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# Effect of Pure Corn Oil on Growth Performance of Japanese Quail (Coturnix Coturnix Japonica)


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**ABSTRACT**

In recent years, consecutive research has been conducted on the nutrient requirements of the quails to find an optimum and affordable legitimate growth promoter. Different types of vegetable oil have been tested so far. This study aimed to evaluate the effects of pure corn oil (PCO) on growth performance and live body weight gain in Japanese quails. A total of 80 four-day-old quail chicks were divided into two groups: control (20 checks) and experimental (60 checks). The experimental group was subdivided into three subgroups ($G_1$, $G_2$, and $G_3$) of 20 chicks per group. All the control and experimental group chicks were fed a commercial grower quail diet in all three growth phases. Despite the commercial diet, the G1, G2, and G3 experimental groups were fed 1, 3, and 5% PCO, respectively. The values for live body weight did not significantly change after adding PCO to the quail's diet. According to the study's findings, adding PCO to the commercial diet of Japanese quails in various amounts had no beneficial effects on feed consumption and growth rate. Additionally, it had an insignificant ($p>0.05$) detrimental impact on the growth performance of the quails compared to control groups. In conclusion, we can say that adding PCO to quail's commercial diet in the hot months of the year under Afghanistan's climate has no positive impact on growth and further slows down the rate of body weight gain.



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## Introduction

The population of the globe is increasing quickly (Alagawany et al., 2020); a severe food scarcity has triggered a particularly harmful crisis in developing nations (Dehghani et al., 2018; Mnisi & Mlambo, 2017). Among the nutrients, protein, which has a crucial role in the

structure and normal functions of the tissues and organs (Sudhakararao et al., 2019), especially in the growth and development of children (Kårlund et al., 2019), is not available in sufficient quantity and quality in developing countries (Jeke, Phiri, Chitindingu, et al., 2018b). Plant proteins are less digestible in the human GI system (Kårlund et al., 2019; Tomé, 2013), and most of them cannot meet all the requirements of the human body for essential amino acids (Chardigny et al., 2016; Fussell et al., 2021; Gorissen et al., 2018), so animal protein sources are of particular importance in the human diet. Among proteins, animal proteins that contain essential amino acids are of vital value to the human body because these amino acids are not synthesized in the human body (Ha & Zemel, 2003; Kårlund et al., 2019; Lim et al., 2021; Sudhakararao et al., 2019). This protein is significant in providing enough well-balanced nutrition for human health and advancing physical and mental development (Bulus Doka, 2013).

On one side, animal protein is more expensive than plant protein (Chardigny et al., 2016; Grigg, 1995; Post & Hocquette, 2017), and on the other side, the available sources of animal protein are insufficient to fulfill the expanding nutritional demands of the human population (Delgado, 2003; Henchion et al., 2017; Lassaletta et al., 2016). Between 2010 and 2050, there will likely be a 35% to 56% rise in the world's overall food demand, as by 2050, the globe will need to feed nine billion people (The Work Bank, 2014). On the one hand, the world's population, especially in developing countries like Afghanistan, is increasing rapidly. The current food sources cannot meet their increasing demand, and on the other hand, climate change, especially global warming, reduces agricultural production. Afghanistan is among the nations most severely impacted by climate change, particularly in annual droughts that occur back-to-back. This objective will not be accomplished if production levels are not raised in the crop and livestock sectors. Researchers worldwide were trying to find a new source of animal protein that would satisfy human needs and be cheap. The Japanese quail (*Coturnix coturnix japonica*), a small-bodied bird (Odunsi et al., 2007; Vtlchez et al., 1990), was considered suitable for this purpose because it can provide quality protein at a relatively low price through egg and meat production, and it can circulate this food chain faster through its fast (5–6 weeks) growth period (Abd El-Gawad et al., 2008; Donaldson et al., 2015).

