Effect of Turmeric Powder supplementation on egg production, hatchability and internal egg quality characteristics of quail eggs

ABSTRACT

The present study was conducted to investigate the effect of different levels of dietary supplementation of turmeric powder at a rate 0, 1, and 2% on egg production, hatchability and internal egg quality characteristics of Japanese quails (*Coturnix Japonica*). A total of 225 numbers of 54 weeks old Japanese quails were randomly selected from the Poultry farm, Instructional Livestock Farm Complex, College of Veterinary Sciences and Animal Husbandry, Central Agricultural University, Selesih, Aizawl, Mizoram, of which 150 were female and 75 were male. The birds were divided equally into three treatment groups i.e. T_0, T_1 and T_2 comprise of 75 birds each. T_0, T_1 and T_2 were supplemented with 0, 1 and 2 per cent turmeric powder of basal diet respectively. Each group were again divided equally into five replicates trails. The mean Hen Day Egg Production (%) was significantly higher ($P<0.01$) during 59^{th} weeks of age in turmeric supplemented groups of T_1 followed by T_2. No significant difference was observed between the treatment groups in regard to hatchability percentage. Albumen index and Haugh unit were recorded as non- significant between the treatment groups. Yolk index and shell thickness was significantly higher at ($P<0.01$) and ($P<0.05$) respectively in 2 percent turmeric supplementation. The yolk colour score was found to be significantly higher ($P<0.01$) with increased level of turmeric powder supplementation. Therefore, it is concluded that supplementation of 1% turmeric powder in the diet improve egg production while 2% inclusion improves the internal egg quality characteristics (yolk index and yolk colour) of quail eggs.

Keywords: Japanese Quail, turmeric powder, egg production, hatchability, egg quality

1. INTRODUCTION

The poultry industry is one of the most diverse components of worldwide in animal production system, it comprises of chicken, duck, Geese and Japanese quails etc. Therefore poultry remains the most widespread enterprises in meat and egg production system which significantly support the improvement of food security, socio-cultural and economic expansion in most of the countries. The Japanese quail (*Coturnix coturnix japonica*) is one of the enterprises gaining attention as the ideal poultry species for meeting the animal protein needs in most of the developing countries [2,32,33,34,35]. Quail is suited for commercial rearing for meat and egg production under intensive management, due to its early maturity, high laying intensity, diseases resistance, low space requirement, high nutritional value of egg and cheaper production cost, making commercial quail farming a choice of the farmers [1, 14]. However, maximum production potential of the bird can be achieved through different dietary supplementation above the basal diet (Normal quail rations). Similarly [29] found that the egg characteristics and consistency, such as the size and portions of the main content of the yolk and albumin is influenced by the quality of nutrition given to the birds. One of the potent supplement ingredients is turmeric (*Curcuma longa*), a natural herb of the ginger family because of its bioactive substance curcumin, demethoxycurcumin, bisdemethoxycurcumin, tetrahydrocurcuminoids present up to the extent of 2 to 5 per cent in turmeric powder [16,19, 30]. The

rate of ovulation and developing follicles in the ovary during laying period determines the egg production, ovulation rate are determined by deposition of yolk components into the developing follicles and it depend on the liver function. Liver function declines with age and advancement in egg production. The availability and deposition of yolk components or ovogenesis during follicular development, in turn, is affected by the synthesis and production of vitellogenin by the liver cells under the stimulation of estrogen produced by the developing follicles [6, 8]. Similarly, liver cell on vitellogenin productions was described by [5, 7, 9, 10, 13]. It is also reported that curcumin modulates and speeds up the process of repair or regeneration of liver cells [20].

The egg characteristics and consistency, such as the size and portions of the main content of the yolk and albumin is influenced by the quality of nutrition given to the birds [29]. Characteristics of quail egg such as egg weight, shell quality, egg yolk and egg white characteristics can be improved by providing turmeric powder; the active principal curcumin, present in turmeric also helps in reducing the level of liver and serum cholesterol [23] and it is evident that cholesterol content in quail egg is higher as compared to other poultry eggs [4].

Keeping the value of turmeric in the diet of poultry in view, the present study was conceptualized to study the effect of turmeric powder supplementation on egg production, hatchability and internal egg quality characteristics of quail egg.

