Effect of Zinc Sulfate, Copper Sulfate and Lead Acetate on the some Biochemical Parameters of the New Zealand Rabbits

S. Th. J. Alrawi, A. I. Ali and M. J. Muhaidi
College of Veterinary Medicine/ University of Al-Fallujah

Abstract

This study conducted to investigate the effect of zinc sulfate, copper sulfate and lead acetate on the serum total protein, albumin and globulin of rabbits. Forty-two adult rabbits were divided randomly into seven groups of six rabbits, they were fed a basic ration and treated as the following; Group 1 (G1): Drenched distal water as a control group. Group 2 and 3 (G2, G3): Drenched with zinc sulfate (5, 10 mg/ kg BW respectively). Group 4 and 5 (G4, G5): Drenched with copper sulfate (2.5, 5 mg/ kg BW respectively). Group 6 and 7 (G 6, G 7): Drenched with Lead acetate (2.5, 5 mg/ kg BW respectively). Blood were collected from the heart at the end of the experiment (4 weeks). The results showed a significant increased ($P<0.05$) in total protein in the (G3) that treated with zinc sulfate compared with (G4, G5, G6, G7) that treated with copper sulfate and lead acetate, whereas the groups that treated with copper sulfate and lead acetate (5 mg/ kg BW) (G5, G7) showed a significant decrement ($P<0.05$) compare with control group (G1). The albumin concentration significantly increased ($P<0.05$) in the group that had treated with zinc sulfate (10 mg/ kg BW) (G3) compare with (G1, G2, G5, G7). While the globulin concentration showed a significant decrement ($P<0.05$) in groups the administrated copper sulfate (G4, G5) and lead acetate (G6, G7) compare with the control group (G1) and groups that treated with zinc sulfate (G2, G3). In conclusion, the copper sulfate and lead acetate caused a decrease in total protein, albumin and globulin concentration in the serum, whereas the zinc sulfate has improvement effect.

Key words: Zinc sulfate, copper sulfate, lead acetate, rabbit.
E-mail: saad_alrawe@yahoo.com, ayoubibrahiali@gmail.com, mjm20002014@gmail.com

تأثير كبريتات الزنك وكبريتات النحاس وخلات الصوديوم على بعض المعايير البايوكيمياوية في الأرانب النيوزلندية

سعد ثابت جاسم الراوي، أيوب إبراهيم علي ومحمد جبير مهيدي
كلية الطب البيطري/ جامعة الفلوجة

الخلاصة

صممت هذه الدراسة للتحري عن تأثير كل من لكبريتات الزنك وكبريتات النحاس وخلات الرصاص على البروتين الكلي والألبومين والكلوبيولين في مصل الأرانب. تم استخدام اثنان وأربعون أرنبا بالغاً، قسمت بشكل عشوائي إلى 7 مجاميع. ضمت كل مجموعة 6 أرانب. حيث غذيت هذه الأرانب على عليقة أساسية وعوملت كما يلي: المجموعة الأولى G1 جرعت بالماء المقطر واعتبرت كمجموعة سيطرة. المجموعة الثانية والثالثة G2, G3 جرعت بكبريتات الزنك (5 ,10 ملغ/ كلغ من وزن الجسم) على التوالي. المجموعة الرابعة والخامسة G4, G5 جرعت بكبريتات النحاس (2.5 ,5 ملغ/ كلغ من وزن الجسم) على التوالي. المجموعة السادسة والسابعة G6, G7 جرعت بخلات الرصاص (2.5 ,5 ملغ/ كلغ من وزن الجسم) على التوالي. تم جمع عينات الدم من القلب في نهاية التجربة (بعد مرور 4 اسابيع). أظهرت نتائج الدراسة وجود زيادة معنوية ($P<0.05$) في البروتين الكلي للمجموعة الثالثة G3 التي جرعت بكبريتات الزنك مقارنة بالمجاميع G4, G5, G6, G7 التي جرعت بكبريتات

