Effects of dietary levels of sun-dried sheep manure on productive performance and egg quality parameters of Shika-brown layers

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Abstract

An experiment was conducted to test the effect of dietary levels of sun-dried sheep manure (SSM) on egg quality parameters and productive performance of Shika-Brown layers. Six isonitrogenous and almost isocaloric diets were formulated to contain SSM at 0.0, 1.0, 2.0, 3.0, 4.0 and 5.0 % level of inclusion. Diet 1, which had no sheep manure, served as the control. White maize was used for the formulation of the diets. Each of the six diets was replicated four times with five birds per replicate in a completely randomised design experiment. The birds were housed singly in cages. The laying hens were first maintained on the control diet which contained very little or no yolk pigmenting factor for a depigmentation period of twenty-one days. During this period, samples of eggs were broken out and yolk colour scores were determined using the Roche Yolk Colour Fan (RYCF). By the twenty-first day, the (RYCF) scores had dropped to the lowest value of one. The hens were then placed on the experimental diets for the study, which covered a period of twelve weeks. Parameters measured for the egg quality included egg yolk colour, Haugh unit value, yolk index and shell thickness. For the performance characteristics, parameters measured included percent hen day and hen housed egg production, percent peak egg production, feed intake, feed conversion efficiency (kg feed/12 eggs) and feed cost per 12 eggs produced. Results obtained indicate that dietary levels of SSM had a significant ($P < 0.05$) effect on RYCF scores and feed intake but had no significant ($P > 0.05$) effect on other parameters such as egg weight, Haugh unit, yolk index, shell thickness, shell weight, percent shell, feed conversion efficiency, feed cost (N/12 eggs), percent hen day, hen housed and peak egg production.

Keywords: Sheep manure, egg quality, RYCF score, Xanthophylls, Carotenoid.

Introduction

In developing countries like Nigeria, emphasis is usually placed more on quantity and not on quality of products (Abeke *et al* 2003). The poor people dwelling in the rural and semi urban areas do not really place much emphasis on the quality of eggs they consume. That is why hatchery rejects, candled eggs as well as unhatched eggs from hatcheries and from local chickens are still being sold and consumed in many parts of the country. This may be attributed to poverty. However, the trend is bound to change as standard of living of the people improves.

There is need to place emphasis on the quality of eggs sold in our markets and outlets so as to improve on the quality of eggs being produced by poultry farmers. This was the reason that necessitated a survey by Ogundipe *et al* (1992) to determine the minimum acceptable Roche Yolk Colour Fan (RYCF) score by individual consumers and those in the pastery industries. According to the authors, deeper coloured yolk have higher levels of vitamin A than lighter coloured yolk, and therefore are richer in this important vitamin for body metabolism and function. In the past, imported egg yolk colouring agents were

used for deepening egg yolk colour but these synthetic materials are very expensive and may contain other harmful substances. Presently, there is a high awareness about the danger of cholesterol levels in eggs and other fatty foods and emphasis is being placed on the production of eggs that have little or no cholesterol.

Fortunately, Nigeria is blessed with many live-stock and the manure which are obtained in large quantities contain high levels of xanthophylls and carotenoid compounds which imparts deep colour to egg yolk when fed in small quantities in the diets of laying hens. Xanthophyll and carotene are the precursor of vitamin A and therefore increase the vitamin A content of eggs when small quantity of processed sheep manure are used in laying hens diets. Sheep manure is also very rich in the B complex vitamins, which also increase the levels of these vitamins in the egg when sheep manure, are fed in layers diet (Abeke 1997). Again, sheep manure is an organic substance which when properly handled and processed do not have any negative effect on humans when included in small quantity in the diets of laying hens (Ogundipe *et al* 1992). Furthermore, very low levels of sheep manure are needed to optimise the nutritive quality of eggs. This study was therefore conducted to determine the effect of dietary levels of sun-dried sheep manure (SSM) on egg quality parameters and production performance of laying hens.

Materials and Methods

The sheep manure used for this experiment was obtained from the sheep pens at the National Animal Production Research Institute (NAPRI), Shika-Zaria. The sheep were usually taken out for grazing during the day. At night, they were brought into the pens, which had cemented floors. In the morning, their faeces were swept together, straws and other foreign particles

like stones were removed and then bagged.

