OF VETERINARY PARASITOLOGY
BIHAR VETERINARY COLLEGE
P A T N A – 800 014

2006

Dedicated

to my

husband

Dr. Manoj Kr. Jha

&

daughter Khushi

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

CERTIFICATE-I

This is to certify that the thesis entitled ***"Studies on bovine coccidiosis with Special reference to chemoprophylaxis"*** submitted in partial fulfilment of the requirements for the award of Master of Veterinary Science **(Veterinary Parasitology)** of the faculty of post-graduate studies, Rajendra Agricultural University, PUSA, Samastipur, Bihar is the record of bonafide research work carried out by **Dr. Priti Manya, Registration No.- M/V. Para/28/2004-05,** under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.

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

31/5/06

(Dr. S.R.P. Sinha)

Major Advisor

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

CERTIFICATE –II

We the undersigned members of the Advisory Committee of **Dr. Priti Manya, Registration No.- M/V. Para/28/ 2004-05,** a candidate for the Degree of Master of **Veterinary Science** with Major in **Veterinary Parasitology,** have gone through the manuscript of the thesis and agree that the thesis entitled ***"Studies on bovine coccidiosis with Special reference to chemoprophylaxis"*** may be submitted by **Dr. Priti Manya** in partial fulfilment of the requirements for the degree.

31/5/06

(Dr. S.R.P. Sinha)
Chairman, Advisory Committee

Members of Advisory Committee :

1. **Dr. S. Samantaray,** Professor
   Department of Veterinary Parasitology
   Bihar Veterinary College, Patna-14.

31/5/2006

2. **Dr. S.P. Verma,** Professor
   Deptt. of Veterinary Medicine
   Bihar Veterinary College, Patna-14.

05/02/07

3. **Dr. S.B. Verma,** Professor
   Deptt. of A.B.G.
   Bihar Veterinary College, Patna-14.

31/5/06

Dr. Chandramoni, Associate Professor
Department of Animal Nutrition
Bihar Veterinary College, Patna
(Nominee Dean, P.G./R.A.U., Pusa).

5/2/07

31/5/06

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

CERTIFICATE-III

This is to certify that the thesis entitled ***"Studies on bovine coccidiosis with Special reference to chemoprophylaxis"*** submitted by **Dr. Priti Manya, Registration No.- M/V. Para/28/2004-05,** in partial fulfilment of the requirements for the Degree of Master of Veterinary Science **(Veterinary Parasitology)** of the Faculty of Post-Graduate Studies, Rajendra Agricultural University, PUSA, Samastipur, Bihar was examined and approved on ..5../..02./2007.

(Dr. S.R.P. Sinha)
Chairman, Advisory Committee

(DR. P. D. JUYAL)
External Examiner

Members of Advisory Committee :

1. **Dr. S. Samantaray,** Professor
   Department of Veterinary Parasitology
   Bihar Veterinary College, Patna-14.

2. **Dr. S.P. Verma,** Professor
   Deptt. of Veterinary Medicine
   Bihar Veterinary College, Patna-14.

3. **Dr. S.B. Verma,** Professor
   Deptt. of A.B.G.
   Bihar Veterinary College, Patna-14.

Dr. Chandramoni, Associate Professor
Department of Animal Nutrition
Bihar Veterinary College, Patna
(Nominee Dean, P.G./R.A.U., Pusa).

ACKNOWLEDGEMENT

I would like to express my deep sense of gratitude and indebtedness to my major advisor Dr. S.R.P. Sinha, Professor, Department of Parasitology for his sincere guidance, close supervision, constant encouragement and over all homely behaviour throughout the course of research work and preparation of this thesis.

I am grateful to the members of my advisory committee Dr. S. Samantaray, Professor, Department of Parasitology, Dr. S.P. Verma, Professor, Department of Medicine, Dr. S.B. Verma, Professor, Department of A.B.G. for their technical guidance and impeccable suggestions during the entire phase of my research work.

I am also thankful to my Dean P.G. nominee Dr. Chandramoni, Associate Professor, Department of Animal Nutrition for his most valuable and sincere guidance.

I would like to express my sincere gratitude to Dr. C. Jayachandran, Professor, Department of Pharmacology and Toxicology, Dr. B.K. Sinha, Professor, Department of Pathology, Dr. Basant Kumar Sinha, Professor, Department of microbiology, Dr. K.G. Mandal, Assistant Professor, Department of A.B.G. for their critical suggestions and continuous help.

I express my heart felt thanks to Dr. (Mrs.) Sucheta Sinha, J.R.A., Department of Parasitology for her co-operation, suggestion and immense help during the entire research work.

I am also thankful to the members of synopsis committee Dr. S.R. Singh, Professor and Head, Department of A.B.G. and Dr. C. Singh, Professor and Head, Department of physiology for their valuable guidance to improve the synopsis of present investigation.

I record to express the pleasure to acknowledge the co-operation of my seniors Dr. (Miss) Shashi Sinha, Dr. (Miss) Smita Sinha, Dr. Sanjeev Kumar Sharma and Dr. Rampraves Kumar.

I must express my thanks to Dr. Bharat, Dr. Sunil, Dr. Prabha, Dr. Shashikala and Dr. Ajitesh for their encouragement, immense help and co-operation during the period of study and thesis preparation.

I would like to convey my special thanks to my juniors Dr. (Miss) Sucheta, Dr. Hoda, Dr. Rinki Dr. (Miss) Premlata and Richa for their friendly co-operation during the study period.

I am thankful to non-teaching staffs Sri Narendra Kumar, Shesnag, Shankar and Piyariya Devi of Parasitology Department for the help and co-operation rendered by them.

I am equally grateful to campus librarian Dr. B.N. Mishra and other library staffs for extending library facilities.

Sincere feelings of gratitude and obligation are extended to my family members for their inspiration and constant encouragement during the course of study.

At last, but not the least thanks and deep appreciation are due to my husband Dr. Manoj Kumar Jha and daughter Khushi for their warm love and patience, without which this degree would have hardly been possible.

Finally I express my heartiest gratitude to almighty god for giving me patience and strength to overcome the difficulties which crossed by way in accomplishment of this endeavour.

All may not have been mentioned but none has been forgotten.

Date : 31. 5. 2006

Place : Patna

Priti Manya

(Priti Manya)

****

CONTENTS

****

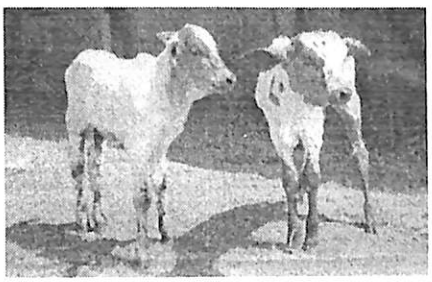
LIST OF TABLES

****

LIST OF HISTOGRAM

NO.	HISTOGRAM
13.	Histogram showing mean ± S.E. of haematological parameters in control and bloody diarrhoea group of bovine.
14.	Histogram showing mean ± S.E. of haematological parameters in control and watery diarrhoea group of bovine.
15.	Histogram showing mean ± S.E. of haematological parameters (DLC) in control and bloody diarrhoea group of bovine.
16.	Histogram showing mean ± S.E. of haematological parameters (DLC) in control and watery diarrhoea group of bovine.
17.	Histogram showing efficacy of Coximar and Fazole against coccidiosis in bovine.

****



CHAPTER - 1

INTRODUCTION

INTRODUCTION

Cattle and buffaloes production constitute the major livestock industry in India, as majority of Indian population depend for animal protein source on milk and milk products. The healthy and improved livestock production has greater scope for increasing rural income by many folds. However, bovines in India have low productivity as compared to dairy cattle of developed countries mainly because of high rate of calves morbidity and mortality. The contaminated pasture, lack of hygiene, unscientific management, lack of awareness regarding prophylactic measures and illiteracy have further aggravated the problems of marginal farmers.

Bovine coccidiosis is one of the economically important intestinal disease in respect to the bovine industry. It is responsible for considerable morbidity and mortality particularly in cattle and buffaloes under one year of age. Fitzgerald (1972) estimated the annual loss due to coccidiosis to be more than one hundred million dollars. Due to the insidious nature of coccidiosis, much of the damage from the disease has already occurred by the time, signs and symptoms are discernible. The expense of animals that die from coccidiosis or secondary infections that gain a foothold because of the coccidiosis, can easily be estimated. However, the major loss from coccidiosis probably comes as the result of poor weight gains from clinically and subclinically infected animals.

Bovine coccidiosis occur world wide and at all the times of the year. In India, bovine coccidiosis is seen throughout the year (Ruprah *et al.* 1985). First of all in 1893, Guillebeau observed the parasites which multiply in both the small and large intestine of calves. In 1908, Zublin reported the eimerian

parasite and named the organism. Various species of *Eimeria* reported by many workers, Patnaik (1965), Bhatia *et al.* (1968), Sanyal *et al.* (1985), Ershaduzzuaman *et al.* (1995), Nambiar and Devada (2002), Bahirathan *et al.* (1995) and Singh and Agrawal (2003). There are 9 to 13 species of *Eimeria* responsible for bovine coccidiosis in India, but relevant information in Bihar is very scanty.

Coccidiosis is caused by unicellular eimerian species, which are host species specific and inhabit the small and large intestine of calves. It is transmitted from animal to animal by faecal-oral route. A single cell oocysts are passed in the faeces of cattle, sporulate in moist and warm condition and become infective within 24-72 hours. Tropical climate with moist and warm condition are favourable for sporulation of oocysts, those are passed from the faeces of infected animals. Sporulated oocysts can remain in the environment for several years and maintain its infectivity. Cattle become infected when placed in contaminated environment or with subclinically infected older animals or other infected calves. Formerly, only calves, over one month of age were thought to be affected, but outbreak condition involves calves aging two to four weeks as well as sporadiac outbreaks can cover older animals too.

Coccidiosis commonly occurs in overcrowded conditions but can occur in free ranging conditions that have congregation areas, such as feeding and watering areas. The disease may be a problem at any time of year so long as conditions of adequate moisture and temperature exist for survival and development of oocysts.

When calves ingest sporulated oocysts, a series of asexual and sexual development stages occur for the production of unsporulated oocysts.

The time taken for the production of unsporulated oocyst in *Eimeria zuernii* is 15-17 days and in *Eimeria bovis* 15-20 days. The ingestion of a single sporulated oocyst has the potential to produce approximately 23 million unsporulated oocysts. During infection, oocyst production with a single species lasts for 5-12 days only, but may be prolonged in multiple species infections. After infection the animal is immune to that particular *Eimeria* species but is still susceptible to other *Eimeria* species.

Primarily coccidia are found within the caecum although ileum and colon may also be affected. The subsequent rupture of cells by its developmental stages are responsible for the clinical signs associated with the disease. Symptomatic infection in calves is usually accompanied by diarrhoea of varying severity from watery to bloody. Affected animals often strain due to the irritation of the lower bowel and rectum. Dehydration, weight loss, depression, loss of appetite and occasionally death may also be observed.

Nervous signs consisting of muscular tremors, hyperaesthesia clonic-tonic convulsion with ventroflexion of head and neck, nystagmus and high mortality rate (80-90%) are also found occasionally. Affected calves may die within 24 hrs after the onset of dysentery and nervous signs.

Asymptomatic infection may nevertheless affect the growth and health of an animal but shed oocysts in manure, so the oocysts accumulate in pastures, on hair coats, yard or barns and may cause severe coccidiosis, when new calves are exposed to these areas. Cattle that recover from coccidiosis usually become immune to later infection. Senger *et al.* (1959) noted that cattle infected with *Eimeria bovis* do develop resistance to reinfection, persisting from three month to one year or longer, but they may

continue to shed occyst in manure, thereby providing a source of infection for susceptible calves. Coccidia also damage their host by inducing immunosuppression which reduces the ability of the host to resist other infections.

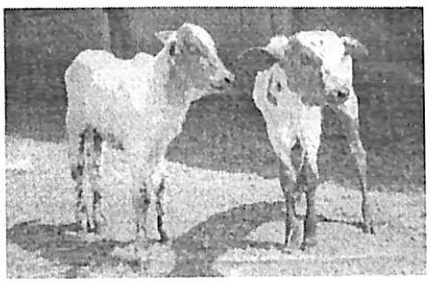
The cost of therapy after a clinical outbreak or subclinical form of this disease is considerably higher for local farmers than the cost of early treatment and applying prophylactic measures. But it is difficult to detect clinical or subclinical infection of coccidiosis, because most of eimerian species are supposed to be non-pathogenic and often first sign is noticed only when bloody streak appear in diarrhoeic faeces. Unfortunately these signs are not specific to coccidiosis only.

Therefore, a strategic plan of preventive management and treatment based on previous incidence and identification of eimerian species in a particular area may offer the best ways to reduce the losses due to bovine coccidiosis.

Keeping in view of these prominent points, the present investigation was undertaken with the following objectives:-

1. To study the prevalence of clinical and subclinical coccidiosis in bovine (cattle and buffaloes) with respect to season, age group, sex and managemental condition in and around Patna.
2. To identify the eimerian species prevalent in clinical and subclinical form of coccidiosis.
3. To study various haematological changes during bovine coccidiosis.
4. To compare the efficacies of Coximar and Fazole for treatment and control of bovine coccidiosis.

****



CHAPTER - 2

REVIEW OF LITERATURE

REVIEW OF LITERATURE

PREVALENCE OF COCCIDIOSIS IN BOVINE:-

Sanyal *et al.* (1985) conducted a study on incidence of bubaline coccidia at Hisar, Haryana and observed overall 51.2% infection. The incidence in female calves, 52.1% was not significantly higher than in males, 50.0%. Highest incidence was found in the 15 days to 6 months old buffalo calves (65.7%) and substantial decline in older calves at 27.8% and 25.9% in the 6 months to one year and 1 to 2.5 years age group respectively. The highest incidence was recorded in the month of October (89.3%) and the lowest in February (17.9%). The highest and lowest infection rate 83.9% and 30.4% were noted during post-monsoon (September to November) and winter season respectively. *Eimeria bareillyi* (33.1%) was the most predominant species and *E. auburnensis* (0.6%) occurred least frequently. 51.8% had mono-infection, 27.2% showed two species, 10% showed three species while more than three species in 10.6% cases out of total sample examined.

Mahajan *et al.* (1985) studied an outbreak of coccidiosis in 15 buffalo calves in Punjab and isolated *Eimeria bareillyi* from faecal examination. OPG varied from 20,000 to 85,000. 3 of the calves died within 4 days of the onset of symptoms. Amprolium was given at 10 mg/kg body weight for 6 days but 3 more calves died.

Ali and Latif (1989) noted 31.5% incidence of coccidiosis in dairy cattle of Baghdad, Iraq. The highest rate of infection (46.8%) was found in calves under one year of age.

Mage *et al.* (1989) conducted an epidemiological investigation involving 1150 suckler calves in the Correze region of France and noted 21.9% of the calves were infected with coccidia. The species detected were *Eimeria zuernii* and *E. bovis*. Haemorrhagic diarrhoea was the main symptom of this disease and was more prevalent under housing calves (16.9%).

Oda and Nishida (1990) conducted a field survey of bovine coccidiosis among dairy and beef cattle in Japan and reported 59.0% coccidial infection in dairy and beef cattle more than 2 weeks old. The prevalence was highest in the animals between 6 to 11 months old and 25% in 24 months old. Eleven *Eimeria* species were noted, out of these *E. bovis* and *E. ellipsoidalis* were the most prevalent, however no clinical coccidiosis was found except few cases.

Bejsovec (1991) examined faecal sample from 14069 animals in large herds in Central Bohemia and observed, 36% coccidiosis among calves in calving houses and 69.8% of animals between the age of 6-12 months. The prevalence vary between 86.7%, 97.2% and 94.5% in heifers (14-19 months old), milking cows and nursing cows respectively for coccidiosis. He further noted a very high percentage (92.7%) of grazing cattle had coccidia infection.

Mage and Reynal conducted a epidemiological investigation in 1993 using cattle from farms in the Correze region, France including cows, grazing males, bullocks, weaning veal calves and breeding animals then reported that 21.9% suckling calves, 16.9% while housed and 4.9% when put out to graze in June or July had coccidiosis.

Kollmann (1993) conducted a field study for *Eimeria* infection among cows and their newborn calves in Korbach, Germany from 4 weeks before to 63

days after delivery. The cows were positive for *E. bovis, E. ellipsoidalis, E. auburnensis* and *E. zuernii* in decreasing order of prevalence, however 20.4% of calves were coccidial species in decreasing order of prevalence were *E. ellipsoidalis, E. bovis, E. alabamensis, E. auburnensis, E. zuernii, E. cylindrica* and *E. subspherica.*

Hayat *et al.* (1994) reported the prevalence of coccidiosis in diarrhoeic cases was 28.9% and 29.1% in cattle and buffaloes repectively while in apparently healthy animals, it was 13.7% and 13.8% in cattle and buffaloes respectively in Pakistan. The important species identified were *E. zuernii, E. bovis, E. cylindrica* and *E. ellipsoidalis.* Highest coccidial infection was in young calves below one year of age and higher infection rate was in grazing than stallfed animals.

Senthilvel (1995) reported a case of cocidiosis in a bullock of about six years old. The bullock was presented with the history of reduced appetite and passing loose stool with streaks of blood and mucus. On microscopic examination of faecal sample, the presence of large number of oocysts of *Eimeria* species confirmed the case to be of coccidiosis.

Ershaduzzaman *et al.* (1995) made a detail study of prevalence of coccidia in calves at village and farm levels of Bangladesh. A total 586 faecal samples of calves from both village and farm out of which 270 (46.1%) were found to be positive for coccidia. Coccidiosis was found insignificantly higher in Military farm (52.6%) than in the village (44.5%). At village level, coccidiosis in calves was observed significantly ($P<0.01$) higher during monsoon/rainy season than in dry season, whereas at farm level disease was

significantly (P<0.05) higher during winter season than other seasons. It was noted that the *Eimeria* infection significantly (P<0.05) higher in younger animals than older animals and it was insignificantly higher in male calves than in female calves. Six species of coccidia were isolated and these were *Eimeria bovis* (40.1%), *Eimeria auburnensis* (27.13%), *Eimeria zuernii* (34.81%), *Eimeria bukidnonensis* (25.05%), *Eimeria cylindrica* (24.06%) and *Eimeria subspherica* (21.16%). Mixed infections were recorded in majority of the positive faecal samples.

Cornelissen *et al.* (1995) conducted a study on 38 Dutch dairy farms and identified 12 species of *Eimeria* in faecal samples. The prevalence was differed markedly in the different age groups on individual farms as well as between farms. It was highest (46%) in calves followed by yearlings (43%) and 16% for cows. The number of oocysts excreted was generally low in cows and yearlings, where as high number of oocysts per gram of faeces were exclusively observed in calves.

Bahiratham *et al.* (1995) studied prevalence and abundance of eimerian oocysts in farm buffalo calves in Sri Lanka between age of 9-13 day to 4.5 months. Nine species of *Eimeria* were identified, *E. bareillyi, E. subspherica* and *E. cylindrica* were the three commonest species in calves from birth to 40 days of age. Inapparently healthy calves, peak oocyst shedding was observed between 21-30 days of age. Mean oocysts count was 2.32 x 106 per gram of faeces (OPG) consisting of *E. bareillyi* (81.9%), *E. subspherica* (16.9%) and other species (1.2%).

Grommes (1996) identified 9 species of coccidia among grazing calves in Central Western Germany. *E. bovis, E. ellipsoidalis, E. auburnensis, E. zuernii, E. canadensis, E. alabamensis, E. cylindrica, E. subspherica* and *E. pellita* (in order of decreasing prevalence) were the prevalent species.

Kambarage *et al.* (1996) studied the prevalence of *Eimeria* and *Cryptosporidium* oocysts in cattle, sheep and goat in Tanzania and observed that the prevalence rate of *Eimeria* oocysts in cattle was 44% with 73.8% of the infected animals showing low count (<103 oocysts/g of faeces).

Charan and Pawaiya (1997) investigated 29 buffalo calves in Indian Veterinary Research Institute, Izatnagar and reported 31.03% incidence of intestinal coccidia in buffalo calves. *Eimeria bareillyi* was most frequent species followed by *E. bovis*, *E. ellipsoidalis* and *E. zuernii.*

Steiner *et al.* (1997) observed prevalence of coccidiosis was 43% in 105 cow – calf farm in Switzerland by examination of faecal sample from diarrhoeic calves and from calves that died due to diarrhoea.

Bhattacharya *et al.* (1998) studied about a relation between oocysts per gram faeces and faecal consistency and observed that animals shedding over 2000 oocysts were showing only the symptoms of diarrhoea. The diarrhoeic cases revealed presence of 3 species, *E. zuernii* (46.12%), *E. subspherica* (29.93%) and *E. bovis* (23.95%).

Tamasaukas *et al.* (1998) reported about prevalence of coccidial infection was 40.5% of bovine in faecal samples (1509) during the rainy season in farms of Venezuela, 40.2% in cattle aged < 12 months, 25.7% in cattle aged 13-24 months and 34.0% in aged > 24 months. The predominant species identified

were *E. zuernii, E. bovis, E. alabamensis* and *E. ellipsoidalis.* They further noted 100% prevalence in the tropical dry bush region and were higher in dual purpose farms and in those where cereals (especially sorghum) were grown. Prevalence was also higher in farms where preventive or curative anticoccidial treatments were not used.

Ramirez *et al.* (1998) observed prevalence of coccidiosis was 53% in cattle from faecal sample on dairy and dual purpose farms of Venezuela. Determination of *Eimeria* species was carried out on samples with count of >500 O.P.G. The species identified were *E.bovis, E. ellipsodalis, E. zuernii, E. auburnensis* and *E. alabamensis*. Prevalence of infection was 63%, 65% and 22% for cattle aged <12, 12-24 months and >24 months respectively. O.P.G. decreased with increasing age. Lower prevalence of coccidiosis was observed in farms with better management practices and no significant differences in prevalence or intensity between different breeds was found.

Bharkad *et al.* (1999) investigated about gastrointestinal parasitosis in bovine calves in Marathwada, India. Faecal examination of 406 buffalo calves and 141 cow calves up to 3 months of age revealed that 64.03% and 36.87% of bovine calves respectively were positive for various parasitic infections. The coccidial infection was 21.12% and 17.02% for buffalo calves and cow calves respectively.

Hirani *et al.* (1999) studied prevalence of 7.86% coccidial infection in cattle and buffaloes in Kheda, Gujarat. Significant increase in infection was observed from August to March.

Zhang-longxian *et al.* (2000) conducted a survey to study epidemiology of dairy cow coccidiosis in China and identified 13 coccidian species including *E. alabamensis, E. auburnensis, E. bovis, E. bombayensis, E. canadensis, E. cylindrica, E. ellipsoidalis, E. illinoisensis, E.subspherica, E. wyomingensis, E. zuernii* in calves.

Gulegen and Okursoy (2000) conducted a study about coccidia species and noted 49.3% prevalence in cattle in the Province of Bursa and reported that most frequent species was *E. bovis* (28.5%) followed by *E.auburnensis (17.2%), E. ellipsoidalis* (14.7%), *E. zuernii* (12.4%), *E. canadensis* (6.2%), *E. cylindrica* (3.7%), *E. subspherica* (1.9%), *E. alabamensis* (1.6%), *E. brasiliensis* (1.2%) and *E. bukidnonensis* (0.5%). Prevalence of infection was 69.8%, 54.5% and 23% for calves, 6 to 12 months and >12 months old animals respectively. 36% of the animals were infected with a single species and 64% with 2 or more species. Most (82%) of the mixed infections were caused by 2 species. Young animals had higher O.P.G. counts.

Kurkela *et al.* (2000) made studies on prevalence of coccidiosis in finnish calves. Faecal samples from 439 calves were examined and observed the coccidial infection was very common. The prevalence of the infection was 58% for market calves and only 34% of farms were free from coccidia. The prevalence of coccidia among the grazing calves was almost 100%.

Pal *et al.* (2001) investigated about prevalence of gastro-intestinal parasitosis in cattle and buffaloes farm, Chhattisgarh. *Eimeria* species was recorded from 5.63% of cow calves and 3.6% of buffalo calves in faecal

samples. The prevalence rate of parasitic infections was higher in younger animals (<6 month) than in adult.

Nambiar and Devada (2002) assessed the prevalence of coccidial infections in cattle belonging to all age groups and observed that the overall prevalence rate was 2.2 per cent. The incidence was found to be higher in the animals below one year and female animals during the rainy and humid months. She identified eight species of *Eimeria,* the commonest species was *Eimeria ellipsoidalis* (60%) followed by *Eimeria zuernii* (55%), *Eimeria bovis* (35%), *Eimeria subspherica* (10%) *Eimeria wyomingensis* (10%), *Eimeria cylindrica*, *Eimeria bareillyi* and *Eimeria brasiliensis* 5% each. She further noted that mixed infections were encountered in most of the samples.

Quijada *et al.* (2002) carried out a study in order to determine prevalence of coccidiosis and its associated factors in calves before weaning in 9 farms of Venezuela and noted significant difference among farms with higher prevalence in rainy season among calves aging between 0 to 3 months.

Andrews (2002) conducted a survey to determine the extent of coccidiosis in 50 farms in UK, in weaned calves (250) aged between 4 to 20 weeks. The overall infection rate was 50% and oocyst count varied from 0 or <50 to 180000 O.P.G. (mean 2445 OPG). The higher count also associated with in age group of 1 to 5 months old calves showing scouring and poor growth.

Singh and Agrawal (2003b) reported 35.58% incidence of coccidian infection in buffaloes in Mathura from faecal samples. The highest prevalence of coccidian infection was in rainy (38.40%) followed by summer (35.38%) and winter (32.84%) seasons. The month wise study revealed highest coccidian

infection in September (50.48%) and lowest in March (27.38%). Nine eimerian species were identified. *E. bovis* (15.55%), *E. zuernii* (9.46%), *E. ellipsoidalis* (9.17%), *E. subspherica* (8%), *E. wyomingensis* (6.89%), *E. alabamensis* (4.91%), *E. canadensis* (4.25%), *E. bareillyi* and *E. cylindrica* (1.17%). The highest rate (58.88%) of infection was recorded in 3-6 months age and lowest 22.40% in age above 3 years.

