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Haematological alteration in *Fasciola hepatica* infected *Capra hircus* (goats)

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Abstract

The present study was aimed with study the haematological alteration in *Fasciola hepatica* infected goats. The study duration was one year in which summer, rainy and winter season included. Total 60 goats were included for this study. Goats were divided in two groups one was slaughter house and second was house hold. Blood samples were taken from the jugular vein into evacuated EDTA tubes and stored at 4 °C. Samples were analyzed within 12 h. In these samples Total leucocytes count (TLC) Differential leucocyte count (DLC), Total erythrocyte count (TEC), packed cell volume (PCV), mean corpuscular hemoglobin (MCH) pictogram (pg), mean corpuscular volume (MCV) and mean corpuscular hemoglobin concentration (MCHC) were observed. In all three season TEC, Lymphocytes, PCV and MCHC value was decreased as compared to control value. TLC, Eosinophiles, MCH and MCV value was increased as compared to control value. Neutrophile, Basophile and Monocytes fluctuated as compared to control value in house hold and slaughter house goats. Haematological values highly altered in rainy season then winter and followed by summer season. The results of present can be useful in early diagnosis of goat fascioliasis.

Keywords: Fascioliasis, *Capra hircus* (Goat), TLC, DLC, TEC, PCV, MCH, MCV and MCHC

Introduction

Fasciolosis also known as Fascioliasis, Distomatosis and liver Rot is an important disease of cattle caused by trematodes *i.e.* *Fasciola hepatica* and *Fasciola gigantica* (common liver flukes). This condition of internal parasitism is one of the major problems that lower the livestock productivity throughout the world said to Vercreyusse and Claserebont (2001) [32]. Rondelaud *et al.* (2001) [26] have been reported the significance of helminth infestation has been increased many folds in developing countries, the disease is of paramount importance due to its broad distribution and definite hosts. It causes acute and chronic infections Sampaio Silva *et al.* (1996) [27]. The disease in predominantly caused by *Fasciola hepatica* or *Fasciola gigantica* Soulsby (1987) [29].

Goats are the most second important livestock in India which contributes in poverty alleviation and by supplying animal protein of high caloric value in the form of milk and meat. Parasitic diseases especially *Fasciola hepatica* infection in ruminants causes enormous economic losses of the livestock population and these losses are due to costs of anthelmintics, reduction in milk and meat production, fertility and draught power. The disease also has public health significance, causing human fascioliasis (Bhuyan, 1970; Lebbie *et al.*, 1994) [3, 16].

Fasciolosis is a significant live stock problem; yearly an estimated US\$ 2 billion are foregone due to weight loss, reduction in milk yield and fertility in production animals. Fasciolosis is a dangerous disease leading to huge economic losses in live stock production and causing severe illness in human livers (Mas-Coma, *et al.*, 2005 and Hussein, *et al.*, 2009) [19, 12].

The aim of present study was to compare hematological findings between *F. hepatica* naturally infected and non-infected goats of slaughter house and household. We discuss about the usefulness of these findings as diagnostic tools and for the estimation of severity of fasciolosis in affected animals. These findings can be useful for further studies of *F. hepatica* and diagnostic purposes in goats, especially, in areas where fasciolosis is not endemic.

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Since less previous work has already been carried out on the present parameters this work can be of high priority and prime importance.

Materials and Methods

Experimental animal: The goats (*Capra hircus*) were used as experimental animal for present study. Total 60 goats were included for this study. The goats were categorized into two categories one was slaughter house and second was household.

Experimental parasite: *Fasciola hepatica* (Liver fluke) was used as experimental parasite for present study.

Study area: This study was conducted in Indore regions. The different region of Indore such as Dakachya, Mangalya, Sanwer, Mhow and Rao were included for present study.

Study Period: This study was conducted over 1 year period. The one year period was divided into three seasons such as Rainy, winter and summer.

Collection of blood samples: Blood samples were taken from the jugular vein into evacuated EDTA tubes and stored at 4 °C. Samples were analyzed within 12 h.

Haematological parameters: The Haematological parameters viz. Total leucocytes count (TLC), Differential leucocyte count (DLC), Total erythrocyte count (TEC), packed cell volume (PCV), mean corpuscular hemoglobin (MCH), mean corpuscular volume (MCV) and mean corpuscular hemoglobin concentration (MCHC) were studied. Haematological parameters were analyzed by Brar *et al.* (2004) [5].

Results and Discussion

Blood samples were taken from the jugular vein into evacuated EDTA tubes and stored at 4 °C. Samples were analyzed within 12 h. In these samples Total leucocytes count (TLC), Differential leucocyte count (DLC), Total erythrocyte count (TEC), packed cell volume (PCV), mean corpuscular haemoglobin (MCH) pictogram (pg), mean corpuscular volume (MCV) and mean corpuscular haemoglobin concentration (MCHC) were observed.

The control values of Haematological parameters of goats were Total leucocytes count (TLC) – (4-12 x 10³/cumm), Differential leucocyte count (DLC) Lymphocytes percentage - (50-70%), Neutrophils percentage - (30-48%), Eosinophils percentage - (1-8%), Monocytes percentage -(0-4%) and Basophils percentage (0-1%), Total erythrocyte count (TEC) - (8-17 million/ml), packed cell volume (PCV)- (23-39%), mean corpuscular haemoglobin (MCH) - (5-8 pg), mean corpuscular volume (MCV)- (15-26 fl) and Mean corpuscular haemoglobin concentration (MCHC)- 30-35 gm/dl.

Results

The results of Haematological parameters of fascioliasis in household and slaughter house goats in rainy season are summarized in table- 4 and figure8-13.

