EFFICACY OF *Embelia ribes* SEED POWDER AND DRIED *Aloe vera* PULP AGAINST GASTROINTESTINAL HELMINTHOSIS IN GOATS

T H E S I S

Submitted

In partial fulfillment of the requirements for the Degree of

MASTER OF VETERINARY SCIENCE

IN

VETERINARY CLINICAL MEDICINE, ETHICS AND JURISPRUDENCE

BY

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2021

DECLARATION OF STUDENT

I hereby declare that the experimental research work and interpretation of the thesis entitled, **"EFFICACY OF *Embelia ribes* SEED POWDER AND DRIED *Aloe vera* PULP AGAINST GASTROINTESTINAL HELMINTHOSIS IN GOATS"** or part thereof has not been submitted for any other degree or diploma of any University, nor the data have been derived from any thesis / publication of any University or scientific organization. The sources of materials used and all assistance received during the course of investigation have been duly acknowledged

Date: / /2021

Signature

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Mr. GARUDI SHANKAR DEVRAO has satisfactorily prosecuted his course of research for a period of not less than one semester and that the thesis entitled, **"EFFICACY OF *Embelia ribes* SEED POWDER AND DRIED *Aloe vera* PULP AGAINST GASTROINTESTINAL HELMINTHOSIS IN GOATS"** submitted by him is the result of original research work is sufficient to warrant its presentation to the examination in the subject of **VETERINARY CLINICAL MEDICINE, ETHICS AND JURISPRUDENCE** for the award of **MASTER OF VETERINARY SCIENCE** degree by the Maharashtra Animal and Fishery Sciences University, Nagpur.

We also certify that the thesis or part thereof has not been previously submitted by him for a degree of any other University.

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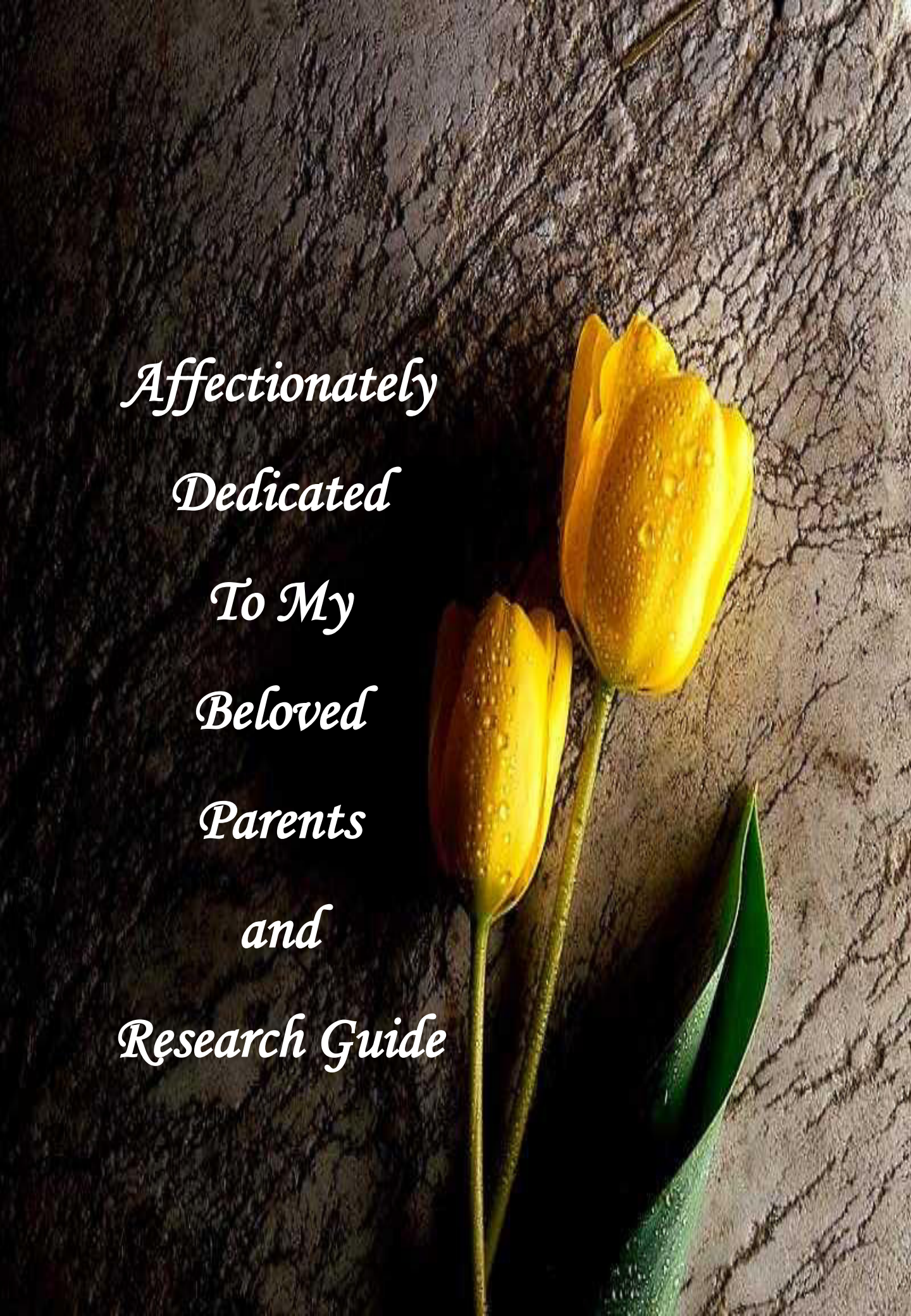
Affectionately
Dedicated
To My
Beloved
Parents
and
Research Guide

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Place : Parbhani

Date : / / 2021 **(Garudi Shankar Devrao)**

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ABBREVIATIONS

%	: Percent
et.al	: et alii (masculine), et alia neuter-plural form
@	: At the rate of
ML	: Milliliter
µl	: Microliter
IU	: International Unit
dL	: DeciLitre
Mg	: Milligram
Kg	: Kilo grams
BW	: Body weight
PO	: Per orally
no.	: Number
NS	: Non-significant
SE	: Standard error
SD	: Standard deviation
CD	: Critical difference
i.e.	: that is
viz.	: which is
^{0}F	: Degrees Fahrenheit

≤	: Lesser than or equal to
≥	Greater than or equal to
BT	: Before therapy
PT	: Post therapy
Hb	: Haemoglobin
PCV	: Packed cell Volume
TEC	: Total Erythrocyte Count
TLC	: Total Leukocyte Count
DLC	: Differential Leukocyte Count
AST	: Aspartate aminotransferase
ALT	: Alanine aminotransferase
FECRT	: Faecal egg count reduction test
EPG	: Eggs per gram of feces
ANOVA	: Analysis of Variance
WASP	: Web Agri Stats Package
TVCC	: Teaching Veterinary Clinical Complex
COVAS	: College of Veterinary and Animal Sciences
MAFSU	: Maharashtra Animal and Fishery Sciences University

Introduction

CHAPTER - I

INTRODUCTION

Goats are among the first domesticated farm animals. Due to its outstanding adaptability to changing environmental conditions and diverse dietary regimes under which it developed and subsequently preserved, this species has been disseminated all over the world. As per FAOSTAT (2018) The world's total number of goats is 861.9 million, and of these more than 50% (514.4 million) are located in Asian countries.

India's goat population ranks 2nd India's total number of goats is 148.88 million. The goat population is 10.6 million in Maharashtra (20th Livestock Census, Government of India, 2019)

In developing countries, small ruminants such as sheep and goats occupy an important economic and ecological role in agricultural systems (Devendra, 2005). Goats play an important role in food and nutritional security of rural poor, especially in rain-fed regions where crop production is uncertain and where acute scarcity of feed and fodder restricts the rearing of large ruminants. Due to its lower initial expenditure, low input demand, greater prolificacy, early sexual maturity and ease of marketing, goat rearing has distinct economic and managerial advantages over other livestock. In unfavourable conditions, goats can effectively live on available shrubs and trees. Goats are held as a source of additional income in rural societies in India and as protection against income shocks from crop failure. Moreover, goats are the best substitute source of supplementary income and milk for those who can't afford to keep a cow or a buffalo.

A goat is usually portrayed, a poor man's cow Goats are more durable, multi-useful, easy to manage and productive animals compared to cows, which can effectively turn low-value vegetation, tree leaves and crop residues into high-value meat, milk, hide, manure and fiber. It therefore serves as an important means of

subsistence and nutritional protection in countries such as India for small and marginal farmers and landless rural households.

Health management activities are the key factors in the determination of viability and success of goat production in order to maximize production. Goats suffer from multiple diseases, contributing to mortality and morbidity, resulting in poor animal productivity. Gastrointestinal diseases are more significant among the numerous diseases that cause severe economic loss in the form of morbidity and mortality.

Gastrointestinal nematode-induced parasitic gastroenteritis poses a significant threat to health and impairs the productivity of goats due to the associated morbidity and mortality (Nwosu *et al.,* 2007; Bandyopadhyay *et al*., 2010). Infestation with parasitic nematodes in the gastrointestinal tract remains one of the key constraints on milk production, especially goat production (Rinaldi *et al*., 2007). In addition, goats are more likely than sheep to be infested with gastrointestinal nematodes (Jallow *et al*., 1994)

In particular, parasitic infestations with gastrointestinal nematode and trematode hamper livestock production due to the related morbidity, mortality, treatment costs and control measures (Nwosu *et al*., 2007; Raza *et al*., 2010). The prevalence of small ruminant helminths contributes to low productivity due to stunted growth, poor weight gain and poor use of feed (Pedreira *et al*., 2006). Helminthiasis has a harmful impact on ruminants, contributing to haematological and biochemical disorders (Ijaz *et al*., 2009), anorexia, weight loss, poor reproductive output and even lamb death (Hussain and Usmani, 2006).

Haemonchus contortus, *Trichostrongylus colubriformis*, *Teladorsagia circumcincta*, *Cooperia spp., Nematodirus spathiger, Oesophagostomum spp., Trichuris spp*., *Dictyocaulus filaria* and *Strongyloides papillosus* are prominent nematodes that infect goats and sheep. In small ruminants populations, the proportions of each of these nematodes differ by host, geographic position,

production management and other factors that determine the overall degree of gastrointestinal parasitism. Regulation of internal parasites in every small ruminant health management programme is of primary concern and is very important to operational profitability. Small ruminants, naturally infected, typically have mixed infestations of various nematode species.

In small ruminants Gastrointestinal helminth parasites causes huge economic loss owing to decreased growth rate, productivity and mortality. The main prevalent parasitic diseases affecting low productivity of ruminants worldwide, especially in tropics and subtropics, are gastrointestinal nematode infections. Due to their grazing habit, goats are more susceptible to various gastrointestinal helminth parasite infections. Rough dull coat, weakness, diarrhoea, sub mandibular oedema (bottle jaw), loss of appetite and weight loss are shown by goats infected with internal parasites clinically. In addition to this some *trichostrongyle* nematodes cause anemia.

Anthelmintic resistance is becoming a major worldwide constraint now days in animals under field conditions and it depends upon various factors .These are, use of same group of drug frequently, underdosing of drugs, use of single anthelmintic drug continuously under field condition and prophylactic mass treatment to the animals which leads to development of resistance in helminthes (Shalaby, 2013). So to solve the problem of drug resistance use of medicinal plants is one of the way to treat helminth problem in small ruminants.

The plant *Aloe vera* is used in Ayurvedic, homoeopathic and allopathic streams of medicine, and not only tribal community but also most of the people for food and medicine. The plant leaves contains numerous vitamins, minerals, enzymes, amino acids, natural sugars and other bioactive compounds with emollient, purgative, antimicrobial, anti inflammatory, anti-oxidant, aphrodisiac, anti-helmenthic, antifungal, antiseptic and cosmetic values for health care.(Sahu *et al.* 2013)

Fruits of *Embelia ribes* have antifertility and anti-implantation properties. Fruits are acrid, astringent, anthelmintic, bitter, brain tonic, carminative, diuretic, febrifuge, laxative, stimulant, and thermogenic.(Choudhary 2012)

Embelia ribes fruit is hot, dry, with a sharp bitter taste; it is a good appetizer; carminative, anthelmintic, laxative, alterative, cures tumor, ascites, bronchitis, mental diseases, dyspnoea, diseases of the heart, urinary discharges, jaundice, hemicrania, and worms in wounds. The seeds are of high repute as anthelmintic. Pulp of the fruit is purgative. Fresh juice is cooling, diuretic and laxative (Harish *et al*., 2012)

Miller and Morrison (1992) has reported that Fenbendazole and ivermectin are two anthelmintics used for controlling Strongylate nematode parasitism. Both products are highly efficacious against adult and immature stages residing in the gastrointestinal tract.

Flubendazole (FLU) and fenbendazole (FEN) belonging to benzimidazoles group are anthelmintic drugs widely used in veterinary medicine in order to treat diseases in agriculture and aquaculture and also in human medicine (Danaher *et al*., 2006). Being excreted from the body with faeces and urine, they reach environment via different routes.(Wagil *et al*.,2014)

Fenbendazole is an old benzimidazole anthelmintic with a broad spectrum of action that is often used for the treatment of numerous intestinal helminthosis in animals. It is effective at doses of 7.5–10 mg/kg against nematodosis, at the dose of 15 mg/kg against protostrongylide lungworms, at the dose of 100 mg/kg against *Fasciola spp.* infection and *Dicrocoelium dendriticum* infection of sheep. The mechanism of action is associated with degradation of microtubules of helminths and violation of glucose uptake in nematodes. Reduction of glucose uptake causes a decrease in energy reserves resulting in the death of the parasite. Fenbendazole is considered safe and non-toxic anthelmintic (Arkhipov *et al*., 2019)

Considering these facts, it was decided to undertake the present study with following objectives.

Objectives:

1) To study the incidence of gastrointestinal helminthosis in goats and around Parbhani.

2) To evaluate haemato-biochemical alterations in affected goats.

3) To study comparative efficacy of *Embelia ribes* seed powder and dried *Aloe vera* pulp in comparison to Fenbendazole.

Review Of Literature

CHAPTER - II

REVIEW OF LITERATURE

2.1 INCIDENCE

Saha *et al.* (1990) while studying incidence of gastrointestinal nematodes in goats of West Bengal reported that, infection of gastrointestinal nematodes was 75.83 per cent. The highest incidence was observed during winter (79.41%) followed by monsoon (76.40%) and summer (72.28%).

Khyrul *et al.* (1991) observed 89.29% occurrence of *Oesophagostomum* infection in Black Bengal goats from Bangladesh. alongwith 93.54 % and 82.05 % infection in winter and rainy seasons, respectively.

Fritsche *et al*. (1993), conducted a prevalence analysis of gastrointestinal nematodes in small ruminants of Gambia and found a wide range of 16 helminth parasite species in them.

Joshi (1994) recorded that, *Haemonchus contortus* (49.4%) and *Trichostrongylus spp*. (43.5%) were most common helminth parasites in goats under sedentary management practices in Nepal followed by *Oesophagostomum venulosum* (4.2%), *Bunostomum trigonocephalum* (4%) and *Ostertagia cicumcincta* (2.5%).

Pandey *et al*. (1994) conducted a study on seasonal prevalence of gastrointestinal nematodes in goats in Zimbabwe and noticed that *Haemonchus contortus, Trichostrongylus axei, Trichostrongylus colubriformis* and *Oseophagus columbianum* were the dominant species found in 88.97% of the examined animals followed by *Trichuris* (21%)*., Srongyloides papillosus* (9%) and *Bunostomum spp*. (3%).

Parihar *et al*. (1996) studied the prevalence of gastrointestinal parasites in goats in Rajasthan and found *Eimeria spp., Strongylus spp., Trichuris spp., Moniezia*

spp., and *Strongyloides spp*. in 83.4 percent, 73.7 percent, 10.6 percent, 9.6 percent, and 6.3 percent of goats, respectively.

Sahay *et al*. (1996) reported a common (75.85%) incidence of nematodes in goats round the year in West Bengal. They reported 61.67, 27.08, 7.92, 37.92, 14.17 and 32.08% of *Oesophagostomum columbianum, Oesophagostomum asperum, Oesophagostomum venulosum, Trichuris globulosa, Gaigeria pachyscelis* and *Haemonchus contortus* ,respectively in them. They also recorded the prevalence of 79.41, 76.40 and 72.28 percent in winter, monsoon and summer seasons, respectively.

Talukdar (1996) found 17 species of nematodes, 7 species of trematodes and 6 species of cestodes in goats from Assam. It was further reported that, nematodes, trematodes, and cestodes in 8.15 %, 3.98 %, and 15.27 % of young goats, respectively, compared to 19.25 %, 14.20 %, and 12.56 % in adult goats.

Alyousif (1997) observed that the *Trichuris ovis* and *Nematodirus spathiger* were most prevalent nematodes found in the gastrointestinal tracts of 130 slaughtered adult male goats, where as *Trichostrongylus probolurus, Haemonchus contortus,* and *Camelostrongylus mentulatus* were found in lower numbers.

Jitendran (1997) found 94.0 % overall helminth infection in sheep and goats from the Himalayan area while conducting epidemiological studies on gastrointestinal nematodes. During the rainy season, high level of infection with 236-3,400 and 325-5,900 EPG of *Strongyle* worms in sheep and goats, respectively.

Jeyathilakan and Sathianesan (1998) reported 77% occurrence of nematodes in goats from the state of Kerala.

Katoch *et al.* (1998) observed *Strongylus* and *Nematodirus spp.* infection during the winter in sheep and goats from Himachal Pradesh.

Silva *et al.* (1998) performed necropsies on goats aged 1 to 12 months and found gastrointestinal nematodes *viz*., *Trichostrongylus colubriformis, Haemonchus contortus*, and *Oesophagostomum columbianum*. It was also discovered that the

worm burden in 11-12 month old animals was substantially ($P<0.05$) higher than in the other age groups.

Arosemena *et al.* (1999) observed 83.3% prevalence of gastrointestinal nematodes upon post mortem examination of 48 sheep and goats in Brazil.

Singh *et al.* (1999) studied the occurrence of gastrointestinal nematodes in sheep and goats and observed an incidence of 81.21% of *Trichostrongylus spp.* , followed by *Haemonchus spp*. (16.75%), *Trichuris spp*. (16.34%) and *Strongylus spp* (9.64%) in sheep and goats in Madhya Pradesh, India.

Bhojane *et al*. (2002) looked for parasitic infection in faecal samples of 507 goats. Approximately 70% of the goats tested positive for various infections. Infection with *Strongylus* (16.57%) and *Haemonchus* (12.23%) was substantially higher than infection with mixed bacteria.

Debela (2002) investigated the prevalence of helminth species in Rift Valley goats. Ten nematode and three cestode species were identified. *Haemonchus contortus* was the most prevalent followed by *Strongyloides papillosus* and *Trichostrongylus spp.* with prevalence rates 66.5%, 36.1% and 30.4 %, respectively. *Moniezia expansa* showed 32.2% prevalence rate.

Tsotetsi and Mbati (2003) investigated the veterinary value of helminth parasites in cattle, sheep, and goats in the northeastern Free State, as well as their intensities, seasonal occurrence, and distribution. Helminthosis was found to be a concern in small-stock animals, with EPG counts exceeding 1000.

Garg *et al*. (2004) on coproculture examination observed the prevalence of gastrointestinal nematodes as mixed infestation in sheep and goats and found the larvae of *Haemonchus contortus* (74.4±1.02%), *Oesophagostomum spp*. (23.0 ± 0.45%) and *Trichostrongylus spp.* (3.6 ± 1.57%).

Gorski *et al.* (2004) conducted research on 400 sheep and 180 goats from different parts of Poland. Internal parasitic infection was found to be more prevalent

in goats than that of sheep. *Muellerius capillaris* (lungworm) infection was ten times more common in goats. *Trichostrongylus* species was the most common gastrointestinal nematode in the both host species.

Muraleedharan (2005) observed the prevalence of gastrointestinal parasites among goats (46.12%), sheep (39.34%), buffaloes (20.85%) and cattle (18.22%) of southern taluks of central dry zone of Karnataka during drought period. *Strongyles* were the most common nematode. *Toxocara* infection was slightly higher in buffaloes than in cattle. *Fasciola, amphistomes, Moniezia* and *Entamoeba* infections were low among livestock but *Fasciola* infection was not seen in sheep.

Umur (2005) studied the gastro-intestinal organs of 50 goats in Burdur region of Turkey, for the prevalence of gastro-intestinal nematodes and the seasonal activity of the parasites was examined. *Ostertagia circumcincta* (78%), *Marshallagia marshalli* (72%), *Nematodirus abnormalis* (66%), *Trichuris ovis* (60%), *N. spathiger* (52%), *T. skrjabini* (50%) and *Trichostrongylus vitrinus* (40%) were the most frequently detected nematodes in the goats

Wesongah *et al.* (2005) observed the prevalence of parasitic infestations in small ruminants in a pastoral community of Narok district, Kenya. The percentage of animals with at least one or more helminths eggs detected during the wet season in sheep and goats was 36% and 52% respectively.

Das *et al.* (2006) looked for the prevalence of gastrointestinal helminthosis in goats raised in five rural areas near Ranchi, India. A total of 62.54 % of 1506 goat faecal samples tested positive for at least one helminth species. During the rainy season, parasitism was also found to be more prevalent

Regassa *et al.* (2006) performed a study to determine the prevalence and risk factors associated with gastrointestinal parasitism in western Oromia and reported that the overall prevalence of gastrointestinal parasites was 69.6% with 50.2%, 75.3%, and 84.1% in cattle, sheep, and goats, respectively..

Padmaja *et al.* (2007) studied prevalence of gastrointestinal parasitism in goats and found that gastrointestinal nematodiasis was highest in male goats (32.84%) than in females (30.57%).

Sissay *et al.* (2007) collected viscera of 655 sheep and 632 goats from four abattoirs in eastern Ethiopia for a two-year epidemiological analysis of small ruminant helminths. In the sheep and goats, there were 13 nematode species and four fluke species, with *Haemonchus contortus* being the most common (65–80%), followed by *Trichostrongylus species.*.

Kanyari *et al.* (2009) conducted a study to determine the prevalence of endoparasites in sheep and goats kept by farmers in Kisumu Municipality, Kenya. Faecal samples were collected from 66 sheep and 60 goats, from different areas in the municipality. The prevalence of various types of parasites respectively in sheep and goats were: *strongyles* 80% and 90%; *Strongyloides spp*. 5% and 13%; *Trichuris spp*. 0% and 2%; *Fasciola spp.* 37% and 36%; *Paramphistomum spp.* 30% and 12%; *Moniezia spp*. 21% and 16%; *Coccidia* 35% and 48%; *Entamoeba spp*. 87% and 77%; *Balantidium coli* 2 %and 3%; and *Giardia spp*. 10% and 10%.

Abebe *et al.* (2010) discovered five similar genera of nematodes in sheep and goats, which were *Haemonchus* (56.3%), *Trichostrongylus* (39.6%), *Oesophagostomum* (22.9%), *Trichuris* (21.6%), and *Bunostomum* (10.4%). in order of predominance.

Singh *et al.* (2010) found that the prevalence of gastrointestinal nematodes in goats was higher in “below 1 year age group” than in 1-3 years and above 3 years of age groups.

Kedar *et al.* (2012) based on their study observed that prevalence of gastro intestinal parasitism in goats was highly influenced by the climatic conditions.

Raza *et al*. (2012) conducted a study to determine the prevalence of helminths in goats. Five hundred faecal samples were collected from rectum of goats

at different localities of tehsil Jatoi, Pakistan and examined by using direct/indirect and copro-culture techniques. The identification of helminth eggs/larvae was done according to the standard parasitological procedures. The results showed that a total eight different species of helminths were prevalent in the area comprising 4 species of nematodes, 3 species of trematodes and 1 species of cestode. Overall prevalence of helminths was 52% while age-wise study has shown 73% prevalence in kids and 40 % in adults. Upon sex wise analysis of data it was observed that the prevalence of helminths was higher in males (56%) as compared to females (49%).

Khajuria *et al.* (2013) studied gastrointestinal helminths in small ruminants and reported that the gastrointestinal nematodes were found higher in young ones (73.22%) as compared to adults (61.25%).

