Uttar Pradesh Journal of Zoology

Volume 45, Issue 13, Page 294-300, 2024; Article no.UPJOZ.3603
ISSN: 0256-971X (P)

Impact of *Moringa oleifera* Leaf Meal on Egg Quality Traits in Japanese quail

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Authors' contributions

This work was carried out in collaboration among all authors. Authors AY, AKS, AJ, NS and RP did the conceptualizated. Authors AY and AKS did the experimental procedure and data collection. Authors AY and AJ data processing and performed the statistical analysis. Author AY wrote-original draft. Authors AY, AKS, AJ, NS, RP and AD wrote-reviewed and edited manuscript. All authors read and approved the final manuscript.

Article Information

DOI: https://doi.org/10.56557/upjoz/2024/v45i134156

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://prh.mbimph.com/review-history/3603

Original Research Article

Received: 06/04/2024
Accepted: 12/06/2024
Published: 15/06/2024

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Cite as: *Yadav, Aayush, Ajit Kumar Santra, Asit Jain, Nishma Singh, Rupal Pathak, and Ashutosh Dubey. 2024. "Impact of Moringa Oleifera Leaf Meal on Egg Quality Traits in Japanese Quail". UTTAR PRADESH JOURNAL OF ZOOLOGY 45 (13):294-300. https://doi.org/10.56557/upjoz/2024/v45i134156.*

ABSTRACT

To evaluate the effect of diet supplementation with *Moringa oleifera* leaf meal (MOLM) on egg quality traits of Japanese quails, a study was conducted for 16 weeks. For this purpose, a total of 270 adult female quails and 90 adult male quails of seven weeks of age were divided into 5 groups (M_0, $M_{0.5}$, M_1, $M_{1.5}$, and M_2) of 3 replicates of 24 birds (18 females and 6 males) each. The groups corresponded to 0, 0.5, 1, 1.5, and 2% inclusion levels of MOLM. The egg quality traits were studied fortnightly in four randomly collected eggs per replicate. An improvement (P≤0.05) in the egg quality traits, particularly egg shape index, albumen index, yolk colour score, and Haugh unit was recorded in the quails fed MOLM-based diets which denote better egg quality and higher chances of acceptability of the eggs by the consumer. It is concluded that MOLM can be safely included at 2% in the diets of Japanese quails.

Keywords: Acceptability; consumer; egg quality traits; Japanese quails; leaf meal; Moringa oleifera.

1. INTRODUCTION

The egg quality plays a pivotal role in the egg industry and displays the signs of egg freshness and optimal shelf life, thus influencing economic profitability [1]. The diversification of conventional protein sources and therefore their limited availability in the poultry sector is sought to hamper the egg quality of the birds [2]. The production of good quality eggs thus needs the addition of cheap and locally available non-conventional protein sources such as *Moringa oleifera* leaves in the diet of poultry. The active components of *Moringa oleifera* leaves appear to ameliorate oviposition and uterine health, thus improving egg quality [3,4-6]. *Moringa oleifera* leaf meal has been found to produce eggs of good quality countless times in poultry [7,8,9,10] excluding Japanese quails where the studies are minimal. Therefore, the study aimed to denote the significance of *Moringa oleifera* leaf meal on the egg quality traits of Japanese quails.

2. MATERIALS AND METHODS

A completely randomized design-based trial was conducted for a period of 16 weeks at the Poultry Demonstration and Experimental Unit of College of Veterinary Science and Animal Husbandry, Anjora, Durg, C.G., India, consisting of 270 adult female quails and 90 adult male quails in 3:1 sex ratio of uniform age (7 weeks) and weight in 5 groups (M_0, $M_{0.5}$, M_1, $M_{1.5}$, and M_2) of 3 replicates of 24 birds (18 females and 6 males) each. The groups denote gradual substitution of soybean and maize with 0, 0.5, 1, 1.5, and 2% *Moringa oleifera* leaf meal (MOLM) in diets (Table 1). The birds were maintained on floors under standard management practices. An isocaloric and isonitrogenous diet was offered to the birds twice daily consisting of 18.60% crude protein and 2850 Kcal/Kg metabolizable energy [11] along with *ad libitum* drinking water. MOLM was prepared at regular intervals as per the standard procedure [12].

