

Comparison Of Some Haematological And Biochemical Parameters In Different Pathologies In Sheep

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Abstract— The sheep have an important role in terms of economics, source of food and nutrition by providing milk, mutton, wool, etc. Parasitic diseases are one of the main obstacles in the development of livestock production and industry worldwide.

The aim of this study was to determine the prevalence of dicrocoeliasis in sheep. Infestation was perceived throughout liver's macroscopic examination in slaughterhouses and microscopic examination too. Another objective of this study was to assess the hematological and biochemical indicators in sheep infested naturally by different parasites. An abattoir study was carried out on a total of 224 sheep slaughtered and examined in Tirana, Albania. Hematological, serum biochemical and histopathological changes were investigated in 39 sheep. Values of hemoglobin and red blood cells in sheep infested by *F. hepatica* appear low compared with the reference limits. The average value of hemoglobin (52.89 g/dl) and the number of erythrocytes ($5.55 \times 10^6/\mu\text{l}$) are lower compared to those of reference in sheep infested by *D. dendriticum*. Amongst leukocyte indicators with significant changes is has been found that eosinophils are reaching at 15.82%. Values of hemoglobin and RBC in sheep infested by *E. granulosus* appear low compared with reference values. Hipereosinophilia (15.64 %) is typical of parasitic diseases. Biochemical indicators that vary significantly in infection by *F. hepatica* are albumin, BUN, total bilirubin and LDH. Biochemical indicators that vary significantly in infection by *D. dendriticum*, are albumin, BUN, creatinine, total bilirubin, AST, ALT and lactate dehydrogenase (LDH). Creatinine (0.75 mg/dL) compared with the reference values appear low. Albumin (4.33 g/dL) in the infested sheep by *D. dendriticum* compared with reference values results higher. Compared with the

reference values, lactate dehydrogenase values resulted higher.

Keywords— *sheep, fascioliasis, dicrocoeliasis, echinococcosis, haematological, biochemical.*

I. INTRODUCTION

Sheep are an important national asset for our country. In Albania, arrange about 2,000,000 sheep, while in Tirana is bred about 15,000 sheep. Livestock breeding flocks in Albania continues to be mostly type housing pasture system gives relatively large batches. Such a system shows damage and economic loss caused by many diseases, particularly parasitic nature.

Morbidity and productivity under optimal levels in rural agro-ecological regions of our country are a consequence of the pathogen agents, among them helminths parasites occupy an important place. Decrease in production is attributed to these agents.

Liver pathologies occupy an important place in the range of veterinary issues important to the health of flocks and herds affecting production decline and to shorten the productive life of animals.

Liver plays a central role in the physiology of the body, it performs over 500 functions. Liver plays a major role in metabolism and has a number of functions, including glycogen storage, decomposition of red blood cells, plasma protein synthesis, hormone production, etc (Stalker MJ and (Tony) Hayes MA, 2009).

A special feature of the liver, as a body, is the fact that its pathologies, in most cases, are not manifested clinically, and the damage that comes from their health and animal production, is great (Radostits O.M. et al. , 2009). Touching the body will affect systemic change and ultimately causes a decrease in production (Behm and Sangster, 1999; Stalker MJ and Hayes MA, 2009).

In the group of parasitic pathogenic agents that affect ruminants in general and in particular sheep, important place *Fasciola hepatica* and *Echinococcus granulosus*, causing damage mainly in the liver. Fascioliasis caused by *F. hepatica* and *F. gigantica* is an important parasitic disease of ruminants, with about 700 million at risk of becoming infected and production animals worldwide economic loss amounting to about \$ 3.2 billion (Spithill et al., 1999). But, it is included in the list of zoonotic diseases and the World Health Organization has recognized fascioliasis as an emergency disease to human populations.

Echinococcosis is zoonotic infection caused by *Echinococcus granulosus* and is endemic parasitic disease in the Mediterranean, North Africa, Spain, Greece, Turkey, Portugal, etc. (Taherkhani H., 2001). The incidence of infestation by *E. granulosus* in endemic areas ranges from 1 - 220 cases per 100,000 inhabitants.

