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Apparent metabolizable energy and feeding value of high lysine maize (Nityashree) in broiler chickens

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ABSTRACT

Two experiments were conducted to determine the apparent metabolizable energy (AME) and feeding value of high lysine maize, Nityashree hybrid (NHM) vis-à-vis normal maize (NM) in broiler chickens. The AME values were measured by the European reference method utilizing 18 adult White Leghorn cockerels (28 wk). The feeding value of NHM vis-à-vis NM was evaluated utilizing day-old broiler chicks for 6 weeks. Day-old-male broiler (250) chicks were equally distributed into 5 treatment groups. A standard control broiler diet based on maize soybean meal was prepared. Four more test diets were prepared by substituting normal maize with NHM at 25, 50, 75 and 100% level. All the diets were isocaloric and isonitrogenous and had the same levels of lysine. Each diet was offered to 10 replicates of 5 chicks each up to 6 weeks of age. The results of energy bioassay revealed that AME content of NHM (3326 kcal/kg) was comparable to that of NM (3352 kcal/kg). The growth performance of chicks fed diet containing NM or NHM with respect to body weight gain, feed consumption and feed conversion ratio did not differ statistically either during starter or finisher phases. The serum biochemical parameters measured in terms of protein, Ca, P, total and HDL cholesterol, triglycerides and activity of enzyme alkaline phosphatase was comparable between NM and NHM group. None of the carcass attributes varied significantly by dietary replacement of NM with NHM either partially or completely except the giblet weight. It may be concluded that the apparent metabolizable energy and feeding value of Nityashree hybrid maize for broiler chicks were similar to normal maize.

Key words: Broiler, Feeding value, Lysin, Metabolizable energy

Maize is a preferred energy source in poultry but its protein content is low compared to other cereals (NRC 1994). Further, normal maize contains high zein fraction, which is practically devoid of lysine and low in tryptophan (Prasanna *et al.* 2001). Lysine is the second limiting amino acid in maize-soybean meal based poultry diet. While formulating the poultry diet, lysine is therefore supplemented in synthetic form to meet the requirement, which is quite expensive.

Breeding for improved protein quality in maize began in the mid-1960 with the discovery of mutants, such as opaque-2 (Mertz *et al.* 1964) and floury-2 (Nelson *et al.* 1965) which produced higher levels of lysine and tryptophan. However, these mutants had soft endosperm that results in damaged kernels with increased susceptibility to pests and fungal diseases and also the yields were lower. The search led to the development of newer hybrids of maize (example Quality protein maize) in which the entire negative features as mentioned earlier were alleviated. Nityashree is one such variety of hybrid maize (NHM) developed at Zonal Agricultural Research Centre, VC Farm Mandya under the aegis of University of Agricultural Sciences, Bengaluru, India, through conventional plant breeding technique. Developers claimed that NHM contained higher lysine compared to normal maize. However, no information is available on the nutritional value of NHM in poultry. Therefore, the present study was conducted to determine apparent metabolizable energy and feeding value of Nityashree hybrid maize in broiler chickens.

MATERIALS AND METHODS

Experiment 1: Apparent metabolizable energy assay

The apparent metabolizable energy (AME) values of Nityashree hybrid maize (NHM) vis-à-vis normal maize (NM) were measured by the European reference method (Bourdillon *et al.* 1990). The experiment was conducted in a completely randomized design on 18 adult White Leghorn

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cockerels (28 wk) originating from the same hatch and of comparable body weight. The cockerels were randomly divided into 3 groups of 6 birds each and kept in individual wire-mesh cages (45cm length × 30cm width × 46 cm heights) with the provision of individual feeding and excreta collection facility. The maize varieties were analyzed for crude protein, ether extract, crude fibre, calcium and total phosphorus content (AOAC 1990). During the preliminary feeding of 14d, the birds were maintained on a commercial grower diet containing 18% protein and 2600 kcal ME/kg diet. Subsequently, each maize variety (NHM and NM) was fed at 97% with 3% vitamin and mineral premix to 6 White Leghorn cockerels for 3 days, 7 h after 7 days adaptation period on the same diets. The total excreta collection method was used. Dry matter intake of feed and total excreta voided was recorded and samples were analyzed for gross energy. The AME content was calculated as the difference between energy intake and energy voided.

Experiment 2: Feeding value of Nityashree hybrid maize vis-a-vis normal maize in broiler chickens

Birds and management: Day-old-male broiler (250) chicks were equally distributed into 5 treatment groups with 10 replicates of 5 chicks each and distributed in 40 battery brooders pens made up of stainless steel. The brooder temperature was maintained at 34 + 1°C up to 7 days of age and gradually reduced to 26 + 1°C by 21 days of age after which, chicks were maintained at room temperature. Uniform management and vaccination schedules were followed for all the birds.

Diets: A standard control broiler diet based on maize soybean meal was prepared (Table 3). Four more test diets were prepared by substituting normal maize with Nityashree hybrid maize at 25, 50, 75 and 100% level. All the diets were isocaloric and isonitrogenous and had the same levels of lysine. Each diet was offered to 10 replicates of 5 chicks each up to 6 weeks of age.

