5.1. Prevalence of Helminth Parasites

It is a well understood fact that epidemiology forms the foundation on which the edifice of the control of parasitic diseases can be constructed. The present limited studies on the prevalence of the helminth parasites of sheep in Kashmir valley proves significant (p<0.05) difference between the exotic and native breeds. In the present study results showed that exotic breeds are more susceptible to helminth parasites as low worm burden was observed in native breeds compared to exotic breeds. The observation that native breeds of sheep are more resistant to helminth parasites than exotic breeds indicates that resistance to the parasites is genetically determined (Gray et al., 1992; Bisst et al., 1994). Charleston (1965) observed some breeds of sheep are more resistant to *Haemonchus contortus* than other, indicating that resistance to the parasites is genetically determined. Sanad and Al-Megrin (2005) observed high infection rate among imported sheep compared to local. Genetic resistance in sheep to helminth parasites is mediated by an immune response and is based on the recognition of parasite antigens by the major histocompatibility complex (MHC) and stimulation of CD^3^ T-lymphocytes. This stimulation leads to a cascade of events culminating in the genesis of mastocytosis, tissue and blood eosinophilia and in the production of specific antibodies (Gill et al., 2000) which inturn impairs the establishment and fecundity of the helminths. The parasitological survey of the present study has shown that nematodes show highest prevalence (68%) followed by cestodes (31.01%) and trematodes (28.98%).

The incidence of the cestode infection recorded in the present study was higher as compared to the trematode infection which is against the findings of Hirani et al., (1999) and Pal et al., (2001) who reported lowest incidence of
cestode parasites compared to nematodes and trematodes in Jurat and Chattisgrah (as cited by Pandit et al., 2004). Results of the present investigation showed higher prevalence of trematode and cestode parasites in older animals. Effect of age on the prevalence of fluke infections have been earlier studied by Choudhary et al., (1994) and Tamloorker et al., (2002). The results of the present study are largely in agreement with the results of earlier reports. Grazing of adult animals under feral conditions in the study area and around marshy lands increase the chance of snail borne fluke infections. Similar observations were made by Castelino and Preston (1979) in cattle infected with *Fasciola gigantica* in Kenya.

The observations on the incidence of *Fasciola* spp. does not confirm the findings of Sharma et al., (1989) who reported 51.3% of sheep infected with *Fasciola* spp. in Kashmir valley. Makhdoomi et al., (1995) reported 0.05% incidence of amphistomes and 1.38% *Fasciola* spp. in sheep from Kashmir valley. Khajura and Kapoor (2003) reported 12.48% of *Dicrocelium* spp. and 1.5% of amphistome spp. in sheep from Kathua of Jammu province, whereas, in the present study the prevalence of *Fasciola* spp., *D. dendriticum* and amphistome was 33.88%, 4.45% and 2.71% respectively. This difference in the prevalence of helminth parasites in two different geographical areas of the state of J & K is attributed to most conducive climatic conditions for the breeding of snails and development of larval stages of flukes similar to that described by Pandit et al., (1989). The highest incidence of trematode and cestode parasites observed during summer and autumn months is attributed to the fact that temperature slowly starts rising above 20°C which is a favorable temperature for larval development in the secondary hosts. Navaspur and Prokopie (1979) found that temperature variation affected the development of *Monezia expansa* in Oribatid mite. The life cycle was completed in 27 days at 28°C while as it took 97
days at 18°C to 20°C. This suggests that temperature above 20°C is favourable for the development of Oribatid mite which in turn determines the percentage of cestode infection in sheep. Our results are largely in agreement with the findings of Phiri et al., (2005) and Rauf et al., (2005) who observed highest prevalence of flukes and cestodes in warmer months. The trematode and cestode prevalence in sheep was found equally affected by environmental factors with a significant degree of correlation. Rainfall, humidity and minimum temperature had a significant positive relationship with fluke population, while maximum temperature and bright sunshine hours had significant negative relationship. Bright sunshine and maximum temperature cause evaporation faster and whatever the thin film of water is existing on vegetation may get dried off; hence survival of cercaria may be affected. Rainfall helps in creating the breeding places for snails, hence it helps in increasing the fluke prevalence.