Dappawar *et al*. (2018) conducted a study on small ruminants to determine the prevalence of helminths by fecal examination of 753 sheep and 740 goats. The overall prevalence of helminths was observed as 52.32% in sheep and 51.89% in goats. Age-wise analysis of gastrointestinal helminth infection in sheep was 57.30%, 56.68%, and 50.09% and in goats it was 45.00%, 48.25%, 54.32% in the kid, young and adults age group respectively. Upon sex-wise analysis higher infection was recorded in males than in females. Breed-wise analysis for gastrointestinal parasitic infection in Osmanabadi and non-descript goats has shown the infection of 52.89% and 48.93% respectively in them. In sheep infection rate of 52.57% was observed in Deccani and Non-descript sheep showed 52.57% of infection.

2.2 CLINICAL SIGNS

Soulsby (1982) reported that the continued presence of gastrointestinal nematodes is responsible for anorexia, reduced feed intake, alterations in protein metabolism, low levels of minerals, depressed activity of some intestinal enzymes and diarrhoea.

Ameen *et al*. (2006) studied clinical symptoms following experimental *Haemonchus contortus* infection in West African Dwarf kids. Ten apparently healthy kids were experimentally infected orally with 750 infective larvae of *Haemonchus contortus* for a period of 5 weeks. The clinical observations on the infected kids were normal rectal temperature, respiratory rate, heart rate and normal prepatent period with muscular weakness, anorexia, intestinal distension by worms, weight loss, reduced carcass quality, reduced feed intake, diarrhea and anaemia.

Bal *et al.*(2007) studied two severe outbreaks of parasitic gastroenteritis in sheep and goats caused by strongyles particularly *Ostertagia spp., Haemonochus spp.* and *Trichostrongylus spp*. in the Punjab state. Clinical signs of disease were diarrhoea, emaciation, dehydration and death within 1–2 days of the onset of disease.

Valentine *et al.*(2007) studied 152 goats suffering from different parasitic infections. Death was attributed to gastrointestinal parasitism in 31 goats, to coccidiosis in 7 goats, Trichostrongylosis in 6 goats, or to dual infections in 18 goats out of 152 goats. Sudden onset of weakness or death was a common historical finding. iarrhoea was evident in 15 goats.

Rajpura *et al*.(2019) studied 48 goats naturally infected with *Trichostrongylus spp.* from Anand district of Gujarat. The cases having a history of diarrhea, anorexia, weakness, dullness, loss of weight, and not dewormed were selected. Fecal samples of suspected goats were examined by direct smear method for the presence of *Trichostrongylus spp*. and eggs. The infection was confirmed by quantitative evaluation and coproculture of the samples for the identification of larvae. The result indicated that the infected goats had elevated rectal temperature, pulse rate and respiration rate along with diarrhea, dullness, depression, emaciation, and loss of condition.

2.3 EGG PER GRAM (EPG)

Katoch *et al.* (2000) studied the seasonal dynamics of gastrointestinal nematode infection in Barbari goats in the Mathura region. They found that the highest egg per gram of feces (3000±272.78) was during the rainy season at high temperature and relative humidity, and the lowest (1440±26.90) was recorded during the summer. Furthermore, during the winter, at low temperatures and relative humidity, they reported a worm count of 2115±140.76 per gram of feces.

Godara *et al.* (2011) studied drug trials on goats affected by gastrointestinal nematode and found that the mean egg per gram on day 0 and day 14 were 930 ± 175.1 and 710± 199.6 for fenbendazole, 1350 ± 421.1 and 490± 209.4 for levamisole, 1060 ± 224.9 and 20±12.3 for ivermectin and 800 ± 279.7 and 860 ± 274.9 for untreated control group.

Khajuria *et al.* (2013) found that the egg per gram of faeces was highest (1800 ± 110.21) during monsoon and the lowest in winter season for nematodes and other helminths in goats.

Nabi *et al.* (2014) studied 150 faecal samples from goats and discovered that the prevalence and mean egg per gram (EPG) for nematodes were significantly higher ($P < 0.05$) in young animals (1 year old) than in adults.

Pal *et al.* (2015) found that the egg per gram (EPG) ranged from 100 to 700 in experimental induction of *Nematodirus filicollis* infestation in goats.

Sanalkumar *et al.* (2017) upon EPG analysis found that *Strongyles* were the most predominant gastrointestinal nematodes followed by *Trichuris*. Further it was noticed that, Egg per gram peaks during the month of April and October in adults and during January-February and June-October in kids.

Singh *et al.* (2017) measured the eggs of *Strongyles* in goats and reported 1168.57 ± 78.31 as the mean egg per gram in them.

2.3.1 Faecal Examination

Soulsby (1982) went through the various methods of faecal analysis in great detail. Due to a high immunity, oocyst excretion peaks around the time of weaning and then gradually declines after that. Breeding intensification, high stocking rates in premises, poor hygiene, and all causes of stress (physiological, dietary, etc.) to the animals are all risk factors for high excretion.

2.4 HAEMATOLOGICAL PARAMETERS

Kassai *et al*. (1990) investigated the connection between Hb genotype and innate resistance to experimental *H. contortus* in Merino lambs and found that haematocrit values had no bearing on flock selection of high responder individuals.

Richard and Cabaret (1993) found high leukocyte and basophil count and lower lymphocyte levels in kids that are susceptible to *T. circumcincta* than in resistant ones.

Balic *et al.* (2000) revealed that eosinophils were considered to be important elements that respond against nematodes infestations in the animal body.

Pal *et al.* (2001) carried out study on goats naturally infected by *Trichuris* worms. The goats were divided into two groups (group I and group II). Group I was treated with Fenbendazole orally at the dose rate of 10 mg/kg and group II was kept as untreated control. It was concluded that the mean EPG of faeces in group I was reduced than that of group II and a marginal rise in Hb, TEC and neutrophil count and slight decrease in PCV, TLC and lymphocyte count in group I, occurred after treatment in treated group (group I) than pre-treatment values. In treated group increase of neutrophil count and decrease of lymphocyte count which are opposite in control group.

Sharma *et al.* (2005) found significant fall in levels of neutrophil and lymphocyte counts in 12 male Barbari goats, aged between 9-12 months, which were experimentally infested with 5000 larvae of *Haemonchus contortus* .

Bal *et al.* (2007) conducted haematological studies in two severe outbreaks of parasitic gastroenteritis in sheep and goats caused by *Strongyles* particularly *Oestetagia spp., Haemonochus spp*. and *Trichostrongylus spp*. in Punjab state. They reported anaemia and eosinophilia in the affected animals.

Jas *et al*. (2008) conducted haemato-biochemical studies in 60 goats naturally affected with gastrointestinal nematode *strongyles* with EPG >300. They found decrease in Hb and PCV in both the younger and older animals and TEC in older goats. Further, increase in TLC values in younger goats were found significant when compared with older goats.

Jas *et al.* (2010) conducted haemato-biochemical studies in 13 Black Bengal goats of either sex aged between 30-45 days. Experimentally infected *Oseophagostomum columbianum* reported decrease in values of Hb, PCV, TEC and TLC in the affected goats.

Hassan *et al.* (2012) on experimental studies in goats infected with gastrointestinal nematodes and ectoparasites and reported decrease in the levels of PCV, Hb, RBC and increase in eosinophil counts in the affected animals. Further, they reported that the levels of the above parameters returned to normal on undertaking treatment.

Regassa *et al.* (2013) evaluated the mean PCV values in goats affected with gastrointestinal nematodes and treated with deworming drugs. They recorded before and after therapy mean PCV values of 28.6 ± 1.5 and 30.3 ± 1.6, 27.6 ± 1.1 and 31.3 ± 1.0, 26.3 ± 1.1 and 29.6 ± 0.9 in albendazole, ivermectin and tetramisole treated groups, respectively

Ahmed *et al*. (2015) documented a significant decrease ($p<0.05$) in TLC, neutrophil, eosinophil and monocyte counts in goats affected with gastrointestinal nematodes.

Moudgil *et al.* (2017) conducted haemato-biochemical studies in goats affected with blood-sucking *Haemonchus contortus* and reported a significant ($p<0.05$) decrease in Hb (6.93 ± 0.56) PCV (15.28 ± 1.51) and TEC (15.07 ± 1.23) counts in them.

Rajpura *et al.*(2019) documented significant decrease in the mean Hb (7.30 ± 0.05), TEC (7.77 ± 0.07), PCV(22.23 ± 0.17) and lymphocytes (44.72 ± 0.28) and significant increase in TLC(13.28±0.19), Neutrophils (44.25±0.26) ,Monocytes (4.23 ±0.03), Eosinophils (6.55±0.14) in goats affected with trichostrongylosis .

2.5 BIOCHEMICAL PARAMETERS

Jas *et al.* (2008) studied the effect of gastrointestinal nematodes on haemato-biochemical parameters under field conditions in 60 goats having *strongyle* egg count >300. Serum albumin level significantly declined but this was significant in younger goats. In older goats hyperglobulinemia was observed, which resulted in non-significant alteration in total serum protein level due to gastrointestinal nematode infection.

Jas *et al.* (2010) carried out an experiment to study the haemato-biochemical impact of primary infection of *Oesophagostomum columbianum* infection in goat. *O. columbianum* infection resulted in hyperglobulinemia and hypoproteinemia with decreased value of total serum protein and serum albumin in infected goats.

Hassan *et al*. (2012) analyzed the serum samples of goats infested with parasites especially nematodes and reported a significant ($P<0.05$) increase in levels of SGOT (11.5U/L) and SGPT (37.6U/L) and decrease in TSP(7.8g/dl) and calcium(9.2mg/dl) levels. On undertaking anthelmintic treatment, the values returned to normal.

Ratnesh *et al.* (2013) analysed the serum samples of goats infected with *Haemonchus contortus* and reported increase in values of ALP and ALT in the affected animals.

Ahmed *et al.* (2015) reported a significant (P<0.05) decrease in levels of total serum protein (5.19g/dl) and albumin (3.26g/dl) in gastrointestinal helminths infected goats.

Moudgil *et al.* (2017) analyzed haemato-biochemical changes in goats affected with gastrointestinal parasitic infestations. They reported a significant (P<0.05) decrease in the values of TSP (5.21 ± 0.70), Albumin (2.78 ± 0.26) and a marked increase in the values of Alanine aminotransferase (38.19 ± 1.98) and Aspartate aminotransferase (97.92 ± 2.21) in *Haemonchus spp.* infection.

Rajpura *et al.* (2019) documented significant decrease in serum total protein (5.65±0.07 g/dl), serum calcium (8.72±0.07 mg/dl), serum phosphorus (4.28±0.03 mg/dl) and significant increase in ALT (52.58±0.90 units/L), AST (101.43±0.63 units/L), and ALP (194.89±1.24 units/L) in goats infected with parasites.

2.6 ANTHELMINTIC THERAPY

Javed and Akhtar (1990) evaluated antinematodal activity of a mixed prescription of *Verona anthelminca* seed (Kali zeeri) and *Embelia ribes* fruit (Babrang) in goats. The EPG were counted before treatment and on the $3^{rd,}$ 10^{th} and 15^{th} days of the treatment with 0.5, 1 and 2 g/kg body weight doses with the water and methanol extracts equivalent to 2 g/kg of the original powder. The evaluation of data on the 15th day of the administration showed that 2 g/kg of powder, its equivalent amount of methanol extract and 0.01 g/kg of morantel tartrate are equally effective and safe in treating natural gastrointestinal nematode infection of the local goats.

Miller and Morrison (1992) reported that fenbendazole and ivermectin are two anthelmintics used for controlling strongyle nematode parasitism in cattle. Both products are highly efficacious against adult and immature stages residing in the gastrointestinal tract..

Rajurkar (2000) reported that *Embelia ribes* seed powder @150 mg/kg as well as dried *Aloe vera* @ 300 mg/kg body weight body weight orally are useful in treating gastrointestinal helminth infection in animals.

Garg *et al.* (2004) studied nematodiosis in 47 Barberi goats of either sex for around one year. They observed higher therapeutic efficacy of fenbendazole @ 7.5mg/kg body weight. It not only reduced the EPG to zero but all the animals became free of Haemonchus worms as revealed by critical trial results

Jabbar *et al* (2006) reported that *Aloe vera* leaves powder @ 50–125 gram as well as *Embelia ribes* seed powder @ 50–75 gram as a total dose is useful in gastrointestinal helminth infection in small ruminants, after mixing with jiggery.

Godara *et al*. (2011) studied efficacy of fenbendazole, levamisole and ivermectin which was checked in comparison to untreated controls in twenty Jamunapari goats, naturally infected with gastrointestinal nematode parasites. Faecal examination at day 0 revealed an egg per gram of 930 ± 175.1, 1350 ± 421.1, 1060 ± 224.9 and 800 ± 279.7 in group A, B, C and D, respectively having five animals each. Faecal egg counts of the animals treated with fenbendazole (group A), levamisole (group B) and ivermectin (group C) were reduced by 23.66, 63.70 and 98.11%, respectively on day 14 post-treatment.

Joseph and Raj (2011) reported that *Aloe vera* is anti-inflammatory, diuretic, uterine tonic, spermatogenic, laxative and fever reliever. It is used in ayurvedic formulations as appetite stimulant, purgative and anthelmintic.

Chaudhary (2012) reported that fruits of *Embelia ribes* are used as astringent, anthelmintic, brain tonic, carminative, diuretic, laxative and stimulant.

Harish *et al.* (2012) reported that the dried fruits of *Embelia ribes* are used for preparation of medicine which is widely used as anthelmintic, carminative, antibacterial, anti-inflammatory, diuretic and astringent.

Rajeswari *et al.*(2012) reported that consumption of *Aloe vera* juice acts as digestive tonic and helps in cleaning of digestive tract leading to improvement in peristaltic movement.

Sahu *et al.* (2013) reported that *Aloe vera* is anthelmintic, carminative, diuretic and stomachic. Its juice is also used in skin care medicine and in constipation.

Akanda *et al*. (2014) studied the efficacy of three different drugs against nematodiasis in goats. Twenty goats were divided into 4 groups of 5 animals each. Group 'D' served as control, whereas group A, B, and C were treated with ivermectin, fenbendazole and albendazole respectively. The therapeutic efficacy was evaluated through determination of eggs per gram (EPG) count. Faecal samples were collected before treatment on day 0, and on post-treatment days 7, 14, 21 and 28 of study. Pre and post-treatment EPG values were recorded and efficacies compared. The results showed that the efficacy of albendazole was 87%, ivermectin 85% and fenbendazole was 92% efficacious.

Sharma *et al*. (2015) conducted a study on twenty seven goats with diarrhoea and loss of body condition. They were divided into three groups after qualitative examination Group I was treated with ivermectin at dose rate of 0.2 mg per kg body weight orally. Group II was treated with fenbendazole @ 5 mg/kg body weight orally and Group III goats were kept as untreated control. Quantitative examination for EPG was conducted on day 0, 7 and 14 by Stoll's technique. FECRT percentage revealed 100% efficacy of ivermectin @ 0.2mg/kg b.wt. whereas FECRT percentage for fenbendazole treated group was found to be 57.44% on day 7 and 70.87% on day 14 post treatment.

Meenakshisundaram *et al.* (2016) studied anthelmintic activity of aqueous and ethanolic extracts of *Aloe vera* against gastrointestinal nematodes of sheep by in vitro and in vivo tests. In vitro egg hatch assay with aqueous extract of *Aloe vera* demonstrated inhibition of egg hatch at all the significant concentrations tested and

the ED50 value of egg hatch inhibition was 0.57 mg/ml. It was also observed that aqueous extract of *Aloe vera* inhibited larval development at all the tested concentrations.

Meenakshisundaram *et al* (2016) conducted in vitro experiments to determine the anthelmintic effects of crude aqueous and ethanolic extract of five indigenous plants *viz*. the petals of *Aloe vera* , seeds of *Cucurbita pepo* , fruits of *Embelia ribes* , leaves of *Indigofera tinctoria* and *Sebania grandiflora* against mixed gastrointestinal nematodes of sheep by egg hatch assay (EHT), larval development assay (LDA) and larval migration inhibition assay (LMIA). It was reported that aqueous extract of *A. vera, C. pepo, S. grandiflora* and ethanolic extract of *I. tinctoria* demonstrated significant inhibition of egg hatch at 40 mg/ml and 80 mg/ml concentration. Both aqueous and ethanolic extracts of all the five plants (10-80mg/ml) showed limited inhibition of larval development.

Tramboo *et al* (2016) treated 30 goats with fenbendazole and observed 99% efficacy

Ibrahim and Nzalawahe (2017) compared *Aloe vera* aqueous crude extracts with ivermectin in treating gastrointestinal nematode infection in goats at Sokoine University of Agriculture in Morogoro. Faecal samples were collected at day 0 of treatment and days 14 and 21 post treatment. The effectiveness of the *Aloe Vera* and ivermectin was assessed using Fecal Egg Count Reduction Test (FECRT). The anthelmintic was considered to be effective when the calculated FECRT percentage was ≥ 95%. Lower Confidence Limit (LCL) was ≥ 90%. The day 14 post treatment results of FECRT percentage and LCL for *Aloe vera* were 97% and 74% while for ivermectin results were 96% and 69% respectively. However, the FECRT percentage and LCL results at day 21 post treatment were 100% for both products. The findings of this study indicate that *Aloe vera* aqueous crude extracts were as effective as ivermectin in treatment of GIT nematode infection in goats.

Sinha *et al* (2020) evaluated use of powder formulation of *Embelia ribes* fruits and *Vernonia anthelmintica* seeds for their anthelmintic efficacy against gastrointestinal nematodes in sheep. In this study, twelve naturally infected female sheep were selected based on egg per gram (EPG) and then randomly divided into two groups, group I (G I) and group II (G II) having six animals each. G I animals were treated with powder formulations of *Embelia ribes* fruits and *Vernonia anthelmintica* seeds (1:1) at the dose rate of 600 mg/kg.b.wt. orally whereas G II animals were left as untreated infected control. Faecal and blood samples were collected on days 0, 3, 7 and 10 post treatment to record reduction in faecal egg count and improvement in haematological and biochemical parameters post treatment. On day 10 post treatment, 62.07% reduction in faecal egg count was observed. Post treatment, there was improvement in haematological, total protein and albumin level indicating reduction in worm burden. Post treatment AST, ALT and serum creatinine values suggested no side effects. The study revealed promising activity of the herbal formulations which can be further exploited to improve the efficacy against gastrointestinal nematodes of sheep.

Materials And Methods

CHAPTER - III

MATERIAL AND METHODS

The present research project was carried out in and around Parbhani (Maharashtra) and nearby villages. Fecal samples of goats irrespective of age were screened for the presence of gastro-intestinal parasitic infection using direct, qualitative and quantitative fecal examination methods. The positive animals with EPG >250 were randomly distributed in three groups containing ten goats in each group (n=10). The fecal samples were examined on day 0 (before treatment) 3rd, 7th and 14th days post treatment for evaluation of therapeutic efficacy of each drug.

3.1 Incidence

The cases of gasto-intestinal parasitism in goats were diagnosed by screening the animals having clinical signs such as rough dull coat, weakness, loss of appetite, diarrhoea and gradual weight loss and further subjecting them to faecal analysis, both qualitative and quantitative. Qualitative faecal examination was performed by direct microscopy, sedimentation and flotation technique, while quantitative examination was done with Stoll‟s technique. The study on gastro-intestinal parasitism in goats was conducted in and around Parbhani city and also nearby villages. The data on the occurrence of gastro-intestinal parasitism was further analyzed.

3.2 Selection of animal

Screening was done by carrying out faecal examination for helminth infection. The goats were selected on the basis of clinical signs such as rough dull coat, weakness, diarrhea, loss of appetite, weight loss and EPG>250.The cases of gastro-intestinal parasitism, so detected in goats, were randomly selected and utilized for the present investigation. Thirty (30) clinical cases of goats suffering from gastro-intestinal parasites were used for evaluating the therapeutic efficacy of different anti-parasitic preparations. The positive animals were randomly distributed in three different groups containing ten (n=10) goats in each group.

The faecal samples of treated groups were examined on day 0 (before treatment) and on day 3rd, 7th and 14th post therapy for evaluation of therapeutic efficacy of each drug.

3.3 Clinical parameters:

3.3.1 Heart rate (Beats/min)

Auscultation of the heart was performed on the chest area in between 3rd to 5th inter-costal space on the left side of thorax at the level of point of elbow. The LUBB-DUBB sounds audible over a period of 1 minute i.e. Heart rate (HR) was recorded and expressed in beats per minute (bpm).

3.3.2 Respiratory rate (Breaths/min)

The respiratory rate (RR) was recorded by feeling the air movements at nostrils. Hand was placed in front of the nostrils and the air current was counted for a period of 1 minute. Stethoscope was also put over the thorax to auscultate the inspiratory and expiratory efforts of the goat. The respiratory rate was expressed as breaths per minute (Breaths/min).

3.3.3 Rectal Temperature (^{0}F)

The rectal temperature (RT) was recorded by inserting a clinical thermometer per rectally close in contact with rectal mucosa for about 2 minutes and expressed in (^{0}F)

3.3.4 Colour of mucus membrane

Mucus membrane was examined by pressing the upper eyelid down over the eyeball and pulling down the lower eyelid, thus exposing the mucus membrane of lower eyelid for examination.

3.3.5 General body condition

Gastro-intestinal parasitism usually results in loss of body condition and reduced performance. Poor or declining body condition can also be a sign of age, poor nutrition or other diseases. However, in accordance with associated clinical

signs of gastro-intestinal parasitism, the body condition of goats was scored on the scale of 0-5 as detailed below.

Table 3.1: General body condition score

Sr. no	Score	Body Condition	Conclusion
I	0	Very weak, thin with cachexia, may be resultant of severe wasting.	very poor
II	1	Poor body condition with all bones and ribs prominent.	Poor
III	2	Lean animal with visible ribs and very less buttock.	Weak
IV	3	Lean animal with ribs somewhat visible with fewer muscles on the buttock area.	Moderate
V	4	Well developed	Good
VI	5	No hint of ribs, buttock muscles well developed.	Best

3.3.6 Faecal consistency

The consistency of faecal matter changes as per the parasitic load. Helminth infection is normally exhibited by scour (diarrhoea). The hindquarters of the goats were particularly examined to determine the degree of fecal soiling.

3.4 Faecal examination

Faecal samples from all the goats were collected per-rectally on day 0 (BT) and on day 3, 7 & 14 (post treatment). The faecal samples were placed in sterile sample bags that were labeled with animal identification details and date & place of collection. The samples were stored at 20^{o}C and processed within 6-7 hours from the time of collection for correct identification of the parasitic eggs. These samples were analysed both qualitatively and quantitatively for

identification of parasites and the density of infection. Later on, the samples were preserved in 10% formalin to facilitate examination of faeces beyond 1-2 days.

3.4.1 Qualitative examination of faeces

Qualitative examination of faecal samples was performed to determine the type of parasitic infection and to have a rough idea regarding the intensity of infection.

3.4.1a Direct microscopy

Direct microscopic examination was performed to identify helminth eggs when infection is heavy. Follwing procedure was performed for this:

i) Small amount of faeces was taken on the slide.

ii) one drop of distilled water was added on it.

iii) Cover slip was placed over the faecal smear.

iv) The prepared mounts were observed under a microscope.

3.4.1b Sedimentation technique

i) Two grams of fecal sample was taken in a beaker to which 40-50 ml of water was added.

ii) The fecal mass was broken with the help of glass rod to prepare uniform fecal suspension.

iii) The fecal suspension was then strained in the sedimentation flask through an ordinary strainer with a thin layer of cloth on it.

iv) The flask was filled with water up to the brim and the fecal suspension in flask was allowed to stand for 20-30 minutes.

v) After 20-30 minutes the supernatant was discarded to obtain 3-5 ml of sediment at the bottom of sedimentation flask.

vi) About 2-3 drops of sediments was placed on a glass slide to which coverslip was applied and fecal smear examined under microscope.