Table 1. Feed composition (%) of layer (7-22 weeks) Japanese quail diets

Ingredients	M_0	$M_{0.5}$	M_1	$M_{1.5}$	M_2
Maize	60.600	60.400	60.200	59.800	59.500
Soybean meal	27.400	27.100	26.800	26.600	26.400
Soybean oil	1.900	1.900	1.900	2.000	2.000
Limestone powder	7.800	7.800	7.800	7.800	7.800
Di-calcium phosphate	1.300	1.300	1.300	1.300	1.300
Methionine	0.100	0.100	0.100	0.100	0.100
Salt	0.500	0.500	0.500	0.500	0.500
TM. Premix	0.100	0.100	0.100	0.100	0.100
Vitamin Premix	0.150	0.150	0.150	0.150	0.150
Vitamin B complex	0.015	0.015	0.015	0.015	0.015
Choline Chloride	0.050	0.050	0.050	0.050	0.050
Toxin binder	0.050	0.050	0.050	0.050	0.050
Vitamin C	0.010	0.010	0.010	0.010	0.010
Moringa oleifera leaf meal	0.000	0.500	1.000	1.500	2.000

Ingredients	M_0	$M_{0.5}$	M_1	$M_{1.5}$	M_2
Coccidiostat	-	-	-	-	-
Total	100.00	100.00	100.00	100.00	100.00
CP (%)	18.60	18.59	18.59	18.60	18.60
ME (Kcal/Kg)	2850	2850	2850	2850	2850
Calcium (%)	3.00	3.00	3.00	3.00	3.00
Phosphorus (%)	0.32	0.32	0.32	0.32	0.32
Lysine (%)	1.00	1.00	1.00	1.00	1.00
Methionine (%)	0.40	0.40	0.40	0.40	0.40

The egg quality traits were studied fortnightly in four randomly collected eggs per replicate. The eggs were dry-cleaned and labelled before taking observations. The external egg quality traits studied were:

1. Egg specific gravity was determined by the brine flotation method.
2. Egg weight was measured using an electronic weighing balance.
3. Egg length and width were measured using a digital vernier calliper.
4. Egg shape index was calculated in % as $\frac{\text{Egg width}}{\text{Egg length}}$ x 100.

The following internal egg quality traits were studied within 15 hours of the collection of eggs. The measurements of the internal components were obtained by gently breaking the egg with a scalpel and emptying the contents on a flat tile.

1. The eggshell together with the shell membrane was weighed on an electronic weighing balance to determine eggshell weight.
2. Later, the egg shells were washed and dried in a hot air oven at 100 ± 2°C for 24 hours. After cooling to room temperature, the shell along with the shell membrane was measured at the air cell, equator, and narrow end using a screw gauge to determine the eggshell thickness.
3. The egg albumen was measured for height, width and length using a spherometer, and digital vernier calliper, respectively.
4. Later, thick and thin albumin was cut at one end using a scalpel and drained on a petri dish to obtain yolk for measurements. The egg yolk was measured for height, width, and weight using a spherometer, digital vernier calliper, and an electronic weighing balance, respectively.
5. The weight of albumen was calculated by subtracting the weight of the yolk and shell from the weight of the whole egg.
6. Yolk index was calculated in % as $\frac{\text{Yolk height (cm)}}{\text{Yolk diameter (cm)}}$x100
7. Albumen index was calculated in % as $\frac{\text{Height (cm) of thick albumen}}{\text{Width (cm) of thick albumen}}$x100
8. Egg yolk colour was determined by comparing the colour of the properly mixed yolk sample with the colour strips of Roche colour fan, which consisted of 1-16 strips ranging from pale to orange-yellow in colour.
9. Haugh unit was calculated as [$100 \times \log_{10} (H - 1.7W^{0.37} + 7.56)$]

Where ‘H’ is the height of albumen in millimetres and ‘W’ is the weight of the egg in grams.

10. The percentage of egg components i.e. albumen, yolk and shell was calculated to the total egg weight.

All the data were analysed using the IBM SPSS software version 22 at a 5% probability level to compare the mean differences.