النحاس و بخلات الرصاص. بينما أظهرت النتائج انخفاض معنوي ($P<0.05$) في المجموعة الخامسة والسابعة G5, G7 والتي جرعة بكبريتات النحاس وخلات الرصاص بتركيز (5 ملغ/ كلغ من وزن الجسم) على التوالي مقارنة بمجموعة السيطرة G1. ان تركيز الألبومين اظهر زيادة معنوية ($P<0.05$) في المجموعة التي عوملت بكبريتات الزنك (10 ملغ/ كلغ من وزن الجسم) G3 مقارنة مع المجاميع الأولى والثانية والخامسة والسابعة G1, G2, G5, G7. بينما اظهر تركيز الكلوبيولين انخفاض معنوي ($P<0.05$) في مجموعتي التي جرعت بكبريتات النحاس المجموعة الرابعة والخامسة G4, G5 ومجموعتي التي جرعت خلات الرصاص السادسة والسابعة G6, G7 مقارنة بمجموعة السيطرة ومجموعتي التي جرعت كبريتات الزنك المجموعة الثانية والثالثة G2, G3. نستنتج من هذه الدراسة ان تجريع كبريتات النحاس وخلات الرصاص أدى انخفاض تركيز البروتين الكلي، الألبومين والكلوبيولين في المصل، في حين ان كبريتات الزنك كان لها تأثير تحسيني.

الكلمات المفتاحية: كبريتات الزنك، كبريتات النحاس، خلات الرصاص، الأرانب.

Introduction

Zinc (Zn) considered as an essential minerals for animals. It is required for skeletal system and skin growth, appetite, reproduction, wound healing, immune capability and biochemical processes (1), it is an important component of enzymes (more than 300 enzymes), that essential in assimilation of energy, carbohydrates and protein metabolism. Zinc is essential for activate several enzymatic systems. Its play a role in peptidases, dehydrogenases and esterases. It has effective in the immune system, synthesis of protein and DNA, proliferation of cells (2). In addition, it has both structural and catalytic functions in metalloenzymes (3). Zinc is one of the most important antioxidant. However, its increases the synthesis of metallothionein (4). Zinc deficiency in animals characterized by inhibition of feed intake, retarding of growth, decreasing the levels of growth hormone and insulin like growth factor-I, and inhibition creation of insulin-like growth factor-I. Zinc positively affects feed utilization through the metabolism of carbohydrates, lipids, and proteins (3). Whereas a copper play a vital role in the body of animals: for fetal growth and early post-natal development, bone development and inflammatory process (5). Copper is essential as a trace element for metabolic process. In spite of being an important biological trace element, necessary for different physiological system copper has a toxic effect (6). The toxicity of copper occurs in two forms acute and chronic, the first form is acute copper toxicity results from ingestion of high copper salts, pesticides، poultry litter. Acute poisoning occur during copper intake (20-100 mg/kg) in sheep and calves, while (200-800 mg/kg) in adult cattle. The second form is a chronic toxicity occur when high levels of copper are intakes for long time (7). Lead is considered as one of the most hazard and cumulative pollutant that affect biological systems through exposure from air, water and food sources (8). It is toxic to animals and humans (9). Lead is a poisonous metal, which has two forms organic and inorganic (10). Lead exposure induces clinical-pathological alterations through toxicity happened to endocrine system and kidney (11). High blood lead concentration in animals causing reproductive failure (12), as it affects circulatory level of progesterone (13). In addition, it causes a decrease in reproductive fitness (14). Lead is a element which present in the environment and using in several industrial activities including mining, refining and producing batteries (15). Lead heavy metal remains a significant public health problem. Animals exposure to lead by contaminated food or water (16). The major routes of lead the alimentary and respiratory tract (17). Elevated lead concentration in the body have been related with cardiac, renal disease, hematologic poisoning and permanent neurologic destruction (18), exposure to acute lead poisoning has been associated with hemolytic anemia (19). In addition, the central

nervous system considered as a primary site of lead action (20). This study was designed to evaluate the effect of zinc sulfate, copper sulfate and lead acetate on the total protein, albumin and globulin of rabbit's serum.

