Studies on
Ecto and Endo Parasites of Quail (*Coturnix coturnix japonica*)

THESIS

SUBMITTED TO THE

RAJENDRA AGRICULTUTRAL UNIVERSITY , BIHAR

(FACULTY OF VETERINARY SCIENCE)

PUSA (SAMASTIPUR)

By

Rinesh Kumar

(Reg. No. M/Vety.Para//32 of 1998-99)

In partial fulfilment of the requirements

FOR AWARD OF THE DEGREE OF

MASTER OF VETERINARY SCIENCE

IN

VETERINARY PARASITOLOGY

DEPARTMENT OF VETERINARY PARASITOLOGY

BIHAR VETERINARY COLLEGE

PATNA - 800 014

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BIHAR VETERINARY COLLEGE, PATNA - 14
RAJENDRA AGRICULTURE UNIVERSITY
BIHAR

CERTIFICATE-I

This is to certify that thesis entitled **"Studies on ecto and endo parasites of quail"** (*Coturnix coturnix japonica*) submitted in partial fulfilment of the requirements for the Degree of **Master of Veterinary Science (Veterinary Parasitology)** of the Faculty of post-graduate studies, Rajendra Agriculture University, Bihar, is the record of bonafied research carried out by **Dr. Rinesh Kumar** under my supervision and guidance. No part of the thesis has been submitted for any other degree or Diploma.

It is further certified that such help or information, received during the course of this investigation and preparation of thesis have been duly acknowledged.

(Dr.S.R.P. Sinha)
Major Advisor

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CERTIFICATE-II

We, the undersigned, Members of the Advisory Committee of **Dr. Rinesh Kumar**, 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 ecto and endo-parasites of Japanese quail"**(*Coturnix coturnix japonica*) may be submitted by **Dr. Rinesh Kumar** in partial fulfilment of the requirements for the Degree.

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

Members of the Advisory Committee:

1. Dr. M.N. Sahay, Assoc.Prof. & Head (Co-Major Advisor) Department of Parasitology
2. Dr. L.N. Prasad, Assoc. Prof., Department of Pathology.
3. Dr. S.B. Verma, Assoc. Prof., Department of Animal Breeding & Genetics.
4. Dr. V.K.Sinha, Assoc. Prof. & Head., Department of Epidemiology & Preventive Medicine
5. C. Jayachandran, Assoc. Prof., Department of Pharmacology.

Dr. Mani Mohan **(Nominee Dean, P.G.)**

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CERTFICATE - III

This is to certify that the thesis entitled **"Studies on ecto and endo-parasites of Japanese quail"** (*Coturnix coturnix Japonica*), submitted by **Dr. Rinesh Kumar** 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, Bihar was examined and approved on. 8th Jan. 2001.

8/01/2001
Dr. S.R.P.Sinha
Chairman,Advisory/Examination Committee

Members of the Advisory Committee:

1. Dr. M.N.Sahay,Assoc.Prof. & Head (Co-Major Advisor) (Department of Parasitology) — 8/1/2001
2. Dr. L.N.Prasad, Assoc. Prof., Department of Pathology. — 8/1/2001
3. Dr. S.B. Verma, Assoc. Prof., Department of Animal Breeding & Genetics. — 8/1/2001
4. Dr. V.K.Sinha, Assoc. Prof. & Head., Department of Epidemiology & Preventive Medicine — 8/1/2001
5. Dr. C.Jayachandran, Assoc. Prof. Department of Pharmacology. — 8/1/2001

Dr. Mani Mohan (Nominee Dean, P.G.) — 8/1/2001

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All good things have to come to an end but then there are the memories. At this stage of metamorphosis in retrospect, I would like to thank all those who have helped me to see this day. To begin with, I would like to express my sincere thanks to my cogent and perspicacious major advisor Dr.S.R.P.Sinha, Associate Professor, Department of parasitology for his sagacious guidance, ingenious appreciation, moral boosting and overall his homely behaviour throughout the course of the research work and preparation of this manuscript.

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Every cloud has a silver lining. The arduous task of statistical design and data analysis was made easy by the kind co-operation and help of Dr. S.B.Verma, Associate Professor, Department of Animal Breeding and Genetics. I am highly obliged to him. My thanks are also due to Dr. V.K.Sinha Professor & Head , Department of Veterinary Epidemiology & Preventive Medicine, and Dr. C. Jayachandran , Associate Professor, Department of Pharmacology, for their erudite suggestions and necessary facilities provided during the course of my research work.

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The help rendered by the all technical and non-technical staff of the, Department Of Parasitology, deserves appreciation. I must appreciate the assistance of Sri Narendra, Laboratory technician ,who helped me constantly throughout the course of my research work.

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Lastly, I feel for the suffering of all quails, which relinquished their precious life to keep my research work alive.

In the end, I must place on record my appreciation to my family members, specially my father Dr. Basant Kumar Sinha, without whom the sailing through would have been a sink.

And at the end of it all I thank my 'stars' !!

Rinesh Kumar

(Rinesh Kumar)

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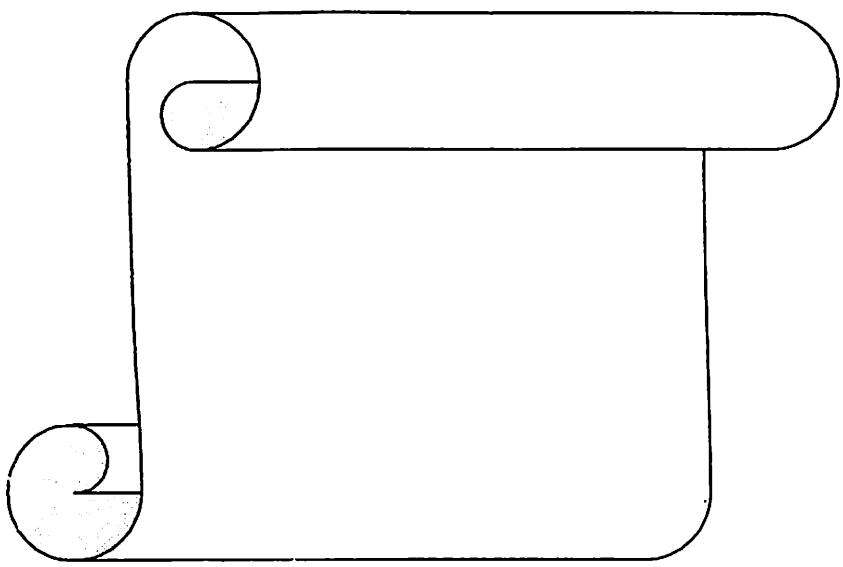
CHAPTER - I



INTRODUCTION

INTRODUCTION

Japanese quail a natural habitat of Japanese island belongs to class - Aves, family - Phasianidae, genus - *Coturnix* and hence the name *Coturnix coturnix japonica.* Coturnix quail have been referred to in the Bible as a source of food. Anyone who researches into the beginning of quail farming may find the origin in a Japanese desire for quail eggs as an antidote for reputed cure for tuberculosis. Japanese quail was domesticated in Japan, China and Taiwan as early as sixteenth century. Japanese recognised the unique abilities of hardness and adaptability to diversified agro - climatic conditions in quails. The use of domesticated coturnix quail as a source of egg and meat for human consumption, gained commercial status in Japan during the 20th century. At present coturnix quail provides large quantities of egg and meat for human consumption in Japan, Hongkong, Italy, France, United States of America, China and Denmark. These countries are leading in commercial farming of quail. In Italy and France 80 million and 96 million quails are produced every year. Quail industry in Honkong is having the turnover of more than 48 million dollar annually (Prakashbabu *et al.*, 1980). In Denmark the first quail slaughter house having a current production capacity of 500 quails/hour likely to expand to 1000 quails/hour soon, has been built very recently.

Recognising the immense potential of quail as an alternative to poultry farming in providing gainful employment, supplementary income and as a valuable source of meat, egg, this avian species was introduced in India by the Central Avian Research Institute (CARI), Izatnagar in 1974. The concerted research and development efforts have made since then

have lead not only to the rapid propagation of this avian species but also in the establishment of several small to large quail farms in different parts of the country. The time is not far off when quail production will acquire commercial proposition on a wider scale and become an important segment of fast expanding Indian poultry industry as quail meat being a delicacy and said to possess many medicinal properties fetches always better price than meat of other avian species. Besides this, quail meat has no religious taboo and thus acceptable to various religious group as a good source of animal protein.

Japanese quail a fairly domesticated economic avian species is ideally suited for commercial rearing for egg and meat purposes under intensive conditions, because it possess some unique characteristics, such as , fast growth rate, earlier sexual maturity, high rate of laying, short generation interval, less floor space and feed requirement and above all easy and convenient management. Owing to minimum capital outlay required for quail farming and quick return over investment made it is not surprising to find commercial quail production being promoted increasingly in number of countries.

Quail are susceptible to a number of infectious diseases. Almost all the common disease of chicken have been reported in quails. (Mohanty and Verma, 1982). It has already been recognised that the quails are susceptible to a large number of ecto and endo- parasites (Doster *et al.*,1980 and Davidson *et al.*,1980). Ectoparasites survive on their host as true parasites and may affect the health of the host through direct damage as well as through transmission of number of infective agents such as bacteria, viruses, fungi and parasites etc. These may be host specific in

many species. Various endoparasites such as protozoa and helminths may also inflict heavy economic loss to quail industry. Important diseases caused by protozoa include coccidiosis, cryptosporidiosis and histomoniasis. *Hexamita, Chilomastix* and *Trichomonas* sp. have been associated with diarrhoea and mortality in quail. Even 100% mortality has been recorded during a outbreak due to *Histomonas meliagridis.* Among the helminthic infections capillarids, ascarids, caecal worms, gapeworms and visceral larva migrans are common and important disease of quails. Tapeworms are occasionally seen and may be numerous (Hafeez,1989). Trematodes and acanthocephalans are also poorly represented in quails (Kellogg and Calpin,1971). These diseases fall under the broad term "worm infestation" and are capable of causing an appreciable loss of revenue in course of time. The damage done by these infestations is quite small in the begining in a flock. However, it is not so simple or innocent matter to be set aside so lightly. If proper and timely care is not taken the quail keepers may be faced with the bleak prospect of closer of establishment.

Different ecto and endo-parasites may cause various health problems such as irritation, indigestion, emaciation, anaemia, diarrhoea, enteritis, weight loss and fall in egg production etc. So, these parasites affect the revenue receipts of a quail farm to a great extent. In fact it could be said that the worms eat into the profits of the quail farms. A prosperous and healthy quail flock can soon be turned into an ill, parasitised, loosing concern by these worm infestations. So , it is very necessary to control the parasitic infestations in the quails, otherwise it will adversely affect the profitability and economy of the farmers who are taking quail farming as a small agro-industry.

The literature on the parasitic disease spectrum of this novel avian species is scanty and no systematic studies appears to have been undertaken in this country, especially in Bihar on the prevalence of ecto and endo-parasites of this bird. Hence, the present work was envisaged to study the prevalence of different ecto and endo-parasites with the following objectives:-

1. To study the prevalence of the parasites in respect to its occurrence in various seasons, age and managemental conditions.
2. To identify the species of different ecto and endo-parasites which are prevalent in disease or outbreak conditions, if any.
3. To study the various haematological changes haemoglobin percentage, total erythrocytic count, total leucocytic count, differential leucocytic count and erythrocyte sedimentation rate of the birds naturally affected with parasites and will be compared with the healthy birds.
4. To study the pathology (gross and microscopic) of the affected bird particularly the liver and gastrointestinal tract.

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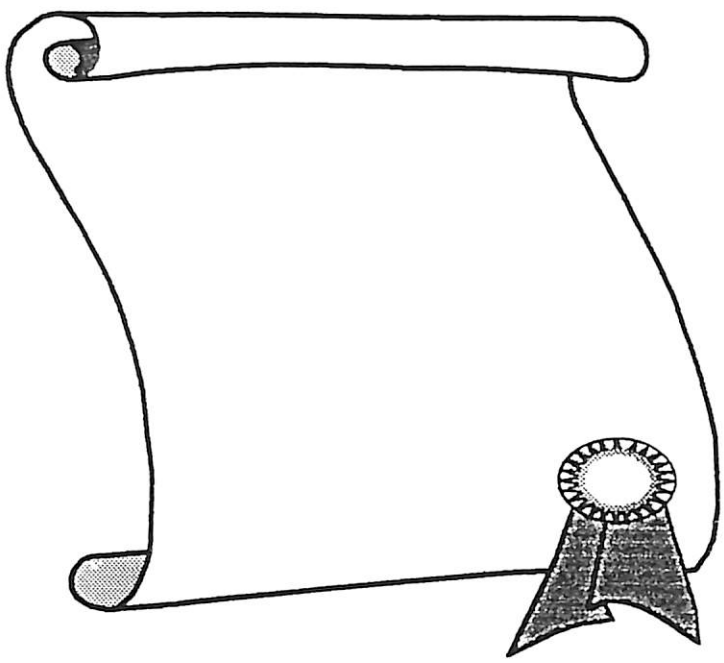
CHAPTER - II



REVIEW OF LITERATURE

REVIEW OF THE LITERATURE

Natt and Herrick (1955) suggested haematocrit as a quick and easy method for determining the severity of haemmorhage in *Eimeria tenella* infection of chicken. They reported decreased packed cell volume (PCV) on day five and six in *E. tenella* infection accompanied by parallel decrease in erthrocytic count.

Atwal *et al.* (1964) for the first time made haematological studies in the Japanese quail from birth to maturity. The erythrocytic count , haematocrit and haemoglobin concentration of coturnix showed an over all increase during the growth period. The mean corpuscular volume (MCV) and to a lesser degree the mean corpuscular haemoglobin (MCH) decreased during growth, the mean corpuscular haemoglobin concentration (MCHC) did not change appreciably. There was no significant difference in total leucocyte count during the development. The lymphocytes and heterophils were most abundant with the lymphocytes being the predominant type to sexual maturity. Thereafter the two cell types were present in equal number.

Bhatia *et al.* (1965) reported a new species of coccidia i.e. *Eimeria bateri* from the patches of small intestine of Indian grey quails (*Coturnix coturnix coturnix*). The patches revealed distinct lesions characterised by small congested and oedematous areas, which on scraping yielded gametogonic and oocystic stages. The information on the various endogenous stages was provided by histological study of the intestinal tissue. The endogenous stages viz., schizonts, macro -and micro-

gametocytes, observed by these workers were mostly confined to the lower lesions of the small intestine.

Shellenberger *et al.* (1965) compared the visual and electronic methods for counting of erythrocytes and leucocytes in *Coturnix* quail. Visually, leucocytes were counted using the procedure of Ree and Ecker (1923) whereas the electronic technique was based on preferential lysis of erythrocytes prior to lysis of leucocytes. They suggested that because of the speed and apparent accuracy of the electronic counting procedures, these methods may be adopted and used for routine enumeration of leucocytes and erythrocytes in quails.

Mazurkiewicz *et al.*(1967) made report on *E. tenella* in a flock of caged Japanese quail from an outbreak of caecal coccidiosis resulting in blood stained diarrhoea and enlargement of caecum and erosion of intestinal mucosa.

Mukkur and Bradley (1969) observed that single dose of 5,000 or more *E. tenella* oocysts to the birds resulted in a singnificant drop in packed cell volume (PCV) and haemoblobin value at six to seven days after exposure. This reduction was proportional to the intensity of the disease which in turn depended on the number of oocysts used for exposure The decrease in PCV was accompanied by a decrease in haemoglobin value.

Kellogg and Calpin (1971) did an extensive literature review and prepared a check list of diseases and parasites reported from the bobwhite quail (*Collinus virginianus*). The check list included four viral, 15 bacterial and 2 mycotic diseases. Parasitic diseases included were 12 protozoan, one trematode, 13 cestodes, 3 acanthocephalan, 13 nematodes and 39 arthropode parasites. Forty species of helminths have been

recorded from the bobwhite. Cestodes and nematodes make up the bulk of this number. Trematodes and Acathocephalans are poorly represented.

Nirmalan and Robinson (1971) examined blood samples of thirty, 2-week old unsexed chicks, 25 adult males, 30 non-laying hens to characterise haematological norms in Japanese quail (*Coturnix coturnix japonica*) under various physiological conditions ,such as, age, sex and laying. Young quails had significantly lower erythrocyte counts, packed cell volumes, haemoglobin content, mean corpuscular haemoglobin concentrations, number of thrombocytes, percentage of lymphocytes and plasma protein levels than did the adult males and non-laying hens. The total leucocyte count of the young birds was not significantly different from that of the males and just different from that of the non-laying hens. The young birds also showed a higher mean corpuscular volume, mean corpuscular haemoglobin and percentage of heterophils and monocytes in comparison with the adult males and he non-laying hens. A comparison between males and females showed that males had a higher erythrocytic count, packed cell volume and haemoglobin content and a lower concentration of plasma protein than the adult females. Excepting for an elevated count of eosinophils, no influence attributed to laying was observed.

Norton and Peirce (1971) studied the life cycle of *Eimeria bateri* in the Japanese quail (*C.c.japonica*) as an alternative host. The first generation schizont developed in the glands of the duodenum and upper part of the intestine, whereas 2nd, 3rd and 4th generation schizonts and gametocytes occurred in the villous epithelium. There was a gradual spread along the small intestine until the whole organs was affected. The

prepatent period of four days and the patent period of six days were recorded.

Shah and Johnson (1971) investigated an outbreak in a flock of Hungarian quail (*C.c. coturnix*) due to *Eimeria bateri* maintained for laboratory use in USA. Lesions were observed in the duodenum and the lower part of intestine including the caecal neck of the dead bird.

Tsunoda and Muraki (1971) investigated a new species of coccidium *Eimeria uzura* from duodenum and upper part of the small intestine which resembled *E. coturnicx* and *E.bateri* in the morphology of oocysts except for the presence of micropyle. A pure strain of this species was obtained by the single oocyst infection mehod.

Acedo and Reguera (1972) reported an outbreak of coccidiosis in. Spain, due to *E.bateri* in *Coturnix coturnix coturnix* farm consisting of 10,000 birds of 2 months of age. Ten percent of the population was affected, which resulted in 1% mortality,

Hansen and Robel (1972) studied seasonal trends in prevalence of nematodes and cestodes in bobwhite quail during a three year period in Kansas, USA. Their study revealed a peak prevelence of cestodes in the spring and peak prevalence of nematodes in November and February. The total prevalence of helminthiasis in their study was 23 %.

Sawada and Funabashi (1972) recorded for the first time a new avian cestode , *Metroliasthes coturnis* from the small intestine of Japanese quail in Japan.

Tsutsumi (1972) described a highly pathogenic new species of coccidium *E. tsunodai* from Japanese quail, which infect the caeca alone extensively and induced symptoms of caecal enteritis.

Alwar and Lalitha (1974) recovered different mites from 10 quails (*C.c. coturnix*) procured from the market in Madras. The mites were belonged to family Analgidae (feather mites), Petrolichidae (Feather mite), Dermoglyphidae (shaft mites) and Epdirmoptidae (skin mites).

Panda and Tripathy (1974) studied the effect of age on the susceptibility of coccidial infection in chickens.

Mohan and Pande (1976) described 14 most common diseases of Japanese quail.Of which parasitic diseases described were coccidiosis, trichomoniasis and toxoplasmosis.

Panda (1978) identified *E. bateri* from an outbreak of coccidiosis among 10 to 15 day old quail chicks (*Coturnix coturnix japonica*) causing watery reddish diarrhoea. This was based on the morphology of oocyst and post mortem lesions of dead birds. The macroscopic changes at autopsy were also described.

Doster *et al.*(1980) collected 480 samples from Bobwhite quail from nine areas belonging to four states of Southeastern United States. Twenty one species of ectoparasites in 19 genera was recorded. Of the 21 species, five had not previously been recoeded from this host. These were *Ixodex minor* Neium, *Neotrombicula whartoni* Ewing, *Dermoglyphus* species, *Microlichus* species and a species of *Rivoltasia* (near *R. coturnicola*). Data were presented on the prevalence, geographical location, host age and number of quails infected from each species . No significant lesions were observed.

Dhillon *et al.*(1980) diagnosed an outbreak of histomonad infection in a flock of about 850 bobwhite quail. Mortality was 95% over a 3-week period. The most prominant gross pathological lesions were in the liver showing occasionally disseminated white foci of necrosis, 1 to 2 mm in

diameter and subcapsular multifocal splenic necrosis. Lower intestinal lesions were infrequent. Histological examination of liver and spleen sections revealed focal necrosis associated with variable number of protozoal organism identified as a *Histomonad* sp. Identification of protozoa was ascertained by electron microscopy. Histomonads were isolated from affected quail livers and propagated in specific pathogen free chicken embroys. Lesion produced in embryos were evaluated. Isolates of the organism were used to reproduce the disease in young bobwhite quail.

Davidson *et al.* (1980) made helminthological studies of 120 adult and 465 juvenile Bobwhite (*Colinus virginianus*) from Leon county, Florida, during a one year period revealed seven common (> 30% prevalence) species including *Raillietina cesticillus*, *R. colinia*, *Cheilospirura spinosa* , *Cyrnea colini*, *Heterakis bonasae*, *Tetrameres pattersoni* and *Trichostrongylus tenuis*. Less frequently found helminths included *Hymenolepsis* sp., *Rhabdometra odiosa*, *Mediorhynchus papillosis*, *Aproctella stoddrdi*, *Dispharyns nasuta*, *Gogylonema ingluvicola*, *Strongyloides avium* and *Subulura* species. Juvenile bobwhite had acquired infections of 6 of the 7 common helminths by July and all seven species by August. A shift from a predominance of immature to mature parasites was noted with increasing age of juvenile bobwhites. Patterns of acquisition of common helminths by juvenile bobwhite followed both linear and non-linear (plateau effect) trends when compared to the age of the host. By mid winter total helminth burdens of juvenile birds approached levels in adult. *Cheilospirura spinosa*, *C.colini* and *T. pattersoni* showed marked peaks in transmission between June and September. The two caecal nematodes, *H .bonasae* and *T. tenuis*, showed seasonal shifts in relative abundance with *H. bonasae* predominating

during the summer and *T. tenuis* predominating during the winter. Lesions attributable to helminths were rare and involved minimal tissue damage.

Reed *et al.* (1981) diagnosed severe non-suppurative meningo-encephalitis with multifocal areas of malacia as the cause of a progressive neurological disorder in the flock of 85 bobwhite quails. The histological alterations were shown to be associated with the larval migration of the common roundworm of the raccoons, *Baylisascaris procynosis*.

Than *et al.*(1982) reported cryptosporidial infection in four weeks old *C.coturnix* quail on electron microscopical examination of the affected epithelium of lamina propria, trachea, bronchi and nasal cavity.

Ruff *et al.*(1984) reported mixed coccidial infection consisting of 65% *E. uzura*, 35% *E. tusnodai* and 2% *E. taldykuragalia* from natural outbreak in Japanese quail from Maryland, U.S.A. The coccidium was found to heavily infest the lower part of the duodenum and jejunum and moderate in the ileum, although some oocyst were found in the caecum and large intestine. The pathogenicity caused by *E. uzura* in Japanese quail was discussed in terms of gross lesions , blood parameters, egg production and hatchability and its relationship to age.

Uchida *et al.*(1984) studied cycles of cestode, *Choantaenia infundibulum* in Japanese quail. They found that cysticercoides developed into adult in 8 to 12 days in quails and then gravid proglottides were passed in faeces.

Mazhar and Bano (1985) reported superficial erosion and hypertrophy of villi after 48 to 72 hours of infection with *E. garnhami* in quails. Severe tissue damage was evident after 72 to 96 hours with erosion and sloughing of the tissue. There was loss of continuity of the epithelial

cells , tunica propria and muscle cells of muscularis mucosa. In chronic heavy infection infracts , oedema and atrophy of tissue were observed.

