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Research Article
Evaluation of Growth Performance and Effect of Quality of Eggs of Japanese Quails at Different Levels of Zinc Supplementation under Agro-climatic Condition of Mizoram, India

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Abstract

Background and Objective: Zinc (An essential trace element) has an important function in metabolic activities such as protein synthesis, carbohydrate metabolism, reproduction, growth and a variety of biochemical reactions. The zinc ion is a co-factor of many enzymes and a component of metalloenzymes that participates in a number of metabolic processes. In quails, the deficiency of zinc is characterized by slow growth, abnormal feathering, labored respiration, in-coordinated gait, loss of appetite, decrease in egg production and reproductive performance, problems in bone and skin development and also increased mortality. The aim of this study was to determine the growth performance and egg quality of Japanese quails under different levels of zinc supplementation. **Methodology:** In order to carry out the experiment, a total of 400 days-old quail chicks were randomly selected and sub-divided into four groups i.e., C, T_1, T_2 and T_3 having hundred quails with 10 replicates having 10 quail chicks in each which were supplemented with zinc oxide powder at the rate of 0, 25, 50 and 75 mg kg^{-1} of diet respectively. The quails were reared under deep litter system using paddy husk as litter material. The birds were fed twice daily at 6:00 am in the morning and 4:30 pm in the afternoon with basal diet of broiler pre-starter and starter rations containing 22 and 18 mg of zinc, respectively. Small portions of the basal diet were first mixed with the respective amount of zinc oxide powder; this small amount was then mixed with a larger quantity of the basal diet until the total quantity was homogenous. **Results:** The inclusion of zinc in the diet had no significant effect on growth performance in terms of day old body weight, 5th week body weight and daily gain. Zinc supplementation was found to have significant effect in T_1, T_2 and T_3 on albumen index but no significant effects were observed among treatment groups with respect to egg weight, shape index, yolk index, yolk %, albumen %, shell weight % and Haugh unit. **Conclusion:** The results showed that zinc supplementation at the rate of 50 mg kg^{-1} of feed and 75 mg kg^{-1} of feed have significant effect on the albumen index but not on other quality parameters or on body weight gain in terms of day old body weight, 5th week body weight as daily gain.

Key words: Zinc supplement, Japanese quail, growth performance, egg quality, India

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Zinc is an essential micronutrient performing various biological functions because it acts as a co-factor of various enzymes[1,2]. In addition to this, zinc is related to its antioxidant role and its participation in antioxidant defense mechanism[3,4]. In quails, deficiency of zinc results in slow growth rate, feathering abnormality, labored respiration, in-coordinated gait and low tibia ash[5]. Deficiency of zinc also lead to loss of appetite, decrease in egg production and reproductive performances, improper development of bone and skin and also increases in mortality and blood disorders[6]. In swine, a lack of zinc in the diet causes parakeratosis being characterized by dermatitis, decreased appetite, severe weight loss and death.

Some researchers reported that a lower level of zinc supplementation in organic forms is sufficient to meet the requirements[7-9]. The requirement of zinc for starter and grower quails is 90 mg kg^{-1} of diet and for breeder quails it is 70-80 mg kg^{-1} of diet[10]. Zinc can be administered in the diet in the organic or inorganic forms i.e., zinc oxide, zinc sulphate, zinc picolinate or zinc in combination with amino acids. Zinc is usually absorbed at the rate of 14-67% depending on chemical form and concentrations of elements acting antagonistically such as Calcium[11], Cadmium, Copper, Sulphur, Phosphorus and Magnesium[12]. In view of the above report of the important functions of zinc and its effect, the present study was carried out to underscore growth performance and effect of quality of eggs of Japanese quails at different levels of zinc supplementation under agro-climatic condition of Mizoram, India.

