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Chronic Fascioliasis as Cause of Unthriftiness in Sheep with Reference to its Impacts on Blood Constituents

Taha A. Fouda[1*], Mohammed A. Youssef[2] and Maged R. Al-Ashkar[2]

[1]Department of Clinical Studies, College of Veterinary Medicine & Animal Resources, King Faisal University, Al-Ahsa, 31982, P.O. Box: 1757, KINGDOM OF SAUDI ARABIA
[2]Department of Internal Medicine & Infectious Diseases, College of Veterinary Medicine Mansoura University, Mansoura, EGYPT

**Corresponding Author: T A Fouda; Email: foudataha@yahoo.com*

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ABSTRACT

Ten adult sheep (2-4years of age) and eight lambs (5-12 month old), of both sexes were involved in this study. Ten apparently healthy sheep (5 adults and 5 lambs) were also used as a control group. The selected animals were presented with prominent clinical signs of progressive weight loss (in adults), underweight (in lambs), profuse watery diarrhea and edematous swelling of the intermandibular space. Blood as well as fecal and feed samples were analyzed for the selected parameters.

The obtained results for hematological values revealed significant decrease ($P<0.05$) in the total erythrocytic cell counts, hemoglobin concentration and packed cell volume in both sheep and lambs if compared with those of the apparently healthy ones. The mean values of mean corpuscular volume (MCV) were significantly increased associated with significant decrease ($P<0.05$) in mean corpuscular hemoglobin concentration (MCHC) indicating a macrocytic hypochromic anemia. Also there was significant increase ($P<0.05$) in the total leucocytic counts with marked eosinophilia in ill thrifty sheep and lambs when compared with those of the apparently healthy ones.

The obtained values for the selected biochemical parameters in blood serum values revealed a significant reduction ($P<0.05$) in the mean values of serum copper, iron, zinc, glucose, total protein and albumin in unthrifty sheep and lambs compared with those of the apparently healthy ones. Fecal examination revealed yellow brown thin walled, operculated eggs specific for fasciola species. The diseased animals were treated by using closantil at a dose rate of 1ml/10 kg Bwt S/C, there were significant improvement in the general health status of all diseased animals.

Keywords: Sheep, ill-thrift, fascioliasis, hemogram, biochemical

Unthriftiness considered to be a major problem in sheep where failure of some animals to thrive at a time when all other classes of sheep appeared to be in

satisfactory health and in good body condition. Clinically, gradual loss of body condition, some degree of diarrhea and mortalities were evident**.** A number of different diseases had been associated with this syndrome (Radostits *et al*., 2007). The authors added that nutritional deficiency diseases such as copper, iron, zinc and protein energy malnutrition, gastro-intestinal parasitism, chronic fascioliasis and chronic wasting diseases were reported as causative agents of ill-thrift.

Fascioliasis is a well-known parasitic disease, with worldwide distribution, which causes great losses in livestock production and has become an important emerging foodborn trematode infection of increasing concern (Hosseini *et al*., 2012).

Fascioliasis and other food-borne trematodiases are included in the list of important helminthiases with a great impact on human development (Mas-Coma *et al*., 2005). Chronic fascioliasis in sheep was characterized clinically by unthriftiness, reduced body weight, lethargy and intermandibular edema. Chronic fascioliasis developed slowly and was due to the activity of the adult flukes in the bile ducts, consequently cholangitis, billiary obstruction, destruction of hepatic tissues and anemia had been resulted (Dunn, 1978; Dargie and Berry, 1979; Whitelaw and Fawcett, 1981; Taylor *et al*., 1994 and Smith, 1996). Then in conclusion the overall prevalence of ovine fascioliasis indicated that it was the major factors for the reduction of livestock product and productivity of the study area and strategic deworming of the flock is better to prevent the disease (Gebreyohannes *et al*., 2013).

