PJN
ISSN 1680-5194

PAKISTAN JOURNAL OF NUTRITION

ANSInet
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorpjn@gmail.com

Pakistan Journal of Nutrition 7 (4): 578-581, 2008
ISSN 1680-5194

Effect of Zinc from Zinc Sulfate on Ewes' Weight, Milk Yield, Zn Concentrations in Serum and Serum Alkaline Phosphates Activity of Varamini Ewes

A. Zali, A. Nik-Khah, A. Zare Shahneh, K. Rezayazdi and M. Ganjkhanlou
Department of Animal Science, Faculty of Agronomy and Animal Science,
University of Tehran, P.O. Box # 3158711167-4111, Karaj, Iran

Abstract: This experiment was conducted to investigate the effect of feeding supplemental zinc (zinc sulfate) in different levels (0, 15 and 30 mg/kg) on ewes weight, milk production, Zn concentrations in serum and serum alkaline phosphates activity. Thirty lactating Varaminni ewes were assigned to three experimental groups according to their live body weights, milk production and lambs sex in a completely randomized design. Ewes were fed a basal diet containing alfalfa, wheat straw, cottonseed meal, barley grain, wheat bran, cracked corn and vitamin-mineral supplements at 3.2% of BW to meet NRC requirements for protein, energy, macro minerals and micro minerals. The basal diet contained 15 mg/kg Zn and Zinc sulfate was added to the basal diet to supply 30 or 45 mg/kg of dietary zinc. Milk yielded, milk composition and ewes' weight was recorded at 7 and 21 days intervals respectively. Samples of the blood were taken three times (0, 35 and 64) for determination of Concentration of Zn, Cu and Fe, Na, K, Ca in serum. Also serum alkaline phosphates concentration of ewes was measured. Milk yield, milk composition and ewes' weight of ewes were not affected by supplemental zinc ($p>0.05$). Alkaline phosphatase concentration was increased with supplemental zinc linearly and this increase was significant ($p<0.05$). Blood mineral concentration was not affected by treatment ($p>0.05$).

Key words: Supplemental zinc, zinc sulfate, varaminni ewes

Introduction

Zinc deficiency was reported in many parts of Iranian soils and this phenomenon affected on zinc content of all plant and animal species (Church, 1980). Zinc is a trace element essential for every form of life (Underwood, 1956). Poor growth is a prominent characteristic of Zn deficiency of animal and plant species (Dijkhuizen *et al*., 2001). Zinc is involved in many metabolic processes and, consequently, zinc deficiency leads to a wide range of manifestations, including decreased growth, impaired immune competence and develop mental delay (Allen, 1994; Gibson, 1994). Zinc is essential trace mineral, whose requirements, form (chelate, complex, sulfate, oxide, etc.) and interactions with each other are not clearly understood. Impaired growth is one of the most consistent signs of malnutrition and although it is in itself not hazardous to health, it is associated with poverty, poor health and low production (Hatfield *et al*., 2001).

Hatfield *et al*. (1992) demonstrated the benefit of feeding Zn at six times the NRC (1985) recommended level to feedlot lambs in a stressful environment. High levels of supplemental Zn in the form of Zn were also shown to have a positive influence on ewe milk production and ultimately lamb weaning weights (Hatfield *et al*., 1995). In addition, sheep producers often feed supplemental Zn at concentrations higher than NRC (1985) recommendations to prevent foot infections in sheep subject to damp, muddy, con-finement situations. However, the influence of form of supplemental Zn (organic vs inorganic) on sheep Zn status around NRC recommendation has not been well documented (Rojas *et al*., 1995). Blood plasma serves as an immediate source of stored Zn. However, The objectives of this study were conducted to compare three levels of inorganic Zn (zinc sulfate) around of NRC (1985) recommendation in Iranian sheep by evaluating Zn concentrations in serum, also alkaline phosphates activity and milk production of varamini ewes breed.