3. RESULTS

The details of egg quality traits are presented in Table 2. A noticeable ($P \le 0.05$) improvement in the specific gravity of eggs by 6.18-11.34%, egg shape index by 1.77-3.93%, albumen height by 6.98-27.02%, albumen index by 7.23-23.77%, yolk colour score by 19.57-83.23%, and Haugh unit by 2.14-7.02% was recorded in MOLM based groups than control. Besides, a marked ($P \le 0.05$) reduction was recorded in the yolk height (9.84%), yolk index (11.31%), and shell per cent in whole egg (3.25%) at 1.5% level of inclusion, while the remaining levels of inclusion showed a decline in the said parameters in the range of 4.16-5.60, 1.58-5.08, and 0.65-2.08%, respectively. Nevertheless, the remaining egg parameters exhibited no variations ($P > 0.05$) between the groups, but were found to excel in the MOLM-based groups than the control.

Table 2. Overall fortnight average of egg quality traits (Mean ± SE) of Japanese quails under different dietary groups

Egg quality traits	M_0	$M_{0.5}$	M_1	$M_{1.5}$	M_2
Specific gravity	0.97^{b}±0.01	1.03^{a}±0.01	1.04^{a}±0.01	0.95^{b}±0.02	1.08^{a}±0.01
Egg weight (g)	12.23±0.38	12.53±0.24	12.71±0.22	12.95±0.19	12.80±0.19
Egg length (mm)	33.20±0.51	32.76±0.73	32.87±0.37	32.34±0.48	33.72±0.44
Egg width (mm)	25.44±0.60	25.65±0.48	25.92±0.23	25.59±0.32	26.27±0.37
Egg shape index (%)	76.59^{c}±0.27	78.46^{b}±0.38	78.91^{ba}±0.24	79.60^{a}±0.45	77.95^{b}±0.36
Eggshell weight (g)	0.94±0.03	0.95±0.02	0.95±0.02	0.96±0.01	0.96±0.02
Eggshell thickness (mm)	0.21±0.009	0.20±0.004	0.21±0.005	0.21±0.004	0.21±0.005
Egg albumen height (mm)	4.44^{b}±0.43	4.75^{b}±0.13	4.85^{b}±0.11	4.89^{b}±0.15	5.64^{a}±0.25
Egg albumen weight (g)	7.44±0.28	7.65±0.14	7.90±0.15	7.83±0.14	7.64±0.08
egg albumen length (mm)	48.20±1.78	43.91±0.82	46.18±1.47	45.14±1.23	47.03±1.74
Egg albumen width (mm)	34.15^{cba}±0.55	33.10^{cb}±0.78	34.88^{ba}±0.67	32.50^{c}±0.50	35.16^{a}±0.57
Egg yolk weight (g)	3.85±0.08	3.92±0.11	3.85±0.14	4.16±0.06	4.19±0.13
Egg yolk width (mm)	23.35±0.36	23.27±0.49	22.91±0.59	23.76±0.39	23.93±0.36
Egg yolk height (mm)	11.07^{a}±0.35	10.45^{ba}±0.22	10.61^{ba}±0.22	9.98^{b}±0.15	11.11^{a}±0.47
Egg yolk index (%)	47.38^{a}±1.20	44.97^{ba}±0.94	46.63^{a}±1.84	42.02^{b}±0.32	46.31^{a}±1.36
Egg albumen index (%)	13.00^{d}±0.34	14.51^{cb}±0.23	13.94^{c}±0.15	15.05^{b}±0.10	16.09^{a}±0.22
Egg yolk colour score	4.65^{e}±0.03	5.56^{d}±0.05	6.56^{c}±0.02	7.67^{b}±0.05	8.52^{a}±0.06
Haugh unit	88.29^{c}±0.61	90.18^{b}±0.26	90.53^{b}±0.32	90.65^{b}±0.26	94.49^{a}±0.40
Shell per cent in whole egg	7.68^{a}±0.06	7.63^{ba}±0.05	7.52^{ba}±0.05	7.43^{b}±0.05	7.54^{ba}±0.10
Albumen per cent in whole egg	60.88^{ba}±0.50	61.35^{ba}±0.64	62.10^{a}±0.84	60.33^{ba}±0.45	59.80^{b}±0.60
Yolk per cent in whole egg	31.56^{ba}±0.61	31.26^{ba}±0.53	30.26^{b}±0.89	32.14^{ba}±0.43	32.69^{a}±0.66

$^{a, b, c, d \text{ and } e}$ *Mean with different superscripts differ significantly within rows (P≤0.05)*

4. DISCUSSION

The increase in the specific gravity of eggs in MOLM-based groups is a positive response toward customer satisfaction; however, this could neither be confirmed nor denied due to the unavailability of literature concerning moringa feeding. But, in addition to egg size and shell colour, this also reflects the viability of an egg and is therefore the major attraction for customers.

