ISSN 1682-8356
ansinet.org/ijps

INTERNATIONAL JOURNAL OF POULTRY SCIENCE

ANSInet
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan
Mob: +92 300 3008585, Fax: +92 41 8815544
E-mail: editorijps@gmail.com

International Journal of Poultry Science 11 (1): 65-72, 2012
ISSN 1682-8356

Effects of Replacing Peanut Seed Cake with Brewery Dried Yeast on Laying Performance, Egg Quality and Carcass Characteristics of Rhode Island Red Chicken

Meseret Girma[1], Berhan Tamir[2] and Tadelle Dessie[3]
[1]Department of Animal Sciences, Wollo University, P.O. Box 1145, Dessie, Ethiopia
[2]Faculty of Veterinary Medicine, Addis Ababa University, Ethiopia
[3]International Livestock Research Institute (ILRI), Addis Ababa, Ethiopia

Abstract: One hundred and eighty 26-week old Rhode Island Red chicken were used to determine the performance, fertility, hatchability and economic of chicken fed with ration containing Peanut Seed Cake (PSC) and Brewery Dried Yeast (BDY). The treatments were T_1 (20% PSC + 0% BDY), T_2 (15% PSC + 5% BDY), T_3 (10% PSC + 10% BDY), T_4 (5% PSC + 15% BDY), T_5 (0% PSC + 20% BDY) and T_6 as control (commercial layer's ration) and the experiment lasted for 12 weeks. The experiment was arranged in a Completely Randomized Design (CRD) with six treatments, each replicated two times with 15 birds per replicate. Hens were individually weighed at the start and end of the experiment. Data on Dry Matter Intake (DMI), Hen Day Egg Production (HDEP), egg weight and were recorded daily. Egg quality parameters were determined at an interval of 3 days on 6 eggs per replicate. The chemical analysis showed that BDY contained 41.2% CP and 2982.04 kcal ME/kg DM and PSC 42.2% CP and 2842.5 kcal ME/kg DM, indicating their potential to be used as sources of both protein and energy in poultry feeding. DMI of birds on T_3 and T_4 were similar with that of birds on control diet, but diet T_5 resulted in significantly increased DMI than control diet. Diets T_1 and T_2 resulted in a significantly ($p<0.05$) decreased DMI than control diet. Final body weight and body weight gain of birds was significantly lower ($p<0.05$) for T_1 and T_2 than that of birds on T_4. Birds on T_3 had higher HDEP compared to birds on control ration. Diet containing T_4 resulted in a significant increase ($p<0.05$) in egg weight than that of birds on T_2 and control diet but the diet containing T_1 resulted in a significantly decreased ($p<0.05$) egg weight than control diet and other treatment groups. Birds on T_4, T_5, T_3 and T_2 showed better results in fertility than control and T_1. Similarly birds in T_2, T_3, T_4 and T_5 were better in hatchability than the birds in control and T_1. Eggs of birds on T_3, T_4 and T_5 showed higher yolk color value than birds on control diet. Birds of treatment T_3 had lower feed cost per dozen of egg than control, indicating the importance of this form of combination for feeding layers as least cost ration than that of the birds on control. The results also showed that initial body weight, feed efficiency, albumen height in terms of Haugh unit, shell thickness and egg sale to feed cost ratio did not vary ($p>0.05$) among dietary treatments. Brewery dried yeast could be included in Rhode Island Red chicken feed in order to increase fertility and hatchability of fertile eggs, yolk color and it also increase egg mass. Based on the results of this study, T_3 (10% BDY + 10% PSC) or 50% replacement of BDY by PSC appeared to be a diet of good feeding value, more economical or reasonably cheaper ration which can be used as protein supplement in formulation of layers ration without adverse effects on egg laying performance of pullets between 26-38 weeks of age.

Key words: Peanut seed cake, brewery dried yeast, fertility, hatchability, egg quality, Rhode Island Red

INTRODUCTION

The nutritional status of many people in developing countries of the world is very poor. It is also these countries that population is increasing rapidly (FAO, 2004). The contribution of intensive commercial poultry industry to the supply of poultry meat and egg in Ethiopia has been very small (Alemu, 1995). To meet the demand for animal protein source, the productivity of poultry needs to be improved (FAO, 2004).

The profit from poultry production can be attained by minimizing feed cost which accounts more than half of the total cost of production. According to Wilson and Beyer (2000) feed cost accounts 60-70% of the total animal production cost. Any attempt to improve commercial poultry production and increase its efficiency therefore, needs to focus on better utilization of available feed resources. Knowledge of nutritional characteristics of these feeds and its optimal levels of inclusion in

Corresponding Author: Meseret Girma, Department of Animal Sciences, Wollo University, P.O. Box 1145, Dessie, Ethiopia

rations and optimum combination of ingredients composed locally available materials are very useful (Kamalzadeh *et al*., 2008). Nevertheless, there is comparatively little information on the actual uses of agro-industrial by products in Ethiopia and few researches have been done on Peanut Seed Cake (PSC) and Brewery Dried Yeast (BDY) up to now. In tropical countries like Ethiopia where cereal grains are staple diet of human, the use of agro-industrial by-products as an alternate source of protein, partially or/and fully enables cheaper egg and meat production which in turn decrease consumption of cereal grains by animal.

