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Effect of Multi-Enzymes Supplementation on Growth Performance of Broiler

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Abstract.- Non-starch polysaccharides (NSPs) are not fully digested by broiler's endogenous enzymes and consequently the soluble NSPs in feed results in high digesta viscosity and poor retention of nutrients. Supplementation of NSPs digesting enzymes may release the nutrients from feed and reduce the anti-nutritional effects of NSPs. The present study was conducted to determine the effects of NSPs digesting enzymes (Zympex) in broiler chicks. A total of 120 day old broiler chicks (Hubbard) were categorized into 3 treatments and each treatment was having four replicates comprised of 10 chicks in each. Dietary treatments comprised of Basal diet (2740 KCal/kg) as control-1 (T_1), low energy diet (2630 KCal/kg) control-2 (T_2) and low energy diet with 0.5 gm/kg enzyme as T_3. Multi-enzymes supplementation showed significant ($P<0.05$) positive effect on weight gain (last three weeks), feed intake (last two weeks), FCR (1st, 2nd, 4th and 5th week) and nutrient retention in T_3 when compared with control-2. Weight gain was lower ($P<0.05$) in low caloric feed group C when compared with control-1 in all weeks except last week ($P>0.05$), feed consumption was significantly lower ($P<0.05$) in 5th week and results showed poor FCR ($P<0.05$) in 2nd, 3rd and 4th week but non-significant effect in 1st and 5th week when compared with control-1 group, which revealed the positive effect of enzyme supplementation in low energy diet. These results revealed that enzyme supplementation releases more energy from low energy diets and results in equal performance to the optimal diet.

Key words: Body weight, FCR, feed intake, non-starch polysaccharides.

INTRODUCTION

In commercial poultry farming feed cost is a major contributor as it covers 65-70% of farm expenses. In feed formulation grains have major share which contain non-starch polysaccharides (NSPs). These NSPs are not digestible by the endogenous enzymes of poultry. In order to make them available for digestion, certain enzymes are supplemented. A lot of enzymes are available in market to improve nutritive value in those grains. Utilization of most grains is influenced by the presence of indigestible complex carbohydrates, such as NSPs. Grains have α-galactosides (raffinose and stachyose) and non starch polysaccharide that cannot be digested in the small intestine of simple stomach animals due to the lack of endogenous enzymes with α-galactosidase activity. Legume seeds also contain NSP-like hemicelluloses, mannan, and raffinose (Iirish *et al.*, 1995; Veldman and Vahl, 1994). Chickens are unable to produce some enzymes, such as galactosidases; thus, corn-soybean-based diets without supplemented enzymes such as xylanases and pectinases might result in gas accumulation in the gut and diarrhea (Wu *et al.*, 2005; Jaroni *et al.*, 1999).

The accumulation of above mentioned oligosaccharides in the alimentary tract results in fluid retention and an increased flow rate of digesta, which negatively affects the digestion and absorption of nutrients. Supplementation of poultry diets with exogenous enzymes is one approach to help animals in hydrolysis of these oligosaccharides (Kidd *et al.*, 2001; Graham *et al.*, 2002). Enzyme supplementation is considered to break the bond among NSPs and reduce their anti-nutritional effect and results in improved nutritional value of feed materials (Giraldo *et al.*, 2008; Balamurugan and Chandrasekaran, 2009). The effect of exogenous enzyme may be variable as it is dependent on different factors like bird age, feed type and quality (Bedford, 2000; Acamovic, 2001).

