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CLINICAL, HAEMATOBIOCHEMICAL AND ELECTROCARDIGRAPHIC CHANGES OF DIARRHEIC SHEEP

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A B S T R A C T

This study was planned to investigate the concurrent changes related to enteritis and the effect of a five day-treatment with an oral minced nutmeg or oxytetracycline, a total number of 60 sheep (40 diarrheic and 20 apparently healthy (control) sheep) were used. The diarrheic sheep showed significant ($P<0.05$) increase in body temp, respiratory rate, pulse rate with reduction of ruminal movement and increase in PCV%, RBCs count, Hb, WBCs count, granulocyte, lymphocyte and monocyte count, but significant ($P<0.05$) hypocalcaemia, hyponateremia, hypochloremia, hyperkalemia, hypoglycemia, total protein, globulin and albumin levels compared to control. The most common pathogens isolated from diseased sheep were E.coli and Salmonella. Antioxidant marker (SOD) significantly ($P<0.05$) reduced, whereas oxidant marker (MDA) significantly increased ($P<0.05$) in diseased sheep. In addition, there were significant elevations in liver enzymes and kidney function test. Electrocardigraphic changes showed shorter QRS wave amplitudes, longer T wave duration, sinus arrhythmia with tachycardia. Microscopic examination of ruminal protozoa showed reduced numbers with sluggish motility. The clinical parameters of diarrhea were improved 24 hr post-treatment with freshly minced nutmeg, whereas these signs were disappeared 48 hrs post-treatment with oxytetracycline. Serum urea nitrogen concentration maintained at high levels, and the protozoal count revealed a significant drop in oxytetetracyclin-treated group compared to nutmeg-treated group. It was concluded that bacteria diarrhea in sheep is associated with haematological, biochemical, electrocardigraphic changes as well as disturbance in the oxidant–antioxidant balance. Treatment with minced nutmeg is preferable to oxytetracylcine because of its rapid effectiveness without significant suppression of the ruminal prozoal activity and kidney function.

KEY WORDS: Diarrhea, Electrocardiograph, Haemato-biochemical, Nutmeg, Oxytetracycline, Sheep.

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1. INTRODUCTION

Diarrhea is one of the major problems facing sheep production especially those are bred under intensive or semi-intensive system of breeding, it also cause significant mortalities among lambs, weight loss or even late growth. [23]. Diarrhea defined as increased fecal water content or to increased volume of feces excreted or a combination of both and characterized clinically by excessive water, electrolyte discharge in the intestine [18]. Etiology of diarrhea is multiple, including infectious agents, poor management, reproductive factors, nutritional factor and immune status of ewes and lambs [11].The diarrheic animals loosed fluid, rapidly dehydrated and suffered from electrolyte loss, acidosis and infectious agents may cause initial damage to the intestine but death from scours usually result from dehydration, acidosis and loss of electrolytes [33]. Most of the diseased lambs showed inappetance and

depression. The feces of the animals varied from clay to yellowish gray or grayish to greenish in color, contained mucous and sometimes blood. Many cases showed rise in of body temperature. The diarrheic lambs showed varying degree of dehydration with congested mucous membrane [35]. Identification of infectious agents that cause diarrhea is essential for implementation of effective preventive and treatment measures [33]. Diarrhea associated with heamatological changes such as marked increase in the values of Hb, PCV%, RBCs, WBCs count [17], also diarrhea associated with biochemical changes such as decreased total protein, hypoglycemia, hyponatremia, hyperkalemia, hypocalcaemia, increase AST, ALT activity [16], increase urea nitrogen and creatinine level [17]. There is also oxidant injury diagnosed by decrease in the level of SOD and increase in the level of MDA [3]. The decreased SOD in diarrheic sheep throws more lights on the role of oxidative stress in the pathogenesis of enteritis [25]. ECG patterns during diarrhea may be suitable as an indicator of the severity of serum electrolyte changes [10]. ECG patterns during the electrolyte imbalance are largely comparable between different species, and are characterized by a widening and flattening of P wave, broadening of QRS complex, increased P-R interval, shortening of the QT interval as well as tall, symmetric, peaked T waves [32]. The principles of treatment of diarrhea are removal of the causative agent, replacement of lost fluid and electrolyte, alteration of the diet if necessary and the possible use of drugs to inhibit secretion and control of intestinal hypermotility [9]. A large variety of antibacterial preparation for both oral and parental administration is available. The choice will depend on previous experience, the disease suspected and the result of culture and antibiotic sensitivity test [6]. Nowadays, there is an increasing trend towards the use of herbal medicine in Egypt that reflects an increasing confidence in such remedies [2]. Medicinal plant chemicals may relieve diarrhea in numerous ways, besides providing nutrients and generally increasing gastrointestinal health, plant chemicals can act and bind with a number of different cells in the gastrointestinal tract environment, including epithelial cells, immune system cells, commensal flora, or pathogenic bacteria [39]. Nutmeg crude suspension decreased the mean number of loose stools or increased the latency period, increased intestinal tone, inhibited the contraction produced by acetylcholine, histamine and prostaglandin, thus nutmeg showed a good antidiarrheal effect, with a significant sedative property. It also possessed only a weak analgesic effect, with no harmful effects on ECG [46]. This work aimed at recording the main the clinical signs, the most common etiological agents, haematobiochemical changes, the oxidant-antioxidant activity and electrocardiographic changes associated with diarrhea in sheep. A further objective was to evaluate the effectiveness of nutmeg and oxytetracycline tablet in treatment of such problems to evaluate the best one for veterinary uses.

