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Effect of partially substituted barley malt on performance, bone ash, calcium and phosphorus of broiler chickens

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Abstract

This experiment was conducted to study the effect of barley malt partially substituted for corn on performance, bone ash, calcium (Ca) and phosphorus (P) of broiler chickens. A total of 192 one day-old broiler chickens (Ross 308) were randomly allocated to 6 experimental treatments. Each treatment consisted of 4 replicates of 8 birds. A basal diet was formulated and barley malt was replaced with corn at concentrations of 5, 10, 15, 20 and 25% for 42 days. Feed intake increased significantly ($P<0.05$) at 25% substitution at the end of experiment. With increasing barley malt in the diets, daily weight gain was reduced significantly ($P<0.05$). Feed conversion ratio increased ($P<0.05$) due to increasing dietary barley malt. Our results indicated that barley malt had no significant effect on femur ash, calcium and phosphorus of broiler chickens. The best performance was negatively affected by substitution of barley malt with corn without affecting the bone ash, Ca and P.

Key words: Barley malt; bone ash and calcium; broiler chickens

Introduction

Corn is one of the main grains used in poultry diets, but its price is increasing due to ethanol production from corn, therefore, it seems necessary to find a suitable substitution for this grain. Wheat and barley are the alternative grains for corn in poultry diets. These grains have lower energy and more fiber than corn. Barley contains higher crude protein, amino acids, vitamins and mineral elements than corn. Presence of non-starch polysaccharides (NSP) in barley limited its use in poultry diets. β-glucan and other NSP increases gut viscosity and changes intestinal micro flora and pH (Friesen et al., 1992; Annison et al., 1993), consequently, lower mineral elements absorption and causes bone abnormalities and leg weakness in poultry (Boren et al., 1992).

Malt is a barley by-product, which is produced after germination. This by-product contains higher protein and enzymes such as phytase. Use of barley malt in poultry diets resulted in higher calcium and phosphorus absorption and also improvement in digestibility of energy and protein (Sabet Moghaddam et al., 2009). The aim of the present study was to investigate the effect of barley malt partially substituted on performance and bone strength indices of chickens.

Materials and Methods

A total of 192 one day-old broiler chickens (ROSS 308) were randomly allocated to six experimental treatments. Each treatment consisted of 4 replicates of 8 birds. The experiment lasted for 42 days. Basal diets for starter, grower and finisher were formulated according to NRC (1994) recommendations (Table 1). Experimental diets were formulated by replacement of 5, 10, 15, 20 and 25% barley malt for corn (Table 2). At the end of experiment (day 42), the chickens were fasted for 12 hours. Then from each pen, 2 chickens were randomly selected, weighed, slaughtered and eviscerated. Left femur was removed cleaned. The bones were dried at 60°C for 24h, then were ashed at 600°C, and percentage of Ca, P and ash was calculated (AOAC, 2000).

Statistical analysis

The experiment was performed in a completely randomized design. Data were analyzed by SAS (2002).

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Table 1: Ingredients and composition of basal die

(%) Ingredient	Starter	Grower	Finisher
Corn	57.90	63.00	66.00
Soybean Meal -48%	32.50	29.00	27.00
Menhaden Meal	3.00	2.00	0.00
Soybean Oil	2.50	2.30	3.50
Di calcium Phosphate	1.30	0.90	0.90
Vitamin Premix[1]	0.25	0.25	0.25
Mineral Premix[2]	0.25	0.25	0.25
Common Salt	0.31	0.23	0.21
DL-Methionine	0.25	0.20	0.20
Oyster Shells	1.60	1.50	1.50
Bicarbonate-Ca	0.14	0.12	0.09
Calculated nutritive value			
(Metabolizable Energy (kcal/kg	3.04	3.08	3.18
(%)Protein	22.81	20.93	19.01
(%) Calcium	1.13	0.95	0.84
(%) Total Phosphorus	0.69	0.58	0.52
(%) Available Phosphorus	0.42	0.33	0.29
(%) LYS	1.25	1.11	0.97
(%)MET, CYS	0.97	0.87	0.80

