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Performance and egg quality characteristics of commercial layers responses to vitamin-mineral premixes

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Target Audience: *Nutritionists, feed millers, poultry farmers and researchers.*

Abstract

Ninety-six point of lay (20 weeks) ISA Brown strain of layers was used to compare their productive response and egg quality characteristics to four commercial vitamin-mineral premises. The birds were fed on isocaloric and isonitrogenous diets supplemented with four different vitamin mineral premises labeled as VMP1, VMP2, VMP3 and VMP4. There were eight birds per replicate and three replicate per treatment making a total of 24 birds per treatment in a complete randomized design. Collection of data on eggs was done for 10 weeks. Three eggs were picked per replicate on a weekly basis for analysis. Results shows that the daily weight changes, egg feed price ratio, hen day egg production, shell weight, percentage yolk weight, yolk percentage, shell surface area, yolk height and feed efficiency per dozen egg were significantly ($P<0.05$) affected by the dietary treatments but egg mass, egg weight daily feed intake, feed conversion per kg egg weight, egg width, egg length, shell thickness, egg shell index, albumen length, albumen weight, albumen percentage weight, yolk index and feed conversion per kg egg mass were not significantly ($P>0.05$) influenced by the varied dietary Treatments. It was concluded that the four vitamin and mineral premises used in this study did not adversely affect the external and internal egg parameters. However, VMP3 gave better hen day egg production but the efficacy of all commercial premixes in terms of egg weight and egg mass are the same.

Keywords: *Brown egg-type, hen day egg production, vitamin-mineral premixes, yolk weight and egg weight*

Description of Problem

In poultry production, availability of balanced feed is paramount because birds can only perform economically and profitably if they consume feeds with appropriate amount of required energy, protein, vitamins and minerals (1). While macro-minerals are required in the diet at concentrations more than 100 mg/kg (2), trace elements, including copper, iodine, iron, manganese, selenium, zinc and cobalt serve as components of larger molecules and as co-factors of enzymes in various metabolic reactions; hence, they are referred to as micro-minerals (3). The deficiencies of micro-minerals and vitamins in the diet can cause certain diseases, thus addition of these micro-minerals and vitamins as premix to layers diet could be a good means of protecting birds from diseases, stress and disorders (4, 5). These make vitamin-mineral premix a critical input in the feeding of commercial layers because the use of quality premix will ensure profitable production (6). In addition, the inclusion of vitamin-mineral premix in the diet of layers is of prime

importance because feed ingredients are usually low in some vitamins and minerals and gut flora of chickens can synthesize only very little amount (7, 5). In practical poultry operation, the cost of fortifying the ration with the essential vitamins and minerals is increasing, and these necessitate an analysis of risk of losses from vitamin-minerals deficiency conditions and sub-optimum performance for successful and profitable poultry operations (8).

There are different proprietary vitamin-mineral premixes being commercially traded in Nigeria with each manufacturer ascribing superior effectiveness and potency to their products. Most times, the labels would indicate slightly different or similar composition but the same potency and efficacy claim without any cognate experimental evidence (5). Results from farms and the farmers' experiences have shown that some are not quality product. However, there is lack of dedicated laboratory to test the efficacy of marketed premixes and make appropriate recommendations to farmers. Additionally, there is paucity of experimental evidences about the efficacy of different vitamin-mineral premixes with different trade names available in Nigeria (5). Hence, this experiment was designed to evaluate the productive response and some egg quality parameters of brown-egg type layers to four commercial vitamin-mineral premixes.

Materials and Methods

Experimental location

This experiment was carried out at the Poultry Unit of the Teaching and Research farm of Ladoke Akintola University of Technology, Ogbomoso Oyo state, Nigeria. The location falls within the Derived Savannah Agro-ecological zone of Nigeria, and the geographical positioning coordinates of the area is located on latitude 8°15'N of the equator and longitude 4°5'E of the Greenwich meridian (9).

Procurement of the test materials, experimental birds and their management

The vitamin-mineral premixes (VMP) used were purchased from accredited distributors. The comparative composition as provided by the manufacturers on the labels as well as the recommended rate per ton of feed is presented in Table 1. Ninety-six point of lay, Isa Brown strain of pullets was randomly assigned to four dietary treatments of 24 hens each.

Each treatment had 3 replicates of 8 birds in a completely randomized design experiment. The hens were managed intensively in two tiers, battery cage system and the birds were stocked at the rate of three birds per cell. Chickens in all groups were reared under the same environmental, managerial and hygienic conditions. The hens received a typical layer diet containing 2499.70 ME kcal/kg and 17.19% crude protein to meet the nutrient requirement recommendation as shown in Table 2 (10).

