Evaluation of dietary replacement of soybean meal by chickpea supplemented by enzymes on performance of broiler chicks

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This experiment was carried out to determine the effect of dietary inclusion of chickpea seeds with or without two commercial enzyme products on the performance of broiler chicks. A total of 396 unsexed day-old Cobb broiler chicks were randomly distributed in 36 floor pens of 11 birds each. Six replicates were allocated to one of six iso-energetic and iso-nitrogenous experimental diets. Chickpea were included in corn-soybean based diets at 100 g/kg as a partial replacement. Diets used were diet 1, a corn-soybean based diet; diet 2, a low phosphorous corn-soybean based diet supplemented with Ronozyme (phytase activity); diet 3, a corn-soybean based diet supplemented by Hemicell (β-mannanase activity); diet 4, a corn-soybean-chickpea based diet; diet 5, a low phosphorous corn-soybean-chickpea based diet supplemented with Ronozyme ; diet 6, a corn-soybean-chickpea based diet supplemented by Hemicell. Partial replacement of soybean meal by chickpea had no detrimental effects on BWG, FI and FCR. The addition of Hemicell to chickpea-included diets improved BWG; however, the effect of enzyme was not statistically significant in soybean meal-based diets. Performance of birds fed low P level plus phytase supplementation had no statistically significant difference with chicks fed soybean- or chickpea-included control diets.

Key words: chickpea; phytase; β-mannanase; performance; broilers

Introduction

Although most of chickpea is produced for human consumption, a stock-feed market would provide a secondary market for reject grain and for excess production which is likely to occur occasionally in rapidly expanding industry, while providing the animal production industries with alternative sources of protein and energy-rich foods. Like other legumes, chickpea seeds contain varieties of anti-nutritional factors such as protease and amylase inhibitors, lectins, polyphenols and oligosaccharides (Chavan *et al*., 1986; Cerioli *et al*., 1998). Increasing the proportion of chickpea seed in the broiler diet negatively influenced body weight gain, food intake and food efficiency (Farrel 1999; Viveros *et al*., 2001).

β-Mannan and its derivatives are integral components of cell walls in all legumes (Reid, 1985). 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; Teves *et al*., 1988; Furuse and Mabayo, 1996). 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). 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 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: Teves *et al*., 1988). 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 inability of poultry to utilize phytate P, due to lack of endogenous phytase, results in the addition of inorganic feed P to poultry diets in order to meet the P requirements of poultry. However, P is the third most expensive nutrient in poultry diets after energy and protein (Biehl *et al*., 1998), and phytate P passed out in animal excreta leading to accumulation of P in soils and subsequently its entry into surface and ground waters and sparking off major environmental concerns (Kornegay and Harper, 1997). Phytase degrades phytate to yield inositol monophosphate and orthophosphate via inositol penta to monophosphates as intermediary products (Liu *et al*., 1998). It has been well documented that phytase improves P utilization in poultry (Simons *et al*., 1990; Roberson and Edwards, 1994; Beihl *et al.,* 1995; Denbow *et al*., 1995; Gordon and Roland, 1997; Van der klis *et al*., 1997; Boling-Frankenbach *et al.,* 2001; Onyango, *et al.,* 2005; Ravindran, *et al*., 2006).

Although the benefits of the addition of exogenous enzymes to wheat, rye, barley, oilseeds and lupins have well documented, whether the benefits of phytase and β–mannanase will also be demonstrable in chickpea-based diets is not as evident. The present experiment was conducted in order to investigate the effects of addition of exogenous enzymes to chickpea included diets on performance of growing broiler chicks.

Materials and methods

Two commercial exogenous dietary enzyme preparations which were used in this study, Hemicell® and Ronozyme P 5000 (CT: Coated Thermotolerant) ® have β-mannanase and phytase activity, respectively. The Hemicell was provided by Chem Gen Co., Ltd., and the activity of *β*-mannanase was greater than 165 × 10^6 U/kg (inclusion dose: 400 g/t feed). Ronozyme P 5000 was provided by DSM Nutritional Products Ltd, Switzerland (inclusion dose: 150 g/t feed). A total of 396 unsexed day-old Cobb broiler chicks were obtained from a local hatchery, weighed and randomly allocated to 36 pens. Eleven birds placed in each pen. Any birds showing signs of ill health, injury or being in poor condition were discarded. There were a total of six iso-energetic and iso-nitrogenous experimental diets, each replicated 6 times. Chickpea were included in corn-soybean based diets at 100 g/kg as a partial replacement. Diets used were diet 1, a corn-soybean based diet; diet 2, a low phosphorous corn-soybean based diet supplemented with Ronozyme; diet 3, a corn-soybean based diet supplemented by Hemicell; diet 4, a corn-soybean-chickpea based diet; diet 5, a low phosphorous corn-soybean-chickpea based diet supplemented with Ronozyme ; diet 6, a corn-soybean-chickpea based diet supplemented by Hemicell. The levels of dietary Ca and available P in control and low P groups were 0.89, 0.40 and 0.89, 0.24 in starter, 0.82, 0.32 and 0.82, 0.19 in grower, and 0.74, 0.28 and 0.74, 0.17 in finisher diets, respectively. Diets were fed *ad libitum* from one day old for a period of 49 d. Starting (ME=2850 Kcal/kg and 20.48 % CP), growing (ME=2900 Kcal/kg and 18.13 % CP), and finishing (ME=2950 Kcal/kg and 16.59 % CP) diets were fed from 0-21, 22-42, and 43-49 days of age, respectively. Data were analyzed using the GLM procedures of SAS. Means were separated for significance by Duncan's multiple range test at significance level of $P < 0.05$ or as indicated.

