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Effect of dietary organic selenium supplementation on some semen quality traits of Local Iraqi roosters

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Abstract: Reduced reproductive efficiency in Local Iraqi roosters is one of the primary challenges facing local poultry breeding flocks. This decline can be attributed to several factors, most notably nutritional imbalances and suboptimal management, alongside the deterioration of physiological and reproductive performance, the present study aimed to investigate the effects of selenium—a trace element known for its broad physiological impact—and evaluate its efficacy as a dietary supplement on the semen quality parameters of roosters. A total of 80 roosters, 22 weeks of age, were utilized in this study. The birds were randomly assigned to four treatment groups (20 roosters per treatment), with two replicates per treatment (10 roosters per replicate), The roosters were fed a nutritionally balanced basal diet supplemented with selenium from the onset of the study, All birds underwent continuous training for semen collection to ensure acclimatization to the procedure, Semen was collected bi-weekly throughout the 3-month experimental period, and mean values for each trait were calculated monthly for data presentation, The study evaluated various seminal characteristics, including ejaculate volume, mass activity, individual sperm motility, sperm concentration, packed sperm volume (PSV), and the percentages of dead and abnormal spermatozoa. The results of the current study indicated that selenium supplementation exerted effects ranging from significant to highly significant ($P < 0.05$and $P < 0.01$) across all studied traits throughout the experimental period. These findings suggest that selenium serves as a safe and effective nutritional tool for enhancing the reproductive efficiency of roosters, thereby opening new horizons for future research into utilizing the semen of these roosters for experimental insemination and fertility efficiency testing.

Keywords: *Local poultry; Roosters; Organic selenium; Inorganic selenium; Semen quality; Reproductive performance.*

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Introduction

The global population has reached approximately six billion people, with half of this number residing in Asia. Alarmingly, half of the Asian population lives below the poverty line, lacking basic life necessities, including food security. This situation presents a profound global challenge, driving researchers to maximize both plant and animal production resources to bridge the existing nutritional gap, one proposed solution is to enhance poultry production to provide meat and eggs, which serve as the primary nutritional sources for most populations in the developing world. Focus has been directed toward poultry projects due to the birds' rapid growth rates and short life cycles, which allow for a timely response to food shortages. However, these projects have faced significant production declines due to devastating epidemic diseases affecting commercial flocks, to address these challenges, several strategies have been suggested, most notably the use of dietary supplements. These additives are preferred due to their availability in local markets and their high safety profile for consumers upon the final marketing of the birds (Jabbar et al., 2015; Dalla and Sheboun, 2015; Panaite et al., 2018).

One of these crucial additives is Selenium (Se), a trace mineral found in nature in very minute quantities. Despite its scarcity, it is a fundamental component of dietary formulations, playing vital physiological roles in both humans and animals (Silva et al., 2019). Selenium is an integral part of selenoproteins, which are essential for intracellular antioxidant defense systems. Specifically, it is a key structural component of the enzyme Glutathione Peroxidase (GSH-Px). This enzyme protects sperm cells from damage caused by free radicals and metabolic oxidation, as well as from stressors and adverse environmental conditions (Hosseintabar-Ghasemabad et al., 2024). Furthermore, selenium plays a significant role in enhancing immune system function and defensive responses by contributing to the synthesis of immune proteins and reducing oxidative damage to immune cells (Ahmed et al., 2025). It is also a critical factor in the synthesis of thyroid hormones (T_3 and T_4), which are essential for metabolism and reproduction. Studies have indicated that selenium deficiency leads to decreased activity of these hormones, negatively impacting the overall physiological performance of the bird (Jianhua et al., 2000). Additionally, selenium contributes to mitigating oxidative stress within the sensitive tissues of the testes and ovaries, thereby maintaining semen quality and increasing fertility rates. It also helps balance key reproductive hormones such as FSH, LH, and testosterone, which are vital for spermatogenesis and reproductive processes. Consequently, this study aimed to investigate the effect of dietary selenium supplementation in the rations of indigenous Iraqi roosters and evaluate its efficacy in regulating sperm production.

Materials and Methods

This study was conducted to investigate the effect of supplementing different levels of organic selenium in the diets of local rooster chickens and to determine its impact on their reproductive performance. The experimental period extended from October 1, 2025, to January 5, 2026, A total of 80 local rooster chickens were used in this study and were obtained from local markets. The birds were randomly allocated into four experimental treatments, with 20 roosters per treatment. Each treatment consisted of two replicates, with 10 roosters per replicate.

The experimental treatments were arranged as follows:

- **Treatment 1 (S1):** Control treatment, in which birds were fed a basal diet without any supplementation.
- **Treatment 2 (S2):** Birds were fed a basal diet supplemented with organic selenium at a level of 0.15 mg Se/kg feed.
- **Treatment 3 (S3):** Birds were fed a basal diet supplemented with organic selenium at a level of 0.25 mg Se/kg feed.
- **Treatment 4 (S4):** Birds were fed a basal diet supplemented with organic selenium at a level of 0.35 mg Se/kg feed.

