Biological Forum – An International Journal **7**(1): 564-569(2015)

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

The effects of Hull less Barley with and without enzyme on Performance and Blood Parameters of Arian Broilers

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(Received 25 January, 2015, Accepted 12 March, 2015)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: The study was conducted on Four hundred one-day Arian broiler chicken to investigate the effect of hull less barley with and without enzyme supplementation on performance and blood parameters in (Arian) broilers. Chicks were allotted into 5 equal groups (80 chicks of mixed sex per group). Two experimental diets were formulated, basal diet containing 10% and 15% hull less barley with and without enzyme supplementation from 1 to 21 day and 15% and 20% hull less barley with and without enzyme supplementation from 21 to 42 day together control diet. Enzyme supplementation significantly (p<0.05) improved the feed Conversion ratio, body weight gain and body weight of broilers from 1 to 42 d. The concentrations of serum glucose, triglyceride, HDL, LDL, albumin, globulin and total protein were not affected by the supplementation of enzyme but cholesterol was affected (p<0.05).

Key Words: Enzyme, NSP, Broilers, Blood Parameters

INTRODUCTION

Corn is a major ingredient (above 50%) in broiler diets, contributing about 65% of broiler ME requirements. However, increasing corn prices by reason of its preferential diversion toward human consumption and corn ethanol industry have compelled the poultry industry to reduce reliance on corn. Despite numerous scientific investigations no alternative grain to corn has yet been identified. The use of wheat and barley grains in broiler feed is limited by the presence of soluble non-starch polysaccharides, particularly xylans, arabinoxylans and Beta-glucans components (Pourreza *et al.,* 2007). Majority of coarse cereals in poultry diets contains high fiber and low energy (Rama-Rao *et al.,* 2004). It is recognized that poultry diets contain variable levels of poorly digested NSP including arabinoxylans, glucons and pectin (Campbell and Bedford, 1992) that possess chemical cross-linking between them and are not well digested by poultry (Adams and Pough, 1993). Poultry produce a number of enzymes, including amylases to digest starch, proteases to digest protein and lipases to digest fats. Birds do not produce enzymes like cellulase, xylanase, required for the digestion of NSPs. However, they do not produce enzymes to digest fibers in feeds. Due to the chemical structure of plant cell wall matrix, NSP degrading enzymes has been recommended to enhance poultries performance.

Soluble high molecular weight fiber polysaccharide complexes are responsible for high digesta viscosity. These complexes are only a fraction of the polysaccharides present in the digesta, and are made up of a number of different components. High digesta viscosity can lead to reduced feed intake, slower digesta passage rate and impaired nutrient digestion (Austin *et al.,* 1999; Naqvi and Nadeem, 2004). The inclusion of appropriate multi-enzyme systems can lower digesta viscosity and improve chick's performance. For common poultry diets, the enzymes of the digestive system cause normal hydrolysis of the dietary proteins, carbohydrates and fats. Thus, no benefit may be expected from the use of enzyme preparation as feed additives unless feed composed of higher amounts of barley, wheat, sunflower, rice bran or oat grains are fed to chickens (Banerjee, 1992). Enzyme supplementation is well documented as effective in breaking polymeric chains of NSPs and hence improving the nutritive value of feedstuffs (Giraldo *et al,* 2008). The main potential of enzyme addition to feed appears for digestion of substances that an animal is intrinsically incapable of digesting (Cheeke, 1991). These enzymes can open up the complex feed cell walls, allowing the animals own enzymes to digest the enclosed nutrients. Therefore adding NSP-degrading enzymes in poultry diets has increased considerably in recent years.

Supplementation of NSPs degrading enzymes may not only reduce the anti-nutritive effects of NSPs, but also releases some nutrients from these, which could be utilized by the birds (Balamurugan and Chandrasekaran, 2009). However, the effects of exogenous enzymes can be variable and it depends on a large number of factors such as the age of the bird and the quality and type of diet (Bedford, 2000 and Acamovic, 2001). Nutritional status is an important factor in the regulation of plasma hormones and intermediary metabolism in broiler chickens (Gao *et al*, 2007; Buyse *et al*, 2002; Swennen *et al*, 2005). Evaluation of plasma biochemistry in birds allows for the identification of metabolic alterations due to realizing of factors such as age and husbandry conditions (Alonso-Alvarez and Ferrer, 2001) multi-enzymes supplementation on performance, carcass characteristics and some blood parameters in broilers fed on corn-soybean meal-wheat diets. Because starch is the major energy yielding component inside cereals, attention should be paid to its digestion. The positive effect of the slowly digestible starch rate on chicken performance was suggested to result from a better synchronization of energy to protein availability and to a more continuous supply of glucose to the intestinal lumen. The rate of starch digestion could be reflected in plasma glucose levels and glycemic index (Englyst *et al.*, 1996). Therefore, the objective of the present study was to investigate the effects of different levels of enzyme supplementation on performance and blood parameters in broilers fed hull less barley-based diets.

