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# Lipid sources in diets for egg-laying japanese quail: performance and egg quality

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**ABSTRACT.** This study evaluated the effect of using lipid sources of plant and animal origin in diets for Japanese quail (*Coturnix coturnix japonica*) on production performance and internal egg quality. Japanese quails (n = 160) were distributed in a completely randomized design with four treatments and eight replications of five birds each. Lipid sources evaluated were: soybean oil, from poultry slaughterhouse, fish waste and grape seed. The characteristics of performance and internal egg quality were measured every 21 days for a total period of 84 days. Data were subjected to analysis of variance and the means were compared by Tukey's test. There was no effect of treatments on the production performance of birds, except for feed intake, which was higher for birds fed grape seed oil in the diet. Lipid sources evaluated had no influence on the internal egg quality. It can be concluded that the lipid sources evaluated here in can be used as alternative energy in feed for laying quails, without affecting the performance and internal egg quality.

**Keywords:** poultry slaughterhouse, soybean oil, fish waste, grape seed.

## Fontes lipídicas nas dietas para codornas japonesas em postura: desempenho e qualidade do ovo

**RESUMO.** O objetivo deste trabalho foi avaliar a utilização de fontes lipídicas de origem animal e vegetal nas rações para codornas japonesas (*Coturnix coturnix japonica*), em relação ao desempenho zootécnico e à qualidade interna do ovo. Foram utilizadas 160 codornas japonesas, distribuídas em delineamento inteiramente casualizado, com quatro tratamentos e oito repetições por tratamento, com cinco aves por repetição. As fontes lipídicas avaliadas foram: óleo de soja, de abatedouro avícola, de resíduo de peixe e de semente de uva. As características de desempenho e qualidade interna dos ovos foram mensurados a cada 21 dias, em um período total de 84 dias. Os dados obtidos foram submetidos à análise de variância e as médias comparadas pelo teste de Tukey. Não houve efeito dos tratamentos sobre o desempenho produtivo das aves, exceto para o consumo de ração, que foi maior para aves alimentadas com óleo de semente de uva nas rações. As fontes energéticas avaliadas não influenciaram a qualidade interna dos ovos. Diante disso, conclui-se que as fontes lipídicas avaliadas neste estudo podem ser utilizadas como ingredientes energéticos nas rações para codornas em postura, sem afetar o desempenho e a qualidade interna dos ovos.

**Palavras-chave:** abatedouro avícola, óleo de soja, resíduo de peixe, semente de uva.

## Introduction

Animal origin products have great importance in the human diet and health. Thus, products, such as milk, meat and eggs have been the focus of much research aimed at identifying nutrients or agents that can promote healthy nutrition and, consequently, human health.

Accordingly, the use of certain ingredients in the diet of farm animals has attracted attention in research, in order to evaluate positive and negative points of their use. The increased animal productivity and even the change in the chemical, physical or organoleptic composition of products obtained are taken into account in these researches, which may affect both animal production costs and the gain in human health.

Among all the nutrients in a food, the energy source is one of the ingredients with high contribution in the total cost of animal feed, besides having the ability to change the fatty acid composition of egg and/or meat, especially polyunsaturated, improving its availability for human consumption.

An egg supplies about 13% of the daily requirements of protein for an adult and 25% for children. Thus, the egg is an important component in human diet due to protein input, containing nutrients essential for vital functions, such as, for example, lipids, vitamins and minerals. Moreover, it has been noted the interest of consumers for the quality of animal products (egg, meat or milk), considering characteristics such as color, size and weight, factors influencing the acquisition of a particular product (Grela, Ognik, Czech, & Matras, 2014).

According to Bologa, Pop, and Albu (2013), many studies show that the chemical composition, biological value and physical and chemical properties of eggs are results of the effects of numerous factors, including breed, rearing condition, storage and culinary process of eggs in addition to animal nutrition.

In this context, the inclusion of ingredients, more specifically, oils or fats of plant or animal origin to the diet for birds, to change the lipid profile of animal products is a global trend given the demand of critical consumer for high quality products, with appeal to human health.

Thus, this study evaluated the addition of lipid sources to the diet of egg-laying Japanese quails in relation to production performance and internal egg quality.

## Material and methods

The study was conducted at the Poultry Sector, Experimental Center of Unicastelo, Campus Descalvado, and previously approved by the Ethics Committee on Animal Use of the institution (003/2013).

Japanese quails (n = 160; *Coturnix coturnix japonica*), with 16 weeks of age were housed in galvanized wire cages with trough feeder and nipple drinker in conventional shed with galvanized wire mesh and curtains. The experimental design was completely randomized with four treatments (lipid sources) and eight replications per treatment, with five birds per repetition. Lipid sources evaluated were: soybean oil, poultry slaughterhouse waste, fish waste and grape seed. Alternative sources were used to replace soybean oil, considered as the control diet.

Experimental diets were based on corn and soybean meal, prepared according to the nutritional requirements determined by Silva and Costa (2009), Table 1. The composition of food was determined according to Rostagno et al. (2011).

