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Effect of Zinc Proteinate on the Intestinal Morphometry of the *Coturnix coturnix japonica* Chicks

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Abstract: An experiment was conducted to compare the effect of different levels from an organic source of zinc (Zn proteinate) supplementation (0, 4, 8 and 12 mg day^{-1}) in intestinal development of *Coturnix coturnix japonica*. Four hundred one day old quail chicks were used, which were randomly assigned for treatments. Every third day 10% was humanely sacrificed and the gizzard, pancreas, liver, intestine (separated in segments) and the bursa of Fabricius were removed and wet measured and weighted. In general, Zn supplementation had no effect ($p>0.05$) on any of the parameters assessed, only the age had an important effect in those. These results suggest that no extra mineral Zn is needed for the intestinal and related organ development in the quail.

Key words: Zinc proteinate, *Coturnix coturnix japonica*, intestinal morphometry, organ development, supplementation

INTRODUCTION

Zinc (Zn) is an important mineral in the organism since it participates in metalloenzymes of vital cycles (Ao *et al*., 2006; Brandae *et al*., 1995; Caq *et al*., 2002; NRC, 1994; Salqueri *et al*., 2000). According to Payne *et al*. (2006) Zn is necessary for the acid-base balance and bone development in the pig. Probably this function makes the Zn an essential part in the treatment in heat stress in poultry industry (Payne *et al*., 2006; NRC, 1994) Sahin and Omer (2003) reported that supplementing 30 or 60 mg of Zn as sulfate ($ZnSO_4$) in the egg producing quail (*Coturnix coturnix japonica*) in feed, they could resist the effect in heat stress and increases blood antioxidant status.

Also, Cunningham-Rundles *et al*. (1990) and Pimentel *et al*. (1991) reported that Zn acts as antioxidant reducing the cell membrane damage due to radicals, which in turn according to Powell (2000) alters the immunological status of the animal.

Hence, poultry and growing pig diets are generally supplemented with Zn to ensure its dietary adequacy from inorganic and organic sources of the mineral. However organic sources of the Zn have greater bioavailability and present lower excretion by the animal (Caq *et al*., 2002; NRC, 1994). Despite the reports on the effects of Zn in pigs and laying hen and quails, information on the effect of the organic source of the mineral on the intestinal morphometry, pancreas, liver and Fabricius bursa development during the rapid growing stage of the Coturnix coturnix japonica is lacking.

MATERIALS AND METHODS

Four hundred one day old Coturnix coturnix japonica were placed in a 30×30×50 cm cage with wooden floor. Food was always available *ad libitum*. Animals were used to assess four levels of Zn (80 mg of the mineral kg^{-1} dry matter; control treatment) and the addition with Zn proteinate (4, 8, 12 mg of the mineral). The diet was a corn soybean based to fulfil the animals requirements (NRC, 1994). Each treatment had four replicates of 25 chicks.

Every third day 10% of the animals were humanely sacrificed under the supervision of a representative of animal right and following the animal protection mexican act (NOM-062-ZOO-1999) and the body weight was recorded, as well as the length and weight of abdominal organs. After the intestine was removed from the quail chick, it was rinsed with saline solution to remove the digesta and then separated in three segments (duodenum, jejunum and ileum). Initial parameters were used as covariate for the response variables. The weight of the bursa of Fabricius was also evaluated as response of the Zn level in the diet.

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Table 1: Effect of zinc supplementation on the development of organs of the *Coturnix coturnix japonica*

	Zinc level (mg)				Probability		
	0	4	8	12	Zn	Age	age×Zn
Weight, g							
Body	42.310	43.614	41.267	41.600	0.3297	0.0001	0.5971
Gizzard	1.49a	1.65b	1.61ab	1.59ab	0.0478	0.0001	0.3095
Pancreas	0.20	0.19	0.22	0.21	0.0700	0.0001	0.1090
Liver	1.85	1.89	1.78	1.90	0.3865	0.0001	0.3938
Duodenum	0.68	0.68	0.70	0.64	0.1688	0.0001	0.0001
Jejunum	0.77	0.82	0.76	0.77	0.5591	0.0001	0.9552
Ileum	0.44	0.50	0.52	0.49	0.0833	0.0001	0.0002
Gross intestine	0.73	0.96	0.85	0.75	0.2995	0.0001	0.2640
Bursa of fabricius	0.07	0.04	0.06	0.05	0.3723	0.0001	0.9119
Length, cm							
Duodenum	9.45	9.07	9.15	9.20	0.7828	0.0001	0.0652
Jejunum	14.39	14.80	13.54	14.59	0.1374	0.0001	0.9177
Ileum	8.62	9.14	9.46	9.48	0.0993	0.0001	0.6767
Gross intestine	8.633	8.415	8.356	8.356	0.7317	0.0001	0.1909