Hoerr *et al.* (1986) reported fatal diarrhoea in quail due to *Cryptosporidium* sp. At necropsy, the small intestine showed clear fluid content and the caecum was distended by brown foamy fluid. Histopathological findings in the small intestine were shortened villi with detached enterocytes at the tip. Electron microscopy revealed that microvillus border was colonised by numerous round to oval *Crytosporidium* sp. measuring 2-4μm in diameter.

Ritter *et al.* (1986) studied an acute enteric disease of young pen raised Bobwhite quails. Affected quails had white, watery diarrhoea accompanied by dehydration and subsequent death. Mortality from hatched to 17 days of age ranged from 30 to 45 percent in the three flocks examined. Small intestines were thin walled and distended with fluid and gas. Microscopic lesions in the intestinal tract consisted of villus atrophy, villus fusion and sloughing of cells at the tip of the villi in duodenum, jejunum and ileum. Cryptosporidium sp. and Reovirus were identified in affected quails.

Moore *et al.* (1987) recorded a total of 12 helminthic species from intestine of 128 Bobwhite quails. The species of helminths were *Cheilospirura spinosa, Cyrnea colini, Dispharynx nasuta, Gongylonema ingluvicola, Heterakis isolonche, Tetrameres pattersoni, Trichostrogylus tenuis, Raillietina cesticillus, Raillietina colinia, Rhabdometra odiosa, Mebiorhynchus papillosis and Brachylaema* sp.

Rao *et al.* (1987) reported *E. uzura* to be another common prevalent Eimerian species of Japanese quail associated in mixed infection with *E. bateri* at Central Avian Research Institute (CARI) quail farm at Izatnagar.

Panda *et al.* (1988) investigated coccidiosis in quail in two quail breeding farms from January,1986 to December,1987 and recorded several outbreaks of disease. They screened 480 faecal samples, out of which 416 (86.6%) were found positive for coccidial oocysts. The oocyst load and death rate in birds of 1-3 weeks of age were maximum during winter season, while minimum deaths occurred during summer. Higher death in young chicks were directly related to susceptible age together with ingestion of large number of oocyst from unhygienic battery brooders. The common gross lesions were enteritis, balloning and bleaching of intestine and caeca. Few haemorrhagic spots were also noted on caecal surface. Morphological and biometrical studies and cross infection with oocysts isolated from faecal and intestinal scrapings revealed mixed infection with three species of *Eimeria* viz, *E. uzura, E. bateri* and *E. tsunodai.* Mortality in relation to oocyst load was higher in California line than the German line.

Hafeez (1989) described symptoms, diagnosis, gross pathology and control of some of the diseases of quails caused by different protozoan and helminths.

Moore *et al.*(1989) made study on helminths of California quail (*Callipepla californic*) and Mountain quail (*Oreortyn pictus*).The study was conducted at E.E.Wilson wildlife area near Monmouth, Oregon,USA from February 1986 to November 1987. Eighty birds were infected with three species of nematodes, *Hetrakis isolonche*, *Dispharynx nasuta* and *Capillaria* species of nematodes and two species of cestodes *Rhabadometra-odiosa* and *Davainea* species. Apart from *Dispharynx nasuta,* prevalence did not exceed 5%, despite mesic conditions in the collection areas. Two mountain quails were collected from Lane country,

Oregon, USA near blue river reservoir, both were infected with the nematode *Trichostrongylus tenuis.*

Biswas *et al.* (1990) studied the infectivity of oocysts of *Eimeria tenella* in Japaneses quail . They observed no clinical symptoms in infected quails but the quails started passing oocysts since six days till day eight when all were sacrificed.

Boggs and Peoples (1990) observed for the first time that *Physalopterid* larvas were found in 5 of 64 quails examined from Northeastern Oklahoma, USA. Coiled larvas were associated with necrosis and granulomatous reaction.

Moore and Simberloff (1990) found 12 species of intestinal helminths in 158 Northern Bobwhite quails (*Colinus virginianus*) in Northern Florida, U. S.A., from 1983 to 1984. Of these six species were common : the cestodes, *Raillietina cesticillus* and *Raillietina colinia*, the caecal nematodes, *Heterakis isolonche* and *Trichostrogylus tenuis*, the proventricular nematode, *Dispharynx nasuta*, and the gizzard nematode *Cyrnea colini.* Four pairs of species had statistically significant numerical associations. The cestodes were negatively associated, and positive associations existed between the caecal nematodes, *R. cesticilus-D. nasuta* and *H. isolonche-C.colini.* When, either, ceacal nematodes was present in high densities, *H. isolonche* shifted its location, indicating a possible negative interaction. There were some intraspecific relationships between cestodes density and mean location, location variance and biomass. In addition, *R. cesticillus* biomass was negatively corrlated with *R. colinia* density. This community, while not characterised by high species, is readily colonised and exhibits evidence of inter and intraspecific

interaction. It does not conform to current models of parasite community structure.

Pahari and Sasmal (1991) made study on the migration and distribution of *T. canis* larvae in tissues of Japanese quail infected orally with $5x10^3$ infected eggs. Larval yield at necropsy from various tissues and organs of quail varied from 4.72 to 7.54% of the infected eggs inoculated within the periods of 1 to 60 days. The percent inoculum recovered at necropsy was highest on day 60. Most of the larvae were found in the liver throughout the period and only a few migrated to other tissues such as lungs, heart, muscle and brain. Later in 1991 Pahari *et al.* made study on experimental infection of Japanese quail with *Toxocara canis* larvae through earthworm.

Naveen and Arun (1992) described the diagnosis, prevention, treatment and pathology of several diseases. The disease caused by nematodes are *Cappilaria contrarta*, *C. obsignata, Syngamus trachea, Dispharynx nasuta, Cyrina colini, Trichostrongylus pergracillis, T. tenuis, Heterakis gallinarum, Baylisascaris procynosis* are described. The different protozoal diseases described were Coccidiosis (*Eimeria* spp.), Histomoniasis (*Histomonas meleagridis*), Crytosporidiosis and *Haemoproteus lophortyx* infection.

Patro *et al.* (1992) studied the occurrence and pathology of lesions in 650 adult quails at necropsy to elucidated the spectrum of diseases causing mortality in Japanese quail. Of these, 90 quails showing specific pathological lesions were collected for histopathological studies to ascertain the cause of death. Along with other diseases, ascariasis was found one of the cause of mortality. The species identified was *Ascaridia galli* which were found admixed with catarrhal exudates in the intestine.

Rao and Sharma (1992) studied the prevalence of different coccidial species affecting Japanese quails (*Coturnix coturnix japonica*) in the states of Andhra Pradesh, Tamil Nadu, Haryana, Uttar Pradesh and Union Territory of Delhi,on the basis of examination of faecal droppings and intestinal scrapings collected at the time of necropsy. The criteria for indentification/confirmation of the coccidial species were based on morphological studies of the unsporulated and sporulated oocysts, sporulating time, parasite habitat, prepatent period and post-mortem changes observed in spontaneous cases at necropsy/slaughter etc. The incidence in 1080 topotypes collected was 16.11%. The intestinal coccidiosis accounted for 16.11% and caecal coccidiosis for 4.65% cases. Mixed infection of *E.bateri* and *E. uzura* was recorded.

Kundu *et al.* (1993) made studies on some haematological and blood chemistry parameters in young female quails (1.5 months old), adult quails (3 months male and laying females) and old quails (one year old females) compared with the other groups. Young quails had lower haemoglobulin levels and erythrocytic counts than adult males, while level of serum protein and calcium were quite high. In the adult males serum cholesterol was higher. In old birds the level of all the parameters were low.

Movessian and Pkhrikian(1994) conducted an experiment in which 100 Japanese quails were infected with *Ascaridia galli* and *Hetrakis gallinarum*. The result obtained suggested that *A. galli* requires 30-33 days to reach maturity while *H. gallinarum* requires 20 - 25 days to reach maturity. The average infection prevalence in quails was 87.5%. It was found that the nematodes developed in host (quail) without exerting noticeable influence on each other.

Gonzales-Acuna (1997) studied the endo and ecto parasitess of 114 California quails in the province of Nuble in Central Chils . Of the 114 quails, 24 (21.1%) had endo-parasites and all 114 (100%) had ecto-parasites. Of the endo-parasites, the cestode *Anonchotaenia* species , the nematodes *Dispharynx nasuta*, *Heterakis gallinarum* and *Cappilaria caudinflata* were dected in 7.9, 4.4, 3.5 and 1.8 percent of birds respectively. Among coccidian parasites *Eimeria* spp. and *Eimeria tenella* were detected in 3.5 and 2.6 percent of birds respectively. Among ecto-parasites, *Megninia ginglymura*, *Pseudolichus* spp., *Amblyomma* spp. and unidentified *Trombiculidae* were detected in 100, 43.13 and 11.0 percent of birds respectively. Among insects *Epicolinus* and *Zlotorzyckella stafani* were detecd in 28 and 60 percent of birds respectively.

William *et al.* (1997) reported for the first time nematode larvas in the brain and lung of a adult male quail. The species identified was *Baylisascaris* on morphological and histopathological criteria.

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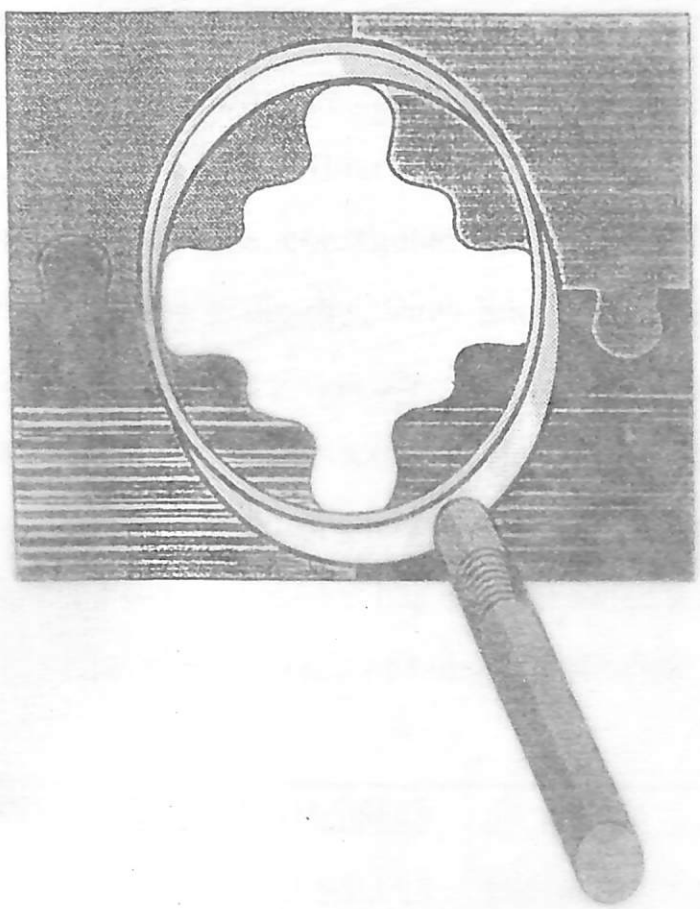
CHAPTER - III



MATERIALS AND METHODS

MATERIALS AND METHODS

The present investigation aimed to study the prevalence of different ecto and endo parasites of the Japanese quail (*Coturnix coturnix japonica*), the different haematological changes and histopathological examination of the affected intestine and liver.

COLLECTION OF MATERIALS

Japanese quail (*Coturnix coturnix japonica*) belonging to Central Poultry Farm, Patna, Bihar Military Police Poultry Farm, Patna and local market in and around Patna, constituted the materials for the present study. One hundred fifty skin scrapings, three hundred faecal samples and three hundred intestinal scrapings were screened to know the status of different ecto and endo parasities prevalent in Japanese quail. The details of materials collected from young (less than 8 weeks) and adult birds (more than 8 weeks) in different seasons has been depicted in Table-1.

Table :1. Details of samples collected

S.N	SEASONS	ECTOPARASITE		ENDO PARASITES			
		Skin scraping		Faecal samples.		Intes.Scrapings	
		Young	Adult	Young	Adult	Young.	Adult.
1.	Monsoon	25	25	50	50	50	50
2.	Winter	25	25	50	50	50	50
3.	Summer	25	25	50	50	50	50
TOTAL		75	75	150	150	150	150

N.B.:- Monsoon constituted from July to October months.
Winter constituted from November to February
Summer constitute from March to June

FAECAL SAMPLES:- Faecal droppings were collected in sterile plastic vials. These vials containing faecal sample were properly labeled depicting the sample number, age of the birds, place and seasons. These vials were brought to the laboratory within an hour of collection. In case where delay was anticipated in processing of the samples a few drops of 10% formaline was added to the sample to preserve the morphological characteristic of helminthic ova and protozoal cysts.

INTESTINAL SCRAPINGS :- The gastro-intestinal tract and the liver of the birds were collected and brought to laboratory as soon as possible. Portion of the liver and gastrointestinal tract showing characteristic changes were kept in 10% formaline for histopathological studies.

BLOOD :- The whole blood of apparently healthy and naturally parasitic infected birds of young and adult age groups were collected and studied for the haematological parameters such as Haemoglobin percentage (Hb%), Total Erythrocytic Count (TEC), Total Leucocytic Count (TLC), Differential Leucocytic Count (DLC) and Erythrocyte Sedimentation Rate (ESR).

Method of Blood Collection:

Anticoagulant:-Anticoagulant mixture of the following composition was prepared as described below:-

Potassium oxalate	-	0.8 gm
Ammonium oxalate	-	1.2 gm
Distilled water	-	100 ml.

The above anticoagulant mixture is known as "Heller Pouls Oxalate mixture". Small sterilized empty neutral glass vials were filled with 0.25 ml of anticoagulant mixture and were dried in an oven below 60^0C (Sharma,1967).

Collection of blood:- 2 to 3 ml. of blood was collected in vials containing dried anticoagulants from the wing vein of birds with the help of sterilized disposable syringe after removal of feathers and proper sterilizing the surface with 70% alcohol. For DLC thin and uniform smears were prepared on a clean and grease free slides. Smears were dried in air and properly labelled.

SKIN SCRAPINGS :- Skin scrapings were collected with the help of scalpel from the suspected lesions on a clean dried paper and also the whole of the body was throughly searched for the presence of any ectoparasites.

EXAMINATION OF COLLECTED MATERIALS

FAECAL SAMPLES :- The collected faecal samples were examined by following methods:-

Direct smear examination:- Normal saline preparation and iodine preparation of the faecal samples were prepared for examination of protozoal cysts and helminthic ova. The above preparations were examined first under low power objective and then under high power objectives for detailed diagnosis.

Concentration method :- The following concentration methods were done for detection of the cysts and ova of different parasites.

Salt floatation technique:- This method is a qualitative test for the detection of nematodes , cestodes eggs and protozoal oocyst in the faeces. It is based on the separating of eggs from faecal materials and concentrating them by means of a saturated salt solution of specific gravity 1.20.This was prepared by allowing an excess of common salt to boil in a basin until a scum forms on the surface. When cooled, it is stored in a bottle, leaving an excess of undissolved salt at the bottom.

About 1 to 2 gms of faecal sample triturated in motor and pestle by addition of small amount of saturated salt solution. The aliquote was then strained through a wire mesh and the filtrate was kept in a small glass vial. The final filling of the vial is carried out by means of a dropper, until a convex miniscus is formed. A clean microscopic slide was kept on the vial in such a way that it should touch the upper convex miniscus of the fluid. This preparation was allowed to stand about 30 minutes after which the microscopic slide was quickly lifted, turned over smoothly so as to avoid spilling of the liquid and immediately covered with a cover slip. This preparation was examined under the microscope. The examination was conducted within 25 to 30 minutes after preparation so that ova/oocysts may not start distorting, due to osmosis.

Sedimentation technique:- This technique is a qualitative method for detecting trematodes eggs. 1 to 2 gms of faecal sample was triturated in mortar and pestle with the addition of distilled water. The suspension was then filtered through wire mesh and the filtrate was centrifuged at 2,000 rpm for 10 minutes .The supernatant fluid was discarded and the pellet was broken by a glass rod and a drop from this was taken on a clean microscopic slide and then covered with a cover slip. This preparation was examined first under low and then high power of the microscope .

Identification of protozoal oocysts and helminthic ova:- The identification of protozoal oocysts and the helminthic ova was done as described by Solusby (1982) and Yamaguti (1959 and 1961).

Protozoal oocyst for coccidial spp. were also identified by the characters described by Tyzzer, 1929; Bhatia *et al.* 1965; Tsunoda and Muraki, 1971; Shah and Johnson, 1971; Norton and Peirce, 1971;Tsutsumi, 1972;Levine,1973 and Ruff *et al.* (1984).

Faecal samples showing presence of coccidial oocysts were mixed with 2.5% potassium dichromate ($K_2Cr_2O_7$) solution .The suspension was poured into petri dish to a depth of 5 mm and allowed to sporulate at room temperature. These samples were examined under microscope from time to time to note the sporulation time. Only those oocyst which contained all the four sporocyst were considered to have complete the sporulation. After complete sporulation the sporulated oocyst were identified on the basis of their morphological features described by the above authors.

SKIN SCRAPINGS:- The collected materials were first directly examined in normal saline preparation under dissecting microscope. If the material was too dense for direct examination, it was boiled in 10% KOH to dissolve the debris and other unwanted materials. After that material was centrifused and the sediment was examined under low and high power of the microscope. If the material was suspected for any ectoparasites it was identified by the method of Ansari (1955) , Sen and Fletcher (1962) Solusby (1982) and Urquhart *et al.* (1996).

INTESTINAL SCRAPINGS :- The gastrointestinal tract was placed in a metal tray containing some lukewarm water. Intestine was cut along with their entire length and all visible helminths were recovered and the gross pathological lesions were noted ,if any. The mucosae were carefully examined for parasites and then scrapped with a slide to recover any embedded worm or larva. The material was collected in petridish and a little portion was examined by taking them in watch glass under dissecting microscope. Wet mount smears of mucosal scrapping were also made and examined directly under the microscope for the presence of oocyst, merozoites and schizonts of different stages of protozoal parasites.

The collected nematodes were washed by shaking in 0.9% saline and immediately dropped into 5% formal saline to fix them in an extended state. The staining of nematodes was not done and these were examined microscopically after clearing them in lactophenol. Cestodes and trematodes were fixed and stained . All the detected helminths were identified as described by Yamaguti (1959 and 1961) and Solusby (1965 and 1982).

SEASONAL PREVALENCE :- Seasonal variations in the prevalence of different ecto and endo (helminthic and protozoal) parasites in Japanese quail were studied in the present investigation. According to the regional weather conditions the period of study was divided into Monsoon (July to October), Winter (November to February) and Summer (March to June). Altogether 150 skin scrapings (50 scrapings in each seasons) were screened for the presence of any ectoparasites. For endoparasites overall three hundred faecal samples and three hundred intestinal scrapings were screened. Out of them 100 faecal samples and 100 intestinal scrapings were screened in all three seasons (Table-1).

MANAGMENTAL CONDITION:- In the present investigation managmental conditions adopted by various farms in the context of sanitation, type of rearing (Deep litter or cage system) feeding, watering were also examined.

BLOOD SMEAR :- Fresh blood smears were prepared with the collected blood, stained with Giemsa stain and examined under oil immersion lens to detect the blood protozoan infection as per method described by Solusby (1982) and Rubrah (1985)

HAEMATOLOGICAL STUDIES :-

For the determination of various haematological parameters the tests were carried out by the methods of Jain (1986).

Haemoglobin Estimation :- Estimation of haemoglobin was done by Sahli's acid haematin method. In this method blood was diluted with N/10 Hcl and colour was matched with a permanent coloured glass standard of haemoglobinometer. Briefly, N/10 Hcl was taken in a diluting tube upto the mark 10. Blood is taken in Hb pipette up to 20 c.mm. mark and blown into diluting tube and rinsed well. After 10 minutes distilled water was added drop by drop and mixed well with glass stirrer until it has exactly the same colour as the comparison standards. The reading was noted which indicates the percentage of haemoglobin.

Erythrocytes sedimentation rate (ESR):-

Estimation of ESR was done by Wintrobe's method with the help of Wintrob's haemocratic tubes. The collected blood for ESR was sucked upto 0 mark and was allowed to stand in Wintrobe's rack in vertical position and the reading was taken at every one hour.

Total Erythrocytic and Leucocytic Count :-

As the avian blood cells (both erythrocytes and leucocytes) are nucleated so the methods used in the mammals are not followed . Here a special diluting fluid as suggested by Natt and Herrick (1952) was used. The composition of the diluting fluid was as follows :-

Sodium sulphate	2.5 gms
Sodium chloride	3.88 gms
Potassium hydrogen phosphate	0.25 gm
Di-sodium hydrogen phosphate	2.91 gms
Formaline (37%)	7.50 ml
Methyl violet 2B	0.10 gm
Distill. water	1000 ml.

All the above components were dissolved in a volumetric flask. After standing it for overnight the solution was filtered through fine filter paper and the pH was adjusted to 7.4

Total erythrocytic count :- Blood was sucked in a R.B.C. pipette up to 0.5 mark. The tip of the pipette is then wiped and dipped vertically into the above mentioned diluting fluid, which is then gently sucked up to 101 mark. Air bubbles were avoided at the time of drawing the diluting fluid in the pipette. The content of the pipette is mixed with the twisting motion. The counting chamber of the haemocytometer and the coverslip were cleaned properly and the R.B.C. counting chamber was focused under low magnification of the microscope. A few drops of fluid (diluted blood) from the pipette was discarded first and then a drop of diluted blood was allowed to trickle in space between coverslip and the groove of the Neubauer's counting chamber of the haemocytometer. The erythrocytes in five small squares chambers (four corner squares and one central square) were counted and the number of R.B.C. per cubic mm. was calculated.

Total leucocytic count :- Blood was sucked up to 0.5 mark of the W.B.C. pipette and was diluted with the diluting fluid up to 11 mark taking care that no air bubbles are included. The pipette was shaken and the Neubauer's counting chamber was filled as described in 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.

Differential Leucocytic Count :- For differential count a thin and uniform smear of blood was prepared on a clean grease free slide and dried in the air. The smear was stained with Leishman 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 by placing a drop of cedar wood oil in well spread film. While counting, the edges were avoided and the cells running in strips the whole length of the film was examined .During examination of the film 200 cells were counted and the percentage of different cells were recorded . Leucocytes were differentiated on the basis of the description made by Olson (1937) and Strukie (1965).

HISTOPATHOLOGICAL STUDIES :

Tissues from affected part of gastrointestinal tract and liver of the infected quails were collected separately and fixed in 10% formol saline. The tissues were processed, sectioned at 5 microns and stained with haematoxylin and eosin for microscopic study.

STATISTICAL ANALYSIS-

Statistical analysis of data was done according to Snedecor and Cochran (1967). Traits measured in percentage were transformed to angles corresponding to percentage as given by C.I. Bliss before further statistical analysis of data.

