

INFLUENCE OF ORGANIC AND INORGANIC SELENIUM FORMS ON CARCASS TRAITS AND BIOCHEMICAL PARAMETERS IN QUAILS

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ABSTRACT

The aim of the study was to evaluate the effects of different forms of selenium, including selenium nanoparticles, administered as dietary supplements in feed mixtures, on carcass characteristics and the sensory properties of quail meat. A total of 200 Japanese quails were included in the experiment and randomly allocated into four experimental groups (n = 50 per group). The results demonstrated that selenium supplementation, particularly in organic and inorganic forms, exerted beneficial effects on meat quality, especially with regard to oxidative stability, fat content, and protein content. Moreover, the observed effects appeared to be dependent on the specific form of selenium administered, suggesting distinct physiological and metabolic responses associated with different selenium sources.

Keywords: dietary supplementation; oxidative stability; carcass traits; lipid metabolism

INTRODUCTION

Over the past decade, nanotechnology has attracted considerable attention in the fields of diagnostics, medicine, and nutrition. Recently, there has been a growing interest in the potential application of nanomaterials in poultry nutrition. The primary use of nanotechnology in this area involves nano-sized mineral elements, which may reduce the antagonistic interactions commonly observed with conventional inorganic minerals in the gastrointestinal tract and enhance their bioavailability (Gopi et al., 2017). As a result, lower dietary inclusion levels may achieve comparable or even superior biological effects.



Furthermore, improved bioavailability and utilization of trace elements can positively influence metabolic processes and reduce mineral excretion, thereby minimizing the environmental impact associated with poultry production (Surai et al., 2017). The application of nanoparticles in poultry diets has also been associated with a reduction in pathogenic bacterial populations while promoting the growth of beneficial probiotic microorganisms, which may subsequently improve growth performance and overall health status (Mahmoud, 2012).

Among the various nanomaterials, selenium nanoparticles (SeNPs) have received particular attention because of their unique physicochemical properties, high biological activity, and lower toxicity compared with conventional selenium sources. Previous studies have demonstrated that SeNPs may enhance feed efficiency, growth performance, reproductive functions, and immune responses in poultry and other animal species (Marković et al., 2018). In addition, selenium plays a crucial role in antioxidant defense mechanisms as an essential component of several selenoproteins, including glutathione peroxidase, thereby contributing to the protection of tissues against oxidative damage. Consequently, selenium nanoparticles represent a promising alternative selenium source in poultry nutrition, with potential benefits for animal health, productive performance, and meat quality.

MATERIALS AND METHODS

Experimental Animals and Housing Conditions

A total of 200 Japanese quails (*Coturnix japonica*) were included in the present study. The birds were reared under identical environmental and management conditions in cages measuring 150 × 150 × 200 cm, with 50 quails housed in each cage. Throughout the experimental period, all birds had unrestricted access to drinking water and were fed a standard commercial diet *ad libitum*.

At the beginning of the experiment, the birds were randomly assigned to four experimental groups (n = 50 per group), with two replicates established within each group. The control group (C) received a basal diet without selenium supplementation. Experimental group EXG1 received the basal diet supplemented with selenium nanoparticles (SeNPs). Experimental group EXG2 was supplemented with sodium selenite as an inorganic selenium source, whereas experimental group EXG3 received selenium-enriched yeast as an organic selenium source.

All birds were maintained under identical husbandry conditions throughout the experiment in order to minimize the influence of environmental factors on the evaluated parameters.

Experimental Procedure and Carcass Evaluation

The experimental period lasted 50 days. At the end of the experiment, the birds were slaughtered by severing the jugular vein, and blood samples were collected for subsequent laboratory analyses.

After slaughter, carcasses were processed by removing the head, feathers, internal organs, and distal portions of the limbs. Carcass weight was determined immediately after processing. Carcass yield was calculated as the ratio between live body weight before slaughter and carcass weight and was expressed as a percentage.

Chemical Analysis of Meat

Samples of the breast muscle (*Musculus pectoralis major*) were collected for the determination of the basic chemical composition of the meat. The analyses included the determination of crude protein, fat, moisture, and ash content according to the methodology described by (Marcinčák et al., 2023).

Sensory Evaluation

Sensory properties of the meat were evaluated by a panel of trained assessors. The assessed attributes included appearance, aroma, tenderness, juiciness, and overall acceptability. Samples were prepared under identical conditions prior to evaluation.

Statistical Analysis

The obtained data were statistically evaluated using one-way analysis of variance (ANOVA). Differences among experimental groups were assessed using Tukey's post hoc test. The results were expressed as mean values $\pm$ standard deviation (SD), and differences were considered statistically significant at $P < 0.05$.

RESULTS AND DISCUSSION

Table 1 presents the values of live body weight, carcass weight, and breast muscle weight on day 50 of the fattening period. On this day, no significant differences were observed in live body weight, carcass weight, or breast muscle weight between the experimental groups and the control group. Furthermore, lower carcass weight values were recorded in the Na_2SeO_3 group, in which quails were supplemented with inorganic selenium, compared with the control group.

Similar findings were reported by (Liu et al., 2015), who did not observe significant improvements in growth performance in chickens supplemented with either organic or inorganic forms of selenium. According to the study by (Reda et al., 2024), dietary supplementation with nano-selenium had no significant effect on carcass characteristics. Likewise, (Sevim et al., 2022) found that dietary nano-selenium supplementation did not influence carcass yield in broiler chickens. (Bakhshalinejad et al., 2019) also reported that dietary nano-selenium supplementation at levels of 0.1 and 0.3 mg/kg had no significant effect on carcass traits in broiler chickens.