Maddox and Vestergaard (2003) studied about coccidium species, pathogenesis, epidemiology and prevention in organic herds of Denmark and observed *Eimeria* species in all (100%) herds and in 88% of the calves and altogether twelve eimerian species were identified.

Snoep and Potters (2004) investigated meadow coccidiosis as a cause of diarrhoea in calves in a farm in the Neatherland, all of them represented *E. alabamensis.*

Pilarczyk and Balicka-Ramisz (2004) reported the overall prevalence of *Eimeria* species in a outbreak of calf enteritis-diarrhoea in preweaned calf was 21.34% in U.K. The species identified over *E. bovis, E. auburnensis, E. zuernii* and *E. cylindrica.*

Godara and Manohar (2004) reported prevalence of gastro-intestinal parasitism in different breeds of cattle of Rajasthan by examination of faecal samples. Overall prevalence of gastro-intestinal parasites was 47% and *Eimeria* species were recorded from 7% cattle.

Muraleedharan (2005) reported gastrointestinal parasites by examination of fresh faecal samples in Central dryzone of Karnataka and noted 18.22%

cattle were positive for various gastrointestinal parasitic infection. *Eimeria* species were recorded only in 1.69% cattle and buffaloes.

HAEMATOLOGICAL STUDIES:-

Fitzgerald and Mansfield (1972) studied the effects of bovine coccidiosis on certain blood components, feeds consumption and body weight changes of calves. Packed cell volume and Hb values were altered in severely affected calves, but changes in group averages were not significant. Serum total protein was significantly affected in severely infected calves.

Akimaru (1986) reported haematological changes in artificially infected calves with *Eimeria bovis*. The infection had no effect on haematological value.

Holst and Svensson (1994) investigated changes in the blood composition of calves during both experimental and natural infections with *Eimeria alabamensis*. The serum activities of glutamate dehydrogenase (GLDH), alkaline phosphatase (AP) and the serum concentration of total bile acids decreased in the infected animals while total bilirubin increased. In the trial serum fibrinogen, total protein and protein fractions were also investigated and noted all the significant changes were less.

Gasmir *et al.* (1997) studied pathological changes in bovine coccidiosis in experimentally infected zebu calves by inoculating orally with 840000 sporulated oocysts of *E. bovis* and *E. zuernii*. The main haematological changes were observed anaemia, increased PCV, RBC count and WBCcount.

Haematological, bio-chemical and therapeutic studies on clinically suspected young rabbits with coccidiosis was studied by Sena *et al.* (1997) and found decrease in the value of blood glucose, serum total protein. Whereas

haematological values revealed decrease in the TEC, Hb content and PCV in coccidiosis with an increases in the values of T.L.C. In therapeutic trials, Sulphaquinoxaline sodium @ 125 mg/kg bwt. for 3 days and with a gap of 2 days again showed 100% efficacy against coccidiosis while Amprolium hydrochloride was proven to be 90% effective at a dose rate of 100 mg/kg bwt. for 7 consecutive days and furaltadone hydrochloride at the dose rate of 100 mg/kg bwt. for 7 successive days showed 100% efficacy.

Al-Farwachi (2000) observed haematological changes in cattle infected with intestinal parasites and noted decreased mean value of PCV and Hb concentration with leucocytosis with lymphocytosis, eosinophilia and neutropenia.

CHEMOTHERAPEUTIC STUDIES:-

Stockdale and Sheard (1982) evaluated the resistance to reinfection with *E. bovis* produced after chemotherapy in experimentally infected calves. They inoculated calves with *E. bovis* (5×10^5 oocysts by mouth) and administered Monensin or Amprolium at 1 mg/kg or 10 mg/kg respectively, daily on days 10-20 after infection. It was observed that both drugs protected calves as shown by lack of clinical signs, no decrease in weight gain and reduced oocyst shedding. All calves were resistant to re-infection 35 days after the initial inoculation.

Khahra *et al.* (1983) experimentally infected the buffalo calves with 5 lacs sporulated oocysts of mixed species of *Eimeria*. Treatment commenced with the onset of diarrhoea, it was evident that Sulphadimidine sodium, injected

at 125 mg/kg body weight at first intravenously and then intramuscularly for 4 days, was slightly more effective than Amprolium (20 mg/kg) given orally.

Dzerzhinskii (1987) treated naturally coccidiosis infected calves with Sulphadimethoxine at 50 mg/kg b. wt. and Chimcoccid-7 at 300 mg/kg for 6 consecutive days and noted a reduction in infection intensity (as judged by the numbers of faecal oocysts) starting from day 3 of treatment. Two weeks after treatment, the calves had recovered although a few oocysts were still detected.

Cerqueira *et al.*(1989) evaluated the efficacy of Amprolium to control the coccidiosis in extensively managed cattle. Thiry-three 15-day old calves administered amprolium at a dosage of 5 mg/kg body weight, in mineral mixture, for 90 days and control group of 33 calves received only mineral mixture without coccidiostat. It was observed that treated group had significantly lower faecal eimerian oocyst count and slightly higher weight gain.

Rudetskii (1989) studied calf coccidiosis and noted that the best drugs for treatment and prevention of coccidiosis were Sulphathiazole and Sulphadimidine.

Mage *et al.* (1990) studied coccidiosis in suckled limousin calves and noted 63.6% efficacy of anticoccidial therapy within 5-7 days of beginning of treatment.

Suresh *et al.* (1990) successfully treated coccidiosis in a cow with Sulphadimidine at 200 mg/kg bwt, daily for 5 days.

Lochkarev (1993) incorporated Furazolidone at 0.012%, Dinitolmide at 0.02% and Metronidazole at 0.12% into the feed and observed that mixture was highly effective to reducing further losses due to coccidiosis.

Mage and Reynal (1993) made a epidemiological study of coccidiosis on beef cattle farms, regarding the situation in farm management, calving distribution, pasture management and anticoccidial treatment. Amprolium or Sulphadimethoxine were effective anticoccidial agent in 63.6% of the calves.

Treatment of calves infected with *Eimeria* species was done by Hasbullah *et al.* (1996) with Sulphamonomethoxine and Ormetoprim at the rate of 5g/100kg of body weight/day for 5 days and 5,10 and 20 ml/100kg bwt/day respectively. Diarrhoea was completely recovered after 3 days of medication in all the groups, and no oocysts were detected on and after day 5,2,1 or 3 from calves of the respective medicated groups.

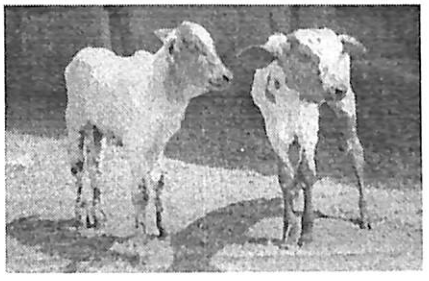
Mage *et al.* (1997) carried out a comparative trial between therapeutic method and hygienic method for the prevention of coccidiosis in cattle. The animals were placed in 3 groups, group I were kept in an area which was cleaned and disinfected with boiling water at the beginning of the test. Group II received feed supplemented with Sulphamethoxine and group III was a control group and no hygienic or therapeutic measures were taken. At the end of 2 years of experiment it was observed that the mean daily weight gain and feed consumption were much greater in group II than in the others. It was also noted that therapeutic prevention greatly decreased excretion of oocysts in faeces of the calves.

Rossanigo (1997) made a study about clinical signs and lesions in outbreaks of coccidiosis and observed that the outbreaks occurred in the autumn, morbidity ranged from 1 to 23% and mean mortality rate 1%. Treatment by S.C. injection of Sulphonamides was successful in all cases.

Sarashina *et al.* (1998) tested the effects of Sulphamonomethoxine combined with Ormetoprim on 32 beef cattle excreting *E. zuernii* or *E. bovis* oocysts in faeces, were divided into III groups. Group I was treated with Sulphamonomethoxine and Ormetoprim for 3 or 5 consecutive days, group II was treated with Sulphamonomethoxine (15 mg kg – 1 day – 1) plus Ormetoprim (5 mg kg-1 day-1) and group III treated with Sulphamonomethoxine alone (30 mg kg-1 day-1). Approximately 60% of cattle showed clinical improvement after 3 to 7 days of treatment. No significant differences between the 3 groups were observed but faecal oocyst excretion was most significantly reduced in group III.

Singh and Agrawal (2003a) tested the efficacy of Amprolsol against coccidian infection in 12 naturally infected buffalo calves. The buffalo calves were divided into two groups of six animal in each. Group-I was treated with Amprolsol 20% @ 100mg/kg body weight for 7 days and group-II was kept as untreated control. It was observed that in the treated group, watery diarrhoea was completely checked in all the six calves within 4 days of treatment. The O.P.G. count reached at zero level after seven days of treatment and average gain in weight was 0.7 kg per calf. In the untreated group, the O.P.G counts remained high and the body weight declined on the average 0.16 kg per calf.

****



CHAPTER - 3

MATERIALS AND METHODS

MATERIALS AND METHODS

In the present study, an attempt was made to evaluate the prevalence of coccidiosis in bovine population of Patna and its surrounding areas, on the basis of season, age, sex and managemental condition. The period of study was between June 2005 to May 2006. Naturally infected cattle and buffaloes were identified and haematological changes were analysed during coccidiosis. The evaluation of efficacy of chemotherapeutic agents viz., Coximar and Fazole were carried out in naturally infected bovines with coccidiosis.

COLLECTION OF MATERIALS:-

A total 580 samples (562 faecal samples and 18 intestinal scrapings) were randomly collected from cattle and buffaloes from Bihar Veterinary College, Patna, Govt. Cattle Farm, Patna, Privately organized Khatals of Patna and local unorganized private owner in and around Patna. During collection of samples record of seasons, age, sex and managemental conditions were accounted, the details of which are depicted below:

Table – 1

Season	Cattle	Buffaloes
Monsoon (June to August)	85	105
Post-Monsoon (September to November)	75	92
Winter (December to February)	40	55
Summer (March to May)	60	68
Total	**260**	**320**

Table – 2

Age groups	Cattle	Buffaloes
0 – 3 months	40	55
3 – 6 months	57	80
6 – 12 months	68	75
1 – 2 years	53	62
2 year and above	42	48
Total	**260**	**320**

Table – 3

Sex	Cattle	Buffaloes
Male	120	180
Female	140	140
Total	**260**	**320**

Table – 4

Management	Cattle	Buffaloes
Farm condition	120	170
Free range condition	140	150
Total	**260**	**320**

Intestinal Scraping:-

Eighteen intestinal scrapings were collected from local slaughter houses, Patna and from the post mortem section of Department of pathology, Bihar Veterinary College, Patna to find out the prevalence of coccidial infections.

Blood:-

Five animals with bloody diarrhoea and five animals with watery diarrhoea were selected and their blood was collected for the study. Similarly, the blood samples were also collected from 5 healthy animals which served as control.

Three to five ml. of blood was collected in vials containing anticoagulant (E.D.T.A.) from the ear vein of each animal with the help of sterilized disposable syringe after removal of hairs and proper sterilizing the surface with 70% alcohol. For differential leucocyte count (D.L.C.), thin and uniform smears were prepared on clean and grease free slides. Smears were dried in air and properly labelled.

Therapeutic trials:-

A total 15 bovine calves naturally infected with coccidiosis were randomly selected from clinical cases and divided into three groups. These calves were marked. Design process of experiments was explained to the owners and then permission was taken to do the trials on their animals before the commencement of experiment.

Coximar and Fazole were used for the therapeutic trials.

EXAMINATION OF COLLECTED MATERIALS:-

[1] FAECAL AND INTESTINAL SCRAPING:-

Randomly collected faecal samples from cattle and buffaloes were kept in individual vials and properly labelled. The samples were examined in laboratory within 12 hrs. and positive samples for coccidiosis were further processed for sporulation.

Intestinal samples were also processed for presence of coccidial oocyst and positive samples immediately placed in Petridishes for sporulation.

The collected faecal samples were examined by the following methods.

Direct method:-

One to two drop of normal saline or distilled water kept on clean glass slide and very small amount of faecal material was added to this with the broom-stick or glass rod. This mixture was homogenized and then covered with a cover slip. This preparation was examined first under low power objective and then under high power objective for detailed diagnosis. For each sample, separate stick was used.

Concentration method:-

A part of each sample was subjected to centrifugal sedimentation and floatation technique using saturated salt solution for demonstrating the presence of coccidian oocyst.

[2] IDENTIFICATION OF COCCIDIAN OOCYST:-

The faecal samples which were positive for coccidian oocyst at demonstrable level were placed in petridishes with 2.5% potassium dichromate

at room temperature for 2-7 days for sporulation. The sporulated oocysts were observed daily and maximum sporulation was noted for species identification.

The sporulated oocysts in dichromate solution when reached to maximum sporulation, were floated with saturated salt solution. This solution emulsified thoroughly and filled in centrifuge tube and then centrifuged for 2 min to 1000 r.p.m. Before centrifuging a cover glass was also placed on each tube. Cover glass was removed carefully with a deliberately upward movement and placed in a clean slide for each sample and they were examined for identification by the morphology of coccidian oocyst.

The micrometry of at least 50 sporulated oocysts was speciated on the basis of sporocyst placement, sporulation time and morphometry was done by camera lucida keeping the 40-micron scale.

The identification of coccidian oocyst was done as per the description given by Soulsby (1982), Ruprah (1985), Levine (1985), Kaufmann (1996) and Bhatia (2000).

Intestinal Scraping:-

Intestine was placed in a metal tray containing some lukewarm water. The intestine was cut entirely lengthwise and enlargement of villi, haemorrhagic spots, necrotic areas were observed for the presence of coccidian oocyst. The little portion of each intestinal fluid was examined under microscope for the presence of coccidian oocyst.

[3] EFFECT OF SEASON, AGE, SEX AND MANAGEMENTAL CONDITION ON THE PREVALENCE OF COCCIDIOSIS IN BOVINE:-

To estimate magnitude of coccidial infection in bovine, samples collected were grouped in different age groups, seasons, sexes and its managemental conditions as depicted in Table 1, 2, 3 and 4.

Further studies were conducted as described below:

(a) Effect of Seasonal Prevalence:-

Seasonal variations of coccidiosis in cattle and buffaloes were studied in the present investigation, according to the regional weather conditions. The period of study was divided into monsoon (June to August), post-monsoon (September to November), winter (December to February) and summer (March to May).

In cattle, out of 260 samples, 85, 75, 40, and 60 were screened in monsoon, post-monsoon, winter and summer seasons respectively (Table-1). In buffaloes, out of 320 samples, 105, 92, 55 and 68 were screened in monsoon, post-monsoon, winter and summer seasons respectively (Table-1).

(b) Age groups:-

According to Table-2, the collected faecal samples were divided in the five age groups viz. 0-3 months, 3-6 months, 6-12 months, 1-2 years and 2 years above.

(c) Effect of Sex:-

In cattle out of 260 samples 120 of them were male and 140 of them were female (Table-3). In buffaloes, out of 320 samples 180 of them were male and 140 of them were female (Table-3).

(d) Effect of Management Condition:-

The samples collected were divided into two groups according to their managemental condition. Samples collected from cattle and buffaloes farm were notified as farm condition whereas the samples from private owners, farmers, stall fed, and grazing were selected under free range condition (Table-4).

[4] HAEMATOLOGICAL STUDIES:-

The haematological studies in 5 healthy and 10 infected animals with symptoms of bloody and watery diarrhoea (each five with positive cases of coccidiosis) were conducted immediately after collection of blood. Various studies were performed as per the method described below:

(i) Haemoglobin (Hb %):-

Haemoglobin value of cattle and buffaloes naturally infected with coccidiosis and healthy control was obtained by Hellige-Sahlis method described by Schalm *et al* (1975).

(ii) Total Erythrocyte Count (TEC):-

The blood sample was taken upto 0.5 mark in the R.B.C. diluting pipette of Haemocytometer and then diluted with R.B.C. diluting fluid up to 101 mark. The content of the pipette was mixed with twisting motion. A few drops of this diluted blood was discarded and then a drop of it was allowed to trickle in the

gap between cover glass and Neubauer's counting chamber of Haemocytometer. All the cells including touching all the side of the wall of 5 big squares or 80 small squares for counting cells of R.B.C. were counted and the total number of erythrocyte count per cubic mm was calculated.

(iii) Total Leucocyte Count (TLC) :-

Blood was sucked upto 0.5 mark of the W.B.C. diluting pipette and was diluted with the W.B.C. diluting fluid up to 11 mark taking care that no air bubble was included. The pipette was shaken and the Neubauer's counting chamber was filled as described for R.B.C. counting method. The white cells were counted in the four large corner squares of the chamber and the total number of leucocyte count per cubic mm. was calculated.

(iv) Differential Leucocyte Count (DLC):-

For DLC thin and uniform smear of blood was prepared on a clean grease free slide and dried in the air. The smear was stained with Leishman's stain. The stained blood film was seen under low power objective of the microscope to see whether the film was homogeneously stained or not and then examined under oil immersion objective of the microscope placing a drop of cedar oil in well separated film. While counting, the edges were avoided and the cells running in strips in the whole length of the film was examined. During examination of the cell, 200 cells were counted and the percentage of different cells was recorded. Leucocytes were differentiated as per standard technique (Schalm *et al.*, 1975).

(v) Packed Cell Volume (PCV):-

The PCV of all the blood samples were carried out with the help of microhaematocrit method. For this, the blood was shaked properly and then capillary tubes (70mm x 1 mm) were filled with blood by capillary action upto two third portions and the opposite end was sealed with molding clay. The open end of capillary tube was placed towards the periphery of the rotary disc of centrifuge and then microhaematocrit centrifuge machine was run for 2-3 minutes at 12,00 r.p.m. The tubes were then read one by one, placing them on a reader supplied with the instrument. The height of the red cell layer i.e., packed cell volume was then read as % cell volume. All the reading was taken as per the procedure given by Schalm *et al.* (1975).

[5] THERAPEUTIC TRIAL:-

A total of 15 bovine calves naturally infected with coccidiosis were randomly selected from clinical cases and divided into three groups viz. GI, GII and GIII. Each comprising of 5 bovine calves as shown in Table-5. For administration of the drugs Coximar and Fazole the animals of group GII and GIII respectively were selected. Group GI was kept untreated throughout the period of study and they served as control.

Percent Efficacy:-

(i) The faecal sample from each animal was collected before treatment and after 7^{th}, 14^{th} and 21^{st} day after commencement of treatment.

(ii) The samples were processed by Stoll's technique but dilution was set as for the easy counting of oocysts.

(iii) The percent efficacy of the drugs for the control of coccidiosis was calculated by following formula in each group on all observation days.

$$\% \text{ efficacy} = \frac{\text{Pre treatment O.P.G.} - \text{Post treatment O.P.G.}}{\text{Pre treatment O.P.G.}} \times 100$$

Table – 5 : Experimental dosing of anticoccidial drug trials in bovine infected with coccidiosis :

Group	No. of animals	Drugs used for chemotherapy	Dose	Route
G I	5	Untreated control		
G II	5	Coximar Powder (Sulphaquinoxaline I.P. (Vet) 16.67% w/w and Amprolium HCL I.P. (Vet) 16.67% w/w **(Agrivet)**	100 mg/kg b.wt. for 7 days.	Oral
G III	5	Fazole bolus (Each bolus contains Metronidazole B.P. (Vet) 1 gm. and Furazolidone B.P. (Vet.) 200 mg.) **(Unichem)**	1 bolus/50 kg b.wt. b.i.d. for 5 days	Oral

The O.P.G. of the faecal samples were calculated according to the Stoll's techniques:-

(a) 5 gm of faeces was taken and mixed thoroughly with 45 ml of tap water in a 120 ml wide-mouthed glass-stoppered bottle.

(b) Faecal suspension was then poured through a wire a mesh screen of aperture 0.15 mm, collecting filtrate in a clean, dry bowl.

(c) The filtrate was mixed thoroughly to ensure that there was a uniform suspension of faecal material and aliquot was transferred to a centrifuge tube.

(d) Centrifugation was done for 2 minutes at 1000 r.p.m.

(e) The supernatant fluid was discarded and packed sediment was emulsified with saturated salt solution (Nacl).

(f) The volume was made equal that of initial aliquot of filtrate. At this stage further dilution was done to 1:10 with saturated salt solution. It was required necessary because oocyst counts were very high in number in present experiment.

(g) This diluted solution was inverted for several times so that sediment should evenly mixed and 0.5 ml. of fluid sediment taken on slide with a clean fine pipette and covered with cover slip.

(h) Oocysts were counted within the cover slip with battlement method under microscope.

(i) The figures obtained from the count (i.e. the total no. of oocysts present in 0.5 ml. of diluted faeces) were multiplied by 200 to give the number of oocysts per gram of the original faecal sample.

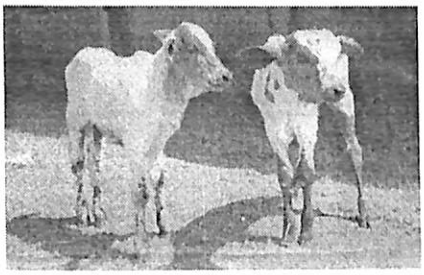
(j) After recording their average O.P.G. just prior to the treatment (0 days), different drugs were administered as per experimental plan and the O.P.G. was measured on 7^{th}, 14^{th} and 21^{st} days post drug treatment.

The counting of days was started just first day of drug administration. The efficacy of drug was evaluated on the declining rate of oocyst per gram.

[6] STATISTICAL ANALYSIS:-

The data, thus collected was tabulated and statistically analysed using standard statistical techniques (Snedecor and Cochran, 1967).

****



CHAPTER - 4

RESULTS

RESULTS

Coccidiosis is considered as one of the serious problem of livestock development. In cattle and buffaloes, clinical and subclinical coccidiosis occurs in young and adult animals respectively. The present study has been conducted to determine the distribution of coccidiosis in local bovine population of Patna and its surrounding areas. Further identification of species under watery and bloody diarrhoea was isolated and haematological changes were also evaluated. The drug Coximar and Fazole were applied in calves suffering from natural clinical coccidiosis to compare their efficacies.

[A] (i) PREVALENCE OF COCCIDIOSIS IN BOVINE POPULATION IN AND AROUND PATNA:-

A detail study was carried out to find the prevalence and incidence of coccidiosis in bovine in and around Patna. All together 580 faecal samples and intestinal scrapings were examined of which 134 were found positive for coccidian infection indicating an overall 23.10% infection which is presented in Table-1 and Fig. 1. The prevalence of clinical and subclinical infections is presented in Table-1 (a) which were found 20 (14.92%) and 114 (85.07%) respectively. The Table- 2 and fig. 2 show the prevalence of coccidiosis in cattle which was found to be 52 (20.96%) out of 248 faecal samples and 2 (16.6%) out of 12 intestinal scrapings of cattle and overall prevalence was observed to be 54 (20.76%). Similarly the prevalence of coccidiosis in buffaloes is depicted in Table-3 and fig. 3 which was 79 (25.1%) out of 314 faecal samples and 1 (16.6%) out of 6 intestinal scrapings and overall prevalence was found to be 80 (25%). However the prevalence of coccidiosis in buffaloes population was more than cattle but the overall prevalence of

coccidiosis was found to be non-significant among cattle and buffaloes population (Table-1 and Fig-1). The distribution of infection was also noted to be non-significant between faecal and intestinal scraping samples in both the cases (Table-2 and 3) and (Fig. 2 and 3).

(ii) EFFECT OF SEASON ON THE PREVALENCE OF BOVINE COCCIDIOSIS:-

Seasonal changes on the prevalence of bovine coccidiosis revealed wide variation. The highest prevalence of coccidiosis in cattle was recorded during monsoon (37.64%) followed by post monsoon, summer and winter seasons which were 20%, 16.6% and 15% respectively and depicted in Table 4 and fig. 4. Table-5 and fig. 5 showing seasonal variation of the prevalence of coccidiosis in buffaloes, the highest prevalence was found during monsoon (38.09%) and the lowest during winter season (12.72%). The value of chi-square showed highly significant ($P<0.01$) variation among different seasons in both the cases of cattle and buffaloes, which reflects that season may highly affect the prevalence of coccidiosis in bovine.

(iii) EFFECT OF AGE ON THE PREVALENCE OF BOVINE COCCIDIOSIS: -

In the present study cattle and buffaloes were divided into five age groups (Table 6 and 7) and (Fig. 6 and 7) in 0-3 months, 3-6 months, 6-12 months, 1-2 years and above 2 years. The highest percentage of infection was observed in the 3-6 months old cattle calves (35.08%) and in buffalo calves (37.5%). The lowest percentage was recorded in the age group above 2 years, in case of cattle (7.14%) and buffaloes (8.33%). The percentage of infection in cattle between the age groups of 0-3 months, 6-12 months and 1-2 years were 22.5%, 22% and 13.20% respectively. Similarly, the percentage

of infection in buffaloes in the age groups 0-3 months, 6-12 months and 1-2 years were found to be 21.81%, 30.66% and 17.74% respectively.

The chi-sqaure test revealed a highly significant ($P<0.01$) effect of age in the prevalence of coccidiosis in case of both cattle and buffaloes. This result further indicates that coccidiosis has maximum prevalent among the age group of 0-6 months. The severity of infection was highest between 3-6 months and gradually the rate of infection decreased with the advancement of age both in case of cattle and buffaloes. (Table 6 and 7) and (Fig. 6 and 7).

(iv) A RELATION BETWEEN NO. OF OOCYST COUNT AND INTENSITY OF INFECTION:-

The intensity of infection of coccidiosis is presented in Table-8. The study was done by counting oocyst per gram faeces and observed that cattle and buffalo calves which passed more than 4,000 O.P.G. were having only the symptoms of coccidiosis infection. Those which passed less than 4,000 O.P.G were subclinical infection. It was further noted that the incidence of clinical infection was maximum between the age group of 3-6 months (12/137) and it was also prevalent between 0-3 months (4/95) and 6-12 months (4/143) but the incidence of clinical infection was found to be negligible in older animals above age of one year.

