Egg Quality Parameters of Laying Hens Fed Dried Tomato Meal in Diet

Jein R. Leke[1], Jet S. Mandey[2], Jacqluien Laihad[1], Cherly Sarajar[1]

[1] Animal Production Department, Animal Husbandry Faculty, Sam Ratulangi University
[2]Animal Nutrition Department, Animal Husbandry Faculty, Sam Ratulangi University
Jl. Kampus Selatan, Manado 95115; * rinileke@yahoo.com , jetsm_fapet@yahoo.co.id

Abstract

In an experiment with one hundred MB 402 laying hens (36 weeks of age), the effect of dried tomato meal in diet on egg quality was determined. The birds were allocated into five experimental diets and each was divided into four replicate groups of five birds per replicate. The control diet (based diet) was formulated to contain 51% corn, 14% rice bran, 7% fish meal, 6% CaCO3, and 22% commercial diet. Tomato meal was included in four experimental diets at levels of 2, 4, 6, 8% to substitute based diet. The treatments were: R0 = 100% based diet (BD) + 0% tomato meal (TM); R1 = 98% BD + 2% TM; R2 = 96% BD + 4% TM; R3 = 94% BD + 6% TM; and R4 = 92% BD + 8% TM. Chemical composition of tomato meal were: 16.73% crude protein, 1.53% fat, 30.94% crude fiber, 0.98% Ca, 1.20% P, and 2416 Kcal/kg ME. Feed and water were provided for *ad libitum*. The study was conducted over a period of 8 weeks. Data were collected on eggs quality: egg weight, egg shell weight, egg shell thickness, egg yolk weight an egg albumin weight. Data were analyzed by one-way analysis of variance (ANOVA). The treatment means were compared using Duncan's multiple range test. The results showed that no differences in hen egg weight, egg shell weight and egg shell thickness between treatments R1, R2, R3, and R4 compared to treatment R0 (control). It can be concluded that tomato meal can be used as an alternative feedstuff in laying hen diets at inclusion levels up to 8% without negative effects on egg quality.

Keywords: Dried tomato meal, egg quality, laying hens

Introduction

The information on the structure of egg are essential for an understanding of egg quality of the poultry. Age, feed, protein levels and temperature are some of the factors that affect egg size in chickens (Banerjee, 1992). Egg quality traits such as weight, size, yolk and albumen contents are quantitative traits with continuous variability (Das, 1994). Selection for egg quality was used mainly to avoid any negative shift in eggshell quality or internal defect. The relationship between weight, length and width of eggs has been reported by Danilov (2000) who also noted the proportion of yolk, albumen and shell that contribute to the egg weight. Thus egg weight is one of the important phenotypic traits which influence egg quality of the chicken parents (Islam, *et al*., 2001).

Egg shell quality is a vital factor in poultry production as large number of eggs with defective shell lead to great economic losses (Lavelin, *et al*., 2000). The external and internal quality of eggs is influenced by a broad range of factors. This is because egg quality criteria includes such diverse and important aspects as safety, nutritional and organoleptic properties or technological properties for cooking. Nutrition is important for controlling eggshell quality and can successfully enrich the egg in some minor components of interest for human nutrition.

As Roland, *et al*. (1996) reported, that calcium deficiency lead to decreased egg production, egg weight, egg specific gravity, feed consumption and bone density and strength. While excess calcium significantly reduced egg production, egg weight, and feed consumption (Harms and Waldroup, 1971). Wistedt (2013) reported that egg shell mainly composed by calcium that indicate calcium will play important role affecting egg shell weight.

*) Diseminarkan dalam International Conference on Food, Agriculture and Culinary Tourism 2015. Samarinda, 4-6 Agustus 2015.

Tomato are excellent sources of potassium, folate, and vitamins A, C, and E, but are superior sources of α-tocopherol and vitamin C. Fiber is another dietary component and appreciable amounts are found in tomato. Tomatoes also contains a variety of phytochemicals, including carotenoids and polyphenols (Campbell, *et al*., 2004). The nutritional value of tomato can provide the poultry industry with an alternative feedstuff.

