Effect of Cellulytic Enzyme Supplementation (Extracted from *Chatomium thermophyle*) on Production Performance and Economic Appraisal in Aged Layers Using High Fiber Diets

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Abstract: One hundred and twenty white leghorn layers of 80 weeks having uniform body weight were randomly divided into 15 experimental units of 8 birds each and reared under standard managemental conditions. Five treatments (each having three replicates) i.e. control T1 (commercial layer mash), T2 (layer mash having 6% fiber + 1X enzyme), T3 (layer mash having 8% fiber + 1X enzyme), T4 (layer mash having 6% fiber + 2X enzyme) and T5 (layer mash having 8% fiber + 2X enzyme) were randomly allotted to experimental units. Egg production, egg weight and feed consumption were recorded for eight weeks. Egg mass, feed conversion ratio/dozen egg and feed conversion ration/kg egg mass was also calculated. Data was analyzed statistically using analysis of variance technique under completely randomized design. Treatment means were compared using least significant test. It was found that egg production increased significantly by the T2 but was non-significant with the control group. The different treatments showed significant decrease in feed consumption as compared with control group. Significant improvement in egg mass was found in control group and was non-significant with T2 and T4. There was significant effect of enzyme supplementation on feed conversion ration/dozen egg and feed conversion ratio/kg egg mass. T2 and T4 showed best feed conversion ratios per dozen and per kg egg mass. Maximum profit/bird was observed in T2 followed by T4, T5, T3 and T1, respectively.

Keywords: Fiber degrading enzyme, Layers, production performance, Economical appraisal.

INTRODUCTION

Cereal grains are rich in starch and non-starch polysaccharides (NSP). Non-starch polysaccharides are also known as fiber. Among NSP's cellulose is the main structural component of the cell wall, while the hemicellulose, the second largest component is primarily composed of three main groups of polysaccharides such as xylans, mannans and galactomannans [1, 2]. Ingestion of NSP by monogastrics results in increased viscosity of the digesta. This increased viscosity reduces the passage rate of the feed leading to overall reductions in consumption and decreased performance, sticky droppings and dirty eggs [3]. The addition of enzymes to the diet to address NSP viscosity can improve feed efficiency, improve manure quality and increase the use of lower cost feed ingredients [1, 4-7].

Normal digesta require substrate, enzyme and digestion products throughout the gut wall. As the viscosity of digesta increases; the rate of diffusion increases and this cause reduced digestibility of all substrates [1].

In poultry diet, addition of enzymes such as amylase and xylanase are useful in the utilization of the non-starch polysaccharide component. Likewse, enzymes supplementation increase the effectiveness of nutrient utilization resulting in improved performance [8-10].

The benefits of adding commercial enzyme preparations to poultry feed have been researched extensively for broilers [3, 9, 11-16]. However, there is little information available about the benefits of adding enzymes to layer diets [17]. Layers and broilers differ in a number of ways including the fact that broilers are immature birds, whereas layers are mature birds. There is evidence that bird age, even within broilers, can influence digestive function [18, 19].

Enzymes addition is reported to increase hen day production (%) and egg weight from age of 31st week to 66th week with low ME diet and with high ME diet [10] In old age, layers birds are in downswing of their production curve. During this period the feed intake of the birds remains constant while the egg production decreases which results in decreased profitability/bird. To increase the profitability/bird the cost/kg feed can be reduced by increasing the fiber level up to 6 or 8% with the addition of enzymes.

An enzyme cellulase is extracted from the fungus *Chaetomium thermophile* at National Institute of Biotechnology and Genetic Engineering (NIBGE) Faisalabad. This enzyme contains Xylanase (30U/ml),

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Endoglucanase (2.5 U/ml) and B glucosidase (1.5 U/ml) and is under trial for final recommendation. A project thus has been planned with collaboration of National Institute of Biotechnology and Genetic Engineering (NIBGE) Faisalabad with the objective to study the effect of cellulase enzyme on egg production and to determine the economic feasibility of using enzymes in high fiber layer ration.

MATERIALS AND METHODS

In order to evaluate the effect of fiber degrading enzyme using different levels of fiber in the layer diets (having 80 week age), an experiment was conducted to see its effects on the performance parameters of the layers. This study was carried out at Poultry Research center, University of Agriculture, Faisalabad.

