

The Effects Of Copper Deficiency On Biochemical Blood Parameters Of Chickens

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ABSTRACT: In this study, it was purposed to investigate the effects of copper deficiency on some plasma metabolites,electrolites and enzyme activities in chickens. Statistically significant differences were not determined in plasma albumin, uric acid, urea, creatinine, sodium (Na), potassium (K), chloride (Cl), inorganic phosphorus (IP) levels , aspartate amino transferase (AST), alanine amino transferase (ALT) , acid phosphatase (AcP), gamma glutamyl transpeptidase (GGT), lactate dehidrogenase and α .amylase activities between control and trial groups. Total cholesterol was found higher in trial chickens than controls ($p < 0.001$). Total protein was found lower in trial chickens than controls ($p < 0.01$). It was observed that copper deficiency did not cause important changes in biochemical blood parameters except cholesterol and total protein.

Key Words : Copper, deficiency, chicken, plasma, biochemical parameters.

Piliçlerde Bakır Noksanlığının Biyokimyasal Kan Parametreleri Üzerine Etkisi

Ö ZET: Bu çalışmada piliçlerde bakır noksanlığının bazı plazma metabolitleri, elektrolitleri ve enzim aktiviteleri üzerine etkisini araştırmak amaçlanmıştır. Bakır noksanlığı, plazma albumin, ürik asit, üre, kreatinin, sodyum (Na), potasyum (K), klor (Cl), inorganik fosfor (IP) düzeyleri ve aspartat amino transferaz (AST), alanin amino transferaz (ALT) , asit fosfataz (AcP), gama glutamil transpeptidaz (GGT), laktat dehidrojenaz , α .amilaz enzim aktiviteleri bakımından istatistik bir farklılık meydana getirmemiştir. Toplam kolesterol deneme piliçlerinde kontrollerinkinden daha yüksek ($p < 0.001$), toplam protein ise deneme piliçlerinde kontrollerinkinden daha düşük ($p < 0.01$) bulunmuştur.

Piliçlerde bakır noksanlığının toplam kolesterol ve toplam protein dışında plazma biyokimyasal parametrelerinde önemli değişikliklere sebep olmadığı kanısına varılmıştır.

Anahtar Kelimeler : Bakır, noksanlık, piliç, plazma, biyokimyasal parametreler

INTRODUCTION

Copper (Cu) is an essential factor for the growth and development of living matter (15,24). It is required for a variety of functions in animals including bone formation, cardiac function, connective tissue development, myelination of spinal cord, keratinization and tissue pigmentation (12,18) . Copper deficiency develops when the Cu content of the diet is less than animal requirements or when the Cu content of the diet is marginal to normal but absorption and utilization of ingested Cu is impaired by other minerals (28). It is also suggested that histidine-excess diet caused copper deficiency (5).

Copper deficiency causes many disorders. Its deficiency is associated with skeletal abnormalities in rabbits, chickens, pigs, sheep and goats (2). It is reported that growth retardation, blood disorders including anemia, leucopenia and neutropenia, acute hearth failure, elastic tissue abnormalities, aortic lesions, hypercholesterolemia, impaired glucose metabolism and decreased antibody formation occur in copper deficiency (13,17,27). It is also suggested that perinatal Cu deficiency may impair cerebellar maturation in rats (19).

This investigation was conducted to determine the effects of copper deficiency on some plasma metabolites , electrolite levels and enzyme activities in chickens.

MATERIAL AND METHOD

One hundred day-old Isobrown x Lohmann chicks were used in this study. Fifty control and fifty trial chicks were fed with a special ration which was prepared from foodstuff contain copper in low levels according to NRC (National Research Council) foodstuff composition tables for five months. Trial chicks were fed ration without copper while control chicks were fed ration with standart mineral mix (containing 5 mg/kg copper). To prevent the usage of copper came from the foodstuff, 2 mg/kg molybdenum was added to the ration of trial chicks. Bidistilled water was given to the trial chicks while tap water was given to the control chicks,.

At the end of the feeding for five months , ten control and ten trial chickens were chosen randomly. Blood were taken into tubes with EDTA during the slaughter. Plasma copper levels were analyzed by Atomic Absorption Spectrophotometer (Sp 9 Pye Unicam, England). Plasma albumin, total protein, total cholesterol, uric acid, urea, creatinine, sodium (Na), potassium (K), chloride and inorganic phosphorus (IP) levels and aspartate aminotransferase (AST), alanin amino transferase (ALT), acid phosphatase (AcP), gamma glutamyl transpeptidase (GGT), lactic acid dehydrogenase (LDH) and amylase enzyme activities were determined by using Auto Technicon DA X 72

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autoanalyzer and its kits. The foodstuff of control and trial chickens were analyzed by using the methods in AOAC (Association of Agricultural Chemists) (1). Statistical analysis of findings was performed by Minitab Statistical Packet Program Independent sample t test from parametric tests was used to evaluate any differences between groups (22).