In the present study, *Haemonchus contortus* was found to be the most prevalent nematode parasites of sheep in Kashmir valley. Similar observations were made by Waruiru et al., (2005) in small ruminants. Throughout the investigation this parasite represented more than 30% of the total faecal egg counts. Two waves of peak infections were observed during the course of study. First peak wave of infection was observed in the month of May. This wave of infection was apparently derived from eggs deposited by animals in early spring (March) and over wintered larvae on the pastures grazed by infected animals in previous summer and autumn. These over wintered larvae remain viable up to the next month. The second peak wave of infection appeared in the month of August. The second wave of infection is attributed to eggs deposited by the first generation of infection. During the months of autumn, the animals migrate back to subhilly areas where they pick up infection while grazing in the paddy fields.
The epidemiological pattern of this study is similar to that described for other temperate areas, such as Newzealand (Brunsdson 1980). The low prevalence of nematode infection observed in the summer months is because of the fact that sheep migrate to up hills in late spring where chances of reinfection remains less.

The present investigation showed highest prevalence of trematode and cestode parasites in above 4 years of age group while as 0-2 year age group was found to have highest prevalence of nematode parasites. Similar observations have been made by Castelino and Preston (1979) and Tamlookar et al. (2002). This may be attributed to less availability of larval stages due to low temperatures, longer and indirect life cycle of trematodes and cestodes. The highest prevalence of nematode parasites in 0-2 year age group is attributed to undeveloped protective immune response and availability of infected pastures throughout year. The low prevalence in aged animals may reflect the development of host resistance and possibly difference in the number of infective larvae ingested. The increased variation among older animals is in consistent with our understanding of protective immune responses in sheep.

5.2. Histopathology

Parasitism is known to affect the host animal in at least two ways. The first effect induces a loss of appetite in the host, which reduces pasture consumption compared to the parasite free animal. The second major effect of parasitism is the reduction in the metabolic efficiency of the host which decreases nutrient available for maintenance and growth (Louie et al., 2007). The pathogenicity of a particular parasite population depends on the parasite load and site of infection. The heavier the infection the more dramatic is the effect, although there are both lower and upper threshold limits. However, in the field
many different factors contribute to determine the clinical outcome of a parasitic infection. Age and previous parasite experience increase resistance to infection in most of the animal species. It is also generally accepted that the nutrition of the animal affects its overall response to the infection, either by affecting the rate of establishment of the parasite or modifying the effects of the infection. Resistance to infection is often reduced by stressful conditions.

Fascioliasis is caused by *Fasciola hepatica* and *Fasciola gigantica* in all herbivores. Disease due to parasitism with *Fasciola* species is classified either as acute fascioliasis caused by migration of a large number of juvenile flukes and chronic fascioliasis due to adult flukes. Shiria *et al.* (2006) classified degree of pathological changes in bile ducts caused by fascioliasis into five levels.

*Fasciola hepatica* flukes were primarily observed in bile duct of the host and the number of flukes observed in the infected livers depended on the size of bile duct. The number of flukes recovered varied and was related to age of the host. The juvenile and adult flukes were observed in hepatic parenchyma and bile duct respectively. Similar observations were made by Ashizawa (1963; 1964a, b); Dow *et al.* (1967, 1968) and Rahko (1969) in sheep and goats. The hepatic lesions observed in the infected livers were in accordance with the observations of Dow *et al.* (1967), who described hepatic lesions in sheep experimentally infected with *Fasciola hepatica*. The liver injury observed in the present study is attributed to the mechanical damage caused by the spiny tegument of parasite during its migration. The liver damage might be induced by the proteases and other tissue degrading enzymes secreted by parasites. Similar conclusions were made by Gajewska *et al.* (2005) in *Fasciola hepatica* infected animals. Fibrotic tissues observed in *Fasciola* infected livers were similar to those described by Shirai (1963, 2005); Ross (1965) and Alim *et al.* (1998) (references cited by
More prominent fibrotic tissues observed in the left lobe are considered to be related to the fact that the changes to the left lobe are readily detected by fibrotic changes on the visceral surface. Hyperplasia of hepatic epithelium is frequently seen and may result from the high protein excretion by the parasite (Isserofy 1977, cited by Shirai et al., 2006). Tsochevagayj and Zhieva (2005) described hyperplasia only in acute cases and isolated the tumor inhibitor compounds in chronic cases of fascioliasis. Bile ducts varied in thickness, became rod shaped as they lost their branches and resemble a dead tree in regions where atrophic fibrosis were noted. Similar observations were made by Daito (1952; cited by Shirai et al., 2006) in Clonorchis sinensis infected rabbits. Marked atrophy of portal veins, irregular thickness with occasional nodular dilation and marked decrease in small branches noted in the infected liver were similar to those described by Tanaca (Daito) in Fasciola infected rabbits.