II. MATERIAL AND METHODS:

a. **The study area, animals and sample collection:**

Macroscopical and microscopical controll: The study was carried out in different slaughterhouses in Tirana. A total of 224 sheep livers were controlled. Animals were randomly chosen in slaughterhouses; the animals were of different age and origin. Liver examination has been made in accordance with the method described by Ogambo–Ongoma. For every liver examined macroscopically, a sample was taken and was put in formaline 10%. Microscopic samples were prepared in pathologic anatomy laboratory in Faculty of Veterinary Medicine, Thessaloniki and were stained with hematoxiline and eosine.

b. Haematology: Blood samples were taken from the jugular vein into evacuated EDTA tubes and stored at +4°C. Samples were analysed within 6 hours. Enumeration of erythrocytes and leukocytes was enacted by a manual method on Bürcher camera. Haemoglobin was measured using a technic haemometer. Hematocrit was measured by a classic method with capillary tubes, regarding to [1]. Formula of leukocytes and the cell's alterations were observed on the blood slide in microscopic observation with immersion. Differential Leukocytes Count: D. L. count was down by making of blood smears and referring [5]. The haematological parameters were analysed at the Faculty of Veterinary Medicine, Agricultural University of Tirana, Albania.

c. Biochemical assays: Blood was drawn from jugular vein into serum separating tubes. It was then centrifuged to collect the serum, the serum they were stored until analysed at the Faculty of Veterinary Medicine, Aristotle University of Thessaloniki, Greece. Sera were frozen in plastic tubes at -80°C.

Parameters: Serum samples were analyzed for Total Protein, Albumin, Blood Urea Nitrogen (BUN), Creatinine, Total Bilirubin, Direct Bilirubin, Alkaline Phosphatase (ALP), Alanine Aminotransferase (ALT), Aspartate Aminotransferase (AST), Gamma -

Glutamyl Transferase (GGT) and Lactate Dehydrogenase (LDH).

Analyzer: The Vitalab Flexor E automatic clinical chemistry analyzer (Vital Scientific N.V., Netherlands) was used in combination with certain reagents for in vitro diagnostic measurement (photometric measurement) of analytes in samples of sheep serum. Reagents: a) Creatinine, Urea, Total Bilirubin, Direct Bilirubin, γ -GT, (Thermo Scientific, Fisher Diagnostics, USA), b) ALP, ALT, AST, Albumin, Total Protein, LDH (Zafiropoulos Diagnostica, Greece).

-Quality control: To ensure the accuracy of the test results, biochemical analyzer and reagents were checked with quality control kits of known values for the various constituents (Data-Troll Normal Control - Thermo SCIENTIFIC, Fisher Diagnostics, USA).

d. Statistical analysis: Data were analyzed using Statistica 7.1 for Windows (StatSoft, Tulsa, USA). Results are expressed as means \pm SD (standard deviation). Significance of difference between herds was determined by Student's t test. Values of $P < 0.005$, $P < 0.001$, $P < 0.0005$ were considered significant.

III. RESULT AND DISCUSSION

Hematological and biochemical indicators were evaluated on 91 individuals of sheep with macroscopic lesions. Hematological parameters of sheep are summarized in Table 1.

Our values compared to the reference, indicate for significant anemia of sheep. Hb level was significantly lower (55.80 g / dl) than the reference value (90 - 150 g / dl) by (JW Kramer, 2000), Hindson J. C. and Winter A. C., (2002) and Radostits et al., (2009) and even higher values of this study (84 g / dl) were lower than normal values quoted by these authors. We found low number also for erythrocytes. The average number of sheep's red blood cells studied is $5.48 \times 10^6/\mu\text{l}$. So low levels of these indicators show for damaging action on the liver, referred and by other authors as (Asra M., 2004). PCV value appears in the rate.

The level of rise in eosinophils count was also reported to be dependant on the levels of infective metacercariae (Chauvin et al., 2001). Elevated levels of eosinophils, neutrophils and lymphocytes particularly, and the early period of the infection encountered in this study is in conformity with the findings of (Chauvin, et al., 2001) that elevated eosinophils, neutrophils and lymphocytes participate in the defence against *F. hepatica*. This significant increase in the number of eosinophils, hipereosinophilia, shows high parasitic burden of these animals since the increase in the number of these cells in peripheral blood is characteristic of

parasitic infestation and is cited by some authors (Waweru, et al., 1999; Mekroud, et al., 2007).