2. MATERIALS AND METHODS

The present study was carried out at the Poultry farm, Instructional Livestock Farm Complex, College of Veterinary Sciences and Animal Husbandry, Central Agricultural University, Selesih, Aizawl, Mizoram, India, for the period of 126 days. A total of 225 numbers of 54 weeks old Japanese quails were taken for the study of which 150 were female and 75 were male and reared up to 65 week of age.

The birds were divided equally into 3 treatment group viz, T_0, T_1 and T_2 with 0%, 1% and 2% turmeric supplementation on basal diet respectively. Each category was further divided into five replicates. The birds were kept in battery cage and maintained properly with standard management procedure.

2.1. EGG PRODUCTION

Daily egg production from each treatment and replicates groups were recorded for 12 weeks.

2.1.1 Hen Day Egg Production

Egg production was studied for 12 weeks and the HDEP was recorded using the following formula.

$$\text{Hen Day Egg Production (\%)} = \frac{\text{Total number of eggs produced during the period}}{\text{Total number of hen days in the same period}} \times 100$$

2.2. INCUBATION OF EGGS

Eggs produced at 60th weeks of age were collected and incubated according to treatment groups and replicates groups to study the hatchability percentage. The eggs were set into the setter with the temperature maintained at 99.5^{0}F (37.5^{0}C) with a relative humidity of 60 per cent for the first 15 days

of incubation. Candling was done on 7th day to remove unfertile egg. On last two days 17-18th days, the eggs were transferred to the hatcher in a hatcher box where the eggs were placed horizontally, and the temperature maintained at 98.9^{0}F (37.2^{0}C) with a relative humidity of 70 per cent.

2.3. HATCHING OF EGGS

The hatched quail chicks were counted and weighed individually using a digital weighing balance and then transferred to brooder and egg that were not able to hatched were counted to know the hatchability percentage

2.3.1 Hatchability study

Hatchability percentage was calculated after hatching of the chicks as the number of chicks produced from the total number of eggs set in the incubator multiplied by 100.

2.4. INTERNAL EGG QUALITY CHARACTERISTICS

A total of twenty five (25) eggs from respective groups consisting of five egg from each replicates were collected randomly for internal egg quality study *viz*. Albumin Index, Yolk Index, Haugh Unit, Shell Thickness and Yolk colour.

2.4.1 *Albumen index*

Albumen index was recorded as the ratio of the height of the thick albumen (mm) to the width of thick albumen (mm) taken with a three-legged micrometer screw measured with the assistance of a vernier caliper.

The albumen index was observed using the formula given below:

$$\text{Albumen index} = \frac{\text{Height of the thick albumen (mm)}}{\text{Width of the thick albumen (mm)}} \times 100$$

2.4.2 *Yolk index*

Yolk index was measured as the ratio of the height of yolk (mm) to the width of yolk (mm) measured with a three-legged micrometer screw along the line of chalaza with the help of a slide caliper with 0.02 mm accuracy.

The yolk index was observed using the following formula:

$$\text{Yolk index} = \frac{\text{Height of the yolk (mm)}}{\text{Width of the yolk (mm)}} \times 100$$

2.4.3 *Haugh unit*

Haugh unit was measured according to the formula described by Williams 1992 as given below.

$HU = 100 \log (H+7.7-1.7\ W^{0.37})$

Where H is the height of the thick albumen in mm, W is the egg weight (g).

2.4.4 *Shell Thickness*

Shell thickness was recorded by using screw gauze. The unit of shell thickness was mm.

2.4.5 *Yolk colour*

Yolk colour was examined using DMS Yolk colour fan. DMS yolk colour fan ranges from 0-15 colours.

3.STATISTICAL ANALYSIS

Results were analysed by using ANOVA and means were compared by Duncan's multiple range test in SPSS version 25.

4. RESULTS AND DISCUSSION

The weekly average Hen Day Egg Production (%) ranged from 28.28 ± 1.77 to 48.85 ± 1.38 per cent in T_0 group, 33.42 ± 1.89 to 59.42 ± 1.84 per cent in T_1 group and 36.28 ± 2.87 to 56.00 ± 1.71 per cent in T_2 group. Statistical analysis (Table 1) revealed that the Hen Day Egg Production was significantly higher in T_1 and T_2 group during 59^{th} week of age as compared to T_0 group. Significant difference was not recorded among the treatment groups in other weeks in regard to the weekly average Hen Day Egg Production. Significantly higher Hen Day Egg Production in the T_1 and T_2 group could be due to dietary supplementation with turmeric powder which could have improved egg production by facilitating the release of vitellogenin from the liver cells thereby leading to higher folliculogenesis and ovogenesis.

