ORIGINAL ARTICLE

PERFORMANCE AND EGG QUALITY OF BABCOCK LAYER CHICKEN FED COCONUT OIL AND SOYA LECITHIN OIL IN THE RATION

Clarita T. Dagaas*, Herald Nygel F. Bautista and Edwin S. Luis

ABSTRACT

A study was conducted to determine the performance and the quality of eggs laid by layers fed coconut oil and soya lecithin oil supplemented diets for 16 weeks. Ninety 40-week old individually-caged layers were randomly assigned to three dietary treatments following a completely randomized design replicated 30 times. The dietary treatments were: basal diet with 2% coconut oil (T1), basal diet with 1% coconut oil and 1% soya lecithin oil (T2) and basal diet with 2% soya lecithin oil on equivalent weight basis (T3). Results showed that T2 layers were significantly (P<0.05) better feed converter to eggs, had significantly lowest feed consumption and highest weight loss among the three treatments. Likewise, layers fed diets containing 1% coconut oil plus 1% soya lecithin oil (T2) had the highest IOFC and, therefore, is the most economical. No significant differences were found on other production and egg quality parameters measured. It is more profitable using soya lecithin oil in combination with coconut oil in the production of table eggs. The study suggests that soya lecithin oil can be a good replacement for coconut oil, especially when the latter's price increases in the local market.

Keywords: coconut oil, income over feed cost, layer, soya lecithin oil

INTRODUCTION

Small profit margins and higher production costs are leading poultry farmers to look for alternatives to make their business more viable. The stakeholders in the poultry industry, especially those engaged in egg production, are studying continuously on how to improve the management, nutrition, breed and health and medication programs to fully supply the demand for eggs. In the Philippines, the annual volume of egg production in 2012 was 421.06 thousand metric tons (BAS, 2012). Chicken eggs, as one of the most affordable foods, are also a good source of proteins, nutrients and vitamins. They are also a main raw material in baking products (Lambio and Luis, 2010). Therefore, factors that may affect the performance of the layers and egg quality should be addressed to maximize the potential profit of a business.

The nutrient requirement for commercial egg-type layer should be met to produce good quality eggs. Laying rations that will support good levels of production can be well

Animal and Dairy Sciences Cluster, College of Agriculture, University of the Philippines Los Baños, College, Laguna, Philippines (email: clarita.dagaas@gmail.com; herald.bautista@gmail.com).

formulated from farm grains, meat scraps and soybean meal. The use of high energy laying rations with added fat increases feed efficiency and helps maintain egg production at high levels. Fat is an oleaginous material which is solid at room temperature, while its liquid form is called oil (Seiden, 1957).

In the Philippines, coconut oil is the local additive used in feed rations because it is abundant and less expensive. The main components of coconut oil are tri-acylglycerols, fatty acids, phospholipids, tocopherols, trace metals, sterols, volatiles, mono- and di-acylglycerol (Rahman, 2000). Coconut oil has high content of short and moderately long chain fatty acids. It solidifies at ambient temperatures in temperate countries. On the other hand, soya lecithin oil obtained from soybeans is a phosphorus-containing lipid found in all living plant and animal cells (Sartoretto as cited by Villaroman, 1980). It consists of glycerol combined with fatty acid radicals namely, phosphoric acid and choline, which is important in the synthesis of the phospholipids in cell membranes. It is also necessary for methyl metabolism, cholinergic neurotransmission, transmembrane signaling and lipid-cholesterol transport and metabolism. Without choline, cell membranes would harden, prohibiting important nutrients from entering and leaving the cell (United Soybean Board, 2001).

The study aimed to determine the effects of soya lecithin on the production performance and egg quality of the layers and to evaluate the economics of using soya lecithin oil in the production of table eggs.