2. MATERIALS AND METHODS

2.1.Animals and study design

This study was conducted on 60 sheep, 1-6 months of the ages (diarrheic sheep; n=40, apparently healthy; n=20) belonged to Mosthtohor Farm, Production sector, Agriculture research center. All animals were subjected to detailed clinical examination including recording of temperature, pulse and respiratory rates, mucous membranes and ruminal movement investigation [33]. The degree of dehydration had been estimated by capillary refill time and other clinical parameters [36].

Animals were further subgrouped according to clinical examination, preliminary etiological investigation and isolation of the causative agents into:

Group I: apparently healthy sheep (n=10) were kept as control.
Group II: sheep suffered from bacterial diarrhea (n=10) were subdivided into two therapeutic groups (n=5 per each) treated with 3-5gm/kg B.Wt. of freshly minced nutmeg orally [46] or 20 mg/kg bwt oxytetracycline (Oxy-tab®, Unipharma Industrial Co.) daily for five successive days [6].
All diseased animals were given an oral fluid therapy (Sacrolyte®, Univet/ Ireland, consists of 100 g of dextrose monohydrate 72.70 g, sodium chloride 6.50g, sodium citrate 4.5g, potassium chloride 2.50g, monopotassium phosphate 1.30g, calcium pantothenate 150mg, vitamin B_1 75 mg and vitamin B^6 40 mg) twice daily [36].
Blood and/or fecal samples were collected from control and diarrheic sheep before and at day 5 after treatment.

2.2.Isolation and identification of causative agents:

Fecal swabs were obtained aseptically from rectum of diarrheic sheep, dept in sterile nutrient broth tube and incubated at 37°C for 24 hours before being transferred aseptically on specific media (McConky's agar) and re-incubated at 37°C for 24 hours. Smears were prepared from suspected bacterial colonies, stained with Gram's stain and examined for the morphological appearance, arrangement and staining reaction of the isolates [8].

2.3. Blood and serum analysis:

Two blood samples were drained from the jugular vein. The first sample was taken with anticoagulant (EDTA) for determination of blood picture using hematology analyzer (RBCs count, Hb content, PCV%, WBCs and differential leukocytic count) [20]. The second sample was collected without anticoagulant for biochemical determination of glucose [45], urea nitrogen, creatinine [45], calcium [41], sodium, potassium [19], chloride [24], AST [7], ALT [40], total protein [31], albumin [14]. Globulin was determined by the differences between total protein and albumin [7]. A/G ratio was calculated by dividing the albumin over globulin [14], superoxide dismutase SOD [30] and L-MDA [13] as was described previously.

2.4. Ruminal juice analysis:

The ruminal juice was collected from all animals by using a simple ordinary stomach tube connecting with a suction plastic syringe 50 ml capacity. These samples were sieved and strained through a 2 folds of sterile gauze and examined immediately to estimate ruminal pH, physical characters [33], protozoal activity, motility and numbers [1].

2.5. Electrocardiographic examination:

ECG traces were recorded on a bipolar base apex lead system in all animals using lead II and ECG Monitor [15]. Animals were kept standing without any sedation and with minimum restraint. When animals got calm, ECGs were recorded, using alligator-type electrodes attached to the skin after cleaning it with ethanol and applying ethyl alcohol to improve the contact. The right forelimb electrode (RA) was placed on the neck along the jugular groove one third of the way up to the neck. The left forelimb electrode (LA) was placed on the ventral midline under the apex of heart. Both hind limb electrodes (green [N] and black [F]) were attached to the left and right stifle joints, respectively. All ECGs were obtained with a single channel electrocardiographic machine (BTL-08 SD ECG, Industries Ltd.161 Cleveland Way, Stevenage, Hertfordshire, SG1 6BU, United Kingdom) with paper speed of 25 mm/s and calibration of 10 mm equal to 1 mV as in (Figure 1). The amplitudes and durations of all wave form were calculated manually, were each small square represent 0.02ms on the vertical plan and 0.1mv on the horizontal plan.

2.6. Statistical analysis:

The data were statically analyzed by one way analysis of variance (ANOVA) with Dunnet's as post-hoc test as previously described [4] using SPSS software (Ver. 16). Values (mean ± S.E.) were considered significantly different from control healthy when $P \leq 0.05$.