The present findings were in close agreement with the findings of [3, 21, 23, 24], who recorded an increase in egg production in turmeric supplemented groups in laying hens. It is also reported an increase in egg production in different levels of turmeric supplementation [11, 22]. They reported that the increasing levels of turmeric extract in the drinking water increased the hen-day egg production of laying quail [18].

Table 1: Hen Day Egg Production (%) of quails under different levels of dietary turmeric powder supplementation

Age of bird (weeks)	Hen Day Egg Production (%)			P-value
	T_0	T_1	T_2	
54^{th}	33.42 ± 1.89	36.28 ± 1.78	39.14 ± 0.72	0.070^{NS}
55^{th}	28.28 ± 1.77	33.42 ± 1.39	36.28 ± 2.87	0.057^{NS}
56^{th}	33.11 ± 2.42	40.85 ± 3.68	40.50 ± 2.05	0.131^{NS}
57^{th}	48.85 ± 1.38	50.85 ± 3.76	49.42 ± 3.01	0.883^{NS}
58^{th}	46.28 ± 2.65	54.85 ± 4.39	48.00 ± 3.95	0.269^{NS}
59^{th}	47.14 ± 2.51^{a}	59.42 ± 1.84^{b}	56.00 ± 1.71^{b}	0.003^{**}
60^{th}	44.28 ± 3.96	51.71 ± 4.52	45.42 ± 1.82	0.331^{NS}
61^{st}	41.71 ± 3.76	48.00 ± 4.34	43.42 ± 2.45	0.468^{NS}
62^{nd}	37.42 ± 1.04	41.14 ± 3.45	38.28 ± 2.23	0.549^{NS}
63^{rd}	37.42 ± 1.04	41.14 ± 3.45	38.28 ± 2.23	0.549^{NS}
64^{th}	37.42 ± 1.04	41.14 ± 3.45	38.28 ± 2.23	0.549^{NS}
65^{th}	34.28 ± 3.52	37.20 ± 3.94	38.00 ± 1.16	0.684^{NS}

4.1. Hatchability

The mean hatchability percentage was recorded as 60.8, 69.6 and 72.0 per cent in T_0, T_1 and T_2 group respectively. Statistical analysis (Table 2), have shown that there was no significant difference

in the hatchability percentage due to different levels of dietary turmeric powder supplementation. Although there was no significant difference among the treatment groups hatchability percentage tended to increase from non-supplemented group to supplemented group. It is also reported there is no significant difference between the dietary treatment groups due to turmeric powder supplementation [24]. On the contrary, it is reported an improvement in hatchability percentage in the turmeric supplementation in Hi-sex White leghorn [27].

Table 2: Hatchability (%) of quail under different levels of dietary turmeric powder supplementation

Treatment Groups	Hatchability %	Chi-square value
T_0	60.8	0.138^{NS}
T_1	69.6	
T_2	72.0	

4.2. Internal egg quality characteristics

4.2.1 *Albumen Index*

The mean albumen index was found to be 12.76 ± 0.56, 13.04 ± 0.56 and 13.22 ± 0.29 in T_0 (0%), T_1 (1%) and T_2 (2%) groups respectively. Table 3 revealed that there was no significant difference between the treatment groups due to dietary turmeric supplementation. Although there was no significant difference between the treatment groups the mean albumen index tended to increase from non-supplemented to supplemented group. The present findings could be well comparable with the findings, who reported that albumen index was not significantly influenced by dietary treatments [11]. On the contrary to the finding, it is reported that a significant increase in albumen index in turmeric supplemented groups in quail egg [28].

Table 3: Albumen index of quail eggs under different levels of turmeric powder supplementation.

Treatment Groups	Albumen Index	P- value
T_0	12.76±0.56	0.795^{NS}
T_1	13.04±0.56	
T_2	13.22±0.29	

4.2.2 Yolk Index

The average yolk index was recorded as 45.59 ± 0.63 in T_0, 48.19 ± 0.73 in T_1 and 48.56 ± 0.61 in T_2. Statistically (Table 4) the average yolk index was found to be significant higher in T_1 and T_2 groups as compared to T_0. The significantly higher yolk index in turmeric supplemented groups could be due to the more vitellogenin synthesis by hepatocytes and more yolk deposition resulting in an increased

height of yolk. The present finding was in close agreement, who recorded significant increase in yolk index with an increase in turmeric levels [25]. There is report of increase and then decrease in yolk index with the increase levels of turmeric supplementation [11, 15, 26, 28].