Like chickens, Japanese quails are also related to the Galliformem order and the Phasinidae family (Haqani et al., 2023). The first egg lines were developed by selecting the Japanese quail at the beginning of 1920 when intensive production of the Japanese quail began (Badawi, 2017). Following this, Japanese quails were transported to West Asia, Europe, and America, where extensive research has been conducted on these birds as an avian research model (Minvielle, 2004). Across the globe, Japanese quails are reared for egg and meat production (Altine et al., 2016). They provide meat that is both highly nutritious and has a unique flavor. The low fat (especially cholesterol and saturated fat) content of quail meat makes it a popular choice for consumers compared to white meats like broiler chickens and ducks and red meat (Arunrao et al., 2023). A daily consumption of two quails supplies the human body with 27–28 g of protein (containing 11 g of essential amino acids). It accounts for

40% of the protein humans need (Genchev et al., 2008). Producing eggs is one of the most essential industries in the Far East and Asian countries, whereas producing meat is a significant industry in European countries (Akarikiya et al., 2022). Both American quails (C. coturnix) and Japanese quails (C. coturnix japonica) are suited to breeding on farms (Rahman et al., 2016). Compared to chickens, which require 120–130 g of feed daily, Japanese quails only need 20–25 g. At the age of 4 weeks, Japanese quail reaches the market weight of 160–170g (Akram et al., 2014). It is estimated that Japanese quail lay 290 to 300 eggs during their first year of production (Jatoi et al., 2015). They can be reared in cage and floor farming systems. The roof can be thatched or tiled in the floor farming system, and the floor must be cement or concrete for easy cleaning and disinfection. When the purpose of the rearing is meat production, five quails can be kept per square foot (Bulus Doka, 2013). Generally speaking, better management practices and an increased genetic potential for Japanese quail can boost production performance (Arunrao et al., 2023).

In the past few years, quail production has grown well in Afghanistan, and now, many breeding farms for this bird can be seen in different parts of the country. The demand for this bird's meat and eggs is rising due to its numerous health advantages. In recent years, numerous studies have been conducted on the nutritional needs of quails (Altine et al., 2016; Jeke, Phiri, Chitiindingu et al., 2018a) to find an optimum and affordable legitimate growth promoter (Lokapirnasari et al., 2017; Vargas-Sánchez et al., 2019). For this purpose, different types of oil and fat sources (vegetable oils and animal oils) have been supplemented to poultry feed as a source of energy and the polyunsaturated fatty acid contents they have (Al-Daraji et al., 2010; Dupont et al., 1990; Mousa et al., 2017). Moreover, adding vegetable oils to the poultry diet enhances fat-soluble vitamin absorption (Abdelhady et al., 2018). Corn, a widely used vegetable oil, is highly digestible and provides essential fatty acids (Dupont et al., 1990). Likewise, corn oil is also rich in omega-6 fatty acids, especially linoleic acid (Reda et al., 2020; Singh, 2019). The current study was designed to evaluate the effects of PCO, one of the most widely consumed oils, on the growth performance of Japanese quails at various growth stages.

## Material and methods

### *Study area*

The present study was conducted in the Dehsabz district located (34° 32′ 36″ N, 69° 17′ 16″ E) in the northeast of the Kabul province, Afghanistan. As far as the landscape is concerned, Dehsabz is a mountainous area with some trees scattered around. According to the UNHCR, the district's population was estimated at 100,000 in 2000. The district borders Kalakan and Qarabagh districts on the northwest, Shakardara and Mir Bacha Kot districts on the west, Surobi on the southeast, Parwan province on the north and east, and Bagrami district and Kabul city on the south. According to data from UNHCR 2000, 46 villages are in the district, and the largest are Tara Khail, Deh Yahya, and Bakht Yaran. The majority of the population of the district lives in villages. Even though drought is a significant issue,

agriculture is the primary source of income for the residents (UNHCR, 2023).