Rainy Season

1. Total leucocytes count (TLC)

The TLC values of infected goats found increased as compare to control. The TLC values of infected house hold goats were 16, 15.9, 15, 13.5 & 14.2 (10³/cumm) at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum TLC value was 16 x 10³/cumm was found at Dakachya and the minimum TLC value 13.5 x 10³/cumm was found at Mhow. The TLC values of infected slaughter house goats were 16.7, 16, 15.5, 14.5 & 13.7 x 10³/cumm at

Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum TLC value 16.7 x 10³/cumm was found at Dakachya and the minimum TLC value 13.7 x 10³/cumm was found at Rao.

2. Differential leucocyte count (DLC)

A. Lymphocytes

The lymphocytes values found decreased in infected goats as compare to control. The lymphocytes values of infected house hold goats were 47.8, 48.1, 48.2, 48.7 & 48.3% at Dakachya, Mangalya, Sanwer, Mhow and Rao respectively. The maximum lymphocytes value 48.7% was found at Mhow and the minimum lymphocytes value 47.8% was found at Dakachya. The Lymphocytes values of infected slaughter house goats were 47.5, 47.9, 48.3, 48.1 & 48.5% at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum lymphocytes value 48.5% was found at Mhow and the minimum lymphocytes value 47.5% was found at Dakachya.

B. Neutrophils

The Neutrophils values found fluctuated in infected goats as compare to control. The Neutrophils values of infected house hold goats were 34.9, 36, 34.3, 35.3% & 35.4% at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum neutrophils value 36% was found at Mangalya and the minimum Neutrophils value 34.3% was found at Sanwer. The Neutrophils values of infected slaughter house goats were 34.1, 35.3, 34.3, 35.2 & 36.5% at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum neutrophils value 36.5% was found at Rao and the minimum neutrophils value 34.1% was found at Dakachya.

C. Eosinophils

The Eosinophils values found increased in infected goats as compare to control. The Eosinophils values of infected house hold goats were 13.3, 12.9, 12.7, 11 & 12.8% at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum Eosinophils value 13.3% was found at Dakachya and the minimum Eosinophils value 11% was found at Mhow. The Eosinophils values of infected slaughter house goats were 13.5, 13, 12.9, 12 & 11.2% at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum Eosinophils value 13.5% was found at Dakachya and the minimum Eosinophils value 11.2% was found at Rao.

D. Monocytes

The Monocytes values found fluctuated in infected goats as compare to control. The Monocytes values of infected house hold goats were 3, 2, 3.8, 4 & 2.9% at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum lymphocytes value 4% was found at Mhow and the minimum lymphocytes value 2% was found at Mangalya. The Monocytes values of infected slaughter house goats were 3.9, 2.9, 3.9, 3.8 & 3% at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum monocytes value 3.9% was found at Sanwer and the minimum monocytes value 2.9% was found at Mangalya.

E. Basophils

The Basophils values found fluctuated in infected goats as compare to control. The Basophils values of infected house hold goats were 1, 1, 0.9, 1 & 0.8% at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum Basophils value 1% was found at Dakachya, Mangalya, Rao

and the minimum Basophils value 0.8% was found at Rao. The Basophils values of infected slaughter house goats were 1, 0.9, 0.7, 0.9 & 1% at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum Basophils value 1% was found at Dakachya, Rao and the minimum Basophils value 0.7% was found at Sanwer.

3. Total erythrocyte count (TEC)

The TEC values found decreased in infected goats as compare to control. The TEC values of infected house hold goats were 6.4, 6.6, 6.8, 7.8 & 6.6 (million/ml) at Dakachya, Mangalya, Sanwer, Mhow and Rao respectively. The maximum TEC value 7.8 million/cumm was found at Mhow and the minimum TEC value 6.4 million/cumm was found at Dakachya. The TEC values of infected slaughter house goats were 6.2, 6.4, 6.6, 6.5 & 7.6 million/ml at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum TEC value 7.6 million/cumm was found at Rao and the minimum TEC value 6.2 million/cumm was found at Dakachya.

4. Packed cell volume (PCV)

The PCV values found decreased in infected goats as compare to control. The PCV values of infected house hold goats were 19.5, 20.1, 20.5, 21.5 & 20.9% at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum PCV value 21.5% was found at Mhow and the minimum PCV value 19.5% was found at Dakachya. The PCV values of infected slaughter house goats 19.4, 19.9, 20.3, 20.5 & 21.3% at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum PCV value 21.3% was found at Rao and the minimum PCV value 19.4% was found at Dakachya.

5. Mean corpuscular haemoglobin (MCH)

The MCH values found increased in infected goats as compare to control. The MCH values of infected house hold goats were 15.9, 15.7, 14.6, 13.6 & 14.1pg at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum MCH value 15.9pg was found at Dakachya and the minimum MCH value 13.6 pg was found at Mhow. The MCH values of infected slaughter house goats 16.1, 15.8, 14.8, 14.3 & 13.8 pg at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum MCH value 16.1pg was found at Dakachya and the minimum MCH value 13.8 pg was found at Rao.

6. Mean corpuscular volume (MCV)

The MCV values found increased in infected goats as compare to control. The MCV values of infected house hold goats were 29.3, 28.9, 28.3, 27.1 & 28.3 fl at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum MCV value 29.3 fl was found at Dakachya and the minimum MCV value 27.1 fl was found at Mhow. The MCV values of infected slaughter house goats 29.5, 29, 28.5, 27.9 & 27.2 fl at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum MCV value 29.5 fl was found at Dakachya and the minimum MCV value 27.2 fl was found at Rao.

7. Mean corpuscular haemoglobin concentration (MCHC)

The MCHC values found decreased in infected goats as compare to control. The MCHC values of infected house hold goats were 28.8, 29.1, 29.3, 29.9 & 29.5 gm/dl at

Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum MCHC value was 29.9 gm/dl found at Mhow and the minimum MCHC value was 28.8 gm/dl found at Dakachya. The MCHC values of infected slaughter house goats 28.7, 28.9, 29.1, 29.3 & 29.6 gm/dl at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum MCHC value 29.6 gm/dl was found at Rao and the minimum MCHC value 28.7 gm/dl was found at Dakachya.

