# INFLUENCE OF GHEE RESIDUE ON JAPANESE QUAIL LAYER PERFORMANCE

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## Abstract

An experiment was conducted to assess the influence of ghee residue (GR) on Japanese quail layer performance. GR was included in the ration at 0, 5, 10 and 15% levels and fed to 200 Japanese quail layers (four treatments with five replicates each) for 6-16 weeks of age. The experimental diet was formulated on isocaloric and isonitrogenous basis. There was no mortality recorded during the entire study period, so the Hen Day Egg Production (HDEP) and Hen Housed Egg Production (HHEP) remained the same. Age at sexual maturity and egg yolk cholesterol levels were not affected by the treatment groups. HDEP in $T_1$ (57.1), T2 (60.74), T3 (59.55) and T4 (61.99) were highly significant ($P<0.01$). Egg weight and albumen index were significant ($P<0.05$), where it was highest in ghee residue supplemented groups compared to the control group. The myristic, arachidic, eicosapentaenoic and docosahexaenoic acid content of eggs were significantly ($P<0.05$) higher in GR supplemented groups. The study concluded that, ghee residue could be included in the Japanese quail layer ration up to 15% level for improving its egg production and quality characteristics.

## Introduction

Low maintenance cost associated with its small body size coupled with its shorter generation interval, resistance to diseases and high egg production rendered Japanese quail an excellent laboratory as well as commercial bird. Thus commercial quail farming is becoming more popular and is being promoted in Asian and European countries. Soaring high cost and sometimes the non-availability of conventional feed ingredients act as the major constraint in future expansion of poultry industry as feed alone occupies 60 - 70 per cent of the production cost. Hence, the quest for alternative feed ingredients has increased to economize the feed cost and the search for alternatives to replace the corn-soya based diet has led to the use of agro-industrial by products.

According to Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture (2014-15) reports, the total milk production in India was around 1, 46, 314, 000 metric tonnes. About 30 to 33 per cent of total milk produced in India is being utilized for ghee preparation (Dairy India, 2007) and the average yield of ghee residue is calculated as one-tenth of ghee produced (Varma and Narender Raju, 2008). Ghee residue, the charred light to dark brown residue is a by-product of ghee industry and is obtained on the cloth strainer after the ghee is filtered and is available at nominal cost. It is not only a good source of protein and energy, but also a rich source of minerals especially calcium, phosphorus and iron (Arumugam *et al.,* 1989). It could be used as a potential alternate unconventional feed ingredient in Japanese quail rations.

However, no study on utilizisation of ghee residue as a feed ingredient in Japanese quails has been carried out. This study has been proposed to analyze the chemical composition of ghee residue and also to study the influence of ghee residue supplementation on Japanese quail layer performance.

**Materials and methods**

Ghee residue was procured from a private ghee manufacturing industry located at Erode district of Tamilnadu and analyzed for its moisture, crude protein, crude fibre, ether extract and total ash as per AOAC (2002). The TME was estimated using adult Japanese quails as per (Sibbald, 1976). After analyzing the nutritive value of ghee residue the control diet was formulated based on the standards provided for Namakkal quails by the Department of Poultry Science, VC&RI, Namakkal, Tamilnadu. Experimental rations were formulated on isocaloric, isonitrogenous, isolysine and isomethionine basis at 0 (control-$T_1$), 5% ($T_2$), 10% ($T_3$) and 15% ($T_4$) levels. The experimental quails were fed *ad libitum* with layer ration (Table 1).

A total of 200 Japanese quails randomly divided into four treatment groups ($T_1$- 50, $T_2$- 50, $T_3$-50 and $T_4$-50), respectively with five replicates each. All the birds were reared in cages. Standard uniform managemental conditions were provided to the experimental birds with regard to feed, water and light. HDEP and HHEP were calculated by the formulae suggested by Murad Ali *et al.,* 2003. External egg quality characteristics like egg weight, shape index, specific gravity and internal egg quality characteristics like shell thickness, albumen index, yolk index, Haugh unit and yolk colour were studied as per the procedure described by Guclu *et al.* (2008).