### *Chicks and Diet*

A total of 80 unsexed, four-day-old Japanese quail chicks were purchased from a local farm located in the 13th district (Shahrak Haji Nabi/Omid-E-Sabz) of the Kabul city. When the chicks were purchased from the farm, they were transferred to the research site (Dehsabz district of Kabul province) under suitable conditions (~38℃). After a short period, when the chicks' stress had subsided, they were distributed randomly into four groups, each containing 20 chicks. Three ($G_1$, $G_2$ & $G_3$) of the four groups were experimental, and one ($G_0$) was the control. All four groups were fed a pelleted commercial grower quail diet (containing 25% crude protein and 2960 kcal of metabolizable energy per kg of diet). Despite the commercial diet (Table. 1), experimental groups were supplemented with 1, 3, and 5% PCO in all three (starter, grower, and finisher) growth phases. Pure corn oil was obtained from the local market of Kabul City. Similar environmental, managerial, and sanitary conditions were used for all groups during the experiment. During the experimental period, fresh feed and clean water were offered to quails (by two house-made drinkers and a feeder for each cage). The whole study was conducted during the spring (May & June) of 2018. Quails were not vaccinated.

*Table 1. Composition of the experimental diet's ingredients and nutrients*

| **Ingredients** | **Unite** | **Amount** |
|---|---|---|
| Metabolizable energy | kcal/kg | 2960 |
| Crud protein | % | 25 |
| Raw fiber (maximum) | % | 5 |
| Methionine (SID) | % | 0.46 |
| Methionine + Cysteine (SID) | % | 0.90 |
| Lysine (SID) | % | 1.19 |
| Threonine (SID) | % | 0.75 |
| Calcium | % | 0.5 |
| Metabolizable sulfur | % | 0.5 |
| Sodium | % | 0.16 |

### *Housing System*

Quails were kept in a cage system (one cage for each group of 20 chicks), as enough floor space was considered for each chick. There was a medium-sized hole in the sides of the cages for better ventilation. As the quail chicks in the first three weeks need 34–37 ℃ (93.2–98.6 ℉) temperature, they were wormed by a wood stove as a heat source until 21 days. Their temperature was checked daily via a classic thermometer. After the 3rd week, the heater was removed, and they were kept at an average room temperature of 25 ℃ (77 ℉) until the end of the trial (5th week). Throughout the 41 days of the experimental period, 24 hours of light was regularly provided.

### *Data collection*

Chicks were weighed on the first day of the trial when they were four days old. After that, the chicks' live body weight (LBW) was recorded twice a week (on Monday and Friday) using a digital balance. Body weight gain (BWG) was calculated at the end of the experiment. Daily feed consumption was observed three times a day. After collection, the data were entered into an Excel sheet and imported into SPSS data analysis software.

### *Statistical Analysis*

Microsoft Excel and SPSS (version 21, IBM, NY, USA) software were used for data analysis. One-way Analysis of Variance (ANOVA) and post hoc test (Scheffe) were performed to compare the means. The P-value of 0.05 was used to determine if the differences were significant. The BWG of the chicks was calculated using the following formula (Jatoi et al., 2015).

"Weight gain = final body weight - initial body weight"

## Results

The result of PCO on the growth performance parameters "initial body weight, final body weight, and body weight gain" of Japanese quails are presented in Table. 2. Until the end of the trial, 2 (10%) chicks from the $G_0$ and $G_1$ groups, as well as 5 (25%) and 4 (20%) chicks from the $G_2$ and $G_3$ groups, perished, respectively. In the post-mortem examinations of the chicks, no pathological changes indicated any infectious disease. After supplementing the quails' diet with PCO, the values for live body weight did not change considerably. The present study showed that adding PCO to the quail commercial diet in different amounts (1, 3 & 5%) had no positive effects on the growth performance of Japanese quails. The highest body weight gain (192.5 g) was recorded in the control group. The findings showed that different trial groups experienced varied unfavorable effects of PCO. No significant difference existed between the control and experimental groups until the end of the first growth phase (21 days). Moreover, when the control and experimental groups were compared regarding weight gain, non-significant ($p>0.05$) adverse effects of PCO supplementation were observed in all three experimental groups. The adverse impact of PCO became greater in the $G_2$, $G_3$, and $G_1$ groups, respectively, as the starting phase progressed (Figure. 1). During the study, a decrease in the feed intake of the experimental groups was observed. The more the diet was oily, the less it was consumed.

