Evaluation of dietary replacement of soybean meal by canola meal supplemented by ß-mannanase (Hemicell) on performance of broiler chicks

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To investigate the replacement value of canola meal (CM) for soybean meal (SBM) in broiler diets supplemented with Hemicell (containing β-mannanase activity) on performance of growing broiler chicks, three hundred sixty unsexed 1-d-old chicks were randomly allocated to 4 treatments, each of which had 9 pens of 10 chicks per pen. Four iso-energetic and iso-nitrogenous diets were fed *ad libitum* as starter (days 0-21), grower (days 22-42) and finisher (days 43-49). All diets included a high proportion of corn as the main cereal component. The diets with CM included (15, 15 and 5%) CM in place of SBM in starter, grower and finisher diets, respectively. Experimental groups were: control group (Corn-SBM), corn-SBM with Hemicell, corn-SBM-CM without Hemicell, and corn-SBM-CM with Hemicell. The inclusion of CM in place of SBM reduced feed intake (FI) and body weight gain (BWG) of birds and increased feed conversion ratio (FCR) compared with birds fed on control diet. The addition of Hemicell to CM-included diets improved FI, BWG and FCR; however, only improvement in BWG and body weight (BW) compared with CM-included diets with no enzyme was statistically significant. Enzyme inclusion in SBM-based diets improved BW, BWG and FCR ($P \leq 0.05$).

Key words: soybean meal; canola meal; *β*-mannanase; growth performance; broilers

Introduction

The introduction of low glucosinolate rapeseed (canola) has made CM a suitable alternative to SBM as a vegetable protein source in broiler diets. However, the low level of available energy, the reduced level of crude protein as well as lysine, and the increased levels of indigestible carbohydrates of CM compared with SBM (Bell, 1993) make CM a less competitive alternative when used at high levels in broiler diets. The relatively low level of available energy in CM is associated with high levels of non-starch polysaccharides (NSP) (Bell, 1993). NSP are complex high molecular weight carbohydrates found in the structure of plant cell walls and reduce nutrient bioavailability in poultry production (Annison and Choct, 1991; Classen and Bedford, 1991; Bedford and Classen, 1993; Choct, 2002). The NSP include various fiber types such as lignin, β-glucans, arabinoxylans (pentosans), uronic acid, galactose, and mannose in poultry feedstuffs (Aman and Graham, 1990).

Slominski and Campbell (1990) determine that the digestibility of NSP in CM in poultry is very low. The work of Rassmussen and Petterson (1997) showed that the addition of a multi-carbohydrase enzyme product to a soy-canola meal-sorghum diet significantly improved overall broiler growth performance. Kocher (2000) found that the addition of two commercial enzyme products with polygalacturonase activities significantly reduced the amount of soluble NSP in the jejunum.

β-Mannan and its derivatives are integral components of cell walls in all legumes (Reid, 1985). Certain protein concentrates, especially palm kernel meal, copra meal, and guar meal, are among the feedstuffs rich in glucomannans and galactomannans (Amang and Graham, 1990; Ward and Fodge, 1996). Several studies have demonstrated the negative effects of dietary β-mannan found in palm kernel meal, copra meal, guar gum, and guar meal (Ray et al., 1982; Furuse and Mabayo, 1996). β-Mannan is a linear polysaccharide composed of repeating β-1-4 mannose and 1-6 galactose and glucose units attached to β-mannan backbone. The inclusion rate of 2 to 4% in feed severely retards growth and decreases feed efficiency in broilers (Ray et al., 1982; Verma and McNab, 1982). It has been shown that β-galacto-mannan interferes with glucose metabolism and insulin secretion rates in swine. The suppression of insulin secretion can impair the intestinal uptake and utilization of glucose and amino acids in peripheral tissues such as striated muscle by mono-gastric animals, resulting in reduced growth and feed efficiency.

Hemicell® is a fermentation product of *Bacillus lentus*. It contains high amounts of β-Mannanase that degrade β-mannan in feed. β-Mannanase has been shown to improve feed conversion of swine (Hahn et al., 1995) and broilers (Ward and Fodge, 1996). Copra and guar meals have also bean reported to increase utilization with bacterial mannanase treatment (Verma and McNab, 1982; Patel and McGinnis, 1985). Broilers fed low-energy diets supplemented with β-Mannanase performed slightly better than broilers fed high-energy diets without enzyme (McNaughton et al., 1998).

The current study investigated the replacement value of CM for soyben meal in broiler diets supplemented with commercial carbohydrase enzyme product containing β-mannanase activity on performance of growing broiler chicks.

Materials and methods

Three hundred sixty unsexed 1-d-old Cobb 500 broiler chicks were purchased from a local supplier and randomly allocated to 4 experimental treatments. Any birds showing signs of ill health, injury or being in poor condition were discarded. The experiment was carried out in 36 floor pens (each 1.2 × 1 m) with 10 chicks per pen and was used to investigate the effects of *β*-mannanase (Hemicell) on growth performance of birds fed on corn-soy and corn-soy-canola meal diets. The birds were given 23L: 1D during each 24-h period throughout the trial. The trial terminated when the birds were 49d of age.