Sun-dried sheep manure (SSM) was obtained by spreading about 50kg of the manure outdoors on a cemented floor and left to dry in the sun for three days. The product was then milled and samples taken to the laboratory for proximate analysis according to A.O.A.C (1990) procedure. The metabolisable energy was determined experimentally using mature cocks according to the method of Hill and Anderson (1958).

$$\text{A.M.E/g of feed} = \frac{(F^1 \times \text{Ge}^f) - (E \times \text{GE}^e)}{F^1}$$

Where F^1 = Feed intake (g)

E = Excreta output (g)

Ge^f = Gross energy of feed (kcal/g)

GE^e = Gross energy of excreta (kcal/g)

The ME of the test ingredient was then calculated using simple algebraic equation

If ME of the basal diet (control diet) 'X' is 'a' kcal/g and that of the 20% substituted ration 'Y' was 'b' kcal/g, then the equation becomes

$$1X = \frac{a \text{ kcal}}{1}$$

$$0.8X + 0.2Y = b \text{ kcal}$$

$$0.8a \text{ kcal} + 0.2Y = b \text{ kcal}$$

$$0.2Y = b - 0.8a$$

$$Y = \frac{b - 0.8a}{0.2}$$

$$0.2$$

Total phosphorus was determined as described by Yoshida *et al* (1976). Calcium content was determined with an atomic adsorption spectrophotometer (Pye Unicam Sp9).

Six diets were formulated to contain graded levels of SSM at 0.0, 1.0, 2.0, 3.0, 4.0 and 5.0 percent respectively (Table 1). White maize was used for the formulation of all the diets. Diet 1, which had no sheep manure, served as the control. Each of the six diets was replicated four times with five 5 birds per replicate making a total of 120 birds for the experiment. The birds were housed singly in

cages. The birds were 30 weeks old and were at 50% production when the experiment started and were 45 weeks old when it was terminated. Feed and water were given *ad libitum*. The birds were weighed before the commencement of the experiment and at the end of the study.

The laying hens were first maintained on the control diet which contained very little or no yolk pigmenting factor for a depigmentation period of twenty-one days. During this period, samples of eggs were broken out and yolk colour scores were determined using the Roche Yolk Colour Fan (RYCF). By the twenty-first day, the RYCF scores had dropped to the lowest value of one. The hens were then placed on the experimental diets for a period of 12 weeks.

Data were collected on daily egg production while feed intake was measured weekly. Three eggs from each replicate group were sampled in the first day and every other day thereafter for the 12 weeks. These were used to determine egg weight. After weighing, the eggs were broken out into a flat white plate and with the aid of the RYCF the yolk colour was read. Albumin heights were measured using a pair of vernier calliper for the calculation of Haugh unit using the formula $HU = 100 \log_{10} (h - 1.7W^{0.37} + 7.6)$ where HU is Haugh unit; h = observed height of the albumin in millimetres and W = weight of the eggs in grammes (Oluyemi and Roberts 1985). Also the yolk height and width were measured (the yolk height was measured by placing the movable pin of the vernier callipers on the centre of the yolk and pressing down the calliper until the base touches the top of the yolk while yolk width was measured by adjusting the two gripping forceps of the calliper to touch both ends of the yolk) for the calculation of the yolk index. The shells were dried for three days and weighed using the mettler 1400 electronic platform scale to determine the shell weight. The shell thickness was measured using the vernier calli-

pers. From the primary data collected for feed intake and egg production, other data were generated for feed conversion efficiency, feed cost per ten eggs produced and percent hen day and hen housed egg production.

All data were subjected to the analysis of variance and differences between treatment means were determined using Duncan's multiple range test (Steel and Torrie 1980).

Results and Discussion

The chemical composition of SSM, the feed composition, the effect of SSM on egg quality parameters and the effect of SSM on production performance of the laying hens are presented in tables 1, 2, 3 and 4 respectively.

The result of the chemical composition of SSM indicates that it is fairly high in crude protein (19.06%), moderate in ether extract (3.77%), Calcium (0.96%) and phosphorus (0.48%). The value of crude protein (19.06%) is higher than the crude protein of palm kernel cake (18.0%) and rice offal (6.0%), which are presently being used in formulating poultry rations. This means that SSM can replace some of the more expensive protein feed stuff in poultry diets. However, the high fibre content of SSM (27.07%) and low metabolisable energy (1092 kcal/kg) may limit their level of inclusion in poultry diets.

The results obtained for the egg quality parameters (Table 3) indicate that SSM had a significant ($P < 0.05$) effect on egg yolk colour. The RYCF scores increased with every increase in the dietary level of SSM. The RYCF scores increased from the lowest value of 1 recorded for the control diet, which had no SSM to 3.53, at the 1.0% dietary level and finally reaching 13.75 at 5.0% dietary level of SSM. This observation agrees with the report of Ogundipe *et al* (1992) that sun-dried sheep manure is a powerful egg yolk

Effect of sundried sheep manure in layers

Table 1: Proximate composition of sun dried sheep manure (SSM) used for diet formulation.