Winter Season

The results of Haematological parameters of fascioliasis in household and slaughter house goats in winter season are summarized in table- 4 and figure- 10, 11.

1. Total leucocytes count (TLC)

The TLC values of infected goats found increased as compare to control. The TLC values of infected house hold goats were 15.8, 15.5, 14.9, 14.9 & 13.9 x 10³/cumm at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum TLC value 15.8 x 10³/cumm was found at Dakachya and the minimum TLC value 13.9 x 10³/cumm was found at Rao. The TLC values of infected slaughter house goats were 16.5, 15.8, 15.2, 14.3 & 13.5 x 10³/cumm at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum TLC value was found at Dakachya 16.5 x 10³/cumm and the minimum TLC value was found at Rao 13.5 x 10³/cumm.

2. Differential leucocyte count (DLC)

A. Lymphocytes

The lymphocytes values found decreased in infected goats as compare to control. The Lymphocytes values of infected house hold goats were 47.9, 48.3, 48.5, 48.5 & 48.8% at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. Maximum lymphocytes value 48.8% was found at Rao and the minimum lymphocytes value 47.9% was found at Dakachya. The Lymphocytes values of infected slaughter house goats were 47.8, 48, 48.3, 48.2 & 48.7% at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum lymphocytes value 48.7% was found at Rao and the minimum lymphocytes value 47.8% was found at Dakachya.

B. Neutrophils percentage

The Neutrophils values found fluctuated in infected goats as compare to control. The Neutrophils values of infected house hold goats were 34.2, 35.2, 34.6, 34.3 & 35.5% at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum neutrophils value 35.5% was found at Rao and the minimum neutrophils value 34.2% was found at Dakachya. The Neutrophils values of infected slaughter house goats were 34.2, 35.1, 34.3, 35.5 & 36.6% at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum neutrophils value 36.6% was found at Rao and the minimum neutrophils value 34.1% was found at Dakachya.

C. Eosinophils percentage

The Eosinophils values found increased in infected goats as compare to control. The Eosinophils values of infected house hold goats were 13.1, 12.7, 12.3, 12.3 & 10.8% at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum eosinophils value 13.1% was found at Dakachya and the minimum eosinophils value 10.8% was found at Rao. The Eosinophils values of infected slaughter house goats

were 13.3, 12.9, 12.7, 11.8 & 10.9% at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum eosinophils value 13.3% was found at Dakachya and the minimum eosinophils value 10.9% was found at Rao.

D. Monocytes percentage

The Monocytes values found fluctuated in infected goats as compare to control. The Monocytes values of infected house hold goats were 4, 3, 3.6, 3.9 & 3.8% at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum lymphocytes value 4% was found at Dakachya and the minimum lymphocytes value 3% was found at Mangalya. The Monocytes values of infected slaughter house goats were 3.8, 3, 3.8, 3.7 & 3.1% at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum monocytes value 3.8% was found at Dakachya, Sanwer and the minimum monocytes value 3% was found at Mangalya.

E. Basophils percentage

The Basophils values found fluctuated in infected goats as compare to control. The Basophils values of infected house hold goats were 0.8, 0.8, 1, 1 & 0.9% at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum basophils value 1% was found at Sanwer, Mhow and the minimum basophils value 0.8% was found at Dakachya, Mangalya. The Basophils values of infected slaughter house goats were 0.9, 1, 0.8, 0.8 & 0.7% at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum basophils value 1% was found at Mangalya and the minimum basophils value 0.7% was found at Rao.

3. Total erythrocyte count (TEC)

The TEC values found decreased in infected goats as compare to control. The TEC values of infected house hold goats were 6.6, 6.8, 7.1, 7.1 & 7.8 million/ml at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum TEC value 7.8 million/cumm was found at Rao and the minimum TEC value 6.6 million/cumm was found at Dakachya. The TEC values of infected slaughter house goats were 6.4, 6.5, 6.6, 6.7 & 7.2 million/ml at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum TEC value 7.2 million/cumm was found at Rao and the minimum TEC value 6.4 million/cumm was found at Dakachya.

4. Packed cell volume (PCV)

The PCV values found decreased in infected goats as compare to control. The PCV values of infected house hold goats were 19.7, 20.2, 20.7, 21.1 & 21.4% at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum PCV value 21.4% was found at Rao and the minimum PCV value 19.7% was found at Dakachya. The PCV values of infected slaughter house goats were 19.5, 20, 20.4, 20.6 & 21.4% at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum PCV value 21.4% was found at Rao and the minimum PCV value 19.5% was found at Dakachya.

5. Mean corpuscular haemoglobin (MCH)

The MCH values found increased in infected goats as compare to control. The MCH values of infected house hold goats were 15.7, 15.6, 14.4, 13.9 & 13.4 at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum MCH value 15.7pg was found at Dakachya and

the minimum MCH value 13.4 pg was found at Rao. The MCH values of infected slaughter house goats 15.9, 15.6, 14.5, 14.5 & 13.7pg at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum MCH value 15.9pg was found at Dakachya and the minimum MCH value 13.7pg was found at Rao.

6. Mean corpuscular volume (MCV)

The MCH values found increased in infected goats as compare to control. The MCV values of infected house hold goats were 29.1, 28.7, 28.1, 28.1 & 26.9 fl at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum MCV value 29.1fl was found at Dakachya and the minimum MCV value 26.9fl was found at Rao. The MCV values of infected slaughter house goats 29.3, 28.9, 28.3, 27.7 & 27 fl at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum MCV value 29.3 fl was found at Dakachya and the minimum MCV value was 27 fl found at Rao.

