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Efficacy of Different Commercial Vitamin - Mineral Premixes on Productive Performance of Caged Laying Pullets

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Abstract: A total of ninety-six Shaver 579 pullets were fed on isocaloric and isonitrogenous diet with vitamin-mineral premixes, Supramixes Layer, Acimix Super-L and Adivit-L and without premix (control) in the age duration from 25 to 40 weeks to evaluate the efficacy of different commercial premixes. Daily feed intake and body weight gain of the pullets did not differ significantly (P>0.05). Hen day egg production of different treatments differed significantly (P<0.01). Higher and statistically similar egg production was obtained in Supramix layer (75.4%) and Acimix Super-L (74.12%) treatment. The lowest (62.5%) and statistically similar (65.99%) egg production occurred in control and Adivit-L treatment respectively. Egg weight of the treatments differed significantly (P<0.01). The highest (57.15g) and statistically similar (56.57g) egg weight was observed in supramix Layer and Acimix Super-L group respectively. The highest egg mass output of Supramix Layer (42.98) differed significantly (P<0.01) from the control (33.98). Significant (P<0.01) difference was observed in the FCR value of Supramix Layer (2.68) and control (3.43) group. Broken egg percent of the treatments differed significantly (P<0.01). High broken egg (4.11%) was observed in control group. No significant (P>0.05) differences were observed in livability. The observation of the results showed that use of commercial vitamin-mineral premix to supplement the diet of caged laying pullets is inevitable to maintain desirable production level. But the efficacy of all commercial premixes was not equal. The quality of marketed premixes is not uniform which is revealed in terms of performance test in the study.

Key words: Premix, supramix-layer, acimix super-L, adivit-L, vitamin, mineral

Introduction

Vitamin-mineral premix is the combination of vitamins and minerals which is added to the formulated diet to meet up the requirements of at least few vitamins and minerals that are deficient in the formulated diet. Inclusion of vitamin-mineral premix in the formulated diet has become indispensable practice because feed ingredients do not contain all essential vitamins and minerals at the right amounts needed for chicken. Critical vitamins (choline, folic acid, pantothenic acid, pyridoxine, riboflavin, Vit-A, Vit-D_3 and Vit-E) and minerals (Calcium, phosphorus, copper, iodine, iron, manganese, sodium and zinc) should be checked carefully in the diet. It is not unusual to add all vitamins in poultry diets. Minerals and vitamins contribute only 10 per cent of the total cost of feed (Singh and Panda, 1988a). Economisation on these or neglecting or reducing safety margin restricts performance of birds with heavy losses.

In comparison to other species chickens are more susceptible to vitamin deficiency because gut flora of chickens provide very little vitamin synthesis but compete with the host for dietary vitamins and intensively kept chickens undergo many stresses. Vitamins A, D, riboflavin and B_{12} are usually low in poultry diets. However, adding of other vitamins to poultry diets is a good insurance to protect birds from deficiency diseases and disorders. The vitamin D and B_{12} are almost completely absent from diet based on corn and soybean meal. Vitamin K is generally added to poultry diets more than to those for other species because birds have less intestinal synthesis because of a shorter intestinal tract and faster rate of food passage.

Deficiency of vitamin and mineral cause various diseases such as xerophthalmia, cage layer fatigue, rickets etc. Anisuzzaman (1993) observed deficiency diseases of various natures in broiler flocks in spite of adding vitamin-mineral premix in the experimental diet. This was probably due to poor quality of premix used for experimentation. Supplementing Vit-E in well balanced diets has shown increase of humoral immunity for monogastric species (Langweiler *et al*., 1983; Wuryastuti *et al*., 1993). In recent years, the importance of certain trace minerals in immune function has become increasingly evident. Selenium, copper, zinc and iron have been showed to alter various components of the immune system. (Suttle and Jones, 1989).

