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Research Article
Effect of *Eruca sativa* Seeds on Egg Quality in layers (Lohmann layers)

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Abstract

Background and Objective: Recently, a lot of efforts have been done by scientist to improve the quality of poultry products by manipulating the poultry diet. By doing so, the nutritional values of eggs would be improved, adding essential nutritional requirements for humans. In this context, this study was conducted to investigate the effects of two levels (0.01 and 0.02%) of *Eruca sativa* on egg quality traits in lohmann layers. **Materials and Methods:** According to the level of *Eruca sativa*, 45 chickens of Lohmann breed (age seven month) were assigned into three equal experimental groups, 0.00% (control), 0.01% or 0.02% *Eruca sativa* seeds. External quality traits such as; egg weight, shell thickness and internal qualities traits such as; albumin weight and yolk color were studied using 90 eggs in 2 separate collection periods (6 weeks and 8 weeks after treatment). **Results:** Data were statistically analyzed using one-way ANOVA test (SPSS version 16). Both levels of *Eruca sativa* did not exert any significant effect on: whole egg weight, albumin weight, shell weight, yolk weight, albumin thickness and yolk thickness. Nevertheless, significant effects were exerted by *Eruca sativa* (0.02%) on the intensity of the yolk color and egg thickness. **Conclusion:** Generally, *Eruca sativa* improved the egg quality in lohmann layers by improving shell thickness and the density of the yolk color.

Key words: *Eruca sativa*, seeds, egg quality, layers

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Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

The need for nutrients, especially proteins is growing with expanding world population. Poultry products are considered as the cheapest type of proteins which can efficiently meet the demands for protein in human. Recently, many studies have been conducted to improve the quality of poultry products, especially table-eggs. This was achieved by manipulating poultry diet by using some natural products, having nutritional traits. This method leads to development of what is known as designed egg. The rocket seeds contain carotenoids, vitamin C, flavonoids, such as saponin and luteolin and glucosinolate, the precursors of isothiocyanates and sulfaraphene[1], volatile oils like myristicin, apoile and B-Glucosinolates[2]. Glucosinolate exhibits several biological activities including anti-carcinogenic, antifungal, antibacterial effects plus their antioxidant actions[3].

The major glucosinolate in seeds is erucin, which is potentially capable of protecting cells against oxidative stress via three mechanisms: (i) Induction of phase II enzymes (ii) Scavenging hydrogen peroxide and alkyl hydroperoxides accumulated in cells and peripheral blood and (iii) Acting as a precursor of sulforaphene, a potent inducer detoxifies electrophiles and increases cellular antioxidant defenses[4]. They also contain Zn, Cu, Fe, Mg, Mn and other elements[5], which increase immune response and the reproductive performance. Carotenoids can protect phagocytic cells from anti-oxidative response and increase the production of certain interleukins[6]. Also, they increase plasma IgG concentration[7]. Because of these beneficial components of *Eruca sativa*, this research work has been conducted to show its effects on egg quality as part of the efforts paid now a days by scientist in a growing research field, nutritional egg designing.

MATERIALS AND METHODS

Experimental birds and management: This study was carried out in the poultry production unit in Shambat, University of Khartoum, Sudan July 2014 - March 2015, as part extended research work. The experiment was carried out in disinfected open poultry house, partitioned into 3 similar pens of 1 m^2 each. About 45 chickens of Lohmann breed (age 7 month) were used in this experiment. The *Eruca sativa* seeds were crushed and incorporated as a feed additive to the basal diet to come out with three experimental diets containing either 0.00% (control), 0.01% or 0.02% *Eruca sativa* seeds. Wood shavings were used as a litter and the pens were provided with a clean feeders and drinkers with 24 h of light. The three experimental diets were randomly and evenly assigned among 9 prepared pens (5 chickens per each pen).

Chickens were let to feed and drink *ad libitum*. Two reads of egg quality parameters were taken for a total of 45 eggs.

Feeding: The formula of the basal diet is shown in Table 1 while its chemical composition is presented in Table 2. Table 3, on the other hand, shows the chemical composition of *Eruca sativa*.

Statistical analysis: The experimental work of this study was carried out under complete randomized design. The data of the measured parameters were analyzed with one way ANOVA, using the computer programme SPSS, version (16.0). The results were given in terms of mean ± standard error, after the differences between means were statistically assessed, using Duncan multiple range test.