..... to control. The MCHC values of infected house hold goats were 28.9, 29.3, 29.6, 29.6 & 29.8 gm/dl at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum MCHC value 29.8 gm/dl was found at Rao and the minimum MCHC value 28.9 gm/dl was found at Dakachya. The MCHC values of infected slaughter house goats 28.8, 29, 29.2, 29.5 & 29.7 gm/dl at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum MCHC value 29.7 gm/dl was found at Rao and the minimum MCHC value 28.8 gm/dl was found at Dakachya.

Summer Season

The results of Haematological parameters of fascioliasis in household and slaughter house goats in summer season are summarized in table- 4 and figure- 12, 13.

1. Total leucocytes count (TLC)

The TLC values of infected goats found increased as compare to control. The TLC values of infected house hold goats were 15.4, 15.2, 15, 14.7 & 13.7 x 10³/cumm at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum TLC value 15.4 x 10³/cumm was found at Dakachya and the minimum TLC value 13.7 x 10³/cumm was found at Rao. The TLC values of infected slaughter house goats were 15.8, 14.9, 14.5, 14.1 & 13.3 x 10³/cumm at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum TLC value 15.8 x 10³/cumm was found at Dakachya and the minimum TLC value 13.3 x 10³/cumm was found at Rao.

2. Differential leucocyte count (DLC)

A. Lymphocytes percentage

The Lymphocytes values found decreased in infected goats as compare to control. The Lymphocytes values of infected house hold goats were 48, 48.6, 48.6, 48.7 & 48.8% at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. Maximum lymphocytes value 48.8% was found at Rao and the minimum lymphocytes value 48% was found at Dakachya. The Lymphocytes values of infected slaughter house goats were 48, 48.2, 48.4, 48.3 & 48.8% at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum lymphocytes value 48.8% was found at Rao and the minimum lymphocytes value 48% was found at Dakachya.

B. Neutrophils percentage

The Neutrophils values found fluctuated in infected goats as compare to control. The Neutrophils values of infected house hold goats were 34.4, 35.2, 35, 34.5 & 36% at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum neutrophils value 36% was found at Rao and the minimum neutrophils value 34.4% was found at Dakachya. The Neutrophils values of infected slaughter house goats were 34.1, 34.6, 34.9, 36.7 & 36.8% at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum neutrophils value 36.7% was found at Rao and the minimum neutrophils value 34.1% was found at Dakachya.

C. Eosinophils percentage

The Eosinophils values found increased in infected goats as compare to control. The Eosinophils values of infected house hold goats were 12.8, 12.2, 12.2, 11.9 & 10.4% at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum eosinophils value 12.8% was found at Dakachya and the minimum eosinophils value 10.4% was found at Rao. The Eosinophils values of infected slaughter house goats were 13, 12.5, 12.6, 11.2 & 10.4% at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum eosinophils value 13% was found at Dakachya and the minimum eosinophils value 10.4% was found at Rao.

D. Monocytes percentage

The Monocytes values found fluctuated in infected goats as compare to control. The Monocytes values of infected house hold goats were 3.9, 3.5, 3.2, 4 & 3.9% at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum lymphocytes value 4% was found at Mhow and the minimum lymphocytes value 3.2% was found at Sanwer. The Monocytes values of infected slaughter house goats were 3.9, 3.8, 4, 3.8 & 3.5% at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum monocytes value 3.9% was found at Dakachya and the minimum monocytes value 3.5% was found at Rao.

E. Basophils percentage

The Basophils values found fluctuated in infected goats as compare to control. The Basophils values of infected house hold goats were 0.9, 0.5, 1, 0.9 & 0.9% at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum Basophils value 1% was found at Sanwer and the minimum Basophils value 0.5% was found at Dakachya, Mangalya. The Basophils values of infected slaughter house goats were 0.9, 1, 0.8, 0.8 & 0.7% at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum basophils value 1% was found at Mangalya and the minimum basophils value 0.7% was found at Rao.

3. Total erythrocyte count (TEC)

The TEC values found decreased in infected goats as compare to control. The TEC values of infected house hold goats were 6.8, 7, 7, 7.2, & 7.6 million/ml at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum TEC value 7.6 million/cumm was found at Rao and the minimum TEC value 6.8 million/cumm was found at Dakachya. The TEC values of infected slaughter house goats were 6.5, 6.6, 6.7, 6.9 & 7.4 million/ml at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum TEC value 7.4 million/cumm was found at Rao

and the minimum TEC value 6.5 million/cumm was found at Dakachya.

4. Packed cell volume (PCV)

The PCV values found decreased in infected goats as compare to control. The PCV values of infected house hold goats were 19.8, 20.5, 20.5, 21.3 & 21.8% at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum PCV value 21.8% was found at Rao and the minimum PCV value 19.8% was found at Dakachya. The PCV values of infected slaughter house goats 19.7, 20.2, 20.6, 20.9 & 21.6% at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum PCV value 21.6% was found at Rao and the minimum PCV value 19.7% was found at Dakachya.

5. Mean corpuscular haemoglobin (MCH)

The MCH values found increased in infected goats as compare to control. The MCH values of infected house hold goats were 15.1, 14.7, 14.2, 13.4 & 12.9 at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum MCH value 15.1pg was found at Dakachya and the minimum MCH value 12.9 pg was found at Rao. The MCH values of infected slaughter house goats 15.6, 15, 14.4, 14 & 13.1 pg at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum MCH value 15.6pg was found at Dakachya and the minimum MCH value 13.1 pg was found at Rao.

6. Mean corpuscular volume (MCV)

The MCV values found increased in infected goats as compare to control. The MCV values of infected house hold goats were 28.9, 28.3, 28.3, 27.8 & 26.1 fl at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum MCV value 28.9 fl was found at Dakachya and the minimum MCV value 26.1 fl was found at Rao. The MCV values of infected slaughter house goats 29, 28.5, 27.9, 27.1 & 26.9 fl at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum MCV value 29 fl was found at Dakachya and the minimum MCV value 26.9 fl was found at Rao.