Table 1. Composition (g/kg) of experimental diets

Ingredients	Days 0 to 21(starter)				Days 21 to 42 (grower)				Days 42 to 49 (finisher)			
	No enzyme		Hemicell		Corn		Canola		Corn		Canola	
	SBM	CM	SBM	CM	SBM	CM	SBM	CM	SBM	CM	SBM	CM
Corn	566.6	562.5	566.7	562.5	646.7	642.7	646.8	642.9	664.8	663.4	664.9	663.5
Soybean meal	337.2	234.0	337.5	234.3	267.8	164.7	268.1	164.9	184.6	150.2	184.8	150.4
Canola meal	-	15.0	-	15.0	-	15.0	-	15.0	-	5.0	-	5.0
Wheat bran	40.6	0.7	39.9	-	40.9	0.9	40.1	-	120.3	107.0	119.5	106.2
Sunflower oil	17.6	17.6	17.6	17.6	9.5	9.5	9.5	9.5	-	-	-	-
DCP	13.3	12.8	13.3	12.8	9.8	9.4	9.8	9.4	7.2	7.0	7.2	7.0
Oyster shell	12.3	11.0	12.3	11.0	13.2	11.9	13.2	11.9	12.0	11.6	12.0	11.6
Common salt	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Vitamin premix	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Mineral premix	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
HCl-Lysine	1.1	0.5	1.1	0.5	1.5	0.9	1.5	0.9	0.9	0.7	0.9	0.7
DLMethionine	1.3	0.9	1.3	0.9	0.6	0.1	0.6	0.1	0.2	-	0.2	-
Hemicell	-	-	0.4	0.4	-	-	0.4	0.4	-	-	0.4	0.4
Calculated												
ME Kcal /kg	2850	2850	2850	2850	2900	2900	2900	2900	2800	2800	2800	2800
CP	204.8	204.8	204.8	204.8	181.3	181.3	181.3	181.3	157.5	157.5	157.5	157.5

Soybean meal (SBM), Canola meal (CM)

Table 2. Growth rate (gain/bird/d), feed intake (feed/bird/d) and feed conversion ratio (g: g) for broiler chicks fed on corn-soybean- and corn-soybean-canola meal-based diets with and without Hemicell supplementation

Rearing period		0-21	22-42	43-49	0-49
Diet	Enzyme	Body weight gain (g/chick/day)			
Corn-SBM	No enzyme	28.9 ± 0.4[b]	67.1 ± 4.11[b]	80.9±18.40	52.5±2.77[b]
Corn-SBM-CM	No enzyme	25.6 ± 0.72[d]	63.2 ± 5.85[b]	72.1 ± 24.13	46.2 ± 2.27[d]
Corn-SBM	Hemicell	29.9 ± 0.62[a]	73.8 ± 5.27[a]	82.5 ± 19.2	56.2 ± 1.58[a]
Corn-SBM-CM	Hemicell	27.0 ± 0.64[c]	64.6 ± 4.62[b]	72.8 ± 10.65	48.6 ± 1.71[c]
MSE		0.29	1.05	3.09	0.72
		Feed intake (g/chick/day)			
Corn-SBM	No enzyme	48.8 ± 0.88[ab]	141.1 ± 10.10	204.5 ± 23.14	109.8 ± 3.45[a]
Corn-SBM-CM	No enzyme	45.3 ± 3.16[c]	133.4 ± 11.79	196.5 ± 19.85	102.6 ± 6.59[b]
Corn-SBM	Hemicell	49.4 ± 1.11[a]	141.3 ± 4.57	204.6 ±10.31	111.0 ± 3.47[a]
Corn-SBM-CM	Hemicell	47.1 ± 2.32[bc]	136.8 ± 7.94	195.1±18.71	103.8 ± 3.54[b]
MSE		0.42	1.53	3.05	0.94
		Feed conversion ratio (g: g)			
Corn-SBM	No enzyme	1.68±0.03[bc]	2.10±0.13[a]	2.65±0.70	2.09±0.08[b]
Corn-SBM-CM	No enzyme	1.77±0.09[a]	2.11±0.12[a]	2.95±0.84	2.21±0.08[a]
Corn-SBM	Hemicell	1.65±0.05[c]	1.91±0.09[b]	2.62±0.78	1.97±0.07[c]
Corn-SBM-CM	Hemicell	1.74±0.07[ab]	2.12 ±0.10[a]	2.73±0.46	2.13±0.10[ab]
Pooled MSE		0.013	0.023	0.11	0.02

[a-b] Means within columns with different superscript are significantly different ($P \leq 0.05$).

Starter, grower and finisher diets were offered to birds from 0 to 21 d, 21 to 42 d and 42 to 49 d of age, respectively. Feed and water were provided *ad libitum* throughout the experiment. For each feeding period, diets were calculated to be iso-energetic and iso-nitrogenous to meet or exceed the nutrient requirements recommended by the NRC (1994) for broilers. The Hemicell was provided by Chem Gen Co., Ltd. and the activity of β-mannanase was greater than 165×10^6 U/kg. Ingredient composition and nutrient content of the experimental diets are presented in Table1.

Results and discussion

Growth rate, FI, and FCR of broilers fed SBM- or CM-included diets with and without added enzyme are shown in table 2. Lesson et al. (1987), Borcea et al. (1996) and Kocher et al. (2001) showed that CM could replace SBM in broiler diets without any detrimental effects on bird performance. In the present study; however, the addition of CM reduced BWG of birds, but this effect was not statistically significant in finishing period. The addition of CM reduced FI of chicks; however, the differences were not statistically significant in growing and finishing periods. Broilers fed SBM-included diets had improved FCR in comparison with birds fed CM diets.

Dietary enzyme supplementation improved BWG and FCR of broilers fed SBM-based diets; however, the effects of enzyme addition on BWG, FI, and FCR of birds fed CM-based diets were not statistically significant. It can be concluded that the addition of β-mannanase could improve the performance of growing broiler chicks fed on practical corn-SMB-based diets.

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