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The Use of Prebiotic and Organic Minerals in Rations for Japanese Laying Quail

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Abstract: The aim of this research was to evaluate the effects of prebiotics and organic minerals usage upon both the productive performance and the eggs internal and external quality of quail. 300 Japanese laying quails (*Coturnix coturnix japonica*) was used, from 13 to 28 weeks of age, distributed in a completely randomized design, with five treatments and six replicates and 10 quails per experimental unit. Treatments consisted in T1 - Control (neither Bio-Mos nor Bioplex Repro), T2 (0.5 kg/ton Bio-Mos), T3 (1.0 kg/ton Bio-Mos), T4 (0.5 kg/ton Bio-Mos + 1.0 kg/ton Bioplex Repro and T5 (1.0 kg/ton Bio-Mos + 1.0 kg/ton Bioplex Repro). It was not verified effect of the treatments on the weight of eggs, feed conversion by egg dozen and feed conversion by egg mass. Notwithstanding, feed intake, egg production and mass were influenced, being the best production and egg mass (79.8% and 10.2 g/bird/day, respectively) observed under a diet containing 0.05% of Bio-Mos (prebiotic) to Japanese laying quails.

Key words: Quail, egg production, internal quality of egg, external quality of egg

Introduction

The intestinal epithelium acts as a natural barrier against pathogenic toxin substances existing in the intestine. Stress agents, pathogenic and chemical substances may cause damage to the micro flora or to the intestinal epithelium, resulting in some alteration of this natural barrier permeability, easing the invasion of pathogenic and toxic substances and modifying both the metabolism and the capacity for digestion, as well as the absorption of nutrients, with the possibility of a chronically mucosal inflammation process, disturbing, thus, the birds performance.

Due to the restriction of the use of antibiotics in animal rations (which promote growing), there comes the necessity of studies on alternative products that can replace them, in order to keep the final products high level of productivity and quality. Prebiotics have been appointed as possible substitutes for antibiotics and have their effectiveness based on the decreasing of various enteropathogenic bacteria through pH reduction, which results from a rising in the production of lactic acid in the ceca (Juskiewicz *et al*., 2004). Some bacteria can recognize linking spots in the prebiotics molecules, reducing the colonization of the intestinal mucous.

Allied to the improving of the intestinal health, one can also obtain a higher absorption of nutrients through diet manipulation. Studies with organic or quelated minerals have been developed, aiming at guaranteeing the mineral absorption by the intestinal treat, without entering the process of ionic competition (ionic pressure of the intestinal mucous), commonly determined by the presence of a higher concentration of the mineral ions. Organic minerals differentiate themselves for optimizing the absorption of essential micro minerals for the majority of the physiological processes. Such optimization makes certain phenomena more efficient, as the development of the immunological system (Zn, Nn and Cu); blood circulation, bone formation (Zn); fathering (Se) and other processes in which the micro minerals participate, either direct or indirectly.

Trace mineral requirements are typically met via feed ingredients. Supplementation usually involves a premix composed of minerals in their elemental salt forms. In contrast, organic minerals are typically chelates composed of peptides or amino acids. Leeson (2005) stated that inorganic trace minerals have a wide range of availability (40 to 78%) and the addition of a peptide improves the bioavailability of the mineral complex (90 to 95%). The difference in bioavailability is most likely due to how organic minerals are absorbed through the brush border membrane and the increased stability of the complex in the lumen of the gastrointestinal tract. However, Novak and Troche (2007) comment than although trace minerals are relatively cheap to supplement, high supplementation may lead to environmental concerns regarding excess trace mineral excretion. The increased bioavailability of organic minerals may allow for more efficient incorporation of minerals into tissue and thus correct for excess mineral excretion.

Therefore, this experiment was designed to evaluate the effects of prebiotics and organic minerals usage upon both the productive performance and the eggs internal and external quality of quail.

Materials and Methods

This experience was conducted in Animal Science Department of the Agrarian Science Center of the