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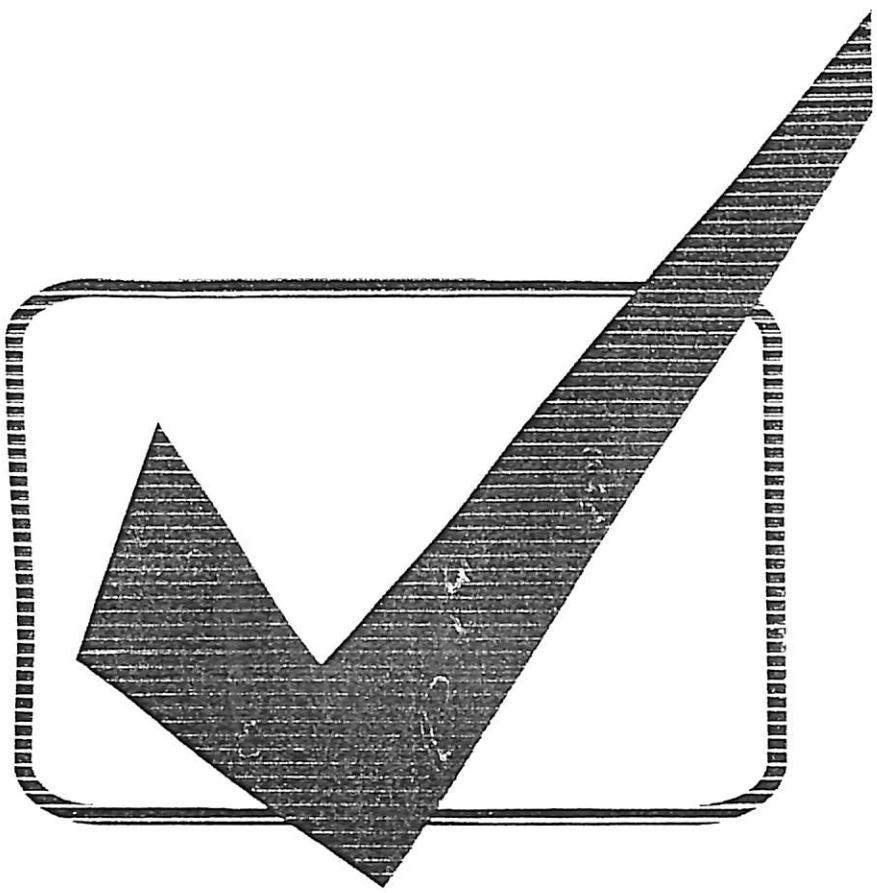
CHAPTER - IV



RESULTS

RESULTS

Various parasitic infestations adversely influence the successful rearing of the quails as they are the chief cause of unthriftiness leading to emaciation, decreased meat and egg production. Investigation conducted under this title aimed to gather the knowledge about the identity of parasites harboured by the quails which are essential to formulate effective treatment and control measures against the parasites .

PREVALENCE OF PARASITES IN JAPANESE QUAILS:

To estimate the prevalence of different ecto and endo parasites in Japanese quail (*Coturnix coturnix japonica*), an extensive survey was conducted in quails farms situated in and around Patna during the period of July, 1999 to June, 2000.The prevalence of different parasites were screened through 150 skin scrapings, 300 faecal samples and 300 intestinal scrapings.

No ecto parasites was detected in the present investigation. The consolidated data pertaining to the prevalence of various helminthic and protozoal parasites alongwith their percentage of infection detected through faecal examination and intestinal scrapings have been shown in Table- 2A and 2B and Fig.-1 . It is evident from these tables that five types of nematodes viz; *Strogyloides avium, Dispharynx nasuta, Ascaridia galli, Heterakis gallinarum, Capillaria obsignata*, one cestode i.e. *Raillietina tetragona* and three protozoal species i.e. *Eimeria bateri, Eimeria uzura* and *Trichomonas* sp. were detected.

In case of nematodes examined through faecal samples (Table-2A and Fig.1). *H. gallinarum* showed highest prevalence (15%) and *C.obsignata* showed lowest prevalence (5%). Other nematodes such as

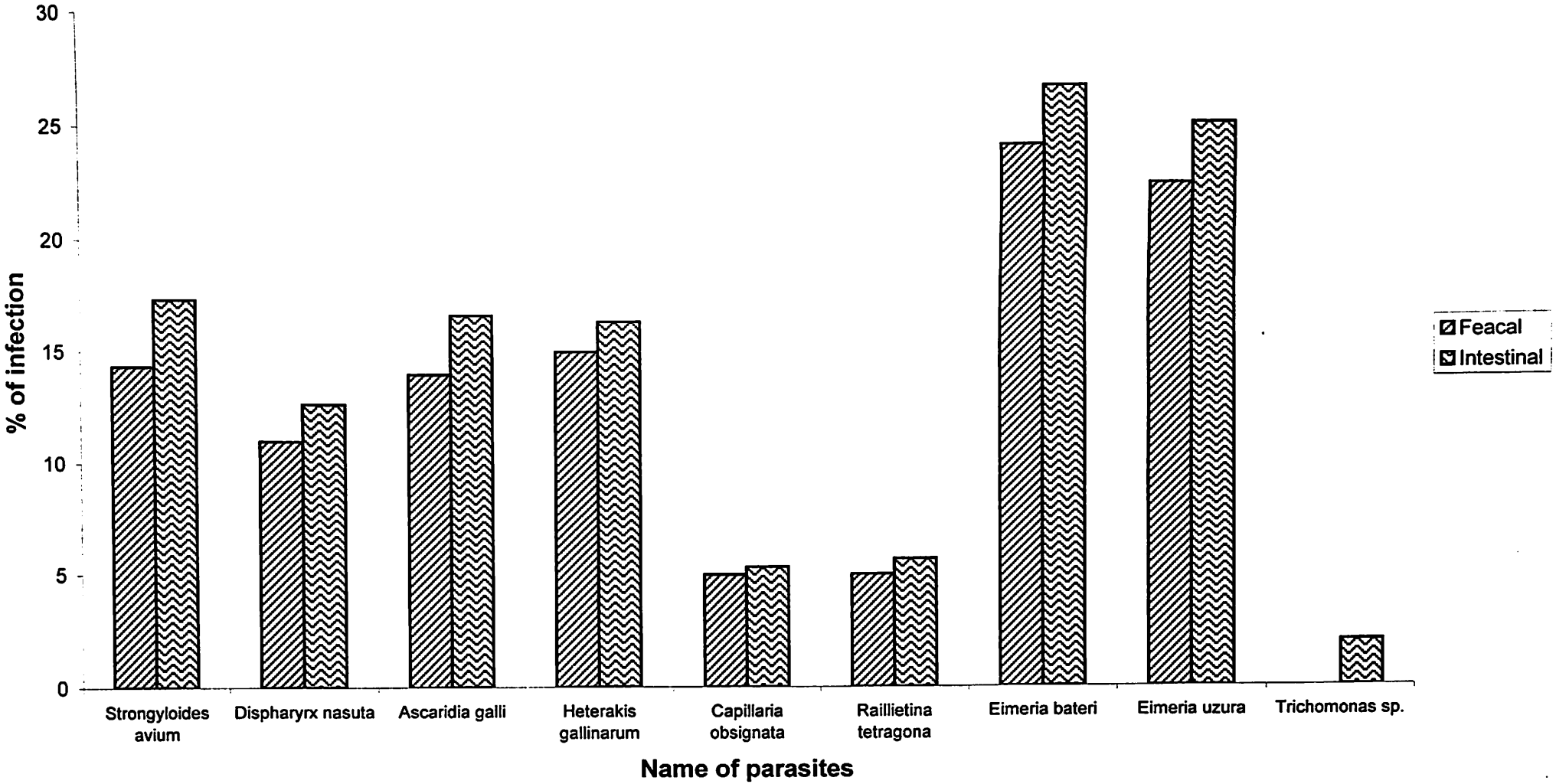
TABLE- 2A. PERCENTAGE OF INFECTION IN JAPANESE QUAILS WITH DIFFERENT PARASITES THROUGH EXAMINATION OF FAECAL SAMPLES.

Name of Parasites	300 faecal samples examined in total	
	No of birds found infected	% of infection
(A) NEMATODES		
1. Strongyloides avium	43	14.33
2. Dispharynx nasuta	33	11.00
3. Ascaridia galli	42	14.00
4. Heterakis gallinarum	45	15.00
5. Capillaria obsignata	15	5.00
(B) CESTODES		
1. Raillietina tetragona	15	5.00
(C) PROTOZOA		
1. Eimeria bateri	72	24.00
2. Eimeria uzura	67	22.33

TABLE- 2B. PERCENTAGE OF INFECTION IN JAPANESE QUAILS WITH DIFFERENT PARASITES THROUGH EXAMINATION OF INTESTINAL SCRAPINGS.

Name of Parasites	300 Intestinal scrapings examined in total	
	No of birds found infected	% of infection
(A) NEMATODES		
1. Strongyloides avium	52	17.33
2. Dispharynx nasuta	38	12.66
3. Ascaridia galli	50	16.66
4. Heterakis gallinarum	49	16.33
5. Capillaria obsignata	16	5.33
(B) CESTODES		
1. Raillietina tetragona	17	5.66
(C) PROTOZOA		
1. Eimeria bateri	80	26.66
2. Eimeria uzura	75	25.00
3. Trichomonas sp.	6	2.00

Fig. 1. Overall percentage of infection in Japanese quails with different parasites through examination of three hundred faecal samples/intestinal scrapings.



A.galli. D.nasuta, and *S. avium* were detected in the percentages of 14.0, 11.0 and 14.33 respectively. The cestode *R. tetragona* showed the prevalence of 5%. Among protozoa found through faecal samples *E.bateri* and *E.uzura* showed the prevalence of 24 and 22.33% respectively (Table-2A and Fig-1).

In the intestinal scrapings, *Strogyloides avium* nematode was found in the highest percentage (17.33%) and *Capillaria obsignata* showed lowest prevalence of 5.33%. The prevalence percentage of other nematodes such as *Ascaridia galli, Heterakis gallinarum* and *Dyspharynx nasuta* were found to be 16.66, 16.33 and 12.66 respectively. The cestode *Raillietina tetragona* showed the prevalence of 5.66%. Among protozoa *E.bateri, E.uzura* and *Trichomonas* sp. were found in the percentages of 26.66, 25.0 and 2.0 respectively (Table-2B and Fig-1).

MIXED INFECTIONS:-

Occurrence of mixed infection among different helminth and protozoa obtained through faecal samples and intestinal scrapings have been depicted in Table- 3A and 3B respectively. It is evident from the tables that in both faecal samples and intestinal scrapings different nematodes, cestodes and protozoa either occurred singly or in combination with one another. Generally mixed double infection were found. It can be observed from the Table-3A that nematodes infection in Japanese quails are generally accompanied with protozoal infection or vice versa except in the case of *Ascaridia galli* which occurred singly . It is also observed that cestode *(R. tetragona)* occurred singly in most of the cases except in one cases each where it was found to be in combination with nematode (*D . nasuta*) and protozoa (*E. bateri* or *E. uzura*) .

TABLE-3A : MIXED INFECTION OF ENDOPARASITES FOUND IN FAECAL SAMPLES

	NEMATODES					CESTODES	PROTOZOA		
PARASITES	*S. avium*	*D. nasuta*	*A. galli.*	*H. gallinarm*	*C. obsignata.*	*R .tetragona .*	*E. bateri.*	*E. uzura*	Total
S. avium	30	1	0	0	1	0	7	4	43
D. nasuta.	1	28	0	0	0	1	1	2	33
A. galli.	0	0	42	0	0	0	0	0	42
H.gallinarum	0	0	0	34	0	0	6	5	45
C. obsignata.	1	0	0	0	9	0	3	2	15
R.tetragona.	0	1	0	0	0	12	1	1	15
E. bateri.	7	1	0	6	3	1	34	20	72
E. uzura.	4	2	0	5	2	1	20	33	67
Total	43	33	42	45	15	15	72	67	

N.B.: Diagonal figures represent the number of parasites which occur singly.

TABLE-3B. MIXED INFECTION OF ENDOPARASITES FOUND IN INTESTINAL SCRAPINGS.

	NEMATODES					CESTODES	PROTOZOA			
PARASITES	*S. avium*	*D. nasuta*	*A. galli.*	*H. gallinarm*	*C. obsignata.*	*R .tetragona*	*E. bateri.*	*E. uzura.*	*Trichomonas sp.*	Total
S. avium	36	2	0	0	1	0	7	5	1	52
D. nasuta .	2	25	1	0	0	0	5	4	1	38
A. galli.	0	1	38	0	0	0	5	6	0	50
H.gallinarum	0	0	0	42	1	0	4	2	0	49
C.obsignata.	1	0	0	1	11	0	1	1	1	16
R.tetra-gona.	0	0	0	0	0	17	0	0	0	17
E. bateri.	7	5	5	4	1	0	40	17	1	80
E. uzura	5	4	6	2	1	0	17	40	0	75
Trichomonas	1	1	0	0	1	0	1	0	2	6
Total	52	38	50	49	16	17	80	75	6	

N.B.: Diagonal figures represent the number of parasites which occur singly.

Mixed infection obtained through intestinal scrapings (Table - 3B), revealed more or less same observation as detected in faecal samples except in the case of cestode, *R.tetragona* which occurred singly. It was found neither in combination with nematodes nor in combination with protozoa. The nematode *Ascaridia galli* in intestinal scrapings were also found to be occurred with protozoa. it can also be observed from the table that nematodes and cestodes were not found together both in faecal samples and intestinal scrapings.

SEASONAL PREVALENCE:-

SEASONAL PREVALENCE OF NEMATODE PARASITES IN QUAILS :-

The seasonal prevalence of nematode parasites in 300 faecal samples have been depicted in Table-4A and Fig.-2. It was observed from the table that season had significant effect on the prevalence of *S.avium, D.nasuta* and *H.gallinarum,* while it was non-significant for *A.galli* and *C.obsignata.* As far the percentage of prevalence is concerned it is evident from the Table-4A, that most of the infections were higher in winter seasons followed by monsoon and summer seasons. It is also evident from the table that the prevalence of *S. avium* was highest during during winter season (21%) followed by monsoon (14%) and the lowest in summer (8%) seasons. The value of $X^2_{2\ d.f.}$ found to be significant ($P<0.01$) for the seasonal prevalence of *S.avium* . The prevalence of *D.nasuta* was found to be at peak during winter season (17%) followed by monsoon (11%) and the lowest in summer (5%) seasons. The value of $X^2_{2\ d.f.}$ revealed significant ($P<0.01$) difference for the seasonal prevalence of this nematode parasites. Although the prevalence of *A. galli* in winter, monsoon and summer seasons were found to be 18%, 15% and 9% respectively, yet, $X^2_{2\ d.f.}$ did not reveal any significant difference. It was

TABLE- 4A. SEASONAL PREVALENCE OF NEMATODE PARASITES IN FAECAL SAMPLES.

Nematodes		Seasons			χ^2_2 d.f.
		Monsoon	Winter	Summer	
	No. of birds examined	100	100	100	
Strongyloides avium	No. of birds infected	14	21	8	6.88**
	% of infection	14	21	8	
Dispharynx nasuta	No. of birds infected	11	17	5	7.28**
	% of infection	11	17	5	
Ascaridia galli	No. of birds infected	15	18	9	3.41NS
	% of infection	15	18	9	
Heterakis gallinarum	No. of birds infected	17	20	8	10.23**
	% of infection	17	20	8	
Capillaria obsignata	No. of birds infected	5	8	2	3.78NS
	% of infection	5	8	2	

NS Non-significant
** Significant at P<0.01

noted that nematode *H.gallinarum* was found to be highest during winter season (20%) followed by monsoon (17%) and the lowest in summer (8%) seasons. The value of chi-square test revealed significant difference ($P<0.01$) for the seasonal prevalence of *H.gallinarum*. It was observed that prevalence of *C.obsiganata* was at peak during winter seasons (8%) followed by monsoon (5%) and lowest in summer (2%) seasons. The value of $X^2_{2d\cdot f.}$ revealed no significant difference for the seasonal prevalence of *C. obsignata*.

Seasonal prevalence of nematode parasites obtained through 300 intestinal scrapings has been shown in Table-4B and Fig.-3. The trend of prevalence was more or less similar to that of prevalence found in faecal samples. It was noticed that the prevalence of *S.avium,* was highest during winter season (25%), followed by monsoon (17%) and the lowest in summer (10%) seasons. The value of chi-square reflected significant difference ($P<0.05$) for the seasonal prevalence of *S.avium*. It was observed that the prevalence of *D.nasuta* in winter, monsoon and summer seasons were found to be 19%, 13% and 6% respectively. The value of $X^2_{2d.f.}$ revealed significant difference($P<0.01$) for the seasonal prevalence of *D. nasuta*. The prevalence of *A.galli* during winter season (21%) was observed to be highest followed by monsoon (18%) and summer (11%) seasons. The value of $X^2_{2d.f.}$ reflected significant difference ($P<0.05$) for the seasonal prevalence of *A.galli*. It was noted that prevalence of *H.gallinarum* was highest in winter season (21%) followed by monsoon (19%) and lowest in summer (9%) seasons. The value of $X^2_{2d.f.}$ revealed significant seasonal difference ($P<0.05$) for the prevalence of *H.gallinurum*. Although the prevalence of *C.obsignata* was noted to be highest during winter season (8%) followed by monsoon (6%) and the

TABLE- 4B. SEASONAL PREVALENCE OF NEMATODE PARASITES IN INTESTINAL SCRAPINGS.

Nematodes		Seasons			χ^2_2 d.f.
		Monsoon	Winter	Summer	
	No. of birds examined	100	100	100	
Strongyloides avium	No. of birds infected	17	25	10	4.469*
	% of infection	17	25	10	
Dispharynx nasuta	No. of birds infected	13	19	6	7.655**
	% of infection	13	19	6	
Ascaridia galli	No. of birds infected	18	21	11	3.859*
	% of infection	18	21	11	
Heterakis gallinarum	No. of birds infected	19	21	9	6.047*
	% of infection	19	21	9	
Capillaria obsignata	No. of birds infected	6	8	2	3.696^{NS}
	% of infection	6	8	2	

^{NS} Non-significant
* Significant at P<0.05
** Significant at P<0.01

lowest in winter (2%) seasons, yet, the $X^2_{2d.f.}$ did not reveal any significant difference for seasonal prevalence of *C.obsignata.*

SEASONAL PREVALENCE OF CESTODE PARASITES IN QUAILS:-

Seasonal prevalence of cestode, *R.tetragona* in faecal samples in different seasons has been shown in Table-5A and Fig.-2. It was noticed that the prevalence of *R.tetragona* was found to be highest during monsoon season (8%) followed by winter (5%) and the lowest in summer (2%)seasons. However, the value of $X^2_{2d.f.}$ did not reveal significant difference on the seasonal prevalence of *R.tetragona* in quails.

Seasonal prevalence of *R.tetragona* in intestinal scrapings in different seasons has been summerised in Table-5B and Fig-3. The trend was similar to the prevalence obtained through faecal samples. The prevalence was at peak during monsoon season (9%) followed by winter (6%) and the lowest in summer (2%) seasons. The value of chi-square test revealed significant difference ($P<0.05$) for seasonal prevalence.

SEASONAL PREVALENCE OF PROTOZOAL PARASITES IN QUAILS :-

The protozoal parasites detected in present investigations were *Eimeria bateri* and *Eimeria uzura* which comes under order coccidia. The seasonal incidence of coccidia found in faecal samples has been presented in Table-6A and Fig.-2. It is evident from the table that both species of coccidia showed the highest prevalence in monsoon seasons followed by winter and summer seasons. It can also be interpreted from the table that the prevalence of *E.bateri* during monsoon seasons (34%) was found to be highest, followed by winter (25%) and the lowest in summer (13%) seasons. The value of $X^2_{2d.f.}$ revealed significant difference ($P<0.01$) on the seasonal prevalence of this coccidia species. Similarly, the prevalence of *E.uzura* was at peak during monsoon season (32%) followed by winter

TABLE- 5A. SEASONAL PREVALENCE OF CESTODE PARASITES IN FAECAL SAMPLES.

Cestodes		Seasons			χ^2_2 d.f.
		Monsoon	Winter	Summer	
	No. of birds examined	100	100	100	
Raillietina tetragona	No. of birds infected	8	5	2	3.78^{NS}
	% of infection	8	5	2	

^{NS} Non-significant

Table- 5B. SEASONAL PREVALENCE OF CESTODE PARASITES IN INTESTINAL SCRAPINGS.

Cestodes		Seasons			χ^2_2 d.f.
		Monsoon	Winter	Summer	
	No. of birds examined	100	100	100	
Raillietina tetragona	No. of birds infected	9	6	2	4.50^{*}
	% of infection	9	6	2	

* Significant at $P<0.05$

TABLE- 6A. SEASONAL PREVALENCE OF PROTOZOAL PARASITES IN FAECAL SAMPLES.

Protozoa		Seasons			χ^2_2 d.f.
		Monsoon	Winter	Summer	
	No. of birds examined	100	100	100	
E. bateri	No. of birds infected	34	25	13	10.713**
	% of infection	34	25	13	
E. uzura	No. of birds infected	32	23	12	10.367**
	% of infection	32	23	12	

** Significant at P<0.01

TABLE- 6B. SEASONAL PREVALENCE OF PROTOZOAL PARASITES IN INTESTINAL SCRAPINGS.

Protozoa		Seasons			χ^2_2 d.f.
		Monsoon	Winter	Summer	
	No. of birds examined	100	100	100	
E. bateri	No. of birds infected	34	30	16	9.38**
	% of infection	34	30	16	
E. uzura	No. of birds infected	35	27	13	13.116**
	% of infection	35	27	13	
Trichomonas sp.	No. of birds infected	1	3	2	1.020NS
	% of infection	1	3	2	

NS Non-significant

** Significant at P<0.01

Fig. - 2. Seasonal prevalence of nematode, cestode and protozoal parasites in faecal samples.