Widely used enzymes in feed industry are α-galactosidase, amlyase, β-glucanase, cellulase,

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protease, pectinase, and xylanase that cleave the non-starch polysaccharides in cereals and vegetable meals. ZYMPEX® 008 is a multi-enzyme complex consisting of enzymes necessary for breakdown of fiber, starch, NSPs and proteins as α-galactosidase is a fungal origin enzyme and causes hydrolysis of the oligosaccharides, β-mannanase which hydrolyze the mannan part of carbohydrate, cellulase is class of enzymes produced mainly by fungi, bacteria, and protozoans that catalyze the hydrolysis of cellulose, amylase breaks starch into sugar, β-xylanase degrades the linear polysaccharide β-1,4-xylan into xylose, thus breaking down hemicellulose, the major components of plant cell walls (Dashek, 1997), β-glucanase catalyzes the α-glucosan in plants into glucose, so as to reduce the viscosity of digesta. Protease breaks down proteins by proteolysis of the peptide bonds that link amino acids together in the polypeptide chain forming the protein. Proteases work best in acidic conditions except alkaline proteases. Its optimal activity is shown in alkaline pH (Barrett *et al.,* 2003). The current research project was conducted to evaluate the effect of multi-enzyme complex (NSP enzyme, Impextraco, Belgium) on growth performance and feed intake of broilers when added in feed having low energy.

MATERIALS AND METHODS

Experimental design and dietary treatments

This experiment was conducted at broiler production unit of UVAS, Lahore. Total 120, day old broiler birds were purchased from SB Chicks. After procurement, all birds were weighed individually and kept in fumigated experimental house under uniform managemental conditions. Experimental diet and clean water was offered *ad libitum*. Vaccination schedule, lighting and other managemental practices were followed according to standard schedule.

Chicks (n=120) were divided into 3 groups (A, B, C) and each group was further divided into four replicates with 10 birds each. Group A was control group-1 and fed only normal NRC (1994) recommended diet. Group B was control-2 having low energy (2630Kcal/kg) and group C was a treatment group provided with enzyme supplementation @ 0.5gm/kg of feed. Three experimental diets were allotted randomly to three groups. Complete dietary protocol is depicted in Table I.

Experimental parameters

In the beginning of the experiment, all day old chicks were weighed and initial body weight recorded on the 1st day after delivery at poultry house. The birds were weighed regularly at the end of each week individually to calculate their weekly body weight gain. The weekly average weight gain was calculated by subtracting the average body weight of previous week from the average body weight at the end of next week. At the end of the experiment, the total body weight gain was recorded. Feed consumption was recorded on weekly basis during the whole experiment. Data regarding weight gain and feed intake, was used to calculate weekly FCR.

RESULTS

Results of treatment diets were compared with control-1 group of broilers given nutritionally adequate diet (group A) and control-2 low caloric feed (group B). Weekly weight results showed that broilers of basal diet gain maximum weight which was followed by low energy diet having 500g/ton zympex and low energy diet group B (Table I). The differences of average weights of various groups when compared statistically with group A, revealed that the weights of group B were significantly different ($p<0.05$) having less body weight as compared to group A. Whereas the difference between group A and C was found significant ($p<0.05$) upto 4 weeks but it has non-significant effect in 5th week. When group C was compared with group B (Control-2) it showed non-significant difference for first 2 weeks but have significant difference ($p<0.05$) in last 3 weeks. These results indicated that the weight gain of birds fed low energy diet (group B) is less as compared to group A, while the weight gain of group C fed low energy diet having enzyme supplement showed less weight gain in first 4 weeks but have equal body weight at 5th week when compared with A, which illustrates the possible positive effect of enzyme as it has low energy but weight is equal to control-1. When compared group C with control-2 (group B) it

Table I.- Effect of enzyme supplementation on weight gain, feed consumption and feed conversion ratio in broiler.

