AN EVALUATION OF THE EFFECT OF STORAGE OF A LOCALLY-PRODUCED NATURAL VITAMIN PREMIX ON THE PERFORMANCE OF LAYING HENS

BY

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ABSTRACT

One hundred and eight (108) Harco pullets (38 weeks old and 14 weeks in lay) were fed diets containing a locally-produced natural vitamin premix (NVP) variously stored for 19, 20, 21, 22 and 23 weeks (to form diets B, C, D, E and F respectively) for 6 weeks; and their performance were compared to a synthetic vitamin premix (SVP) diet (Diet A). Daily feed intake was significantly higher (P<0.05) for the SVP diet (85.16g) than for those obtained for the natural premix diets (B: 79.05g, C: 81.59g, D: 81.19g, E: 81.11g and F: 80.95g), but there were no significant (P>0.05) differences in weekly egg number (A: 67, B:70, C:73, D:70, E: 72 and F: 70), hen day production (A: 53%, B: 56%, C: 58%, D: 56%, E: 57% and F: 55%) and total egg mass in g/bird/week (A: 222.68, B: 234.31, C: 246.87, D; 231.25, E: 236.04 and F: 227.46) for the different diets. Also, there was no significant (P>0.05) difference among the various dietary treatments in egg specific gravity, egg shell thickness, yolk colour score, yolk index and Haugh Unit, but birds fed the NVP diets produced better feed utilization (kg of feed per dozen eggs laid) and better gross profit values (₦) than birds fed the SVP diet. Hence, it can be concluded that the NVP as compounded by Bolu and Balogun (1998) can be stored for about 6 months without the use of any anti-oxidant and give a satisfactory egg laying performance in laying hens.

Key words: Natural premix, antioxidant, storage, performance, layers.

INTRODUCTION

Ever since the discovery of vitamins at the beginning of the 20th century, a lot of efforts have been made at their characterization and the determination of their true functions in the body of livestock. For poultry, 13 essential vitamins have been identified as required in trace amounts (in mg, µg or ppm) for the maintenance of physiological functions and optimum level of health (Barroeta and Hernandez, 2010). Deficiencies of these essential vitamins in the diet have been known to produce characteristic deficiency diseases such as rickets, beri-beri, scurvy, crazy chick disease, xerophthalmia, dermatitis of the skin, opacity of the cornea and slipped tendon or perosis, etc. (Loosli *et al*., 1974). In slightly higher than normal doses, some of these vitamins have been found to exert some special multi-dimentional effects. Egg production may increase when vitamin B_2 (Riboflavin) is supplemented at a level 25% higher than that recommended by NRC, 1994 (2.5mg/kg diet). Also, egg production, egg weight and body weight increased in breeding hens when NRC (1984) recommendations (2.2mg/kg diet) was increased by two or four times; while biotin and pyridoxine (Vitamin B_5), at supplementation levels that exceed the averages for turkey (174.60mg/kg and 3.94g/kg for biotin and pyridoxine respectively), have been found to increase egg hatchability (Robel and Christensen, 1987 and Robel and Christensen, 1991).

To increase the efficiency of feed production in Nigeria, efforts have been made to produce a completely "Nigerianised Feed", using a vitamin-mineral premix produced 100% from locally-sourced feed ingredients and feedstuffs (Bolu and Balogun, 1998). However, this locally-produced natural vitamin premix (NVP) for layers has a high concentration of oils and fats (from the animal products used in formulating it) which may lead to fat rancidity and deterioration of its nutritional quality over time. For the main cause of deterioration of lipids and lipid-containing foodstuffs is lipid autoxidation (Gray, 1978). The autoxidation process is initiated by a free radical chain reaction involving polyunsaturated fatty acids; caused by exposure of lipids to light, oxygen, moisture, ionization radiation, metal ions and metalloprotein catalysts. This lead to the production of primary products such as hydroperoxides (which are colourless and odourless), which are broken down, in series of complex reactions, to produce secondary products such as alcohols and carbonyl compounds. These are then oxidized further to aldehydes, ketones, carboxylic acids and epoxides (Behrooz *et al*., 2008) which eventually affect the nutritional and organoleptic qualities of feed, due to the production of rancid smell and taste (Maforimbo, 2002).

Questions about the safety of synthetic antioxidants increasingly plague the food industry today. Some antioxidants are mutagenic and/or carcinogenic, hence, there has been a decrease in their use by fats and oils product manufacturers, and a renewed interest in naturally-derived antioxidants (Ramanathan and Das, 1993). Hence, this study was carried out to investigate the effect of storage of a locally-produced natural vitamin premix, without the use of any artificial antioxidant, on its efficacy or effectiveness in still meeting the essential vitamin requirements of laying hens as reflected by performance characteristics such as egg-laying performance, egg quality indices and feed utilization efficiency.

MATERIALS AND METHODS

Experimental animals

A total of 108 (38-weeks-old, 14 weeks in-lay) Harco layers were used for this study. They were selected using quality parameters characteristic of good layers and then randomly distributed into six treatment groups of three replicates, making a total of 18 birds per treatment. Prior to the commencement of the experiment, the birds were subjected to a regime of thorough therapeutic medications such as deworming, administration of broad-spectrum antibiotics as well as the giving of recommended vaccinations.

