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Supplementation of Multiple Enzymes and Organic Trace Mineral Supplementation to the Diets Containing Sub-Optimal Energy on Performance and Carcass Traits of Commercial Broilers

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ABSTRACT

An experiment was conducted to study the performance and carcass parameters of broilers fed with sub-optimal metabolizable energy (100 and 200 kcal/kg less ME) diets supplemented with multiple Enzyme (400g/ton feed) and organic trace mineral supplement. A total of 300-day-old commercial broiler chickens were distributed in a completely randomized design into 6 treatments with 10 replicates of 5 chicks each. Treatments comprised of T_1- basal diet (BD) without enzyme (EZ) or organic mineral (OM) supplementation; T_2- 100 kcal/kg less metabolizable energy (ME) without EZ and OM (BD 1); T_3- 100 kcal/kg less ME with EN (BD1+EZ); T_4- 200 kcal/kg less ME without EN and OM (BD 2); T_5- 200 kcal/kg less ME with EZ (BD2+EZ); T_6- BD with organomin supplementation (BD+OM).The results revealed significantly ($P<0.05$) improved body weight in all dietary treatments groups except BD2 (200 kcal/kg less ME without EN and OM) at 6 weeks of age. Significantly ($P<0.05$) higher feed intake was observed in BD1+EZ, BD+OM and BD1 compared to control and other treatment groups. No significant difference was recorded in feed efficiency among different dietary treatments. All dietary treatments failed to exert any significant ($P>0.05$) influence on various carcass parameters except abdominal fat which was significantly high in BD+OM group compared to other treatments.

Key Words: Body weight, Carcass traits, Enzymes, FCR, Organic minerals

INTRODUCTION

It has been recognized that poultry diets contain variable levels of poorly digested NSP including arabinoxylans, glucons and pectin that are not well digested by poultry (Adams and Pough, 1993). Subsequently, water intake increases and undesirable ileal microbial fermentation starts, thus increasing moisture in the excreta and resulting in potential diarrhea (Dunn, 1996). However, the most detrimental effect of NSP is the reduced access of endogenous enzymes to feed particles and nutrients trapped in this carbohydrate water matrix resulting in decreased feed digestibility. In the recent past, exogenous feed enzymes have been developed to degrade these anti-nutritive factors and ameliorate their negative effects. The beneficial effect of the NSP degrading enzymes is primarily the reduction in the viscosity in gastrointestinal tract and secondarily the release of sugars. There is report which indicate positive influence of organic mineral supplementation on performance of broilers (Srinivasa Rao *et al.* 2018). Thus, it would be of interest to see the efficacy of supplementation organic trace elements vis-à-vis exogenous enzyme supplementation. In view of the above, this experiment was designed to evaluate the effect of multiple enzyme and organic minerals supplementation on growth performance and carcass characteristics of broilers.

MATERIALS AND METHODS

A total of 300-day-old commercial male broiler (*Cobb* 400) chicks were procured, wing banded and weighed individually. Ten replicates were allocated to each of the treatments (6), employing five birds/replicate. Six experimental diets were prepared as follows: T_1- basal diet (BD) without enzyme or organic mineral supplementation (BIS, 2007); T_2- diet having 100 kcal/kg less metabolizable energy (ME) without enzyme and organic trace mineral supplementation (BD 1); T_3- diet having 100 kcal/kg less ME with enzyme (40 0g/ton feed) supplementation (BD1+EZ); T_4- diet

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having 200 kcal/kg less ME without enzyme and organic mineral supplementation (BD 2). T5- diet having 200 kcal/kg less ME with enzyme (400g/ton feed) supplementation (BD2+EZ); T6- Basal diet with organomin supplementation (BD+organomin). Ingredients and nutrient composition of the experimental diets are detailed in Table 1. A non-starch polysaccharide degrading enzyme preparation was used which contained amylase, galactosidase, cellulase, beta-glucanase, lipase, phytase, pectinase, proteinase, xylanase, mannanase and *Bacillus sporogenes*. Organic trace minerals were produced by fermentation of yeast with minerals. During the fermentation, yeast peptides complex with minerals to form organic mineral proteinates (multiple enzyme and organic trace mineral was supplied by Zeus Biotech Limited, Hyderabad).