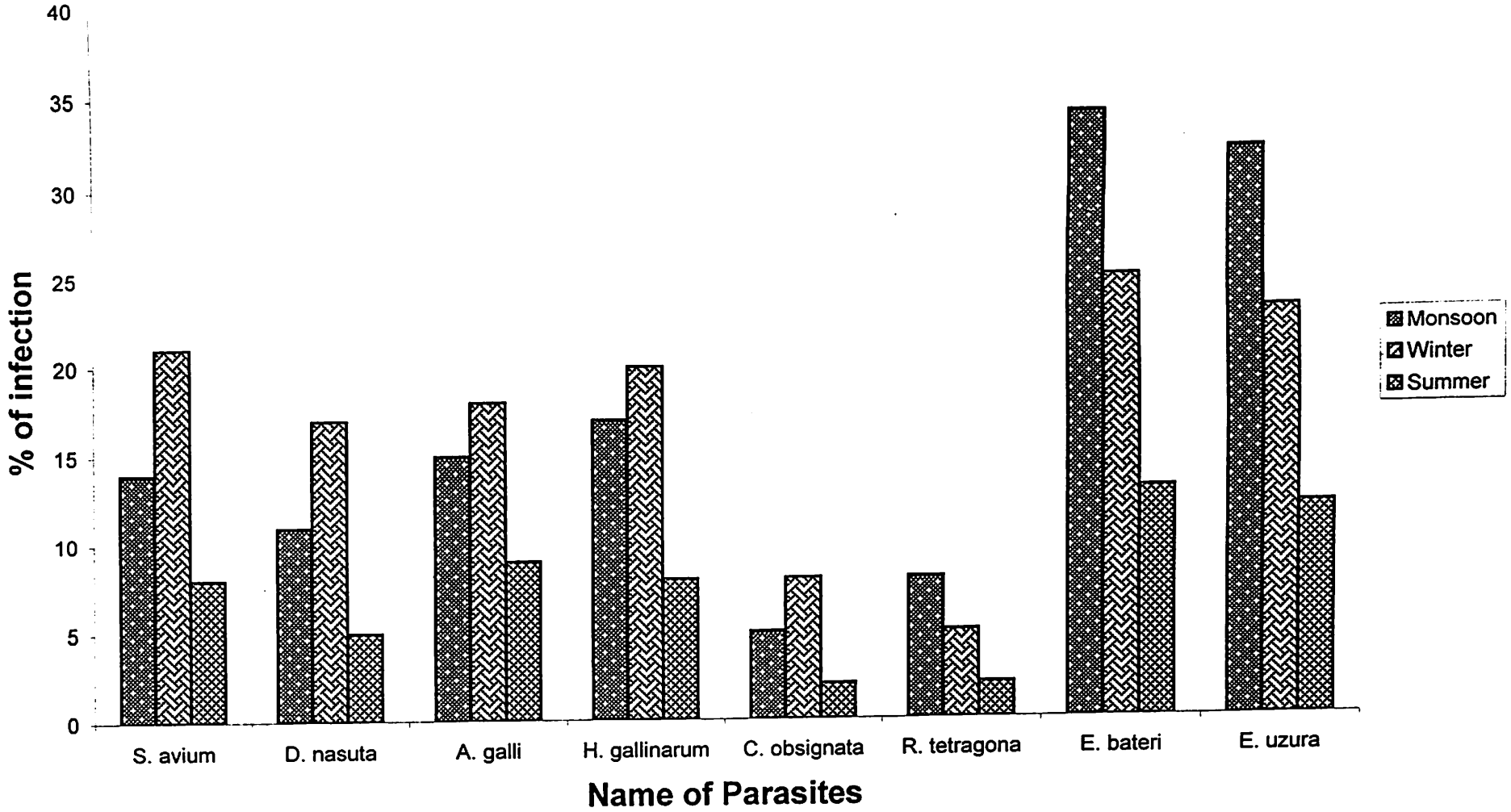
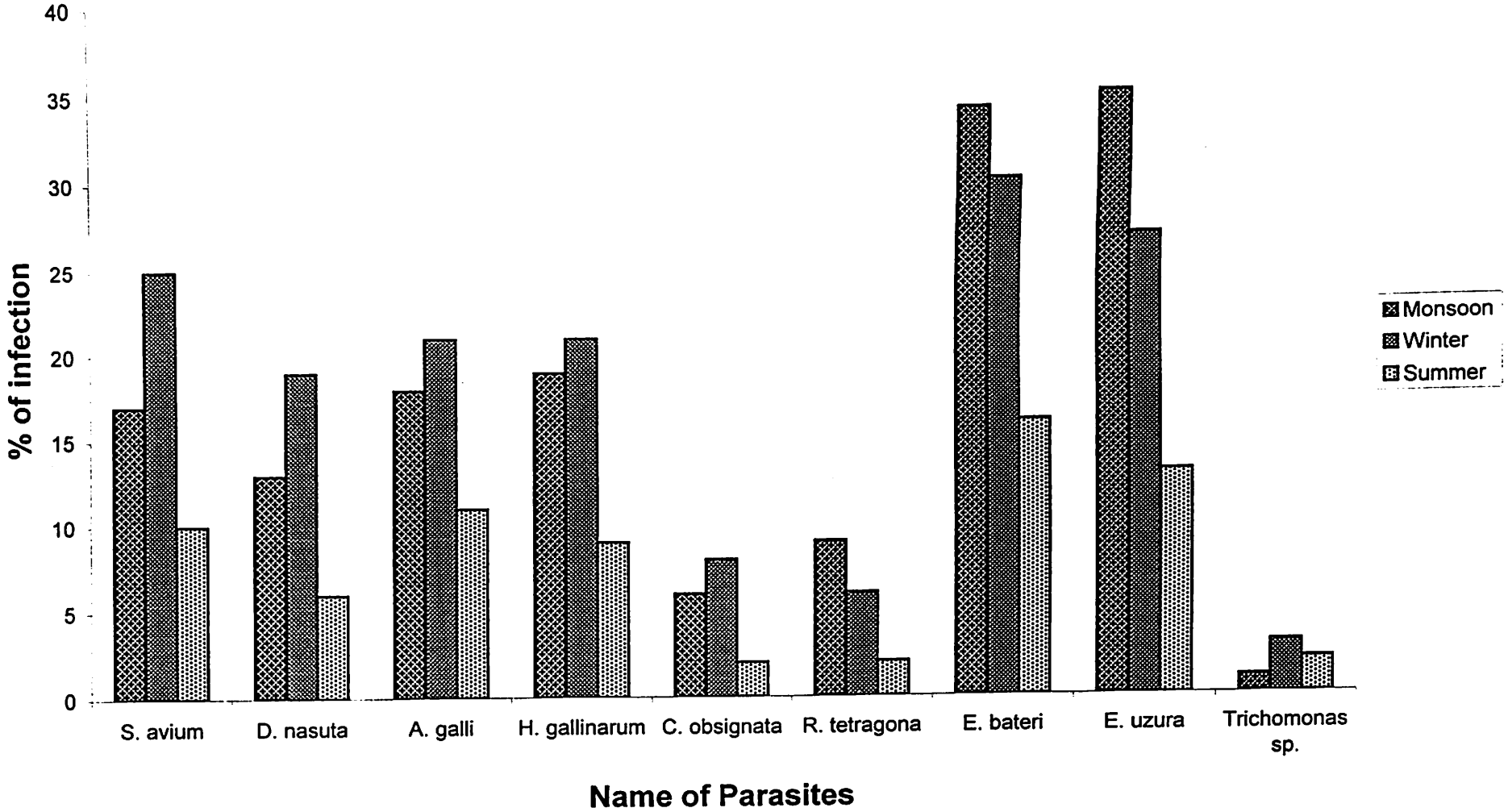


Fig. - 3. Seasonal prevalence of nematode, cestode and protozoal parasites in intestinal scrapings.



(23%) and the lowest in summer (12%) seasons. The value of chi-square test revealed significant difference ($P<0.01$) for the seasonal prevalence of *E.uzura.*

Seasonal prevalence of protozoal parasites examined through intestinal scrapings in different seasons have been shown in Table-6B and Fig.-3. It was noticed that one more protozoal parasites i.e. *Trichomonas* sp. was found in the present study. It was observed that *E.bateri* and *E.uzura* showed highest prevalence in monsoon seasons, followed by winter and summer seasons while the *Trichomonas* sp. showed highest prevalence in winter followed by summer and monsoon seasons. The prevalence of *E. bateri* in monsoon, winter and summer seasons were found to be 34%, 30% and 16% respectively. The value of $X^2_{2d.f}$ revealed significant seasonal difference ($P<0.01$) for the prevalence of *E.bateri.* In the same manner the prevalence of *E.uzura* was found to be highest during monsoon season (35%), followed by winter (27%) and the lowest in summer(13%) seasons. The value of $X^2_{2d.f.}$ was found to be significant ($P<0.01$) for the seasonal prevalence of *E. uzura.*

Table-6B and Fig.-3, also showed that prevalence of *Trichomonas* sp. during winter season (3%) was found to be highest, followed by summer (2%) and the lowest in monsoon (1%) seasons, yet, the value of $X^2_{2\ d.f.}$ was found to be non-significant.

AGE GROUP:-

PREVALENCE OF NEMATODE PARASITES IN YOUNG AND ADULT AGE GROUP OF QUAILS :-

The prevalence percentage of different nematodes in young and adult quails found in faecal samples are presented in Table-7A and Fig.-4. It is evident from the table that the prevalence of *S.avium* (Fig.-6) among

TABLE-7A. PREVALENCE OF NEMATODE PARASITES IN DIFFERENT AGE GROUPS OF JAPANESE QUAILS IN FAECAL SAMPLES.

Nematodes	Age group	No. of birds examined	No. of birds infected	% of infection	X^2_1 d.f.
Strongyloides avium	Young	150	13	8.66	12.842**
	Adult	150	30	20.00	
Dispharynx nasuta	Young	150	21	14.00	2.741^{NS}
	Adult	150	12	8.00	
Ascaridia galli	Young	150	24	16.00	0.996^{NS}
	Adult	150	18	12.00	
Heterakis gallinarum	Young	150	21	14.00	0.235^{NS}
	Adult	150	24	16.00	
Capillaria obsignata	Young	150	8	5.33	0.070^{NS}
	Adult	150	7	4.60	

^{NS} Non-significant

** Significant at $P<0.01$

the young and adult quails were observed to be 8.66% and 20.0% respectively. The value of $X^2_{1d.f.}$ revealed significant effect ($P<0.01$) of age on the prevalence of *S.avium*. It was also noticed that prevalence of *D.nasuta,* in young and adult quails was observed to be 14% and 8% respectively, however, the value of $X^2_{1d.f.}$ revealed the difference to be non-significant in the young and adult age groups of quails. Similarly, the prevalence of *A.galli* was detected to be 16% and 12% in young and adult quails respectively, yet, the value of $X^2_{1d.f.}$ did not reveal any significant difference in the young and adult age group of quails. It can also be interpreted from the table that the prevalence of nematode *H.gallinarum* among young and adult quails, was observed to be 14% and 16% respectively, however, the value of $X^2_{1d.f.}$ did not reveal any significant difference on the prevalence of *H. gallinarum* in young and adult age group of quails. The prevalence of *Capillaria obsignata* among the young and adult quails, was found to be 5.33% and 4.60% respectively, however, the value of $X^2_{1d.f.}$ did not reveal any significant effect on the prevalence of *C.obsignata* in the young and adult age group of quails.

The prevalence percentage of different nematodes in young and adult quails found in intestinal scrapings are depicted in Table-7B and Fig.-5. It is evident from the table that the prevalence of *S.avium* among the young and adult quails were observed to be 10.66% and 24.0% respectively. The value of $X^2_{1d.f.}$ revealed significant effect ($P<0.01$) of age on the prevalence of *S.avium*. It was also noticed that prevalence of *D.nasuta,* in young and adult quails was observed to be 16.0% and 9.30% respectively, however, the value of $X^2_{1d.f.}$ revealed the difference to be significant ($P<0.05$) in the young and adult age groups of quails. Similarly, the prevalence of *A.galli* was detected to be 20.0% and 13.33% in young

TABLE- 7B. PREVALENCE OF NEMATODE PARASITES IN DIFFERENT AGE GROUPS OF JAPANESE QUAILS IN INTESTINAL SCRAPINGS.

Nematodes	Age group	No. of birds examined	No. of birds infected	% of infection	X^2_1 d.f.
Strongyloides avium	Young	150	16	10.66	9.305**
	Adult	150	36	24.00	
Dispharynx nasuta	Young	150	24	16.00	4.873*
	Adult	150	14	9.30	
Ascaridia galli	Young	150	30	20.00	2.400NS
	Adult	150	20	13.33	
Heterakis gallinarum	Young	150	21	14.00	1.986NS
	Adult	150	28	18.60	
Capillaria obsignata	Young	150	9	6.00	0.407NS
	Adult	150	7	4.60	

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

and adult quails respectively, yet, the value of $X^2_{1d.f.}$ did not reveal any significant difference in the young and adult age group of quails. It can also be interpreted from the table that the prevalence of nematode *H.gallinarum* among young and adult quails, was observed to be 14.0% and 18.60% respectively, however, the value of $X^2_{1\ d.f.}$ did not reveal any significant difference on the prevalence of *H. gallinarum* in young and adult age group of quails. The prevalence of *Capillaria obsignata* among the young and adult quails, was found to be 6.0% and 4.60% respectively, however, the value of $X^2_{1.d.f}$ did not reveal any significant effect on the prevalence of *C.obsignata* in the young and adult age group of quails.

PREVALENCE OF CESTODE PARASITES IN YOUNG AND ADULT AGE GROUPS OF QUAILS:-

The prevalence of cestode parasite (*R.tetragona*) among young and adult quails in faecal samples are presented in Table-8A and Fig-4. It was observed that the prevalence of *R.tetragona* was found to be 4% in young quails and 6% in adult quails, however, the value of $X^2_{1d.f.}$ did not reveal any significant effect on the prevalence of *R.tetragona* in the young and adult age group of quails.

The prevalence of cestodes among young and adult quails in the intestinal scrapings are depicted in Table-8B and Fig.-5. It was noticed that the prevalence of *R.tetragona* was found to be 4.60% and 6.66% in young and adult quails respectively, however the value $X^2_{1.d.f.}$ found to be non-significant.

PREVALENCE OF PROTOZOAL PARASITES IN YOUNG AND ADULT AGE GROUPS OF QUAILS :-

The prevalence of protozoal parasites (*E.bateri* and *E.uzura*) in young and adult age group of quails found in faecal samples are presented

TABLE- 8A. PREVALENCE OF CESTODE PARASITES IN DIFFERENT AGE GROUPS OF JAPANESE QUAILS IN FAECAL SAMPLES .

Cestodes	Age group	No. of birds examined	No. of birds infected	% of infection	X^2_1 d.f.
Raillietina tetragona	Young	150	6	4.00	0.631^{NS}
	Adult	150	9	6.00	

^{NS} Non-significant

TABLE- 8B. PREVALENCE OF CESTODE PARASITES IN DIFFERENT AGE GROUPS OF JAPANESE QUAILS IN INTESTINAL SCRAPINGS.

Cestodes	Age group	No. of birds examined	No. of birds infected	% of infection	X^2_1 d.f.
Raillietina tetragona	Young	150	7	4.60	0.561^{NS}
	Adult	150	10	6.66	

^{NS} Non-significant

in Table -9A and Fig.-4. The prevalence of *E. bateri* among young and adult quails were observed to be 30.66% and 17.33% respectively. The value of $X^2_{1d.f.}$ for the prevalence *E. bateri* was found to be significant ($P<0.01$) for young and adult age groups of quails. Similarly the prevalence of *E.uzura* among the young and adult quails were observed to be 28.66.0% and 16.00% respectively. The value of $X^2_{1d.f.}$ revealed significant effect ($P<0.01$) of age on the prevalence *E.uzura.*

The prevalence of protozoal parasites (*E.bateri, E.uzura* and *Trichomonas* sp.) in young and adult quails found in intestinal scrapings have been depicted in Table-9B and Fig.-5. It was observed that the prevalence of *E.bateri* in young and adult quails was found to be 34.66% and 18.66% respectively. The value of $X^2_{1d.f.}$ revealed significant effect ($P<0.01$) of age on the prevalence *E.bateri.* It was noticed that the prevalence of *E.uzura* in young and adult quails was found to be 32.0% and 18.0% respectively. The value of $X^2_{1d.f}$ revealed the significant effect ($P<0.01$) of age on the prevalence of *E.uzura* in young and adult quails. As far as *Trichomonas* sp. was concerned the prevalence percentage was found to be equal (2.0%) in both young and adult quails .

MANAGMENTAL CONDITIONS :-

The general methods of managemental practices adopted by most of the farms were poor. Deep litter rearing of quails were common and no farms had adopted the cage system of rearing. They used to keep young and adult quails together without changing the litter. Feeding troughs and water appliances were paid little attention. The human attendant handling chickens and quails were common. Over crowding was not common factor in farms. It was observed that most of the quail houses in farms were closely located with the chicken farms.

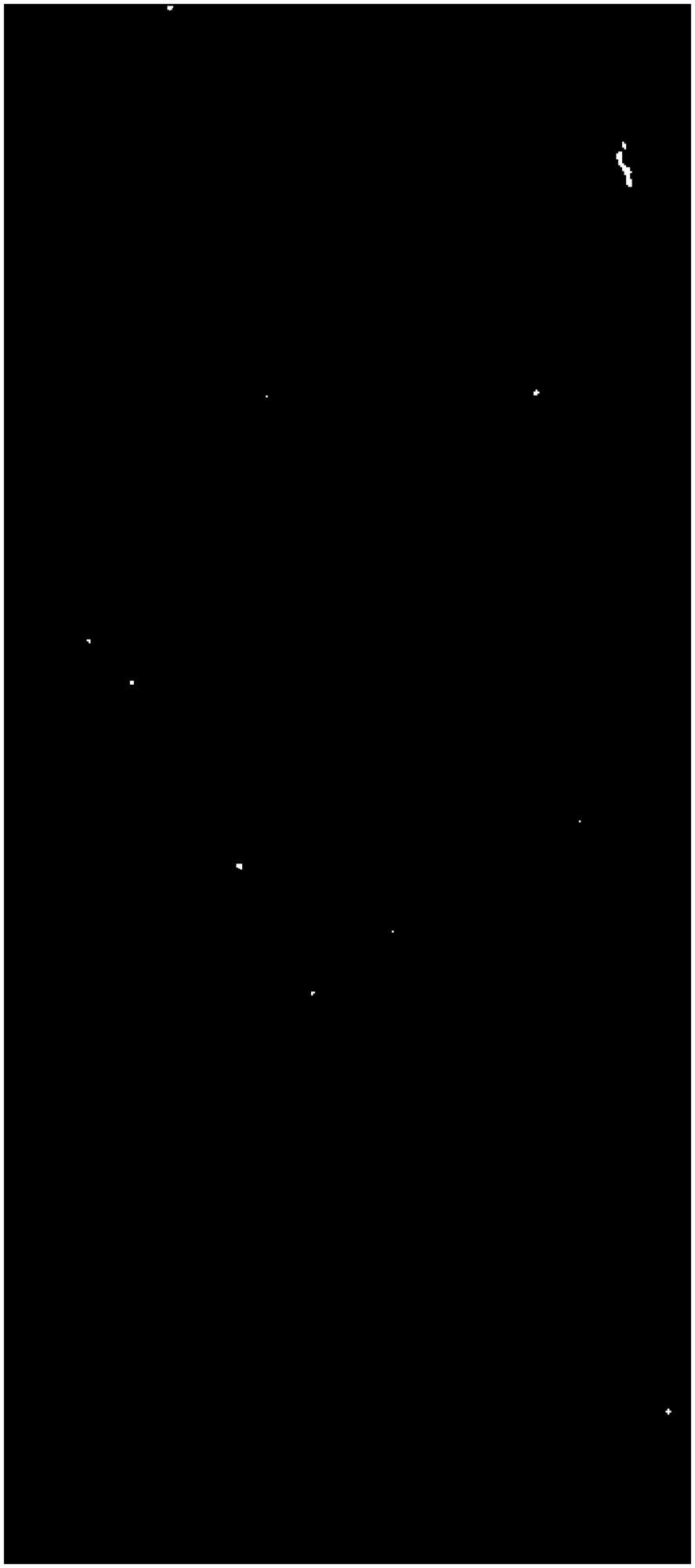


TABLE- 9A. PREVALENCE OF PROTOZOAL PARASITES IN DIFFERENT AGE GROUPS OF JAPANESE QUAILS IN FAECAL SAMPLES .

Protozoa	Age group	No. of birds examined	No. of birds infected	% of infection	X^2_1 d.f.
Eimeria bateri	Young	150	46	30.66	7.309**
	Adult	150	26	17.33	
Eimeria uzura	Young	150	43	28.66	6.937**
	Adult	150	24	16.00	

** Significant at P<0.01

TABLE- 9B. PREVALENCE OF PROTOZOAL PARASITES IN DIFFERENT AGE GROUPS OF JAPANESE QUAILS IN INTESTINAL SCRAPINGS.

Protozoa	Age group	No. of birds examined	No. of birds infected	% of infection	X^2_1 d.f.
Eimeria bateri	Young	150	52	34.66	9.818**
	Adult	150	28	18.66	
Eimeria uzura	Young	150	48	32.00	7.84**
	Adult	150	27	18.00	
Trichomonas sp.	Young	150	3	2.00	0.307NS
	Adult	150	3	2.00	

NS Non-significant

** Significant at P<0.01

Fig. - 4. Prevalence of nematode, cestode and protozoal parasites in young and adult age groups of Japanese quails found in feacal samples

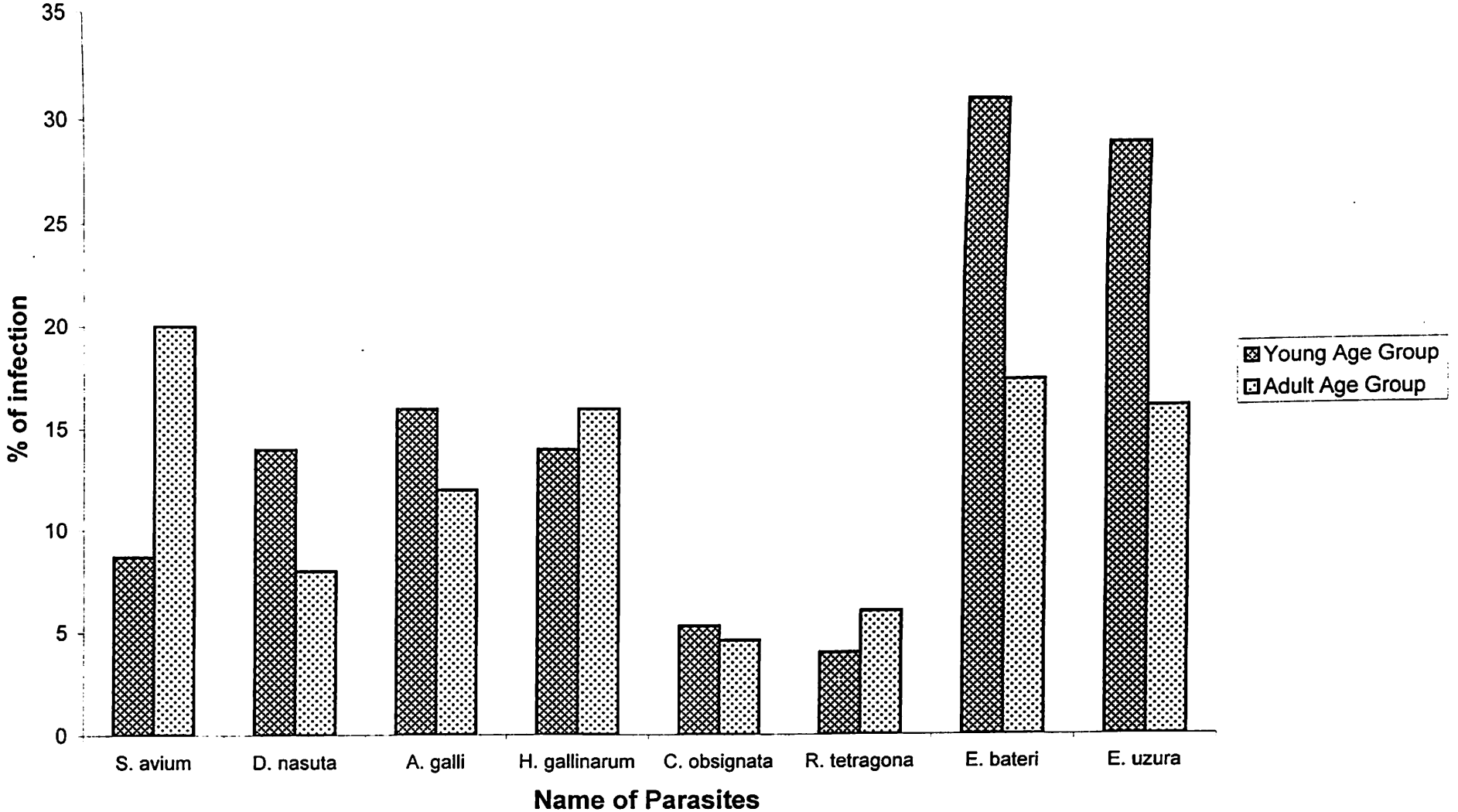
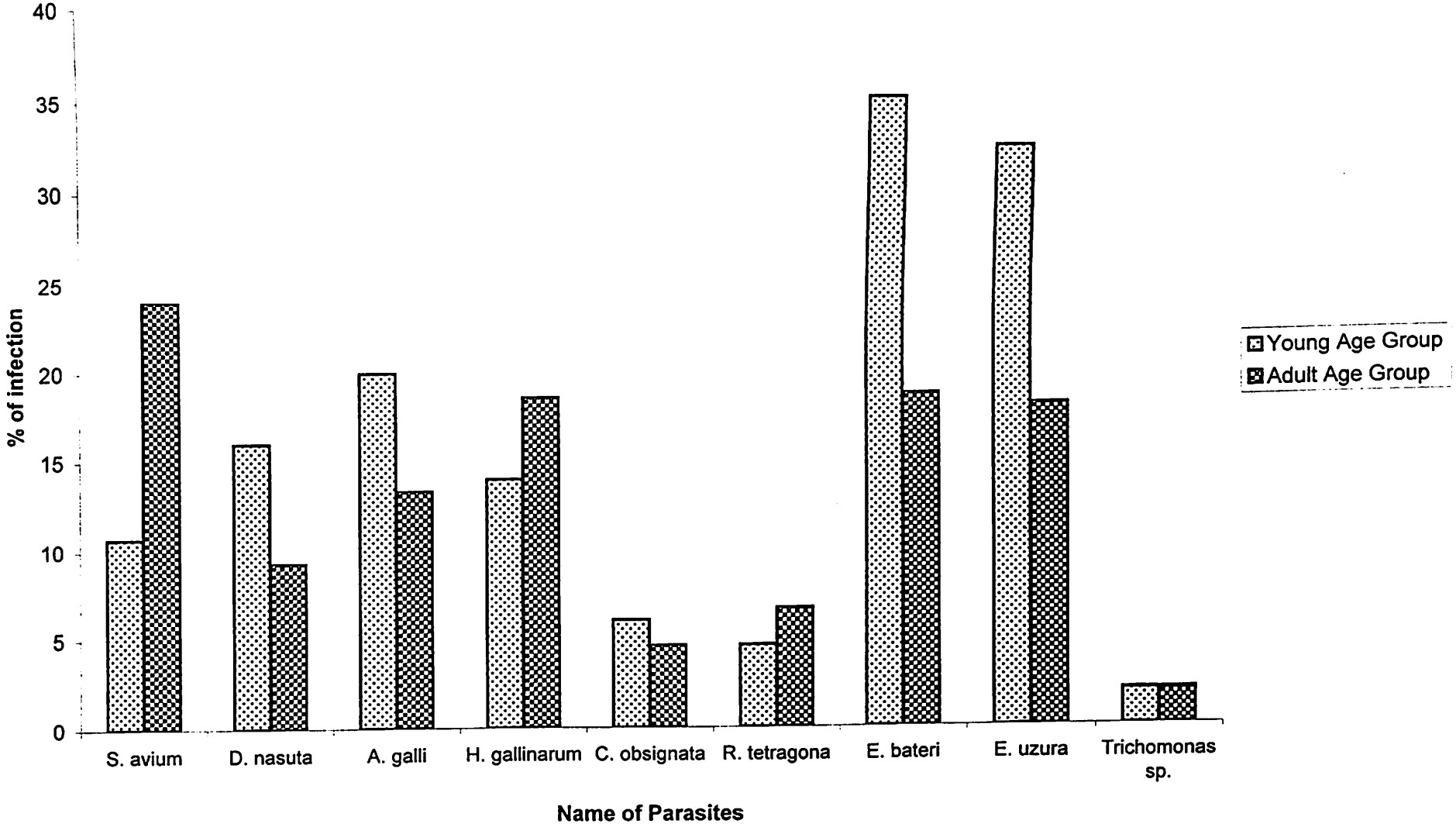


Fig. - 5. Prevalence of nematode, cestode and protozoal parasites in young and adult age groups of Japanese quails found in intestinal scrapings.