Experimental diets

The locally-produced natural vitamin premix was prepared using the procedures of Bolu and Balogun (1998); and its composition is given in Table 1 below. The component ingredients were mixed together in their correct proportions to obtain the vitamin supplements. They were then air-dried for 24 hours, before being transferred into plastic containers (with lid), where they were stored without the use of any antioxidant. The premixes were variously stored for 19, 20, 21, 22 and 23 weeks, and then mixed with other feed ingredients to form diets B, C, D, E and F respectively (Table 2). For the control diet (diet A), a standard ROCHE® vitamin-mineral premix for layers was used. The diets were fed to the birds for 6 weeks.

Table 1: Composition of the natural vitamin premix for layers

Ingredient	*% Composition*
Carrot (*Daucus carota)*	9.00
“EERU” (*Xylopia aethiopica)*	8.60
Red pepper or “Tatase” (*Capsicuum annum)*	13.60
“LURU” or “KUKA” (*Adansonia digitata)* leaf	24.65
Fish by-product oil	19.65
Poultry renderings or offal	24.50
Total	100.00

Table 2: Gross composition of the experimental diets (%)

Ingredients	*Diet A (Control)*	*Diet B (19 wks)*	*Diet C (20 wks)*	*Diet D (21 wks)*	*Diet E (22 wks)*	*Diet F (23 wks)*
Yellow maize	30.00	30.00	30.00	30.00	30.00	30.00
Maize offal	20.00	20.00	20.00	20.00	20.00	20.00
Wheat offal	10.50	10.25	10.25	10.25	10.25	10.25
Soybean meal	22.00	22.00	22.00	22.00	22.00	22.00
Fish meal	2.00	2.00	2.00	2.00	2.00	2.00
Palm kernel meal	5.00	5.00	5.00	5.00	5.00	5.00
Bone meal	2.00	2.00	2.00	2.00	2.00	2.00
Oyster shell	8.00	8.00	8.00	8.00	8.00	8.00
Common salt	0.25	0.25	0.25	0.25	0.25	0.25
*ROCHE® SVP	0.25	-	-	-	-	-
LPNVP	-	0.50	0.50	0.50	0.50	0.50
Total	100.00	100.00	100.00	100.00	100.00	100.00

LPNVP = Locally-produced natural vitamin premix

*ROCHE® SVP = Synthetic vitamin premix commercially sold by ROCHE® for layers. It contained the following nutrients/2.5kg of the product: Vitamin A= 4,000,000 IU; D3= 1,000,000 IU; E= 10,000 IU; K= 0.8g; B1= 0.40g; B2= 2.00g; B6= 1.20g; B12= 4.80mg; biotin= 0.02g; nicotinic acid= 12.00g; folic acid= 0.40g; calcium pantothenate= 4.00g; choline chloride= 120g; Mn= 40g; Fe= 20g; Zn= 18g, Cu= 0.80g; I= 0.62g; Co= 0.09g and Se= 0.04g.

Egg laying performance and egg quality determination

The animals were housed in double-tiered laying cages measuring 40cm x 25cm x 45cm. They were fed *ad libitum* twice daily (at 0900 and 1600 hrs); with 24 hours unrestricted access to water supply. Eggs were collected twice daily (at 1000 and 1800 hrs) and weighed individually to the nearest 0.01g, using a sensitive top loading electric weighing balance. Egg shell thickness was determined, using a micrometer screw gauge, at the broad end, tapering end and the mid-section of the egg, and the mean value recorded for each egg. Egg specific gravity (density) was determined using the water displacement method through the use of a graduated measuring cylinder. The internal egg quality was determined using the procedures of Ayanwale *et al*. (2006). Yolk index was determined using the Roche Colour Disc while the albumen and yolk heights were determined using tripod micrometer. Haugh Unit (HU) was calculated using the following formula:

$$HU = 100 \log (H + 7.57 - 1.7W^{0.37})$$

Where H = Albumen height (mm), and W = egg weight (g).

Feed utilization efficiency (FUE) and Gross profit (GP) was calculated using the procedure of Bolu and Balogun (1998) as follows:

$$\text{FUE (in terms of feed consumed /dozen eggs laid)} = \frac{12 \text{ x feed consumed (in kg)}}{\text{Total number of eggs produced}}$$

Gross profit was calculated in terms of Gross Profit/dozen eggs laid as follows:

GP (₦) = (12 x unit price of egg) – (Feed consumed/dozen egg laid x unit price of feed/kg)

Chemical analysis

The proximate composition of the experimental diets was determined using the procedures outlined by AOAC (2000).

Data analysis

The data collected on performance and egg quality parameters were statistically analyzed using the Completely Randomized Design (CRD) model and where means were significant, they were separated using the Duncan's Multiple Range Test (DMRT) as outlined by Steel and Torrie (1980).