Poultry under intensive production systems are particularly susceptible to vitamin-mineral deficiencies and it is a general practice to include all supplemental vitamins and minerals in a premix at the levels that will provide margins of safety which are adequate under all of the various stress conditions to which chickens may be exposed (Scott *et al*., 1982). Specially birds in cages require more attention for supplying vitamin-mineral premix than those of floor housing because of more

limited opportunity for coprophagy.

So it is clear that vitamin and mineral requirement is very much important in poultry production. Recently, many pharmaceutical companies marketed vitamin-mineral premixes using different trade names. Many products are imported in our country and the packages of the product contain the name of country and company that manufactured it. Recently few marketed vitamin-mineral premix packet do not contain name of origin of product but attributed to appreciative quality of the product. Many poultry farmers reported that among many-marketed vitamin-mineral premixes few are not quality product. Most probably impostor businessmen cheat them. Registration and analysis of quality of every product is obligatory. Nevertheless, especially poultry nutritional and medicinal products are being marketed throughout the country without any established recognition. The registration of feed additives is based on three different arguments. The claimed effects of a product on the farm animals and birds (Performance, disease prevention, antioxidant effect, pigmentation etc.) must be clearly demonstrated by experiments and the absence of undesired side effects has to well documented. Furthermore safety for man, animal and environment must be guaranteed (Wenk, 2000). However, there is lack of unbiased research station or poultry authority to test the efficacy of marketed premixes and suggest the poultry farmers on the quality of these. Simultaneously there is lack of sufficient experimental evidence about the performance efficacy of different vitamin-mineral premixes with different trade names available in Bangladesh.

So this experiment has been designed to evaluate efficacy of different vitamin-mineral premixes on productive performance of caged laying pullets in terms of growth rate, feed consumption, feed efficiency, egg production and mortality, to study the economic feasibility of using vitamin-mineral premix in laying diet and to recommend a suitable vitamin-mineral premix to the poultry producers from those available in the market.

Materials and Methods

The research was conducted for 16 weeks duration at Bangladesh Agricultural University Poultry Farm, Mymensingh with 96 Shaver 579 pullets to evaluate the efficacy of a few vitamin-mineral premixes available in Bangladesh on the performance of laying birds. Four treatments were compared for this experiment. Each treatment had 3 replications. The layout of the experiment is shown in the Table 1.

Required feed ingredients for making diet for experimental birds were supplied by the Poultry Farm of BAU. Vitamin-mineral premixes were purchased from the local market of Mymensingh district town. The premixes Supramix layer of Jayson Agrovet, Acimix super-L of ACI and Adivit-L of FNF company were considered for experimental purpose.

The experimental house was first made clean and disinfected by using disinfectant to avoid microbial contamination. The feeder, waterer and feed container also cleaned and disinfected. Then birds were transferred gently in clean laying cages and randomly to avoid biasness. The caged birds were allowed two weeks to adjust before feeding test diets. A diet without vitamin-mineral premix was given to the experimental birds of all treatments for a week to observe the actual effect of premix in subsequent experimental period. Locally available feed ingredients supplied by BAU Poultry Farm formulated diets. Here, it is notable that the amount of all ingredients for four diets of the treatments was same. The requirements of ME, CP, critical and limiting amino acids, Ca and P content were satisfied according to the recommendation of Shaver Breeding company, Canada.

The samples of supplied feed ingredients were made for chemical analysis. Samples of feed ingredients (wheat, fish meal, soybean meal, rice polish, bone meal, sesame oil cake and oyster shell) were stored in airtight screw capped bottles for subsequent chemical analysis. Samples of feed ingredients were analyzed to determine dry matter (DM), crude protein (CP), crude fibre (CF), ether extract (EE), nitrogen free extract (NFE) and total ash in the Poultry Science Laboratory following the standard procedures of proximate analysis. Analytical procedures to determine crude protein (CP), crude fibre (CF), total ash, and ether extract (EE) content of all the feed ingredients were performed following A.O.A.C. (1990) and Krishna and Ranjhan (1980).

