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Effect of Zinc Supplementation on some Physiological and Growth Traits in Local Male Rabbit

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ABSTRACT

Dietary supplementation of rabbits with zinc (pure zinc) was carried out to determine its effect on some physiological, reproductive performance and growth rate of rabbit during the period from1st March, 2014 to 1st May, 2014. Eighteen locally male rabbits (10weeks age) were randomly assigned to three groups (6 rabbits per group), the control group (T1) was not supplemented with zinc (0 mg zn/kg feed) while treatment groups T2(100mg/kg zn) and T3(200 mg /kg feed) were supplemented with zinc for eight weeks. The results indicated that the T2 and T3 treatments achieved the best significant ($P \leq 0.05$) results in terms of increasing the body weight gain. While no significant differences were observed among T2, T3 and the control group regarding the WBC, RBC, weight and relative weight of testes count. Significant ($P \leq 0.05$) decreases were recorded in FCR in treated animals as compare with the control group. In conclusion, supplementation of pure zinc to the diets of local rabbit acts as an ameliorative tool of some productive traits of rabbits.

Keywords: Zinc, Rabbit, Male, Growth, Feed conversion rate

INTRODUCTION

Zinc is an essential element in the nutrition of human beings, animals, and plants. Zinc is required in the genetic makeup of every cell and is an absolute requirement for all biologic reproduction. Zinc is needed in all DNA and RNA syntheses and is required at every step of the cell cycle (Kornberg, 1982; Rhodes and Klug, 1993 and Chrastinova et al., 2015).

Zinc is a component of various enzymes that help maintain structural integrity of proteins and regulate gene expression. Zinc is an integral component of about 200 zinc metalloenzymes include ribonucleic acid

(RNA) polymerases, alcohol dehydrogenase, carbonic anhydrase,carboxypeptidase,glutamic dehydrogenase, lactic dehydrogenase andalkaline phosphatase(King and Keen1999; McDonald et al.,2002 and Chrastinova et al., 2015), as well as hormones, such as thymulin, testosterone, prolactin, and somatomedin (Zapsalis and Beck, 1985).The biological function of zinc can be catalytic, structural or regulatory. More than 85% of total body zinc is found in skeletal muscle and bone (King and Keen, 1999).DNA is about 5000 times less susceptible to damage by Zn^{2+} ion than is RNA, suggesting its role in the predominant evolutionary selection of DNA, rather than RNA, as the bearer of the primary genetic information, as well as in cellular differentiation,synthesis and stability of DNA (Butzow and Eichhorn, 1975 and Evenson et al., 1993).Deficiencies of zinc are quite common. It is also essential in cell division and important for the production of healthy sperm. It is the most critical trace mineral for male sexual function. It is needed for testosterone metabolism, testicle growth, sperm production, motility, count, reducing excess estrogen in male reproductive tissue. Every time a man ejaculates he loses about 5 mg of zinc. Alcohol depletes zinc in the body. Folic acid, tea, coffee, high fiber intake, and iron may inhibit absorption. Vitamin B6 and C may aid absorption (Amen and Al-Daraji, 2012).

The sources of zinc are lean meat, fish, seafood, chicken, eggs, pumpkin and sunflower seeds, rye, oats, whole grains, legumes, ginger, parsley, mushrooms, brewer's yeast, and wheat germ (Amen and Al-Daraji, 2011).

About 2 grams of zinc is distributed throughout the body (average 10 to 200 mg/gm) of an adult human being(Zapsalis and Beck, 1985).Absorption of dietary zinc occurs over the duodenal and jejunal regions of the gastrointestinal tract. Active transport of zinc into portal blood is mediated by metallothionein. Zinc competes with other metals for absorption, and absorption is believed greatly retarded by ingestion of fiber and phytates(Oberleas and Harland, 1977;Zapsalis and Beck, 1985).

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Plasma zinc is compound to organic forming a complex. Zinc-albumin complexes account for about 50 percent of the zinc and the metal is readily exchangeable throughout the peripheral circulation. About 7 to 8 percent is loosely bound to amino acid constituents in plasma. The remaining 42 percentage of plasma zinc is largely bound to macroglobulins and unavailable for nutritional purposes. Serum and plasma zinc concentrations in adults range from 80 to 150 mg/dL (Zapsalis and Beck, 1985).