(v) EFFECT OF SEX ON THE PREVALENCE OF BOVINE COCCIDIOSIS:-

The influence of sex on prevalence of bovine coccidiosis is presented in Table- 9 and 10 and fig. 8 and 9. The percentage of infection in cattle was noted 16.6% and 24.28% in males and females respectively. Though the female had higher percentage of infection but the influence of sex was found to be non-significant statistically. In contrast, in buffaloes the percentage of

infection was almost same 24.44% and 25.71% in male and female respectively and it was found statistically non-significant too.

(vi) EFFECT OF MANAGEMENTAL CONDITION ON THE PREVALENCE OF BOVINE COCCIDIOSIS:-

The effect of managemental conditions on coccidiosis in cattle depicted in Table-11 and fig.10. A sum of 120 and 140 samples were collected from farm and free range managed cattle respectively, out of which 34 (28.33%) and 20 (14.28%) samples were found to be positive for coccidiosis among farm and free range managed cattle respectively. But in buffaloes higher infection rate (32%) was found in free range condition and it was lower (18.82%) in farm condition (Table – 12 and Fig.11).

The chi-square test revealed highly significant ($P<0.01$) influence of managemental conditions for the prevalence of coccidiosis infection in both cattle and buffaloes.

[B] IDENTIFICATION OF VARIOUS SPECIES OF *EIMERIA* DURING CLINICAL OR SUBCLINICAL INFECTION OF COCCIDIOSIS:-

Faecal samples and intestinal scrapings positive with clinical symptoms and subclinical cases were subjected to sporulation in dichromate solution and the species identification was carried out on the basis of morphological characteristics (Table-13) and morphometry and sporulation time (Table-14) on maximum sporulation.

Intensity of infection has been presented in Table-15 on the basis of number of oocysts present in the average 50 microscopic field of 10 x X 10x. *Eimeria zuernii* (62%) was the most prevalent species followed by *Eimeria*

bovis (45%), *Eimeria ellipsoidalis* (40%) and *Eimeria subspherica* (10%) (Table-15). Overall, out of total 20 clinical cases of coccidiosis in cattle and buffaloes, *Eimeria bovis* and *Eimeria zuernii* were found in all the cases, while in subclinical infection the highest incidence (50%) was due to *Eimeria ellipsoidalis* followed by *Eimeria subspherica* (48%), *Eimeria zuernii* (45%) and *Eimeria bovis* (26%). Further identification of species was confirmed on the basis of micrometry, camera lucida, photographs, morphometry of 50 oocysts at their maximum sporulation and reports and information present in literatures.

Table-14 revealed that the *E. bovis* was the longest (25.76 μm) among all the species followed by *E. ellipsoidalis, Eimeria zuernii, E subspherica.* The *E. bovis* was found to be significantly ($P<0.01$) 10.34 μm, 8.12 μm and 15.4 μm longer than *E. zuernii, E. ellipsoidalis* and *E. subspherica respectively. E. ellipsoidalis* was observed to be significantly ($P<0.05$) longer by 2.22 μm and 7.28 μm than *E. zuernii* and *E. subspherica.* Besides *E. zuernii* was also observed to be significantly ($P<0.01$) 5.06 μm longer than *E. subspherica.*

The trend of width among different species of Eimeria was almost similar to the trend obtained for length. The *E. bovis* was observed to be significant ($P<0.01$) 4.92 μm, 4.76 μm and 10.44 μm wider than *E. zuernii, E. ellipsoidalis* and *E. subspherica. E. zuernii* and *E. ellipsoidalis* were also observed to significantly ($P<0.01$) wider by 5.52 μm and 5.68 μm than *E. subspherica* respectively. However there was no significant difference between *E. zuernii* and *E. ellipsoidalis* with respect to width.

The details of the data for each species (Table-13 and 14) are as follows:-

***Eimeria bovis* :-**

The sporulation time of the oocyst of *Eimeria bovis* was found between 80-96 hrs in 2.5% potassium dichromate at room temperature. The mean length and width of oocyst of this species were measured to be 25.76 µm and 19.02 µm respectively. The shape index was found to be 1.35. The shape of oocyst was observed ovoidal and the shape of sporocyst was elongated ovoidal. The micropyle was present but polarcap was absent.

***Eimeria zuernii* :-**

The sporulation time of oocyst of *Eimeria zuernii* was found within 72-90 hrs. The mean length and width of this species were measured to be 15.42 µm and 14.1 µm respectively. The shape index was found to be 1.09. The shape of oocyst was spherical to ovoidal without micropyle and polarcap. The shape of sporocyst was elongated ovoidal.

***Eimeria ellipsoidalis*:-**

The oocysts were found ellipsoidal with micropyle and without polarcap. The mean length and width of the oocyst were measured to be 17.64 µm and 14.26 µm respectively. The shape index was found to be 1.23. The sporulation time was 80-96 hrs.

***Eimeria subspherica*:-**

The mean length and width of oocyst were measured to be 10.36 µm and 8.58 µm respectively. The shape index was found to be 1.2. The oocyst was sporulated within 90-96 hrs. The oocysts were subspherical without presence of micropyle and polarcap.

[C] HAEMATOLOGICAL STUDIES:-

Five healthy bovine calves as control group and five calves having watery diarrhoea and five calves having bloody diarrhoea were randomly

selected as infected groups for haematological studies. The following haematological changes were observed.

(i) Haemoglobin:-

The mean along with standard error (S.E.) of healthy and infected bovine calves are presented in Table-16 and 17 and Fig.13 and 14. The mean value of bloody diarrhoea group (6.48 gm %) was found to be significantly ($P<0.05$) lower than the control group (8.94 gm%), where as in watery diarrhoea group it was found to be non significant.

(ii) Total Erythrocyte Count (TEC):-

It is evident from the Table -16 and Fig. 13, the mean and standard error of TEC value in control and bloody diarrhoea groups were 7.78 ± 0.28 X $10^6/mm^3$ and 4.054 ± 0.43 X $10^6/mm^3$ respectively. TEC value was found to be significantly ($P<0.05$) decreased in bloody diarrhoea group. The TEC value (Table-17 and Fig. 14) in watery diarrhoea group was found to be 7.58 ± 0.33 x $10^6/mm^3$, which is statistically non-significant.

(iii) Total leucocyte count (TLC) :-

The mean alongwith their standard error of total leucocyte count of control and bloody diarrhoea groups have been presented in Table-16 and Fig.- 13. The mean value of bloody diarrhoea group (11.25 x $10^3/mm^3$) was found to be significantly higher ($P<0.05$) than the control group (10.05 x $10^3/mm^3$).

The mean value of TLC in watery diarrhoea group (Table – 17 and Fig. 14) was found to be 10.88 x $10^3/mm^3$ which is statistically non-significant.

(iv) Packed cell volume (PCV):-

The arcsin value and mean value of PCV of bloody diarrhoea and control group has been depicted in Table-16 and Fig. 13. It was observed that mean PCV value of bloody diarrhoea group (24.8%) was found to be significantly ($P<0.05$) lower than the mean value of control group (31.6%), where as in watery diarrhoea group (Table-17 and Fig.14) the mean PCV value was found to be 31.2% which is statistically non-significant.

Differential leucocyte count (DLC):-

(i) Lymphocytes: -

Table – 18 and 19 and Fig.15 and 16 present the value of lymphocyte count in control, bloody diarrhoea and watery diarrhoea groups. Mean arcsin and S.E. value of lymphocytes in control, bloody diarrhoea and watery diarrhoea groups were found to be 49.49 ± 0.8%, 49.95 + 0.6% and 51.61 ± 1.1% respectively. The data revealed that there was a significant ($P<0.05$) increase in the value of watery diarrhoea group as compared to control group, whereas it was non significant in bloody diarrhoea group.

(ii) Neutrophils:-

The mean of neutrophil count in control group, bloody diarrhoea group and watery diarrhoea group were found to be 38.4%, 34.6% and 33.8% respectively. However, analysis of arcsin value of these data indicated non-significant change between the value of control and infected group (Table-18 and 19) and (Fig. 15 and 16).

(iii) Eosinophils:-

The mean ± S.E. values of eosinophils count in control and infected groups have been depicted in Table-18 and 19 and Fig.15 and 16. The mean value of eosinophil in control was found to be 3.6% whereas in bloody

diarrhoea and watery diarrhoea groups the value was 6.2% and 3.6% respectively. The analysis of arcsin values reflect that eosinophil count did not change significantly in infected group.

(iv) Monocytes:-

The mean along with standard error of monocytes of control and infected groups have been presented in Table 18 and 19 and fig. 15 and 16. The mean value of control group was found to be 0.2% and in bloody diarrhoea and watery diarrhoea groups were found to be 0.8% and 1.2% respectively. The arcsin value revealed significant ($P<0.05$) change between control and watery diarrhoea group. The change was however remained non-significant in bloody diarrhoea group.

[D] EFFICACY OF COXIMAR AND FAZOLE AGAINST COCCIDIOSIS IN BOVINE:-

To evaluate the efficacy of Coximar and Fazole against bovine coccidiosis, 15 naturally infected calves with coccidiosis were selected and divided into three groups. The group I (Gr. I) which was kept as control throughout the period of the experiment, whereas other two groups II and III were treated with Coximar @ 100 mg/kg b.wt. for 7 days and Fazole @ 1 bolus/50 kg b.wt. b.i.d. for 5 days respectively. The average number of O.P.G. on 0 day, prior to commencement of treatment and on 7^{th}, 14^{th} and 21^{st} day of post-treatment of the drug in each group were counted. Mean value along with their standard error (S.E.) were calculated which is presented in Table-20. The average O.P.G. of control group from day 0 to 21 day of observation ranged between 9234.60 to 11286.40. There was an increasing trend in oocysts count observed throughout the period of experiment.

The average O.P.G. in Coximar treated group (Gr. II) were gradually decreased from 9203.6 on 0 day to 809.8, 385.4 and 157.6 on 7^{th}, 14^{th} and 21^{st} day of post-treatment respectively and they differed significantly ($P<0.05$) from day 0. It was observed that average no. of O.P.G. had declined significantly with advancement of treatment and on that basis it was estimated that the efficacy of Coximar was 91.20%, 95.81% and 98.28% on 7^{th}, 14^{th} and 21^{st} day of post-treatment respectively.

The group III treated with Fazole was observed similarly as group II. The mean O.P.G. on 0 day was observed to be decreased significantly ($P<0.05$) from 9047.2 to 1928.8, 935.6 and 455.2 on 7^{th}, 14^{th} and 21^{st} day of post-treatment respectively. The efficacy of Fazole was found to be 78.68%, 89.65% and 94.96% on 7^{th}, 14^{th} and 21^{st} day of post-treatment respectively, after administration of 1gm Metronidazole and 0.2gm Furazolidone/kg body weight in two divided dose for 5 days.

On the basis of percent efficacy, Coximar was found to be superior to Fazole on all the 3 periods of observation. The efficacy of Coximar on 7^{th}, 14^{th} and 21^{st} day was found to be 12.50%, 6.16% and 3.32% superior respectively to Fazole treated groups (Gr. III).

****

Table-1

Overall prevalence of bovine coccidiosis in and around Patna.

Animals	Number of samples collected	Positive for coccidial infection	Percentage of infection (%)	$\chi^2_{1d.f.}$
Cattle	260	54	20.76	1.33^{NS}
Buffaloes	320	80	25	
Total	580	134	23.10	

NS= Non-Significant.

Fig.1 : Histogram showing overall prevalence of bovine coccidiosis in and around Patna.

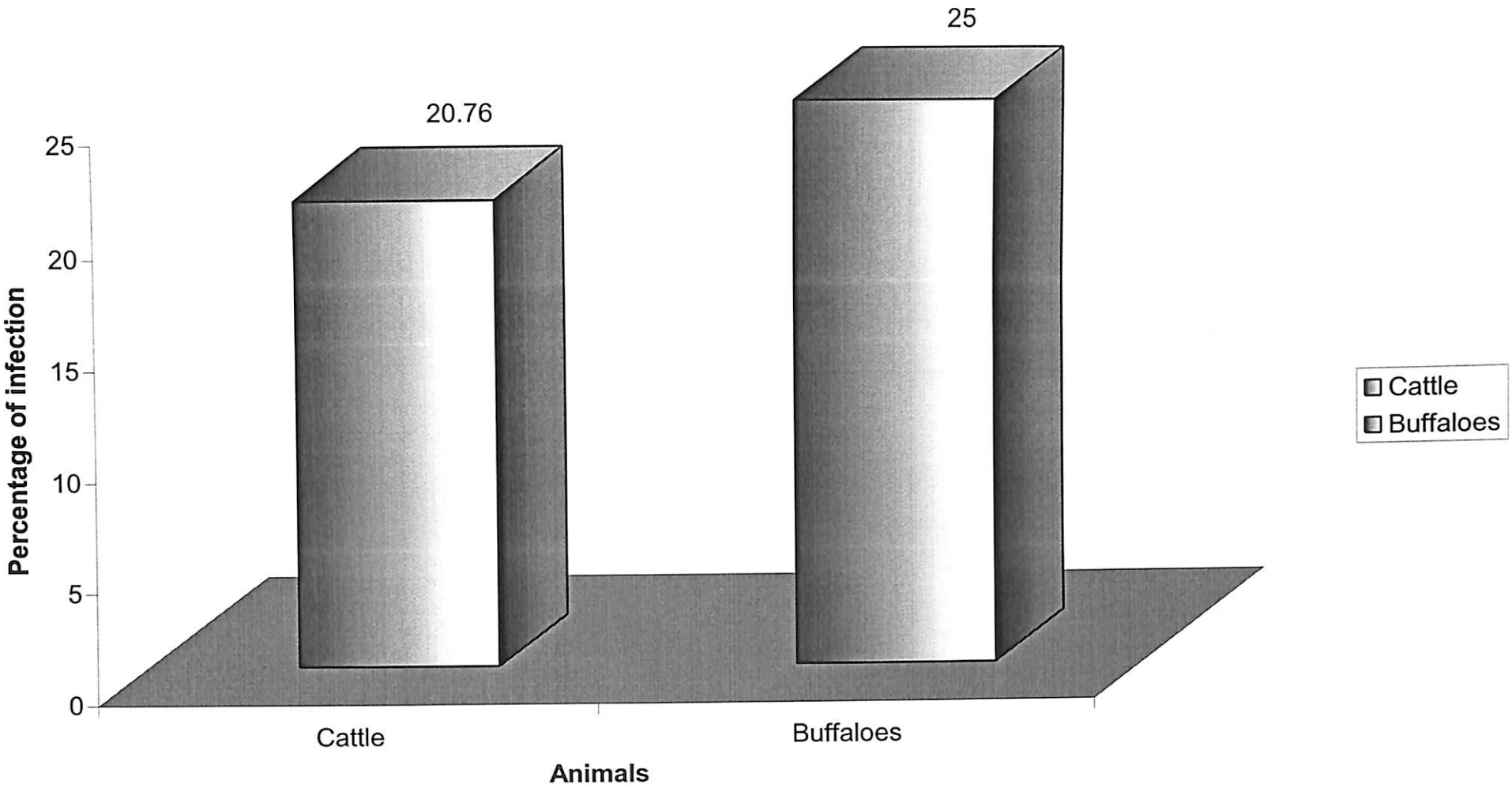


Table-1(a)

Overall prevalence of bovine coccidiosis in and around Patna.

Intensity of infection	Number of samples positive	Percentage of infection (%)
Subclinical	114	85.07
Clinical	20	14.92
Total	134	100

NB = Clinical- 4000 and above oocysts per gram

Subclinical- less than 4000 oocysts per gram

Fig. 1(a) : Histogram showing overall prevalence of bovine coccidiosis in and around Patna.

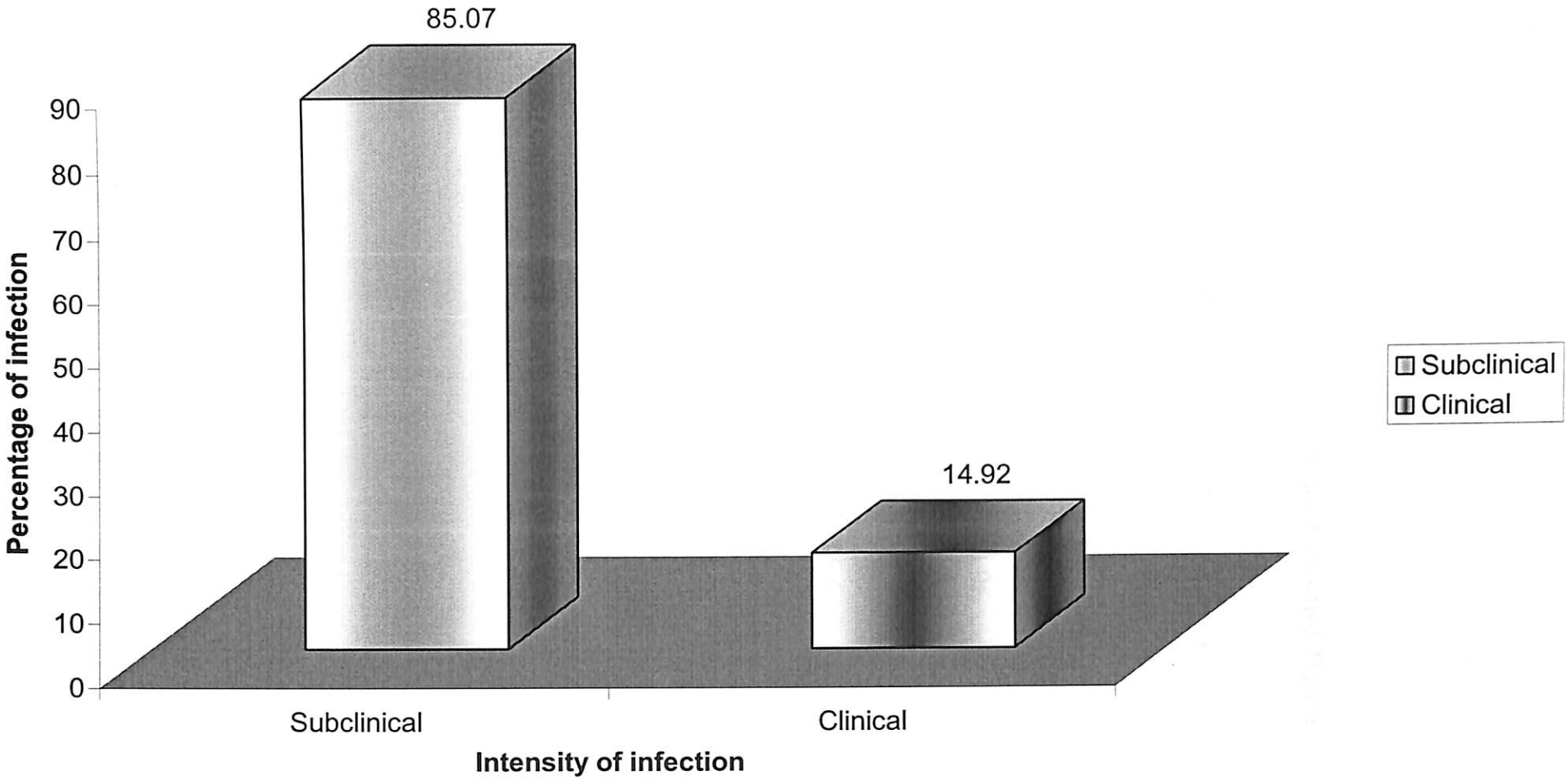


Table-2

Prevalence of coccidiosis in cattle in and around Patna.

Samples	Number of samples collected	Positive for coccidial infection	Pecentage of infection (%)	$\chi^2_{1d.f.}$
Faecal samples	248	52	20.96	0.09^{NS}
Intestinal scraping	12	2	16.6	
Total	260	54	20.76	

NS= Non-Significant.

Fig. 2 : Histogram showing prevalence of coccidiosis in cattle in and around Patna.

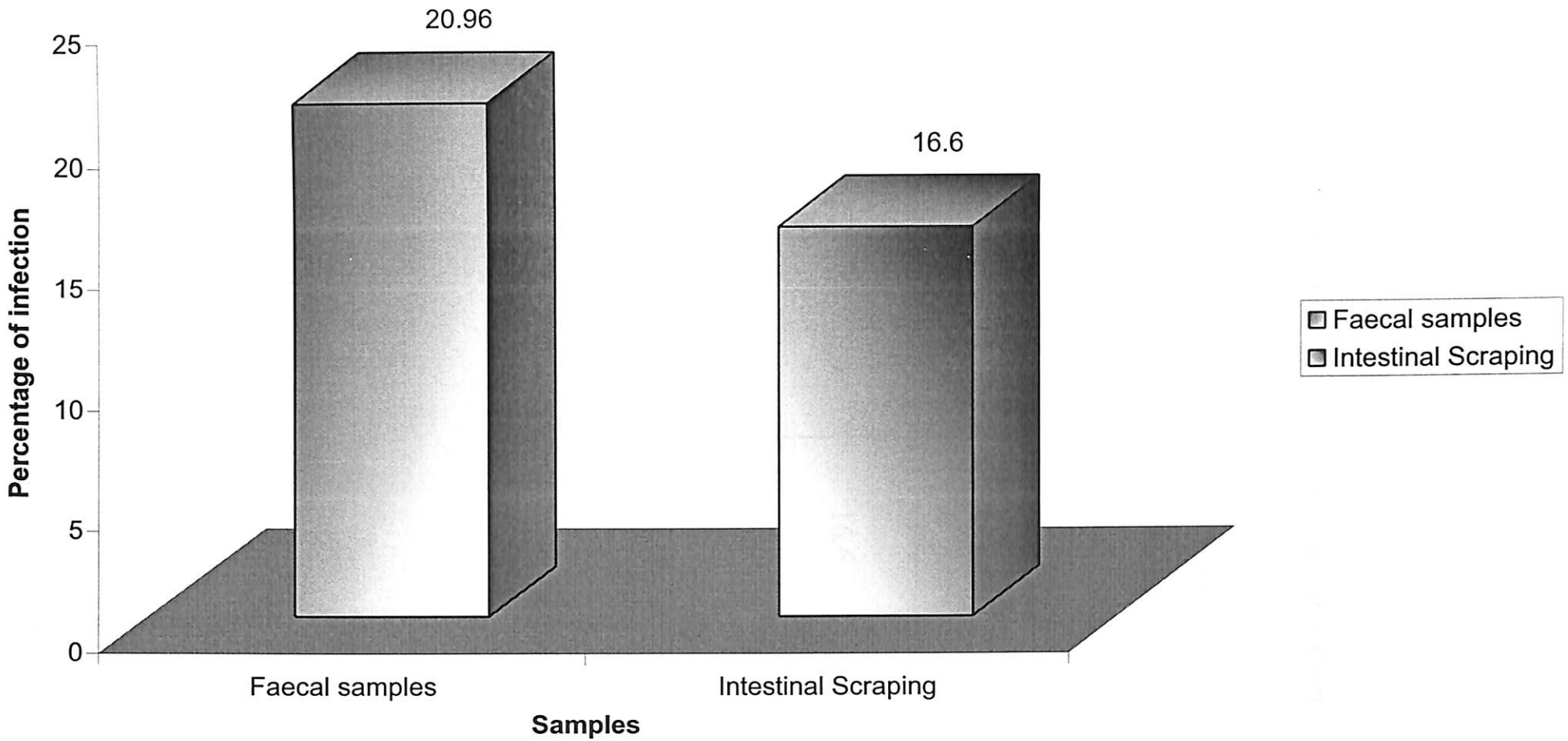


Table-3

Prevalence of coccidiosis in buffaloes in and around Patna.

Samples	Number of samples collected	Positive for coccidial infection	Percentage of infection (%)	$\chi^2_{1d.f.}$
Faecal samples	314	79	25.1	0.261^{NS}
Intestinal Scraping	6	1	16.6	
Total	320	80	25	

NS= Non-Significant

Fig. 3 : Histogram showing prevalence of coccidiosis in buffaloes in and around Patna.

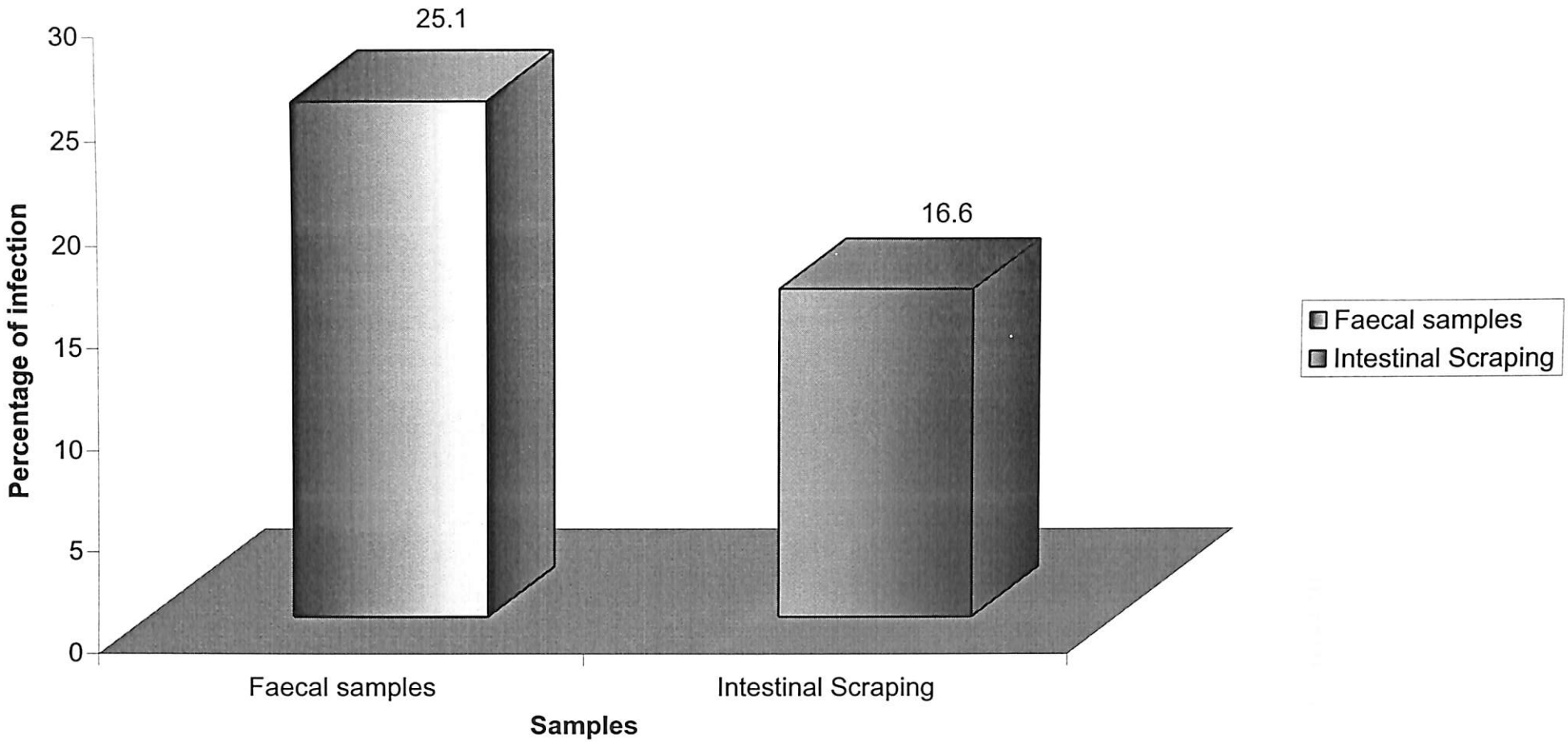


Table-4

Effect of season on the prevalence of coccidiosis in cattle in and around Patna.

