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BIOCHEMICAL CHANGES IN THE SERUM OF CAMELS INFESTED WITH SOME INTESTINAL PARASITES

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SUMMARY

Clinical and laboratory investigations of 60 camels aged 2 –5 years in Giza province, Egypt, revealed that 12 of them were apparently healthy and 48 suffered variable degree of diarrhea. Parasitological examination revealed that all of the diarrheic camels (80 %) were infested with gastrointestinal parasites. Eimeria cameli infestation was recorded in 26 (43.33 %), 18 of them (69.23 %) were mixed infestations with gastrointestinal nematodes. The severity of infection and recovered species of nematodes were recorded and tabulated.

Decreased serum concentrations of the total proteins, albumin, carotene, vitamin A, vitamin E, calcium, inorganic phosphorus, magnesium, sodium, and chlorides together with increased AST, AP, urea and uric acid serum levels are the most characteristic alterations that accompanied parasitic gastroenteritis. Significantly increased serum ALT activity together with decreased serum potassium concentration were only detectable in camels with severe Eimeria cameli infection and may be considered indicative for severe camel coccidiosis.

INTRODUCTION

Parasitic infestation among farm animals constitutes a major hazard to livestock production. The gastrointestinal parasites adversely affect the nutritional status of animals and the most important losses inflicted upon them were retardation of growth, emaciation, remarkable decrease in their efficacy as well as decreased production.

Infestation of camels with gastrointestinal helminthes was studied by many authors in Egypt among them were: Selim and Rahman (1972), El-

Magawry (1980), Nafie et al. (1992) and Awad (1996), who reported variable incidence rates and egg counts among the examined camels.

Regarding the importance of coccidiosis in camels, different opinions in the literature exist. Severe coccidiosis causing enteritis and a mortality rate up to 10% in young camels have been reported in few cases (Hamanchadran et al. 1968 ; Chineme, 1980 ; Kawasmeh and El-Bihairi, 1983 ; Levine, 1985 ; Hussein et al. 1987 and Kinne and Wernery, 1997). On the other hand many reports concerning the presence of coccidia oocysts in camels are based on investigations of fecal samples of healthy camels (Dubey and Pande, 1964 ; Gruvel and Graber, 1969 ; Gill, 1976 ; Mirza and El-Rawas, 1976 and Yagoub, 1989). The reported Eimeria species were E.dromedarii, E.pellerdy, E.bacteriani, E.noelleri,E.rajasthani and E.cameli.

Concerning the serum biochemical parameter alterations, few of the reviewed literature points to the effect of gastrointestinal parasites on serum biochemical parameters which affects the general health condition of infected camels. Ragab (1975) stated that camels infested with nematodes of the family trichostrongylidae showed decreased serum concentration of total proteins, albumin, calcium and inorganic phosphorus. Nafie et al. (1992) found hypoproteinaemia and hypoalbuminaemia in camels infected with gastrointestinal helminthes and / or coccidia species.

The aim of this study is to check the incidence and clinical signs of parasitic gastroenteritis in camels together with monitoring some serum biochemical parameter alterations with a special reference to the liver and kidney functions tests.

MATERIALS and METHODS

I – Materials:

Fecal and blood samples were collected from 60 camels aged between 2 – 5 years (12 apparently healthy and 48 with variable degree of diarrhea) in Giza province Egypt.

Rectal fecal samples were collected immediately after defecation or individually from the rectum in nylon sacs.

Blood samples were collected from the jugular vein from each camel under investigation and the whole blood was allowed to clot for obtaining the serum, which was used for measuring serum biochemical parameters.

II – Methods:

A – Parasitological methods used for fecal examination:

1 – Macroscopical examination was carried out for each fecal sample to detect the presence of gross parasites, blood or mucous, odour and consistency.

2 – Microscopical examination including direct smear, flotation and sedimentation techniques were performed according to Soulsby (1982).

3 – Fecal egg count was carried on to determine the degree of infestation using the Stoll's dilution method described by Soulsby (1982).

4 – Fecal culture and larval differentiation were performed according to Soulsby (1982) and Abdel-Gawad (1974).

5 – Fecal samples positive for coccidia were identified and cultured in 2.5% Potassium dichromate at room temperature for 6 – 8 weeks for the sporocyst formation according to Kinne and Wernery (1998).

