

Article

# Effect of Adding Different Levels of Flaxseed Oil to Diets on The Rate of Mass and Individual Motility of Spermatozoa in Ostrich Semen

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**Abstract:** This study was conducted at the Babylon Reserve for Ostrich, Falcon, and Deer Breeding, located in Al-Musayyab District, Al-Hindiya Subdistrict, Babylon Province, to investigate the effect of adding flaxseed oil to ostrich diets at inclusion levels of 1% and 2% on the mass and individual sperm motility in ostrich semen. A total of 27 sexually mature ostriches were used in the study and were randomly allocated into three treatment groups, each with three replicates. A standardized diet was provided to both males and females, containing 17.34% crude protein and an energy level of 2740.56 kcal of metabolizable energy per kg of feed, offered twice daily (morning and evening). The study involved an evaluation of semen characteristics, specifically focusing on mass and individual sperm motility. The results indicated significant to highly significant improvements in most evaluated parameters across the treatment periods. These findings suggest that flaxseed oil, as a rich source of omega-3 fatty acids, can effectively enhance reproductive performance in ostriches.

**Keywords:** Ostrich, Flaxseed Oil, Omega-3, Individual Motility, Mass Motility, Semen

## Introduction

The ostrich (*Struthio camelus*) is the largest living bird on Earth and belongs to the order Struthioniformes. One of the distinctive characteristics of this species is its high adaptability to hot environments, in addition to its remarkable speed, which can reach up to 70 km/h. These traits make the ostrich a bird with a unique biological structure and behavior [1].

In recent decades, interest in ostrich farming has grown significantly due to the nutritional value of its meat, which is completely free of cholesterol, and the high quality of its by-products. These include its leather—used in the production of premium leather goods—feathers used for cleaning delicate electronic equipment, and most notably, the ostrich cornea, which can be worth thousands of dollars due to its use in ophthalmic cosmetic surgeries [2], [3]. Despite its commercial potential, ostrich farming faces several challenges, most notably low fertility and hatchability rates, which are among the major constraints limiting commercial ostrich production [4]. These reproductive issues may stem from several critical factors, including poor nutrition, inadequate management practices, genetic and hormonal imbalances, and suboptimal environmental conditions [5], [6]. As a result, growing attention has been directed toward identifying nutritional alternatives that can enhance the physiological and reproductive performance of ostriches. Among these alternatives is flaxseed oil, a rich source of unsaturated fatty acids, particularly alpha-linolenic acid (ALA), an essential omega-3 fatty acid.

Omega-3 fatty acids exhibit physiological activity that can enhance reproductive efficiency through their effects on hormone regulation, semen quality, and reduction of oxidative damage to cells (Gopi et al). Accordingly, the present study aimed to evaluate the effectiveness of flaxseed oil supplementation on selected semen quality parameters in ostriches.

## Materials and Methods

This study was conducted at the Babylon Reserve for Ostrich, Falcon, and Deer Breeding, located in Al-Hindiya Subdistrict, approximately 65 km south of Baghdad. The purpose of the study was to examine the effects of adding different levels of flaxseed oil—a dietary source of Omega-3 fatty acids—to the feed on the productive, reproductive, and physiological performance of ostriches. The experimental period extended from October 16, 2015, to April 10, 2016, with the initial 14 days designated as an adaptation phase to allow the birds to acclimate to the experimental conditions.

From the first day of the trial, males were separated from females, and all birds were provided with a uniform diet. The floors of the enclosures were covered with clean, fine sand to prevent the presence of harmful metallic or plastic objects that could be ingested and lead to mortality. Specialized feeding equipment was used for both sexes, consisting of modified plastic water tanks (100 × 100 × 50 cm) for feed delivery. Each pen was also equipped with metal water containers connected to water hoses and drainage systems to allow for daily cleaning. Feed was administered twice daily—morning and evening.

The experimental design consisted of three dietary treatment groups as follows:

Treatment 1 (T1): Control diet without flaxseed oil, Treatment 2 (T2): Standard diet supplemented with 1% flaxseed oil, Treatment 3 (T3): Standard diet supplemented with 2% flaxseed oil.

## Studied Traits

**Mass and individual Sperm Motility:** Semen quality was assessed through mass and individual sperm motility. One drop of semen was placed on a pre-warmed glass slide at 41°C, covered gently with a coverslip, and evaluated under a microscope. The assessment of motility parameters was conducted according to the grading scale and method [7].

## Results

### Assessment of Mass Sperm Motility:

Table 1 the result showed related to mass sperm motility in male ostriches. That indicate the flaxseed oil treatment at 2% inclusion level (T3) had a highly significant effect ( $P \leq 0.01$ ) on improving the average values of this parameter across all experimental periods when compared to the control group. Furthermore, the treatment T3 demonstrated a highly significant superiority ( $P \leq 0.01$ ) over the 1% flaxseed oil treatment (T2) during periods 1. However, no significant differences were observed between the T2 and T3 treatments during periods 2, 3, 4, 5, On the other hand, the T2 treatment showed a highly significant improvement ( $P \leq 0.01$ ) in comparison to the control treatment only during periods 5. For the remaining periods (1, 2, 3, 4, 5), no statistically significant differences were observed between T2 and the control group.

**Table 1.** Effect of different levels of flaxseed oil supplementation in the diet on mass sperm motility (%) (mean ± standard error) in male ostriches.