Materials and Methods

Animals and location of experiment: Thirty lactating Varaminni ewes (n = 30; initial BW 47.95±2.86 kg) were used in a 70-d study (February 22 to April 30) at the sheep facility of the Animal Science Department of Tehran University in Karaj, approximately 45 km west of Tehran city to determine the effects of supplemental Zn (0 mg, 15 mg and 30mg Zn_ewe-1_d-1) on ewes weight, milk production, Zn concentrations in serum and serum alkaline phosphates activity. Zinc supplements were administered daily for 70 d. Supplies of premixes needed for the trial were prepared prior to the start of the trial by zinc sulfate. The rations were fed to ewes as Total Mixed Rations (TMR), but zinc premix was top-dressed on the a.m. Based on NRC (1985) estimated DMI for a 50-kg lactating ewe of 1.6 kg DMI_ewe-1_ d-1(3.2% BW). The diets were fed twice daily (0800 and, 1600 h) and feed offered was adjusted daily about 5%

Table 1: Components and chemical composition of basal diet

Item	Diet	Water
CP (%)	12.2	---
Zn ppm	15.0	<001
Fe ppm	88.0	<001
Cu	9.0	<001
Ca(%)	0.9	---
P (%)	0.6	---

All of composition on DM basis

orts. The TMR was comprised of 65% forage and 35% of a concentrate mix to formulate diets to meet NRC (1985). diet plus zinc supplements provided 15, 30 and 45 mg/kg DM of Zn, which was approximately around the Zn recommended levels of NRC (1985).

Ewes were managed as one group with ad libitum access to feed, water and white salt and the mineral composition of basal diet and water was presented in Table 1. Ewes were weighed on d 1, 21, 42, 63 and 70 after an overnight shrink without food or water.

Milk yielded of ewes was recorded at 7 days intervals and this value was assumption mean yield for one weak. Samples of the milk were taken once per week for determination of milk composition and milk fat, protein and lactose were determined in centre laboratory in animal science department.

To determine the effect of treatments on blood Zn. on d 1, 35 and 64, blood was collected from each ewe via jugular venipuncture using unheparinized vacutainers (10 mL). Blood was allowed to coagulate at room temperature. Samples were centrifuged for 20 min at 1,000×g, separating blood serum from red blood cells. Serum was decanted into plastic serum tubes, which were then capped and stored frozen at-20°C until analyzed. Samples collected on d 64 were analyzed for alkaline phosphatase activity in Tehran Veterinary Laboratory. Zn, Cu, Fe, Na, K and Ca concentration was determined by flame atomic absorption in kavosh laboratory (AOAC, 1990). Serum alkaline phosphatase activity was also measured as an indication of Zn status using an alkaline phosphatase kit (Sigma Diagnostics, St. Louis, MO).

Experimental design: Ewe was the experimental unit in a completely randomized design that assigned to three experimental groups according to their live body weights, milk production and lambs sex. The procedure of GLM (SAS, 1998) was used to evaluate blood Zn, Fe and Cu status and alkaline phosphatase activity. Also ewes BW and milk production were evaluated using the PROC GLM procedure of SAS (1998).

Results

Ewe BW at the end of the study and ewe BW change from beginning to end of the study did not differ ($p>0.05$) between ewes supplemented with sulfate zinc and control ewes (Table 2). Supplemented ewes with Zn sulfate had no effect ($p>0.05$) on milk production (Table 2). blood Zn concentration was higher in Zn supplemented than control ewes although this increase was not significant ($p>0.05$). Blood Cu, Fe, Na, K and Ca concentration did not differ ($p>0.05$) between ewes supplemented with sulfate zinc and control ewes (Table 3). Serum alkaline phosphatase activity was differ ($p<0.05$) between control and supplemented ewes (Table 4) and alkaline phosphatase activity tended to be greater in supplemented ewes than control group.