3. RESULTS

3.1. Etiological agents causing diarrhea in sheep:

Bacterial agent involving in diarrhea including E.coli which represent (30.00%), Salmonella sp. which represent (15.00%), proteus sp. which represent (5.00%), Klebsiella spp. which represent (8.33%) and mixed infection by (E.coli+ proteus spp, which represent (8.33%). E.coli and Salmonella were the main cause of bacterial diarrhea in sheep. All % of affected animals was calculated relative to the total examined sheep (60) as in (Table 1).

3.2. The clinical examination:

The common clinical signs appeared on the control group were normal appetite, shiny coat, shiny eyes, their tail were fatty and normal defecation in form of small hard pellets. Body temperature, respiratory rate, pulse rate and ruminal movement were 39.2±0.17°C, 23.66±1.2/minute, 81.0±1.52/minute and 3.00±0.31/2 respectively as in (Table, 3). Mucous membranes were light rosy red in color. In diarrheic sheep affected animals suffered from moderate to sever diarrhea, depression, dullness, loss of appetite and moderate degree of dehydration. The feces was semi fluid to watery in consistency and grayish to yellowish green in color, contained mucous and sometimes blood. The perineum and tail were soiled with feces (Figure 3, 4). There was significant ($P \leq 0.05$) increase in body temp, respiratory rate, pulse rate with reduction of ruminal movement (Table 2). Mucous membranes were congested (Figure 2). Clinical parameters of sheep suffering from diarrhea after treatment by freshly grated nutmeg and oxytetracyclin tablet was significantly changed toward the normal value (Table 3).

3.3. Hematological examination:

There was a highly significant ($P \leq 0.05$) increase in PCV%, RBCs, significant ($P \leq 0.05$) increase in Hb, WBCs and Granulocyte, lymphocyte and monocyte count of sheep suffering from diarrhea. Hematological picture of diarrheic sheep was improved and slightly returned to the normal after treatment by nutmeg and oxytetracycline tablet as in (Table 3).

The serum biochemical analysis:

There was a significant ($P \leq 0.05$) decrease in serum glucose level and in level of total serum protein in diarrheic sheep while there was non significant ($P \leq 0.05$) decrease in levels of albumin, globulin and A/G ratio in diarrheic sheep. Serum glucose, total protein, albumin, globulin and A/G ratio of diarrheic sheep was improved and slightly returned to the normal after treatment by nutmeg and oxytetracycline tablet as in (Table 4). There was a significant ($P \leq 0.05$) decrease in serum Na, Cl and Ca in sheep suffering from diarrhea, while there was a significant ($P \leq 0.05$) increase in serum K in diarrheic sheep as in (Table 5). Serum Na, Cl, K and Ca were improved and returned nearly to the normal in animals affected with diarrhea after treatment by nutmeg and oxytetracycline tablet. There was a significant ($P \leq 0.05$) increase in serum level of creatinine, AST and ALT activities in diarrheic sheep while there was a highly significant ($P \leq 0.05$) increase in serum level of urea nitrogen in diarrheic sheep (Table 5). Serum level of Urea nitrogen, Creatinine, AST and ALT activities were decreased than in diseased condition after treatment by nutmeg and oxytetracycline tablet. There was a significant ($P \leq 0.05$) decrease in the level of super oxide dismutase in diarrheic sheep,

Table1: Causes and percentage of different etiological agents in diarrheic sheep

Etiological agents	Number of animals	%
I- bacterial agents	40	66.66
A-Escherichia coli.	18	30.00
B-Salmonella spp.	9	15.00
C-Klebsiella spp.	5	8.33
D-Proteus spp.	3	5.00
E-Mixed infection (E.coli+ proteus spp.)	5	8.33

Table 2: Field test for diagnosis of dehydration and severity of diarrhea in sheep

Severity of diarrhea	Capillary refill time (sec.)	Animal attitude	Number of animals	%
Moderate diarrhea	3.8±0.12	Standing or sternal, head down, moderate CNS depression.	35.0	87.5
Severe diarrhea	5.3±0.18	Lateral recumbency, severe CNS depression.	5.0	12.5

Table 3: Clinical parameters in control and diarrheic sheep before and after treatment

Parameter	Control (n=10)	Diarrheic sheep due to bacterial agents		
		Before treatment (n=10)	After treatment by nutmeg (n=5)	After treatment by oxytetracycline (n=5)
Temperature	39.2±0.17 [a]	41.1±0.08 [b]	39.4±0.11 [a]	39.1±0.06 [a]
respiration rate/minute	23.66±1.20 [a]	37.33±0.88 [c]	27.0±1.70 [a b]	28.33±0.89 [b]
pulse rate/minute	81.0±1.52 [a]	121.6±2.60 [c]	90.66±2.18 [b]	90.00±0.57 [b]
Ruminal m/2minute	3.00±0.31 [b]	1.60±0.24 [a]	3.40±0.24 [b]	2.65±0.19 [b]

Means with different superscript letters in the same raw are significantly different at $P \leq 0.05$.