Table 1: Composition of diets

Ingredients	T1	T2	T3	T4	T5
Corn	55.319	55.319	55.319	55.319	55.319
Soybean meal	33.656	33.656	33.656	33.656	33.656
Limestone	5.345	5.345	5.345	5.345	5.345
Soybean oil	2.695	2.695	2.695	2.695	2.695
Dicalcium phosphate	1.302	1.302	1.302	1.302	1.302
Corn gluten meal	0.616	0.616	0.616	0.616	0.616
Salt	0.454	0.454	0.454	0.454	0.454
DL-Methionine	0.104	0.104	0.104	0.104	0.104
Mineral mix	0.100	0.100	0.100	0.100	0.100
Vitamin mix	0.100	0.100	0.100	0.100	0.100
Choline Chloride 60%	0.100	0.100	0.100	0.100	0.100
Antioxidant	0.010	0.010	0.010	0.010	0.010
Inert	0.200	0.150	0.100	0.050	0.000
Bio-Mos	0.000	0.050	0.100	0.050	0.100
BioPlex Repro	0.000	0.000	0.000	0.100	0.100
Total	100.000	100.000	100.000	100.000	100.000
Calculated composition					
Metabolizable energy (kcal/kg)	2900	2900	2900	2900	2900
Crude protein (%)	20.00	20.00	20.00	20.00	20.00
Calcium (%)	2.500	2.500	2.500	2.500	2.500
Non-phytate phosphorus (%)	0.350	0.350	0.350	0.350	0.350
Potassium (%)	0.786	0.786	0.786	0.786	0.786
Lysine (%)	1.070	1.070	1.070	1.070	1.070
Methionine+cystine (%)	0.750	0.750	0.750	0.750	0.750
Methionine (%)	0.407	0.407	0.407	0.407	0.407
Threonine (%)	0.781	0.781	0.781	0.781	0.781
Tryptophan (%)	0.240	0.240	0.240	0.240	0.240

Federal University of Paraiba, PB and Brazil. The experimental period was shared five cycles of 21 days each, where 300 Japanese laying quails (*Coturnix coturnix japonica*) was used, from 13 to 28 weeks of age, distributed in an completely randomized design, with five treatments and six replicates and 10 quails per experimental unit. Isonutritive rations have been formulated, based on corn and soybean meal, according to NRC (1994). The treatments were T1 - Control (neither Bio-Mos nor Bioplex Repro), T2 (0.5 kg/ton Bio-Mos), T3 (1.0 kg/ton Bio-Mos), T4 (0.5 kg/ton Bio-Mos + 1.0 kg/ton Bioplex Repro and T5 (1.0 kg/ton Bio-Mos + 1.0 kg/ton Bioplex Repro) and compositions of diets are presented in Table 1. The utilized products are from Alltech Inc.

Variable analyzed in each period were: feed intake (g/bird/day), egg production (%), egg weight (g) and egg mass (g/bird/day), feed conversion by egg mass (kg/kg) and by egg dozen (kg/dz), yolk, albumen and shell weight (g) and percentage (%), specific gravity and yolk coloration score. Every experimental period end, rests of rations of each experimental unit was collected for feed intake calculation.

Egg collection was performed twice a day (10 am and 4 pm) and intact and defected eggs and mortality were recorded in laying frequency sheet. Egg production in percentage was calculated through the division of total egg amount per experimental unit by number of birds. Eggs from the last three days of each experimental period were individually weighed in order to obtain eggs mean weight. Calculation of egg mass was performed through the product of egg production by mean egg weight, by experimental unit. Feed conversion by egg mass was calculates through the ratio between feed intake and egg mass produced. Feed conversion by egg dozen was calculated through the ratio between feed intake and egg production and the obtained value was multiplied by twelve.

Out of the total amount of eggs collected by replicate, six unites were selected for weight and percentage determination of yolk, albumen and shell, specific gravity and yolk pigmentation. After manual separation of these components, shells were placed in 105°C stove for four hours. Percentage was obtained by dividing those variables weights by mean egg weights and next, multiplying them by 100. Yolk coloration score was determined by calorimetric fan (Roche®), which after visual comparison, it was attributed the numeric value from the fan to the most alike color of the yolk.

Specific gravity was determined by saline fluctuation method, as described by Hamiltom (1982). Every experimental period end, representative samples (two eggs) of each experimental unit were selected; further, eggs were immersed in different saline solutions with the correspondents adjustments for a volume of 25 liters of water, with densities varying from 1.060 to 1.100, with 0.0025 intervals. Eggs were placed into the buckets containing those solutions, from the lowest to the highest density and withdrew when floating, with the recording of the respective density values correspondent

Table 2: Feed intake (FI), egg production (EP), egg weight (EW), egg mass (EM), feed conversion by egg dozen (FCED) and by egg mass (FCEM) of Japanese laying quail fed rations with prebiotic and organic minerals

Treatments	FI(g/bird)	EP(%)	EW(g)	EM (g/bird/day)	FCED (kg/dz.)	FCEM (kg/kg)
T1 - Control	24.5b	72.3b	12.4	9.0b	0.405	2.714
T2 - 0.05% Bio-Mos	26.5a	79.8a	12.7	10.2a	0.399	2.628
T3 - 0.10% Bio-Mos	25.6ab	75.6ab	12.9	9.8ab	0.407	2.627
T4 - 0.05% Bio-Mos + Bioplex Repro	25.7ab	78.5ab	12.9	10.1ab	0.393	2.542
T5 - 0.10% Bio-Mos + Bioplex Repro	25.4ab	77.7ab	12.9	10.1ab	0.393	2.537
Mean	25.5	76.8	12.8	9.8	0.399	2.609
Contrasts	---------- Probability ----------					
Control vs treatments	0.0098	0.0084	0.1032	0.0026	0.2918	0.0581
Control vs Bio-Mos	0.0048	0.0184	0.1968	0.0090	0.7582	0.2398
0.05% Bio-Mos vs 0.10% BioMos	0.1404	0.1363	0.5373	0.4329	0.5554	0.9619
Without Bioplex vs with Bioplex	0.1791	0.8026	0.5899	0.5624	0.1132	0.1426
CV (%)	3.47	4.81	3.82	5.37	3.8800	5.3100