MATERIALS AND METHODS

The research work was carried out at the Quails Farm, Department of Livestock Production & Management, College of Veterinary Sciences and A.H, Selesih, Aizawl, Mizoram, India. The research work consists of two experiments i.e.:

- **Growth study:** The first experiment was conducted to find out the effect of zinc supplementation on the growth performance from day old to 5th week of age. Four hundred days-old quail chicks were randomly selected and the chicks were distributed by maintaining 4 groups having hundred quails in each group i.e., Control (C: Without zinc supplementation), T_1 (25 mg Zn kg^{-1} of feed), T_2 (50 mg Zn kg^{-1} of feed) and T_3 (75 mg Zn kg^{-1} of feed). The 4 groups were sub-divided into 10 sub-groups to make 10 replicates having 10 quail chicks in each. The quails were reared under deep litter system and the parameters like day-old body weight, weekly body weight, daily feed intake and daily body weight gain were recorded (Wensar digital platform balance, PFB 300, Kolkatta, West Bengal, India). The quails during the study were provided with basal diet of broiler pre-starter and starter rations containing 22 and 18 mg of zinc, respectively
- **Study on egg quality:** For this study also, four groups were maintained i.e., Control (C: Without zinc supplementation), T_1 (25 mg Zn kg^{-1} of feed), T_2 (50 mg Zn kg^{-1} of feed) and T_3 (75 mg Zn kg^{-1} of feed). The quails were randomly selected within the group and were kept at the sex ratio of 1:3 (Male:Female). During the laying period, they were provided layer mash containing 88.25 ppm of zinc. Ten numbers of eggs were randomly collected from each group for a period of 15 weeks to study the internal and external quality. The weight of eggs and yolk were recorded by digital electronic balance (Wensar, HPB 2000-10 mg, Kolkatta, West Bengal, India.) The length and width of eggs, width of albumen and diameter of yolk was measured with the help of Verneir's Caliper (150 mm/6 inch, Sunshine Instruments, Coimbatore Chinnys Chamber, Tamil Nadu, India). Data were analyzed using one-way ANOVA and statistical significance was set at ($p>0.05$, $p>0.01$)

RESULTS

The average day old body weight of quail chicks hatched out from quails supplemented with zinc at different levels were studied and the results is shown in Table 1 and Fig. 1. The overall day old body weight recorded was 7.53±0.18 g. The supplemented zinc did not affect significantly ($p>0.05$) on

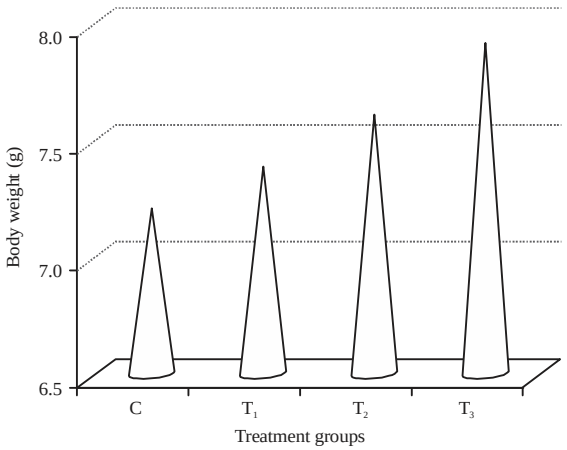

Fig. 1: Day old body weight/bird (g) of quails under different levels of zinc treatments

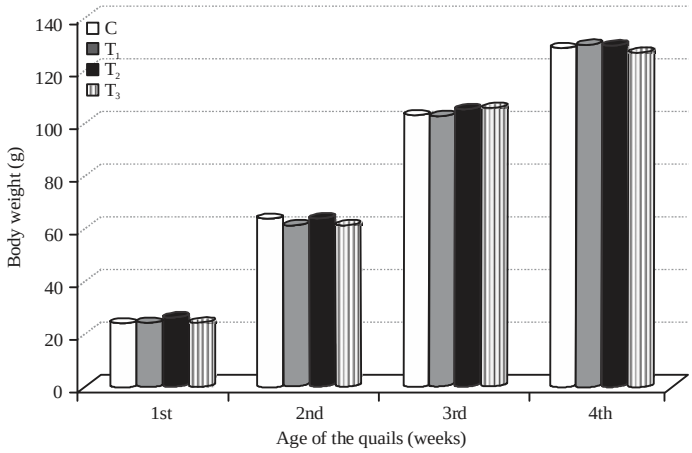

Fig. 2: Weekly body weight/bird (g) of quails under different levels of zinc treatments

