Effect of Adding Octacosanol, Oils of Wheat Germ, and Rice to The Diet on Sexual Maturity, Fertility, Hatching and Reproductive System Weight of Quail

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Abstract

This research was conducted to study the effect of adding different percentages of octacosanol (OC), wheat germ oil (WGO), and rice oil (RO) to the ration as an indicator of fertility and hatching of quail birds. Two hundred and eighty-eight quails were used in this study, aged 45 days, and distributed into 24 cages, each cage contained 12 birds (9 females /3 males) for three months. Quail birds were fed production ration. Treatments were added according to the following six treatments: (T1) as a control treatment without any addition, (T2) adding 15 mg octacosanol/kg feedstuff, (T3) adding 20 mg octacosanol/kg feedstuff, (T4) adding 25 mg octacosanol/kg feedstuff, (T5) adding 5 ml of wheat germ oil/kg feedstuff, (T6) adding 5 ml of rice oil/kg feedstuff. After the flock production exceeded 50% and the production of the herd stabilized, 300 eggs were randomly taken from all treatments (50 eggs/treatment) and inserted into an incubator for hatching. Age at sexual maturity, production of 25 and 50%, fertility rate, hatching ratio, The relative weight of the ovaries, egg ducts, and yolk weight were measured in this study. Results found a significant increase (P≤0.05) in the fertility rate for all treatments, but not T3, compared to the control group. Also, the hatchability rate of two ratios of hatching (total eggs and hatching from fertilized eggs) showed a significant increase in T4 compared to other treatments groups. In addition, results showed a significant increase in the relative weight of the second and third yolks for T4 compared to the control group. However, no significant differences showed between all of the experimental treatments in age at sexual maturity and production of 25 and 50% for quail eggs, ovarian weight, oviduct weights, and the relative weight of the first yolk.

Keywords: Octacosanol, Wheat germ oil, Rice oil, Quail, Reproductive traits.

1. Introduction

In the development of ovaries and follicles in chickens, a strict hierarchical system of follicular development has been established by a natural selection and atresia mechanism, which makes these follicles develop according to a definite sequence [1]. Although egg production is one of the most efficient industries nowadays in animal production, it remains a great potential for further advancement, including the time needed from prim parity to peak egg production, the sustaining of this peak period, and the decline rate of laying performance after the peak production. The main reasons for the decline in the egg production of laying hens in the late laying period are the numbers of small growing follicles, decrease in between-grade follicles, increment in the number of atretic follicles, decrease in the ovulation rate [2]. Research on the regulatory mechanism of avian ovarian and follicular development is important for maintaining high laying performance and feed efficiency. Therefore, improving the health status of poultry, enhancing reproductive performance, and prolonging peak production has become highly topical research areas. Studies on the relationship between feed additives and follicular development of poultry can provide a theoretical basis for improving laying performance and for constructing an ideal model for the study of mechanisms regulating follicular development.

Octacosanol [HO-CH2-(CH2)12CH3] is long-chain aliphatic alcohol with prominent physiological activity and pharmacological effects. It is the main component of a natural wax product that exists in wheat germ oil, rice bran oil, fruits, and leaves [3,4]. Since only very small amounts are ingested in human or animal diets, octacosanol must be externally supplied to gain health benefits. Extensive studies on humans and rodents have shown that octacosanol has a variety of biological activities, including anti-fatigue properties [5], antioxidant activities [6], cholesterol-lowering effects [7],...
cytoprotective function [8], ergogenic proper-ties [9], and high level of safety [10]. No research has yet been undertaken on the effect of dietary octacosanol supplementation on reproductive function in laying hens. Studies have shown that octacosanol may affect the endocrine system, in particular causing the secretion of gonadal hormones such as testosterone and cortisol [11]. It is reasonable to suspect that octacosanol probably causes variations in the levels of gonadal hormones, thereby affecting the reproductive performance of laying hens. Therefore, it may be feasible to study the effect of octacosanol as a potential feed additive to improve laying performance. Therefore, this study aimed to evaluate the effects of octacosanol, wheat germ oil, and rice bran oil on fertility and hatching of laying quail.