HAEMATOLOGICAL STUDIES:-

Total Erythocytic Count (TEC) : -The Mean along with Standard error (S.E.) and coefficient of variation percentage (C.V.%) of total erythrocytic count of young and adult quail has been depicted in Table-11A and 11B respectively. As evident from Table-11A, the Mean ± S.E. value of TEC in young quail having infection with nematodes, cestodes and protozoa was found to be 3.00±0.15, 2.90±0.30 and 3.10±0.33 respectively, whereas in control the value was 3.48±0.31. Analysis of variance (Table-10A) revealed that there was no significant change in TEC of young quails infected with different helminthic and protozoal parasites. It can be interpreted from the mean Table -11A, that in general TEC registered a drop of 0.48, 0.58 and 0.38 in nematodes, cestodes and protozoa infected birds respectively, but this change did not prove to be statistically significant.

The Mean ± S.E. value of TEC in adult quails infected with nematodes, cestodes and protozoa was found to be 4.42±0.25, 4.50±0.27 and 4.44±0.19 respectively, whereas in control adult bird the value was found to be 5.16±0.25. (Table -11B).Analysis of variance showed that TEC did not differ significantly in different helminthic and protozoal infected quails (Table-10B). It is evident from mean Table-11B, that TEC registered a drop of 0.74, 0.66 and 0.72 respectively in nematodes, cestodes and protozoa infected birds but this decrease in TEC was found to be statistically non-significant.

Haemoglobin percentage (Hb%):-

Means along with their Standard error (S.E.) and coefficient of variation percentage (C.V.%) of healthy and parasitic infected young and adult quails are presented in Table-12A & 12B. The Mean ± S.E.value of

TABLE 10A. ANALYSIS OF VARIANCE SHOWING THE EFFECT OF PARASITES ON DIFFERENT HAEMATOLOGICAL PARAMETERS OF YOUNG JAPANESE QUAILS.

HAEMATOLOGY	SOURCES OF VARIATION	DEGREE OF FREEDOM	MEAN SQUARES	F-VALUE
Total Erythrocytic count.	Between groups Error	3 16	0.32 0.41	0.78^{NS}
Haemoglobin	Between groups Error	3 16	13.09 1.46	8.93^{**}
Erythrocytes Sedimentation rate	Between groups Error	3 16	0.55 0.19	2.77^{NS}
Total Leucocytic Count	Between groups Error	3 16	15.38 2.17	7.07^{**}
Heterophils	Between groups Error	3 16	11.55 1.77	6.50^{**}
Lymphocytes	Between groups Error	3 16	6.18 1.40	4.41^{**}
Eosinophils	Between groups Error	3 16	6.89 2.12	3.25^{*}
Monocytes	Between groups Error	3 16	5.64 3.39	1.43^{NS}
Basophils	Between groups Error	3 16	2.42 10.75	0.22^{NS}

^{NS} Non-significant
* Significant at $P<0.05$
** Significant at $p<0.01$

TABLE 10B. ANALYSIS OF VARIANCE SHOWING THE EFFECT OF PARASITES ON DIFFERENT HAEMATOLOGICAL PARAMETERS OF ADULT JAPANESE QUAILS.

HAEMATOLOGY	SOURCES OF VARIATION	DEGREE OF FREEDOM	MEAN SQUARES	F-VALUE
Total Erythrocytic count.	Between groups Error	3 16	0.63 0.36	1.73^{NS}
Haemoglobin	Between groups Error	3 16	12.76 1.30	9.81^{**}
Erythrocytes Sedimentation rate	Between groups Error	3 16	5.52 0.43	12.19^{**}
Total Leucocytic Count	Between groups Error	3 16	29.73 2.67	11.11^{**}
Heterophils	Between groups Error	3 16	7.04 1.08	6.51^{**}
Lymphocytes	Between groups Error	3 16	9.55 1.38	6.92^{**}
Eosinophils	Between groups Error	3 16	8.29 2.48	3.34^{*}
Monocytes	Between groups Error	3 16	2.07 1.34	1.57^{NS}
Basophils	Between groups Error	3 16	23.55 8.23	2.86^{NS}

^{NS} Non-significant
* Significant at $P<0.05$
** Significant at $p<0.01$

TABLE-11A. MEANS ALONG WITH THEIR STANDARD ERRORS (S.E.) AND COEFFICIENT OF VARIATION PERCENTAGES (CV%) OF TOTAL ERYTHROCYTIC COUNT (TEC) OF YOUNG QUAILS.

GROUPS.	MEAN ± S.E. (10^6/ Cu.mm)	C.V .%
Control.	3.48 ± 0.31	20.25
Nematodes	3.00 ± 0.15	11.78
Cestodes	2.90 ± 0.30	23.64
Protozoa	3.10 ± 0.33	23.92

TABLE-11B. MEANS ALONGWITH THEIR STANDARD ERRORS (S.E.) AND COEFFICIENT OF VARIATION PERCENTAGES (CV%) OF TOTAL ERYTHROCYTIC COUNT OF ADULT QUAILS.

GROUPS.	MEAN ± S.E. (10^6/Cu.mm)	C. V.%
Control	5.16 ± 0.25	11.18
Nematodes	4.42 ± 0.25	16.88
Cestodes	4.50 ± 0.27	13.51
Protozoa	4.44 ± 0.19	9.89

TABLE-12A. MEANS ALONGWITH THEIR STANDARD ERRORS (S.E.) AND COEFFICIENT OF VARIATION PERCENTAGES (CV%) Of HAEMOGLOBIN CONCENTRATION OF YOUNG QUAILS.

GROUPS	MEAN ± S.E. (gm / 100 ml)	C . V.%
Control	$10.34^{a} \pm 0.71$	15.46
Nematodes	$8.24^{b} \pm 0.55$	14.92
Cestodes	$7.84^{b} \pm 0.48$	13.68
Protozoa	$9.46^{ab} \pm 0.51$	12.20

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

TABLE-12B. MEANS ALONG WITH THEIR STANDARD ERRORS (S. E.) AND COEFFICIENT OF VARIATION PERCENTAGES (CV%) OF HAEMOGLOBIN CONCENTRATION OF ADULT QUAILS.

GROUPS.	MEAN ± S.E (gm / 100 ml)	C .V. %
Control	$13.18^{a} \pm 0.50$	8.59
Nematodes	$11.40^{b} \pm 0.37$	7.31
Cestodes	$9.28^{c} \pm 0.73$	17.66
Protozoa	$11.50^{b} \pm 0.33$	6.56

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

haemoglobin percentage in young quails infected with nematodes, cestodes and protozoa was found to be 8.24±0.55, 7.84±0.48 and 9.46±0.51 respectively, whereas in control group this value was recorded to be 10.34±0.71(Table-12A). Analysis of variance (Table-10A) showed that Hb % differ significantly ($P<0.01$) in parasitic infected young quails. From the mean table-12A, it is evident that Hb% reduced significantly ($P<0.05$) by 2.1 and 2.5 respectively in nematodes and cestodes infected birds, whereas, in protozoal infected bird it was reduced by 0.88, which was found to be statistically non-significant.

The Mean ± S.E. value of Hb% recorded in adult quail having infection of nematodes, cestodes and protozoa was 11.40±0.37, 9.28±0.73 and 11.50±0.33 respectively, whereas in control this value was found to be 13.18±0.50 (Table-12B). Analysis of variance (Table-10B) showed that Hb% differ significantly in adult quails infected with various parasitic infection. It can be interpreted from the mean table-12B that Hb% decreased significantly ($P<0.05$) by 1.78, 3.90 and 1.68 respectively in nematodes, cestodes and protozoa infected birds.

Erythrocyte Sedimentation Rate (ESR) :-

The Mean ± S.E. and coefficient of variation percentage (C.V.%) of ESR of young and adult quails infected with nematodes, cestodes and protozoa along with their control has been presented in Table-13A and 13B respectively . The Mean ± S.E. value of ESR of young quails infected with nematodes, cestodes and protozoa were estimated to be 3.1±0.18, 3.4±0.24 and 3.1±0.17 respectively whereas in control group this value was found to be 2.6±0.18 (Table-13A). The analysis of variance (Table-10A) revealed that there was no significant change in ESR of

TABLE-13A. MEANS ALONGWITH THEIR STANDARD ERRORS (S.E.) AND COEFFICIENT OF VARIATION PERCENTAGES (CV%) OF ERYTHROCYTES SEDIMENTATION RATE (ESR) OF YOUNG QUAILS.

GROUPS.	MEAN ± S.E. (mm / hr.)	C.V.%.
Control	2.6 ± 0.18	16.08
Nematodes	3.1 ± 0.18	13.49
Cestodes	3.4 ± 0.24	16.10
Protozoa	3.1 ± 0.17	12.28

TABLE-13B. MEANS ALONGWITH THEIR STANDARD ERRORS (S.E.) AND COEFFICIENT OF VARIATION PERCENTAGES (CV%) OF ERYTHROCYTES SEDIMENTATION RATES (ESR) OF ADULT QUAILS.

GROUPS	MEAN ± S.E. (mm / hr)	C.V.%
Control	$1.8^{a} \pm 0.33$	42.12
Nematodes	$3.76^{b} \pm 0.11$	6.67
Cestodes	$3.74^{b} \pm 0.29$	17.79
Protozoa	$2.08^{a} \pm 0.38$	41.13

Means bearing different superscripts differs significantly ($P<0.01$).

young quails infected with different helminths and protozoal infection. From the mean Table-13A, it is evident that ESR in nematodes, cestodes and protozoa infected birds increased by 0.5,0.8 and 0.5 respectively but this change did not differ significantly.

The Mean ± S.E. value of ESR in adult quails infected with nematodes, cestodes and protozoa was found to be 3.76±0.11, 3.74±0.29 and 2.08±0.38 respectively, whereas in healthy adult bird this value was found to be 1.8±0.33 (Table-13B). Analysis of variance revealed the significant effect ($P<0.01$) of different parasites on ESR (Table-10B). It is evident from mean table-13B, that ESR of nematodes, cestodes and protozoal infected group increased significantly ($P<0.01$) by 1.96, 1.94 and 1.66 respectively.

Total Leucocytic Count (TLC) :-

The Mean along with their standard error (S.E.) and coefficient of variation percentage (C.V.%) of total leucocytic count of young and adult Japanese quail infected with nematodes, cestodes and protozoa along with their control has been presented in Table-14A and 14B respectively. As evident from Table-14A, that Mean ± S.E. value of TLC of young quails having infection with nematodes, cestodes and protozoa was found to be 15.4±0.51 ,14.6±0.68 and 17.4±0.86 respectively whereas in control this value was found to be 18.4±0.75. Analysis of variance(Table-10A) revealed the significant effect ($P<0.01$) of different helminthic and protozoal infection on TLC of young quails. It was observed that mean TLC value of nematodes and cestodes infected young quail diminished significantly ($P< 0.05$) by 3.0 and 3.8 respectively from the control , while in protozoal infected group TLC value was shown to be decreased by 1.0 from the control, however, the difference was non-significant (Table-14A).

TABLE -14A. MEANS ALONG WITH THEIR STANDARD ERRORS (S.E.) AND COEFFICIENT OF VARIATION PERCENTAGES (CV%) OF TOTAL LEUCOCYTIC COUNT (TLC) OF YOUNG QUAILS.

GROUPS	MEAN ± S.E. (10^3/ Cu.mm)	C.V.%
Control	$18.4^{a} \pm 0.75$	9.09
Nematodes	$15.4^{b} \pm 0.51$	7.40
Cestodes	$14.6^{b} \pm 0.68$	10.38
Protozoa	$17.4^{a} \pm 0.68$	8.71

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

TABLE-14B. MEANS ALONGWITH THEIR STANDARD ERRORS (S.E.) AND COEFFICIENT OF VARIATION PERCENTAGES (CV%) OF TOTAL LEUCOCYTIC COUNT (TLC) OF ADULT QUAILS.

GROUPS	MEAN ± S.E. (10^3/ Cu. mm)	C. V. %
Control	$23.8^{a} \pm 0.58$	5.47
Nematodes	$20.4^{b} \pm 0.75$	8.20
Cestodes	$18.0^{c} \pm 0.70$	8.78
Protozoa	$21.8^{ab} \pm 0.86$	8.82

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

The Mean ± S.E. values of TLC in adult quails showing nematodes, cestodes and protozoal infection was found to be 20.4±0.75, 18.0±0.70 and 21.8±0.86 respectively and in the control this value was 23.8±0.58 (Table-14B). The analysis of variance showed the significant effect ($P<0.01$) of different helminthic and protozoal infection on TLC (Table-10B). It was observed from the Table-14B that the mean TLC values of nematodes and cestodes infected group depressed significantly ($P<0.05$) by 3.4 and 5.8 respectively. The mean TLC value in protozoal infected group decreased by 2.0 from the control, however, the difference was non-significant.

Differential Count (DC) of White blood corpuscles:-

Heterophils:- Means along with their Standard error (S.E.) and coefficient of variation percentage (C.V.%) of heterophils of young and adult quails infected with nematodes, cestodes and protozoa has been depicted in Table-15A & 15B respectively. The Mean ± S.E. value of heterophils in young quails infected with nematodes, cestodes and protozoa were found to be 31.77±0.56, 35.04±0.75 and 32.02±0.56 respectively, whereas in control group this value was recorded as 32.32±0.47. Analysis of variance (Table-10A) revealed the significant effect of ($P<0.01$) different helminthic and protozoal infection on heterophils count. It can be interpreted from the mean Table-15A, that heterophils count in cestodes infected birds rose significantly ($P < 0.01$) by 2.72, whereas in nematodes and protozoa infected birds heterophil counts decreased by 0.55 and 0.30 respectively, but this change did not prove to be significant on statistical analysis.

Mean ± S.E. value of heterophils in adult quails infected with nematodes, cestodes and protozoa were recorded as 29.04±0.62,

TABLE-15A. MEAN ± S.E. OF THE ANGLES CORRESPONDING TO PERCENTAGE (Angle = Arcsin $\sqrt{\text{Percentage}}$) OF HETEROPHILS OF YOUNG QUAILS.

GROUPS	MEAN ± S.E.	C.V.%
Control	$32.32^{a} \pm 0.47$ (28.6)	3.09
Nematodes	$31.77^{a} \pm 0.56$ (27.8)	3.95
Cestodes	$35.04^{b} \pm 0.75$ (33.0)	4.78
Protozoa	$32.02^{a} \pm 0.56$ (28.2)	3.91

Figures in parentheses denote the percentage mean.
Means bearing different superscripts differ significantly ($P<0.01$).

TABLE-15B. MEAN ± S.E. OF THE ANGLES CORRESPONDING TO PERCENTAGE (Angle = Arcsin $\sqrt{\text{Percentage}}$) OF HETEROPHILS OF ADULT QUAILS.

GROUPS	MEAN ± S.E.	C.V.%
Control	$28.92^{a} \pm 0.34$ (23.4)	2.66
Nematodes	$29.04^{a} \pm 0.62$ (23.6)	4.83
Cestodes	$31.22^{b} \pm 0.35$ (27.0)	2.53
Protozoa	$28.64^{a} \pm 0.48$ (23.0)	3.75.

Figures in parentheses denote the percentage mean.
Means bearing different superscripts differ significantly ($P<0.01$).

31.22±0.35 and 28.64±0.48 respectively, whereas in control bird this value was found to be 28.92±0.34 (Table-15B). Analysis of variance (Table-10B) reflected the significant effect (P<0.01) of different helminthic and protozoal infection on heterophils count. It is evident from the mean Table-15B, that heterophils count increased significantly (P<0.01) by 2.30 in cestode infected bird. Heterophils count in nematodes infected bird also registered a increase of 0.12, but this change was found to be non-significant. It was also observed that heterophils count in protozoa infected birds decreased by 0.18, which was also found to be non- significant statistically.

Lymphocytes:- Means along with the Standard error (S.E.) and coefficient of variation percentage (C.V.%) of lymphocytes of young and adult quails are presented in Table-16A and 16B respectively. Mean ± S.E. value of lymphocytes in young quails infected with nematodes, cestodes and protozoa were recorded as 51.94±0.26, 50.54±0.77 and 52.53±0.26 respectively, whereas in control bird this value was found to be 53.13±0.62. Analysis of variance (Table-10A) showed the significant effect of (P<0.01) of different helminthic and protozoal infection on lymphocytes count. It can be construed from the mean Table-16A that lymphocytes count decreased significantly (P<0.01) by 2.59 in quails infected with cestodes whereas in nematodes and protozoa infected birds lymphocytes count decreased by 1.19 and 0.60 respectively, but this change was found to be statistically non-significant.

The Mean ± S.E. value of lymphocytes in adult quail infected with nematodes, cestodes and protozoa were found to be 55.8±0.60, 53.85±0.48 and 56.42±0.57 respectively, whereas in control bird this value was

TABLE-16A. MEAN ± S.E. OF THE ANGLES CORRESPONDING TO PERCENTAGE (Angle = Arcsin√Percentage) OF LYMPHOCYTES OF YOUNG QUAILS.

GROUPS.	MEAN ± S.E.	C.V. %
Control	$53.13^{a} \pm 0.62$ (64.0)	2.61
Nematodes	$51.94^{ab} \pm 0.26$ (62.0)	1.13
Cestodes	$50.54^{b} \pm 0.77$ (59.6)	3.41
Protozoa	$52.53^{ac} \pm 0.26$ (63.0)	1.13

Figures in parentheses denote the percentage mean.
Means bearing different superscripts differ significantly ($P < 0.01$)

TABLE -16B. MEAN ± S.E. OF THE ANGLES CORRESPONDING TO PERCENTAGE (Angle= Arcsin √Percentage) OF LYMPHOCYTES OF ADULT QUAILS.

GROUPS	MEAN ± S.E	C.V.%
Control	$57.04^{a} \pm 0.42$ (70.4)	1.66
Nematodes	$55.8^{a} \pm 0.60$ (68.4)	2.41
Cestodes	$53.85^{b} \pm 0.48$ (65.0)	2.00
Protozoa	$56.42^{a} \pm 0.57$ (69.4)	2.28

Figures in parentheses denotes percentage mean.
Means bearing different superscripts differ significantly ($P < 0.01$)

recorded to be 57.04±0.42 (Table-16B). Analysis of variance (Table-10B) showed that lymphocytes count differ significantly (P<0.01) for quails infected with helminthic and protozoal infection. It is evident from mean table-16B, that lymphocytes count decreased significantly (P<0.01) by 3.19 in birds infected with cestodes. It was also noticed that lymphocytes count also registered a drop of 1.24 and 0.62 respectively in quails infected with nematodes and protozoa but this change did not prove to be significant on statistical analysis.

Eosinophils:- Means along with the Standard error (S.E.) and coefficient of variation percentage (C.V.%) of young and adult quails infected with nematodes, cestodes and protozoa has been shown in Table - 17A and 17B respectively. The Mean ± S.E. value of eosinophils in young quails infected with nematodes, cestodes and protozoa were estimated to be 12.03±0.71, 10.29±0.31 and 11.72±0.82 respectively, whereas in healthy bird this value was found to be 9.55±0.64(Table-17A). Analysis of variance (Table-10A) revealed significant effect (p<0.05) of different helminthic and protozoal infection on eosinophils count. It can be interpreted from the mean table-17A, that eosinophils count increased significantly (p<0.05) by 2.48 and 2.17 in nematodes and protozoal infected birds respectively. It was also observed that eosinophils count increased by 0.74 in quails infected with cestodes but this change was found to be non-significant.

The Mean ± S.E. value of eosinophils in adult quails infected with nematodes, cestodes and protozoa were found to be 12.05±0.58, 11.72±0.82 and 9.86±0.76 respectively, whereas in control bird this value was recorded as 9.55±0.64 (Table- 17B). Analysis of variance (Table-10B)

TABLE-17A. MEAN ± S.E. OF THE ANGLES CORRESPONDING TO PERCENTAGE (Angle = Arcsin$\sqrt{\text{Percentage}}$) OF EOSINOPHILS OF YOUNG QUAIL.

GROUPS	MEAN ± S.E.	C.V. %
Control	$9.55^{a} \pm 0.64$ (2.8)	15.14
Nematodes	$12.03^{b} \pm 0.71$ (4.4)	13.20
Cestodes	$10.29^{ab} \pm 0.31$ (3.6)	6.77
Protozoa	$11.72^{b} \pm 0.82$ (4.2)	15.72

Figures in parentheses denotes the percentage mean.
Means bearing different superscripts differ significantly ($P < 0.05$).

TABLE-17B. MEAN ± S.E. OF THE ANGLES CORRESPONDING TO PERCENTAGE (Angle = Arcsin$\sqrt{\text{Percentage}}$) OF EOSINOPHILS OF ADULT QUAILS.

GROUPS	MEAN ± S.E.	C. V. %
Control	$9.55^{a} \pm 0.64$ (2.8)	15.14
Nematodes	$12.05^{b} \pm 0.58$ (4.4)	10.83
Cestodes	$11.72^{bc} \pm 0.82$ (4.2)	15.72
Protozoa	$9.86^{ac} \pm 0.76$ (3.0)	17.30

Figures in parentheses denote percentage mean.
Means bearing different superscripts differ significantly ($P < 0.05$)

showed that eosinophils count differed significantly ($P<0.05$) in quails infected with different helminths and protozoa. It is evident from mean table-17B, that eosinophils count increased significantly ($P<0.05$) by 2.50 and 2.17 in quails infected with nematodes and cestodes. It was also observed that eosinophils count increased by 0.31 in quails infected with protozoa but this change was not a significant one.

Monocytes:- Means along with the Standard error (S.E.) and coefficient of variation percentage (C.V.%) of young and adult quail infected with helminths and protozoa were depicted in Table-18A and 18B respectively. The Mean ± S.E. value of monocytes in young quails infected with nematodes, cestodes and protozoa were found to be 12.42±1.24, 10.23±0.69 and 10.14±0.94 respectively where as in control bird this value was recorded as 11.19 ± 0.55 (Table-18A). Analysis of variance (Table-10A) reflected that there was no significant change in monocytes of quails infected with different helminthic and protozoal parasites. It is evident from the mean table that monocytes count increased by 1.23 in quails infected with nematodes, but this change was found to be non- significant statistically. It was also observed that monocytes count decreased by 0.96 and 1.05 in quails infected with cestodes and protozoa respectively, but this change was also found to be non- significant on statistical analysis.

