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Effect of using *Moringa oleifera* leaf meal on quality and sensory parameters of Japanese quail eggs

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Abstract
A 300 numbers of unsexed day-old Japanese quail chicks were randomly divided into 5 dietary treatments with 3 replicates to analyze the effect of feeding diets containing different levels of *Moringa oleifera* leaf meal on egg quality traits and sensory evaluation of eggs. Dietary treatments were T_0 (control) group fed only a basal diet, while the other four groups (T_1, T_2, T_3 and T_4) were fed a basal diet supplemented with 0.25, 0.50, 0.75 and 1.00% *Moringa oleifera* leaf meal (on dry matter basis), respectively for a period of 14 weeks. Results showed that the egg quality traits like egg weight, shape index, albumen index and yolk index did not differ significantly ($P>0.05$) except yolk colour which showed significantly ($P\leq0.05$) higher value at 1.00% level as compared to the other groups. The various organoleptic parameters of quail egg like colour, flavour, texture, juiciness and overall acceptability did not differ significantly ($P>0.05$) among the different experimental groups.

Keywords: Japanese quail, *Moringa oleifera* leaf meal, egg quality traits, treatment

Introduction
Eggs and meat from quails are sources of high quality dietary protein that can be used to enhance food and nutritional security particularly in resource poor communities of developing countries (Mulaudzi *et al*. 2019) [7]. Quail eggs are more nutritious than other poultry eggs because of its comparatively more protein, phosphorus, iron, vitamin A, B_1 and B_2 and can play a vital role to meet up the demand of food and nutrition (Teixeira *et al*., 2014) [14]. Egg nutritive value depends on geography and feed composition which influences egg size, egg weight, albumen ratio, yolk ratio and shell ratio (Teteh *et al*., 2016, Sparks, 2006) [13, 11]. Other considerations for use of plant based feedstuffs in poultry feeding are the improving of yolk colouration and their high content in macronutrients which is the key element of protein source. For this use of plant based feedstuffs with possible nutraceutical properties such as *Moringa oleifera* can be a cost effective and safe strategy to improve the performance and the product quality of intensively reared quails. The leaves are very rich with large amounts of vitamins (A, B and C), protein, iron, calcium and phosphorus (Murro *et al*., 2003) [8]. Also, it contains sufficient amounts of methionine, cysteine, carotene, ascorbic acid and iron (Fouad and El-Rayes, 2019) [4]. *Moringa oleifera* is a plant that possesses multiple advantages. Effect of *Moringa oleifera* leaves on egg quality of quail were not much investigated. The aim of this study was to determine the optimum level of *Moringa oleifera* leaves in quail diet for egg quality improvement.

Materials and methods
The trial was carried out at College of Veterinary Science, Assam Agricultural University, Guwahati, Assam. 14 weeks trial was undertaken using 300 Japanese quail chicks fed with 5 types of diet containing *Moringa oleifera* leaf meal at different levels (T_0, T_1, T_2, T_3 and T_4). *Moringa oleifera* leaf were collected from local source, sun dried and pulverized. The chicks were divided into 5 groups with 60 chicks each and each group subdivided into 3 replicates (20 chicks each). The groups are fed with quail starter and finisher diets supplemented with *Moringa oleifera* leaf meal at the rate from 0.25, 0.50, 0.75 and 1.00%.
Eggs were collected daily and quality determination was done. Soft-shelled, cracked and small eggs were not used in the study. Measurements of egg quality were taken on average of 30 eggs from each treatment groups. Eggs were weighed through the sensitive electronic scale. A vernier caliper was used for external and internal quality measuring the length, width of the egg, yolk diameters, length and width of the thick albumen. The height of the thick albumen and yolk were

recorded with triploid stand micrometer. The average of the 2 measurements of thick albumen height (one near to yolk and the other at the end of dense albumen) was recorded. The shape index, albumen index, yolk index and yolk colour of collected eggs were determined using standard method (Talik and Saatci, 2004) [12].

Shape index
For determination of shape index of egg average width of the egg and average length of the egg was calculated and expressed using following formula.

$$\text{Egg shape index} = \frac{\textbf{Average width of the egg}}{\textbf{Average length of the egg}} \times 100$$

Albumen index
For determination of albumen index height, length and width of albumen was measured and albumen index was calculated using the following formula

$$\text{Albumen index} = \frac{\textbf{Albumen height}}{\textbf{Albumen lenght+Albumen width}} \times 100$$

Yolk index
The yolk index was calculated by dividing the yolk height by the yolk diameter of the egg broken on flat surface

$$\text{Yolk index} = \frac{\textbf{Yolk height}}{\textbf{Yolk diameter}}$$

Yolk colour
Yolk color intensity was evaluated and scored according to the Roche yolk color fan (1, light yellow; 15, orange).

Sensory evaluation of boiled egg
The quail egg samples from the four groups were taken. The eggs were boiled for 15 minutes and then subjected to taste panel evaluation. Coded samples were served immediately to a 19 member semi trained panelist. The panelists were provided with a 7 point hedonic score card to assess the colour, flavour, tenderness, juiciness and overall acceptability of the sample as described by Bratzler (1971) [2].

Table 1: Score Card under Hedonic Scale for Evaluation of Quail Egg

Score Under Hedonic Scale	
Excellent	7
Very Good	6
Good	5
Fair	4
Poor	3
Very poor	2
Extremely Poor	1

Results
The egg quality traits and their mean ±SE values of Japanese quail egg under different groups are presented in Table 02.