All roosters were fed a balanced diet containing 16% crude protein and 2,708 kcal/kg metabolizable energy.

The males were housed in a designated rearing hall to allow adaptation to the housing conditions and the experimental diets, as well as to train them to respond to semen collection procedures. A two-week adaptation period was allocated to ensure proper acclimatization of the birds before the commencement of experimental measurements. Semen collection was carried out at 1:00 p.m., preceded by feed and water withdrawal to prevent contamination of the collected semen with feces and excreta. The semen collection procedure described by Al-Daraji (2013) was followed. This method involves two persons: the first holds the bird between his thighs, pulls the head backward, and pushes the cloaca forward. The second person performs a gentle dorso-abdominal massage until the papilla becomes erect and clearly protruded, while holding the collection tube with the other hand, Immediately after collection, the semen samples were transferred in special tubes to a foam container to avoid exposure to direct sunlight during transport from the experimental site to the specialized laboratory for evaluation of the studied traits, Ejaculate volume was determined directly after collection for each male individually by weighing the tubes empty and then reweighing them after semen collection; the difference in weight represented the ejaculate volume. Individual and mass sperm motility were evaluated in the laboratory according to the method described by Al-Daraji (2013), A drop of semen was placed on a pre-warmed glass slide, and sperm motility was assessed using a microscope at 40× magnification. Motility was evaluated according to a graded scale ranging from 0 to 100%.

Sperm concentration was determined using a hemocytometer, where sperm cells were counted in five squares according to the method described by Allen and Champion (1955), The percentage of dead spermatozoa was calculated using a mixture of eosin–nigrosin stain. A drop of semen was placed on a glass slide, followed by a drop of the stain on the same slide, and the two were mixed using the edge of another glass slide, according to the method of Lake and Stewart (1978), The percentage of abnormal spermatozoa was estimated following the procedure described by Al-Daraji et al. (2002), using a mixture of eosin bluish and fast green stains (Eosin bluish–fast green), Packed sperm volume was determined according to the method described by Al-Daraji (2002) using capillary tubes. the tubes were filled to three-quarters of their volume, placed in a specialized centrifugation device, and then read using a calibrated ruler designed for this purpose, the experimental data were statistically analyzed using the SPSS software package. A Completely Randomized Design (C.R.D.) was applied to determine the effects of the different treatments on the studied traits. Duncan's Multiple Range Test (1955) was used to assess the significance of differences among treatment means.

Table 1. Composition of the diet used in feeding birds

Fodder material	Usage rate
yellow corn	60
Barley	7
Soybean meal (40% protein)	23
limestone	6.7
table salt	0.3
Mixture of vitamins and minerals	3
the total	100
Chemical composition	
Crude protein	16
Representative energy (kWh/kg suspension)	2708
Lysine	0.75
Methionine	0.36
Methionine and cysteine	0.64
Calcium	3.36
Available phosphorous	0.41

The values of the chemical composition of the fodder materials included in the composition of the feed were calculated according to the reports of the US National Research Council (N.R.C., 1994). (Al-Daraji and Razuki, 2012).

Results and Discussion

The results presented in Table (2) demonstrate the effect of organic selenium supplementation on ejaculate volume in the

roosters used in the present study, indicating the extent to which dietary selenium improved the studied reproductive traits. The data reveal that organic selenium supplementation had a significant effect ($P \leq 0.05$) on ejaculate volume (ml) throughout the three months of the study, the treatment supplemented with 0.35 mg organic selenium/kg feed (S4) recorded the highest ejaculate volume compared with the other supplemented treatments and the control group. Regarding the overall monthly averages, the third month showed the highest mean ejaculate volume compared with the first and second months, Similarly, sperm concentration, also presented in Table (2), was significantly influenced ($P \leq 0.05$) by organic selenium supplementation during the three months of the experiment. The fourth treatment (S4), supplemented with 0.35 mg selenium/kg feed, achieved the highest sperm concentration ($\times 10^9/cm^3$) compared with the other supplementation treatments and the control group, As for the overall monthly mean of sperm concentration, the third month recorded the highest average compared with the remaining months of the study.

Table 2. Effect of dietary organic selenium supplementation on ejaculate volume (mL) and sperm concentration ($\times 10^6$ sperm/cm^3) of Iraqi chicken roosters during different experimental periods (means ± stander error).