The standardization of fatty acid profile was done with egg yolk lipids as per the procedure described by Wang *et al.* (2000).The fatty acids analyzed includes Myristic acid, Palmitic acid, Palmitoleic acid, Stearic acid, Oleic acid, Linoleic acid, Linolenic acid, Arachidic acid, Behenic acid, Eicosapentaenoic acid, Docosahexaenoic acid and other fatty acids. Egg cholesterol estimation was done as per the procedure described by Zarina *et al*. (2012).

Data collected over various parameters were statistically analyzed by one-way ANOVA by using SPSS version.20.0 software. The significance was tested using Duncan multiple range test (Duncan, 1955). The statistical tool like one-way ANOVA was used for analyzing the data collected over the parameters like age at sexual maturity, egg quality characteristics, fatty acid composition of egg and cholesterol content of egg. Chi-square test was used for analysis of parameters like mortality and egg production.

## Results and discussion

### Egg production

Age at sexual maturity was not affected due to feeding of ghee residue even at higher levels of 15 per cent. HDEP (%) was highly significant during 6-9 weeks of age among the treatment groups and no significant difference was observed among the treatment groups at a later period of 10-16 weeks of age. HDEP (%) for the overall period of 6-16 weeks showed highly significant difference among the treatment groups, where highest egg production was recorded in $T_4$ (61.99) and lowest in $T_1$ (57.17) throughout the study period. No mortality was recorded during the entire study so the HDEP and HHEP remained same in all treatment groups. This was in agreement with Kemal *et al.* (2010) who reported that supplemental fat in the diet consistently improved the productivity of laying hens.

### Egg quality characteristics

Highest egg weight was recorded in $T_2$ (14.28) and lowest in $T_1$ (13.33), Albumin index (0.15) was highest in both $T_3$ and $T_4$ and lowest in $T_1$ (0.13). Dietary fatty acids increased egg weight and albumen weight by a mechanism that involves a stimulation of oviduct protein synthesis which is elucidated by Guclu *et al.* (2008) who reported that the oil added to the diet of layer hens and quail would have positive influence over egg weight, yolk height and diameter, albumen height and diameter considerably. The results on egg production and quality characteristics clearly indicated that the egg number was highest in group supplemented with 15 per cent ghee residue, whereas highest egg weight was recorded in 5 per cent level which revealed the general fact that egg number and egg weight are inversely proportional to each other.

### Egg fatty acid profile

Saturated fatty acids like Myristic acid level decreases as the level of ghee residue increased. Inclusion of ghee residue at higher levels will increase the level of SFA like Arachidic acid and PUFA (Eicosapentaenoic and Docosahexaenoic) in Japanese quail eggs considerably. Inclusion of ghee residue in Japanese quail diet did not influence the egg yolk cholesterol level even at higher levels of 15 per cent and this is supported by Kemal *et al.* (2010) who reported that supplemented fat in the diet of laying hens will not affect the egg yolk cholesterol levels.

### Conclusion

The present study concluded that inclusion of ghee residue at 15 per cent level in layer Japanese quail ration would have positive influence over egg production and quality characteristics with improved fatty acid profile.