Data collection

Weighed quantities (75.00g and 50.00g) of the formulated diets were offered to each treatment groups at 08: 00 hours and 02.00 hours respectively each day. Eggs collection was carried out at 12:00hours and 3:00 hours daily throughout the experimental period that lasted for 10 weeks. The feed intake was calculated by subtracting the left over from the amount of feed offered to the birds. Feed efficiency was calculated as the ratio between amounts of feed consumed to the egg mass. Feed efficiency per dozen eggs was calculated as the ratio between the feed consumed and the number of eggs produced multiplied by 12 (11, 12). The egg weight was determined by weighing whole intact eggs on a sensitive scale. Egg

mass was calculated by multiplying percentage hen day egg production by the average egg weight. Egg feed price ratio was used to find out the ratio between the receipts from eggs and expenditure on feed. The internal and external egg qualities parameters were measured using the procedures of (11, 13) while the proximate composition of the diets was determined by the procedures of (14).

Table 1: Composition of VMP as provided by the Manufacturers

CONTENT	VMP1	VMP2	VMP3	VMP4
Vitamins A	10,000.00iu/kg	25,000,000.00iu	10,000.00iu	12,000,000iu
Vitamin D3	2,00,000iu/kg	3,000,000,00iu	2,200.000iu	3,000,000iu
Vitamin E	2,000mg/kg	25,000,00mg	10,000mg	30g
Vitamin K3	800mg/kg	2,000,00mg	2,000mg	2g
Vitamin B2	2,000mg/kg	6,000mg	5,000mg	6kg
Vitamin B3	3,600mg/kg	-	-	-
Vitamin B6	1200mg/kg	5,000mg	1,500mg	-
Vitamin B12	4mg/kg	25.00mg	10g	15mg
Vitamin PP	12,000mg/kg	-	-	-
Thiamine (B1)	1,200mg/kg	3,000.00mg	1500mg	2g
Pyridoxine (B6)	1,200mg/kg	5,000.00mg	1500mg	4g
Niacin	-	50,000.00mg	15,000.00mg	40g
Calcium	17.6%	15,000.00mg	-	-
Folic Acid	400mg/kg	1,000.00mg	20mg	1g
Biotin	-	50.00mg	-	-
Choline chloride	80,000mg/kg	100,000.00mg	150,000mg	500g
Manganese	2.40%	120,000.00mg	70,000mg	100g
Iron	-	100,000mg	40,000mg	30g
Zinc	2.80%	80,000.00mg	50,000mg	60g
Copper	0.20%	8,500.00mg	4,000mg	12g
Iodine	0.04%	80,000.00mg	1,000mg	1g
Selenium	1.60%	15,000.00mg	200mg	200mg
Cobalt	0.04%	100.00mg	200mg	200mg
Lysine	-	100,000.00mg	-	-
Methionine	-	85,000.00mg	-	-
Anti-oxidant BHT	0.5%	-	125,000mg	100g
Pantothenic acid	-	-	-	10g
Magnesium	-	-	-	50g
Calpan				
Recommended rate per ton	2.5kg	2.5kg	2.5kg	2.0kg

Table 2: Gross composition of experimental diets (%)

Ingredients (%)	VMP1	VMP2	VMP3	VMP4
Maize	45.00	45.00	45.00	45.00
Soya bean meal	18.00	18.00	18.00	18.00
Wheat offal	18.50	18.50	18.50	18.50
Fish meal	2.00	2.00	2.00	2.00
Palm kernel cake	3.00	3.00	3.00	3.00
Bone meal	3.50	3.50	3.50	3.50
Oyster shell	9.00	9.00	9.00	9.00
Salt	0.25	0.25	0.25	0.25
Methionine	0.25	0.25	0.25	0.25
Lysine	0.25	0.25	0.25	0.25
VMP1	0.25	-	-	-
VMP2	-	0.25	-	-
VMP3	-	-	0.25	-
VMP4	-	-	-	0.25
Total	100.00	100.00	100.00	100.00
Price per kg of feed	₦86	₦78	₦80	₦88
Calculated nutrient composition				
Crude protein (%)	17.19	17.19	17.19	17.19
Fat (%)	3.35	3.35	3.35	3.35
Fibre (%)	3.79	3.79	3.79	3.79
Calcium (%)	4.62	4.62	4.62	4.62
Phosphorus (%)	0.79	0.79	0.79	0.79
Lysine (%)	0.80	0.80	0.80	0.80
Methionine (%)	0.50	0.50	0.50	0.50
Metabolisable energy (Kcal/kg)	2499.70	2499.70	2499.70	2499.70

*₦ = Naira (one-naira equivalent to 0.0027 USD)

Statistical Analysis Method

Data collected were analyzed using Analysis of Variance (ANOVA) using the General Linear model of (15). Means were separated using Duncan multiple range test of the same package.