Treatments	Diets	1st week	2nd week	3rd week	4th week	5th week
Average body weight (g)						
Normal basal diet (2740 Kcal/Kg)	A	150.86±5.17[a]	367.20±6.14[a]	738.80±3.42[a]	1247.80±5.63[a]	1727.80±6.50[a]
Low energy diet (2630 Kcal /kg)	B	134.78±8.00[b]	340.60±8.11[b]	711.60±8.68[c]	1215.20±3.96[c]	1691.20±5.81[b]
Low energy diet (2630 Kcal /kg) +0.5 gm /kg enzyme Zympex	C	141.64±10.96[b]	349.80±7.66[b]	720.20±5.93[b]	1225.00±6.08[b]	1723.20±6.06[a]
Average feed consumption						
Normal basal diet (2740 Kcal/Kg)	A	162.80±5.93[a]	555.60±6.80[a]	1180.00±6.78[a]	2124.00±5.10[b]	3236.60±6.77[c]
Low energy diet (2630 Kcal /kg)	B	165.20±7.29[a]	560.40±4.28[a]	1181.80±4.82[a]	2135.00±7.21[a]	3260.00±7.91[a]
Low energy diet (2630 Kcal /kg) +0.5 gm /kg enzyme Zympex	C	164.00±2.92[a]	554.00±6.52[a]	1177.00±7.11[a]	2122.00±3.61[b]	3235.00±6.82[c]
Feed consumption ratio						
Normal basal diet (2740 Kcal/Kg)	A	1.08±0.06[b]	1.51±0.02[b]	1.28±0.70[b]	1.70±0.01[a]	1.87±0.01[b]
Low energy diet (2630 Kcal /kg)	B	1.23±0.06[ac]	1.65±0.04[a]	1.66±0.02[a]	1.76±0.01[b]	1.93±0.00[a]
Low energy diet (2630 Kcal /kg) +0.5 gm /kg enzyme Zympex	C	1.16±0.08[c]	1.58±0.03[c]	1.64±0.02[a]	1.73±0.01[c]	1.88±0.01[b]

Superscripts with same alphabet indicate NS ($p>0.05$). Superscripts with different alphabets indicate significant differences ($p<0.05$)

showed more weight gain in last 3 weeks as compared to group B.

Group B showed the non-significant difference ($p>0.05$) in feed consumption upto 3rd week as compared to group A and a significant negative ($p<0.05$) effect in last 2 weeks as predicted in Table I. Group C remained non-significant ($p<0.05$) throughout the experimental period when compared with group A. When group C was compared with group B (control-2) it revealed non-significant difference among the treatments upto 3 weeks but positive significant difference ($p>0.05$) in last 2 weeks. Results explained that the feed intake was not different in group B for 3 three weeks but the feed intake was higher in group B in last 2 weeks as compared to A. The feed intake of group C is also statistically same as compared to group A. By comparing B and C feed intake was less in last 2 weeks in C group as compared to B.

The overall FCR of group A was found to be optimal among all groups, which was followed by group C, B (Table I). The analysis of variance among different experimental groups showed a significant difference ($p<0.05$) upto four weeks and non-significant in last week in group B when compared with group A which reveals that the FCR was poor in group C as compared to other groups during first 4 weeks but no difference in last week. During last week FCR was equal to control-1 which indicates the positive effect of enzyme supplementation in low energy diet in last week. When group C was compared with group B (Control-2) it showed significant difference ($p<0.05$) in all weeks except during 3rd week which indicated that the FCR of group B containing low energy was poor as compared to group C which contained low energy with enzyme supplementation. The FCR of group B was poor among all groups.

DISCUSSION

The advantages of enzyme addition in feed for improvement in availability of nutrients and performance of bird are well known (Bedford and Morgan, 1996). Some cereals grains like barley, wheat and corn may have non-starch polysaccharides which exhibit their suppressive and anti-nutritional effect on the broiler performance and addition of enzyme can minimize the adverse effect (Annison and Choct, 1991).

The poultry is lacking endogenous enzyme for the digestion of NSPs so these remain undigested and energy is wasted in them but with the use of exogenous enzyme NSPs can be digested

resulting in energy release. By using enzyme we can formulate the feed with less energy as some part of energy is compensated by the action of exogenous enzyme on NSPs and results in increased nutrient digestibility and growth performance (Zanella *et al.*, 1999). Enzyme supplementation in corn-soya based feed increase growth performance of broiler (Kavitha Rani *et al.,* 2003).