The existence of a number of cooking oil processing plants and brewery plants creates great opportunity for utilizing these agro-industrial by-products in poultry as protein sources. Even though there is no statistical data on the amount of these industrial by-products, undoubtedly an appreciable quantity is produced each year. In the residues from the production of 1000 liters of beer 35 to 45 kg, dry matter of BDY is contained (Parra and Escobar, 1985). In addition, Ethiopia produces large quantities of groundnut, which is estimated to be 29,000 metric tons (Solomon, 1992). Hence peanut seed cake is not balanced in amino acids pattern desirable for poultry. It is deficient in lysine, methionine and tryptophan (Singh *et al*., 1981). Its keeping quality is poor as it may develop aflatoxins during storage (Mishra, 1993). In comparison of PSC the amino acid pattern of brewery dried yeast approximates more to dietary requirement of poultry. Brewery dried yeast is also superior to peanut seed cake. It contains critical amino acids in sufficient quantity for poultry (McDonald *et al*., 2002). Therefore, the objective of this study is to determine optimum feeding and replacement value of BDY for PSC for optimum performance of Rhode Island Red (RIR) chicken.

MATERIALS AND METHODS

Ingredients and experimental rations: The study was conducted in Haramaya University poultry Farm, Ethiopia located at 42° 3` E longitude, 9° 26`N latitude and at an altitude of 1980 meter above sea level. The mean annual rainfall of the area is 780 mm and the average minimum and maximum temperatures are 8 and 24°C, respectively (Samuel, 2008). The ingredients used for ration formulation in this study were maize, peanut seed cake, brewery dried yeast, wheat bran, full fat soybean, limestone, salt, vitamin premix and dicalcium phosphate. Before grinding soybean grain was heat treated at temperature of 160°C for eight minutes against anti-nutritional factors naturally present in raw soybean. Except brewery dried yeast, wheat bran, limestone, vitamin premix, dicalcium phosphate the rest ingredients were ground at Haramaya University feed mill before mixing.

Samples of maize, peanut seed cake, brewery dried yeast, wheat bran and soybeans were taken for chemical analysis (Table 1). Samples were analyzed for Dry Matter (DM), Crude Protein (CP), Ether Extract (EE), Crude Fiber (CF) and ash following the proximate method of analysis (AOAC, 1995). The experiment comprised six different rations was used. The different rations contained PSC and BDY combinations at the inclusion level (20%, 0%), (15%, 5%), (10%, 10%), (5%, 15%), (0%, 20%) of total diet and (0%, 0%) or control diet (commercial layers ration) representing T_1, T_2, T_3, T_4, T_5 and T_6 respectively. The diet formulated to be isocaloric and isonitrogenous 2800 kcal ME/kg DM and 16% CP as predetermined in the commercial ration (control) (Leeson and Summers, 2001). The different rations contained peanut seed cake and brewery dried yeast combinations at the rate of 100: 0%, 75: 25%, 50: 50%, 25: 75%, 0: 100% and control, representing T_1, T_2, T_3, T_4, T_5 and T_6, respectively, whereby 100% peanut seed cake was equivalent to 20% inclusion level in the ration.

Management of experimental birds: The birds were kept in deep litter pens covered with sawdust litter material. Before the commencement of the actual experiment, the experimental pens, watering and feeding troughs and laying nests were thoroughly cleaned, disinfected and sprayed against external parasites. The hens were vaccinated against Newcastle disease, gumburo disease and fowl typhoid. The wet litter was changed with dry, disinfected and clean

Table 1: Chemical composition of feed ingredients

	Ingredients				
Chemical components	BDY	PSC	Soyabean	Maize	Wheat bran
DM (%)	92.60	94.00	95.79	91.66	90.50
CP (% DM)	41.20	42.20	38.10	8.20	14.61
EE (% DM)	3.56	9.03	19.53	5.14	4.20
Ash (% DM)	8.20	9.02	4.93	1.79	8.20
CF (% DM)	8.51	12.02	6.67	3.61	12.40
Ca (% DM)	0.16	0.17	0.28	0.04	0.12
P (% DM)	1.51	0.86	0.61	0.25	1.21
ME (kcal/kg DM)	2982.04	2842.50	4040.95	3602.11	2402.00

BDY = Brewery Dried Yeast; PSC = Peanut Seed Cake; DM = Dry Matter; CP = Crude Protein; EE = Ether Extract; CF = Crude Fiber; Ca = Calcium; P = Phosphorus; ME = Metabolizable Energy

Table 2: Percentage composition of experimental diets

	Treatments					
Ingredients	T_1	T_2	T_3	T_4	T_5	T_6
Corn	53.0	52.0	51.5	51.0	50.0	Commercial
Wheat bran	12.0	13.0	13.5	14.0	15.0	layer's
Peanut cake	20.0	15.0	10.0	5.0	-	ration
Brewery dried yeast	-	5.0	10.0	15.0	20.0	
Limestone	7.0	7.0	7.0	7.0	7.0	
Soybean	6.0	6.0	6.0	6.0	6.0	
Salt	0.5	0.5	0.5	0.5	0.5	
Vitamin premix	0.7	0.7	0.7	0.7	0.7	
Dicalcium phosphate	0.8	0.8	0.8	0.8	0.8	
Total	100.0	100.0	100.0	100.0	100.0	