The experimental birds were exposed to similar care and management through out the experimental period. At the same time, strict care was maintained to protect pullets from unhealthy condition. The day length was less than 16 hours during the experimental period. So a provision was made by using 60-watt electric bulb to meet up 16 hours light per day for maximum laying performance according to the recommendation of Shaver 579 Breeder Company. Feeder and waterer were cleaned and disinfected regularly to avoid microbial contamination. The floor of the experimental house was cleaned regularly. The experimental diets were prepared weekly and stored in tin container. Feed and water was offered twice daily, once in the morning and again in the afternoon in such a way that feeders and waterers were not kept empty.

The eggs laid by the experimental birds were collected two times daily i.e., in the morning at 11 o'clock and in the afternoon at 3.30 PM. Treatment wise body weight of birds were taken at the beginning of the experiment and then fortnightly to monitor the change in body weight during the experimental period. Weekly feed consumption for each treatment was recorded by subtracting the left over of the feed from the total amount

Table 1: Layout of the experiment

Treatment group	Total No. of birds in each treatment group	Treatment
T1	24	Control (without premix)
T2	24	Basal+0.025% Supramix Layer premix
T3	24	Basal+0.025% Acimix Super-L premix
T4	24	Basal+0.025% Adivit-L premix

of feed supplied to the respective treatment. The number of eggs laid by each treatment was recorded daily and weighed just after collection in replication wise. In case of broken or abnormal eggs, weights were considered as average of the eggs laid by the same replication of the treatment on the same day. Replication wise the number of broken eggs were recorded daily. Any kind of shell broken of eggs was recorded.

The collected data on laying performance and egg quality characteristics were analyzed using a package program Stat Graphics (1993). Data for different variables were subjected to analysis of variance in Completely Randomized Design (CRD) (Steel and Torrie, 1980). Multiple comparisons were made where ANOVA showed significant differences. Duncan's Multiple Range Test (Duncan, 1955) was used to compare the pair of mean values.

Results and Discussion

The data obtained during the experimental period were analyzed and the results were presented in the Tables. For proper interpretation each table was discussed separately.

Comparison among the composition of different commercial vitamin-mineral premixes: To evaluate the efficacy of different commercial vitamin-mineral premixes, it is necessary to know the comparative composition of each premix. For this purpose, the comparative composition of the vitamin-mineral premixes was shown in Table 2. Here, it was evident that most of the contents of premixes were more or less similar except little differences in vitamin K_3, vitamin B_{12}, folic acid, choline, cobalt and iron. The lowest amount of vitamin K_3, folic acid, cobalt, iron and iodine were observed in the premix Adivit-L. On the other hand, choline chloride was fully absent in the Adivit-L premix. Both lysine and B.H.T. were absent in Supramix layer premix but in Adivit-L only B.H.T. So, it was observed that the printed composition of the three vitamin-mineral premixes more or less similar except for few vitamins and minerals content. But during the 16 weeks trial period significant differences in productive performance of the pullets were observed. This might be occurred due to poorer quality Adivit-L premix. In this regard, it may be mentioned that the result of Jakic-Dimic *et al.* (1997) who evaluated the quality of vitamin-mineral premixes obtained locally or from abroad and reported that manufacturers employed different approaches and these could have decisive effect on feed quality. They also reported that there were noticeable discrepancies between the declared and the actual contents of premixes. They observed different growth performances in feeding trial on poultry with various premixes.

Effect of vitamin-mineral premixes on productive performance

Feed intake: Daily feed intake of the four treatments were 115.22 g, 116.05g, 115.25g, and 115.18g for control (without premix), Supramix-Layer, Acimix Super-L and Adivit-L respectively (Table 3). These data did not differ significantly. This might be occurred because vitamin and mineral did not have profound influence on feed intake of bird.

