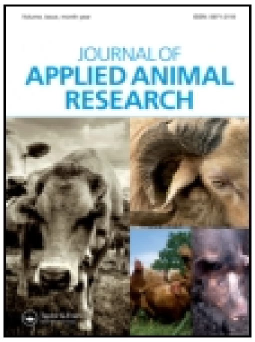

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Efficacy of quality protein maize in meeting energy and essential amino acid requirements in broiler chicken production

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Quality protein maize (QPM), with almost double lysine and tryptophan in protein, is no different from regular maize (RM) in terms of quantity of energy and protein. The objective of the study was to assess whether QPM can substitute RM as an efficient energy source as well as requirement of essential amino acids in poultry feed. Experiments were conducted to determine apparent metabolizable energy (AME), digestible amino acid values, and utilization pattern of QPM and RM in chickens. AME of QPM was similar to RM. Lysine and threonine digestibilities were significantly ($P \leq 0.05$) higher in QPM than RM. Dietary replacement of RM by QPM at 50% or higher level significantly improved the body-weight gain. The overall feed conversion ratio (0–40 days) improved significantly in QPM compared to RM at 50% replacement level or higher. Abdominal fat content decreased by 40% and breast meat yield increased by 4.91% by dietary replacement of RM with QPM at 100% level. The protein concentration in serum increased linearly by increasing the level of replacement of RM by QPM. Serum cholesterol decreased significantly in the dietary group where RM was replaced by QPM at 100% level. Neither dressed weight nor giblet weight was influenced by replacement of RM by QPM or supplementing lysine to RM-based diet. However, the breast weight increased and abdominal fat content decreased significantly where RM was replaced by QPM at 50% level or higher. Our findings clearly indicated that feeding value of QPM was higher than RM in broiler chickens.

Keywords: quality protein maize; energy; essential amino acids; broiler chicken; performance

1. Introduction

Modern breeds of broilers are continuously selected for faster growth. This has resulted in reducing the marketable age of broilers from 42 to 35 days. Broiler chicks, which weigh about 40–45 g at day 1, are growing to 2400–2600 g by 6 weeks of age. This puts a tremendous task to the nutritionist to formulate feed in such a way that it will exploit the genetic potential fully vis-a-vis optimizing the profitability. Feed being the most expensive input (65–70% of broiler production cost) deserves befitting attention in poultry production. Cereal grains are the main source of dietary energy, and maize is the principal energy source in poultry diets due to its high energy, low fiber, higher palatability, and presence of pigments and essential fatty acids. Although marginally lower in protein, due to higher levels of inclusion (50–70%), it contributes about one third of the protein requirement of the bird as well apart from energy needs. However, maize like other cereals is deficient in certain essential amino acids, particularly lysine and tryptophan. Mono-gastric animals, such as poultry, are not able to synthesize "essential" amino acids found in proteins, including lysine and tryptophan, and therefore must be acquired through diet. To meet the requirement of the essential amino acids poultry farmer and poultry feed producer use to supplement it through synthetic amino acids in poultry ration.

The need to enhance protein quality of maize through genetic selection has been recognized for a long time (Osborne & Mendel 1914). Breeding for improved protein quality in maize began in the mid-1960s 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, the two essential amino acids deficient in maize proteins. However, adverse pleiotropic effects imposed severe constraints on successful exploitation of these mutants. The search then continued for new mutants that could alter the amino acid profile of maize endosperm protein, which resulted in the development of quality protein maize (QPM). QPM has higher nutritional and biological value and is essentially interchangeable with RM in cultivation and kernel phenotype (Vasal 2000). It is no different from that of regular maize (RM) in terms of quantity of energy and protein, but differs in protein quality

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because it contains almost double amount of lysine and tryptophan in comparison to RM.

