

## Biochemical and Histopathological Studies on Sheep Suffering From Besnoitiosis

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### ABSTRACT

The aim of this work was to determine the causes which lead to the death of 12 sheep out of 300 after signs of inactivity, severe weakness and depression. The sheep farm was in Kafr El-Sheikh Governorate. Their ages ranged from 12-20 weeks. There was no death among the neonates, the adults and the old animals. The recorded signs included severe bloody diarrhea associated with inactivity, weakness and severe loss of body weight. The postmortum examination showed congestion of the intestine which was filled with bloody gelatinous fluid. The examination of the intestinal content of the dead animals was done. And the parasitological examination showed infection of these lambs with Besnoitiosis. Moreover, samples of blood were taken for haematological and biochemical examination besides the determination of the different levels of the main and rare minerals. Specimens were collected from the intestine and liver of the obligatory slaughtered and freshly dead animals for histopathological examination. This study showed severe changes in the intestine and liver besides severe losses in the level of the main and rare minerals. Moreover, the disturbance in the blood constituents which was associated with severe bloody diarrhea, inactivity and severe weakness was determined.

### INTRODUCTION

Sheep are regarded as one of the most important groups of livestock as they provide meat, milk and wool. The total number of sheep in Egypt is nearly about three millions head (1).

Enteritis is a major problem facing sheep production in lambs. It can be caused by bacteria, viruses, protozoa and some environmental factors (2). Enteritis represents about 20% of all gastrointestinal tract disorders (3). Coccidia are common intestinal parasites of sheep and goats(4), it represents the highest prevalence (24.58%) among all parasites causing diarrhea in sheep (5). Coccidiosis in sheep results from a complex interaction between parasites and host, and its severity is influenced by many factors (6). The current study was designed to evaluate the biochemical and histopathological findings accompanied with the acute coccidiosis seen in sheep in a private farm.

### MATERIAL AND METHODS

#### Animal and history

Five diseased sheep (3-5 months old) out

of 300 were admitted to the Animal Health Research Institute, Dokki, Giza during the last week of December 2005 with a history of inappetance, weakness and severe diarrhea. The animals belonged to a private farm in Kafr El-Sheikh Governorate. On visiting the farm thirty animal were chosen and classified according to the No. of fecal oocyste into three groups (+++ ve, ++ ve, + ve) (Table 1.)

#### Sampling and analysis

##### Fecal sampling

Faecal samples were prepared for parasitological examination using centrifugal flotation technique for detection of eggs or oocysts (7).

##### Blood sampling

Five blood samples with and without anticoagulant were collected from the clinically diseased sheep and 5 blood samples with and without anticoagulant were collected from the apparently healthy sheep from the same farm.

##### Analysis

##### Hematological analysis

The haemoglobin content was estimated

by using Sahlis haemometer according to the previously described method (8). The result was expressed in gm%. The packed cell volume was determined by using the microhaematocrit method (9). The reading was expressed in %. Both the total and leucocytic count were employed using the improved Neubour chamber (10).

#### Biochemical analysis

The serum concentrations of the total protein, the serum albumin, (11,12), calcium (13), phosphorus (14), magnesium (15), cooper, zinc, cobalt, manganese (16), and iron (17), level were measured respectively. Serum sodium and potassium concentration were measured through flame photometry using corning 410-C flame photometer (18).

#### Histopathological study

Different specimens of the congested intestine and liver (recently dead or slaughtered sheep), were collected. The specimens were fixed in 10% neutral buffered formalin. Paraffin sections of 5 micron thickness were prepared and stained with hematoxyline and eosin for the histopathological examination (19).

#### Statistical analysis

Statistical analysis of the obtained data was carried out according to (20).

## RESULTS

#### Signs

The signs observed in a flock of sheep (3-5 month old), were diarrhea, depression and anorexia. The severely affected animals showed weakness, weight loss, dehydration and in some cases sudden death.

#### Macroscopical findings

The intestinal contents were greenish, watery and mixed with tissue debris. The intestinal wall was frequently congested, thickened and oedematous. The liver was swollen and congested.

#### Parasitological examination

Ten grams of fecal samples were examined microscopically and classified according to the number of oocysts where samples containing over 500 oocyst were considered +++ve and that having up to 30 oocyst were ++ve and less than 10 were +ve.

Table 1. Groups of sheep, age, number examined and severity of infection.