Data collection: Egg weight was measured using a 0.0 g sensitive digital scale, measurements of the internal components were obtained by carefully making an opening around the sharp end of the egg, large enough to allow passage of both the albumen and the yolk through it, without mixing their contents together. The yolk is then carefully separated from the albumen and placed in a Petri dish for weighing. Simultaneously, the associated albumen was placed on another Petri dish and weighed. Both Petri dishes used in weighing the egg contents had been initially weighed and the

Table 1: Formula of the basal diet

Ingredients	Percentage
Sorghum	59.0
Groundnut cake	15.0
Wheat bran	11.83
Super concentrate	5.0
Dicalcium	0.5
Lame stone	8.0
NaCl	0.3
Methionine	0.02
Premix	0.25
Antifungal	0.1

Table 2: Chemical composition of the basal diet

DM (%)	CP (%)	CF (%)	EE (%)	Ash (%)	NFE (%)
92.06	18.23	3.99	3.84	8.18	57.85

Table 3: Chemical analysis of *Eruca sativa* seeds

DM (%)	CP (%)	CF (%)	EE (%)	Ash (%)	NFE (%)
94.7	21.94	18.32	16.45	4.64	13.34

difference in the weights of the Petri dish after and before the egg component was taken as the weight of the egg components. After each weighing, the Petri dishes were washed in clean water and wiped dry before next weighing. The yolk thickness and albumin thickness of the egg were measured with electronic caliper[8]. The shell weight with membrane was obtained by carefully placing the opened part in the shell and weighing on the electronic scale. The thickness (mm) of the shell with intact membranes was measured at three different points and the average of the broad, sharp and middle parts of the egg was obtained by using the electronic digital vernier caliper[9]. The yolk color was determined using the Roche yolk color fan.

RESULTS

Whole egg weight: The effects of *Eruca sativa* on the whole egg weight were presented in Fig. 1. Although, there were slight increases in egg weights in response to *Eruca sativa*, the data revealed that the egg weight was not significantly affected by the two levels used during the experimental period.

Albumin weight: As shown in Fig. 2, the first read (6 weeks after providing the birds with *Eruca sativa*) showed that there was no significant difference between the control and *Eruca sativa* treated groups. In the second read (8 months) the control groups showed slight but in significant increase in albumin weight compared to 0.01 and 0.02% *Eruca sativa* treated groups.

Shell weight: Figure 3 revealed that there were no significant differences in shell weights between the three experimental groups at both collections times.

Yolk weight: As it has been shown in Fig. 4, no significant differences between the three experimental groups were noticed regarding yolk weight. However,

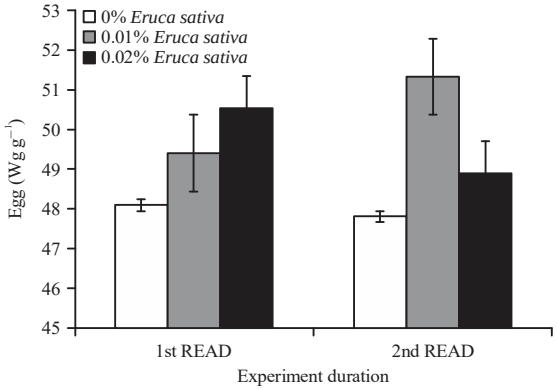

Fig. 1: Effect of the dietary *Eruca sativa* seeds on egg weight (g)

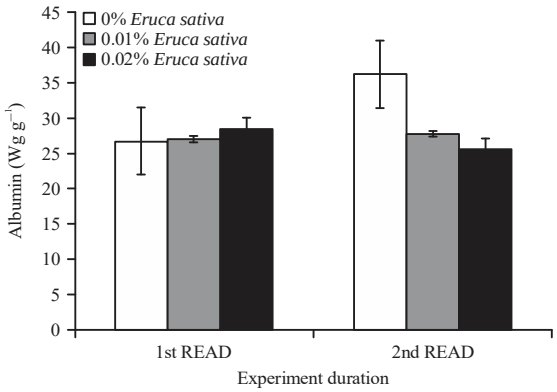

Fig. 2: Effect of the dietary *Eruca sativa* seeds on albumin weight (g)