MATERIALS AND METHODS

A total of ninety 40-weeks-old Babcock layers were used in the study. The layers, housed in individual layer cage, were randomly assigned to three dietary treatments following a Completely Randomized Design with thirty replications. The dietary treatments were as follows:

Treatment	**Description**
Diet 1 (T1)	Basal diet with 2% coconut oil (CO) supplementation
Diet 2 (T2)	Basal diet with 1% coconut oil and 1% soya lecithin oil (SLO) supplementation
Diet 3 (T3)	Basal diet supplemented with 2% SLO as replacement for 2% CO on equivalent weight basis

The layers were fed basal diet for a period of one week. Thereafter, the layers were fed their respective diets (basal layer diet with CO and SLO) for four months or 16 weeks. Table 1 shows the percent composition and calculated analysis of basal layer diet to meet the energy requirement of the layers.

An average of 110 g of the diet per layer were provided every morning at around 7:00 AM. Daily cleaning of the watering trough and provision of clean potable water were done at all times. Artificial light (20-watt fluorescent bulb) was installed to provide the layers with required length of light exposure for efficient egg production. Eggs were collected twice daily every 10:00 AM and 3:00 PM. The egg weight was taken by weighing all the eggs laid by the layers per diet treatment on the last three days of every second week from the start of the feeding period.

The individual body weight of 40 week-old layers was taken and recorded at the start and end of the feeding trials. Analysis of covariance was done to remove the

Table 1. Composition (%) and calculated analysis of basal layer diet.

Ingredients	%
Corn, Yellow (local)	42.982
Soya, Us Hi Pro	26.442
Rice Bran D1	16.000
Limestone, fine	6.081
Limestone, grit	4.000
Coco oil, crude	2.000
Biofos	1.740
Salt	0.300
Poultry, Vit. Premix	0.125
Dl-methionine	0.118
Poultry, Min. Premix	0.100
Choline Chloride, 50%	0.050
Anti-mold	0.050
Anti-oxidant	0.013
Total	100.000
Calculated nutrient content	
Crude protein, %	17.500
Crude fat, %	5.705
Crude fiber, %	2.981
Calcium, %	3.895
Phosphorus, %	0.500
ME Poultry, kcal/kg	2,750
Lysine, total %	0.997
Met+Cys, total %	0.730
Threonine, total %	0.682
Tryptophan, total %	0.222
Linoleic acid %	1.414

variability in the initial weight. The difference between the weights was computed. The weekly feed consumption was obtained by subtracting the weight of the feed offered from the feed remaining in the feeders per week. The quality of the egg was determined on egg weight basis. Six eggs per treatment were randomly selected. The composition of the egg components were expressed as % yolk, % albumen, and % shell with membrane. These were computed by getting the weight of the yolk, albumen and shell with membrane divided by weight of egg. Yolk color was described by using the standard yolk color fan (Roche Yolk Color Fan). An eggshell caliper was used for eggshell thickness (mm).

Data were analyzed statistically using analysis of variance, for body weight (analysis of covariance) in completely randomized design. Comparison of treatment means were done using Least Significance Difference Test.

RESULTS AND DISCUSSION

Body weight

The average initial and final weights, difference in weight and percent livability of 40-week old layers for 16 weeks feeding period are presented in Table 2. All the layers in different diet treatments showed decrease in their final body weight. The decrease was highest in layers fed diets with 1% CO and 1% SLO. North and Bell (1990) reported that during the laying period, weekly weight increase are materially lesser during egg production. On an individual bird basis, the curve is vastly different from that for flock averages. A large share of the increase in weight of the bird near sexual maturity occurs prior to, and within a week after, the first egg is laid. For the next 10 weeks of egg production, the individual bird shows little or no gain in weight. In fact, many birds will lose weight.

Table 2. Average initial and final body weights and livability of layers fed diets supplemented with coconut oil (CO) and soya lecithin oil (SLO).

Parameter	Diets			
	2% CO	1% CO:1% SLO	2% SLO	CV
Body weight (g)				
Initial weight	1468.33	1465.00	1413.33	5.81
Final weight	1438.67	1378.00	1391.67	9.45
Difference	-2.96^{a}	-8.70^{b}	-2.16^{a}	-229.47
Livability %	96.67	93.33	100	18.67

Means within rows with different superscripts are different from each other ($P<0.05$).

Livability

There were no significant differences in the livability of layers among treatments (Table 2). However, layer fed with diet with 1% CO and 1% SLO had the lowest livability because of prolapse. The mortality rate shown, however, is still acceptable as per FAO (2003) standard which is about 12 % at 20 and 70 weeks of age.