Period	T1 (Control)	T2 (1% Flaxseed Oil)	T3 (2% Flaxseed Oil)	Significance Level
1	68.0 <sup>B</sup> ± 1.73	73.3 <sup>B</sup> ± 2.40	86.3 <sup>A</sup> ± 2.18	0.01
2	70.0 <sup>B</sup> ± 3.60	74.3 <sup>AB</sup> ± 1.45	80.0 <sup>A</sup> ± 1.52	0.05
3	66.0 <sup>B</sup> ± 1.15	72.6 <sup>AB</sup> ± 2.02	80.6 <sup>A</sup> ± 4.25	0.05
4	72.6 <sup>B</sup> ± 3.84	77.0 <sup>AB</sup> ± 1.00	86.0 <sup>A</sup> ± 3.05	0.05
5	68.6 <sup>B</sup> ± 3.17	75.6 <sup>AB</sup> ± 1.20	82.6 <sup>A</sup> ± 2.72	0.05

\*Treatments: T1 (0% flaxseed oil), T2 (1% flaxseed oil), T3 (2% flaxseed oil) \*Each period represents 14 days. \*Different letters within the same row indicate significant differences among treatment means at the 0.05 and 0.01 levels of significance. \*NS = Not significant

### Estimation of Individual Sperm Motility:

Result showed in table 2 the individual sperm motility in male ostriches. that results indicated the treatment group receiving 2% flaxseed oil (T3) showed highly significant ( $P \leq 0.01$ ) improvement in this parameter compared to the control group and treatment T2 in period 1. Furthermore, It was observed during periods two, three, four, and five that treatment three (T3) showed a significant superiority compared to treatment one (T1), whereas no significant differences were noted between treatments three (T3) and two (T2), nor between treatments two (T2) and one (T1), despite the statistical advantage observed in favor of the supplemented treatments.

**Table 2.** Effect of different levels of flaxseed oil supplementation in the diet on individual sperm motility (%) (Mean  $\pm$  Standard Error) in male ostriches.

Period	T1 (Control)	T2 (1% Flaxseed Oil)	T3 (2% Flaxseed Oil)	Significance Level
1	70.0 <sup>B</sup> $\pm$ 1.52	75.6 <sup>B</sup> $\pm$ 2.72	87.6 <sup>A</sup> $\pm$ 1.85	0.01
2	71.3 <sup>B</sup> $\pm$ 3.52	76.3 <sup>AB</sup> $\pm$ 1.45	82.0 <sup>A</sup> $\pm$ 1.52	0.05
3	68.0 <sup>B</sup> $\pm$ 1.15	74.6 <sup>AB</sup> $\pm$ 1.85	82.3 <sup>A</sup> $\pm$ 3.92	0.05
4	74.6 <sup>B</sup> $\pm$ 3.84	79.0 <sup>AB</sup> $\pm$ 1.00	87.6 <sup>A</sup> $\pm$ 2.84	0.05
5	70.6 <sup>B</sup> $\pm$ 3.17	77.6 <sup>AB</sup> $\pm$ 1.20	84.6 <sup>A</sup> $\pm$ 2.72	0.05

\*Treatments: T1 (0% flaxseed oil), T2 (1% flaxseed oil), T3 (2% flaxseed oil) \*Each period represents 14 days. \*Different letters within the same row indicate significant differences among treatment means at the 0.05 and 0.01 levels of significance. \*NS = Not significant

### Discussion

Fatty acids may contribute to an increase in testosterone secretion, as decreased levels of this hormone have been directly associated with an increased production of abnormal and malformed spermatozoa, while elevated testosterone levels effectively reduce the rates of sperm abnormalities. An increase in testosterone may also indicate elevated levels of follicle-stimulating hormone (FSH) and luteinizing hormone (LH), both of which play crucial roles in spermatogenesis and the maturation of Sertoli cells, as well as the development of Leydig cells. These hormonal effects collectively improve semen quality in both quantity and quality. Additionally, omega-3 fatty acids can enhance the integrity of the sperm cell membrane, which is essential since spermatozoa require lipids for motility, maturation, and as an energy source during the acrosome reaction and penetration of the oocyte membrane [8].

Moreover, omega-3 fatty acids have the potential to stimulate the activity of steroid hormone-secreting glands. The role of fatty acids in mediating significant changes in reproductive tissues that directly enhance hormone secretion [9]. According to omega-3 is a fundamental factor in maintaining cell membrane integrity due to its role as a precursor of docosahexaenoic acid (DHA), which is the primary fatty acid responsible for preserving sperm membrane stability. Furthermore, supplementation with lipid sources rich in polyunsaturated fatty acids (PUFAs) positively reduces plasma triglyceride concentrations and increases sperm concentration.

The current study's findings align that omega-3 supplementation significantly improved individual and mass sperm motility as well as total sperm count [10], [11], [12], [13]. Flaxseed oil, rich in omega-3 and particularly DHA, significantly enhanced total motility rates in rabbit spermatozoa [14]. DHA has been shown to effectively contribute to overall sperm motility. The development and maturation of Leydig and Sertoli cells are directly influenced by omega-3 rich fat sources, in addition to sperm motility and quality being improved [15]. In conclusion, this study suggests that supplementation of ostrich diets with flaxseed oil positively enhances sperm morphological traits, as evidenced by increased ejaculate volume, sperm concentration, and improvements in both mass and individual motility, along with reductions in the percentages of dead and abnormal spermatozoa.

### Conclusion

In conclusion, this study suggests that supplementation of ostrich diets with flaxseed oil positively enhances sperm morphological traits, as evidenced by increased ejaculate volume, sperm

concentration, and improvements in both mass and individual motility, along with reductions in the percentages of dead and abnormal spermatozoa.

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