Effects of hull-less barley inclusion in corn-soy diet on the nutrients digestion of broiler chickens

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Abstract

Two experiments with broiler chickens was conducted to study the effect of inclusion of hull-less barley and exogenous enzyme to broiler diet on the apparent metabolizable energy and digestibility. The experiment was a randomized design with 3×4 factorial arrangement with 3 levels of enzyme (0, 300 and 600 g/ton)and four levels of hull-less barley inclusion (0,10,20,and 30%) in diet and performed in buttery cage with 432 male broiler chickens. The experimental diets were fed to the chickens from 15-21 (starter) and 35-45(finisher) days of age. Excreta were collected at 18-21 and 41-43 days of age at starter and finisher periods, respectively. Also, Ileal content collected at 22 and 44 days of age using the slaughtering technique. Increasing the proportion of dietary hull-less barley in starter diets resulted in depression in AME and reduced ileal and total tract digestibility of organic matter, crude protein, crude fat and starch and metabolizability of gross energy in the starting period($p<0.01$). The hull-less barley inclusion, however, did not significantly influence the nutrient digestibility (exclude crude fat) and ME in the finishing period. There was no effect of addition with the different levels of enzyme on the coefficient of apparent digestibility of nutrients measured in ileum and excreta in the starting and finishing periods. From the results obtained, it can be indicated that the high levels of hull-less barley inclusion in diet have the most negative effect on nutrient digestion of broilers at starter period.

Introduction

Hull-less barley grain contains highly viscous carbohydrates known as Non-starch polysaccharides (NSPs) especially beta glucans. Classen et al.(1985) was found that high level of NSPs in hull-less barley caused serious digestive problem in poultry. Choct et al. (1996), show that the addition of extracted NSPs from cereals grains to broiler diets can decrease digestibility of protein, Starch and fat, thus decrease broiler performance. Reduction growth performance was shown in broiler fed diets containing high concentration of NSPs that mediated by dietary high levels of hull-less barley inclusion (Sharifi et al. 2003). The aim of current study was to investigate the effects of inclusion different levels of hull-less barley on the precaecal and total digestibility of nutrients and metabolizable energy values of experimental diets in the starting and finishing periods.

Material and Methods

These experiments were randomized design with a 4×3 factorial arrangement for hull-less barley inclusion rate (0, 10, 20 and 30%) and for enzyme addition(0, 300 and600 g/ton) in iso-nitrogenous and iso-calorific experimental diets. The compositions of basal diet used in two consecutive experiments are shown in table 1. The basal diet was given as starter (0-21 days of age) and as a finisher (21-45 days of age). In all 432 one-day-old broiler chickens were used in each of the two experiments. The birds were randomly distributed to 36 metabolism cages (7 and 5 birds per cage for first and second experiment, respectively) given a total of three replicates per treatment in each period. Chromic oxide(3gr/kg) was added to the diets as an indigestible marker to all diets, and the experimental diets containing chromic oxide were given to chickens during 3-day adaptation period(days 15-17 and 38-40) and during the three collection periods. In the following 3 days (days 18-20 and 41-43), excreta were collected from each cage and were stored in closed container at -20°C immediately after collection. On days 21 and 44, four and two chickens, respectively, from each replicate were killed by cervical dislocation. Immediately after death, the total intestinal content was collected from 2 cm posterior to meckel's diverticulum to 2 cm anterior to the ileal – caecal junction and then stored at -20°C. The collected excreta and ileal contents dried at 70°C for 48 hours and ground for analysis. The proximate feed and excreta analysis was performed according to AOAC(1991).Chromic oxide was determined using the method of Feton and feton(1979). Apparent digestibility coefficient of nutrients in ileum/excreta and metbolizability of gross energy were calculated relative to the Cr_2O_3 marker. All collected data were analyzed by the ANOVA technique, using SAS package and difference between mean values were identified by the use of Duncan's test.