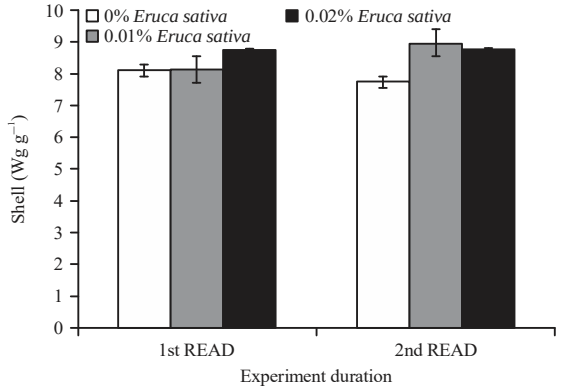

Fig. 3: Effect of the dietary *Eruca sativa* seeds on shell weight (g)

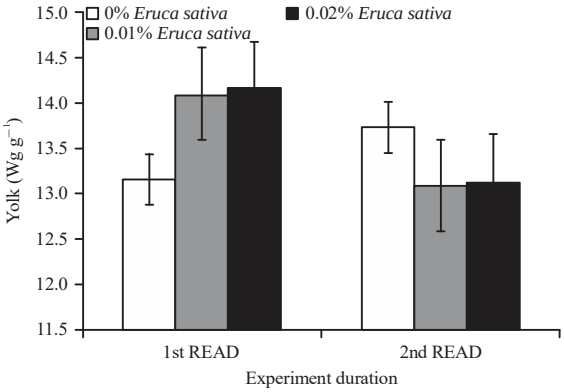

Fig. 4: Effect of the dietary *Eruca sativa* seeds on yolk weight (g)

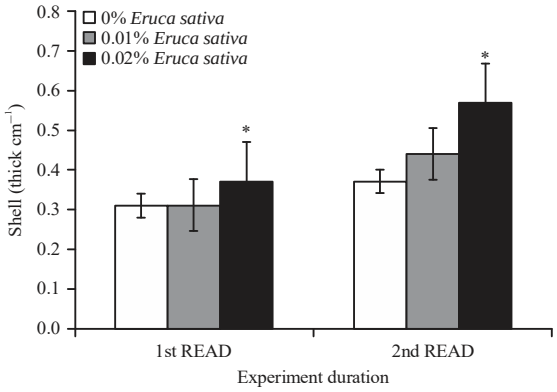

Fig. 5: Effect of the dietary *Eruca sativa* seeds on shell thickness (cm)

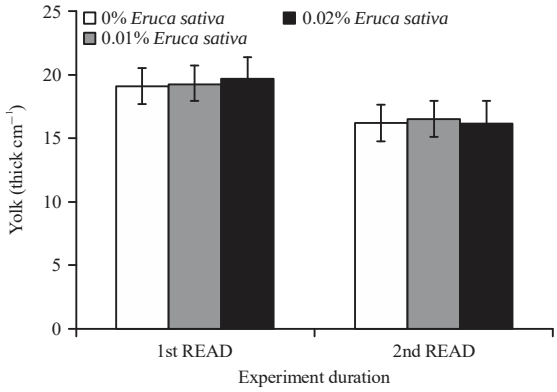

Fig. 7: Effect of the dietary *Eruca sativa* seeds on yolk thickness (cm)

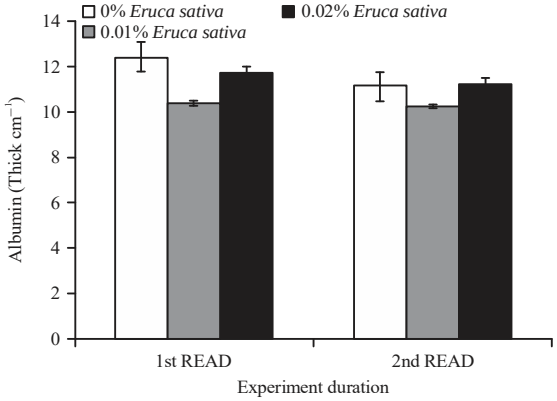

Fig. 6: Effect of the dietary *Eruca sativa* seeds on albumin thickness (cm)