7. Mean corpuscular haemoglobin concentration (MCHC)

The MCHC values found decreased in infected goats as compare to control. The MCHC values of infected house hold goats were 29, 29.4, 29.5, 29.7 & 29.9 gm/dl at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum MCHC value 29.9 gm/dl was found at Rao and the minimum MCHC value 29 gm/dl was found at Dakachya. The MCHC values of infected slaughter house goats 28.9, 29.1, 29.3, 29.6 & 29.8 gm/dl at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum MCHC value 29.8 gm/dl was found at Rao and the minimum MCHC value 28.9 gm/dl was found at Dakachya. In all three seasons TEC, Lymphocytes, PCV and MCHC value was decreased as compared to control value. TLC, Eosinophiles, MCH and MCV value was increased as compared to control value. Neutrophile, Basophile and Monocytes fluctuated as compared to control value in house hold and slaughter house goats. Haematological values highly altered in rainy season then winter and followed by summer season.

Table 4: Haematological parameters of fascioliasis in household and slaughter house goats of Indore regions.

Seasons	Parametrs	Household											Slaughter house										
		TLC (x 10 ³ /cumm)	DLC					TEC (Million/ cummm)	PCV(%)	MCH (pg)	MCV(fl)	MCHC (g/dl)	TLC (x 10 ³ /cumm)	DLC					TEC (Million/ cummm)	PCV(%)	MCH (pg)	MCV(fl)	MCHC (g/dl)
L%	N%		E%	M%	B%	L%	N%							E%	M%	B%							
Rainy Seasons	Control	4-12	50-70	30-48	1-8	0-4	0-1	8-17	23-39	5-8	15-26	30-35	4-12	50-70	30-48	1-8	0-4	0-1	8-17	23-39	5-8	15-26	30-35
	Dakachya	16.0	47.8	34.9	13.3	3	1	6.4	19.5	15.9	29.3	28.8	16.7	47.5	34.1	13.5	3.9	1	6.2	19.4	16.1	29.5	28.7
	Mangalya	15.9	48.1	36	12.9	2	1	6.6	20.1	15.7	28.9	29.1	16	47.9	35.3	13	2.9	0.9	6.4	19.9	15.8	29	28.9
	Sanwer	15.0	48.2	34.3	12.7	3.8	0.9	6.8	20.5	14.6	28.3	29.3	15.5	48.3	34.3	12.9	3.9	0.7	6.6	20.3	14.8	28.5	29.1
	Mhow	13.5	48.7	35.3	11	4	1	7.8	21.5	13.6	27.1	29.9	14.5	48.1	35.2	12	3.8	0.9	6.5	20.5	14.3	27.9	29.3
	Rao	14.2	48.3	35.4	12.8	2.9	0.8	6.6	20.9	14.1	28.3	29.5	13.7	48.5	36.5	11.2	3	1	7.6	21.3	13.8	27.2	29.6
Winter Seasons	Control	4-12	50-70	30-48	1-8	0-4	0-1	8-17	23-39	5-8	15-26	30-35	4-12	50-70	30-48	1-8	0-4	0-1	8-17	23-39	5-8	15-26	30-35
	Dakachya	15.8	47.9	34.2	13.1	4	0.8	6.6	19.7	15.7	29.1	28.9	16.5	47.8	34.2	13.3	3.8	0.9	6.4	19.5	15.9	29.3	28.8
	Mangalya	15.5	48.3	35.2	12.7	3	0.8	6.8	20.2	15.6	28.7	29.3	15.8	48.0	35.1	12.9	3	1	6.5	20.0	15.6	28.9	29.0
	Sanwer	14.9	48.5	34.6	12.3	3.6	1	7.1	20.7	14.4	28.1	29.6	15.2	48.3	34.3	12.7	3.8	0.8	6.6	20.4	14.5	28.3	29.2
	Mhow	14.9	48.5	34.3	12.3	3.9	1	7.1	21.1	13.9	28.1	29.6	14.3	48.2	35.5	11.8	3.7	0.8	6.7	20.6	14.5	27.7	29.5
	Rao	13.9	48.8	35.5	10.8	3.8	0.9	7.8	21.4	13.4	26.9	29.8	13.5	48.7	36.6	10.9	3.1	0.7	7.2	21.4	13.7	27.0	29.7
Summer Seasons	Control	4-12	50-70	30-48	1-8	0-4	0-1	8-17	23-39	5-8	15-26	30-35	4-12	50-70	30-48	1-8	0-4	0-1	8-17	23-39	5-8	15-26	30-35
	Dakachya	15.4	48.0	34.4	12.8	3.9	0.9	6.8	19.8	15.1	28.9	29	15.8	48.0	34.1	13.0	3.9	1	6.5	19.7	15.6	29.0	28.9
	Mangalya	15.2	48.6	35.2	12.2	3.5	0.5	7.0	20.5	14.7	28.3	29.4	14.9	48.2	34.6	12.5	3.8	0.9	6.6	20.2	15.0	28.5	29.1
	Sanwer	15.0	48.6	35	12.2	3.2	1.0	7.0	20.5	14.2	28.3	29.5	14.5	48.4	34.9	12.0	4	0.7	6.7	20.6	14.4	27.9	29.3
	Mhow	14.7	48.7	34.5	11.9	4	0.9	7.2	21.3	13.4	27.8	29.7	14.1	48.3	36.7	11.2	3.8	0.9	6.9	20.9	14.0	27.1	29.6
	Rao	13.7	48.8	36	10.4	3.9	0.9	7.6	21.8	12.9	26.1	29.9	13.3	48.8	36.8	10.1	3.5	0.8	7.4	21.6	13.1	26.9	29.8

* The each value was mean of 10 experiments.