Feed consumption

There were significant differences observed on the overall average feed consumed by the layers (Table 3). Layers fed 1% CO + 1% SLO had the lowest average feed consumed (107.45 g). The combination of coconut oil and soya lecithin oil made the energy of the feed higher. This was in agreement with Roxas (2006) who reported that feed intake is largely governed by energy level of the diet, such that birds eat less as the energy level of the diet increases, and vice versa. Results are also supported by the findings of North *et al*. (1990) who showed that feed intake can be affected by the density and energy content of the diet. The average feed consumption by layers in all diets is within the recommendation of Lambio *et al*. (2010). An egg-type layer will be able to consume between 90 to 110 g of feeds per day.

Hen-day egg production

There were no significant differences observed on average bi-weekly hen-day (%) of layers fed with different sources of oil-supplemented diets among the treatments (Table 3). The results are in consonance with those observed by Virtucio (1997), who reported that there were no significant differences regardless of the source as well as the levels of oil that was added to the feeds. The layers exhibited a declining egg production rate. Layers fed with 1% CO + 1% SLO showed an erratic egg production rate and lowest at 55th to 56th weeks of age. Egg production decreases after 30-32 weeks of age; this is termed as post-peak egg production (North and Bell, 1990). It will decrease at 50th week of age with 82.5% on its hen-day egg production and continually decreases to approximately 50% at around 60-70 weeks of age (Meunier and Latour, 2008).

Table 3. Average overall daily feed consumption, bi-weekly hen-day egg production and feed conversion efficiency of layers fed diets supplemented with coconut oil (CO) and soya lecithin oil (SLO).

Parameter	Diets			
	2% CO	1% CO:1% SLO	2% SLO	CV
Feed intake (g)	109.81^{a}	107.45^{b}	109.80^{a}	1.39
Hen-day (%)	88.18	87.74	88.75	14.50
FCR	2.06^{a}	1.77^{b}	1.97^{ab}	12.18

Means within rows with different superscripts are different from each other ($P<0.05$).

Feed conversion efficiency

The average bi-weekly feed conversion efficiency of layers fed different sources of oil in the diet is shown in Table 3. There were significant differences observed on the 55th to 56th week of age and on the overall average feed efficiency of layers. The results are in agreement with the findings of North and Bell (1990) that most of the effect of oil is due to the increase of readily absorbable fatty acids and according to Round (2013) fatty acid like linoleic acid has a positive effect on egg weight, which is higher in energy feeds. This typically contains more oil or fat which facilitates the provision of higher levels of linoleic acid.

Layers fed with 2% CO had the lowest feed conversion efficiency during 47th to 48th week of age compared to the other two treatments. Since soya lecithin oil has the highest linoleic acid content (1.6 to 9.2%), there is a possibility that it has some synergistic effect when combined with coconut oil. This made the 1% CO + 1% SLO diet obtained the best feed conversion efficiency.

Egg quality parameters

Egg weight

There were no significant differences in the overall average egg weight of layers fed different sources of oil supplemented diets (Table 4). Layers fed 1% CO plus 1% SLO had the heaviest egg on the average; they also had the best performance in terms of feed conversion efficiency. North *et al*. (1990) reported that egg size gradually increases as hens become older, until maximum size is reached near the end of her first laying cycle when the size of egg can be affected by age.

T1 and T3 layers (2% CO and 2% SLO, respectively) had overall average size eggs of a jumbo which is 62 grams and above. Bigger egg size is due to good feed conversion efficiency as shown in Table 5.

Percent yolk

There were no significant differences on the yolk percentage among the diet treatments (Table 4). However, layers fed 2% CO had the highest average overall percent yolk (26.31%) while layers fed 2%SLO had the lowest percentage yolk (25.83%). The observed result is not far from the report of Silversides and Budgell (2004) showing that yolk content from Babcock line contains 26.8% yolk.