Table 1: Day old body weight of quail chicks (g)

Age	C Mean±SE (g)	T_1 Mean±SE (g)	T_2 Mean±SE (g)	T_3 Mean±SE (g)	Overall (g)
Day old	7.21±0.25	7.39±0.14	7.61±0.12	7.92±0.14	7.53 ± 0.18^{NS}

NS: Non-significant

Table 2: Weekly body weight/bird (g) of quails under different levels of zinc treatment

Age (weeks)	C Mean±SE (g)	T_1 Mean±SE (g)	T_2 Mean±SE (g)	T_3 Mean±SE (g)
1st	24.07 ± 0.69^{b}	24.19 ± 0.56^{b}	26.45 ± 0.46^{a}	24.30 ± 0.57^{b}
2nd	63.66±1.16	61.25±1.13	63.95±0.43	61.17±0.35
3rd	103.00±1.04	102.72±2.06	105.28±0.77	105.65±1.37
4th	128.33±1.66	129.67±2.70	129.33±2.12	126.78±2.03
5th	156.28±6.58	157.84±4.63	155.92±2.84	153.35±3.58

Mean bearing different superscript within same row differ significantly (p<0.05)

Table 3: Daily body weight gain/bird (g) of quails under different levels of zinc treatment

Age (weeks)	C Mean±SE (g)	T_1 Mean±SE (g)	T_2 Mean±SE (g)	T_3 Mean±SE (g)	Overall (g)
1st	$2.26\pm0.07^{B}{}_{C}$	$2.22\pm0.07^{B}{}_{C}$	$2.57\pm0.06^{A}{}_{C}$	$2.19\pm0.08^{B}{}_{E}$	$2.32\pm0.04_{E}$
2nd	$5.65\pm0.26_{A}$	$5.29\pm0.12_{A}$	$5.35\pm0.07_{A}$	$5.29\pm0.10_{B}$	$5.34\pm0.05_{B}$
3rd	$5.61\pm0.24_{A}$	$5.92\pm0.28_{A}$	$5.90\pm0.13_{A}$	$6.22\pm0.14_{A}$	$5.98\pm0.10_{A}$
4th	$3.62\pm0.16_{B}$	$3.84\pm0.398_{B}$	$3.43\pm0.34_{B}$	$3.01\pm0.27_{D}$	$3.39\pm0.19_{D}$
5th	$3.99\pm0.84_{B}$	$4.02\pm0.35_{B}$	$3.79\pm0.38_{B}$	$3.79\pm0.43_{C}$	$3.88\pm1.20_{C}$
Overall	4.10±0.41	4.26±0.218	4.21±0.20	4.10±0.23	

Mean bearing different superscript within same row differ significantly (p<0.01), Mean bearing different subscript within same column differ significantly (p<0.01)

the body weight of day old quail chicks among treatment groups. The Mean±SE value (g) of weekly body weight of quail chicks from 1st-5th week under different zinc supplementation have been presented in Table 2 and Fig. 2. Statistical analysis showed that the body weight of quails supplemented with 50 mg zinc (T_2) was significantly higher ($p<0.05$) than the other treatments during 1st week, however, the zinc supplementation did not affect significantly ($p>0.05$) on the body weight of quails among treatment groups in the subsequent week.

The daily body weight gain of quail chicks from 1st-5th week are presented in Table 3 and Fig. 3. Experimental results showed that the daily body weight gain was significantly higher ($p<0.05$) for T_2 during the 1st week but there was no significant difference ($p>0.05$) among the treatments in the subsequent weeks although highest daily body weight gain was observed during the 3rd week in the all treatment groups.