Egg weight
The mean weight of egg weight of Japanese quail of groups T_0, T_1, T_2, T_3 and T_4 were recorded as 11.33 ± 0.20, 12.06 ± 0.21, 11.76 ± 0.23, 11.36 ± 0.25 and 11.34 ± 0.26 respectively. The results (Table 02) revealed that there was no significant (P>0.05) difference in egg weight of the Japanese quail among the different treatment groups. These findings were in normal range of egg weight of Japanese quail and are in accordance with findings of Alikwe *et al.* (2016) [1]. Contrary to the present findings Ebeneb *et al.* (2013) [3] and Paguia *et al.* (2014) [9]. reported significant (P<0.05) improvement in egg weight in *Moringa oleifera* leaf meal treated groups compared to control. However Raphael *et al.* (2015) [10] and Mabusela *et al.* (2018) [6] reported significantly (P<0.05) decreased egg weight with increasing levels of *Moringa oleifera* leaf meal in the diets.

Shape index
The egg shape index under different treatment groups were recorded as 73.41±0.46, 74.85±0.22, 75.22±0.31, 74.52±0.18 and 73.82±0.42 g for T_0, T_1, T_2, T_3 and T_4 groups, respectively. The results indicated that the supplementation of *Moringa oleifera* leaf meal in feed had no influence on the shape index of Japanese quail egg. These findings are in agreement with the findings of Ebenebe *et al.* (2013) [3], Lu *et al.* (2016) [5] and Mabusela *et al.* (2018) [6].

Albumen index
The albumen index of egg of Japanese quail under different treatment groups were 5.85±0.05, 6.07±0.18, 6.13±0.04, 5.99±0.06 and 5.97±0.08 for T_0, T_1, T_2, T_3 and T_4 groups respectively. The results (Table 02) of the present study indicated that *Moringa oleifera* leaf meal supplementation had no effect on the albumen index of quail eggs. Contrary to the present study Lu *et al.* (2016) [5]. reported significant (P>0.05) increase in albumen height among groups with increasing level of *Moringa oleifera* leaf meal.

Table 2: Mean ± Se scores for egg quality evaluation of japanese quail egg under different treatment groups

Group / Parameters	T_0 (Control)	T_1 (MOLM- 0.25%)	T_2 (MOLM-0.50%)	T_3 (MOLM-0.75%)	T_4 (MOLM-1.00%)
Egg weight	11.33^{a}±0.20	12.06^{a} ±0.21	11.76^{a}±0.23	11.36^{a}±0.25	11.33^{a}±0.26
Shape index	73.41^{a}±0.46	74.85^{a}±0.22	75.22^{a}±0.31	74.52^{a}±0.18	73.82^{a}±0.42
Albumen index	5.85^{a}±0.05	6.07^{a}±0.18	6.13^{a}±0.04	5.99^{a}±0.06	5.97^{a}±0.08
Yolk index	44.97^{a}±0.28	45.18^{a}±0.24	45.56^{a}±0.11	44.98^{a}±0.34	44.77^{a}±0.39
Yolk colour	3.66^{a}±0.13	3.70^{ab}±0.18	3.76^{ab}±0.17	3.83^{ab}±0.15	4.33^{b}±0.19

Means bearing same superscripts in a row did not differ significantly.

Yolk index

The mean yolk index scores of T_0, T_1, T_2, T_3 and T_4 groups were found as 44.97 ± 0.28, 45.18 ± 0.24, 45.56 ± 0.11, 44.98 ± 0.34 and 44.77 ± 0.39 respectively. The analysis of variance (Table 02) revealed that there was no significant (P>0.05) difference in yolk index value of the Japanese quail egg among the different treatment groups. These observations were in accordance with Raphael *et al*. (2015) [10] who found non-significant differences in the yolk index among the control and *Moringa oleifera* fed groups.

Yolk colour

The mean value of yolk colour (Table 02) of Japanese quails egg among the different treatment groups improved numerically. However, the T_4 group showed significantly (P<0.05) higher yolk colour as compared to control group. These finding are in accordance with Lu *et al*. (2016) [5] and Mabusela *et al.* (2018) [6] who reported that the mean value of yolk colour were higher in *Moringa oleifera* leaf meal fed group compared to control group.

Organoleptic evaluation of egg

The mean (Table 03) scores for organoleptic evaluation of Japanese quail egg under different treatment groups did not differ significantly (P>0.05). Thus the various organoleptic parameters of quail egg like colour, flavour, texture, juiciness and overall acceptability were not affected due to supplementation of *Moringa oleifera* leaf meal in feed. The mean overall acceptance of various groups of quail egg ranged from 5.53 to 5.97 and hence according to the hedonic scale, the quail egg can be said as of good to very good quality. These findings are in agreement with findings of Paguia *et al.*, (2014) [9] who reported no significant (P>0.05) differences in scores for sensory evaluation of egg among control and *Moringa oleifera* leaf meal treatment groups.

Table 3: Mean ± se scores for organoleptic evaluation of japanese quail egg under different treatment groups

Group / Parameters	T_0 (Control)	T_1 (MOLM- 0.25%)	T_2 (MOLM-0.50%)	T_3 (MOLM-0.75%)	T_4 (MOLM-1.00%)
Colour	6.05^a±0.17	5.47^a±0.26	5.57^a±0.24	5.31^a±0.26	5.57^a±0.20
Flavour	5.94^a±0.17	5.52^a±0.23	5.68^a±0.20	5.63^a±0.23	5.68^a±0.23
Texture	5.52^a±0.25	5.47^a±0.28	5.57^a±0.23	5.52^a±0.25	5.78^a±0.22
Juiciness	5.94^a±0.24	5.47^a±0.30	5.47^a±0.28	5.47^a±0.28	5.52^a±0.26
Overall acceptance	5.53^a±0.18	5.78 ^{a}±0.25	5.97^a±0.20	5.68±^{a}0.23	5.82^a±0.20

Means bearing same superscripts in a row did not differ significantly.

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