Birds were fed *ad libitum* throughout the rearing period. The lighting program was 16 hours light daily. Maximum and minimum temperatures, inside the shed, were recorded daily with the aid of a digital thermometer (29±1.5°C and 22±1.0°C, respectively).

**Table 1.** Proximate and nutritional composition of the control diet for egg-laying quails.

| Ingredient | Control |
|---|---|
| Corn grain | 50.478 |
| Soybean meal – 45% | 36.527 |
| Limestone | 5.360 |
| Soybean oil | 3.000 |
| Common salt | 0.400 |
| DL-methionine – 99% | 0.150 |
| L-Lysine HCl – 79% | 0.075 |
| Mineral-Vitamin Supplement[1] | 4.000 |
| Antioxidant[2] | 0.010 |
| Total | 100.00 |
| Nutritional requirements | |
| Metabolizable energy (kcal $kg^{-1}$) | 2.850 |
| Crude protein (%) | 22.00 |
| Calcium (%) | 3.15 |
| Available phosphorus (%) | 0.30 |
| Gross fiber (%) | 3.42 |
| Digestible lysine (%) | 1.08 |
| Digestible methionine (%) | 0.44 |
| Methionine + digestible cystine (%) | 0.72 |
| Sodium (%) | 0.20 |
| Chlorine (%) | 0.26 |
| Potassium (%) | 0.82 |
| DEB[3] (mEq $kg^{-1}$) | 221.78 |

[1]Composition of mineral and vitamin supplement (kg product): Vitamin A (min) 12.000,00 UI $kg^{-1}$; vitamin B1 (min) 2.40 mg $kg^{-1}$; vitamin B12 (min) 20.00 mcg $kg^{-1}$; vitamin B2 (min) 11.00, and vitamin B6 (min) 4.00 mg $kg^{-1}$; vitamin D3 (min) 2.400,00, and vitamin E (min) 24,000 UI $kg^{-1}$; vitamin k3 (min) 3.00; cobalt (min) 0.18; copper (min) 9.00; iron (min) 45.00; iodine (min) 0.90; manganese (min) 54.00; selenium (min) 0.32; sodium (min) 1.800,00; zinc (min) 45.00; folic acid (min) 2.00; pantothenic acid (min) 19.95; biotin (min) 0.14; niacin (min) 48.00; and choline (min) 180.00 mg $kg^{-1}$. [2]BHT: Butyl Hydroxy Toluene. [3]Dietary Electrolyte Balance, according to Mongin (1981). Mongin Number = [(% Na*10,000/22.990) + (% K*10,000/39.102)]-(% Cl*10,000/35.453).

Production performance characteristics (% egg laying, feed intake, feed conversion and viability) were measured every 21 days, considered a production cycle, during the 84 experimental days. To quantify the total feed intake, feed was weighed at the beginning and end of each production cycle. Feed conversion ratio was determined from the relationship between the feed intake and the number of dozen eggs produced (kg $dz^{-1}$) and egg mass (kg $kg^{-1}$). Viability of birds, expressed in percentage, considered the mortality during the experimental period.

For the evaluation of the internal egg quality, in the last three days of each cycle, total egg production was used for determining the average egg weight. Three eggs per experimental unit were used to determine the Haugh Unit, yolk index and yolk color.

Eggs were individually weighed, cut in the central region, and placed on a flat surface to measure albumen height, height and diameter of yolk and yolk color. Haugh Unit was determined according to Brant and Shrader (1958), according Equation 1:

$$HU = 100 * \log (H + 7.57 - 1.7\, W^{0.37}) \quad (1)$$

where:
H = albumen height (mm) and W = egg weight (g).

Yolk index was obtained by the ratio between height and diameter of the yolk (Nesheim, Austic, & Card, 1979). Yolk color was obtained with the aid of a Roche® color fan with a numerical scale from 1 to 15 (from white to red).

Data were subjected to analysis of variance and means were compared by Tukey's test at 5% significance using the statistical software Statistical Analysis System (SAS, 2002).

## Results and discussion

Mean values of the production performance characteristics are listed in Table 2. There was no significant difference ($p > 0.05$) for the characteristics evaluated, except for daily feed intake, because quails fed grape seed oil in the diet showed higher intake in relation to the other treatments, with no difference only from diet containing soybean oil.

The results above corroborate those obtained by Costa et al. (2008), who evaluated different levels of linseed oil content replacing soybean oil in the diet for laying hens and observed no significant results for the feed intake, % of lay, egg weight and mass and feed conversion ratio (per mass and per dozen eggs). Likewise, Oliveira et al. (2010) analyzed the addition of vegetable oil to the diet for young hens, aged 20 to 28 weeks of age, and verified no significant effect on feed intake, feed conversion and egg production. In contrast, Santos et al. (2009) investigated the addition of vegetable oils in diets for laying hens and detected a significant increase in the percentage of eggs for birds fed diet with 2% linseed oil and soybean oil. However, there was no significant increase in feed intake between the levels of inclusion of vegetable oils.