Season	Number of samples examined	Number of samples found positive	Percentage of infection (%)	$\chi^2_{3d.f.}$
Monsoon (June-August)	85	32	37.64	15.39^{**}
Post monsoon (September-November)	75	15	20	
Winter (December- February)	40	6	15	
Summer (March-May)	60	10	16.6	
Total	260	54	20.76	

** Significant at P<0.01

Fig. 4 : Histogram showing effect of season on the prevalence of coccidiosis in cattle in and around Patna.

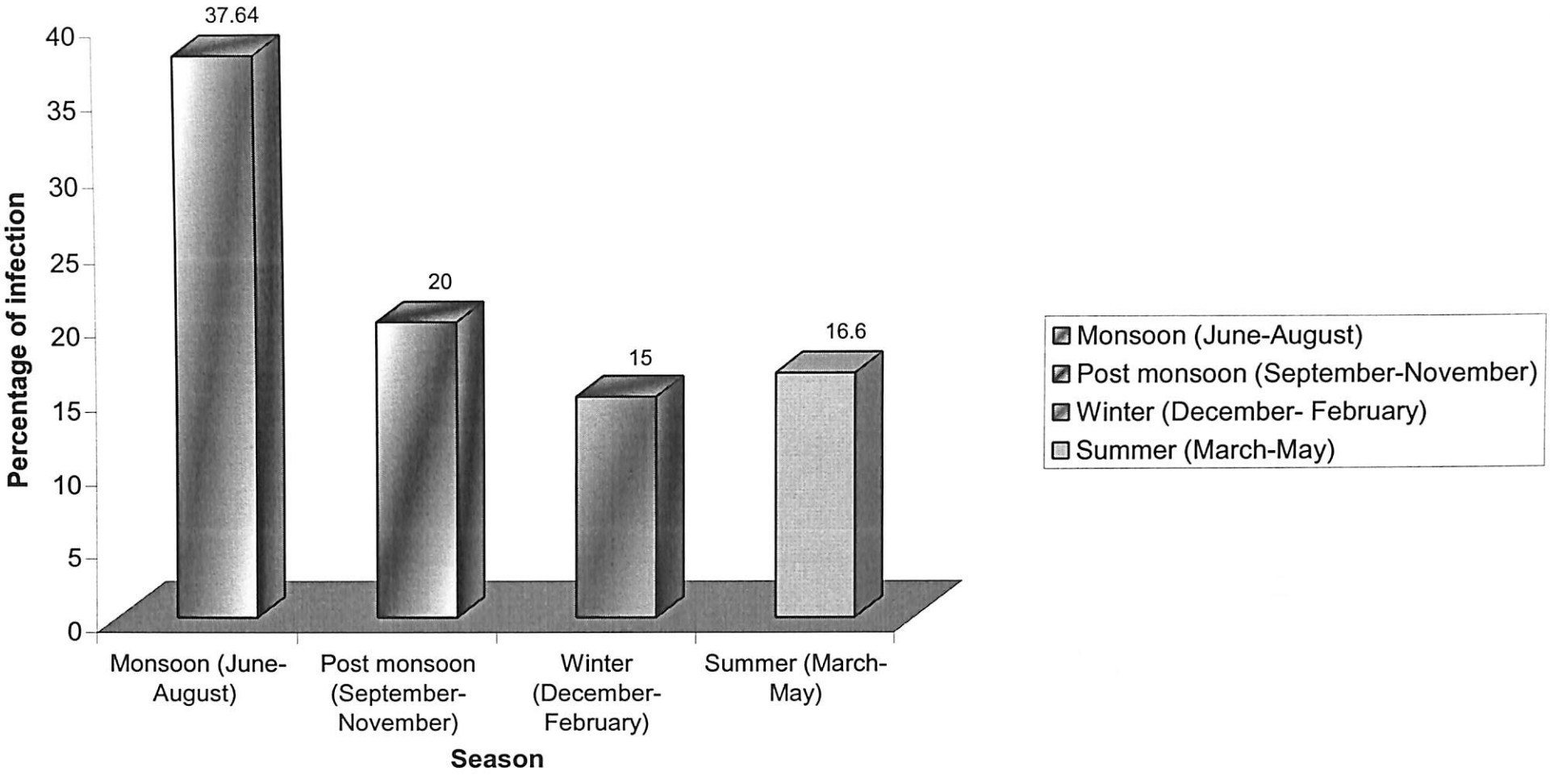


Table-5

Effect of season on the prevalence of coccidiosis in buffaloes in and around Patna.

Season	Number of samples examined	Number of samples found positive	Percentage of infection (%)	$\chi^2_{3d.f.}$
Monsoon (June-August)	105	40	38.09	16.86^{**}
Post monsoon (September-November)	92	22	23.9	
Winter (December-February)	55	7	12.72	
Summer (March-May)	68	11	16.17	
Total	320	80	25	

** Significant at P<0.01

Fig. 5 : Histogram showing effect of season on the prevalence of coccidiosis in buffaloes in and around Patna.

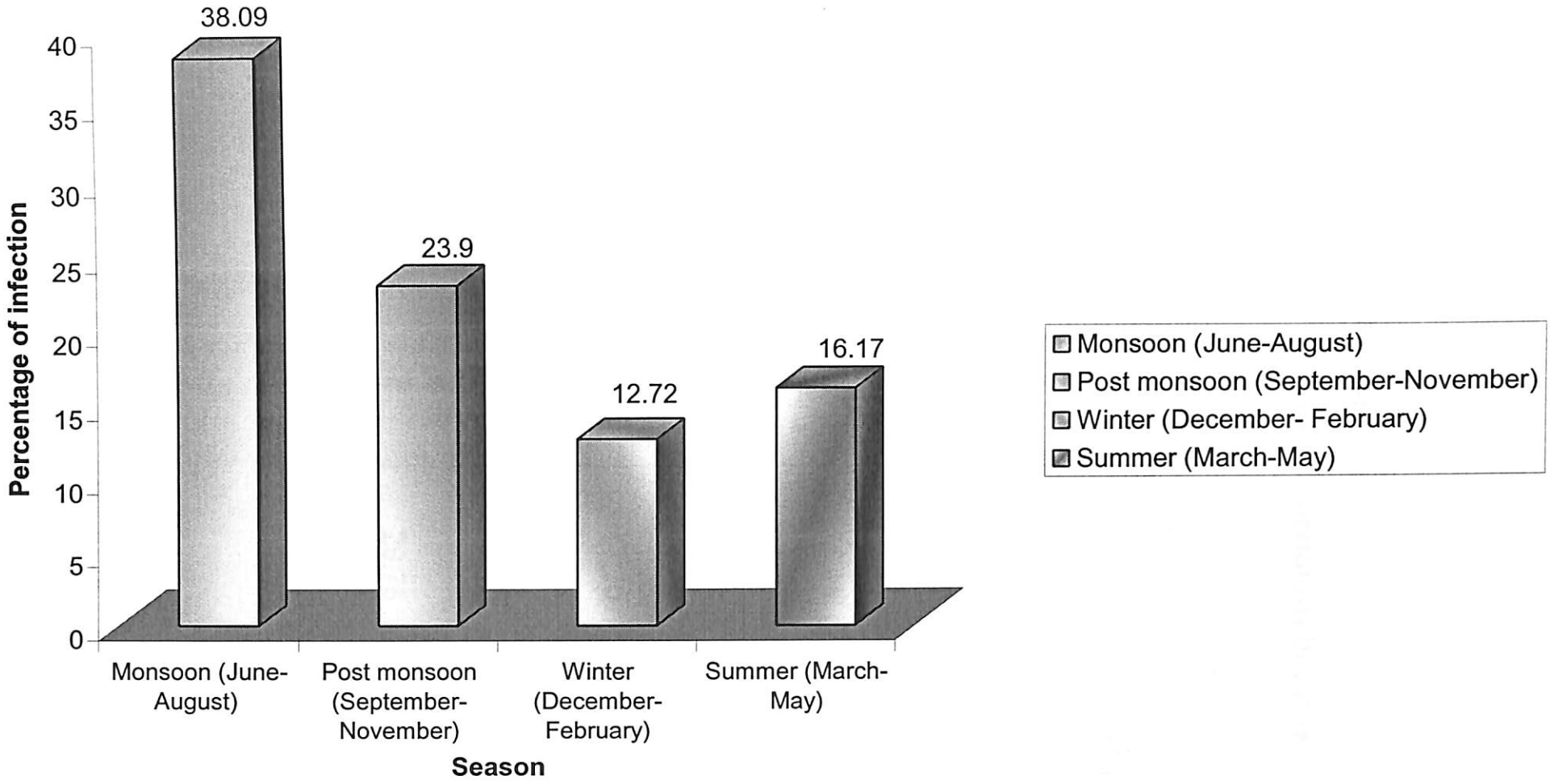


Table-6

Effect of age groups on prevalence of coccidiosis in cattle.

Age groups of cattle	Number of samples examined	Number of samples found positive	Percentage of infection (%)	$\chi^2_{4d.f.}$
0-3 months	40	9	22.5	13.54^{**}
3-6 months	57	20	35.08	
6-12 months	68	15	22	
1-2 Years	53	7	13.20	
2 Years and above	42	3	7.14	
Total	260	54	20.76	

** Significant at $P<0.01$

Fig. 6 : Histogram showing effect of age groups on prevalence of coccidiosis in cattle.

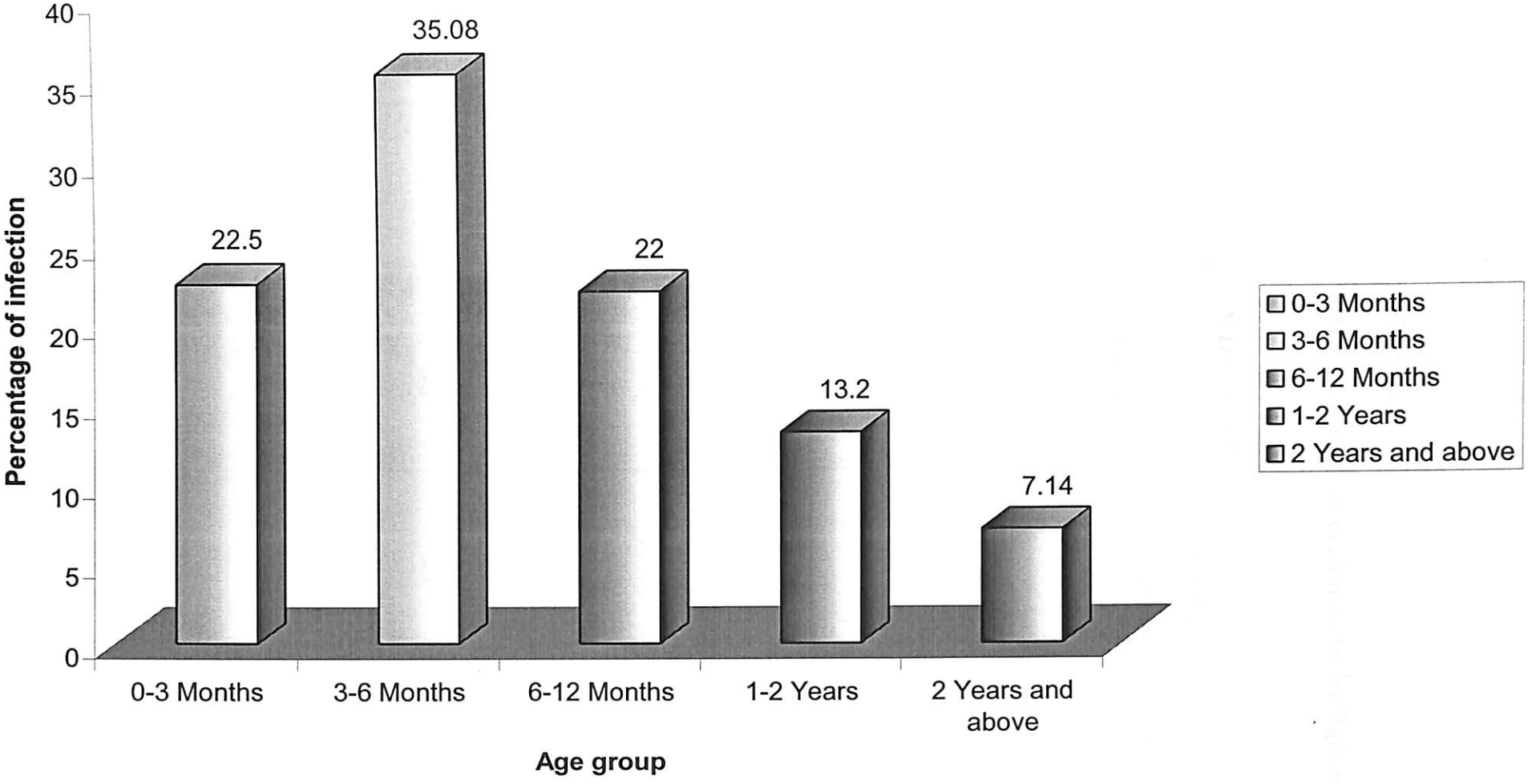


Table-7

Effect of age groups on the prevalence of coccidiosis in buffaloes.

Age groups of buffaloes	Number of samples examined	Number of samples found positive	Percentage of infection (%)	$\chi^2_{4d.f.}$
0-3 months	55	12	21.81	16.85^{**}
3-6 months	80	30	37.5	
6-12 months	75	23	30.66	
1-2 Years	62	11	17.74	
2 Years and above	48	4	8.33	
Total	320	80	25	

** Significant at $P<0.01$

Fig. 7 : Histogram showing effect of age groups on the prevalence of coccidiosis in buffaloes.

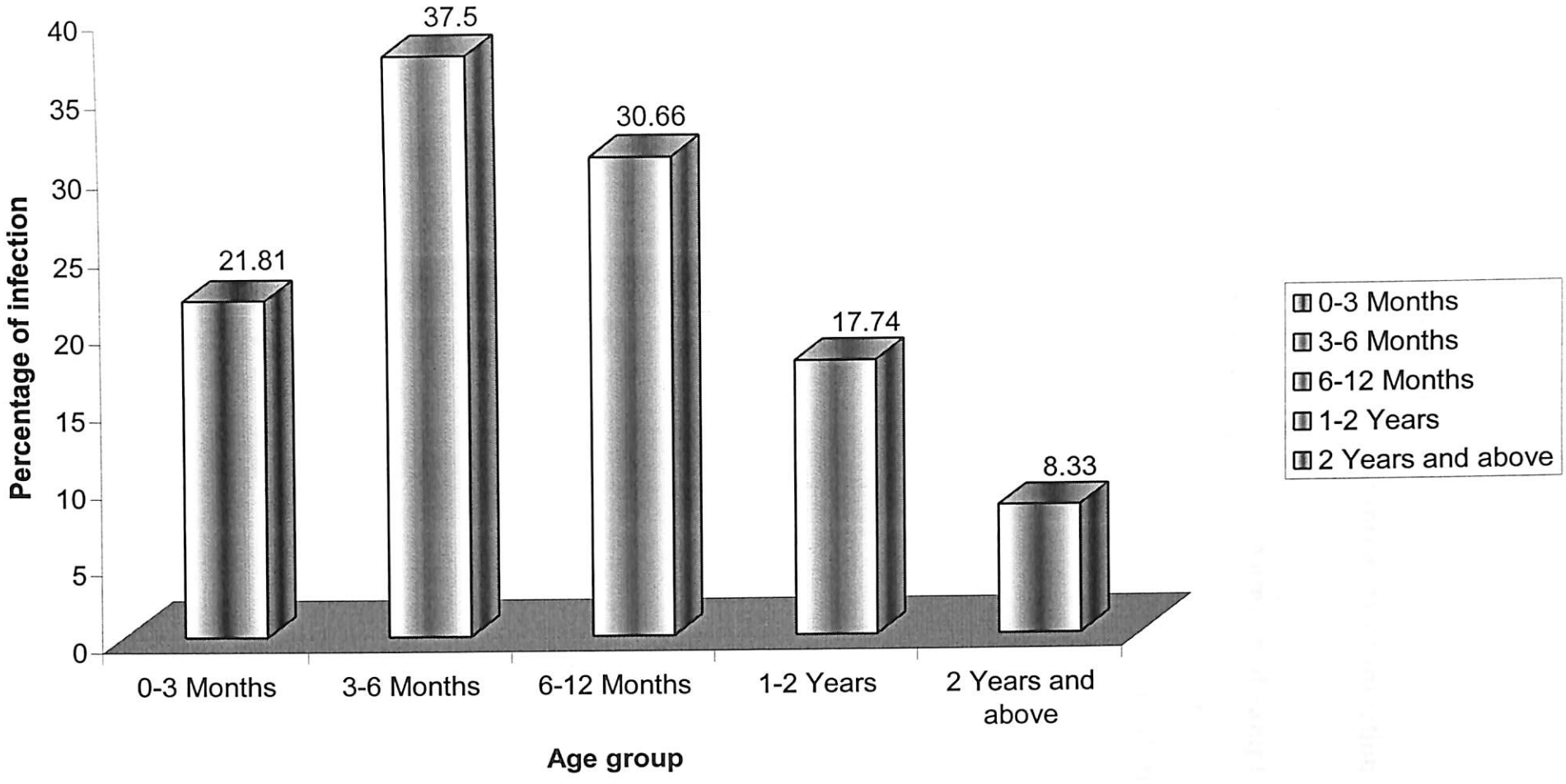


Table-8

A relation between no. of oocyst count and intensity of infection.

Age groups	Number of samples examined	Number of samples positive.	
		Clinical*	Subclinical**
0-3 months	95	4	17
3-6 months	137	12	38
6-12 months	143	4	34
1-2 Years	115	-	18
2 Years and above	90	-	7
Total	580	20	114

NB:

* Clinical- 4000 and above oocysts per gram

** Subclinical- Less than 4000 oocysts per gram.

Table-9

Influence of sex on the prevalence of coccidiosis in cattle.

Sex	Number of samples examined	Number of samples positive	Percentage of infection (%)	$\chi^2_{1d.f}$
Male	120	20	16.6	2.04^{NS}
Female	140	34	24.28	
Total	260	54	20.76	

NS= Non-significant.

Fig. 8 : Histogram showing influence of sex on the prevalence of coccidiosis in cattle.

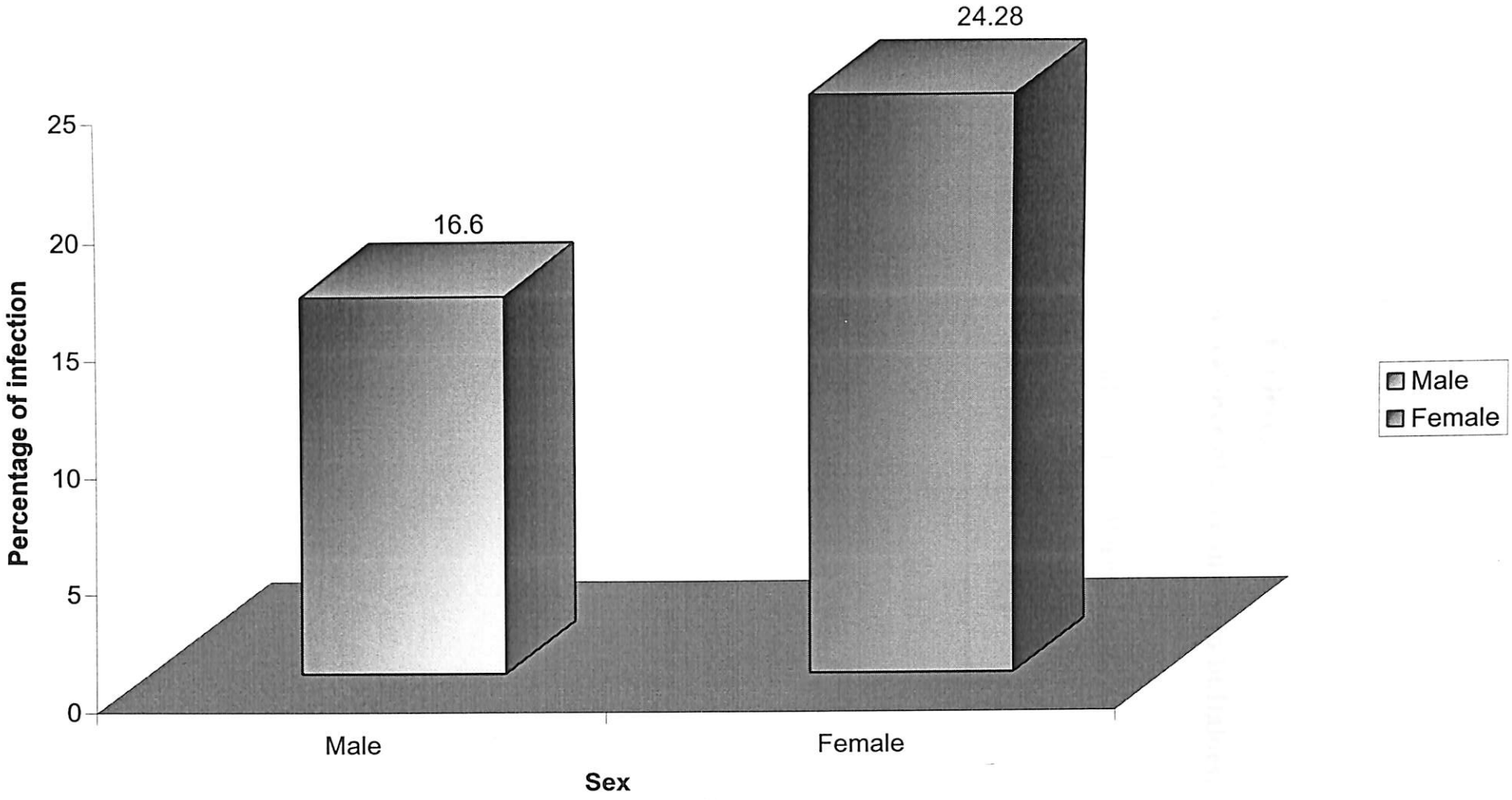


Table-10

Influence of sex on the prevalence of coccidiosis in buffaloes.

Sex	Number of samples examined	Number of samples positive	Percentage of infection (%)	$\chi^2_{1d.f}$
Male	180	44	24.44	0.0569^{NS}
Female	140	36	25.71	
Total	320	80	25	

NS= Non-significant.

Fig.9 : Histogram showing influence of sex on the prevalence of coccidiosis in buffaloes.

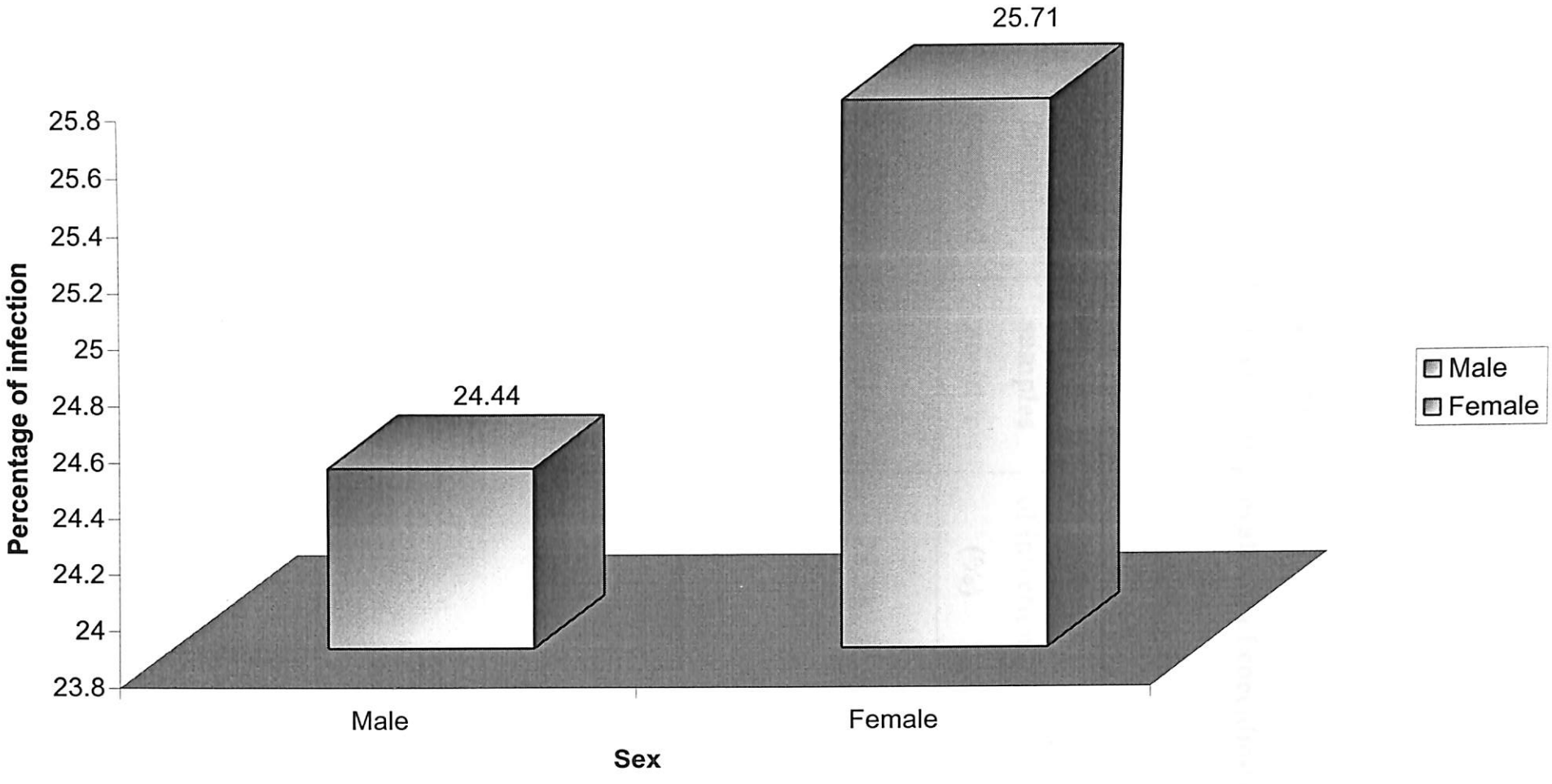


Table-11

Effect of managemental conditions on the prevalence of coccidiosis in cattle.

