EFFECT OF DIETARY SUPPLEMENTATION OF CALCIUM, CARNITINEAND ZINC ON FERTILITY OF CROSS-BRED CHICKEN

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ABSTRACT

An experiment was conducted to study the effect of dietary supplementation of calcium, carnitine, zinc and their combinations for 5 weeks in eighty adult cross-bred cocks which were divided into eight treatment groups each consisting of ten cocks. Cocks were fed with treatment diets. The treatment groups consisted of control (T_1), control + calcium 2 per cent (T_2), control + carnitine 250 mg/kg (T_3), control + zinc 100 mg/kg (T_4), control + calcium 2 per cent + carnitine 250 mg/kg (T_5), control + calcium 2 per cent + zinc 100 mg/kg (T_6), control + carnitine 250 mg/kg + zinc 100 mg/kg (T_7) and control + calcium 2 per cent + carnitine 250 mg/kg + zinc 100 mg/kg (T_8). Semen volume revealed no significant difference between treatment groups during five weeks period. Overall sperm motility was significant (P<0.01) between treatment groups except between T_4 and T_5 groups. Inclusion of calcium 2 per cent, carnitine 250 mg/kg, zinc 100 mg/kg and their combinations in cross-bred cock diet improved the fertility rate.

Key words: Calcium, Carnitine, Crossbred, Fertility and Zinc

INRODUCTION

Large-scale production of hatching eggs is the primary goal of the poultry breeder industry. Profitable poultry farming depends on quality chick, feed and good management. Many hatcheries rear their own parent stock in cages where artificial insemination is commonly practiced for the production of commercial layer and broiler chicks. This technique of artificial insemination (AI) has the advantage that one cockerel can be used to inseminate 20 to

30 hens; while in natural mating one cockerel can be utilized for 8 to 10 hens. Hens can lay a series of fertilized eggs over a period of 7 to 10 days following a single insemination. The use of AI will reduce the cost of production of day-old chicks.

Nutrition plays a pivotal role in fertility and subsequent reproduction. In addition to a well-balanced diet, supplementation with specific nutrients can contribute directly to fertility and reproductive success. Among that, amino acids and minerals either individually or in combination will help to improve the semen quality when they are included in the poultry breeder diet. Lysine and methionine are the most critical amino acids. Carnitine is a quaternary amine whose structure resembles that of an amino acid. The amino acids lysine and methionine act as precursors. The vitamins B_6, B_{12}, C, folic acid and niacin and the trace element iron are also necessary as catalysis for the synthesis of L-carnitine (Harmeyer, 2002). So carnitine can be used in poultry breeder diet for the replacement of amino acids.

Calcium accounts for 56 per cent of the motility-stimulating activity of fowl seminal plasma and also fowl seminal plasma restores and stimulates the motility of fowl spermatozoa at 40°C in presence of calcium (Ashizawa and Wishart, 1987). Calcium recommended in cocks diet for attaining good semen quality could not be the same as recommended for female (Khalil *et al.*, 2012). Supplementing the diet of broiler breeder males with zinc resulted in significant improvement in histological traits of testes. Therefore, adding zinc to the diet could be used as an efficient tool for improving reproductive performance of roosters (Al-Daraji and Amen, 2012).

MATERIALS AND METHODS

The biological experiment was conducted in eighty cross-bred cocks at the age of thirty weeks by feeding diet containing calcium, carnitine, zinc and their combinations.The experiment was designed and conducted for a period of five weeks during winter season (December 2012 - January 2013) at the Poultry Farm Complex, Department of Poultry Science, Veterinary College and Research Institute, Namakkal,which is situated in North-Western agro-climatic zone of Tamil Nadu at 11.2°N and 78.2°E at an altitude of 404 m above the mean sea level.