Body weight: The body weight gain of experimental birds were recorded biweekly during the experimental period. The body weight gain of different treatments were 46.0 g, 61.0 g, 51.33 g and 40.33 g for control, Supramix Layer, Acimix Super-L and Adivit-L respectively (Table 3). Statistically these body weight gain data were non significant ($P>0.05$). This might be the result of insignificant feed consumption level of pullets during the trial period. Ali *et al.* (1985) observed no significant body weight gain using diet supplemented with commercial or home made vitamin-mineral premixes. However, the highest body weight gain was obtained by the Supramix Layer treatment (61.0g) and the Acimix Super-L treatment group obtained the second highest (51.33g) body weight gain. These might occurred due to the presence of choline content of diet, which was supplemented through the premix of both treatment groups. But choline was absent in the control and the premix Adivit-L group (Table 2). This result supported the observation of Tsiagbe *et al.* (1987) who observed improvement in body weight gain of chick with choline supplementation. Reza *et al.* (1983) also reported lowest body weight gain in broiler fed diet without premix.

Egg production: Hen-day egg production percent of the treatments differed significantly ($P<0.01$) (Table 3). The highest (75.4%) egg production percent was obtained using the premix Supramix Layer. Statistically similar result (74.12%) was also obtained using the premix Acimix Super-L. Use of premix Adivit-L resulted in 65.99% egg production. On the other hand, the treatment without premix caused the poorest egg production

Table 2: Comparative composition of different vitamin-mineral premixes (per kg)

Content	Supramix Layer (Jayson)	Acimix-Super-L (ACI)	Adivit-L (FNF)
Vitamin A (IU)	48,00000	48,00,000	48,00,000
Vitamin D_3 (IU)	9,60,000	10,00,000	9,60,000
Vitamin E (mg)	8,000	8,000	10,000
Vitamin K_3 (mg)	800	1,600	0.8
Vitamin B_1 (mg)	800	600	600
Vitamin B_2 (mg)	2,000	2,000	2,000
Nicotinic acid (mg)	12,000	12,000	12,000
Pantothenic acid (mg)	3,200	4,000	3,500
Vitamin B_6 (mg)	1,600	1,600	1,600
Vitamin B_{12} (mg)	4	4	4
Folic acid (mg)	320	200	20
Biotin (mg)	20	20	16
Choline chloride (mg)	1,00,000	1,00,000	-
Zinc (mg)	16,000	16,000	16,000
Copper (mg)	2,400	2,400	2,500
Cobalt (mg)	100	120	10
Iodine (mg)	200	240	25
Iron (mg)	9,600	9,600	10,000
Selenium (mg)	48	48	50
Manganese (mg)	20,000	19,200	20,000
Methionine (mg)	20,000	20,000	20,000
Lysine (mg)	-	12,000	15,000
B.H.T. (mg)	-	20,000	-

(62.5%), which was statistically similar to Adivit-L group. These results might occurred due to the continuous absence of essential vitamin-mineral in the control (without premix) group and poor quality of premix in Adivit-L group. Banerjee (1988) was on the opinion that diets continuously deficient in any one of the required vitamins will seriously tell initially upon the egg production of chickens. On the contrary, high egg production was occurred in Supramix layer and Acimix Super-L treatment due to continuous presence of essential vitamins and minerals in the diet, which was supplied through these premixes. Sato *et al.* (1994) observed that vitamin A deficiency lowered the egg production but high levels of vitamin-A improved egg production rapidly. Bartov *et al.* (1990) reported that high doses of vitamin E improved the egg production. Panda and Reddy (1976) reported that a marked deficiency of any one or more of calcium, manganese, protein, vitamin A, vitamin D, riboflavin and choline, causes a reduction or even a cessation of egg production. In case of treatment Adivit-L moderate egg production was obtained which might be due to poor quality of premix. This inference was supported by the opinion of Jakic Dimic *et al.* (1997) who evaluated the quality of vitamin-mineral premix and concluded that there were noticeable discrepancies between the declared and the actual content of premixes.