B – Biochemical methods used for determination of the studied serum biochemical parameters:

The collected serum samples were used for determination of the concentration of: total proteins (Hoffmann and Richterrich, 1970), albumin and globulins (Doumas et al. 1971), amino transferases activity (Reitman and Frankel, 1957), alkaline phosphatase (Kilichling and Freiberg, 1951), urea (Tabacco, 1979), uric acid (Archibald, 1957), creatinine (Husdan and Rapoport, 1968), carotene and vitamin A (Dann and Evelyn, 1938), vitamin E (Ferri chloride method) according to Quaife and Dju (1949), calcium (Glinder and King, 1972), inorganic phosphorus (Kilichling and Freiberg, 1951), magnesium (Neil and Nelly, 1956), sodium and potassium (by flame photometry) according to Oser (1979) and chlorides according to the method initiated by Van Slyke (1923) and described by Varley et al. (1980).

Statistical analysis of the obtained data for the mean, standard error and "t" test for significant differences between serum values of the non-infected controls and those of the camels with parasitic gastroenteritis were carried out according to Snedecor and Cochran (1976).

RESULTS

Diarrhea with soft to watery feces, sometimes with unusual amounts of mucous, which soiled the perineal region, hind limbs and tail was associated with anorexia, emaciation and decreased performance in most of the diarrheic 48 camels.

Table (1) presents the incidence of gastrointestinal parasites in the examined camels in relation to the severity of infestation. It is worthwhile to mention that the simple flotation method might not be adequate enough to isolate the large and heavy oocysts of Eimeria cameli. Therefore a combined sedimentation and flotation method

may be necessary for routine parasitological examination of camel feces.

Table (2) points to the prevalence of the strongylid type species of nematodes in the infested camels by using larval fecal culture.

Tables (3, 4 and 5) present the biochemical data obtained from serum analysis of the infested camel groups in comparison to those of non-infested apparently healthy camels.

Table (1): Incidence of gastrointestinal parasites in the examined camels (n = 60) in relation to the severity of infestation (egg and oocyst count, EOPGF).

Item	Degree of Infestation				Total	
	Moderate < 300 EOPGF		Severe < 300 EOPGF			
	No. of animals	%	No. of animals	%	No. of animals	%
Negative	-	-	-	-	12	20.00
Infested	20	33.33	28	46.67	48	80.00
Coccidia	-	-	8	13.33	8	13.33
Coccidia + Strongylid type spp.	8	13.33	10	16.67	18	30.00
Strongylid type spp.	6	10.00	5	8.33	11	18.33
Strongylid type spp. + Nematodirus spp.	-	-	3	5.00	3	5.00
Nematodirus spp.	-	-	2	3.33	2	3.33
Trichuris spp.	6	10.00	-	-	6	10.00

EOPGF = Egg and Oocyst Per Gram Feces

Table (2): Prevalence of the strongylid type species of nematodes in the infested camels by using larval fecal culture (n = 32)

Item	Strongylid type spp.				
	Trichostrongylus	Cooperia	Haemonchus	Oestertagia	Oesophagostomum
No. of animals	15	11	7	5	2
% of infestation	46.88	34.38	21.88	15.63	6.25

Table (3): Proteinogram of the infested camels in comparison to non-infested apparently healthy control (n = 60)

Biochemical Parameter	Control (n=12)	Infested Camels (n=48)				
		Single infestations			Mixed Infestations	
		Coccidia	Helminthes		Coccidia + Helminthes	
		Severe >300 OPGF (n=8)	Moderate <300 EPGF (n=12)	Severe >300 OPGF (n=10)	Moderate <300 EPGF (n=10)	Severe >300 OPGF (n=8)
Total proteins g/dl	8.30±0.22	5.80***± 0.21	7.40*±0.31	6.86**±0.39	7.30*±0.53	7.17**±0.30
Albumin g / dl	3.23±0.13	1.80***± 0.15	2.31***±0.19	2.16***±0.18	2.30***±0.15	2.22***±0.12
Globulins g / dl	5.07±0.40	4.00±0.33	5.09±0.31	4.70±0.44	5.00±0.38	4.95±0.35
A / G Ratio	0.64±0.06	0.45*±0.04	0.45**±0.03	0.46*±0.05	0.46*0.06	0.45**±0.03

Biochemical Parameter
EPGF = Egg per gram feces.
OPGF = Oocyst per gram feces.
EOPGF = Egg and oocyst per gram feces.