The chronic infected sheep lost their weight, developed submandibular edema (bottle-jaw) and pallor of the mucosa over a period of weeks (Radostits *et al*., 2007). Chronic fascioliasis was the commonest form and resulted in a progressive loss of condition due to the presence of adult flukes in the bile ducts and characterized by emaciation with typical submandibular edema and severe anemia (Dargie and Berry, 1979; Jensen and Swift, 1982). Animals infected with subacute fascioliasis usually suffered loss of body condition, and the flock as a whole showed ill thrift, a degree of lethargy, poor fleece and low body condition scores (Dunn, 1978).

In chronic fascioliasis, many sheep showed no more than ill-thrift when fluke burden were low or when adequate nutrition was available (Whitelaw and Fawcett, 1981). Infected ewes with chronic fascioliasis reduced fertility, growth rate, feed conversion, and feed intake, which lead to a reduction in efficiency and utilization of metabolized energy and reduction in calcium and protein deposition (Taylor *et al*., 1994). Moreover, Smith (1996) mentioned that the main clinical signs in sheep suffered chronic fascioliasis were emaciation, depression, weight loss, dehydration, icterus, edema and/or ascitis, anemia, rough hair coat or dry brittle wool, wool loss and either constipation or diarrhea.

Kaneko and Cornelius (1970) reported that chronic inflammation due to intestinal parasites, copper deficiency, and infectious diseases were generally associated with decrease in serum iron levels**.** While**,** Haroun and Hussein (1975) suggested that the mean values of serum iron were markedly reduced in sheep naturally infected with fascioliasis. Reduced concentrations of serum iron, copper and zinc were

recorded in sheep infected with fasciolaisis (Abdel All, 1991; Ali, 1999; El-Hetw *et al*., 1975; El Sangary, 1999).

Anderson *et al*. (1977) and Dragie (1987) reported that hypoalbuminemia and hyperglobulinemia were commonly associated with liver fluke infection in all host species. Moreover, Smith (1996) mentioned that sheep suffered from chronic fascioliasis had variable values of total serum protein with decreased albumin synthesis, increased albumin loss and elevated serum globulin levels. Non significant changes in the organic components such as urea nitrogen in the serum obtained over 14 weeks after infection by fascioliasis in sheep had been observed (Jemli *et al*., 1993). El-Sawalhy and Hassan (1996) reported that there was an increase in serum urea nitrogen in sheep suffered parasitic gastroenteritis. Several ways of treatment were applied. In a study carried out by Okaiyeto *et al*. (20011) it was observed that single injection of Ivermectin Super administered in December and a repeat treatment in April respectively when used as a protocol may effectively control the incidence of bovine fascioliasis. In addition, mechanical destruction of the intermediate hosts (snails) may be of value alongside chemotherapy.

Consequently, this study aimed at investigation of the effect of chronic fascioliasis on the body weight of sheep and its effect on both cellular and biochemical constituents of the blood.

MATERIALS AND METHODS

Animals

Ten adult sheep (2-4 years of age) and eight lambs (5-12 month old), of both sexes were involved in this study. Ten apparently healthy sheep (5 adults and 5 lambs) were also used as a control group (Table, 1). These animals were raised on free grazing throughout the daylight, and commercial concentrate diet was offered to those animals at night.

Table 1: Categorization of the selected animals.

	Diseased sheep			Control (healthy sheep)		
Animals	NO	Age	Sex	NO	Age	Sex
Adults	10	2-4 years	both sexes	5	2-4 years	both sexes
Lambs	8	5-12 months	both sexes	5	5-12 months	both sexes

Table 2: Percentage of chemical composition of commercial concentrates

Item	Unit	Group (1)	Group (2)	Group (3)
Crude protein	%	12.4	14.9	11.6
Crude fiber	%	2.41	3.2	2.1
Ash	%	2.47	13	12.22
Total digestible nutrients (TDN)	%	65	65	60
Copper	mg/kg DM	5.0	5.8	5.2
Iron	mg/kg DM	10.33	11.14	10.53
Zinc	mg/kg DM	2.44	3.2	2.76

SAMPLES, SAMPLING PROTOCOL AND METHODS ADOPTED

Blood samples

Two types of blood samples were collected from each animals through jugular vein puncture in two occasions from diseased sheep. The first samples were obtained from the diseased animals before treatment while the second samples were obtained 15 days post treatment.