Experimental diet

The experimental diet was formulated according to the standards prescribed in Bureau of Indian Standards (B.I.S., 1992). The treatments includes, Control (T_1), Calcium 2 per cent (T_2),

Carnitine 250 mg/kg (T_3), Zinc 100 mg/kg (T_4), Calcium 2 per cent + Carnitine 250 mg/kg (T_5), Calcium 2 per cent + Zinc 100 mg/kg (T_6), Carnitine 250 mg/kg + Zinc 100 mg/kg (T_7) and Calcium 2 per cent + Carnitine 250 mg/kg + Zinc 100 mg/kg (T_8). The diets were subjected to proximate analysis as per A.O.A.C., 1995. During the period of study, the average minimum and maximum temperature and relative humidity recorded were 19.24 ± 0.24 and 31.92 ± 0.22°C and 46.84 ± 1.44 and 73.07 ± 1.37 per cent, respectively(Anonymous, 2012).

Semen collected from each treatment group was inseminated twice in a week to ten cross-bred hens maintained in individual cages under uniform management conditions. They were fed with normal layer breeder diet.

RESULTS AND DISCUSSION

Statistical analysis revealed that there was highly significant ($P<0.01$) difference observed with regard to overall fertility percentage in all treatment groups fed with calcium, carnitine, zinc and their combinations except T_4 and T_7 and the highest fertility percentage was observed in T_8 group. The combination of all three supplements showed best fertility rate.

The increase in intracellular Ca^{2+} lead to high sperm motility and which subsequently improved the fertility of cocks. Increased fertility in L-carnitine supplementation might be due to increased sperm concentration and decrease in sperm lipid peroxidation or its antioxidant properties thatmight preserve sperm membranes in roosters, thereby extending the life span of sperm.

These findings are in accordance with the findings of Kidd *et al.* (1992), El-Aziz *et al.* (2004), Adabi*et al.* (2006) and Khalil *et al.* (2012)who demonstrated that calcium and carnitine supplemented cocks showed significantly increased fertility percentage.

In contrary, Sarica*et al.* (2007) showed no significant effect in L-carnitine (250 or 500mg/kg) supplemented group in which fertility rate showed numerically a negative correlation with the age of the male Japanese quail breeders but was positively correlated with dietary L-carnitine supplementation. Similarly, Amen and Al-Daraji (2011) noticed significant ($P<0.05$) difference in fertility rate of zinc (100mg/kg) supplemented groups in broiler breeder birds which was conducted for a long duration.

SUMMARY

Inclusion of calcium 2 per cent, carnitine 250 mg/kg, zinc 100 mg/kg and their combinations in cross-bred cock diet improved the fertility rate.

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Table 1

Ingredients and nutrient composition (%DM) of breeder ration

Ingredients (kg)	Male breeder ration								Female breeder ration
	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8	
Maize	44.20	44.20	44.20	44.20	44.20	44.20	44.20	44.20	47.0
Soyabean meal	21.00	21.00	21.00	21.00	21.00	21.00	21.00	21.00	21.5
De-oiled rice bran	32.00	32.00	32.00	32.00	32.00	32.00	32.00	32.00	11.0
Sun Flower Oil Cake	-	-	-	-	-	-	-	-	10.0
Shell grit	2.30	**2.57**	2.30	2.30	**2.57**	**2.57**	2.30	**2.57**	**06.5**
Calcite	-	-	-	-	-	-	-	-	03.0
Di-calcium phosphate	-	-	-	-	-	-	-	-	0.25
Total	**99.50**	**99.57**	**99.50**	**99.50**	**99.57**	**99.57**	**99.50**	**99.57**	**99.25**
Supplements									
Salt	0.290	0.290	0.290	0.290	0.290	0.290	0.290	0.290	0.370
Ultra TM[1]	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100	0.100
Us Cura tax[2]	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	-
Hyblend[3]	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.015
Meriplex[4]	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.025
Livoliv[5]	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030	0.030
DOT/Coxitec[6]	0.050	0.050	0.050	0.050	0.050	0.050	0.050	0.050	-
Choline chloride	-	-	-	-	-	-	-	-	0.100
Bioplex Zinc[7]	-	-	-	0.033	-	0.033	0.033	0.033	-
Carniking[TM 8]	0.000	0.000	0.050	0.000	0.050	0.000	0.050	0.050	-
Sodium bicarbonate	-	-	-	-	-	-	-	-	0.050
Methionine	-	-	-	-	-	-	-	-	0.100
Total	**0.564**	**0.564**	**0.614**	**0.597**	**0.614**	**0.597**	**0.647**	**0.647**	**0.79**
Nutrients (%)									
Moisture	11.33	11.73	11.88	11.90	11.53	11.24	11.66	11.64	10.34

