Indian Journal of Animal Sciences **82** (4): 410–414, April 2012

Efficacy of enzyme and yeast supplements on performance of broiler chicken fed high fiber diets

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Received: 9 May 2011; Accepted: 29 October 2011

ABSTRACT

The aim of the study was to determine the influence of exogenous enzyme and yeast supplements on the performance, blood parameters and carcass characteristics of broiler chicken fed high fiber diets. Broiler chicks (210) were distributed randomly into 5 groups of 3 replicates with 14 chicks each. Diets formulated comprised a control diet (6% crude fiber only) as T1, 8% crude fiber level supplemented with enzyme @ 200 g/tonne of feed as T2, 10% crude fiber level supplemented with enzyme @ 200 g/tonne of feed as T3, 8% crude fiber level supplemented with yeast @ 200 g/tonne of feed as T4, 10% crude fiber level supplemented with yeast @ 200 g/tonne of feed as T5. With respect to control (T1) there was a significant decrease in the body weight of birds in all other treatment groups except in T2 where a non-significant reduction was recorded. Similar trend was noticed in cumulative feed consumption with lowest feed intake in T5. The feed conversion ratio did not show any significant difference between T1 and T2, but in rest of the treatment groups it was deteriorated, when compared with the control. Poorest FCR was recorded in the group of birds fed diets containing 10 % crude fiber supplemented with yeast (T5). No significant differences were observed in the serum glucose and protein levels, but calcium, phosphorus, SGPT and SGOT levels were significantly increased amongst the groups fed high fiber diets. Serum cholesterol levels were significantly decreased in T3, T4 and T4 when compared with T1 and T2. Except for the gizzard weight, no significant effect was observed on the carcass characteristics of birds fed higher fiber levels when compared with the control.

Key words: Blood biochemistry, Broiler, Carcass characteristics.

The increase in the price of conventional feed ingredients like soybean and maize in recent years has encouraged poultry nutritionists to search for alternative local cheaper feed ingredients. One of such alternatives is sunflower cake which has been used in poultry diets as a good source of protein, however at very low inclusion level due to its high fibre content (Senkoylu and Dale 2006). Poultry cannot utilize high fibre diets because it lacks the digestive framework that can elaborately digest large amounts of fibre (Taibipour and Kermanshashi 2004). To facilitate the use of these high fibrous diets in birds, it becomes mandatory to use feed additives, viz. enzymes and yeast. Enzyme supplementation in poultry diets reportedly influences the performance of birds by degrading non-starchy polysaccharides and improving the digestion and absorption of nutrients (McCraeken and Quintin 2000, Tufarelli *et al.* 2007). Supplementation of dried yeast containing *Saccharomyces cerevisiae* as a pure culture to high fibre diets in broiler chicks resulted in significantly improved body weight gain, feed efficiency, and apparent retention coefficients of dry matter, crude protein, ether extract, crude fibre, neutral detergent fibre (Onifade and Babatunde 1996), and improved growth performance and immune system (Gao *et al.* 2008). *Saccharomyces cerevisiae* is used as growth promoter in poultry feed but limited research has been done to use yeast culture for improving the utilization of high fibre diets in broiler chicken. Therefore, the present study was undertaken to evaluate the efficacy of enzyme and yeast supplements in assisting the broiler chicken in utilizing the high fibre diets.

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MATERIALS AND METHODS

Day-old commercial broiler chicks (210) procured commercially were reared in battery cages until 7 days of age. During this period, all the birds were provided with a pre-starter mash (23% crude protein and 2800 Kcal/kg metabolisable energy). Birds had free access to feed and water throughout and were maintained on a constant 24 h light schedule. On eighth day, the chicks were individually weighed, distributed into 5 treatment groups of 3 replicates with 14 chicks in each in a completely randomized design so that the treatment means differ as little as possible. Diets formulated comprised of a control diet (6% crude fibre only) as T1, 8% crude fibre level supplemented with enzyme (40253 IU/g xylanase) @ 200 g/tonne of feed as T2, 10% crude fibre level supplemented with enzyme (40253 IU/g xylanase) @ 200 g/tonne of feed as T3, 8% crude fibre level supplemented with yeast @ 200 g/tonne of feed as T4, 10% crude fibre level supplemented with yeast @ 200 g/tonne of feed as T5. The diets were formulated to meet the recommendations of the Bureau of Indian Standards (BIS 1992). The diets were iso-nitrogenous and isocaloric. The ingredient and nutrient compositions of the experimental diets are shown in Table 1. Percentage Crude protein, total ash, ether extract and crude fibre content of the feed samples were determined as per AOAC (1985). All chicks were vaccinated against Ranikhet disease on fifth day with F1 strain vaccine and IBV-95 vaccine against infectious bursal disease on 15th day. Chicks were checked twice daily for mortality, if any. Birds were kept under the same managerial, hygienic and environmental conditions.