Meanwhile, egg weight is influenced mainly by genetics, environment, and hen age. This could explain why there was no significant difference in the current study as all the quails were of the same age and strain, and exposed to the same environment. A negligible increase in the egg weight corresponds with the findings of Mohammed et al. [9] in Rhode Island Red laying hens and Kakengi et al. [13] in commercial layers. This increase in egg weight was ascribed to the higher protein content or sulphur-containing amino acids in diets incorporated with moringa leaves as compared to the un-supplemented diet [14]. In contrast, Swain et al. [15] surmised that the weight of eggs declined at

2% inclusion of *Moringa oleifera* leaf meal in the diet of layers.

Besides, no variations in the egg length and width in the present study resemble the investigation of Kouatcho et al. [14] on layer quails at a 1-3% inclusion level of MOLM.

An increase in the egg shape index corroborates with the study of Olugbemi et al. [10] at 5-10% dietary incorporation of MOLM in layer chickens. The better the egg shape index is, the better the transportation and handling of the eggs. Contrarily, no change in the egg shape index was recorded by Kouatcho et al. [14] in quails and Swain et al. [15] in Vanraja laying hens.

The unvarying results of eggshell weight between the groups could not be discussed due to the lack of literature. The study however suggests that the inclusion of MOLM in diets did not hamper the dietary utilization of calcium, phosphorus, and magnesium in birds, leading to the constant weight of egg shells.

The uniformity in the thickness of eggshell between the groups resembles the study of Swain et al. [15] and Mohammed et al. [9] in poultry. The findings were left unsupported by Olugbemi et al. [10] who observed an increase in the eggshell thickness in layer chickens.

The unvarying results of egg albumen weight, length and width, and yolk weight and width between the groups could not be discussed due to the lack of literature.

An increase in the egg albumen height in MOLM-based groups was in line with the result of Lu et al. [8] at 10% inclusion of moringa leaf powder in the diet of commercial layers.

Further, no authors explored the impact of MOLM on the egg yolk height, egg yolk index and egg albumen index.

The improvement in egg yolk colour is confirmed by several investigators in layer chickens [8,16,10]. The more the yellow colour of the egg yolk is, the more it is preferred by the consumers. This colouration is generally associated with utilization of higher concentrations of dietary pigments i.e. carotenoids and xanthophylls in moringa leaves by birds, indicating high bioavailability of pigmenting agents in the Moringa leaf meal. The MOLM can therefore be used as an effective pigmenting agent in the poultry industry.

The improvement in the Haugh unit was confirmed by Lu et al. [8] indicating better albumen quality of the birds fed test diets.

The uniformity in the eggshell percentage in $M_{0.5}$, M_1 and M_2 corroborates with the studies of Swain et al. [15] and Abou-Elezz et al. [16] in poultry. The significant reduction in the eggshell percentage in $M_{1.5}$ remains unconfirmed due to the lack of literature. The inconsequential results of the egg albumen percentage and egg yolk percentage in the whole egg was supported by few investigators in poultry [15,16,10].

5. CONCLUSION

At last, the MOLM incorporated diets are assumed to support the egg quality of Japanese quails with significant improvements in egg shape index at a 1.5% level of inclusion, and egg albumen index, yolk colour score and Haugh unit at a 2% level of inclusion. It is concluded that MOLM can be safely included at 2% in the diet of Japanese quail without any adverse effects on their body functions. Further studies are still needed as of now a common level of inclusion could not be identified for all the parameters studied.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of manuscripts.

ETHICAL APPROVAL

This trial includes table birds which are exempted from the guidelines of the Institutional Animal Ethics Committee.