The Mean ± S.E. of monocytes count in adult quails infected with nematodes cestodes and protozoa were found to be 9.55 ± 0.64, 9.92±0.54 and 8.50 ±0.37 respectively where as in control this value was recorded as 8.87±0.45 (Table-18B). Analysis of variance (Table-10B) reflected that monocytes count did not differ significantly in quails

TABLE-18A. MEANS ± S.E. OF THE ANGLES CORRESPONDING TO PERCENTAGE (Angle= Arcsin$\sqrt{\text{percentage}}$) OF MONOCYTES OF YOUNG QUAILS.

GROUPS	MEAN ± S.E.	C.V.%
Control	11.19± 0.55 (3.8)	11.09
Nematodes	12.42± 1.24 (4.8)	22.43
Cestodes	10.23± 0.69 (3.2)	13.79
Protozoa	10.14± 0.94 (3.2)	20.80

TABLE-18B. MEAN ± S.E OF THE ANGLES CORRESPONDING T0 PERCENTAGE (Angle= Arcsin$\sqrt{\text{Percentage}}$) OF MONOCYTES OF ADULT QUAILS

GROUPS	MEAN ± S.E.	C.V.%
Control	8.87 ± 0.45 (2.4)	11.42
Nematodes	9.55 ± 0.64 (2.8)	15.14
Cestodes	9.92 ± 0.54 (3.0)	12.17
Protozoa	8.50 ± 0.37 (2.2)	9.73

infected with different helminths and protozoa. It can be interpreted from the mean table-18B, that monocytes count increased by 0.68 and 1.05 in quails infected with nematods and cestodes respectively, but this change was not found to be significant statistically. It was also noticed that monocytes count in quails infected with protozoa registered a drop of 0.37 but this change was did not prove to be significant on statistical analysis.

Basophils:-Means along with Standard error (S.E) and coefficient of variation percentage of basophils of young and adult quails has been shown in Table -19A and 19B. The Mean ± S.E. value of basophils of young quails infected with nematodes, cestodes and protozoa were found to be 5.07 ± 1.35, 5.07± 1.35 and 5.54 ± 1.49 respectively whereas in control healthy bird this value was found to be 3.92 ± 1.66 (Table-19A). Analysis of variance (Table-10A) revealed no significant change in basophils count of birds infected with helminths and protozoa. It can be construed from the mean table-19A, that basophils count increased by 1.15, 1.15 and 1.62 in quails infected with nematodes cestodes and protozoa respectively, but this change was found to be non-significant.

The Mean ± S.E. of basophils count in adult quails infected with nematodes, cestodes and protozoa were found to be 4.59±1.51, 3.92±1.66 and 8.76±0.83 respectively whereas in healthy bird this value was recorded as 5.07±1.35 (Table-19B). Analysis of variance (Table-10B) reflected that there was no significant change in basophils count in birds infected with helminth and protozoa. It can be interpreted from the mean table-19B, that basophils count decreased by 0.48 and 1.15 in quails infected with nematodes and cestodes but this change was proved to be non significant on statistical analysis. It was also noticed that basophils count increased by

TABLE-19A. MEAN ± S.E. OF THE ANGLES CORRESPONDING TO PERCENTAGE (Angle= Arcsin $\sqrt{\text{Percentage}}$) OF BASOPHILS OF YOUNG QUAILS.

GROUPS	MEAN ± S.E	C.V.%
Control	3.92± 1.66 (0.8)	94.66
Nematodes	5.07 ± 1.35 (1.0)	59.51
Cestodes	5.07 ± 1.35 (0.8)	59.51
Protozoa	5.54± 1.49 (1.4)	59.99

TABLE-19B. MEAN ± S.E OF THE ANGLES CORRESPONDING TO PERCENTAGE (Angle= Arcsin $\sqrt{\text{Percentage}}$) OF BASOPHILS OF ADULT QUAILS.

GROUPS	MEAN ± S.E.	C.V.%
Control	5.07 ± 1.35 (1.0)	59.71
Nematodes	4.59 ± 1.51 (0.8)	55.90
Cestodes	3.92 ± 1.66 (0.8)	94.61
Protozoa	8.76 ± 0.83 (2.4)	21.30

3.96 in birds infected with protozoa , but this change was also found to be non-significant.

HISTOPATHOLOGICAL STUDIES :-

Gross changes:- Altogether 215 quails which were found to be positive for various helminthic and protozoal infection were examined in the laboratory for gross lesions after conducting the postmortem examination. The significant gross lesions were observed in 150 quails in their different visceral organs particularly the digestive tracts including proventriculus, caeca, small and large intestine.

The striking gross changes noticed in the different parts of intestine were, severe congestion of the serosal layer of the intestine with the thickening . On opening the intestine it was observed that the lumen was full of blood tinged faecal materials . In few cases the lining epithelial appeared eroded and the mucosal surface of the intestine particularly the small intestine was covered with whitish flakes, which on removal showed raw red areas. The caeca appeared enlarged swollen and sometimes blood tinged.

It was observed that quails having the less load of nematodes *S.avium* and *H.gallinarum* showed no gross changes. In case of heavy infection with *S.avium* wall of caeca found to be slightly thickened while in the case of *H.gallinarum* caeca showed marked inflammation. The tiny nodules were also observed in the wall of caeca in few cases. In quails infected with *A.galli* severe haemorrhagic and inflammatory changes were noticed (Plate-11). Quails infected with *C. obsignata* showed no marked gross changes in intestine except some thickening of the wall of the affected intestine. Quails having the slight infection with *D. nasuta* showed no marked pathological changes, however, in heavy infection

ulcers were often observed in the wall of proventriculus. Thickening and maceration in proventriculus was also observed in most of the cases. Quails infected with cestode *R.tetragona* showed severe enteritis which was frequently haemorrhagic in heavy infection.

The gross pathological lesions in quails infected with protozoa *E.bateri* and *E. uzura* were mostly comprised of bleaching and balloning of intestine and caeca . Watery intestinal contents and bronze coloured caecal contents with few haemorrhagic spots on the caecal mucous membrane were also observed (Plate-`10).

Microscopic changes:- On microscopic examination of the section prepared from the same infected intestine showed the change of catarrahal, suppurative and haemorrhagic enteritis. These changes were characterised by appearance of mucinous cells in the submucosal gland as well as the lining epithelium of the villi. The lamina propria also revealed thickening (Plate-12).

The suppurative enteritis were characterised by heavy infiltration of heterophils in the submucosal layer with mucinous degeneration in the submucosal gland (Plate-13).The haemorrhagic enteritis showed erythrocytes in the mucosal and submucosal layer of the intestine (Plate-14). In few cases there was severe haemorrhagic inflammatory changes were noticed in the caeca. The intestine affected with coccidia showed oocyst in the lamina propria and submucosal layer on microscopic examination (Plate-15).

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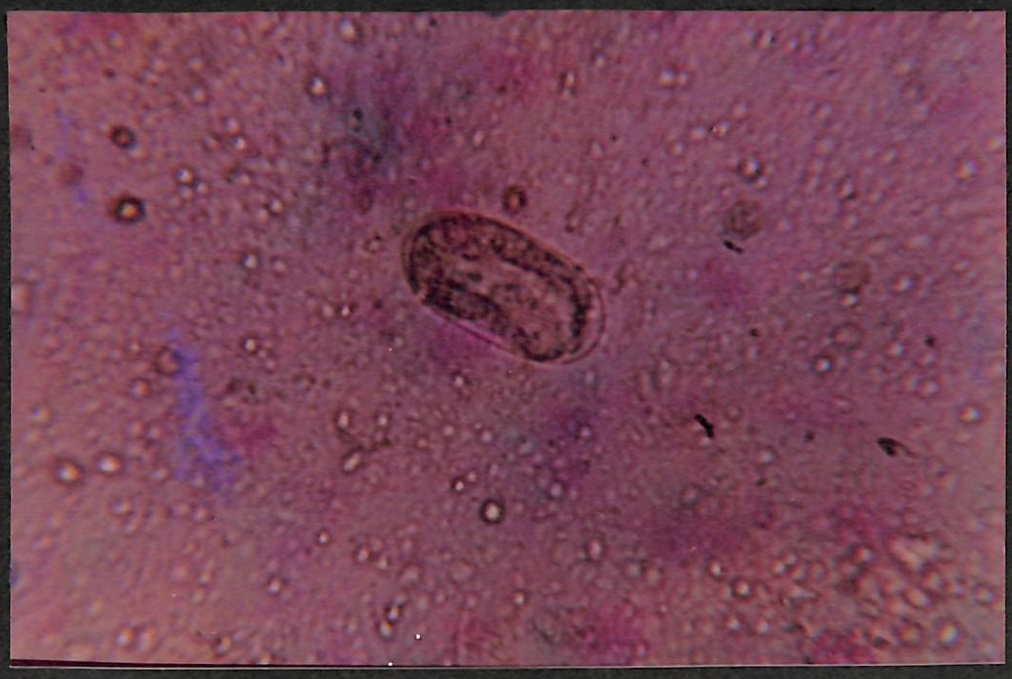


Plate1: Direct preparation of faecal sample showing the egg of *Strongyloides avium* (x 400).

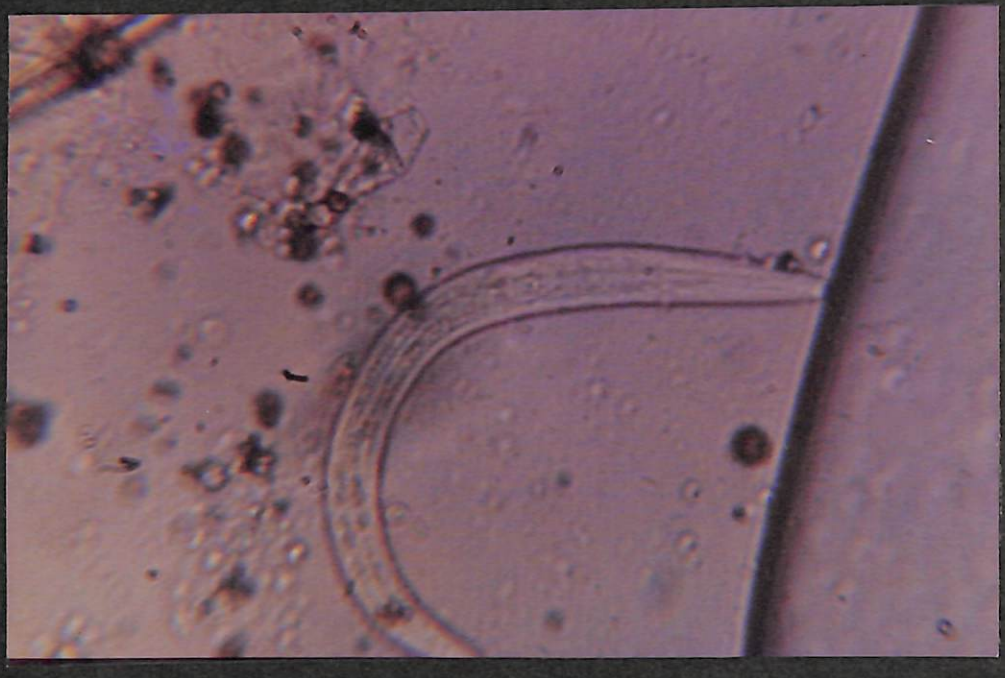


Plate 2: Direct preparation of intestinal scrapings showing larva of *Strongyloides avium*.(x400)

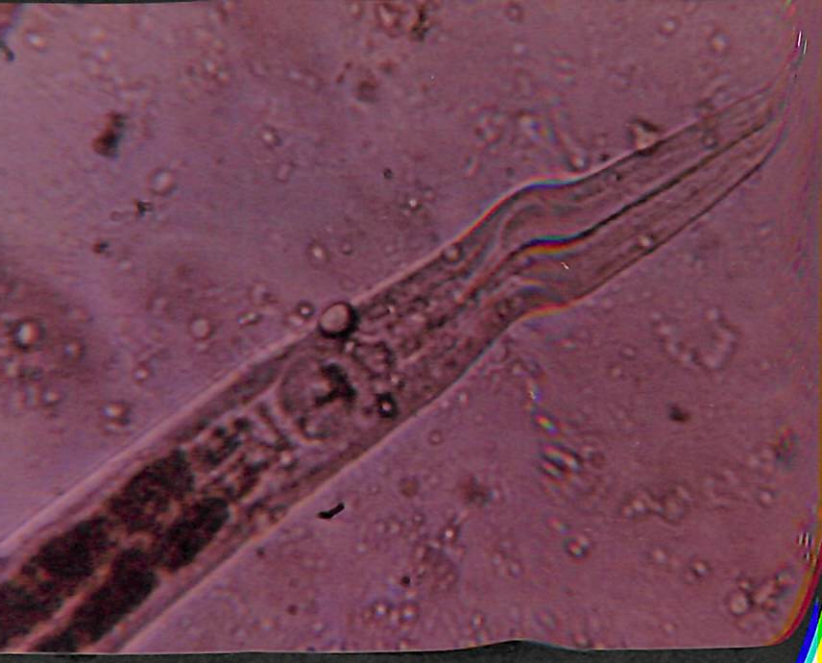


Plate 3: Direct preparation of intestinal scrapings showing the anterior portion of *Strongyloides avium*

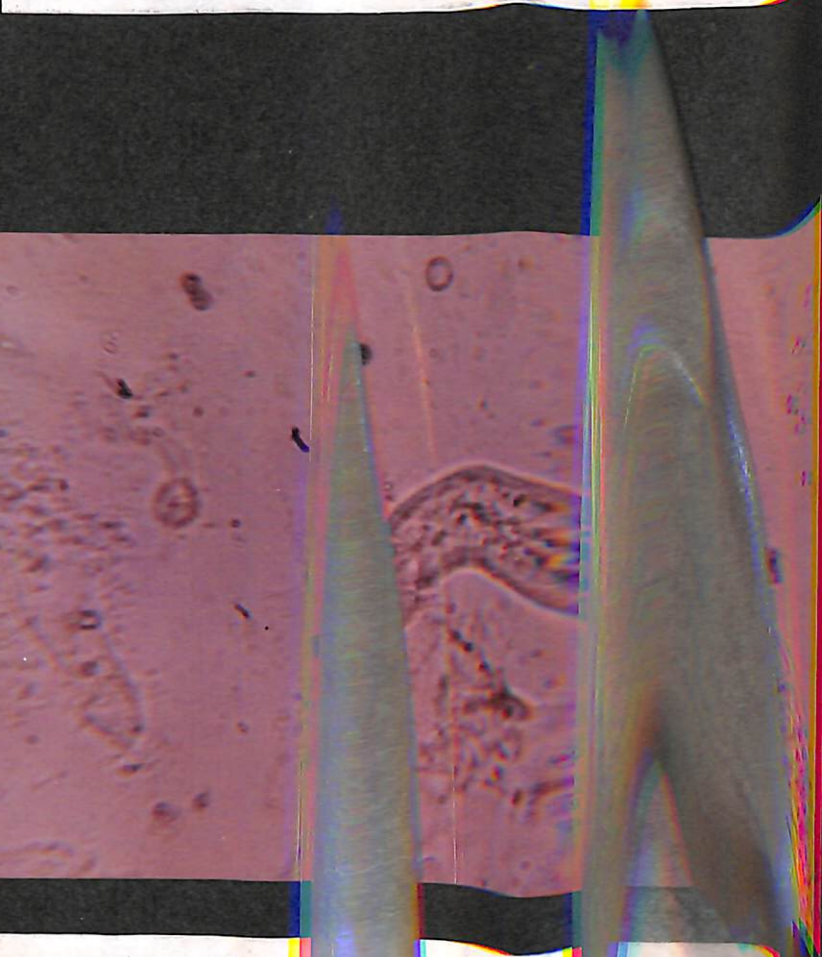


Plate 4: Direct ... on of intestinal scrapings showing the pos... rtion of ... loides avium

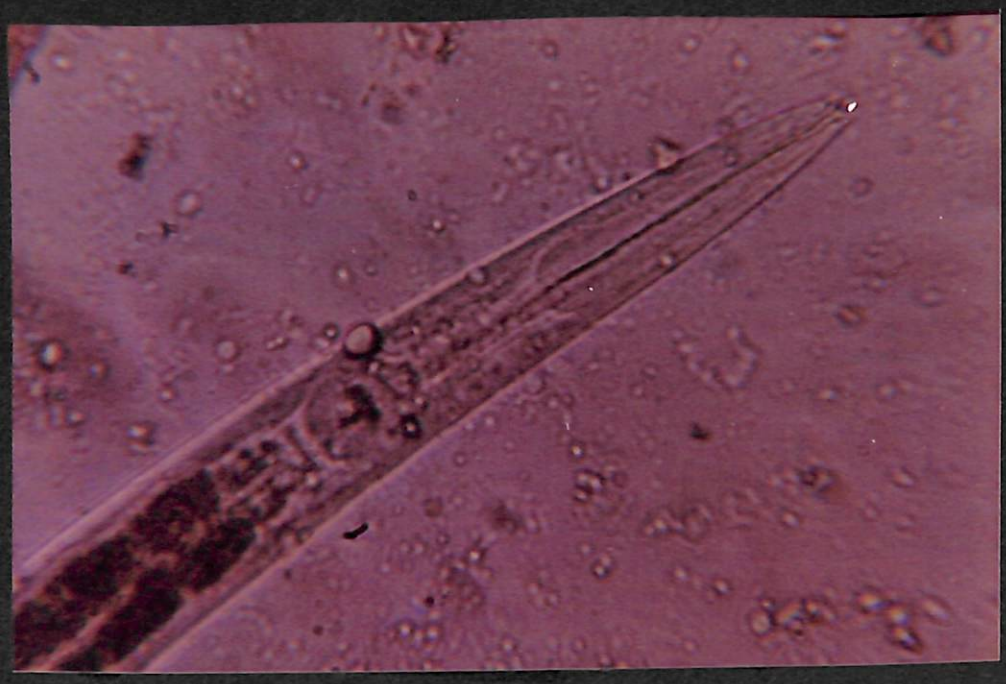


Plate 3: Direct preparation of intestinal scrapings showing the anterior portion of *Strongyloides avium*.(x400).

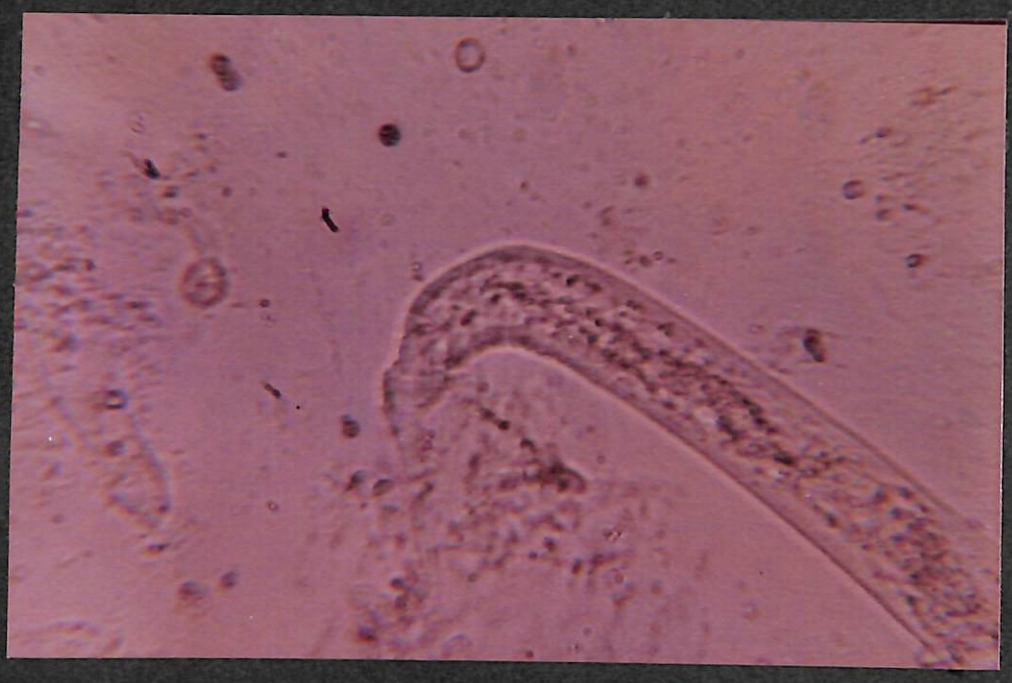


Plate 4: Direct preparation of intestinal scrapings showing the posterior portion of *Strongyloides avium*.(x400).

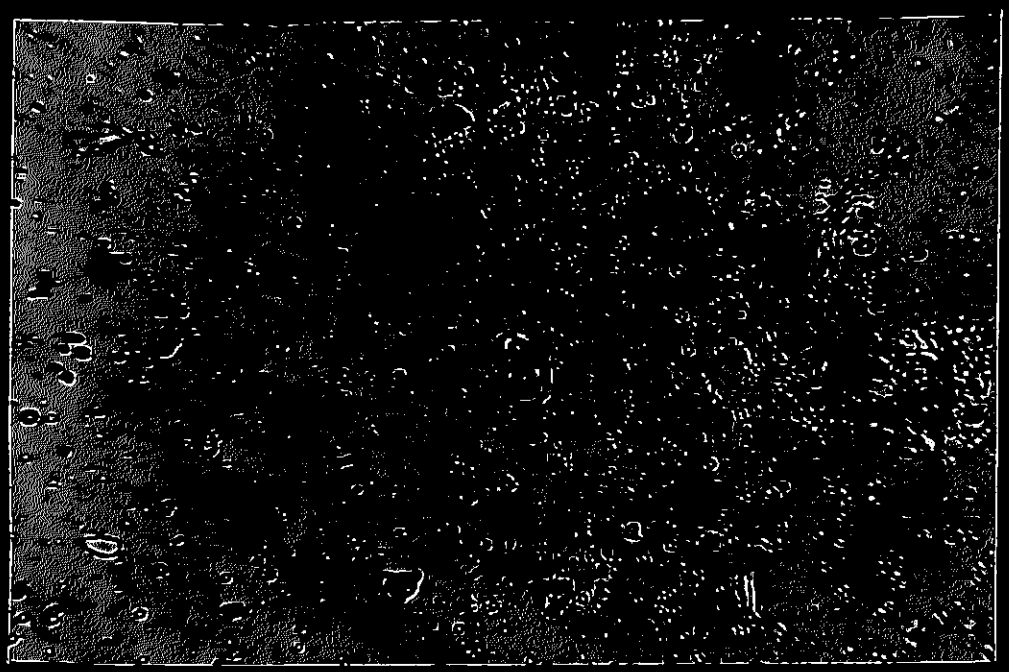


Plate5: Direct preparation of faecal sample showing the egg of *Dispharynx nasuta* (x 400).

Plate 10 : Gross photograph of intestine and caecum of Japanese quail infected with coccidia showing bleaching of intestine and haemorrhagic spots on caecum .