a-c. Means within the same row with different letter differ significantly ($p<0.05$)

Data collected were statistically analyzed by ANOVA as repeated measurements in a random design. Treatments difference were considered significant by stablishing an alpha of 0.05 and when they exist the means were separated using the Duncan method (SAS, 1985).

RESULTS AND DISCUSSION

Final body weight of the chicks averaged 40.33 grams. Even though there were little numerical advantage with Zn proteinate supplementation, the difference was not significant ($p>0.05$) on this parameter. Also no effect of the interaction age×Zn proteinate was observed ($p>0.05$). Ao *et al*. (2006) and Sewalt *et al*. (2006) supplementing broilers with Zn proteinate observed an increase of weight, which is contrary to the observation of the present experiment, however the level of Zn was higher than the use here.

The gizzard length was not affected by the supplementation of Zn proteinate level or its interaction with the age ($p>0.05$). The organ weight averaged 0.405 grams and was affected by the Zn supplementation to the feed ($p = 0.053$; Table 1). The organ weight was not affected by the interaction Zn level and age ($p>0.05$).

The mean wet weight of the gizzard in relation to body weight was 1.095% and changed with the Zn level in feed ($p<0.05$; 1.0581, 1.0381, 1.1424, 1.1398 for 0, 4, 8 and 12 mg Zn proteinate, respectively). On the other hand the variable was affected by the interaction of Zn level and age of the quail ($p<0.05$). Pancreas wet weight averaged 0.20 g and tended ($p = 0.07$) to be affected by the Zn supplementation, but not by the interaction of the mineral and age ($p>0.05$). Liver weight of the Coturnix coturnix japonica remained unchanged ($p> 0.05$; Table 1) by the Zn treatments evaluated in the present trial.

Neither the length nor weight of the duodenum was changed by the level of Zn proteinate supplementation ($p>0.05$; Table 1). The duodenum length was affected by the age of the animal ($p<0.05$) but not by the interaction between Zn level and age of the chick ($p<0.05$). On the other hand the wet weight of the duodenum was affected by the age of the animal ($p<0.05$). The ratio wet weight and body weight averaged 1.94% and was not affected by treatments ($p>0.05$), hence density calculated remained unchanged. The jejunum development (length and weight) had the same tendency as observed in duodenum ($p>0.05$) related with the Zn supplementation.

In general, the ratio weight of duodenum and jejunum to body weight was unchanged by the Zn supplementation ($p>0.05$). Payne *et al*. (2006) working with the Zn source observed no effect of the mineral on the intestinal development of piglets, which in general is in agreement with the findings of the present trial.

On other hand, the Zn level in the diet tended to affect length ($p = 0.09$) and weight of the ileum of the quails ($p = 0.08$). But only the weight of the intestine segment was significantly changed by the interaction with the age of the animal ($p<0.05$). The gross intestine of the quail remained unchanged by the amount of Zn supplemented in the diet ($p>0.05$) the interaction with this and the age of the animal ($p>0.05$).

On the other hand, the weight of the bursa of Fabricius of the quail chicks averaged 0.055 g and was unaffected by the Zn supplementation ($p>0.05$) or the interaction with the age of the animal ($p>0.05$). Also when the weight of the bursa was expressed in relation with body weight (averaged 0.12%), no effect was observed for the treatments ($p>0.05$).

According to the results found, we can conclude that supplementing more than 80 mg of Zn kg-1 dry matter had no important effect on the intestinal organs and intestine development in the *Coturnix coturnix japonica*.

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