Results and Discussion

The apparent ileal and total tract daigetibility of dietary nutrients and AME in broilers fed the experimental diets are shown in table 2. Increase amounts of hull-less barley inclusion rate linearly decreased the AME and apparent ileal and total tract digestibility of protein, fat, starch and organic matter digestibility in starting period($p<0.01$). No differences($P>0.05$) were observed in apparent ileal and total tract digestibilities of the dietary constituents and AME among the exprimental diets in the finishing period except for ileal digestibility of crude fat. Enzyme supplementation had no significant effects on AME (kcal/kg) and apparent digestibility (%) of dietary constituents in ileum and total tract in the starting and finishing periods. The results obtained in the present study indicate that AME, along with CP, CF, OM and starch digestibility were markedly decreased by hull-less barley inclusion to diet, especially in starting period The reason for the lower digestibility of nutrients in the diets containing hull-less barley may be due to the higher level of NSPs. In the current study the soluble NSPs concentration increased by increasing in inclusion rate of hull-less barley to diets (table 1). Choct *et al*. (1996) fed high non-starch polysaccharides diet to the broilers that resulted in low nutrients digestion in the ileum. Soluble NSPs will increase digesta retention time and thicken the unstirred water layer in the GI tract due to its viscosity (Johnson et al. 1986) and then, they reduce diffusion of digestive enzymes, their substrates and their products and promote the secretion of endogenous enzymes (Choct and annison, 1992). Sharifi *et al*.(2004) indicated a decrease in the heights and widths of the intestinal villus of broilers fed diets containing high concentration of soluble NSPs. Therefore, excessive reduction in absorptive area in digestive tract could be one of the factors for poor nutrients digestion found in broiler chickens fed diet with high inclusion levels of hull-less barley. Results from this study did not show any significant effects of hull-less barley inclusion levels on ileal and excreta digestibility of nutrients in the finishing period. Classen and Bedford (1999) reported that the major negative effect of feeding high ß-glucan barley is during the first 4 week of life for broiler chickens. Older birds appear capable of more readily transporting viscous material in the gastrointestinal tract and therefore nutrients digestions are not adversely affected.

Conclusion

The results obtained in this experiment suggest strong relation between inclusion rate of hull-less barley in diet and the reduction of ileal and total tract digestibility coeficients of nutrients in broiler chickens at starting period. In conclusion, the negative effect of high level of hull-less barley in broiler diets are primary due to high content of soluble non-starch from the barley, which depressed AME and apparent digestibility of dietary nutrients. Nutrients digestibility coeficients are improved by aging the broiler chickens.

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Table 1. Composition(%)of the experimental diets*

	Starter				Finisher			
Ingredients	1	2	3	4	1	2	3	4
Maize	65.15	56. 3	49.6	44.3	72.21	64.42	55.7	48.3
Soya bean meal	25.52	24.24	21.05	14.33	23.75	22.5	21.21	18.7
Hull-less barley	-	10	20	30	-	10	20	30
Fish meal	6.5	7	7	6.5	-	-	-	-
DCP	0.7	0.6	0.66	0.82	2.02	1.25	1.18	1.03
Oyster shell	0.85	0.85	0.85	0.93	1.25	0.99	1.01	1.12
Salt	0.21	0.1	0.09	0.08	0.2	0.2	0.15	0.1
DL- Methionine	0.2	0.2	0.2	0.18	0.05	0.15	0.15	0.15
Lysine	0.25	0.15	0.1	0.1			0.1	0.1
Vit.+Min Permix	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Calculated composition								
AMEn(kcal/kg)	2950	2950	2950	2950	2950	2950	2950	2950
CP(%)	21.2	21.2	21.2	21.2	16.6	16.6	16.6	16.6
Soluble NSPs(%)	3.61	4.08	4.28	4.4	3.27	3.84	4.3	4.6

* Each diets were supplemented with different levels of Endofeed enzyme(0, 300 and 600g/ton)

Table 2.AME (kcal/kg) and apparent digestibility (%) of dietary constituents in ileum and excreta of broiler chickens fed diets containing different levels of hull-less barley and enzyme*.