The first blood samples

Five ml of blood were collected into clean, dry vacutainer tubes with 5mg sodium ethylene diamine tetra acetic acid (EDTA) as anticoagulant. These samples were used for hematological evaluation including total erythrocytic cell counts (TRBCs), total leucocytic (TWBCs) and differential leucocytic counts, hemoglobin concentration (Hb) and packed cell volume (PCV)**.** Blood cell indices mainly the mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC) were carried out using the automated cell counter.

The second blood samples

Ten ml of blood were obtained in dry, clean plain vacutainer tube without anticoagulant in order to obtain clear blood sera. Only clear, non-hemolyzed sera were transferred into clean tubes. As rapidly as possible, serum glucose level was determined (Schalm, 1986). The blood serum samples were used for biochemical analysis of the selected elements particularly, serum copper, iron, zinc, total protein, albumin and urea nitrogen. The biochemical values of blood sera for the selected parameters mainly Copper (Cu), Zinc (Zn), Iron (Fe), Glucose (Gluc), Total protein (Tp), Albumin (Alb) and Blood Urea Nitrogen (BUN) were measured spectrophotometrically using the commercial test kits supplied by Sinreactt, Centronic GmbH. Germany, Eli TEC diagnostics, Diamonds company, Boehringer Mannheim, ABC Diagnostics and Biodiagnostics, respectively according to Zak (1958), Johnson and Eliasson (1987), Callahan and Cook (1980), Weichselbaum (1946), Drupt (1972), and Patton and Crouch (1977), respectively. While globulin

was calculated by subtracting the values of serum albumin from the values of total serum proteins after Schalm (1986).

Fecal samples

Fecal samples were collected directly from the rectum, and kept in a plastic bags for parasitological examination using direct smear technique, concentrated floatation and sedimentation techniques (Kelly, 1984).

Diet samples

A random sample of the animal feed (commercial concentrate) was obtained and subjected to biochemical analysis for copper, iron and zinc as well as determination of protein, energy and fiber content of the ration according to A.O.A.C, (1990).

Statistical analysis

All data were subjected to statistical analysis using analysis of variance according to Snedecor and Cochran (1982).

Treatment

The diseases animals had received Closantil 5% at a dose rate of 1ml/10kg BW as S/C injection in two occasions with 6 weeks interval.(Shreeji Pharma)

RESULTS AND DISCUSSION

The animals under investigation showed clinical signs of progressive weight loss in adults, underweight in lambs when compared with their herd mates, profuse watery diarrhea and edematous swelling of the intermandibular space (Fig. 1 and 2). The obtained results for hematological values were summarized in Table 3 and 4. There were significant decrease in the total erythrocytic cell counts, hemoglobin concentration and packed cell volume in both sheep and lambs if compared with those of the apparently healthy ones. The mean values of MCV were significantly increased ($P<0.05$) associated with significant decrease ($P<0.05$) in MCHC indicating a macrocytic hypochromic anemia. Also there was significant increase ($P<0.05$) in the total leucocytic counts with marked eosinophilia in ill thrifty sheep and lambs when compared with those of the apparently healthy ones.

The obtained values for the selected biochemical parameters in blood serum values were tabulated in Table 5. The results revealed a significant reduction ($P<0.05$) in the mean values of serum copper, iron, zinc, glucose, total protein and albumin in unthrifty sheep and lambs compared with those of the apparently healthy ones. While there was a significant increase ($P<0.05$) in serum globulin in unthrifty sheep if compared with their values in apparently healthy ones. Non-significant ($P>0.05$)changes in serum urea nitrogen in both diseased and apparently healthy animals were also evident. The results of feed analysis were summarized in Table 2. Fecal examination revealed yellow brown thin walled, operculated eggs specific for fasciola species by sedimentation technique.