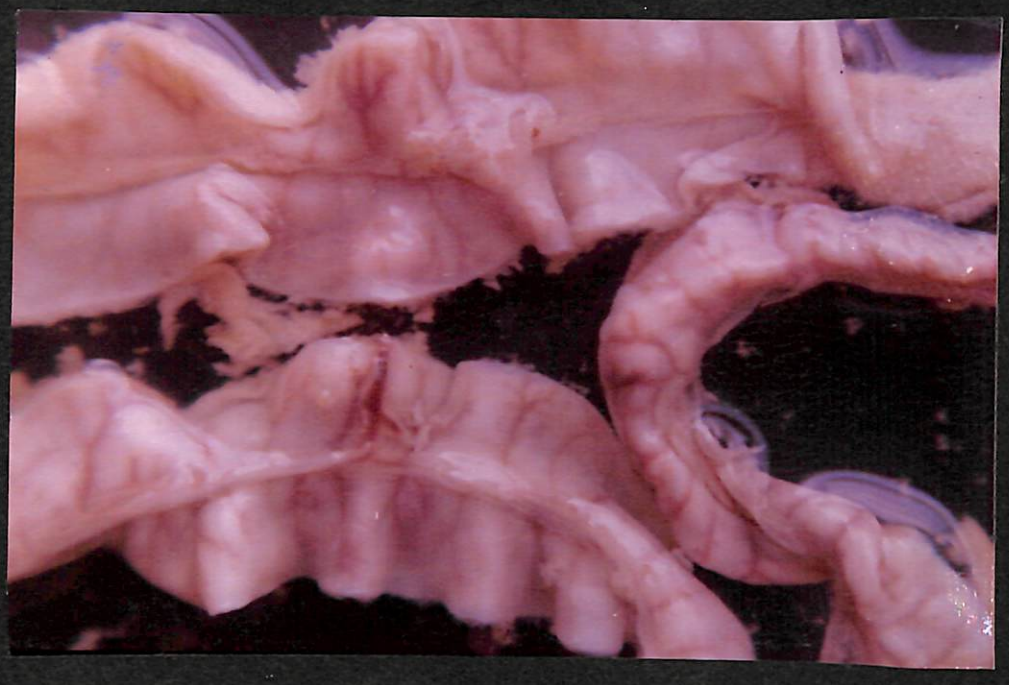


Plate 11 : Gross photograph of intestine of Japanese quail affected with *Ascaridia galli* ,showing thickening , inflammation and congestion

CHAPTER - V

DISCUSSION

DISCUSSION

Japanese Quail (*Coturnix coturnix japonica*), which has been recently domesticated has now emerged as a commercial table bird. Quail is considered to be resistant to most of the poultry diseases, perhaps because of its lack of contact with the domestic fowl and also being free from the stress of intensive rearing for commercial purposes. With the setting of quail farms along with the chicken farm, a number of poultry diseases have now appeared in quails (Singh *et al.*,1996).

There is paucity of information on the prevalence of various ecto and endo parasites in this novel avian species in the country especially in Bihar, except for a couple of reports that originated from routine disease surveillance studies undertaken in some of the institutions. Parasitic infections, both helminthic and protozoal have been regarded as one of the important cause of loss in quail farming. Helminthic infection includes various nematodes, cestodes and trematodes, whereas protozoa mainly includes coccidial infection. In the present investigation both the helminthic and protozoal infection were investigated in faecal samples and intestinal scrapings to know their prevalence.

PREVALENCE :-

Altogether 300 faecal samples and 300 intestinal scrapings were screened in the present investigation, the result of which has been depicted in Table- 2A and 2B. The tables revealed the presence of five types of nematodes viz. *Strongyloides avium, Dispharynx nasuta, Ascaridia galli, Heterakis gallinarum* and *Capillaria obsignata*, one type of cestodes viz. *Railletina tetragona* and three types of protozoa i.e. *Eimeria bateri, Eimeria uzura* and *Trichomonas* sp. It can also be interpreted from the

Table-2A and 2B, that nematodes were widely prevalent, followed by protozoa and cestodes. In the present investigation trematodes, acanthocephalans and blood protozoan parasites were not found. These findings are in concordance with the reporting of several workers who observed that in quails nematodes and protozoal parasites are widely prevalent, tape worms are occassionaly found but trematodes and acanthocephalens are very rare. (Hafeez,1989; Naveen and Arun,1992 and Kellogg and Calpin,1971.)

MIXED INFECTION :- Mixed infection in nature exists as a rule rather than exception. In the present investigation mixed infection were also found quite common in birds infected with different helminths and protozoa. This finding is in confirmation with the findings of Islam (1985a) who also detected mixed infections between nematodes and cestodes of domestic fowls in Zambia. He further noticed that fowls could be affected with two, three, four even up to ten species of nematodes and cestodes but the percentage of mixed infection in birds decreases with the increase number of species of nematodes and cestodes involved in the mixed infection. Islam (1985b) also observed mixed helminthic infection in turkeys in Zambia.

Mixed protozoal infections were also found to be quite common in the present investigation. The two protozoal species i.e. *Eimeria bateri* and *Eimeria uzura* were found to be in combination in many Japanese quails. This finding corroborates the findings of Ruff *et al.* (1984) who reported mixed coccidial infection consisting of *E.uzura*, *E.tusnodai* and *E.taldykuragali* from natural outbreaks in Japanese quails from Maryland, U.S.A. Rao and Sharma (1992) also noticed mixed infection of *E.bateri* and *E. uzura* from Japanese quail.

PREVALENCE OF NEMATODES PARASITES IN JAPANESE QUAILS:-

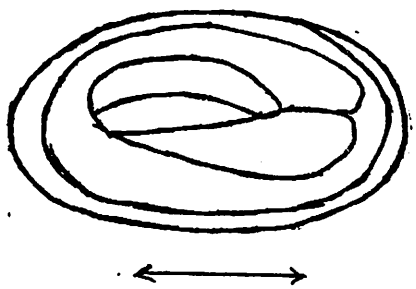
In the present investigation five types of nematodes viz. *S.avium*, *D.nasuta*, *A.galli*, *H.gallinarum* and *C.obsignata* were detected in both faecal samples and intestinal scrapings, which were shown in Table-2A and 2B, along with their percentage of infection. The tables showed that in general nematodes infection were higher in winter seasons followed by monsoon and summer seasons. These observations corroborates the findings of Hansen and Robel (1972) who reported peak prevalence of nematodes in winter in bobwhite quails.

Strongyloides avium :- It is evident from Table-2A and-2B, that infection of *S.avium* was observed in the range of 14% to 17%. This finding is more or less similar with the findings of Davidson *et al.* (1980) who also reported prevalence rate of less than 30% of this nematode in bobwhite quails in Florida, America. *S. Avium* was also reported in bobwhite quail by Cram (1929 and 1930). Samad *et al.* (1985) reported the prevalence rate of 1.11% of *S.avium* in the domestic fowls of Bangladesh.

It was observed that season has significant effect on the prevalence of *S. avium* obtained through faecal samples and intestinal scrapings (Table-4A and 4B).The prevalence was significantly higher during winter seasons followed by monsoon and summer seasons. However, Samad *et al.* (1985) observed prevalence of *S. avium* slightly more in summer than winter and lowest in monsoon seasons. Difference in the finding of prevalence percentage in different season might be due to some climatic variations from place to place.

As far as the prevalence of *S. avium* in young and adult age group is concerned it was observed that age had significant effect on prevalence of *S. avium* (Table -7A and 7B). It is evident from the tables that prevalence

Fig. 6. CAMARA LUCIDA DIAGRAMME OF EGG OF *STROGYLOIDES AVIUM*



0.02mm
(42μ x 21μ)

of *S.avium* in adult group was significantly more (P<0.01) than young group . There findings are in confirmation with the findings of Davidson *et al.*(1980) who observed significantly higher prevalence of *S. avium* in adult bobwhite quails in Georgia, U.S.A. The higher prevalence of *S. avium* in adult than young was due to host age or to a general decline of *S. avium* on the study area is unknown.

Dispharynx nasuta :- The overall prevalence rate of *D. nasuta* in 300 faecal samples and 300 intestinal scrapings were found to be 11.0 % and 12.66% respectively (Table 2A and 2B). *D. nasuta* was observed as one of the important nematode parasite of quails by several workers (Cram,1932; Goble and Kutz,1945; Burnette, 1963; Kellogg and Prestwood, 1968 and Hafeez 1989.). The seasonal influence on the prevalence of *D. nasuta* in quails revealed that winter seasons had highest prevalence followed by monsoon and summer seasons both in faecal samples and intestinal scrapings (Table-4A and 4B). The prevalence of this nematode in different seasons was found to be highly significant (P<0.01). This confirms the findings of Moore *et al.* (1987) who recorded the highest prevalence of *D .nasuta* in winter followed by monsoon seasons.

Prevalence of *D. nasuta* in young quails was observed to be higher than that of adult quails (Table-7A and 7B) but this difference was found to be non significant in faecal samples , however, it was significant (P<0.01) for intestinal scrapings. These findings are in confirmation with the finding of Davidson *et al.* (1980) who observed that adult bobwhite quails has significantly lower prevalence of *D. nasuta.* Ruff (1994) also observed that mostly young quails suffered from the infection of *D. nasuta.*

Ascaridia galli:- It is one of the most widely prevalent roundworm of chicken, turkey, duck etc. Infection with *A. galli* not only directly damages the host but also predisposes the birds to other infections. For the last few years large number of quail farms are being established along with the chicken farms. Due to this close proximity with chicken, it might be possible that quail has now become a another host of *A. galli*. Hafeez (1989) also observed *Ascaridia* sp. as one of the important parasitic diseases of quails. The other species of Ascaridia i.e. *Ascaridia compar* has been reported in bobwhite quail by Cram (1927) and Walton (1927). *Ascaridia lineata*, a another sp. has also been reported in bobwhite by Cram (1929).

In the present investigation prevalence rate of *Ascaridia galli* was found to be 14% and 16.66% in 300 faecal samples and 300 intestinal scrapings respectively (Table-2A and 2B).The prevalence percentage of *A. galli* is widely fluctuating as observed by different workers. Samad *et al.* (1985), Umakantha (1989) and Pandit *et al.* (1991) detected the prevalence percentage of 44.82, 56, and 28 respectively in fowls.

The seasonal influence on the prevalence of *A. galli* in quails was recorded from faecal samples and intestinal scraping. It was observed that in both faecal samples and intestinal scrapings the prevalence of *A. galli* was slightly more in winter than monsoon seasons and lowest in summer seasons. (Table-4A and 4B). These findings are in confirmation with the findings of Samad *et al.* (1985) who also observed highest prevalence of *A. galli* in winter seasons followed by monsoon and summer seasons in the domestic fowls of Bangladesh. However, Panda *et al.* (1996) noticed highest prevalence in monsoon than winter season in the ducks of Bhubneswar. The more prevalence of *A. galli* in monsoon and winter

season might be due to low temperature and high humidity prevailing during these seasons which are necessary for survival of the eggs. The lowest prevalence in summer season might be due to fact that eggs are rapidly killed by dry, hot weather even when they are six inches deep under the soil exposed to sun light.

It was observed that infection of *A .galli* was more prominent in young quails than adult quails (Table -7A and 7B). It is well recognised that young birds are more susceptible to infection than adult birds. Chicken which are three months of age or older manifest considerable resistance to infection with *A. galli* if they are on adequate ration. This is shown by the fact that fewer worms and smaller worms will develop in the older birds. Ackert *et al.* (1939) have attributed this development of age resistance to the increased number of goblet cells in the duodenal epithelium .The mucus secreted by these cells in older birds inhibits the development of the roundworm and is not antibody in nature. Eisenbrandt and Ackert (1940) have shown that duodenal mucus extracts of adult dogs and hogs caused a much more rapid death of *A. galli in vitro.*

Heterakis gallinarum :- This nematode parasite is generally found in the caeca of chicken, turkey, duck etc. that is why these are also called caecal worms . It is one of the widely prevalent and most pathogenic parasites of poultry. *H. gallinarum* in bobwhite quails have also been reported by several workers (Ward, 1945; Parmalee, 1952; Burnette , 1963 and Kellogg and Prestwood , 1968). *H. gallinarum* was observed as one of the important parasitic diseases of quails by Hafeez (1989) and Naveen and Arun (1992).

In the present investigation out of three hundred faecal samples and three hundred intestinal scrapings examined, *H. gallinarum* was found in

15% and 16.33% of quail respectively (Table-2A and 2B). Several workers recorded the different percentage of infection of *H .gallinarum* in domestic fowls. Umakantha (1989) and Pandit *et al.* (1991) recorded prevalence rate of 20.4% and 22.0% respectively in fowls.

The effect of season on the prevalence percentage of *H. gallinarum* was found to be significant both in faecal samples and intestinal scraping (Table-4A and 4B). It is evident from the tables that highest prevalence occurred in winter seasons than monsoon seasons and lowest in summer seasons. This finding is in concordance with the findings of Samad *et al.* (1985) who also observed highest prevalence of *H. gallinarum* in ducks in monsoon followed by winter seasons. The difference in finding might be due to different age and climatic conditions.

The prevalence of *H. gallinarum* in young and adult Japanese quails was found to be non-significant.

Capillaria obsignata :- This parasite inhabits the mucosa of the small intestine but does not cause gross lesions, other than thickening of the gut wall with a rough appearance of the mucosa. They can easily be found in washed mucosal scrapings. In the present investigation *C. obsignata* was detected both in faecal samples and intestinal scrapings in the percentage of 5% and 5.33% respectively (Table-2A and 2B). Ruff (1994) listed quails as one of the host of *C. obsignata.* Hafeez (1989) and Naveen and Arun (1992) have also observed *C.obsignata* as one of the common parasites of quails.

The effect of season on the prevalence of *C. obsignata* is found to be non-significant. However, it was observed that the prevalence was highest in winter followed by monsoon and summer season in both faecal samples and intestinal scraping (Table- 4A and 4B) . This finding is in confirmity

with the findings of Samad *et al.* (1985) who also observed highest prevalence of capillariasis in winter.

As far as the prevalence of *C. obsignata* in different age group is concerned it is evident from Table - 7A and 7B, that the prevalence percent was almost equal in both young and adult age group of quails. The comparison of this data could not be made due to unavailibility of literature .

PREVALENCE OF CESTODES PARASITES IN JAPANESE QUAILS:-

In the present investigation only one tapeworm *Railletina tetragona* was found. Out of 300 faecal samples and 300 intestinal scrapings screened only 15 birds (5.0%) and 17 birds (5.66%) respectively were found to be affected with *R. tetragona* (Table -2A and 2B). The tapeworm *R .tetragona* has also been reported in bobwhite quails by several workers (Webster, 1947 and Parmalee, 1952). Quails have been recorded to be seriously parasitised with this species of cestodes and death has been attributed to it (Morgan and Hawkins, 1949). The other species of the genus *Raillietina* such as *R. cestillus* and *R. colini*, have been reported in bobwhite quails by different workers (Webster, 1947; Sawda 1965; Kellogg and Prestwood 1968; Davidson *et al.*,1980 and Moore *et al.*,1987).

R. tetragona is very common tapeworm of fowls. Available literature revealed that the infection percentage of *R. tetragona* in fowls can vary from 5% to 77%. Kumar *et al.* (1971), Joshi and Shah (1981), Bhowmik and Sinha (1982), Umakantha (1989) and Pandit *et al.*(1991) observed the prevalence of *R. tetragona* in fowls to be 5.72% , 32.3%, 7.36%, 77.1% and 20% respectively. In Bangladesh 37.69% of

R.tetragona infection in domestic fowl was observed by samad *et al.* (1985).

As far the effect of season on the prevalence of tapeworm *R .tetragona* is concerned it is found to be non-significant in faecal samples but significant ($P<0.05$) in intestinal scrapings. (Table-5A and 5B). It might be due to various reasons such as, larval stages are recovered in intestinal scrapings ,eggs are generally detected in heavy infections and sometimes eggs get dried while making faecal examination. The result of present study indicates that the prevelance of *R. tetragona* in quails is slightly more in monsoon than winter seasons and low in summer seasons. Hoffman and Stover (1942), Matta (1978) and Bhowmik and Sinha (1982) observed the similar findings in fowls affected with *R. tetragona.* However, Kumar *et al.* (1971) observed more prevalence of *R. tetragona* in winter than monsoon seasons and lowest in summer seasons.

The highest prevalence of *R. tetragona* in monsoon might be due to favourable environmental conditions which suddenly increase the number of intermediate host in these seasons. The decrease in number of parasites in summer may be due to the extremely hot climate with low relative humidity. These factors are unfavourable for the survival of intermediate host in which exogenous stages of parasites are passed and accordingly the birds pick up low infection.

It was observed that age had no significant effect on the prevalence of *R. tetragona* found in faecal samples and intestinal scrapings, although it was found to be more prevalent in adult age group. (Table- 8A and 8B) This finding could not be compared due to paucity of literature.

PREVALENCE OF PROTOZOAL PARASITES IN JAPANESE QUAILS :-

To know the prevalence of different protozoal parasites in Japanese quails 300 faecal samples and 300 intestinal scrapings were screened, the results of which has been depicted in table 2A and 2B. It is evident from Table- 2A that in faecal samples only two protozoal parasites viz. *Eimeria bateri* and *Eimeri uzura* were found where as three protozoal parasites viz. *E.bateri* , *E. uzura* and *Trichomonas* sp. were found in intestinal scrapings (Table-2B). It is also evident from the Table-2A and 2B that *E.bateri* and *E.uzura* constituted the highest rate of prevalence (between 22.33% to 26.66%) among all the parasites detected in the present investigation which reflected their parasitic importance in Japanese quails. The parasites *E.bateri* and *E.uzura* belong to the family Eimeriidae and class Coccidia. Trichomoniasis is observed as one of the common disease of Japanese quail by Mohan and Pande (1976).

Coccidiosis in Japanese quail has been regarded as the disease of universal importance because of its ubiquitous present in almost every where in the world. McDougald and Reid (1994) viewed that protozoan parasites of the genus *Eimeria* multiply in intestinal tract and cause tissue damage with resulting interruption of feeding and digestive processes or nutrient absorption, dehydration and blood loss and increased susceptibility to other disease agents. The cause of death due to coccidia might be due to severe caecal haemorrhages and extensive blood loss. In the present study also caecal haemorrhages was commonly observed in quails parasitised with either *E.bateri* and/or *E.uzura* .

In the quails so far several different species of coccidia have been recorded viz. *E. dispersa, E. lophortygos, E. okanaganensis, E. taldykurganic, E. garnhami, E. coturnicis, E. bateri, E. uzura and E.*

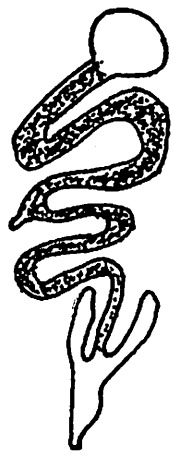
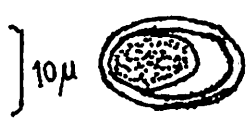
tsunodai. Unfortunately there is no cross immunity between species of *Eimeria* in birds and later outbreak may be the result of different species. The short direct life cycle and high reproducing potential of coccodia in quails intensifies the potential for severe outbreaks of disease in the quail farms. In addition to this emergence of drug resistance strains of coccidia may be also posing serious threat to quail industry (Gill and Bajwa ,1979).

In the present study, two species of *Eimeria* i.e. *E. bateri* and *E .uzura* were identified. The criteria for identification were based on morphological study of the unsporulated and sporulated oocysts (Fig.8,9,10 and 11), their sporulation time, parasitic habit in the host and the post-mortem changes observed in quails (Fig.7). Panda (1978) identified *E. bateri* from an outbreak of coccidiosis among quails 10-15 days old. Panda *et al.* (1988) observed that out of 480 faecal samples examined 416 (86.6%) were found positive for coccidial oocysts. Morphological and biometrical studies and cross infection with oocysts isolated from faecal and intestinal scrapings revealed mixed infection with three species of *Eimeria* viz. *E. bateri*, *E. uzura* and *E. tsunodai.*

Seasonal influence on the prevalence of *E. bateri* and *E. uzura* was recorded from faecal samples and intestinal scrapings (Table-6A and 6B). It was observed that in both the faecal samples and intestinal scrapings the prevalence of *E. bateri* and *E. uzura* were more in monsoon than winter seasons and lowest in summer seasons. However, Panda *et al.* (1988) noticed more mortality due to coccidiosis in winter seasons and low in summer seasons. Panda and Tripathy (1979) also observed more death in winter and low in summer due to coccidiosis in chicken. Seasonal variation and moisture content of litter play a great role in prevalence percentage of coccidia (Davis and Joyner, 1955 and Ramappa, 1968). In

Fig.7. DIFFERENTIAL CHARACTERISTICS OF JAPANESE QUAIL COCCIDIA.

(Morphological, Biometrical and Gross-pathological Characteristic)

CHARACTERISTICS	EIMERIA BATERI	EIMERIA UZURA
ZONE PARASITIZED.		
REGION OF INTESTINE AFFECTED.	DUODENUM AND SMALL INTESTINE	DUODENUM AND SMALL INTESTINE.
MICROSCOPIC CHARACTERISTICS. OOCYST REDRAWN FROM ORIGINAL		
LENGTH X WIDTH LENGTH = WIDTH =	Av: 23.5 x 17.7 (µm) 18 - 31 13 - 23	Av: 24.6 x 18.6 (µm) 20 - 31 14 - 24
OOCYST SHAPE	BROADLY OVOID OR ELLIPSOIDAL.	BROADLY ELLIPSOIDAL, SEMI OVAL OR SPHERICAL.
MICROPYLE	ABSENT	PRESENT
SPORULATION TIME	18 - 22 HOURS	20 - 24 HOURS

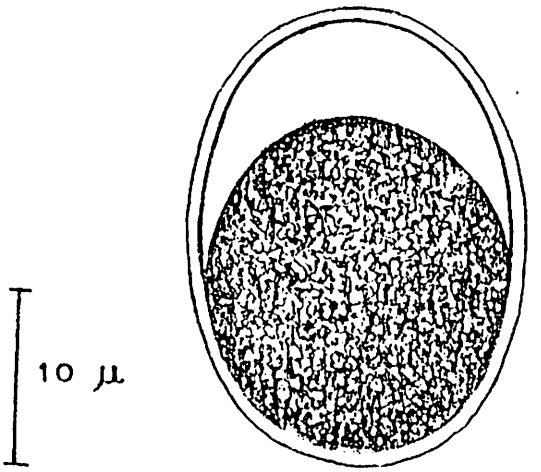


FIG.8.- UNSPORULATED OOCYST OF *EIMERIA BATERI*

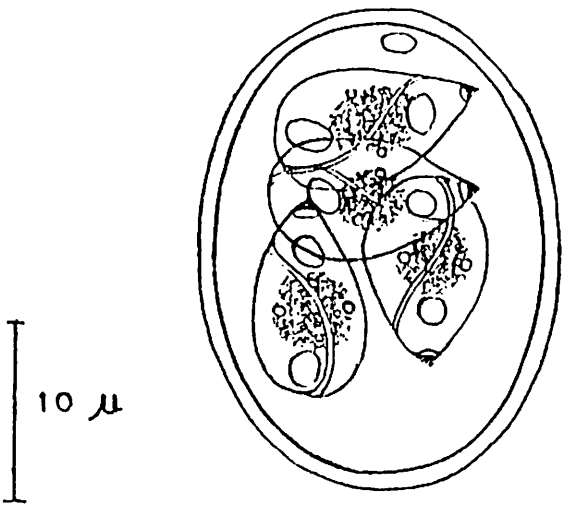


FIG.9.- SPORULATED OOCYST OF *EIMERIA BATERI*

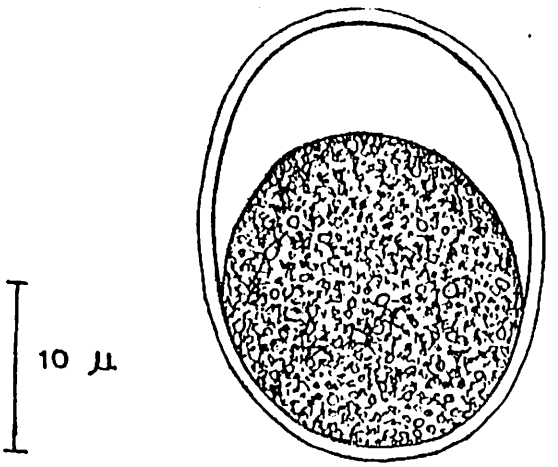


FIG. 10.- UNSPORULATED OOCYST OF *EIMERIA UZURA.*

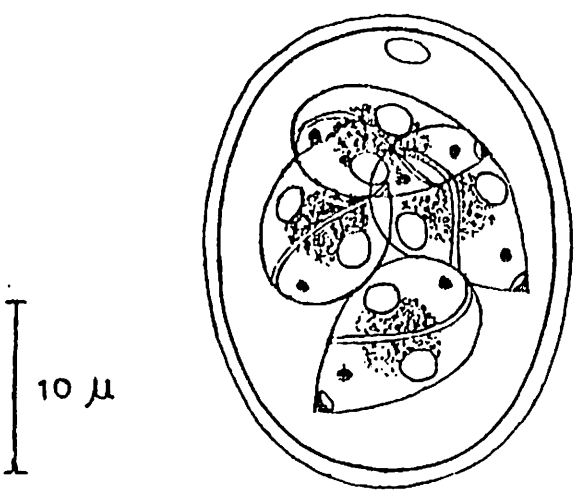


FIG. 11.- SPORULATED OOCYST OF *EIMERIA UZURA.*

the persent study the highest prevalence of coccidia in monsoon might be due to prevailing low temprature and humid conditions which are conducive for quick and easy sporulation of the oocysts, leading to repeated infections. It was also observed in present study that prevalence during winter season was slightly less then monsoon season. It might be attributed to sporadic rains followed by continuous dry period prevaled in the area of study which increased the humidity in the air resulting in sporulation of large number of oocysts. Besides this, chill and cold months during winter also acts as a pre-disposing factor for the high incidence of the disease (Panda and Tripathy, 1979). The lowest prevalence in summer might be due to extreme hot climate and dry weather which were unfavourable for the sporulation of oocysts as the sporulation of coccidial oocyst require moisture and optimum temperature of 30^0C. (Pellerdy, 1974). As far as the prevalence of *Trichomonas* sp. is concerned it was found to be more in winter followed by summer and monsoon season. This finding could not be compared as no literature is available in this regard.

