Studies on Biochemical alteration in *Fasciola hepatica* infected Capra hircus (goats)

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**ABSTRACT**

The present study was aimed with study the biochemical 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 without evacuated EDTA tubes and stored at 4°C. Samples were analyzed within 12 h. In Serum samples were stored at - 20°C until the biochemical analysis Total protein, Blood glucose, ALT (Alanine Aminotransferase test) or SGPT (Serum glutamic pyruvic transaminase) and Serum bilirubin were observed. In all three season Total protein and Blood glucose value was decreased as compared to control value. ALT (Alanine Aminotransferase test) or SGPT (Serum glutamic pyruvic transaminase) and Serum bilirubin value was increased as compared to control value in house hold and slaughter house goats. Biochemical values highly altered in rainy season then winter and followed by summer season.

**Keywords:** Fascioliasis, Capra hircus (Goat), serum biochemical, Total protein, Blood glucose, ALT and SGPT.

**INTRODUCTION**

Fasciolosis is a common disease of domestic ruminants with important implications for animal health and welfare and farming economics. In sheep production, the disease causes severe losses because of reduced growth and productivity, immune suppression, and death of heavily infected animals [1-2].

Since the liver is the main metabolic organ of the body, infection of the hepatocytes is an essential feature of certain parasitic infections. In fascioliasis, the metabolic processes of the liver [3] and kidney are gradually reduced. Hepatic and renal functions can be assessed using biochemical tests such as blood glucose, creatinine, urea, serum proteins, and serum lipids, while the activity of certain serum enzymes such as AST, ALT and ALP, which increase following hepatic injury, can be measured [4]. These enzymes have a predominantly intracellular action and thus, under normal conditions, the serum enzyme activity is very low or absent; any increase in their activity would be evidence of damage in the tissues in which they are lodged [5].

The aim of present study was to compare biochemical 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 fascioliosis is not endemic. 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 without evacuated EDTA tubes and stored at 4°C. Samples were analyzed within 12 h.

Preparation of serum
About 5-6 ml of blood was collected in the sterile glass test tubes. The blood containing tubes were placed in a slanting position at room temperature for 6 hours. The tubes were then incubated over night in the refrigerator (4°C). The serum samples were separated and centrifuged to get rid of unwanted blood cells. Serum samples were stored at - 20°C until the biochemical analysis was done in diagnostic laboratory at Indore.

Biochemical parameters
The Biochemical parameters viz. Total protein, Blood glucose, ALT (SGPT) and Serum bilirubin were studied. Biochemical parameters were analyzed [6].

RESULTS AND DISCUSSION

In the present study we investigated the biochemical parameters such Total protein, Blood glucose, ALT (Alanine Aminotransferase test) or SGPT (Serum glutamic pyruvic transaminase) and Serum bilirubin in Fasciola hepatica infected goats and compare with non-infected goat. The result of present studies summarized in Table: -1 and fig.: 1-6.

The control (non-infected) value of biochemical parameters were Total protein - 6-7.5 (g/dl), Blood glucose - 48.2-76 (mg/dl), ALT (SGPT) - 15.3-25.3 (IU/L) and Serum bilirubin- 0.1-0.2 (mg/dl).

Rainy Season
Total protein
The total protein values found decreased in infected goats as compare to control. The total protein values of infected house hold goats were 3.6, 4.0, 4.3, 4.6 and 4.4 (g/dl) at Dakachya, Mangalya, Sanwer, Mhow and Rao respectively. The maximum total protein value 4.6 (g/dl) was found at Mhow and the minimum total protein value 3.6 (g/dl) was found at Dakachya. The total protein values of infected slaughter house goats were 3.3, 3.7, 4.0, 4.1 and 4.2 (g/dl) at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum total protein value 4.2 (g/dl) was found at Rao and the minimum total protein value 3.3 (g/dl) was found at Dakachya.

Blood glucose
The Blood glucose values found decreased in infected goats as compare to control. The Blood glucose values of infected house hold goats were 31.3, 33.9, 34.6, 36.7 and 35.2 (mg/dl) at Dakachya, Mangalya, Sanwer, Mhow and Rao.
Rao respectively. The maximum Blood glucose value 36.7 (mg/dl) was found at Mhow and the minimum Blood glucose value 31.3 (mg/dl) was found at Dakachya. The Blood glucose value of infected slaughter house goats were 30.9, 33.6, 34.3, 34.9 and 36.4 (mg/dl) at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum Blood glucose value 36.4 (mg/dl) was found at Rao and the minimum Blood glucose value 30.9 (mg/dl) was found at Dakachya.

