http://www.pjbs.org

PJBS

ISSN 1028-8880

Pakistan Journal of Biological Sciences

ANSInet
Asian Network for Scientific Information
308 Lasani Town, Sargodha Road, Faisalabad - Pakistan

Pakistan Journal of Biological Sciences 9 (14): 2677-2680, 2006
ISSN 1028-8880

Effect of Hulled and Hull-less Barley With and Without Enzyme Supplementation on Broiler Chicken Performance

[1]S.A. Tabeidian and [2]G.H. Sadeghi
[1]Department of Animal Sc ience, Khorasgan Islamic Azad University of Isfahan, Isfahan, Iran
[2]Department of Animal Science, University of Kurdistan, Kurdistan, Iran

Abstract: Three hundred and sixty one-day-old chicks (Arian) were used in a completely randomized design with 6 treatments and 4 replicates for each treatment. The experimental treatments were included: corn-soybean diet as control, 20% hulled barley and 20% hull-less barley with and without beta-glucanase enzyme. Body weights, feed intake and feed conversion were determined weekly. At 49 day 4 chicks were chosen randomly from each pen and killed to determine carcass and organs weight. The ME values of hulled and hull-less barley with and without enzyme were determined with adult roosters. The AMEn value obtained with hull-less barley significantly ($p<0.05$) was higher than hulled barley and the TMEn and AMEn values of hulled barley were increased 2.1 and 1.7% due to enzyme supplementation. There were no significant different in feed intake between chicks that fed with hulled or hull-less barley and control group in all ages. Body weight gain in 7 to 21 day were higher significantly ($p<0.05$) in broiler chickens that fed with corn-soybean diet and hull-less barley diet with enzyme supplementation. Enzyme supplementation improved feed conversion ratio at 7 to 49 day yin birds fed with barley, especially in hull-less barley diets. Abdominal fat pad, liver, pancreas and gizzard weight as a percentage of carcass weight were not affected significantly by treatments, but in all cases use of enzyme improved these organs weight. Birds that fed with barley based diets, especially hulled barley, had elevated intestinal weight.

Key words: Broiler, hulled, hull-less, barley, enzyme, metabolizable energy

INTRODUCTION

Barley is the preferred grain for cultivation in many areas in the world due to its resistance to drought and ability to mature in climates with a short growth season. Its use for poultry has however been limited by the considerable amounts of fiber components in this grain. The soluble fiber fraction, which mainly consists of mixed-linked (1-3) (1-4) beta-glucans, is associated with an increased gut viscosity, which in turn inhibits digestion and absorption of nutrients. Use of enzymes that degrade soluble fiber have reduced this problem and increased the potential for use of barley in poultry diets. The majority of the insoluble fiber fraction consists of the hull, which will reduce the nutrient concentration of the grain, whilst having no anti-nutritive effect (Scott *et al*., 1998). Although barley is the lowest priced, its level of inclusion is limited to 25% because of its negative effects on bird performance, adverse effects on litter quality and increasing the incidence of sticky droppings (Hesselman and Aman, 1986; Oscarsson *et al*., 1996). Different approaches may reduce adverse effect of NSP's in barley including soaking in water, antibiotic supplementation, gamma radiation; de hulling and enzyme supplementation (Annison and Choct, 1991). Viscosity can be reduced by enzyme supplementation (Hesselman and Aman, 1986; Brenes *et al*., 1993; Mohammed, 1995). An accurate estimation of barley energy value, with and without enzyme supplementation is essential to establish an accurate quality: price ratio for feed formulation (Villamide *et al*., 1997). Some researches have been done to study the effect of enzyme addition to poultry diet on the energy value of barley based diets (Rotter *et al*., 1990; Friesen *et al*., 1992; Garcia *et al*., 2003). A significant increase due to enzyme addition was found for AMEn values, however, no differences were found for TMEn values determined with adult roosters (Rotter *et al*., 1990; Fuente *et al*., 1995). De hulling is another way to eliminate adverse effect of NSP in barley nutrition for broiler chicken. Combination of de-hulling with enzyme supplementation may induce better results. There is little data on enzyme effect on hull-less barley nutritional value for broiler chicken in comparison with hulled barley. The objectives of this study were to determine the energy value of hulled and hull-less barley with and without enzyme supplementation and to study the effect ofenzyme addition to hulled and hull-less barley based diets on performance of broiler chicks.