Results and Discussion

The proximate composition of experimental diet is presented in Table 3.

Table 3: Proximate composition of experimental diets

Parameters	VMP1	VMP2	VMP3	VMP4
Dry matter (%)	91.21	91.09	90.94	91.16
Crude protein (%)	17.79	17.87	17.59	17.78
Crude fat (%)	3.73	3.76	3.66	3.78
Crude fibre (%)	4.15	4.15	4.24	4.23
NFE (%)	56.4	56.18	56.47	55.88
Ash (%)	6.10	6.17	5.93	6.20

The productive response of ISA brown egg type layers fed four different vitamin-mineral premixes is summarized in Table 4. Feeding different vitamin mineral premixes significantly ($p<0.05$) affected final weight, total weight gain, hen day percentage, egg feed price ratio and feed efficiency per dozen eggs.

Table 4: Performance responses of ISA Brown layers to commercial vitamin-mineral premixes

Parameters	Treatments				SEM	P-Value
	VMP1	VMP2	VMP3	VMP4		
Initial weight(g)	1.55	1.52	1.56	1.57	0.01	0.08
Final weight (g)	1.94[b]	1.65[c]	1.88[b]	2.09[a]	0.02	0.01
Egg mass (g)	40.65	42.05	41.48	40.98	0.21	0.06
Egg weight (g)	60.25	61.08	60.75	59.32	0.35	0.11
Hen day egg production (%)	71.05[b]	74.94[b]	83.33[a]	78.74[ab]	1.94	0.04
Daily feed intake (g)	124.82	122.47	123.13	124.83	1.54	0.13
Feed conversion per kg egg mass	13.74	13.48	11.86	13.57	0.32	0.07
Egg: feed price ratio	77.50[b]	79.60[ab]	79.92[a]	89.00[ab]	1.64	0.05
Feed efficiency per dozen egg	0.18[a]	0.16[ab]	0.14[b]	0.16[ab]	0.00	0.03

[ab] Mean in the same row with different superscripts are significantly ($p<0.05$) different.

The highest total weight gain (0.52kg) was obtained in the VMP4; this might be due to the abundance of choline in the diet which is supplied through the premix used. (16) reported a significant difference ($p<0.05$) in the average final weight, average weight gain, daily weight gain, daily feed intake, and feed conversion ratio with improvement as the choline supplementation increased from 500 to 2,000 mg/Kg of feed. The weight changes can be attributed to the presence of high choline which has been observed to improve body weight gain of commercial layers (12,7) this is line with the report of (16).

Body weight and egg weight are two relevant productive traits in poultry breeding business, but egg weight is most paramount in layer farm, therefore farmer must watch the composition of the premixes used in order to achieve their goal.

Hen day egg production (HDEP) differed significantly; the highest (83.33%) was obtained in VMP3. However, statistically similar results (71.05 and 74.94%) was obtained in layers on VMP 1and VMP 2 respectively and were the lowest. It has been established that in layers, each 1-g increment in average egg weight may improve income by about 4% whereas in meat-type poultry, the same increase may enhance marketing weight by 2 to 13 g (13), this will make the farmers to record high income per the same number of eggs produced. In this study, egg weights were not significantly affected.

The result of external egg quality parameters of ISA Brown layers fed four different vitamin mineral premixes is presented in Table 5.

The egg weight, egg width, egg length, egg mass, shell thickness and egg shell index were not significantly ($P>0.05$) affected by the dietary treatments; whereas, shell weight, shell surface area and percentage shell weight were significantly affected ($P<0.05$) by the dietary treatments. The egg weights obtained in this study is similar to the results obtained by 14. The egg length and egg width obtained in this study are similar to the result obtained by (15). The similarity in the result obtained for egg weight could mean that an appropriate level of vitamins and minerals does not change the egg weight of laying birds (16). The shell thickness obtained in this study is lower than the shell

thickness reported by (17). According to (18), reduced blood bio-carbonate will result in reduced bio-carbonate concentrations in uterine fluid thereby decreasing utilization of blood calcium leading to reduced shell quality and impaired egg shell formation. The shell weight and percentage shell weight are higher than that of (3) and the value obtained for shell surface area is higher than the value of (17).