ALT (Alanine Aminotransferase test) or SGPT (Serum glutamic pyruvic transaminase)
The ALT values found increased in infected goats as compare to control. The ALT values of infected house hold goats were 54.4, 54.0, 53.6, 53.0 and 53.4 (IU/L) at Dakachya, Mangalya, Sanwer, Mhow and Rao respectively. The maximum ALT value 54.4 (IU/L) was found at Dakachya and the minimum ALT value 53.0 (IU/L) was found at Mhow. The ALT values of infected slaughter house goats were 54.7, 54.3, 53.9, 53.7 and 53.3 (IU/L) at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum ALT value 54.7 (IU/L) was found at Dakachya and the minimum ALT value 53.3 (IU/L) was found at Rao.

Serum bilirubin
The Serum bilirubin values found increased in infected goats as compare to control. The Serum bilirubin values of infected house hold goats were 1.4, 1.3, 1.2, 0.9 and 1.1 (mg/dl) at Dakachya, Mangalya, Sanwer, Mhow and Rao respectively. The maximum Serum bilirubin value 1.4 (mg/dl) was found at Dakachya and the minimum Serum bilirubin value 0.9 (mg/dl) was found at Mhow. The Serum bilirubin values of infected slaughter house goats were 1.6, 1.4, 1.3, 1.1 and 1.0 (mg/dl) at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum Serum bilirubin value 1.6 (mg/dl) was found at Dakachya and the minimum Serum bilirubin value 1.0 (mg/dl) was found at Rao.

Winter Season
Total protein
The total protein values found decreased in infected goats as compare to control. The total protein values of infected house hold goats were 3.8, 4.2, 4.5, 4.6 and 4.7 (g/dl) at Dakachya, Mangalya, Sanwer, Mhow and Rao respectively. The maximum total protein value 4.7 (g/dl) was found at Rao and the minimum total protein value 3.8 (g/dl) was found at Dakachya. The total protein values of infected slaughter house goats were 3.5, 3.9, 4.2, 4.3 and 4.4 (g/dl) at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum total protein value 4.4 (g/dl) was found at Rao and the minimum total protein value 3.5 (g/dl) was found at Dakachya.

Blood glucose
The Blood glucose values found decreased in infected goats as compare to control. The Blood glucose values of infected house hold goats were 31.0, 33.0, 34.2, 35.0 and 36.4 (mg/dl) at Dakachya, Mangalya, Sanwer, Mhow and Rao respectively. The maximum Blood glucose value 36.4 (mg/dl) was found at Rao and the minimum Blood glucose value 31.0 (mg/dl) was found at Dakachya. The Blood glucose value of infected slaughter house goats were 30.5, 33.3, 33.9, 34.6 and 36.1 (mg/dl) at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum Blood glucose value 36.1 (mg/dl) was found at Rao and the minimum Blood glucose value 30.5 (mg/dl) was found at Dakachya.

ALT (Alanine Aminotransferase test) or SGPT (Serum glutamic pyruvic transaminase)
The ALT values found increased in infected goats as compare to control. The ALT values of infected house hold goats were 54.1, 53.6, 53.4, 53.2 and 52.8 (IU/L) at Dakachya, Mangalya, Sanwer, Mhow and Rao respectively. The maximum ALT value 54.1 (IU/L) was found at Dakachya and the minimum ALT value 52.8 (IU/L) was found at Rao. The ALT values of infected slaughter house goats were 54.4, 54.0, 53.6, 53.5 and 53.0 (IU/L) at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum ALT value 54.4 (IU/L) was found at Dakachya and the minimum ALT value 53.0 (IU/L) was found at Rao.

Serum bilirubin
The Serum bilirubin values found increased in infected goats as compare to control. The Serum bilirubin values of infected house hold goats were 1.3, 1.2, 1.1, 1.1 and 0.8 (mg/dl) at Dakachya, Mangalya, Sanwer, Mhow and Rao respectively. The maximum Serum bilirubin value 1.3 (mg/dl) was found at Dakachya and the minimum Serum bilirubin value 0.8 (mg/dl) was found at Rao. The Serum bilirubin values of infected slaughter house goats were 1.4, 1.3, 1.2, 1.1 and 0.9 (mg/dl) at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum Serum
The total protein values found decreased in infected goats as compare to control. The total protein values of infected household goats were 4.0, 4.4, 4.7, 4.9 and 5.0 (g/dl) at Dakachya, Mangalya, Sanwer, Mhow and Rao respectively. The maximum total protein value 5.0 (g/dl) was found at Rao and the minimum total protein value 4.0 (g/dl) was found at Dakachya. The total protein values of infected slaughter house goats were 3.7, 4.1, 4.4, 4.6, and 4.7 (g/dl) at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum total protein value 4.7 (g/dl) was found at Rao and the minimum total protein value 3.7 (g/dl) was found at Dakachya.