Table 1. Ingredient and nutrient composition of experimental diets

Ingredient (%)	T1	T2	T3	T4	T5
Maize	53	50	50	50	50
Soybean meal	33	26	26	6	6
Sunflower cake	7.25	16.15	16.15	35.15	35.15
Fish meal	5	5	5	5	5
Fat	0	0.5	0.5	1.5	1.5
Limestone	1	1	1	1	1
Di-calcium phosphate	0.5	0.5	0.5	0.5	0.5
Vitamin and mineral premix*	0.5	0.5	0.5	0.5	0.5
Total	100	100	100	100	100
Crude protein (%)	23.2	22.95	22.95	22.89	22.89
Crude fibre (%)	6.17	8.02	8.02	10.15	10.13
Ether extract (%)	3.45	3.70	3.72	3.36	3.34
Total ash (%)	3.7	4.03	4.01	3.87	3.89
Calcium** (%)	1.45	1.27	1.27	1.29	1.29
Available phosphorus** (%)	0.65	0.57	0.57	0.68	0.68
Lysine** (%)	1.03	0.96	0.96	0.92	0.92
Methionine** (%)	0.5	0.48	0.48	0.45	0.45
Metabolizable energy (Kcal/kg diet)**	2862	2812	2812	2809	2809

* Mineral premix contained provided the following per kg of diet: Vitamin-A 2,00,000 I.U; vitamin-D_3 25,000 I.U; vitamin-E 300 mg; vitamin-K 400 mg; vitamin-B_1 800 mg; vitamin-B_6 2 g; vitamin-B_{12} 240 mcg; calcium-pentothenate 1.2 g; choline-chloride 70 g; calcium 280 g; phosphorus 70 g; manganese 12 g; iodine 400 mg; Iron 3.2 g; zinc 3 g; copper 1 g; cobalt 200 mg; antioxidant 200 mg; methionine 120 units and sufficiently added with propionic acid, zeolites, benzoates, acetates and formic acid.
**calculated value.

The body weight of the experimental birds was recorded early in the morning on individual basis at weekly intervals. The feed consumption was recorded on group basis at weekly intervals. Feed conversion ratio of the experimental birds was worked out at weekly intervals for the entire experimental period by taking into consideration weekly feed consumption and body weight gain.

Blood samples from birds in different dietary groups were collected for haematological study. For this purpose 2 birds/replicate were randomly selected for the collection of blood. Whole blood was collected from brachial vein of the birds in sterile test tubes, without the addition of anticoagulant and kept in slanting position. The tubes containing blood were incubated at 37°C for 1 h. Blood clots were broken and tubes were centrifuged at 3000 rpm for 30 min. The serum was pipetted out in small tubes which were stored under deep freeze condition (–20°C) until analysis. SGPT, SGOT, serum glucose, protein and cholesterol were estimated with the aid of auto analyzer equipment and colorimeter by using respective biochemical kits.

At the end of feeding trial, 2 birds/replicate were selected at random, starved for 12 h to empty their crops and utilized for carcass evaluation study. Each bird was weighed immediately before severing the jugular vein at the atlanto-occipital joint and then allowed to bleed. The shanks were cut off at the hock joint and carcass was subjected to scalding process at 60°C for 30 sec. The feathers were removed completely by hand picking leaving the skin intact. Thereafter, the abdominal cavity was opened to expose the visceral organs and the carcass characteristics were evaluated.

The data obtained was statistically assessed by the analysis of variance (ANOVA) through general linear model procedure of SPSS (10.0) software considering replicates as experimental units and the values were expressed as means±standard error. Duncan's multiple range test (Duncan 1955) was used to test the significance of difference between means by considering the differences significant at $P \leq 0.05$.