Squires, *et al.* (1992) reported that tomato pomace could be used in broiler chicken diets up to level of 20 %. That using of dried tomato pomace (only separated tomato seeds) in broiler chicken diets were caused an extended shelf life for broiler meats, because of alpha-, beta-, gamma- and delta-tocopherols in tomato pomace cause an antioxidant effect. Dried tomato pomace was fed to laying hens at an inclusion rate of 12%, which resulted in similar egg production, feed efficiency, egg weight and shell. Dried tomato pomace contains 10% moisture, 20.77% crude protein, 1760 Kcal/kg ME, 39.8% crude fiber, 7.3% ether extract, 4.24% ash, 0.5% calcium and 0.45% phosphorus (Jafari, *et al*., 2006). The limiting factors of dried tomato pomace in poultry diets are low energy and high fiber contents (Squires, *et al*., 1992). The tomato seed protein is rich in lysine (approximately 13% more lysine than soya protein) and can supplement feed that is deficient in lysine (Latlief and Knorr, 1983).

The objective of this research was to evaluate the use of dried tomato meal in diet to egg quality of laying hens.

Materials and Methods

The tomatoes were washed, cut, and sun-dried to constant weight for 3-5 days. Part of tomato then was ground to fine powder using mortar and pestle. After that, mixed with other ingredients to compound the feed.

One hundred MB 402 laying hens (36 weeks of age) were used for the study. The birds were divided into five experimental diets and each was divided into four replicate groups of five birds per replicate using completely randomized design. The control diet (based diet) was formulated to contain 51% corn, 14% rice bran, 7% fish meal, 6% CaCO3, and 22% commercial diet. Tomato meal was included in four experimental diets at levels of 2, 4, 6, 8% to substitute based diet. The treatments were: R0 = 100% based diet (BD) + 0% tomato meal (TM); R1 = 98% BD + 2% TM; R2 = 96% BD + 4% TM; R3 = 94% BD + 6% TM; and R4 = 92% BD + 8% TM. Chemical composition of tomato meal were: 20.73% crude protein, 1.53% fat, 30.94% crude fiber, 0.98% Ca, 1.20% P, and 2416 Kcal/kg ME, and chemical composition of the diets are shown in Table 1.

Feed and water were provided for *ad libitum*. Eggs were collected two times a day. The study was conducted over a period of 8 weeks. Data were collected on egg weight, eggshell weight, eggshell thickness, egg yolk weight and egg albumin weight. Egg weight, egg shell weight, and egg shell thickness were determined for eggs collected during the last 3 days of each period. Egg shell weight and yolk and albumin weight were calculated by formula:

a. Egg shell weight (g/egg) is measured by broken down the eggs, then egg shell separated from albumen and yolk. Egg shell is cleaned from the rest of albumen and then weighed (An, *et al*., 2010).

b. Yolk weight (g/egg) is measured by separate yolk from albumen then weighed (An, *et al*., 2010).

c. Albumen weight (g/egg) is calculated by egg weight minus by egg shell weight and yolk weight (An, *et al*., 2010).

Data collected were subjected to analysis of variance (ANOVA). Where significant variance ratios were detected, differences between treatment means were tested using Duncan's multiple range test procedures (Snedecor and Cochran, 1967).

TABLE 1. CHEMICAL COMPOSITION OF THE DIETS

Nutrients	Diets				
	R0	R1	R2	R3	R4
Crude protein (%)	17.49	17.47	17.45	17.44	17.42
Fat (%)	6.63	6.61	6.59	6.57	6.56
Crude fiber (%)	4.31	5.41	6.50	7.24	8.69
Ca (%)	2.76	2.75	2.69	2.66	2.56
P (%)	1.42	1.16	1.42	1.41	1.40
ME (Kcal/kg)	2766	2759	2752	2745	2738

Results and Discussion

The effects of dietary dried tomato meal on the egg quality of laying hens during the entire trial period are shown in Table 2. Results showed that no differences in hen egg weight, egg shell weight and egg shell thickness, egg yolk weight and egg albumin weight between treatments R1, R2, R3, and R4 compared to treatment R0 (control).

