SHORT COMMUNICATION

Comparative Evaluation of Yeast Selenium and Sodium Selenite Supplementation on Fertility, Hatchability and Antioxidant Status in Dual Purpose Laying Hens

Pramod Dodamani[1]*, Malathi Venkataramaiah[2], Abhishek Mahadev Jolapure[1], Deepthi Vedamurthy[1], Jayanaik[2]

Abstract

Selenium is an essential trace element, involved in many biological processes in animals, such as antioxidant status, reproduction, immunity and thyroid hormone metabolism. In this study, dual purpose Giriraja (200) hens of 30 weeks of age were randomly distributed into 4 treatment groups having 5 replicates of 10 (1 male + 9 female) birds each. Treatment groups were divided based on additional selenium supplementation to the basal diet. Accordingly, the basal diet was T_1, with further addition of sodium selenite alone, sodium selenite + selenium-enriched yeast, and selenium enriched yeast alone @ 0.5, 0.3 + 0.2, and 0.5 mg Se/kg basal diet to form diets for T_2, T_3, and T_4, respectively. The experimental period was for 8 weeks @ 150 g feed/day/bird. Fertility, hatchability and antioxidant status, *viz*., levels of Glutathione peroxidase, Superoxide dismutase and Catalase were assessed. The addition of different sources of selenium alone and their combination did not show any significant difference in fertility and hatchability parameters at the end of 4th and 8th weeks of the study. Similarly, no significant improvement was seen in the antioxidant status of the birds at the end of the experiment. In conclusion, the requirement of selenium, in layer (0.05-0.08 mg/kg diet) can be met with the amount of Se present in the feed raw material. Hence additional selenium supplementation may not be required under normal environment and production conditions.

Key words: Antioxidant status, Fertility, Hatchability, Laying hens, Selenium.

Ind J Vet Sci and Biotech (2023): 10.48165/ijvsbt.19.5.25

Introduction

Selenium (Se) is an important trace mineral in chickens' diet which may cause adverse effects on productive and reproductive performance in deficit supplementation. Se carries out its biological effects within mammalian systems mainly through selenocysteine, which is incorporated into selenoproteins. Selenoproteins have antioxidant properties and protect the organism against the actions of free radicals and carcinogenic factors (Lu *et al.,* 2020). Many authors showed the addition of organic Se sources like yeast selenium (SY) and selenomethionine (SM) to the diet significantly improved the antioxidant status of birds by increasing the activity of enzymes like glutathione peroxidise (GSH-Px), superoxide dismutase (SOD) and catalase (Mohapatra *et al.,* 2014; Jing *et al.,* 2015). Avian semen is rich in long-chain polyunsaturated fatty acids, making it more prone to lipid peroxidation and decreasing spermatozoa viability. Thus, supplementation of antioxidants such as Se and vitamin E improved the survivability of spermatozoa inside hen uterine system and further increase fertility. Many such reports of Se supplementation alone or in combination with vitamin E have shown improvement in fertility and hatchability (Osman *et al.,* 2010; Adebiyi *et al.,* 2014). With this background, the present study was undertaken to evaluate the effect of organic Se, *i.e.,* SY and its combination with inorganic Se sources such as sodium selenite (SS) on fertility, hatchability and antioxidant status of laying hens.

[1]Department of Livestock Production Management, Veterinary College, Bangalore - 560024, KVAFSU, Karnataka, India

[2]Department of Poultry Science, Veterinary College, Bangalore - 560024, KVAFSU, Karnataka, India

Corresponding Author: Pramod Dodamani; Department of Livestock Production Management, Veterinary College, Bangalore - 560024, KVAFSU, Karnataka, India, E-mail: pramodkdodamani@gmail.com

How to cite this article: Dodamani, P., Venkataramaiah, M., Jolapure, A. M., Vedamurthy, D., & Jayanaik. (2023). Comparative Evaluation of Yeast Selenium and Sodium Selenite Supplementation on Fertility, Hatchability and Antioxidant Status in Dual Purpose Laying Hens. Ind J Vet Sci and Biotech. 19(5), 114-117.

Source of support: Nil

Conflict of interest: None

Submitted: 03/07/2023 **Accepted:** 20/07/2023 **Published:** 10/09/2023

Materials and Methods

Ethical Statement

The study was carried out in 2019 at the Department of Poultry Sciences, Bengaluru. All the procedures followed in the experiment were approved by Institutional Animal Ethics Committee (IAEC) with IAEC No. VCH/IAEC/2019/107.