Discussion

In the present study, zinc supplement did not affect final BW, BW change and milk production. This agrees with other researcher (Hatfield *et al*., 2001), but Hatfield *et al*. (1995, 1992) in two separated studies, observed zinc supplement in above NRC (1985) recommendation increased feedlot lamb performance and had a positive influence on ewe milk production and, ultimately, lambs weaning weight. Similar results have been reported previously when dairy cows were supplemented with chelated minerals (Formigoni *et al*., 1993). Also milk components were not affected by treatment, which is similar to results in another study (Hansen *et al*., 1994). There were no effects of the Zn supplement on blood plasma element concentrations. Although Serum Zn concentrations increased with supplemental Zn but this increase no significant. Therefore, it is impossible to speculate from these data about tissue Zn retention by the different treatment groups. Element accumulation occurs if homeostatic or homeorhetic mechanisms cannot maintain a constant concentration in the body. The absorption of many essential metals is controlled by these mechanisms, such as Zn, whose absorption can vary from less than 10 to over 80% depending on the animal's status (Underwood and Suttle, 1999). Other mineral concentration in blood unaffected by zinc supplement. In many studies zinc supplement affected tissue concentration of mineral but unaffected on serum mineral concentration (Schell *et al*., 1996). In our study diet had a 15 mg/kg of Zn that this is lower than NRC (1985) recommended.

Serum alkaline phosphatase was increased with Zn supplement and this increase was linearly. This result was supported by other research (Wan *et al*., 1993., Kraus *et al*., 1997) Blood alkaline phosphatase has been used as an indication of animal Zn status. Wan *et al*. (1993) and Kraus *et al*. (1997) reported higher plasma alkaline phosphatase concentrations in Zn-adequate than in Zn-deficient rats. Healy and Davis (1975) reported that total serum alkaline phosphatase activity increased more in lambs fed 100% wheat or 67% wheat-33% alfalfa than in lambs fed diets containing 33% wheat and 67% alfalfa or diets composed of 100%

Table 2: Effect of zinc supplement on final BW and average BW change during 70-d study (Mean±SE)

Items	Control group* (Mean±SE)	Supplemental Zn (15mg/kg)	Supplemental Zn (30mg/kg)	Significance
Final BW (kg)	48.14±4.01	49.00±3.79	48.45±4.02	NS
BW change (kg)	1.30±0.39	1.48±0.42	1.39±0.37	NS

*no supplemental Zn

Table 3: Effect of dietary supplementation with zinc on milk production and composition

	Supplemental zinc (mg/kg)			
	0	15	30	Significance
Milk production[1]	49.30±7.27	49.70±7.53	50.31±7.32	NS
Milk Composition**				
Fat%	4.14±0.93	5.42±0.48	4.78±0.72	NS
Protein%	5.42±0.80	5.98±0.52	5.21±0.85	NS
Lactose%	5.53±0.45	5.48±0.34	5.22±0.42	NS

[1-]Milk yield was reported in 70-d

Table 4: Effect of zinc supplement on mineral and alkaline phosphatas concentration in blood (Mean±SE)

Items	Control group	Supplemental Zn (15mg/kg)	Supplemental Zn (30mg/kg)	Significance
Serum Zn (µg/dl)	85±14	91±11	100±10	NS*
Serum Cu (µg/dl)	78±8	78±10	65±7	NS
Serum Fe (µg/dl)	132±11	110±11	99±12	NS
Serum Na (MEq/l)	157±15	130±15	119±16	NS
Serum K (MEq/l)	4.95±0.27	4.8±0.17	4.5±0.29	NS
Serum Ca (Mg/dl)	10.1±1.28	9.4±1.35	9.3±1.51	NS
Serum ALP (U/l)	103±0.001[b]	113±0.008[ab]	131±0.02[a]	0.05

*NS: p>0.05

alfalfa hay. These results reflect the Zn concentrations of wheat and alfalfa. In dogs, alkaline phosphatase did not respond to level or form of Zn supplementation in a consistent manner (Lowe and Wiseman, 1998).

Implication: Feeding supplemental Zn was increased Serum alkaline phosphatase concentration And assumption had good effect on production and sheep health if feeding high level from NRC (1985) recommendation. We recommend this study investigate in pregnancy period and those effected on milk production and ewes and lambs health be study. In region such as Iran that animal species was toiled from Zn deficiency, we recommend Zn was supplemented to diet.

References

Allen, L.H., 1994. Nutritional influences on linear growth: a general review. Eu. J. Clin. Nutr., 48: S75-S89.