* = Significant at P< 0.05
** = Significant at P< 0.01
*** = Significant at P< 0.001

Table (4): Liver and Kidney functions of the infested camels in comparison to non-infested apparently healthy control (n = 60)

Biochemical Parameter	Control (n=12)	Infested Camels (n=48)				
		Single infestations			Mixed Infestations	
		Coccidia	Helminthes		Coccidia + Helminthes	
		Severe >300 OPGF (n=8)	Moderate <300 EPGF (n=12)	Severe >300 OPGF (n=10)	Moderate <300 EPGF (n=10)	Severe >300 OPGF (n=8)
ALT U / l	15.75±0.84	20.00*±1.30	15.42±0.67	17.40±0.77	17.30±0.60	18.07±0.54
AST U / l	32.75±0.74	43.38***± 1.93	39.00*±2.18	48.75***± 2.05	35.63±1.48	43.60**±3.20
AP mmu / l	0.92±0.08	1.31***± 0.08	1.14*±0.04	1.12**±0.05	1.07±0.04	1.13*±0.03
Urea mg / dl	40.00±2.70	52.76***± 1.54	50.24*±2.14	52.64**±2.01	51.83**±2.72	55.94**±3.60
Uric acid mg / dl	1.65±0.11	2.68***± 0.27	1.61±0.17	2.72**±0.31	1.86±0.19	3.12**±0.39
Creatinine mg / dl	1.79±0.02	1.92±0.06	1.85±0.03	1.88±0.04	1.76±0.02	1.86±0.03

Table (5): Fat soluble vitamins' and certain minerals' values in the serum of infested camels in comparison to non-infested apparently healthy control (n = 60).

Biochemical Parameter	Control (n=12)	Infested Camels (n=48)				
		Single infestations			Mixed Infestations	
		Coccidia	Helminthes		Coccidia + Helminthes	
		Severe >300 OPGF (n=8)	Moderate <300 EPGF (n=12)	Severe >300 OPGF (n=10)	Moderate <300 EPGF (n=10)	Severe >300 OPGF (n=8)
Carotene µg / dl	35.42±0.85	20.59***± 2.44	26.18*±2.42	23.70**±2.97	26.70*±2.04	21.22**±1.60
Vitamin A IU /dl	59.01±4.31	36.49***± 1.12	46.79*±2.77	43.25**± 2.73	43.46**±1.46	41.54***± 1.20
Vitamin E µg / dl	559.55±12.27	505.90***± 6.78	495.25***± 10.21	464.40***± 15.23	525.63*±8.75	396.25***± 7.21
Calcium mg / dl	11.35±0.38	5.71***± 0.28	10.61±0.23	8.43***±0.26	8.84***±0.52	7.80***±0.43
Inorganic Phosphorus mg / dl	8.38±0.30	4.19***± 0.18	5.59***±0.38	4.71***±0.29	6.13***±0.42	5.62***±0.32
Calcium / Phosphorus Ratio	1.33±0.03	1.36±0.21	1.90***±0.02	1.79***±0.02	1.44±0.04	1.39±0.02
Magnesium mg / dl	3.05±0.25	2.22**±0.15	2.27*±0.18	2.24*±0.15	2.81±0.23	2.21***±0.15
Sodium mEq/ l	117.08±1.69	105.63***± 1.78	106.88*± 4.76	103.80*± 5.61	108.63*±2.92	97.91***± 4.46
Potassium mEq / l	4.54±0.38	2.96**±0.25	4.81±0.64	5.11+0.76	3.41±0.49	5.10±0.87
Sodium / Potassium Ratio	25.79±0.87	35.68***± 2.00	22.22±1.75	20.31*±2.01	31.86±2.85	19.20**±1.50
Chlorides mEq / l	364.08±14.29	277.44***± 12.62	286.83**± 15.00	291.60**± 9.76	327.22*±5.17	2.99.40**± 9.03

EPGF = Egg per gram feces.
OPGF = Oocyst per gram feces.
EOPGF = Egg and oocyst per gram feces.

* = Significant at P< 0.05
** = Significant at P< 0.01
*** = Significant at P< 0.001

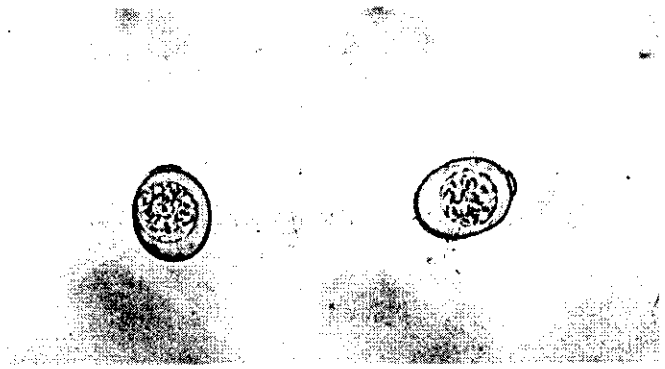

Fig. (1) Eimria cameli oocysts (X400)

Figure (1) shows the recovered coccidia oocysts (Eimeria cameli) from the infected camels under investigation.