Group	Age (month)	No. of examined animals	Severity of infection oocysts / gm of feces
1	3	10	+++
2	4	10	++
3	5	10	+

#### Haematological results

The haemograms of the apparently healthy sheep were  $8.6 \pm 0.07 \times 10^6/\mu\text{l}$ ,  $12.3 \pm 0.6 \text{ gm/dl}$ ,  $41.3 \pm 2.53 \mu\text{g}/100 \text{ ml}$ ,  $47.7 \pm 2.2 \text{ fl}$ ,  $14.12 \pm 0.6 \text{ Pg/cell}$  and  $30.2 \pm 2.8 \text{ gm}$  for RBCs, Hb, PCV, MCV, MCH and MCHC respectively (Table 2). The lambs which suffered from coccidiosis, diarrhoea and emaciation had microcytic normochromic anaemia with mean in increasing in RBCs, Hb, PCV, MCV and MCHC values ( $10.7 \pm 0.35 \times 10^{16}/\mu\text{l}$ ,  $13.7 \pm 0.3 \text{ gm}\%$ ,  $50 \pm 0.3\%$ ,  $40.3 \pm 2.3 \text{ fl}$  and  $29 \pm 1.16 \text{ gm/dl}$ ) respectively (Table 2).

The leucogram of clinically healthy sheep showed  $10^3/\mu\text{l}$  were  $9.8 \pm 0.8$ ,  $62.5 \pm 3.2\%$ ,  $1.4 \pm 0.45\%$ ,  $32 \pm 3.1\%$ ,  $1.2 \pm 0.37\%$  and  $0.2 \pm 0.01\%$  for TLC, lymphocyte%, monocyte%, neutrophils%, eosinophils % and basophils % respectively (Table 3). The diseased lambs showed  $9.0 \pm 1.1 \times 10^3$ ,  $61.1 \pm 0.5\%$ ,  $2 \pm 0.2\%$ ,  $30.3 \pm 0.5\%$ ,  $6.2 \pm 0.8\%$  and  $0.4 \pm 0.18\%$  for TLC, L, M, N, E and B% respectively (Table 3).

#### V-Biochemical results

The results of the total serum protein, albumin and globulin of the clinically healthy

and infected sheep with coccidiosis are shown in Table 4.

The sheep which suffered from diarrhea and coccidiosis showed a significant decrease in the total serum protein and albumin than the normal sheep and the levels were  $5.7 \pm 0.5$  gm/dl and  $3.4 \pm 0.3$  gm/dl respectively (Table

4). The lambs which suffered from coccidiosis and diarrhea showed a significant decrease in the serum, sodium, potassium, phosphorus, magnesium, copper, cobalt, iron and manganese levels in comparison with the clinically normal lambs (Table 5).

**Table 2. Haemogram findings in the clinically healthy sheep and those suffering from coccidiosis**

Parameter	Apparently healthy sheep (n=5)	Sheep suffering from coccidiosis (n=5)
RBCs ( $10^6/\mu\text{l}$ )	$8.6 \pm 0.07$	$10.7 \pm 0.35^{***}$
Hb (gm/dl)	$12.3 \pm 0.6$	$13.7 \pm 0.3^{***}$
PCV%	$41.3 \pm 2.53$	$50 \pm 0.3^{**}$
MCV (fl)	$47.7 \pm 2.2$	$40.3 \pm 2.3^*$
MCH (pg/cell)	$14.12 \pm 0.6$	$13.14 \pm 0.62$
MCHC (gm/dl)	$30.2 \pm 2.8$	$29 \pm 1.16^*$

\*Significant at  $<0.05$  \*\* Significant at  $<0.01$  \*\*\* Significant at  $<0.001$

**Table 3. Leucogram findings in the clinically healthy sheep and those suffering from coccidiosis**

Parameter	Apparently healthy sheep (n=5)	Sheep suffering from coccidiosis (n=5)
Total WBCs ( $\times 10^3$ )	$9.8 \pm 0.8$	$9 \pm 1.1$
Lymphocyte (%)	$62.5 \pm 3.2$	$61.1 \pm 0.5$
Monocytes (%)	$1.4 \pm 0.45$	$2 \pm 0.2$
Neutrophils (%)	$32 \pm 3.1$	$30.3 \pm 0.5$
Eosinophils (%)	$1.2 \pm 0.37$	$6.2 \pm 0.8^{***}$
Basophils (%)	$0.2 \pm 0.01$	$0.4 \pm 0.18$

\*Significant at  $<0.05$  \*\* Significant at  $<0.01$  \*\*\* Significant at  $<0.001$

**Table 4. Mean values of serum protein, albumin and globulins of coccidiosis infected sheep compared with the healthy ones**

Parameter	Apparently healthy sheep (n=5)	Sheep suffering from coccidiosis (n=5)
Total protein (g/dl)	$7.6 \pm 0.7$	$5.7 \pm 0.5^*$
Albumin (g/dl)	$4.8 \pm 0.8$	$3.4 \pm 0.3^*$
Globulin (g/dl)	$2.8 \pm 0.8$	$2.3 \pm 0.3$

