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Full Length Research Paper

Laying chickens' response to various levels of palm kernel cake in diets

Zanu H. K.[1]*, Abangiba J., Arthur-Badoo W., Akparibo A. D. and Sam R.

Department of Animal Science Education, University of Education, Winneba, P.O.Box 40, Mampong-Ashanti, Ghana.

Abstract

The response of 120 Lohmann Brown laying hens which were fed on graded levels of palm kernel cake (PKC) meal was studied. Four dietary treatments incorporating 0, 5, 10 and 15% of PKC meals were used and the birds were randomly assigned in equal members in a completely randomized design. The diets were isocaloric and iso-nitrogenenous and were fed *ad libitum*. Water was also provided free choice. The study revealed that inclusion of PKC at 15% reduced (P>0.05) daily body weight gain (DBG) by about 400% when compared with control while, lower inclusion levels of PKC (5 and 10%) reduced (P<0.05) DBG by about 8.6 and 13.6% respectively. Feeding PKC at 15% adversely affected egg production though feed intake was not significantly affected. Additionally, PKC had no significant effect on hematological parameters assessed except mean corpuscular hemoglobin concentration (MCHC). The results indicated that inclusion of PKC can reduce the cost of feed. It was also revealed that PKC, if included up to 15% of the diet of laying hens could reduce egg production.

Key words: Palm kernel cake, laying hens', production performance, hematology.

INTRODUCTION

It has been estimated that feed is the major cost associated with commercial poultry production. Hence, inclusion of non conventional feed resource becomes of primordial importance in livestock production to maintain the productivity but at a lower cost. Kwari et al. (2004) stressed the need to utilize alternative feed ingredients in order to reduce feed cost and the cost of poultry products. According to Boateng et al. (2008), palm kernel cake (PKC) is an agro-industrial by-product that is produced locally and within the West African sub-region in sizeable quantities and if when used as livestock feed can help curb the problem of environmental pollution that accompanies its disposal. Results of analyses of palm kernel cake (Abonyi and Uchendu, 2005) showed that this by-product contain 90.89, 22.84, 4.02, 12.85, 58.06 and 2.23% of dry matter, crude protein, crude fibre, ether extract, Nitrogen-Free Extract (NFE) and ash respectively. However, this depends on the efficiency of oil extraction from the kernel (Onwudike, 1986). Sundu et al. (2005) have reported that the cake is moderately rich in metabolizable energy which varies between 1479 and 2260 Kcal/kg. This experiment was therefore undertaken to investigate the response of various levels of PKC in laying hens.

*Corresponding author. **E-mail**: holy_zanu@yahoo.com

MATERIALS AND METHODS

The PKC used in this study was obtained as a by-product of palm kernel oil extraction from local processors in Asante Mampong township. One hundred and twenty Lohmann Brown laying hens (40 weeks old) which were reared under the same nutrition and management regime were allotted in equal numbers to four dietary treatments incorporating 0, 5, 10, and 15 kg PKC meal respectively (Table 1). Each treatment was replicated thrice with 15 birds per treatment. The treatments were designated as PKC_0 (Control), PKC_5, PKC_{10}, and PCK_{15}. The average weight of the fowls was assessed to be 1.5 kg. Feed and water were supplied *ad libitum.* Data was collected for eight weeks on egg production, egg weight, yolk colour score, egg shell thickness, and Haugh unit score. Hen-day production was calculated daily and averaged for each week while egg weight, yolk color score, egg shell thickness, and Haugh unit score were determined every 14 days. Egg yolk score was determined by visual comparison of the fresh yolk with the different colours of the Roche colour fan; egg shell thickness was measured with the aid of the Ames thickness measure at the equatorial plane of the egg after removal of the shell membranes. All hematological parameters were assessed at the end of the experiment. Blood samples (2 ml each) were drawn from the ventral lateral wing vein

Table 1. Percentage composition of experimental diets.

Ingredients	Level of dietary PKC meal			
	PKC_0	**PKC_5**	**PKC_{10}**	**PKC_{15}**
Maize	53	53	53	53
Russian fish meal (64% CP)	3	3	3	3
Tuna Fish Meal (52% CP)	7	7	7	7
Soyabean meal	8	4	0	0
Palm kernel cake	0	5	10	15
Wheat bran	20	20	18	13
Oyster shell	7.5	7.5	7.5	7.5
Vit/mineral premix	0.5	0.5	0.5	0.5
Salt	0.5	0.5	0.5	0.5
Dicalcium phosphate	0.5	0.5	0.5	0.5
Proximate analysis (% DM):				
Dry matter	89.1	88.5	88.2	87.6
Crude protein	17.7	17.5	17.9	17.6
Crude fibre	4.18	4.0	4.6	4.8
Ether extract	3.8	4.0	4.2	4.9
Ash	3.1	2.9	2.9	2.8
Nitrogen free extract	60.2	60.1	58.6	57.5
Calculated composition (%):				
Calcium	3.4	3.2	3.3	3.3
Available phosphorus	0.7	0.6	0.6	0.6
Lysine	2.5	2.6	2.7	2.7
Methionine	0.3	0.3	0.3	0.3
ME (K cal/kg)	2,609	2,619	2,659	2,699

