



NUTRIENT UTILIZATION OF BROILER CHICKEN FED HIGH FIBER DIETS SUPPLEMENTED WITH ENZYME AND YEAST

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ABSTRACT

An experiment was conducted to study the influence of enzyme and yeast supplementation in broiler chicken fed high fiber diets. Diets comprised of a control diet [6.2% crude fiber (CF) only] and 8.0 or 10.1% CF level supplemented with either enzyme or yeast @ 200 g ton⁻¹ feed. No significant effect was noticed on apparent digestibility values of crude protein and ether extract by the addition of enzyme or yeast in treatment groups. The CF digestion and body weight gains were significantly higher in control and 8.0% CF + 200 g enzyme ton⁻¹ as compared to other treatments. The results suggested that CF level can be increased upto 8.0% with enzyme supplementation without having deleterious effect in broiler chicken.

Key words: Broiler chicken, nutrient utilization, fiber, enzyme, yeast.

INTRODUCTION

As the prices of conventional feed ingredients like soybean and maize continue to increase, it has become imperative to search for alternative available feed ingredients which may reduce the feed cost in broiler chicken. 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 fiber content (Senkoylu and Dale, 1999, 2006). Poultry cannot utilize high fibre diets because it lacks the digestive framework that can elaborately digest large amounts of fiber (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). Beneficial effect of yeast supplementation has earlier been reported by Gao *et al.* (2008). Yeast, *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 fiber diets in broiler chicken. This work, therefore, was designed to investigate how effectively enzyme and yeast supplementation would assist the broiler chicken in utilizing the high fibre diets.

MATERIALS AND METHODS

One week old 210 commercial broiler chicks were individually weighed and divided into five treatment groups with three replicates in each group in a completely randomized design. Five iso-nitrogenous and isocaloric treatment diets were formulated which comprised of a control diet [6.2% crude fiber (CF) only], 8.0 and 10.1% CF diets supplemented with either enzyme or yeast @ 200 g ton⁻¹ feed. The diets were formulated to meet the nutrient requirements as per the Bureau of Indian Standards (1992). The

ingredient and nutrient composition of experimental diets are shown in Table 1. The crude protein, total ash, ether extract and crude fibre contents of feed samples were determined as per AOAC (1995). Birds had free access to feed and water throughout, and were maintained on a constant 24 hr light schedule. Birds were kept under the same managerial, hygienic and environmental conditions. All chicks were vaccinated against Ranikhet disease on 5th day with F₁ strain vaccine and IBV-95 vaccine against infectious bursal disease on 15th day. The effect of yeast and enzyme supplementation on nutrient utilization of broilers fed high fiber diet was examined in a balance study carried out with 6 week old male broiler chicks. Six birds from each of the five experimental groups were randomly selected and housed individually in cages suitable for metabolic study. The birds were offered same diet as were being fed previously. The study lasted for seven days including the period of collection of samples during the last three days when the feed consumed by each bird in the respective treatment group was recorded and droppings voided over the same period collected quantitatively. The droppings, collected daily, were free of any contamination such as down feathers and feed particles. The collected samples were transferred to the respective poly-bags which were stored in a deep freezer at 25±1°C. Excreta samples were subsequently dried in an oven at 100°C, weighed and ground through a 0.5 mm sieve. The samples were stored in an airtight plastic container until analysis. The samples of experimental diets as well as droppings were analyzed for crude protein, crude fiber and ether extract contents. The balances or retention data were derived from various ingested and excreted constituents by each experimental chick and the values expressed percent apparent digestibility of a particular constituent as shown here under:

$$\text{Apparent digestibility} = \frac{\text{Intake (g chick}^{-1}) - \text{Outgo (g chick}^{-1})}{\text{Intake (g chick}^{-1})} \times 100$$

The body weight of 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 by taking into consideration weekly feed consumption and body weight gain. The data was analyzed by the analysis of variance through general linear model procedure of SPSS (10.0) software considering replicates as experimental units. DMRT was used to test the significance of difference between means by considering the differences significant at $p \leq 0.05$ (Duncan, 1955).

RESULTS AND DISCUSSION

The chemical composition of ration used revealed that the crude protein and metabolizable energy content were more or less similar in all the treatment groups (Table 1). The CF content was 6.2% in control group, 8.0% each in group 2nd and 3rd, and 10.1% each in group 4th and 5th. The nutrient utilization by broiler chicken fed with high fiber diets revealed that the addition of enzyme and yeast in diet did not affect the digestibility of crude protein and ether extract as compared to control (Table 2). However, the apparent digestibility of CF differed significantly among different groups. Apparent digestibility of CF in birds fed 8.0% CF supplemented with enzyme was almost similar to that of control. Contrary to our findings, Khan *et al.* (2006) recorded improved crude protein and ether extract digestibility due to the enzyme supplementation while Oyedele *et al.* (2008) reported that apparent digestibility of crude protein and ether extract was not affected by yeast supplementation, irrespective of the level used. Apparent digestibility of crude fiber in birds fed 8.0% crude fiber supplemented with enzyme was almost similar to that of control. The bird fed 8.0% CF supplemented with yeast and the birds fed 10.1% CF supplemented with either enzyme or yeast showed significant decrease in digestibility of crude fiber as compared to control and the birds fed 8.0% CF supplemented with enzyme. The improvement in CF digestibility due to enzyme supplementation has previously been reported by Iyayi and Losel (2001) and Al-Harthi (2006). The increased apparent digestibility of CF observed is an indication of the break-down of non-starch polysaccharides by the enzyme. Enzymes have the ability to breakdown xylan backbone of soluble arabino-xylans, thus preventing the formation