Managemental conditions	Number of samples examined	Number of samples positive	Percentage of infection (%)	$\chi^2_{1d.f}$
Farm condition	120	34	28.33	7.66^{**}
Free range condition	140	20	14.28	
Total	260	54	20.76	

**Significant at P<0.01

Fig. 10 : Histogram showing effect of managemental conditions on the prevalence of coccidiosis in cattle.

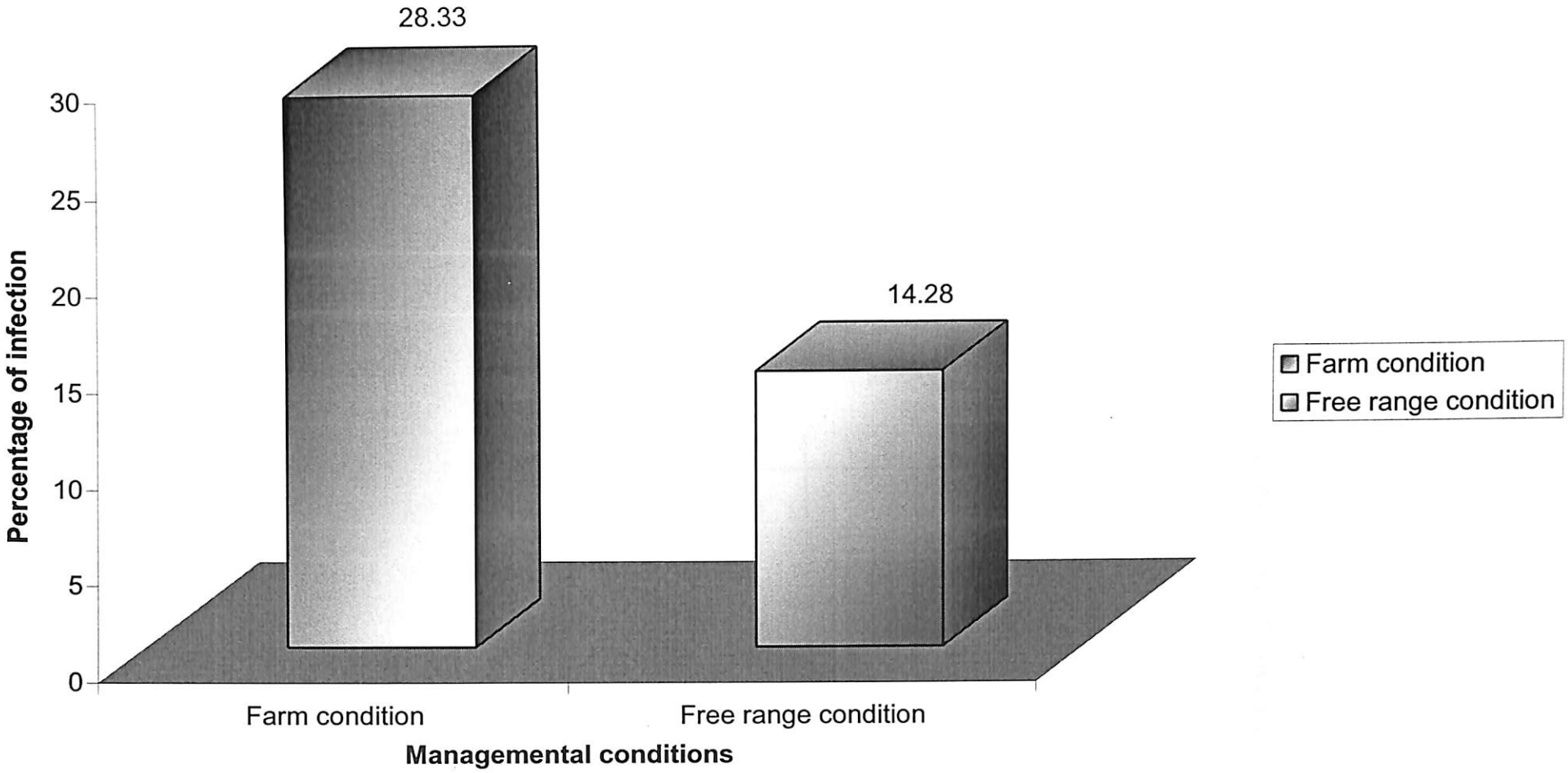


Table-12

Effect of managemental conditions on the prevalence of coccidiosis in buffaloes.

Managemental conditions	Number of samples examined	Number of samples positive	Percentage of infection (%)	$\chi^2_{1d.f}$
Farm condition	170	32	18.82	7.22^{**}
Free range condition	150	48	32	
Total	320	80	25	

** Significant at P<0.01

Fig. 11 : Histogram showing effect of managemental conditions on the prevalence of coccidiosis in buffaloes.

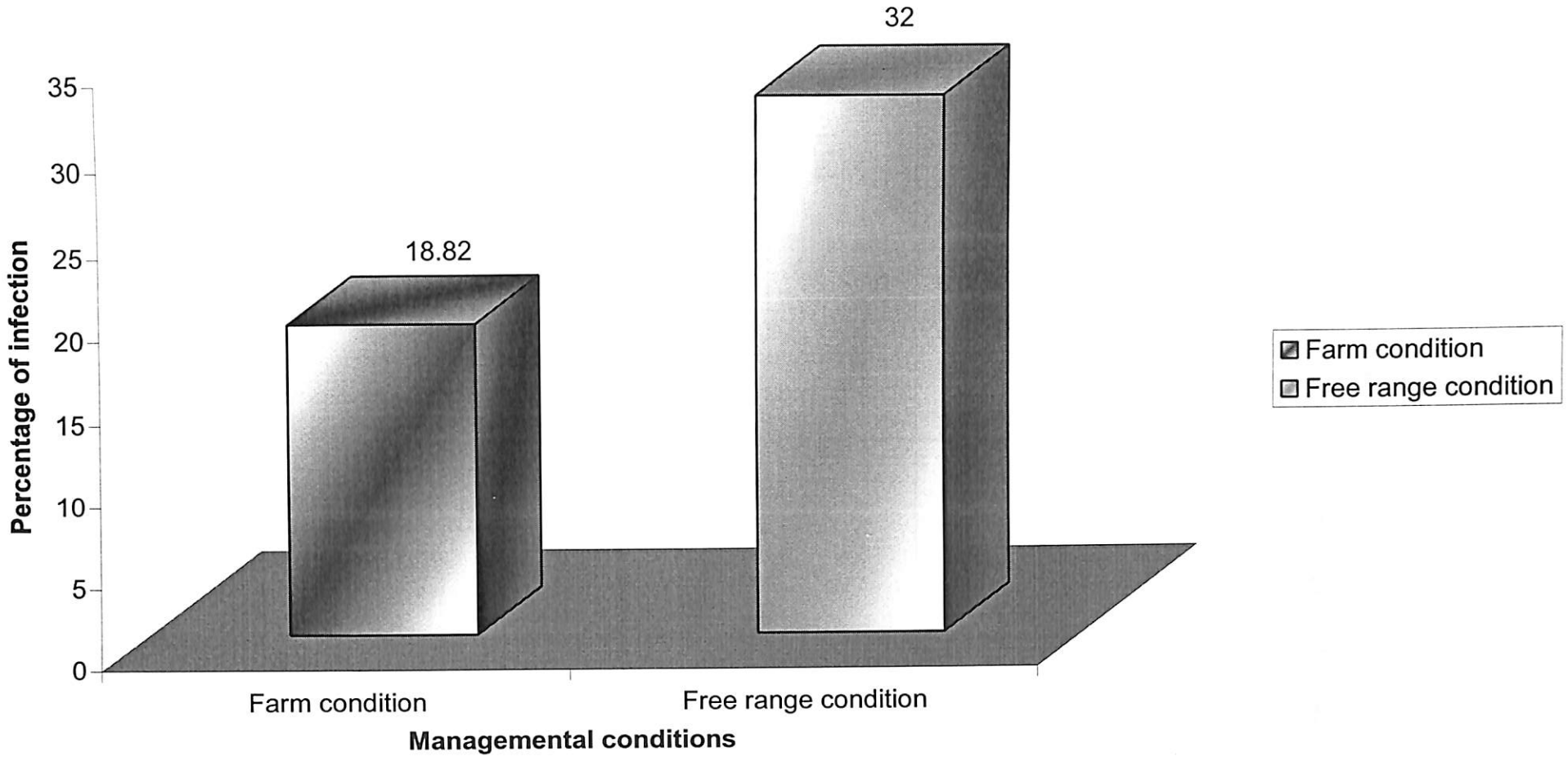


Table-13

The morphological characteristics of different species of *Eimeria* isolated from bovine of Patna.

Species	Shape of oocyst	Presence of Micropyle	Presence of Polarcap	Shape of sporocyst
Eimeria bovis	Ovoidal	Present	Absent	Elongate ovoidal
Eimeria zuernii	Spherical to ovoidal	Absent	Absent	Elongate ovoidal
Eimeria ellipsoidalis	Ellipsoidal	Present	Absent	Elongate ovoidal
Eimeria subspherica	Subspherical	Absent	Absent	Spindle shaped

Table-14

Morphometry and sporulation time of different species of *Eimeria* isolated from bovine of Patna.

Species	Length (µm) Mean ± S.E	Width (µm) Mean ± S.E	Shape Index	Sporulation time (In hours) (In 2.5% potassium dichromate at room temp.)
Eimeria bovis	$25.76^{a} \pm 0.56$	$19.02^{a} \pm 0.42$	1.35	80 – 96 hrs
Eimeria zuernii	$15.42^{b} \pm 0.49$	$14.1^{b} \pm 0.64$	1.09	72 – 90 hrs
Eimeria ellipsoidalis	$17.64^{c} \pm 0.59$	$14.26^{b} \pm 0.49$	1.23	80 – 96 hrs
Eimeria subspherica	$10.36^{d} \pm 0.64$	$8.58^{c} \pm 0.52$	1.2	89 – 96 hrs

NB:- All the measurements are in microns (µ)

Means (columnwise) with different superscripts differ significantly ($P<0.05$).

Table-15

Prevalence of different species of *Eimeria* in clinical and subclinical cases.

Species	Oocyst Percentage (%)	Percentage present in clinical cases (%)	Percentage present in subclinical cases (%)
Eimeria bovis	45	100	26
Eimeria zuernii	62	100	45
Eimeria ellipsoidalis	40	-	50
Eimeria subspherica	10	-	48

Fig.12 : Histogram showing prevalence of different species of *Eimeria* isolated from bovine.

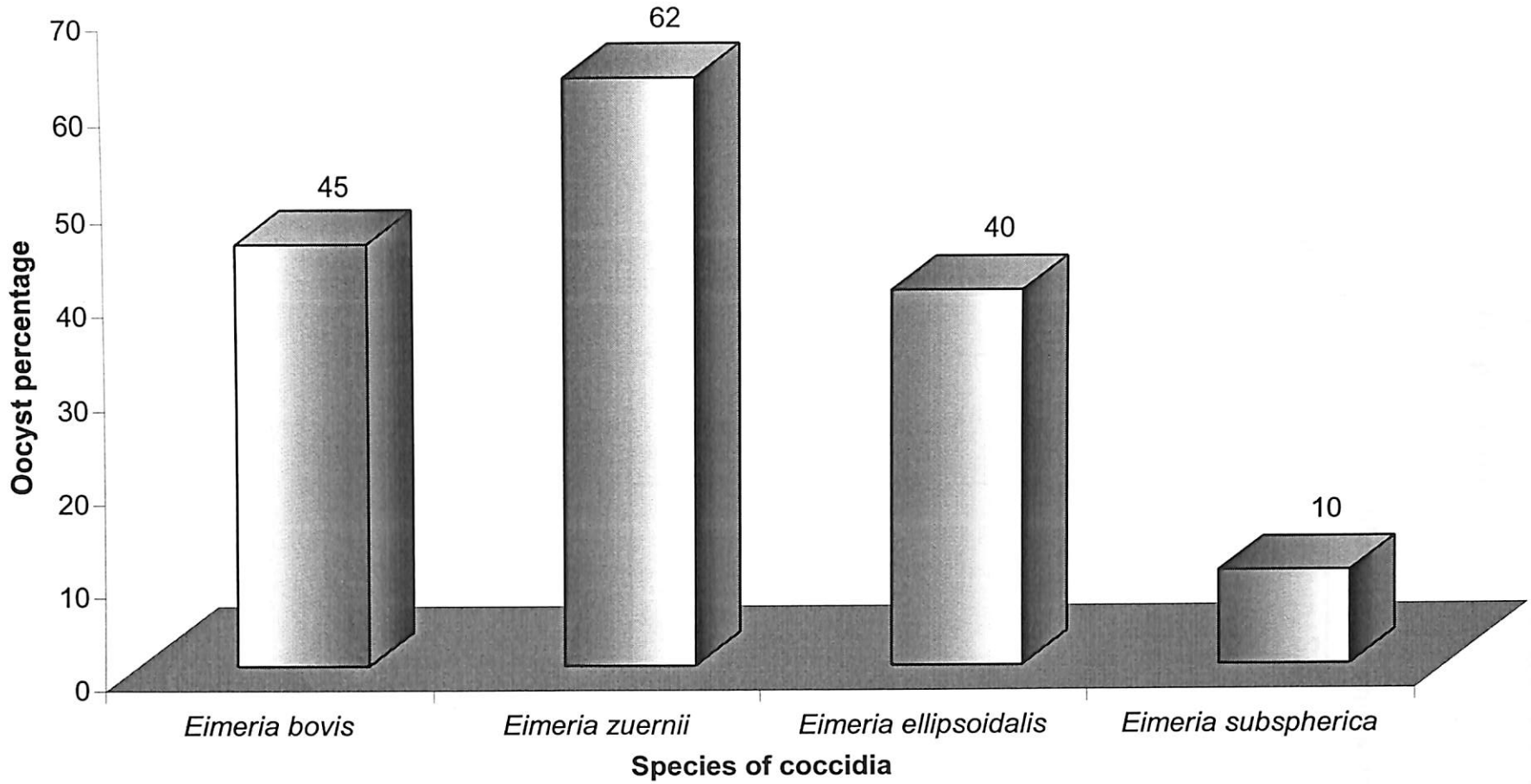


Table-16

Mean ± S.E. of haematological parameters in control and bloody diarrhoea group of bovine.

Control group (5)			Bloody diarrhoea group (5)	
Parameters	Mean±S.E	CV%	Mean±S.E	CV%
Haemoglobin (gm%)	17.57^{a}±0.53 (8.94)	6.71	14.74^{b}±0.24 (6.48)	3.66
Total Erythrocyte count (TEC) $10^6/mm^3$	7.78^{a}±0.28	8.09	4.054^{b}±0.43	23
Total leucocyte count (TLC) $10^3/mm^3$	10.05^{a}±0.52	11.44	11.25^{a}± 0.72	14.22
Packed cell volume (PCV) (%)	34.18^{a}±0.85 (31.6)	5.47	29.85^{b}±0.58 (24.8)	4.28

* Values of Hb (gm%) and PCV (%) are the values of angles corresponding to percentages (Angle= Arcsin $\sqrt{\text{Percentage}}$)

Figures in Parenthesis indicate mean Percentages of original value.

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

Fig. 13 : Histogram showing mean ± S.E. of haematological parameters in control and bloody diarrhoea group of bovine.

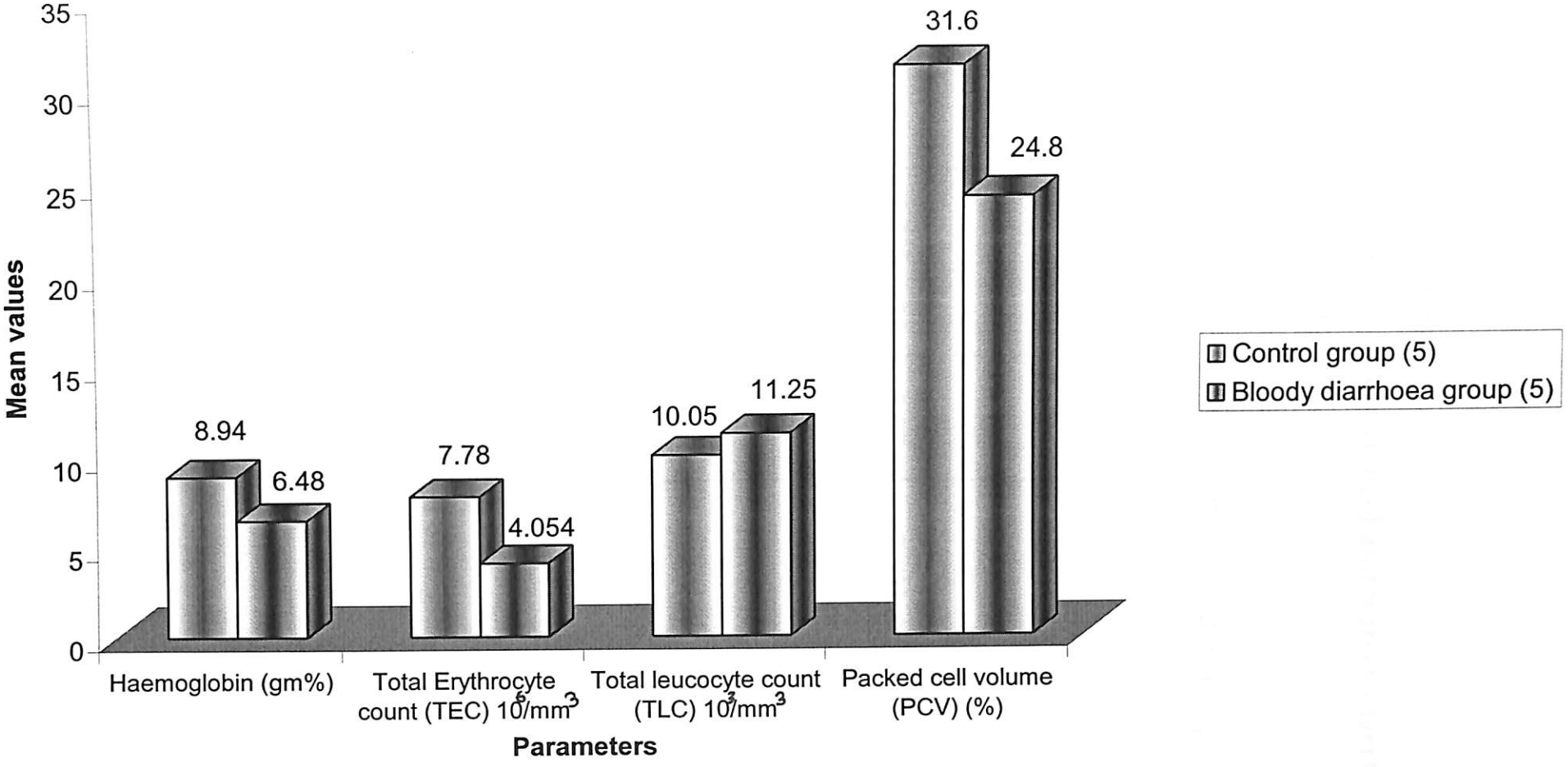


Table-17

Mean ± S.E. of haematological Parameters in control and watery diarrhoea group of bovine.

Control group (5)			Watery diarrhoea group (5)	
Parameters	Mean ± S.E	CV%	Mean ± S.E	CV%
Haemoglobin (gm%)	17.57^{a}±0.53 (8.94)	6.71	17.14^{a}±0.57 (8.72)	7.35
Total Erythrocyte count (TEC) $10^6/mm^3$	7.78^{a}±0.28	8.09	7.58^{a}±0.33	9.76
Total leucocyte count (TLC) $10^3/mm^3$	10.05^{a}±0.52	11.44	10.88^{a}± 0.52	10.56
Packed cell volume (PCV) (%)	34.18^{a}±0.85 (31.6)	5.47	33.9^{a}±0.6 (31.2)	4.04

* Values of Hb (gm%) and PCV (%) are the values of angles corresponding to percentages (Angle= Arcsin $\sqrt{\text{Percentage}}$)

Figures in Parenthesis indicate mean percentages of original value.

NB- Means (row-wise) with same superscripts do not differ significantly.

Fig. 14 : Histogram showing mean ± S.E. of haematological parameters in control and watery diarrhoea group of bovine.

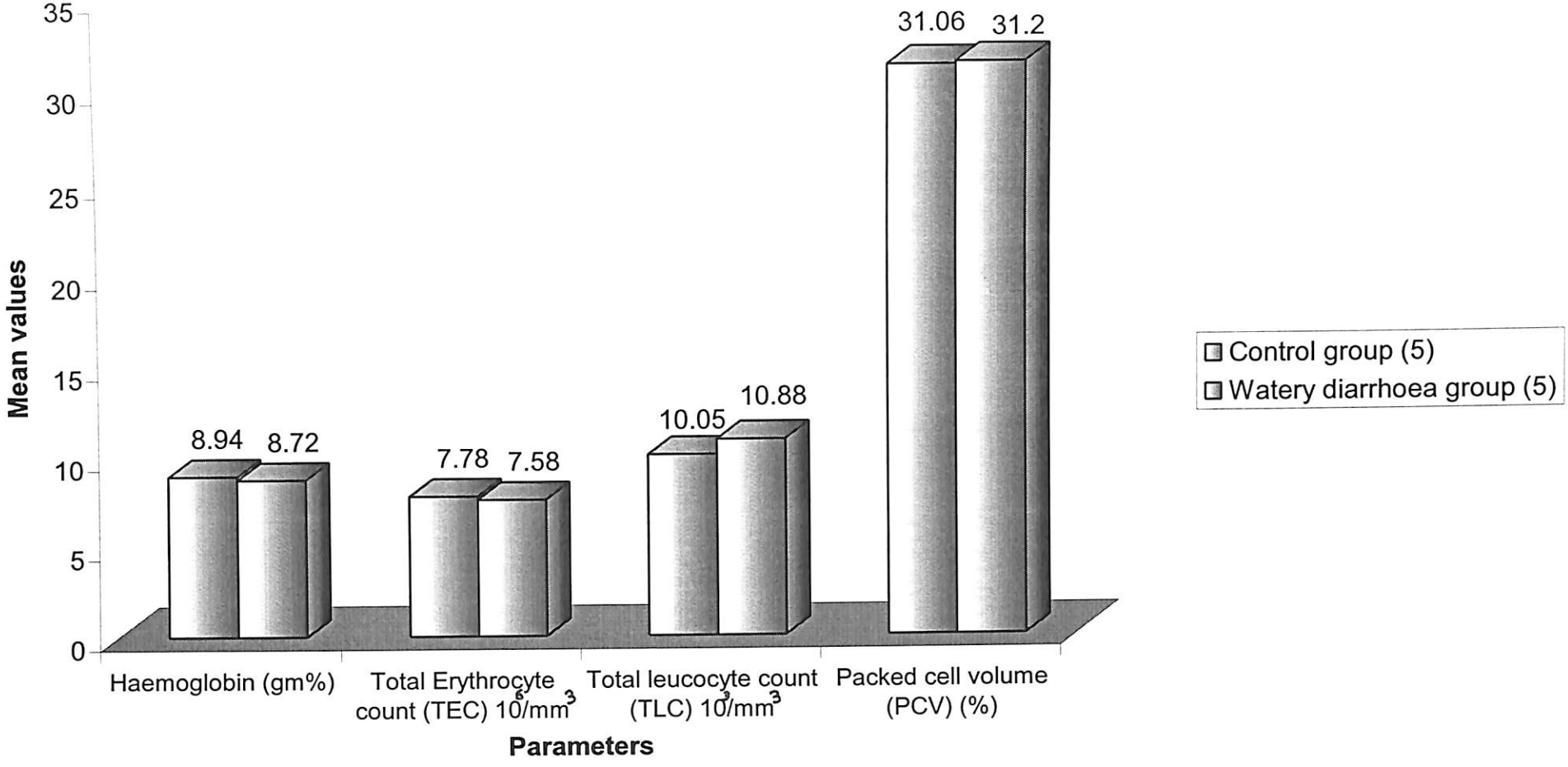


Table-18

Mean ± S.E. of haematological parameters (DLC) in control and bloody diarrhoea group of bovine.