On the other hand, Al-Daraji, Al-Mashadani, Al-Hayani, Mirza, and Al-Hassani (2010) emphasized that the inclusion of fish oil and linseed oil in the diets of groups with male and female quails improved the production performance (body weight, feed intake, egg weight, % of lay, egg mass and feed conversion ratio) and reproductive performance (fertile eggs and embryo mortality) of these animals.

Regarding characteristics of internal egg quality of quails fed different lipid sources, the mean results are presented in Table 3. There was no significant difference ($p > 0.05$) for egg weight, yolk color, Haugh Unit (HU) and yolk index between the treatments. Nevertheless, the results characterize a good internal quality of eggs. The HU values above 72 indicate good quality with respect to freshness, classifying eggs into AA, according to the United States Department of Agriculture (USDA, 2000).

These results are in agreement with the findings of Santos et al. (2009) who verified a greater egg weight of laying hens fed diets containing 4% soybean oil, although the diet with 4% cottonseed oil resulted in eggs with lower weight.

As for yolk color, similar results were found by Faitarone et al. (2016), who concluded that the inclusion of vegetable oils in commercial white layer (Lohmann LSL) diets does not significantly change egg yolk pigmentation, as colorimetrically evaluated. The diets evaluated were with 2.5% linseed oil inclusion; or with 2.5% canola oil; or with 2.5% soybean oil; or with 5.0% linseed oil; or diet with 5.0% canola oil; diet with 5.0% soybean oil; diet with 2.5% linseed oil + 2.5% soybean oil; diet with 2.5% canola oil + 2.5% soybean oil; and T1 diet with 2.5% linseed oil + 2.5% canola oil.

According to Stadelman and Cotterill (1995), Lee, Kim, and Lee (2001), Santos-Bocanegra, Ospina-Osorio, and Oviedo-Rondón (2004), usually a darker yolk color in eggs of commercial laying hens is desirable and depends exclusively on the feed supplied, since they are not able to synthesize these color pigments, but can absorb 20-60% of the feed pigments.

The use of alternative lipid sources in feed for quails has been evaluated considering the high cost of the energy component in the feed and hence in the total production of poultry. Certain lipid sources can alter the lipid profile of eggs, so as to increasing the content of polyunsaturated fatty acids. Therefore, assessments in the chemical composition of eggs are required for a greater power of decision making in the use of alternative energy sources in the diets for laying quails.

**Table 2.** Production performance characteristics of Japanese quais fed diets containing different lipid sources.

| Lipid source | Egg-laying (%) | FCR (kg $dz^{-1}$) | FCR (kg $kg^{-1}$) | FI (g $bird^{-1}$ $day^{-1}$) | Viability (%) |
|---|---|---|---|---|---|
| Soybean | 77.95±2.51 | 0.408±0.027 | 3.142±0.195 | 29.010±0.035 ab | 97.50 |
| Poultry slaughterhouse | 76.28±2.11 | 0.430±0.038 | 3.087±0.185 | 28.691±0.053 b | 100.00 |
| Fish | 77.44±2.34 | 0.386±0.043 | 3.103±0.208 | 28.869±0.047 b | 100.00 |
| Grape seed oil | 77.69±2.21 | 0.392±0.082 | 3.180±0.202 | 30.013±0.042 a | 92.50 |
| p value | 0.716 | 0.779 | 0.634 | 0.043 | 0.815 |
| CV (%) | 9.36 | 9.95 | 11.14 | 3.38 | 10.25 |

Mean ± standard deviation; Different letters in the same column are significantly different by Tukey's test ($p < 0.05$). FCR = feed conversion ratio (kg $kg^{-1}$ and kg $dz^{-1}$); FI = daily feed intake (g $bird^{-1}$ $day^{-1}$).

**Table 3.** Characteristics of internal egg quality of quails fed diets containing different lipid sources.

| Lipid source | Egg weight (g) | Yolk color | Haugh Unit | Yolk index |
|---|---|---|---|---|
| Soybean | 11.52±0.64 | 3.44±0.41 | 85.86±1.84 | 0.43±0.02 |
| Poultry slaughterhouse | 11.86±0.62 | 3.18±0.28 | 85.21±2.51 | 0.42±0.03 |
| Fish | 11.57±0.75 | 3.41±0.33 | 85.50±2.10 | 0.42±0.02 |
| Grape seed oil | 11.97±0.69 | 3.25±0.41 | 85.62±2.36 | 0.43±0.03 |
| p value | 0.066 | 0.410 | 0.778 | 0.222 |
| CV (%) | 5.79 | 10.96 | 2.59 | 6.27 |

Mean ± standard deviation; Different letters in the same column are significantly different by Tukey's test ($p < 0.05$).

## Conclusion

In summary, lipid sources evaluated in this study can be used as alternative energy sources in diets for egg-laying quails, without affecting the performance and internal egg quality.

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