\* Significant at  $<0.05$

**Table 5. Mean values of serum level of Macro and Micro-elements in the healthy and coccidiosis infected sheep**

Parameter	Apparently healthy sheep (n=5)	Sheep suffered from coccidiosis (n=5)
Sodium mg/dl	140±2.11	130±1.3*
Potassium (mg/dl)	4.2±0.07	2.7±0.51*
Calcium (mg/dl)	7.4±0.24	6.9±0.09*
Phosphorus (mg/dl)	3.6±0.12	2.7±0.11*
Magnesium (mg/dl)	4.1±0.71	3.05±0.21*
Copper Cu (ug/100 ml)	172.4±13.1	102.1±6.1***
Zinc (ug/100 ml)	89.8±5.8	81.2±4.2
Cobalt (mg/L)	0.082±0.007	0.023±0.003***
Iron (ug/100 ml)	83.3±1.6	48.1±5.9**
Manganese (ug/100 ml)	12.4±0.6	6.8±0.3***

\*Significant at <0.05 \*\* Significant at <0.01 \*\*\* Significant at <0.001

### Histopathological results

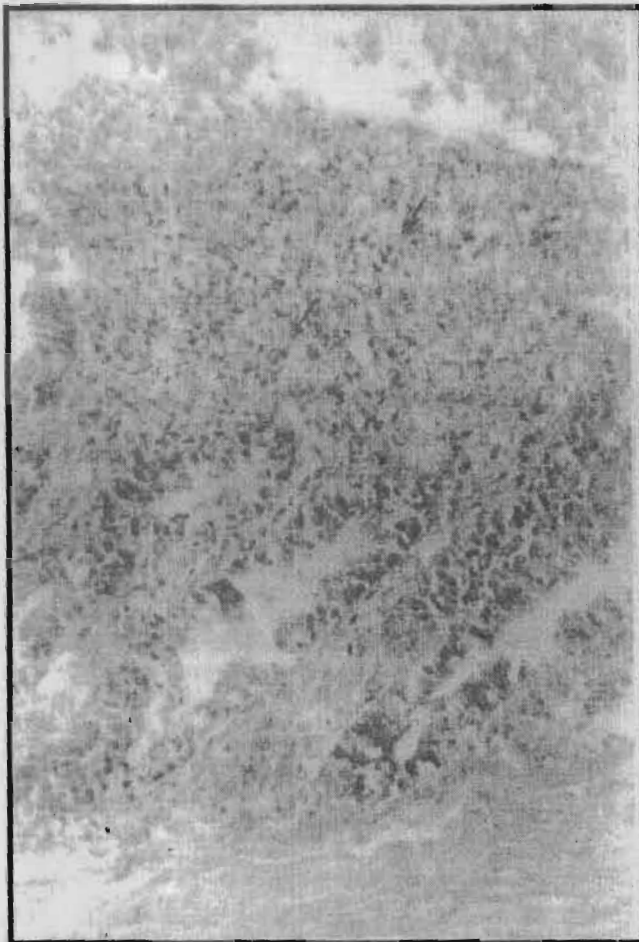
#### Intestine

Microscopically, the intestine revealed destruction of the epithelial covering of the villi and intestinal glands as well as leucocytic infiltration in the lamina propria (Figs. 1, 2, 3, 4). Newly formed capillaries (Fig. 2, 4) and edema were seen in the lamina propria of the intestinal mucosa (Fig. 3). Extensive necrosis of intestinal glands was noticed (Fig. 4). Schizonts of *Besnoitia gilruthi* surrounded by mononuclear cells and destructed intestinal glands were seen (Figs. 5, 6). Moreover, infiltration of the lamina propria with a large number of eosinophils was present among the destructed intestinal glands (Fig. 7).