In the present study the mucosa of naturally infected abomasae was significantly heavier corresponding to the uninfected control. The heavier abomasal mucosa was primarily due to mucous cell hyperplasia. Mucosal hyperplasia of abomasae is attributed to Haemonchosis and Ostertagiasis. Mucosal hyperplasia in Ostertagia infected lambs was largely confined to the vicinity of parasitized glands which appeared macroscopically as nodules. Hyperplasia within nodules affects the full mucosal thickness, the mature secretory cells of the gastric glands, the pepsinogen-producing chief cells and acid secreting cells, being replaced by a population of immature cells phenotypically closer in appearance to mucous cells. In contrast, Haemonchus contortus larvae emerge from the gastric glands at the fourth larval stage, 2-3 days after gland penetration and thereafter ambulatory over the abomasal surface.
(Charleston, 1965; Nicholls *et al.*, 1985; cited by Scott *et al.*, 1998). In haemonchosis, hyperplasia is therefore generalized and is thought to occur only in the more superficial layers of the epithelium, so that parietal and chief cell membranes are not necessarily affected (by Scott *et al.*, 1998). Mucosal damage in *Ostertagia circumcincta* and *Haemonchus contortus* infected abomasae is attributed to inflammatory reaction in the abomasal mucosae. The abomasal damage was more prominent in *Ostertagia circumcincta* infected sheep. Mechanical damage to the abomasa is attributed to the emergence of adult worms from the gastric gland which disturbs the physiological process of abomasum. Plasma pepsinogen and pH levels were significantly elevated in sheep infected with *Ostertagia circumcincta* and *Haemonchus contortus*. This is attributed to the damage of HCl producing cells caused by the emergence of L4 larvae, altering the integrity of the epithelium and allowing for the leakage of macromolecules. Damage to these HCl producing cells must have resulted in the increased plasma pepsinogen concentration. Pepsinogen is inactive and is converted into active pepsin by HCl. Since HCl concentration decreases due to infection therefore pepsinogen gets accumulated. Our results are in accordance with the findings of Mapes and Coop, 1970; Nickolls *et al.*, 1988 and Simpson *et al.*, 1997; references cited by Scott *et al.*, 1998) and Merkelbach (2000), who observed increased concentrations of plasma pepsinogen and elevated abomasal pH in *Haemonchus contortus* infected abomasae.

Pathological changes due to *Paramphistomum* were observed in small intestines and little bit in rumen. Pathological changes varied with fluke burden, from a local enteritis and villous atrophy in duodenum in light infections to severe destruction of the mucosa extending into most part of the jejunum in heavy infections. In heavy infections of *Paramphistomum*, extensive thickening
and fibroplasiasis in the mucosa and submucosa characterized the pathological changes. In very heavy infections, severe damage to the mucosa of rumen characterized by infiltration of phagocytic cells was observed. No pathological alterations were observed in light infections of adult *Paramphistomum*. Histologically there was extensive hemorrhagic inflammation of duodenum and jejunum with destruction of intestinal glands and degeneration of associated lymph nodes. Very minute migratory tracks were observed with infiltrated macrophages and lymphocytes. Similar observations were made by Singh *et al.* (1984) in sheep experimentally infected with *Paramphistomum cervi*.

The histopathological examination of duodenum collected from the naturally infected sheep with *Moneizia* and *Stilesia* species showed proliferation of lining cells with the shortening and flattening of intestinal villi similar to that described by Baruah *et al.* (2002). The mucosal and submucosal layers were thickened due to mild to diffuse infiltration of mononuclear cells. Thickening of mucosa and submucosa layers is attributed to oedema and hyperplasia. Similar findings were observed by other workers in small ruminants infected with other cestodes (Amjadi 1971 and Baruah *et al.* 2002). The cavities observed in mucosa of small intestines are attributed to pressure atrophy caused by mature proglottids.