Table 3: Mean values ± SE of Hemogram profile in healthy as well as ill-thrifty sheep and lambs with chronic fascioliasis before and after treatment

Animals		RBCs x10^6	PCV %	Hb g/dl	MCV fl	MCH pg	MCHC %
Control	Adults	9.8 ±0.3 [a]	30.2 *±0.3* [a]	10.5 *±0.3* [a]	30.7 *±0.9* [a]	10.5 *±0.5* [a]	34 *±0.9* [a]
	Lambs	9.5 *±0.2* [a]	29.4 *±0.5* [a]	9.3 *±0.1* [a]	30.8 *±0.4* [a]	9.8 *±0.1* [a]	31.8 *±0.1* [a]
Diseased sheep before treatment	Adults	6.7 *±0.2* [b]	24.9 *±0.2* [b]	6.7 *±0.1* [b]	37.5 *±0.08* [a]	9.9 *±0.1* [b]	26.2 *±0.4* [b]
	Lambs	6.5 *±0.1* [b]	24 *±0.2* [b]	6.6 *±0.2* [b]	36.7 *±0.6* [b]	10.1 *±0.2* [a]	27.1 *±0.6* [b]
Diseased sheep after treatment	Adults	8.9 *±0.2* [a]	28.6 *±0.4* [b]	8.8 *±0.2* [b]	31.9 ±0.5 [b]	9.7 *±0.6* [b]	30.6 *±0.4* [b]
	Lambs	9.6 *±0.1* [a]	29.5 *±0.1* [a]	9.2 *±0.1* [a]	30.6± *0.1* [a]	9.5 *±0.7* [a]	31.2 *±0.3* [a]

The different superscript within the same column are significantly differ (P<0.05), while the same superscript within the same column are non significant (P<0.05).

Table 4: Mean values ± SE of Leucogram profile in healthy as well as ill-thrifty sheep and lambs with chronic fascioliasis before and after treatment:

Animals		TWBCs x10^3	Neutrophil %	Lymphocytes %	Eosinophils %	Basophils %	Monocytes %
Control	Adults	8.02±*0.1* [a]	50±*0.4* [a]	46.4±*0.4* [a]	0.6 [a]	0.4 [a]	0.6 [a]
	Lambs	8.4±*0.7* [a]	49.4±*0.5* [a]	48±*0.5* [a]	1±*0.4* [a]	0.6 [a]	1.0 [a]
Diseased sheep before treatment	Adults	14.8±*0.5* [b]	52.3±*0.2* [a]	39.o6±*0.4* [a]	7.7±*0.4* [b]	0.4 [a]	0.6 [a]
	Lambs	13.5±*0.05* [b]	50.3±*0.5* [a]	40.2±*0.7* [a]	8.6±*0.6* [b]	0.12 [a]	0.5 [a]
Diseased sheep after treatment	Adults	80.7±*0.6* [a]	49.9±*0.3* [a]	46.5±*0.6* [a]	2.6±0.1 [a]	0.4 [a]	0.6 [a]
	Lambs	80.2±*0.2* [a]	47.7±*0.8* [a]	49.3±*0.9* [a]	2.4±*0.2* [b]	0.8 [a]	0.2 [a]

The different superscript within the same column are significantly differ (P<0.05), while the same superscript within the same column are non significant. (P<0.05).