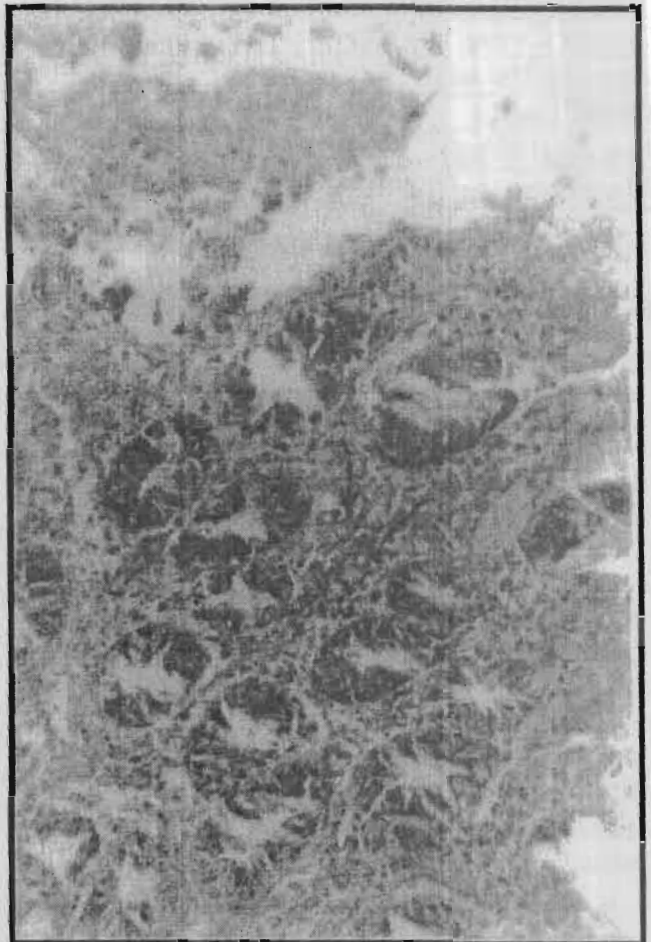
Edema of the lamina propria (Figs. 8, 9) and submucosa (Fig. 9) together with congestion of the mucosal and submucosal blood vessels were encountered (Figs. 8, 9).

#### Liver

The liver were encountered revealed hydropic degeneration of some hepatocytes and pyknosis of the nuclei of other hepatocytes (Fig. 10). Focal hepatic haemorrhage and focal necrosis of hepatocytes were observed (Fig. 11). The portal triads showed extensive fibrous connective tissue proliferation compressing and obliterating the bile ducts (Fig. 12). Portal haemorrhage was also seen (Fig. 13) in the examined sections.



(Fig. 1)



(Fig. 2)

Fig. 1. Destruction of the epithelial covering of the villi and intestinal glands as well as leucocytic infiltration in the lamina propria (H & E x200).

Fig. 2. Destruction and desquamation of the epithelial covering of the villi and intestinal gland (small arrow), leucocytic infiltration in the lamina propria as well as appearance of newly formed blood capillaries (large arrow) (H & E x200).



Fig. 3. Necrosis and desquamation of the epithelial lining of the intestinal glands (small arrow), necrosis of the intestinal glands as well as edema in the lamina propria (large arrow) (H & E x100).

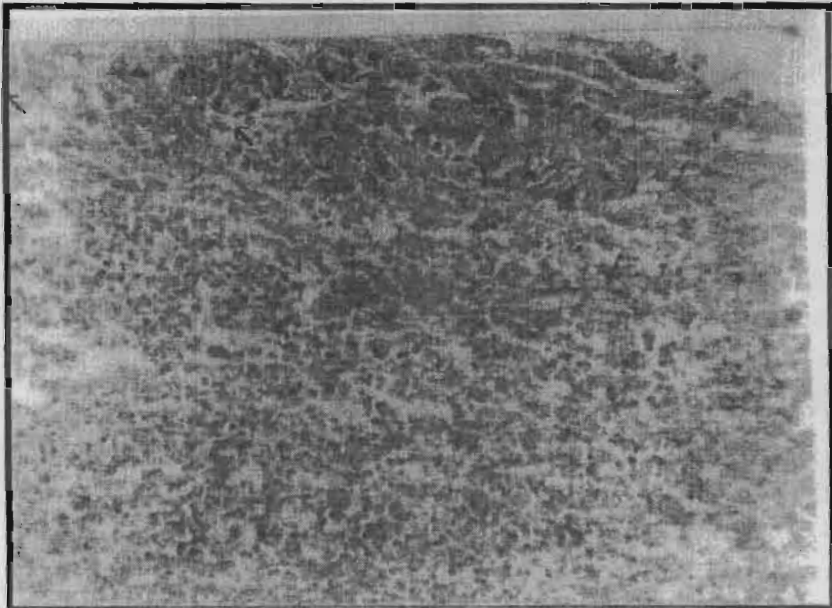


Fig. 4. Extensive necrosis of the glands and mononuclear infiltration in the lamina propria (arrows) (H & E x200).



Fig. 5. Schizont of *Besnoitia gilruthi* surrounded by mononuclear which replaced some intestinal glands (H & E  $\times 200$ ).