Table 4: Hematological picture of control and diarrheic sheep before and after treatment

parameter	Control (n=10)	Diarrheic sheep due to bacterial agents		
		Before treatment (n=10)	After treatment by nutmeg (n=5)	After treatment by oxytetracycline (n=5)
Hb (gm/dl)	10.42±0.18 [a]	14.25±0.33 [b]	11.08±0.10 [a]	11.06±0.11 [a]
PCV%	27.92±0.90 [a]	35.61±0.66 [c]	29.91±0.11 [b]	29.77±0.16 [a b]
RBCs(10^6/mm^3)	10.53±0.66 [a]	13.80±0.34 [c]	12.60±0.19 [b]	11.17±0.13 [a b]
WBCs (10^3/ mm^3)	9.48±0.29 [a]	13.83±0.32 [c]	12.02±0.09 [b]	12.77±0.27 [b]
Granulocyte(10^3/ mm^3)	3.70+0.13[a]	5.73+0.06 [c]	4.86+0.08 [ab]	5.18+0.12 [b]
Lymphocyte (10^3/ mm^3)	5.26+0.15 [b]	7.40+0.23 [c]	6.51+0.02 [b]	6.89+0.24 [b]
Monocyte (10^3/ mm^3)	0.52+0.02 [a]	0.69+0.03 [b]	0.64+0.02 [b]	0.69+0.02 [b]

Table 5: Mean values of selected serum biochemical parameters in control and diarrheic sheep before and after treatment

parameter	Control (n=10)	Diarrheic sheep due to bacterial agents		
		Before treatment (n=10)	After treatment by nutmeg (n=5)	After treatment by oxytetracycline (n=5)
Glucose (mg/ dL)	54.80±0.83[b]	39.52±0.52[a]	55.59±0.73[b]	56.62±0.47[b]
Total protein (gm/dL)	6.49±0.16[a]	5.56±0.75[a]	6.50±0.11[b]	6.31±0.16[b]
Albumin (gm/dL)	3.22±0.21[a]	2.89±0.11[a]	3.37±0.21[a]	3.1±0.11[a]
Globulin (gm/dL)	3.27±0.30[a]	2.67±0.14[a]	3.13±0.11[a]	3.20±0.27[a]
A/G ratio	1.01±0.14[a]	1.08±0.09[a]	1.07±0.09[a]	0.89±0.12[a]
Sodium (mmol/L)	146.48±1.14[c]	133.11±1.79[a]	145.71±81[b c]	142.01±1.15[b]
Chloride (mmol/L)	94.46±1.57[b]	81.63±1.37[a]	93.38±1.58[b]	94.05±1.58[b]
Potassium (mmol/L)	5.54±0.15[a]	6.67±0.16[b]	5.30±0.18[a]	5.38±0.16[a]
Calcium(mg/dL)	10.09±0.84[c]	8.50±0.10[a]	9.95±0.43[b c]	9.65±0.12[b]
Urea nitrogen(mg/dl)	35.31±0.56[a]	49.03±0.92[c]	37.54±0.93[a]	40.25±0.59[b]
Creatinine (mg/dl)	1.02±0.05[a]	1.33±0.04[b]	1.01±0.05[a]	1.12±0.06[a]
AST (I.U/L)	49.92±1.34[a]	67.16±1.43[b]	50.28±1.15[a]	48.82±0.88[a]
ALT (I.U/L)	30.14±1.04[a]	39.52±0.75[b]	30.54±1.52[a]	27.77±1.21[a]
SOD (IU/ml)	195.1±10.83[b]	153.43±18.73[a]	203.03±6.67[b]	207.41±16.93[b]
L-MDA (mmol/ml)	1.98±0.32[a]	3.74±0.58[b]	1.93±0.28[a]	2.15±0.32[a]

Means with different superscript letters in the same raw are significantly different at $P \leq 0.05$.

Table 6: Examination of ruminal juice in control and diarrheic sheep before and after treatment

parameter	Control (n=10)	Diarrheic sheep due to bacterial agents		
		Before Treatment (n=10)	After treatment by nutmeg (n=5)	After treatment by oxytetracycline (n=5)
Color	Olive green	Grayish yellow	Olive green	yellowish green
Odor	aromatic	aromatic	aromatic	aromatic
Consistency	viscous	Slimy	viscous	viscous
S.A.T	30.66±1.20[a b]	35.66±0.88[b]	31.00±1.52[a b]	32.66±0.88[a]
pH	6.80±0.05[a]	7.2±0.05[b]	6.83±0.03[a]	6.76±0.03[a]
Activity of ruminal protozoa	+++	+	+++	++
Protozoal count×10^5/ml	4.16 ± 0.42[b]	1.83±0.33[a]	4.01±0.28[b]	2.83±0.16[a]

Means with different superscript letters in the same raw are significantly different at $P \leq 0.05$.