Table 5: Mean values ± SE of serum biochemical analysis in healthy as well as ill-thrifty sheep and lambs with chronic fascioliasis before and after treatment:

Animals		Copper µg/dl	Iron µg/dl	Zinc µg/dl	Glucose mg/dl	Total protein g/dl	Albumin g/dl	Globulin g/dl	Urea nitrogenm g/dl
Control	Adults	119.2±1.2 [a]	159.2±1.7 [a]	81.8±3.6 [a]	51.4±2.7 [a]	6.2±0.2 [a]	3.2±0.1 [a]	3.04±0.1 [a]	22.7±0.5 [a]
	Lambs	111.8±1.2 [a]	142.4±2.6 [a]	75.8±4.4 [a]	44.6±0.5 [a]	6.0±0.1 [a]	2.9±0.7 [a]	3.1±0.8 [a]	21.1±0.3 [a]
Diseased sheepbefore treatment	Adults	83.6±2.5 [b]	100.1±2.0 [b]	49.7±0.8 [b]	40.6±1.0 [b]	5.5±0.8 [b]	1.8±0.05 [b]	3.6±0.1[b]	21.6±0.4[b]
	Lambs	78.7±1.6 [b]	95±1.7 [b]	42.12±1. 7[b]	38.7±1.7 [b]	5.0±0.2 [b]	1.8±0.4 [b]	3.2±0.3 [a]	19.6±0.6[b]
Diseased sheepafter treatment	Adults	100.2±2.8 [a]	134.3±1.5 [b]	64.2±1.6 [b]	48.2±2.2 [a]	6.04±0.5 [a]	2.9±0.1 [b]	3±0.1 [b]	22.6±0.3[b]
	Lambs	94.3±2.9 [b]	110.2±1.8 [b]	58.8±1.5 [b]	40.0±0.7 [b]	5.6±0.7 [a]	2.6±0.3 [b]	3±0.6 [b]	20.6±0.1[b]

The different superscript within the same column are significantly differ (P<0.05) , while the same superscript within the same column are non significant (P<0.05).

The diseased animals were injected by closantil at a dose rate of 1ml/10 kg BW S/C, there were significant improvement in the general health status of all diseased animals proved by absence of diarrhea and increased feed intake which reflect the efficiency of treatment. The blood picture and levels of biochemical elements returned toward their normal levels fifteen days post treatment. Periodical fecal examination revealed negative results for liver flukes after seven days post treatment.

Fig. 1: Three years old ewe suffered extreme loss of body weight, unthriftiness, deteriorated body condition, rough wool coat, and persistent watery diarrhea because of chronic fascioliasis

Fig. 2: Six months old lamb suffered emaciation, reduced weight gain, easily detached wool, prostration, rough wool coat and loss of wool crimp primarily because of chronic fascioliasis

Because of its multifactorial origin, ill thrift syndrome was difficult to be diagnosed in sheep. However, the appearance of the prominent clinical signs announced the suspicious of nutritional deficiency diseases, heavy parasitic infestation or chronic wasting diseases. Most researchers on unthriftness of young sheep have aimed at understanding nutritional managerial factors that influenced growth rate.

In this study, sheep under investigation showed different degrees of unthriftiness, progressive weight loss in adults, underweight in lambs, profuse and persistent watery diarrhea, lethargy, and edematous swelling in the intermandibular space. The obtained results were in agreement with those reported by Dunn (1978), Dargie and Berry (1979), Whitelaw and Fawcett (1981), Smith (1996) and Radostits *et al*. (2007). The resultant conditions of reduced weight gain could be a result of either reduced feed conversion or anorexia (Sinclair, 1975), reduced feed conversion and feed intake with consequent reduction in efficiency and utilization of metabolizable energy and reduction of calcium and protein deposition (Taylor *et al*., 1994).