MATERIALS AND METHODS

A. Experimental Design

This study was carried out at Animal Science Research Institute of Iran. A total of 400 one-day-old Arian broiler chicks were randomly allocated to 5 group with 4 replicates containing 20 birds (10 males + 10 females).

Table 1: Composition of experimental diets (1-21d).

Ingredients (%)	HB_1[3]	HB_2[4]	HB_1E[5]	HB_2E[6]	Control
Corn	45.50	43.00	45.50	43.00	55.34
Hull less barely	10.00	15.00	10.00	15.00	-
Soybean meal	37.00	35.00	37.00	35.00	37.69
Vegetable oil	3.63	3.11	3.63	3.11	2.94
Oyster shell	1.50	1.50	1.50	1.5	1.50
Dicalcium phosphate	1.00	1.00	1.00	1.00	1.35
Salt	0.20	0.22	0.22	0.22	0.32
Vitamin mix[1]	0.25	0.25	0.25	0.25	0.25
Mineral mix[2]	0.25	0.25	0.25	0.25	0.25
DL-Methionine	0.22	0.22	0.22	0.22	0.24
L-Lysine	0.45	0.45	0.45	0.45	0.12
Multi enzyme[7]	-	-	0.005	0.005	-
Calculated composition of					
AMEn (kcal/kg)	3050	3050	3050	3050	3050
Crude Protein	22.00	22.00	22.00	22.00	22.00
Calcium	1.00	1.00	1.00	1.00	1.00
Total Phosphorus	0.57	0.57	0.57	0.57	0.57
Available Phosphorus	0.50	0.50	0.50	0.50	0.50
Methionine	0.52	0.52	0.52	0.52	0.52
Methionine+Cystine	1.00	1.00	1.00	1.00	1.00
Lysine	1.47	1.47	1.47	1.47	1.47
CF[8]	4.00	4.00	4.00	4.00	4.00

[1]Vitamin mix provided the following (per kg of diet): thiamin-mononitrate, 2.4 mg; nicotinic acid, 44 mg;riboflavin, 4.4 mg; D-Ca pantothenate, 12 mg; vitamin B12 (cobalamin), 12.0 mg; pyridoxine HCL, 4.7 mg; Dbiotin,0.11 mg; folic acid, 5.5 mg; menadione sodium bisulfate complex, 3.34 mg; choline chloride, 220 mg;cholecalciferol, 27.5 mg; transretinyl acetate, 1892 mg; all-rac α tocopheryl acetate, 11 mg; ethoxyquin, 125mg.

[2]Trace mineral mix provided the following (per kg of diet): manganese (MnSO4-H2O), 60 mg; iron (FeSO4-7H2O), 30 mg; zinc (ZnO), 50 mg; copper (CuSO4-5H2O), 5 mg; iodine (ethylene diamine dihydroiodide),0.15 mg; selenium (NaSe03), 0.3 mg3 Dietary cation-anion balance

[3]15% hull less barley without enzyme, [4] 20% hull less barley without enzyme, [5] 15% hull less barley with enzyme, [6] 20% hull less barley with enzyme 7 Natuzyme P_{50}:content 70,000,000 unit of Xylanase and 4,900,000 unit of β glucanase

[8] Crude fiber is a measure of the quantity of indigestible cellulose, pentosans, lignin, and other components of this type in present feeds.

The experimental design was CRD. Three experimental diets contain one control diet and tow diets were formulated, basal diet containing 10% and 15% hull less barley with (HB_1 and HB_2E) and without (HB_1 and HB_2) enzyme supplementation from 1 to 21 day and 15% and 20% hull less barley with (HB_1E and HB_2E) and without (HB_1 and HB_2) enzyme supplementation from 21 to 42 day Formulation and composition of experimental diets are given in Table 1 to 4.

Table 2. Composition of experimental diets (22-42d).

