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Laying Performance and Egg Quality Traits of Vanaraja Birds as Influenced by Dietary Supplementation of Turmeric Powder

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ABSTRACT: The present study was conducted to use turmeric powder as an alternative to antibiotics properties. The current study was designed to determine laying performance, albumin index, yolk index, haugh unit, and yolk cholesterol as influenced by different levels of turmeric powder dietary supplementation. The experimental birds were randomly divided into four treatment groups designated as T_1, T_2, T_3 and T_4 with thirty (30) chicks in each group having five replicates of six (6) birds each. They were subjected to four dietary levels of turmeric powder containing 0%, 0.5%, 0.75%, and 1.5%, respectively, for a period of 365 days. The overall level of statistical significance was defined as $p<0.05$. The significance of the result was evaluated using an analysis of variance (ANOVA) in the computer software WASP. Dietary supplementation with turmeric powder improved laying performance and enhanced egg quality traits. Yolk index and albumen index increased ($p<0.05$) while yolk cholesterol decreased with the increase in the level of turmeric powder. On the basis of the above findings, supplementation of turmeric powder at 0.75 per cent of feed can be recommended under Nagaland's agro-climatic conditions.

Keywords: Vanaraja birds, Turmeric, Egg production, albumen index, yolk cholesterol.

INTRODUCTION

Poultry farming is a rapidly growing segment of the agricultural sector in India and contributes significantly to the national economy. It is an important economic activity that has great scope not only for socio-economic development but also for the supply of nutritious food to rural and urban populations. It is an important and attractive entrepreneurial activity. As per the 20th Livestock Census (2019), the total poultry population in India has increased from 729.2 million to 851.81 million, with a percent change of 16.80 over the previous census. Currently, Nagaland has 28.32 lakh poultry birds. The yearly egg production of native and improved chickens is recorded to be 91.15 and 183.41, respectively. The per capita availability is 15 eggs per year, compared to 79 eggs per year in the country. The state is deficient by 51.34 % in meat production and 79.61 % in egg production. Poultry eggs and meat are widely consumed animal products and are considered the cheapest animal protein sources for rural and urban populations. The rearing of improved poultry germplasm, such as Vanaraja birds, is becoming the choice among the local poultry growers in the state. The preference for these types of birds is mainly due to their meat quality and higher adaptability and productivity. Availability and quality of feed constitute one of the biggest constraints in poultry farming, which determines the growth and profitability of this sector. Numerous studies have been carried out in poultry, focusing particularly on the enhancement of feed utilization for better productivity through the use of herbal products. Plant-based additives are considered to be safe and effective for maintaining health and well-being because of their bioactive compounds. Turmeric is a widely used herbal medicine. Since the bioactive ingredients of turmeric have therapeutic and antioxidant properties, it has been successfully utilized as a suitable feed additive for poultry, among other herbs and vitamins. Several researchers have reported enhancements in laying performance and egg quality traits due to turmeric supplementation in poultry diets (Kanagaraju *et al.*, 2017; Chauhan *et al.*, 2018; Mousa *et al.*, 2018). Rahardja *et al.* (2015) reported that supplementation of turmeric powder up to 4% could improve and maintain the egg production performance of the old laying hen at a higher level with a lower yolk cholesterol content. Turmeric is grown locally and thrives well under the prevailing climatic conditions of the region. The use of turmeric can enhance production

and also provide quality meat and egg at an effective cost. Hence, the present study was conceived to study the effect of turmeric powder on the laying performance and egg quality traits of Vanaraja birds.

MATERIALS AND METHODS

Location of the study. The present trial was carried out at the Instructional Livestock Unit of the Department of Livestock Production and Management, School of Agricultural Sciences, Nagaland University. The farm is located at 93.20°E to 95.15°E longitude and latitude between 25.6°N at an elevation of 310 meter above mean sea level (MSL) with an average annual rainfall between175 to 250 cm.

Experimental Birds. The experiment was conducted using one hundred and twenty numbers (120) of Vanaraja pullets of uniform age (8 weeks) and size, procured from ICAR Research Complex, Jharnapani, Nagaland.

Experimental diet. The experimental birds were randomly divided into four treatment groups designated as T_1, T_2, T_3 and T_4 with thirty (30) chicks in each group having five replicates of six (6) birds each. They were subjected to four dietary levels of turmeric powder containing 0%, 0.5%, 0.75% and 1.5%, respectively for a period 365 days of age.

Turmeric powder. Pure and fresh turmeric powder was procured from local farmer at source which was stored in airtight container till it was needed.