Materials and Methods

- **Experimental animals:** Forty-two adult rabbits were the age of 8-12 months and weight 900-1400 grams. Rabbits were divided randomly into seven groups, each group consist of 6 rabbits all groups were fed basic ration, Group 1 (G1): Rabbits of this group were let without treatment and drenched distal water as control group. Group 2 and 3 (G2, G3): Rabbits of these groups drenched with zinc sulfate (5, 10 mg/ kg BW respectively). Group 4 and 5 (G4, G5): Rabbits of these group were drenched with copper sulfate (2.5, 5 mg/ kg BW respectively). Group 6 and 7 (G 6, G 7): Rabbits of these groups were drenched with lead acetate (2.5, 5 mg/ kg BW respectively). After four weeks, blood was collected from the heart, the spectrophotometric methods kits (Biolabo) were used to measuring the serum total protein, albumin and globulin in serum according to (21).
- **Statistical Analysis**: The data were subjected to statistical analysis using one-way analysis of variance (ANOVA) and Least significant differences (LSD) test was done by using SPSS (22).

Result and Discussion

The results showed a significant ($P<0.05$) increase of total protein in the G3 compare with G4, G5, G6, G7 and the results refer to a significant ($P<0.05$) decrease in the G5, G7 compare with G1 and G2 (Table 1). Total protein, albumin, globulin were affected significantly by dietary zinc supplementation. The obtained values was increase by increasing zinc concentration in the feed, this may be accredited to the adequate zinc to increase the activity of zinc metalloenzymes, which stimulate the synthesis of body protein (23). On other hand, zinc stimulating glucose dependent insulin secretion from the pancreas cells (24), the increasing in the insulin levels causing decrease protein catabolism, amino acid degradation then increment the protein synthesis (25), this results were in agreement with (26) who reported that considerable rise in the total protein in broiler chicks, which fed zinc, because zinc is an important component of a several enzymes contributing in the synthesis of proteins and nucleic acids. The low concentrations of the total protein in the serum of rabbit that fed copper sulfate G4, G5, may be occur with a nephritic syndrome (27) and liver disorder (28). Serum protein reduction in copper exposure may be attributed to the protein catabolism, the process changing protein to energy, to meet higher energy demand during the prevailing stress and it can indicates cirrhosis or significant liver damage (29). The results of study indicate that of total protein content decreases with increase in copper concentration, this agree with the (30), who suggested may be due to binding of copper with group of sulfhydryl of protein and instigating deleterious effect in the normal protein form. Total proteins decrease in G6, G7 may be attributed to reduced protein synthesis as a result of liver disorder (31). On the other hand, the decrement in protein could result from the protein breakdown to amino acids and other elementary molecules. The decreased in serum proteins may be attributed to renal toxicity and hepatotoxicity as result over dose of lead intake (32), whereas reduction in total protein levels may be due to decreased of protein synthesis by the specific enzymes in cell and little excretion of hormones (such as T3 and T4) (33) or may be due to increased transaminase, increasing the activity of these enzymes lead to failure to reproduce protein. Destruction of muscles under stress is leading to decrease protein in tissue. In fact, the reduction in stress proteins can be affected by the inability to absorb food (34) this decrease in protein concentration may be because liver damage which responsible for protein synthesis in the body. The latter