TABLE I. HEMATOLOGICAL PARAMETERS OF SHEEP INFESTED BY F. HEPATICA, D. DENDRITICUM AND E. GRANULOSUS (MEAN ± SDA, MIN AND MAX)

Nr	Parameters	Mini mu m	Maxi mum	Sheep n = 91	Ovine Referen ces
1.	Hb (g/dl)	45	84	55.80 ± 10.24	90 - 150a,b,c
2.	RBC (x10 ⁶ /µl)	4.4	7.7	5.48 ± 0.90	9.0 - 15.0a,b,
3.	PCV (%)	30	58	37.60 ± 7.13	27 - 45a,b,c
4.	MCV (fl)	52.9	120.83	69.14 ± 11.83	28 - 40a,b,c
5.	MCH (pg)	57.6	164.7	102.31 ± 16.00	80 - 120a,c,d
6.	MCHC (g/dl)	115.	170.58	148.85 ± 10.99	310 - 340a,b,c
7.	WBC (x10 ⁹ /l)	8.5	14.9	12.05 ± 1.78	4.0 - 12.0a,b,
8.	White cell parameters Lymphocytes	29	48	38.24 ± 4.65	40 - 75a,b,d
9.		0	8	4.12 ± 1.92	0 - 6a,b,d
10.		0	24	15.52 ± 3.67	0 - 10a,b,d
11.		0	0	0	0 - 3a,b,d
12.		34	61	41.42 ± 3.79	10 - 50a,b,d

^aKramer J. W. (2000); ^bHindson J. C. and Winter A. C., (2002); ^cRadostits et al., (2009); ^dDuncan and Prasse's, (2003).

To conclude, the above results indicate that the number of eosinophils shows interest because it can be used routinely as a biological indicator for establishing a preliminary diagnosis which is likely accurate for parasitic.

Biochemical results are presented in Table 2. The values of these indicators vary; several indicators are in normal limits and some change.

Determination of the activity of some enzymes in serum gives us a more complete picture of activity and functional status of the liver. We have selected some enzymes, which not only define this condition, but also can serve as biological markers with diagnostic value.

The values of the general clinical biochemistry parameters that were selected, were situated within the reference intervals published for the ovine species, with a few exceptions, namely the total bilirubin, direct bilirubin, ALP and AST that were slightly higher than the maximum value. LDH value is very high compared with references.

TABLE II. BIOCHEMICAL PARAMETERS OF 91 SHEEP (MEAN ± SDA, MIN AND MAX).

Nr	Parameters	Sheep n = 91	Ovine References
1.	Total protein (g/dL)	8.00 ± 1.06 6.20 - 11.50	6.0 - 7.9a 5.9 - 7.8c
2.	Albumin (g/dL)	2.71 ± 1.11 1.00 - 7.00	2.4 - 3.0a 2.7 - 3.7c
3.	BUN (mg/dL)	24.98 ± 6.09 14.10 - 47.80	8 - 20a,b 10 - 26c
4.	Creatinine (mg/dL)	0.74 ± 0.29 0.50 - 2.70	1.2 - 1.9a,b 0.9 - 2.0c
5.	Total Bilirubin (mg/dL)	0.77 ± 0.31 0.10 - 1.60	0.10 - 0.50a,c
6.	Direct Bilirubin (mg/dL)	0.22 ± 0.13 0.00 - 0.70	0 - 0.27a 0 - 0.12b
7.	Alkaline phosphatase (ALP)	181.36 ± 74.13	70 - 390a 27 - 156c
8.	Alanine aminotransferase (ALT) (U/I)	28 ± 15.92 10.00 - 62.00	22 - 38a 30 ± 4b 15 - 44c
9.	Aspartate aminotransferase	131.75 ± 34.78	60 - 280a,b 49 - 123c
10.	γ-glutamyl transferase (GGT) (U/I)	24.65 ± 4.48 17.00 - 35.00	20 - 52a 33.5 ± 4.3b 22 - 44c
11.	Lactate dehydrogenase (LDH) (U/I)	735.29 ± 105.77 603.00 - 969	240 - 440a 238 - 440b 83 - 476c

^aRadostits et al., (2009); ^bKaneko J. J. et al., (2008); ^cDuncan and Prasse's, (2003).

