Pakistan J. Zool., pp 1-4, 2024. DOI: https://dx.doi.org/10.17582/journal.pjz/20230828121423

Short Communication

Feeding Value of Extruded Hatchery Waste Meal and its Impact on Egg Production and Quality in Laying Hens

Rafiullah[1,2], Athar Mahmud[2], Sarzamin Khan[1], Asad Sultan[1], Naseer Ahmad[1], Majid Ali[1]* and Baitullah Khan[3]

[1]*Department of Poultry Sciences, University of Agriculture, Peshawar, Pakistan*
[2]*Department of Poultry Production, University of Veterinary and Animal Sciences, Lahore*
[3]*Directorate General (Research) Livestock and Dairy Development Department, Khyber Pakhtunkhwa, Peshawar.*

Article Information
Received 28 August 2023
Revised 05 December 2023
Accepted 26 December 2023
Available online 14 March 2024 (early access)

Authors' Contribution
RU conducted trial and laboratory analysis. AM designed the study and performed investigation. SK and AS did data evaluation. NA did software analysis. MA and BU performed visualization, manuscript review.

Key words
Hatchery waste, Extrusion, Laying hen, Egg production, Egg quality

ABSTRACT

Hatchery wastes can potentially be used as highly nutritious, low-cost poultry feed ingredient if processed scientifically. The aim of present study was to examine the feeding value of extruded hatchery waste meal (HWM) and its influence on egg production and egg quality in laying hens. In the first study hatchery wastes were collected, oven dried (60 °C), grounded, and extruded for 30 seconds at 115-155 °C. After extrusion the nutrient profile of the hatchery waste was determined. In second study, 250single comb White Leg horn (Babcock) layers were randomly allocated to five dietary treatments, containing 0, 2, 4, 6 and 8 % extruded HWM of the commercial laying hen ration. Each dietary treatment was replicated five times with 10 birds per replicate. Egg production was recorded and quality was determined using standard scientific protocols. Dietary treatments had no effect on egg production and egg quality except in group-D supplemented with 6% extruded HWM that had numerically higher egg production. These findings reflect that extruded HWM can be added in laying hen ration without compromising egg production performance and quality. However, further research is needed to assess higher inclusion of extruded HWM in laying at different stages of egg production.

Poultry, a fast-growing industry has expanded haphazardly during the past few decades and consequently numerous problems and challenges have emerged including high mortality, disposal of dead birds, poultry/hatchery waste and use of spent hens (Christmas *et al*., 1996). Every year tons of hatchery wastes are collected and are disposed off improperly. Raw hatchery wastes (RHW) consist of infertile eggs, egg shells, egg membranes and dead embryos (Hamm and Whitehead, 1982).

Hatchery waste has highly nutritive feed ingredient for poultry if treated and processed scientifically (Dhaliwal *et al*., 1996). Haque *et al*. (1991) reported that the extrusion can effectively kill microorganisms and this method can process RHW into a highly utilizable protein source and nutrient substitute in the diets of the commercial broiler (Saima *et al*., 2003). RHW has been reported to contain 44.25% crude protein, 30.01% ether extract, 1.90% crude fiber, 14.04% ash, 9.80% nitrogen free extract, 4572 Kcal kg^{-1} gross energy and 3600 Kcal kg^{-1} metabolizable energy (Rasool *et al*., 1999). The high nutritive value of RHW has drawn considerable attention for replacing expensive dietary protein sources in poultry ration.

Soybean meal, an expensive protein source could be replaced with non-conventional protein sources to minimize cost of poultry ration (Hazarika and Baruah, 1993). Moreover, RHW is also a good source of calcium in ration of laying hens due to high number of egg shells in the waste. Wisman (1964) and Vandepopuliere *et al*. (1977) determined the feeding value of hatchery by-products for both laying hens and growing chickens. It has been reported that raw hatchery material when cooked and

* Corresponding author: majidaup1@gmail.com
0030-9923/2024/0001-0001 $ 9.00/0

dehydrated can be successfully used to replace meat and bone meal, and soybean meal protein in broiler and laying hen diets. The RHW has been processed for recycling in poultry feed due to its high nutrient contents and to reduce environmental pollution (Dhaliwal *et al*, 1996).