Corresponding Author: G.H. Sadeghi, Department of Animal Science, University of Kurdistan, Kurdistan, Iran
Tel/Fax: +98-9183717052

Table 1: Composition of experimental chicken diets and calculated major components (%)

	Age								
	1-21			21-42			42-49		
Ingredients	Control	Hulled	Hull-less	Control	Hulled	Hull-less	Control	Hulled	Hull-less
Corn	63.90	41.96	43.76	68.60	52.00	52.55	71.80	55.30	56.41
Barley	0.00	20.00	20.00	0.00	20.00	20.00	0.00	20.00	20.00
Soybean meal	30.16	29.70	28.80	23.95	21.60	21.34	20.20	19.08	18.40
Fish meal	2.00	2.00	2.00	1.50	2.00	2.00	1.20	1.00	3.0
Soybean oil	0.50	2.90	2.00	0.55	1.00	0.75	0.90	0.75	0.75
DCP	1.10	1.10	1.10	1.05	1.05	1.05	1.00	1.00	1.00
Oyster shell	1.50	1.50	1.50	1.45	1.45	1.45	1.40	1.40	1.40
Inert matter	0.00	0.00	0.00	2.00	0.00	0.00	2.66	0.20	0.20
NaCl	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26	0.26
DL-Methionin	0.08	0.08	0.08	0.07	0.07	0.07	0.06	0.06	0.06
Mineral premix [a]	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Vitamin premix [b]	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Calculated Composition									
ME (Kcal kg^{-1})	2910.00	2903.00	2900.00	2917.00	2905.00	2925.00	2962.00	2964.00	2962.00
CP (%)	20.92	20.87	20.85	18.23	18.16	18.27	16.65	16.66	16.67
ME/CP	139.10	139.10	139.10	160.00	160.00	160.00	177.90	177.90	177.80
Met (%)	0.44	0.44	0.44	0.40	0.40	0.40	0.34	0.34	0.34
Met+Cys (%)	0.80	0.80	0.80	0.75	0.75	0.75	0.65	0.65	0.65
Lys (%)	1.20	1.20	1.20	1.00	1.00	1.00	0.90	0.90	0.90
AP (%)	0.40	0.40	0.40	0.38	0.38	0.38	0.33	0.33	0.33
Ca (%)	0.92	0.92	0.92	0.87	0.87	0.87	0.78	0.78	0.78

[a] Supplemented (mg kg^{-1} of diet): Mn, 1200; Fe, 60; Zn, 120; Cu, 12; I, 1.2; Se, 0.24, [b]supplemented (mg or IU kg^{-1} of diet): Vit. A, 10800 IU; D_3, 2400 IU; E, 21.6 IU; K_3, 2.4 IU;B_1, 2.16; B_2, 7.9; B_3, 12; B_5, 3.6; B_9, 1.2; B_{12},0.015; Biotin, 0.12; choline chloride, 600 and adequate anti oxidant

MATERIALS AND METHODS

Three hundred and sixty one-day-old (Arian) chicks were placed in 24 pens, 15 per each. The chicks were allocated randomly to 6 experimental diets in a completely randomized design. Feed and water were provided *ad libitum*. All chicks were fed by isocaloric and isonitrogenous diets. The diets (Table 1) formulated to meet all nutrients requirements according to NRC (1994). Treatments were included: corn-soybean based diet (control), 20% hulled and 20% hull-less barley diets with and without a commercial enzyme with high beta-glucanase activity (Safizym GP 500, 5600 unit g^{-1}) at 3 g kg^{-1}. Each treatment group consisted of 4 replicates. Broilers were weighed on a pen basis at 7, 21, 42 and 49 day of age and weight gains were calculated. Feed intake was determined at 21, 42 and 49 day of age and adjusted for mortality. Feed conversion ratios were calculated at 21, 42 and 49 day of age. At 49 day of age four chicks were chosen randomly from each pen, killed and abdominal fat pad, gizzard, liver and intestine were removed, weighed and expressed as a percentage of live body weight. Metabolizable energy content of hulled and hull-less barley with and without enzyme determined by Sibbald (1986) method using twenty adult white leghorn cockerels in a completely randomized design. Four roosters considered as control to correct endogenous energy. Gross energy was determined using an adiabatic bomb calorimeter (Parr Instrument, Moline, IL, USA). Using a benzoic acid standard. In order to determine AMEn and TMEn excreta samples were analyzed for nitrogen (Kjeldahl) contents. The results obtained from the experiment were analyzed by an analysis of variance using the General Linear Model (GLM) procedure of SAS and means were compared by Duncan's Multiple Range Test (SAS Institute, 1990).

RESULTS AND DISCUSSION

Metabolizable energy content: The AMEn value obtained with hull-less barley significantly ($p<0.05$) was higher than hulled barley (Table 2). TMEn content of hull-less barley was also higher than hulled barley. Increase in the metabolizable energy content of the hull-less barley is a result of de-hulling process that eliminates dilution effect of the fibrous hull. The TMEn and AMEn values of hulled barley were increased 2.1 and 1.7% due to enzyme supplementation. However Enzyme inclusion did not significantly influence TMEn and AMEn values of hull-less barley. These results are consisted with the finding of Rotter *et al*. (1990) and Fuente *et al*. (1995), who reported a significant increase due to enzyme addition, for AMEn values, however, no differences were found for TMEn values determined with adult roosters.