TABLE 2. EFFECT OF DRIED TOMATO MEAL IN DIET ON EGG QUALITY

Variable	Treatments				
	R0	R1	R2	R3	R4
Egg Weight (g/egg))	60.50 ± 0.80^a	60.00 ± 1.07^a	61.48 ± 2.84^a	60.01 ± 1.73^a	60.42 ± 0.47^a
Yolk Weight (g/egg)	14.77 ± 0.66^a	14.69 ± 0.54^a	15.66 ± 0.60^a	15.06 ± 0.45^a	14.89 ± 0.54^a
Albumen Weight (g/egg)	35.94 ± 1.84^a	35.84 ± 1.46^a	34.42 ± 2.48^a	35.29 ± 1.84^a	36.83 ± 1.6^a
Egg Shell Weight (g)	5.98 ± 0.27^a	5.97 ± 0.04^a	6.09 ± 0.19^a	6.06 ± 0.18^a	5.99 ± 0.09^a
Egg Shell Thickness (mm)	0.39 ± 0.01^a	0.37 ± 0.01^a	0.38 ± 0.00^a	0.37 ± 0.00^a	0.36 ± 0.00^a

Notes: Various characters within each class indicate the presence of significant differences at the level of probability ($p<0.05$).

Yannakopoulos, *et al*. (1991) reported that body weight gain, egg number, feed consumption and mortality of laying hens were not significantly affected by 150 g kg^{-1} tomato meal. But, mean egg weight tended to be increased by tomato meal. Egg shell quality and egg shape index were not significantly affected by the diets. So, tomato meal could be used for laying hens for improving egg quality. That egg shell weight and egg shell thickness in this experiment were not affected by the increasing level of dried tomato meal are in agreement with Bordowski and Geisman (1980), Yannakopoulos, *et al*. (1992) and Dotas, *et al*. (1999), and that could be due to the similar calcium and phosphorus contents in all treatments diets. Egg shell mainly composed of calcium carbonate, and some of trace minerals such as magnesium (Leeson and Summer, 2005). Calcium plays important role in affecting egg shell weight. Ahmad (2013) also reported that supplementation of canola oil (omega-3 PUFA sources) and vitamin A (antioxidant sources) to laying hen feed did not give significant effect on egg shell weight and egg shell thickness. Vasupen, *et al*. (2013) and Mansoori *et al*. (2008) reported that feeding laying hens diets containing tomato pomace at inclusion 10% did not affect egg production, egg weight, feed consumption and efficiency of the hens.

Yolk synthesis was complex mechanisms that involve nutrient metabolism and physiological function. Anton (2007) found that lipids contribute to about 65% of dry matter content of egg yolk, which indicated lipid/fat consumption was the most important thing affected yolk weight. Supplementation of 3000 ppm fish oil + 150 ppm tomato powder in feed give best result on yolk

weight and albumen weight of local duck (Andri, *et al*, 2015). It may be due to the presence of tomato powder that provide vitamin C and E which can act as antioxidant to prevent oxidative stress caused by fish oil, which indicated that tomato powder could be potential as antioxidant to support fish oil to increase egg quality.

Leke, *et al*. (2015) in previous study reported that the obtained of whole egg nutrients results indicated that the tomato diet up to 8% have similar quality to based diet, so, that could have beneficial nutritional impact for laying hens. These suggest that the use of tomato meal in laying hen diets might have positive effects on whole egg quality. So, it is a possible alternative for satisfying consumers' preferences about egg quality.

Conclusion

These finding indicated that dried tomato meal could be used as an alternative feedstuff in laying hen diets to substitute based diet, at inclusion levels up to 8% without negative effects on egg quality.

References

Ahmad, S. 2010. *Effect of supplementing dietary sources of n-3 fatty acids and vitamin A on laying performance, egg quality, and immune response in laying hens.* Ph.D Thesis. Department of Poultry Science, University of Agriculture. Pakistan.

An, S.Y., Y.M. Guo, S.D. Ma, J.M. Yuan, and G.Z. Liu. 2010. Effects of different oil sources and vitamin E in breeder diet on egg quality, hatchability and development of the neonatal offspring. Asian-Australasian J. of Anim. Sci., **23**(2): 234-239.

Andri, F., E. Widodo, and O. Sjofjan. 2015. Effect Of Fish Oil Alone Or In Combination With Tomato Powder Supplementation In Feed On Egg Quality Of Local Ducks. Res. J. of Life Sci. April-2015 Vol. **02** No. 01.

Anton, M. 2007. Composition and structure of hen egg yolk. In: **Bioactive Egg Compounds**,1-7. Ed. D. Czeschlik. Springer-Verlag. Berlin Heidelberg.