The primary objective of this study was to investigate the feeding value of extruded hatchery waste meal (HWM) in laying hens and to monitor egg production and quality response.

Materials and methods

This research was done at the poultry research facility of The University of Veterinary and Animal Sciences, Lahore.

Raw hatchery waste was collected from a local hatchery, dried in an oven (60°C) and grounded. The dry grounded material was extruded at 115-155ºC for 30 seconds as described by Harper (1981).

A total of 250, 35-weeks-old single comb White Leg horn (Babcock) layers were randomly assigned to five dietary treatments containing 0 (Diet-A), 2 (Diet-B), 4 (Diet-C), 6 (Diet-D) and 8 (Diet-E) % extruded HWM of the commercial laying hen ration. Each dietary treatment was replicated five times with 10 birds per replicate. Birds were reared in cages and recommended optimum environmental conditions were maintained. The birds were given *ad libitum* access to water while fed restrictedly (twice a day). Experimental rations (Table II) were formulated according to nutrient requirements outlined in NRC (1994). A lighting program of 16 h light: 8h dark was practiced. Birds fed with Diet-A received a standard commercial layer ration, while in birds fed with diet B, C, D and E received 2, 4, 6 and 8% extruded HWM as a replacement for the commercial ration, respectively. The experimental data were collected on weekly basis.

Data were statistically analyzed using standard procedures of the analysis of variance (Steel *et al*, 1997) and means were compared using Duncan's Multiple Range Test (Duncan, 1955) using Statistical Analysis System (SAS, 2003).

Results and discussion

The proximate chemical composition of the raw and extruded HWM is given in Table I. Extruded HWM had no significant effect on the egg production data such as have insignificant eggs production, egg weight, shell weight, shell thickness, albumen weight, albumen height, haugh unit, yolk weight, yolk diameter, and the yolk color presented in Table III. Egg production varied from 49.975±1.82 to 53.250±1.15 with different dietary treatments with insignificant difference among all dietary groups (Table III). These finding could be related to work of Salami (1997) who observed insignificant effect on eggs production by replacing conventional protein source in diet with poultry visceral offal meal. Extruded HWM had no significant effect on egg weight at all inclusion level and an insignificant trend was seen in reduction in egg weight with high inclusion of extruded HWM. This depicts that the digestibility of extruded HWM might be lower and needed to be examined. Similar findings were reported by Tadtiyanant *et al*. (1993) that extruded HWM in laying hens ration has no significant ($P>0.05$) effect on egg weight (P. value 0.345). Senkoylu *et al*. (2005) also worked out post peak egg production in layers by feeding in diet poultry byproduct meal and feather meal separately or in combination and observed no significant effect on egg weight and egg production.

Table I. Chemical composition of raw and extruded HWM on dry matter basis.

Nutrients (%)	Raw HW	Extruded HWM
Crude protein	44.63±0.76	38.64±0.76
Crude fat	27.06±0.81	28.85±0.53
Crude fiber	1.05±0.38	1.47±0.43
Total ash	25.88±0.65	28.90±0.87
NFE[3]	1.38±0.46	2.14±0.42
Calcium	17.56±0.50	18.95±0.34
Phosphorus	1.63±0.17	1.54±0.11

Table II. Ingredient composition of experimental diets.