T1 = diet containing 20% PSC and 0% BDY; T2 = diet containing 15%PSC and 5% BDY; T3 = diet containing 10% PSC and 10% BDY; T4 = diet containing 5% PSC and 15% BDY; T5 = diet containing 0% PSC and 20% BDY; T6 = 0% PSC and 0% BDY; *Vitamin premix 50 kg contains, Vit A = 2000000iu, Vit D_3 = 400000 iu, Vit E = 10000 mg, Vit K_3 = 300 mg, Vit B_1 = 150 mg, Vit B_2 = 1000 mg, Vit B_3 = 2000 mg, Vit B_6 = 500 mg, Vit B_{12} = 4 mg, Vitpp = 60000 mg, Folic acid = 160 mg, Choline chloride = 30000 mg, Anti-oxidant = 500 gm, Manganese = 10000 mg, Zinc = 14000 mg, Iron = 9000 mg, Copper = 1000 mg, Sodium = 200 mg, Selenium = 80 mg, Calcium = 28.2%

sawdust whenever necessary. Vitamins and anti-coccidiosis were given through drinking water according to the manufacturer's recommendation as preventive medications. One hundred eighty RIR 26 week-old birds with body weight of 1554.67±1.01 g (mean±SD) were divided into six dietary treatments in a Completely Randomized Design (CRD) experiment. The birds were randomly divided into 6 groups of 30 birds each. Each group of chicks was further randomly divided into two replicates of 15 birds (13 hens and 2 cocks in each pen). The birds were adapted to experimental diets for 7 days before the commencement of data collection.

Data collection and measurements: Feed was offered to the birds *ad libitum* twice per day at 0800 and 1700 hours and clean tap water was available all the time. The amount of feed offered and refused per pen was recorded daily. The amount of feed consumed was determined as the difference between the feed offered and refused on DM basis. Feed offered and refused were sampled daily per pen and pooled per treatment for the entire experimental period for chemical analysis. The samples were analyzed for DM, CP, EE, CF, ash, calcium and total phosphorous following the proximate method of analysis (AOAC, 1995). Birds were individually weighed at the start and end of the experiment and body weight change was calculated as the difference between the final and initial body weight. Eggs laid by hens in a pen were collected three times a day at 0800, 1300 and 1700 hrs and daily egg production was calculated as the sum of the three collections. Eggs collected daily were weighed immediately after collection for each pen and average egg weight was computed by dividing the total egg mass to the number of eggs. Hen-day egg production as percentage was determined following the method of Hunton (1995) as:

$$\%\text{ Hen-day egg production} = \frac{\text{Number of eggs collected per day}}{\text{Number of hens present on that day}} \times 100$$

Feed efficiency was determined per replicate by calculating the weight of feed consumed to produce a dozen of eggs. The eggs for incubation were collected and stored for 5 days at temperature of 14°C. Medium size egg was selected by visual inspection were setted for incubation. Fertility was determined by candling the incubated eggs on the 9th, 14th and 18th day of incubation. Average percentage fertility for each treatment was computed by taking the average values of the replicates which was arrived at by dividing the total number of eggs found fertile at candling by total number of eggs set and multiplying by 100. Finally the average percentage of fertility of the 9th, 14th and 18th day of incubation was taken (Bonnier and Kasper, 1990). Average percentage hatchability of the fertile eggs for each treatment was computed by dividing the number chicks hatched by the number of fertile eggs set and multiplying the value by 100. Birds were closely observed for any abnormalities and mortality during the entire experimental period.

Egg quality characteristics, such as egg shell thickness and egg yolk color were determined at an interval of 3 days on freshly laid 6 eggs per replicate after breaking and separating each of the components. Egg shell, were measured using sensitive balance. Albumen height was measured with a tripod micrometer. Egg shell thickness was measured by eggshell thickness micrometer gauge. Measurements were taken from three regions (large end, small end and on the equator region of the eggshell) and the average value was considered. Yolk color was determined by comparing the color of properly mixed yolk sample placed on white paper with the color strips of Roche fan measurement, which consist 1-15 strips ranging from pale to orange yellow color. Haugh unit was calculated from the egg weight and albumen height using the formula suggested by Haugh (1937), HU = 100 log (H + 7.57 - 1.7 W $^{0.37}$), where, HU = Haugh Unit, H = albumen height, W = Egg weight (g).

At the end of the experiment, six randomly selected birds from each replicate (12 per treatment group) were starved for 16 hrs and weighed immediately before slaughter, slaughtered and properly dressed to find out the dressing, eviscerated percentage and carcass characteristics. To estimate the economic benefits of the replacement of brewery dried yeast for peanut seed cake in RIR layer ration the partial budget was analyzed taking into consideration the feed cost per dozen of eggs and egg sale to feed cost for dozen of eggs. For this study, the egg sale price of Haramaya University (6 Birr/dozen of eggs) was used to calculate egg sales to feed cost ratio.