Several researchers demonstrated the superior protein quality and protein digestibility of QPM over RM (Graham et al. 1980; Paes & Bicudo 1995). The biological value of normal maize is 45% compared to that of QPM, which is 80% and only 37% of RM protein intake is utilized compared to 74% of the same amount of high-quality maize protein. Many studies have shown that in maize-based diets where QPM is substituted for RM, rates of gain are increased (Sullivan et al. 1989) or the requirements for supplementation with lysine-rich feed components such as fishmeal (Kemm et al. 1977) or soybean meal (Burgoon et al. 1992) decreased. The other nutritional benefits of QPM include higher niacin availability due to higher tryptophan and lower leucine content, higher calcium and carbohydrate (Graham et al. 1980) and carotene utilization (De Bosque et al. 1988). It has also been reported that QPM can be transformed into edible products without deterioration of its quality or acceptability and can be used in conventional and new food products.

Dietary requirements for protein in poultry are actually requirements for the amino acids contained in the dietary protein. Amino acids obtained from dietary protein are used by poultry to fulfill a diversity of functions. If dietary protein (amino acids) is inadequate, there is a reduction or cessation of growth or productivity and a withdrawal of protein from less vital body tissues to maintain the functions of more vital tissues (NRC 1994). Among the amino acids methionine, lysine, threonine, and tryptophan are the first four limiting amino acids in the order in maize-soybean-meal-based diet in poultry. So, these amino acids are usually supplemented in the practical poultry diets to meet the requirement of the birds. As the QPM is rich in lysine and tryptophan, it is assumed that the use of such quality maize in poultry diets will reduce the dependency on external amino acid supplementation and feed manufacturer can produce poultry feeds with no additional/minimal supplementation of crystalline amino acids. However, it is of paramount interest to determine the nutritional value of such feed ingredient before its exploitation as poultry feed ingredient. Only limited information is available with respect to the nutritional value of QPM in broiler chicken (Amonelo & Roxas 2008; Onimisi et al. 2009). Therefore, the present study was conducted to study the efficacy of QPM in replacing RM on growth and development of broiler chicken, and also on their serum biochemical indices and carcass characteristics.

2. Materials and methods

Two experiments were conducted to determine the apparent metabolizable energy (AME) and digestible amino acid values of QPM and RM in cockerels. The third experiment was conducted to evaluate the utilization of QPM in broiler chicken diet. The experimental procedures adopted were approved by the institute animal ethics committee.

2.1. *Experiment I*

2.1.1. *Apparent metabolizable energy assay*

The AME values of various maize cultivars (QPM and RM) were measured by the European reference method (Bourdillon et al. 1990). The experiment was conducted in a completely randomized design on 16 adult White Leghorn cockerels (28 weeks) of a single hatch having similar body weight. The cockerels were randomly divided into two groups of eight birds each and kept in individual wire-mesh cages (45 cm length × 30 cm width × 46 cm height) with the provision of individual feeding and excreta collection facility.

The maize varieties (RM and QPM) were analyzed for crude protein, ether extract, crude fiber, calcium, and total phosphorus content (AOAC 1995). During the initial 14-day adaptation period, the birds were maintained on a grower diet containing 18% protein and 2600 kcal ME/kg diet. Subsequently, each maize variety (QPM and RM) was fed at 97% with 3% vitamin and mineral premix to 8 White Leghorn cockerels for 3 days, 7 hours after 7-day adaptation period on the same diets. The total excreta collection method was used. Dry-matter intake of feed and total excreta voided were recorded and samples were analyzed for gross energy. The AME content was calculated as the difference between energy intake and energy voided. The AME_N values of the diets were calculated by the method of Hill and Anderson (1958).

2.2. *Experiment II*

2.2.1. *Apparent amino acid digestibility assay*

The experimental design, rearing of birds, and preliminary feeding were similar to that of experiment I. After the preliminary feeding, birds were trained for another 14 days to eat their daily feed allowance in 1 hour. After the adaptation period, the cockerels were divided into 2 groups of 8 each and were kept for fasting for 48 hours. Then, each maize cultivar (RM and QPM) was offered to one group for 1 hour (Farrell et al. 1978). The excreta voided were collected individually for the following 48 hours (at 12-hour intervals) and were dried, weighed, ground, and analyzed for its amino acid content. The amino acid concentrations of test ingredients and excreta samples were analyzed (Llames & Fontaine 1994). The samples were hydrolyzed with 6 N HCl at 110°C for 18 hours and were oxidized with performic acid prior to acid hydrolysis. Ninhydrin was used for color development. For tryptophan analysis, the samples were hydrolyzed with 2 N HCl with paradimethyl amino benzoldehyde as coloring agent. Apparent digestibilities of amino acids were calculated as the difference between amino acid intake and amino acid excreted.