During the acute phase of some parasitic, diagnosis can be established with the help of several hepatic enzymes activity evaluation as ALP, released from damaged hepatocytes. But a diagnosis of natural infection is much more complicated because interfere with many other factors such as a deficiently feed or mixed infections with gastrointestinal nematodes. In conclusion, one of the goals of this issue was to determine the parameters that indicate variation in animals with liver pathology, in order to be used as markers to establish an accurate diagnosis as final. The study showed that as markers for the diagnosis can be used eosinophils, bilirubin, and lactate dehydrogenase. Evaluation of these indicators and the determination of markers gave us a more complete picture of the pathology encountered in the livers of butchery animals and will help to establish the postmortem diagnosis in sheep.

COMPARISON OF SOME HAEMATOLOGICAL AND BIOCHEMICAL PARAMETERS IN DIFFERENT PATHOLOGIES IN SHEEP

In this issue we present hematological and biochemical findings according to the most frequent pathologies in controlled sheep liver.

Livers controlled in this study resulted in various pathologies, the most common ones were fascioliasis (5.54 %), dicroceliosis (8.32 %) and echinococcosis (3.62 %).

Values of hemoglobin and red blood cells in sheep infested by *F. hepatica* appear low compared with the reference limits by J. Kramer W. (2000), J. Hindson C. and Winter A. C., (2002) and Radostits et al. (2009). Low levels of these indicators represent other authors as Boray C., (2007), Gajewska A, et al., (2005), Matanovic K. et al.. (2007).

Hematocrit value in sheep infested by *F. hepatica* is within the norm.

In sheep infested by *F. hepatica*, is noticed a slightly increase in the number of leukocytes. Increase of leukocytes demonstrate also other studies from Matanovic K. et al., (2007) and H.W. Raadsma, (2007). It has been well documented that infection of some breeds of sheep with *F. hepatica* causes a large infiltration of white blood cells into the liver Tliba et al., (2000).

As in studies by different authors (Matanovic K. et al., 2007; Raadsma HW., 2007 and Mekroud A., et al., 2008), in our study in sheep infested by *F. hepatica*, in hematological indicators values, hipereosinophili demonstrated.

Dicroceliosis, caused by the parasite *D. dendriticum* have no clear clinical picture, especially in mild cases (Otranto D. and D. Traversa, 2002). Light infections (Taylor et al., 2007) are usually asymptomatic but severe infections can cause liver fibrosis, cirrhosis and enlargement of bile ducts associated with anemia, a fact which is also found in our study.

The average value of hemoglobin (52.89 g / dl) and the number of erythrocytes (5.55 x106/μl) are lower compared to those of reference (table 3).

Between leukocyte indicators with significant changes is worth mentioning eosinophils who arrive at 15.82%.

TABLE III. HEMATOLOGICAL PARAMETERS OF SHEEP INFESTED BY *F. HEPATICA*, *D. DENDRITICUM* AND *E. GRANULOSUS* (MEAN ± SDA, MIN AND MAX)

