South African Journal of Animal Science 2008, 38 (1)

Short Communication

Determination of metabolisable energy of five cultivars of hulless barley using adult Leghorn cockerels

M. Rezaei[1#], M. Dehghan[1] and M. Ayatollahy[2]
[1] Dept. of Animal Science, College of Animal Science and Fisheries, Mazandaran University, P.O. Box 578, Sari, Iran
[2] Agricultural and Natural Resources Research Centre, Yazd, Iran

Abstract

Hulless barley contains more digestible nutrients than do whole barleys due to a lower content of indigestible fibre, but also contains a higher concentration of β-glucans. The chemical composition and apparent metabolisable energy (AME) of five cultivars (3, 7, 12, 15 and KC-31) of hulless barley were determined with adult Leghorn cockerels using a precision-feeding method. Cultivars KC-31 and 15 had the highest (121 g/kg) and lowest (87 g/kg) levels of crude protein, respectively. The AME_n for the five cultivars was 13.91, 12.20, 12.88, 13.23 and 10.95 MJ/kg DM, respectively. The true metabolisable energy corrected for nitrogen of the above cultivars was 14.37, 12.66, 13.34, 13.69 and 11.41 MJ/kg DM, respectively. Cultivar 3 contained the highest AME and TME levels, and differences between cultivars were significant. In general hulless barley can be used as a source of energy in poultry diets.

Keywords: Hulless barley cultivars, apparent metabolisable energy, true metabolisable energy, poultry
[#] Corresponding author. E-mail: m.rezaei@umz.ac.ir

Hulless barley is a comparatively new crop for inclusion in poultry diets in Iran. It can be used successfully in broiler and laying hen diets (Classen *et al*., 1985; Newman & Newman, 1988). Hulless barley is high in metabolisable energy, fat (similar to hulled barley), protein and lysine, and low in fibre. It usually contains a higher concentration of β-glucans than ordinary barley (Boros *et al*., 1996). By adding a suitable enzyme to digest the β-glucans it can substitute whole maize in broiler diets without any adverse effects on the birds (Rotter *et al*., 1990; Bedford, 1995). Scott *et al*. (1998) reported that the apparent metabolisable energy (AME) content of hulless barley cultivars measured on broiler chickens was lower than that of whole barley, but increased substantially with the supplementation of β-glucanase. Rotter *et al*. (1990) reported that the substitution of wheat by 750 g hulless barley/kg feed in a broiler chick diet did not have a significant effect on the metabolisable energy content of the diet or the body weight and feed conversion ratio of the birds. The aim of the present investigation was to determine the metabolisable energy content of five cultivars of hulless barley using adult Leghorn cockerels.

This experiment was carried out in the summer of 2006 at the Poultry Centre of the Animal Research Institute, Karj, Iran. The crude protein and gross energy content of five cultivars (3, 7, 12, 15 and KC-31) of hulless barley were measured (AOAC, 1990). These new cultivars have been cultivated recently in some areas of Iran. These cultivars were selected to establish if they differ in nutritive value. The metabolisable energy content was determined using the precision-feeding method of Sibbald (1986). Twenty-four cockerels drawn from a large population were used for this investigation. These cockerels were housed individually in metabolism cages in a temperature-controlled room with 14 h of light per day. The temperature and relative humidity were kept at 24 °C and 60%, respectively. Each cage was fitted with an individual feeder and nipple drinker. An aluminium tray was placed underneath each cage to allow excreta to be collected. Before the onset of the experiment, feed was withheld from the birds for 24 h to ensure that no dietary residues remain in their digestive tracts. The experimental period lasted 72 h and excreta were collected during the final 48 h. An additional four cockerels were given no feed and served as negative controls to provide a measure of endogenous energy loss (EEL). The test birds received 35 g ground hulless barley of each cultivar. The excreta were collected during the 48 h after feeding, were weighed and frozen. For analyses the frozen samples were placed in an oven and dried at 90 ° C for 16 h. Samples of the ground hulless barley and the excreta were analysed for gross energy using an adiabatic bomb calorimeter. Nitrogen content was determined on these samples according to the Kjeldahl procedure (AOAC, 1990). Total intake of gross energy, excreta energy and excreta endogenous nitrogen were measured for each bird. The experiment was conducted on the basis of a completely randomized design with five treatments and four replicates in each treatment, using the General Linear Model (GLM) procedure of SAS software (SAS, 1998). The Duncan's multiple range test was applied to test whether there were significant differences between treatments (Steel & Torrie, 1980). Level of significance was chosen as $P < 0.05$.

The results of the experiment are shown in Tables 1 and 2. These results show that cultivars KC-31 had the highest (121 g /kg DM) and cultivar 15 the lowest (87 g /kg DM) concentrations of crude protein. For AME_n there were significant differences among cultivars ($P < 0.05$). Cultivar 3 had the highest and cultivar KC-31 the lowest AME_n contents. For TME_n there were significant differences among cultivars, similar to those in AME_n ($P < 0.05$).

Table 1 Gross energy (GE) and crude protein (CP) content of different cultivars of hulless barley (Dry matter (DM) basis)

	Cultivars				
	3	7	12	15	KC-31
DM (g/kg)	951	950	951	953	952
GE (MJ/kg)	17.1	17.3	17.2	17.1	17.2
CP (g/kg)	107^{b}	106^{b}	101^{c}	87^{d}	121^{a}

Means with different superscripts in each row are significantly different at $P < 0.05$.