Zinc deficiency symptoms are nonspecific, perhaps in part because of their need in so many enzymes and their critical roles in both protein synthesis and molecular genetics. Many enzymes may become nonfunctional in the absence of zinc, even though the presence of the enzyme remains undisturbed. The integrity of cell membranes, including the integrity of red and white blood cells, depends upon loosely bound ionic zinc. Zinc deficiency stunts growth and causes serious metabolic disturbances. Inadequate intake in people and animals results in serious immunodeficiency, increased numbers of infections, increased severity of infections, stunted growth, skin lesions and delayed sexual maturation (Zapsalis and Beck, 1985). So this study was carried outto investigate the effect of dietary zinc (Pure zinc) of local male rabbit onsome Physiological traits, productive andreproductive performance.

MATRIALS AND METHODS

Experimental animals, diets and studied traits

A total of 18 local male rabbits (10 weeks age) were used in this study. They were divided randomly into 3 equal group (six rabbits per group) in a completely randomized designwere randomly allotted to three dietary zincT1=Control without zinc supplementation,T2=100ppm zinc/kg feed and T3=200ppm/kg feed. Theirweights wereranged between 965-1015gm,where has been sheltering in the housewith temperature21-24 C° and light 14hours per day,water and feed were offered *ad-libitum*. Commercial feed were providedwhich contained 15%crude protein and 3.5% crude fat,fiber23%, Nitrogen Free Extract (NFE)43% and ash 11%throughout the research(NRC,1994).Using a special room for rabbits outside the Kalar technical institute. The animals were individually housed in cleaned and sterilized metal cages prepared for this purpose,raised 60 cm above the floor, measuring 60×30×30 cm and provided with wire screened floor which permit or allow feces and urine to drop. Each animal was provided with water canal and feeder and left the rabbits for two weeks for the purpose of adjusting to environmental and experimental conditionsto stabilize them and they were later treated with dietary zinc for eight weeks. The experimental diets were offered ad-libitum. A record of feed intake and body weight changes were kept weeklyas well as Feed Conversion Ratio (FCR)was calculated as(FCR equal Feed intake / Body weight gain). At end of the experiment the animals were killed humanlyand rules of animal welfare were applied for humane handling of experimental animals throughout the study.The following parameters were measured:

Body weight gain equaldifferences in the body weight at the beginning and at the end of the experiment were determined.

Testes weight (Paired):Both testes (left and right testes) wereweighed.

Relative testes weightequalpaired testes weight divided by body weight and multiply by 100.

Hematological Parameters

Three individual blood samples were collected from each replicate for each analysis in a test tube with EDTA from the jugular vein of the rabbit, to determine the RBCs, and WBC count at four different time periods (twice a month) ofanimal age and throughout the study. Counting was done with haemocytometer chamber and according to Al-Daraji et al. (2008).

Ethical approval

The ethics regarding the handling and euthanizing of the animals have been approved by scientific committee of animal’s health department and Kalar technical institute at Sulaimani Polytechnic University which have been performed according to animal welfare principles.

Statistics Analysis

Data generated from experiment was carried out in a complete randomized design (Steel and Torrie, 1980). These data were subjected to ANOVA according to general linear model procedure of statistical analysis system software (SAS, 2001**).** The significant differences among means were determined by Duncan's multiple range tests (1955) with ($P \leq 0.05$) level of significance.

RESULTS AND DISCUSSION

Some performance traits (body weight gain, feed intake and FCR) of rabbit at different levels of dietary zinc as a mean value was presented in table 1,body weight gain and final body weight of rabbits treated with dietary zinc(T2 and

T3) were significantly (P≤0.05) increased in compared with thecontrolgroup (T1).While, there was no significant difference between T2 andT3regarding thesetraits.As well as, no significant differences were observed among T1, T2 and T3 in feed intake.Significantly (P≤0.05) decreased in FCR were observed of treated animals as compared with control. Results revealed thatno significant differences were observed among T1, T2 and T3 regarding the traits WBC and RBC in table 2 and testes and relative testes weight in table 3.

Table 1. Effect of different levels of dietary zinc on some productive traits of local male rabbits (Mean ± Se)

Traits	Treatments		
	T1(Control)	**T2(0.1 gm zinc /kg feed)**	**T3(0.2 gm zinc /kg feed)**
Initial body weight (gm)	1005	990	1015
Body weight gain (gm)	722.67±12.01[b]	916.33±5.03[a]	1067.67±14.47[a]
Total feed intake (gm/week/rabbit)	4186.33±52.82[a]	4105.02±15.01[a]	4291.65±27.54[a]
Final body weight (gm) (20weeks)	1718±36.18[b]	1915±37.75[a]	2091 ±45.37[a]
Feed Conversion Ratio (FCR)	5.79±0.02[a]	4.49±0.04[b]	4.03±0.03[b]

[ab] means along rows with different superscripts are significantly different (P<0.01)