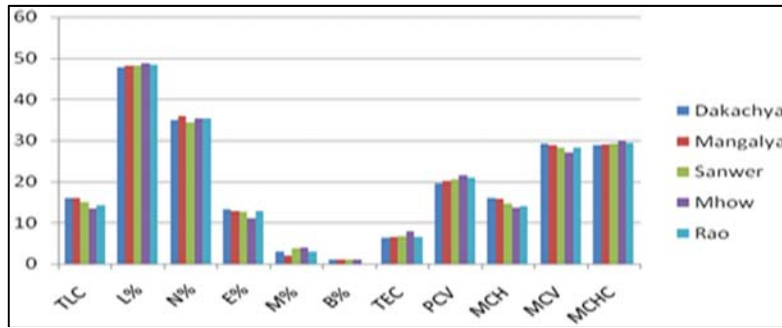


Fig 8: Haematological parameters of fascioliasis in household goats of Indore regions during rainy season.

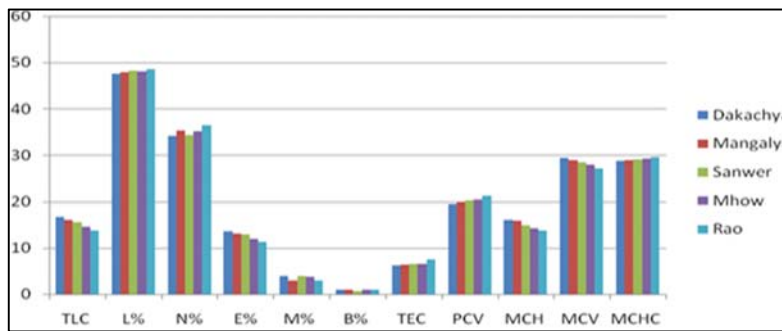


Fig 9: Haematological parameters of fascioliasis in slaughter house goats of Indore regions during rainy season.

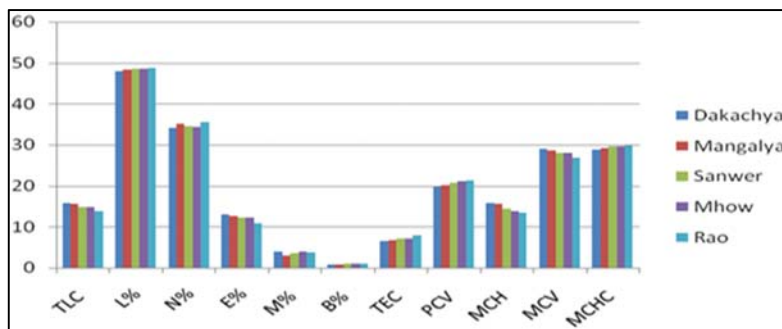


Fig 10: Haematological parameters of fascioliasis in household goats of Indore regions during winter season.

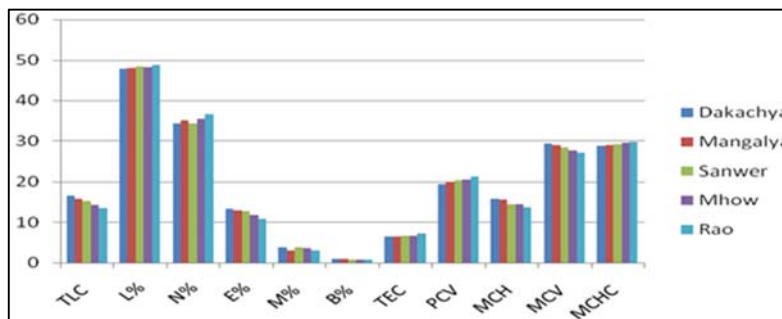


Fig 11: Haematological parameters of fascioliasis in slaughter house goats of Indore regions during winter season.

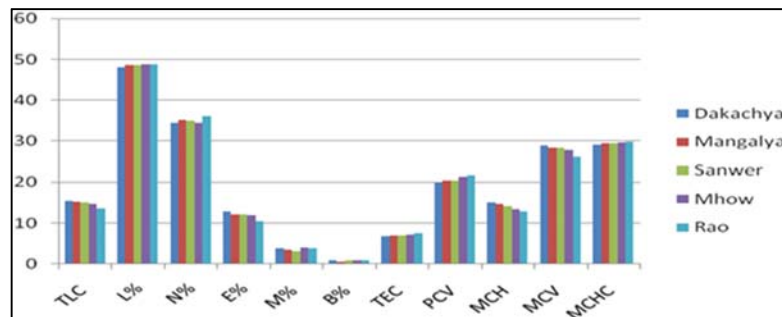


Fig 12: Haematological parameters of fascioliasis in household goats of Indore regions during summer season.

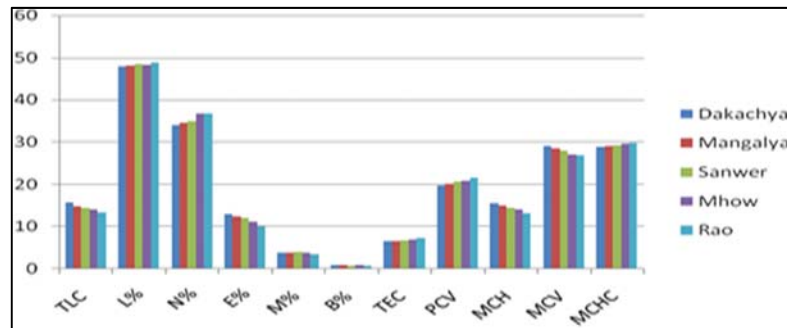


Fig 13: Haematological parameters of fascioliasis in slaughter house goats of Indore regions during summer season.

Discussion

Fasciolosis is very important disease in India and outside because it causes heavy loss in milk production and put animal under stress condition. In the present study we encountered anaemia, low pack cell volume and increased total leucocyte counts in infected animals compared to non-infected animals. The results of haematological alteration in infected goats with Fasciolosis are summarized in table -4 and figure 8, 9, 10, 11, 12 and 13.