Parameters	<i>F. hepatica</i> n = 26	<i>D. dendriticum</i> n = 39	<i>E. granulosus</i> n = 17	Ovine References	
Hb (g/dl)	51.34±4.63 40-70	52.89±6.52 45-68	65.29±14.12 45-84	90-150 a,b,c	
RBC (x10 ⁶ /μl)	4.89±0.35 4.4-5.8	5.55±0.95 4.4-7.6	5.72±0.89 4.7-7.7	9.0-15.0 a,b,c	
PCV (%)	34.65±3.44 30-40	35.89±5.42 30-52	44.29±9.82 30-58	27-45 a,b,c	
MCV (fl)	70.83±5.76 61.53-83.33	65.30±8.25 52.94-83.33	78.34±19.29 57.69-120.83	28-40 a,b,c	
MCH (pg)	105.02±8.42 92-122	95.68±11.71 57.69-119.14	113.74±26.64 57.69-164.70	80-120 a,c,d	
MCHC (g/dl)	148.88±13.1 120-170.58	148.16±10.2 120-166.66	147.38±10.62 115.51-159.18	310-340 a,b,c	
WBC (x10 ⁹ /l)	12.13±1.83 8.5-14.9	12.04±1.83 9.1-14.9	12.31±1.68 9.5-14.9	4.0-12.0 a,b,c	
White cell parameters (%)	L	38.46±4.12 29-48	37.79±4.73 29-48	39.23±5.09 29-48	40-75 a,b,d
		4.11±1.98 0-8	4.05±1.90 0-8	4.29±2.08 0-8	0-6 a,b,d
	E	16.46±3.08 11-24	15.82±2.75 11-24	15.64±2.91 11-24	0-10 a,b,d
		0	0	0	0-3 a,b,d
	N	41.03±3.10 34-48	41.12±3.20 34-48	40.70±2.51 34-45	10-50 a,b,d

^aKramer J. W. (2000); ^bHindson J. C. and Winter A. C., (2002); ^cRadostits et al., (2009); ^dDuncan and Prasse's, (2003).

The value of leukocyte noticed slight increase compared with the reference values. Value increased leukocyte infestation by *D. dendriticum* refer Manga-González MY, and Gonzalez Lanza C., (2005).

Table 3 shows that Hb, RBC, MCV and MCHC submit changes. Values of hemoglobin and RBC in sheep infested by *E. granulosus* appear low compared with reference values, indicate anemia, as well as in other parasitic diseases mentioned above.

Hipereosinophilia (15.64 %) is typical of parasitic diseases, as underlined in the above mentioned diseases. Poor picture of hematological indicators in infestation by *E. granulosus* is cited by other authors as Morariu S., et al., (2010).

Biochemical indicators of sheep infested by *F. hepatica* presented in table 5 observed variability of some of them. Biochemical indicators that vary significantly in infection by *F. hepatica* are albumin, BUN, total bilirubin and lactate dehydrogenase (LDH).

Hipoalbuminemia caused by a damage of liver parenchyma is commonly found during subacute (Scott et al. 2005). Hipoalbuminemia, is also found in similar studies by (Asrat M, 2004; Kozat S., and Denizhan V., 2010; Matanović K. et al., 2007; Ayaz E., et al., 2006).

Results from our study support those observations and are consistent with pathological findings which may or may not be accompanied with clinical signs of fasciolosis. Significantly increased levels of serum LDH found in our study confirm the presence of flukes in the bile ducts. At the same time the activity of AST was because of a short half-life in the plasma, already within the reference limits for sheep, indicating young flukes have migrated through the liver parenchyma. Authors (Wiedosari E., et al., 1990; Gonzalo-Orden et al. 2003) observed that AST activity returned to normal values 11 weeks postinfection.

Between biochemical indicators of sheep infested by *D. dendriticum*, presented in table 4 is worth noting that change from the reference values of albumin, BUN, creatinine, total bilirubin, AST, ALT and lactate dehydrogenase (LDH).

TABLE IV. BIOCHEMICAL PARAMETERS OF SHEEP INFESTED BY *F. hepatica*, *D. dendriticum* AND *E. granulosus* (MEAN \pm SDA, MIN AND MAX)