[a,b,c] Means followed by different letters in the same row differ statistically among each other, by Tukey's test, at 5% of probability Designed contrasts. 1 - Control vs Treatments = Effect of the prebiotic and organic minerals supply. 2 - Controle vs Bio-Mos = Effect of the prebiotic supply. 3 - 0.05% Bio-Mos vs 0.10% Bio-Mos = Effect of the amount of prebiotic. 4 - Without Bioplex vs with de Bioplex = Effect of the organic minerals supply in diets with Bio-Mos

to recipient solutions. Before every evaluation densities were calibrated using a petroleum densimeter.

Data will be submitted to variance analysis, being the media compared by the Turkey test, at 5% per cent of probability. The following contrasts will also be analyzed: Control *vs* Treatments (effect of the addition of Bio-Mos and Bioplex); Control *vs* Bio-Mos (effect of the addition of Bio-Mos; 0, 0.5% Bio-Mos *vs* 0.10% BioMos (effect of the used quantity of Bio-Mos); without Bioplex *vs* addition of Bioplex (effect of the addition of Bioplex on a diet with Bio-Mos).

Results and Discussion

Table 2 presents the results of the Japanese quail's productive performance after get diets with supplementation of Bio-Mos and Bioplex.

It was not verified effect of the treatments on the weight of eggs, feed conversion by egg dozen and feed conversion by egg mass ($P > 0.05$). Notwithstanding, feed intake, egg production and mass were influenced, being the best production and egg mass (79.8% and 10.2 g/bird/day, respectively) observed under a diet containing Bio-Mos (prebiotic), independent from the used quantity (0.05 or 0.10%), while the lowest production and egg mass (72.3% and 9.0 g/bird/day) was obtained under a control diet (without Bio-Mos or Bioplex).

The results observed in relation to the egg production are agreeing with Chen *et al.* (2005) observed where dietary oligofructose and insulin can increase egg production of white laying hens. However, these authors also verified improvement in the feed conversion that was not evidenced in the present study.

Ferket (2004) relates the best performance of the birds fed with mananoligosacharides (MOS) diets increase of the resistance to the intestinal pathogenic microorganisms, for improving the availability of the dietary energy, through to the reduction of the competition between bacteria and host for the starch and sugars and diminishing intestinal pH, that it suppresses the proliferation of pathogenic bacteria that excrete ammonia as by-product of the fermentation.

Working with supplying of prebiotic (Bio-Mos) and organic selenium (Sel-Plex) in laying hens diets, Stanley *et al.* (2004) observed that egg production from the Sel-Plex-fed hens was significantly higher than the control (88 versus 81%) and Bio-Mos (83.2%). Egg production of the Bio-Mos plus Sel-Plex-fed hens was also significantly higher (90%) than the control (81.4%). According these authors, the results suggested that Sel-Plex had beneficial effects on egg production and there appears to be a synergistic effect of Bio-Mos and Sel-Plex on egg production.

Observing the contrasts one can perceive that the addiction of 0.05% of BioMos in the diet is enough for keeping the best egg production and that the addiction of Bioplex in diets containing BioMos did not have any influence in the eggs production. These results has been demonstrated by Sefton and Leeson (2006) where the egg production of laying hens received supplemented diets with Bioplex did not differ that birds which had got control diet.

The applied treatments had some influence on the egg mass, being the highest values obtained with the use of 0.05% Bio-Mos. In a similar way to the results of egg production, where observing the contrasts one can perceive that the addiction of 0.05% in the diet is enough to maximize the egg mass. A probable explanation for this lies in the fact that quails present a faster food passage tax and a higher relative CR to body weigh when compared to chickens. The presence of a higher quantity of oligosaccharides in the 0.10% supplementation diet may have stimulated still more the quickness of the intestinal transit, thus reducing the nutrients digestibility in relation to the 0.05% BioMos diet.