AOAC, 1990. Official methods of analysis, 15th Ed. Association of Official Analytical Chemists. Washington, DC, pp: 69-90.

Church, D.C., R.P. Randall and E. Ortega, 1980. Relationships between eating rate of sheep and live weight gain, weight and fill of the gastrointestinal tract. J. Anim. Sci., 51: 1373-1380.

Dijkhuizen, M.A., F.T. Wieringa, C.E. West, S. Martuti and Muhilal, 2001. Effects of Iron and Zinc supplementation in indonesian infants on micronutrient status and growth. J. Nutr., 131: 2860-2865.

Formigoni, A., P. Parisini and F. Corradi, 1993. The use of amino acid chelates in high production milk cows. Pages 170-186 in The Roles of Amino Acid Chelates in Animal Nutrition. H.D. Ashmead, Ed. Noyes Publ., Park Ridge, NJ.

Gibson, R.S., 1994. Zinc nutrition in developing countries. Nutr. Res. Rev., 7: 151-173.

Hansen, W.P., D.E. Otterby, J.G. Linn, J.F. Anderson and R.G. Eggert, 1994. Multi-farm use of bovine somatotropin for two consecutive lactations and its effects on lactational performance, health and reproduction. J. Dairy Sci., 77: 94-110.

Hatfield, P.G., C.K. Swenson, R.W. Kott, R.P. Ansotegui, N.J. Roth and B.L. Robinson, 2001. Zinc and copper status in ewes supplemented with sulfate- and amino acid-complexed forms of zinc and copper. J. Anim. Sci., 79: 261-266.

Hatfield, P.G., G.D. Snowder and H.A. Glimp, 1992. The effects of chelated zinc methionine on feedlot lamb performance, cost of gain and carcass characteristics. Sheep and Goat Res. J., 8: 1-4.

Hatfield, P.G., G.D. Snowder, W.A. Head Jr., H.A. Glimp, R.H. Stobart and T. Besser, 1995. Production by ewes rearing single or twin lambs: Effects of dietary crude protein percentage and supplemental zinc methionine. J. Anim. Sci., 73: 1227-1238.

Healy, P.J. and C.H. Davis, 1975. An interaction between diet and blood group upon serum alkaline phosphatase activity in lambs. Res. Vet. Sci., 18: 161-164.

Kraus, A., H. Roth and M. Kirchgessner, 1997. Supplementation with vitamin C, vitamin E, or beta carotene influences osmotic fragility and oxidative damage of erythrocytes of zinc-deficient rats. J. Nutr., 127: 1290-1296.

Lowe, J.A. and J. Wiseman, 1998. A comparison of the bioavailability of three dietary sources using four different physiological parameters in dogs. J. Nutr., 128: 2809-2811.

NRC, 1985. Nutrient requirements of sheep, sixth revised Ed. National Academy Press, Washington, DC, pp: 45-53.

Rojas, L.X., L.R. McDowell, R.J. Cousins, F.G. Martint, N.S. Wilkinson, A.B. Johnsons and J.B. Velasquez, 1995. Relative bioavailability of two organic and two inorganic zinc sources fed to sheep. J. Anim. Sci., 73: 1202-1207.

SAS/STAT, 1998. User's guide, version 8.0. SAS Inst., Inc., Cary, NC.

Schell, T.C. and E.T. Kornegay, 1996. Zinc concentration in tissues and performance of weanling pigs fed pharmacological levels of zinc from ZnO, Zn-Methionine, Zn-Lysine, or ZnSO4. J. Anim. Sci., 74: 1584-1593.

Underwood, E.J. and N.F. Suttle, 1999. The Mineral Nutrition of Livestock. CABI, allingford, U.K.

Underwood, E.J., 1956. Trace Elements in Human and Animal Nutrition. Academic Press, Inc. New York, NY.

Wan, D.Y., F.L. Cerklewski and J.E. Leklem, 1993. Increased plasma pyridoxal-5'-phosphate when alkaline phosphatase activity is reduced in moderately zinc-deficient rats. Biol. Trace Elem. Res., 39: 203-210.