[1]Each Kg of vitamin premix contained: vitamin A, 3500000 IU; vitamin D3, 1000000 IU; vitamin E, 9000 IU; vitamin K3, 1000 mg; vitamin B1, 900 mg; vitamin B2, 3300 mg; vitamin B3, 5000 mg; vitamin B5, 15000 mg; vitamin B6, 150 mg; vitamin B9, 500 mg; vitamin B12, 7.5 mg; choline, 250000 mg; biotin, 0.1 mg ;[2]Each Kg of mineral premix contained 50000 mg; iron, 25000; zinc, 50000; copper, 5000 mg; iodine, 500 mg; selenium, 100 mg.ts; Significant differences among treatment means were determined by Duncan's multiple-range test (1955).

Results

As indicated in Table 3, daily feed intake was significantly high in birds fed 25% barley malt compared to control. Daily weight gain was significantly low in the group fed 20% barley malt. However, FCR was significantly low in 20 and 25% malt fed birds. No significant effect of levels of barley malt was found on the bone ash, calcium and phosphorus percentage of broilers (Table 4).

Discussion

Feed intake was not increased due to barley malt substitution for corn, except for level of 25% replacement. Increasing in feed intake due to high level of barley malt has been reported (Sabet Moghaddam et al., 2009). Hussaini et al. (2010) reported no significant increase in feed intake due to 7.5 and 15% barley malt inclusion in broilers, which is in agreement with the finding of the present study. Daily body gain was reduced significantly at 20%. Some of the reports have indicated that barley can be used in broiler at higher levels without negative effect on body weight gain (Fosnaught et al., 1997), but other reports indicate reduction in body weight gain due to use of barley in the diet (Friesen et al., 1992; Rotter et al., 1990; Fuente et al., 1998). Reduction in daily body weight gain of

Table 2: Ingredients and composition of experimental diets

Ingredient (%)	Substitution levels of barley malt														
	5%			10%			15%			20%			25%		
	Starter	Grower	Finisher	Starter	Grower	Finisher	Starter	Grower	Finisher	Starter	Grower	Finisher	Starter	Grower	Finisher
Corn	55.01	59.85	62.70	52.11	56.70	59.40	49.22	53.55	56.10	46.32	50.40	52.80	43.43	47.25	49.50
Barley Malt	2.89	3.15	3.30	5.79	6.30	6.60	8.68	9.45	9.90	11.58	12.60	13.20	14.47	15.75	16.50
%48-Soybean Meal	32.50	29.00	27.00	32.50	29.00	27.00	32.50	29.00	27.00	32.50	29.00	27.00	32.50	29.00	27.00
Menhaden Meal	3.00	2.00	0.00	3.00	2.00	0.00	3.00	2.00	0.00	3.00	2.00	0.00	3.00	2.00	0.00
Soybean Oil	2.50	2.30	3.50	2.50	2.30	3.50	2.50	2.30	3.50	2.50	2.30	3.50	2.50	2.30	3.50
.Dical. Phos	1.30	0.90	0.90	1.30	0.90	0.90	1.30	0.90	0.90	1.30	0.90	0.90	1.30	0.90	0.90
Vitamin Premix[1]	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Mineral Premix[2]	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Common Salt	0.31	0.23	0.21	0.31	0.23	0.21	0.31	0.23	0.21	0.31	0.23	0.21	0.31	0.23	0.21
DL-Methionine	0.25	0.20	0.20	0.25	0.20	0.20	0.25	0.20	0.20	0.25	0.20	0.20	0.25	0.20	0.20
Oyster Shells	1.60	1.50	1.50	1.60	1.50	1.50	1.60	1.50	1.50	1.60	1.50	1.50	1.60	1.50	1.50
Cal. Bicarbonate	0.14	0.12	0.09	0.14	0.12	0.09	0.14	0.12	0.09	0.14	0.12	0.09	0.14	0.12	0.09
Calculated nutritive value															
Metabolizable (kcal/g)Energy	3.05	3.08	3.19	3.05	3.09	3.19	3.05	3.09	3.19	3.06	3.10	3.20	3.06	3.10	3.20
(%) Protein	22.86	20.98	19.07	22.91	21.03	19.12	22.95	21.08	19.17	23.00	21.13	19.23	23.04	21.18	19.28
(%) Calcium	1.14	0.96	0.85	1.14	0.96	0.85	1.15	0.96	0.86	1.15	0.97	0.86	1.15	0.97	0.87
(%) Total Phosphorus	0.69	0.58	0.52	0.69	0.58	0.52	0.69	0.58	0.52	0.69	0.58	0.52	0.69	0.58	0.52
(%) Avail. Phosphorus	0.41	0.33	0.29	0.42	0.33	0.29	0.42	0.33	0.29	0.42	0.41	0.38	0.42	0.41	0.37
(%) LYS	1.26	1.12	0.98	1.27	1.13	0.98	1.27	1.13	0.98	1.27	1.14	0.99	1.28	1.14	0.99
(%) MET, CYS	0.98	0.88	0.81	0.98	0.88	0.81	0.98	0.88	0.82	0.98	0.88	0.82	0.99	0.89	0.82