Results and discussion

Body weight (BW), body weight gain (BWG), feed intake (FI) and feed conversion ratio (FCR) are provided in table 2. Partial replacement of soybean meal by chickpea had no detrimental effects on BWG, FI and FCR. In other studies increasing the proportion of chickpea seed in the broiler diets negatively influenced body weight gain, food intake and food efficiency (Farrel 1999; Viveros *et. al*., 2001). These differences might be due to the inclusion level or chickpea varieties used.

The addition of Hemicell to chickpea-included diets improved BWG; however, the effect of enzyme was not statistically significant in soybean meal-based diets. These finding disagree with reports from McNaughten *et al.* (1998) and Odetallah *et al.* (2002), which both showed that the addition of β-mannanase to corn-soybean diets improved performance of birds fed soybean-based diets.

Table1. Growth rate (gain/bird/d), feed intake (feed/bird/d) and feed conversion ratio (FCR) for broiler chicks fed on experimental diets.

Rearing periods		0-21	22-42	43-49	0-49
Diet	Enzyme	Body weight gain (g/chick/day)			
Soybean	No enzyme	28.38 ± 0.76	58.09 ± 3.44[ab]	64.7 ± 11.23[ab]	46.37 ± 1.45[ab]
Soybean-low P	Phytase	27.69 ± 1.18	61.07 ± 2.96[a]	51.74 ± 4.80[b]	45.32 ± 1.77[ab]
Soybean	β-Mannanase	27.28 ± 1.79	56.73 ± 6.06[ab]	56.29 ± 5.83[ab]	44.99 ± 1.77[b]
Chickpea	No enzyme	27.99 ± 1.73	57.88 ± 3.56[ab]	57.88± 11.89[ab]	44.88 ± 2.46[b]
Chickpea-low P	Phytase	27.69 ± 0.74	55.20 ± 5.34[b]	62.91 ±14.39[ab]	44.58 ± 1.38[b]
Chickpea	β-Mannanase	28.28 ± 0.73	60.47 ± 1.87[ab]	67.03 ± 10.41[a]	47.44 ± 2.27[a]
Pooled MSE		0.202	0.723	1.831	0.337
		Feed intake (g/chick/day)			
Soybean	No enzyme	47.88 ± 3.55	114.27± 3.29[ab]	179.67± 13.62	95.37 ± 3.14[ab]
Soybean-low P	Phytase	49.43 ± 1.51	118.2 ± 4.51[ab]	180.74 ± 8.05	96.72 ± 1.84[ab]
Soybean	β-Mannanase	49.84 ± 1.12	120.3 ± 5.63[a]	179.46 ± 9.11	97.94 ± 3.45[a]
Chickpea	No enzyme	47.68 ± 1.01	111.59 ± 4.11[b]	179.11 ± 8.29	92.91 ± 4.85[b]
Chickpea-low P	Phytase	47.98 ± 1.63	114.65± 2.19[ab]	181.54 ± 9.40	95.07 ± 1.07[ab]
Chickpea	β-Mannanase	48.78 ± 0.43	116.29± 4.09[ab]	181.74 ± 8.53	95.88 ± 2.02[ab]
Pooled MSE		0.310	1.022	1.511	0.531
		Feed conversion ratio (g: g)			
Soybean	No enzyme	1.69 ± 0.16[b]	1.97 ± 0.09	2.85 ± 0.49[ab]	2.06 ± 0.11[ab]
Soybean-low P	Phytase	1.79 ± 0.79[ab]	1.94 ± 0.11	3.51 ± 0.25[a]	2.14 ± 0.08[ab]
Soybean	β-Mannanase	1.83 ± 0.09[a]	2.14 ± 0.27	3.20 ± 0.17[ab]	2.18 ± 0.21[a]
Chickpea	No enzyme	1.71 ± 0.12[ab]	1.94 ± 0.27	3.19 ± 0.58[ab]	2.08 ± 0.15[ab]
Chickpea-low P	Phytase	1.77 ± 0.07[ab]	2.09 ± 0.18	3.01 ± 0.64[ab]	2.13 ± 0.06[ab]
Chickpea	β-Mannanase	1.73 ± 0.05[ab]	1.93 ± 0.11	2.76 ± 0.41[b]	2.03 ± 0.12[b]
Pooled MSE		0.018	0.032	0.082	0.018

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

In conclusion, the results of this study indicate that chickpea could replace soybean meal by 10 % with no adverse effect on bird performance and *β*-mannanase supplementation can of improve BWG of broilers fed soybean-chickpea-based diets.

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