Percent albumen

Similarly, no significant differences were observed in the overall percent albumen among the three treatments (Table 4). Layers fed 1% CO + 1% SLO had the highest average overall albumen percentage (61.73%) while layers fed 2% CO had the lowest albumen percentage (61.07%). There was a decreasing trend of albumen observed on layers fed 2% CO up to 53rd to 54tth week of age indicating that as the albumen percentage increases, the yolk weight percentage decreases. This result is in consonance with the findings of Ahn *et al*. (1997).

Table 4. Average bi-weekly egg weight (g), percent yolk, percent albumen, percent shell with membrane and yolk color scores of eggs laid by layers fed diets supplemented with coconut oil (CO) and soya lecithin oil (SLO).

Parameter	Diets			
	2% CO	1% CO:1% SLO	2% SLO	CV
Egg weight (g)	62.99	64.19	63.31	1.77
Yolk (%)	26.31	25.85	25.83	2.07
Albumen (%)	61.07	61.73	61.62	1.11
Shell + membrane (%)	12.60	12.42	12.65	4.38
Yolk color score	0.388	0.387	0.385	2.40

Means within a row with different superscripts are significantly different from each other ($P<0.05$).

Percent shell with membrane

There were no significant differences observed in the percent shell with membrane among the three treatments (Table 4). Layers fed 2% CO and 2%SLO had the highest percent shell with membrane at 45th to 46th weeks of age. Layers fed 1% CO + 1% SLO had the lowest percent shell with membrane on the average. Egg shell formation is not influenced by the different kinds of oil used in the diets (Virtucio, 1992).

Egg shell thickness

No significant differences on the shell thickness among the treatments were observed (Table 4). The results are in agreement with the findings of Virtucio (1992) who showed that kinds and levels of oil used in the diet showed no significant interactions on the overall shell thickness. Nevertheless, all the treatments showed a declining egg shell thickness as the hens aged. The same findings were obtained by Dagaas *et al*. (2010) who stated that as the layers get older, shell becomes thinner even with supplementation of additional calcium on the diet. The layers exhibited a declining shell thickness as the hens aged. This was in agreement with the findings of North *et al*. (1990) that egg shell becomes thinner as eggs get progressively larger, the shell material should be spread over a larger area.

Yolk color

There were no significant differences on the yolk color score among the treatments (Table 4). On the average, the overall yolk color score obtained among the treatments was 6.9-7.0 which is color yellow in the Roche Yolk Color Fan and is acceptable for human consumption. The layers exhibited a declining yolk color score. These findings assumed that as the hens aged, the absorption of yellow pigments xanthophylls decreased.

Economic analysis

Table 5 shows income over feed cost (IOFC) analysis of layers fed different sources oil supplemented diets. The selling price of egg was based on Animal and Dairy Sciences Cluster Meat Store as of February 2013. Layers fed 1% CO + 1% SLO had the highest IOFC since they produced heavy eggs with lower production cost. The income from the eggs was also high in the entire feeding period.

To sustain the energy requirement of the layers, feeding with 1% coconut oil plus 1% soya lecithin oil had the best performance in terms of feed conversion efficiency and overall feed consumption. Combination of coconut oil and soya lecithin oil in layer diets depicts a synergistic effect. When the price of coconut oil increases, 50% substitution of soya lecithin oil on the total percent oil in layer diet can be a practical and economical practice, which can give high income over feed cost and low cost to produce an egg.

Table 5. Income over feed cost analysis of layers fed diets supplemented with coconut oil (CO) and soya lecithin oil (SLO) (16 weeks feeding period).

Parameter	2% CO	1% CO:1% SLO	2% SLO
Average feed consumed/day (g)	109.81	107.45	109.8
Average feed cost/day (PhP)	2.33	2.28	2.36
Feed cost/kg (PhP)	21.22	21.22	21.53
Income/sales (PhP)	11245.5	11844	11317.75
No. of eggs	2646	2632	2663
Price/egg (PhP)	4.25	4.5	4.25
Average total feed cost (PhP)	7829.37	7661.10	7943.02
Cost to produce an egg (PhP)	2.96	2.91	2.98
Income per egg (above feed cost) (PhP)	1.29	1.59	1.27
IOFC (PhP)	3416.13	4182.90	3374.73

IOFC: income over feed cost.

