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Effect of feeding mulberry (*Morus Alba*) leaves on external egg quality traits of white leghorn

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Abstract
This experiment entitled, "Effect of Feeding Mulberry (*Morus Alba*) Leaves on External Egg Quality Traits of White Leghorn" was carried out at Poultry Unit, Division of Animal Husbandry and Dairy Science, College of Agriculture, Pune. The objective was to study external egg quality traits in White leghorn layers by feeding fresh Mulberry leaves. To achieve the objective a total of 240 White leghorn laying hens, were distributed into six treatment groups as T_0, T_1, T_2, T_3, T_4 and T_5 of forty hens each. Laying hens were cater the same experimental diets with varying levels of fresh succulent Mulberry leaves supplementation as in case of layer trial over the duration of experiment from 18 to 33 weeks of age. All hens were reared under identical housing conditions. The diets were designed to meet the requirement of laying hens consuming 120 g of feed per day, which was based on the National Research Council (NRC, 1994). T_0 (control-basal diet only), T_1 (basal diet with 3% fresh Mulberry leaves), T_2 (basal diet with 6% fresh Mulberry leaves), T_3 (basal diet with 9% fresh Mulberry leaves), T_4 (basal diet with 12% fresh Mulberry leaves), and T_5 (basal diet with 15% fresh Mulberry leaves). The data were analyzed using General Linear Model procedure of statistical package for social sciences (SPSS). Fresh Mulberry leaf inclusion among all treatment groups and comprehensive study of external egg quality evaluation revealed no significant differences across treatments for egg weight (52.82-56.16 g), shell weight (5.25-6.00 g), shell thickness (0.30-0.36 mm), shell shape index (76.76-79.82%), specific gravity (1.08-1.09), indicating maintenance of commercial egg quality standards. According to the current findings, adding fresh mulberry leaves to the diet has not significantly changed any of the parameters pertaining to the external egg quantity.

Keywords: Layers, mulberry leaves, eggs quality, external egg quantity

Introduction
Poultry sector with an average annual growth rate of 6-8% in egg production, poultry is one of the agricultural sectors in India that is expanding the fastest. The poultry market in India has reached a value of over USD 30.46 billion in 2024, expected to increase between 2025 and 2034. North America, the U.S. remains a significant egg producer and has increased its production by approximately 10% over the last 10 years, reaching 9.13 billion dozen eggs in 2023. (According to data from the U.S. Department of Agriculture (USDA)). India is the world's seventh-largest producer of chicken meat and third-largest producer of eggs. (2015, Watt Executive Guide). In India, 270 million layers generate around 74 billion of eggs annually. As per the 20th Livestock Census, the total poultry population reached 851.81 million, an increase of 16.8%. Backyard poultry saw a significant rise of 45.8%, while commercial poultry grew by 4.5%, the layer population in India is approximately 270 million and the poultry population increased by 16.8% over the previous Census. The poultry sector employs around 20 million farmers, and there are about 1,000 hatcheries in India.
As feed comprises about 70-80 per cent of the total cost of poultry enterprises, the increased production of quality meat and eggs at lower cost is need of the day. The costs of traditional products for protein feed, like groundnut cake, soybean meals and fish meal have fly up so high in recent times that it is becoming uneconomical to use them into poultry feeds. Therefore, it is needed to look for locally available and cheap sources of feed ingredients, particularly those that do not attract competition in consumption between humans and livestock. Because they are readily available locally and are regarded as unconventional foods, leaf meals are becoming more and more popular in poultry diets.

Mulberry is useful because it is readily available and simple to set up, mulberry has the potential to boost small-scale farmers' productivity levels by feeding poultry.