Feed intake: There was no significant different in feed intake between chicks that fed with hulled or hull-less barley and control group in all ages ($p>0.05$) and in 1-21

Table 2: Metabolizable energy content of hulled and hull-less barley with and without enzyme supplementation

Barley	Enzyme	AMEn	TMEn
Hulled	-	2730[b]	3105[b]
Hulled	+	2776[b]	3170[a]
Hull-less	-	2870[a]	3210[a]
Hull-less	+	2898[a]	3228

[a]Means in a column with no common superscripts differ significantly ($p<0.05$), +: With enzyme, -: Without enzyme

Table 3: Mean daily feed intake in broiler chickens fed with hulled and hull-less barley with and without enzyme supplementation in comparison to control group

Diet	Enzyme	Daily feed intake (g) 7-21 day	22-42 day	43-49 day	7-49 day
Corn-soybean	-	44.53	107.44	145.38	103.21
	+	44.10	105.66	150.72	100.34
Hulled barley	-	42.03	106.31	146.75	100.35
	+	42.80	109.84	147.11	102.77
Hull-less barley	-	42.81	106.85	149.24	101.84
	+	45.71	110.70	150.06	104.30

Means in a column with no common superscripts differ significantly ($p<0.05$), +: With enzyme, -: Without enzyme

and 1-49 days periods chicks that fed with hull-less barley with enzyme had similar feed intake to chicks that fed with corn-soybean based diets (Table 3). This illustrates that use of hull-less barley has no adverse effect on gut viscosity and passage rate. The removal of fibrous hull of barley, with anti-nutrient factors, during the de-hulling process will in fact improve palatability, therefore, increased feed intake.

Body weight gain: Body weight gain in 7 to 21day were higher significantly ($p<0.05$) in broiler chickens that fed with corn-soybean diet and hull-less barley diet with enzyme supplementation. Lowest feed intake was belonged to chickens that fed with hulled barley diets. It could be attributed to high fiber or NSP's content in this diet that interferes with nutrient digestion and absorption. In grower and finisher periods, there were no significant differences among the treatments. In 7-49 day period, enzyme inclusion significantly ($p<0.05$) increased weight gain of broilers fed with hulled barley diet (Table 4). It may be due to higher beta- glucan content in the hulled than hull-less barley, so enzyme is more effective on it.

Feed conversion ratio: No significant differences were observed between treatments in feed conversion ratios

Table 4: Mean daily weight gain in broiler chickens fed with hulled and hull-less barley with and without enzyme supplementation in comparison to control group

Diet	Enzyme	Daily weight gain (g) 7-21 day	22-42 day	43-49 day	7-49 day
Corn-soybean	-	24.6[a]	59.3	59.1	46.7[b]
	+	23.9[a]	58.2	62.8	45.2[b]
Hulled barley	-	21.0[b]	57.2	58.7	45.0[b]
	+	22.6[ab]	57.8	55.1	47.8[ab]
Hull-less barley	-	22.1[ab]	58.3	57.4	46.3[b]
	+	23.9[a]	59.4	61.0	46.3

[b]Means in a column with no common superscripts differ significantly ($p<0.05$), +: With enzyme, -: Without enzyme

Table 5: Mean feed conversion ratio in broiler chickens that fed with hulled and hull-less barley with and without enzyme supplementation in comparison to control group

Diet	Enzyme	Feed conversion ratio ($g\ g^{-1}$) 7-21 day	22-42 day	43-49 day	7-49 day
Corn-soybean	-	1.81	1.80	2.46	2.21
	+	1.84	1.91	2.40	2.22
Hulled barley	-	1.93	1.89	2.50	2.23
	+	1.88	1.89	2.67	2.15
Hull-less barley	-	1.86	1.85	2.60	2.20
	+	1.90	1.83	2.46	2.12

Means in a column with no common superscripts differ significantly ($p<0.05$), +: With enzyme, -: Without enzyme

(Table 5), but enzyme supplementation improved feed conversion ratio at 7 to 49 day in birds fed with barley, especially in hull-less barley diets.

Carcass analysis: Abdominal fat pad, liver, pancreas and gizzard weight as a percentage of carcass weight were not affected significantly by treatments, but in all cases use of enzyme improved these organs weight (Table 6). Birds fed with barley based diets, especially hulled barley, have been shown to have elevated intestinal weight, which negatively affects the carcass yield. This negative effect is reduced pronouncedly by enzyme supplementation. These results are in agree with Brenes *et al.* (1993) who showed that inclusion of high beta-glucan barley strain increased the relative weight of the duodenum, jejunum and ileum. Almirall *et al.* (1995) also obtained similar result with decreased relative weight in the GI tract by supplementation diet with beta-glucanase. Also, it has been shown that enzyme supplementation of cereals based diet may reduce gastrointestinal tract weight up to 20% (Petterson and Aman, 1989).