Statistical analysis: Except yolk color, which was analyzed by logistic regression, all other parameters were statistically analyzed using the general linear model procedure of SAS (SAS, 2002). Differences between treatment means were separated using Least Significance Difference (LSD) method (SAS, 2002).

RESULTS AND DISCUSSION

Chemical composition of experimental rations: The results of the laboratory analysis and estimation of nutritive values of the different experimental feed ingredients and six formulated experimental rations are shown in Table 1 and 3. The energy contents of brewery dried yeast and peanut seed cake were 2982.04 and 2842.50 kcal/kg DM, respectively. The protein contents of brewery dried yeast and peanut seed cake were relatively high, which could make them to be good protein supplement feed ingredients for poultry as a whole.

The crude protein and Metabolizable energy contents of treatments were comparable throughout inclusion levels (Table 3). The CP and ME levels were within the ranges of the recommended levels 14-19% and 2700-2900 kcal/kg, respectively for layers (Leeson and Summers, 2001).

Dry matter intake: The effect of including varying levels of peanut seed cake and brewery dried yeast in layers ration on dry matter intake is presented in Table 4. The dry matter intake of birds on T_3 (10% PSC + 10% BDY) and T_4 (5% PSC + 15% BDY) were similar with that of the birds on the control diet (T_6), but diet T_5 (0% PSC + 20% BDY) resulted in significantly ($p<0.05$) increased dry matter intake than the control diet and the other treatments. The diets T_1 (20% PSC + 0% BDY) and T_2 (15% PSC + 5% BDY) resulted in a significantly ($p<0.05$) decreased dry matter intake than the control diet and other treatments.

The high DM intake at higher levels of brewery dried yeast might be due to the compositional quality of brewery dried yeast in which it could supply all the critical amino acids in sufficient quantity (Leeson and Summers, 2001). The low DM intake at lower levels of brewery dried yeast or at higher levels of peanut seed cake could be related to the amino acid pattern of the diet, where peanut seed cake contains lower than the brewery dried yeast in lysine and methionine plus cystine (McDonald *et al.*, 2002). The work of Hill (1969) showed that methionine and lysine are required for optimum feed intake. Wu *et al.* (2001) reported that protein has a significant effect on feed consumption, where diets deficient in protein could decrease feed consumption.

Body weight change: There was no significant ($p>0.05$) difference in initial body weight of pullets (Table 4). The final body weight of pullets on the diet containing 15% brewery dried yeast was significantly ($p<0.05$) higher than that of the birds on T_1 (20% PSC + 0% BDY) and T_2 (15% PSC + 5% BDY), which might be associated with meeting of amino acids that is required for higher growth rate of chicks. The body weight gain of birds was significantly ($p<0.05$) lower for T_1 (20% PSC + 0% BDY) and T_2 (15% PSC +5% BDY) than that of the birds assigned to T_4 (5% PSC + 15% BDY). The reduced body

Table 3: Chemical composition of treatment diets containing different proportions of peanut seed cake and brewery dried yeast

Chemical components	Treatments T1 (20:0)	T2 (15:5)	T3 (10:10)	T4 (5:15)	T5 (0:20)	T6 (0:0)
DM (%)	91.70	91.98	91.02	91.00	91.51	91.95
EE (% DM)	3.31	3.22	3.05	3.50	2.40	4.30
Ash (% DM)	9.01	10.02	10.94	11.06	12.02	8.98
CF (% DM)	9.22	8.90	8.23	8.18	7.81	10.60
NFE (% DM)	56.08	54.27	55.00	54.08	53.02	55.12
P (% DM)	0.55	0.54	0.54	0.56	0.55	0.70
Ca (% DM)	3.30	3.40	3.00	3.30	3.09	2.81
CP (% DM)	16.53	17.02	16.75	17.08	17.33	17.17
ME kcal/kg	2870.95	2867.52	2898.38	2881.11	2898.33	2875.90

T1 = diet containing 20% PSC and 0% BDY; T2 = diet containing 15%PSC and 5% BDY; T3 = diet containing 10% PSC and 10% BDY; T4 = diet containing 5% PSC and 15% BDY; T5 = diet containing 0% PSC and 20% BDY; T6 = 0% PSC and 0% BDY; DM = Dry Matter; EE = Ether Extract; CF = Crude Fiber; NFE = Nitrogen Free extract; P = Phosphorus; Ca= Calcium; CP = Crude Protein; ME= Metabolizable Energy

Table 4: Feed intake and performance of Rhode Island Red chicken fed with rations containing different proportions of peanut seed cake and brewery dried yeast

	Treatments						
Parameters	T_1 (20:0)	T_2 (15:5)	T_3 (10:10)	T_4 (5:15)	T_5 (0:20)	T_6 (0:0)	SEM
DMI (g/hen/day)	131.70^d	132.10^c	133.70^b	133.80^b	135.90^a	133.10^b	0.410
Initial BW (g)	1558.50	1557.00	1554.50	1550.00	1552.00	1556.00	1.010
Final BW (g)	1570.50^b	1572.50^b	1576.00^{ab}	1578.50^a	1577.50^{ab}	1574.50^{ab}	1.000
BW gain (g/head)	12.00^b	15.00^b	21.00^{ab}	28.00^a	25.00^{ab}	18.00^{ab}	1.830
HDEP (%)	85.30^a	85.90^a	87.90^a	84.80^{ab}	84.90^{ab}	81.80^b	0.710
Egg weight (g)	54.80^c	55.00^b	56.10^{ab}	57.00^a	56.20^{ab}	55.40^b	0.270
Feed efficiency	2.01	2.02	1.98	2.09	2.10	2.14	0.020