Management of Experimental Birds. The birds were reared in cages following standard management practices under strict sanitation and hygiene. Vaccination was done as per standard schedule. They were offered standard grower ration up to 18 weeks of age followed by layer finisher ration which was procured from reputed commercial feed supplier.

EXPERIMENTAL PROCEDURE

Dietary Supplementation of Turmeric Powder. Accurate quantity of turmeric powder was measured using a digital weighing balance and it was mixed properly with the feed. The details of dietary supplementation of turmeric powder are summarized in Table 1.

Table 1: Details of Dietary Supplementation of Turmeric Powder.

Treatment Groups	Level of turmeric supplementation
T_1	Basal diet
T_2	Basal diet + Turmeric powder at the rate of 0.5 per cent
T_3	Basal diet + Turmeric powder at the rate of 0.75 per cent
T_4	Basal diet + Turmeric powder at the rate of 1.5per cent

Egg production and Quality Traits. To estimate egg production, clutch size, hen day and hen housed egg production, the daily egg production was recorded till the trial period (52 weeks). Hen day egg production and hen housed egg production was calculated by using the following formula.

$$\text{HDEP} = \frac{\text{Total no. of egg laid during a given time}}{\text{Total hens days during the period}} \times 100$$

$$\text{AI} = \frac{\text{Total numbers of egg laid during a given time}}{\text{Number of hens housed at the beginning of the laying period}} \times 100$$

Egg quality traits. Egg quality traits were evaluated at 180 days, 242 days and 365 days. In order to determine egg quality, five eggs were randomly taken from each treatment. Yolk height and albumen height was measured with speedometer while Vernier caliper was used to measure the length and diameter of yolk and albumen.

Albumen index. Albumen index was calculated by following the standard formula:

$$\text{AI} = \frac{\text{Albumen height (mm)}}{\text{Albumen lenght(mm)} + \text{Albumen width}} \times 100$$

Yolk index. Eggs with yolk index above 0.38 were considered as extra fresh while those ranging from 0.28 to 0.38 as fresh and those below 0.28 were considered regular. Yolk index was calculated by using the following standard formula given by Romanoff and Romanoff (1949).

$$\text{YI} = \frac{\text{YH (mm)}}{\text{YD (mm)}} \times 100$$

Where, YI= yolk index, YH= height of the yolk and YD= diameter of the yolk.

Haugh unit. The haugh unit score was calculated by adopting the following formula:

$\text{HU}=100\text{xlog}\ (\text{H}-1.7\text{W}^{0.37}+7.6)$

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

The haugh unit values range from 0 to 130 and can be ranked as below:

AA: 72 or more (firm), A: 71 or 60 (reasonably firm), B: 59-31 (Weak and watery).

Yolk cholesterol. Yolk Cholesterol was examined by following a rapid technique for extraction of yolk cholesterol as per the method described by Washburn and Nix (1973). For cholesterol assay it was done using standard kit from DIATEK healthcare Pvt. Ltd while Cholesterol (mg/g yolk) concentration was estimated by Zlatkis method (Zlatkis *et al.*, 1953).

Statistical Analysis. The experimental data collected was subjected to statistical analysis in a completely randomized design as described by Gomez and Gomez (1984). The overall level of statistical significance was defined as $p<0.05$. The significance of the result was evaluated using Analysis of variance (ANOVA) in computer software WASP.

RESULTS AND DISCUSSION

A. Laying Performance

Table 2 provides the total egg production per bird, egg production per hen house, and egg production per hen

day (%) for the various treatment groups T_1, T_2, T_3 and T_4. For the various treatment groups T_1, T_2, T_3, and T_4, the respective egg production per bird from the date of laying to the completion of the trial, or 365 days, was 149.86 0.25, 157.06 1.03, 169.73 1.34, and 156.43 1.54 numbers. Due to the addition of turmeric, the results of the analysis of variance revealed a significant (p 0.05) change in egg production. The turmeric supplementation groups produced more eggs than the control group, which may be related to the bioactive components in turmeric. The findings of the present investigation and those of Park *et al.* (2012); Saraswati *et al.* (2013a) were in agreement. Azouz *et al.* (2019) also noted that turmeric powder had a considerable impact on egg production in laying chickens.