The individual body weight of chicks and replicate-wise feed intake were recorded at weekly intervals throughout the experimental period (0-42 days) and weekly feed conversion ratio was calculated. At 42nd day of age, one bird from each replicate of a dietary treatment was slaughtered through cervical dislocation after fasting for ten hours with free access to water. The ready to cook yield, breast, liver, abdominal fat weights and weight of giblet (liver, heart and gizzard) were recorded. The data were analyzed by using SPSS 20.0 version and comparison of means was done using Duncan's multiple range test (Duncan,

Table 1. Ingredient composition of basal diets (in kgs) fed to the commercial broilers from 0-42days.

Ingredient	Pre-starter(0-14d)	Starter(15-28d)	Finisher(29-42d)
Maize	55.49	56.5	59.8
Oil	2.49	3.5	5.3
Soyabean meal	37.7	35.1	30.1
Stone grit	1.58	1.83	1.88
Dicalcium phosphate	1.85	1.90	1.96
Salt	0.45	0.45	0.48
DL-methionine	0.22	0.18	0.16
L-lysine HCl	0.17	0.15	0.13
Trace mineral mixture*	0.10	0.10	0.10
Vitamin AB2D3K**	0.020	0.020	0.020
Vitamin B-Complex**	0.025	0.025	0.025
Coccidiostat	0.05	0.05	0.05
Choline chloride (50%)	0.15	0.15	0.15
Toxin binder	0.10	0.10	0.10
Tylosine	0.05	0.05	0.05
Total	**100**	**100**	**100**
Nutrient composition			
ME (kcal/kg)	3000	3101	3200
Crude protein (%)	23.01	22.01	19.9
Lysine (%)	1.30	1.21	1.08
Methionine (%)	0.55	0.49	0.45
Calcium (%)	0.97	1.04	1.06
Available phosphorous (%)	0.45	0.45	0.45

*Trace mineral provided per kg diet: Manganese 120 mg, Zinc 8 0mg, Iron 25 mg, Copper 10 mg, Iodine 1mg and Selenium 0.1mg; **Vitamin premix provided per kg diet: Vitamin A 200000 IU, Vitamin D3 3000 IU, Vitamin E 10 mg, vitamin k 2 mg, riboflavin 25 mg, vitamin B1 1mg, vitamin B6 2 mg, vitamin B12 40mg and niacin 15 mg.

Table 2. Effect of multiple enzymes and organic trace element supplementation to the diets containing sub-optimal energy on body weight (g) of commercial broilers

Treatments	Diets	Body weight (g)					
		1st wk	2nd wk	3rd wk	4th wk	5th wk	6th wk
T_1	Control (BD)	123.0	379.2^{a}	794.2^{a}	1272^{a}	1747^{abc}	2299^{ab}
T_2	BD 1	114.4	360.1^{a}	750.2^{a}	1225^{ab}	1776^{ab}	2347^{a}
T_3	BD 1+Enzyme	115.4	368.3^{a}	781.5^{a}	1273^{a}	1806^{a}	2317^{a}
T_4	BD 2	105.9	328.2^{b}	699.8^{b}	1133^{c}	1633^{cd}	2204^{b}
T_5	BD 2+ Enzyme	97.03	307.5^{b}	702.0^{b}	1160^{bc}	1596^{d}	2284^{ab}
T_6	BD+organomineral	123.6	373.2^{a}	781.3^{a}	1229^{a}	1733^{abc}	2262^{ab}
P		0.061	0.001	0.001	0.001	0.002	0.756
SEM		1.999	4.885	7.505	10.180	16.277	25.286

Mean bearing at least one common superscript in a column do not differ significantly (P<0.05); Basal Diet 1 = less 100 kcal/kg; Basal Diet 2 = less 200 kcal/kg.