Experimental Design

A total of two hundred (20 males + 180 females) dual purpose, 30 weeks old Giriraja laying hens with uniform body weight were wing banded and randomly distributed in 20 experimental pens having 4 treatment groups and 5 replicates each having 9 females and 1 male bird in each pen. The treatment groups were divided based on the addition of Se to the corn-soybean meal based basal diet (control diet, T1) formulated according to national research council (NRC, 1994) specifications. Similarly, the mg Se/kg diet dose of 0.5 of SS was made as group T2, SS + SY @ 0.3+0.2 was assigned as T3, and SY @ 0.5 as T4. The trial was conducted for 8 weeks period on a deep litter system in a conventional open-sided poultry house that suits Indian commercial poultry farming practices. The experiment was conducted under standard managemental practices and a light schedule of 16 h followed. Feeding was done once in the morning @ 150 g/ day with *ad lib* access to water throughout the experimental period. Eggs were collected every two h, marked pen-wise, and shifted to the cold store in the hatchery.

Parameters Studied

All the eggs produced from each replicate were subjected to evaluate fertility and hatchability at the end of the fourth and eighth week of the experiment. Eggs from each treatment were collected for five days and sorted based on shape, size, cracked and crushed eggs to get the settable eggs and stored in a cold store of the hatchery at 16°C. Eggs were brought to room temperature before setting in the incubator. A temperature of 37.6 to 37.9 °C and humidity of 65 % were maintained in the incubator. On the 18th day of incubation, eggs were subjected to mass candling, the infertile eggs were discarded, and only the fertile eggs were transferred to the hatcher, which was set at 36.1 to 36.7°C temperature and 70 % humidity. The day-old chicks were pulled out from the hatcher on the hatch day. Fertility and hatchability (based on the total and fertile egg set) were calculated using the standard formula at the end of 4th and 8th week of the experiment.

At the end of 8th week of the trial, 2 mL of blood was collected from the brachial vein of birds using a sterilized syringe and needle in plain tubes without anticoagulant. Blood was collected from two birds from each replicate. The serum was transferred to Eppendorf tubes and stored immediately at -40°C until subjected to estimation of Glutathione peroxidase (GSH-Px), Superoxide dismutase (SOD) and Catalase. GSH-Px and SOD activities were estimated using Sigma kits. Catalase activity was assayed spectrophotometrically according to the method described by Aebi (1983) in terms of hydrogen peroxide (H_2O_2) utilization and was expressed as mM H_2O_2 utilized/min.

All the data pertaining to various parameters were analysed statistically by one-way analysis of variance using Software Package for Social Sciences (SPSS) software. Differences between the means were tested using Tukey's test at $p< 0.05$.

Results and Discussion

The results of our study showed that supplementation of different sources of Se alone or their combination did not significantly improve fertility and hatchability (Table 1) at the end of the fourth and eighth week of the experiment. This was in agreement with Attia *et al.* (2010), who found no significant effect on fertility percent upon additional supplementation of different sources of Se at different levels (SS and SM @ 0.15 and 0.30 mg Se/kg diet each), where the basal diet was having 0.1 mg Se/kg diet. Emamverdi *et al.* (2019) showed that different sources of Se (SY, SM and SS) had no significant influence on fertility percentage compared to the control group. Similarly, Kahraman *et al.* (2020) reported no significant improvement in hatchability upon additional supplementation of different sources of Se at different levels (SY and SS @ 0.20 and 0.35 mg Se/kg diet each), where the basal diet was containing 0.13 mg Se/kg diet. Contrarily, Osman *et al.* (2010) showed a significant increase in fertility percent of 42 week old breeder hens in dose dependent manner upon supplementing two dietary levels of organic Se @ 0.1 and 0.2 mg Se/kg diet. Rizk (2018) found significantly improved fertility and hatchability percentage upon the addition of organic Se @ 0.3 mg Se/kg diet in 22 weeks old hens subjected to heat stress compared to the unsupplemented group.