In all three season TEC, Lymphocytes, PCV and MCHC value was decreased as compared to control value. TLC, Eosinophiles, MCH and MCV value was increased as compared to control value. Neutrophile, Basophile and Monocytes fluctuated as compared to control value in house hold and slaughter house goats. Haematological values highly altered in rainy season then winter and followed by summer season.

Similar findings were observed by Taimur *et al.* (1993) [31] who documented total decline of TEC Value, PCV volume as compared control and they observed higher eosinophil and lower lymphocyte count in fasciola infected cattle in comparison with the non-infested animals.

It is evident that control group had higher total erythrocyte, and PCV comparing with infected goats. These findings are resemble to those of Jagpreet Singh *et al.* (2013) [13], Al-Emarah *et al.* (2012) [2], Rahman *et al.* (2009) [25], Ghanem *et al.* (2005) [9], Howlader *et al.* (2004) [11], Das and Prasad (2004) [6], Ogunrinade and Bomgboxe (1980) [24], Mohsin *et al.* (1991) [21] who reported significantly ($P < 0.01$) decreased values of total erythrocyte, and packed cell volume in *Fasciola gigantica* infected cattle. Vishe *et al.* (2012) [33], recorded a pronounced reduction in the values of haemoglobin, packed cell volume, total erythrocyte count. A decrease TEC, Hb and PCV is an indication of severe anaemia whereas increased total leukocyte is an indication of severe parasitic larva burden in different orualis which probably caused marked eosinophilia.

The present findings of hematological activity of infected group clearly indicate that the migration of metacercariae through hepatic parenchyma causes deleterious effects on host physiology. Associated changes in total erythrocyte count. *Fasciola hepatica* infection revealed significantly lower erythrocyte count MCHC and PCV% which indicated anaemia Martina and Jozica (2012) [18], Bostelman *et al.* (2000) [4] and Muroshkin *et al.* (1964) [23].

In the present study, leukocytosis and eosinophilia were similar to those previously reported (Zhang *et al.*, 2005; Sykes *et al.*, 1980; Sinclair 1967) [35, 30, 28]. Zhang *et al.* (2005) [35] observed no significant change in neutrophil counts in infected sheep and goat whereas our results showed fluctuation neutrophil counts compared to non-infected sheep

and goat. The increased number of WBCs in the present study was similar to those previously reported by Ahmed *et al.* (2006) [1], Zhang *et al.* (2005) [35] and Sykes *et al.* (1980) [30].

It was observed that high significant decrease existed in the PCV, and MCHC of *Fasciola* infected cattle when compared with those of the control, there by indicating a normochromic and normocytic anaemia. The results for PCV and MCHC are similar to those found by Molina *et al.* (2006) [22] in cattle, while the results for RBC and Hb were similar to those reported by Haroun and Hussein (1975) [10] in cattle and by Doaa *et al.* (2007) [7], El-Aziz *et al.* (2002) [8] and Waweru *et al.* (1999) in sheep. Matanović *et al.* (2007) and Ahmed *et al.* (2006) [1] had similar observations in PCV and MCHC in sheep/goat with fascioliasis. Also, Sykes *et al.* (1980) [30] found significantly lower PCV and MCHC together with higher MCV and MCH during chronic subclinical fascioliasis in sheep/ goat. The reduction in MCHC and PCV in this study may be attributed to the acute loss of blood caused by the flukes or extensive loss of blood into bile duct due to the large amounts of flukes present in the liver. Kaneko *et al.* (1997) [14], Kramer (2000) [15] and Lotfy *et al.* (2003) [17] also reported that the severe anaemia may be due to a chronic liver inflammation, which causes depression of erythropoiesis.

We recommend that the Health regulatory agencies should establish and run modern veterinary infrastructure with adequate medications to control liver fluke gastrointestinal parasites. Animal breeders should be enlightened on the appropriate breeding methods to adopt, application of proper sanitation, effect of malnutrition, etc.

The overall higher incidence of heminths infection in the areas surveyed could be attributed to lower immunity of hosts as a result of malnutrition. All the livestock in the area under investigation largely depended on grazing in deteriorated range-lands. It was also observed that farms in these areas lack fences and cattle, sheep and goats use the same pasture for grazing.

Reference

1. Ahmed MI, Ambali AG, Baba SS. Hematological and biochemical responses of Balami sheep to experimental *Fasciola gigantica* infection. J Food Agric Environ. 2006; 4(2):71-74.
2. Al-Emarah, Khudor MH, Daham HR. Biochemical Changes in calves naturally infected with *Toxocara vitulorum* Ind. J of Anim Sci. 2012; 82(10):1142-1145.
3. Bhuyan MA. A survey of helminths parasitising the livers of domesticated ruminants in East Pakistan. M.Sc. (Vet. Sc.) Thesis, East Pakistan Agricultural University, Mymensingh. 1970.