In different studies it has already been reported that the addition of exogenous multi-enzyme (xylanase, protease and amylase) in feed has a positive effect on growth performance in broiler (Zanella *et al.,* 1999; Ghazi *et al.,* 2002; Yu *et al.,* 2007). However the enzyme efficiency is related to some extent with age of the bird also as older birds have more microbial population and more intestinal fermentation rate so they can combat with viscous feed ingredients (Choct *et al.,* 1996; Vranjes and Wenk, 1995). In another study by Lázaro *et al.* (2003) it was observed that by reducing viscosity of digesta enzyme efficiency may increase and results in better performance of broiler. Addition of phytase enzyme also results in improved body weight and FCR in layers (Khalique *et al.,* 2010).

In current study multi-enzyme supplementation has no significant effect in different age groups as compared with the control-1 as all treatments were comprising less energy but when compared low energy diet supplemented with enzyme (T3) it resulted in positive effect on growth performance as compared to control-2 and in last week group C performance was equal to group A although it was non-significant but it clearly showed that inspite of having less energy this diet performance was competing with normal diet group A which was the evidence of enzymes effect (Hajati, 2010), and it was according to the finding of previous studies by Zanella *et al.* (1999) who found that Avizyme (a cocktail enzyme) supplementation had resulted in improved weight gain. It was also observed in previous studies that NSPs digesting enzymes usually resulted in increased utilization of nutrients which leads to better weight gain, FCR and reduced digesta viscosity and decreased environmental pollution (Broz and Ward, 2007; Costa *et al.,* 2008). When we compared group C with group B (control-2) it revealed significant positive weight gain in last two weeks which indicated the efficiency of exogenous enzyme. Similar findings were also reported by (Kavitha Rani *et al.*, 2003) that addition of multi-enzyme resulted in increased weight. (Ao *et al.,* 2009; Olukosi *et al.,* 2007; Gutierrez del Alamo *et al.,* 2008; Gao *et al.,* 2007; Yu *et al.*, 2007; Paul *et al.,* 2007) also reported the positive effect of enzyme supplementation on performance of broiler.

In present study feed intake by group C was non-significant during whole experimental period as compared with control-1 which indicated that the feed intake of enzyme supplemented group was almost similar as in normal diet group A. The previous studies showed the reduced feed intake by enzyme supplementation (Kocher *et al.,* 2002) and similar observations were also reported by (Sikka and Chawla, 2002). The difference might be due to low energy diet used in current study but inspite of having low energy its feed consumption was near the control group A but when compared group C with group B (control-2) it showed significant reduced feed intake in group C which was having enzyme supplementation as previous studies also reported the similar results regarding feed consumption and weight gain (Gutierrez del Alamo *et al.,* 2008; Gao *et al.,* 2007; Yu *et al.,* 2007).

Feed Conversion Ratio was recorded significantly poor in group C when compared with group A except in last week, which was in contrary to the findings of (Zanella *et al.,* 1999) who observed that supplementation of multi-enzyme results in better FCR. The similar findings were also observed in other studies that enzyme addition results in better feed efficiency (Kavitha Rani *et al.*, 2003; Singh and Khatta, 2003; Wu *et al.*, 2004). This difference is might be due to low energy diets used in this experiment as in previous studies enzyme supplementation was done in basal diet.

CONCLUSION

The inclusion of enzyme in feed showed that the performance of the low energy diet groups is competing with the basal diet group. It has been revealed that enzyme supplementation in low energy diets have positive effect on bird performance .In current study multi-enzyme was supplemented in

low caloric feed and it is anticipated that it may show better performance if added in basal diet.

REFERENCES

AO, T., CANTOR, A. H., PESCATORE, A. J., FORD, M. J., PIERCE, J. L. AND DAWSON, K. A., 2009**.** Effect of enzyme supplementation and acidification of diets on nutrient digestibility and growth performance of broiler chicks. *Poult Sci.*, **88**:111-117.

ANNISON, G. AND CHOCT, M., 1991. Anti-nutritive activities of cereal non-starch polysaccharides in broiler diets and strategies minimizing their effects. *World's Poult. Sci. J.*, **47**: 232–242.

