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BIOCHEMICAL CHANGES IN THE SERA OF LACTATING GOATS AFFECTED WITH AFLATOXICOSIS

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SUMMARY

Aflatoxicosis syndrome was observed in 10 lactating female goats at Borg El-Arab, Egypt. Examination of feed samples showed that the available ration was contaminated with about 200 ppb. aflatoxin B_1. A control apparently health group was taken from another farm in the same locality. Investigation of serum samples from affected female goats revealed increased activities of serum amino transferases, alkaline phosphatase, urea and creatinine concentrations, triacylglycerol and free fatty acids. Together with decreased serum total proteins, albumin, globulins, calcium, inorganic phosphorus, magnesium, potassium, vitamin A, vitamin E, total lipids, total cholesterol, high and low density lipoproteins and phospholipids concentrations.

Aflatoxin residue (less than 1 to 2.5 ppb.) was detected in the milk of examined female goats.

INTRODUCTION

Aflatoxins represent a group of secondary fungal metabolites that were discovered as contaminants of certain lots of animal feed. The recorded signs of aflatoxicosis in goats were decreased food consumption, loss of body weight, mucopurlent nasal discharge and diarrhea (Clark, et al. 1984 and Arafa et al. 2001).

Aflatoxin (AF) B_1 has shown to be carcinogenic at levels of 1ppb. In the diet of the rat (Wogan, et al. 1974). They were transmitted from feed of lactating animals to their milk. Investigation of this transfer, in general, have been limited to the detection of aflatoxin M_1 (AFM_1) in milk

(Alloroft and Roberts, 1968; Masri, et al. 1969; Purchase, 1972 and Paterson et al. 1980).

Aflatoxins were also found to adversely affect the physiological functions of several organs leading to increased incidence of immune suppression and reduced productivity of affected animals (Ramos, et al. 1996). Liver seems to be the major organ that can be damaged by aflatoxin exposure. Increased serum AST, ALT and AP activities were reported in goats exposed to ration contaminated with aflatoxins (Maryamma and Sivadas, 1975). Reduced serum albumin, and globulins were also reported in goats exposed to ration contaminated with aflatoxins (Farag, 2001). Agag et al. (1992) showed that calves fed ration containing 10-30 % cottonseed meal contaminated with aflatoxins had increased serum creatinine together with decreased calcium, total lipids and vitamin A concentration.

The aim of the present work is to investigate the biochemical changes of some serum biochemical parameters in the early lactating female goats affected with aflatoxicosis and showing aflatoxin residue in their milk.

MATERIAL and METHODS

MATERIAL:

- Ten lactating Zaraibi goats (2-3 years old) showing clinical signs of aflatoxicosis in a farm at Borg El-Arab, Egypt (Group II, test group).
- Fifteen apparently healthy lactating female goats in a different farms at the same locality (Group I, control).
- Feed samples from the available ration to both groups.
- Milk and Blood samples were collected from both groups.

METHODS:

Ration samples were examined for the presence of aflatoxin B_1 according to the method described by Roberts and Patterson (1975).

Milk samples were examined for the presence of aflatoxin M_1 by the flurometric method after passage on immunaffinity column according to Hansen (1993).

Serum samples were examined for the activity of amino transeferases (ALT and AST) according to Reitman and Frankel (1957) and alkaline phosphatase (AP) according to Kilichling and Freiburg (1951). Serum creatinine, urea, total proteins and albumin and globulin concentrations were measured according to the methods described by Husdan and Rapoport (1968), Tabacco (1979), Hoffamann and Richterrich (1970), Doumas et al. (1971) respectively.

Total lipids, total cholesterol, triacylglycerol, free fatty acids, phospholipids and the low density (LDL), high-density (HDL) and very low density (VLDL) lipoproteins were measured according to

the methods described by Knight et al. (1972), Watson (1960), Fossati and Principe (1962), Schuster, 1979), Zilvermit and Davis (1950) and Lopez-Virella et al. (1977) respectively.

Calcium, inorganic phosphorus and magnesium serum concentrations were measured according to Glindler and King (1972), Kilichling and Freiburg (1951) and Neill and Nelly (1956) respectively. Serum sodium and potassium concentrations were measured by flame photometry according to Oser (1979).

Vitamin A was measured according to Dann and Evelyn (1938), and vitamin E by the ferric chloride depyridyl method (Quaife and Dju, 1949) cited by Oser (1979).

Statistical analysis of the obtained data for the standard error and student's "t" test for significant differences between mean values of female goats suffering from aflatoxicosis and those of the control group were done according to Snedicor and Cochran (1976).