damage cannot prevent lost of protein from the blood to urine. These results may be attributed to liver necrosis (because of toxicant) of lead, which caused to leak from liver to the circulatory system and inhibition of liver enzymes (35). The results of current study were agreement with (36, 37). From this study, the results showed a significant ($P<0.05$) increase of albumin in the G3 compare with the G1, G2, G5 and G7, these findings are in agreement with those reported by (38), who suggested that adding additional Zn improved the levels of total protein, albumin and globulin, because zinc is an essential for many enzymes contributing in the production and synthesis of proteins. Globulins is essential component in immune response (antibodies), the increased serum globulin concentrations with zinc supplementation this agreement with (39, 40). The serum Globulin level dropped in the group that drenched lead acetate and copper sulfate may suppressed the immune system. In general, reduction of protein synthesis in the liver affects directly on the level of globulins (34). (41) recorded that administration of 10 mg lead significantly ($P<0.05$) decreased the serum total proteins, albumin, and globulins compared to the control values due to decrease in immunoglobulins with dysfunctions in different organ systems of the body, such as the immune system. Conclusion, the copper sulfate and lead acetate impact the health of rabbits and caused a decrease in total protein, albumin and globulin concentration in the serum, whereas the zinc sulfate has improvement effect and caused increased in total protein, albumin and globulin concentration.

Table (1) Effect of zinc sulfate, copper sulfate and lead acetate on the serum total protein, albumin and globulin (g/dl) of the New Zealand rabbits

Parameters / Groups	Total protein	Albumin	Globulin
G1 Control	6.24 ±0.16 AB	3.62 ± 0.05 B	2.62 ± 0.11 A
G2 Zinc sulfate (5 mg/ kg b. w)	6.27 ± 0. 37 AB	3.61 ± 0.29 B	2.70 ± 0.29 A
G3 Zinc sulfate (10 mg/ kg b. w)	6.95 ± 0.07 A	4.15 ± 0.11 A	2.80 ± 0.04 A
G4 Copper sulfate (2.5 mg/ kg b. w)	5.86 ± 0.24 BC	4.01 ± 0.16 AB	1.85 ± 0.24 B
G5 Copper sulfate (5 mg/ kg b. w)	5.13 ± 0.21 C	3. 75 ± 0.25 B	1.38 ± 0.12 B
G6 Lead acetate (2.5 mg/ kg b. w)	5.66 ± 0.44 BC	3.97 ± 0.34 AB	1.69 ± 0.12 B
G7 Lead acetate (5 mg/ kg b. w)	5.04 ± 0.27 C	3.67 ± 0.14 B	1.37 ± 0.21 B

The different capital letters refer to a significant difference between different groups at ($P<0.05$)

References

1. Bettrger, W. J. & O'Dell, B. L. (1993). Physiological roles of zinc in the plasma membrane of mammalian cells. J. Nut. Biochem., 4: 194-207.
2. Wuehler, S. E.; Peerson, J. M. & Brown, K. H. (2005). Use of national food balance data to estimate the adequacy of zinc in national food supplies: methodology and regional estimates. J. Pub. Heal. Nut., 8: 812-819**.**
3. McDonald, R. S. (2000). The role of zinc in growth and cell proliferation. J. Nut., 130: 1500-1508.
4. Oteiza, P. L.; Olin, K. L.; Fraga, C. G. & Keen, C. L. (1996). Oxidant defense systems in testes from Zn deficient rats. Proceedings of the Society for Exp. Bio. Med., 213: 85-91.