Table 1: Ingredient and nutrient composition of experimental diets

Ingredient of diets (%)	6.2% CF	8.0% CF + enzyme	8.0% CF + yeast	10.1% CF + enzyme	10.1% CF + yeast
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
Chemical composition (%)					
Crude protein	23.2	22.95	22.95	22.89	22.89
Crude fibre	6.2	8.0	8.0	10.1	10.1
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 ⁻¹ diet)**	2862	2812	2812	2809	2809

*Mineral premix contained provided the following per kg diet: Vitamin A 2,00,000 I.U, vitamin-D₃ 25,000 I.U, vitamin E 300 mg, vitamin K 400 mg, vitamin B₁ 800 mg, vitamin B₆ 2 g, vitamin B₁₂ 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; CF = crude fibre

of viscous polymers which result in better digestion and absorption of nutrients. Gunal and Yasar (2004) reported that enzyme supplementation decreases the digesta viscosity which, in turn, affects the digesta and fecal dry matter contents. Dietary inclusion of exogenous enzyme results in partial degradation and solubilization of cell wall polysaccharides, and reduces digesta viscosity in small intestines. This probably allows greater digestion and absorption of nutrients, thereby improves the bird performance (Ravindran *et al.*, 2000; Choct, 2004). Improvement in body weight gains and feed conversion ratio (FCR) of birds fed with enzyme supplemented diet was also observed in the present study (Table 2). After control, the highest body weight gains among the treatment groups was observed in group fed 8.0% crude fiber supplemented with enzyme thus confirms the fiber degrading quality of enzymes. Alam *et al.* (2003) and Rahman *et al.* (2005) observed higher body weight gains in birds fed enzyme supplemented diets. Besides degradation of fiber, beneficial effect on gain in body weights has been attributed to the ability of enzymes in reducing the digesta viscosity and indirectly altering the bacterial population in different regions of the digestive tract of birds (Gunal and Yasar, 2004). FCR value which is the most critical factor in assessing performance was significantly ($p < 0.05$) improved in birds fed 8% crude fiber supplemented with enzyme. Highest feed consumption was recorded in the control group indicating that birds consume less fiber diets more readily compared to diets having high fiber content (Table 2).

The birds fed 10.1% CF supplemented with enzyme showed reduced fiber digestibility compared to the birds fed 8.0% CF supplemented with enzyme and control group. This might be due to the fact that high content of fiber allows exaggerated multiplication of intestinal bacteria which may reach superior portions of jejunum producing acids which cause degradation of enzyme (Tabeidian *et al.*, 2011). This indicated that increased level of enzyme was required to bring about the desired effect in the 10.1% CF diets.

Table 2: Effect of yeast and enzyme supplementation on growth and nutrient utilization of broiler chicken fed high fiber diets

Parameters	Treatment groups					SEM
	6.2% CF	8.0% CF + enzyme	8.0% CF + yeast	10.1% CF + enzyme	10.1% CF + yeast	
CP digestibility (%)	66.11	65.93	65.34	65.75	64.98	0.69
EE digestibility (%)	75.23	75.34	74.97	75.14	74.81	0.82
CF digestibility (%)	35.60 ^a	35.50 ^a	31.10 ^b	32.66 ^c	29.66 ^d	0.17
Feed consumption (kg bird ⁻¹)	2550.2 ^a	2538.7 ^a	2157.2 ^b	2144.5 ^b	2122.5 ^c	5.13
Body weight gain (kg bird ⁻¹)	1.37	1.36	1.09	1.07	0.91	0.015
FCR	1.86	1.86	1.98	1.99	2.32	0.008

Means within the same row with different superscripts significant differ from each other.

The birds fed with 8.0 and 10.1% CF supplemented with yeast had reduced apparent digestibility of CF as compared to control. The results are contrary to the findings of Gao *et al.* (2008) who reported that yeast supplementation in high fiber diets was beneficial in degrading CF, however such study was conducted using relatively low fiber diets. Oyedele *et al.* (2008) observed significant increase in CF retention in birds fed diets supplemented with yeast. Further, they found that yeast has the ability to degrade fibrous materials in poultry feed but no such effect was observed in the present study. It seems that the yeast incorporated in the diet contained insufficient concentration to degrade CF content at 8.0 and 10.1% levels in broiler chicken diet which was reflected in their performance as well (Table 2). Birds fed yeast supplemented diets had significantly reduced body weight gains and FCR compared to control. These results differ from Charlie (1998) who reported that supplementation of yeast is effective in improving growth and feed efficiency in broilers. The contrasting results could be due to the difference in the strains of yeast, concentration and form of yeast used.