*Table 2. Growth parameters and mortality rate of quail chicks.*

| *Group* | *Level of PCO* | *IBW (g)* | *FBW (g)* | *BWG (g/41-day)* | *Mortality rate (%)* | *p-value of GP* |
|---|---|---|---|---|---|---|
| $G_0$ | 0% | 11.5 | 204 | 192.5 | 10% | |
| $G_1$ | 1% | 11.7 | 185.9 | 174.2 | 10% | 0.983 |
| $G_2$ | 3% | 10.7 | 199.7 | 189 | 25% | 0.999 |
| $G_3$ | 5% | 10.7 | 190.2 | 179.5 | 20% | 0.989 |

"IBW: initial body weight, FBW: final body weight, BWG: body weight gain," GP: growth performance, alpha (0.05)

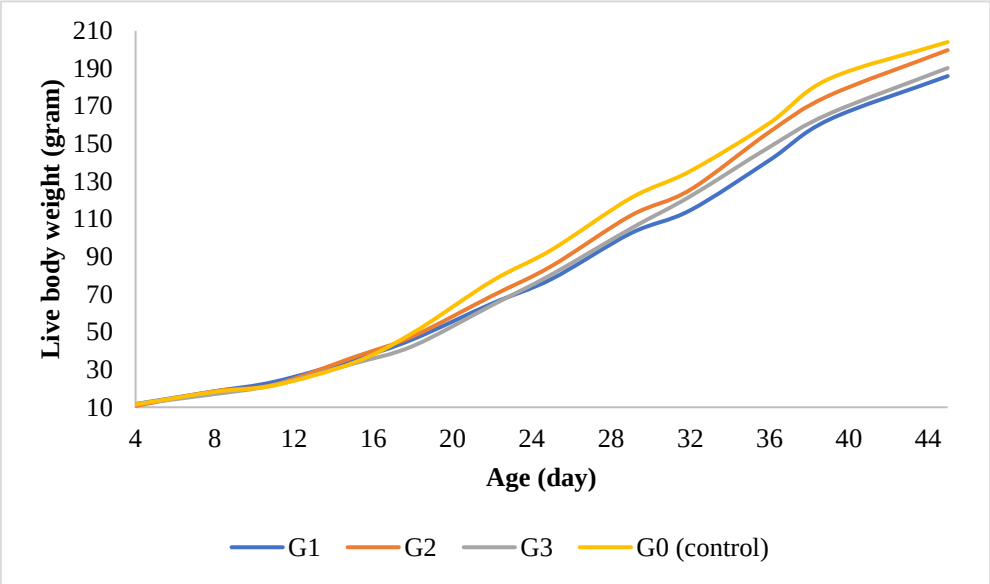


Figure 1. Growth differences in various experimental and control groups

This figure shows that the growth rate of quail chicks until three weeks is not different in the control and experimental groups. However, after the third week, the control group grew faster than the experimental groups, and at the same time, an increase in feed consumption was also observed in the control group.

## Discussion

This study is the first to assess the effects of three different levels of pure corn oil on the growth performance of Japanese quails in various growth phases in Afghanistan. The present study revealed that adding PCO to the commercial diet of quails did not significantly affect the FBW and BWG in the experimental groups compared with the control group over a 41-day trial period. This observation is consistent with the results of Al-Daraji et al. (2010), who evaluated the effects of corn and sunflower oil on the growth performance of Japanese quail and reported no significant changes between the control and experimental groups. In contrast to corn and sunflower oil, the same study's results indicated that adding fish and flax oil to the quail diet improved the productive and reproductive ability of the birds. The main reason for corn and sunflower oil's ineffectiveness could be the low level of omega-3 fatty acids compared to fish and flax oil.