Table 7: Electrocardiographic values in control and diarrheic sheep before and after treatment

Parameter	Control (n=10)	Diarrheic sheep due to bacterial agents		
		Before treatment (n=10)	After treatment by nutmeg (n=5)	After treatment by oxytetracycline (n=5)
P duration (ms)	0.026±0.006 [a]	0.047±0.006 [a]	0.033±0.33 [a]	0.036±0.003 [a]
P amplitude (mv)	0.18+0.016 [a]	0.15+0.028 [a]	0.167+0.016 [a]	0.167+0.016 [a]
P R interval (ms)	0.07+0.006 [a]	0.11+0.0058 [b]	0.083+0.003 [a]	0.080+0.00 [a]
QRS amplitude (mv)	0.96+0.03 [c]	0.73+0.03 [a]	0.86+0.03 [b c]	0.85+0.05 [b]
T duration (ms)	0.03+0.003 [a]	0.063+0.006 [b]	0.033+0.003 [a]	0.036+0.003 [a]
T amplitude (mv)	0.18+0.016 [a]	0.50+0.057 [b]	0.21+0.017 [a]	0.023+0.033 [a]
QT intervals (ms)	0.11+0.006 [a]	0.18+0.007 [b]	0.12+0.006 [a]	0.13+0.006 [a]

Means with different superscript letters in the same raw are significantly different at P≤0.05.

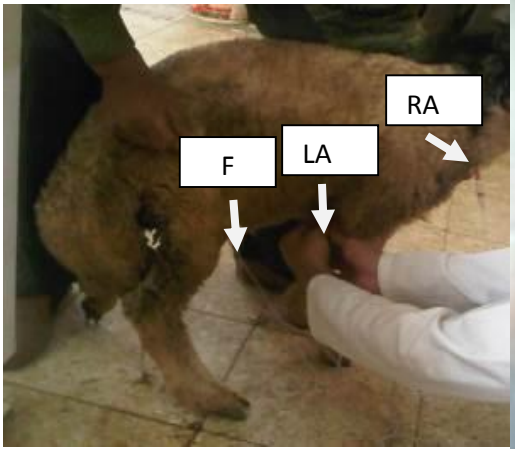

Fig.1: Base –apex lead system for electrode position in diarrheic sheep.

Fig.2: sheep with congested mucous membrane due to bacterial diarrhea.

Fig.3: sheep with moderate clinical signs of bacterial diarrhea which represented by soiled hindquarter.

Fig.4: sheep with clinical signs of severe diarrhea showed lateral recumbancy and soiled hindquarter.

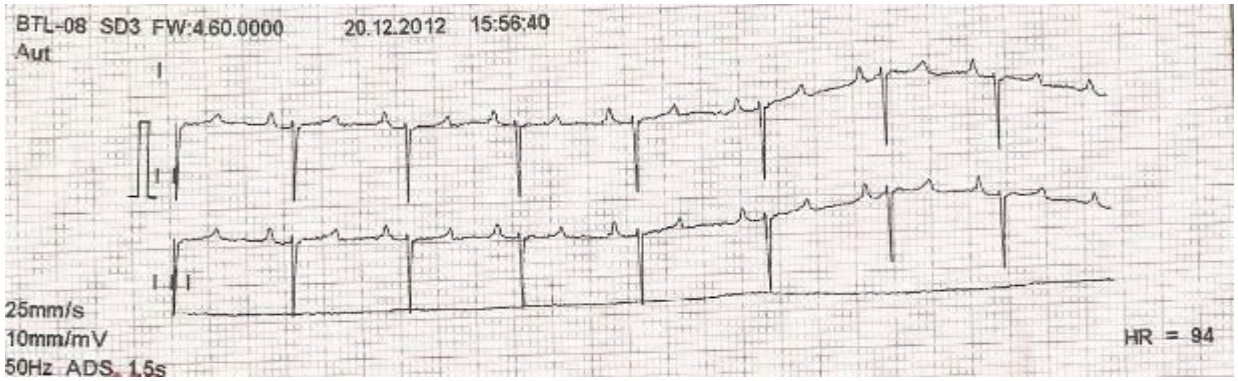

Fig.5: ECG trace of apparently healthy sheep using base-apex lead system showing normal sinus rhythm. Notice that the intervals between R waves (RR interval) are equal. The heart rate is 94. The trace is recorded at paper speed of 25mm/sec and calibration of 10mm/mV (1 cm= 1 mV)