The result obtained for internal egg quality parameter of brown egg type layers fed four different vitamin mineral premixes is presented in Table 6. Dietary treatment had no effect ($P > 0.05$) on albumen height, albumen length, albumen weight, albumen percentage, yolk colour, yolk length and yolk index.

Table 5: External egg quality parameters of brown egg type layers fed four commercial vitamin-mineral premixes

Parameters	Treatments				SEM	P-Value
	VMP1	VMP2	VMP3	VMP4		
Egg weight (g)	60.25	61.08	60.75	59.32	0.35	0.11
Egg width (cm)	4.40	4.39	4.40	4.36	0.14	0.37
Egg length (cm)	5.57	5.57	5.61	5.51	0.17	0.05
Egg mass (g)	40.65	42.05	41.48	40.98	0.21	0.06
Egg thickness (mm)	0.22	0.23	0.23	0.23	0.00	0.57
Egg shell index	0.79	0.79	0.79	0.79	0.11	0.20
Shell weight (g)	7.46^{a}	6.97^{b}	7.05^{ab}	7.13^{ab}	0.08	0.03
Shell surface area	74.59^{ab}	75.72^{a}	75.28^{ab}	73.40^{b}	0.34	0.02
Shell weight (%)	12.47^{a}	11.49^{b}	11.53^{b}	12.04^{ab}	0.13	0.02

^{ab} Means in the same row with different superscripts are significantly ($p<0.05$) different.

Table 6: internal egg quality parameters of brown egg type layers fed four commercial vitamin-mineral premixes

Parameters	Treatments				SEM	P- Value
	VMP1	VMP2	VMP3	VMP4		
Albumen height (mm)	7.01	6.59	6.60	6.45	0.12	0.13
Albumen length (cm)	6.99	7.08	7.03	7.19	0.05	0.19
Albumen weight (g)	32.64	32.13	33.44	32.71	0.31	0.18
Albumen (%)	54.29	54.39	54.40	55.43	0.36	0.32
Yolk colour	3.15	3.23	3.43	4,23	0.25	0.17
Yolk length (cm)	4.06	3.93	3.98	3.99	0.02	0.13
Yolk height (mm)	8.52^{b}	8.67^{ab}	8.99^{a}	8.93^{ab}	0.08	0.03
Yolk weight (g)	14.44^{a}	14.18^{ab}	14.35^{ab}	13.86^{b}	0.10	0.02
Yolk weight (%)	24.61^{a}	22.98^{c}	23.38^{bc}	23.90^{ab}	0.16	0.01
Yolk index	2.25	2.35	2.42	2.32	0.44	0.22
Haugh unit (%)	79.49^{a}	80.31^{a}	79.37^{a}	76.63^{b}	0.40	0.04

^{abc} : Mean in the same row with different superscripts are significantly ($p<0.05$) different.

However, the yolk weight, percentage yolk weight, yolk height and haugh unit were however significantly ($P<0.05$) affected. The albumen height obtained in this study is lower than that of (18). Yolk Color was not significantly ($P>0.05$) affected by the dietary treatment. The values obtained for yolk colour are similar to that of 19. The primary determinant of yolk colour is the xanthophyll plant pigment content of

the diet consumed (20) while the yolk weight obtained in this study is similar to the value reported by (3). The yolk height is lower than the value reported by authors. The haugh unit is a measure of egg protein quality and is determined by the height of the albumen and the weight of the egg (21). The haugh units obtained in this study is within the usuall recommended normal range of 75 and 85 which indicates that the height of the albumen and egg weight are normal and this also implies that the egg white is free from discoloration or from any foreign bodies floating in it. This is in agreement with the observation of (19). Yolk index and haugh unit are the best indicator of internal egg quality, this is in agreement with (22 and 23) who reported that the higher the yolk index and the haugh unit, the more desirable the internal quality of the egg.

Conclusion and Applications

1. It can be concluded from this study that the four vitamin mineral premixes used in this study have no adverse~~ly~~ effects on the external and internal egg parameters and the use of VMP3 to supplement the diet of laying birds translated to better hen day egg production, however the four commercial VMP resulted in similar egg weight and egg mass.
2. This study will help farmers especially layer farmers in their choice of the brand to be used.
3. The layers did not respond adversely to any of the VMP used indicating their safety.

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