ACAMOVIC, T., 2001. Commercial application of enzyme technology for poultry production. *World Poult. Sci. J.*, **57**: 225-243. DOI: 10.1079/WPS20010016.

BALAMURUGAN, R. AND CHANDRASEKARAN, D., 2009. Effect of multienzyme supplementation on weight gain, feed intake, feed efficiency and blood glucose in broiler chickens. *Indian J. Sci. Technol*., **3**: 193-195.

BARRETT, A. J., RAWLINGS, N. D. AND WOESSNER, J. F., 2003. *The handbook of proteolytic enzymes*, 2nd ed. Academic Press.

BEDFORD, M. R. AND MORGAN, A. J., 1996. The use of enzymes in poultry diets. *World's Poult. Sci. J.*, **52**:61–68.

BEDFORD, M.R., 2000. Exogenous enzymes in monogastric nutrition-their current value and future benefits. *Anim. Feed Sci. Technol*., **86**: 1-13.

BROZ, J. AND WARD, N.E., 2007. The role of vitamins and feed enzymes in combating metabolic challenges and disorders. *J. appl. Poult. Res.*, **16**: 150-159.

CHOCT, M., HUGHES, R. J., WANG, J., BEDFORD, M.R., MORGAN, A. J. AND ANNISON, G., 1996. Increased small intestinal fermentation is partly responsible for the anti-nutritive activity of non-starch polysaccharides in chickens. *Br. Poult. Sci*., **37**: 609-621.

COSTA, F.G.P., GOULART, C.C., FIGUEIREDO, D.F., OLIVEIRA, C.S.F. AND SILVA, J.H.V., 2008. Economic and environmental impact of using exogenous enzymes on poultry feeding. *Int. J. Poult. Sci*., **7**: 311-314.

DASHEK, W. V., 1997. *Methods in plant biochemistry and molecular biology*. CRC Press, pp. 313.

GIRALDO, L.A., TEJIDO, M.L., RANILLA, M.J., RAMOS, S. AND CARRO, M.D., 2008. Influence of direct-fed fibrolytic enzymes on diet digestibility and ruminal activity in sheep fed grass hay-based diet. *J. Anim. Sci*., **86**: 1617-1623.

GRAHAM, K. K., KERLEY, M. S., FIRMAN, J. D. AND ALLEE, G. L., 2002. The effect of enzyme treatment of soybean meal on oligosaccharide disappearance and chick growth performance. *Poult. Sci.*, **81**:1014–1019.

GAO, F.Y., JIANG ZHOU, G.H. AND HAN, Z.K., 2007. The effects of xylanase supplementation on performance, characteristics of the gastrointestinal tract, blood parameters and gut microfelora in broilers fed on wheat-based diets. *Anim. Feed Sci. Technol*., **142**: 173-184.

GUTIERREZ DEL ALAMO, A., VERSTEGEN, M.W.A., DEN HARTOG, L.A., PEREZ DE AYALA, P. AND VILLAMIDE, M.J., 2008. Effect of wheat cultivar and enzyme addition to broiler chicken diets on nutrient digestibility, performance and apparent metabolizable energy content. *Poult. Sci*., **87**: 759-767.

GHAZI, SROOKE, J.A., GALBRAITH, H. AND BEDFORD, M.R., 2002. The potential for the improvement of the nutritive value of soya-bean meal by different proteases in broiler chicks and broiler cockerels. *Br. Poult. Sci*., **43**: 70-77.

HAJATI, H., 2010. Effects of enzyme supplementation on performance, carcass characteristics, carcass composition and some blood parameters of broiler chicken. *Am. J. Anim. Vet. Sci.*, **5**: 221-227.

IRISH, G.G., BARBOUR, G.W., CLASSEN, H.L., TYLER, R.T. AND BEDFORD, M.R., 1995. Removal of the galactosides of source from soybean meal using either ethanol extraction or exogenous galactosides and broiler performance. *Poult. Sci*., **74**:1484–1494

JARONI, D., SCHEIDELER, S.E., BECK, M. AND WYATT, C., 1999. The effect of dietary wheat middlings and enzyme supplementation. 1. Late egg production efficiency, egg yields, and egg composition in two strains of Leghorn hens. *Poult. Sci*., **78**:841–847.