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**Table 1**

**Ingredient and nutrient composition of experimental layer Japanese quail rations (6- 16 weeks)**

| Ingredients | $T_1$ (control) | $T_2$ (5%GR) | $T_3$ (10%GR) | $T_4$ (15%GR) |
|---|---|---|---|---|
| **Maize** | 59.85 | 51.04 | 41.21 | 31.31 |
| **Ghee residue** | 0.00 | 5.00 | 10.00 | 15.00 |
| **DORB** | 0.60 | 7.60 | 16.40 | 25.30 |
| **Soyabean meal** | 30.20 | 27.00 | 23.20 | 19.50 |
| **Shell grit** | 2.10 | 2.10 | 1.90 | 1.80 |
| **Calcite** | 3.50 | 3.50 | 3.50 | 3.50 |
| **DCP** | 1.00 | 1.00 | 1.00 | 0.80 |
| **Mineral mixture**[1] | 2.00 | 2.00 | 2.00 | 2.00 |
| **Salt** | 0.20 | 0.20 | 0.20 | 0.20 |
| **$AB_2D_3k$** | 0.02 | 0.02 | 0.02 | 0.02 |
| **Toxin binder**[2] | 0.10 | 0.10 | 0.10 | 0.10 |
| **Vetroliv** | 0.05 | 0.05 | 0.05 | 0.05 |
| **Vitamin premix**[3] | 0.02 | 0.02 | 0.02 | 0.02 |
| **Sodium bicarbonate** | 0.05 | 0.05 | 0.05 | 0.05 |
| **DL-methionine** | 0.07 | 0.07 | 0.07 | 0.05 |
| **Lysine** | 0.20 | 0.21 | 0.24 | 0.26 |
| **Direct fed microbials** [4] | 0.01 | 0.01 | 0.01 | 0.01 |
| **Larvanil** | 0.03 | 0.03 | 0.03 | 0.03 |
| **Total** | 100.00 | 100.00 | 100.00 | 100.00 |
| **Calculated nutrient composition** | | | | |
| **ME (kcal/kg)** | 2.75 | 2.75 | 2.75 | 2.75 |
| **Crude protein (%)** | 19.02 | 19.04 | 19.01 | 19.00 |
| **Calcium (%)** | 3.03 | 3.06 | 3.03 | 3.00 |
| **Available Phosphorus (%)** | 0.42 | 0.42 | 0.42 | 0.40 |
| **Lysine (%)** | 1.01 | 1.00 | 1.01 | 1.01 |
| **Methionine (%)** | 0.33 | 0.33 | 0.34 | 0.33 |
| **Crude fibre (%)** | 3.26 | 4.06 | 5.08 | 6.14 |
| **Ether extract (%)** | 2.71 | 4.47 | 6.21 | 7.93 |
| **Feed cost/kg** | 27.00 | 26.00 | 25.00 | 24.00 |

Rations were formulated based on nutritive value of individual ingredients. **1. Mineral mixture** -prepared by addition (per cent) of DCP -64.12, Calcite-22, FeSo4-2.4, MnSo4-0.345,ZnO-0.480,CuSo4-0.262, KIO3-0.046,Sodium Selenite-0.00005 and MgO-10.32. **2.Toxin binder**[2]-(Mixture of phylosilicates (lllite), Tectosilicates (clinoptilolite),Organic acids and Gentian violet.**3.Vitamin premix**[3]- (Each 100 g contains 0.1 mg of Vitamin B12**) 4.Direct fed microbials**[4]- (Each gram provides total viable count of 1000 billion colony forming units 1012 CFU of selective strains of 13 essential of direct fed microbial).

**Table 2**
**Age at sexual maturity (days) and egg production (%) of Japanese quails fed with graded levels of ghee residue (Mean ± SE)**

| Age at sexual maturity (days) | | | | |
|---|---|---|---|---|
| | $T_1$ (0%GR) | $T_2$ (5%GR) | $T_3$ (10%GR) | $T_4$ (15% GR) |
| Age at sexual maturity$^{NS}$ (days) | 40.80±1.16 | 42.20±1.59 | 44.40±0.93 | 46.20±1.66 |
| **Hen Day Egg production (%)** | | | | |
| 6-9 Weeks$^{**}$ | 22.17 | 29.30 | 26.93 | 35.04 |
| 10-16 Weeks$^{NS}$ | 77.16 | 77.18 | 79.68 | 78.99 |
| 6-16 Weeks$^{**}$ | 57.17 | 60.74 | 59.55 | 61.99 |
| **Hen Housed Egg Production (%)** | | | | |
| 6-16 Weeks$^{**}$ | 57.17 | 60.74 | 59.55 | 61.99 |

$^{NS}$-Non significant; **-Highly significant (P<0.01)