^{a,b}Means within a row with different superscripts differ (p<0.05); DM = Dry Matter; BW = Body Weight; FC = Feed Conversion Ratio; HDEP = Hen Day Egg Production; SEM = Standard Error of the Mean; T1 = diet containing 20% PSC and 0% BDY; T2 = diet containing 15%PSC and 5% BDY; T3 = diet containing 10% PSC and 10% BDY; T4 = diet containing 5% PSC and 15% BDY; T5 = diet containing 0% PSC and 20% BDY; T6 = 0% PSC and 0% BDY

weight gain at T_1 and T_2 might be probably due to the deficiencies or lower levels of amino acids in peanut seed cake and associated low feed intake at lower level of brewery dried yeast inclusion. Wu *et al.* (2001) stated that essential amino acids affect feed consumption and growth in chicken.

Egg production: The effect of including varying levels of peanut seed cake and brewery dried yeast in layers ration on hen-day egg production is presented in Table 4 shows egg production performance of RIR chicken during the feeding period. The mean percentage of hen-day egg production of birds was significantly (p<0.05) lower for birds fed on commercial layers, ration (control) than that of birds on T_1, T_2 and T_3. Partial replacement of peanut seed cake by brewery dried yeast (T_3) resulted in a slightly higher egg production than higher and lower levels of inclusion, which might be associated with a good balance of amino acids by combining the two feed ingredients (Singh and Zombade, 1986).

Egg weight: The effect of including varying levels of peanut seed cake and brewery dried yeast in the layers ration on egg weight is presented in Table 4. The egg weight of birds on the diet T_2 (15% PSC + 5% BDY) was similar with that of the birds on the control diet, but diets containing 15% brewery dried yeast (T_4) resulted in a significantly (p<0.05) higher egg weight than that of the birds on T_1, T_2 and the control diet. The diet T_1 (20% PSC + 0% BDY) resulted in a significantly (p<0.05) decreased egg weight than the control diet and other treatments. The reasons for the improved egg weight might be associated with improvement in methionine content with reduced peanut seed cake (Naulia and Singh, 2002).

Feed efficiency: The effect of including varying levels of peanut seed cake and brewery dried yeast in layers ration on feed efficiency expressed feed consumed per dozen of egg presented in Table 4. The feed conversion ratio did not differ significantly (p>0.05) between treatments.

Fertility and hatchability of fertile eggs: The effect of including varying levels of peanut seed cake and brewery dried yeast in the layers ration on fertility is presented in Table 5. Fertility of chicken was significantly (p<0.05) higher BDY replaced PSC with the highest obtained at 75% replacement level. Fertility of birds on the diet containing T_1 (20% PSC + 0% BDY) was similar with that of the birds on the control diet, but diets containing T_2 (15% PSC + 5% BDY), T_3 (10% PSC + 10% BDY), T_4 (5% PSC + 15% BDY) and T_5 (0% PSC + 20% BDY) resulted in a significantly (p<0.05) higher fertility than that of the control diet (T_6). The reasons for increased fertility might be associated with unidentified growth factors in brewery by-products (Fombad and Mafeni, 2001).

The results of the mean percentage hatchability of fertile eggs from each of six treatment rations are presented in Table 5. Hatchability of chicken was significantly (p<0.05) improved when BDY included in the diet with highest obtained at maximum level of replacement. Hatchability of birds on the diet containing T_1 (20% PSC + 0% BDY) was similar with that of the birds on the control diet, but the diets containing T_2 (15% PSC + 5% BDY), T_3 (10% PSC + 10% BDY), T_4 (5% PSC + 15% BDY) and T_5 (0% PSC + 20% BDY) resulted in significantly (p<0.05) higher in hatchability than that of the control diet.

The reason for the hatchability differences might be due to the richness of brewery dried yeast in vitamin B that plays an important role in improving the hatchability of eggs in chicken (Gohl, 1981). It could be also due to the fact that addition of yeast cultures to poultry diets might enhance better utilization of minerals like calcium, phosphorous, potassium and manganese which play a role in enhancing the hatchability of eggs (Wilson, 1997).