KHALIQUE, A., AHMAD, F., MAHMUD, A. AND YOUNUS, M., 2010. Effect of locally produced phytase on growth of layer chicks. *Pakistan J. Zool.,* **42**: 445-450.

KIDD, M.T., MORGAN, G.W. AND ZUMWALT, C.D., 2001. α-Galactosidase enzyme supplementation to corn and soybean meal broiler diets. *J. appl. Poult. Res*., **10**:186–193.

KOCHER, A., CHOCT, M., PORTER, M.D. AND BROZ, J., 2002. Effects of feed enzymes on nutritive value of soyabean meal fed to broilers. *Br. Poult. Sci*., **43**:54-63.

KAVITHA RANI, B., JAYASHREE DESAI., DEEPIKA REDDY AND RADHAKRISHNA, P.M., 2003. Effect of supplementation of enzymes for non starch polysaccharides in corn-soya diet in broilers. *Indian J. Anim. Nutr*., 20: 63-69.

LÁZARO, R., GARCÍA, M., MEDEL, P. AND MATEOS, G.G., 2003. Influence of enzymes on performance and digestive parameters of broilers fed rye-based diets. *Poult. Sci.*, **82**: 132-140.

NRC., 1994. *Nutrient requirements of poultry*. 9th rev. ed. National Academy Press, Washington, DC.

OLUKOSI, O.A., COWIESON, A.J. AND ADEOLA, O., 2007. Age-related influence of a cocktail of xylanase,

amylase, and protease or phytase individually or in combination in broilers. *Poult. Sci*., **86**:77–86.

PAUL, S. K., SAMANTA, G., HALDER, G. AND BISWAS, P., 2007. *Effect of combination of organic acid salts as antibiotic replacer on the performance and gut health of broiler chickens.* Livestock Research for Rural Development. 171(19).

SIKKA, S.S. AND CHAWLA, J.S., 2002. Influence of enzyme supplementation of wheat and rice kani based diets on the performance of broilers. *Anim. Nutri. Feed Tech*., **2**:11-18.

SINGH, P.K. AND KHATTA, V.K., 2003. Effect of phytase supplementation on the performance of broiler chickens fed wheat based diets. *Indian J. Anim. Nutr.*, **20**1:57-62.

VELDMAN, A. AND VAHL, H.A., 1994. Xylanase in broiler diets with differences in characteristics and content of wheat. *Br. Poult. Sci*., **35**:537–550.

VRANJES, M.V. AND WENK, **C.,** 1995. Influence of dietary enzyme complex on the performance of broilers fed on diets with and without antibiotic supplementation. *Br. Poult. Sci*., **36**: 265-275.

WU, G., BRYANT, M.M., VOITLE, R.A. AND ROLAND, SR. D.A., 2005. Effect of β-mannanase in corn-soy diets on commercial Leghorns in second cycle hens. *Poult. Sci*., **84**:894–897.

WU, Y.B., RAVINDRAN, V., THOMAS, D.G., BIRTLES, M.J. AND HENDRIKS, W.H., 2004. Influence of phytase and xylanase, individually or in combination on performance, apparent metabolisable energy, digestive tract measurements and gut morphology in broilers fed wheat based diets containing adequate level of phosphorus. *Br. Poult. Sci*., **45**:76-84.

YU, B., WU, S.T., LIU, C.C., GAUTHIER, R. AND CHIOU, P.W.S., 2007. Effects of enzyme inclusion in a corn-soybean diet on broiler performance. *Anim. Feed. Sci. Tech*., **134**: 283-294.

ZANELLA, SAKOMURA, N. K., SILVERSIDES, F. G., FIQUEIRDO, A. AND PACK, M., 1999. Effect of enzyme supplementation of broiler diets based on corn and soybeans. *Poult. Sci*., **78**:561–568.

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