ACKNOWLEDGEMENTS

The authors would like to thank the staff of the Poultry Demonstration and Experimental Unit of the College of Veterinary Science and Animal Husbandry, Anjora, Durg, C.G., India for rearing and caring for the experimental birds.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Ozek K, Wellmann KT, Ertekin B, Tarım B. Effects of dietary herbal essential oil mixture and organic acid preparation on laying traits, gastrointestinal tract characteristics, blood parameters and immune response of laying hens in a hot summer season. Journal of Animal and Feed Sciences. 2011; 20(4): 575-586.
2. Mendonça Jr CXD, Lima FRD. Effect of dietary protein and methionine levels on forced molt performance of laying hens. Brazilian Journal of Veterinary Research and Animal Science. 1999; 36: 332-338.
3. Abdel-Wareth AA, Lohakare J. Moringa oleifera leaves as eco-friendly feed additive in diets of hy line brown hens during the late laying period. Animals. 2021;11(4):1116.
4. Daramola O.T, Jimoh, O.A. Supplementation Value of Cinnamomum ceylon Powder on Growth Performance, Serum Metabolites, Antioxidant Activities and Meat Analysis of Broiler Chickens . Asian J. Res. Animal Vet. Sci. 2024;7(2):150-8.

   [Acceson: 2024 May 29];

   Available:https://journalajravs.com/index.php/AJRAVS/article/view/300
5. Reddy C, Gopala GT, Harisha M, Rudresh BH, Gowda BGV, Shreyansh SH. Assessment of Extension Advisory Services in Contract and Non-Contract Broiler Farming. J. Exp. Agric. Int. 2023;45(9):1-8.

   [Acceson: 2024 May 29];

   Available:https://journaljeai.com/index.php/JEAI/article/view/2169
6. Lotfi E, Zerehdaran S, Raoufi Z. Genetic properties of egg quality traits and their correlations with performance traits in Japanese quail. British poultry science. 2012;53(5):585-91.
7. Briones J, Leung A, Bautista N, Golin S, Caliwag N, Carlos MA, Guevarra J, Miranda J, Guevarra JK, Pili NL. Utilization of Moringa oleifera Lam. in animal production. Acta Horticulturae. 2017;1158:54.
8. Lu W, Wang J, Zhang HJ, Wu SG, Qi GH. Evaluation of Moringa oleifera leaf in laying hens: Effects on laying performance, egg quality, plasma biochemistry and organ histopathological indices. Italian Journal of Animal Science. 2016; 15(4):658-665.
9. Mohammed KAEF, Sarmiento-Franco L, Santos-Ricalde R, Solorio-Sanchez JF. The nutritional effect of Moringa oleifera fresh leaves as feed supplement on Rhode Island Red hen egg production and quality. Tropical Animal Health and Production. 2012;44(5):1035-1040.
10. Olugbemi TS, Mutayoba SK, Lekule FP. Evaluation of Moringa oleifera leaf meal inclusion in cassava chip based diets fed to laying birds. Livestock Research for Rural Development. 2010; 22(6):1-6.
11. ICAR. Nutrient requirements of poultry. Indian Council of Agricultural Research, New Delhi, India; 2013.
12. Yadav A, Santra AK, Dinani OP, Singh N, Pathak R, Parveen K, Dubey A, Kumar V. Dietary inclusion of Moringa oleifera leaf meal improves egg fertility and hatchability in Japanese quails (Coturnix coturnix japonica). International Journal of Agriculture Sciences. 2022; 14(7): 11469-11471.
13. Kakengi AMV, Kaijage JT, Sarwatt SV, Mutayobe SK, Shem MN, Fujihara T. Effect of Moringa oleifera leaf meal as a substitute for sunflower seed meal on performance of laying hens in Tanzania. Livestock Research for Rural Development. 2007;19(8):446.
14. Kouatcho FD, Simiz E, Radu-Rusu RM, Pidotcho G, Djanabou M, Ngoula F. Effect of diet supplementation with Moringa Oleifera leaf meal on growth and laying performances of female quail (Coturnix sp.) in Soudano-Guinean zone of Cameroon. Advanced Research in Life Sciences. 2020;4(1): 22-29.
15. Swain BK, Naik PK, Chakurkar EB, Singh NP. Effect of supplementation of Moringa oleifera leaf meal (MOLM) on the performance of Vanaraja laying hens. Indian Journal of Animal Sciences. 2017;87(3): 353-355.
16. Abou-Elezz FMK, Sarmiento-Franco L, Santos-Ricalde R, Solorio-Sanchez F.

Nutritional effects of dietary inclusion of Leucaena leucocephala and Moringa oleifera leaf meal on Rhode Island Red hens' performance. Cuban Journal of Agricultural Science. 2011;45(2): 163-169.

Peer-review history:
The peer review history for this paper can be accessed here:
https://prh.mbimph.com/review-history/3603