**Table 3**
**Egg quality characteristics in Japanese quails fed with graded levels of ghee residue (Mean ±SE)**

| Egg quality traits | Inclusion of ghee residue at graded levels in feed (n=20) | | | |
|---|---|---|---|---|
| | $T_1$ (0%GR) | $T_2$ (5%GR) | $T_3$ (10%GR) | $T_4$ (15%GR) |
| Egg weight$^{*}$ (g) | 13.33$^{b}$±0.20 | 14.28$^{a}$±0.31 | 13.65$^{ab}$±0.17 | 13.50$^{b}$±0.21 |
| Shape index$^{NS}$ (%) | 77.62±0.78 | 77.75±0.68 | 79.19±0.60 | 78.23±0.81 |
| Specific gravity$^{NS}$ | 0.89±0.01 | 0.86±0.02 | 0.91±0.01 | 0.90±0.01 |
| Albumen index$^{*}$ | 0.13$^{b}$±0.00 | 0.14$^{ab}$±0.01 | 0.15$^{a}$±0.01 | 0.15$^{a}$±0.00 |
| Yolk index$^{NS}$ | 0.50±0.01 | 0.48±0.01 | 0.47±0.01 | 0.49±0.01 |
| Haugh unit$^{NS}$ | 93.60±1.03 | 92.82±1.04 | 91.98±1.26 | 92.59±0.69 |
| Shell thickness$^{NS}$(mm) | 0.15±0.00 | 0.16±0.01 | 0.15±0.00 | 0.15±0.00 |
| Yolk colour$^{NS}$ | 5.65±0.37 | 6.00±0.36 | 6.85±0.27 | 6.45±0.34 |

Mean values bearing same superscript within a row do not differ significantly
$^{NS}$-Non significant; **-Highly significant (P<0.01);*-Significant (P<0.05)

**Table 4**
**Fatty acid (%) and cholesterol content (mg/g of yolk) of eggs of Japanese quails fed with graded levels of ghee residue (Mean ±SE)**

| | $T_1$ (0% GR) | $T_2$ (5% GR) | $T_3$ (10% GR) | $T_4$ (15% GR) |
|---|---|---|---|---|
| **Myristic acid*** | $0.70^{a}$±0.06 | $0.37^{b}$±0.13 | $0.17^{b}$±0.09 | $0.33^{b}$±0.07 |
| **Palmitic acid$^{NS}$** | 31.07±0.55 | 30.63±0.72 | 29.67±0.41 | 30.70±0.81 |
| **Palmitoleic acid$^{NS}$** | 4.37±0.70 | 4.17±0.60 | 4.07±0.42 | 6.00±0.75 |
| **Stearic acid$^{NS}$** | 9.00±0.47 | 10.17±0.59 | 11.27±1.16 | 8.57±0.72 |
| **Oleic acid$^{NS}$** | 36.53±0.48 | 34.10±0.60 | 33.47±1.38 | 37.07±1.74 |
| **Linoleic acid$^{NS}$** | 11.77±0.27 | 11.63±0.22 | 12.87±0.84 | 11.97±0.52 |
| **Linolenic acid$^{NS}$** | 0.60±0.10 | 0.77±0.07 | 0.70±0.17 | 0.93±0.03 |
| **Arachidic*** | $2.50^{bc}$±0.15 | $3.50^{ab}$±0.32 | $3.70^{a}$±0.58 | $1.93^{c}$±0.03 |
| **Eicosapentaenoic acid*** | $0.33^{b}$±0.15 | $0.97^{a}$±0.27 | $0.43^{ab}$±0.09 | $0.07^{b}$±0.07 |
| **Docosahexaenoic acid*** | $0.67^{b}$±0.12 | $2.40^{a}$±0.47 | $2.77^{a}$±0.37 | $1.77^{ab}$±0.41 |
| **Others**** | $2.50^{a}$±0.25 | $1.30^{b}$±0.40 | $0.90^{b}$±0.17 | $0.67^{b}$±0.12 |
| **Cholesterol$^{NS}$** | 14.93±0.99 | 13.02±1.26 | 13.81±1.10 | 14.52±0.37 |

Mean values bearing same superscript within rows do not differ significantly.

$^{NS}$- Non significant, **-Highly significant (P<0.01); *-Significant (P<0.05)