5. Meredyth, J.; Jones, D. & Deon, V. M. (2008). Copper toxicity in sheep is on the rise in Kansas and Nebraska. comparative Toxicology, Kansas. State Vet. Diag. lab.,12:25-28.
6. Wu, X.; Cui, H.; Gao, X. & Yang, F. (2015). Effects of dietary copper on elemental balance, plasma minerals and serum biochemical parameters of growing-furring male mink (*Mustela vison*). Anim. Nut., 1:36-40.
7. McDowell, L. R. (1992). Minerals in animal and human Nutrition (Academic press) 3rd (ed.,). P. 524.
8. Patra, R. C. & Swarup, D. (2000). Effect of lead on erythrocytic antioxidant defense, lipid peroxide level and thiol groups in calves. Res. Vet. Sci., 68: 71-74.
9. Khan, M. S. H.; Mostofa, M.; Jahan, M. A.; Sayed, M. A. & Hossain, M. A. (2008). Effect of garlic and vitamin B-complex in lead acetate induced toxicities in mice. J. Vet. Med., 6(2): 203-210.
10. Shalan, M. G.; Mostafa, M. S.; Hassouna, M. M.; Hassab El-Nabi, S. & El-Refue, A. (2005). Amelioration of lead toxicity on rat liver with vitamin C and silymarin supplements. J. Toxicol., 206:1-15.
11. Jadhav, S. H.; Sarkar, S. N.; Patil, R. D. & Tripathi, H. C. (2007). Effects of sub chronic exposure via drinking water to a mixture of eight water-contaminating metals, a biochemical and histopathological study in male rats. Arch. Environ. Conta. Toxicol., 53: 667-677.
12. Ahmed, W. M.; Abed El-Hameed, A. R. & El-Moghazy, F. M. (2008). Some reproductive and health aspects of female buffaloes in relation to blood lead concentration. Int. J. Dai. Sci., 3: 63-70.
13. Franks, P. A.; Laughlin, N. K.; Dierschke, D. J.; Bowman, R. E. & Meller, P. A. (1989). Effects of lead on luteal function in Rhesus monkeys. Biol. Reprod., 41: 1055-1062.
14. Abdalla, M. A.; Taha, A. A.; Ibrahim, A. H.; Hani, S. A.; Abed El-lateef, S. & Mahmoud, S. E. (1992). Effect of air pollution, produced by auto exhaust on reproductive performance in rats. Zagazig Vet. J., 20: 442-452.
15. Flora, S. J.; Pante, M.; Kannan, G. M. & Meh, A. (2004). Lead induced oxidative stress and its recovery following co-administration of melatonin or N-acetylcysteine during chelation with succimer in male rats. Cell Mol. Biol.; 50:543-551.
16. Goyer, R. A. (1989). Mechanism of lead and cadmium nephrotoxicity. Toxiol. Lett., 46:153-162.
17. Fischbein, A. (1999). Occupational and environmental lead exposure. In environmental and occupational medicine. 2nd (ed.), Boston Little, PP. 735-758.
18. Jacob, B.; Ritz, B.; Heinrich, J.; Hoelscher, B. & Wichmann, H. E. (2000). The effects of low level of blood lead on hematological parameters in children. Environ. Res., 82:150-159.
19. Gurer-Orhan, H.; Sabir, H. U. & Ozgüneş, H. (2004). Correlation between clinical indicator of lead poisoning and oxidative stress parameters in controls and lead-exposed workers. J. Toxicol., 195:147-154.
20. Bressler, J. P. & Goldstein, G. W. (1991). Mechanisms of lead neurotoxicity. Biochem. Pharmacol. J., 41: 479-484.
21. Tietz, N. W. (1999). Clinical guide to laboratory test, 3rd (ed.). 1096-1099.
22. Snedecor, G. W. & Cochran, W. G. (1989). Statistical Methods. 7th (ed.). The State University Press American, Iowa.
23. Rirodan, J. F. & Vallee, B. L. (1976). Trace elements in human health and disease. Structure and function of zinc metalloenzymes. Acad. Press., PP. 227-256.