RESULTS AND DISCUSSION

Table 3 shows the proximate composition of the experimental diets. The diets had, on the average, crude protein content of 16% and metabolizable energy (ME) of 2850 kCal/kg, as recommended for laying hens by NRC (1984).

Table 3: Proximate composition of the experimental diets (% basis)

Parameters	*Diet A (Control)*	*Diet B (19 wks)*	*Diet C (20 wks)*	*Diet D (21 wks)*	*Diet E (22 wks)*	*Diet F (23 wks)*
Dry matter	89.28	88.82	88.25	89.57	89.76	90.21
Crude protein	16.28	16.27	16.08	16.03	16.26	16.31
Crude fibre	5.83	5.79	5.65	5.81	5.75	5.80
Ash	5.24	5.43	5.35	5.33	5.29	5.36
Ether extract	3.02	2.95	3.10	2.96	3.01	3.03
NFE	69.63	69.56	69.82	69.87	69.69	69.50

NFE = Nitrogen free extract

Table 4: Performance and egg quality parameters of laying birds fed the synthetic and natural premix diets stored for different time periods

Parameters	*Diet A (Control)*	*Diet B (19 wks)*	*Diet C (20 wks)*	*Diet D (21 wks)*	*Diet E (22 wks)*	*Diet F (23 wks)*	*SEM*	*LS*
Feed intake (g/bird/day)	85.16^{b}	79.05^{a}	81.59^{b}	81.19^{a}	81.11^{a}	80.95^{a}	0.17	*
Egg number per treatment (Weekly)	67	70	73	70	72	70	2	NS
Hen day Production (%)	53.31	55.82	57.80	55.56	57.01	55.16	4.57	NS
Egg weight (g)	59.48	59.93	60.91	59.33	59.05	58.84	1.77	NS
Total egg mass (g/bird/week)	222.68	234.31	246.87	231.25	236.04	227.46	11.84	NS
Egg specific Gravity (g/cm^3)	1.086	1.077	1.080	1.067	1.075	1.061	0.027	NS
Egg shell Thickness (mm)	0.44	0.42	0.41	0.42	0.43	0.44	0.04	NS
Yolk colour Score (1-4)	2.7	2.7	2.6	2.5	2.6	2.6	0.5	NS
Yolk index	0.47	0.47	0.47	0.45	0.46	0.47	0.03	NS
Haugh unit (%)	67.29	68.98	65.32	64.47	66.42	66.94	6.14	NS
Weight gained (g/bird)	70.6	76.7	79.4	79.4	81.7	61.7	3.28	NS
FUE (kg/dozen eggs)	1.97	1.71	1.82	1.82	1.75	1.81	0.18	NS
Gross profit (₦)	19.98	22.41	21.53	21.53	22.09	21.61	0.84	NS

FUE = Feed utilization efficiency

Table 4 shows the egg laying performance and egg quality characteristics of layers fed the different diets. Feed intake was significantly (P<0.05) higher for the synthetic vitamin premix (SVP) diet than for the locally-produced natural vitamin premix (NVP) diets. Egg number and hen day production (HDP) was higher for the NVS diets than for the SVP diet (control), though they were not statistically significant (P>0.05). This is in agreement with Bolu and Balogun (1998) who obtained higher HDP for laying birds fed on NVP diets than for the SVP diet. This may be attributable to the extra-special quality of the NVP over the SVP in meeting more adequately the vitamin-mineral requirements of laying hens, hence obviating the need for importation of premixes for layers. Rather, they should be prepared using local feed ingredients and resources.

There were no significant (P>0.05) differences in total egg mass, egg specific gravity (density), egg shell thickness, yolk colour score, yolk index and Haugh Unit values obtained for both the birds fed the NVP and SVP diets. But birds fed the NVP diets produced better FUE and gross profit values, on the average, than birds fed the SVP diet, though the differences were not statistically significant (P>0.05). This indicates that in spite of the storage period, the NVP (variously stored for different periods) had not undergone any significant lipid peroxidation to cause deterioration in its nutrient quality. For peroxidation of fats may result in the destruction of some vitamin components of the feed and the destruction of linoleic acid, leading to odour and flavour reversion (Gurr and James, 1975). This absence of lipid peroxidation may be due to the antioxidant effect of vitamin E present in the NVP (Sanders, 1983).

CONCLUSION AND RECOMMENDATION

From the results of this study, it has been established that the locally-produced NVP as compounded by Bolu and Balogun can be stored for 23 weeks (about 6 months) without the use of any artificial or synthetic antioxidant. The premix maintained its odour and visual appeal even after the storage period and sustained satisfactory egg production and egg quality in layers. As the feed fed to chicken can influence the number of eggs laid, size of birds, finish of the birds, quality of the egg shell, the internal quality of the egg, as well as trace minerals deposited in the flesh and egg (Fritz and Titus, 1971), it is believed that the NVP stored for different time periods had impacted positively on layers' performance. Hence, the premix is highly recommended to poultry farmers and animal nutritionists even after storage for 6 months. This is because of its efficacy in sustaining satisfactory egg laying performance in laying hens. Also, the NVP diets produced better gross profit values than the SVP diet.

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