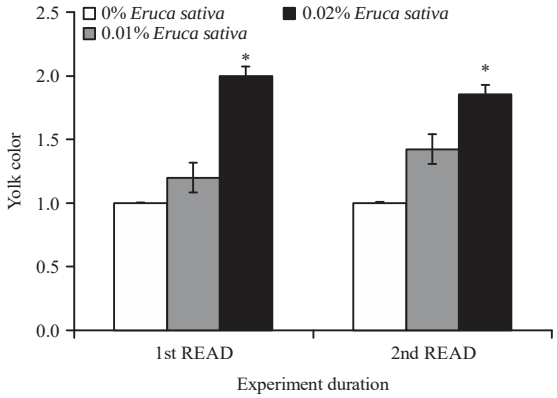

Fig. 8: Effect of the dietary *Eruca sativa* seeds on yolk color

both levels of *Eruca sativa* slightly increased the yolk weight after 6 weeks (1st read).

Shell thickness: The effect of *Eruca sativa* on egg shell thickness has been shown in Fig. 5. After 6 weeks, the low level (0.01%) of *Eruca sativa* did not show any significant effect on shell thickness. However, the treated group with higher level (0.02%) showed significant increase in egg shell thickness. At the 2nd read (collection), the significant effect of 0.02% *Eruca sativa* was still persistent, since the shell thickness in this group was significantly higher than the two other experimental groups. Noteworthy, although it was not significant, the shell thickness in 0.01% *Eruca sativa* group was higher than that of the control group.

Albumin thickness: The effect of *Eruca sativa* on egg albumin thickness has been summarized in Fig. 6. It revealed that there were no significant differences between the control and *Eruca sativa* treated groups in first collection (1st read, after 6 weeks). In the second collection (2nd read, 8 weeks after treatment), the control and 0.02% *Eruca sativa* was superior to 0.01% *Eruca sativa* in albumin thickness. Nevertheless, the differences were not significant.

Yolk thickness: As shown in Fig. 7, the yolk thickness did not affected by the two levels of *Eruca sativa* in both collection periods.

Yolk color: The effect of *Eruca sativa* on the egg yolk color has been shown in Fig. 8. The egg yolk color was significantly ($p<0.05$) potentiated by the 0.02% *Eruca sativa*.

DISCUSSION

Recently, a new trend in research has been developed toward improving the quality food and to overcome the economical losses especially in poultry production sector by manipulating feed of animals in order to provide humans feed

with ingredients of higher nutritional values. This study was designed to provide some data regarding the effects of *Eruca sativa* on egg quality indices. Generally, the current findings showed that *Eruca sativa* seeds exerted positive effects on the egg quality indices such as, egg weight, shell weight, albumin weight, yolk weight, albumin thickness and yolk thickness. Nevertheless, the positive effect on shell thickness was very significant using 0.02% *Eruca sativa* seeds. This in consistent with the findings of Flanders and Abdulkarim[10], who proved that, the *Eruca sativa* seed analysis indicated high levels of calcium and potassium (1186 and 1116 mg/100 g of whole seed, respectively). Also there is a significant increase in intensity of the yolk color in 0.02% *Eruca sativa* group which could be due to the high content of fat/oil in *Eruca sativa* seed which reaches 20% as it has been shown by Nail *et al.*[11]. Increasing the intensity of the yolk color could be due to high rate of incorporation of lipids soluble-ingredient giving this color. The most important ones are carotenoids, vitamin C and luteolin[1]. These compounds are known to increase the potentiality of the immune system. Moreover, the most effective prevention of macular degeneration, which results in progressive and irreversible loss of central region vision leading to blindness, to date is increasing our intake of lutein[12-14].

CONCLUSION

It has been considered that, *Eruca sativa* effects are superior to the control one, especially in shell thickness and yolk color. This might reduce the economical egg loss due to cracking of egg shell during summer season in hot climate, resulting from decreasing the egg shell thickness as a result of panting. Moreover, the intensity of the egg yolk color may improve the quality of the egg and satisfy the consumer reflecting a positive economical impact on the poultry industry. This is addition to the ingredients added to yolk as fat-soluble compounds; carotin and lutein. Further studies are needed to investigate the effects of *Eruca sativa* on general health parameters and productivity by using biochemical analysis of the eggs.

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