The results revealed a significant decrease ($P<0.05$) in the total erythrocytic counts, packed cell volume and hemoglobin concentration in diseased sheep if compared with their values in apparently healthy one. Our results agreed with those reported by Smith (1996) and Dalton (1999) in sheep with chronic fasciolaisis and in experimental fasciolaisis in sheep (Doaa Teleb *et al*., 2007). In this study macrocytic hypochromic anemia was evident, and this was in agreement with those previously mentioned by Dawes and Hughes (1964), Dalton (1999), Carolyn and Nicholas (1999) and Radostits *et al*. (2007). Such anemia could be attributed to the blood sucking activity by the mature flukes as the rate of blood loss was 0.2 – 0.5 ml per day per fluke was reported (Dalton, 1999), uptaking of vitamin B_{12} by the mature flukes (Obara *et al*., 1964) and blood sucking activity of the flukes and the continuous drain on iron reserves (Carolyn and Nicholas, 1999). Significant leucocytosis with marked eosinophilia was evident in diseased sheep and lambs. These results were in concern with those reported by Ross *et al*. (1966), Smith (1996), Schalm (1986) and Radostits *et al*. (2007) in sheep suffered chronic fascioliasis. Leucocytosis and eosinophilia could be attributed to the reaction and sensitivity of the host against secretory products of the parasites (Schalm, 1986).

Significant reduction ($P<0.05$) in serum copper, iron and zinc levels in unthrifty sheep when compared with those of the apparently healthy ones. These results were endorsed with those reported by Aziza (1987), Abdel All (1991) and Ali (1999) in sheep and lambs with parasitic gastroenteritis, and El-Hetw *et al*. (1975) in sheep and lambs with chronic fascioliasis. Such reduction in serum copper could be attributed to the reduction in iron level which might be due to the role of copper containing enzyme (ceruloplasmin) in the absorption of iron from the reticuloendothelial system to blood stream.

The reduction in serum copper levels could be explained by the fact that parasitic infestation led to loss of appetite with consequence of great loss in blood (Kaneko (1997).

The obtained results revealed significant reduction in serum glucose levels in unthrifty sheep compared with the values in apparently healthy ones. The reduction of blood glucose could be considered as multifactorial problem. Lewis *et al.* (1975) mentioned that hypoglycemia associated with parasitic gastroenteritis could be attributed to anorexia, decreased intestinal absorption of glucose and a low level of glucose reserve (Lewis *et al*.,1975; Coles, 1986).

The reduction in the total serum protein and albumin concentrations could be attributed to the decrease in food intake or increased albumin loss as a result of increased capillary permeability in copper deficient animals or to the lowering of synthetic power of albumin by the liver which caused by undernutrition (O'Dell, 1976; Varely, 1976; Rucker and Tinkler, 1977 and Wyngarden and Smith, 1985). Similar results obtained by Smith, (1996) who reported that malnutrition, chronic liver disease and chronic gastrointestinal diseases may interfere with digestion and absorption of nutrients that may led to inadequate provision of amino acid substrate for general protein production.

In recent years a variety of new compounds that have high efficiency against adult and immature flukes have been established and applied clinically. In this study, the use of Closantel at a dose rate of 10 mg/ kg BW (S/C injection) gave long activity against mature and immature liver flukes. Application of the treatment trials in sheep under investigation revealed that the values of blood constituents nearly returned to the normal levels (1-2 months) post treatment. There were an improvement in the general health condition of most of the examined animals, proved by gradual increase in their appetite, absence of diarrhea and gradual disappearance of alopecia. Our results were in agreement with those obtained by Robert and Suhardono (1996), Smith (1996) and Radostits *et al*. (2007) who reported that closantel killed the majority of flukes older than 4 weeks, in sheep at a dose rate of 10 mg/kg and delayed egg laying by animals grazing contaminated pasture for up to 12 weeks. The authors added that closantel had a residual effect against hemonchus contortus**.**

CONCLUSION

It could be concluded from this study that chronic fascioliasis was reported as a major causative agents of ill-thrift. The animals under investigation showed clinical signs of progressive weight loss in adults, underweight in lambs, profuse watery diarrhea and edematous swelling of the intermandibular space. Such disease condition had an adverse effects on the cellular and biochemical constituents of the blood in diseased animals.

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