2. Materials and Methods

The study was carried out in the poultry field of the Animal Production Department of the Faculty of Agriculture at Tikrit University. Two hundred and eighty-eight quails were used in this study, aged 45 days, and distributed into 24 cages, each cage contained 12 birds (9 females /3 males) for three months. Quail birds were fed production ration (table1). Treatments were added according to the following six treatments: (T1) as a control treatment without any addition, (T2) adding 15 mg octacosanol/kg feedstuff, (T3) adding 20 mg octacosanol/kg feedstuff, (T4) adding 25 mg octacosanol/kg feedstuff, (T5) adding 5 ml of wheat germ oil/kg feedstuff, (T6) adding 5 ml of rice oil/kg feedstuff. After the flock production exceeded 50% and the production of the herd stabilized, 300 eggs were randomly taken from all treatments (50 eggs/treatment) and inserted into an incubator for hatching. Age at sexual maturity, production of 25 and 50%, fertility rate, hatching ratio, The relative weight of the ovaries, egg ducts, and yolk weight were measured in this study.

Table 1. The percentages and chemical composition of the quail ration used in the experiment (production).

| Ingredients                                      | %   |
|-------------------------------------------------|-----|
| Yellow corn                                      | 42.7|
| Wheat                                           | 16  |
| Soybean cake (48% crude protein)                | 30  |
| Protein concentrate                             | -   |
| Mixtures of vitamins and minerals *              | 2.5 |
| Di-calcium phosphate                            | 0.5 |
| Vegetable oil                                   | 2   |
| Limestone                                       | 6   |
| Table salt                                      | 0.3 |
| Total                                           | 100 |
| Calculated chemical composition **              |     |
| Crude protein%                                   | 20.00|
| Metabolic energy kcal/kg feed                   | 2850 |
| Calcium%                                        | 2.99 |
| Phosphorous%                                     | 0.52 |
| Lysine%                                         | 1.00 |
| Methionine%                                      | 0.43 |
| Methionine + cysteine%                          | 0.74 |
| Crude fiber%                                     | 3.56 |

* Vitamin A1400 IU, Vitamin D33000 IU, Vitamin E 50 mg, Vitamin K3 4 mg, Vitamin B1 3 mg, Vitamin B2 15 mg, Vitamin B6 6 mg, Vitamin B12 0.04 mg, Niacin 60 mg, Pantothenic acid 20 mg, Folic acid 0.20 mg, Choline 150 mg, Calcium 4.8 mg, Phosphorous 3.18 mg, Manganese 100 mg, Iron 50 mg, Zinc 80 mg, Copper 10 mg, Cobalt 0.25 mg, Iodine 1.5 mg, Selenium 0.20 mg, Zinc 20 mg, Methionine 810 mg.

**The chemical composition values of the forage materials included in the composition of the diet were calculated according to what was measured in [12].

3. Results and Discussions

3.1. Age at sexual maturity and production of 25% and 50%

The data analysis showed (Figure 1) no significant differences occurred between treatment regarding the age at the first egg, age when egg production reaching 25%, and age when egg production reaching 50% for the quail birds.
At the first egg
At 25%
At 50%
Age/day
eggs production
age at sexual maturity
T1 control
T2 (15mg OC)
T3 (20mg OC)
T4 (25mg OC)
T5 (5ml WGO)
T6 (5ml RO)

Figure 1. The effect of adding different proportions of octacosanol, wheat germ oil, and rice oil on age at sexual maturity and production of 25 and 50% for quail eggs.