RESULTS AND DISCUSSION

The body weight gain in birds (Table 2) fed diets containing 8% crude fibre level supplemented with enzymes showed significantly ($P<0.05$) higher body weight compared to the birds fed either higher levels of crude fibre (10%) supplemented with enzyme or the group of birds fed diets with 8 and 10% crude fibre levels supplemented with yeast but the differences were non-significant ($P>0.05$) when compared to the control. Similar results were observed by Alam *et al.* (2003) and Rahman *et al.* (2005) indicating the ability of enzyme to breakdown NSPs of diet. The

Table 2. Performance of broiler chicken fed different fiber levels supplemented either with enzyme or yeast

Week	T1	T2	T3	T4	T5
Body weight gain (g)					
1-3	398.09 ^{a} ±4.71	392.14 ^{a} ±3.61	340.95 ^{b} ±5.52	335.23 ^{b} ±4.79	312.14 ^{c} ±3.77
1-6	1370 ^{a} ±21.47	1358.21 ^{a} ±20.87	1086.66 ^{b} ±12.05	1069.76 ^{b} ±12.88	913.21 ^{c} ±15.98
Feed consumption (g)					
1-3	589.54 ^{a} ±4.6	582.38 ^{a} ±2.3	549.20 ^{b} ±4.0	541.31 ^{b} ±3.49	525.67 ^{c} ±344
1-6	2550.26 ^{a} ±8.06	2538.75 ^{a} ±6.37	2157.27 ^{b} ±8.06	2144.58 ^{b} ±6.93	2122.55 ^{c} ±6.89
Feed conversion ratio					
1-3	1.48 ^{a} ±0.035	1.48 ^{a} ±0.025	1.61 ^{b} ±0.038	1.61 ^{b} ±0.040	1.68 ^{b} ±0.038
1-6	1.86 ^{a} ±0.003	1.86 ^{a} ±0.004	1.98 ^{b} ±0.004	1.99 ^{b} ±0.007	2.32 ^{c} ±0.010

Means within the same row with different superscripts are significantly different ($P \leq 0.05$).

Table 3. Serum characteristics of broiler chicken fed high fiber diets supplemented either with enzyme or yeast

Parameters	T1	T2	T3	T4	T5
Glucose (mg/dl)	197.67 ±3.28	200.6 ±2.96	202.33 ±3.28	204.33 ±2.91	203.2 ±2.4
Protein (g/dl)	5.93 ±0.07	5.81 ±0.07	5.81 ±0.03	5.79 ±0.07	5.80 ±0.05
Cholesterol (mg/dl)	174.78 ^{a} ±0.57	175.79 ^{a} ±0.64	157.56 ^{b} ±0.61	156.94 ^{b} ±0.42	157.84 ^{b} ±0.41
Calcium (mg/dl)	10.01^{a} ± 0.16	11.94 ^{b} ±0.10	12.02^{b} ± 0.25	11.76 ^{b} ±0.32	11.97 ^{b} ±0.30
Phosphorus (mg/dl)	6.22^{a} ±0.26	7.48 ^{b} ±0.22	7.59^{b} ±0.30	7.50 ^{b} ±0.13	8.42 ^{c} ±0.34
SGPT (μ/l)	15.63 ^{a} ±0.47	15.95 ^{a} ±0.86	17.91 ^{b} ±2.04	19.623 ^{b} ±1.42	18.31 ^{b} ±2.04
SGOT (μ/l)	92.25 ^{a} ±9.04	93.61 ^{a} ±1.20	101.48 ^{b} ± 5.12	105.25 ^{b} ±6.35	107.25 ^{b} ±6.76

Means within the same row with different superscripts are significantly different ($P \leq 0.05$).

improvement in the bodyweight gain due to enzyme supplementation could be attributed to the breakdown of xylan backbone of soluble arabinoxylans, thus preventing the formation of viscous polymers which resulted in better digestion and absorption of nutrients. Ravindran *et al.* (2000) and Choct (2004) reported that dietary inclusion of exogenous enzyme resulted in partial degradation, solubilization of cell wall polysaccharides and reduced digesta viscosity in the small intestine which may have allowed the greater digestion and absorption of nutrients, thereby improving the body weight gains. The group of birds fed diets containing 10% crude fibre level supplemented with enzymes had significantly ($P<0.05$) lower body weight gains when compared with the group fed lower levels of crude fibre. It seems that the enzyme preparation incorporated in the diet did not contain sufficient enzyme activity which could have been able to improve the performance of birds fed diets containing 10% crude fibre levels. Among the different dietary treatments, the group of birds fed diets containing 10% crude fibre levels supplemented with yeast showed significantly ($P<0.05$) lowest body weight. It was expected that supplementation of yeast to high fibre diets may prove beneficial in improving the body weight of chicken but that was not noticed. Conversely, the performance of chickens was significantly ($P<0.05$) reduced when diets containing both 8 and 10% crude fibre levels were supplemented with yeast. Our results do not conform with the findings of Gary *et al.* (1994) and Gao *et al.* (2008) who concluded that yeast (*Saccharomyces cervisiae*) supplementation in higher fibre diets was beneficial in degrading the crude fibre. However, such studies were conducted using relatively low fibre ration. In the present study, it seems that the yeast culture (*Saccharomyces cervisiae*) incorporated in the diet did not contain sufficient level to degrade the crude fibre content in the diet for optimum performance of birds.