The effect of zinc supplementation on egg quality of Japanese quails is presented in Table 4. In the present study, zinc supplementation significantly increase the albumen index in T_2, T_3 ($p<0.05$) and T_1 ($p<0.01$). The albumen index increases with increase in zinc supplementation but the zinc supplementation did not significantly increase or decrease the

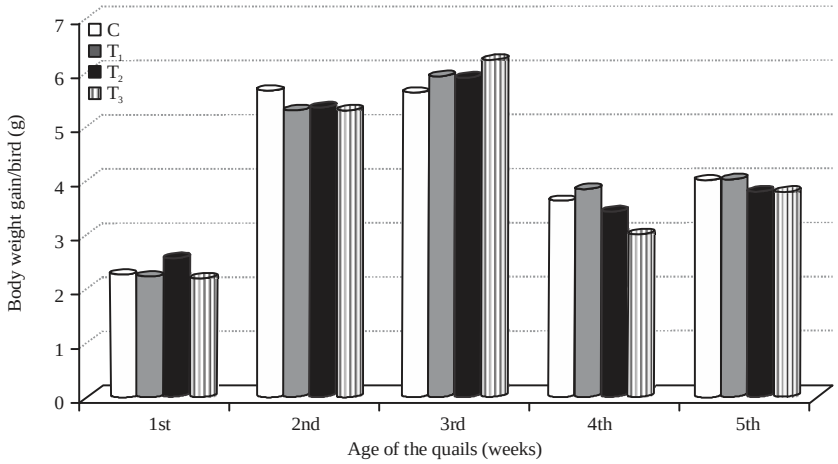

Fig. 3: Daily body weight gain/bird (g) of quails under different levels of zinc treatment

Table 4: Effect of zinc supplementation on egg quality of Japanese quails (g)

Parameters	C Mean±SE (g)	T_1 Mean±SE (g)	T_2 Mean±SE (g)	T_3 Mean±SE (g)	Mean
Egg weight (g)	10.740±0.28	10.520±0.22	9.730±0.29	10.300±0.25	10.322±0.14
Shape index	80.058±1.02	78.734±1.14	77.238±0.98	76.619±1.20	78.162±0.56
Albumin index	12.855±0.91^{b}	14.806±1.05^{ab}	16.458±0.57^{a}	16.504±1.06^{a}	15.155±0.50
Yolk index	42.011±0.83	46.109±1.11	45.259±1.54	44.336±0.94	44.428±0.60
Yolk (%)	34.037±0.83	32.001±0.98	34.385±0.91	33.748±0.46	33.542±0.58
Albumin (%)	19.945±1.03	17.901±1.38	20.615±2.34	20.037±0.90	19.624±0.75
Shell weight (%)	14.091±0.58	14.101±0.72	13.771±0.74	13.712±0.58	13.918±0.32
Haugh unit	104.780±1.27	105.680±1.15	107.050±0.67	106.800±0.70	106.080±0.49

Mean bearing different superscript within same column differ significantly ($p<0.05$)

egg weight, shape index, yolk index, yolk %, albumen %, shell weight % and Haugh Unit among treatment groups.

DISCUSSION

The body weight of quails in T_2 was significantly higher ($p<0.05$) at 1st week but zinc supplementation did not show significant effect ($p>0.05$) in the subsequent weeks from 2nd-5th week. Even at the final body weight at 5th week, the supplementation of zinc was not found to produce significant difference ($p>0.05$) among the treatment groups.

The study on egg quality also reveals that although zinc supplementation significantly increase the albumen index in T_2, T_3 ($p<0.05$) and T_1 ($p<0.01$), it did not significantly increase or decrease the egg weight, shape index, yolk index, yolk %, albumen %, shell weight % and Haugh Unit among treatment groups.

In the present study , the day old body weight of chicks produced from breeder quails under different zinc supplementation were comparable to those observed by Stahl *et al.*[13], Kidd *et al.*[14] and Hudson *et al.*[15]. The overall day old weight recorded in the present study was higher than the findings of Khursid *et al.*[16] and lower than Farooq *et al.*[17] but agreed to the finding of Ahuja[10], Randall[18] and Mizutani[19].