3.2. Fertility and hatching ratio

The results showed (Figure 2) significant differences occurred between the treatments in the fertility rate and the hatchability rate. Most of the experimental treatments (T2; 98.07%, T4; 98.21%, T5; 97.72%, and T6; 97.91%) showed a significant improvement (P≤0.05) compared to T1 (90.06%) in the fertility rate, but not T3 (95.64%). Regarding the percentage of hatching, data showed (figure 2) that the T4 (89.28%) significantly increased (P≤0.05) compared to all other treatments in the percentage of hatching from the total eggs that were inserted into the hatchery (T1; 74.43%, T3; 76.44%, T5; 73.29%, and T6; 77.08%, respectively). In addition, T2 showed a significant difference among other treatments, but not T4, in the percentage of hatching from the total eggs compared to T1, T3, T5, and T6. Knowing there were no significant differences among T3, T5, and T6 in the percentage of hatching from the total eggs. As for the hatching percentage of fertilized eggs, T4 (90.93%) also showed a significant increase compared to overall treatments. In addition, T2 (83.97%) and T3 (84.99%) showed a significant increase compared to T1, T5, and T6 (77.95%, 75.11%, and 78.78%, respectively). Also, data showed no significant differences between the T1, T5, and T6.

Figure 2. The effect of adding different percentages of octacosanol, wheat germ oil, and rice oil on the fertility and hatching ratio of quail birds.
3.3. The relative weight of the reproductive system and yolk of a quail bird

It appears from the results shown in figure (3) that there were no significant differences among all the experimental treatments in the relative weight of the ovary, the oviduct, and the first yolk. However, a significant increase ($P \leq 0.05$) was obtained in the relative weight of the second yolk in T4 compared to T1 and T5 (1.96%, 0.92%, and 0.96%, respectively). Also, there were no significant differences between T1 and T5 compared to the T2, T3, and T6 (1.42, 1.27, and 1.20 %, respectively).

It appears from the results shown in figure (3) that there were no significant differences among all the experimental treatments in the relative weight of the ovary, the oviduct, and the first yolk. However, a significant increase ($P \leq 0.05$) was obtained in the relative weight of the second yolk in T4 compared to T1 and T5 (1.96%, 0.92%, and 0.96%, respectively). Also, there were no significant differences between T1 and T5 compared to the T2, T3, and T6 (1.42, 1.27, and 1.20 %, respectively).

Finally, table (3) showed that the T4 (0.68%) significantly increased in the relative weight of the third yolk compared to the T1 and T5 (0.23 and 0.19%, respectively). However, the T4 did not show a significant difference compared to the T2, T3, and T6 (0.36, 0.35, and 0.41%, respectively).

![The relative weight of the ovary, oviduct and first, second, third yolk](image)

**Figure 3.** The effect of adding different percentages of octacosanol, wheat germ oil, and rice oil on the relative weight of the ovaries, egg ducts, and yolk weight of quail.

Fertility and hatching characteristics depend mainly on the either sperm's ability for fertilization or the eggs that meet the requirements of fertilization, growth, and development of the fetus. The production of sperm and eggs depends on a set of nutritional and hormonal factors. The most important hormones are secreted through the hypothalamic-pituitary-gonadal axis. Hypothalamus secretes the Gonadotropin-releasing hormone (GnRH). It stimulates the anterior pituitary gland to release two hormones such as follicle-stimulating hormone (FSH) and Luteinizing hormone (LH). They act on the male and female gonads. In the male, these hormones stimulate the testicles to manufacture the testosterone hormone from the interstitial cells in the testicle, which in turn promotes the process of sperm development by stimulating the intermediate cells with the hormone LH. FSH hormone works directly on the production of sperm inside the seminal tubule. In females, the ovary, LH hormone acts to induce ovulation but FSH hormone stimulates the ovarian cells to produce and release the progesterone and estrogen hormone which stimulate the growth and follicles development [13].

In light of these data, it can be said that octacosanol may act to stimulate the production of sex hormones that can enhance the messenger mRNA action associated with the reproductive axis through the synergistic activity of reproductive hormones and the genetic pressure of their receptors on the development of the reproductive organs and the maturation of the follicles in the laying hens during the breeding period, or it may Its cyclic structure and its antioxidant action provided adequate protection for sperm-producing cells and testosterone [14]. The increase in antioxidants can work to protect the developing fetuses outside the body (the egg). It has been found that octacosanol has an antioxidant action, which may indicate its positive effect on protecting sperm. This ability is characterized by its high content of polyunsaturated fatty acid [15]. The total unsaturated fatty acid content in WGO was approximately 81 and 64% respectively [16].
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