**Blood glucose**

The Blood glucose values found decreased in infected goats as compare to control. The Blood glucose values of infected household goats were 30.9, 32.9, 34.0, 34.9 and 36.3 (mg/dl) at Dakachya, Mangalya, Sanwer, Mhow and Rao respectively. The maximum Blood glucose value 36.3 (mg/dl) was found at Rao and the minimum Blood glucose value 30.9 (mg/dl) was found at Dakachya. The Blood glucose value of infected slaughter house goats were 30.8, 33.5, 34.2, 34.6 and 36.2 (mg/dl) at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum Blood glucose value 36.2 (mg/dl) was found at Rao and the minimum Blood glucose value 30.8 (mg/dl) was found at Dakachya.

**ALT (Alanine Aminotransferase test) or SGPT (Serum glutamic pyruvic transaminase)**

The ALT values found increased in infected goats as compare to control. The ALT values of infected household goats were 53.9, 53.5, 53.1, 52.9 and 52.5 (IU/L) at Dakachya, Mangalya, Sanwer, Mhow and Rao respectively. The maximum ALT value 53.9 (IU/L) was found at Dakachya and the minimum ALT value 52.5 (IU/L) was found at Rao. The ALT values of infected slaughter house goats were 54.1, 53.8, 53.4, 53.2 and 52.8 (IU/L) at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum ALT value 54.1 (IU/L) was found at Dakachya and the minimum ALT value 52.8 (IU/L) was found at Rao.

**Serum bilirubin**

The Serum bilirubin values found increased in infected goats as compare to control. The Serum bilirubin values of infected household goats were 1.2, 1.1, 1.0, 1.0 and 0.7 (mg/dl) at Dakachya, Mangalya, Sanwer, Mhow and Rao respectively. The maximum Serum bilirubin value 1.2 (mg/dl) was found at Dakachya and the minimum Serum bilirubin value 0.7 (mg/dl) was found at Rao. The Serum bilirubin values of infected slaughter house goats were 1.3, 1.2, 1.1, 1.0 and 0.8 (mg/dl) at Dakachya, Mangalya, Sanwer, Mhow and Rao, respectively. The maximum Serum bilirubin value 1.3 (mg/dl) was found at Dakachya and the minimum Serum bilirubin value 0.8 (mg/dl) was found at Rao.
In all three seasons Total protein and Blood glucose value was decreased as compared to control value. ALT (SGPT) and Serum bilirubin value was increased as compared to control value in house hold and slaughter house goats. Biochemical values highly altered in rainy season then winter and followed by summer season.

Figure - 2: Biochemical parameters of fascioliasis in slaughter house goats of Indore regions during rainy season.
Figure - 3: Biochemical parameters of fascioliasis in household goats of Indore regions during winter season.

Figure - 4: Biochemical parameters of fascioliasis in slaughter house goats of Indore regions during winter season.

Figure - 5: Biochemical parameters of fascioliasis in household goats of Indore regions during summer season.
DISCUSSION

Fascioliasis is disease caused by a trematode that invades the hepatic parenchyma and bile ducts of ruminants and other mammals, causing significant economic losses such as mortalities, low production of meat, milk and wool as well as reduced weight gain and impaired fertility [7].

In the present study we investigated the biochemical parameters such Total protein, Blood glucose, ALT (SGPT) and Serum bilirubin in Fasciola hepatica infected goats and compare with non-infected goat. The result of present studies summarized in Table-5 and fig. 14-19.

In the present study mean of total protein value in different pathological conditioned were found to be lower than the normal range (6 to 7.5 g/dl) (6). The similar findings were reported by Jain [8]. Fascioliasis was found to produce hypoproteinaemia and hypoalbuminaemia. Total serum protein and albumin were significantly lower (p<0.05) in infected groups than the control and continued to decrease with increase in worm burden. This agrees with the report of Anderson who found hypoalbuminaemia in infected cattle [9]. Similarly, Vengust observed decrease in serum total protein and albumin in fallow deer infected with F. hepatica [10]. Hypoalbuminaemia may be due to the reduced albumin synthesis caused by liver damage [11]. This produces cholangitis, biliary obstruction, destruction and fibrosis of hepatic tissue and anaemia [12]. Hypoproteinaemia is due to severe infection of the liver, which produced destruction of liver parenchyma resulting in drastic alteration in protein values [13].