5.3. Haematology

The present study revealed a marked reduction in haematocrit, haemoglobin and RBC counts which confirmed the observations of early workers Misra *et al.*, (1996) who observed decreased values of haematocrit, haemoglobin and RBC counts in lambs in relation to nematode and *Paramohistomum* infection. The decreased RBC counts, Hb and PCV values in infected animals
may be attributed to the bleeding of abomasae due to injuries caused by the abomasal parasites similar to that described by Ansari and Ahmed (1989), Abdel Ali (1992) and Ahmad et al., (2006). However, marked blood loss in the infected animals is to be attributed to the blood sucking activities of Haemonchus contortus. Decreased leucocyte counts observed in the present study might be due to the blood loss in the gut. Eosinophilia and increased lymphocyte counts observed in present investigation is in agreement with the findings of Ackerman et al., (1981); Bhat and Sharma (1990) and Murean et al., (2005) who concluded that eosinophilia is associated with antigenic stimulation or parasitic burden. Increased lymphocyte counts might be due to proliferation of lymphocytes due to antigenic excretory secretory product of helminth parasites. Significant increase (p<0.05) in lymphocytes in naturally and experimentally infected animals over uninfected control was however unlike to that reported by Sharma et al., (2005), who described a decline in the lymphocyte and eosinophil counts in infected animals.

5.4. Biochemistry

Biochemical parameters are likely to change due to various disease conditions. Alterations in the biochemical parameters indicate some disruptive activities in the organ of their origin or altered membrane permeability. Decline in total serum proteins observed in infected animals opposed to control animals was similar to Sharma et al., (2001, 2005); Ahmed et al., (2006) and Padmaja et al. (2006), who described decrease in the total serum protein values in sheep haemonchosis. Decrease in total serum proteins observed in the present study may be attributed to haemodilution, a compensatory mechanism for the gut haemorrhages caused by the invading larvae and later on due to loss of large quantities of serum proteins into gut and consequent increased fractional
catabolic rate of albumin. Similar observations were made by Vaughan et al., (2006) in sheep infected with mixed infection of *Trichostrongylus columbriformis* and *Teladorsagia circumcincta*. No remarkable difference was observed in blood glucose, between infected and uninfected animals. However, significant difference was observed in alkaline phosphatases (ALP), acid phosphatases (ACP) and total serum proteins (TSP). Serum enzyme concentrations are likely to change in various clinical disease conditions. The alteration in their levels in serum indicates some disruptive metabolic activities inside the body. Their level could also rise in serum due to lack of excretion or decrease due to impaired synthesis. Elevated levels of alkaline phosphatases (ALP) noticed in the present study was similar to Ahmad and Ansari (1989) who reported increased level of ALP in sheep and goats infected with *Haemonchus contortus* in natural or experimental conditions. The mean ALP observed in the present investigation was comparable to the levels reported by Sharma et al., (2001) for male and female Indian Cheghu goats. However, the present mean was quite lower than enzymatic activities recorded by McDougall et al., (1991) in Scanen goats with mixed infection. An increased level of ALP observed is attributed to damage of abomasal mucosa cells by parasites similar to that described by Hodson (1962) who reported gastrointestinal diseases such as peptic ulcers and ulcerative colitis to be responsible for release of enzymes from the affected mucosa. Significant decrease in ACP levels observed in infected group over control was however unlike to Sharma et al., (2001) who observed increased ACP level in infected animals.

5. 5. Breed Difference

In the present study results showed that the response of Kashmir Mermo and Native breeds to *Haemonchus contortus* infection was related to breed type.
as low worm burden was observed in Native breed compared to Kashmir Marino breed. The Native breed was less severely affected than the Kashmir Merino breed, as judged by haematobiochemical observations. Variation in susceptibility between different breeds of animals to *Haemonchus contortus* might be genetically determined. Charleston (1965) observed some breeds of sheep and even some individuals of the same breed are more resistant to *Haemonchus contortus* than the other, indicating that resistance to the parasites is genetically determined. Decreased values of Hb, PCV and RBC counts observed in the present study are in accordance with findings of Ahmad and Ansari (1989); Ayesha et al., (1990), who observed similar changes in sheep infected with *Haemonchus contortus*. The pathogenic alterations observed in the present study were similar to Amerante et al., (2004) and Misra et al., (1996) who worked on the gastrointestinal nematodes and *Paramphistomum* species of sheep and concluded that reduction in PCV and plasma protein values are negatively correlated with the faecal egg counts and worm burden. Decreased Hb and RBC counts may be attributed to blood sucking habit of *Haemonchus contortus* and the hemorrhages caused by parasite in mucosa and submucosa of abomasae. Significant decrease in RBC counts and Hb is attributed to greater loss of blood in Kashmiri Merino compared to Native breed due to high worm burden as assessed by faecal egg counts.