RESULTS

The observed clinical signs of aflatoxicosis were anorexia, depression and loss of weight.

Ration analysis showed that the available ration for intoxicated female goats (G II) contains about 200 ppb. aflatoxin B_1, while that available to the apparently healthy group (G I, control) was totally free from aflatoxins.

Table (1) presents a significant increase in serum amino transferases (ALT and AST) and alkaline phosphatase (AP) activities, urea and creatinine concentrations, together with a significant decrease in serum total proteins, albumin and total globulins concentrations.

Table (2) showed a significant decrease in serum total lipids, total cholesterol, high-density lipoproteins, low-density lipoproteins and phospholipids together with a significant increase in serum triacylglycerol and free fatty acids concentrations.

Table (3) presents significant decrease in serum calcium, inorganic phosphorus, magnesium, potassium, vitamin A and vitamin E concentrations.

Table (4) presents aflatoxin residue (AFM_1) in milk samples.

Table (1): Liver enzymes, kidney function and proteinogram of lactating female goats exposed to ration contaminated with aflatoxins (200 ppb.)

Serum Biochemical Parameter	Lactating goats exposed to uncontaminated ration n = 15	Lactating goats exposed to contaminated ration n = 10
ALT U / l	27.40 ± 1.03	44.36*** ± 2.29
AST U / l	34.60 ± 1.20	55.00*** ± 1.86
AP mmol. / l	1.5 ± 0.05	2.16*** ± 0.08
Urea mg / dl	33.10 ± 1.12	40.50** ± 1.89
Creatinine mg / dl	1.06 ± 0.03	1.23** ± 0.05
Total protein g / dl	7.03 ± 0.35	4.28*** ± 0.27
Albumin g / dl	3.60 ± 0.22	2.18*** ± 0.16
Globulins g / dl	3.45 ± 0.18	2.06*** ± 0.15
A / G Ratio	1.07 ± 0.03	1.06 ± 0.04

** = Significant at $P < 0.01$

*** = Significant at $P < 0.001$.

Table (2): Lipogram of lactating female goats exposed to ration contaminated with aflatoxins (200 ppb.)

Serum Biochemical Parameter	Lactating goats exposed to uncontaminated ration n = 15	Lactating goats exposed to contaminated ration n = 10
Total lipids mg / dl	349.67 ± 3.07	311.91*** ± 5.20
Total cholesterol mg / dl	115.67 ± 1.88	93.90*** ± 2.75
Triacylglycerol mg / dl	97.35 ± 2.10	108.60*** ± 1.92
HDL mg / dl	23.46 ± 0.80	16.80** ± 0.97
LDL mg / dl	71.80 ± 1.31	55.81*** ± 0.95
VLDL mg / dl	19.40 ± 1.35	21.15 ± 0.87
Free F.A. mmol. / l	1.40 ± 0.05	1.81*** ± 0.03
Phospholipids mg/dl	136.62 ± 4.30	118.80** ± 3.12

** = Significant at $P < 0.01$

*** = Significant at $P < 0.001$.

Table (3): Certain serum minerals and vitamins of lactating female goats exposed to ration contaminated with aflatoxins (200 ppb.)

Serum Biochemical Parameter	Lactating goats exposed to uncontaminated ration n = 15	Lactating goats exposed to contaminated ration n = 10
Total Calcium mg / dl	10.43 ± 0.43	9.09** ± 0.30
Inorganic Phosphorus mg / dl	6.95 ± 0.19	5.20*** ± 0.27
Magnesium mg / dl	2.53 ± 0.13	2.18* ± 0.10
Sodium meq. / l	130.73 ± 2.41	127.50 ± 1.28
Potassium meq. / l	3.56 ± 0.18	2.84** ± 0.15
Vitamin A I.U. / dl	41.60 ± 1.83	24.00*** ± 0.99
Vitamin E µg / dl	623.47 ± 4.27	586.36*** ± 6.45

** = Significant at $P < 0.01$

*** = Significant at $P < 0.001$.

Table (4): Aflatoxin residue (AFM1) in the milk of lactating female goats exposed to ration contaminated with aflatoxins (200 ppb).

AFM_1 residue in milk	Number of Lactating goats
< 1 ppb.	2
1.00 – 1.50 ppb.	4
2.00 – 2.50 ppb.	4
Total	10

DISCUSSION

Aflatoxins posses potent hepatotoxic, nephrotoxic and carcinogenic properties (Arafa et al. 2001 and Wogan et al. 1974). The observed clinical symptoms of aflatoxicosis in the examined Lactating goats agreed with the symptoms described by Clark et al. (1984) and Arafa et al. (2001).