Eimeria cameli (Henry & Masson, 1932) Reichenow, 1952:

Oocysts were pyriform in shape measuring 78 – 100 mm in length by 56 – 80 mm in width. The oocyst wall composed of four layers. Micropyl and micropylar cap was present. A single oocyst polar granule was found. The sporocyst measured 30 – 44 mm in length by 15 – 20 mm in width. The sporozoites were elongated with a one end narrower than the other.

DISCUSSION

The incidence of gastrointestinal parasites (table, 1) was 80 % among the examined camels in Giza province. Nematodes constituted a higher prevalence (66.67 %) than coccidia infection (43.33 %), 18/48 (37.50 %) of them were mixed infestation of nematodes and coccidia. Table (2) presented prevalence rates of the strongylid type species among camels infested with gastrointestinal nematodes.Trichostrongylus spp., Cooperia spp., Haemonchus spp., Ostertagia spp. and Oesophagostomum spp. were recovered from 46.88 , 34.38 , 21.88 , 15.63 and 6.25 %, respectively of the cultured fecal samples from camels infested with strongylid type species of nematodes.

Prevalence rates may vary from region to another as well as from season to another within the same region (Higgins, 1986). Higher prevalence rate (82.7 %) was recorded by Nafie et al. (1992) for gastrointestinal nematodes in the examined camels at North Sinai governorate. On the other hand, Awad (1996) recorded a lower prevalence rate (52.09 %) for gastrointestinal parasitic infestations in the examined camels from Sharkia governorate.

Regarding coccidia infection, fecal examination revealed a prevalence of 43.33 % in the examined camels. This was higher than the 5.33 % prevalence recorded by Nafie et al. (1992) in camels at North Sinai governorate ; the 24 % prevalence of Eimeria species recorded by Gill (1976) among Indian camels and the 17.4 % of Eimeria cameli oocysts recovered from Sudanese camels by Yagoub (1989). However, Mirza and Al-Rawas (1976) recorded higher prevalence (86 %) for Eimeria species infection among the examined camels in Iraq.

The higher prevalence rate of Eimeria oocysts in the camels under investigation might be due to the fact that clover (the possible source of coccidiosis) is an important source of protein for farm animals in the Nile Valley, Egypt. Contamination of fresh clover with coccidia oocysts might occur when clover fields are fertilized with camel or sheep and goat manure. This would then play an important role for the invasion of coccidia oocysts to camel. Another possibility of coccidia invasion is the habit of camels to ingest their own feces.

The descriptive data and measurement figures of the recovered Eimeria cameli oocyst in the present investigation (78 – 100 mm length by 56 – 80 mm width, Fig. 1) coincide with the 86 – 108 mm length by 61 – 86 mm width given by Kawasmeh and El-Bihairi (1983) for Eimeria cameli oocysts recovered from Saudi camels. Measurements of the obtained sporocysts (30 – 44 mm by 15 – 20 mm) was nearly similar to the 30 – 37 mm by 15.5 – 18 mm of Eimeria cameli sporocysts given by Ipcznski (1978).

Proteinogram of the serum samples from investigated camels (Table, 3) revealed highly significant decreases in total proteins, albumin and A/G ratio in the infested camel groups than in the apparently healthy non-infested group. No significant variation could be recorded in the globulins concentration.

These findings were in agreement with Zein El-Abdin et al. (1975), El-Magawry (1983), Mohammed (1988) and Nafie et al. (1992) findings in camels with gastrointestinal parasites and may be attributed to the state of anorexia and the gastroenteritis caused by the presence of parasites

that interfere with the protein intake and absorption (El-Magawry, 1983). The marked decrease in total proteins and albumin concentration observed in the present study may be probably due to the effect of metabolic products of the gastrointestinal parasites on liver cells (Taha et al. 1986), in addition to the albumin loss and leakage of plasma proteins through the damaged blood vessels of the inflamed intestinal mucosa (Mulligan et al. 1963).

Table (4) presented significant increase of serum ALT activity among camels infected with coccidia (> 300 OPGF). AST and AP were siincreased in all infested camel groups except for those with moderate mixed infestation of coccidia and gastrointestinal helminthes (< 300 EOPGF).

These findings are in agreement with Litvinskii (1982) and Ali (1989) findings in lambs infested with coccidiosis. The more pronounced elevation of AST and AP than ALT among the camels infested with gastrointestinal parasites agreed with Siddqua et al. (1989) findings in goats and Abdel All (1991) in sheep infested with gastrointestinal parasites.