Environmentally control house was used and the birds were kept in cages. Thoroughly cleaned and disinfected cages were used. Each cage had four units with specification of 2 birds/ unit having length, width and height of 16.5, 15.5 and 14.5 inches respectively. The birds were given broad-spectrum antibiotics i.e oxytetracycline @ 125g/bag feed for one week prior to start of experiment to reduce the chances of disease outbreak. Birds were also vaccinated against New Castle Disease (ND) according to the recommended schedule. Diets supplemented with enzyme and water was offered *adlibitum*. Seventeen hours light with the intensity of ¾ foot candle was provided to the birds through out the experimental period.

One hundred and twenty White Leghorn Layers of same age (80 weeks) and weight (1700±100 g) were distributed in five groups (each group was comprised of 3 replicates having 8 birds in each replicate). These birds were fed different experimental rations (Tables **1** and **2**) from 80 to 88 weeks of age.

Daily eggs production, egg weight and feed consumption were recorded throughout the experimental period. Egg mass and feed conversion

Table 1: Ingredient Composition of Rations Used

Ingredient	Ration T1 (Control)	Ration T2 Enzyme @ 1X Enzyme	Ration T3 Enzyme @ 1X Enzyme	Ration T4 Enzyme@ 2X Enzyme	Ration T5 Enzyme @ 2X Enzyme
Maize grain	39.50	23.50	25.50	23.50	25.50
Wheat corn	00.00	20.00	10.00	20.00	10.00
Rice Tips	20.00	0.00	0.00	0.00	0.00
Rice Polishing	5.00	13.00	16.00	13.00	16.00
Canola meal	6.00	10.00	2.00	10.00	2.00
Soybean meal	8.00	0.00	0.00	0.00	0.00
Sunflower meal	0.00	10.00	24.00	10.00	24.00
Corn gluten meal 30%	2.00	0.00	0.00	0.00	0.00
Corn gluten meal 60%	1.00	2.50	0.00	2.50	0.00
Soy bean oil	0.00	2.50	4.00	2.50	4.00
Fish meal	4.50	5.00	5.00	5.00	5.00
Molasses	4.00	3.00	3.00	3.00	3.00
Premix	0.50	0.50	0.50	0.50	0.50
Limestones	7.00	9.00	9.00	9.00	9.00
DCP	2.50	1.00	1.00	1.00	1.00
Total	100.00	100.00	100.00	100.00	100.00
Nutrients					
Crude Protein (%)	17.00	17.00	17.00	17.00	17.00
Metabolizable Energy kcal/kg	2732	2618	2615	2618	2615
Crude fiber (%)	4.00	6.00	8.00	6.00	8.00

Table 2: Allocation of Various Treatments to the Experimental Diets

Treatments	Rations	Protein (%)	Energy Kcal/kg
T1 (Control)	Commercial Layer mash (Ration No. 3)	17	2732
T2	Layer mash +1X Enzyme + 6% fiber	17	2618
T3	Layer mash +1X Enzyme + 8% fiber	17	2615
T4	Layer mash +2X Enzyme + 6% fiber	17	2618
T5	Layer mash +2X Enzyme + 8% fiber	17	2615

ratio per dozen egg and per kg egg mass were calculated. At the end of experiment economics of the trial was also calculated. Data collected on laying performance was analyzed statistically using analysis of variance technique with completely randomized design. The significance of differences among the treatments means was evaluated by least significance difference test [20].

RESULTS

The data on egg production, feed consumption and calculated data on egg mass, feed conversion ratio/dozen egg, feed conversion ratio/kg egg mass and profit/bird observed during the trial period are showed in Table **3**.

Egg production was recorded throughout the experiment period (8 weeks) and is expressed in term of egg number per bird. The mean egg no. for treatments T1, T2, T3, T4and T5 was 36.25, 36.50, 30.66, 36.08 and 32.79 per bird through eight weeks experimental period (Table 4.1). The maximum egg production (36.50) was found for the birds fed on treatment T2 (Layer mash +1X Enzyme + 6% fiber). The minimum egg production (30.66) was found for the birds fed on treatment T3 (Layer mash +1X Enzyme + 8% fiber).

Feed consumption was recorded on weekly basis throughout the experiment period. Mean feed consumption per bird during experiment for treatments T1, T2, T3, T4 and T5 was 5.68, 5.34, 5.21, 5.38 and 5.27 kg for 8 weeks (Table **3**). Maximum feed consumption (5.68 kg) was found for the birds fed on treatment T1 (Commercial Layer mash). Minimum feed consumption (5.21 kg) was found for the birds fed on treatment T3 (Layer mash +1X Enzyme + 8% fiber). Treatment T1 showed significantly high feed consumption. Treatment T2 has non significant difference with T4 and T5. Treatment T3 and T5 consumed minimum feed and were also non significant between themselves.