4. Bostelmann SCW, Luz E, Soccol VT, Cirio SM. Hepatopathology of infection by *Fasciola hepatica* in cattle, buffaloes and sheep. *Arch. Vet. Sci.* 2000; 5:95-100.
5. Brar RS, Sandu HS, Singh A. *Veterinary Clinical Diagnosis by Laboratory Methods*. 1st edn. Kalyani Publishers. New Dehli, 2004, 28-30.
6. Das M, Prasad KD. Haematological observations in *G. ni* eniatode infected and anthelmintic treated goats. *J Res Birsa-Agril Uni.* 2004; 16(2):329-331.
7. Doaa FT, Soliman EK, Abd EL- Khalek TMM. Effect of Fascioliasis on hematological, serum biochemical and histopathological changes in sheep. *Egyptian J. Sheep Goat Sci.* 2007; 2(2):15-34.
8. El-Aziz MZA, Emara SA, Salem FS. Clinicopathological studies on fascioliasis among sheep in Giza province. *Egyptian J Vet Sci.* 2002; 36:75-86.
9. Ghanem MM, Abd El-Raof YM. Clinal and haematobiochemical studies on lamb coccidiosis. *Benha Vet Med J.* 2005; 16(2).
10. Haroun EM, Hussein MF. Clinico-pathological studies on naturally-occurring bovine fascioliasis in the Sudan. *J Helminthol.* 1975; 49(3):143-52.
11. Howlader MMR, Begum S, Islam KN, Hat MA, Hossain MG. Further observations on the packed cell volume and haemoglobin concentration in cattle naturally infected with *Fasciola gigantica*. *Bang. J Vet Med.* 2004; 2(2):125-127.
12. Hussein AA, Khalifa RMA. Development and hatching mechanism of *Fasciola* eggs, light and scanning electron microscope. *Saudi. Journal of Biological Science.* 2009, 10-1016.
13. Jagpreet Singh SA, Hussain MG. Etiology and Haematobiochemical alterations in Cattle of Jammu suffering from anaemia. *Veterinary WJ.* 2013; 7(2):49-51.
14. Kaneko JJ, Harvey JW, Bruss ML. *Clinical Biochemistry of Domestic Animals*. 5th Ed., Academic Press. London. 1997.
15. Kramer JW. Normal hematology of cattle, sheep and goats. In: Feldman BF, Zinkl JG and Jain NC (Eds) *Schalm's Veterinary Haematology*, 5th ed. Lippincott Williams and Wilkins, Philadelphia. 2000, 1075-1084.
16. Lebbie SHB, Rey B, Irungu EK. Small ruminant research and development in Africa, Proceedings of the Second Biennial Conference of the African Small Ruminant Research Network, ILCA 1994, 1-5.
17. Lotfy HS, Mahmoud SM, Abdel-Gawad MA. Some studies on Fascioliasis in Mid-Egypt. *Agric. Res.* 2003; 81(2):209-227.
18. Martina Klinkon, Jozica Jezek. Values of Blood Variables in Calves, A Bird's-Eye View of Veterinary Medicine, Dr. Carlos C. Perez-Marin (Ed.), ISBN: 978-953-51-0031-7. 2012.
19. Mas-Coma S, Bargues MD, Valero MA. Fascioliasis and other plant-borne Trematodes Zoonoses. *Int J Parasitology.* 2005; 35:1255-1278.
20. Matanović K, Severin K, Martinković F, Šimpraga M, Janicki Z, Barišić J. Hematological and biochemical changes in organically farmed sheep naturally infected with *Fasciola hepatica*. *J Parasitol Res.* 2007; 101(6):1463-1731.
21. Mohsin M, Rahman M, Das PM, Haque AKMF. Haematological observations in cattle naturally infected with *F. gigantica*. *Bang. Vet.* 1991; 8:31-34.
22. Molina EC, Lozano SP, Barraca AP. The relationship between haematological indices, serum gamma-glutamyl transferase and glutamate dehydrogenase, visual hepatic damage and worm burden in cattle infected with *Fasciola gigantica*. *J Helminthol.* 2006; 80(3):277-279.
23. Muroshkin BF, Kostina AA, Ivanskff BF, Styagain YS. formation in calves experimentally infected with *Fasciola*. *Ph Wrhn T Ou, Moscow.* 1964; 41(10):41-42.
24. Ogunrinade AE, Bamgbie EA. *Haematological* indices and their correlation with worm burden in chronic fascioliasis. *Bri Vet J.* 1980; 136(5):457-462.
25. Rahman M, Mostofa Jahan MS, Kamal MA HM. Comparative efficacy of Neem leaves and Ivermectin (Ivomec®) against ectoparasites in calves *J Bangladesh Agril Univ.* 2009; 7(1):73-78, ISSN 1810-3030.
26. Rondelaud D, Vignoles P, Abrous M, Dreyfuss G. The definitive and intermediate hosts of *Fasciola hepatica* in the natural watercress beds in central France. *Parasitol. Res.* 2001; 87:475-478.
27. Sampaio-Silva ML, Da Costa JM, Da Costa AM, Pires MA, Lopes SA, Castro AM *et al.* Antigenic components of excretory-secretory products of adult *Fasciola hepatica* recognized in human infections. *Am. J Trop Med Hyg.* 1996; 54:146-148.
28. Sinclair KB. The anemia in fascioliasis: experiments with Cr51 labeled red cells. *Vet Rec.* 1967; 80:363.
29. Soulsby EJ. *Parasitology Enfermedades Parasitarias*, seventh ed., Interamericana, Mexico D.F., Mexico. 1987, 40-44, 235-236.
30. Sykes AR, Coop RL, Rushton B. Chronic subclinical fascioliasis in sheep: effects on food intake, food utilisation and blood constituents. *Res Vet Sci* 1980, 28:63-70.
31. Taimur M, Halder A, Chowdhury S, Akhter N, Islam M, Kamal A *et al.* Hematological studies on cattle exposed to *Fasciola gigantica* infestation. *Asian-Australasian J Anim Sci.* 1993; 6:301-303.
32. Vercauteren J, Claerebout E. Treatment vs. non-treatment of helminth infections in cattle: defining the threshold. *Vet. Parasitol.* 2001; 98:195-214.
33. Vishe Pawar K, Gupta HK, Rao GS. Prevalence and hemato biochemical studies in parasitic and non parasitic dermatological disorders in Surti buffalo and buffalo calves *Vet. World.* 2012; 5(4):230-235.
34. Waweru JG, Kanyari PWN, Mwangi DM, Ngatia TA, Nansen P. Comparative parasitological and haematological changes in two breeds of sheep infected with *Fasciola gigantica*. *Trop. Anim. Health Prod.* 1999; 31:363-372.
35. Zhang ZWY, Moreau E, Hope JC, Howard CJ, Huang WY, Chauvin A. *Fasciola hepatica* and *Fasciola gigantica*: comparison of cellular response to experimental infection in sheep. *Exp Parasitol.* 2005; 111:154-59.