Ingredients (%)	Diet-A (0%)	Diet-B (2%)	Diet-C (4%)	Diet-D (6%)	Diet-E (8%)
Maize	35.00	35.00	35.00	35.00	35.00
Rice broken	17.54	12.06	11.85	10.82	11.13
Rice polishing	0.26	8.00	8.00	8.00	8.00
Molasses	5.00	5.00	5.00	5.00	5.00
Calcium carbonate	7.64	6.78	6.15	6.61	6.27
Lysine HCl	0.03	0.05	0.13	0.16	0.2
DL methionine	0.14	0.14	0.14	0.14	0.14
Salt	0.2	0.22	0.19	0.26	0.24
Rapeseed meal	3.00	3.00	3.00	3.00	3.00
Canola meal	6.02	8.78	8.81	8.74	8.76
Sunflower meal	4.00	0.78	4.00	4.00	4.00
Soybean meal	15.8	12.32	8.17	6.27	4.26
Vitamin mineral premix	1.00	1.00	1.00	1.00	1.00
Wheat bran	4.74	4.87	4.56	5.00	5.00
HWM extruded	0	2.00	4.00	6.00	8.00
Total	100	100	100	100	100

Table III. Eggs production and egg quality characteristics of commercial layers fed with different level of extruded HWM diets.

Parameters	Diet-A (0%)	Diet-B (2%)	Diet-C (4%)	Diet-D (6%)	Diet-E (8%)	P. Value
Hen day egg production	50.150±1.29	49.975±1.82	52.625±1.50	53.250±1.15	50.125±2.54	0.350
Egg weight (g)	60.465±0.48	59.467±0.44	59.236±0.47	59.638±0.34	59.218±0.53	0.345
Shell weight (g)	7.239±0.11	7.234±0.08	7.397±0.17	7.367±0.12	7.228±0.06	0.110
Shell thickness (mm)	0.327±0.005	0.328±0.002	0.329±0.004	0.334±0.008	0.317±0.002	0.75
Albumen weight (g)	37.582±0.61	36.125±0.44	35.87±0.44	36.339±0.33	36.207±0.30	0.075
Albumen height (mm)	8.538±0.12	8.316±0.15	8.498±0.10	8.346±0.15	8.291±0.11	0.15
Haugh unit	91.759±0.75	90.849±0.84	91.873±0.57	91.086±0.76	91.759±0.75	0.220
Yolk weight (g)	15.749±0.11	16.088±0.17	15.935±0.11	15.899±0.179	15.779±0.22	0.350
Yolk diameter (mm)	38.634±0.19	38.599±0.108	38.809±0.11	38.571±0.17	37.931±0.32	0.145
Yolk color	5.533±0.11	5.466±0.08	5.550±0.12	5.550±0.09	5.566±0.15	0.235

Mean egg shell weight (MESW) and mean egg shell thickness (MEST) was not significantly altered in any of the dietary treatments (P. value 0.110). However, Group-D had numerically higher MESW and MEST. The high AW (37.582±0.61) and AH (8.53±0.134) was observed in the control group. HU was only numerically greater in Group-C (91.873±0.57). All these quality parameters (AW, AH and HU) were not significantly influenced by different dietary treatments. Ayorinde *et al*. (1999) reported no significant difference (P > 0.05) in Haugh Unit in laying hen eggs fed on high level of HWM. Numerically yolk weight (YW) was higher (16.088±0.17) in group-B, yolk diameter (YD) in group-C (38.809±0.11) and better yolk color (YC) was recorded in Group-E (5.566±0.15). These parameters were, however, statistically insignificant among different experimental groups. Abiola and Onunkwor (2004) observed that values of YW increases with increase in the level of HWM in the diets and can be related to present findings. In contrast, Mehmud (2010) used 12 % extruded hatchery waste in the layer diet and observed differences in treated and non-treated group in term of egg quality.

The present study demonstrated that egg production and quality remain un-affected even with higher level (8%) of inclusion of extruded HWM. Moreover, hatchery waste provides a good opportunity to formulate cheap laying hen ration. This, however, warrant a detail study to examine the digestibility and amino acid profile of hatchery waste and the influence of various processing techniques to further improve its nutritive value.

Acknowledgment

We acknowledge the staff of Department of Poultry Production, University of Veterinary and Animal Sciences, Lahore Pakistan who provided technical and laboratory facilities for conducting this study.