Traits measured: Individual body weight of chicks and replicate wise feed intake were recorded at weekly intervals. Feed conversion ratio was calculated as the ratio between feed consumed and weight gained. On 29th day, 3 ml of blood was collected from 10 birds (1 bird from each replicate) of each dietary treatment and serum biochemical parameters such as protein, total cholesterol, high density cholesterol (HDL), triglycerides and activity of alkaline phosphatase (ALP) were estimated using diagnostic kits. On 43rd day, 10 birds representing mean body weight from each dietary group were sacrificed by cervical dislocation and the dressed weight, giblet, abdominal fat and breast meat yield was recorded and expressed as % pre-slaughter live weight.

Statistical analysis: Data pertaining to the experiments were subjected to analysis of variance using one–way classification of completely randomized design (Snedecor and Cochran 1989). The means were tested for statistical significance using Duncan's multiple range test (Duncan 1955).

RESULTS AND DISCUSSION

The crude protein and lysine contents of Nityashree hybrid maize (NHM) were 6.71 and 11.5% higher (Table 1) compared to normal maize (NM), respectively. The lysine content of NHM, however, was comparatively lower as compared to other high lysine mutants of maize such as LY 038 and Shaktiman I as reported by Lucas *et al.* (2007) and Tyagi *et al.* (2008), respectively. The results of the energy bioassay revealed that AME content of NHM (3326 kcal/kg) was comparable to that of NM (3352 kcal/kg). Tyagi *et al.* (2008) also did not find any significant difference in AME content between high lysine maize and NM in chicken.

Dietary replacement of NM with NHM (partially or completely) in broiler chicks resulted in comparable growth performance with respect to body weight gain, feed consumption and feed conversion ratio both during starter or finisher phases (Table 4). Similarly, Tyagi *et al*. (2008) did not find any difference on growth performance of broiler chicks fed NM based diet compared to quality protein maize diet. However, Onimisi *et al.* (2009) reported significantly

Table 1. Chemical and amino acid composition (%) of normal maize vis-à-vis Nityashree hybrid maize

Nutrients	Normal maize	Nityashree hybrid maize
Crude protein	8.94	9.54
Ether extract	4.66	4.78
Crude fibre	3.51	3.26
Total ash	0.97	0.98
Calcium	0.22	0.20
Phosphorus	0.28	0.24
Methionine	0.18	0.18
Cystine	0.19	0.19
Methionine + cystine	0.37	0.36
Lysine	0.26	0.29
Threonine	0.31	0.31
Tryptophan	0.07	0.07
Arginine	0.40	0.29
Isoleucine	0.29	0.29
Leucine	1.09	0.96
Valine	0.41	0.42
Histidine	0.25	0.26
Phenylalanine	0.44	0.40

Table 2. Apparent metabolizable energy (AME) (kcal/kg) of normal maize vis-à-vis Nityashree hybrid maize in cockerels

Maize variety	AME (kcal/kg)
Normal maize	3352
Nityashree hybrid maize	3326
SEM	24.20

Table 3. Ingredient and calculated nutrient composition (%) of starter and finisher diets

Ingredient	Per cent replacement of normal maize with Nityashree hybrid maize				
	D1 (0)	D2 (25)	D3 (50)	D4 (75)	D5 (100)
Starter (0–3 wk)					
Normal maize	56.22	42.17	28.11	14.05	0.0
Nityashree hybrid maize	0.0	14.05	28.11	42.17	56.22
Soybean meal	38.60	38.60	38.60	38.60	38.60
Lysine	0.08	0.07	0.07	0.06	0.06
Vegetable oil	1.5	1.5	1.5	1.5	1.5
Constant[1]	3.68	3.68	3.68	3.68	3.68
Nutrient composition					
M.E.(kcal/kg)	2911	2907	2903	2899	2897
Protein(%)	22.02	22.24	22.30	22.36	22.40
Lysine (%)	1.30	1.30	1.30	1.30	1.30
Methionine (%)	0.35	0.35	0.35	0.35	0.35
Phosphorous (%)	0.45	0.45	0.45	0.45	0.45
Calcium (%)	1.01	1.01	1.00	1.00	1.00
Finisher (4–6 wk)					
Normal maize	58.34	43.76	29.17	14.58	0.0
Nityashree hybrid maize	0.0	14.58	29.17	43.76	58.34
Soybean meal	35.80	35.80	35.80	35.80	35.80
Lysine	-	-	-	-	-
Vegetable oil	2.50	2.50	2.50	2.50	2.50
Constant[2]	3.36	3.36	3.36	3.36	3.36
Nutrient composition					
M.E. (kcal/kg)	3027	3023	3019	3015	3011
Protein (%)	20.58	20.64	20.72	20.80	20.88
Lysine (%)	1.15	1.15	1.16	1.17	1.17
Methionine (%)	0.35	0.35	0.35	0.35	0.35
Phosphorous (%)	0.40	0.40	0.40	0.40	0.40
Calcium (%)	0.90	0.90	0.90	0.90	0.90

[1] Constant (%): Salt, 0.4; di calcium phosphate, 1.89; shell grit, 0.71; DL-methionine, 0.22; AB2D3K[3], 0.015; B- complex[3], 0.012; choline chloride, 0.06; trace mineral[3], 0.12; toxin binder, 0.2; antibiotic, 0.05.