Parameters	<i>F. hepatica</i> Sheep n = 26	<i>D. dendriticum</i> Sheep n = 39	<i>E. granulosus</i> Sheep n = 17	Ovine References
Total protein (g/dL)	7.90 \pm 1.20 6.20-11.50	7.95 \pm 1.05 6.20-11.50	8.14 \pm 1.13 6.60-11.50	6.0-7.9a 5.9-7.8c
Albumin (g/dL)	2.16 \pm 0.51 1.00-2.70	4.33 \pm 0.56 3.40-7.00	4.34 \pm 0.48 3.50-5.40	2.4-3.0a 2.7-3.7c
BUN (mg/dL)	26.56 \pm 6.22 15.70-40.70	24.56 \pm 6.55 14.60-47.80	23.54 \pm 5.70 14.10-33.40	8-20a,b 10-26c
Creatinine (mg/dL)	0.76 \pm 0.25 0.50-1.50	0.75 \pm 0.36 0.50-2.70	0.71 \pm 0.22 0.50-1.50	1.2-1.9a,b 0.9-2.0c
Total Bilirubin (mg/dL)	0.78 \pm 0.33 0.30-1.60	0.78 \pm 0.33 0.10-1.50	0.79 \pm 0.27 0.40-1.40	0.10-0.50a,c 0.23 \pm 0.1b
Direct Bilirubin (mg/dL)	0.19 \pm 0.12 0.00-0.50	0.22 \pm 0.13 0.00-0.60	0.26 \pm 0.16 0.10-0.70	0-0.27a 0-0.12b
ALP (U/I)	163.19 \pm 49.88 71-293	186.27 \pm 89.65 66-481	192.88 \pm 71.17 100-416	70-390a 27-156c
ALT (U/I)	32.30 \pm 16.77 10.00-60.00	29.62 \pm 15.91 10.00-62.00	23.39 \pm 14.88 10.00-59.00	22-38a 30 \pm 4b 15-44c
AST (U/I)	125.89 \pm 20.50 68.10-158.10	140.19 \pm 43.55 90.20-251	116.32 \pm 15.95 90.00-137	60-280a,b 49-123c
GGT (U/I)	26.58 \pm 4.37 17.00-35.00	24.00 \pm 4.32 17.00-35.00	23.88 \pm 5.01 17.00-34.00	20-52a 33.5 \pm 4.3b 22-44c
LDH (U/I)	842.26 \pm 86.41 687-969	702.92 \pm 77.27 603 - 931	649.88 \pm 33.86 603 - 713	240 - 440a 238 - 440b 83 - 476c

^aRadostits et al., (2009); ^bKaneko J. J. et al., (2008); ^cDuncan and Prasse's, (2003).

Creatinine (0.75 mg / dL) compared with the reference values appear low.

Albumin (4.33 g / dL) in the infested sheep by *D. dendriticum* compared with reference values results higher. Higher values refer Manga - Gonzalez MY, et al. (2004).

Total bilirubin also turned over rate in our study (0.78 mg / dL). Similar findings refer Manga - Gonzalez MY, et al., (2004).

Compared with the reference values, lactate dehydrogenase values resulted higher. According Manga-Gonzalez MY, et al., (2004); Manga-González MY, and González-Lanza C., (2005), the infestation of *D. dendriticum* observed increase of several enzymes (Sanchez-Campos et al., 1999) but for the larval and adult forms it is characteristic lactate dehydrogenase. Most biochemical indicators in sheep infested by *E. granulosus* presented in Table 4 result on norm compared with reference values. Higher growth represent total protein, albumin, ALP and LDH.

High levels of protein also quoted Ayaz E., et al., (2006).

Value of ALP results 192.88 U/I. ALP activity is a useful marker as an indicator to show the presence of lesions in the liver, especially bile ducts. High levels of ALP reported in similar studies by other authors as Onac D., et al., (2009).

Conclusion

Naturally infected sheep evaluation of liver disease severity and organ recovery prognosis in affected animals can be performed based on macroscopic findings at the slaughterhouse, microscopic lesions and laboratory data (blood hematological and biochemical parameters). Hematological indicators with diagnostic value, resulted hemoglobin, number of red blood cells and eosinophils. Their evaluation, because of its low cost, can be used as a routine screening test from districts laboratories determining preliminary diagnosis in flocks infested of liver parasites. The change of hepatic enzymes level serves to monitor the progress of parasitic infection in animals and as a sensitive diagnostic aid in field infections. Albumin, BUN, creatinine and total bilirubin are reliable indicators of the stage and severity of parasitic liver naturally infested sheep in doing so, and constitute an important diagnostic tool in determining of the official diagnosis and an efficient treatment process.

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