Yolk color: The effect of including varying levels of peanut seed cake and brewery dried yeast in layer ration on yolk color according to Roche fan color measurement from each of the six treatment rations is presented in Table 5. Yolk color of birds on the diet containing

Table 5: Fertility, hatchability and egg quality parameters of Rhode Island Red chicken fed diets containing different proportion of peanut seed cake and brewery dried yeast

	Treatments						
Parameters	T_1 (20:0)	T_2 (15:5)	T_3 (10:10)	T_4 (5:15)	T_5 (0:20)	T_6 (0:0)	SEM
Fertility (%)	79.40^b	86.30^a	86.70^a	88.70^a	88.10^a	79.10^b	1.130
Hatchability (%)	59.90^b	66.30^a	68.40^a	66.60^a	68.80^a	59.50^b	1.240
Yolk color (RSP*)	4.20^b	4.40^b	5.30^a	5.30^a	5.30^a	4.20^b	0.180
Haugh unit (μm)	98.70	98.70	97.40	96.40	97.00	97.90	0.420
Shell thickness	0.31	0.30	0.30	0.32	0.30	0.29	0.010

^{a,b}Means within a row with different superscripts differ ($p<0.05$); SEM = Standard Error of the Mean; *RSP = Roche Scale Points; T1 = diet containing 20% PSC and 0% BDY; T2 = diet containing 15%PSC and 5% BDY; T3 = diet containing 10% PSC and 10% BDY; T4 = diet containing 5% PSC and 15% BDY; T5 = diet containing 0% PSC and 20% BDY; T6 = 0% PSC and 0% BDY

Table 6: Carcass yield parameters as affected by feeding brewery dried yeast and peanut seed cake

	Treatments						
Parameters	T_1 (20:0)	T_2 (15:5)	T_3 (10:10)	T_4 (5:15)	T_5 (0:20)	T_6 (0:0)	SEM
Slaughter weight (g)	1570.50	1572.50	1576.00	1578.50	1577.50	1574.50	1.000
Dressing percentage (%)	89.00	88.90	89.40	89.40	89.50	89.30	0.840
Eviscerated percentage (%)	62.40	62.00	63.00	63.30	63.40	63.10	0.820
Breast (%)	17.30	17.10	16.50	16.10	16.00	16.70	1.570
GIT (%)	4.90^a	4.80^a	4.70^a	4.30^b	4.30^b	4.30^b	0.470
Liver (%)	2.70^a	2.70^a	2.50^a	2.50^a	2.10^b	2.40^a	0.200
Reproductive tract (%)	3.72	3.17	3.70	3.68	3.66	3.67	1.000

^{a,b}Means within a row with different superscripts differ ($p<0.05$); SEM = Standard Error of the Mean; GIT = Gastro Intestinal Tract; T1 = diet containing 20% PSC and 0% BDY; T2 = diet containing 15%PSC and 5% BDY; T3 = diet containing 10% PSC and 10% BDY; T4 = diet containing 5% PSC and 15% BDY; T5 = diet containing 0% PSC and 20% BDY; T6 = 0% PSC and 0% BDY

T_1 (20% PSC + 0% BDY) and T_2 (15% PSC + 5% BDY) were similar with that of birds on the control diet, but diets containing T_3 (10% PSC + 10% BDY), T_4 (5% PSC + 15% BDY) and T_5 (0% PSC + 20% BDY) resulted in a significantly ($p<0.05$) higher in yolk color than that of the birds on commercial diet.

The reason for the increased Roche fan measurement for T_3, T_4 and T_5 might be associated with vitamin E content of BDY (Ranjhan, 2004). Vitamin E is anti-oxidant to dietary fat that enhances yolk color by increasing the utilization of oxycarotenoids (Hamilton and Parkhust, 1990). Further, according to Leeson and Summers (2001) the mode of action of yeast in enhancing animal performance is not well understood. The Roche color fan number of 7 to 8 is accepted for eggs in most areas (Leeson and Summers, 2001). But the result of this study was lower than this level.

Haugh unit: The Haugh unit of RIR laying chicken fed with diets containing varying levels of peanut seed cake and brewery dried yeast is presented in Table 5. The Haugh unit measured did not significantly ($p>0.05$) vary up to 20% inclusion of brewery dried yeast compared to that of the birds on control diet. The findings of this study was in agreement with the reports of Adnan (1988) who reported no significant ($p>0.05$) difference in internal quality of eggs expressed in Haugh unit by feeding brewery dried grain up to 25% inclusion level. Fombad and Mafeni (2001) reported also no significant ($p>0.05$) difference in Haugh unit by feeding BDG up to 30 % of the diet. Naulia and Singh (2002) reported that inclusion of groundnut cake up to 30% inclusion levels in layers ration had no effect on Haugh unit.

Eggshell thickness: The mean eggshell thickness resulting from feeding the six treatment rations is shown in Table 5. The results showed that there was no significant ($p>0.05$) difference between dietary treatments in egg shell thickness. These results agreed with the results reported by Adnan (1988) and Lopez *et al.* (1981) who reported that egg shell thickness was not significantly affected by the inclusion of brewery dried grain in layers' ration up to 25 and 30% inclusion levels, respectively. Naulia and Singh (2002) reported that inclusion of groundnut cake up to 30% of layers ration had no effect on shell thickness. Lopez *et al.* (1981) reported that inclusion of 45% BDG in layers ration decreased egg shell quality. The results of this study implied that feeding layers with diets containing different proportions of PSC and BDY would not affect the egg shell quality of chicken.