The prevalence of *E. bateri* and *E. uzura* in young and adult quail also studied in the present investigation. It was observed that age had significant effect on the prevalence of *E. bateri* and *E. uzura* found in faecal samples and intestinal scrapings (Table -9A and 9B). It is evident from the tables that quails in young age group are highly susceptible to coccidial infection. This finding is in concordance with the findings of Ruff *et al.* (1984) and Panda *et al.* (1988) who also observed that quails in the young age groups are more susceptible to coccidial infection and after that oocysts load gradually decreases as age advances. Dubey and Srivastava (1968) also reported the incidence of intestinal form of coccidia in 1-2 week old chicken. The earlier records of Tsutsumi and Tsunoda

(1972) indicated 20% death in 3 day old quail chicks infected with *E. tsunodai*. Panda (1978) reported 10% death in young chicken due to *E. bateri* infection in natural outbreaks. The reason for age difference in susceptibility may be due to length of intestine, availability of cells and physiology of condition for sporozoites penetrates. In addition to that immunity develops in adult bird if they are exposed to infection in young age .The prevalence of trichomonas was found to be equal in both age groups in quails. This could not be compared due to non availibity of literature.

MANAGMENTAL CONDITIONS :-

The good improved and hygienic managemental condition is indispensable for successful farming of quails. In the present investigation it is realised that due to poor managemental practices the precentage of helminthic and protozoal infections were found to be high. The over all high percentage of helminthic (51%) and protozoal (22%) infection in faecal samples and 56% and 26% of helminthic and protozoal infection respectively, in intestinal scraping were found. It may be due to various managemental lacuna. It is well recognised fact that birds reared in cages are less prone to disease than those reared in deep litter system. Operational costs are lesser in cage system and feed wastage minimal (Kulkarni and Gangadhar, 1989) but cage rearing system was not found in any quails farm. Equipments had accumulation of litter and faeces which may act as a source of infection when they were transported to other house in farm. The human attendant, handling quails and chicken flock were common and thus their hand, foot wear and cloths could be the potential source of infection for quails and chickens as well. It was observed that in

most of the farms litter found to be moist due to faulty way of watering which was more pronounced during rainfall.

Quails were supposed to be the more resistant birds than poultry, but due to stress of intensive rearing for commercial purposes and the establishment of quail farms along with chicken farms, this avian species has now become susceptible to number of chicken diseases. If we adopt good and hygienic managemental practices the number and prevalence percentage of various parasitic disease in quails can be reduced.

HAEMATOLOGICAL STUDIES:-

Diseases are dynamic situation in which the haematological parameters of the sample shed some transient light on the physiological conditions of the body. Haematological changes in birds vary to a large extent from bird to bird depending on the degree and duration of parasitism and the nutritional habits of the parasitic species involved. The fact that various parasites such as nematodes, cestodes and protozoa can significantly alter the haematological pattern indicates that these may interfere with the host metabolism and can brought significant metabolic derangement. Available literature revealed that there is paucity of work on the haematology of Japanese quail infected with various parasites .So, in the present studies an attempt was made to analyse the effect of various helminthic and protozoal parasites on the haematological changes of the Japanese quail.

Total Erythrocytic Count (TEC):-

Mean values of TEC recorded in young and adult quails infected with helminths and protozoa found to be non-significant (Table-11A and 11B). It is evident from the table that TEC count in nematode infected young and adult quails decreased non-significantly in the present

investigation. However, Sekhar and Sinha (1986) while investigating the effect of helminthiasis on the cellular constituents of avian blood observed a decreased count of TEC in cockerels whereas it was elevated in the pullets due to spontaneous cases of single or mixed infection.

The mean value of TEC count in cestode infected young (2.90±0.30) and adult bird (4.50±0.27) was also found to be non-significant when compared with the control young (3.48±0.31) and adult bird (5.16±0.25).These findings are in agreement with the findings of Nair and Nadakal (1981), who also observed no significant change in TEC count of fowl infected with cestode (*Raillietina tetragona*).

The mean TEC value recorded in protozoa infected young (3.10±0.33) and adult bird (4.44±0.19) registered a drop ,but this drop was found to be non-significant when compared with the control young (3.48±0.31) and adult bird (5.16±0.25). However, significant decrease in TEC was observed in broiler chicken following infection with caecal coccididosis by Banday *et al.*(1994). Decreased TEC count in poultry experimentally infected with coccidia was also noted by Arnastanskiene and Kadyt (1977).The significant lower TEC count in chickens experimentally infected with *Eimeria tenella* was observed by Oikawa and Kawaguchi (1971).They also noted that decreased erythrocytic count had resulted essentially from the loss of blood from ruptured blood vessels in the infected caeca. In the present study the non-significant decrease in TEC in protozoal infected bird might be due to the fact that *E. bateri* and *E. uzura* did not seem to be highly pathogenic coccidial species found in Japanese quails (Norton and Peirce, 1971).

Haemoglobin (Hb) Concentration:-

Haemoglobin concentration is the indices of health status of living beings. Depression in Hb concentration reflects deviation from normal physiological condition of the host. Decreased in haemoglobin concentration has been observed in various helminthic infections by several workers (Caprarin and Purcheria,1972 and Nair and Nadakal, 1981). In the present studies the value of haemoglobin concentration in nematode infected young birds (8.24±0.55) and adult bird (11.40±0.37) was found to be significantly lower than the control young (10.34±0.58) and adult bird (13.18±0.58) as depicted in Table-12A and 12B . This observation is in conformity with Matta and Ahluwalia (1982) who also observed a low level of haemoglobin in *Ascaridia galli* infectecd fowls. They opined that lowered haemoglobin concentration in infected birds appear to correlates with activities of early larval stage of *Ascaridia galli* in the process of penetration with resultant destruction of mucosa of small intestine and rupture of small blood vessels. Caprarin and Purcheria (1972) also recorded lower haemoglobin value in birds infected with nematodes. However, Ikeme (1971) found no effect of *A.galli* on haemoglobin level in chicken.

Haemoglobin concentration also found to be significantly lower both in young quails (7.84±0.48) and adult quails (9.28±0.73) infected with cestodes as compared to their control where the values was found to be (10.34±0.71) and (13.18±0.50) in young and adult quails respectively (Table 12A and 12B). Nair and Nadakal (1981) also reported low haemoglobin value in domestic fowl infected with cestodes (*R. tetragona*). They suggested that the fall in haemoglobin content of the host bird probably reflects a metabolic disturbances caused by the worm rather than

a direct blood loss. They noticed occurrence of moderate degree of anaemia in infected birds. Anaemia resulting from cestodes infection has been reported by various workers (Ackert and Case,1938 and Sirkar and Sinha ,1974).

As evident from Table-12A and 12B, that haemoglobin level in young quails infected with protozoa (9.46±0.51) did not differ significantly from control bird (10.34±0.71) whereas in adult quail haemoglobin concentration (11.50±0.33) differed significantly from control (13.18±0.50) .Mukkur and Bradley (1969) also observed non-significant difference in whiteleghorn chicken infected with *E. tenella* during early stage of infection but after longer period of infection a significant drop in haemoglobin level was observed in challenged birds as compared to the control birds. They also correlated the level of haemoglobin with the severity of infection. Low haemoglobin content in poultry suffering from coccidia was also reported by several workers (Oikawa and Kawaguchi, 1971; Joshi *et al.*,1974; Dakshinkar and Dharmadhikari,1985 and Banday *et al.*,1994).

Erythrocyte Sedimentation Rate (ESR):-

Rate of sedimentation of erythrocytes is dependent upon two opposing forces: gravity causing the cells to settle and the friction resistance of the surrounding plasma which holds the cells in suspension. Among the factors which may influence the settling rate are cell size, shape and numbers, differences in sp. gravity of plasma and cells and the level and type of plasma proteins and lipids (Myers *et al.*,1953 and Washburn and Myers,1957). In the present investigation ESR was recorded both in young and adult quails having helminthic and protozoal infections, the results of which has been depicted in Table-13A and 13B,

respectively. It is evident from Table-13A, that no significant alteration in ESR was observed in young groups of quails infected with helminthic and protozoal infection. As ESR is the manifestation of chronic ailments so non-significant increase in ESR in young quails might be due to the recent infections . However, significant increase in ESR was detected in adult quails infected with nematodes and cestodes (Table-13B). In birds infected with nematodes the mean value of ESR was 3.76±0.11 showing significant increase when compared with the uninfected control. Matta and Ahluwalia (1982) also recorded increased ESR in case of fowls infected with nematodes.

Mean value of ESR in adult quail infected with cestodes (3.74±0.29) was found to be significantly higher when compared with their control (1.8±0.33). Nair and Nadakal (1981) observed that cestode (*R. tetragona*) can significantly alter the ESR in infected birds. The increased ESR may be due to increase in certain globulin fraction of plasma or to a decrease in plasma albumin (Eastham,1977).Increased ESR has been reported in pigeons infected with *R. echinobothrida* (Sirkar and Sinha, 1974).

No significant increase in ESR was observed in protozoal infection both in young and adult quail. This might be due to the fact that protozoa i.e. *E. bateri* and *E. uzura* found in present study are not very much pathogenic in nature. The parasites which are able to cause significant metabolic derangement's only may lead to increase in ESR. However, increase in ESR in poultry due to various coccidia has been reported by various workers (Banday *et al.*, 1994 and Stephen and Clemson, 1964).

Total Leucocytic Count (TLC):-

Mean value of TLC recorded for Young and quails infected with nematodes and cestodes were found to be significantly different from control (Table-14A and 14B) .Mean TLC value for young and adult quails infected with nematodes was found to be 15.4±0.51 and 20.4±0.75 respectively which were significantly lowered from the control young (18.4±0.75) and adult birds (23.8±0.58). However, Wakelin (1965) noticed no significant difference in total white blood cells in chicks infected with nematode *Capillaria obsignata.*

Quails infected with cestodes also registered significant low value of TLC both in young (14.6±0.68) and adult quails (18.0±0.70) when compared with their control value. This finding is in concordance with the finding of Nair and Nadakal (1981) who also found significant lower value of TLC in domestic fowls infected with cestodes *R.tetragona.* Nadakal *et al.*(1974) observed leucopenia in *R.tetragona* infected egg laying white-leghorn bird. The mechanism of this change is unknown and requires further elucidations.

It is also evident from Table-14A and 14B, that no significant change occurred in TLC value of protozoa infected young and adult quails. Natt (1959) did extensive study on the effect of caecal coccidiosis on the blood cell of domestic fowl and observed that total count remained normal during first six days of infection but later following the hamorrhages the total count started to increase attending a lecocytosis. This increase in leucocytes may be correlated with the heavy infiltration of leucocytes observed in the infected area of caecum (Edger,1944).

Differential Leucocytic Count (DLC):-

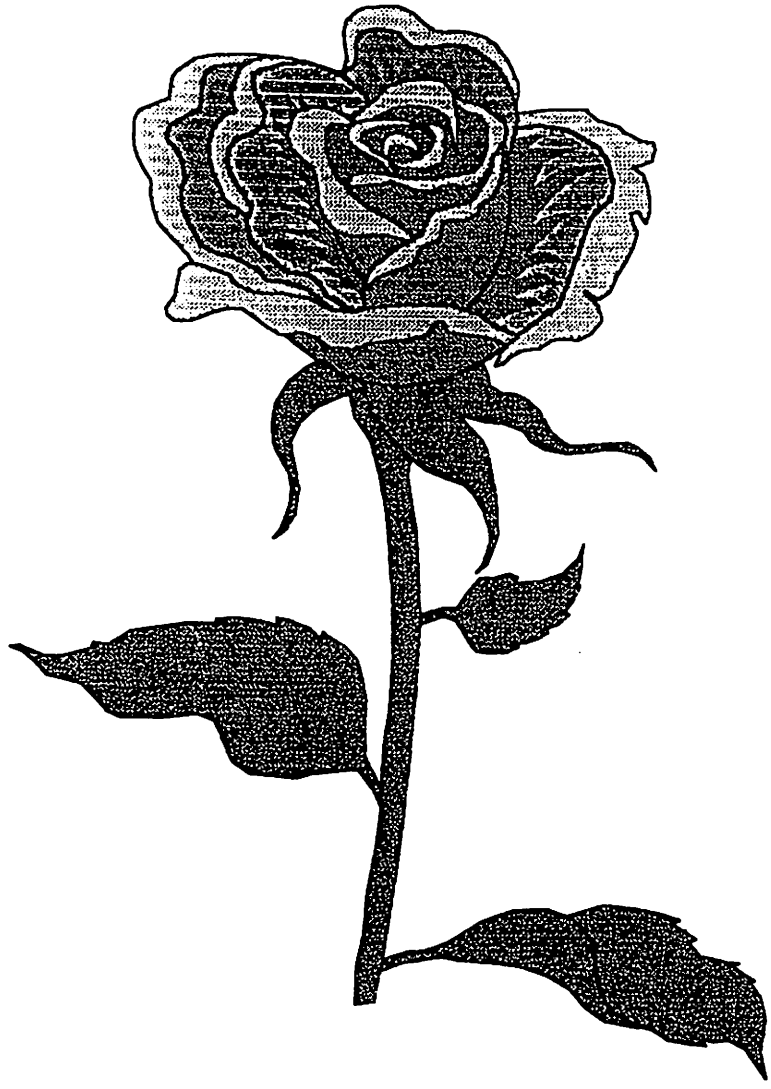
Differential count of the young and adult quails was done in both helminthic and protozoal infection results of which have been depicted in Table -15A to 19B. In young quails infected with nematodes, heterophils (31.77±0.56), lymphocytes (51.94±0.26), monocytes (12.42±1.24) and basophils (5.07±1.35) count were found to be non-significant when compared with their respective controls (Table-15A,16A,18A and 19A). Similarly, in adult quails infected with nematodes, heterophils (29.04±0.62), lymphocytes (55.8±0.60), monocytes (9.55±0.64) and basophils (4.59±1.51) count were recorded to be non-significant when compared with their respective control groups (Table -15B,16B,18B and 19B). However, significant rise in eosinophils count in nematode infected young quail (10.29±0.31) and adult quails (12.05±0.58) was observed (Table-17A and 17B). Generally, in parasitic infections eosinophilia is a common feature as observed by different workers (Thakur and Misra,1973 and Gleason ,1971).

In cestode infection heterophils count increased singnificantly in both young (35.04±0.75) and adult (31.22±0.35) quails, when compared with the control young (32.32±0.47) and adult quails (28.92±0.34). Lymphocytes count in cestode infected young (50.54±0.77) and adult quails (53.85±0.48) decreased significantly when compared with the control young (53.13±0.62) and adult (57.04±0.42) quails. Here it can be interpreted that reversion of lymphocytes i.e. decrease in lymphocytes was observed. Depression in lymphocyte / heterophil ratio was observed in cestode *(R.tetragona)* infection by Nair and Nadakal (1981). They also observed that in longer period of time lymphocytes/heterophil ratio tended

to regain normalcy .Shpolyanskaya (1953) and Bylund (1972) reported changes in the leucocyte picture of the cestode infected fish, including a reduction in the percentage of lymphocytes and an increase in the percentage of phagocytic elements such as heterophils and monocytes which are in confirmation with the present findings. Eosinophil count also increased significantly in cestode infected young (10.29±0.31) and adult (11.72±0.82) quails as compared to their respective controls. This findings are in agreement with the findings of several workers (Tomita,1937; El Hindawy,1948; Sirkar and Sinha,1974 and Nair and Nadakal,1981), who also reported eosinophilia in cestode infection . Monocytes and basophil counts were found to be non-significant in cestode infected young and adult quails.

No significant change in heterophils ,lymphocytes, monocytes and basophils were detected in protozoa (coccidia) infected young and adult quails which confirms the findings of Mukkur and Bradley (1969) who also observed no significant changes in the values of these constituents of WBC, however, eosinophil counts increased significantly in young quails (11.72±0.82) in protozoal infection as compared to their control (9.55±0.64) but in adult quails (9.86±0.76) eosinophil counts increased non-significantly when compared to the control adult group (9.55±0.64). These findings about eosinophils are in confirmation with the findings of Natt (1959), who also recorded a sharp increase in absolute eosinophils count in early stage of infection but unlike the prolonged eosinophilia characteristic of many other parasitic disorders the count rapidly decreased and came to normal. At present no explanation can be made concerning the significance of this change and require further elucidations. So far the basophils count is concerned it increased from 3.92±1.66 to 5.54±1.49 in

CHAPTER - VI



SUMMARY

SUMMARY

Quail farming has recently been emerged as a potential alternative to chicken farming. It is gradually getting the status of small agro -industry especially for rural farmers who are mostly under employed and unemployed. Quails were supposed to be resistant to most of the poultry disease, but due to stress of intensive rearing for commercial purposes and the establishment of quail farms along with chicken farms, this avian species has now become susceptible to various parasitic infestations. These parasitic diseases cause high mortality, morbidity, loss in productivity and thus affect the revenue receipts of a quail farm to a great extant. A prosperous and healthy quail flock can soon be turned into an ill, parasitised, loosing concern by these worm infestations. Keeping this in view the present work was undertaken to ascertain the prevalence of different ecto and endo parasites in young and adult age group of Japanese quails in different seasons.

To know the prevalence of different ecto and endo parasites in Japanese quails ,altogether 150 skin scrapings, 300 faecal samples and 300 intestinal scrapings were screened from various quail farms situated in and around Patna during the period of July 1999 to June, 2000.

No ecto parasites were detected in the present investigation. As far as the endoparasites were concerned altogether five nematodes viz., *Strogyloides avium, Dispharynx nasuta, Ascaridia galli, Heterakis gallinarum, Capillaria obsignata*, one cestode i.e. *Raillietina tetragona* and three protozoal parasites i.e. *Eimeria bateri, E. uzura* and *Trichomonas* sp. were detected.

Among the nematodes found in faecal samples, *H. gallinarum* showed the highest prevalence (15%) and *C. obsignata* showed lowest prevalence (5%). Other nematodes such as *A. galli*. *D. nasuta*, and *S. avium* were detected in the percentages of 14.0, 11.0 and 14.33 respectively. The cestode *R. tetragona* showed the prevalence of 5%. The protozoa detected in faecal samples was *E. bateri* and *E. uzura* in the percentages of 24.0 and 22.33 respectively.

In the intestinal scrapings, *Strogyloides avium* nematode was found in the highest percentage (17.33%) and *Capillaria obsignata* showed lowest prevalence of 5.33%. The prevalence percentage of other nematodes such as *Ascaridia galli, Heterakis gallinarum* and *Dispharynx nasuta* was found to be 16.66, 16.33 and 12.66 respectively. The cestode *Raillietina tetragona* showed the prevalence of 5.66%. Among protozoa *E.bateri, E.uzura* and *Trichomonas* sp. were found in the percentages of 26.66, 25.0 and 2.0 respectively.

So far the effect of seasons on parasites were concerned, it was observed that most of the nematode showed the highest prevalence in winter seasons followed by monsoon and lowest in summer seasons. The more prevalence of different nematodes in winter and monsoon seasons might be due to low temperature and high humidity prevailing during these seasons. The lowest prevalence in summer seasons might be due to fact that eggs are rapidly killed by dry, hot weather. The prevalence of cestode *Railletina tetragona* was found to be at peak during monsoon seasons followed by winter and lowest in summer seasons. The highest prevalence of *R. tetragona* in monsoon might be due to favourable environmental conditions which suddenly increase the number of intermediate host in

these seasons. The decrease in number of parasites in summer may be due to the extremely hot climate with low relative humidity. These factors are unfavourable for the survival of intermediate host in which exogenous stages of parasite are passed and accordingly the birds pick up low infection. As far as the prevalence of protozoal parasites were concerned *Eimeria bateri* and *Eimeria uzura* , were found to be at highest during monsoon seasons followed by winter and lowest in summer seasons. The highest prevalence of coccidia in monsoon might be due to prevailing low temprature and humid conditions which are conducive for quick and easy sporulation of the oocysts, leading to repeated infections. It was also observed in present study that prevalence during winter season was slightly less then monsoon season. It might be attributed to sporadic rains followed by continuous dry period prevaled in the area of study which increased the humidity in the air resulting in sporulation of large number of oocysts. Besides this, chill and cold months during winter also acts as a pre-disposing factor for the high incidence of the disease. The lowest prevalence in summer might be due to extreme hot climate and dry weather which were unfavourable for the sporulation of oocysts as the sporulation of coccidial oocyst require moisture and optimum temperature. As far as the prevalence of *Trichomonas* sp. is concerned it was found to be more in winter followed by summer and monsoon season.

Occurrence of mixed infection among different helminths and protozoa were observed. It was noticed that different nematodes, cestodes and protozoa either occurred singly or in combination with one another. Generally mixed double infection were detected.

It was found that most of the nematodes and protozoal parasites were more prevalent in the young age groups as compared to adult age

group of quails. The cestode *Railletina tetragona* was observed to be more prevalent in adult age groups of quails.

It was observed that bad managemental conditions increases the prevalence of both helminthic and protozoal infection in quails. Thus, to minimize the parasitic infection it is essential to have good hygienic care and managemental conditions

In the present investigation haematological changes in the young and adult age group of quails affected with different parasites varied to a large extent from bird to bird depending on the degree and duration of parasitism and the nutritional habits of the parasitic species involved. The various parasites such as nematodes, cestodes and protozoa can significantly alter the haematological pattern indicates that these may interfere with the host metabolism and can brought significant metabolic derangements. It was estimated that Haemoglobin concentration, Erythrocytes sedimentation rate, Total Leucocytic count, Hetrophils, Lymphocytes and Eosinophils count of the quails infected with various nematodes, cestode and protozoa alter significantly when compared with the healthy birds.

The gross pathological lesions in the quails infected with nematodes ,cestodes and protozoa depended on the load of these worms. When the infection was slight or less no pathological changes were observed , whereas in heavy infection these produced thickening, inflammation, ulcers, haemorrhages and hyperemic lesions in the proventriculus, caeca, and different parts of intestine .

The microscopic changes observed were different types of enteritis such as haemorrhagic, suppurative and mucoid enteritis along with infiltration of heterophils and erythrocytes. The lining epithelium of the

villi contained vacuoles. There was widening of lamina propria, degeneration and desquamation of epithelial lining, cells of villi and moderate degree of necrosis.

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CHAPTER - VII

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