RESULT AND DISCUSSION

The results of the analysis of the control and trial rations, and the biochemical blood parameters and statistical values of control and trial chickens are presented in Table 1 and 2, respectively.

Table-1. The contents of the rations using to feed control and trial chickens

Nutrients (%)	Control group	Trial group
Dry matter	87.135	86.845
Crude protein	24.63	23.29
Ash	10.88	10.22
Crude fiber	8.26	7.07
Ether extracts	3.88	4.1
Calcium	4.12	6.12

Table-2. The biochemical values and statistical results of control and trial chickens. (n=10)

Biochemical parameters	Control group X±Sx	Trial group X±Sx
Copper (µg/dl)	15.8±0.96*	7.94±0.840
Albumin (g/dl)	1.94±0.130	1.66±0.500
Total protein (g/dl)	5.09±0.320*	4.44±0.390
Total cholesterol (mg/dl)	124.8±6.91**	166.1±11.82
Uric acid (mg/dl)	5.84±1.780	5.30±1.510
Urea (mg/dl)	3.08±0.530	2.85±0.630
Creatinine (mg/dl)	0.078±0.0290	0.100±0.0560
AST (U/l)	218.4±19.30	225.6±25.08
ALT (U/l)	21.6±3.13	21.6±3.23
AcP (U/l)	9.6±2.30	8.3±3.20
GGT (U/l)	18.8±4.08	23.10±3.440
LDH (U/l)	650.8±142.90	752±104.30
α Amylase (U/l)	253.6±35.93	298.6±76.73
Sodium (mEq/l)	175±10.22	179.0±9.79
Potassium (mEq/l)	4.82±0.310	5.33±0.740
Chloride (mEq/l)	111.6±5.68	116.3±1.49
Inorganic phosphorus (mg/dl)	5.46±0.560	6.58±0.610

* p < 0.01 ** p < 0.001

At the end of the five months, the plasma copper levels of control and trial chickens were measured as 15.8 and 7.94 (µg/dl), respectively. Statistically significant differences (p < 0.01) were determined between two groups. Copper levels were consistent with values given in literatures (3,4).

Chen et al. (11), determined that various copper levels had no apparent effect on serum α amylase, ALT, ALP, total protein, albumin or uric acid, while there were significant increases in serum AST and CK with high level copper-supplement.

The plasma levels of albumin, uric acid, urea,

creatinin, AST, ALT, GGT, LDH, α amylase, K, Cl, IP were found in normal ranges while the sodium values were higher in this study than reported in literatures (9,14,21,26).

Statistically significant differences were not determined in these parameters between control and trial chickens. Also, AcP values were not different in two groups. The comparison could not be made for normal range since AcP value could not be found in literatures for chicken.

Although plasma total protein and total cholesterol values were found in normal range as in

the literatures (8,14,20), there were statistically significant differences between control and trial chickens for total protein being lower in trial group than control group ($p < 0.01$) and total cholesterol being lower in control group than trial group ($p < 0.001$).

Frank et al. (16), studied on experimental copper deficiency in goats and they found that impaired carbohydrate and lipid metabolisms were seen in copper deficient goats with increased concentrations of glucose, lactate, triglycerides and total bilirubin in serum. Also they determined protein abnormalities in these goats.

In some studies (6,23), it was suggested that hypocholesterolemia and decreased breast muscle cholesterol were observed in copper supplemented birds.

It was suggested that relative or absolute copper deficiency may contribute to elevated serum cholesterol level and to the occurrence of atherosclerotic cardiovascular disease in humans. It was reported that copper deficiency in rats causes an increase in plasma HDL cholesterol (25).

Hypercholesterolemia of copper-deficient rats has been hypothesized due to suppression of the cholesterol degradation process. There are apparent discrepancies regarding the effect of copper deficiency on the ration of saturated and unsaturated fatty acids. In rats, copper deficiency has led to the accumulation of longer-chain polyunsaturated fatty acids in triglycerides of various tissues. Increased lipid peroxidation due to the inhibition of catalase and glutathion peroxidase in liver and the erythrocyte membran occurred with copper deficiency (2). The finding of hypercholesterolemia observed in trial chickens is consistent with the studies which were previously reported (2,6,25).

The plasma proteins are affected with some factors such as age, development, hormones, stress, feeding condition, nutritional disturbances (7,10,14). Cerone et al. (10), suggested that copper deficiency did not cause any changes in the levels of serum total proteins of cattle. In this study, low plasma total protein levels of trial group may be resulted from growth retardation and decreased food conversion.

In this study, it was observed that copper deficiency did not cause important changes in blood biochemical parameters except cholesterol and total protein.

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