Ingredients (%)	**HB_1**[3]	**HB_2**[4]	**HB_1E**[5]	**HB_2E**[6]	**Control**
Corn	50.00	48.00	50.00	48.00	58.65
Hulless barely	15.00	20.00	15.00	20.00	-
Soybean meal	27.57	25.10	27.57	25.10	34.27
Vegetable oil	4.52	4.00	4.52	4.00	3.86
Oyster shell	1.12	1.60	1.12	1.60	0.90
Dicalcium phosphate	1.00	1.00	1.00	1.00	1.22
Salt	0.22	0.22	0.22	0.22	0.28
Vitamin mix[1]	0.25	0.25	0.25	0.25	0.25
Mineral mix[2]	0.25	0.25	0.25	0.25	0.25
DL-Methionine	0.07	0.09	0.07	0.09	0.19
L-Lysine	-	0.03	-	0.03	0.13
Multi enzyme	-	-	0.005	0.005	-
Calculated composition of					
AMEn(kcal/kg)	3200	3200	3200	3200	3200
Crude Protein	19.00	19.00	19.00	19.00	19.00
Calcium	0.85	0.85	0.85	0.85	0.85
Total Phosphorus	0.55	0.55	0.55	0.55	0.55
Available Phosphorus	0.42	0.42	0.42	0.42	0.42
Methionine	0.34	0.34	0.34	0.34	0.34
Methionine + Cystine	0.80	0.80	0.80	0.80	0.80
Lysine	0.90	0.90	0.90	0.90	0.90
CF	4.00	4.00	4.00	4.00	4.00

[1] Vitamin mix provided the following (per kg of diet): thiamin-mononitrate, 2.4 mg; nicotinic acid, 44 mg; riboflavin, 4.4 mg; D-Ca pantothenate, 12 mg; vitamin B12 (cobalamin), 12.0 mg; pyridoxine HCL, 4.7 mg; Dbiotin, 0.11 mg; folic acid, 5.5 mg; menadione sodium bisulfate complex, 3.34 mg; choline chloride, 220 mg; cholecalciferol, 27.5 mg; transretinyl acetate, 1892 mg; all-rac α tocopheryl acetate, 11 mg; ethoxyquin, 125 mg.

[2] Trace mineral mix provided the following (per kg of diet): manganese (MnSO4-H2O), 60 mg; iron (FeSO4- 7H2O), 30 mg; zinc (ZnO), 50 mg; copper (CuSO4-5H2O), 5 mg; iodine (ethylene diamine dihydroiodide), 0.15 mg; selenium (NaSe03), 0.3 mg3 Dietary cation-anion balance

Table 3: Effects of feed formulation methods on productive parameters of broiler chicks (1-42d).

Main Effects[1]	**BW (g)**	**BWG(g/bird/day)**	**FI (g/bird/day)**	**FCR**
HB_1[2]	1893.88^{bc}	44.15^{bc}	90.39	2.05^{a}
HB_2[3]	1803.16^{c}	41.98^{c}	86.78	2.07^{a}
HB_1E[4]	1991.55^{Ab}	46.48^{ab}	90.11	1.94^{ab}
HB_2E[5]	2078.96^{a}	48.56^{a}	89.59	1.84^{b}
C	1961.67^{ab}	45.72^{ab}	94.18	2.06^{a}
p.value	0.0064	0.0063	0.3659	0.0448
SEM	46.4	1.10	1.18	0.04

[1]Means within Colum with different superscripts are significantly different ($p<0.05$)

[2] 15% hull less barley without enzyme,

[3] 20% hull less barley without enzyme,

[4] 15% hull less barley with enzyme, [5] 20% hull less barley with enzyme

Table 4: Effects of feed formulation methods on serum biological parameters of broiler chicks.

Main Effects[1]	Glucose (mg/dl)	Triglyceride (mg/dl)	Cholesterol (mg/dl)	HDL (mg/dl)	LDL (mg/dl)	Albumin (mg/dl)	Globulin (mg/dl)	Total Protein (g/dl)
HB_1[2]	249.10	118.00	112.70^{ab}	68.50	20.80	3.02	1.67	3.02
HB_2[3]	243.80	121.80	109.200^{b}	66.60	18.200	1.36	1.72	3.08
HB_1E[4]	242.80	127.40	118.40^{ab}	69.80	23.200	1.38	1.66	3.04
HB_2E[5]	245.40	123.20	122.40^{a}	72.60	25.200	1.44	1.80	3.24
Con	252.20	92.41	107.20^{b}	64.84	23.88	1.38	1.67	3.06
p.value	0.5329	0.2150	0.0493	0.2061	0.7381	0.7487	0.7663	0.7646
SEM	1.75	6.22	2.84	1.33	1.24	0.02	0.03	0.04