Funding

No funding was provided /received for this study.

IRB approval and ethical statement

This study was approved by the animal welfare and care committee of the Department of Poultry Production, University of Veterinary and Animal Sciences, Lahore Pakistan, and all the measures and tools was considered to minimize the discomfort of birds during the conduction of this experiment.

Statement of conflict of interest

The authors have declared no conflict of interest.

References

Abiola, S.S. and Onunkwor, E.K., 2004. *Bioresour. Tech*., **95**: 103-106. https://doi.org/10.1016/j.biortech.2004.02.001

Anonymous, 2011. *Economic survey of Pakistan*. Planning Division, Govt. of Pakistan.

Ayorinde, K.L., Joseph, J.K., Adewale, O.E. and Ayandibu, I.J., 1999. *Trop. J. Anim. Sci*., **1**: 147–155.

Christmas, R.B., Damron, B.L. and Quart, M.D., 1996. *Poult. Sci*., **75**: 536-539. https://doi.org/10.3382/ps.0750536

Dhaliwal, A.P., Shingari, S.B. and Sapra, K.L., 1996. Processing of HW for feeding to poultry. In: *Proeed World Poultry Congress*, 2-5 Sept., Vol. 4.

Duncan, D.B., 1955. *Biometrics*, **11**: 1. https://doi.org/10.2307/3001478

Hamm, D. and Whitehead, W.K., 1982. *Poult. Sci*., **61**: 1025-1028. https://doi.org/10.3382/ps.0611025

Haque, A.K.M.A., Lyons, J.J. and Vandepopuliere, J.M., 1991. *Poult. Sci*., **70**: 234–240. https://doi.

org/10.3382/ps.0700234

Harper, J.M., 1981. *Extrusion of food*, Vol. 1 and 2. CRC Press, Boca Ration, FL.

Hazarika, M. and Baruah, K.K., 1993. *Poult. Guide*, **11**: 33-35.

Mehmud, A., 2010. *Nutritional evaluation of processed hatchery waste meal and its utilization in layers diet*. Ph. D thesis. Dept. Animal Nutrition. Univ. Vet. Anim. Sci., Lahore, Pakistan.

NRC, 1994. *Nutrient requirements of poultry*. 9th ed. National Academy Press, Washington, DC.

Rasool, S., Rehan, M., Haq, A. and Alam, M.Z., 1999. *J. Anim. Sci*., **12**: 554-557. https://doi.org/10.5713/ajas.1999.554

Saima, Akhtar, M. and Ahmad, Z., 2003. *J. Anim. Pl. Sci*., **13**: 33-35.

Salami, R.I., 1997. *Nig. J. Anim. Prod*., **24**: 37–42. https://doi.org/10.51791/njap.v24i1.2348

SAS®, 2003. *Statistical analysis system, Version 9.1.3, service pack 4*. SAS Institute Inc., Cary, NC, USA.

Senkoylu, N., Samli, H.E., Akyurek, H., Agma, A. and Yasar, S., 2005. *J. appl. Poult. Res*., **14**: 542–547. https://doi.org/10.1093/japr/14.3.542

Steel, R.G.D., Torrie, J.H. and Dickey, D.A., 1997. *Principles and procedures of statistics. A biochemical approach*, 3rd ed. McGraw Hill Book Co. Inc., New York, USA.

Tadtiyanant, C., Lyons, J.J. and Vandepopuliere, J.M., 1993. *Poult. Sci*., **72**: 1515-1527. https://doi.org/10.3382/ps.0721515

Vandepopuliere, J.M., Kanungo, H.K., Walton, H.V. and Cotterill, O.J., 1977. *Poult. Sci*., **56**: 1140–1144. https://doi.org/10.3382/ps.0561140

Wisman, E.L., 1964. *Poult. Sci*., **43**: 871–876. https://doi.org/10.3382/ps.0430871