A significant ($P<0.05$) reduction in the cumulative feed consumption was observed in the present study with the increase in the dietary crude fibre levels irrespective of supplementation of enzymes or yeast in the diet (Table 2). The findings of present study are well correlated with earlier observations of Rezaie and Hafezian (2007) who also recorded lower feed intake in birds fed diets containing higher levels of sunflower cake. Conversely the reduced weight gain was attributed to reduction in the feed intake. However, Kaur *et al*. (2007) and Berwal *et al*. (2008) reported increase in feed intake with the increase in the crude fibre levels in the diet. Enzyme supplementation resulted in a non-significant ($P<0.05$) difference in feed intake in the group of chicks fed diets with 8% crude fibre levels compared with the control diet which might be due to reduction in digesta viscosity resulting in its increased rate of passage and higher absorption rate (Scott *et al*. 1997). The group of birds fed diets containing 10% crude fibre level supplemented with yeast observed the lowest feed intake. These results are in contrast to the earlier reports of Ignacio (1995) who observed that yeast has ability to stimulate feed intake by improving palatability.

Chicks-fed high fibre diets (8 and 10%) with supplementation of either enzymes or yeast did not reveal any significant (P<0.05) difference in feed conversion ratio (FCR) when compared with the control diet up to 2 weeks of age. FCR was statistically (P<0.05) similar between the group of chicks fed diets containing 8% crude fibre level supplemented with enzyme when compared with the control diet. As the age of chicks advanced, the improvement in FCR was observed (Table 2) which could probably be due to better utilization of nutrients, thus improving body weight gain. These results are in harmony with the results of earlier workers (Ranade and Rajmane 1994 and Scott *et al*. 1997) who reported that enzyme supplementation in broiler chicken improved the FCR. In fact the FCR value which is the most sensitive factor in assessing performance significantly improved in the group of chicks fed diets with 8% crude fibre supplemented with enzymes, indicating better utilization of nutrients. The group of chicks fed diets containing 10% crude fibre levels supplemented with enzymes and group of chicks fed diets containing 8% crude fibre levels supplemented with yeast showed moderate improvement in the FCR value when compared with the group fed control diet. Poorest FCR was observed in the group of chicks fed diets with 10% crude fibre supplemented with yeast. These results are not in harmony with earlier reports of Charlie (1998) who reported that supplementation of yeast is effective in improving growth and feed efficiency in broilers. However, in the present study with the increase in crude fibre level there was a significantly (P<0.05) poor FCR indicating poor utilization of nutrients in high fibre diets due to presence of high levels of NSP which increased the viscosity of digesta, thus decreasing the performance of birds.

Data pertaining to blood biochemicals in broiler chicken fed different crude fibre levels supplemented either with yeast or enzyme has been summarized in Table 3. Feeding of high fibre diets supplemented either with yeast or enzyme had no significant (P<0.05) effect on serum glucose and protein levels when compared with the group of chicks fed control diet. These results corroborate well with the earlier reports of Singh *et al.* (2008) who found no significant difference in the blood biochemicals of broiler chicken fed varying levels of enzymes in feed. In the present study the serum calcium and phosphorus levels were significantly (P<0.05) high in the group of chicks fed high fibre diets supplemented either with enzymes or yeast when compared with the group fed control group. This could be attributed to the fact that there is some acid production during fibre digestion which will decrease the pH of intestine resulting in the improvement in the digestibility of some minerals. There was a significant decrease in the serum cholesterol levels in the chicks fed high fibre diets supplemented either with enzymes or yeast when compared with control group. These results are in

Table 4. Slaughter and yield characteristics of broilers fed high fiber diets supplemented either with enzyme or yeast