Table2. Effect of different levels of dietary zinc on the mean of some hematological traits of local male rabbits at different periods (Mean ± Se)

Hematological traits	Periods (each2week)	Treatments		
		T1(Control)	**T2(0.1 g zinc /kg feed)**	**T3(0.2 g zinc /kg feed)**
RBC (10^6/mm^3)	1	6.35±0.39a	6.81±0.59a	6.72 ±0.20a
	2	6.36±0.34a	6.92±0.49 a	6.73±0.30a
	3	6.05±0.40a	6.83±0.67a	6.94±0.29a
	4	6.10±0.36[a]	6.93±0.47[a]	7.09±0.56[a]
WBC (x10^3/mm^3)	1	7.72±0.42[a]	8.03±0.90[a]	7.62±0.83[a]
	2	6.45±0.66[a]	7.32±0.31[a]	7.46 ±0.75[a]
	3	7.73. 40±0.83a	8.20±1.46[a]	8.17 ±1.84[a]
	4	7.70±0.71[a]	8.54±0.99[a]	8.62±0.94[a]

[ab] means along rows with different superscripts are significantly different (P<0.01)

Table 3. Effect of different levels of dietary zinc on the mean weight and relative weight of testes in local male rabbits (Mean ± Se)

Traits	Treatments		
	T1(Control)	**T2(0.1 g zinc /kg feed)**	**T3(0.2 g zinc /kg feed)**
Body weight (gm)	1718	1915	2091
Testes weight gm (paired)	3.90±0.13[a]	4.10±0.19[a]	4.32±0.3[a]
Relative testes weight (%)	0.23±0.17[a]	0.21±0.015[a]	0.20 ±0.005[a]

[ab] means along rows with different superscripts are significantly different (P<0.01)

The positive results obtained in the production traits may be due to zinc has role in insulin secretion by protamine zinc–insulin and globulin zinc- insulin contain Zn++ for their functioning also zinc involved in storage and secretion of insulin as well as zinc has role in growth and reproduction, zinc can improve intestinal absorption (Chatterjea, 2009).Zinc participates actively in protein synthesis and carbohydrate metabolism. The discovery that the enzyme carbonic anhydrase contains 0.33 % of zinc in its molecule is considered the first acceptable explanation of Zn mechanism of action. After that, DNA-polymerase, being fundamental in cell division process (Chrastinova et al., 2015).Large quantities of zinc were found to provide stability to the structures of RNA, DNA and ribosomes (Prask and Plocke, 1971; Dowel, 1992 and Chrastinova et al., 2015).Perhaps with the intervention of trace elements such as zinc as dietary supplement, we may improve animal protein production by regulating growth rate inrabbit.These results were in agreement with Abd El-Rahim et al,,1995; Nessrinet al., 2012; Ayyat and Maria,2000) who observed that dietary zinc levels did significantly affect (P≤0.05) body weight and Feed Conversion Ratio (FCR) when adding Zn by levels 50,100 or 200mg /kg diet. While incompatibility with Al-Khalifa(2006) who reported that supplemental dietary Zn by levels of

50,100 or 200ppm had no significant effect on live weight gain and FCR. On the other hand, the obtained data suggests that live weight gain and FCR of growing rabbits could be improved by 12.3and 10.6 % respectively, with supplementing the diet with 100 Zn mg /kg over the content provided by the control diet (Nessrinet al., 2012).On the other hand, Chrastinova et al. (2016) concluded that growing rabbit is acceptable to excessive dietary doses of the macroelements or Zinc. Also, a supplemental Zinc in the rate of 100 mg/kg diet leads to improving live body weight gain and significantly improves feed conversion ratio of the rabbit,as well asfeeding of rabbits with inorganic or organic zinc sources had no negative effect on the rabbit growth performance.Zinc plays a crucial role in metabolism as an essential trace element with antioxidant properties (Hao and Maret, 2005). A previous study suggested that Zn acts as an intracellular signaling molecule, plays a role in communicating between cells by converting extracellular stimuli to intracellular signals, and controls intracellular events. Abnormal Zn homeostasis can lead to a variety of health problems including growth retardation, hypogonadism, immunodeficiency, and neuronal and sensory dysfunctions (Fukadaet al., 2011). For many years, zinc has been shown to play an important role in central nervous system as a neurosecretory factor and as a biofactor, is responsible for activation of numerous enzymes engaged in the metabolic processes and simultaneously in brain development from the early neonatal stage to the maintenance of brain function in adults (Frederickson and Moncrieff, 1994; Frederickson et al., 2000).

Competing interests

Authors have declared that there is no competing interest.

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