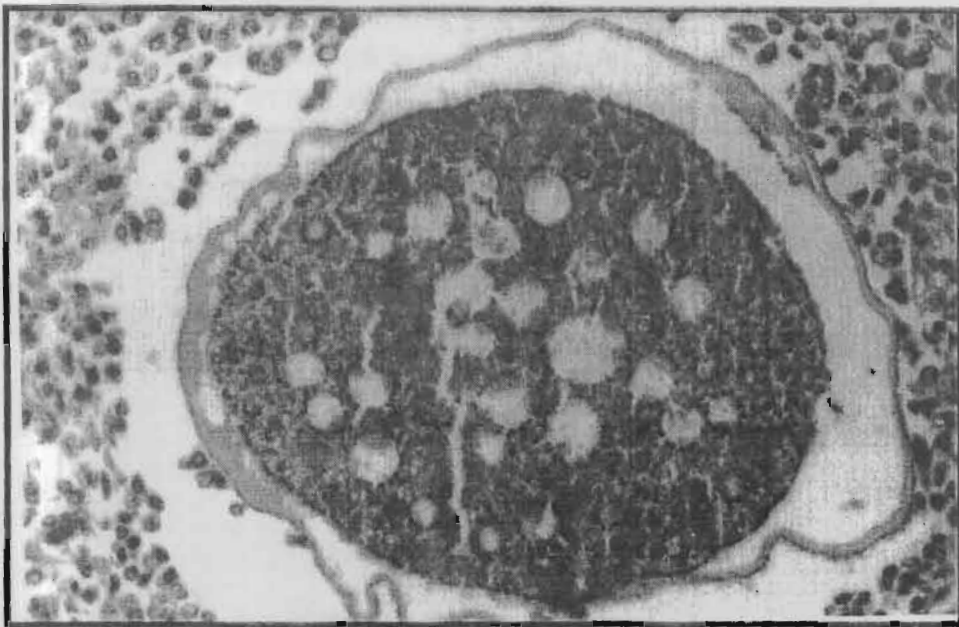


Fig. 6. Higher magnification of the previous photo showing a large cyst filled with bradyzoites (H&E X 400).

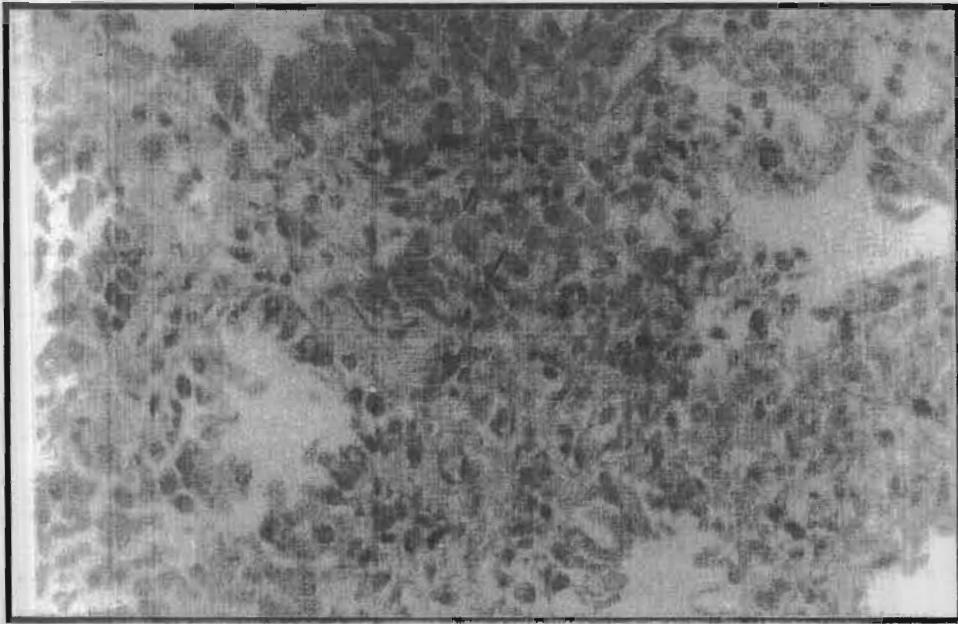


Fig. 7. Necrosis of the intestinal glands and infiltration of lamina propria with eosinophiles (arrows) (H & E X 400).