Table 2 Apparent (AME) and true metabolisable energy (TME) corrected for nitrogen content (means ± s.d.) of different cultivars of hulless barley (MJ/kg dry matter)

	Cultivars				
	3	7	12	15	KC-31
AME_n	$13.9^{a} \pm 1.02$	$12.2^{ab} \pm 0.78$	$12.9^{ab} \pm 0.47$	$13.2^{a} \pm 0.63$	$11.0^{b} \pm 0.84$
TME_n	$14.4^{a} \pm 0.92$	$12.7^{ab} \pm 0.61$	$13.3^{ab} \pm 0.52$	$13.7^{a} \pm 0.88$	$11.4^{b} \pm 0.762$

Means with different superscripts in each row are significantly different at $P < 0.05$.

These results are not in agreement with the results obtained in other experiments (Rotter *et al*, 1990). Scott *et al*. (1998) reported a value of 12.1 MJ/kg DM for AME_n in hulless barley of Canadian origin and found a 14% increase after β-glucanase supplementation. Bekta *et al*. (2006) reported that the ME_n content of unsupplemented and enzyme (β-glucanase) supplemented hulless barley cv. Rastik in broiler chickens was 10.8 and 13.1 MJ/kg, respectively. In the present study the metabolisable energy values of some of the cultivars tested were similar to values obtained in other studies only after the supplementation of β-glucanase. These differences may be due to conditions of cultivation and variations among cultivars. Due to high concentrations of soluble non-starch polysaccharides (NSP) in barley and rye the proportions of AME_n to GE are 0.6 to 0.65. The soluble NSP content of hulless barley was reported to be 40-50 g/kg DM (Henry, 1987). By increasing the soluble NSP concentration in diets, the viscosity of digesta increases and the passage rate decreases, hence the loss of energy increases (Bedford, 1995; Gracia *et al*., 2000). Chesson (2001) showed that β-glucanase readily cleaved some bonds within β-glucans, resulting in a mixture of gluco-oligosaccharides with lower viscoelastic properties, positively affecting digestion and absorption from the small intestine of broiler chickens. Due to the constant microflora population in adult birds, the harmful effects of NSP are reduced (Danick *et al.*, 2001). Results of the present study showed that hulless barley can be used as an alternative to maize or other grains in supplying energy in poultry diets. Further research is needed to understand and clarify the influence of the different cultivars of hulless barley on performance of different classes of poultry.

Hulless barley is a suitable feedstuff for use as an energy source in poultry diets. The metabolisable energy content of some cultivars of this feedstuff is high and comparable to other grains such as wheat.

References

AOAC, 1990. Official Methods of Analysis (15th ed.). Association of Official Analytical Chemists, Inc. Washington, D.C., USA.

Bedford, M.R., 1995. Mechanism of action and potential environmental benefits from the use of feed enzymes. Anim. Feed Sci. Technol. 53, 145-155.

Bekta, M., Fabijanska, M. & Smulikowska, S., 2006. The effect of β-glucanase on nutritive value of hulless barley cv. Rastik for broiler chickens. J. Anim. Feed Sci. 15, Suppl. pp. 107-110.

Boros, D., Rek-Cieply, B. & Cyran, M., 1996. A note on the composition and nutritional value of hulless barley. J. Anim. Feed Sci. 5, 417-424.

Chesson, A., 2001. Non-starch polysaccharide degrading enzymes in poultry diets: Influence of ingredients on the selection of activities. World's Poult. Sci. J. 57, 251-263.

Classen, H.L., Campbell, G.L., Rossnagel, B.G., Bhatty, R. & Reichert, R.D., 1985. Studies on the use of hulless barley in chick diet deleterious effect and methods of alleviation. Can. J. Anim. Sci. 65, 723-733.

Danicke, S., 2001. Interaction between cereal identity and fat quality and content in response to feed enzymes in broilers. In: Enzymes in Farm Animal Nutrition. Eds. Bedford, M.R. & Partridge, G.G., CABI, Wallingford. pp. 199-236.

Gracia, M., Salado, S., Gracia, M.I., Cachaldora, P. & Mateos, G.G., 2000. Variation of response to enzyme supplementation with broiler age and viscosity of diet. 3th European Symp. Feed Enzyme, 8-10 May, Noordwijkerhout, Netherlands. p. 53.

Henry, R.J., 1987. Pentosan, (1,3) and (1,4) β–glucan concentration in endosperm of whole grain of wheat, barley, oats and rye. J. Cereal Sci. 6, 253-258.

Newman, R.K. & Newman, C.W., 1988. Nutritive value of a new hulless barley cultivar in broiler chicks. Poult. Sci. 67, 1573-1579.

Rotter, B.A., Friens, O.D., Guenter, W. & Marawardt, R.R., 1990. Influence of enzyme supplementation on the bioavailability of energy of barley. Poult. Sci. 69, 1174-81.

SAS, 1998. Statistical Analysis System user's guide (Release Version 7.00). SAS Institute Inc. Cary, N.C., USA.

Scott,T.A., Silversides, F.G., Classen, H.L., Swift, M.L., Bedford, M.R. & Hall, J.W., 1998. Broiler chick bioassay for measuring the feeding value of wheat and barley in complete diets. Poult. Sci. 77, 449-455.

Sibbald, I.R., 1986. The TME system of feed evaluation methodology: Feed composition data and bibliography. Technical Bull. 1986-4E, Animal Research Center, Research Branch, Agriculture Canada, Ottawa, Canada.

Steel, R.G.D., & Torrie, J.H., 1980. Principles and Procedures of Statistics. 2nd ed. McGraw-Hill Book Co, Inc, New York, USA.