The antioxidant status of animals is mainly assessed by the level of antioxidant enzymes. In this study, the addition of Se did not show any significant difference in levels of GSH-Px, SOD and catalase at the end of experiment (Table 1). Similar results were obtained by many authors who showed no significant difference in levels of GSH-Px (Delezie *et al.,* 2014; Li *et al.,* 2018), SOD (Han *et al.,* 2017; Bakhshalinejad *et al.,* 2018) and catalase (Li *et al.,* 2018) in the additional Se supplemented groups to that of the control group. Contrary to our findings, Han *et al.* (2017) showed a significant increase in GSH-Px activity in the organic Se supplemented group compared to the inorganic and control group. Similarly, the increased activity of SOD (Lin *et al.,* 2020) and catalase (Meng *et al.,* 2018) was also reported upon additional Se supplementation compared to control groups.

The possible reason for non-significant difference in our study might be due to the fact that the Se requirement in laying hens is very less (0.05 - 0.08 mg Se/kg diet), it might be met through the Se content in raw materials of basal diet. Hence further addition of Se may not make any significant difference in fertility, hatchability and antioxidant status.

In short, the results of our study indicate that the addition of different sources of Se and their combinations into the basal diet had no significant influence on the fertility, hatchability and antioxidant status of birds. However, the influence of this trace mineral on these parameters under stress conditions has to be assessed.

Table 1: Effect of additional Yeast Selenium and/or Sodium Selenite on fertility, hatchability of total egg set, hatchability of fertile egg set and levels of GSH-Px, SOD and catalase in laying hens

Treatment groups	Fertility (%)		Hatchability of total egg set (%)		Hatchability of fertile egg set (%)		Enzyme activity (8th week)		
	Week 4	Week 8	Week 4	Week 8	Week 4	Week 8	GSH-Px (U/ml)	SOD (U/ml)	Catalase (mM H_2O_2 utilized/ min)
T1	95.24 ± 2.32	96.88 ± 3.13	89.08 ± 1.80	89.30 ± 7.37	93.64 ± 2.23	91.76 ± 5.17	372.66 ± 2.16	102.98 ± 3.48	113.08 ± 15.06
T2	94.95 ± 2.57	91.48 ± 2.95	89.83 ± 2.74	81.49 ± 2.02	94.62 ± 1.47	90.40 ± 3.30	380.06 ± 7.01	103.24 ± 3.44	125.00 ± 30.05
T3	95.44 ± 1.82	95.62 ± 1.68	86.56 ± 3.02	86.54 ± 2.50	90.69 ± 2.56	90.51 ± 2.17	410.00 ± 18.83	102.45 ± 3.68	139.75 ± 26.00
T4	94.74 ± 0.66	92.59 ± 1.39	89.75 ± 1.74	85.14 ± 2.85	94.73 ± 1.65	92.89 ± 2.22	410.90 ± 14.32	104.22 ± 2.59	153.18 ± 42.72

T1: Control diet (without Se), T2: Control diet + sodium selenite (0.5 mg/kg), T3: Control diet + sodium selenite (0.3 mg/kg) + Yeast selenium (0.2 mg/kg), T4: Control diet + Yeast selenium (0.5 mg/kg).

Note: None of the parameters differed significantly between treatments on 4th or 8th week of the experiment.

Acknowledgments

The authors thank the Department of Poultry Science, Veterinary College, Bangalore and Karnataka Veterinary, Animal and Fisheries Sciences University for providing all necessary facilities for the conduct of the experiment and all analysis.

References

Adebiyi, O.A., Aliu, O.T., Majekodunmi, B.C., & Adeniji, O.A. (2014). Effect of vitamin E and selenium on fertility, hatchability and survivability of turkey. *Journal of Animal Science Advances*, *4*(7), 955-961.

Aebi, H. (1983). Catalase. In: *Methods of Enzymatic Analysis. Vol-3*. 3rd edn. Wiley Publication, New Jersey, USA.

Attia, Y.A., Abdalah, A.A., Zeweil, H.S., Bovera, F., El-Din, A.T., & Araft, M.A. (2010). Effect of inorganic or organic selenium supplementation on productive performance, egg quality and some physiological traits of dual-purpose breeding hens. *Czech Journal of Animal Science*, *55*(11), 505-519.

Bakhshalinejad, R., Akbari Moghaddam Kakhki, R., & Zoidis, E. (2018). Effects of different dietary sources and levels of selenium supplements on growth performance, antioxidant status and immune parameters in Ross 308 broiler chickens. *British Poultry Science*, *59*(1), 81-91.

Delezie, E., Rovers, M., Van der Aa, A., Ruttens, A., Wittocx, S., & Segers, L. (2014). Comparing responses to different selenium sources and dosages in laying hens. *Poultry Science*, *93*(12), 3083-3090.