Carcass yield parameter: The effect of including varying levels of BDY and PSC in RIR layers slaughter weight (g), dressing percentage %, eviscerated percentage %, breast % and reproductive tract % is presented in (Table 6). There were no significant differences ($p>0.05$) in slaughter weight, dressing percentage %, eviscerated percentage %, breast % and reproductive tract % between the diets. The diet containing T_4 and T_5 resulted

Table 7: Economic consideration of Rhode Island Red chicken fed diets containing different proportion of peanut seed cake and brewery dried yeast

	Treatments						
Parameters	T_1 (20:0)	T_2 (15:5)	T_3 (10:10)	T_4 (5:15)	T_5 (0:20)	T_6 (0:0)	SEM
Feed cost/kg (Birr)	172.55	172.75	173.30	173.85	174.05	176.99	-
Feed cost per dozen of eggs (Birr)	3.46[ab]	3.49[ab]	3.43[b]	3.63[ab]	3.65[ab]	3.78[a]	0.040
Egg sale/feed cost	1.73	1.72	1.75	1.66	1.64	1.59	0.020

[a,b]Means within a row with different superscripts differ ($p<0.05$); SEM = Standard Error of the Mean; *RSP = Roche Scale Points; T1 = diet containing 20% PSC and 0% BDY; T2 = diet containing 15%PSC and 5% BDY; T3 = diet containing 10% PSC and 10% BDY; T4 = diet containing 5% PSC and 15% BDY; T5 = diet containing 0% PSC and 20% BDY; T6 = 0% PSC and 0% BDY

in the highest body weight but not significantly different from others. The least body weight was obtained on diets containing T_1 (100% replacement of BDY by PSC). The gastrointestinal tract % and liver % resulting from feeding the six treatment rations is presented in (Table 6). GIT % of birds on the diet containing T_4 (15% BDY + 5% PSC) and T_5 (20% BDY + 0% PSC) was similar with that of the birds on the control diet. The GIT % birds were significantly ($p<0.05$) higher at T_1 (0% BDY + 20% PSC), T_2 (5% BDY + 15% PSC) and T_3 (10% BDY + 10% PSC) than control diet. The reason for the higher result of GIT % diets containing in T_1, T_2 and T_3 might be the CF content of the diet. In this regard Deaton *et al.* (1979) noted that GIT weight was significantly increased with more dietary fiber. The liver % of birds was significantly ($p<0.05$) lower at T_5 (20% BDY + 0% PSC) than birds assigned on T_1 (0% BDY + 20% PSC), T_2 (5% BDY + 15% PSC), T_3 (10% BDY + 10% PSC), T_4 (15% BDY + 5% PSC) and control diet. In this experiment as the substitution of PSC by BDY increased it resulted in lower liver weight. Moreover, the result of this study suggested that a high level of brewery dried yeast might help in preventing the fatty liver syndrome. The reason for the reduction in liver weight by high level of BDY might be due to an intrinsic nutritional property of fermentation residues, which maintain normal liver lipid metabolism in chicken (Jensen *et al.*, 1974).

Partial budget analysis: As shown in Table 7, the results of the economic consideration as a mean of feed cost/dozen of eggs produced were 3.46, 3.49, 3.43, 3.63, 3.65 and 3.78 Birr for the treatments 1 to 6 respectively. There was statistically significant ($p<0.05$) difference in mean feed cost per dozen of eggs produced and treatment 6 (control) was a costly diet than Treatment 3, a ration with 10% peanut seed cake and 10% brewery dried yeast.

Diet on T_3 was slightly the least cost ration than control diet to produce eggs. The better utilization of nutrients at 50% replacement level might have resulted in reduced feed required to produce dozen of eggs, which might be due to optimum combination of peanut seed cake and brewery dried yeast for improved amino acid balance required for protein synthesis for egg production.

The economic comparison expressed as egg sale to feed cost ratio for Treatment 1, 2, 3, 4, 5 and 6 were 1.73, 1.72, 1.75, 1.66, 1.64 and 1.59 Birr, respectively. Statistically there was no significant difference ($p>0.05$) between the different dietary treatments, but treatment 3, a ration supplemented with 10% peanut seed cake and 10% brewery dried yeast was higher than the rest of the diets in egg sale to feed cost ratio, hence it could be considered as the least cost ration.

Conclusion: Feed efficiency, dressing percentage, eviscerated percentage, breast percentage and reproductive tract percentage of RIR was not negatively impacted by 100 % replacing of PSC by BDY. Brewery dried yeast could be also included in Rhode Island Red chicken feed in order to increase yolk color. Birds of treatment T_3 (10% PSC + 10% BDY) had lower feed cost per dozen of egg than T_6, indicating least cost ration than control diet. Brewery dried yeast could be included in Rhode Island Red chicken feed in order to increase fertility and hatchability of fertile eggs and it also increase egg weight. The economic evaluation showed treatment three T_3 (10% PSC + 10% BDY) with highest ratio could be considered as the least cost ration indicating the highest return from sale of eggs than the control and slightly other treatments. On the other hand, the laying performance of hens fed T_3 (10% PSC + 10% BDY) was higher than control diet, suggesting that brewery dried yeast could replace 50% of peanut seed cake (partial replacement) in layers, ration.

REFERENCES

Adnan Beker, 1988. Evaluation of the Nutritive and Supplementary Value of Brewers Dried Grain in Layers Poultry Ration. M.Sc. Thesis Alemaya University, Ethiopia, pp: 70.

Alemu Yami, 1995. Poultry production in Ethiopia. World Poult. Sci J., 51: 197-201.