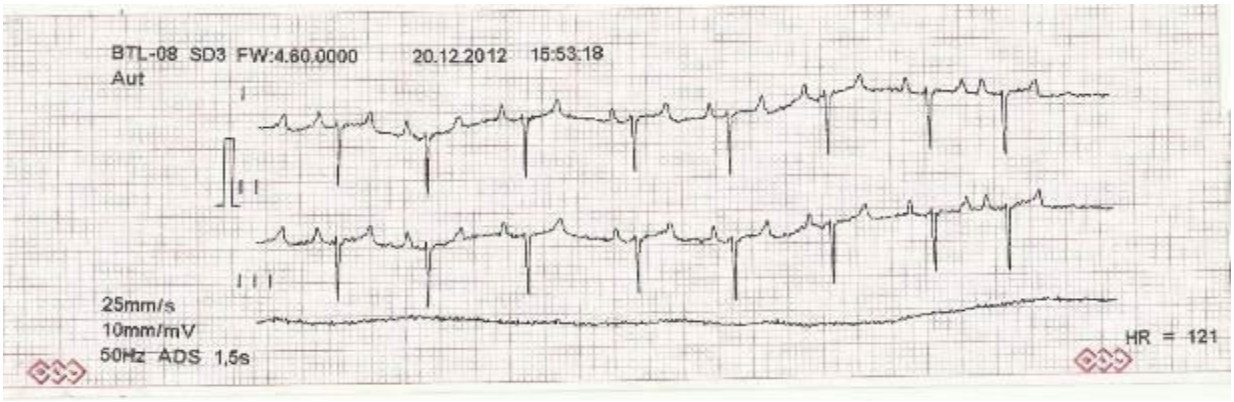

Fig.6: ECG trace of a diarrheic sheep using base-apex lead system showed shorter QRS wave amplitudes, longer T wave duration, sinus arrhythmia with tachycardia that the intervals between R waves are not equal (variable RR intervals). The heart rate is 121. Trace is recorded at paper speed is 25mmlsec and calibration of 10mm/mV (1 cm= 1 mV).

while there was a significant (P≤ 0.05) increase in the level of malondialdehyde in diarrheic sheep (Table 5). Serum level of SOD and MDA of diarrheic sheep was improved and slightly returned to the normal after treatment by nutmeg and oxytetracycline tablet.

3.4. Ruminal juice examination:

Physical properties of ruminal juice in apparently healthy and diarrheic sheep due to bacterial agents before and after treatment by nutmeg and oxytetracyclin tablet were shown in (Table 6). There was a significant (P≤ 0.05) increase in PH in sheep suffered from diarrhea. Microscopic examination of ruminal juice revealed that presence of few numbers of live protozoa and their number showed significant (P≤ 0.05) decrease in diarrheic sheep than healthy sheep as in (Table 9). PH, Activity of ruminal protozoa returned nearly too normal level after treatment by nutmeg and oxytetracycline tablet. Number of protozoa returned to normal level after treatment by nutmeg only while still showed a significant decrease after treatment by oxytetracycline.

3.5. Electrocardiographic examination:

In apparently healthy sheep ECGs tracing that were obtained by using the base apex lead system had a large wave forms, free from artifact. Positive component of the P wave were very clear and prominent, the QRS complexes were large and negative (2mv) and the T wave are large and positive as shown in

(Figure 5), while in diarrheic sheep ECGs showed shorter QRS wave amplitudes, longer T wave duration, sinus arrhythmia with tachycardia and the time intervals between R waves are not equal as shown in (Figure 6). Amplitude and duration of ECG waves are presented in (Table 7). ECGs values of diarrheic sheep were returned to the normal after treatment by nutmeg and oxytetracycline tablet.

4. DISCUSSION

Diarrhea constitutes one of the most serious problems among sheep which lead to considerable economic loss in sheep flocks. As livestock production becomes more intensified so, every practical economical effort should be made to minimize the disease and mortality rate. Bacterial agent involving in diarrhea represent (66.66%) from total examined animals and include Escherichia coli (30.00%), Salmonella spp. (15.00%), proteus spp. (5.00%), Klebsiella spp. (8.33%) and mixed infection by (E.coli+ proteus spp) (8.33%). Several investigations isolated the same organisms with various percentages [23, 34]. In colibacillosis, there are adhesive factor and enterotoxic factor. E.coli bacteria adhere to the apical portion of microvilli. These microvilli fuse with one another and become atrophic resulting in indigestion and malabsorption [34]. In salmonellosis, there in an excessive stimulation of active chloride secretion with inhibition of sodium absorption resulting in drawing of water tissue to gut leading to diarrhea [33]. Proteus sp. and Klebsiella sp. appear to play a minor role as causative agents of diarrhea in sheep. Such observation was previously recorded [23]. The clinical examination of affected animals revealed that sheep suffered from moderate to severe diarrhea, depression, dullness, loss of appetite and moderate degree of dehydration. The faeces was semi fluid to watery in consistency and grayish to yellowish green in color, contained mucous and sometimes blood. The perineum and tail were soiled with feces. Mucous membranes were congested. These results come in agreement with those previously recorded [27]. The recorded anorexia, depression and dullness may be attributed to muscular weakness due to escape of intracellular potassium, hyperkalemia and hypoglycemia [33].