Treat.	Percentage Period	Ejaculated volume (ml)			Sperm concentration (cm^3)		
		1	2	3	1	2	3
Se1	0.00	0.34 ± 0.02^{d}	0.38 ± 0.01^{d}	0.41 ± 0.01^{d}	1.10 ± 0.14^{d}	1.48 ± 0.9^{d}	1.85 ± 0.10^{d}
Se2	0.15	0.39 ± 0.02^{c}	0.43 ± 0.01^{c}	0.45 ± 0.01^{c}	1.45 ± 0.09^{c}	1.75 ± 0.10^{c}	1.82 ± 0.24^{c}
Se3	0.25	0.45 ± 0.02^{b}	0.47 ± 0.02^{b}	0.49 ± 0.03^{b}	1.77 ± 0.13^{b}	2.20 ± 0.11^{b}	2.35 ± 0.10^{b}
Se4	0.35	0.49 ± 0.03^{a}	0.52 ± 0.02^{a}	0.55 ± 0.03^{a}	2.05 ± 0.11^{a}	2.45 ± 0.12^{a}	2.55 ± 0.13^{a}
Sig.		0.05	0.05	0.05	0.05	0.05	0.05

The different letters within one column indicate significant differences between the averages of the treatments at the level of significance ($P\leq0.05$), N.S is not significant, the numbers from 1 to 3 indicated the study periods (each number represents a period of one month), the treatments Se1, the first treatment (control), Se2, the second treatment, was fed on a diet with 0.15 mg/kg of selenium in feed, Se3, the third treatment, was fed on a diet with 0.25 mg/kg of selenium in feed, Se4 The fourth treatment was fed on an added diet To it 0.35mg / kg of selenium in feed.

It can be observed from Table (3), which illustrates the effect of different levels of organic selenium supplementation in rooster diets, that selenium treatment had a significant effect on both mass and individual sperm motility when compared with the control treatment across all experimental periods.

Table 3. Effect of dietary organic selenium supplementation on mass and individual sperm motility (%) of Iraqi chicken roosters during different experimental periods (means ± stander error).

Treat.	Percentage Period	Mass sperm motility%			Individual sperm motility%		
		1	2	3	1	2	3
Se1	0.00	62± 1.3	66±1.4	60±1.3	66±1.02	70±2.2	64±1.03
Se2	0.15	68±1.4	70±1.2	72±2.02	72±2.12	75±2.01	77±1.3
Se3	0.25	72±2.0	75±3.0	78±2.0	76±2.03	80±2.04	82±2.11
Se4	0.35	74±3.0	78±2.0	80±2.0	79±2.11	82±2.13	82±2.22
Sig.		0.05	0.05	0.05	0.05	0.05	0.05

The different letters within one column indicate significant differences between the averages of the treatments at the level of significance ($P\leq0.05$), N.S is not significant, the numbers from 1 to 3 indicated the study periods (each number represents a period of one month), the treatments Se1, the first treatment (control), Se2, the second treatment, was fed on a diet with 0.15 mg/kg of selenium in feed, Se3, the third treatment, was fed on a diet with 0.25 mg/kg of selenium in feed, Se4 The fourth treatment was fed on an added diet To it 0.35mg / kg of selenium in feed.

Discussion

The results presented in Tables (2) and (3), which included ejaculate volume, sperm concentration, and both mass and individual sperm motility, demonstrated a clear superiority of the selenium-supplemented treatments compared with the control group. This improvement may be attributed to the vital biological role of selenium. Selenium is an essential component of specific proteins known as selenoproteins, which constitute a major part of antioxidant enzymes such as glutathione peroxidase. This enzyme plays a pivotal role in protecting reproductive system cells in general, and spermatozoa in particular, from oxidative damage caused by free radical formation. It is well established that semen contains high levels of unsaturated fatty acids, which are highly susceptible to lipid peroxidation. Therefore, antioxidant enzyme activity increases to protect sperm cells from oxidative damage and to maintain their functional integrity. Selenium also contributes to DNA integrity and mitochondrial function, thereby enhancing sperm activity and efficiency (Sabzian-Melei et al., 2022). Furthermore, selenium improves semen quality by increasing sperm motility, as observed in the results presented in Table (3), and by enhancing the functional integrity of the sperm plasma membrane. It also reduces the percentage of dead and abnormal spermatozoa due to its antioxidant properties. These combined effects are reflected in the observed increases in ejaculate volume

and sperm concentration shown in Table (2) (Namazi Zadegan et al., 2022). The mechanism of selenium action primarily involves its incorporation into selenoproteins, which form part of the antioxidant defense system. Organic selenium sources, particularly selenomethionine (under investigation in the present study) and selenium yeast, are more readily absorbed and more efficiently retained in tissues than inorganic selenium, thereby improving its bioavailability within body tissues (Abd El-Hack et al., 2024). The findings of the present study are consistent with those reported by Long et al. (2024), who confirmed that supplementation of rooster diets with 0.4 mg selenium/kg feed significantly improved sperm motility, reduced sperm abnormalities, increased glutathione enzyme activity, and decreased lipid peroxidation indicators, as measured by malondialdehyde levels—an established biomarker of oxidative stress and lipid oxidation.

Conclusions

Based on the presented results, it can be concluded that the supplementation of mineral elements, particularly selenium, represents an important factor in improving reproductive performance. This effect is attributed to selenium's vital biological role in enhancing reproductive efficiency, especially in local rooster breeds that are characterized by relatively low fertility.

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