Emamverdi, M., Zare-Shahneh, A., Zhandi, M., Zaghari, M., Minai-Tehrani, D., & Khodaei-Motlagh, M. (2019). An improvement in productive and reproductive performance of aged broiler breeder hens by dietary supplementation of organic selenium. *Theriogenology*, *126,* 279-285.

Han, X.J., Qin, P., Li, W.X., Ma, Q.G., Ji, C., Zhang, J.Y., & Zhao, L.H. (2017). Effect of sodium selenite and selenium yeast on performance, egg quality, antioxidant capacity, and selenium deposition of laying hens. *Poultry Science*, *96*(11), 3973-3980.

Jing, C.L., Dong, X.F., Wang, Z.M., Liu, S., & Tong, J.M. (2015). Comparative study of DL-selenomethionine vs sodium selenite and seleno-yeast on antioxidant activity and selenium status in laying hens. *Poultry Science*, *94*(5), 965-975.

Kahraman, Z., Yenice, E., Goger, H., Kamanli, S., Gultekin, M., Unay, E., Sen, F., & Yalcin, S. (2020). Effect of source and concentration of dietary selenium on laying performance of egg-type breeders and antioxidant status of their offspring under delayed post-hatch feeding. *European Poultry Science*, *84* (294), 1-12.

Li, K.X., Wang, J.S., Yuan, D., Zhao, R.X., Wang, Y.X., & Zhan, X.A. (2018). Effects of different selenium sources and levels on antioxidant status in broiler breeders. *Asian-Australasian Journal of Animal Sciences*, *31*(12), 1939.

Lin, X., Yang, T., Li, H., Ji, Y., Zhao, Y., & He, J. (2020). Interactions between different selenium compounds and essential trace elements involved in the antioxidant system of laying hens. *Biological Trace Element Research*, *193,* 252-260.

Lu, J., Qu, L., Ma, M., Li, Y.F., Wang, X.G., Yang, Z., & Wang, K.H. (2020). Efficacy evaluation of selenium-enriched yeast in laying hens: Effects on performance, egg quality, organ development, and selenium deposition. *Poultry Science*, *99*(11), 6267-6277.

Meng, T., Liu, Y.L., Xie, C.Y., Zhang, B., Huang, Y.Q., Zhang, Y.W., Yao, Y., Huang, R., & Wu, X. (2019). Effects of different selenium sources on laying performance, egg selenium concentration, and antioxidant capacity in laying hens. *Biological Trace Element Research*, *189,* 548-555.

Mohapatra, P., Swain, R.K., Mishra, S.K., Behera, T., Swain, P., Mishra, S.S., Behura, N.C., Sabat, S.C., Sethy, K., Dhama, K., & Jayasankar, P. (2014). Effects of dietary nano-selenium on tissue selenium deposition, antioxidant status and immune functions in layer chicks. *International Journal of Pharmacology*, *10*(3), 160-167.

Osman, A.M.R., Abdel Wahed, H.M., & Ragab, M.S. (2010). Effects of supplementing laying hens diets with organic selenium on egg production, egg quality, fertility and hatchability. *Egyptian Poultry Science Journal*, *30,* 893-915.

Rizk, Y.S. (2018). Effect of dietary source of selenium on productive and reproductive performance of Sinai laying hens under heat stress conditions. *Egyptian Poultry Science Journal*, *37*(2), 461-489.

ANNOUNCEMENT

X Annual Convention and National Symposium of SVSBT-2023

Extension of Date of Abstract Submission

This is to inform that on request from many participants, the last date of submission of Abstract through **e-mail svsbt2023@gmail.com is extended till 23rd September, 2023 for presentation in the *X Annual Convention*** of the Society for Veterinary Science & Biotechnology ***(SVSBT)*** and ***National Symposium on "Recent Biotechnological Advances in Health and Management of Livestock, Poultry and* Companion Animals"** to be Hosted by College of Veterinary Science & Animal Husbandry (NDVSU, Jabalpur), **Mhow, Indore, M.P. during 5th to 7th October, 2023**. The other details floated in Brochure cum Invitation remain unchanged. The abstracts received **after 23rd September, 2023 will not be entertained**.

For Further details, please contact:

Dr. R.K. Bagherwal and **Dr. B.P. Shukla**

Organizing Secretaries,
College of Veterinary Science & Animal Husbandry,
Mhow, Indore (MP), India
Whatsapp No.: 9589387634 (RKB), 9826298323 (BPS).