3.4.1c Flotation technique

i) 2 gm of faeces was taken into a container

ii) Forty milliliters of saturated salt solution was poured on it.

iii) It was mixed completely with a stirring rod.

iv) The resulting faecal suspension was passed through a tea strainer

v) The filtered faecal suspension was poured into a test tube.

vi) The test tube was placed vertically in a test tube stand.

vii) The test tube was topped up gently with the faecal suspension, leaving a convex meniscus at the top of the tube and carefully placed a coverslip on top of the test tube.

viii) The test tube was allowed to stand for 20 minutes.

ix) The coverslip was lifted from the tube, together with the drop of fluid adhering to it, and was placed immediately on a microslide.

x) Microscopic examination was carried out

3.4.2 Quantitative Examination of Faeces

3.4.2a Eggs per gram (EPG) calculation by Stoll's technique (Soulsby 1982)

1) Three grams of fecal sample was weighed.
2) Forty two milliliters of clean water was measured and placed into a dish. Using a tongue depressor, 3 grams of feces were pushed through a sieve into the water, lifting the sieve, any remaining water was pushed from the feces.
3) While stirring the water-feces mixture, 0.15 ml of the suspension was taken and spread over 2 slides. Each slide was covered with a long cover slip (or 2 regular size cover slips)
4) Both slides were examined for parasitic eggs. The total number of eggs counted X 100 represented the number of eggs per gram of feces.
5) Since 0.15 ml is $1/300^{th}$ of 45 ml (42 ml water and 3 gm feces), the number of eggs in 0.15 ml X 100 is equal to 1/3 of the total number of eggs in the original 3 grams and thus the number derived is equal to eggs per gram (EPG) of faeces.

EPG = Number of eggs counted X 100

3.5 Collection of blood sample

Blood samples were collected on day '0' (before treatment) and on 7^{th} & 14^{th} day after therapy from jugular vein aseptically for hematological analysis, in a sterile tube containing ethylene diamine tetra acetic acid (EDTA) 3.5% from all the affected goats. Similarly, the blood samples were also collected in a clot activator tube for serum sample from all the goats.

3.5.1 Hematological analysis

The estimation of hemoglobin (Hb), packed cell volume (PCV), total erythrocyte count (TEC), total leukocyte count (TLC) and absolute count were carried out as per standard procedure using (Coulter Ac T5diff; Five part Differential) with automatic haemo-analyser.

3.5.1a Hemoglobin (Hb)

The hemoglobin was estimated by using haemo-analyzer and the results were expressed in gram per deciliter (g/dL) of blood.

3.5.1b Packed cell volume (PCV)

The packed cell volume (PCV) was determined by using haemo-analyzer and the results were expressed in per cent (%).

3.5.1c Total erythrocyte count (TEC)

The total erythrocyte count (TEC) was enumerated with the use of haemo-analyzer and the results were expressed in million cells per microliter ($x10^6$ /µL).

3.5.1d Total leukocyte count (TLC)

The total leukocyte count (TLC) was estimated using haem-oanalyzer and the finding was expressed in thousands per microliter ($x10^3$ /µL).

3.5.1e Diffrential leukocyte Count (DLC)

Freshly prepared, thin and methanol fixed blood smears were stained with Giemsa's stain. Diffrential leukocyte Count (DLC) was carried out as per the standard method described by Jain (1986) and the count was expressed in per cent (%).

3.6 Blood biochemical estimations:

Blood biochemical studies were carried out on serum samples collected before administration of anti-parasitic preparation (BT) on day 0 and post therapy (PT) on day 7^{th} & 14^{th} in all the groups. The serum samples were separated from the clotted blood and stored at -20^0C until use i.e. upto 72 hours of collection, within which all the biochemical estimations were carried out using biochemical kits supplied by M/S Ambica diagnostics, MIDC, Parbhani by Spectrophotometry. Estimations of Total protein, serum albumin, serum globulin, AST and ALT were carried out in all the affected goats on day 0 (BT) and on day 7 & day 14 after therapy (AT) using standard protocol prescribed with the kit.

3.6.1 Serum Protein

Total serum protein was determined quantitatively by Biuret end point method using standard diagnostic kits from M/S Ambica diagnostics, MIDC, Parbhani in Ebra Chem-7 biochemical autoanalyzer. The values of total serum protein were expressed as g/dl of serum.

3.6.2 Serum Albumin

The total serum albumin was determined by anionic dye bromocresol green (BCG) method using standard diagnostic kits from M/S Ambica diagnostics, MIDC, Parbhani in and the value of total serum albumin was expressed as g/dl.

3.6.3 Serum Globulin

The amount of globulin was calculated by subtracting the albumin concentration from the total proteins and the values were expressed in g/dl.

3.6.4 Aspartate aminotransferase (AST/SGOT)

One thousand µL of working reagent was added with 100 µL of serum sample and was mixed and incubated for 1 minute at 37^0C and the absorbance was measured at 340 nm with a factor of 1745. The value was expressed in IU/L.

3.6.5 Alanine aminotransferase(ALT/SGPT)

One thousand µL of working reagent was added with 100 µL of serum sample, mixed and incubated for 1 minute at 37^0C and the absorbance was measured at 340 nm with a factor of 1745. The value was expressed in IU/L.

3.7 Procurement of anthelmintic drug

Dried Aloe vera and *Embelia ribes* seed powder was purchased from an authentic shop from the local market of Parbhani and confirmed by experts from Department of Botany, Shri Shivaji College Parbhani.

3.8 Faecal egg count reduction test (FECRT)

A faecal egg count reduction test (FECRT) was employed to assess anthelmintic efficacy by calculating the percentage of worms killed (as determined by reduction in EPG) by the drug administered. The percentage of fecal egg count reduction test (FECRT) was calculated by using the following formula.

$$\text{FECRT}(\%) = \frac{\text{EPG (Pre-treatment)} - \text{EPG (post-treatment)}}{\text{EPG (Pre-treatment)}} \times 100$$

Plate no 3.1: Egg of *Strongyloides spp*

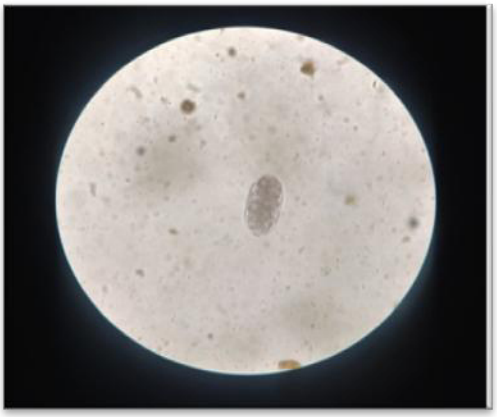

Plate no 3.2: Egg of *Strongyle spp*

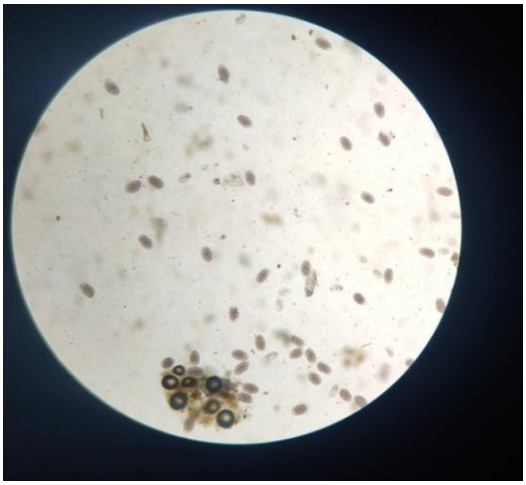

Plate no 3.3:Egg of *Strongyle* and *Strongloides* spp

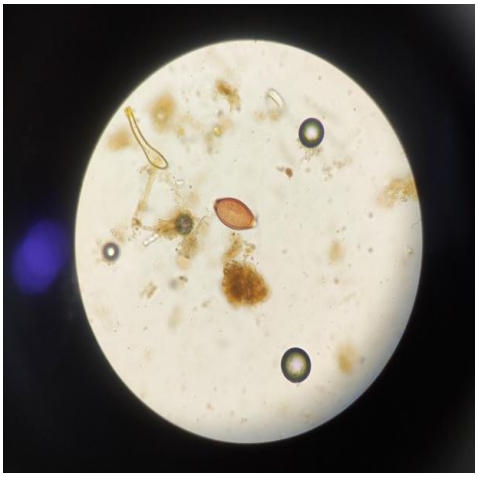

Plate no 3.4: Egg of *Trichuris spp* egg

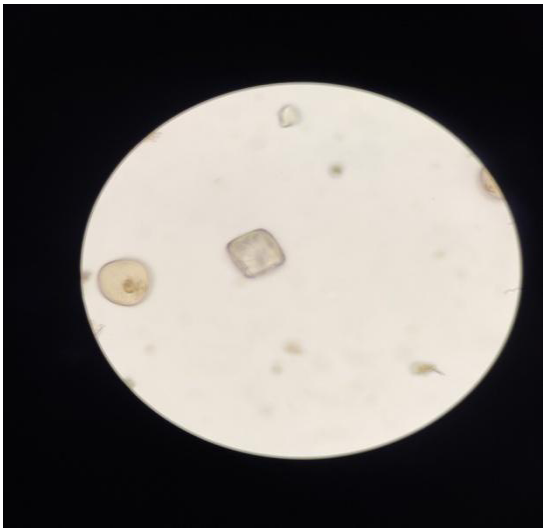

Plate no 3.5:Egg of *Monezia spp*

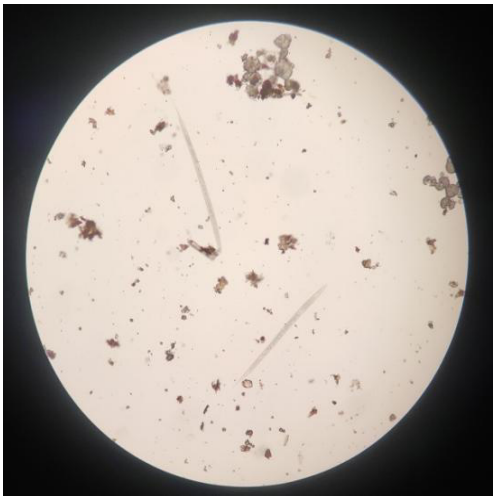

Plate no 3.6: Larvae of *Strongyle spp*

Plate no 3.7: *Embelia ribes* seed powder

Plate no 3.8: Dried *Aloe vera* pulp

Plate no 3.9: Fenbendazole bolus

3.9 Evaluation of therapeutic efficacy of different anthelmintic drugs:

The goats exhibiting signs of gastro-intestinal parasitism and EPG>250 were randomly selected and distributed into three different groups, each containing ten (n=10) animals for evaluation study. Three different oral anthelmintic preparations viz fenbendazole, *Embelia ribes* seed powder & dried *Aloe vera* pulp were evaluated for their therapeutic efficacy against gastrointestinal parasites as below:

Table 3.2: **Details of therapeutic regimen**

Group	No of animals	Therapeutic drug	Dose	Schedule
I	10	*Embelia ribes seed powder*	150 mg/kg body weight (Rajurkar,2000)	Orally daily once for 7 days
II	10	Dried *Aloe vera*	300 mg/kg body weight (Rajurkar,2000)	Orally daily once for 7 days
III	10	Fenbendazole	10 mg/kg body weight (Sandhu,2013)	Orally once only

Statistical analysis

The analysis of the data of the present research work was done as per Completely Randomized Design (CRD) using Wed Agri Stats Package (WASP 2.0) and values were expressed as Mean±SE.

3.10 In vitro study to evaluate the antihelnintic efficacy of *Embelia ribes* and *Aloe vera*

Plant extract preparation

Collection and identification of plant material:

An authenticated dried *Aloe vera* pulp and *Embelia Ribes* seed powder were purchased from the local market of Parbhani and identified in the Department of Pharmacology and Toxicology, college of veterinary and animal sciences, Parbhani.

Preparation of aqueous hot extract of *Embelia Ribes* and *Aloe vera*

Soaking:

Dried *Aloe vera* pulp and *Embelia Ribes* seed powder was soaked in the distilled water for 24 hours in 10% weight/volume proportion (100 gm in 900 ± 100 ml solvent respectively) for extraction in the round bottom flask with intermittent vigorous shaking which was done at hourly interval during the soaking process.

Boiling:

The soaked plant material was transferred in the stainless steel container for the hot extraction process which was done at 80-100 ^{0}C up to the reduction to half of the total volume of solvent.

Filteration:

The condensed solvent was filtered with a muslin cloth to separate the liquid portion from solid mass of the plant material. Afterwards liquid portion thus obtained was filtered with the help of Whatman's filter paper No. 41 for next 24 hours.

Evaporation:

The filtered liquid portion was then transferred in the petri plates for the evaporation for next 48 to 72 hours.

Separation and storage of extract:

The extract thus obtained was transferred in the dispensing bottles which were stored in the desiccator at the temperature of 25 ^{0}C up to its use in trail.

From 10% aqueous extract of *Embelia ribes* and *Aloe vera* , five different dilutions such as 10 mg/ml, 20 mg/ml, 30 mg/ml, 40 mg/ml and 50 mg/ml were

prepared and utilized in egg hatching test to evaluate the antihelmintic efficacy of these extracts.

3.11 Egg hatching test:

The egg hatching test was performed by the method described by Costa *et al* (2008) to evaluate the efficacy of *Embelia ribes* and *Aloe vera*. For collection of eggs of *Strongyle spp*. faecal sample was processed in the laboratory by sedimentation technique. After removal of supernatant, when 5 ml sediment was remaining in the sedimentation flask, 100 µl of it was taken on a glass slide and the quantity of the eggs was measured. After calculation the eggs present / ml of the sedimentation solution was adjusted as 400 eggs /ml of solution. A 0.25 ml suspension containing approximately 100 eggs was transferred in a well of flat bottom micro titer plate. Such 5 wells were loaded as above with faecal suspension and in each well equal volume of plant extract in different concentration was mixed. One well was kept as a control in which equal amount of faecal suspension and distilled water was mixed. The plate was incubated for 48 hours at room temperature. After 48 hours lugols drop were added to stop the hatching of the eggs. After incubation period eggs which failed to embrionate and hatch were counted in each well. The results were tabulated and analyzed.

Plate no 3.10: Aqueous extract of *Embelia ribes* seed powder

Plate no 3.11: Aqueous extract of dried *Aloe vera* pulp

Results And Discussion

CHAPTER - IV

RESULT AND DISCUSSION

The present research project was planned to study the incidence of gastrointestinal helminthosis in and around Parbhani and to record clinico-haematological and blood biochemical alterations in affected goats and to evaluate the efficacy of *Embelia ribes* seed powder and dried *Aloe vera* pulp in comparison to Fenbendazole.

4.1 Incidence

The incidence of gastrointestinal helminthosis in goats was studied by screening the goat population of Parbhani city and surrounding villages like Raipur, Asola, Takali, Dharmapuri and goats presented to Veterinary Clinical Complex .COVAS, Parbhani during the period from December 2020 to April 2021.

In the present study a total no of 121 goats were screened for gastro intestinal helminth, of which 68 were positive, indicating overall incidence of gastrointestinal helminthosis as 56.19 percent (Table 4.1,fig.4.1) Out of total 121 goats screened 35 (28.93%) were kids upto 4 month of age, 45 (37.19%) were young once having age between 4 months to 1 year and 41 (33.88%) were adults with age of 1 year or more. Out of 35 kids 15 (42.86%), out of 45 young goats 21 (46.67%) and out of 41 adult goats 32 (78.04%) were found to be affected with helminth infection. (Table 4.2 fig 4.2) Similar observations of incidence have been recorded by Dappawar *et al.,* (2018) who found an overall incidence of 51.89 percent with 45 percent incidence in kids and 54.52% in adults. Dabasa *et al.,* (2017) observed 81.1 percent incidence of helminthosis in adult goats.

Table no 4.1 Overall incidence of helminthosis in goats

Total no of faecal samples examined	No of faecal samples positive for helminth infection	Overall incidence (%)
121	68	56.19

Table no.4.2 Age wise incidence of helminthosis in goats

Age	No of goats examined	No of goats positive for GI helminthosis	Percent positive (%)
Kid (0-4 months)	35	15	42.86
Young (4 months- 1 year)	45	21	46.67
Adult (above 1 year)	41	32	78.04
Total	121	68	56.19

Out of 73 female goats examined 36 were positive for helminthosis, indicating incidence rate in female goats as 49.32 percent. Among 48 male goats 32 were positive for helminthosis with an incidence rate 66.67 percent (Table 4.3,fig.4.3) Similar findings have been recorded by Dappawar *et al.,* (2018) who observed 64.66% incidence in male and 49.09% incidence in female goats respectively, where as Raza *et al.,* (2012) found 56% incidence in male and 49% in female goats.

Table no 4. 3. Sex wise incidence of helminthosis in goats.

Age	No. of goats examined	No.of animals positive for GI helminthosis	Percent positive (%)
Female	73	36	49.32
Male	48	32	66.67
Total	121	68	56.19

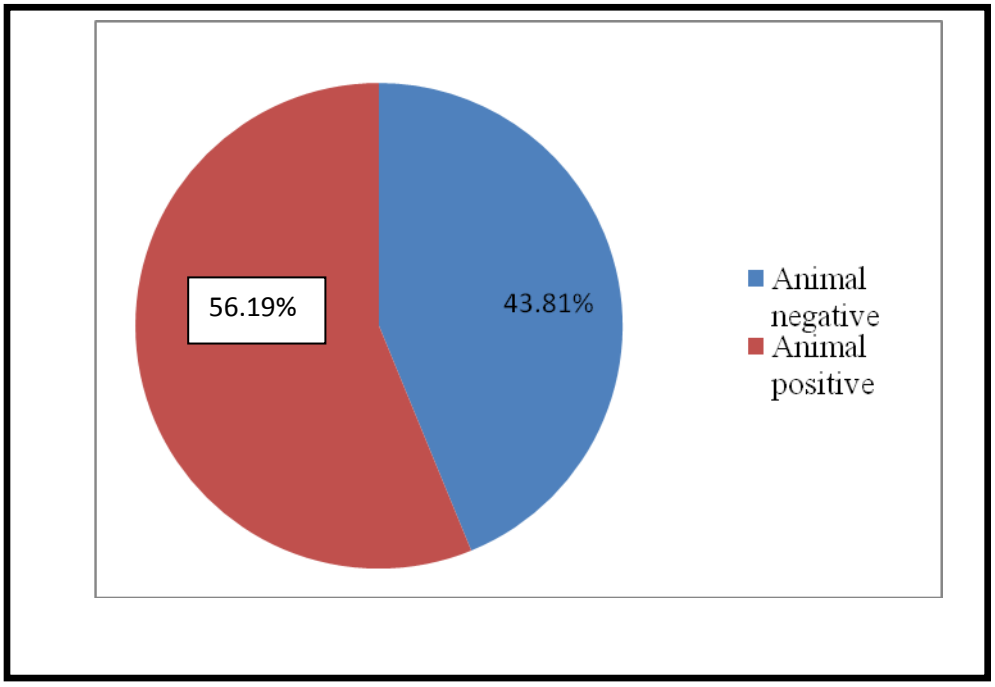

Fig.4.1: Overall incidence of helminthosis in goats

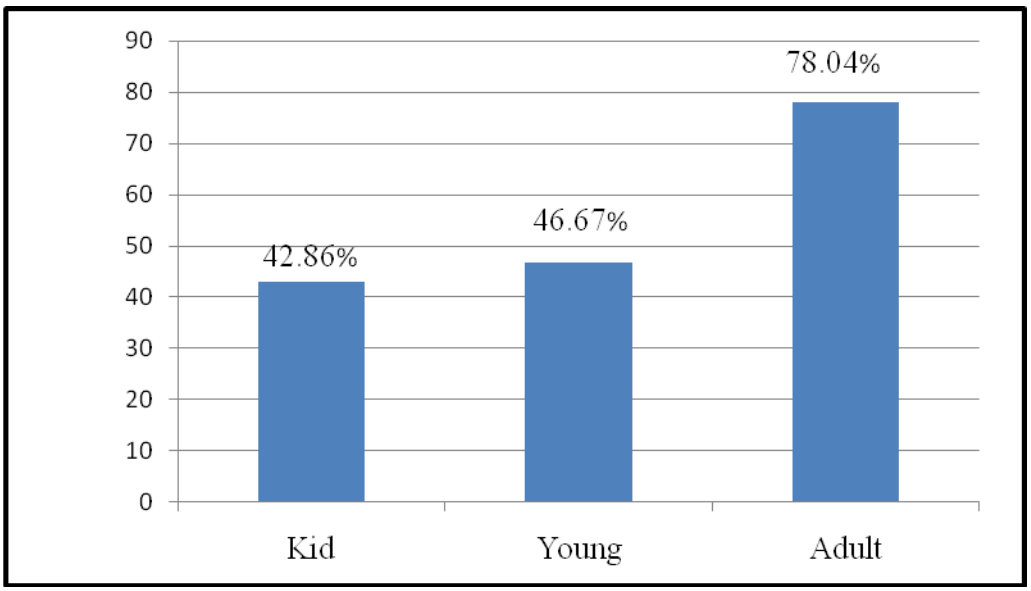

Fig. 4.2: Age wise incidence of helminthosis in goats

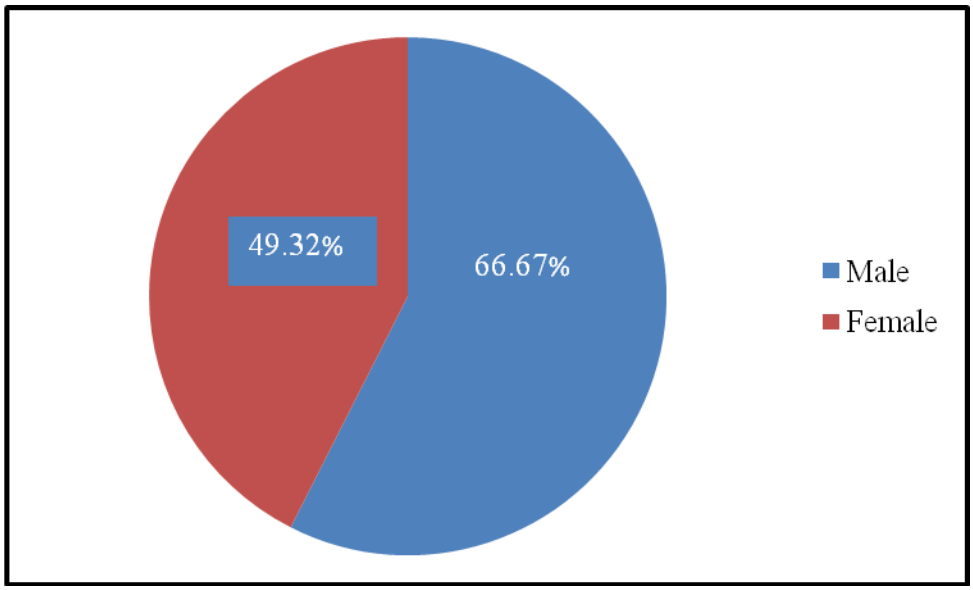

Fig. 4.3: Sex wise incidence of helminthosis in goats

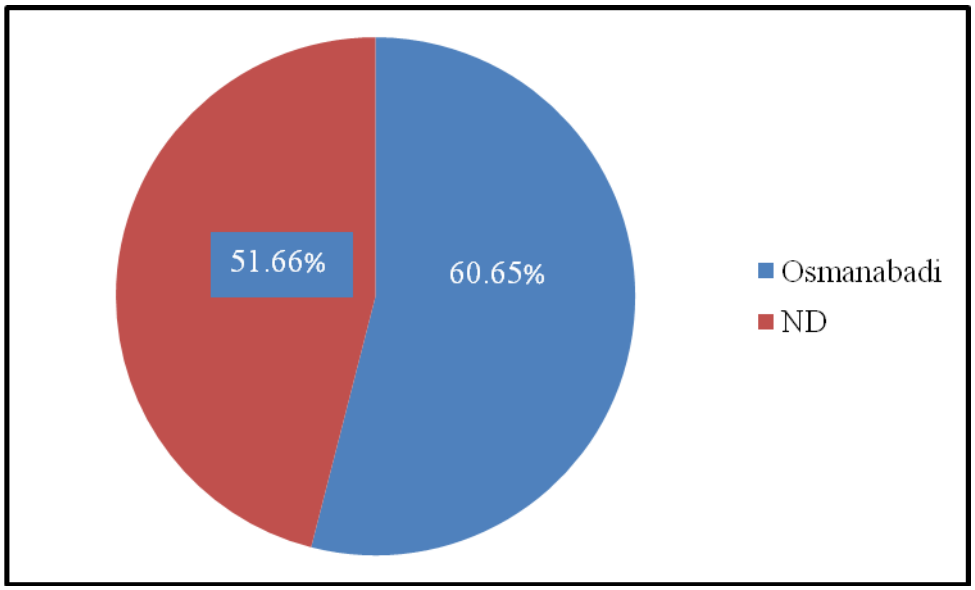

Fig. 4.4: Breed wise incidence of helminthosis in goats

Data regarding breed wise incidence has been presented in (Table 4.4,fig. 4.4) It was observed that out of 61 Osmanabadi goats 37 (60.65%) and out of 60 nondescript goats 31 (51.66%) were positive for helminthosis. Dappawar *et al.,* (2018) found helminthosis in 52.89% Osmanabadi and 48.93% nondescript goats.