2.3. Experiment III

2.3.1. Stock, diet, and husbandry

Three-hundred-day-old male broiler (Cobb) chicks were equally distributed into 6 treatment groups with 10 replicates of 5 chicks each and distributed in 60 battery brooder 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.

Six different diets were prepared. Diets 1–4 were formulated to meet all the nutrient requirements except lysine (Vencobb 400-VHL India). Diet 1 was control diet based on maize and soybean meal. In diets 2, 3, 4, and 5, QPM was replaced by RM at 25, 50, 75, and 100%, respectively. Diet 6 was same as control diet but supplemented with synthetic lysine to meet the requirement. The pre-starter (0–10 days), starter (11–21 days), and finisher (22–42 days) diets contained 2950, 3050, and 3150 ME kcal/kg and 22.5, 21, and 19.5% CP, respectively. Each diet was fed *ad lib* to one of the treatment groups during the experimental period of 1–40 days of age. The chicks were fed pre-starter, starter, and finisher diets from 1 to 10 days, 11 to 21 days, and 22 to 40 days, respectively (Table 1).

Table 1. Composition of basal pre-starter, starter, and finisher diets (Diet 1)[a].

Ingredients	Pre-starter (0–10 days)	Starter (11–21 days)	Finisher (22–40 days)
Normal maize	54.21	57.29	61.59
Soybean meal	39.29	35.38	31.25
Salt	0.45	0.45	0.45
Di-calcium phosphate	1.89	1.81	1.66
Shell grit	0.72	0.67	0.67
DL-methionine	0.22	0.21	0.19
AB2D3K[b]	0.015	0.015	0.015
B complex[b]	0.015	0.015	0.015
Choline chloride 50%	0.06	0.06	0.06
Mineral mixture[c]	0.12	0.12	0.12
Toxin binder	0.20	0.20	0.20
Antibiotic[d]	0.05	0.05	0.05
Coccidiostat[e]	0.05	0.05	0.05
Vegetable oil	2.71	3.68	3.68
Nutrient composition			
Metabolizable energy (kcal/kg)	2950	3050	3100
Crude protein (%)	22.5	21.0	19.5
Lysine (%)	1.25	1.14	1.04
Methionine (%)	0.55	0.52	0.48
Calcium (%)	0.90	0.85	0.80
Non-phytate phosphorus (%)	0.45	0.43	0.40

[a]In diets 2, 3, 4, and 5 RM was replaced by QPM at 25, 50, 75, and 100%, respectively. Diet 6 supplemented with lysine to maintain as per standard.
[b]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 µg; niacin, 18 mg; pantothenic acid, 12 mg.
[c]Mn, 90 mg; Zn, 72 mg; Fe, 60 mg; Cu, 10 mg; I, 1.2 mg.
[d]Furazolidone, 22.4% w/w.
[e]Coban™ (Monensin sodium, 10% w/w).

2.3.2. 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) and high-density lipoprotein (HDL) cholesterol, aspartate amino transferase (AST), and alanine amino transferase (ALT) were estimated using diagnostic kits (Randox Laboratories India Pvt. Ltd). On 41st 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 were recorded and expressed as% pre-slaughter live weight.

2.4. Statistical analysis

Data pertaining to the experiments were subjected to analyses of variance using one-way classification of completely randomized design (Snedecor & Cochran 1989). The means were tested for statistical significance using Duncan's multiple-range test (Duncan 1955). Significance was considered at $P \leq 0.05$.

3. Results

The proximate composition of RM was similar to QPM except protein (Table 2). The CP content of QPM was 8.61% higher than QPM. The lysine and tryptophan contents of QPM were 54 and 32% higher, respectively, compared to RM (Table 3),

Table 2. Chemical composition (g/kg) of dietary ingredients on dry-matter basis.