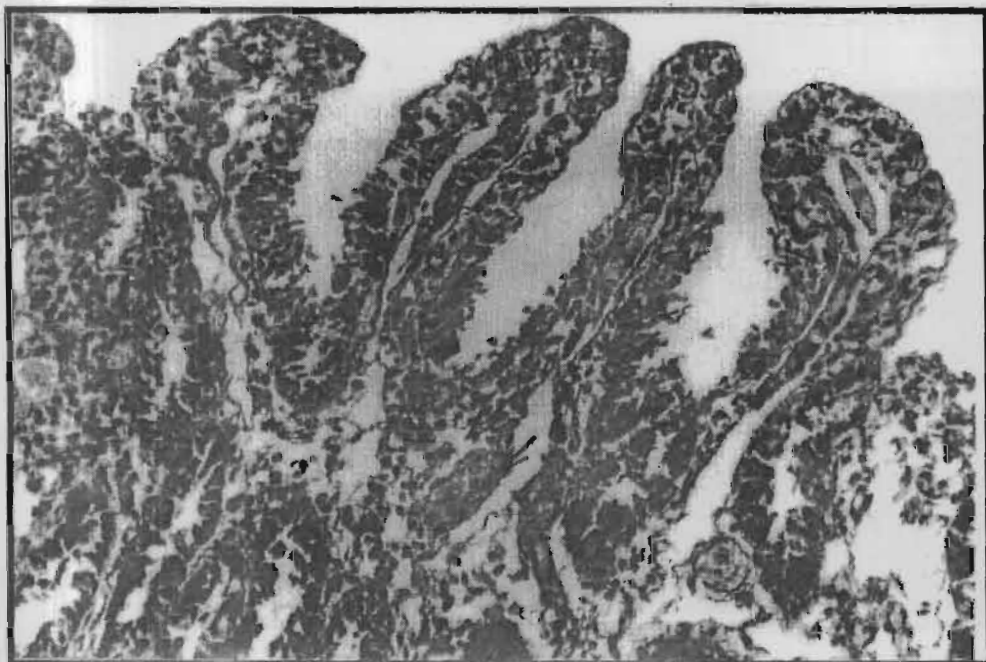


Fig. 8. Edema in the lamina propria as well as congestion of the mucosal blood capillaries (H & E x200).





Fig. 9. Edema in the lamina propria and submucosa (small arrow) as well as dilatation and congestion of mucosal and submucosal blood vessels (large arrows) (H & E x100).

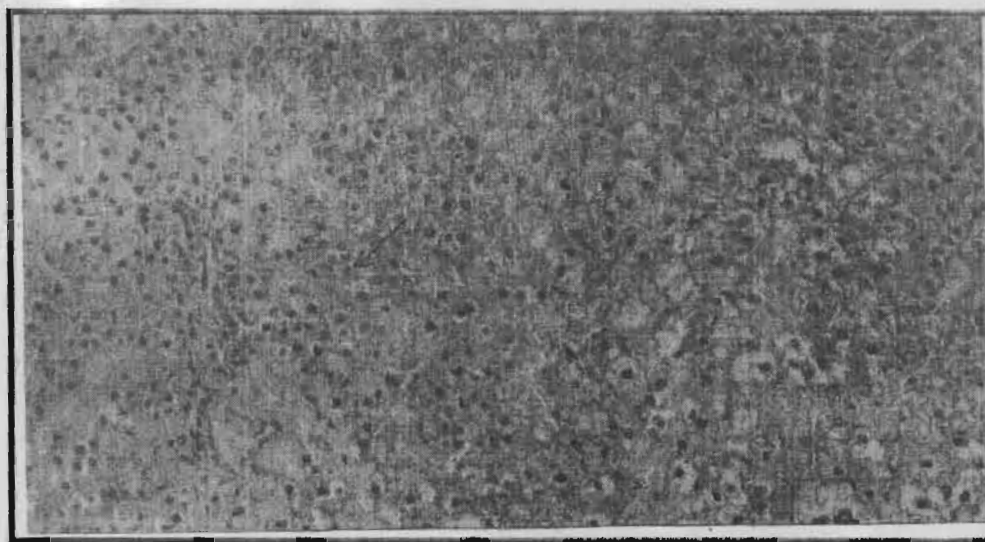


Fig.10. Hydropic degeneration of hepatocytes (small arrow) and Pyknosis of some nuclei of hepatocytes (large arrow) (H & E x200).