1955) and significance was considered at P<0.05.

RESULTS AND DISCUSSION

Cumulative body weight of broilers was significantly (P<0.05) influenced by addition of enzyme and organic mineral supplementation during 2nd, 3rd, 4th 5th and 6th weeks of age (Table 2). From 2nd to 5th weeks of age, there was no significant (P>0.05) difference between BD, BD 1, BD 1 + enzyme and BD + organomineral (OM) groups but they had significantly (P<0.05) higher cumulative body weight than BD2 and BD 2+ Enzyme groups. At 6 weeks of age, BD1 and BD 1 + enzyme groups had significantly (P<0.05) higher body weight compared to control and other treatment groups. However, BD 2 (200 kcal/kg less ME) recorded the lowest body weight among all the treatment groups. No significant (P>0.05) difference was recorded among control (BD), BD 2+ Enzyme and BD + organomineral (OM) supplemented groups at 6th week of age.

The positive effect on body weight might be due to multiple enzyme supplementation which are capable of hydrolyzing various non-starch polysaccharides (NSP) present in the diet, and supplementation of NSPs degrading enzymes may not only reduce the anti-nutritive effects, but also releases nutrients which could be utilized by bird (Balamurugan and Chandrasekaran 2010). Chesson (1993) reported that

Table 3. Effect of multiple enzymes and organic trace element supplementation to the diets containing sub-optimal energy on cumulative Feed intake (g) of commercial broilers

Treatments	Diets	Feed intake, (g/bird)					
		1st wk	2nd wk	3rd wk	4th wk	5th wk	6th wk
T_1	Control (BD)	134.6	481.9	1123	1922	2807	3771^{bc}
T_2	BD 1	130.5	488.9	1098	1872	2817	3870^{ab}
T_3	BD 1+Enzyme	138.1	501.4	1130	1973	2977	3987^{a}
T_4	BD 2	120.7	453.6	1008	1747	2625	3599^{c}
T_5	BD 2+ Enzyme	119.5	443.6	1025	1805	2706	3689^{bc}
T_6	BD+organomineral	142.5	488.8	1088	1889	2853	3857^{ab}
P		0.2501	0.231	0.5801	0.091	0.081	0.004
SEM		2.941	4.607	9.271	13.83	21.041	28.240

^{a,b}Mean bearing different superscript in a column differ significantly (P<0.05)

Table 4. Effect of multiple enzymes and organic trace element supplementation to the diets containing sub-optimal energy on FCR of commercial broilers

Treatments	Diets	Feed conversion ratio (FCR)					
		1st wk	2nd wk	3rd wk	4th wk	5th wk	6th wk
T_1	Control (BD)	1.095	1.273	1.329	1.514	1.610	1.641
T_2	BD 1	1.144	1.361	1.371	1.529	1.593	1.655
T_3	BD 1+Enzyme	1.201	1.363	1.359	1.550	1.651	1.731
T_4	BD 2	1.139	1.383	1.343	1.544	1.609	1.636
T_5	BD 2+ Enzyme	1.240	1.462	1.364	1.558	1.701	1.636
T_6	BD+organomineral	1.161	1.319	1.317	1.539	1.652	1.709
P		0.112	0.110	0.575	0.616	0.125	0.049
SEM		0.015	0.0140	0.0083	0.0086	0.011	0.082