*Composition of vitamin/mineral premix per kg: Vitamin E, 25 mg; Vitamin A, 6250 IU; Vitamin D3, 1250 IU; Vitamin K3, 25 mg; Vitamin B1, 25 mg; Vitamin B2, 60 mg; Vitamin B6, 40 mg; Vitamin B12, 2 mg; Elemental calcium, 25 mg; Elemental phosphorus, 9 mg; Elemental magnesium, 300 mg; Iron, 400 mg; Selenium 1.0 mg, Iodine 20 mg, Copper 60 mg, Magnesium 100 mg, cobalt 10 mg, Zink, 150 mg; Sodium Chloride, 1.5 mg; Choline Chloride, 500 mg; Live Lactobaccillus spore, 0.2 million cfu; Niacin, 40 mg; Folic Acid, 10 mg; d-Biotin, 5 mcg.

of two birds randomly selected from each replicate into EDTA-containing vacutainer tubes and immediately analyzed for haematology. Other measurements were food consumption, body weight gain and efficiency of food utilization. In addition, weights of certain digestive and metabolic organs were determined at the termination of the experiment (Table 3). The effects of treatments on the parameters measured were statistically analyzed. Differences between means were determined by the use of the Duncan's Multiple Range Test (Steel et al., 1997). The computations were performed using the general linear models procedures of the Statistical Analysis System Institute Inc (SAS).

RESULTS AND DISCUSSION

A perusal of Table 2 reveals that except for weight gain, hen-day egg production, hen-housed egg production and yolk colour score, dietary treatments did not significantly (P>0.5) affect the other variables. The data indicated that higher inclusion of PKC at 15% significantly (P<0.05) reduced body weight gain (BG) by about 400% when compared with control while, lower inclusion levels of PKC (5 and 10%) reduced (P>0.05) BG by about 8.6 and 13.6% respectively. Reduction of body weight (BW) with increasing PKC to 15% inclusion levels in diets may be attributed to the lower nutrient digestibility with PKC inclusion. Explanation supported by Sundu and Dingle (2003) had earlier reported that during processing, PKC may also undergo Maillard reaction (the reaction of mannose with amino groups leading to the formation of a brown complex) due to heat applied in the process before and during oil extraction and this adversely affect the digestibility. Also the data is in agreement with similar work by Ojewola and Ozuo (2006) who reported that birds fed on diets containing 15 and 20% of PKC instead of soybean meal depressed the body weight.

Longe (1984) found that laying hens fed 20% PKC diets produced fewer eggs than those fed a control corn-soybean meal diet. The present work indicated that

Table 2. Effect of PKC meal on growth, feed intake and egg production.

Variable	Level of dietary PKC meal (%)				
	0	**5**	**10**	**15**	**SEM**
Mean Initial body weight (kg/bird)	1.5	1.5	1.5	1.5	0.0
Mean final body weight (kg/bird)	1.8^{a}	1.7^{a}	1.7^{a}	1.5^{b}	0.9*
Mean body weight gain (kg/bird)	0.3^{a}	0.2	0.2	0.1^{b}	0.1*
Mean feed consumption (g/bird/day)	136.3	133.7	136.7	131.3	3.7
Hen-day egg production (%)	77.0^{a}	79.7^{b}	81.0^{c}	64.3^{d}	3.2*
Hen-house egg production (%)	77.0^{a}	79.7^{b}	81.0^{c}	65.0^{d}	3.2*
Mean egg weight (g)	64.7	62.5	68.5	63.3	2.2
Yolk color score	2.0^{a}	3.7^{a}	4.7^{b}	6.0^{c}	0.5*
Egg shell thickness (mm)	0.4	0.4	0.4	0.4	0.0
Haugh unit score	91.0	92.0	94.3	94.0	1.9
Egg mass/day	26.7	26.7	29.7	22.1	-
Mortality (%)	0	0	0	6.7	-

SEM = Standard error of mean, *Significant difference at $p<0.05$, (a,b,c,d) treatment means with different superscripts within the same row are significantly different at $p<0.05$

Table 3. Effect of PKC meal on organ weights (g/kg live weight) in laying chickens.