Tab. 1: Effect of selenium supplementation on live body weight and carcass parameters of quails on day 50.

	Live weight (LW)		Carcass weight (CW)		Carcass yield	Pectoral muscle weight		
	g				% LW	g		%CW
Group	x	sd	x	sd	x	xs	sd	x
Control	289.66 ^a	23.70	185.6 ^a	13.46	64.09	60.33	7.91	32.49
SeNP	278.0 ^{a,b}	21.18	180.0 ^{a,b}	16.64	64.74	58.16	10.19	32.31
Na ₂ SeO ₃	261.82 ^b	12.38	168.0 ^b	9.97	64.16	55.5	3.88	33.03
Yeast Se	279.66 ^{a,b}	17.89	178.0 ^{a,b}	14.81	63.64	59.83	6.79	33.61

Note: SeNP – quails supplemented with selenium nanoparticles; Na₂SeO₃ – quails supplemented with sodium selenite; Se yeast – quails supplemented with selenium-enriched yeast; different superscript letters within a column indicate statistically significant differences at $P < 0.05$.

Table 2 summarizes the results of selected meat quality parameters in quails on day 50 of the fattening period. The moisture content increased ($P < 0.05$) in the experimental group supplemented with inorganic selenium (Na₂SeO₃) compared with all other groups.

The fat content was lower ($P < 0.05$) in all experimental groups compared with the control group, with the most pronounced reduction observed in the group supplemented with the organic form of selenium. A slight decrease in protein content ($P < 0.05$) was recorded in the SeNP group as well as in the group supplemented with the organic form of selenium (Se yeast) compared with the control group and the inorganic selenium group (Na₂SeO₃).

The pH value was lower in the SeNP group and in the group supplemented with the organic form of selenium (Se yeast) compared with the control group and the inorganic selenium group. The MDA concentration was lower ($P < 0.05$) in the experimental groups supplemented with organic selenium and inorganic selenium compared with the control group.

Similar findings were reported by (Reda et al., 2024), who observed a significant reduction in MDA values ($P = 0.0009$) following dietary supplementation with biological nano-selenium in quails compared with the control group. Dietary supplementation with selenium nanoparticles also improved the plasma lipid profile in quails.

(Mohapatra et al., 2014) reported that the inclusion of nano-selenium in the diets of laying hens significantly reduced fat levels. Likewise, (Elsaid, 2015) observed a significant decrease in blood triglyceride concentrations in birds treated with nano-selenium. (Oppenheimer et al., 1991) suggested that the beneficial effects of selenium on the lipid profile may be attributed to enhanced lipolysis induced by selenium intake. Furthermore, selenium supplementation increased the levels of 15-deoxy- $\Delta^{12,14}$ -prostaglandin J₂, resulting in reduced concentrations of sterol regulatory element-binding protein-2 and consequently decreased cholesterol synthesis.

Tab. 2: Comparison of selected meat quality parameters in quails on day 50 of the fattening period.

Parameter	SeNP		Na ₂ SeO ₃		Yeast Se		Control	
	x	Sd	x	sd	x	sd	x	sd
Water	69.36 ^b	0.28	70.47 ^a	0.31	69.81 ^b	0.29	69.70 ^b	0.51
Fat	2.52	0.18	2.62	0.13	2.47 ^b	0.18	2.77 ^a	0.08
Ash	1.03 ^a	0.01	1.07 ^b	0.07	1.05	0.02	0.94	0.03
Protein	24.18 ^b	0.40	25.15 ^a	0.80	24.45 ^b	0.40	25.24 ^a	0.44
Ph	6.56 ^b	0.02	6.93 ^a	0.06	6.40 ^b	0.05	6.86 ^a	0.05
MDA	1.05 ^a	0.13	0.691 ^c	0.09	0.829 ^b	0.12	1.01 ^a	0.17

Note: SeNP – quails supplemented with selenium nanoparticles; Na₂SeO₃ – quails supplemented with sodium selenite; Se yeast – quails supplemented with selenium-enriched yeast. Different superscript letters within a column indicate statistically significant differences at $P < 0.05$.

CONCLUSION

In conclusion, no significant differences were observed between the experimental groups and the control group in the evaluated growth and carcass parameters on day 50 of the fattening period, although the group supplemented with inorganic selenium (Na₂SeO₃) exhibited slightly lower carcass weight values. These findings indicate that selenium nanoparticle supplementation did not significantly affect the growth performance of quails during the experimental period. However, further studies are needed to elucidate the potential long-term effects of this selenium source on the health status and productive performance of poultry.

Dietary supplementation with different forms of selenium influenced selected meat quality parameters during the experimental period. On day 50, the group supplemented with organic selenium (selenium-enriched yeast) exhibited lower fat content, reduced pH values, and decreased MDA concentrations, whereas higher moisture content was observed in comparison with the other experimental groups.

Overall, the results suggest that selenium supplementation, particularly in organic and inorganic forms, exerts beneficial effects on quail meat quality, especially with respect to oxidative stability and fat and protein content. The observed effects appear to depend on the chemical form of selenium administered, indicating distinct physiological responses associated with different selenium sources.

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