Crude protein	18.73	18.88	18.73	18.73	18.92	18.79	18.90	18.85	17.48
M.E (kcal/kg)*	2501	2503	2515	2502	2519	2502	2523	2521	2602
Crude fibre	5.49	5.12	5.23	5.45	5.43	5.32	5.18	5.45	7.98
Ether extract	2.13	2.43	2.23	2.21	2.54	2.10	2.24	2.34	1.90
Total ash	7.43	7.70	7.16	7.18	7.46	7.10	7.73	7.45	6.90
Nitrogen free extract*	54.89	54.14	54.77	54.53	54.12	54.45	54.29	54.27	55.4
Calcium	1.05	**2.00**	1.03	0.99	**2.00**	**2.00**	1.00	**2.00**	3.37
Carnitine	0.000	0.000	**0.025**	0.000	**0.025**	0.000	**0.025**	**0.025**	-
Zinc	0.005	0.005	0.005	**0.01**	0.005	**0.010**	**0.010**	**0.010**	-
Available phosphorus	0.73	0.65	0.69	0.75	0.71	0.74	0.68	0.72	0.53
Sand and silica	2.05	2.15	2.18	2.25	2.12	2.06	2.35	2.15	2.65

*Calculated values.

[1]Ultra TM – Each 5 kilo gram contains manganese – 270gm, zinc – 260gm, iron – 100gm, iodine – 10gm, copper – 10 gm, cobalt – 5gm, selenium – 1.5gm

[2]Us Cura tax – mixture of silicates, cross linked insoluble poly vinyl pyrrolidone homo-polymer, mannon oligosaccharides and yeast cell wall extracts, activated charcoal, XMB factors, multi organic acids, lipotropic factors.

[3]Hyblend – nutritional value per gram- vitamin A – 82500IU, vitamin B2 – 50 mg, vitamin D3 – 12000IU, menaphthone sodium bisulphate, and vitamin K – stabilized – 10mg.

[4]Meriplex – each gram contains – vitamin B1 – 8mg, vitamin B6 – 16 mg, vitamin B12 – 80 mcg, vitamin E50 – 80 mg, niacin – 120mg, folic acid – 8mg, calcium D pantothenate – 80mg, calcium – 86 mg.

[5]Livoliv - nutritional information – fat, protein, crude fibre, carbohydrate, minerals, natural enzymes.

[6]DOT/Coxitec – Contains 120g/Kg

[7]Bioplex Zinc – Contains 15% Zinc Proteinate[8]Carniking™ – Contains L-Carnitine 48-52%.

Table 2

Mean (±S.E.) fertility percentage of cross-bred cocks fed with calcium, carnitine, zinc and their combinations

Period after start of experiment	Treatments							
	T_1	T_2	T_3	T_4	T_5	T_6	T_7	T_8
I Week	88.89	92.31	95.00	92.86	92.86	91.67	88.89	93.33
II Week	83.33	93.33	92.86	92.86	92.86	100.00	91.67	93.33
III Week	91.67	94.44	94.12	94.12	100.00	100.00	93.33	100.00
IV Week	80.00	100.00	100.00	93.75	100.00	100.00	94.12	100.00
V Week	80.00	100.00	100.00	95.00	100.00	100.00	94.44	100.00
Overall (I-V weeks)	84.78^{B} ±2.37	96.02^{A} ±1.66	96.39^{A} ±1.51	93.72^{AB} ±0.41	97.14^{A} ±1.75	98.33^{A} ±1.67	92.49^{AB} ±1.02	97.33^{A} ±1.63

$^{A-B}$Means having common superscript within a row do not differ significantly (P<0.01)