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Effect of supplementing encapsulated microbial enzymes to corn-soybean meal based pelleted diets on performance and carcass variables in coloured broiler chicken

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Krishibro, is a multicoloured hardy meat type chicken, which is widely accepted in the rural areas due to the aesthetic features, native look and cultural reasons. Profitability is highly dependent on the cost and nutritive value of available feed ingredients. Feed ingredients of plant origin contain a number of components that cannot be digested by birds because of insufficiency of endogenous enzymes (Mateos *et al.* 2012). Fibrolytic enzymes play an important role in efficient utilization of fibre and other nutrients of the diet (Slominski 2011, Rama Rao *et al.* 2014). Further, pelleting is the preferred method to deliver poultry feeds. However, during the process of pelleting, the enzymes become denatured (Beaman *et al.* 2012). Therefore, encapsulation seems to be helpful in overcoming the denaturation of the enzymes. Recently, encapsulation of enzyme is being practiced with a food grade matter so as to prevent the denaturation of the dietary enzymes (Srinath *et al.* 2012). Birds fed with coated phytase supplemented diets and pelleted at 80°C and 90°C revealed better feed conversion ratio (FCR) (Asiedu *et al.* 2007). Therefore, the experiment was conducted to determine the dietary supplementation of encapsulated (EC) enzymes on performance of the colour broiler chicken.

A feeding trial of 6 weeks duration was conducted on 350 day-old Krishibro coloured broiler chicks. The chicks were randomly distributed into 10 treatment groups having 7 replicates with 5 chicks in each replicate. The phytase, enzyme cocktail and xylanase were procured. The experimental diets were formulated by supplementing uncoated or coated enzymes to the maize and soybean based control diet. The control (starter and finisher) diet (1[st]) was formulated as per the NRC (1994) recommendations (Table 1). Three diets (2[nd] to 4[th]) were formulated to contain 5% lower metabolizable energy (ME) and were supplemented with cocktail of amylase (2500 IU/kg),

Table 1. Ingredients and nutrient composition of control diet formulated as per NRC (1994) requirement

Ingredients, kg/100 kg	Starter[¥]	Finisher[¥]
Maize	59.5	62.3
Vegetable oil	2.20	4.10
Soybean meal	34.0	29.3
Shell grit	1.22	1.45
Di-calcium phosphate	1.90	1.65
Salt	0.40	0.40
DL-methionine	0.19	0.16
Lysine	0.14	0.11
Premix[a]	0.489	0.489
Nutrient composition		
ME[b] (kcal/kg)	3010	3152
CP[c] (%)	21.5	19.5
Ether extract[c] (%)	4.71	6.66
Crude fibre[c] (%)	3.35	3.13
Calcium[b] (%)	0.99	1.01
NPP[b] (%)	0.45	0.40
Lysine[d] (%)	1.196	1.05
Methionine[d] (%)	0.50	0.45

[a]Premix provided (in milligrams/kg diet): thiamin, 1; pyridoxine, 2; cyanocobalamine, 0.01; niacin, 15; pantothenic acid, 10; α-tocopherol,10 IU; riboflavin, 10; biotin, 0.08; menadione, 2; retinol acetate, 2.75; cholecalciferol, 0.03; choline, 650; copper, 8; iron, 45; manganese, 80; zinc, 60; selenium, 0.18; monensin sodium, 50; hydrated sodium calciumalumino silicates, 800. [b]Calculated values, [c]Analyzed values, [d]Calculated based on analyzed ingredient composition. [¥]Three diets with 5% lower ME with cocktail of encapsulated or unencapsulated polysaccharide hydrolyzing enzymes, 3 diets with 7.5% lower CP with encapsulated or unencapsulated protease and 3 diets with 20% lower phosphorus with encapsulated or unencapsulated phytase.

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xylanase (2,000 IU/kg), cellulase (500 IU/kg), hemicellulase (500 IU/kg) and pectinase (500 IU/kg) in EC or unencapsulated (UEC) forms. Another 3 diets (5^{th} to 7^{th}) were formulated to contain 7.5% lower crude protein (CP) and supplemented with protease (4,000 IU/kg) in EC or UEC forms. Further, 3 more diets (8^{th} to 10^{th}) were formulated to contain 20% lower non phytate phosphorus and supplemented with phytase (500 IU/kg) in EC or UEC forms. All the diets were subjected to pelleting at 80°C in a steam conditioner of 0.6 MPa for 10 sec. The pelleted diets were sundried and subjected to grinding to prepare the diets in mash form. The birds were maintained in battery brooders and fed with respective diets *ad lib.* up to 6 weeks of age. During the experimental period, standard medication and vaccination schedules were followed. Weekly feed intake and body weight (BW) were recorded till 6 weeks of age. The FCR was calculated as feed intake per unit BW gain from 0–6 weeks of age at weekly intervals.