24. Hannan, J. M.; Ali, I.; Rokeya, B.; Khaleque, J.; Khter, M.; Flatt, P. R. & Abdel Wahab, H. A. (2007). Soluble dietary fiber fraction of fenugreek seed improve glucose homeostasis in animal models of type 1 and type 2 diabetes by delaying carbohydrate digestion and absorption, and enhancing insulin action. Brt. J. Nut., 97:514-521.
25. Moller, N. & Nair, K. S. (2008). Diabetes and protein metabolism. Bas. J. Vet. Res., 12 (1):175-180.
26. Maggini, S.; Wintergerst, E. S.; Beveridge, S. & Hornig, D. H. (2007). Selected vitamins and trace elements support immune function by strengthening epithelial barriers and cellular and humoral immune responses. Br. J. Nut., 98: 29-35.
27. Chen, Y.; Wooster, G. A.; Getchell, R.G.; Bowser, P. R. & Timmons, M. B. (2003). Blood chemistry of healthy, nephrocalcinosis- affected and ozone- treated tilapia in a recirculation system, with application of discriminant analysis. Aquaculture, 218: 89-102.
28. John, P. J. (2007). Alteration of certain blood parameters of freshwater teleost Mystus viitatus after chronic exposure to Metasystox and Sevin. Fish Physiol. Biochem J., 33: 15-20.
29. Das, P. C.; Ayyappan, S. & Jena, J. K. (2006). Hematological changes in the three Indian major carps Catla Catla, Labeo rohita (Hamilton) and Cirrhinus mrigala (Hamilton) exposed to acidic and alkaline water pH. Aquaculture, 256: 80-87.
30. Singh, D.; Nath, K. & Sharma, Y. K. (2007). Response of wheat seed germination and seedling growth under copper stress. J. Environ. Biol., 28:409 - 414.
31. El-Sayed, A. & Shokr, M. (2015). Effect of zinc on hematology and biochemistry of Nile Tilapia. J. Chem. Pharmacol. Res., 7(3): 1943-1950.
32. Hashem, M. A. & El-Sharkawy, N. I. (2009). Hemato-biochemical and immunotoxicological effects of low electromagnetic field and its interaction with lead acetate in mice. Iraq. J. Vet. Sci., 23: 105-114.
33. Nabil, M. I.; Esam, A.; Eweis, H.; El-Beltagi, S. & Yasmin, E. A. (2012). Effect of lead acetate toxicity on experimental male albino rat. Asian Pac. J. Trop. Biomed., 2 (1): 41–46.
34. Fatemeh, H.; Hamid, R.; Mahdi, B. & Saeideh, J. (2016). Bioaccumulation of lead in the tissues of Japanese Quails and its effects on blood biochemical factors. Iraqi J. Toxocol., 2: 13-21.
35. Abdallah, G. M.; El-Sayed, S. M. & Abo-Salem, O. M. (2010). Effect of lead toxicity on coenzyme Q levels in rat tissues. Food Chem. Toxicol. J., 48: 1753-1756.
36. Amal, R.; Abd, E. S.; Shalaby, I.; Amira, A.; Mohamed, H. & Sabra, H. A. (2008). Effect of oral administration of lead acetate on some biochemical and hormonal parameters during pregnancy in Baladi Goats. Glo. Vet. J., 2 (6): 301-307.
37. Khalaf-Allah, S. S. & Abd El-aal, S. A. (1999). Effect of lead emissions on sheep grazing in heavy industrized area in Helwan, Egypt. Assiut. Vet. Med. J., 40: 147-155.
38. Feng, J. & Wang, Y. (2011). Effects of zinc glycine chelate on growth, hematological and immunological characteristics in broilers. Biol. Trace. Elem. Res., 431-439.
39. Kearney, J. F.; Bartles, J. H.; Lehuen, A. M.; Solvason, A. J. & Vakil, M. (1992). Development and function of the early B cell repertoire.J.Int.Rev.Imm., 8: 247-57.
40. Shakweer, I. M.; Mustafa, G. M.; Ahmed, G. A. & Ismail, M. I. (2010). Effect of zinc or/ and manganese methionine supplements on performance of lactating buffaloes. J. Anim. Poul. Prod., 1 (11):589-602.
41. Ayatollahi, M. (2002). Study of the impact of blood lead level on humoral immunity in humans. J. Toxicol. Ind. Heal., 18: 39-44.