Table no 4.4 Breed wise incidence of helminthosis in goats.

Age	No of goats examined	No of animals positive for GI helminthosis	Percent positive (%)
Osmanabadi	61	37	60.65
ND	60	31	51.66
Total	121	68	56.19

Table no 4.5 Incidence of different helminth parasites in goats.

Helminthes parasites		No. of positive goats	Percentage %
Nematodes	*Strongyle*	29	42.64
	Trichuris	12	17.64
	Strongyloides	12	17.64
		53	77.94
Trematodes	*Fasciola*	6	8.82
Cestodes	*Moniezia*	9	13.23
Total		68	

Data regarding helminth wise incidence is presented in (Table no 4.5, fig. 4.5) Out of 68 positive cases 53 (77.94%) were positive for Nematodes 6 (8.82%) for Trematodes and 9 for (13.23%) Cestodes. Out of 68 positive goats, 29 (42.64%) were positive for Strongyles and 12 (17.64%) each for Trichuris and Strongyloides. Among Trematodes 6 (8.82%) cases were positive for *Fasciola spp.* and among cestodes 9 (13.23%) were positive for *Moniezia spp*. Similar observations have been made by Kelemework *et al.,* (2016) who found 39.88 percent Strongyles,16.31 percent Trichuris , 12.08 percent Strongyloides, 6.04 percent *Fasciola spp*. and 10.57

percent *Moniezia spp*. The findings of Khan *et al.,* (2010) are somewhat different from findings of present study. They recorded an incidence of 24.55 percent for *Haemonchus contortus*, 7.58 percent for *Fasciola spp.*, 8.94% for *Moniezia spp*. and 5.76 percent for *Trichuris spp* respectively.

4.2 Clinical findings

The clinical manifestations recorded in 68 goats suffering from helminthosis has shown that most of the animals were weak with body score ranging from two to three. Examination of conjunctival mucus membrane revealed slight paleness, there was rough hair coat, diarrheic faeces / faeces with mucus/loose or pasty faeces causing soiling of tail and hind quarters and drop in production (plate no 4.1) Similar types of clinical signs in helminth affected goats were recorded by many workers (Khajuria *et al*.2013; Kaplan, 2016; and Shashank, 2019).

The basic physiological parameters viz. rectal temperature (^{0}F) heart rate (beats/minutes) and respiration rate (breath/minutes) were measured in all the three treatment groups on day 0 (before treatment), day 7 and day 14 (Post treatment)

4.2.1 Rectal temperature (°F).

The mean rectal temperature (°F) in group I, II, and III before treatment on day "0" and after treatment on day 7th and day 14th are presented in Table 4.6, Fig.4.6

Table 4.6:The mean rectal temperature (°F) in different groups before and after treatment.

Groups	Rectal Temperature (Mean ± S.E. ^{0}F)				
	Observational day			CD	
	0 day	7th day	14th day		
I	103.79^{a}±0.03	103.09^{bx}± 0.03	102.41^{cy}±0.02	0.103	S
II	103.78^{a}±0.03	103.14^{bx}±0.02	102.55^{cx}±0.02	0.091	S
III	103.81^{a}±0.02	102.78^{by}±0.02	102.01^{cz}±0.03	0.110	S
CD		0.098	0.096		
	NS	S	S		

Normal rectal temperature in goats ranges from 101 to 103 ^{0}F (Chakrabarti, 2014)

Plate no 4.1: Diarrheic goat with soiled perineal region

Plate no 4.2: Changes of faecal consistency due to helminthosis in goats

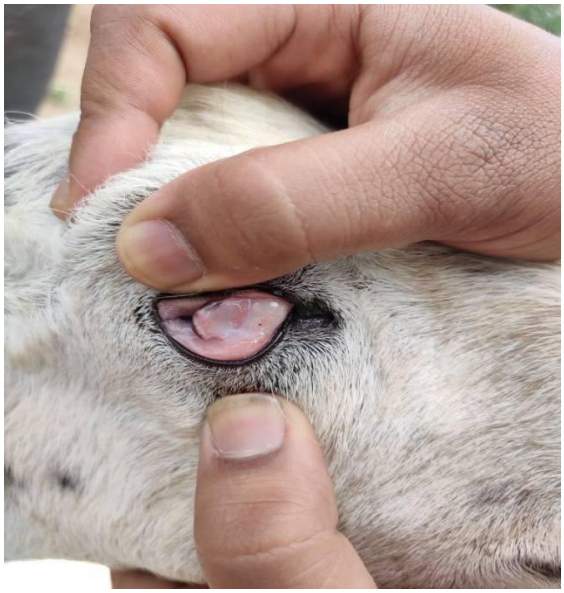

Plate no 4.3: Pale conjunctiva due to helminthosis in goat

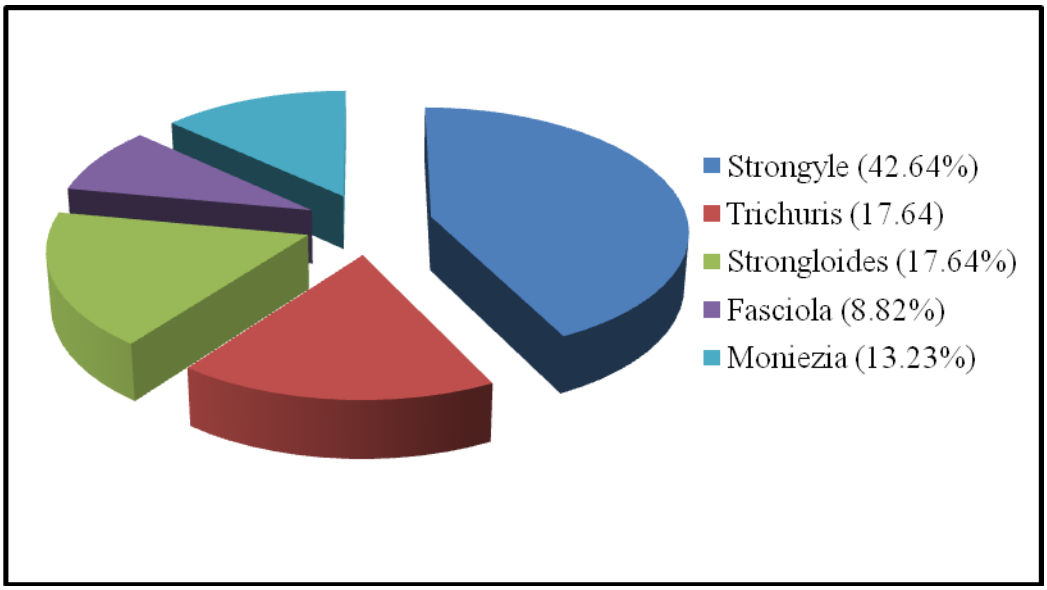

Fig.4.5: Helminth wise incidence in goats

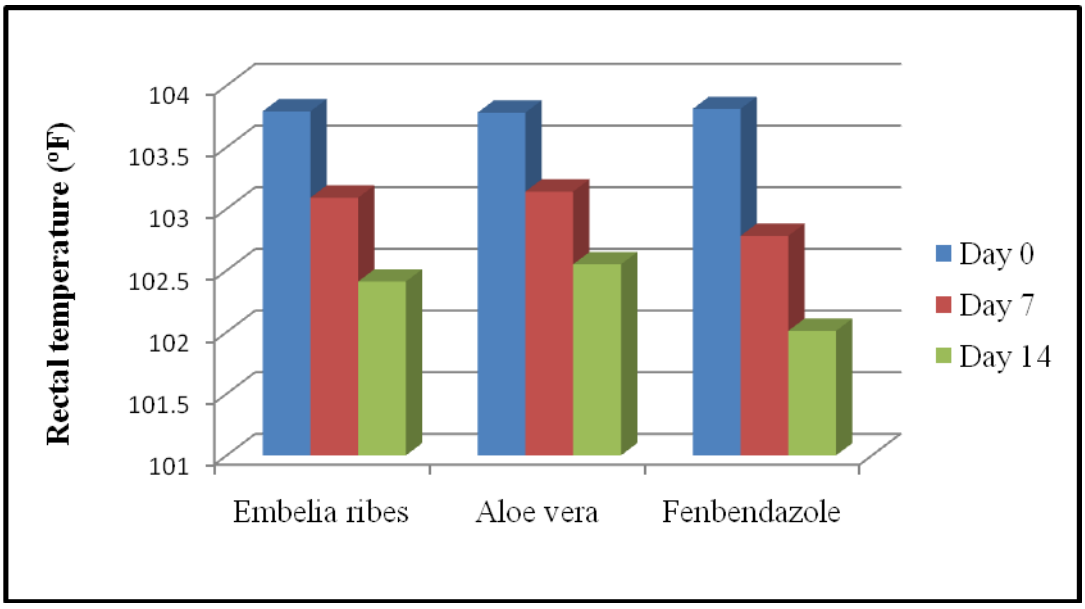

Fig. 4.6: Rectal temperature (°F) in different groups before and after treatment

The mean rectal temperature (°F) of group I, II and III before treatment (day 0) was 103.79 ±0.03 ^{0}F, 103.78 ±0.03 ^{0}F and 103.81 ±0.02 ^{0}F respectively.

Post treatment the mean rectal temperature (^{0}F) in Group I decreased on day 7th (103.09 ± 0.03 ^{0}F) and on day 14th (102.41 ±0.02 ^{0}F). Post treatment the mean rectal temperature (^{0}F) in Group II also decreased on day 7th (103.14 ±0.02) and on day 14th (102.55 ±0.02) After treatment the mean rectal temperature (^{0}F) in Group III decreased on day 7th (102.78 ±0.02) and on day 14th (102.01 ±0.0).It was observed that there was significant reduction in body temperature in all the treatment groups on 7th and 14th day of treatment.

The findings of the present study are in agreement with Sharma *et.al.*,(2001) and Moudgil *et.al.*,(2017). They observed elevated body temperature ranging between 103.9 to 105.2 ^{0}F in goats infected with parasitic infection.

Increase in body temperature is due to blood loss caused by G.I parasites, its compensatory mechanism and migrating larval stages (Soulsby, 1982).

4.2.2 Heart rate (beats/minute)

The Mean heart rate (beats/minute) in group I, II, and III before treatment on day "0" and after treatment on day 7th and day 14th are presented in Table 4.7, Fig. 4.7

Table 4.7: The Mean heart rate (beats/minute) in different groups before and after treatment.

Groups	Heart rate (Mean ± S.E. beats/min)				
	Observational day			CD	
	0 day	7th day	14th day		
I	85.20^{a}±0.25	81.30^{by}±0.30	74.50^{cy}±0.22	1.017	S
II	85.30^{a}±0.21	82.40^{bx}±0.27	75.70^{cx}±0.21	0.911	S
III	86.10^{a}±0.41	80.30^{bz}±0.30	72^{cz}±0.26	1.284	S
CD	-	1.134	0.911		
	NS	S	S		

As per Chakrabarti (2014) the normal heart rates in goats ranges from 42 to 62 beats/minutes

The mean heart rate (beats/minutes) in group I, II, and III before treatment on day "0" was 85.20 ±0.25, 85.30 ±0.21and 86.10 ±0.41 respectively.

Post treatment in Group I heart rate decreased on the 7th day to 81.30 ±0.30 and on the 14th day to 75.70 ±0.21 beats/minutes. This change was statistically significant. Post treatment in Group II also heart rate decreased on 7^{th} day (82.40 ±0.27 beats/minutes) and on day 14^{th} (75.70 ±0.21beats/minutes). This change was significant. Post treatment in Group III heart rate decreased on 7^{th} day (80.30 ±0.30beats/minutes) and on day 14^{th} (72 ±0.26 beats/minutes) This change also was significant.

The finding of present study is in agreement with Rajpura *et al.,* (2019) who found mean heart beats as 90.88 ± 00.28 per minute in goats infected with parasitic infection. Tachycardia due to gastrointestinal parasitism in goats is attributed to blood loss caused by G.I parasites and its compensatory mechanism (Radostits *et al*., 2007)

4.2.3 Respiration rate (breaths/minute)

The mean respiration (breath/minute) in group I, II and III before treatment on day "0" and after treatment on day 7^{th} and day 14^{th} are presented in Table 4.8 Fig.4.8

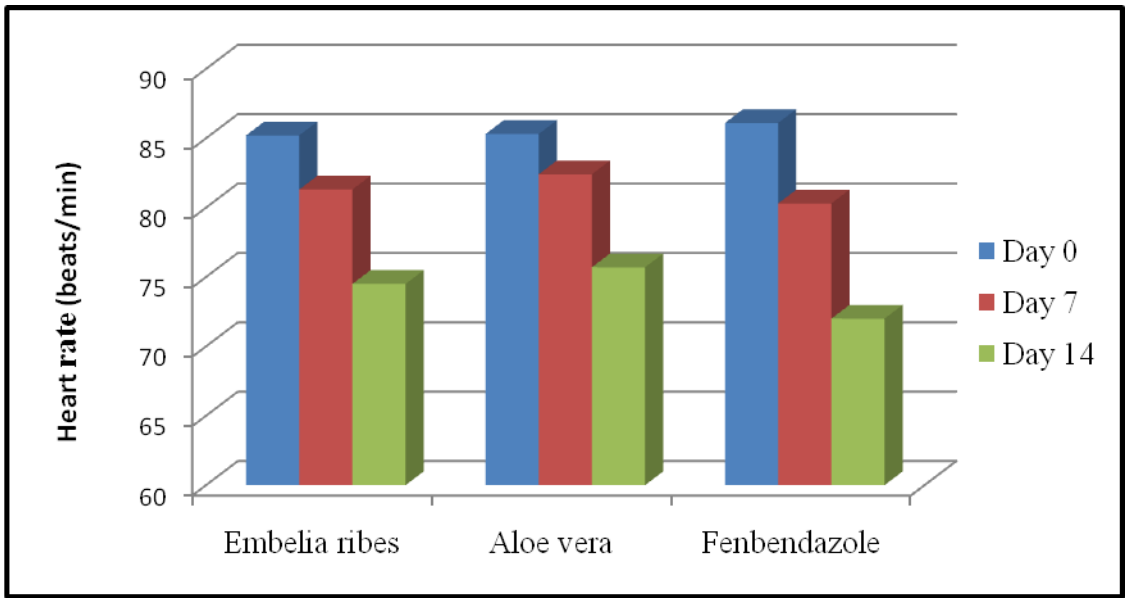

Fig. 4.7: Heart rate (beats/min) in different groups before and after treatment

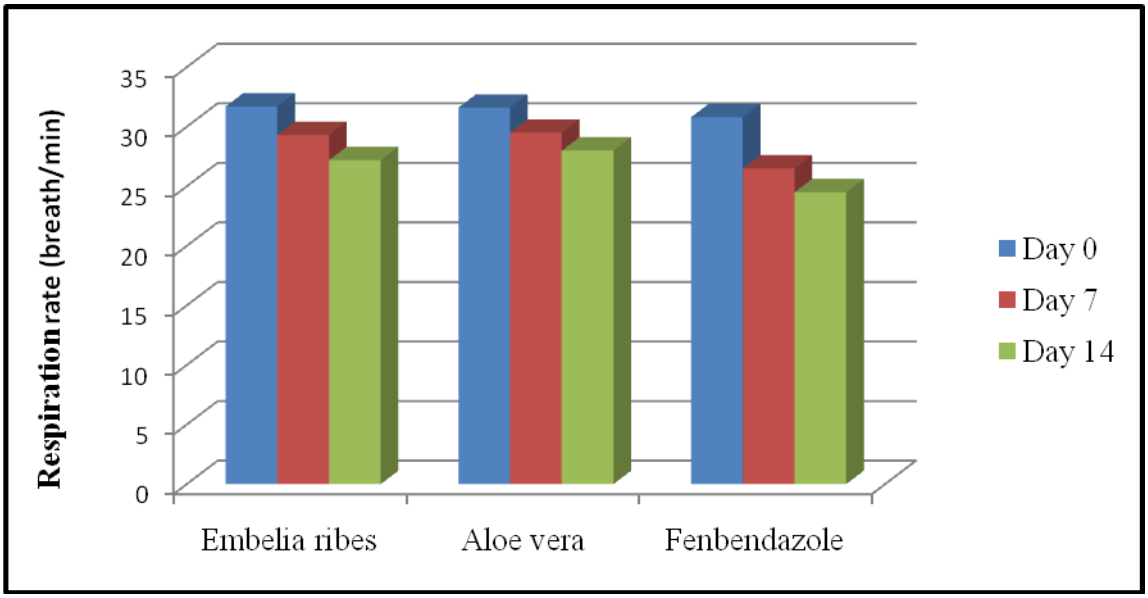

Fig. 4.8: Respiration rate (breath/min) in different groups before and after treatment

Table 4.8:The Mean respiration rate (breath/minute) in different groups before and after treatment.

Groups	Respiration rate (Mean ± S.E. breaths/min)				
	Observational day			CD	
	0 day	7th day	14th day		
I	31.7^{ax} ± 0.26	29.3^{bx} ± 0.15	27.2^{cy} ± 0.20	0.819	S
II	31.6^{ax} ±0.22	29.5^{bx} ± 0.17	28^{bx} ± 0.26	0.857	S
III	30.8^{ay} ±0.25	26.5^{by} ± 0.17	24.5^{cz} ± 0.17	0.779	S
CD	0.709 (5%)	0.635(1%)	0.830(1%)		
	NS	S	S		

Normal respiration rate in goats ranges between 18-25/minute (Chakrabarti, 2014)

The mean respiration rate in goats per minute on day 0 in Group I, II and III and was 31.7 ± 0.26, 31.6 ±0.22, and 30.8 ±0.25 respectively, Similar finding was reported by Rajpura *et al* (2019) who found mean respiratory rate of 28.38 ± 00.35 per minute in helminthosis.

Increase in respiration rate may be attributed mild anaemic changes as a compensatory mechanism of the body (Radositis *et al* 2007)

Post treatment mean respiration (breath/minute) in Group I significantly decreased on 7th day (29.3 ± 0.15) and on day 14th (27.2 ± 0.20).After treatment in Group II respiration rate decreased on 7th day to 29.5 ± 0.17 and on day 14th 28 ± 0.26. This decrease was statistically significant as compared to respiration rate of day 0. After treatment in Group III mean respiration (breath/minute) decreased on 7th day (26.5 ± 0.17) as well as on 14th day (24.5 ± 0.17) Reduction in respiration rate in this group was also statistically significant. Improvement in tachypnea in affected goats was more in fenbendazole group as compared to group I and group II. The finding of present study corroborates with the finding of Rajpura *et al.,* (2019) who found a mean respiratory rate of 28.38± 00.35 per minute in infected goats.

4.3. Hematological analysis

Hematological analysis was done on day "0", day 7th and day 14th in all three treatment groups

4.3.1 Hemoglobin (gm/dl)

The mean hemoglobin (g/dl) in group I, II, and III before treatment on day "0" and after treatment on day 7 and day 14 are presented in Table 4.9, Fig. 4.9

Table 4.9: The mean hemoglobin concentration (g/dl) in different groups before and after treatment

Groups	Hemoglobin (Mean ± S.E. gm/dl)				
	Observational day			CD	
	0 day	7th day	14th day		
I	7.75^{c} ±0.14	8.15^{by}±0.14	8.67^{ay} ±0.10	0.492	S
II	7.62^{c} ±0.11	8.01^{by}±0.11	8.48^{ay}±0.04	0.354	S
III	7.89^{c} ± 0.13	8.76^{bx} ±0.13	9.78^{ax} ±0.14	0.529	S
CD	-	0.494	0.403		
	NS	S	S		

Normal hemoglobin level in goats ranges from 8 to 12 g/dl (Radostits *et al.*,2007)

Mean Hb (g/dl) concentration on day "0" in group I, II and III was 7.75 ±0.14, 7.62 ±0.11 and 7.89 ± 0.13 respectively. This was little less than the normal range indicating mild anaemia before treatment. Following antihelmintic therapy in group I (*Embelia ribes*), group II (*Aloe vera*) and group III (fenbendazole) on day 7th and day 14th, there was significant rise in haemoglobin level as compared to hemoglobin level before treatment. In group I the haemoglobin level was 7.75±0.14 g/dl before treatment which rose to 8.15 ± 0.14 on 7th day and to 8.67 ± 0.10 g/dl on 14th day of treatment. This rise was statistically significant indicating positive effect of *Embelia*

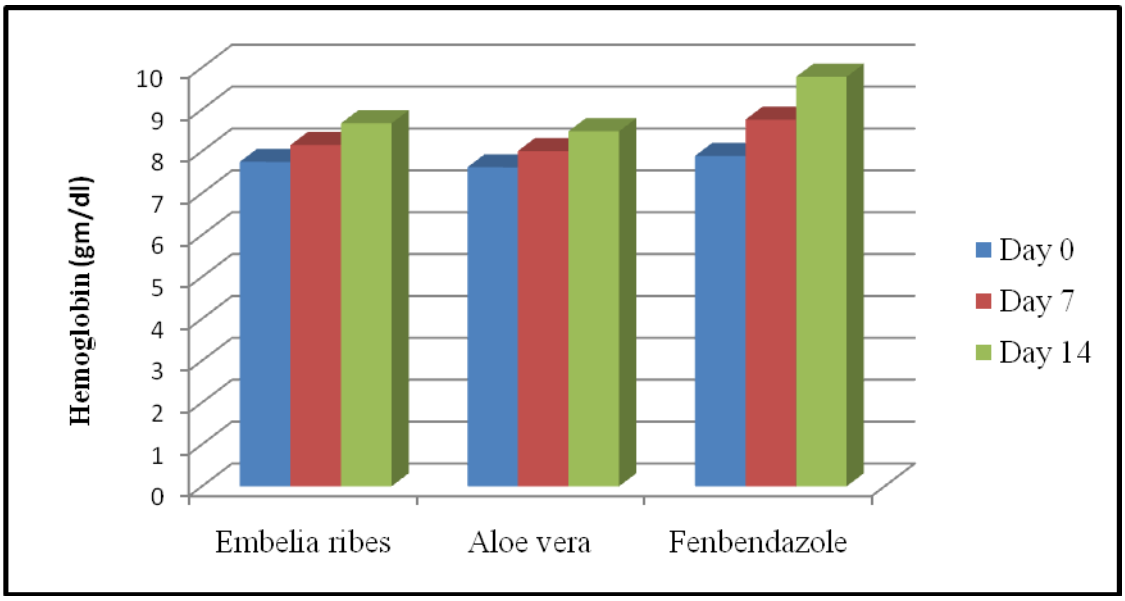

Fig.4.9: Hemoglobin (gm/dl) in different groups before and after treatment

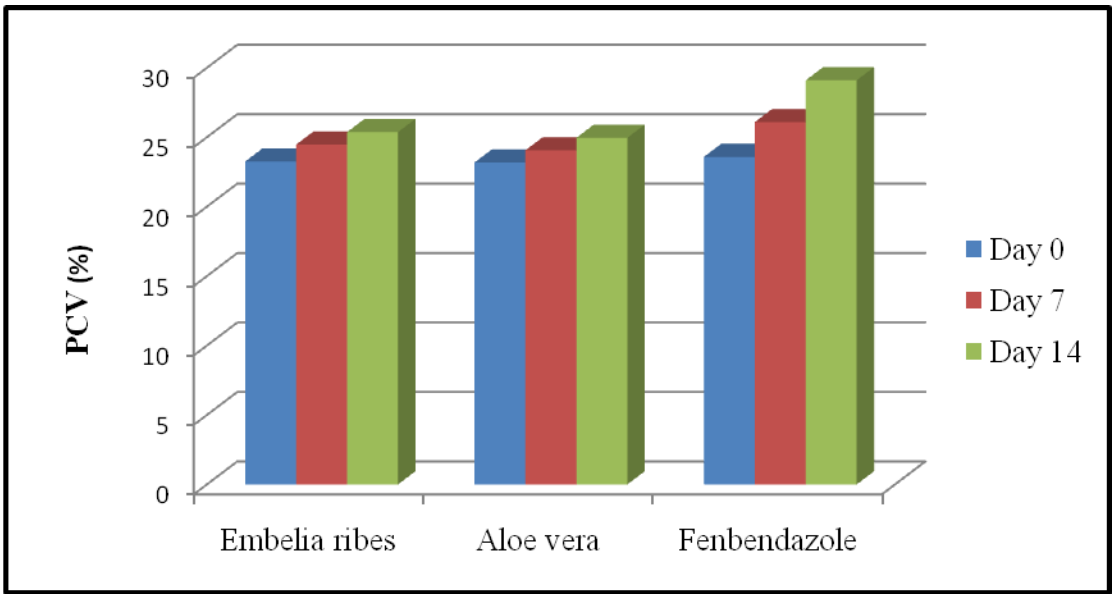

Fig.4.10: PCV (%) in different groups before and after treatment

ribes therapy on helminth infection. Similarly in group II there was also a significant increase in hemoglobin level on day 7th and day14th which was 8.01±0.11 and 8.48 ±0.04 respectively. In Group III there was a significant increase in hemoglobin level on day 7th (8.76 ±0.13) and day14th (9.78 ±0.14), respectively. Improvement in hemoglobin concentration following fenbendazole therapy was maximum as compared to the other two therapies indicating better results of fenbendazole.