According to Srivastava *et al*. (2006) [6], mulberry leaves contain β-carotene, which poultry may convert to vitamin A and xanthophylls with differing degrees of effectiveness. The latter can be an excellent source of the pigmentation in egg yolks. The use of mulberry (*Morus Alba*) leaves as a source of nutritional protein for commercial livestock and poultry operations is one of the potential feed substitutes. The white mulberry, or *Morus Alba*, is a small to medium-sized tree that grows quickly, reaching a height of 10 to 20 meters. Although some examples are known to be over 250 years old, the tree has a short lifespan in general. The plant is widely cultivated and endemic to northern China. In temperate climates, trees are typically deciduous, but in tropical climates, they can become evergreen. Mulberries are said to offer exceptional nutritional value as feed and grow well in tropical and subtropical climates. The open-type bushes of the mulberry (*Morus Alba*) V1 variety have simple, upright, rough branches with short internodes. The leaves are oblong-broadly ovate, palmately veined, glossy, dark green, simple, smooth, unlobed, grouped alternately or spirally, and succulent with a high moisture content. In India, mulberry trees have been reported to produce roughly 40 tonnes of fresh leaves per hectare annually. It has been determined that mulberry leaf meals are a locally accessible substitute protein source for poultry feeds that could increase the quantity and quality of eggs produced. Due to excellent climatic circumstances, mulberry trees are locally available in India and are robust, deeply rooted, and thrive in nearly all sorts of soils. It can flourish in arid and semi-arid regions (ASALs) and is drought tolerant. Therefore, the purpose of this study was to examine the exterior quality of eggs that were put on the market by incorporating mulberry leaves into the meals of the layers. Mulberry leaves' high protein content have made them a desirable addition to layer feed. On the other hand, little scientific data exists regarding their impact on external egg quality and layer productivity. Therefore, by examining the effects of feeding Mulberry leaves on the production performance and exterior egg quality attributes of White Leghorn layers, this study aims to close this information gap.

Materials and Methods

A total number of 240 White leghorn laying hen, of 18 weeks of age at the beginning of the study were used for the present study. The laying hens were distributed randomly into six treatment groups viz., T_0, T_1, T_2, T_3, T_4 and T_5 with 40 laying hen in each treatment. The laying hens were fed the same experimental diets with different levels of fresh mulberry leaves supplementation in laying hen trial during the experimental period from 18 to 33 weeks of age.

Treatment details

- T_0: Basal Diet without Mulberry leaves (Control)
- T_1: Basal Diet + 3 percent Fresh Mulberry Leaves.
- T_2: Basal Diet + 6 percent Fresh Mulberry Leaves.
- T_3: Basal Diet + 9 percent Fresh Mulberry Leaves.
- T_4: Basal Diet + 12 percent Fresh Mulberry Leaves.
- T_5: Basal diet + 15 percent Fresh Mulberry Leaves.

Data collection

- **Egg weight:** All eggs for each replicate were numbered and weighed at the 7th day of each ending week and average egg weight (g) was calculated.
- **Specific gravity:** Specific gravity is the ratio of the weight of an object to the weight of an equal volume of water. In other words, weigh the egg and then divide the weight by the volume of the egg. Older layers have eggs with declining specific gravity. This is partly due to the size of the egg increasing more rapidly than shell weight. Therefore, differences in specific gravity are mainly due to difference in the amount of shell.
- **Egg shell thickness:** Shell thickness was recorded using a Vernier Caliper in millimeters (mm). Shell membrane was removed manually and two readings from two different places of the shell were recorded. Average of the two was taken as the final reading for egg shell thickness.
- **Eggs Shell weight:** The weight of shell along with shell membrane was recorded on electronic weighing balance (in grams). Each egg was broken on flat glass surface. Then egg shell was cleaned with a tissue paper and then weighed.
- **Egg Shape Index (Percent):** The length and width of eggs were measured with the help of Vernier Caliper and the shape index of eggs was calculated by the following formula:

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

Statistical analysis

The statistical method used for data analysis was General Linear Model procedure of statistical package for social sciences (SPSS).

Results and Discussion

- **Average egg weight (gm)**

The average egg weight during experimental period were 54.24, 54.36, 54.14, 54.53, 54.18 and 54.02 in T_0, T_1, T_2, T_3, T_4 and T_5 group, respectively. The maximum average egg weight (54.53 g) was observed in (T_3) group and the lowest egg weight (54.02 g) recorded in (T_5) treatment. According to statistical analysis, the weight of the eggs in the various treatment groups during the study period did not differ significantly.

Table 1: Average Eggs Weight (g) of Laying Hens

Treatment	Phase				Overall Average
	I	II	III	IV	
T_0	52.82	53.35	55.28	55.50	54.24
T_1	52.96	53.45	55.43	55.59	54.36
T_2	52.79	53.61	54.82	55.34	54.14
T_3	53.03	53.64	55.30	56.16	54.53
T_4	52.78	53.43	55.02	55.51	54.18
T_5	52.84	53.49	54.07	55.69	54.02
S.E. ±	0.22	0.32	0.46	0.47	
CD @ 5%	NS	NS	NS	NS	

The present results were in close relation with Park & Kim (2012) found no significant differences in parameters including egg weight among hens fed 0 %, 1 %, 2 % or 5 % Mulberry-leaf powder. Kamruzzaman *et al.* (2022) [2] (substituting rice polish with Mulberry leaf powder) also observed no effect on cumulative performance or egg weight when up to 4.5 % of the diet was Mulberry powder.