	Diet						
	1	2	3	4	*SEM***	*P-value for hull-less barley*	*P-value for enzyme*
Ileum(day21)							
Protein	77.9[a]	76.01[b]	73.5[c]	71.7[d]	1.09	0.001	0.1
Fat	88.0[a]	86.6[a]	86.3[a]	78.4[b]	2.7	0.001	0.12
OM	74.7[a]	73.2[b]	71.3[c]	70.5[c]	0.87	0.001	0.06
AME	3130.8[a]	3060.7[b]	3037.3[bc]	3016.8[c]	32.4	0.001	0.12
Excreta (days18-20)							
Protein	70.1[a]	66[b]	60.4[c]	60.8[c]	0.61	0.0001	0.21
Fat	92.8[a]	89.4[b]	88.8[b]	78.4[c]	3.2	0.0001	0.18
OM	80.8[a]	78.4[a]	74.7[b]	73.9[b]	4.1	0.0001	0.30

Starch	97.7[a]	96.7[b]	96.6[b]	94.6[c]	2.5	0.0001	0.29
AME	3298.8[a]	3196.1[a]	3069.6[b]	3068.7[b]	124.2	0.001	0.71
Ileum(day 44)							
Protein	78	77.4	75.3	76.5	3.13	0.30	0.6
Fat	86.2[a]	86.3[a]	82.7[b]	83.4[b]	3.1	.04	0.84
OM	81.2	80.4	81.6	81.6	2.2	0.60	0.61
AME	3423	3364.7	3298.1	3311.9	125.1	0.07	0.52
Excreta (days 41-43)							
Protein	70.6	70.1	70.2	70.4	4.5	0.99	0.70
Fat	89	88.5	87.9	87.2	2.9	0.30	0.08
OM	84.6	85.2	82.1	82.1	2.9	0.22	0.73
Starch	97.7	97.8	97.5	97.1	0.62	0.12	0.06
AME	3518.1	3573.7	3513.1	3452.9	119.3	0.23	0.20

*Means within rows with different letters are significantly different (P<0.05). ** Standard error of mean

Grinding size and grinding method and interaction with pelleting for wheat-based broiler chicken diets

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Abstract

A hard wheat was ground by the use of hammer mill fitted with a 3 or 6.1 mm sieve, or to the same geometric mean diameter by the use of a roller mill. When diets containing 573.5 g ground wheat/kg were pelleted, wet sieving revealed that the proportion of fine particles smaller than 0.2 mm in size increased substantially. In addition, the pelleting process tended to even out differences in particle distribution between diets. When diets were fed to broiler chickens either as mash or after pelleting, extent of grinding had no conclusive effect on performance. Pelleting increased performance, and increased apparent metabolisable energy (AME) of the diets from 11.6 to 11.8 MJ/kg. The increase in AME was however not reflected in a higher starch digestibility. The results indicate that pelleting will even out differences in particle distribution, and that coarse grinding of wheat has no negative effect on broiler performance.

Introduction

Although grinding represents a considerable cost in terms of energy consumption and feed mill capacity, cereals used for poultry are usually finely ground in a hammer mill fitted with a screen between 3 and 4.5 mm in size. It has been shown that coarse particles are completely ground in the gizzard (Hetland et al., 2002), and that this grinding does not affect passage rate through the intestinal tract (Svihus et al., 2002). This indicates that from a nutritional point of view the cereals used for poultry can be ground more coarsely than current practice. Roller mills are not commonly used in feed production, despite the fact that they grind with a lower energy consumption per ton feed (Nir et al., 1990), gives less dust during grinding and are less noisy (Heimann, 2002). It has also been shown that roller mills grind cereals more uniformly and produce a lower amount of fines than hammer mills (Nir et al., 1990; 1995). As roller mills are considered to be particularly effective for coarse grinding, the advantages of roller mills will increase when a coarse grinding is used. The consensus is that pelleting increases performance due to a higher feed intake and an increased feed efficiency. It is not clear, however, whether the increased feed per gain is caused solely by reduced maintenance requirements, or whether pelleting in itself may improve digestibility. In fact, recent results indicate that pelleting decreases digestibility of starch compared to mash feeding, despite an improvement in feed per gain (Svihus and Hetland, 2001). Thus, this cast doubt on the hypothesis that pelleting increases feed utilization.