Table 6: Mean values of carcass weight (percentage of live weight) and abdominal fat, kidney, pancreas and intestine weights (percentages of carcass weight) in broiler chicks fed with hulled and hull-less barley with and without enzyme supplementation in comparison to control group at 49 days

	Carcass		Abdominal fat		Liver		Pancreas		Intestine	
Enzyme →	-	+	-	+	-	+	-	+	-	+
Corn-soybean	75.0	74.4	2.30	2.20	2.20	1.90	0.22	0.21	4.10	4.00
Hulled barley	73.9	71.7	2.80	2.30	2.10	2.30	0.21	0.18	4.60	3.90
Hull-less barley	74.5	71.9	3.01	2.80	2.30	2.00	0.24	0.19	4.40	4.10

Present findings showed that de-hulling process in barley increases its metabolizable energy content and eliminate its adverse effects on broiler performance. Use of 20% hull-less barley produce a performance similar to soybean-corn diets and use of enzyme supplementation could improve growth performance in barley based broiler diets.

REFERENCES

Almirall, M., M. Francesch, A.M. Perez-Venderell, J. Brufau and E. Esteve-Garcia, 1995. The differences in intestinal viscosity produced by barley and β-glucanase alter digesta enzyme activities and ileal nutrient digestibilities more in broiler chicks than in cocks. J. Nutr., 125: 947-955.

Annison, G. and M. Choct, 1991. Anti-nutritive activities of cereals non starch polysaccharides in broiler diets and strategies minimizing their effect. Worlds Poult. Sci. J., 47: 232-242.

Brenes, A., M. Smith, Y. Guenter and R.R. Marquardt, 1993. Effect of enzyme supplementation on the performance and digestive tract size of broiler chickens fed wheat-and barley-based diets. Poult. Sci., 72: 1731-1739.

Friesen, O.D., W. Guenter, R.R. Marquardt and B.A. Rotter, 1992. The effect of enzyme supplementation on the apparent metabolizable energy and nutrient digestibilities of wheat, barley, oats and rye for the young broiler chick. Poult. Sci., 71: 1710-1721.

Fuente, J.M., P.P. Ayala and M.J. Villamide, 1995. Effect of dietary enzyme on the metabolizable energy of diets with increasing levels of barley fed to broilers at different ages. Animal Feed Sci. Technol., 56: 45-53.

Garcia, M.I., M.A. Latorre, M. Garcia, R. Lazaro and G.G. Mateos, 2003. Heat processing of barley and enzyme supplementation of diet for broilers. Poult. Sci., 82: 1281-1291.

Hesselman, K. and P. Aman, 1986. The effect of beta-glucanase on the utilization of starch and nitrogen by broiler chickens fed barley of low or high viscosity. Anim. Feed Sci. Technol., 15: 83-93.

Mohammed, A.M., 1995. Barley varieties enzyme supplementation and broiler performance. J. Applied Poult. Res., 4: 230-234.

National Research Council, 1994. Nutrient Requirements of Poultry. 9th Edn., National Academy Press, Washington DC.

Oscarsson, M., R. Andersson, A.C. Salomonson and P. Aman, 1996. Chemical composition of barley samples focusing on dietary fiber components. J. Cer. Sci., 24: 161-170.

Petterson, D. and P. Aman, 1989. Enzyme supplementation of a poultry diet containing rye and wheat. Br. J. Nutr., 62: 139-149

Rotter, B.A., O.D. Freisen, W. Gunter and R.R. Marquart, 1990. Influence of enzyme on the bioavailable energy of barley. Poult. Sci., 69: 1174-1181.

SAS Institute, 1990. SAS User Guide. SAS Institute Inc., Cary, NC.

Scott, T.A., F.G. Silversides, H.L. Classen, M.L. Swift and M.R. Bedford, 1998. Effect of cultivar and environment on the feeding value of western Canadian wheat and barley samples with and without enzyme supplementation. Can. J. Anim. Sci., 78: 649-656.

Sibbald, I.R., 1986. The TME System of Feed Evaluation: Methodology, Feed Composition Data and Bibliography. Technical Bulletin 1986 4E, Agriculture Canada, Ottawa, ON, Canada.

Villamide, M.J., J.M. Fuente, P.P. de Ayala and A. Flores, 1997. Energy evaluation of eight barley cultivars for poultry: Effect of dietary enzyme addition. Poult. Sci., 76: 834-840.