The finding of present study is in corroboration with finding of and Rajpura *et al.,* (2019) and Alam *et al.,* (2020) who observed 7.30± 0.05 gm/dl and 7.62± 0.24 g/dl hemoglobin concentration in helminthosis.

Gastrointestinal parasites like *Haemonchus spp* are the potent blood suckers. Blood sucking activity of these parities results in decrease in haemoglobin, total erythrocyte count as well as packed cell volume (Soulsby, 1982)

4.3.2 Packed cell volume (%)

The mean PCV (%) in group I, II and III before treatment on day "0" and after treatment on day 7th and day 14th are presented in Table 4.10, Fig.4.10

Table 4.10: The mean PCV percentage in different groups before and after treatment

Groups	PCV (Mean ± S.E. %)				
	Observational day			CD	
	0 day	7th day	14th day		
I	23.25^{b}± 0.41	24.47^{ay} ± 0.41	25.37^{ay} ± 0.44	1.644	S
II	23.18^{b}±0.33	24.06^{aby} ± 0.32	24.96^{ay} ± 0.32	1.281	S
III	23.58^{c}± 0.41	26.09^{bx} ± 0.42	29.1^{ax} ± 0.50	1.738	S
CD	-	1.511	1.679		
	NS	S	S		

Normal PCV level in goats ranges from 28 to 35 percent (Chakrabarti, 2014).

The mean PCV percentage of goats with gastrointestinal helminthosis on day 0 in group I (*Embelia ribes*) group II (*Aloe vera*) and group III (fenbendazole) was 23.25± 0.41, 23.18±0.33 and 23.58± 0.41 respectively. The values of PCV before treatment in all treatment groups were below normal range (28 to 35 %) indicating anemia in affected goats. After antihelmintic therapy the values significantly improved on day 7th and day 14th in group I (24.47 ± 0.41 and 25.37 ± 0.44) respectively. Also in group II on day 7th and day 14th there was significant increase in PCV value i.e 24.06 ± 0.32 and 24.96 ± 0.32 respectively. After treatment in group III on day 7th and day 14th there was significant rise in PCV values i.e. 26.09 ± 0.42 and 29.1 ± 0.50 respectively. Rise in PCV following fenbendazole therapy was maximum, indicating better efficacy of fenbendazole in comparison to other two treatments. The findings of present study corroborate with Ameen *et al.,* (2006) who observed 22.85% PCV in affected goats. Hassan *et al.,* (2012) recorded a range of 18.8 to 23.5 % PCV level in goats infected with parasitic infection.

4.3.3 TEC (× 10^6/µl)

The mean TEC in group I, II and III before treatment on day "0" and after treatment on day 7th and day 14th are presented in Table 4.11, Fig. 4.11

Table 4.11: The mean TEC (×10^6/µl) in different groups before and after treatment

Groups	TEC (Mean ± S.E. ×10^6/µL)				
	Observational day			CD	
	0 day	7th day	14th day		
I	6.90^{cx} ± 0.05	7.84^{bx} ± 0.04	8.03^{ay} ± 0.04	0.170	S
II	6.66^{cy} ± 0.05	6.95^{by} ± 0.05	7.52^{az} ± 0.04	0.180	S
III	6.99^{cx} ± 0.10	7.92^{bx} ± 0.09	8.84^{ax} ± 0.10	0.375	S
CD	0.264	0.250	0.264		
	S	S	S		

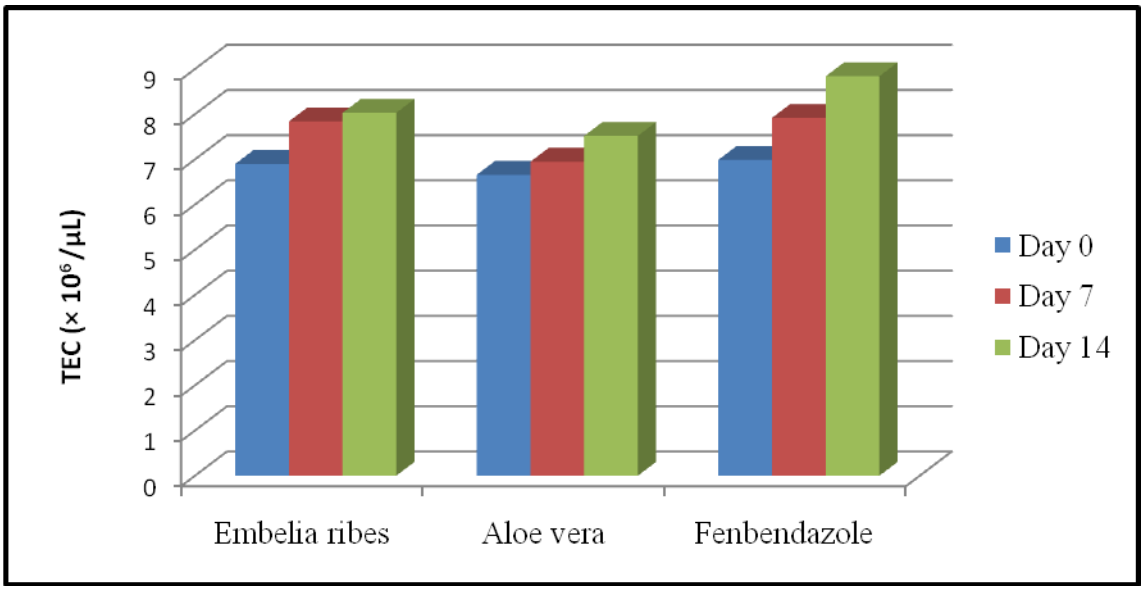

Fig. 4.11: TEC (× 10^6 /µL) in different groups before and after treatment

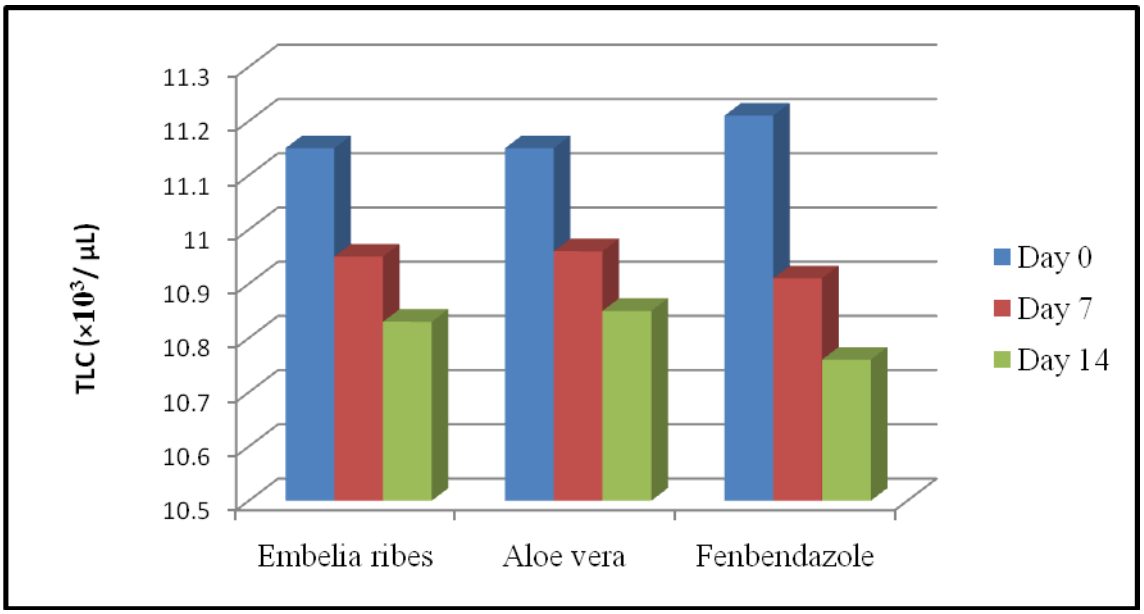

Fig.4.12: TLC (×10^3/ µL) in different groups before and after treatment

Normal TEC level in goats ranges from 11 to 13 million/C.mm (Chakrabarti 2014)

The mean erythrocyte count ($\times 10^{6/}\mu L$) in affected goats of group I,II and group III on day 0 (BT) was 6.90±0.05, 6.66± 0.05 and 6.99±0.10 respectively. Following antihelmintic therapy the TEC was elevated to 7.84 ± 0.04, 6.95 ± 0.05, 7.92 ± 0.09 and 8.03 ± 0.04, 7.52 ± 0.04, 8.84 ± 0.10 on day 7 and day 14 respectively . There was a significant increase in TEC in all groups after treatment. Hassan *et al.,* (2012) recorded a range of 6.1 to 9.24 ($\times 10^{6/}\mu L$) TEC level in goats affected with parasitic infection. The finding of the present study is in corroboration with the finding of Alam *et al.,* (2020) who observed 6.30 $X10^{6/}\mu L$ TEC level in goats affected with parasitic infection. The Total erythrocyte count in all the groups on day 0 was below normal range indicating anemic condition of the goats before treatment. The TEC improved after treatment in all the group indicating positive impact of the drug under study. The anaemia in helminth affected goats is attributed to blood sucking nature of some of the parasites like *Haemonchus contartus* (Soulsby, 1982)

4.3.4 TLC ($\times 10^3/\mu l$)

The mean TLC in group I, II and group III before treatment on day "0" and after treatment on day 7 and day 14 are presented in Table 4.12, Fig. 4.12

Table 4.12: The mean TLC ($\times 10^3/\mu l$) in different group before and after treatment

Groups	TLC (Mean ± S.E. $\times 10^{3/}\mu L$)				
	Observational day			CD	
	0 day	7th day	14th day		
I	$11.15^a \pm 0.03$	$10.95^b \pm 0.03$	$10.83^c \pm 0.02$	0.100	S
II	$11.15^a \pm 0.02$	$10.96^b \pm 0.02$	$10.85^c \pm 0.01$	0.069	S
III	11.21 ± 0.09	10.91 ± 0.14	10.76 ± 0.14	-	NS
CD	-	-	-		
	NS	NS	NS		

Normal TLC level in goats 5.14 thousand/C.mm (Chakarbarti 2014)

The Mean TLC in affected goats on day 0 in group I, II and III was 11.15 ± 0.03, 11.15 ± 0.02 and 11.21 ± 0.09 respectively.

Post treatment in group I TLC significantly decreased on day 7 as well as day 14 to 10.95 ± 0.03 and 10.83 ± 0.02 respectively. In group II also there was a significant decrease in TLC on day 7 and day 14 (10.96 ± 0.02 and 10.85 ± 0.01 respectively). In group III there was non significant decrease in TLC on day 7^{th} and day 14^{th} (10.91 ± 0.14 and 10.76 ± 0.14 respectively). This finding of present study is in agreement with Jayraw and Raote (2004) and Shashank *et al.,* (2019) who observed 11.36±1.61 and 11.09 ± 0.02 ($\times 10^{3/}\mu L$) TLC in goats infected with parasitic infection.

Increase in TLC is due to an increase in local immune response by eosinophils and may be due to presence of secondary bacterial infection as reported by Ahmed *et al.* (2015)

4.3.5 Differential count (%)

4.3.5a Neutrophil

The mean neutrophil percentage in group I, II and III before treatment on day "0" and after treatment on day 7 and day 14 are presented in Table 4.13, Fig. 4.13

Table 4.13: The Mean Neutrophil percentage in different group before and after treatment

Groups	Neutrophil (Mean ± S.E. %)				
	Observational day			CD	
	0 day	7^{th} day	14^{th} day		
I	47.16^{ay} ± 0.02	44.16^{by} ± 0.02	42.17^{cy} ± 0.02	0.080	S
II	47.15^{ay} ±0.06	46.14^{bx} ± 0.06	45.13^{cx} ± 0.05	0.212	S
III	47.93^{ax} ± 0.07	43.94^{bz} ± 0.07	39.93^{cz} ± 0.07	0.282	S
CD	0.215	0.210	0.202		
	S	S	S		

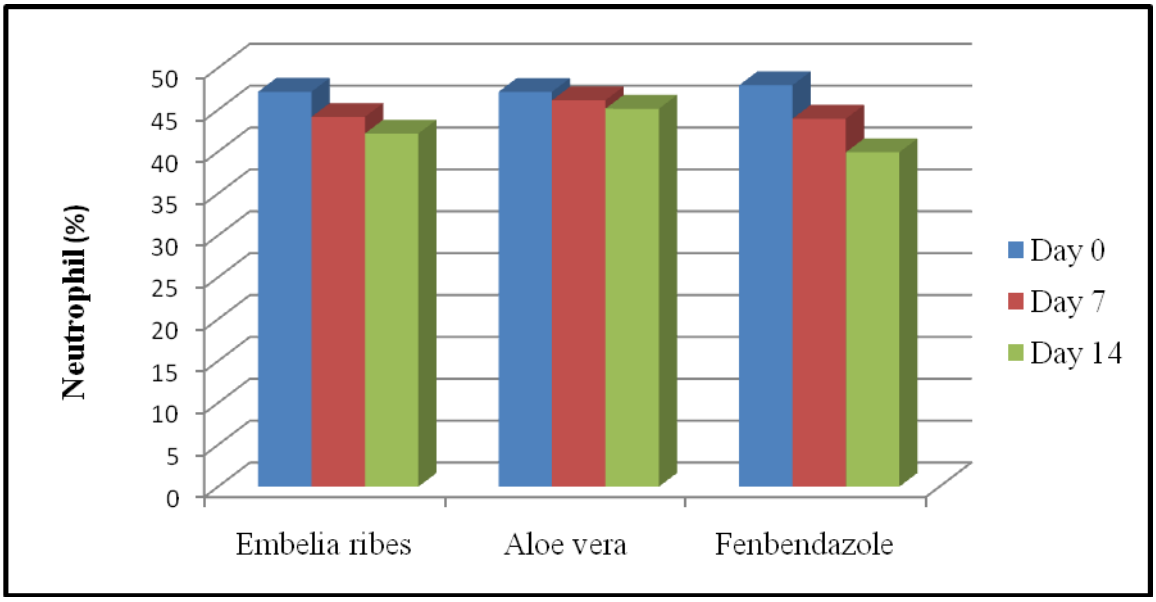

Fig.4.13: Neutrophil (%) in different groups before and after treatment

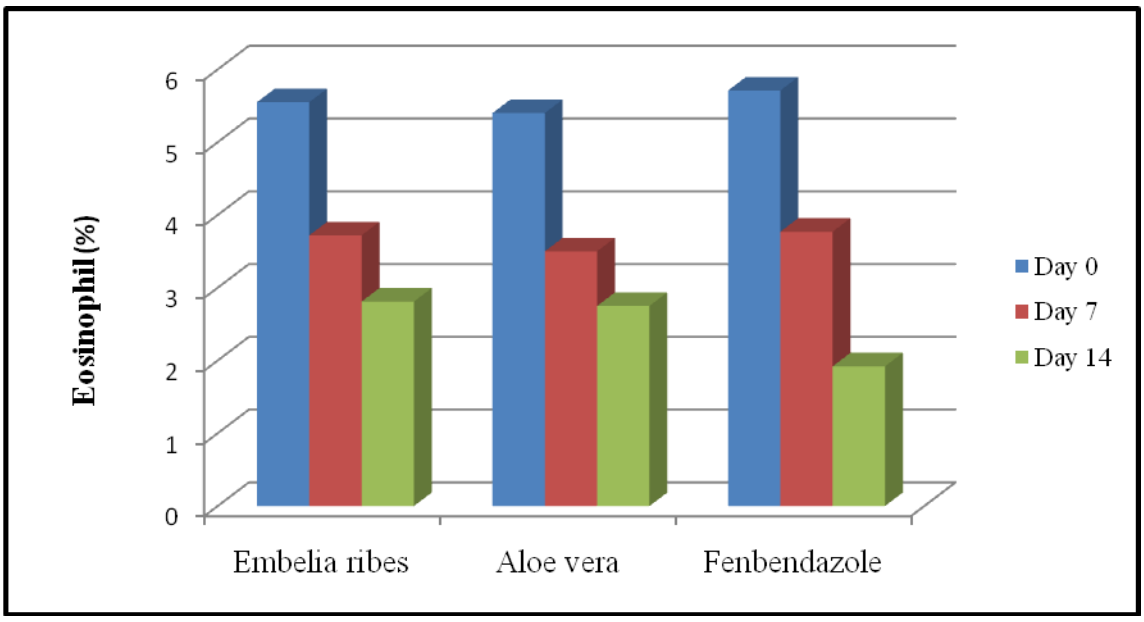

Fig.4.14: Eosinophil (%) in different groups before and after treatment

Normal Neutrophil level in goats ranges from 35 to 40 per cent (Chakrabarti 2014)

The mean neutrophil percentage on day 0 in group I (*Embelia ribes*), group II (*Aloe vera*) and group III (Fenbendazole) was 47.16 ± 0.02, 47.15 ±0.06 and 47.93 ± 0.07 % respectively. Following antihelmintic therapy in group I, group II and group III on day 7 neutrophil count was significantly decreased to 44.16 ± 0.02, 46.14 ± 0.06 and 43.94 ± 0.07. On day 14 neutrophil count in group I, group II and group III was significantly decreased to 42.17 ± 0.02, 45.13 ± 0.05 and 39.93 ± 0.07%. Similar findings were observed by Ameen *et al.,* (2006) who observed 48.1±16.3% neutrophils in goats infected with parasitic infection.

The increase in neutrophil, monocytes eosinophils and basophils is caused due to phagocytic activity of the cell digesting the particulate matter and debris of parasites as an effect of cell mediated immune immune response as reported by Ahmed *et al.,* (2006) and Amulya *et al*., (2014)

4.3.5b Eosinophil

The mean Eosinophil percentage in group I, II and III before treatment on day "0" and after treatment on day 7 and day 14 is presented in Table 4.14, Fig. 4.14

Table 4.14: The Mean Eosinophil percentage in different group before and after treatment

Groups	**Eosinophil (Mean ± S.E.%)**				
	Observational day			CD	
	0 day	7th day	14th day		
I	$5.55^{ay} \pm 0.02$	$3.72^{bx} \pm 0.03$	$2.81^{cx} \pm 0.02$	0.107	S
II	$5.40^{az} \pm 0.03$	$3.50^{by} \pm 0.03$	$2.75^{cy} \pm 0.01$	0.109	S
III	$5.71^{ax} \pm 0.03$	$3.77^{bx} \pm 0.03$	$1.92^{cz} \pm 0.01$	0.096	S
CD	0.113	0.124	0.067		
	S	S	S		

Normal eosinophil level in goats ranges from 2 to 3 percent (Chakrabarti, 2014)

The mean eosinophil count on day 0 in affected animals of groups I, II and III was 5.55 ± 0.02, 5.40 ± 0.03 and 5.71 ± 0.03% respectively. Post treatment with antiparasitic in group I (*Embelia ribes*), group II (*Aloe vera*) and group III (Fenbendazole) on day 7th there was significant reduction in eosinophil count i.e 3.72 ± 0.03, 3.50 ± 0.03 and 3.77 ± 0.03 respectively, On day 14th also eosinophil count in group I, group II and group III was significantly further decreased to 2.81 ± 0.02, 2.75 ± 0.01 and 1.92 ± 0.01% respectively. Hassan *et al.,* (2012) recorded a range of 5.2 to 10.4% eosinophil level in goats infected with parasitic infection while Shashank *et al.,* (2019) observed a eosinophil level with a range from 6.97±0.10 to 7.12 ± 0.17%. Reduction in eosinophil count is indicative of effectiveness of treatment.