Nutrients	Composition
DM (%)	83.96
Crude Protein (%)	19.06
Crude Fibre (%)	27.07
Ether Extract (%)	3.77
Ash (%)	20.81
Calcium (%)	0.96
Phosphorus (%)	0.48
NFE (%)	13.25
ME (kcal/kg)	1092

The values in the table are means of three determinations

Table 2: Composition of experimental layer rations with graded levels of SSM

Ingredients	Diets					
	1	2	3	4	5	6
Maize	49.14	48.33	47.51	46.68	45.86	45.05
Groundnut cake	25.81	25.62	25.44	25.27	25.09	24.90
SSM	0.00	1.00	2.00	3.00	4.00	5.00
Soya cake	5.00	5.00	5.00	5.00	5.00	5.00
Rice offal	9.00	9.00	9.00	9.00	9.00	9.00
Limestone	7.50	7.50	7.50	7.50	7.50	7.50
Bonemeal	3.00	3.00	3.00	3.00	3.00	3.00
Salt	0.30	0.30	0.30	0.30	0.30	0.30
Premix	0.25	0.25	0.25	0.25	0.25	0.25
Total	100.0	100.0	100.0	100.0	100.0	100.0
<u>Calculated analysis</u>						
ME(kcal/kg)	2621	2605	2586	2567	2549	2530
Protein (%)	17.22	17.17	17.14	17.09	17.06	17.01
Fibre (%)	7.18	7.40	7.63	7.85	8.08	8.30
Calcium(%)	3.43	3.42	3.43	3.42	3.43	3.41
Available P (%)	0.45	0.45	0.45	0.46	0.46	0.46
Lysine (%)	0.74	0.73	0.71	0.69	0.68	0.66
Methionine (%)	0.40	0.39	0.37	0.36	0.35	0.35
Cystine (%)	0.31	0.26	0.27	0.25	0.24	0.23
Feed cost (₹/kg)	15.63	15.59	15.55	15.52	15.48	15.43

Premix supplied per kg ration: vitamin A 10,000 I.U.; Vit. B3 2500 I.U.; Vit K 0.002gm; Vit.B1 0.001gm; Vit. B2 0.0045gm; Vit. B6 0.003gm; Nicotinic acid 0.025gm; Calcium D pantothenate 0.01gm; Vit. B12 0.012gm; Folic acid 0.0003gm; Vit. C 0.05GM; Chlorine chloride 0.3gm; Manganese 0.1gm; Iron 0.05gm; Zinc 0.045gm; Copper 0.002gm; Iodine 0.001gm; Cobalt 0.000225gm; Selenium 0.0001gm

Table 3: Effect of dietary levels of sun dried sheep manure (SSM) on egg quality parameters of layers.

Dietary treatment %SSM	RYCF score	Haugh unit(%)	Yolk index	Mean egg wt. (g)	Shell thickness (mm)	Percent shell	Shell wt. (g)
0.	1.00 ^f	96.89	0.48	58.25	0.42	8.97	6.05
1.	3.53 ^e	94.96	0.49	59.50	0.41	8.91	6.12
2.	5.75 ^d	94.70	0.49	60.25	0.40	8.87	6.10
3.	7.63 ^c	96.98	0.48	58.75	0.43	9.01	6.09
4.	11.75 ^b	96.01	0.50	59.50	0.41	8.88	6.08
5.	13.75 ^a	96.65	0.49	60.00	0.40	8.96	6.05
SEM	0.90	1.34	0.08	0.59	0.09	0.08	0.21

Means within the same column with different letter superscripts are significantly different ($P < 0.05$)

SEM = Standard error of the means

RYCF = Roche yolk colour fan.

Table 4: Effect of dietary levels of sun dried sheep manure (SSM) on the productive performance of layers.

Dietary treatment %SSM	Feed intake (g/d/day)	FCE (kgfeed/12 eggs)	Feedcost (₦/12eggs)	Henday eggprod. (%)	Henhoused egg prod. (%)	Peak egg prod. (%)	Mortality (%)	Final Wt(kg)
0.	129.20 ^c	3.92	61.27	60.28	60.28	85.63	0.00	2.21
1.	130.43 ^c	3.76	58.62	62.26	62.26	84.98	0.00	2.22
2.	133.35 ^c	3.67	57.07	63.85	63.85	89.65	0.00	2.19
3.	137.70 ^{bc}	4.03	62.55	61.67	61.67	82.69	0.00	2.19
4.	143.82 ^b	4.18	64.71	62.26	62.26	82.59	0.00	2.18
5.	150.11 ^a	4.09	63.11	62.05	62.05	83.11	0.00	2.17
SEM	3.05	0.62	3.85	1.98	1.98	2.68	0.00	0.75

Means within the same column with different letter superscripts are significantly different ($P < 0.05$)

SEM = Standard error of the means.