In the same way, the research shows that obtaining long-chain omega-3 fatty acids through the diet compared to omega-6 fatty acids, if the ratio of omega-3 fatty acids to omega-6 is higher, has significant positive effects on the production of Japanese quails (Al-Daraji et al., 2010). It has been determined that corn oil has a low amount of omega-3 fatty acids compared to omega-6 (Shoemaker, 2019), so this could be the main reason for the ineffectiveness of adding corn oil to the diet of Japanese quails. The results of Herve et al.

(2018), who assessed Ginger essential oil's effects on Japanese quails' growth parameters, also agreed with our results. The same results are reported by Abdelhady, El-Faham, and Ali (2018), who found no significant differences between groups in terms of final body weight and body weight gain while using 1, 2 and 3% soybean oil and palm oil in starter, grower, and finisher diets. In contrast, Alagawany et al. (2020) reported that supplementing quail diets with Chia oil significantly improved the growth performance parameters at 5 weeks of age. The results of Khaksar et al. (2012) and Badiri & Saber (2016) who respectively investigated the effects of Thyme (1g/kg) and Oregano oil (58mg/kg) on the growth performance of Japanese quails and discovered a significant increase in live body weight in the experimental groups, is also inconsistent with our results.

When control and experimental groups were compared, it was observed that they did not differ much in terms of growth until the 3$^{rd}$ week of the experiment. This result agrees with the results of Dowarah & Sethi (2014), who investigated three different levels of metabolizable energy without considering the various levels of protein on quails in the starter phase, and none of the changes in the final body weight was observed. It has been observed that after the third week, feed consumption of experimental groups decreased compared to the control group, and PCO had numerically adverse effects on the growth of the $G_1$, $G_2$, and $G_3$ groups. This is consistent with the results of Ding et al. (2016) and Shunthwal et al. (2017), who stated that increasing the amount of metabolizable energy and linseed oil can significantly reduce feed consumption in birds. The fact that supplementation of different levels of pure corn oil did not affect the feed intake and growth performance of Japanese quails in the first three weeks of the experiment, the reason could be that the feathers of the quails were not fully developed until this age and extra amount of the energy in the diet of the experimental groups could be used as a source of heat production. When birds reach puberty, the high amount of energy in the diet decreases the feed intake of the quails and thus results in a slow rate of growth. It is worth mentioning that since this study was conducted in the hot season of the year, heat stress may have exacerbated the reduction in feed consumption and thus decreased the growth rate. Meanwhile, the results obtained from our study disagree with the findings of Mahmood et al. (2014), who stated that different energy levels do not affect the feed consumption of birds.

The inclusion of a small number of birds was due to the lack of funds, not separating male and female chicks, taking no measurements of how much feed each group has been given and how much feed is left over, and conducting the research in the hot season of the year are among the limitations of this research.

**Conclusion**

This study aimed to investigate how the development pattern of Japanese quail (Coturnix coturnix japonica) was affected by the addition of PCO to the commercial feed of these birds. It was designed to assess the rate of body weight gain in distinct growth periods. As a result, we can conclude that adding PCO to the commercial diet of quails under the climatic conditions of Afghanistan does not have any positive effects and, to some extent, reduces

the rate of weight gain. It can be proposed to those who want to research this area that instead of corn oil, use other vegetable oils with a high level of omega-3. As we noticed throughout the trial, some birds in different experimental groups showed the best growth compared to the rest of the birds, and this may be related to the sex of the birds; thus, we recommend separating the male and female birds into different groups. In addition, it is suggested that those who want to research this area survey the number of farms in the Japanese quail in the country, especially in Kabul province.

Since this is a bird species with excellent breeding characteristics such as high egg and meat production, short maturation period, and healthy meat and low-cholesterol eggs and can meet the goals of providing fast and high-quality animal protein well, it is highly recommended to increase the production of the bird in the country. At the same time, the government and partner institutions are requested to support the production of this bird across the country. It is proposed that the government and research centers support the scientists who want to research in this field to do more studies on nutrition and the production of eggs and meat.

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## Conflicts of Interest

The authors declare that there is no conflict of interest.

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