4.3.5c Basophil

The mean basophil count in group I, II and III before treatment on day "0" and post treatment on day 7 and day 14 are presented in Table 4.15, Fig.4.15

Table 4.15: The mean basophil percentage in different group before and after treatment

Groups	**Basophil (Mean ± S.E.%)**				
	Observational day			CD	
	0 day	7th day	14th day		
I	0.54^{a}± 0.00	0.48^{by}± 0.00	0.46^{cy} ± 0.00	0.008	S
II	0.54^{a}± 0.00	0.50^{bx}± 0.00	0.48^{cx} ± 0.00	0.009	S
III	0.54^{a}± 0.00	0.46^{bz}± 0.00	0.43^{cz} ± 0.00	0.009	S
CD	-	0.008	0.006		
	NS	S	S		

Normal basophil level in goats ranges from 0.5 to 1percent. (Chakrabarti 2014)

The mean basophil count on day 0 in affected goats in group I , group II and group III was 0.54 ± 0.00, 0.54 ± 0.00 and 0.54 ± 0.00 respectively. Post treatment in

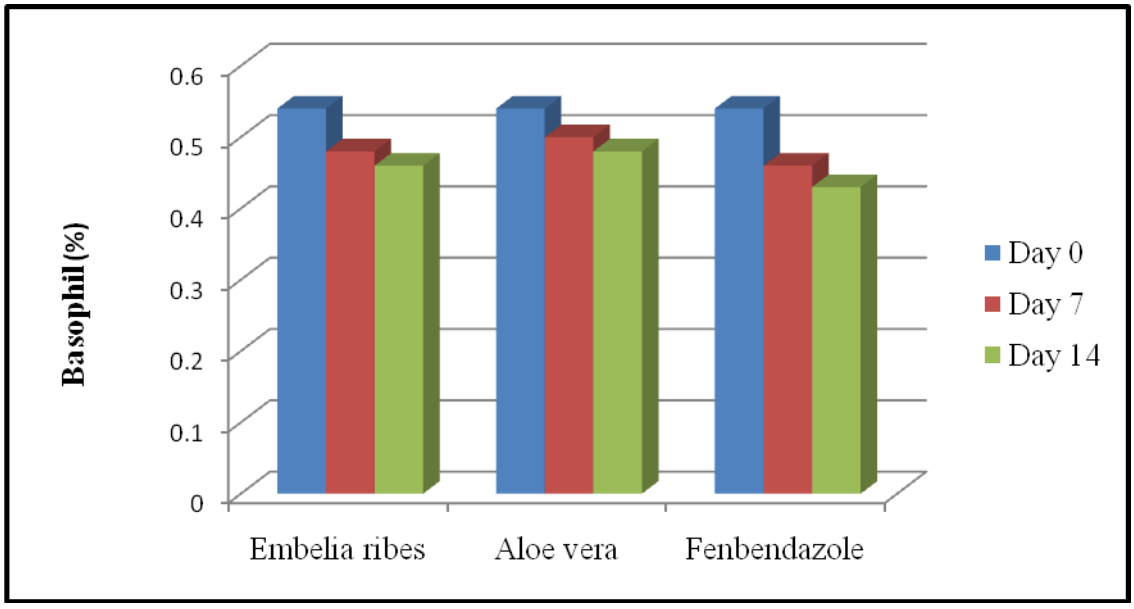

Fig. 4.15: Basophil (%) in different groups before and after treatment

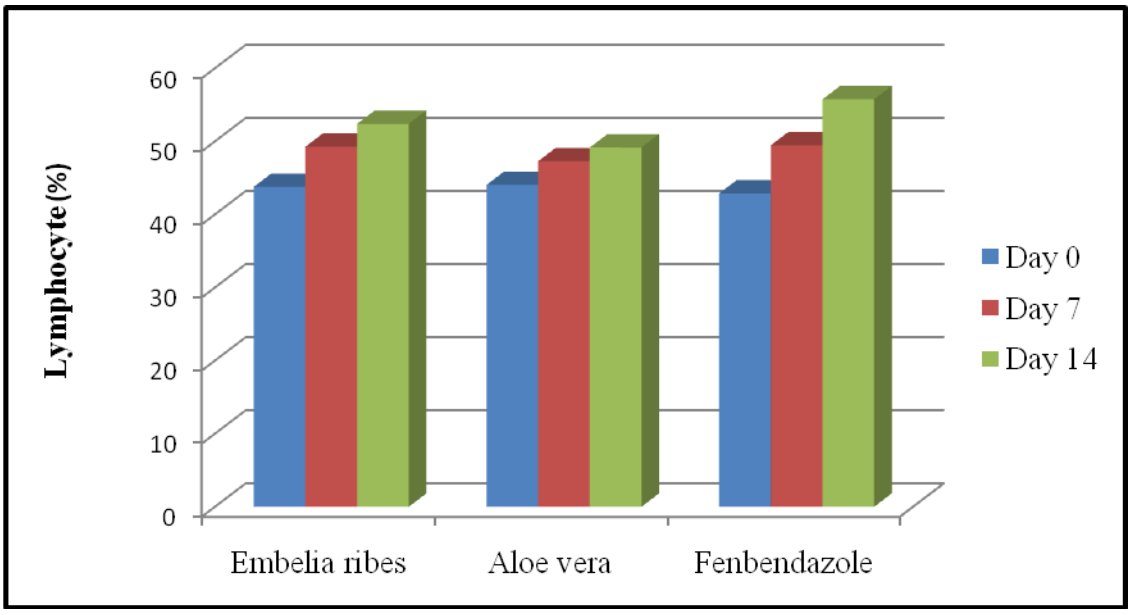

Fig.4.16: Lymphocyte (%) in different groups before and after treatment

group I , group II and group III on day 7 and also on day 14 there was significant decrease in basophil count (0.48 ± 0.00, 0.50 ± 0.00, 0.46 ± 0.00 and 0.46 ± 0.00, 0.48 ± 0.00, 0.43 ± 0.00 respectively). Similar findings were observed by Ahmed *et al.,* (2015) and Shashank *et al.,* (2019) who observed 0.57±0.34% and 0.51±0.04% basophils in goats infected with parasitic infection.

4.3.5d Lymphocytes

The mean lymphocyte count in group I, II and III before treatment on day "0" and post treatment on 7th day and 14th day are presented in Table 4.16, Fig.4.16

Table 4.16:The mean lymphocyte percentage in different treatment groups before and after treatment.

Groups	Lymphocytes (Mean ± S.E.%)				
	Observational day			CD value	
	0 day	7th day	14th day		
I	43.77^{cy}± 0.04	49.27^{bx}± 0.04	52.40^{ay} ± 0.03	0.132	S
II	44.03^{cx}± 0.06	47.28^{by}± 0.06	49.16^{az} ± 0.06	0.246	S
III	42.86^{cz}± 0.09	49.46^{bx}± 0.09	55.75^{ax} ± 0.08	0.344	S
CD	0.268	0.270	0.227		
	S	S	S		

Normal lymphocyte count in goats ranges from 48 to 50 % (Chakrabarti, 2014)

The mean lymphocyte (%) in group I, II, and III before treatment on day "0" was 43.77 ± 0.04, 44.03 ± 0.06 and 42.86 ± 0.09% respectively.

Post treatment in Group I lymphocyte count increased on the 7th day to 49.27 ± 0.04% and on the 14th day to 52.40 ± 0.03%. This change was statistically significant. Post treatment in Group II also lymphocyte count increased on the 7th day (47.28 ± 0.06 %) and on day 14th (49.16 ± 0.06%) This change was significant. Post treatment in Group III lymphocyte count increased on the 7th day (49.46 ± 0.09%) and

on day 14th the count was 55.75 ± 0.08 per cent. This change also was significant. These findings were in agreement with Ameen *et al.,* (2006) and Rajpura *et al.,* (2019) who observed 41.10±11.90% and 44.72 ± 0.28% lymphocytes in helminth infection.

Reduction in the lymphocyte count may be attributed to increased sequestration of white blood cells to abomasum where the worm is localized, or may be due to the secretion of a chemical by parasites that stimulates the migration of neutrophil and lymphocyte cells from circulation or indicates immunodepression. Ortolani *et al*., (2013)

4.3.5e Monocytes

The mean Monocytes count in group I, II and Group III before treatment on day "0" and post treatment on day 7 and day 14 are presented in Table 4.17, Fig.4.17

Table 4.17: The Mean monocyte percentage in different groups before and after treatment

Groups	Monocytes (Mean ± S.E.%)				
	Observational day			CD	
	0 day	7th day	14th day		
I	$2.94^{ax} \pm 0.01$	$2.34^{by} \pm 0.01$	$2.14^{cy} \pm 0.01$	0.025	S
II	$2.86^{ay} \pm 0.01$	$2.56^{bx} \pm 0.01$	$2.46^{cx} \pm 0.01$	0.027	S
III	$2.94^{ax} \pm 0.00$	$2.34^{by} \pm 0.00$	$1.94^{cz} \pm 0.00$	0.018	S
CD	0.025	0.024	0.024		
	S	S	S		

Normal monocytes level in goats ranges from 1 to 2 % (Chakrabarti, 2014)

The mean Monocytes (%) in group I, II and Group III before treatment on day "0" was 2.94 ± 0.01, 2.86 ± 0.01 and 2.94 ± 0.00 respectively.

Post treatment in Group I Monocyte count decreased on 7th day to 2.34 ± 0.01 % and on 14th day to 2.14 ± 0.01 per cent. This change was statistically significant.

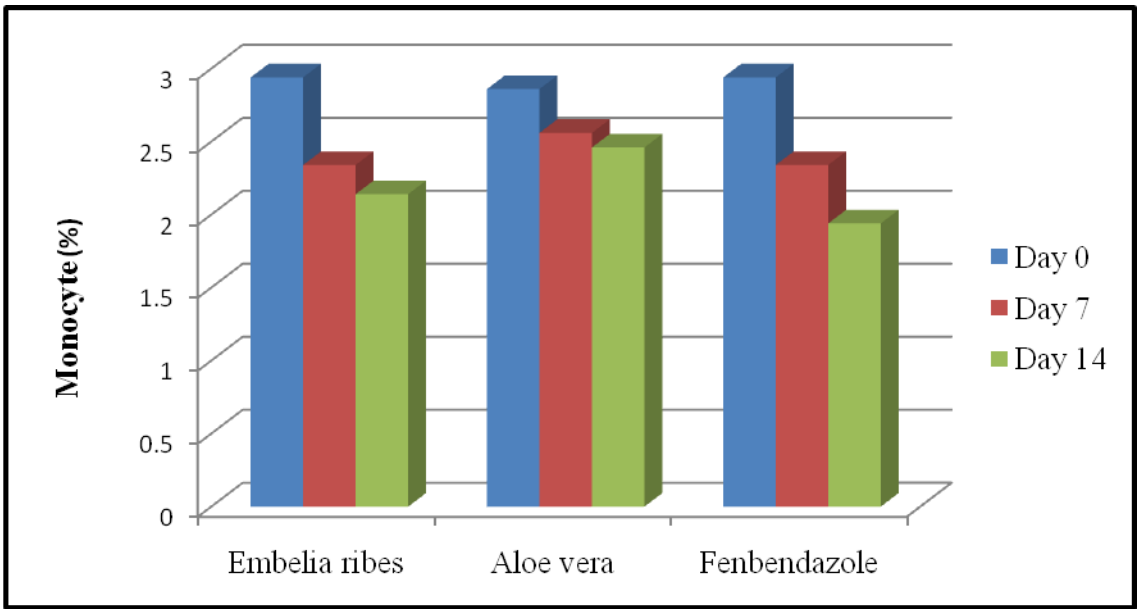

Fig.4.17: Monocyte (%) in different groups before and after treatment

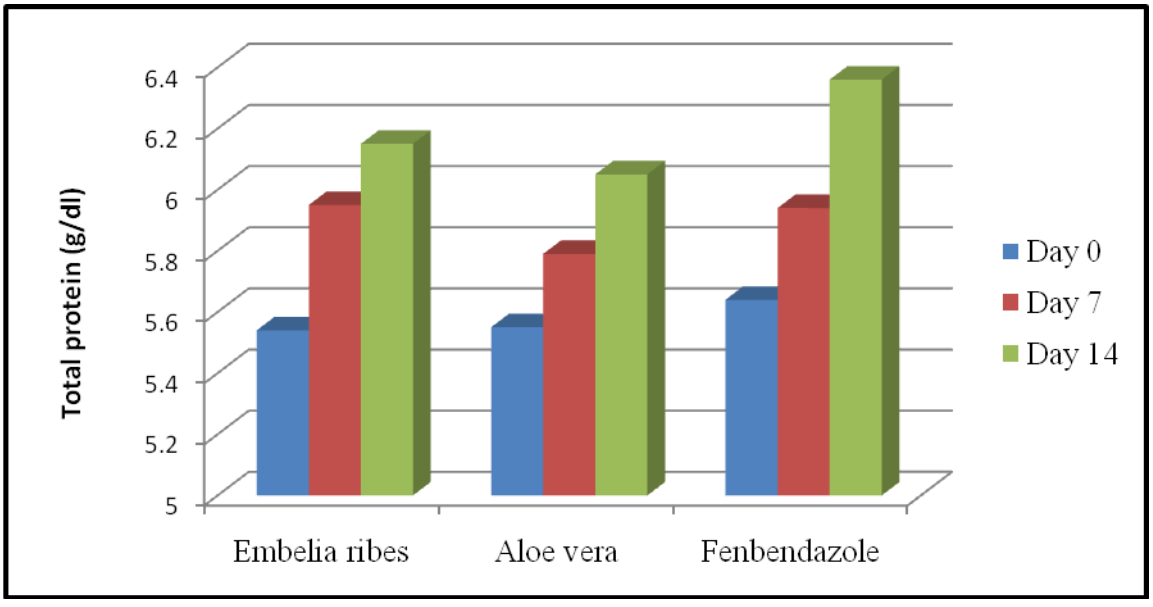

Fig.4.18: Total protein (g/dl) in different groups before and after treatment

Post treatment in Group II also Monocyte count decreased on 7th day (2.56 ± 0.01%) and on day 14th (2.46 ± 0.01%) This change was significant. Post treatment in Group III Monocyte count decreased on 7th day (2.34 ± 0.00%) and on day 14th (1.94 ± 0.00%) This change also was significant. These findings were in agreement with Shashank *et al.,* (2019) who observed a monocyte count of 2.96 ± 0.01% in helminth infection. However, Ameen *et al.,* (2006) recorded a count of 2.4±1.2% in helminthosis.

The increase in monocytes was due to phagocytic activity of the cell digesting the particulate matter and debris of parasites as observed in cell mediated immune responses (Ahmed *et al*., 2015)

4.4. Biochemical analysis

4.4.1 Total protein (g/dl)

The mean Total protein (g/dl) in group I, II and III before treatment on day "0" and post treatment on day 7 and day 14 are presented in Table 4.18, Fig. 4.18

Table 4.18: The Mean Total protein concentration (g/dl) in different treatment groups before and after treatment

Groups	Total protein (Mean ± S.E. g/dL)				
	Observational day			CD	
	0 day	7th day	14th day		
I	5.54^{cy}±0.01	$5.95^{b\,x}$± 0.01	6.15^{ay} ± 0.01	0.033	S
II	5.55^{cy}±0.01	5.79^{by} ± 0.00	6.05^{az} ± 0.01	0.026	S
III	5.64^{cx}±0.01	5.94^{bx} ± 0.01	6.36^{ax} ± 0.01	0.033	S
CD	0.035	0.025	0.032		
	S	S	S		

Normal Total protein level in goats ranges from 6.40 to 7.90 g/dl (Chakrabarti, 2014)

The mean Total protein in group I, II, and III before treatment on day "0" was 5.54 ± 0.01, 5.55 ± 0.01 and 5.64 ± 0.01 g/dl respectively.

Post treatment in Group I Total protein increased on 7th day to 5.95± 0.01 g/dl and on 14th day to 6.15 ± 0.01g/dl. This change was statistically significant. Post treatment in Group II also total protein increased on 7th day (5.79 ± 0.00 g/dl) and on day 14th (6.05 ± 0.01g/dl) This change was significant. Post treatment in Group III total protein increased on 7th day (5.94 ± 0.01 g/dl) and also on day 14th (6.36 ± 0.01 g/dl.) This change also was significant. These findings were in agreement with Ahmed *et al*., (2015) and Moudgil *et al*., (2017) who observed 5.19 ± 1.31g/dl and 5.21 ± 0.7 g/dl total protein concentration in helminthosis infection, respectively.

Goats naturally infected with *Haemonchus contortus* revealed a marked reduction in total protein, albumin and globulins, which is attributed to decrease food intake and loss of protein in the gut during infection with haemonchosis, leading to protein losing enteropathy (Soulsby, 1982)

4.4.2 Albumin (g/dl)

The mean Albumin concentration (g/dl) in group I, II and III before treatment on day "0" and post treatment on day 7 and day 14 is presented in Table 4.19, Fig.4.19

Table 4.19:The Mean albumin concentration (g/dl) in different groups before and after treatment.

Groups	Albumin (Mean ± S.E.g/dl)				
	Observational day			CD value	
	0 day	7th day	14th day		
I	2.72^{cy}±0.00	2.92^{by}± 0.00	3.10^{ay} ± 0.01	0.018	S
II	2.75^{cx}±0.01	2.93^{by}± 0.01	3.05^{az} ± 0.01	0.031	S
III	2.74^{cxy}±0.01	3.02^{bx}± 0.01	3.29^{ax} ± 0.00	0.019	S
CD	0.019(5%)	0.022	0.023		
	S	S	S		

Normal albumin level in goats ranges from 2.7 to 3.9 g/dl (Chakrabarti, 2014)

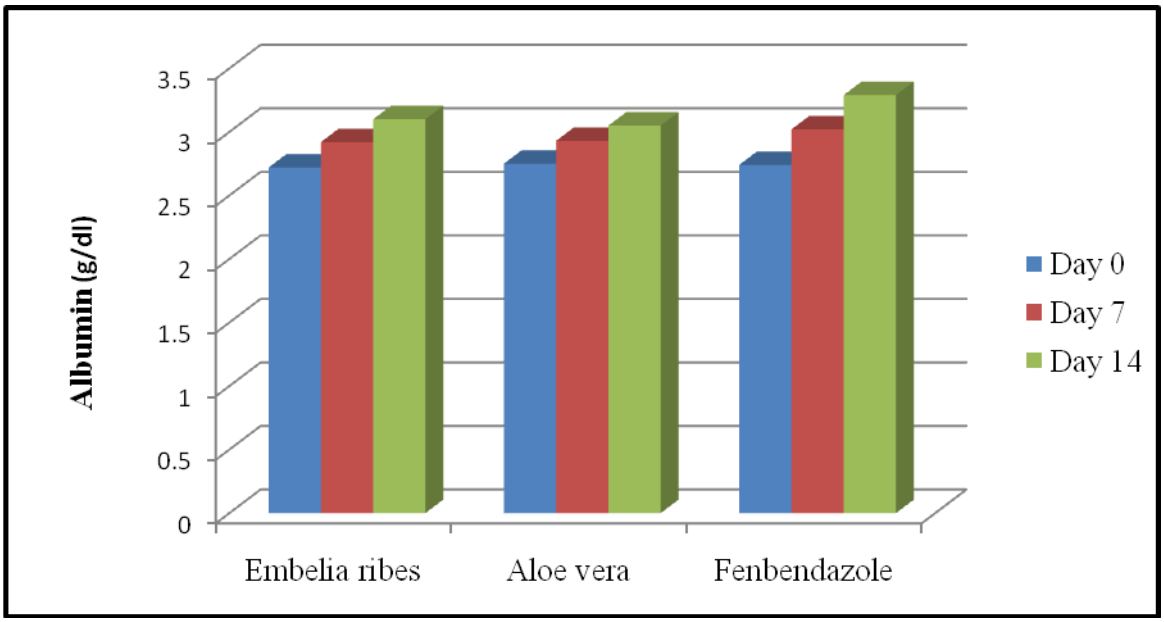

Fig.4.19: Albumin (g/dl) in different groups before and after treatment

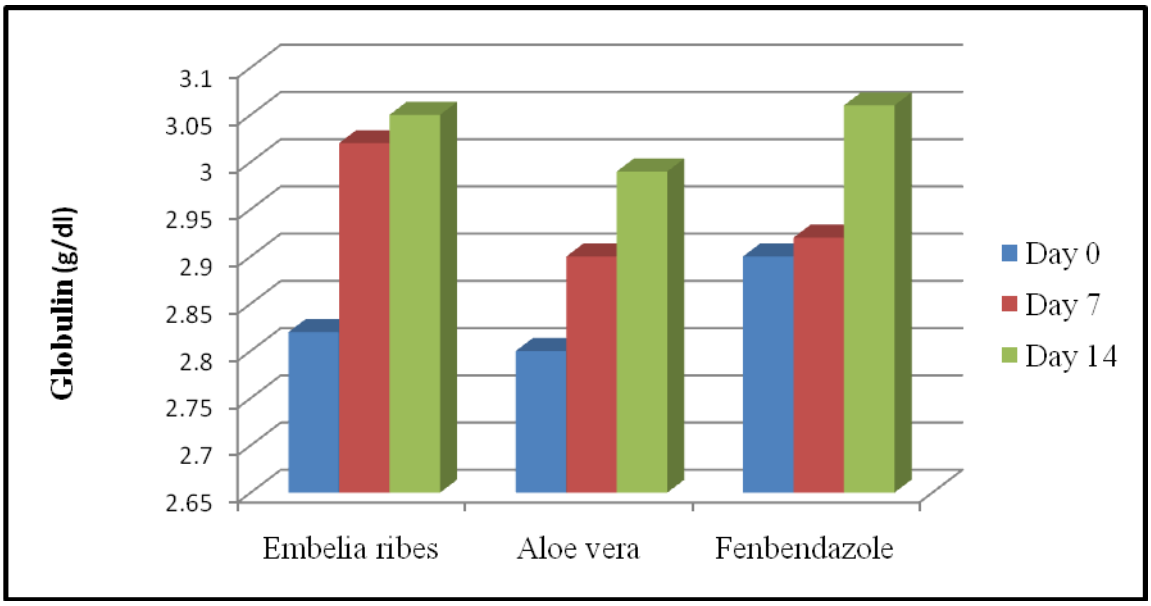

Fig .4.20: Globulin (g/dl) in different groups before and after treatment

The mean albumin concentration (g/dl) in group I, II, and III before treatment on day "0" was 2.72 ± 0.00, 2.75 ± 0.01 and 2.74 ± 0.01 respectively

Post treatment in Group I albumin concentration increased on 7th day to 2.92 ± 0.00 g/dl and on 14th day to 3.10 ± 0.01 g/dl. This change was statistically significant. Post treatment in Group II also albumin concentration increased on 7th day (2.93 ± 0.01 g/dl) and on day 14th (3.05 ± 0.01 g/dl). This change was significant. Post treatment in Group III also albumin concentration increased on 7th day (3.02 ± 0.01 g/dl) and on day 14th (3.29 ± 0.00 g/dl.). This change also was significant. These findings were in agreement with Moudgil *et al*., (2017) and Shashank *et al.,* (2019) who observed 2.78 ± 0.26 g/dl and 2.02 ± 0.04 g/dl concentration of albumin in helminth infection in small ruminants.

4.4.3 Globulin (g/dl)

The mean Globulin (g/dl) in group I, II and III before treatment on day "0" and post treatment on day 7 and day 14 are presented in Table 4.20, Fig.4.20

Table 4.20:The Mean globulin concentration (g/dl) in different groups before and after treatment.

Groups	Globulin (Mean ± S.E. g/dl)				
	Observational day			CD	
	0 day	7th day	14th day		
I	2.82^{cy}±0.01	3.02^{bx} ± 0.01	3.05^{ax} ± 0.01	0.033	S
II	2.80^{cy}±0.01	2.90^{bz} ± 0.01	2.99^{ay} ± 0.01	0.044	S
III	2.90^{bx}±0.01	2.92^{by} ± 0.01	3.06^{ax} ± 0.01	0.034	S
CD	0.043	0.026	0.041		
	S	S	S		

Normal globulin level in goats ranges from 3.7 to 4 g/dl (Chakrabarti, 2014)

The mean globulin concentration (g/dl) in group I, II and III before treatment on day "0" was 2.82 ± 0.01, 2.80 ± 0.01 and 2.90 ±0.01 respectively.

Post treatment in Group I globulin concentration increased on 7th day to 3.02 ± 0.01 g/dl and on 14th day to 3.05 ± 0.01 g/dl. This change was statistically significant. Post treatment in Group II also globulin level increased on 7th day (2.90 ± 0.01 g/dl) and on 14th day (2.99 ± 0.01 g/dl). This change was significant. Post treatment in Group III globulin concentration increased on 7th day (2.92 ± 0.01 g/dl) and on day 14th (3.06 ± 0.01 g/dl). This change also was significant. Moudgil *et al.,* (2017) recorded a range 2.03±1.23 g/dl to 2.43±0.45 g/dl globulin level in goats infected with parasitic infection while Alam *et al.,* (2020) observed serum globulin level with a range of 4.10±0.06 g/dl to 4.12±0.04 g/dl in goats suffering from *Haemonchus contortus* infection.

4.4.4 AST (IU/L)

The AST concentration (IU/L) in group I, II and III before treatment on day "0" and post treatment on day 7 and day 14 is presented in Table 4.21, Fig.4.21

Table 4.21:The Mean AST concentration (IU/L) in different groups before and after treatment.