Decline in total serum proteins in infected animals opposed to control animals was similar to the observations of Raisinghani et al., (1971), Ahmad et al., (1989) and Knox et al., (1993) who described decrease in the total serum protein values in sheep Haemonchosis. Raised Plasma pepsinogen concentrations observed in the present study might be due to decline of chief cell granule content in infected animals. Prolonged, strong stimulation of pepsinogen
production and secretion could result in the direct release of pepsinogen without granule formation.

5.6. Immunological Response

The mechanism underlying immunity against helminth parasites is still not completely understood. Analysis of host immune response to helminth parasites is hampered by two main factors (i) the complexity of antigen profile of the parasites (ii) the presence of cross reactive determinants on antigens (Maizels et al., 1987; references cited by Schallig et al., 1994). To identify specific antigens, excretory-secretory products of helminth parasites have received increasing attention. This is due to the fact that excretory secretory products of helminths usually display a relatively simple antigenic composition compared to the somatic worm antigens.

Various techniques have been evaluated for diagnosis since clinical signs are variable and also not efficient. In the early period of infection, the parasites are not sexually mature and cannot release eggs, so observation of helminth eggs in faecal examination is impossible. Immunodiagnosis is an important adjuvant to clinical findings. The need for immunodiagnostic testing for helminthiasis is much greater for livestock as the livelihood of most rural people particularly Gujar and Bakerwal depends upon livestock. Various immunological techniques have been used for diagnosis of human and animal fascioliasis. Most workers today use ELISA and Immunoblots. The value of immunodiagnostic methods used for different techniques has been primarily derived from adult worm extracts or excretory-secretory products. Although some workers have used partially purified fractions for ELISA and DOT ELISA techniques.

In the present study the antigencity of excretory- secretory and somatic...
extracts of adult *Haemonchus contortus* was detected using ELISA and Ouchterlony gel diffusion test. The SDS-PAGE profile of both excretory-secretory and somatic antigens separated several polypeptides and only small number of polypeptides were found to be antigenic. The excretory-secretory products of adult *Haemonchus contortus* comprised a number of polypeptides with the molecular weight ranging from 10 to 205 KDa, however unlike that reported by Schallig *et al.* (1994) who observed 10 to 100 KDa molecular weight proteins in the excretory-secretory products. Among the polypeptides of excretory-secretory products the dominant immunogenic fractions were F3 and F6 which included 14, 15, 23, 24, 45, 46 and 66 KDa polypeptides. Our results are in accordance with the findings of Schalling *et al.* (1997) who observed protective immune response in sheep vaccinated with 14 and 25 KDa proteins. Several investigations have been attempted to characterize the immunodominant antigens in the excretory-secretory products of *Haemonchus contortus* (Derbala and Rahman 2001 and Rathore *et al.*, 2006). Similarly the dominant antigens of crude somatic extract were found in F3 and F6 which comprised 15, 18, 23, 24, 25, 26, 45, 46, 83, and 86 KDa. A variety of protective antigenic components have been identified which include 23, 26 KDa (Ines *et al.*, 2000; Dominguez-Torano *et al.*, 2003).