[1] Means within Colum with different superscripts are significantly different ($p<0.05$)

[2] 15% hull less barley without enzyme, [3] 20% hull less barley without enzyme, [4] 15% hull less barley with enzyme, [5] 20% hull less barley with enzyme

B. Productive and serum biological parameters determination

Body weight (BW) and feed consumption were obtained weekly then daily feed intake (FI), body weight gain (BWG) and feed conversion ratio (FCR) were calculated from these data. At end of the sixth week, 6 birds from each treatment were selected randomly and used for blood sampling. To serum separation, the blood samples centrifuged at 3000 rpm for 15 minutes. The serum preserved at -20°C until use. Glucose, triglyceride, cholesterol, HDL, LDL, albumin, globulin and total protein were measured in serum by Pars'Azmoon standard kit based on colorimetric analysis.

C. Statistical analysis

Measurements of productive and serum biological parameters were subjected to analysis of variance for completely randomized design that including two experimental diet were formulated, basal diet containing high and low hull less barley with and without enzyme supplementation Significant differences between treatment means were identified by Duncan's multiple range with 5% probably.

RESULTS AND DISCUSSION

It is well documented that supplementing exogenous enzymes to diets for broilers can improve performance (Peng, 2003; Wang *et al.*, 2005). The effects of dietary enzyme supplementation on FCR Significantly was better ($P<0.05$). The improved performance may be due to lowered viscosity and/or disruption of cell wall. This may be explained by effects of enzyme supplementation being dependent on the bird's age and older birds having a greater capacity to endure the effects of high viscosity because of enhanced fermentation capacity of the microflora in their intestines (Vukic-Vranjes and Wenk, 1995; Choct *et al.*, 1996). However, there was non-significant difference in feed intake of broiler chicks of all groups during finisher phase ($P<0.05$). The weight gains of broiler chicks of groups HB_1, HB_2, HB_1E, HB_2E and Control during overall growing period were, 44.15, 41.98, 46.48, 48.56, 45.72and g/bird, respectively. Statistically, there was significant difference in weight gains of broiler chicks of all experimental groups during all feeding periods ($P<0.05$). The body weight of broiler chicks of groups HB_1, HB_2, HB_1E, HB_2E and Control during overall growing phases were, 1893.88, 1803.16, 1991.55, 2078.96, 1961.67 and g/bird, respectively.

Statistically, there was significant difference in weight gains of broiler chicks of all experimental groups during all feeding periods ($P<0.05$). Enzyme supplementation improved body weight gains and body weight ($P<0.05$). During the ileal phase, enzymes remove fermentable substrates, during the cecal phase, degradation products of sugars, such as xylose and xylo-oligomers, are fermented by cecal bacteria, thus stimulating the production of VFA and the growth of specific beneficial bacteria (Bedford, 2000b). Castanon *et al.* (1997) reported that the addition of NSP degrading enzyme reduced the recovery of total NSP of barley by hydrolyzing high molecular weight NSP and sugars, and the extent of hydrolysis depended on the level of enzyme. According to Bedford and Classen (1992), low level of enzyme could in fact accumulate high-molecular weight soluble NSP in the hind gut section of broilers and reduce nutrient absorption.

Graham *et al.* (1993) reported that high digesta viscosity blocked the digestive enzyme efficiency in the gut and reduced the absorption of nutrients. The concentrations of serum glucose, triglyceride, HDL, LDL, albumin, globulin and total protein were not affected by the supplementation of enzyme but cholesterol was affected ($p<0.05$). Gao (2001) reported that xylanase supplementation did not affect plasma glucose concentration, but significantly increased the level of glucose in digesta which indicated that, although the digestion of starch was improved by xylanase, the absorption of glucose was not affected. The effects of multi-enzyme supplementation on blood parameters shown in Table 5.Present study showed that adding multi enzyme to broilers diet significantly increased the, concentration of blood total cholesterol ($p<0.05$). Studies with animal models have shown that high level of dietary cholesterol, saturated fatty acids and an increased small intestinal uptake of these components due to, for example, a low dietary fiber concentration or enzyme supplementation of the diet may increase plasma cholesterol levels (Mancini and Parillo 1991; Pettersson and Aman 1992; Sutton *et al.*, 1985).

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