B. Egg quality traits

Table 3 displays the values for the egg quality attributes seen in various treatment groups at 180 days, 242 days, and 365 days. The clutch size was determined to be 5.32 0.29, 5.59 0.25, 5.83 0.44, and 5.53 0.13 for the various treatment groups T_1, T_2, T_3, and T_4, respectively, while the hen house egg production for the corresponding group was 19.55 0.44, 19.63 1.06, 21.21 0.57, and 19.55 0.68 numbers. The percentage values for the number of eggs produced each day by hens were 66.27 0.93, 69.31 0.89, 69.91 0.44, and 68.34 0.77. According to the statistical study, supplementing with turmeric had no effect on hen day, hen house, or clutch size; therefore there was no discernible change. On the other hand, Kanagaraju *et al.* (2017); Widjastuti *et al.* (2017), the addition of turmeric powder to the diet enhanced hen day and hen-housed housed housed egg production. The findings may have varied depending on the species or strain utilized, the duration of the trial, the age of the birds, the agro-climatic circumstances, and the quantity and type of turmeric powder employed.

C. Albumen index

As evident from Table 3, the albumen index of Vanaraja eggs at 180 days for the different treatment groups *i.e*. T_1, T_2, T_3 and T_4 was 0.312 ± 0.00, 0.310 ± 0.00, 0.322 ± 0.00 and 0.318 ± 0.00, respectively. The corresponding values of albumen index at 242 days was 0.326 ± 0.01, 0.350 ± 0.00, 0.368 ± 0.00 and 0.352 ± 0.01 and at 365 days the values were recorded as 0.492± 0.01, 0.496± 0.01, 0.518± 0.00 and 0.512 ± 0.01. Analysis of variance indicated that the albumen index was unaffected at 180 and 365 days however; at 242 days it was found to be significantly higher in turmeric supplemented groups as compared to the control. Similar to the present findings, Mousa *et al.* (2018) had also reported that there was significant ($p<0.05$) increase in albumen index when fed with turmeric supplemented diet. On the contrary, Curvelo *et al.* (2009) revealed that there was no difference in the internal quality of eggs when fed with turmeric on laying hens.

D. Yolk index

The yolk index of Vanaraja eggs at 180 days for the different treatment groups *i.e*. T_1, T_2, T_3 and T_4 was 0.390 ± 0.01, 0.400± 0.01, 0.420 ± 0.00 and 0.410 ± 0.01, respectively. The corresponding values of yolk index at 242 days was 0.406 ± 0.00, 0.412 ± 0.00, 0.418 ± 0.01 and 0.420 ± 0.00; and at 365 days the values was recorded as 0.408 ± 0.01, 0.414± 0.01, 0.420± 0.01 and 0.430 ± 0.01. Yolk index values were above 0.38 in all the treatment groups which indicated that the eggs were extra fresh. No significant difference was observed in yolk index at 180 and 242 days however, at 365 days turmeric powder had positive effect on the yolk index at 1.5 % level of inclusion which could be attributed to the bioactive compounds present in turmeric. Similar to the present finding, researchers such as Radwan *et al.* (2008); Park *et al.* (2012) have also reported significant ($P<0.05$) increase in yolk index when birds were fed with turmeric based diet.

E. Haugh Unit

A higher haugh unit score indicates better egg quality. The Haugh Unit values of Vanaraja eggs at 180 days for the different treatment groups, *i.e.*, T_1, T_2, T_3 and T_4 were 76.58 ± 1.709, 78.50 ± 0.16, 79.00 ± 0.08, and 78.50 ± 0.11, respectively. The corresponding haugh unit values at 242 days were 78.30 ± 0.82, 78.50 ± 0.05, 79.00 ± 0.08 and 78.50 ± 0.08; and at 365 days, the values for the respective group were recorded as 78.86 ± 0.11, 78.90 ± 0.06, 79.76 ± 0.25, and 79.62 ± 0.45. Since the haugh unit score of eggs ranked above 72, the egg quality was considered to be good, and the values were almost uniform for all the treatment groups. Analysis of variance had shown that there was no significant ($P>0.05$) difference in the haugh unit of Vanaraja eggs, which confirmed the findings of Curvelo *et al.* (2009); Saraswati and Tana (2016), who had found no significant differences in haugh unit values due to turmeric supplementation. On the contrary, Kujero *et al.* (2012) reported higher haugh unit values at 1.5% turmeric supplementation.