The immunological study demonstrated that excretory-secretory antigens of adult *Haemonchus contortus* provoke strong protective responses in sheep. The excretory-secretory products contain protein digesting enzymes which dissolve the walls of abomasae and thus are involved in the blood feeding habit of adult parasites (Knox and Jones, 1990). The proteolytic enzymes combined with excretory-secretory products circulate in the host circulatory system thus become target of this system. The results of the present study revealed that
excretory-secretory antigens proved to be better antigens than crude somatic antigen for serodiagnosis of haemonchosis. The diagnostic sensitivity of excretory-secretory antigens observed in ELISA was increased to 87.5% from 72.22% of crude somatic antigen, which was statistically significant. Increased sensitivity of ELISA using excretory-secretory antigens compared to crude somatic antigens may be attributed to strong recognition of excretory-secretory antigens by the sera of infected animals. It has been demonstrated that excretory-secretory antigens elicit strong immune response (Ogilive and Desavigny 1982; cited by Schallig et al., 1994) and may be the potential source of diagnostics (Lightowlers and Richard 1988) or protective antigens (O’Donnell et al., 1989; cited by Schallig et al., 1994). Somatic antigens have been considered poorly immunogenic compared to excretory-secretory antigens (Parkhous et al., 1987). The excretory-secretory product of *Haemonchus contortus* was found to include antigenic polypeptides of 10, 15, 16, 20, 30, 40, 46, 52, 66, 68 and 93 KDa. (Schalling et al., 1994). The 15 and 24 KDa antigenic proteins present in the excretory-secretory products could be specifically recognized by *Haemonchus contortus* primary sera (Schalling et al., 1997). Torganson and Lloyd (1993) demonstrated that *Haemonchus contortus* antigens with molecular weight less than 30 KDa present in excretory-secretory products can induce strong lymphocytic responses. This might indicate that low molecular weight excretory secretory products have protective value. The diagnostic specificity of ELISA using excretory-secretory antigens was increased to 92.02% from 76.81%. The cross reactivity of excretory secretory antigens with the sera samples of Ostertagiasis, Bunostomiasis and Trichuriasis was reduced compared to that of crude somatic antigens. This reduced cross reactivity may be attributed to high levels of 15 and 24 KDa antigenic proteins present in excretory-secretory
products which could be specifically recognized by *Haemonchus contortus* primary sera (Schalling *et al.*, 1997).

The results of ELISA revealed that *Fasciola hepatica* excretory-secretory antigens are better than crude tegumental antigens for protective immune response in sheep. This is attributed to the digestion of most polypeptides including highly immunogenic protein of adult worm by the proteases released during the homogenization process. Thus excretory-secretory antigens of *Fasciola hepatica* could be exploited for the vaccination purposes. Excretory-secretory antigens contain several polypeptides of different antigenicity. Therefore a detailed investigation should be performed on the purification and amino acid sequence analysis of highly antigenic polypeptides of adult *Fasciola hepatica* excretory-secretory antigens. Excretory-secretory antigens have more contacts with the host immune system than somatic antigens, hence could be targeted by host immune system. Since the parasites excrete the content of the intestines like cathepsin and other enzymes with histolytic activities. These enzymes degrade tissues and facilitate the invasion and migration of the parasite, and induce a stronger humoral immune response. Thus these may be useful for diagnostic purposes and also for protection against future infections (Parkhouse *et al.*, 1987).

The diagnostic sensitivity of ELISA with crude antigens was 72.29% which was significantly lower than excretory-secretary antigens (84.51%). Diagnostic specificity of ELISA with excretory secretory antigens was increased to 90.16% from 73.55% by using crude somatic antigens. Both excretory-secretory and crude homogenate antigens showed cross reactivity with the sera samples of *Dicrocoelium* infected sheep.
The preliminary observations on the purification of *Fasciola hepatica* excretory-secretory and somatic Triton X-100 homogenate antigens revealed eight and six peaks respectively using Sephadex G-200 grade. Dasgupta *et al.* (2005) observed similar peaks in G-200 profile of *Fasciola gigantica*. Somatic Triton X-100 peak fractions (FSF₆, FSF₅, and FSF₄) were found highly antigenic and could be detected upto the dilution of 1:6400. The strong reactivity of FSF₆, FSF₅ and FSF₄ fractions of the tegumental antigens is attributed to high polypeptide concentrations of low molecular weight antigens as assessed by SDS-PAGE analysis. Ruiz-Navarrete *et al.* (1993) observed 20-23 KDa molecular weight polypeptides as highly immunogenic in crude somatic extract and 23-27 KDa molecular weights in excretory-secretory products of adult *Fasciola*. So, our results are in consistent with the findings of other authors. Pfister *et al.* (1984) purified six antigenic fractions from adult *Fasciola hepatica* (three somatic tissue and three excretory products) and detected fascioliasis in sheep as early as 12 days after infection using excretory secretory purified fractions. The results of the SDS-PAGE and ELISA revealed that low molecular weight polypeptides of crude somatic and excretory-secretory antigens are highly immunodominant. Similar observations were made by Santiago *et al.* (1986), Goneic *et al.* (2004) and Megeed (2005). A variety of antigenic compounds have been identified in *Fasciola hepatica* excretory-secretory and crude antigens. The results of SDS-PAGE analysis revealed common antigens between secretory products and crude somatic antigens similar to that observed by Moazeni *et al.* (2005).