While Al-Kirshi *et al.* (2010) [1] demonstrated that high levels (10-20%) of Mulberry leaf meal decreased egg weight in

comparison to control diets, Li *et al.* (2017) [3] observed that adding Mulberry leaf powder to the diet significantly raised average egg weight and egg size in White Leghorn layers.

- **Specific Gravity of Eggs**

The data on egg quality parameters concluded that the egg specific gravity was not affected by the fresh Mulberry leaves treatment, the differences after statistical analysis show non-significant results. The specific gravity ranged from 1.08 to 1.09.

Table 2: Average specific gravity of eggs

Treatment	Phase				
	I	II	III	IV	Overall Average
T_0	1.09	1.08	1.09	1.08	1.08
T_1	1.09	1.09	1.09	1.09	1.09
T_2	1.09	1.09	1.09	1.08	1.09
T_3	1.09	1.09	1.09	1.08	1.09
T_4	1.09	1.09	1.09	1.09	1.09
T_5	1.09	1.09	1.09	1.09	1.09
S.E. ±	0.04	0.03	0.03	0.03	0.01
CD @ 5%	NS	NS	NS	NS	NS

- **Eggs Shell Thickness**

Table 3 show that the overall average eggshell thickness was 0.33, 0.32, 0.34, 0.32, 0.34 and 0.32 mm under various treatments T_0, T_1, T_2, T_3, T_4 and T_5 respectively. The statistical results revealed that supplement of Mulberry leaves had no significant effect on eggshell thickness during experiment in different treatment groups.

Table 3: Average Shell Thickness (mm) of Eggs

Treatment	Phase				Overall Average
	I	II	III	IV	
T_0	0.34	0.32	0.33	0.33	0.33
T_1	0.31	0.33	0.30	0.33	0.32
T_2	0.33	0.33	0.35	0.34	0.34
T_3	0.31	0.34	0.30	0.34	0.32
T_4	0.34	0.36	0.35	0.33	0.34
T_5	0.34	0.32	0.30	0.32	0.32
S.E. ±	0.01	0.01	0.02	0.01	
CD @ 5%	NS	NS	NS	NS	

- **Shell Weight**

It is observed from Table 4 that overall average eggshell weight under different treatment groups was 5.41, 5.53, 5.55, 5.58, 5.63 and 5.50, for T_0, T_1, T_2, T_3, T_4 and T_5, respectively. Statistical analysis revealed that there was non-significant difference in shell weight of eggs among different treatments.

Table 4: Average Shell Weight (g) of laying hens eggs

Treatment	Phase				Overall Average
	I	II	III	IV	
T_0	5.25	5.31	5.56	5.50	5.41
T_1	5.31	5.44	5.75	5.63	5.53
T_2	5.50	5.44	5.44	5.81	5.55
T_3	5.50	5.38	5.50	5.94	5.58
T_4	5.44	5.38	5.69	6.00	5.63
T_5	5.38	5.25	5.69	5.69	5.50
S.E. ±	0.16	0.13	0.15	0.14	
CD @ 5%	NS	NS	NS	NS	

The present experiment results are in close agreement with the conclusion of Kamruzzaman *et al.* (2022) [2] and Wang *et al.* (2018) [8] (study on green tea + Mulberry extract) also reported non-significant changes in shell weight.

- **Eggs Shape Index**

During the experimental period the overall average per cent eggs shape index in T_0, T_1, T_2, T_3, T_4 and T_5 group was 77.57, 77.86, 77.73, 77.35, 77.91 and 77.80 respectively. The data on egg quality parameters indicated that the egg shape index (%) was not influenced by the different level of fresh Mulberry leaves group. The statistical analysis resulted that feeding of different amount of fresh Mulberry leaves had no significant effect on egg shape index during experimental period (18 to 33 weeks).

Table 5: Average Eggs Shape Index (%) of laying hens eggs

Treatment	Phase				Overall Average
	I	II	III	IV	
T_0	77.32	77.71	77.62	77.64	77.57
T_1	79.82	77.24	77.63	76.76	77.86
T_2	78.16	77.46	77.73	77.58	77.73
T_3	77.81	77.27	77.34	76.98	77.35
T_4	77.05	78.27	77.79	78.55	77.91
T_5	77.01	78.55	77.87	77.79	77.80
S.E. ±	1.09	0.48	0.40	0.47	
CD @ 5%	NS	NS	NS	NS	

Conclusion

The present results indicate that dietary supplementation of fresh Mulberry leaves have shown no significant effect on various parameters related to external egg quality.

Conflict of Interest

Not available

Financial Support

Not available

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