Hematological examination of diarrheic sheep demonstrated a highly significant increase in PCV%, RBCs, significant increase in Hb. count, WBCs, granulocyte, lymphocyte and monocyte count in compared with control. This increase in hematological parameters may be attributed to haemo-concentration, excessive loss of body fluid and dehydration, which lead to decrease plasma volume. These results were in agreement with that reported by [33, 38]. The degree of leukocytosis within different individuals was influenced by the severity of the infectious agent and the susceptibility of the animal to the infection [8]. Serum analysis of diarrheic sheep showed significant decrease in serum glucose level and in level of total serum protein, while there was non-significant decrease in levels of albumin, globulin and A/G ratio in compared to control. These findings are in agreement with those reported by [17, 22]. The occurrence of hypoglycemia in diarrheic sheep due to bacterial infection may be attributed to lack of glucose absorption from damaged intestine, while reduction in the levels of serum total protein and albumin in diarrheic sheep could be attributed to the destructive effect of bacteria or bacterial toxin on the liver cells resulting in impaired synthesis of albumin or malabsorption from the intestinal tract as recorded by [8].

Serum analysis of diarrheic sheep showed significant decrease in serum Na, Cl and Ca, while there was a significant increase in serum K in compared with control this result were in agreement with that reported by [16, 33]. The significant decrease in the

serum calcium may be attributed to malabsorption and its loss in the gastrointestinal tract [16]. Hyperkalemia in diarrheic sheep could be attributed to increase renal tubular reabsorption of potassium in response to acidosis. Also it could be attributed to oligouria or anuria in which kidney failed to eliminate excess potassium [43]. Hyponatremia, hypochloriemia in diarrheic sheep were attributed to direct loss of sodium and chloride ions via feces as well as failure of intestinal absorption [28]. Serum liver function tests of diarrheic sheep showed significant increase in ALT and AST. This result might be attributed to inflammation of gastrointestinal tract of diarrheic sheep and cellular destruction of the liver and intestinal mucosa [16]. Serum kidney function tests of diarrheic sheep showed significant increase in the mean values of creatinine and highly significant increase in serum level of urea nitrogen. The increased values of serum urea nitrogen and creatinine may be due to decrease renal function and reduction in glomerular filtration rate and decrease urine production resulting from hypovolemia, systemic arterial hypotension and vasopressin release [12]. It could be also due to excessive production of urea by catabolism of body proteins in toxic conditions [8]. Serum analysis of diarrheic sheep showed significant decrease in the level of SOD, while there was a significant increase in the level of malondialdehyde. These results were in agreement with that previously reported [3]. The decreased SOD in diarrheic sheep suggests the role of oxidative stress in the pathogenesis of enteritis, its low level leads to accumulation of oxidant substances and free radical that caused cellular damage to the intestinal lining mucosa, while higher MDA concentration in serum of diarrheic sheep suggests increased production of lipid peroxidation in the liver, and indirectly pointed to enhanced free radical generation, lipid peroxidation and oxidative stress. [26]. This result signifies the importance role of antioxidants as a therapeutic agent during prescription drugs for diarrhea in sheep. Physical properties of ruminal juice showed that color, odor, consistency and sedimentation activity test (S.A.T) of ruminal juice of diarrheic sheep due to bacterial infection were Grayish yellow, aromatic, slimy and 35.66±0.88/minute respectively.Biochemical analysis and microscopical examination of ruminal juice showed that ruminal pH from diarrheic sheep was7.2±0.05, also showed that microscopical examination of ruminal juice from diarrheic sheep revealed sluggish motile and low number protozoa and their count was $1.83\pm0.33\times10^5$/ml. These result showed that there was a significant decrease in the total numbers of protozoa [33]. Electrolyte imbalance and acidosis affect cardiac function, and cardiac arrhythmia is one of the main causes of death in diarrheic sheep [10]. In this study, ECG records were used for the evaluation of cardiac function in diarrheic sheep. Hyperkalemia is the first suspect for ECG changes during sheep diarrhea. The serum potassium level of diarrheic sheep was above the normal [17]. ECG patterns during the hyperkalemia are largely comparable between different species, and are characterized by a widening and flattening of P wave, broadening of QRS complex, increased P-R interval, shortening of the QT interval as well as tall, symmetric, peaked T waves [43]. According to our results, ECG patterns during sheep diarrhea may be suitable as an indicator of the severity of serum electrolyte changes and can be used to estimate the severity of illness in diarrheic sheep. After treatment with oral administration of freshly minced nutmeg, diarrhea was completely stopped after 24 hours post treatment. The clinical findings of sheep indicated decrease frequency of defection with hard pellet feces, The animal is bright and alert, the systemic states included body temperature was within the normal range, pulse, respiratory rates and