[1]- Each Kg of vitamin premix contained: vitamin A, 3500000 IU; vitamin D3, 1000000 IU; vitamin E, 9000 IU; vitamin K3, 1000 mg; vitamin B1, 900 mg; vitamin B2, 3300 mg; vitamin B3, 5000 mg; vitamin B5, 15000 mg; vitamin B6, 150 mg; vitamin B9, 500 mg; vitamin B12, 7.5 mg; choline, 250000 mg; biotin, 0.1 mg; [2]-Each Kg of mineral premix contained 50000 mg; iron, 25000; zinc, 50000; copper, 5000 mg; iodine, 500 mg; selenium, 100 mg.

Table 3: Daily feed intake, weight gain and feed conversion ratio of broiler fed different levels of replaced barley malt

Level of barley malt used	Feed intake (g/d)	Weight gain (g/d)	Feed conversion ratio
Control	107.91[b]	58.84[a]	1.83[c]
5%	108.92[ab]	56.15[ab]	1.94[b]
10%	107.70[b]	54.36[bc]	1.98[ab]
15%	107.51[b]	53.31[bc]	2.01[ab]
20%	106.97[b]	52.70[c]	2.03[a]
25%	110.50[a]	53.98[bc]	2.05[a]
SE	0.80	0.94	0.02

[a-c]different superscripts in a column differ significantly (P<0.05)

Table 4: Influence of barley malt substitution with corn on femur ash, calcium and phosphorus bone percentage

Level of barley malt	Femur bone ash (%)	Femur bone Ca (%)	Femur bone P (%)
Control	48.33	40.22	18.12
5%	48.71	39.08	18.45
10%	48.06	39.44	18.70
15%	49.83	39.03	18.41
20%	48.01	39.53	17.11
25%	48.60	38.89	18.45
SE	0.85	0.72	0.57

birds fed on higher levels of barley malt may be due to NSP contents. Feed conversion ratio was increased by increasing barley malt, which indicated that it may contain enough NSP to upset gut environment and reduces performance. The results of this experiment are in agreement with other reports (White and Bird, 1981; Friesen et al., 1992; Bargava and Sosalsaki., 1986; Hussaini et al., 2010) regarding poor performance due to barley inclusion in broilers.

Conclusion

Barley malt had no negative effect on bone ash, Ca and P but feed intake, daily body weight gain and FCR were negatively affected at high levels of barley malt substitution.

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