FCE = Feed conversion efficiency.

pigmenter when added at a small quantity in layers diet. The deeper yolk colour is an indication of better quality egg yolk because it means that its content of vitamin A and carotene are higher. (Abeke 1997, Abeke *et al* 2003).

A survey by Ogundipe *et al* (1992) revealed that RYCF score of 4 was the minimum acceptable egg yolk colour by individual consumers and pastry industries. This minimum was exceeded at only 2.0% dietary level of SSM. Therefore if egg yolk colour is the main target, SSM can be included in

laying hens diets at only 2.0% dietary level.

Mean egg weight, Haugh unit, yolk index, shell thickness, shell weight and percent shell were not significantly ($P > 0.05$) affected by graded dietary levels of SSM. As a result of the fact that the SSM was included at very low levels, the quality of the diets may not have changed much from one diet to the other, more so that the diets were isonitrogenous and almost isocaloric. Egg weight is more of a function of the age of the laying hens and quality of diet (Abeke 1997).

Therefore since the birds were of same age and ate similar diets, egg weight were not expected to be significantly ($P>0.05$) different from one treatment to another. Similarly, Haugh unit and yolk index are more related to the freshness of the egg rather than diet consumed. These parameters were measured for eggs that were collected together from each treatment and measurement were done within an hour after eggs were laid. Shell thickness, shell weight and percent shell were not significantly ($P>0.05$) different possibly because the calcium and phosphorus levels were similar across the diets. These results are similar to that obtained by Ogundipe *et al* (1992) who reported no significant ($P>0.05$) difference in Haugh unit, yolk index and shell quality when sheep manure was fed in the diets of laying hens.

Feed intake increased significantly ($P<0.05$) as the SSM level increased in the diets. This result may be attributed to the slight decrease in the metabolisable energy (ME) content of the diet as SSM level increased. Chickens generally eat primarily to satisfy their energy requirements, so the decrease in ME may have been responsible for the hens eating more to meet their energy requirement (Fadugba 1987, Etuk, 2001, Ogundipe *et al* 2003, Bawa *et al* 2003, Najime 2003, and Ani and Okeke 2003). The low levels of inclusion of SSM in the diets may not have had any negative effect on palatability and dustiness which might have reduce feed intake.

Feed conversion efficiency (kg feed/12 eggs produced) decreased slightly before increasing as the level of SSM in the diets increased. The decrease of the feed conversion efficiency at the 2.0% dietary level of SSM before increasing continuously as the SSM level increased indicates that the optimum inclusion of SSM for efficient utilisation of feed by laying hens lies around 2.0%. Beyond the 2.0% level, the diets were poorly utilised for egg production. This result is similar

to that of Ogundipe *et al* (1992) and Abeke (1997) who reported poor feed efficiency as the level of sheep manure in laying hens' diets increased. The same trend was observed for feed cost (N 12/ eggs produced), which decreased from the control diet up to the 2.0% dietary level of SSM and then rose as the SSM level increased beyond 2.0% in the diet. As the efficiency of feed utilisation became poorer with increase in the SSM level, cost of feed per ten eggs began to increase. This shows that it is not the cost per kilogramme of feed that really matters but how efficient the feed can be utilized and converted for productive purposes (Abeke *et al* 2003). Therefore, cheap diets do not necessarily mean better profit margin for the farmer.

Percent hen-day and hen-housed egg production increased from the control diet up to the 2.0% SSM diet before decreasing as the level of SSM in the diets increased. This can also be attributed to poor feed utilisation as the SSM level increased. This result is similar to that obtained by Fadugba (1987), Ogundipe *et al* (1992), Sekoni (1997) and Abeke (1997). These authors reported decreases in hen-day and hen-housed egg production as the level of unconventional feed ingredients such as cassava peel meal, sheep manure and rice offal respectively, increased in the diets of laying hens. The reason for this is very obvious. The quality of protein (amino acid profile) of conventional feedstuff such as soyabean and groundnut cake is far better than those of sheep manure. According to Abeke *et al* (2003)) and Bawa *et al* (2003), it is the quality of ingredients in terms of nutrient profile and the bio-availability of their nutrients that is more important than the absolute value of such ingredients in the diets.

There was no record of any mortality throughout the experimental period, an indication that the level of incorporation of the SSM was safe for the birds.

Conclusion

From the results obtained, it can be concluded that 2.0% dietary level of SSM gave the best result in terms of feed conversion efficiency, feed cost (N/10 eggs), percent hen-day, hen housed and peak egg production as well as exceeding the minimum RYCF scores of 4 preferred by individual consumers and pastry industries.

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