ruminal movements were within the normal range nearly as that of apparent healthy ones. Mucous membrane becomes pale rosy red color [33]. Feed intake, appetite, digestion were increased, and general health condition of the animal improved and this may be due to stomachic, stimulant, antibacterial effect and antioxidant activity of nutmeg which attributed to inhibits lipid peroxidation and maintains activities of enzymes like superoxide dismutase, catalase as reported by (46). Haematological and biochemical analysis completely returned to its normal value 5^{th} days post treatment by freshly minced nutmeg. The action of nutmeg on diarrheic sheep was to prevent the formation of prostaglandin like materials leading to vasoconstriction of the intestinal blood vessels. Nutmeg also exhibited anti diarrheal activity by increasing tissue contents of Na^+ and Cl^- ions. This was in agreement with previous results [37]. Regarding the diarrheic sheep treated by oxytetracycline tablet, the clinical signs were disappeared after treatment by 48 hours and most of hematological and biochemical alteration were returned to normal on 5^{th} days post treatment but serum urea nitrogen concentration showed continuous increase, and the protozoal count revealed a significant drop this may be due to the toxic effect of oxytetracycline on kidney and ruminal microflora [33].

It was concluded that bacteria diarrhea in sheep is associated with hematological, biochemical and electrocardigraphic changes with disturbance in the oxidant –anti-oxidant balance. In addition, treatment with minced nutmeg is preferable than oxytetracylcine because of its faster anti-diarrheic effect without suppression the ruminal protozoal activity and kidney function.

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التغيرات الاكلينيكية والبيوكيميائية ورسم القلب في الاغنام المصابة بالإسهال وتأثير العلاج باستخدام جوزة الطيب والأوكسي تتراسيكلين.

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الملخص العربي

أجريت هذه الدراسة للتعرف على مسببات الاسهال والتغيرات الهيماتولوجية والبيوكميائية ومضادات الاكسدة وتغير رسم القلب التي لها علاقة بالإسهال. أجريت هذه الدراسة على عدد 60 من الاغنام منهم 40 حيوانا لهم اعمار مختلفة يعانون من الاسهال بالإضافة الي 20 حيوان سليم اكلينيكيا تم استخدامهم كمجموعة ضابطة. بعد الفحص الاكلينيكي والتحقيق المبدئي للأسباب وجد أن الاي كولاي والسالمونيلا هما السبب الرئيسي للإسهال البكتيري في الاغنام. وقد وجد من الفحص الإكلينيكي للأغنام التي تعاني من الاسهال البكتيري ان هناك زيادة في درجه الحرارة ومعدل التنفس ومعدل النبض كما أن هناك التهابا في الأغشية المخاطية. أوضحت نتائج تحليل الدم وجود زيادة معنوية في صورة الدم متضمنة حجم الخلايا المضغوطة وكرات الدم الحمراء والهيموجلوبين وكرات الدم البيضاء والجرانيولوسيت والخلايا الليمفاوية و المونوسيت أما التغيرات البيوكيميائية اشتملت على نقص الكالسيوم والصوديوم والكلوريد وزيادة في معدل البوتاسيوم وانخفاض معنوى في مستوي السكر في الدم و مستوي السوبو اوكسيد ديسميوتيز وزيادة في مستوي المالوندهايد، وزيادة في الانزيمات الكبدية و وظائف الكلى. كما أوضحت نتائج رسم القلب أن موجة QRS أصبحت قصيرة عن الطبيعي أما موجة T أصبحت أطول وأعرض من الطبيعي كما أن المسافات بين موجات R أصبحت غير متساوية كما أوضحت نتائج التحليل البيوكميائي والفحص الميكرسكوبي لعصارة الكرش أن هناك زيادة في الأس الهيدروجيني الي الجانب القاعدي ونقصا في عدد ونشاط البروتوزوا. ولقد وجد بعد استخدام جوزة الطيب المطحونة حديثا أن الاسهال قد توقف تماما بعد الجرعة الاولي من العلاج كمان أن التغيرات الهيماتولوجية والتغيرات البيوكميائية قد عادت الي معدلاتها الطبيعية في اليوم الخامس بعد العلاج أما بالنسبة للحيوانات المصابة بالإسهال التي تم معالجتها باستخدام حبوب الاوكسي تتراسيكلين ان أعراض الاسهال توقفت بعد 48 ساعة من استخدام العلاج ومعظم التغيرات الهيماتولوجية والبيوكميائية قد عادت الي المعدل الطبيعي تقريبا فيما عدا مستوي اليوريا نيتروجين مازالت مرتفعة عن المعدل الطبيعي وكذلك أعداد البروتوزوا انخفضت عن المعدل الطبيعي. وقد أثبتت هذه الدراسة أن الإسهال البكتيري مصحوب بتغيرات هيماتولوجية وبيوكميائية وتغيرات في عصارة الكرش وتغيرات في رسم القلب وتغيرات في الهستوباثولجي وهناك علاقة بين مضادات الاكسدة وحدوث الاسهال في الاغنام كما أوضحت النتائج أنه يفضل استخدام حبوب جوزة الطيب عن حبوب الاوكسي تتراسيكلين في علاج الاسهال في الاغنام .

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