Variable	Level of dietary PKC meal (%)				
	0	**5**	**10**	**15**	**SEM**
Liver	40.4	43.6	41.4	41.8	1.9
Kidney	3.7^{a}	3.7^{ac}	3.8^{b}	3.7^{c}	0.0
Heart	10.7	8.5	8.0	9.7	0.9
Full crop	16.9	30.1	18.0	21.5	5.1
Empty crop	9.0^{a}	7.7^{bd}	9.3^{ac}	7.3^{bd}	1.2
Full proventriculus	11.6	11.6	12.8	11.9	0.8
Empty proventriculus	10.1	10.5	10.5	16.4	2.1
Full gizzard	46.0^{a}	53.7	56.2	59.8^{b}	3.7*
Empty gizzard	30.3^{a}	32.4^{b}	33.7^{c}	42.5^{d}	0.4*
Small intestine:					
Full	34.4	22.9^{a}	40.9^{b}	26.4	5.5*
Empty	16.9^{a}	14.8^{ab}	21.5^{cd}	19.4^{ad}	0.8*

SEM = Standard error of mean, *Significant difference at $p<0.05$, (a,b,c,d) treatment means with different superscripts within the same row are significantly different at $p<0.05$

feeding 15% PKC diets adversely affected egg production though feed intake was not significant affected. Birds on PKC_{15} were incapable of efficiently converting such diets to eggs compared to their counterparts on the other diets. This might be due to the high crude fibre content of PKC diets (Table 4) leading to impaired nutrient digestibility, particularly amino acids and also to nutrient inbalance. Yolk colour score seemed to have been significantly influenced by the addition of PKC as yolk colour increased with corresponding increase of PKC. This is in contrast to report by Wang et al. (2008) who recorded paler yolk colour score of 2.3 of eggs from bird offered diet containing as much as 25% PKC. The increasing yolk colour associated with a high inclusion rate of PKC in layer diets could be good since most customers prefer a darker yolk colour. There was no significant dietary PKC effect on egg weight (which ranged from 62.48 to 68.53), egg shell thickness and Haugh unit score. According to United State Department of Agriculture (U.S.D.A) score, an egg weighing 56.7g with Haugh unit score of 72 and above is considered as 'AA' quality (Panda, 1995). All the values recorded in this experiment were higher than the value 72 and therefore the eggs produced by birds fed on diets containing PKC

Table 4. Effect of PKC on blood variables.

Parameter	Level of dietary PKC meal (%)				
	0	5	10	15	SEM
WBC ($\times 10^3$/µl)	204.8	179.0	210.6	204.9	21.9
RBC ($\times 10^6$/µl)	2.5	2.0	2.1	2.2	0.2
HGB (g/dl)	8.3	8.3	8.6	8.7	0.8
HCT (%)	29.3	25.9	26.5	25.0	5.9
MCV (fl)	119.7	130.6	126.8	132.2	10.5
MCH (pg)	36.2	42.0	40.9	39.1	3.3
MCHC (g/dl)	30.1^{a}	32.4^{b}	32.3^{bc}	30.4^{ad}	0.6*
LYM (%)	98.8	98.6	97.6	97.6	-

SEM = Standard error of mean, *Significant difference at p<0.05, (a,b,c,d) treatment means with different superscripts within the same row are significantly different at p<0.05.

Table 5. Costs and benefits from feeding the different layer diets.

Parameter	Level of dietary PKC meal (%)			
	0	5	10	15
Feed cost/kg (GH₵)	0.9	0.8	0.8	0.8
Feed cost per bird/day (GH₵)	0.1	0.1	0.1	0.1
Price per kg eggs (GH₵)	3.0	3.0	3.0	3.0
Value of an egg (GH₵)	0.2	0.2	0.2	0.2
Net revenue (GH₵)	0.1	0.1	0.1	0.1

US$ 1.0 = GH¢ 1.5

at various levels could be considered to be of high quality.

The internal organ weight showed that the gizzard of the birds increased with increasing level of PKC. The increase in the sizes of the gizzard as the PKC level increased may be due to the high fiber content (Fasina et al., 2004). The proventriculus is a small portion of the gastro-intestinal tract of the chicken with little digestive or storage function. A lack of effect of PKC on the organ is therefore not surprising. Table 5 shows that feed cost per kilogram diet was reduced when PKC was used. This could be the result of the lower price of PKC. However, the net revenue per bird was the same for each treatment group. The hematological parameters were not significantly (P>0.05) different between treatments except MCHC and the values were in harmony with the normal range for healthy birds stated by Awaad and Zouelfeker (2001). Mortality recorded in this study could not be attributed to the inclusion of PKC at 15% since post-mortem examination revealed no sign of diseases.

Conclusion

The experiment showed that layers can utilize PKC based-diet better up to 5 and 10% inclusion without adverse effects on their production performance. There was a decrease in feed cost and a higher net returns from birds fed PKC based diets at 5 and 10% inclusion, thus, more profit to the poultry farmer. It is therefore, recommended that 5 or 10% PKC is included in the ration for laying hens.

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