So it could be assumed that high production occurred in Supramix layer and Acimix Super-L group because these premixes were rich with the above-mentioned nutrients. But the diet of control and Adivit-L group were not properly supplemented with the proper amount and proportion of these nutrients because control group was treated without premix and Adivit-L premix might be of poorer quality. Especially choline content was totally absent in the premix Adivit-L (Table 2).

Egg weight: The egg weight of the four treatments differed significantly ($P<0.01$). The egg weights of different treatments were 54.28 g, 57.15g, 56.57g and 55.09g for control, Supramix Layer, Acimix Super-L and Adivit-L respectively (Table 3). It appears from the table that statistically similar egg weight was achieved for Supramix Layer and Acimix Super-L treatment. These might be due to the presence of appropriate level of choline, vitamin E, methionine and vitamin B_{12} in the diets, which were supplemented with these premixes. Miles *et al.* (1986) showed that for maximum egg size adequate sulfur amino acids must be present in the diet because supplementing choline will not maximize egg size. Similarly Saly *et al.* (1996) observed that vitamin E increased egg weight. Michael and Edward (1992) reported that vitamin B_{12} increased egg weight when the diet contained 8.0 µ/kg of vitamin B_{12}. On the other hand comparatively lower and statistically similar egg weight was obtained for the treatment control (without premix) and the Adivit-L. Since no premix was supplied in the control group, so it might occur. The absence of appropriate levels of required vitamin and mineral in Adivit-L premix showed result approximately similar to control.

Table 3: Productive performance of pullets of different treatments (25-40 weeks of age)

Variable	Dietary Treatments				Level of significance
	Control (without premix)	Supramix Layer	Acimix Super-L	Adivit-L	
Feed intake (g/bird/day)	115.22±0.925	116.0±0.508	115.25±0.478	115.18±0.571	NS
Body weight gain (g)	46.0±4.163	61.0±8.718	51.33±4.91	40.33±4.177	NS
Hen-day egg production (%)	62.5^{b}±1.461	75.4^{a}-±0.568	74.12^{a}±1.553	65.99^{b}±0.599	**
Egg-weight (g/egg)	54.28^{b}±0.405	57.15a±0.312	56.57^{a}±0.159	55.09^{b}±0.254	**
Egg mass (g/pullet/day)	33.98^{b}±0.835	42.98^{a}±0.637	41.91^{a}±0.893	36.48^{b}±0.217	**
Feed conversion ratio (FCR)	3.43^{a}±0.08	2.68^{c}±0.009	2.77^{c}±0.012	3.19^{b}±0.007	**
Broken egg (%)	411^{a}±0.422	1.14^{c}±0.283	1.31^{c}±0.241	2.73^{b}±0.062	**
Livability (%)	99.13±0.87	100.00±0.00	99.56±0.437	99.13±0.87	NS

Values bearing different superscripts in a row differ significantly. Values indicated ± standard Error, NS=Non Significant, **, P<0.01

Egg mass: There were significant differences (P<0.01) among the egg mass data of the four treatments (Table 3). High and statistically similar egg mass output were obtained for Supramix layer (42.98g) and Acimix Super-L (41.91g). Statistically similar results were observed for Adivit-L (36.48g) and control group (33.98) although the data showed significantly higher values for other diet groups. This result was probably attributed due to the absence of supplementation of any premix to the control diet. In this reference it might be mentioned that Bhowmik (1996) observed that use of diet supplemented with premix caused the highest egg mass output and control diet (without premix and vegetables) causes the lowest egg mass output.