Table 3: Albumen (AW), yolk (YW) and egg-shell weight (SW), albumen (A%), yolk (Y%) and egg-shell (S%) percentage, yolk coloration score (YCS) and specific gravity (SG) of eggs of Japanese laying quails

Treatments	AW(g)	YW(G)	SW(g)	A%(%)	Y%(%)	S%(g)	YCS	SG
T1 - Control	7.17	3.75	1.02	56.9	29.9	8.1	4.3	1.0672
T2 - 0.05% Bio-Mos	7.33	3.89	1.03	56.7	30.2	8.0	4.4	1.0717
T3 - 0.10% Bio-Mos	7.45	4.09	1.05	56.7	31.2	8.0	4.4	1.1549
T4 - 0.05% Bio-Mos + Bioplex Repro	7.52	3.88	1.05	57.4	29.6	8.0	4.2	1.0663
T5 - 0.10% Bio-Mos + Bioplex Repro	7.39	4.01	1.03	56.8	30.7	8.0	4.2	1.0667
Mean	7.37	3.93	1.04	56.9	30.3	8.0	4.3	1.0853
Contrasts	---------- Probability ----------							
Control vs treatments	0.0985	0.1136	0.5014	0.9842	0.4776	0.2386	0.8325	0.6201
Control vs Bio-Mos	0.5280	0.4619	0.2222	0.7360	0.9035	0.9425	0.8725	0.3679
0.05% Bio-Mos vs 0.10% Bio-Mos	0.9812	0.2030	0.8788	0.6346	0.1318	0.7314	0.9581	0.3120
Without Bioplex vs with Bioplex	0.6386	0.4559	0.8943	0.5139	0.4044	0.8981	0.1383	0.2594
CV (%)	4.30	6.58	4.78	2,.2	5.28	3.39	7.43	9.10

[a,b,c] Means followed by different letters in the same row differ statistically among each other, by Tukey's test, at 5% of probability. Designed contrasts. 1 - Control vs Treatments = Effect of the prebiotic and organic minerals supply. 2 - Controle vs Bio-Mos = Effect of the prebiotic supply. 3 – 0.05% Bio-Mos vs 0.10% Bio-Mos = Effect of the amount of prebiotic. 4 - Without Bioplex vs with de Bioplex = Effect of the organic minerals supply in diets with Bio-Mos.

Abdularahim *et al.* (1996) reported that the change of microbial ecology in layers' intestine might enhance their health and improve feed efficiency by the use of feeding probiotics. Chen *et al.* (2005) speculated that both prebiotic products could change the microflora in the layer's intestine, which would have effects on its development and absorptive capacity with, as a consequence, improve feed conversion ratio.

The addiction of Bioplex in Bio-Mos diets together had no efficiency in the increase of the produced egg mass ($P > 0.05$). A positive effect of the organic minerals addition upon the bird's feed conversion was expected. Although not numerically significant, one can perceive a rising of 10.08%; 7.6 and 3.6% in the CAMO and 5.2; 4.2 and 1.3% in the CADZ with the use of the association of 0.10% of Bio-Mos and Bioplex, with relation to the control treatments, 0.05 of Bio-Mos and 0.10% of Bio-Mos. Thus, it is recommendable the procedure of new evaluations, including the economical analysis.

Tucker (2004) observed that organic mineral supplementation improve either egg weight or production around 1% and increase 2% egg mass.

The results of the internal and external quality of the eggs are showed in Table 3.

The variable of internal and external quality of eggs had not been significantly influenced by the experimental treatments.

In study developed will be Stanley *et al.* (2004), was verified that the eggs from the Sel-Plex fed hens weighed significantly more (68.13 g), had heavier yolks (31.9 g) and albumen (59.8 g), compared to the control (63.20%, 18.12g (28.7%) and 35.03g (55.4%), respectively). Sel-Plex plus Bio-Mos fed hens produced yolk (20.68g) and albumen (39.02g) significantly heavier than control (18.12% and 35.51%, respectively). Eggs from the Bio-Mos-fed hens were significantly heavier than the control (65.41g vs 63.21g). However, yolk and albumen weight from Bio-Mos-fed hens [19.42g (29.7%) and 35.91g (54.9%), respectively] did not differ significantly from the control [18.12g (28.7%) and 35.51g (56.2%), respectively]. Hens fed Bio-Mos supplemented-feed had significantly larger eggs (65.41g), yolk [19.38g (29.6%)] and albumen weight [(35.93g (54.93%)] compared to the control [63.14g, 18.07g (28.62%) and 35.47g (56.18%), respectively].

Chen *et al.* (2005) had observed that dietary oligofructose and insulin can increase egg production and feed efficiency of layers without impairing egg quality. In research developed to Tucker (2004) the organic mineral supplementation (Bioplex trace minerals) in laying hen diets resulted in higher degree of mineralization and greater egg density, an increase in eggshell strength and reduction in the number of cracked eggs.

Conclusion: The addition of 0.05% of Bio-Mos in the diets improved the performance of Japanese laying quails.

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