The higher body weight of T_2 quails at 1st week might be due to the fact that the requirement of zinc is usually high few days after hatch and the absorption of zinc is enhanced by initial low zinc status in the animal body[20]. The supplementation of zinc was not found to produce significant effect ($p>0.05$) on the final body weight at 5th week among the treatment groups which is consistent with the findings of Sunder *et al.*[21] who indicated that zinc is not the only growth factor. The final body weight at 5th week observed in the present study was higher than the report of Adeogun and Adeoye[22] but comparatively lower than that reported by Narayan *et al.*[23]. Such differences of body weight at 5th week observed in different studies might be due to variation in nutrient content of diet, management practices and breed involved in different studies.

The significant increase in albumen index in the present study is in agreement with the report of Sahin *et al.*[24], Sahin and Kucuk[25] and Tabatabaie *et al.*[26]. The non observable significant differences of other qualities of eggs were in agreement with the findings of Yildiz *et al.*[12] and Idowu *et al.*[27]. The findings in this study also corroborated the findings of Mabe *et al.*[28] who reported that zinc supplementation did not affect percentage of egg shell and egg shell index. The present report is in stark contrast to Sahin *et al.*[24] who

reported that supplementation of zinc sulphate increased egg weight, egg shell thickness, egg specific gravity and Haugh Unit when layers were subjected to low ambient temperature. This study discovered the possible synergistic effect of zinc supplementation that can be beneficial for growing and laying Japanese quails.

CONCLUSION

From this study it can be concluded that zinc alone cannot significantly improve the body weight gain of quails neither enhance the quality of eggs but a combination of several trace minerals may have desire effects.

The limitation of the present study is that only zinc is used and it would reflect better results if combinations of other minerals are incorporated. Moreover, if the supplemented zinc is in the form of zinc sulphate, the availability of zinc may be higher than the zinc oxide form which was used in this study.

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REFERENCES

1. Sahin, K., M.O. Smith, M. Onderci, N. Sahin, M.F. Garsu and O. Kucuk, 2005. Supplementation of zinc from organic or inorganic source improves performance and antioxidant status of heat-distressed quail. Poult. Sci., 84: 882-887.
2. Chasapis, C.T., A.C. Loutsidou, C.A. Spiliopoulou and M.E. Stefanidou, 2012. Zinc and human health: An update. Arch. Toxicol., 86: 521-534.
3. Powell, S.R., 2000. The antioxidant properties of zinc. J. Nutr., 130: 1447S-1454S.
4. Oteiza, P.I., 2012. Zinc and the modulation of redox homeostasis. Free Radical Biol. Med., 53: 1748-1759.
5. Korenekova, B., M. Skalicka, P. Nad, J. Venglovsky and J. Saly, 2005. Supplementation of zinc and cadmium on egg quality of Japanese quails. Proceedings of the 12th ISAH Congress on Animal Hygiene, Volume 2, September 4-8, 2005, Warsaw, Poland, pp: 118-121.
6. Al-Daraji, H.J. and M.H. Amen, 2011. Effect of dietary zinc on certain blood traits of broiler breeder chickens. Int. J. Poult. Sci., 10: 807-813.
7. Moghaddam, H.N. and R. Jahanian, 2009. Immunological responses of broiler chicks can be modulated by dietary supplementation of zinc-methionine in place of inorganic zinc sources. Asian-Aust. J. Anim. Sci., 22: 396-403.
8. Feng, J., W.Q. Ma, H.H. Niu, X.M. Wu, Y. Wang and J. Feng, 2010. Effects of zinc glycine chelate on growth, hematological and immunological characteristics in broilers. Biol. Trace Elem. Res., 133: 203-211.
9. Ao, T., J.L. Pierce, A.J. Pescatore, A.H. Cantor, K.A. Dawson, M.J. Ford and M. Paul, 2011. Effects of feeding different concentration and forms of zinc on the performance and tissue mineral status of broiler chicks. Br. Poult. Sci., 52: 466-471.
10. Ahuja, S.D., 1990. A Textbook on Quail Husbandry. 1st Edn., ICAR Publication, USA.
11. Deo, C., H.P. Shrivastava, K.T. Praveen and D.P. Singh, 2005. Calcium and zinc levels in laying hens diet: Effect on egg production performance. Proceedings of the 23rd Annual Conference and National Symposium of Indian Poultry Science Association, February 2-4, 2005, Hyderabad.
12. Yildiz, N., Z. Erisir, K.M. Sahin and M. Gurses, 2006. Effect of zinc picolinate on the quality of Japanese quail eggs. J. Anim. Vet. Adv., 5: 1181-1184.
13. Stahl, J.L., M.E. Cook and M.L. Sunde, 1986. Zinc supplementation: Its effect on egg production, feed conversion, fertility and hatchability. Poult. Sci., 65: 2104-2109.
14. Kidd, M.T., N.B. Anthony, Z. Johnson and S. Lee, 1992. Effect of zinc methionine supplementation on the performance of mature broiler breeders. J. Applied Poult. Res., 1: 207-211.
15. Hudson, B.P., W.A. Dozier III and J.L. Wilson, 2005. Broiler live performance response to dietary zinc source and the influence of zinc supplementation in broiler breeder diets. Anim. Feed Sci. Technol., 118: 329-335.
16. Khurshid, A., M. Farooq, F.R. Durrani, K. Sarbiland and A. Manzoor, 2004. Hatching performance of Japanese quails. Livest. Res. R. Dev., Vol. 16, No. 1.
17. Farooq, M., M.A. Mian, M. Ali, F.R. Durrani, A. Asghar and A.K. Muqarrab, 2001. Egg traits of Fayumi birds under subtropical conditions. Sarhad J. Agric., 17: 141-145.
18. Randall, M., 2001. Raising Japanese quail. Ph.D. Thesis, Department of Primary Industries Agriculture, New South Wales, Australian.
19. Mizutani, M., 2003. The Japanese quails. Laboratory Animal Research Station, Nippon Institute for Biology Science, Kobuchizawa, Yamanashi, Japan, pp: 408-441.
20. Shrilakhsmi, B., 1994. Nutrition Science. 2nd Edn., Willey Eastern Ltd., USA., Pages: 201.