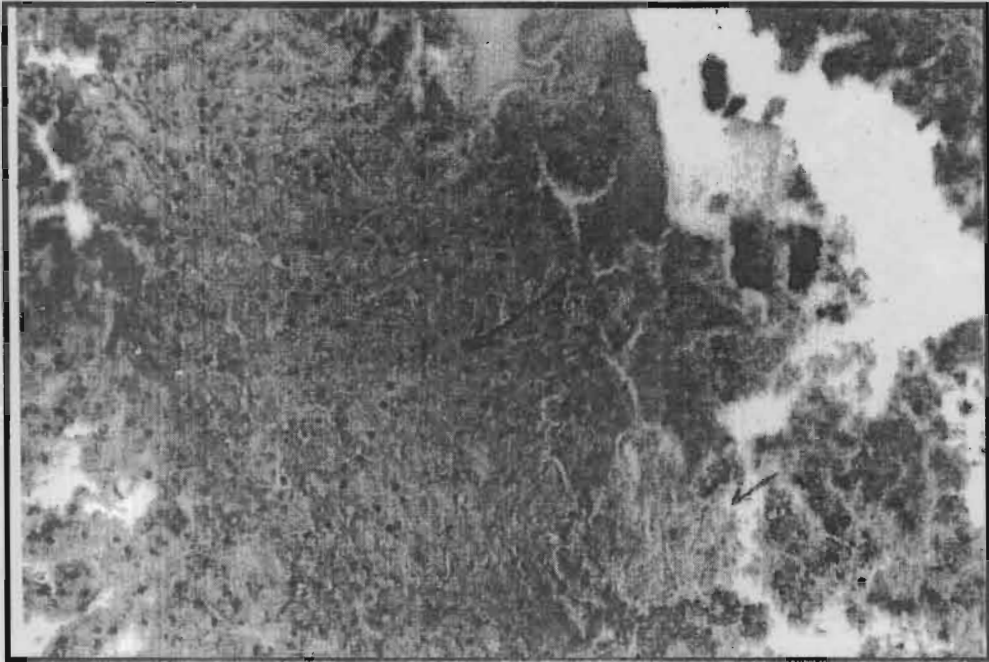


Fig. 11. Focal hepatic haemorrhage (small arrow) and necrosis of hepatocytes (large arrow) (H & E x200).



Fig. 12. Extensive fibrous connective tissue proliferation in the portal triad (H & E x200).

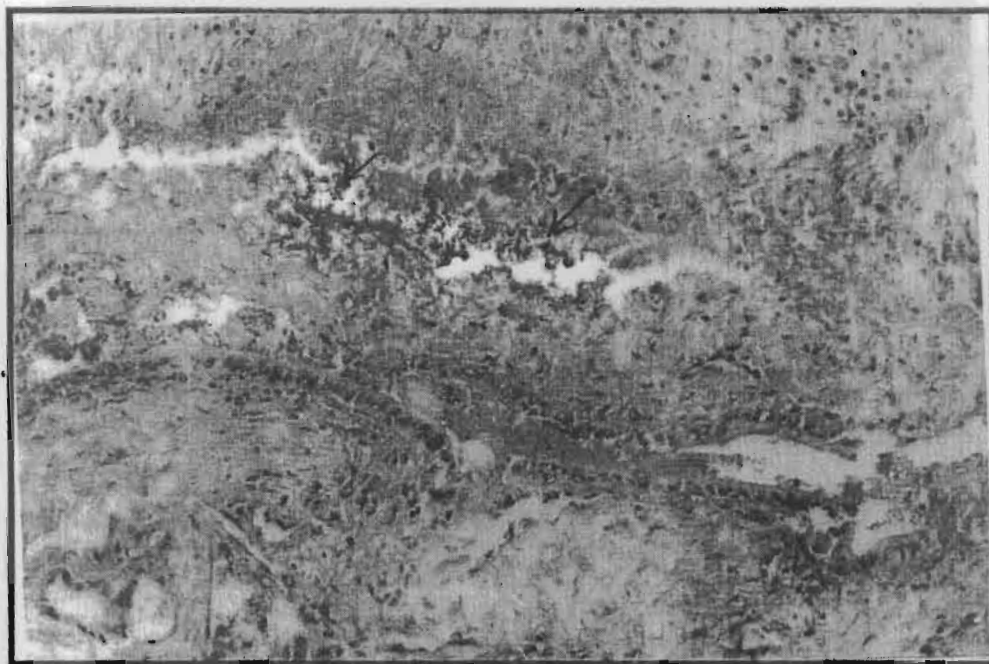


Fig. 13. Section in liver of sheep showing necrosis and haemorrhage (H & E x200).

### DISCUSSION

The present study showed that *Eimeria* infestation in sheep is still considered the most important and widely spread parasitic infection in sheep. The disease caused enteritis with greenish yellow watery or bloody diarrhea with offensive odour, besides general weakness and moderate dehydration. Several investigators (21-23) recorded similar clinical signs.

**Macroscopically**, the intestinal content were greenish watery, mixed with tissue debris. Moreover, the intestinal wall was congested, thickened and oedematous. Similar observations were almost recorded in coccidiosis in camel and lambs (24, 25). The liver appeared congested and swollen, similar to that recently reported (25), however others (23) cited a pale liver in chronic coccidiosis of lambs and kids.

**Microscopically**, the infected intestine revealed destruction and necrosis of the intestinal glands in addition to oedematous lamina propria. These findings agree with those previously reported (26). The intestinal lesions in case of parasitic infestation were mostly manifested by prominent inflammatory cells infiltrating the lamina propria mainly eosinophils. These results are in complete agreement with those reported (6 & 27). *Schizonts* of *Besnoitia gilruthi* were surrounded by mononuclears and destructed glands. These results are in moderate agreement with those noticed by *Kanyari* (28) who recorded *Schizonts* of *Eimeria opsheronica* in the lamina propria where they caused a cellular response. Meanwhile, different stages of coccidia in the epithelial cells of ileum and congestion of the submucosal blood vessels was also observed (29).