Weekly egg number per replicate and average egg weight for that week was used to calculate egg mass per week per replicate. Mean egg mass per bird for all the treatments T1, T2, T3, T4 and T5 was 2.30, 2.27, 1.94, 2.25 and 2.04 kg for eight weeks (Table **3**). Maximum egg mass (2.30 kg) was found for the birds fed on treatment T1 (Commercial Layer mash). Minimum egg mass (1.94 kg) was found for the birds fed on treatment T3 (Layer mash +1X Enzyme + 8% fiber). Treatments T1, T2 and T4 have non significant effect among themselves. Similarly treatment T3 and T5 also showed non significant difference between themselves.

Table 3: Effect of Enzyme Supplementation (*Chaetomium thermophile*) on Layer Production Performance Per Bird During the Experimental Period (80-88) Weeks

Treatment	Egg Production (No.)	Feed Consumption (Kg)	Egg mass (Kg)	FCR/ Dozen egg	FCR/kg egg mass	Profit/ bird
T1 (Control)	36.25^{a}	5.68^{a}	2.30^{a}	1.9^{bc}	2.5^{b}	19.95
T2	36.50^{a}	5.34^{bc}	2.27^{a}	1.8^{c}	2.4^{b}	34.78
T3	30.66^{b}	5.21^{c}	1.94^{b}	2.1^{a}	2.8^{a}	23.42
T4	36.08^{a}	5.38^{b}	2.25^{a}	1.8^{c}	2.4^{b}	33.20
T5	32.79^{b}	5.27^{bc}	2.04^{b}	2.0^{ab}	2.7^{ab}	28.29

Same superscript on means in columns show non significant difference.

Weekly feed consumption per replicate and weekly no of eggs per replicate was recorded throughout the experimental period to calculate feed conversion ratio per dozen eggs, which reflect the potential of the bird to convert feed into eggs. Mean FCR/dozen egg for all the treatments T1, T2, T3, T4 and T5 was 1.9, 1.8, 2.1, 1.8 and 2.0 (Table **3**). Best FCR/dozen eggs (1.8) was recorded in treatment T2 and T4. Poor FCR/dozen eggs (2.1) was recorded in treatment T3 (Layer mash +1X Enzyme + 8% fiber). There was non significant differences between treatment T3 and T5. Treatments T1, T2 and T4 also showed non significant difference among themselves.

Weekly feed consumption per replicate and weekly egg mass per replicate was used to calculate the feed conversion ratio per kg egg mass. Mean FCR/kg egg mass for all the treatments T1, T2, T3, T4 and T5 was 2.5, 2.4, 2.8, 2.4 and 2.7 (Table **3**). Best FCR/kg egg mass (2.4) was recorded in treatment T2 and T4. Poor FCR/kg egg mass (2.8) was recorded in treatment T3 (Layer mash +1X Enzyme + 8% fiber). T3 and T5 were significantly poor and were non significant between themselves. T1, T2, T4 and T5 were non significant among themselves.

DISCUSSION

There was a highly significant (P<0.01) effect of treatment on egg production (Table **3**). The experimental birds under the treatment T2 showed maximum egg production (36.50) but it was non significant with the control group (36.25) while treatment T3 (30.66) showed minimum egg production which was significantly lower from control group, T5 (32.79) differed non-significantly form T3 but significantly form control (T1). The results of this study suggest that highest egg production in treatment T2 might be attributed to enhanced availability of the nutrients to the birds. The results suggested that 1X enzyme concentration provided efficient degradation of diet with 6% fiber, which in turn made ample availability of bind nutrients, helpful for the production of eggs. The results of the present study were in inconsistent with the findings of [8, 10, 18, 21, 22]. They reported non-significant effect of enzyme supplementation on the egg production of the layers. This difference may be due to different environmental conditions. Controversial reports were also found in the literature regarding egg production. The results of the present study were not in agreement with the findings of [5, 13, 23]. They found that enzyme supplementation in the diets of layers significantly reduced egg production.

Enzyme supplementation showed significant reduction in feed consumption as compared to control groups (Table **3**). The result of the present study are also compatible with the finding of Esonu *et al*. (2005) who used different levels of soybean hulls as fiber source @ 0,10, 20 and 30% with or without supplementation of 2.0% cellulase enzyme in the diets of layer birds aging 72 weeks and reported that feed intake was significantly (P<0.05) reduced in 10 and 20% diet with enzyme. The reduction of feed intake in the present study might be due to more availability of energy from fiber when enzymes were used.