Groups	AST (Mean ± S.E. IU/L)				
	Observational day			CD	
	0 day	7th day	14th day		
I	61.46^{ay}± 0.06	59.42^{by}± 0.04	57.3^{cy} ± 0.03	0.178	S
II	62.26^{ax} ±0.11	61.23^{bx}± 0.11	59.24^{cx} ± 0.02	0.359	S
III	61.62^{ay} ±0.08	57.53^{bz} ± 0.05	53.4^{cz} ± 0.04	0.233	S
CD	0.344	0.286	0.123		
	S	S	S		

Normal AST level in goats ranges from 43 to 132 IU/L (Chakrabarti, 2014)

The mean AST concentration (IU/L) in group I, II, and III before treatment on day "0" was 61.46 ± 0.06, 62.26 ±0.11and 61.62 ±0.08 respectively

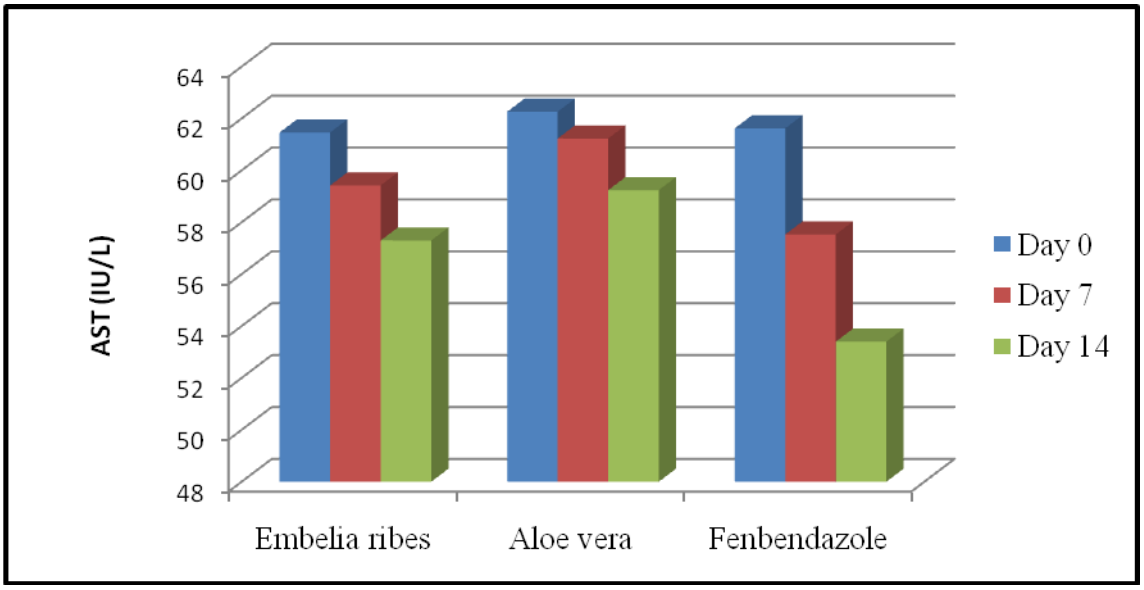

Fig.4.21: AST (IU/L) in different groups before and after treatment

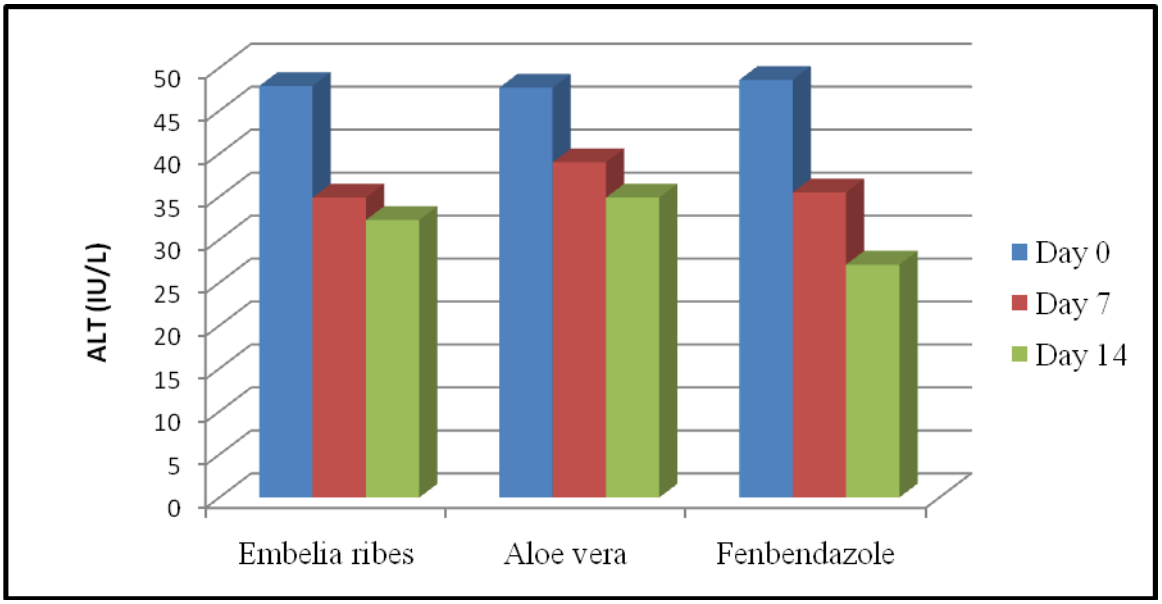

Fig..4.22: ALT (IU/L) in different groups before and after treatment

Post treatment in Group I AST concentration decreased on 7th day to 59.42 ± 0.04 and on 14th day to 57.3 ± 0.03. This change was statistically significant. Post treatment in Group II also AST decreased on 7th day (61.23 ± 0.11) and on day 14th (59.24 ± 0.02) This change was significant. Post treatment in Group III AST decreased on 7th day (57.53 ± 0.05) and on day 14th (53.4 ± 0.04.) This change also was significant. These findings were in agreement with Sharma *et al.,* (2001) and Rajpura *et al.,* (2019) who found 56.75 ± 0.82 IU/L and 52.00 ± 1.26 IU/L concentration of AST in helminth infection.

Increased levels of alanine aminotransferase and aspartate aminotransferase were observed in infected animals due to traumatic damage of abomasal and intestinal lining mucosa caused by adult parasites or damage of deep abomasal muscular layers by the *Haemonchus spp.* larval stages (Sharma *et al*., 2001), which could have resulted in rise in the levels of these enzymes (Bordoloi *et al*., 2012).

4.4.5 ALT (IU/L)

The ALT (IU/L) in group I, II and III before treatment on day "0" and post treatment on day 7 and day 14 are presented in Table 4.22, Fig.4.22

Table 4.22: The Mean ALT concentration (IU/L) in different groups before and after treatment

Groups	ALT (Mean ± S.E. IU/L)				
	Observational day			CD	
	0 day	7th day	14th day		
I	$47.9^{a} \pm 0.38$	$34.9^{by} \pm 0.28$	$32.3^{cy} \pm 0.33$	1.304	S
II	$47.7^{a} \pm 0.47$	$39^{bx} \pm 0.26$	$34.9^{cx} \pm 0.28$	1.370	S
III	$48.6^{a} \pm 0.48$	$35.5^{by} \pm 0.22$	$27.1^{cz} \pm 0.28$	1.345	S
CD	-	0.995	1.166		
	NS	S	S		

Normal ALT level in goats ranges from 7 to 24 IU/L (Chakrabarti, 2014)

The mean ALT (IU/L) in group I, II, and III before treatment on day "0" was 47.9 ± 0.38, 47.7 ± 0.47 and 48.6 ± 0.48 respectively.

Post treatment in Group I ALT concentration decreased on 7th day to 34.9 ± 0.28 and on 14th day to 32.3 ± 0.33 IU/L. This change was statistically significant. Post treatment in Group II also ALT concentration decreased on 7th day (39 ± 0.26) and on day 14th (34.9 ± 0.28) This change was significant. Post treatment in Group III ALT concentration decreased on 7th day (35.5 ± 0.22) and on day 14th (27.1 ± 0.28.) This change also was significant. These findings were in agreement with Moudgil *et al.,* (2017) and Rajpura *et al.,* (2019) who observed 48.51±2.92 IU/L and 52.58±0.90 IU/L concentration of ALT respectively in goats affected with parasitism.

4.5 Faecal examinations

4.5.1 Eggs per gram of feces (EPG)

The EPG (X100) in group I, II and III before treatment on day "0" and post treatment on day 3, day 7 and day 14 are presented in Table 4.23, Fig.4.23

Eggs per gram (X100) of group I (*Embelia ribes*), group II (*Aloe vera*) and group III (fenbendazole) on day 0 were 16.60±0.56 which decreased significantly to 14.2± 0.39, 15.1± 0.50 and 12.8± 0.47 on day 3 as well as on day 7 (11.7± 0.33, 12.9± 0.46 and 8.4± 0.37. On 14th day the reduction in EPG continued in all the three groups significantly and the values were 7.3± 0.30, 11.1± 0.43 and 3.7± 0.15 respectively in Group I, Group II and Group III. The reduction in EPG is attributed to drop in parasitic load in the host body. These findings are in agreement with the finding of Javed and Akhtar (1990), Garg *et al.,* (2004), Sharma *et al.,* (2015) and Sinha *et al*.,(2020).

4.5.2 FECRT (%)

The faecal egg count reduction test (FECRT) was carried out to study the efficacy of different anthelmintic drugs used in this study. FECRT percentage for the group I (*Embelia ribes*), Group II (*Aloe vera*) and Group III (fenbendazole) on 3rd day

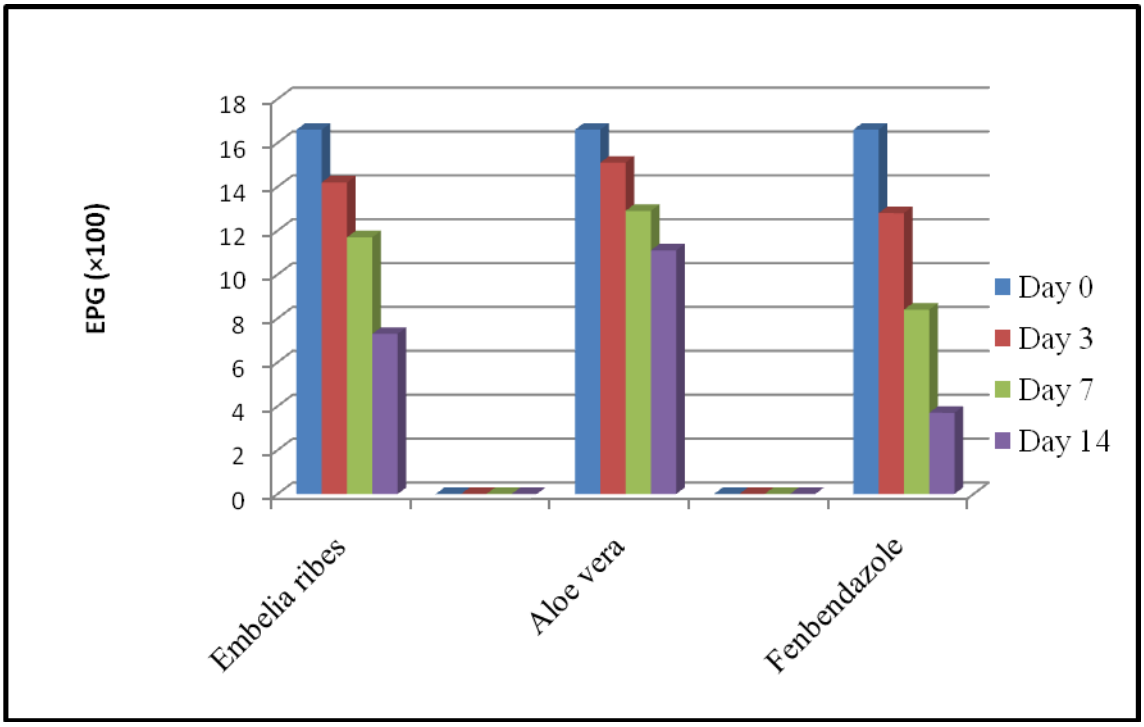

Fig.4.23: EPG (×100) in different groups before and after treatment

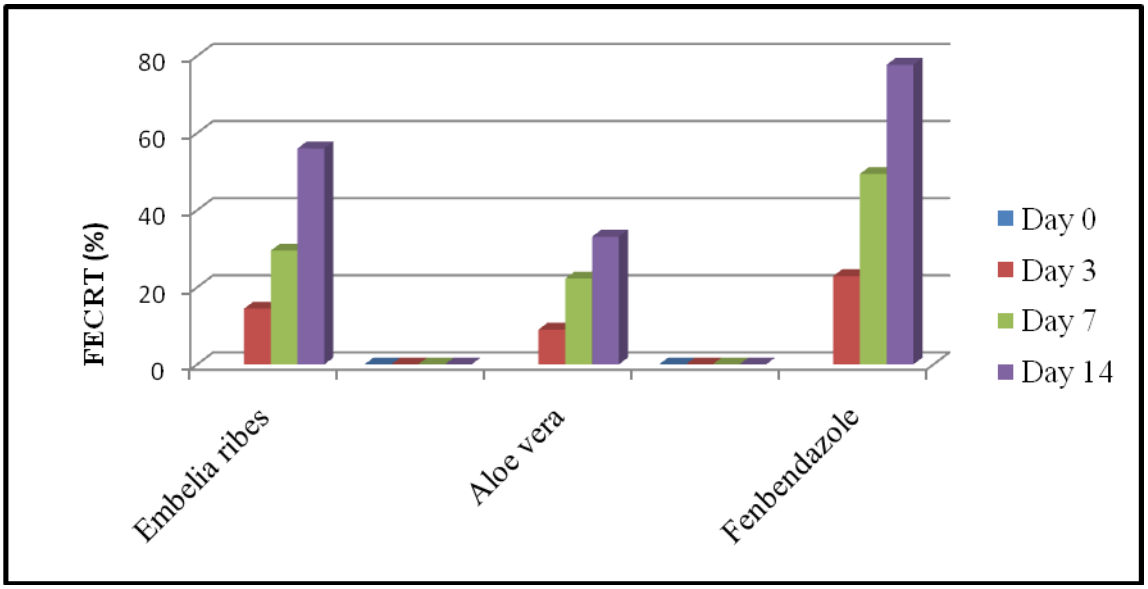

Fig.4.24: FECRT (%) in different groups before and after treatment

was 14.46, 9.03 and 22.89 respectively. On day 7, the FECRT percentage was 29.52, 22.29 and 49.39 and on day 14th it was 56.02, 33.13 and 77.71 respectively for Group I, Group II and Group III (Table 4.23 fig. 4.24) The FECRT percentage was found higher in fenbendazloe treated goats on every observational day as compared to two other groups (*Embelia ribes* and *Aloe vera*). Anthelmintic property of *Embelia ribes* is due to active principles like embelin and seed oil. Antiparasitic property of *Aloe vera* is due to active principle like aloin (Harish *et al.,* 2012,Tiwari and Upadhayay, 2018). Improvement in FECRT percentage in Group III is attributed to restriction of ATP formation by the test drug i.e. fenbendazole inside the parasite body

Table no 4.23 Comparative efficacy of different antihelmintic preparations at various time intervals against gastrointestinal helminthosis in goats before (BT) and post therapy (PT)

Groups	Days	EPG (×100)	FECRT (%)
Group I (*Embelia ribes*)	0	$16.6^{ax} \pm 0.56$	-
	3rd	$14.2^{bx} \pm 0.39$	14.46
	7th	$11.7^{cy} \pm 0.33$	29.52
	14th	$7.3^{dy} \pm 0.30$	56.02
Group II (*Aloe vera*)	0	$16.6^{ax} \pm 0.56$	-
	3rd	$15.1^{bx} \pm 0.50$	9.03
	7th	$12.9^{cx} \pm 0.46$	22.29
	14th	$11.1^{dx} \pm 0.43$	33.13
Group III (Fenbendazole)	0	$16.6^{ax} \pm 0.56$	-
	3rd	$12.8^{by} \pm 0.47$	22.89
	7th	$8.4^{cz} \pm 0.37$	49.39
	14th	$3.7^{dz} \pm 0.15$	77.71

4.6 Therapeutic efficacy

In the present study, goats having EPG>250 were randomly selected and distributed into three groups (n=10) for evaluation of therapeutic efficacy of different anti-parasitic preparations. The goats of group-I (n=10) were administered *Embelia ribes* seed powder @ of 150 mg /kg body weight orally daily once for 7 days. In group-II (n=10) goats were administered dried *Aloe vera* pulp @ 300 mg/kg body weight orally daily once for 7 days. The goats of group-III (n=10) were administered fenbendazole oral preparation @ of 10 mg/kg body weight as a single dose therapy (Table 2)

4.6.1 Embelia ribes

Administration of *Embelia ribes* to the goats of group-I resulted in significant improvement in clinical parameters like body temperature, heart beats and respiratory rate. The improvement was also seen in haematological parameters viz Hb, PCV, TEC, TLC and DLC after *Embelia ribes* therapy. The blood biochemical constituents of affected goats were also significantly improved after therapy. Reduction in EPG was maximum (7.30$\pm$0.30) and FECRT was maximum (56.02%) on 14th day of therapy with *Embelia ribes*. (Table 23) It is revealed that anti–helmintic preparation E*mbelia ribes* has caused relief to G.I parasites affected goats. Therefore it can be concluded that *Embelia ribes* seed powder @ 150 mg/kg body weight once orally for seven days is effective for reducing the worm load in goats to a significant level.

4.6.2 Aloe vera

The anti-parasitic drug *Aloe vera* administered to the goats of group-II resulted in significant improvement in clinical parameters like body temperature, heart beats and respiratory rate. The improvement was also seen in haematological parameters viz Hb, PCV, TEC, TLC and DLC after *Aloe vera* therapy. The blood biochemical constituents of affected goats were also significantly improved after therapy. Reduction in EPG was maximum (11.1$\pm$0.43) and FECRT was maximum

(33.13%) on the 14th day of therapy with *Aloe vera*. (Table 23) It is revealed that therapy with *Aloe vera* has resulted in relief to G.I parasites affected goats. Upon perusal of effect of *Aloe vera* therapy on different parameters it was concluded that dried *Aloe vera* pulp @ 300mg/kg body weight once orally for seven days, is less effective as compared to therapy with *Embelia ribes* seed powder in reducing worm load in goats.

4.6.3 Fenbendazole

The anti-helmintic drug fenbendazole administered to the goats of group-III resulted in significant improvement in clinical parameters like body temperature, heart beats and respiratory rate. The improvement was also seen in haematological parameters viz Hb, PCV, TEC, TLC and DLC after fenbendazole therapy. The blood biochemical constituents of affected goats were also significantly improved after therapy. Reduction in EPG was maximum (3.70±0.15) and FECRT was maximum (77.71%) on 14th day of therapy with fenbendazole. (Table 23) It was revealed that therapy with fenbendazole has resulted in relief to G.I parasites affected goats. It was therefore concluded that fenbendazole oral preparation @ of 10 mg/kg body weight as a single dose is effective for significantly reducing worm load in goats with maximum efficacy as compared to other two drugs under study.

4.6.4 Comparison of efficacy of drugs under study

Upon perusal of the data presented herewith, it was observed that therapy with Fenbendazole has resulted in significant improvement in all the clinical as well as haemato-biochemical parameters of goats as compared to the goats treated with *Embilera ribes* and *Aloe vera*. It was concluded that among the three drugs under study, fenbedazole is the best drug followed by *Embelia ribes* seed power and then dried *Aloe vera* pulp for significantly reducing worm load in goats.

4.7 In vitro study to evaluate the antihelmintic efficacy of *Embelia ribes* and *Aloe vera*

Egg hatching test

The results of egg hatching test showed that aqueous extract of *Embelia ribes* performed slightly better than *Aloe vera* aqueous extract. The lowest efficacy (13%) was observed in 10 mg/ml concentration where as highest efficacy (36.67 %) was recorded in 50 mg/ ml concentration of aqueous extract of *Embelia ribes*. The results indicate that efficacy percentage increases from lower to higher concentration. In the control group for *Embelia ribes* also (6.34%) eggs were failed to hatch in the larval stage.

Similar trend of results were observed in *Aloe vera* aqueous extract in the egg hatching test. The lowest efficacy (17%) was observed in 10 mg/ml concentration where as highest efficacy (34.67 %) was recorded in 50 mg/ ml concentration of *Aloe vera* aqueous extract. The results indicate increase in the efficacy percentage with increase in the concentration of extract. In case of *Aloe vera,* in control group (5%) eggs failed to hatch to the next stage.

The results of the egg hatching test were summarized in table no 24 and 25

Table no.4.24 Efficacy of *Embelia ribes* aqueous extract with egg hatching test

	Percentage of egg hatching at different concentration					
Replicates	10mg/ml	20mg/ml	30mg/ml	40mg/ml	50mg/ml	Control
1	85	84	68	66	62	95
2	90	86	74	69	65	92
3	86	74	64	70	63	94
Mean	87	81.33	68.66	68.33	63.33	93.66
% Efficacy	13	18.67	31.34	31.67	36.67	

Table no.4.25 Efficacy of *Aloe vera* aqueous extract with egg hatching test

	Percentage of egg hatching at different concentration					
Replicates	10mg/ml	20mg/ml	30mg/ml	40mg/ml	50mg/ml	Control
1	80	82	74	72	62	96
2	82	74	72	70	68	95
3	87	85	76	68	66	94
Mean	83	80.33	74	70	65.33	95
% Efficacy	17	19.67	26	30	34.67	

This indicates that the aqueous extract of the *Embelia ribes* and *Aloe vera* both have showed moderate efficacy against egg of *Strongyle spp*. Both the extracts only at higher concentration showed (36.67%) efficacy for *Embelia ribes* and (34.67%) efficacy for A*loe vera*. Also it was noticed that the percentage of efficacy increased with increase in the concentration of extract. The reason behind moderate efficacy of this both these extracts may be the resistant nature of the eggs and tough egg shell present in case of the nematodes.

In comparison to the FECRT results, similar efficacy was found in the egg hatching test for *Aloe vera* aqueous extract where as for *Embelia ribes* lower efficacy was found in comparison to FECRT. Meenakshisundaram *et al* (2016) also performed the egg hatch assay to screen the antihelmintic activity of *Aloe vera* and *Embelia ribes.* They found *Aloe vera* aqueous extract having inhibitory effect on egg hatching. Increase in concentration of these extract resulted in increase inhibition of egg hatching which indicates dose dependent activity. In the present study also increase in efficacy was observed with increase in dose. But in comparison to Meenakshisundaram *et al* (2016) lower efficacy was noted in the present study for *Aloe vera.* This might be due to the different varieties of *Aloe vera* present at different location. The analysis of overall results of the egg hatching test for screening

recorded that both the drugs viz. *Aloe vera* and *Embelia ribes* showed dose dependent activity which indicates that the highest concentration of these extracts may show increased efficacy. As the present study is the preliminary investigation on effect of *Aloe vera* and *Embelia ribes* aqueous extract, further detail study is needed to explore the efficacy of *Aloe vera* and *Embelia ribes* against nematodes.

Summary And Conclusions

CHAPTER - V

SUMMARY AND CONCLUSION

Investigation on the research project entitled " Efficacy of *Embelia ribes* seed powder and dried *Aloe vera* pulp against gastrointestinal helminthosis in goats'' was carried out on goat population of Parbhani and adjoining areas during the period from December 2020 to April 2021. A total of 121 goats were screened for gastrointestinal helminthosis. The study was undertaken with regard to incidence, clinical manifestations, haemato-biochemical alterations in affected goats and to evaluate therapeutic efficacy of *Embelia ribes* seed powder and dried *Aloe vera* pulp for treatment of helminthosis of goats in comparison to fenbendazole.

Among 121 goats screened for gastrointestinal helminthosis, 68 were positive indicating overall incidence of gastrointestinal helminthosis as 56.19 per cent. Out of 35 kids examined 15 (42.86%), out of 45 young ones of 4 months to one year of age 21 (46.67%) and out of 41 adults above 1 year of age 32 (78.04%) were positive for helminthosis. Incidence in female goats was 49.32 and in males it was 66.67 percent. Incidence in Osmanabadi goats was higher (60.65%) than non descript goats (51.60%). Incidence of nematodes was higher (77.92%) than cestodes (13.23%) and trematodes (8.82%). Amongst trematodes the incidence of Stronyles was 42.64 % and that of Strongyloides and Trichuris was 17.64% each.

In the present study, the goats having EPG > 250 were randomly distributed in three groups (n=10) for evaluation of therapeutic efficacy of different antiparasitic preparations. Goats of Group I were administered *Embelia ribes* seed powder @ 150 mg/kg body weight orally daily once for 7 days. The group II (n=10) goats were administered dried *Aloe vera* pulp @ 300 mg/kg body weight orally daily once for 7 days and in group-III (n=10) goats were administered fenbendazole oral preparation @ of 10 mg/kg body weight as a single dose therapy. The faecal samples of treated groups were examined on day 0 (before treatment) and on day 3, 7 and 14 post therapy for evaluation of therapeutic efficacy of each drug.

The average rectal temperature, heart rate and respiration rate in affected goats ranged from 103.78±0.03 to 103.81±0.02^{0}F, from 85.20±0.25 to 86.10±0.41 beats/minute and 30.8 ±0.25 to 31.7± 0.26 breaths/minute respectively in affected goats.

Helminth affected goats were weak, had drop in production, rough hair coat, with increased rectal temperature, increased heart rate, increased respiration rate, had diarrheic faeces / faeces with and mucus /loose or pasty faeces causing soilage of tail and hind quarters.