[2] Constant (%):Salt, 0.4; di calcium phosphate, 1.62; shell grit, 0.68; DL-methionine, 0.20; AB2D3K, 0.015[3]; B- complex, 0.012[3]; choline chloride, 0.06; trace mineral[3], 0.12; toxin binder, 0.2; antibiotic, 0.05.

[3]Supplies per kg diet: Vitamin A, 16,500 IU; vitamin D_3, 3200 ICU; vitamin E, 12 mg; vitamin K, 2 mg; vitamin B_1, 1.2 mg; vitamin B_2 10 mg; vitamin B_6, 2.4 mg; vitamin B_{12}, 12 mg; niacin, 18 mg; pantothenic acid, 12 mg; Mn, 90 mg; Zn, 72 mg; Fe, 60 mg; Cu, 10 mg; I, 1.2 mg.

Table 4. Dietary replacement of normal maize with Nityashree hybrid maize on body weight gain, feed intake and feed conversion ratio of broiler chicken

Diets	0–3 wks			0–6 wks		
(NM:NHM)	Body weight (g)	Feed intake (g)	Feed conversion ratio	Body weight g)	Feed intake (g)	Feed conversion ratio
D1 (100:0)	543	785	1.45	1364	2723	1.99
D2 (75:25)	578	790	1.36	1372	2787	2.03
D3 (50:50)	566	775	1.37	1374	2791	2.03
D4 (25:75)	574	807	1.40	1426	2892	2.02
D5 (0:100)	562	776	1.38	1340	2782	2.07
SEM	4.82	5.59	0.01	9.76	18.64	0.009
P-Value	0.176	0.826	0.298	0.083	0.953	0.133

Table 5. Dietary replacement of normal maize with Nityashree hybrid maize on serum biochemical profiles of broiler chicken

Diets (NM:NHM)	Protein (g/dl)	Ca (mg/dl)	P (mg/dl)	Total cholesterol (mg/dl)	HDL cholesterol (mg/dl)	Triglycerides (mg/dl)	ALP (IU/L)
D1 (100:0)	6.63	11.24	3.89	138.32	63.16	147.67	84.20
D2 (75:25)	6.89	9.71	3.90	154.25	66.24	138.92	70.44
D3 (50:50)	5.97	9.46	3.18	136.55	57.11	139.17	75.11
D4 (25:75)	6.87	10.85	3.62	156.65	78.05	142.67	85.78
D5 (0:100)	7.35	9.88	3.07	128.55	70.64	141.77	67.33
SEM	0.22	0.26	0.13	4.87	2.52	4.11	7.26
P-Value	0.428	0.155	0.117	0.302	0.090	0.969	0.917

Table 6. Dietary replacement of normal maize with Nityashree hybrid maize on carcass characteristics and immune response of broiler chickens

Diets (NM:NHM)	Dressed yield	Breast	Giblet	Fat	Bursa	Spleen	HI titre
D1 (100:0)	72.60	15.15	5.35^{c}	2.043	0.101	0.291	4.00
D2 (75:25)	72.63	15.24	6.06^{a}	1.393	0.063	0.266	3.25
D3 (50:50)	72.50	15.70	5.37^{bc}	1.516	0.083	0.206	4.50
D4 (25:75)	72.41	15.77	5.43^{bc}	1.550	0.090	0.196	4.62
D5 (0:100)	72.19	16.03	5.88^{ab}	1.715	0.094	0.202	4.00
SEM	0.249	0.212	0.087	0.098	0.007	0.014	0.190
P-Value	0.982	0.655	0.012	0.276	0.572	0.126	0.164

higher weight gain and feed efficiency of broiler chickens due to dietary replacement of NM with QPM. These variations noticed on the performance could be attributed to variation in nutrient composition among the QPM cultivars used in different studies.

The serum biochemical parameters measured in terms of protein, Ca, P, total and HDL cholesterol, triglycerides and activity of enzyme alkaline phosphatase was comparable between NM and NHM group (Table 5). None of the carcass attributes varied significantly by dietary replacement of NM with NHM either partially or completely except the giblet weight (Table 6). Though the relative giblet weight differs significantly between dietary groups no definite trend could be noticed. Bai (2002) also did not find any difference in carcass traits by dietary replacement of NM with quality protein maize.

The study thus revealed that the feeding value of Nityashree hybrid maize was comparable to that of normal maize for broiler chicken and could be substituted upto 100% level for normal maize. It may be concluded that the apparent metabolizable energy and feeding value of Nityashree hybrid maize for broiler chicks were similar to normal maize.

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