Controversial reports were also found in the literature regarding feed consumption. The results of the present study differed with the findings of Cowan and Korsbak (1999), Brenes *et al*. (2002). They reported significant increased feed consumption in the layers with enzyme supplementation. The results of the present study were not inline with the findings of Igbasan and Guenter (1997), Pan *et al*. (1998), Scheideler and Abudabos (1998), Jaroni *et al*. (1999 Senkoylu *et al*. (2004) who reported non-significant effect of enzyme supplementation on feed intake of the layers at different ages.

Treatment showed significant effect on egg mass (Table **3**). The results of the present study showed that the egg mass of control group was maximum and it was non-significant with T2 and T4. The results of the present study were inline with the finding of Igbasan and Guenter (1997), Pan *et al*. (1998), Scheideler and Abudabos, (1998). They reported that enzyme supplementation have non-significant effect on egg mass as compared to the control group. Egg mass at lower level of fiber in diet was non-significant with control which might be due to efficient availability of nutrients but with the increase in fiber level i.e. 8% the decrease in feed intake might be the cause of decrease in egg mass. This might be supported with the results of the present study that in T5 the egg mass is more than T3 suggesting that 8% fiber with 1X enzyme is not as efficient as 8% fiber is with 2X concentration of the enzyme. While groups T3 and T5 having high level of fiber showed significantly lower egg mass. Controversial results were reported by Jaroni *et al*. (1999) who fed two levels of wheat middlings (8 and 16%) in corn soy bean based control diet with addition of increasing level of xylanase enzyme (0.1, 0.2%) to layers. He found significant improvement in egg mass.

The results of the present study showed that best FCR/dozen egg was observed in the birds of group T2 and T4 fed diet having 6% fiber with 1X and 2X enzyme concentration and it was non significant with control(Table **2**). The results of the present study were inline with the finding of Igbasan and Guenter, (1997). Who reported that Supplementation of fiber degrading enzyme in diets fed to the layers at different ages have non-significant effect on FCR/Dozen eggs. The results of the present study showed that the increase in fiber level upto 6% with enzyme supplementation improved FCR/dozen eggs but when the fiber level increased upto 8%, deterioration in FCR was observed. This might be due to the fact that 1X and 2X enzyme concentration provided maximum organic matter digestibility, dry matter digestibility at 6% fiber level as compared 8% fiber level.

Best FCR/Kg egg mass was found in the bird of group T2 and T4 fed diet having 1X and 2X enzyme concentration with 6% fiber in the diet and it was non significant with the control group and T5 (Table **3**). Group T3 showed significantly poor FCR/kg egg mass. The results of the present study were inline with the findings of Pan *et al*. (1998), Senkoylu *et al*. (2004) and Esonu *et al*. (2005). They found non-significant effect of enzyme supplementation on FCR/Kg egg mass. The results of the present study showed that the 6% fiber level with enzyme supplementation provide best FCR/ kg egg mass this might be due to efficient utilization of the organic matter and nutrients in the diet as compared to diets containing 8% fiber level. Controversial results were reported by Arturo *et al*. (2004) who studied the effect of endofeed DC (enzyme preparation containing endo 1-3 ß glucanase and endo 1-4 ß xylanase) in cereal base diet containing enzyme @ 0 and 125mg/kg and reported that enzyme supplementation have significantly improved effect on FCR/kg egg mass.

The results of the present study showed that maximum profit per bird was in treatment T2 (20.91) followed by T4(19.50), T5(15.94), T3(11.78) and control group(6.17). Profit per bird was increased from the 6.17 to 20.91 by the enzyme supplementation in layer diets. This showed that enzyme supplementation significantly improved the profit margin in layer bird. T3 showed less profit enzyme supplemented treatments. From the findings it is recommended that for optimum profitability, rations for old age layers can be diluted up to 6% fiber level with 1X enzyme supplementation.

Best FCR/Kg egg mass was found in the bird of group T2 and T4 fed diet having 1X and 2X enzyme concentration with 6% fiber in the diet and it was non significant with the control group and T5 (Table **3**). Group T3 showed significantly poor FCR/kg egg mass. The results of the present study were inline with the findings of Pan *et al*. (1998), Senkoylu *et al*. (2004) and Esonu *et al*. (2005). They found non-significant effect of enzyme supplementation on FCR/Kg egg mass. The results of the present study showed that the 6% fiber level with enzyme supplementation provide best FCR/ kg egg mass this might be due to efficient utilization of the organic matter and nutrients in the diet as compared to diets containing 8% fiber level.

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RECOMMENDATION

From the finding of the above study, it is recommended that for optimum profitability, rations for old age layers can be used upto 6% fiber level with 1X and 2X enzyme supplementation.

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