Control group (5)			Bloody diarrhoea groups (5)	
Parameters (%)	Mean±S.E	CV%	Mean±S.E	CV%
Lymphocytes	49.49^{a}±0.8 (57.8)	3.55	49.95^{a} ±0.6 (58.6)	3.04
Neutrophils	38.28^{a} ±1.75 (38.4)	10.05	36^{a}±1.05 (34.6)	6.41
Eosinophils	10.72^{a}±1.10 (3.6)	22.66	14.10^{a}±1.56 (6.2)	24.39
Monocytes	1.14^{a}±1.16 (0.2)	224.56	3.92^{a}±1.68 (0.8)	94.38

* Values of Lymphocyte (%), Neutrophil (%), Eosinophil (%), and Monocyte (%) are the values of angles corresponding to percentages (Angle= Arcsin $\sqrt{\text{Percentage}}$)

Figures in Parenthesis indicate mean Percentages of original value.

NB- Means (row-wise) with same superscripts do not differ significantly.

Fig. 15 : Histogram showing mean ± S.E. of haematological parameters (DLC) in control and bloody diarrhoea group of bovine.

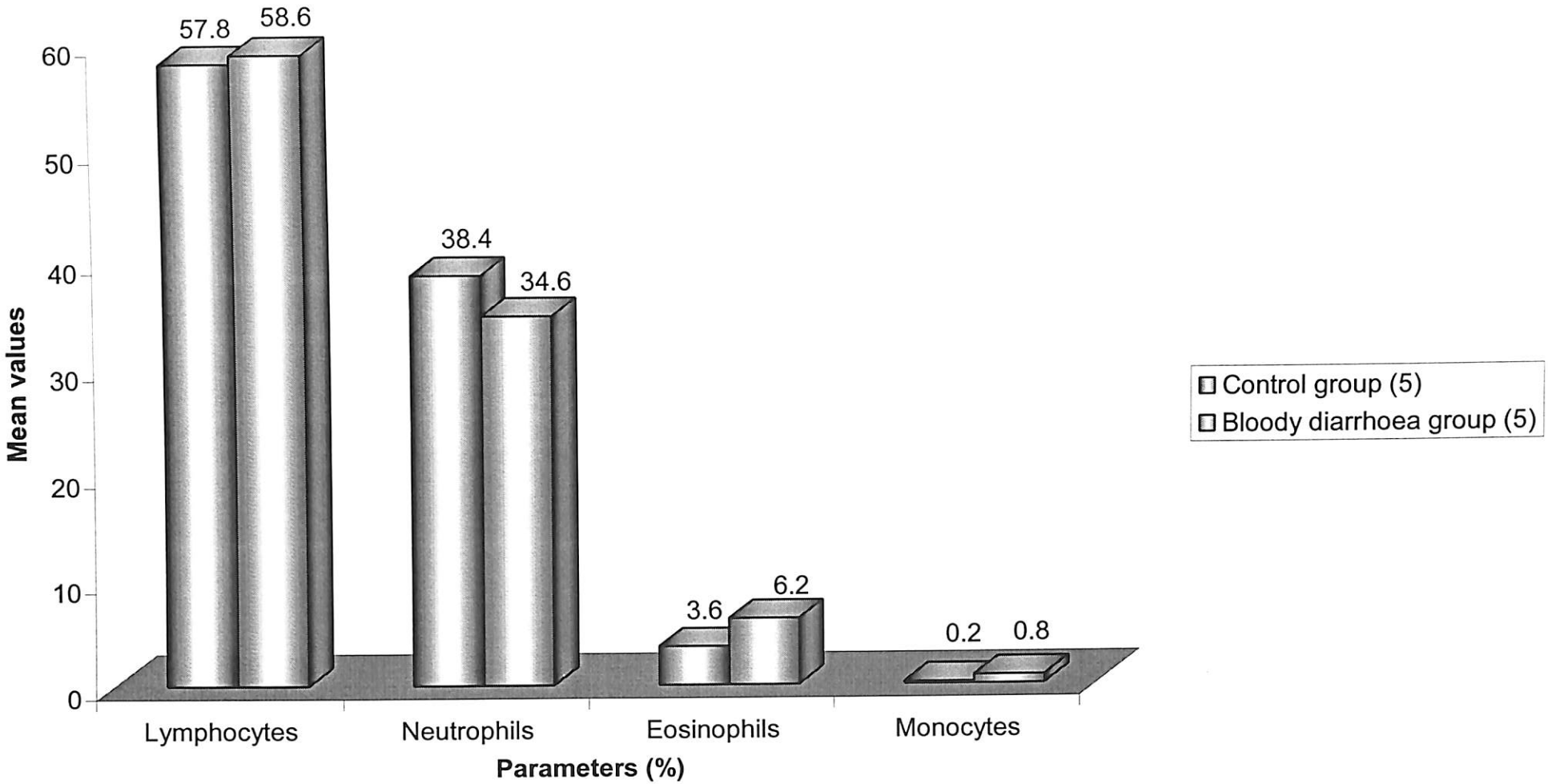


Table-19

Mean ± S.E. of haematological parameters (DLC) in control and watery diarrhoea group of bovine.

Control group (5)			Watery diarrhoea group (5)	
Parameters (%)	Mean±S.E	CV%	Mean±S.E	CV%
Lymphocytes	49.49^{a}±0.8 (57.8)	3.55	51.61^{a}±1.1 (61.4)	4.68
Neutrophils	38.28^{a}±1.75 (38.4)	10.05	35.52^{a}±0.9 (33.8)	5.912
Eosinophils	10.72^{a}±1.10 (3.6)	22.66	10.70^{a}± 1.10 (3.6)	22.64
Monocytes	1.14^{a}±1.16 (0.2)	224.56	5.54^{b}±1.5 (1.2)	59.92

* Values of Lymphocyte(%), Eosinophil (%), Monocyte (%) and Neutrophil (%) are the values of angles corresponding to percentages (Angle = Arcsin $\sqrt{\text{Percentage}}$)

Figures in Parenthesis indicate mean percentage of original value.

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

Fig. 16 : Histogram showing mean ± S.E. of haematological parameters (DLC) in control and watery diarrhoea group of bovine.

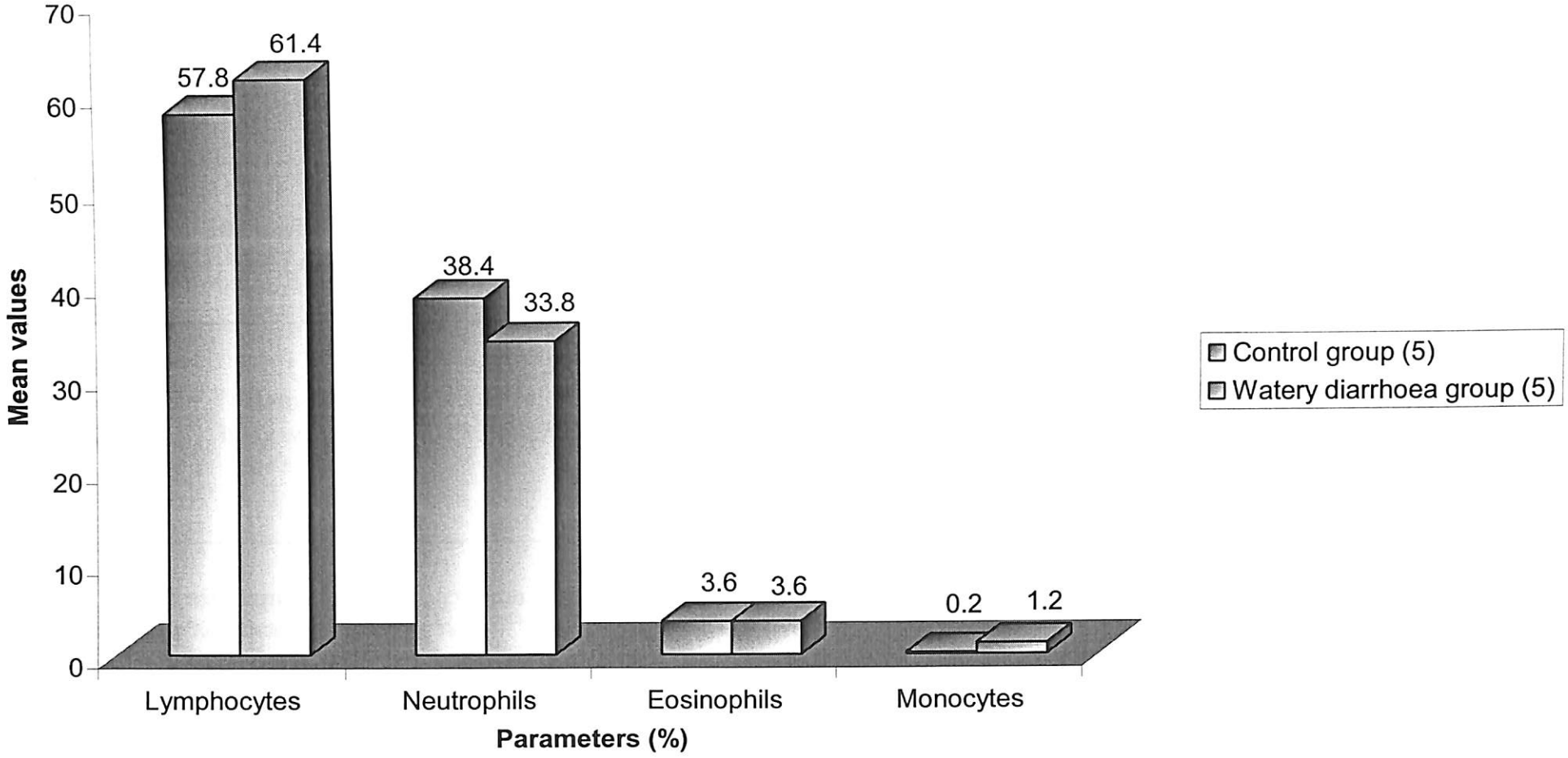


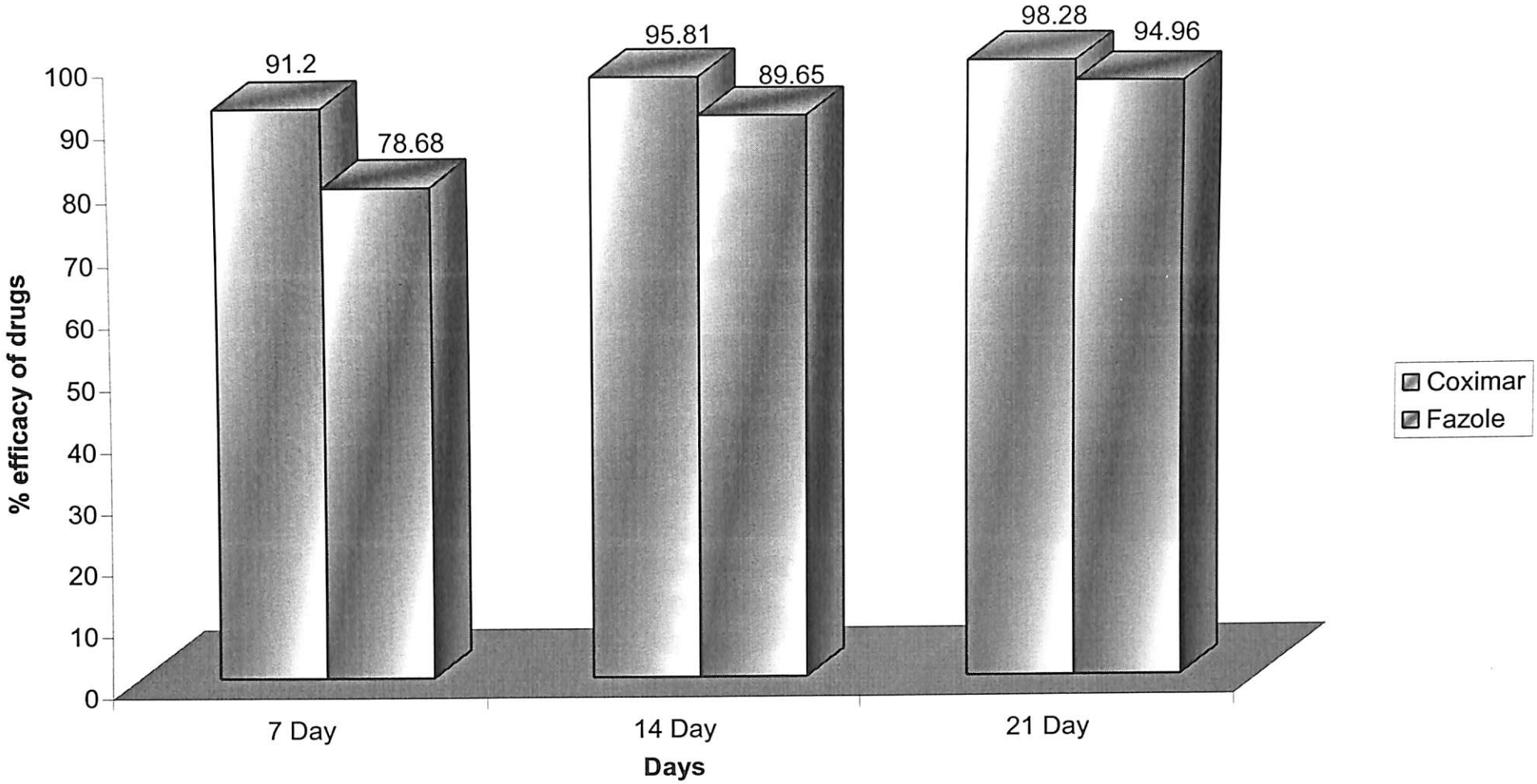
Table-20

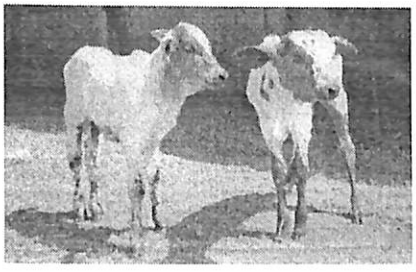
Efficacy of coximar and fazole against coccidiosis infected treated, infected untreated (control) bovine.

Gr.	Drugs used	Dose	Pretreatment	Average O.P.G of Faeces Post treatment (oocyst per gram)					
			0 day	7th day	% efficacy	14th day	% efficacy	21st day	% efficacy
I	Untreated Control (5) (c)		$9234.6^{a}\pm309.48$	$10840.8^{a}\pm148.21$	-	$11242.6^{a}\pm152.31$	-	$11286.4^{a}\pm149.68$	-
II	Coximar (5) (T_1) (Amprolium HCL 16.67% w/w and Sulphaquinoxaline 16.67% w/w)	100 mg/kg b.wt. for 7 days	$9203.6^{a}\pm788.87$	$809.8^{b}\pm127.97$	91.20	$385.4^{b}\pm71.23$	95.81	$157.6^{b}\pm41.01$	98.28
III	Fazole (5) (T_2) (1 Bolus = 1gm Metronidazole + 0.2gm Furazolidone)	1 Bolus/50kg body wt. b.i.d. for 5 days.	$9047.2^{a}\pm827.15$	$1928.8^{b}\pm195.29$	78.68	$935.6^{b}\pm148.39$	89.65	$455.2^{b}\pm107.32$	94.96

N.B. Mean values with same superscripts (column wise) do not differ significantly.
Superiority in % efficacy = T_1 %- T_2 % on 7th day 12.50%
on 14th day 6.16%
and on 21st day 3.32%

Fig. 17 : Histogram showing efficacy of Coximar and Fazole against coccidiosis in bovine.





CHAPTER - 5

DISCUSSION

DISCUSSION

PREVALENCE OF COCCIDIOSIS IN BOVINE:-

Coccidiosis is the major gastrointestinal protozoan disease which is often considered as devastating health hazard of bovine calves especially in absence of proper sanitation, nutrition and chemoprophylaxis. The global losses from coccidiosis have been reported by many researchers in dairy cattle by direct losses due to death, reduced productivity and morbidity. The present discussion incorporates the finding of the investigation entitled "Studies on bovine coccidiosis with special reference to chemoprophylaxis" in and around Patna.

The present study revealed overall 23.10% prevalence of coccidiosis among local bovine population of Patna, out of total 580 faecal and intestinal scraping examined, (Table-1). Sanyal *et al.* (1985), Hirani *et al.* (1999), Agnihotri (1993), Charan and Pawaiya (1997) and Nambiar and Devada (2002) reported 51.2% (Hisar), 7.86% (Anand), 10% (Pantnagar), 31.03% (Izatnagar) and 2.2% (Thrissur) prevalence of bovine coccidiosis respectively in various parts of the country. The prevalence rate varied from place to place because of geographical conditions, the stocking pattern of animals or animal husbandry practices, plane of nutrition, breed, immune status of the animals and climatic conditions etc. The present observation is also in concordance to the findings of Ali and Latif (1989), Mage *et al.* (1989), Oda and Nishida (1990) reported 31.5%, 21.9% and 59.0% prevalence of bovine coccidiosis respectively in Baghdad, France and Japan.

In the present study the prevalence of coccidiosis in buffaloes (25%) was found to be higher than cattle (20.76%) (Table - 2 and 3) however, the

difference was found to be statistically non-significant. These findings are similar to the findings of Bharkad *et al.* (1999) who reported 21.12% and 17.02% coccidiosis in buffaloes and cattle population respectively in Marathwada and findings of Muraleedharan (2005) in Karnataka too. Charan and Pawaiya (1997) observed 31.03% incidence of intestinal coccidiosis in buffalo calves, this again supports the observation of present investigation. Whereas, Pal *et al.* (2001) reported higher incidence rate of eimerian species in cattle than buffaloes in animals below 6 months of age in Chhattisgarh region which is in contrast to the present observation.

In present investigation {Table-1 (a)} majority of infections (87.05%) were subclinical and only 14.92% of infected animals showed clinical features of coccidiosis. Calves which passed more than 4,000 oocysts were having only the symptoms of diarrhoea whereas oocyst count in subclinical cases were found less than 4,000. Bhattacharya *et al.* (1998) noted oocyst count more than 2000 in clinical cases of coccidiosis which is very similar to the present observation. Boughton (1945) reported that 5000 to 10,000 oocysts/gm of faeces may occur in clinical coccidiosis. Gulegen and Okursoy (2000) noted mean OPG 7768 and 665 in cases of diarrhoea and for normal faeces respectively.

EFFECT OF SEASON ON THE PREVALENCE OF COCCIDIOSIS IN BOVINE:-

Studies on the effect of seasons revealed significant ($P<0.01$) variation, the highest infection was noted in monsoon (37.64% and 38.09%) followed by post-monsoon (20% and 23.9%), summer (16.6% and 16.17%) and winter (15% and 12.72%) season for cattle and buffaloes respectively (Table-4 and 5). Nambiar and Devada (2002), Singh and Agrawal (2003b)

and Muraleedharan (2005) observed the highest prevalence of coccidian infection in rainy season followed by summer and winter which support the results of present findings. The present observation is also in concordance to the findings of Ershaduzzaman *et al.* (1995) at village level in Bangladesh who noted significantly high coccidiosis in calves during rainy season. Higher coccidian infection in rainy season may be related to high humidity and temperature favour the easy sporulation of oocyst and also transmission of infection becomes conducive due to water logging and natural contamination. Nambiar and Devada (2002) suggested that the decreased immunotolerance in rainy season responsible for higher incidence of coccidiosis in rainy season. Karim *et al.* (1990) observed maximum prevalence of coccidiosis in wet month. However, Sanyal *et al.* (1985) recorded highest incidence of bovine coccidiosis in post-monsoon months followed by summer, rainy and winter season. In contrast to present findings, Khahra and Singh (1986) recorded highest infection in winter season and Hasbullah *et al.* (1990) recorded higher incidence in April to May and November to January than rainy season.

PREVALENCE OF COCCIDIOSIS IN DIFFERENT AGE GROUPS:-

The prevalence of coccidial infections in cattle and buffaloes were assessed in 5 different age groups (0-3 months, 3-6 months, 6-12 months, 1-2 years and >2 years). The influence of age was found to be highly significant ($P<0.01$). The maximum infection was found between 3-6 months of cattle and buffaloes 35.08% and 38% respectively, followed by 22.5% within the age group 0-3 months of cow calves and 30.66% among the age group 6-12 months of buffalo calves. The lowest infection rate was observed

in both cattle and buffaloes above 2 years of age, 7.14% and 8.33% respectively.

The present findings are similar to the reports of Singh and Agrawal (2003b), Agnihotri (1993), Tamsasaukas *et al.* (1998), Gulegen and Okursoy (2000), Nambiar and Devada (2002). Pal *et al.* (2001) also reported maximum morbidity due to coccidiosis in calves below one year which gradually decreased with the increasing age. Higher level of infection in neonatal calves (0-3 months) than older animals are also reported by Bharkad (1999), Charan and Pawaiya (1997), Mage *et al.* (1989), Bahirathan *et al.* (1995) as they observed maximum calf mortality from birth to 30 days whereas Sanyal *et al.* (1985), Ali and Latif (1989), Andrews (2002) and Pal *et al.* (2001) observed maximum prevalence of coccidiosis in calves from 15th day to 6 months of age. Oda and Nishida (1990) and Bejsovec (1991) found sustained calf mortality within 6 to 12 months. Ershaduzzaman *et al.* (1995) suggested that higher prevalence rate of coccidiosis in young calves due to low immunotolerance in young animals while older animals became gradually resistant due to repeated exposure to coccidial infection. Karim *et al.* (1990) marked that young age susceptibility was not largely affected by any season and recently affected calves always pass higher number of oocysts than older cases.

Table-6 and 7 revealed that maximum clinical infections due to bovine coccidiosis occur among the age of 0 to one year. Higher occurrence of coccidiosis in calves in this age group and its sharp decline with advancement of age reflects vulnerability of calves for this disease during early life. The neonatal nature of this disease might be related to physiological immaturity of calves born to poorly fed dams (Siegmund *et*

al., 1973). Inadequate feeding of colostrum, birth of calves in new and highly contaminated environment, over feeding, poor sanitation and impaired clotting ability of dam's milk were likely other predisposing factor for newly born calves (Yadav and Sharma, 1986).

EFFECT OF SEX ON THE PREVALENCE OF COCCIDIOSIS IN BOVINE:-

Influence of sex on the prevalence of coccidiosis in cattle and buffaloes was however found to be non-significant in the present investigation but female were carrying higher rate of infection both in case of cattle and buffaloes (Table-9 and 10). This is in accordance with the observation of Nambiar and Devada (2002) and Sanyal *et al.* (1985). Since female calves undergo many hormonal changes, this might make them susceptible towards this disease. But in contrast to this finding, Ershaduzzaman *et al.* (1995) and Ali & Latif (1989) found non-significantly higher rate of infection in male calves than in females which substantiated and attributed to better husbandry practice for female calves than the males.

EFFECT OF MANAGEMENTAL CONDITION ON THE PREVALENCE OF COCCIDIOSIS IN BOVINE:-

In the present investigation prevalence of coccidiosis in calves managed under farm condition and free ranging (stallfed + grazing, totally grazing) was determined from total 260 and 320 samples of cattle and buffaloes respectively in local area of Patna and its surrounding areas. The results of the studies indicate significant influence of managemental conditions ($P<0.01$) as cattle managed under farms were more susceptible than free range animals. This may be due to over crowding and lack of

preventive and curative anti-coccidial measures in this region. Ershaduzzaman *et al.* (1995) assumed that over crowding, lack of individual care, moisture, dampness, temperature fluctuations and precipitation of faeces in floor might be the cause of higher incidence in farm level. Further, bedding provides enough warmth and moisture for sporulation and transmission of oocysts. Mage and Reynal (1993), Cerqueira (1989) and Hasbullah *et al.* (1990) reported higher prevalence in housed and suckling calves as most of the calves were kept in closed vicinity. But the result of the prevalence of coccidiosis in buffaloes were found to be in contrary to cattle population as significant higher percentage of infection was observed in buffaloes managed in free range conditions than farm conditions. It may be due to the most of the marginal and poor farmers prefer buffaloes rearing and they mostly depend upon the open grazing and rarely provide any medication or preventive or hygiene measures. Further dwelling nature of buffaloes in dirty water pools also increases the chances of transmission. This finding of this study is also supported by Grommes (1996), Bejsovec (1991), Hayat *et al.* (1994) and Kurkela *et al.* (2000) as they reported higher percentage of infection (92.7% to 100%) in free grazing system.

IDENTIFICATION OF SPECIES OF BOVINE COCCIDIOSIS DURING CLINICAL AND SUBCLINICAL CONDITIONS:-

The occurrence of various eimerian species of bovine coccidiosis resulted in variable degree of mortality and morbidity. As coccidiosis is the five most economically important intestinal diseases in the cattle industry, the studies and reports on prevalence of various eimerian species have been reported by various scientists in different parts of countries. Prevalence of 12 eimerian species during bovine coccidiosis has been reported by Bhatia *et*

al. (1968) and Ruprah (1985) in India. In present investigation, out of total 134 positive cases for coccidiosis, a total of 4 species were identified. The maximum prevalent species was *E. zuernii* (62%) followed by *E. bovis* (45%) and these two species were also prevalent in all clinical cases. Mage *et al.* (1989) also reported presence of *E. zuernii* and *E. bovis* in all haemorrhagic diarrhoeic cases and Bejsovec (1991) and Peralta *et al.* (1994) found *E. bovis* and *E. zuernii* to be the most frequent species in clinical cases. These findings are similar to the present findings. Rudetskii (1989) showed that *E. zuernii* was involved in acute cases of coccidiosis. Apart from *E. bovis* and *E. zuernii,* the other species investigated in present finding were *E.ellipsoidalis* (40%), *E. subspherica* (10%). All these species were prevalent only in subclinical cases. However in India, Sanyal *et al.* (1985) reported maximum prevalence of *E. bareillyi* in buffalo calves of Haryana out of 12 species. Singh and Agrawal (2003b) noted 15.55% incidence of *E. bovis* in Mathura followed by *E. zuernii, E. ellipsoidalis, E. subspherica, E. wyomingensis, E. alabamensis, E. canadensis, E. bareillyi, E. cylindrica*. Charan and Pawaiya (1997) found most prevalent species to be *E. bareillyi* in buffalo calves in winter coccidiosis which is unlike to present finding. Bhattacharya *et al.* (1998) reported prevalence of *E. bovis, E. zuernii* and *E. subspherica* among cattle at Bengal, which is similar to the findings of the present study.