Banerjee, G. C. 1992. *Poultry*. Mohan Primlani for Oxford and IBH Publ. Co. Pvt. Ltd. New Delhi, India. p. 191.

Bordowski, D. L., and J. R. Geisman. 1980. Protein content and amino acid composition of protein of seeds from tomatoes at various stages of ripeness. J. Food Sci. **45**:228-229.

Campbell, J. K., K. Canene-Adams, B. L. Lindshield, T. W. M. Boileau, S. K. Clinton, and J. W. Erdman, Jr. 2004. Tomato phytochemicals and prostate cancer risk. International Research Conference on Food, Nutrition, and Cancer. Held in Washington, DC, July 15-16, 2004.

Danilov, R. V. 2000. Effect of hens' age on quality of hatching eggs and embryonic development. *Proce. 21st World's Poult. Congress.* Montreal, Canada.

Das, S. K. 1994. *Poultry Production*. CBS Pub. and Distributor, New Delhi, India. p. 232.

Dotas, D., S. Zamandis, and J. Balios. 1999. Effect of dried tomato pulp on the performance and egg traits of laying hens. *Br. Poult. Sci*. **40**: 695-697.

Harms, R.H. and P. W. Waldroup. 1971. The effect of high dietary calcium on the performance of laying hens. *Poult. Sci*., **50**: 967-969

Islam, M. A., S. M. Bulbul, G. Seeland, and A. B. Islam. 2001. Egg quality of different chicken genotypes in summer and winter. *Pakistan. J. Biol. Sci*. **4:** 1411-1414.

Jafari, M., R. R. Pirmohammadi, and V. Bampidis. 2006. The use of dried tomato pulp in diets of laying hens. *Int. J. Poult. Sci*., **5**: 618-622.

Lavelin, I., N. Meir. and M. Pines. 2000. New insight in eggshellformation. Poultry Science, **79**:1014-1017.

Latlief, S. J., D. Knorr. 1983. Tomato seed protein concentrates: effects of methods of recovery upon yield and compositional characteristics. *J. Food Sci*. **48**:1583-1586.

Leke, J. R., J. S. Mandey, F. J. Nangoy. 2015. Nutrients and cholesterol of eggs affected by dried tomato meal in laying hens diet. *IJASEIT* Vol.**5** (2015) No. 3.

Leeson, S. and J. D. Summers. 2005. *Commercial Poultry Nutrition*, 3rd Edition. Nottingham University Press, England.

Mansoori, B., M. Modirsanei, and M. M. Kiaei. 2008. Influence of dried tomato pomace as an alternative to wheat bran in maize or wheat based diets, on the performance of laying hens and traits of produced eggs. Iranian Journal of Veterinary Research, Vol. **9** (4) : 341-346.

Roland, D.A., M. M. Bryant, and H. W. Rabon, 1996. Influence of calcium and environmental temperature on performance of first–cycle (phase 1) commercial leghorn. *Poult. Sci*., **75**: 62-68.

Snedecor G.W and W.G. Cochran. 1967. *Statistical Methods*. 6th Ed. Iowa State Univ. Press, Ames, IA.

Squires, W., E. C. Naber, and V. D. Toelle. 1992. The effect of heat, water, acid and alkali treatment of tomato canner wastes on growfh, metabolizable energy value and nitrogen utilization of broiler chicks. Poult. Sci. **71**(3): 522-529.

Vasupen, K., S. Wongsuthavas, S. Bureenok, B. Saenmahayak, K. Ampaporn, and C. Yuangklang. 2013. Effect of Tomato Pomace and Fibrolytic Enzyme on Egg Production and Egg Quality. World Academy of Sci., Engineering and Tech. Vol. **7** 2013-01-28.

Wistedt, A. 2013. *Shell formation and bone strength in laying hens: effect of age, daidzein, and exogenous estrogen*. Doctoral Thesis. Faculty of Veterinary Medicine and Animal Science. Swedish University of Agricultural Sciences, Uppsala.

Yannakopoulos, A. L., A.S. Tserveni-Gousi, and E.V. Christaki. 1991. Effect of locally produced tomato meal on the performance and the egg quality of laying hens. Anim. Feed Sci. and Tech., Volume **36**, Issues 1-2, p. 53–57. DOI: http://dx.doi.org/10.1016/0377-8401(92)90085-K