[a,b]Mean bearing different superscript in a column differ significantly (P<0.05)

breakdown of cell walls requires a number of different exogenous enzymes because birds do not produce enzymes like cellulase, xylanase, phytase *etc.* Castanon *et al.* (1997) reported that the addition of NSP degrading enzyme reduced the recovery of total NSP by hydrolyzing high molecular weight NSP and sugars. Ravindran *et al.* (1999) and Choct and Annison (1990) reported that continuous use of exogenous enzymes might increase digestibility of amino acids and other nutrients which in turns increases the body weight. However, exogenous enzyme supplementation significantly reduced digesta viscosity (Rama Rao *et al.* 2004). Supplementation of organic minerals significantly increased the body weight of broilers was reported by Srinivasa Rao *et al.* (2018). In contrary to above results, Yuan *et al.* (2008) reported that addition of enzyme complex had no effect on body weight of broilers. Nadeem *et al.* (2005) reported that non-starch polysaccharide degrading enzymes did not show significant effect on body weight gain during starter, finisher and overall growing periods.

The ANOVA revealed that, there were no significant (P>0.05) differences in cumulative feed intake among dietary treatments during 1st, 2nd, 3rd, 4th and 5th weeks except during 6th week (Table 3). Significantly (P<0.05) higher cumulative feed intake was observed in BD1+enzyme, BD+OM and BD1 compared to control and other treatment groups at 6th week of age. Similarly, Balamurugan and Chandrasekaran (2010) and Bharathidasan *et al.* (2010) reported that addition

Table 5. Effect of multiple enzymes and organic trace mineral supplementation to the diets containing sub-optimal energy on carcass traits of commercial broilers

Treatments	Diets	Ready to cook yield (g)	Abdominal fat (g)	Breast (g)	Liver (g)	Giblet (g)
T_1	Control (BD)	758.1	16.61[b]	194.2	18.52	39.05
T_2	BD 1	757.8	14.26[b]	209.5	19.39	41.88
T_3	BD 1+Enzyme	762.0	14.38[b]	218.8	19.89	42.49
T_4	BD 2	756.9	13.71[b]	209.3	19.76	41.13
T_5	BD 2+ Enzyme	751.2	13.36[b]	220.4	21.34	43.32
T_6	BD+organomineral	767.9	21.93[a]	213.8	20.53	42.32
P		0.314	0.002	0.162	0.272	0.073
SEM		1.799	0.6757	2.594	0.3828	0.4964

[a,b]Mean bearing different superscript in a column differ significantly (P<0.05)

of multiple enzymes significantly improved the feed intake by decreasing digesta viscosity of broilers.

Statistical analysis of data pertaining to feed conversion ratio (FCR) values revealed that there was no significant (P>0.05) difference among different dietary treatments during entire experimental period (Table 4). However, numerically better FCR was recorded in BD1, BD2 and BD 2+ Enzyme supplemented groups. These results are in accordance with the findings of Jacob *et al.* (2000) who did not find any significant effect on feed intake and FCR with enzyme supplementation. In contrary, Srinivasa Rao *et al.* (2018) found better FCR with organic minerals in broilers.

The data on carcass parameters as influenced by different dietary treatments is presented in Table 5. The Analysis of Variance revealed that different kind of treatment failed to exert any significant (P>0.05) influence on carcass parameters like ready to cook yield, liver, giblet, breast weight, however, abdominal fat which was significantly (P<0.05) higher in BD+OM group as compared to other treatment groups at 42 days of age. The present findings on slaughter attributes were in agreement with Berwal *et al. (*2008) who observed that enzyme supplementation did not affect carcass yield, carcass composition and giblet yields. Other reports (Hanumantha Rao *et al.,* 2003; Rahman *et al.,* 2005; Ramesh and Chandrasekaran, 2011) also indicated no effect of enzyme supplementation on edible organ weights at 42 d of age.

CONCLUSION

Finally, it can be concluded that supplementation of enzyme with basal diet 1 and basal diet 2 (100 and 200 kcal lower ME than control) significantly improved the body weight gain and feed intake of broilers. There was no effect on feed conversion ratio and carcass characteristics at 42 d of age.

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