Feed conversion ratio: The data of feed conversion ratio of the four treatments varied significantly (P<0.01) (Table 3). Reasonable feed efficiency data were obtained for the treatment Supramix layer (2.68) and Acimix Super-L (2.77). But poorer feed utilization was occurred in the control (3.43) and Adivit-L (3.19) group. Since feed intake of the four treatments were more or less similar, this result probably a reflection of lower production for the respective treatments. Choline is capable of increasing the feed conversion efficiency (Pesti *et al*., 1979). But this content was not supplemented in the diet of control and Adivit-L group. The printed composition on the package of Adivit-L vitamin-mineral premix indicated the absence of choline. On the other hand choline was supplemented in the diet of Supramix layer and Acimix super-L group through the respective premixes. This might probably be a reason for the low feed conversion ratio of those groups. This result indicates that birds will not produce enough if their diet is not supplemented with standard quality premix. Reza *et al*. (1983) also observed such a low pattern of production in a experiment using diets with and without premixes.

Broken egg percent: Broken egg percent of caged laying pullets of different treatments differed significantly (P<0.01) (Table 3). Statistically similar broken egg percent was observed in Supramix Layer (1.14%) and Acimix Super-L (1.31%) group and 2.73% broken egg percent was observed in Adivit-L group. These variations might be due to the actual presence of vitamin D_3, Mg, Mn in the commercial premixes, which were essential for the production of strong eggshell. Charles *et al.* (1990) reported that optimal dietary level of vitamin D_3 for improving eggshell quality without affecting egg production was approximately 5µg/mg. In the control group no vitamin D_3 or other shell forming contents was supplemented through premix and so high broken egg per cent (4.11%) was observed. Singh and Panda (1988b) reported that nutritional factors affecting shell strength include the dietary level of calcium, phosphorus, magnesium, manganese and vitamin D_3. Deficiency of vitamin D_3 in the diet reduces shell strength by decreasing the absorption of calcium from the intestines.

However, in terms of actual productive performance criteria of pullets higher number of broken eggs were observed in every treatment probably due to absence of limestone or oyster shell grit in cages which are extra sources of calcium during laying period. Proudfoot and Hulan (1987) revealed that supplementation of limestone grit as extra source of calcium during laying period resulted in improved shell strength. On the other had Keshavaraz and Nakajima (1991) reported that presence of oyster shell had beneficial effect on shell quality even when diet contains generous level of Ca. Another reason might be the high environmental temperature of summer season in which (April-July) the experiment was conducted. High panting of birds cause loss of CO_2 from the blood which in turn resulted in thin-shelled eggs. Gnanamani (1978) revealed that high panting cause increased loss of CO_2 through expired air and this loss of CO_2 from blood of bird will reduce the acidity of the blood which cause reduced level of blood calcium and ultimately resulting in lesser and thin shelled eggs.

Livability: The livability per cent of the four treatment group were not differed significantly (P<0.05) (Table 3). Five birds died on the same day due to heat stroke of which 2 from control, 2 from Adivit-L and 1 from-Acimix-L group. There was no bird died due to treatment effect.

Ghodasara *et al.* (1992) reported that 6.81% laying bird might be died due to heat stroke. This result indicated that absence of commercial vitamin-mineral premix for a limited period in the diet had no dramatic effect on the survivability of bird. No bird was died in the group, which was treated with Supramix layer premix. Most probably vitamin E content was effective for this treatment, which was supplied to the diet through premix. This argument might be supported by the investigation of Bollengier *et al.* (1999) who reported that dietary supplementation of 250 mg vitamin E/kg before, during and after heat stress was optimum for alleviating at least in part the adverse effects of chronic heat stress of laying hens.

Conclusion: From the results of the experiment it is concluded that use of commercial vitamin-mineral premix to supplement the layer diet is inevitable for obtaining desirable production performance. And extra care must be taken for caged laying pullets during summer season in terms of supplementation of vitamins and minerals to the diet to reduce the broken egg per cent. And the efficacy of all marketed commercial vitamin-mineral premixes was not equal rather the quality of some premixes is questionable. So, it will be good enough if government make strict rules and regulations in the light of experience of developed country during importation and marketing of nutritional and medicinal products of poultry.

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