Results of this study suggest that enzyme supplementation to high fiber diets is beneficial in improving the digestibility of crude fiber and body weight gain of birds by eliminating the negative effect of high fiber but no such effect by dietary inclusion of yeast was observed. However, more studies at higher concentrations of yeast to explore its advantage in broiler chicken fed high fiber diets are required.

REFERENCES

- Alam, M.J., Howlider, M.A.R., Pramanik, M.A.H. and Haque, M.A. 2003. Effect of exogenous enzyme in diet on broiler performance. *International Journal of Poultry Science*, 2: 168-173.
- Al-Harthi, M.A. 2006. Impact of supplemental feed enzymes, condiments mixture or their combination on broiler performance, nutrients digestibility and plasma constituents. *International Journal of Poultry Sciences*, 5: 764-771.
- AOAC. 1995. *Official Methods of Analysis* (15th edn.). Association of Official Analytical Chemists, Washington, USA.
- BIS. 1992. *Poultry Feeds Specifications*. Bureau of Indian Standards, Bahadurshah Zafar Marg, New Delhi, India.
- Choct, M. 2004. *Enzymes for Feed Industry: Past, Present and Future*. pp. 126-130. In: Proceedings of the 12th World Poultry Congress, Turkey.
- Duncan, D.B. 1955. Multiple range and multiple F-test. *Biometrics*, 11: 1-42.
- Gao, J., Zhang, H.J., Yu, S.H., Wu, S.G., Yoon, I., Quigley, J., Gao, Y.P. and Qi, G.H. 2008. Effect of yeast culture in broiler diets on performance and immunomodulatory functions. *Poultry Sciences*, 87: 1377-1384.

- Gunal, M. and Yasar, S. 2004. Performance and some digesta parameters of broiler chickens given low or high viscosity wheat-based diets with or without enzyme supplementation. *Turkish Journal of Veterinary and Animal Science*, **28**: 323-327.
- Iyayi, E.A. and Losel, D.M. 2001. Changes in carbohydrate fractions of cassava peel following fungal solid state fermentation. *Journal of Food Technology Africa*, **6**: 101-103.
- Khan, S.H., Sardar, R. and Siddique, B. 2006. Influence of enzymes on performance of broilers fed sunflower-corn based diets. *Pakistan Veterinary Journal*, **26**: 109-114.
- McCracken, K.J. and Quintin, G. 2000. Metabolisable energy content of diets and broiler performance as affected by wheat specific weight and enzyme supplementation. *British Poultry Science*, **41**: 332-342.
- Oyedepi, J.O., Ajayi H.I. and Egere, T. 2008. The effects of increasing levels of yeast culture (Levucel SB) in a high fibre-diet on the performance and nutrient retention of broiler chicken. *Asian Journal of Poultry Science*, **2**: 53-57.
- Rahman, M.M., Mollah, M.B., Islam, F.B. and Howlider, M.A.R. 2005. Effect of enzyme supplementation to parboiled rice polish based diet on broiler performance. *Livestock Research for Rural Development*, **17**: 1-6.
- Ravindran, V., Cabahug, S., Selle, P.H. and Bryden, W.L. 2000. Response of broiler chickens to microbial phytase supplementation as influenced by dietary phytic acid and non-phytate phosphorus levels. II. Effects on apparent metabolizable energy, nutrient digestibility and nutrient retention. *British Poultry Science*, **41**: 193-200.
- Senkoylu, N. and Dale, N. 1999. Sunflower meal in poultry diets: A review. *World's Poultry Science Journal*, **55**: 153-174.
- Senkoylu, N. and Dale, N. 2006. Nutritional evaluation of a high-oil sunflower meal in broiler starter diets. *Journal of Applied Poultry Research*, **15**: 40-47.
- SPSS® 10.0. *Computer Software*, 1999. SPSS Inc., Headquarters, Wacker Drive, Chicago, Illinois, USA.
- Tabeidian, S.A., Toghyani, M., Toghyani, M. and Shahidpour, A. 2011. *Journal of Animal and Veterinary Advances*, **10**: 443-448.
- Taibipour, K. and Kermanshahi, H. 2004. Effect of levels of tallow and NSP degrading enzyme supplements on nutrient efficiency of broiler chickens. pp. 273. **In: Proceedings of the Annual Conference of the British Society of Animal Science**, 5-7 April, 2004, University of York, York, UK.
- Tufarelli, V., Dario M. and Laudadio, V. 2007. Effect of xylanase supplementation and particle-size on performance of guinea fowl broilers fed wheat-based diets. *International Journal of Poultry Sciences*, **6**: 302-307.