Table (1) showed that lactating female goats fed on ration contaminated with about 200 ppb. aflatoxin B_1 had a significantly increased activities of the serum amino transferases (ALT and AST) and alkaline phosphatase (AP), increased serum urea and creatinine concentrations together with a significantly decreased serum total proteins, albumin and total globulins concentrations.

The increased serum activities of ALT, AST and AP in the examined Lactating goats agreed with the results obtained by Maryamma and Sivadas (1975); Suliman et al. (1987) and Farag (2001). Such increased activities might be attributed to hepatocellular damage as liver seems to be the major organ that can be damaged by aflatoxin exposure.

The significantly decreased serum total protein that resulted from the decreased albumin and total globulins in lactating female goats under study was similar to the results reported by Miller and Wilson (1994); Refai (1988) and Saleh et al. (1997) and might be attributed to impaired protein synthesis which was a result of the disruption of DNA transcription and RNA translation in the liver. The significantly decreased serum total protein, albumin, total globulins and the increased liver enzyme activities (ALT, AST and AP) are indicative diagnostic index of hepatocellular damage, liver cirrhosis and proliferation of the biliary caniculi (Pier et al. 1989 and Clark et al. 1984).

The significantly increased serum urea and creatinine concentrations during aflatoxicosis may be attributed to the inflammatory changes of the kidneys and renal pelvis reported by Livolsi et al. (1994).

Table (2) presents a significant decrease in serum total lipids, total cholesterol, high-density lipoproteins (HDL), low-density lipoproteins (LDL) and phospholipids in addition to a significantly increased serum triacylglycerol and free fatty acid (FFA) levels among the examined Lactating goats.

The significantly decreased serum total lipids, total cholesterol, HDL, LDL and phospholipids coincide with the results reported by Agag et al. (1992). Such decreases may be attributed to the altered lipid metabolism (increased of lipids in the liver and reduction of transportation) reported by Teleb and Fakhry (1988).

The significantly increased serum triacylglycerol

and FFA levels could be a result of hepatic toxicity (Cooke et al. 1986 and Harvey et al. 1995) and the hepatocellular damage that were indicated by the increased serum activities of the liver enzymes and decreased serum total proteins, albumin and globulins presented in table (1). On the other hand, adipose tissue contributes the major portion of fatty acid synthesis in the mice, and presumably all mammals, (Favarger, 1965). Triglycerides are formed in the liver through estrification of free fatty acids and are mildly increased in acute hepatic injury (Kaneko, 1989).

Table (3) showed a significant decrease in serum total calcium, inorganic phosphorus, magnesium, potassium, vitamin A and vitamin E concentration in lactating female goats exposed to rations contaminated with aflatoxins.

The significantly decreased serum total calcium, inorganic phosphorus magnesium and potassium are in agreement with the results obtained by Glahn et al. (1990) and Ramos et al. (1996).

The significantly decreased serum calcium and phosphorus levels might be attributed to one or more factors: (1) a direct result of renal tubular damage; (2) decreased mineral absorption from the gut; (3) a result of altered levels of the circulating parathyroid hormone (PTH) or possibly to decreased renal sensitivity to PTH (Ramos et al. 1996). Glahn et al. (1990) attributed the decreased serum calcium and phosphorus levels to the decreased intestinal absorption of calcium and phosphorus, or inhibition of tubular phosphate re-absorption and inhibition of tubular phosphate secretion.

The significant decrease in serum magnesium concentration may be a result of decreased magnesium reabsorption from the inflamed renal tubules that leads to increased magnesium loss (Rayssigurier, 1984).

The significantly decreased serum potassium concentration could be a result of the decreased food intake during the aflatoxicosis syndrome (Carlson, 1989).

The significant decrease of serum vitamins A and E levels coincide with the results reported by Agag (1992). The hypovitaminosis A and E might be attributed to the hepatocellular damage during aflatoxicosis that interferes with the synthesis of retinol binding protein (RBP) which is secreted by the liver and is essential for transportation of vitamins A and E in the serum (Kaneko 1989).

Table (4) presents aflatoxin residue (AFM_1) in milk of the lactating goats showing aflatoxicosis syndrome, which agreed with results obtained by Mashaly et al. (1984) and Helferich et al. (1986). Ingestion of aflatoxin contaminated ration by lactating animals resulted in an increased levels of AFM_1 in their mammary gland than in other tis-

sues (Subbiefield, 1983).

In conclusion, ration analysis of the available ration to female lactating goats showing toxicosis syndrome revealed the presence of aflatoxins which is the real cause of the observed biochemical changes in the investigated serum and the detected AFM_1 residue in milk samples.

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