F. Yolk Cholesterol

As per Table 3, the yolk cholesterol values (mg/g yolk) of Vanaraja eggs at 180 days for the different treatment groups T_1, T_2, T_3 and T_4 were 19.92 ± 0.25, 19.20 ± 0.07, 19.10 ± 0.03, and 18.56 ± 0.37, respectively. The corresponding values at 242 days were 19.30 ± 0.0, 19.10 ± 0.06, 18.92 ± 0.08, and 18.82 ± 0.37; and at 365 days, the values for the respective group were recorded as 19.08 ± 0.07, 19.00 ± 0.08, 18.78 ± 0.66, and 18.74 ± 0.24. An analysis of variance revealed a significant ($p<0.05$) difference in yolk cholesterol due to turmeric supplementation. Yolk cholesterol decreased with an increase in the level of turmeric powder, indicating an enhancement in egg quality. The decrease in yolk cholesterol might be due to the biological activity of the active ingredient, particularly curcumin present in turmeric, which metabolises the lipid, as reported by Dalal and Kosti (2018). At 180, 242, and 365 days, group T_4 had the lowest yolk cholesterol, followed by T_3, T_2 and the highest in control T_1. These results were in agreement with the findings of Rahardja *et al.* (2015); Ayed *et al.* (2018), who reported that yolk cholesterol significantly ($P<0.05$) decreased due to supplementation of turmeric alone or in combination with other herbal additives.

Table 2: Effect of turmeric powder on the laying performance of Vanaraja birds.

Parameters	T_1	T_2	T_3	T_4	CD(0.05)
Total egg production Upto 52 weeks (Nos)	$149.86^{c} \pm 0.26$	$157.06^{b} \pm 1.03$	$169.73^{a} \pm 1.34$	$156.43^{b} \pm 1.54$	4.24
Clutch size (Nos)	5.32±0.29	5.59±0.25	5.83±0.44	5.53 ±0.13	-
Hen house egg production (Nos)	19.55 ± 0.44	19.63 ± 1.06	21.21 ± 0.57	19.55 ± 0.68	-
Hen day egg production (%)	66.27 ± 0.93	69.31 ± 0.89	69.91 ± 0.44	68.34 ± 0.77	-

a, b and c = Means bearing different superscripts in a row differ significantly ($p<0.05$)

Table 3: Effect of Turmeric on Egg Quality Traits at different age in different treatment groups.

Treatment groups	Albumen index			Yolk index			Haugh unit			Yolk cholesterol (mg/g yolk)		
	180 days	242 days	365 days	180 days	242 days	365 days	180 days	242 days	365 days	180 days	242 days	365 Days
T_1	0.312 ±0.00	0.326^{b} ±0.01	0.492 ±0.01	0.390 ±0.01	0.406 ±0.00	0.408^{b} ±0.01	76.58 ±1.71	78.30 ±0.82	78.86 ±0.11	19.92^{a} ±0.25	19.30^{a} ±0.08	19.08^{a} ±0.07
T_2	0.310 ±0.00	0.350^{a} ±0.01	0.496 ±0.01	0.400 ±0.01	0.412 ±0.00	0.414^{b} ±0.01	78.50 ±0.16	78.50 ±0.05	78.90 ±0.06	19.20^{b} ±0.07	19.10^{ab} ±0.06	19.00^{ab} ±0.08
T_3	0.322 ±0.00	0.368^{a} ±0.01	0.518 ±0.00	0.420 ±0.00	0.418 ±0.01	0.420^{ab} ±0.00	79.00 ±0.08	79.00 ±0.08	79.76 ±0.21	19.10^{b} ±0.03	18.92^{bc} ±0.08	18.78^{b} ±0.06
T_4	0.318 ±0.00	0.352^{a} ±0.01	0.512 ±0.01	0.41 ±0.01	0.420 ±0.01	0.430^{a} ±0.00	78.90 ±0.11	78.50 ±0.09	79.62 ±0.45	18.56^{b} ±0.31	18.82^{c} ±0.37	18.74^{b} ±0.24
C.D (0.05) Value	-	0.019	-	-	-	0.014	-	-	-	0.680	0.205	0.263

a,b and c = Means bearing different superscripts in a row differ significantly ($p<0.05$)

CONCLUSIONS

Turmeric powder supplementation at the rate of 0.75 resulted in better performance in egg production and egg quality traits of Vanaraja birds as compared to the control group. Therefore, on the basis of the above findings, the use of turmeric powder as a feed additive at the rate of 0.75 in poultry diets may be advocated for better production performance and for producing better-quality eggs.

FUTURE SCOPE

Further studies should be carried out focusing on the immunomodulatory effect of turmeric and its mode of action in poultry. This will help to ascertain its efficacy and provide strong support for its use in poultry for better health and higher productivity.

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Conflict of Interest. None.

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