The examined liver showed necrosis of hepatocyte and focal hepatic hemorrhage. These results are fairly in agreement with those reporting that the centrilobular hepatic necrosis and congestion of the sinusoids revealed that the value of the Hb and PCV were significantly increased and the erythrocytic count was relatively increased indicating hemoconcentration. This was probably due to loss fluid from the blood into tissues (29- 31). In this work the recorded eosinophilia was cited by several investigations (30, 32 & 33)

The total serum protein values were significantly decreased in the coccidia infected sheep than in the healthy sheep. The mean level of total serum protein in the infected sheep was  $5.7 \pm 0.5$  g/dl versus a mean value of  $7.6 \pm 0.7$  g/dl in the control groups. The serum albumin values were significantly decreased in the coccidia infected sheep. The mean level of the serum albumin in infected sheep was  $3.4 \pm 0.3$  g/dl versus a mean values of  $4.8 \pm 0.8$  g/dl of the control ones. No significant changes were encountered in the total serum globulin. The mean levels of the serum globulin was  $2.3 \pm 0.3$  g/dl and  $2.8 \pm 0.8$  g/dl for coccidia infected and the healthy animals respectively. The significant decrease of total serum protein in the coccidia infected sheep, may be due to the defective of absorption through the inflamed intestinal mucosa besides the leakage of albumin through the damaged intestinal portions and diarrhea (34 , 35). The mean values of serum Cu, iron, cobalt, zinc manganese, sodium, potassium, calcium, phosphorus and magnesium in clinically healthy lambs are nearly similar to that recorded by Salah (36). Concerning the coccidia infected lambs the mean values of serum Cu, iron, cobalt, manganese, sodium K, Ca. Ph and Mg were significantly decreased. These values are coincide with those reported by several investigators (5, 33, 35, 37-40). They observed that the diarrhetic animal produces a large volume of faeces. It is mainly due to the increased excretion of water accompanied by considerable loss of calcium, phosphorus magnesium, sodium, and potassium. The decrease in the blood levels of

iron copper, cobalt and manganese may be due to impaired absorption by the destroyed intestinal epithelium from one side, and the impaired assimilation of these elements by selective body organs on the other side (2).

It could be concluded that coccidiosis is an acute disease that affects the general health. It is fatal in some cases as it induce acute hemorrhagic enteritis. To avoid these previous mentioned haematological, biochemical and pathological alternations associated with coccidial infection it is recommended the following:

- 1- Avoid contamination and the bad hygienic measures during the process of artificial feeding of the suckling lambs and to regulate the suckling periods.
- 2- Colostrum must be given obligatory to the newborn lambs during the first 24 hours of birth to increase the body resistance against diseases.

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### الملخص العربي

#### دراسات بيوكيميائية وهستوباثولوجية على الأغنام المصابة إصابة حادة بالكوكسيديا

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 (٢) وحدة الباثولوجيا - معهد بحوث صحة الحيوان - الزقازيق  
 (٣) وحدة الطفيليات - معهد بحوث صحة الحيوان - الزقازيق

الهدف من هذا البحث هو معرفة الأسباب التى أدت إلى نفوق عدد (١٢) من الأغنام وظهور أعراض خمول وهزال شديد فى مزرعة أغنام بمحافظة كفر الشيخ تتراوح أعمارها من ١٢-٢٠ أسبوع ومكونة من عدد ٣٠٠ رأس ولا يوجد نفوق فى الحملان حديثة الولادة أو البالغة والأعمار الكبيرة - وكانت الأعراض المرضية عبارة عن أعراض معوية (إسهال شديد ومدمم مصاحب بخمول وهزال ونقص شديد بالأوزان). وقد أظهرت الصفة التشريحية احتقان الأمعاء وامتلائها بسائل جيلاتينى مدمم. تم فحص البراز من محتويات أمعاء الحيوانات النافقة وقد أظهرت الفحوص الطفيلية عن إصابة الحملان بطفيل الكوكسيديا. تم أخذ عينات من الدم للفحص الهيماتولوجى والبيوكيميائى وقياس النسب المختلفة من الأملاح الأساسية والنادرة وكذلك تم أخذ عينات من الأمعاء والكبد للفحص الهستوباثولوجى من الحيوانات المذبوحة اضطرارياً أو حديثة النفوق. ومن الدراسة تبين وجود تغيرات شديدة فى الأمعاء والكبد ونقص شديد فى مستويات الأملاح النادرة والأساسية وخلل فى مكونات الدم مما أدى إلى ظهور هذه الحالة من نفوق وإسهال مدمم شديد وخمول وأعراض الهزال الشديد.