ACKNOWLEDGMENT

The authors wish to express their utmost gratitude to VetNext Agri Products, Inc. for funding this study.

REFERENCES

Ahn DU, Kim SM and Shu H. 1997. Effect of egg size and strain an age of hens on solids content of chicken eggs. *Iowa Agriculture and Home Economics Experiment Station*, Ames, Project Number 2794.

Azman MA and Ciftci M. 2004. Effects of replacing dietary fat with lecithin on broiler chicken zootechnical performance. *Revue Med Vet* 155: 445-448.

Connor J and Kent T P. 2007. Citing Websites. *Optimum egg quality- A practical approach*. Accessed 21 July 2013. http://www.thepoultrysite.com/publications/1/egg-quality-handbook/5/internal-and-external-egg-quality

Dagaas CT, Patriarca SMQ, Luis ES, De Castro NL and Lalican NM. 2010. Egg quality and production performance of old layers (51-56 weeks) fed diets with varying levels of calcium supplements. *Philipp J Vet Anim Sci* 36: (2): 147-156.

Department of Agriculture Bureau of Agricultural Statistics, 2012. *Updates on Agricultural Trade Performance January-March 2012*. Vol. 2 No. 4. Accessed 4 December 2012. http://www.bas.gov.ph/situationer/Trade1/TradePerJan-Mar2012.pdf.

Department of Agriculture, Bureau of Agricultural Statistics, 2012. *Performance of Philippine Agriculture January- September 2012.* Accessed 3 December 2012. http://www.bas.gov.ph/?ids=agriperformance.

Food and Agricultural Organization of the United Nations (FAO). 2003. *Egg Marketing: A guide for the production and sale of eggs.* Agricultural Services Bulletin: 150. Rome.

Jacob JP, Miles RD and Mather FB. March 2011. *Egg quality.* Animal Science Department, Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida, Gainesville, 32611.

Lambio AL. 2010. *Poultry Production in the Tropics*. Diliman Quezon City: The University of the Philippines Press.

Mendoza MV. 1998. Crude coconut oil and palm oil in broiler diets. *Undergraduate Thesis*. University of the Philippines Los Baños, College, Laguna.

Meunier R A and Latour M A. 2008. *Commercial egg production and processing.* Department of Curriculum and Instruction and Department of Animal Sciences. Purdue University. 1151 Smith Hall, West Lafayette.

Namratha Oil Refineries. 2008. *Properties of Coconut Oil*. Accessed 4 December 2012. http://www.namratha.in/properties-of-coconut-oil.html.

North MO and Bell DD. 1990. *Commercial Chicken Production Manual.* 4th ed. London: Chapman and Hall.

Rahman HIH. 2000. *The Chemistry of Coconut Oil*. Accessed 4 December 2012. http://fos.ubd.edu.bn/sites/default/files/2000-Paper2.pdf.

Rossell JB, King B and Downes MJ. 1985. Composition of Oil palm kernel and coconut oil. *J Am Oil Chem Soc* 62(2): 221-230

Round J. Citing Websites. *Feeding to control egg size to meet market demands. ABN Poultry Nutrition.* Accessed 20 July 2013. http://www.abn.co.uk/uploads/files/egg%20size.pdf

Seiden R and Che DS. 1957. *The Handbook of Feedstuffs Production: Production Formulation Medication*. New York: Springer Publishing Company, Inc.

Silversides FG and Budgell K. 2004. The relationship among measures of egg albumen height, pH, and whipping volume 1. *Poult Sci* 83: 1619-23.

Szuhaj BF. 2005. *Lecithins*. Bailey™s Industrial Oil and Fat Products, 6th Edition, Six Volume Set. John Wiley and Sons, Inc.

Villaroman ER and Josefino E. 1980. The effect of feeding lecithin on broilers: A preliminary study. *Undergraduate Thesis*. College of Veterinary Medicine, University of the Philippines, Quezon City.

Virtucio AR. 1997. Comparative effects of coconut oil and fish oil on the performance of layers. *Undergraduate Thesis*. College of Agriculture, University of the Philippines Los Baños.