For enzyme encapsulation, enzymes were added into analginate (hydrocolloid solution) and then the cell suspension was extruded through a syringe needle to form droplets, which free-fall into a hardening solution ($CaCl_2$) or setting bath. The size and shape of the beads depend on the diameter of the needle and the distance of free-fall. The concentration of alginate used was 1% to form a gel with 0.5M $CaCl_2$ (Krasaekoopt *et al.* 2003). Variations in different parameters among treatment groups were analyzed using General Linear Model Procedure. The model included different dietary treatments as independent variable and performance as the dependent variable. Treatment means were compared using Tukey's test.

Supplementation of EC enzymes did not improve the coloured broiler performance during the first week of age. However, improved BW and FCR ($P<0.05$) were recorded in EC protease supplemented group compared to those fed diet without enzyme during the third week of age. Further, the nominal improvement in performance was recorded among the groups fed diet supplemented with combination of EC amylase, xylanase, cellulase, hemicellulase and pectinase compared to those fed control diet or diet supplemented with UEC enzymes. However, at the end of the experiment, no difference in the performance parameters was recorded among the different dietary treatments. Similarly, feeding the diets with varying nutrient density did not affect the performance of the coloured broiler chickens throughout the study period. However, supplementation of EC enzymes resulted in improved BW and FCR compared to those fed diets without enzyme supplementation during the finisher phase. It is reported that the enzyme supplementation to cereal based diets improved broiler performance by increasing the rate of weight gain (Srinath *et al.* 2012, Rama Rao *et al.* 2014). Further, they have reported that the EC enzyme supplemented diets significantly improved the BW gain over their respective uncoated supplemented diets during starter phase and finisher phase. Similarly, the birds fed on coated phytase supplemented diets and pelleted at 80°C and 90°C performed better than birds fed the control diet (Srinath *et al.* 2012). This may be attributed to the fact that encapsulation provides stability against pelletization temperature and protects the enzyme from denaturation.

Feeding the birds with low nutrient-density diets (5% low ME, 7.5% low CP and 20% low NPP) did not significantly affect the performance of the coloured broilers in the present experiment. Further, no significant interaction between nutrient and enzymes was recorded for the performance parameters studied. It is demonstrated that chickens will attempt to adjust their feed intake to satisfy their energy requirements (Scott 2002). In the present experiment, the groups fed with lower energy based diets showed marginally increased feed intake and poor feed conversion ratio, which confirms the above statement.

Further, dietary supplementation of enzymes or feeding birds with low nutrient-density did not improve slaughter parameters. However, nominal improvement in ready-to-cook yield was recorded among the groups fed diet supplemented with EC enzymes compared to other dietary groups. Dietary supplementation of EC enzymes resulted in decrease ($P<0.01$) in abdominal fat content compared to those diets with UEC or without enzymes. Further, feeding the diets with low nutrient-density (ME 5% and CP 7.5%) resulted in lower abdominal fat content compared to groups fed control diet. Similar results were also reported by Rabie *et al.* (2010) that the relative weight of abdominal fat was significantly decreased in response to decreasing dietary energy level from 3,100 to 2,700 kcal/kg. The observed reduction in abdominal fat of birds in response to decreasing dietary energy level could be attributed mainly to the narrowed calorie: CP ratio in their diets. An efficient protection of enzyme is crucial in the palletization of the feed. As observed in the present experiment, the encapsulation of enzymes may be an appropriate technique to accomplish this task. Further, supplementation of EC enzymes has resulted in desired performance even among those groups fed lower density nutrient based diets.

SUMMARY

The experiment was conducted to determine the dietary supplementation of encapsulated (EC) or UEC enzymes on performance of colour broilers. The dietary supplementation of EC polysaccharide hydrolyzing enzymes and protease improved the performance compared to other groups. Feeding the birds with low nutrient-density diets did not affect the performance of the coloured broilers. The supplementation of EC enzymes resulted in a decrease in abdominal fat and increase in ready to cook yield compared to those diets with UEC or without enzymes.

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