Nambiar and Devada (2002) observed 8 species of *Eimeria* in Thrissur including all 4 species of present finding with maximum prevalence of *E. zuernii* and *E. bovis* in bovine calves. Sani and Chandrawthani (1987) reported prevalence of *E. bovis, E. cylindrica* and *E. subspherica* in acute and subacute cases of coccidiosis. In Bangladesh, Ershaduzzaman *et al.*

(1995) and Karim *et al.* (1990) noted prevalence of 6 different species of coccidia at village and farm levels. As per former report *E. bovis* and *E. zuernii* were found to be positive in more than 34 to 41% cases whereas *E. alabamensis*, *E. auburnensis, E. cylindrica, E. subspherica* were found to range from 20 to 30%. Roate and Bhagwat (1990) did not find the prevalence of *E. zuernii* in their findings but reported the prevalence of *E. bovis, E. ellipsoidalis, E. alabamensis, E. bukidnonensis, E. cylindrica* and *E. subspherica.*

Similar to the present findings most frequent *Eimeria* species of bovine coccidiosis were *E. zuernii* and *E. bovis* in Argentina (Rossanigo 1997), *E. zuernii* in Cuba (Rodriguez *et al.*, 1988), *E. bovis, E. zuernii, E. ellipsoidalis, E. cylindrica, E. auburnensis* in Kenya (Munyua and Ngotho, 1990), *E. bovis* and *E. zuernii* in France (Mage *et al.*, 1990). In USA and Australia *E. bovis* has been reported to be the most prevalent species with *E. ellipsoidalis* and *E. zuernii* by Fitzgerald and Mansfield (1989) and Parker and Jones (1990) respectively. But Grafner (1989), Snoep and Potters (2004) and Svensson and Olofasson (1996) reported that *E. alabamensis* was the causative agent of bovine coccidiosis in Germany, Neatherland and Sweden respectively which is in contrast to the findings of the present study.

In our neighbour country China, Zhang *et al.* (2000) recorded 13 eimerian species out of which *E. ellipsoidalis* was found to be the most predominant species followed by *E. illinoisensis, E. auburnensis, E. canadensis, E. bovis, E. zuernii, E. bomboyensis, E. cylindrica, E. subspherica* and *E. wyomingensis* whereas in Japan Sarashina *et al.* (1998) reported the dominance of *E. bovis* and *E. zuernii*. Bhatia *et al.* (1971) and

Shastri *et al.* (1974) isolated *E. bareillyi* from the cases of coccidiosis in buffalo calves but it was not dected in present study.

MORPHOMETRY AND SPORULATION TIME OF DIFFERENT SPECIES OF *EIMERIA* IN LOCAL BOVINE CALVES:-

Table – 14 revealed the morphological variability of eimerian oocysts from faecal samples of calves. The speciation was carried out on the basis of micrometry and the images based on camera lucida diagrams. Differences of species were determined by shape index, sporulation time, shape of oocyst and sporocyst, presence of micropyle and polarcap.

MORPHOLOGICAL STUDIES AND SPORULATION TIME:-

Eimeria bovis – The morphological studies of *E. bovis* revealed that maximum sporulation time was 80-96 hrs. and shape of oocyst was ovoidal with presence of micropyle and absence of polarcap. The oocyst contained elongated-ovoidal sporocysts. The mean oocyst size was 25.76 µm x 19.02 µm. The shape and size and other description confirms with the description given by Ruprah (1985), Kaufmann (1996), Bhatia, (2000) and Nambiar and Devada (2002). Sporulation time was also in line with finding of Nambiar and Devada (2000), Bhatia (2000) but Ruprah (1985) reported that maximum sporulation achieved in 2-3 days of *E. bovis* (Table-13 and 14).

Eimeria zuernii – Table – 13 and 14 depicted the shape, size and sporulation time of *E. zuernii*. Ruprah (1985), Bhatia (2000), Nambiar and Devada (2000) have also observed the absence of micropyle, polarcap and spherical to ovoidal shape of oocysts of *E. zuernii*. Size of this oocyst (15.42 µm x 14.1 µm) also ranged within the limits described by them. Maximum sporulation in present study reached within 72-90 hrs. Nambiar and Devada

(2002) also noted similar observation with 3-4 days but Ruprah described maximum sporulation with 40 hrs. at 25^0C.

Eimeria ellipsoidalis – The oocysts of *E. ellipsoidalis* were ellipsoidal and devoid of polarcap but micropyle was present and measurement was 17.64 µm x 14.26 µm. The shape of sporocyst was elongated ovoidal. Similar morphological characters were also described by Nambiar and Devada (2000), Bhatia (2000) and Ruprah (1985). The observation of sporulation time was 80-96 hrs., which is also supported by Bhatia (2000) and Nambiar and Devada (2000) but Ruprah (1985) described maximum sporulation within 2-3 days (Table-13 and 14).

Eimeria subspherica – Morphological characters of *E. subspherica* has been described by Nambiar and Devada (2002), Ruprah (1985), Bhatia (2000) which also in close similarity with present description depicted in Table-13 and 14.

HAEMATOLOGICAL OBSERVATION:-

The diagnosis of coccidiosis is generally made by observing oocyst in faeces and intestinal scraping but haematological changes may help in making diagnosis as well as in the assessment of disease severity.

The haematological findings observed in the present study are depicted in Table-16, 17, 18 and 19. It was observed that in case of bloody diarrhoea haemoglobin percentage, total erythrocyte count and packed cell volume decreased significantly ($P<0.05$) than control, which may be attributed to the tissue damage and consequent blood loss in faeces. Bhatia (2000) described that main lesions of *E.zuernii* were in large intestine in the form of extensive sloughing of mucosa and petechial haemorrhage, which might be the cause of blood loss and consequently anaemic condition. The

present observations are in close similarity to Al-Farwachi (2000), who noted decreased mean values of PCV and Hb concentration with leucocytosis. Gasmir *et al.* (1997) observed marked anaemia and leucocytosis in experimentally infected bovine coccidiosis, which is in close resemblance with present findings but they also observed increase in PCV value and RBC count which are contrary to the present observation.

Akimaru (1986) observed that experimental coccidian infection in calves had no effect on haematological values. Fitzgerald and Mansfield (1972) demonstrated alterations in PCV and Hb value in severely affected calves with bovine coccidiosis but changes were found to be non-significant. This was related with the fluid loss which compensated with supplementation of water and mineral. Holst and Svensson (1994) reported the small but non-significant changes in haematology in calves infected with *E. alabamensis* and concluded that the potential of the haematology as diagnostic marker has minimal effect.

Haematological changes of watery diarrhoea group did not show any significant changes.

The result of differential leucocyte count (DLC) in watery diarrhoea group revealed significant ($P<0.05$) increased monocyte count in infected animals. In bloody diarrhoea group values of eosinophil and monocyte count increased non-significantly whereas neutrophil count decreased non-significantly. Al-Farwachi (2000) reported lymphocytosis, eosinophilia and neutropenia in bovine coccidiosis which is in accordance with the present study.

CHEMOTHERAPEUTIC STUDIES:-

Fifteen randomly selected bovine calves naturally infected with coccidiosis and with clinical feature of bloody and watery diarrhoea were taken into account for this study. The calves were divided into three groups viz. control, Coximar treated and Fazole treated groups. The Coximar which constituted Sulphaquinoxaline 16.67 w/w and Amprolium 16.67 w/w were administered with drinking water @ 100 mg/kg b.wt. for seven days and Fazole, the combination of Metronidazole 1 gram and 0.2 gram Furazolidone in one bolus was given @ 1 bolus/50 kg. b. wt.b.i.d. for 5 days.

The efficacies of the drugs were estimated on the basis of declining rate of O.P.G. on 7^{th}, 14^{th} & 21^{st} days of post-treatment. It was observed that efficacy of Coximar and Fazole 91.20% and 78.68% on 7^{th} post-treatment day respectively gradually increased to 95.81% and 89.65% on 14^{th} day and 98.28% and 94.96% on 21^{st} day respectively after treatment (Table-20). The superiority of efficacy of Coximar of was found on all the days of observation over Fazole. The Coximar was found to be more suitable than Fazole in the present investigation.

Singh and Agrawal (2003a) tried Amprolsol @ 100mg/kg b.wt. for 7 days in buffalo calves and found 100% effectiveness for the coccidian infection. Mage and Reynal (1993) found 63% efficacy of either Amprolium or Sulphadimethoxine in calves suffering from coccidiosis. Amprolium @ 10 mg/kg b.wt. for 10 days used for protection and treatment of clinical coccidiosis in calves was found to be effective as reported by Stockdale and Sheard (1982). This treatment was also effective for built up resistance to reinfection upto 35 days after initial inoculation. Cerqueira *et al.* (1989)

used Amprolium @ 5mg/kg b.wt. with mineral mixture for 90 days and found significantly lower oocyst count for calf coccidiosis.

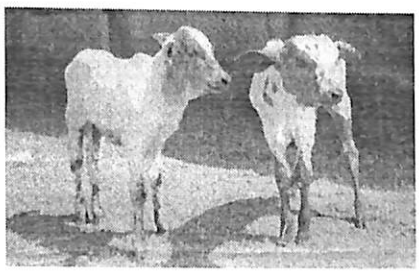
Grafher (1989) successfully controlled coccidiosis of young grazing cattle with Sulphaquinoxaline. Suresh *et al.* (1990) successfully treated a case of bovine coccidiosis with Sulphadimidine @ 200 mg/kg b.wt. daily for 5 days. Dzerzhinskii (1987) successfully treated bovine coccidiosis with Sulphadimethoxine @ 50 mg/kg b.wt. and Chimcoccid-7 @ 300 mg/kg b.wt. to naturally infected calves for 7 consecutive days. Khahra *et al.* (1983) injected Sulphadimidine sodium @ 125 mg/kg b.wt. first i/v then i/m for 4 days against experimental coccidiosis and found it slightly more effective than Amprolium @ 20 mg/kg given by mouth for 7 days.

Alfanso *et al.* (1980) observed that Metronidazole @ 50 to 70 mg/kg b.wt. to be more effective than Sulphadimidine for reduction of oocyst count in calf coccidiosis. Kumar (2003) found 95% efficacy of Fazole for control of coccidiosis in goats. Zhang and Xue (1990) and Lochkarev (1993) reported efficacy of Metronidazole against coccidiosis in various animals.

On the basis of present study and literature available it can be concluded that effective parasite control with administration of Sulfa drugs and Amprolium in early stress period of coccidian infection and its long term control effectively and significantly decrease the number of oocysts excretion into the environment and consequently decrease incidence of coccidiosis. Coximar has been successfully evaluated against poultry and since the manufacturers have recommended this drug for cattle also, this preliminary trial was conducted and the results indicate that Coximar can successfully be used for control and treatment of bovine coccidiosis. However, side effects of both the drugs are required to be evaluated before

recommendation for field application. Further more in future, combination of the compounds in both the drugs may also be a solution to counteract drug resistance problem against coccidiosis which requires confirmation.

****



CHAPTER - 6

SUMMARY AND CONCLUSION

SUMMARY & CONCLUSION

SUMMARY

Parasitic infections are severe constraints to livestock productivity. The prevalence of coccidiosis in cattle and buffaloes has been documented in various parts of the country and information from Bihar State however, seems to be scanty. The present study was, therefore, undertaken to elucidate the prevalence of coccidiosis in cattle and buffaloes in Patna and its surrounding areas. The occurrence of various eimerian species in cattle and buffaloes has also been identified to give a detail account of bovine coccidiosis with reference to haematological changes and the efficacies of combination drugs Coximar (Sulphaquinoxaline and Amprolium) and Fazole (Metronidazole and Furazolidone).

The observations on the incidence were carried out in four seasons, monsoon (June-August), post-monsoon (September-November), winter (December-February) and summer (March-May), during a year long period June 2005 to May 2006. 562 faecal samples of cattle and buffaloes grouped in various range of age groups from 0 to 2 years and above were collected and similarly 18 intestinal scrapings were also collected from local slaughter houses of Patna and its surrounding areas. The prevalence of coccidiosis was 23.1% in local cattle and buffaloes population and majority of 85.07% cases were grouped as subclinical bovine coccidiosis. This study was carried out on the basis of oocysts per gram of faeces. Similarly 14.92% samples were recognized as the cases of clinical coccidiosis with more than 4000 oocysts count per gram of faeces carrying the symptoms of bloody and watery diarrhoea, dehydration, anaemia and depression etc. Out of total sample

examined, the prevalence was found to be non-significant between cattle and buffaloes, but the degree of infection was lower (20.76%) in cattle in comparison to buffaloes (25%).

The seasonal prevalence of coccidiosis was found to be the highest during monsoon season 37.64% and 38.09% for cattle and buffaloes respectively followed by post-monsoon (20% and 23.9%) and the lowest (15% and 12.72%) in winter season. The influence of season on the prevalence of coccidiosis was found to be highly significant ($P<0.01$).

The influence of age on the incidence of coccidiosis was found to be highly significant ($P<0.01$) both in cattle and buffaloes population. The highest incidence was noted among 3 to 6 months old cow calves (35.08%) and buffalo calves (37.5%) followed by 6-12 months (22% and 30.66%) and 0-3 months (22.5% and 21.81%) respectively. Most of the clinical cases of coccidiosis found within the age group of 3-6 months old calves. Whereas calves older than 6 months of age were quite resistant and the infection was noted mostly in subclinical form.

The influence of sex was found to be non-significant in both cattle and buffaloes.

The incidence of coccidiosis in cattle was higher (28.33%) in animals managed under farm condition than free ranged condition (14.28%). But in buffaloes it was vice-versa as buffaloes managed under free ranged were more (32%) infected than farm condition (18.82%).

As per the morphological characteristic viz shape of oocyst, shape of sporocyst, presence or absence of micropyle and polar cap, size of oocyst and sporulation time, there were four species of *Eimeria* isolated from local bovine calves viz: *Eimeria zuernii, Eimeria bovis, Eimeria ellipsoidalis and*

Eimeria subspherica. Mixed infections were encountered in most of the samples. *Eimeria bovis and Eimeria zuernii* were found in all clinical cases. Other species were prevalent in subclinical form of infection.

Studies on haematological changes were carried out in 10 calves with clinical symptoms of bloody or watery diarrhoea. The studies revealed that in calves suffering from bloody diarrhoea, the anaemia was most prominent as Hb%, TEC and PCV were significantly reduced. Whereas, haematological changes were found to be non-significant in calves having symptoms of watery diarrhoea.

The efficacy of Coximar (100mg/kg. b. wt. for 7 days) and Fazole (1 bolus/50 kg b.wt. b.i.d. for 5 days) were tested on naturally infected calves with clinical coccidiosis by counting the average number of oocysts per gram (O.P.G) in faeces. Coximar which is a combination drug of Amprolium and Sulphaquinoxaline has been supposed to be an anticoccidiostat of poultry was proven to be better than Fazole which is also a combination drug of Metronidazole and Furazolidone. The superiority of efficacy of Coximar was found to be 12.50%, 6.16% and 3.32% on 7^{th}, 14^{th}, 21^{st} post-treatment day respectively. The overall efficacy of Coximar and Fazole at 21^{st} day of post-treatment were found 98.28% and 94.96% respectively. This showed that both Coximar and Fazole were quite effective in treating the coccidiosis in cattle and buffaloes but Coximar was comparatively more effective than Fazole.

CONCLUSION

1. The studies on bovine coccidiosis in cattle and buffaloes population among Patna and its surrounding areas indicated that coccidiosis adversely influences the successful performance of these animals. It was found to be one of the important causes of enteritis and bloody diarrhoea among calves leading to dehydration, weight loss, anaemia and under performance. Therefore, in present study, prevalence of coccidiosis, identification of eimerian species among local bovine population including clinical manifestation, haematological changes and control trial against coccidiosis were done for monitoring and chemoprophylaxis.

2. To study the prevalence of coccidiosis among general population of cattle and buffaloes in and around Patna, 562 faecal samples and 18 intestinal scrapings were randomly collected. However overall prevalence was found to be non-significant between cattle and buffaloes. But the percentage of infection was 20.76 % and 25% among cattle and buffaloes respectively.

3. *E. bovis, E. zuernii, E. ellipsoidalis, E. subspherica* are the most prevalent species of coccidiosis among bovine population in and around Patna. *E. bovis* and *E. zuernii* were found to be most pathogenic among calves as these were present in most of the clinical cases. Bovine coccidiosis was seen most frequently in calves among 3 to 12 months of age and it is mostly prevalent in monsoon. The majority of infections were found asymptomatic but maximum animals shed oocysts in their manure.

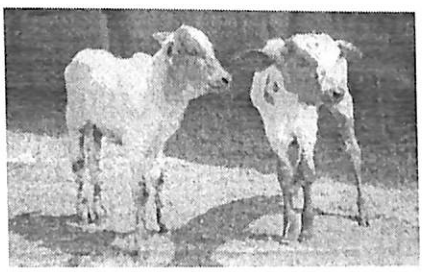
4. In terms of haematological parameters studied, it was clear that coccidiosis is pathogenic enough to cause significant metabolic

derangements and anaemia in calves which severely affect the growth rate of calves which in turn may narrow down the profit.

5. Coximar (Amprolium + Sulphaquinoxaline) and Fazole (Metronidazole + Furazolidone) were found to be more than 90 percent effective for the treatment of coccidiosis. In term of efficacy Coximar was proven to be better than Fazole.

Therefore, early treatment of infection and a strategic plan of preventive management could offer the best way to reduce losses due to bovine coccidiosis. The result of the present investigation showed that both Coximar and Fazole are highly effective for control of coccidiosis. However side effects of both the drugs are required to be evaluated before recommendation for field application.

****



CHAPTER - 7

BIBLIOGRAPHY

BIBLIOGRAPHY

Agnihotri, R.K. (1993). Prevalence of intestinal nematodes and coccidia in buffalo-calves in Tarai region of Western Uttar Pradesh. *Indian Vet. Med. J.*, **17** : 126-129.

Akimaru, M. (1986). Haematology of calves infected with *Eimeria bovis*. *Inaugural-Dissertation, Tieraztliche Hochschule Hannover., pp.96.*

Alfanso, H.A., Marrero, E., Blandino, T. and Gomez, E. (1980). Use of Metronidazole in coccidiosis of calves. *Revista de Salaud Anim.*, **2** : 91-100.

Al-Farwachi, M.I. (2000). Occurrence of internal parasites in cattle, Mosul, Iraq. *Iraqi J. Vet. Sci.*, **13 :** 1, 187-191.

Ali, S.R. and Latif, B.M.A. (1989). Bovine coccidiosis in Baghdad area, Iraq. *Magallat-Buhut-Ulum-Al-Hayat- Journal- of- Biological Science-Research*. **20** : 3, 483-488.

Andrews, T. (2002). UK coccidiosis survey in calves. *Veterinary Times.*, **32** (34) : 22.

Bahirathan, M., Weilgama, D.J., Wigesundera, M.K. S.de. and Miller, J.E. (1995). Prevalence and abundance of eimerian oocysts in buffalo calves on a farm in SriLanka. *Buffalo. J.*, **11** (2) : 183-191.

Bejsovec, J. (1991). Permanent transmission of endodparasites in large herds of cattle. *Acta-Veterinaria-Brno.*, **60** (2) : 205-212.

Bharkad, G.P., Deshpande, P.D. and Narladkar, B.W. (1999). Gastrointestinal Parasitosis in bovine calves in Marathwada. *J. Vet. Parasitol.*, **13** (2) : 143-146.

Bhatia, B.B. (2000). Text book of veterinary protozoology. *Indian Council of Agricultural Research (New Delhi).*, pp – 109-126.

Bhatia, B.B., Pande, B.P., Chauhan, P.P.S. and Arora, G.S. (1968). A study of the sporulated oocysts of twelve eimerian species in Indian buffalo (*Bubalis bubalis*). *Acta Veterinaria Academiae of Scientiarum*, **18** : 115-133.

Bhatia, B.B., Pande, B.P., Chauhan, P.P.S. and Garg, R.K. (1971). Additional notes on the asexual stages in eimerian lesions of a buffalo calf. *Indian J. Ani. Sci.*, **4** : 549-54.

Bhattacharya, D., Sikdar, A., Roy, P.K., Ghosh, A. and Mishra, R.K. (1998). Coccidiosis amongst calves. I. A relation between oocysts per gram faeces and faecal consistency. *Indian J. Anim. Sci.*, **68** (11) : 1130-1131.

Boughton, D.C. (1945). Bovine coccidiosis. From carrier to clinical cases. *North American Veterinarian.*, **26** : 147-153.

Cerqueira, M.M.O.P., Lima, J.D. and Facury filho, E.J. (1989). Control of coccidiosis in extensively managed cattle by continuous administration of anticoccidial (Amprolium) in the mineral mixture. *Arquivo Brasileiro de Medicina Veterinaria e Zootecnia.*, **41** (6) : 483-492.

Charan, K. and Pawaiya, R.V.S. (1997). Coccidiosis in buffalo calves. *Indian Vet. Med. J.*, **21** : 154-156.

Cornelissen, A.W.C.A., Verstegen, R., Brand. H. Van. den., Peri, N.M., Eysker, M., Lam. T.J.G.M. and Pijpers. A. (1995). An observational study of *Eimeria* species in housed cattle on Dutch dairy farms. *Vet. Parasitol.*, **56** (1/3) : 7-16.

Dzerzhinskii, V.A. (1987). The use of Sulphadimethoxine and Chimcoccid-7 against bovine *Eimeria*. *Veterinariya, Moscow, USSR.*, **4** : 46-47.

Ershaduzzaman, M., Chowdhury, S. M. Z. H., Hug, M.M., Rahman, M.F., Mondal, M.M.H. and Karim, M.J. (1995). Prevalence of coccidia in calves at village and farm levels of Bangladesh. *Indian Vet. Med. J.*, **19** : 51-55.

Fitzgerald P.R. (1972). The economics of bovine coccidiosis. *Feedstuffs.*, **4** : 28.

Fitzgerald, P.R. and Mansfield, M.E. (1972). Effects of bovine coccidiosis on certain blood components, feed consumption and body weight changes of calves. *American J. Vet. Res.*, **33** : 7, 1391-1397.

Fitzgerald, P.R. and Mansfield, M.E. (1989). Effects of intermittent and continuous administration of Decoquinate on bovine coccidiosis in male calves. *American J. Vet. Res.*, **50** (6) : 961-964.

Gasmir, G.S., Osman, A.Y., El-Amin-EA. and zakia, A.M. (1997). Pathological changes of bovine coccidiosis in experimentally infected zebu calves. *Sudan J. Vet. Res.*, **15** : 49-55.

Godara, R. and Manohar, G.S. (2004). Prevalence of gastro-intestinal parasitism in different breeds of cattle of Rajasthan. *Indian Vet. Med. J.* **28** : 74.

Grafner, G. (1989). Present distribution, importance and control of parasitoses of grazing cattle in the GDR. *Monatshefte-fur-veterinarmedizin.*, **44** : 13, 435-437.

Grommes, H.G. (1996). Epidemiological study of *Eimeria* infections among grazing calves. *Fachbereich Veterinarmedizin, Justus-Liebig-Universitat, Giessen, Germany.*, PP.91.

Gulegen, A.E. and Okursoy, S. (2000). Coccidia species and their prevalence in cattle in the Province of Bursa. *Turkiye-Parazitoloji-Dergisi.*, **24** (3) : 297-303.

Hasbullah., Akiba, Y., Takano, H. and Ogimoto, K. (1990). Seasonal distribution of bovine coccidia in beef cattle herd in the University farm. *Japanese J. Vet. Sci.*, **52** (6) : 1175-1179.

Hasbullah., Itahana, H., Uchida, T., Inamoto, T., Nakai, Y. and Ogimoto, K. (1996). Medication of feed lot calves infected with *Eimeria* spp by a combination of Sulphamonomethoxine and Ormetoprim. *J. Vet. Med. Sci.*, **58** : 2, 169-170.

Hayat, C.S., Rukn-ud-Din., Hayat, B., and Akhtar, M. (1994). Prevalence of coccidiosis in cattle and buffaloes with emphasis on age, breed, sex season and management. *Pakistan Vet. J.*,**14** (4) : 214-217.

Hirani, S.D., Katariya, M.A., Patel, Abdullah., Hasnani, J.J., Kathiria, L.G. and Patel, P.V. (1999). Prevalence of Gastrointestinal Parasitic infections in cattle and buffaloes of Kheda district of Gujarat. J.Vet. Parasitol., **13** (2) : 147-149.

Holst, H. and Svensson, C. (1994). Changes in the blood composition of calves during experimental and natural infections with *Eimeria alabamensis*. *Res. Vet. Sci.*, **57** : 3, 377-383.

Kambarage, D.M., Kimera, S.I., Kusiluka, L.J.M. and Mtambo, M.M.A. (1996). Prevalence of *Eimeria* and *cryptosporidium* oocysts in cattle, sheep and goats in Morogoro region, Tanzania. *J.-of-Applied-Anim.Res.*, **9** : 1, 73-78.

Karim, M.J., Begum, N. and Rahman, M.H. (1990). Age susceptibility and seasonal dynamics of coccidiosis in cattle and sheep. *Bangladesh-Veterinarian.*, **7** : 1, 22-26.

Kaufmann, J. (1996). Parasitic infections of Domestic animals. *Birkhauser Verlag Basel Bosten, Berlin.*, pp-146-148.

Khahra, S.S., Choudhuri, P.C. and Singh, J. (1983). Therapy of experimental coccidiosis in buffalo calves (*Bubalus bubalis*). *Indian J. Vet. Med.*, 3 (1) : 42-48.

Kollmann, D. (1993). *Eimeria* infections in cows and their calves during the Periparturient Phase. *Inaugural-Dissertation, Veterindremedizin, Justus-Liebig-Universi' tdi, Giessen, Germany.*, PP.150.

Khahra, S.S. and Singh, J. (1986). Coccidiosis in buffalo-calves and its treatment. *Buffalo Bulletin.*, **5** (1) : 9-16.

Kumar, L. (2003). Studies on coccidiosis in goats with special reference to chemotherapy. M.V.Sc. Thesis, Bihar Veterinary College, Rajendra Agricultural University, Bihar. Pp - 25-106.