Table 4: Yolk index of quail eggs under different levels of dietary turmeric powder supplementation

Treatment Groups	Yolk Index	P- Value
T_0	45.59 ± 0.63^{A}	0.004^{**}
T_1	48.19 ± 0.73^{B}	
T_2	48.56 ± 0.61^{B}	

4.2.3 Haugh unit

The mean Haugh unit of quail eggs in T_0, T_1 and T_2 group was found to be 89.72 ± 1.00, 91.10 ± 0.94 and 91.31 ± 0.59 respectively. Statistical analysis (Table 5) has shown that there was no significant difference between all the three dietary treatment groups in respect of average Haugh unit of quail eggs. Although significant difference was not recorded among the treatment groups the mean Haugh unit tended to increase from non-supplemented group to highly supplemented group which could be due to supplementation of turmeric which might have improved the albumen quality the freshness of egg. The present findings of Haugh unit could be compared as there is report of non-significant increase in Haugh unit after dietary supplementation of turmeric in egg of laying hens [15].

There is increase in Haugh unit and then decrease in different range of turmeric supplementation [22, 25]. On the contrary of these findings, it is observed that the Haugh unit decreased in different levels of turmeric powder supplementation in quail egg [28].

Table 5: Haugh unit of quail eggs under different levels of turmeric powder supplementation.

Treatment Groups	Haugh Unit	P- value
T_0	89.72 ± 1.00	0.374^{NS}
T_1	91.10 ± 0.94	
T_2	91.31 ± 0.59	

4.2.4 Shell thickness

The mean shell thickness of quail eggs due to different dietary turmeric powder supplementation was recorded as 0.26 ± 0.01, 0.22 ± 0.01 and 0.29 ± 0.01 in T_0, T_1 and T_2 group respectively. Statistically (Table 6) the average shell thickness was observed to be significantly higher in T_2 group as compared to T_0 and T_1 group. The shell thickness was found to decrease and then increase significantly in 2 per cent turmeric supplementation which could be due to improvement in the environment of uterus which is the site of calcium deposition in shell and shell formation. The present findings in regard to shell

thickness was alike with the observation as it is reported there is significant increase in the shell thickness by supplementing 108 mg/quail/day of turmeric levels [26]. There is obtained significant increase in shell thickness in different levels of turmeric supplementation [17]. Similar observation has been recorded for increase in shell thickness turmeric supplemented groups and then decrease with an increase in higher levels [25]. On the contrary to these findings, it is recorded that there is non-significant decrease in shell thickness in various levels of turmeric supplementation [28].

Table 6: Shell thickness (mm) of quail eggs under different levels of dietary turmeric powder supplementation.

Treatment Groups	**Shell Thickness (mm)**	P- Value
T_0	0.26 ± 0.01^{A}	0.013*
T_1	0.22 ± 0.01^{AB}	
T_2	0.29 ± 0.01^{B}	

4.2.5 Yolk colour

The average yolk colour score of quail eggs was found to be 4.72 ± 0.18 in T_0, 7.20 ± 0.23 in T_1 and 9.40 ± 0.23 in T_2. Statistical analysis (Table 7) has shown that there was significant difference in respect of average yolk colour score due to dietary supplementation of turmeric powder. The average yolk colour score was observed to be significantly increased with increase in turmeric levels which could be due to yellow orange plant pigments known as xanthophyll present in turmeric, which might have deposited in the yolk. It is also reported that natural yellow-orange substances in turmeric might be added to light-coloured feeds to enhance yolk colour [12]. Similar to the current findings, there is significant increase in yolk colour with increase in turmeric levels in laying hens [3, 21]. [18, 28] also obtained significant increase in yolk colour with various levels of turmeric powder supplementation. On the contrary [22] found no significant difference in yolk colour with turmeric supplementation in Hy-Line brown laying hens.

Table 7: Yolk colour score of quail eggs under different levels of dietary turmeric powder supplementation.

Treatment Groups	**Yolk Colour score**	**P-Value**
T_0	4.72 ± 0.187^{A}	0.00*
T_1	7.20 ± 0.231^{B}	
T_2	9.40 ± 0.238^{C}	

3. CONCLUSION

It can be concluded that dietary supplementation of 1% turmeric powder improve egg production in Japanese quails, while 2% inclusion improves the internal egg quality characteristics (yolk index and yolk colour) of quail eggs.

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