The analysis of haemato-biochemical parameters revealed a significant decrease in haemoglobin on day 0 in group I, group II and group III (7.75±0.14, 7.62±0.11 and 7.89±0.13 g/dl). On day 7 and day 14 there was significant increase in haemoglobin concentration (8.15±0.14, 8.01±0.11, 8.76±0.13 g/dl and 8.67±0.10, 8.48±0.04, 9.78±0.14 g/dl respectively.) There was significant decrease in PCV (%) in group I, group II and group III on day 0 (23.25± 0.41, 23.18±0.33 and 23.58± 0.41%) and after treatment there was significant increase in PCV on day 7 and day 14 (24.47 ± 0.41, 24.06 ± 0.32 , 26.09 ± 0.42% and 25.37 ± 0.44, 24.96 ± 0.32 , 29.1 ± 0.50% respectively). There was a significant decrease in TEC ($\times 10^6/\mu l$) in group I, group II and group III on day 0 (6.90 ± 0.05, 6.66 ± 0.05, 6.99 ± 0.10). After treatment there was significant increase in TEC on day 7 and day 14 (7.84 ± 0.04, 6.95 ± 0.05, 7.92 ± 0.09 and 8.03 ± 0.04, 7.52 ± 0.04, 8.84 ± 0.10 respectively). There was a significant increase in TLC ($\times 10^3/\mu l$) in group I, group II and group III on day 0 (11.15 ± 0.03, 11.15 ± 0.02 and 11.21 ± 0.09). After treatment there was a significant decrease in TLC on day 7 and day 14 (10.95 ± 0.03, 10.96 ± 0.02, 10.91 ± 0.14 and 10.83 ± 0.02, 10.85 ± 0.01, 10.76 ± 0.14 respectively). There was a significant increase in neutrophil count on day 0 in group I, group II and group III (47.16 ± 0.02, 47.15 ±0.06 and 47.93 ± 0.07%). After treatment on day 7 and day 14 there was significant decrease in neutrophil count (44.16 ± 0.02, 46.14 ± 0.06, 43.94 ± 0.07 and 42.17 ± 0.02, 45.13 ± 0.05, 39.93 ± 0.07% respectively). There was a significant increase in eosinophil count on day 0 in group I, group II and group III (5.55 ± 0.02, 5.40 ± 0.03 and 5.71 ± 0.03%). After treatment there was a significant decrease in eosinophil count on day 7 and day 14 (3.72± 0.03, 3.50 ± 0.03, 3.77 ± 0.03% and

2.81 ± 0.02, 2.75 ± 0.01, 1.92 ± 0.01% respectively). There was a significant increase in basophil count in group I, group II and group III on day 0 (0.54 ± 0.00%). After treatment on day 7 and day 14 there was a significant decrease in basophil count (0.48 ± 0.00, 0.50 ± 0.00, 0.46 ± 0.00 and 0.46± 0.00, 0.48 ± 0.00, 0.43 ± 0.00% respectively). There was a significant decrease in lymphocytes in group I, group II and group III on day 0 (43.77± 0.04, 44.03 ± 0.06 and 42.86 ± 0.09%). After treatment there was significant increase in lymphocytes count on day 7 and day 14 (49.27 ± 0.04, 47.28 ± 0.06, 49.46 ± 0.09 and 52.40 ± 0.03, 49.16 ± 0.06, 55.75 ± 0.08% respectively). There was a significant increase in monocytes in group I, group II and group III on day 0 (2.94 ± 0.01, 2.86 ± 0.01 and 2.94 ± 0.00%). After treatment there was a significant decrease in monocytes on day 7 and day 14 (2.34 ± 0.01, 2.56± 0.01, 2.34 ± 0.00 and 2.14 ± 0.01, 2.46 ± 0.01, 1.94 ± 0.00% respectively).

There was a significant decrease in total protein on day 0 in group I, group II and group III (5.54 ± 0.01, 5.55 ± 0.01 and 5.64 ± 0.01 g/dl). After treatment there was a significant increase in total protein concentration on day 7 and day 14 (5.95± 0.01, 5.79 ± 0.00, 5.94 ± 0.01 and 6.15 ± 0.01, 6.05± 0.01, 6.36 ± 0.01 g/dl respectively). There was a significant decrease in serum albumin level (g/dl) in group I, group II and group III on day 0 (2.72 ± 0.00, 2.75 ± 0.01 and 2.74 ± 0.01 g/dl). After treatment there was a significant increase in serum albumin level on day 7 and day 14 (2.92 ± 0.00, 2.93 ± 0.01, 3.02 ± 0.01 and 3.10 ± 0.01, 3.05 ± 0.01, 3.29 ± 0.00 g/dl respectively). There was a significant decrease in globulin level (g/dl) on day 0 in group I, group II and group III (2.82 ± 0.01, 2.80 ± 0.01 and 2.90 ±0.01 g/dl respectively). After treatment on day 7 and day 14 there was significant increase in globulin level (3.02 ± 0.01, 2.90 ± 0.01, 2.92 ± 0.01 and 3.05 ± 0.01, 2.99 ± 0.01, 3.06 ± 0.01 respectively). There was a significant increase in AST level (IU/L) in group I, group II and group III on day 0 (61.46 ± 0.06, 62.26 ±0.11 and 61.62 ±0.08 IU/L). After treatment on day 7 and day 14 there was a significant decrease in AST level (59.42 ± 0.04, 61.23 ± 0.11, 57.53 ± 0.05 and 57.3 ± 0.03, 59.24 ± 0.02, 53.4 ± 0.04 IU/L respectively). There was significant increase in ALT level in (IU/L) group I, group II and group III on day 0 (47.9± 0.38, 47.7 ± 0.47 and 48.6 ± 0.48 IU/L). After treatment there was

significant decrease in ALT level on day 7 and day 14 (34.9 ± 0.28, 39 ± 0.26, 35.5 ± 0.22 and 32.3 ± 0.33, 34.9 ± 0.28, 27.1 ± 0.28 IU/L respectively.

The faecal analysis of infected goats with respect to EPG (X100) on day 0 (BT) in group I, II and III was 16.6 ± 0.56 in all the groups. Reduction in EPG was significant and the count on the 3rd day was 14.2 ± 0.39, 15.1 ± 0.50 and 12.8 ± 0.47 for group I, II and III respectively. On the 7th day also the reduction in EPG was significant and the values for group I, II and III were 11.7 ± 0.33, 12.9 ± 0.46, and 8.4±0.37 for group I, II and III respectively. The trend of reduction in EPG continued even on the 14th day and the values were 7.3 ± 0.30, 11.1 ± 0.43 and 3.7 ± 0.154 respectively for group I, II and III.

The FECRT percentage in group I, II and III was 14.46%, 9.03% and 22.89 % respectively on day 3 of treatment. It was 29.52%, 22.29% and 22.89% on 7th day of treatment and 56.02%, 33.13%, and 77.71% respectively on 14th day of treatment The therapeutic efficacy of different anti-parasitic preparations under study was assessed on the basis of improvement in clinical, haematological, blood biochemical parameters as well as reduction in EPG and rise in FECRT percentage. It was revealed that all the drugs under study viz. *Embelia ribes*, *Aloe vera* and Fenbendazole are able to reduce the parasitic load significantly.

Egg hatching test revealed that aqueous extracts of both the drugs viz. *Aloe vera* and *Embelia ribes* showed dose dependent activity and the highest concentration of these extracts has shown increased efficacy.

The comparative evaluation of three anti parasitic preparations against gastrointestinal helminthosis in goats has shown that fenbendazole therapy @ 10 mg/kg body weight is the best drug followed by *Embelia ribes* seed power and then dried *Aloe vera* pulp for minimizing parasitic load in goats.

Conclusions

1) Overall incidence of gastro-intestinal helminthosis was 56.19% in goats in and around Parbhani.
2) Incidence in male (66.67%) was higher than female goats (49.32%). Incidence in Osmanabadi goats was higher (60.65%)

than non descript goats (51.60%). Incidence of Nematodes was higher (77.92%) than Cestodes (13.23%) and Trematodes (8.82%).

3) The goats showed clinical signs like rough hair coat, increase in clinical parameters like rectal temperature, respiratory rate and heart beats, diarrhoea,weakness, faeces with mucus or blood and anaemia.

4) Gastro-intestinal helminth affected goats exhibited significant reduction in haematological parameters like hemoglobin, packed cell volume, total erythrocyte count and lymphocyte percentage with significant fall in the blood biochemical parameters like total protein, albumin, globulin and significant increase in AST and ALT level.

5) Although there was significant improvement in all clinical, haematological and blood biochemical parameters as well as EPG count and FECRT percentage with the therapy of *Embelia ribes, Aloe vera* and fenbendazole, the therapy with fenbendazole @ 10 mg/kg body weight was found to be more efficacious in reducing the worm load in helminth affect goats.

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Appendix

APPENDIX I

Goat population screened for presence of gastrointestinal G.I. helminth Parasites

Sr. No	Animal Code	Animal Type	Sex	Breed	Presence of G.I. helminth Parasites
1	CP_1	Kid	Male	Osmanabadi	-ve
2	CP_2	Kid	Female	Osmanabadi	+ve
3	CP_3	Adult	Male	ND	+ve
4	CP_4	Kid	Female	Osmanabadi	-ve
5	CP_5	Young	Female	ND	+ve
6	CP_6	Young	Male	Osmanabadi	+ve
7	CP_7	Kid	Female	Osmanabadi	-ve
8	CP_8	Adult	Male	ND	+ve
9	CP_9	Adult	Female	Osmanabadi	+ve
10	CP_{10}	Kid	Female	Osmanabadi	-ve
11	CP_{11}	Young	Female	ND	+ve
12	CP_{12}	Kid	Female	Osmanabadi	-ve
13	CP_{13}	Kid	Male	ND	+ve
14	CP_{14}	Young	Male	Osmanabadi	+ve
15	CP_{15}	Kid	Male	Osmanabadi	-ve
16	CP_{16}	Kid	Female	Osmanabadi	-ve
17	CP_{17}	Young	Male	Osmanabadi	+ve
18	CP_{18}	Young	Female	Osmanabadi	-ve
19	CP_{19}	Young	Female	Osmanabadi	-ve
20	CP_{20}	Young	Female	ND	+ve
21	CP_{21}	Young	Female	Osmanabadi	-ve
22	CP_{22}	Kid	Female	Osmanabadi	+ve
23	CP_{23}	Kid	Male	Osmanabadi	-ve
24	CP_{24}	Young	Female	Osmanabadi	-ve
25	R_1	Adult	Male	ND	+ve
26	R_2	Young	Female	Osmanabadi	-ve
27	R_3	Young	Female	Osmanabadi	-ve
28	R_4	Adult	Male	Osmanabadi	+ve

29	R_5	Young	Female	Osmanabadi	-ve
30	R_6	Young	Male	Osmanabadi	+ve
31	R_7	Kid	Female	ND	-ve
32	R_8	Young	Female	ND	+ve
33	R_9	Kid	Female	ND	-ve
34	R_{10}	Kid	Female	ND	-ve
35	R_{11}	Kid	Female	Osmanabadi	+ve
36	R_{12}	Kid	Female	ND	-ve
37	R_{13}	Kid	Male	ND	+ve
38	R_{14}	Kid	Female	Osmanabadi	+ve
39	R_{15}	Kid	Female	ND	-ve
40	R_{16}	Young	Female	ND	-ve
41	R_{17}	Adult	Male	ND	+ve
42	R_{18}	Young	Female	ND	-ve
43	R_{19}	Young	Female	ND	+ve
44	R_{20}	Adult	Male	Osmanabadi	+ve
45	A_1	Young	Female	ND	-ve
46	A_2	Young	Female	ND	-ve
47	A_3	Kid	Male	ND	+ve
48	A_4	Young	Female	ND	-ve
49	A_5	Young	Male	Osmanabadi	+ve
50	A_6	Young	Female	ND	-ve
51	A_7	Adult	Female	ND	+ve
52	A_8	Young	Female	ND	-ve
53	A_9	Adult	Female	Osmanabadi	+ve
54	A_{10}	Young	Female	ND	-ve
55	A_{11}	Adult	Male	Osmanabadi	+ve
56	A_{12}	Young	Female	ND	-ve
57	A_{13}	Young	Male	ND	+ve
58	A_{14}	Adult	Male	Osmanabadi	+ve
59	A_{15}	Young	Female	ND	-ve
60	A_{16}	Young	Female	Osmanabadi	+ve
61	A_{17}	Adult	Male	Osmanabadi	+ve

62	A_{18}	Young	Male	ND	+ve
63	A_{19}	Adult	Female	ND	-ve
64	A_{20}	Adult	Female	Osmanabadi	+ve
65	A_{21}	Adult	Female	ND	+ve
66	A_{22}	Kid	Male	Osmanabadi	-ve
67	A_{23}	Adult	Male	Osmanabadi	+ve
68	A_{24}	Kid	Male	Osmanabadi	-ve
69	T_1	Adult	Female	Osmanabadi	+ve
70	T_2	Adult	Female	ND	+ve
71	T_3	Adult	Male	Osmanabadi	+ve
72	T_4	Adult	Male	Osmanabadi	-ve
73	T_5	Young	Female	Osmanabadi	+ve
74	T_6	Young	Male	ND	+ve
75	T_7	Young	Female	Osmanabadi	-ve
76	T_8	Young	Female	Osmanabadi	-ve
77	T_9	Kid	Male	Osmanabadi	+ve
78	T_{10}	Young	Female	Osmanabadi	-ve
79	T_{11}	Adult	Female	ND	+ve
80	T_{12}	Adult	Female	Osmanabadi	-ve
81	T_{13}	Adult	Female	Osmanabadi	+ve
82	T_{14}	Adult	Female	Osmanabadi	-ve
83	T_{15}	Adult	Female	ND	+ve
84	T_{16}	Adult	Female	Osmanabadi	-ve
85	T_{17}	Kid	Male	Osmanabadi	+ve
86	T_{18}	Adult	Female	ND	-ve
87	T_{19}	Young	Male	ND	+ve
88	T_{20}	Young	Female	Osmanabadi	+ve
89	T_{21}	Adult	Female	ND	-ve
90	T_{22}	Adult	Female	ND	+ve
91	D_1	Adult	Male	Osmanabadi	+ve
92	D_2	Adult	Female	ND	-ve
93	D_3	Adult	Female	Osmanabadi	+ve
94	D_4	Kid	Male	ND	-ve

95	D_5	Young	Male	ND	+ve
96	D_6	Kid	Male	ND	-ve
97	D_7	Kid	Female	ND	+ve
98	D_8	Adult	Female	Osmanabadi	+ve
99	D_9	Kid	Male	ND	-ve
100	D_{10}	Kid	Female	ND	+ve
101	D_{11}	Young	Female	Osmanabadi	+ve
102	D_{12}	Kid	Male	ND	-ve
103	D_{13}	Adult	Female	Osmanabadi	+ve
104	D_{14}	Adult	Male	ND	+ve
105	D_{15}	Kid	Male	Osmanabadi	+ve
106	D_{16}	Kid	Male	ND	-ve
107	D_{17}	Kid	Female	ND	+ve
108	D_{18}	Adult	Female	Osmanabadi	+ve
109	D_{19}	Young	Male	ND	-ve
110	D_{20}	Adult	Male	ND	+ve
111	D_{21}	Young	Male	ND	-ve
112	D_{22}	Young	Female	Osmanabadi	+ve
113	D_{23}	Adult	Female	ND	+ve
114	D_{24}	Kid	Male	Osmanabadi	+ve
115	D_{25}	Young	Male	ND	-ve
116	D_{26}	Adult	Female	Osmanabadi	+ve
117	D_{27}	Young	Male	ND	-ve
118	D_{28}	Kid	Female	ND	+ve
119	D_{29}	Adult	Male	ND	-ve
120	D_{30}	Young	Female	Osmanabadi	+ve
121	D_{31}	Adult	Male	ND	+ve

Animal Code

CP	TVCC COVAS Parbhani
R	Raipur
A	Asola
T	Takali
D	Dharmapuri

Vitae

VITAE

The author Dr. Garudi Shankar Devrao born on 25th January,1996 at post Kok Tq. Jintur Dist. Parbhani (Maharashtra). He completed his Secondary School Certificate (SSC) examination in 2010 from Bal Vidya Mandir high school, parbhani and subsequently completed Higher Secondary Certificate (HSC) examination in 2012 from Queens Junior College Parbhani.

Later he joined College of Veterinary and Animal Sciences, Udgir in 2013 and successfully completed B.V.Sc. and A.H. degree course in second division from MAFSU, Nagpur in 2018. He later joined Master's Degree programme and completed coursework in Clinical Veterinary Medicine from College of Veterinary and Animal Sciences, Parbhani under MAFSU, Nagpur.

He is registered member of Maharashtra State Veterinary Council, Nagpur and Veterinary Council of India.

Thesis Abstract

THESIS ABSTRACT

Title of the thesis (in Capital letters)	**:**	EFFICACY OF E*mbelia ribes* SEED POWDER AND DRIED A*loe vera* PULP AGAINST GASTROINTESTINAL HELMINTHOSIS IN GOATS
Full name of student	**:**	Garudi Shankar Devrao
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ABSTRACT

The research project entitled " Efficacy of *Embelia ribes* seed powder and dried *Aloe vera* pulp against gastrointestinal helminthosis in goats'' was undertaken to study the incidence, clinical manifestations and haemato-biochemical alterations in helminth affected goats and to evaluate therapeutic efficacy of *Embelia ribes* seed powder and dried *Aloe vera* pulp for treatment of helminthosis in goats in comparison to fenbendazole.

Overall incidence of gastro-intestinal helminthosis in goats was 56.19 percent. Incidence in male (66.67%) was higher than female goats (49.32%). Incidence in Osmanabadi goats was higher (60.65%) than non-descript goats (51.60%).

The affected goats exhibited significant reduction in haematological parameters like Hb, PCV, TEC and lymphocyte with significant fall in the blood biochemical parameters like total protein, albumin, globulin and significant increase in AST and ALT level.

The goats having EPG > 250 were randomly distributed in three groups of 10 goats each. Goats of Group I were administered *Embelia ribes* seed powder @ 150 mg/kg body weight, while group II goats were administered dried *Aloe vera* pulp @ 300 mg/kg body weight, orally daily once for 7 days. Group III goats were administered fenbendazole oral preparation @ of 10 mg/kg body weight as a single dose therapy. The faecal samples were examined on day 0 (before treatment) and on day 3, 7 and 14 post therapy for evaluation of therapeutic efficacy of each drug.

It was observed that although there was significant improvement in all clinico-haematological and blood biochemical parameters as well as EPG count and FECRT percentage with the therapy of *Embelia ribes, Aloe vera* and fenbendazole, therapy with fenbendazole was found to be more efficacious in reducing the worm load in helminth affected goats as compared to other two drugs.

प्रबंध सारांश

प्रबंधाचे शीर्षक	:	पोटातील जंतांनी बाधीत शेळयांच्या उपचारासाठी वावडींगाच्या बियांची भुकटी व कोरफडीच्या वाळलेल्या गराची उपयुक्तता तपासणे
विद्यार्थ्याचे पूर्ण नाव	:	गारुडी शंकर देवराव
प्रमुख मार्गदर्शकाचे नाव व पत्ता	:	डॉ. सुधीरकुमार त्र्यंबकराव बोरीकर सहयोगी प्राध्यापक, पशुचिकीत्सालयीन औषधवैद्यकशास्त्र नीतीशास्त्र व न्यायवैद्यकशास्त्र विभाग, पशुवैद्यक व पशुविद्यान महाविद्यालय, परभणी
प्रदान करण्यात येणारी पदवी	:	एम. व्ही. एस सी.
पदवी प्रदान करण्याचे वर्ष	:	२०२१
मुख्य विषय	:	पशुचिकीत्सालयीन औषधवैद्यकशास्त्र नीतीशास्त्र व न्यायवैद्यकशास्त्र विभाग
प्रबंधातील पानांची एकूण संख्या	:	६५
सारांशामधील शब्दांची संख्या	:	२८७
विद्यार्थ्याची स्वाक्षरी	:	
पाठविणाऱ्या अधिकाऱ्याची स्वाक्षरी, नाव व पत्ता (विभागप्रमुख)	:	डॉ. सुधीरकुमार त्र्यंबकराव बोरीकर प्राध्यापक व विभाग प्रमुख, पशुचिकीत्सालयीन औषधवैद्यकशास्त्र नीतीशास्त्र व न्यायवैद्यकशास्त्र विभाग, पशुवैद्यक व पशुविद्यान महाविद्यालय, परभणी

सारांश

सदर संशोधन प्रकल्प “पोटातील जंतांनी बाधीत शेळयांच्या उपचारासाठी वावडींगाच्या बियांची भुकटी व कोरफडीच्या वाळलेल्या गराची उपयुक्तता तपासणे”. शेळयांतील जंत बाधनाचे प्रमाण तपासणे, जंतामुळे शरीरावर तसेच रक्तघटकांवरील होणारे परीणाम अभ्यासणे आणि वावडींगाच्या बियांच्या भुकटीची तसेच कोरफडीच्या वाळलेल्या गराचा जंताच्या उपचारासाठी फेंडबेंडेझॉलच्या तुलनेत उपयुक्तता तपासणे यासाठी करण्यात आला.

सदर अभ्यासात एकंदर ५६.१९ % शेळया जंतांनी बाधीत आढळल्या, बोकडांमध्ये जंतबाधनाचे प्रमाण (६६.६७%) मादी शेळयांपेक्षा (४९.३२%) जास्त् दिसुन आले. उस्मानाबादी शेळया (६०.६५%) गावठी शेळयांपेक्षा (५१.६० %) जास्त् प्रमाणात बाधीत होत्या. एकंदर जंतामध्ये गोलकृमीचे (७७.९२ %) प्रमाण चापट कृमी (१३.२३%) व पर्णाकृती जंतापेक्षा (८.८२%) जास्त् आढळले. जंताच्या ट्रीमॅटोड प्रकारात स्ट्रॉंगाईल्सचे प्रमाण (४२.६४%) तर स्ट्रॉंगायलॉईडस व ट्रायच्युरीसचे प्रत्येकी प्रमाणे १७.६४% होते.

पोटातील जंतानी बाधीत शेळयात कातडीच्या शुस्क्पणा, हागवण, कमजोरी, शारिरीक तापमान, हृदयाची गती तसेच श्वसनाचा दर वाढणे, रक्तक्षय इत्यादी लक्षणे दिसुन आली.

बाधीत शेळयांमध्ये हिमोग्लोबीन, पि.सी.व्ही., तांबडया पेशी, लिंफोसाईट रक्तातील एकूण प्रथीने, अल्ब्युमीन व ग्लोल्ब्युलीन चे प्रमाण लक्षणीयरित्या कमी आढळले तर ए.एस.टी व ए.एल.टी. ची पातळी वाढलेली आढळली.

सदर अभ्यासासाठी १ ग्राम लेंडीमध्ये २५० किंवा त्या पेक्षा जास्त् जंतांची अंडी असलेल्या दहा शेळयांचा एक गट या प्रमाणे ३ गट करण्यात आले. पहिल्या

गटाला १५० मिली ग्राम प्रति किलो वजनास या दराने वावडींगच्या बियांची भुकटी दररोज ७ दिवस तोंडाव्दारे देण्यात आली. शेळयांच्या दुसऱ्या गटाला कोरफडीचा वाळलेला गर प्रती किलो वजनासाठी ३०० मिलीग्राम या दराने तोंडाव्दारे ७ दिवस देण्यात आला. तर शेळयांच्या दिसऱ्या गटाला फेंनबेंडेझॉल हे औषध प्रति किलो वजनाला १० मि.ली. ग्राम या दराने एकदाच तोंडाव्दारे देण्यात आले. तिन्ही गटातील शेळयांची शारिरीक तपासणी तसेच लेंडी व रक्तघटकांची तपासणी उपचारापुर्वी तसेच उपचाराच्या तिसऱ्या, सातव्या व चौदाव्या दिवशी करण्यात आली.

उपचारासाठी वापरण्यात आलेल्या तिनही औषधांचा शेळयांच्या सर्वंकष आरोग्यावर सकारात्मक परिणाम दिसुन आला. तिनही औषधांचा तुलनात्मक अभ्यास केल्या नंतर असे आढळुन आले की, शेळयांतील जंतांच्या अंडयाचे प्रमाण कमी करण्यासाठी फेंनबेंडेझॉल हे औषध इतर दोन औषधांपेक्षा अधिक प्रभावी आहे.