Kurkela, V., Salmela, P., Rautala, H. and Pyorala, S. (2000). Bovine coccidiosis-a literature review and study of prevalence of coccidiosis in finnish calves. *Suomen-Elainlaakarilehti.*, **106** : 6, 364-371.

Levine, N.D. (1985). Veterinary Protozoology. *Iowa State University Press. Ames.*, pp 414.

Lochkarev-V-A. (1993). Treatment of coccidiosis in nutria. *Veterinariay-Moskva.*, **3** : 12.

Maddox-Hyttel, C. and Vestergaard, E.M. (2003). Coccidiosis in cattle : an outline of coccidium species, pathogenesis, epidemiology and

prevention especially in organic herds. *DJF-Rapport-Husdyrbrug.*, **(56)** : 47.

Mage, C. and Reynal, P. (1993). Epidemiology of coccidiosis on beef cattle farms. *Bulletin-des-G. T.V.*, **1** : 43-51.

Mage, C., Reynal, P. and Chasteloux, C. (1990). Coccidiosis in suckled Limousin calves. *Revue-de-Medicine-veterinaire.*, **141** : 8-9, 671-676.

Mage, C., Reynal, P. and Yvore, P. (1989). Epidemiological observations of coccidiosis in suckler calves in France. *Coccidia and intestinal coccidiomorphs Proceedings of the 5th international coccidiosis conference, Tours (France),* 49.

Mage, C., Very, P., Selze, J.C., Bouchant, C. and Hugon, J.C. (1997). Prevention of coccidiosis in suckling charolais calves. *Bulletin-des G.T.V.*, **1** : 51-55.

Mahajan, S.K., Chhabra, M.B. and Jain, A.K. (1985). Clinico-pathological observations on *Eimeria bareillyi* coccidiosis in buffalo calves. *Cheiron.*, **14** (5) : 275-277.

Munyua, W.K. and Ngotho, J.W. (1990). Prevalence of *Eimeria* species in cattle in Kenya. *Vet. Parasitol.*, **35** : 1-2, 163-168.

Muraleedharan, K. (2005). Prevalence of gastrointestinal parasites of livestock in a central dry zone of Karnataka. *J. Vet. Parasitol.*, **19** (1) : 31-33.

Nambiar, K.S. and Devada, K. (2002). Prevalence of bovine coccidiosis in Thrissur. *Indian Vet. Med. J.*, **26** : 211-214.

Oda, K. and Nishida, Y. (1990). Prevalence and distribution of bovine coccidia in Japan. *Japanese J. Vet. Sci.*, **52 :1,** 71-77.

Pal, S., Roy, S. and Pathak, A.K. (2001). Prevalence of gastro-intestinal parasites in cattle and buffaloes from Chhattisgarh region. *J. Vet. Parasitol.*, **15** (2) : 155-156.

Parker, R.J. and Jones, G.W. (1990). Destruction of bovine coccidial oocysts in stimulated cattle yards by dry tropical winter weather. *Vet. Parasitol.*, **35** : 2, 269-272.

Patnaik, M.M. (1965). On the coccidian infection of buffalo calves. A study of oocysts. *Agra Univ. J. Res. Sci.*, **13** : 239-256.

Peralta, J.R., Bertoliono, A. and Guglielmone-G. (1994). The prevalence of coccidial oocysts in faeces of artificially reared calves. *Veterinaria-Argentina.*, **11** : 105, 322-324, 326.

Pilarczyk, B. and Balicka-Ramisz, A. (2004). Prevalence of *Eimeria* and *cryptosporidium* in calves in Western Pomerania. *Acta-Scientiarum-Polonorum-Zootechnika.*, **3** (1) : 49-56.

Quijada, T., Lopez, G., Marchan, V. and Jimenez, M. (2002). Coccidiosis in lactating calves at Moroturo Country, Urdaneta Municipality. Lara state. *XI Congreso Venezolano de Production e industria Animal, Valera, Venezuela.*, **2** : 599-600.

Ramirez, A.D. de., Angel, J.J., Gonzalez, M., Fernandez, E.P. and Iglesia, L.R. (1998). Prevalence of coccidiosis in cattle in Los Lianos de Monay, Trujillo State, Venezuela. *Revista-Cientifica,-Facultad-de-Ciencia-Veterinarias,- Universidad-de-zulia.*, **8** (4) : 346-353.

Roate, Y.V. and Bhagwat, S.S. (1990). A note on prevalence of coccidian of cattle in Akola region. *PKV Res. J.*, **14** (1) : 95-96.

Rodriguez, N., Percedo, M.I. and Fustes, E. (1988). Winter coccidiosis caused by *Eimeria zuernii*. *Rivista-cubana-de-ciencias-veterinarias.*, **19** : 2, 93-98.

Rossanigo, C. (1997). Clinical post weaning bovine coccidiosis in extensive rearing farms in the province of San Luis, Argentina. *Revista-de-Medicina-Veterinaria-Buenos-Aires.*, **78** (6) : 377-379.

Rudetskii, L.A. (1989). Calf coccidiosis. clinical and epidemiological features, treatment and prevention. *Veterinariya (Moskva).*, **11** : 51-52.

Ruprah, N.S. (1985). A test book of clinical protozoology, Oxonian Press Pvt. Ltd. (New Delhi)., pp. 199-202.

Sani, R.A. and Chandrawathani, P. (1987). Coccidia of buffalo calves. *Tropical-Biomedicine.*, **4** : 2, 190-191.

Sanyal, P.K., Ruprah, N.S. and Chhabra, M.B. (1985). Incidence of bubaline coccidia at Hisar, Haryana. *Indian Vet. Med. J.* **9** : 120-122.

Sarashina, T., Uzuka, Y., Park, S., Takeuchi, M., Ishii, M., Koyama, A., Sekiguchi, T., Yoshioka, T., Itahana, H. and Sawano, R. (1998). Effects of Sulphamonomethoxine combined with Ormetoprim on bovine coccidiosis. *J. Japan Vet. Med. Assoc.*, **51** : 10, 579-582.

Schalm, O.W., Jain, N.C. and Carrol, C.J. (1975). Veterinary haematology, 3rd edn. Liea and Febiger, Philadelphia, U.S.A.

Sena, D.S., Suryanarayana, C. and Rao, D.S.T. (1997). Haematological, biochemical and therapeutic studies on coccidiosis in rabbit. *Indian Vet. J.*, **74** : 1022-1024.

Senger, C.M., Hammond, D.M., Thorne, J.L., Johnson, A.E. and Wells, M. (1959). Resistance of calves to reinfection with *Eimeria bovis*. *J. Protozool.*, **6** : 51-58.

Senthilvel, K. (1995). Coccidiosis in bullock. *Indian Vet. Med. J.*, **19** : 311-312.

Shastri, U.V., Krishnamurthy, R. and Ghafoor, M.A. (1974). A note on clinical coccidiosis in buffalo calves due to *Eimeria bareillyi* Gill, Chhabra and Lall, 1963 in Maharshtra. *Indian Vet. J.*, **51** : 301-302.

Siegmund, O.H., Fraser, C.M., Archibald, J., Blood, D.C., Henderson, J.A., Howell, D.G. and Kitchell, R.L. (1973)- "The Merck Veterinary Manual – A hand book of diagnosis and therapy for the veterinarian", 4th Edn., March & Co. ING Rahway, NJ, USA.

Singh, Rajpal and Agrawal, R.D. (2003a). Efficacy of Amprolsol against coccidian infection in buffalo calves. *J. Vet. Parasitol.*, **17** (1) : 77-78.

Singh, Rajpal. and Agrawal, R.D. (2003b). Incidence of coccidian infection in buffaloes in Mathura. *J.Vet. Parasitol.*, **17** (2) : 169-170.

Snedecor, G.W. and Cochran, W.G. (1967). Statistical methods, 6th edn. The Iwoa State Univ. Press Wisconsin, U.S.A.

Snoep, J.J. and Potters, JBMM. (2004). Coccidiosis as a cause of diarrhoea of calves in the meadow: meadow coccidiosis caused by *Eimeria alabamensis*. *Tijdschrift-voor-Diergeneeskunde.*, **129** : 5, 158-160.

Soulsby, E.J.L. (1982). Helminths, Arthropods and Protozoa of domesticated animals 7th edn. Bailliere Tindall and Cassell, London.

Steiner, L., Busato, A., Burnes, A. and Gaillard, C. (1997). Frequency and aetiology of calf diseases before weaning in cow-calf farms II.

Microbiological and Parasitological diagnoses in diarrhoeic calves. *Deutsche-Tierarztliche-Wochen schrift.*, **104** :5, 169-173.

Stockdale, P.H.G. and Sheard, A. (1982). Resistance to *Eimeria bovis* produced after chemotherapy of experimental infections in calves. *Vet. Parasitol.*, **9** (¾) : 171-177.

Suresh, R.V., Rajan, T.S.S., Rasheed, M.A. and Pattabiraman, S.R. (1990). Coccidiosis in a cow- A case report. *Indian Vet. J.*, **67** : 8, 763-764.

Svensson, C. and Olofasson, H. (1996). *Eimeria alabamensis* coccidiosis in grazing calves : control by a long-acting Baquiloprim/Sulphadimidine bolus. *Applied parasitol.*, **37** : 3, 168-176.

Tamsasaukas, R., Ruiz, H., Roa, N. and Cobo, M. (1998). Ecological and epidemiological aspects of bovine coccidiosis on farms in the east of Guarico State, Venezuela.*Revista-Cientifica-facultad-de-ciencias-Veterinarias,-Universidad-del-Zulia.*, **8** (4) : 354-365.

Yadav, B.S. and Sharma, D.N. (1986). Morbidity and mortality in buffalo (*Bos bubalis*) calves. *Indian Vet. Med. J.*, **10** : 219-223.

Zhang, Q. and Xue, S.Y. (1990). Efficacy of Metronidazole against coccidiosis in rabbits. *Chinese J. Vet. Sci. Tech.*, **9** : 27 – 29.

Zhang-Longxian., Ning-Changshen., He-Quingjun., Wang-Ya Bin., Song-Tiejun and Yuan-Yuan (2000). Survey of epidemiology of dairy cow coccidiosis in Zhengshou, Henan Province, China and identification of coccidia species. *J. Henan Agri. Uni.*, **34** : 1, 88 – 93.

****

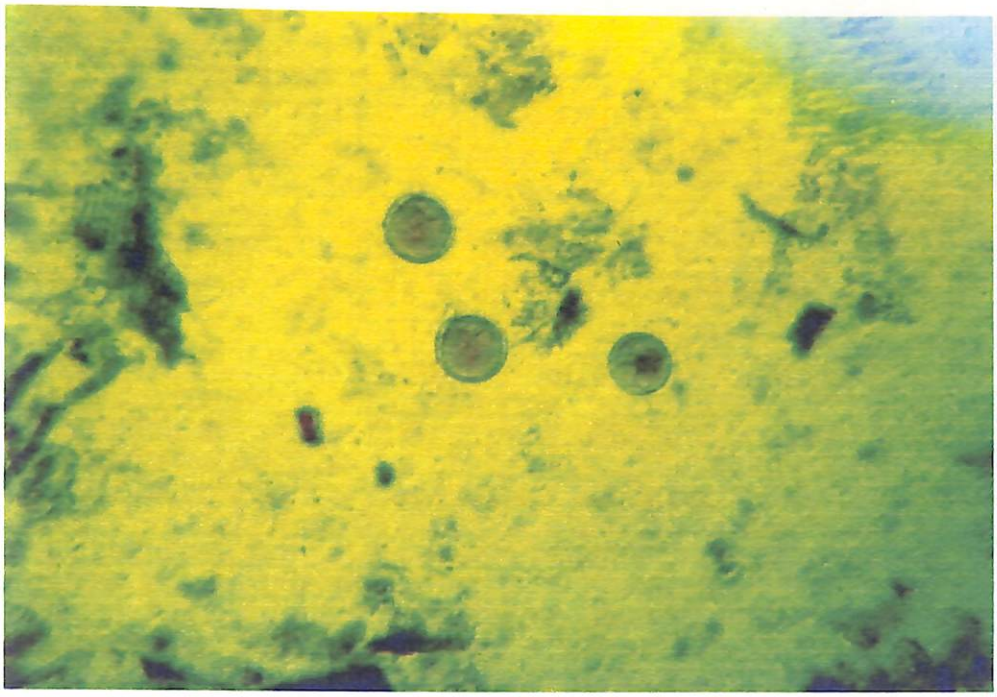


Fig. 1 : Showing the unsporulated oocyst of immature *Eimeria zuernii* under clinical condition (10x)

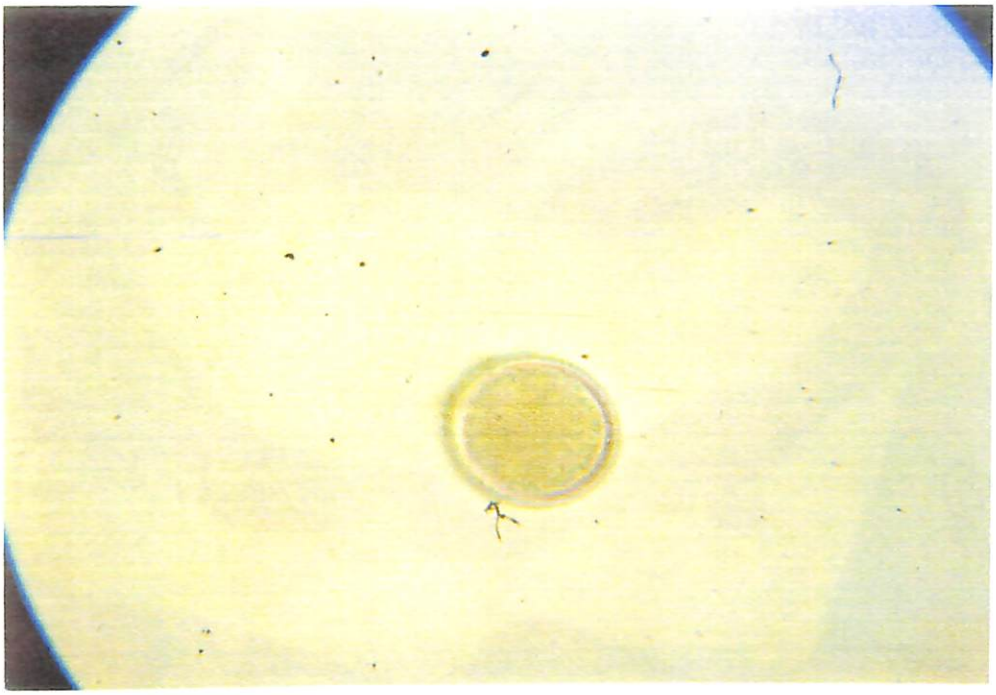


Fig. 2 : Showing the unsporulated oocyst of *Eimeria zuernii* (40x).

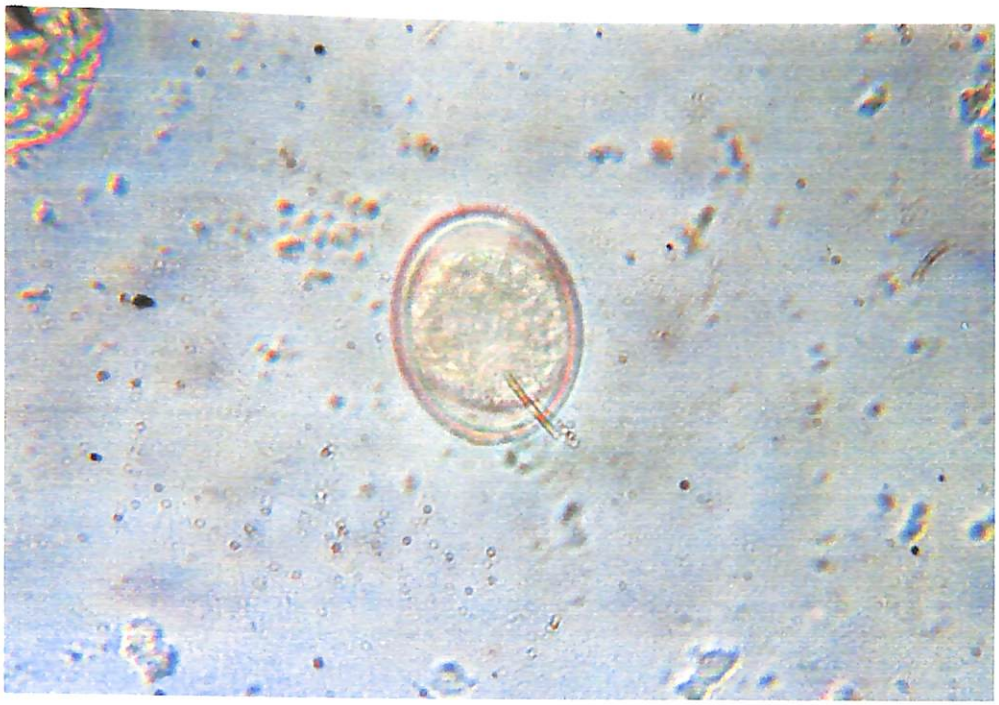


Fig. 3 : Showing the unsporulated oocyst of *Eimeria bovis* (40x).

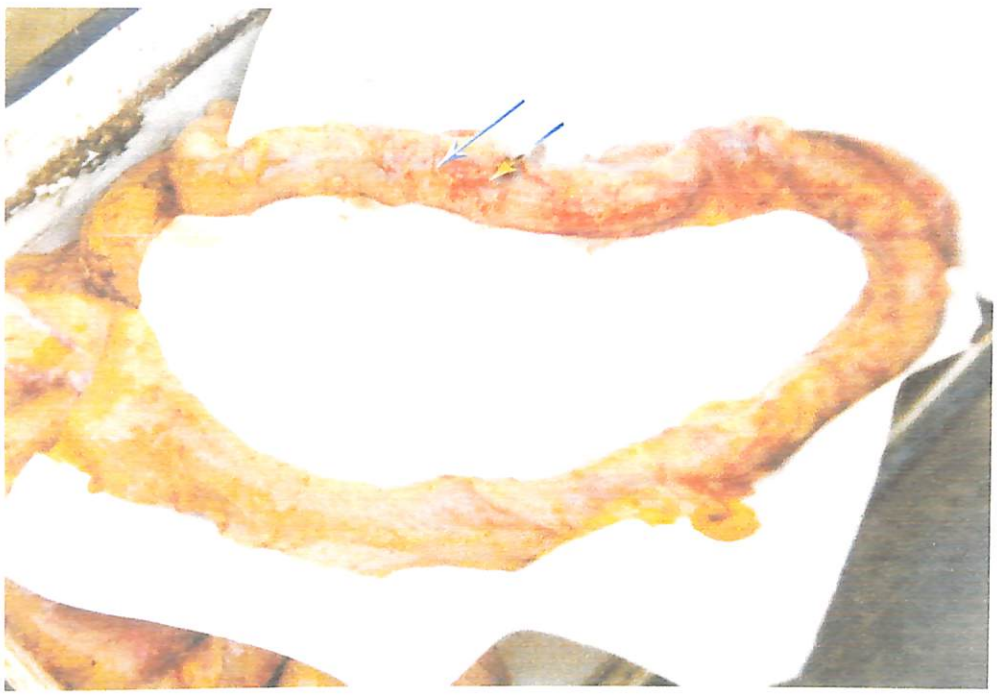


Fig. 4 : Showing the congestion of intestine infected with *Eimeria* species.

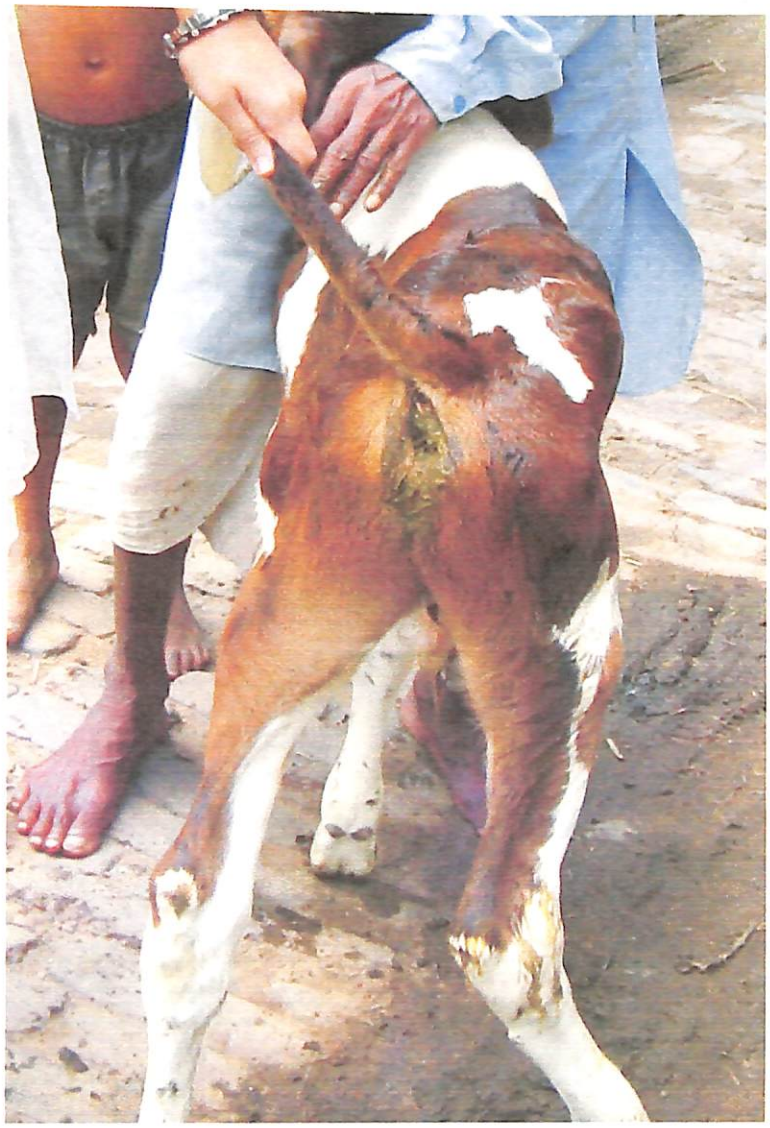


Fig. 5 : Living calf suffering with diarrhoea, positive for coccidiosis.

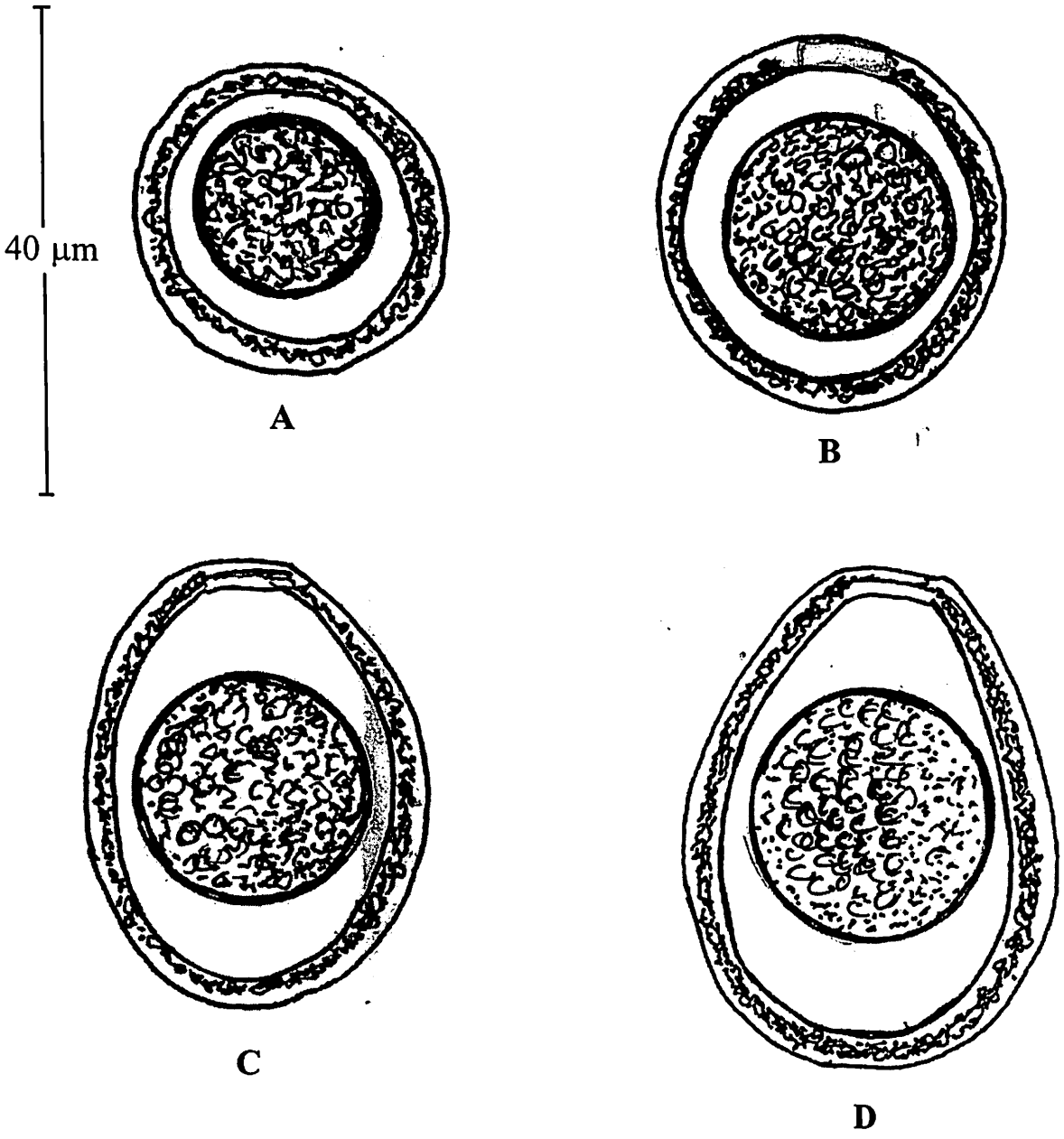


Fig. 6 : Camera lucida diagram of unsporulated oocysts of *Eimeria* in cattle and buffaloes.

A. *Eimeria subspherica*
B. *Eimeria zuernii*
C. *Eimeria ellipsoidalis*
D. *Eimeria bovis*