Parameters	T1	T2	T3	T4	T5
Dressing (%)	67.2 ±0.37	66.86 ±0.33	65.46 ±1.44	65.46 ±1.42	64.2 ±0.60
Liver yield (%)	2.59 ±0.16	2.33 ±0.12	2.73 ±0.21	2.62 ±0.35	2.58 ±0.31
Heart yield (%)	0.65 ±0.06	0.71 ±0.03	0.67 ±0.05	0.76 ±0.10	0.77 ±0.08
Gizzard yield (%)	2.84 [a] ±0.02	2.90 [a] ±0.05	3.30 [b] ±0.05	2.9 [a] ±0.05	3.5 [c] ±0.05
Feather yield (%)	4.38 ±0.18	4.36 ±0.18	4.46 ±0.20	4.38 ±0.24	4.69 ±0.57
Head yield (%)	2.7 ±0.08	2.6 ±0.06	2.7 ±0.08	2.5 ±0.05	2.5 ±0.08
Shanks yield (%)	4.74 ±0.05	4.70 ±0.05	4.7 ±0.04	4.8 ±0.05	4.6 ±0.05

Means within the same row with different superscripts are significantly different (P≤0.05).

Table 5. Cut-ability characteristics of broiler chicken fed high fiber diets supplemented either with enzyme or yeast

Cut-up part	Parameter	T1	T2	T3	T4	T5
Breast	Yield (Plw)	20.81 ±0.58	20.14 ±0.68	20.86 ±0.63	19.99 ±0.88	19.77 ±0.73
	Yield (Pdw)	31.16 ±0.73	30.88 ±0.74	30.32 ±0.71	29.27 ±0.88	29.20 ±0.77
Drum-sticks	Yield (Plw)	9.43 ±0.34	9.83 ±0.17	9.27 ±0.18	9.62 ±0.62	9.32 ±0.61
	Yield (Pdw)	14.90 ±0.51	14.00 ±0.16	13.97 ±0.32	14.31 ±0.89	13.98 ±0.72
Thighs	Yield (Plw)	10.67 ±0.12	10.75 ±0.36	10.32 ±0.11	10.39 ±0.11	10.17 ±0.40
	Yield (Pdw)	16.18 ±0.13	15.95 ±0.43	16.05 ±0.25	16.43 ±1.4	15.76 ±0.55
Wings	Yield (Plw)	7.95 ±0.19	7.87 ±0.24	7.69 ±0.05	8.13 ±0.1 8	8.27 ±0.28
	Yield (Pdw)	11.59 ±0.38	12.08 ±0.46	11.52 ±0.17	12.11 ±0.39	12.06 ±0.42
Back	Yield (Plw)	13.49 ±0.43	12.98 ±0.31	12.39 ±0.25	12.50 ±1.12	12.28 ±0.62
	Yield (Pdw)	19.93 ±0.60	20.91 ±0.54	20.28 ±0.52	20.44 ±1.95	19.97 ±0.92
Neck	Yield (Plw)	4.54 ±0.18	4.33 ±0.23	4.23 ±0.14	4.78 ±0.33	4.88 ±0.31
	Yield (Pdw)	6.89 ±0.29	6.63 ±0.29	6.58 ±0.19	7.36 ±0.43	7.58 ±0.48

Plw, % live weight; Pdw, % dressed weight.

harmony with the results of Singh *et al*. (2008) who recorded decreased serum cholesterol levels in the broiler chicken fed enzyme supplemented diets. The decrease in the cholesterol level is due to inhibited activity of hydroxymethyl glutarate CO-A reductase by feed enzymes which limits the synthesis of cholesterol in the blood. A significant (P<0.05)increase in the serum SGPT and SGOT levels was observed in the group fed high fibre diets supplemented either with enzymes or yeast when compared with the group of chicks fed control diet. However, Singh *et al*. (2008) did not observe any lys significant (P<0.05) difference due to the feeding of enzyme supplemented diets in broiler chicken. Increase in levels of these enzymes might be due to stress on birds due to high fibre diets.

The results of slaughter and yield characteristics (Table 4) revealed no significant (P>0.05) difference between various treatment groups except for the gizzard yield. Birds fed high fibre diets had a significant (P<0.05) increase in the% yield of gizzard when compared with the control. The increased gizzard weight was as a result of greater grinding action required for high fibre diets as observed earlier by Berwal *et al*. (2008). No effect (P>0.05) on cutability characteristics (Table 5) was observed due to feeding of high fibre diets supplemented either with enzymes or yeast in broiler chicken confirming the earlier results of Berwal *et al*. (2008) and El-shareif *et al*. (1997).

It was concluded that out of 2 additives used for degradation of crude fibre, enzymes were appeared more effective than yeast in degrading crude fibre. Yeast supplementation to sunflower based diet did not show any significant (P<0.05) effect on growth performance of broiler chicken fed high fibre diets. Use of high fibre diets (8%) supplemented with enzyme was effectively utilized by broiler chicks up to 6 weeks of age.

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