The increased activities of ALT and AST in sera of infested camels under investigation evidenced that the metabolic products of the parasites may produced a damage in the liver cells (Ismail et al. 1990) and swelling of these damaged liver cells may lead to intrahepatic cholestasis and subsequently increased serum alkaline phosphatase (AP), Mandour and Ragab (1994).

Significantly increased blood urea were observed in all infested camels under investigation, but serum uric acid (UA) levels was only increased among camels with severe parasitic gastroenteritis (> 300 OPGF, >300 EPGF and > 300 EOPGF) as shown in table (4).

The significantly increased urea and UA in the infested camels under investigation agreed with the increment of these parameters in sheep infested with gastrointestinal nematodes reported by Parkins and Roseby (1973), Abbott et al. (1985) and Brar et al. (1991).

Kaneko et al. 1997 stated that urea is the main end product of protein catabolism and the increased urea may reflect an accelerated rate of protein catabolism rather than decreased urinary excretion of urea. This statement greatly explain the significantly increased urea and UA levels in camels infested with gastrointestinal parasites under investigation and may be attributed to increased tissue necrosis caused by the parasite and its products.

Table (5) showed a significantly decreased serum carotene, Vitamin A and Vitamin E concentra-

tions in all the camels infested with gastrointestinal parasites under investigation.

Kaneko et al. (1997) stated that intestinal mucosa has a primary role in the conversion of carotenes, primarily â–carotene (precursor of vitamin A), to the active vitamin A and bile salts are required for the mucosal uptake of â–carotene. The significantly decreased serum carotene and the fat soluble vitamins A and E in the infested camels under investigation could be attributed in one part to the mal absorption of these elements by the inflamed intestinal mucosa and on the other to the decreased amount of secreted bile due to intrahepatic cholestasis (Mandour and Ragab, 1994) as indicated by the significantly increased AP levels in the infested camels under investigation (Table, 4). Significantly decreased serum calcium, inorganic phosphorus and magnesium concentrations were observed in camels with different severity levels of parasitic gastroenteritis (Table, 5). These findings agreed with those reported by Ragab (1975), Zein El-Abdin et al. (1975) and Mohammed (1988) in camels suffering from parasitic gastroenteritis.

The observed hypocalcaemea and hypophosphataemia may be attributed to disturbances in the digestion and absorption as well as to the changes occurring in the duodenum towards alkalinity as a result of parasitic infestation which interfere with the absorption of calcium and phosphorus (Ragab, 1975 and Zein El-Abdin et al. 1975). Moreover, the observed hypocalcaemia among infested camels under investigation may be due to the decreased serum albumin levels (Table, 3) since large amounts of the serum calcium are bound to serum albumin (Sinclair, 1962). The significantly decreased serum magnesium levels might be attributed to the observed hypoalbuminaemia among infested camels under investigation (Table, 3) as Calcium and magnesium ions may compete for the binding site on the protein molecules and so hypoalbuminaemia may be responsible for the occurrence of reduced level in both calcium and magnesium (Carr, 1955), in addition to the mal absorption of magnesium from the inflamed intestinal mucosa of infested camels.

Regarding the effect of parasitic gastroenteritis on serum sodium, chlorides and potassium levels presented in table (5), significantly decreased serum sodium and chloride concentrations were detected in all the camel groups infested with gastrointestinal nematodes and / or cocccidia while serum potassium concentration was significantly decreased in those with severe coccidia infection (> 300 OPGF).

Kaneko et al. (1997) stated that decreased serum sodium concentration (hyponatremia) is often but not invariably associated with conditions which cause sodium depletion such as diarrhea and vom-

iting. The significantly decreased serum sodium and chloride levels among infested camels under investigation may be attributed to the various degrees of sodium depletion in the examined diarrheic camels. The significantly decreased serum potassium concentration (hypokalemia) among camels with severe coccidia infection (>300 OPGF) agreed with Isler et al. (1987) finding in bovine coccidiosis and may be due to potassium depletion associated with excessive potassium loss from the gastrointestinal tract as a result of diarrhea coupled with the reduced dietary intake of potassium due to anorexia (Kaneko et al. 1997).

It could be concluded from the results of this study that camels with parasitic gastroenteritis especially coccidiosis and severe helminthiasis suffered certain degree of liver dysfunction, hypoproteinaemia and hypoalbuminaemia together with serum depletion of certain essential vitamins and minerals that affect the general health condition of infested camels.

Routine periodical parasitological examination and monitoring of serum macro and micro nutrients of camel herds is recommended in order to diagnose and treat sub-clinical cases of gastrointestinal parasitism particularly those of Eimeria cameli. This may aid in keeping camels in a good healthy condition and increase their performance.

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