21. Sunder, G.S., A.K. Panda, N.C.S. Gopinath, S.V.R. Rao, M.V.L.N. Raju, M.R. Reddy and C.V. Kumar, 2008. Effects of higher levels of zinc supplementation on performance, mineral availability and immune competence in broiler chickens. J. Applied Poult. Res., 17: 79-86.
22. Adeogun, I.O. and A.A. Adeoye, 2004. Heritabilities and phenotypic correlations of growth performance traits in Japanese quails. Livest. Res. R. Dev., Vol. 16.
23. Narayan, R., S.K. Agarwal, B.P. Singh, D.P. Singh, S. Majumdar and R.V. Singh, 1998. Development of specialized strains of meat and egg type quails in hot climate. Proceedings of the European Poultry Conference Jerusalem Israel, (EPCJI`98), WPSA-Israel Branch, pp: 322-324.
24. Sahin, K., N. Sahin and M. Onderci, 2002. Vitamin E supplementation can alleviate negative effects of heat stress on egg production, egg quality, digestibility of nutrients and egg yolk mineral concentrations of Japanese quails. Res. Vet. Sci., 73: 307-312.
25. Sahin, K. and O. Kucuk, 2003. Zinc supplementation alleviates heat stress in laying Japanese quail. J. Nutr., 133: 2808-2811.
26. Tabatabaie, M.M., H. Aliarabi, A.A. Saki, A. Ahmadi and S.A. Hosseini Siyar, 2007. Effect of different sources and levels of zinc on egg quality and laying hen performance. Pak. J. Biol. Sci., 10: 3476-3478.
27. Idowu, O.M.O., O.R. Ajuwon, A.O. Fafiolu, A.O. Oso and O.A. Akinloye, 2011. Modulation of cholesterol and copper residue levels in muscles and blood serum of finishing broiler chickens fed copper and ascorbic acid supplements. Pak. J. Nutr., 10: 781-785.
28. Mabe, I., C. Rapp, M.M. Bain and Y. Nys, 2003. Supplementation of a corn-soybean meal diet with manganese, copper and zinc from organic or inorganic sources improves eggshell quality in aged laying hens. Poult. Sci., 82: 1903-1913.