The present study reveal slightly decreased mean values of blood glucose in different pathological conditions in the liver of goat from the normal mean value [6]. This similar finding was reported by Roy [17] and Okoye [18]. Ferre[19] reported decrease in plasma glucose values from 40 day post infection in lambs infected with F. hepatica. It was due to depression in voluntary feed intake and hepaticglycogenic pathways [20]. The hypoglycaemia may be due to the disturbance in gluconeogenesis, which resulted from hepatic disorder [21]; elevation of the ketone bodies from gastroenteritis could result in depression in blood glucose [22].

The present investigations showed increased ALT (SGPT) mean value in pathological conditions of liver with the normal mean value given by Brar [6]. In toxic hepatitis and neoplasm the values increased significantly. The similar finding was reported by [8, 23].
Serum transaminases values of present findings are very much similar to Martina [24] who reported that the AST and ALT level of adult cattle increase chiefly by cell necrosis. The present findings are also similar to [25-30] who found an increase SGOT and SGPT level in Black Bengal goats infected with gastrointestinal helminths. Bulum and Mengi [30] reported that AST, ALT level of cattle affected with fascioliasis were significantly higher than ill healthy cattle.

Liver enzymes assay in the present study indicated that serum ALT and levels were significantly elevated (p< 0.05) in the infected group. Ferre [19] observed the same elevation in ALT of infected cattle which was indicated as a reflection of liver parenchymal damage denoting the migratory phase of infection. Takemoto [31] reported significant higher activities of AST, ALT and ALP in Fasciola infected monkeys than in the control and suggested that the increase in AST and ALT was due to the damaging activities of the migrating immature flukes while the increase in ALP activities indicated penetration of the flukes into the bile ducts. The elevation in serum enzymatic activities may also be attributed to the degenerative changes and cirrhosis of the liver cells and enlargement of gall bladder. Moreover, the cellular changes from parasitism increase the permeability of the hepatic cells and in turn result in the release of the enzymes into the serum. In a similar report, El- Aziz [32] detected significant elevations in the activities of serum AST, ALT and ALP in Fasciola infected sheep and Ahmed[33] reported an increase of AST levels 2 weeks post-infection, synchronizing with the migratory phase of juvenile flukes in the liver parenchyma and a significant elevation in serum ALP activity 6 weeks post-infection, which they claimed have reflected changes in liver and bone function. Since ALP is known to be excreted via the bile duct, its elevation may have synchronized with the arrival of the flukes to the bile duct. In all, liver damage is the most important cause of increase in serum enzymes activities in infected animals [34]. So it is clear that the elevations in serum AST, ALT and ALP activities were sensitive indicators of hepatic cell damage and hepatic dysfunction in fascioliasis [10,33] and that the hepatic damage was hepatobiliary.

The present study reveals increased mean value of serum bilirubin in different pathological conditions than the normal range given by Brar et al. [6]. There were significant increase in serum bilirubin were found in the case of toxic hepatitis, fascioliasis. The similar findings were reported by Roy et al. [17] and Benjamin et al. [23].

The present findings are consistent with those found by Pathak and Gaur [35] who showed a significant increase in enzyme levels in infected goats with C. tenuicollis. Doaa et al. [3] showed that levels of liver enzymes, total bilirubin, gammaglobulins and creatinine were increased in serum of infected sheep with Fasciola hepatica. Matanovic et al. [13] reported similar results in infected cattle with Fasciola gigantica.

Pal and Dasgupta [36] also encountered hypoproteinaemia, hypoalbuminaemia, hyperglobulinemia, increased levels of total serum bilirubin, AST, ALT and ALP level. Raval et al. [37] and Swarup and Pachauri [38] also reported higher values of AST, ALT and total bilirubin which were in agreement with the present findings.

The bilirubin level in infected non-treated group [GP, 2] revealed that the total bilirubin was significantly increased till the end of the experiment. The hyperbilirubinemia occurred as a result of an increased production rate of the bilirubin either from increase catabolism of cytochrom P450 which represents a high percentage of the total heme synthesized in the liver [48 Mayer et al. [39]and from an increased erythrocyte degradation due to hematophagia by the flukes. Our results agree with Lopez et al. [40] who studied the effect of experimental fascioliasis on the bilirubin metabolism in rats.

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.

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