AOAC, 1995. Association of Official Analytical Chemists. Official Methods of Analysis (13th Edn). Washington DC.

Bonnier, P. and H. Kasper, 1990. Hatching Eggs by Hens or in an Incubator. Agrodok No. 34. Agromisa, Wageningen, pp: 39.

Deaton, J.W., J.L. Menaughton and D. Burdek, 1979. High fiber sunflower meal as replacement for soyabean meal in layer Diets. Br. Poult. Sci., 20: 159-162.

FAO, 2004 (Food and Agriculture Organization). Small Scale Poultry Production. Animal Production and Health. Village Poultry Consultant. Waimana, New Zealand, pp: 1-5.

Fombad, R. and J. Mafeni, 2001. The evaluation of brewers dried grain (BDG) in poultry ration 1. Breeder chicken rations. Tropicultura, 19: 61-64.

Gohl, B., 1981. Tropical Feeds: Feeds Information Summary and Nutritive Value. FAO, Rome, Italy, pp: 529.

Hamilton, P.B. and C.R. Parkhust, 1990. Improved deposition of oxycarotenoids in egg yolks by dietary cotton seed oil. Poult. Sci., 69: 354-359.

Haugh, R.R., 1937. The Haugh unit for measuring egg quality. U.S. Egg Poultry Magazine, 43: 552-553 and 572-573. In: Hasin, B.M., A.J.M. Ferdaus, M.A. Islam, M.J. Uddin and M.S. Islam, 2006. Marigold and orange skin as egg yolk color promoting agents. Int. J. Poult. Sci., 5: 979-987.

Hill, F.W., 1969. Poultry nutrition and nutrient requirements. Trop. Anim. Pro., 6: 249-256.

Hunton, P., 1995. Egg Production, Processing and Marketing. In: World Poultry Science, Elsevier, Tokyo, pp: 457-480.

Jensen, J.S., L. Falen and C.H. Chang, 1974. Effects of distillers dried grains with soluble on reproduction and liver fat accumulation in laying hens. Poult. Sci., 53: 586-592.

Kamalzadeh, A., M. Rajabbeygi and A. Kiasat, 2008. Livestock production systems and trends in livestock industry in Iran. J. Agric. Soc. Sci., 4: 183-188.

Leeson, S. and J.D. Summers, 2001. The Nutrition of Chicken. 4th Edn., University Books, Canada, pp: 591.

Lopez, J.D., J.F. Carmona and J.L.M. Pascual, 1981. Evaluation of brewers dried grains in the diets of laying hens. Anim. Feed Sci. Technol., 6: 169-178.

McDonald, P., R.A. Edward, J.F.D. Greehalgn and C.A. Morgan, 2002. Animal Nutrition. 6th Edn., Ashford Color Press, Gasport, pp: 567.

Mishra, A.S., 1993. Feed Aflatoxins and Dietary Treatments to Reduce their Effects in Chicken. Ph.D Thesis, Govind Ballabh Pant University of Agriculture and Technology, Pantnagar, India, pp: 269.

Naulia, U. and K.S. Singh, 2002. Replacement of dietary groundnut cake by soyabean-meal supplemented with di-methionine on performance of layer chickens. In. J. Anim. Sci., 75: 1173-1176.

Parra, R. and A. Escobar, 1985. Use of Fibrous Agriculture Residues in Ruminant Feeding in Latin America. FAO Animal Production and Health Paper. No.50. Rome, Italy, pp: 111.

Ranjhan, S.K., 2004. Animal Nutrition in the Tropics. 5th Edn., Printed in Hindustan. Delhi, pp: 574.

Samuel Sahle, 2008. The Epidemiology and management options of chocolate spot disease (*Botrytis fabae* sard) on faba bean (*Vicia faba* L.) in Northern Ethiopia. Ph.D Dissertation, Haramaya University, Ethiopia, pp: 175.

SAS, 2002. SAS User's Guide. Statistics. SAS Institute, Inc., Cary, NC. USA.

Singh, J. and S.S. Zombade, 1986. Protein quality of groundnut cake as influenced by combining with other vegetable protein sources. In. J. Poult. Sci., 21: 42-48.

Singh, K.S., C.M. Prasad and R.T.D. Brahmakshatriya, 1981. Feeding value of sunflower and groundnut cakes for laying hens. Anim. Feed Sci. Technol., 6: 63-71.

Solomon Moges, 1992. The Effect of Processing Methods of Oil Seed Cakes in Ethiopia on their Nutritive Value: *In Vitro* N-Degradability and N-Metabolism in Growing Sheep Fed a Basal Diet of Maize Stover. Ph.D Thesis, University of Bonn, Germany, pp: 152.

Wilson, H.R., 1997. Effect of maternal nutrition on hatchability. Poult. Sci., 76: 134-143.

Wilson, K.J. and R.S. Beyer, 2000. Poultry Nutrition Information for the Small Flock. Kansas State University Agricultural Experiment Station and Cooperative Extension Service. http://www.oznet.ksu.edu.

Wu, G., Z. Liu, M.M. Bryant and D.A. Roland, 2001. Performance Comparison and Nutritional Requirements of Five Commercial Layer Strains in Phase IV. Department of Poultry Science, Auburn University. http://www.ridley feeding ingridients.com.