Ingredient	CP	EE	CF	TA	NFE	Ca	P
Normal maize	89.4	46.6	35.1	9.7	819.2	2.2	2.8
QPM	97.1	48.7	30.3	10.2	813.7	1.8	3.2
Soybean meal	484.0	22.0	69.4	76.2	349.4	4.4	9.6
Di-calcium phosphate	–	–	–	–	–	234.2	176.3
Shell grit	–	–	–	–	–	348.2	–

CP, crude protein; EE, ether extract; CF, crude fiber; TA, total ash; NFE, nitrogen-free extract; Ca, calcium; P, phosphorus.

whereas leucine content was 20% lower and valine content was 31% higher in QPM than RM. The AME of QPM was similar to RM (Table 4). Lysine and threonine digestibilities were significantly ($P \leq 0.05$) higher in QPM compared to RM. No difference in the digestibilities of other amino acids was found between the two types of maize grains.

Lowest body-weight gain was found in the broiler chicks fed RM-based diet at 21 days. However, dietary replacement of RM with QPM at 25% level significantly improved the weight gain during 0–21 days (Table 5). No further improvement in body-weight gain could be noticed beyond 25% replacement of RM with QPM. Neither feed consumption nor feed conversion ratio was influenced by the replacement of RM by QPM during initial 21 days of age. The lowest body-weight gain was recorded in RM-based diet on 40 days. Replacement of RM by QPM at 25% level significantly increased the body-weight gain compared to RM-based diet. However, at

Table 3. Amino acid content in normal and QPM (analyzed value).

	Normal maize (g/kg)		QPM (g/kg)	
Amino acid	Content[a]	AA in CP	Content[a]	AA in CP
Methionine	1.72	19.9	1.83	18.1
Cystine	1.84	21.3	2.72	27.7
Methionine + Cystine	3.53	41.2	4.54	45.8
Lysine	2.54	28.9	3.92	39.5
Threonine	2.96	34.5	3.64	36.5
Tryptophan	0.62	7.3	0.82	9.04
Arginine	3.94	45.3	6.32	63.8
Isoleucine	2.81	32.8	3.07	30.6
Leucine	10.41	122.2	8.76	88.1
Valine	3.94	45.9	5.14	51.2
Histidine	2.42	28.5	3.73	37.4
Phenylalanine	4.23	49.4	4.17	40.9

[a]Figures standardized to a dry-matter content of 880 g/kg.
AA, amino acid; CP, crude protein.

Table 4. Nitrogen-corrected apparent metabolizable energy (AME_N) (MJ/kg) and amino acid digestibility values of NM and QPM in cockerels.

Nutrients	Normal maize	QPM	SEM	*P* value
AME	13.91	14.05	0.21	0.940
Threonine	63.72[b]	68.48[a]	0.32	0.003
Cystine	70.26	73.24	1.51	0.854
Valine	69.24	69.98	0.41	0.948
Methionine	66.71	66.40	0.60	0.874
Isoleucine	74.12	72.02	1.02	0.592
Leucine	83.51	82.15	0.52	0.768
Phenyl alanine	78.14	77.92	0.42	0.853
Lysine	72.04[b]	75.36[a]	0.23	0.006
Arginine	79.45	82.48	0.72	0.324
Histidine	71.24	72.51	0.48	0.698
Tryptophan	73.90	74.27	0.19	0.872

Note: Means with different superscripts in a row differ significantly.

50% level of replacement of RM by QPM, further improvement in body-weight gain was noticed and no added advantage thereafter. Supplementing synthetic lysine (Lys) to the RM-based diet improved the body weight compared to the RM-based diet without Lys supplementation; however, the improvement was marginal. The feed consumption was significantly higher in all the diets where RM was replaced with QPM at 50% level or higher. No improvement in feed conversion ratio was observed by either replacement of RM by QPM at 25% level or supplementing Lys to RM-based diet. But, the feed conversion ratio improved significantly in the diets in which RM was replaced by QPM at 50 or 100% level.

The protein concentration in serum increased linearly by increasing the level of replacement of RM by QPM (Table 6). Highest concentration of protein in the serum was found in the dietary group where RM was completely replaced by QPM. The activities of enzymes such as AST and ALT were not influenced by the dietary replacement of RM by QPM or supplementing lysine to RM-based diet. The concentration of cholesterol in serum was not influenced by dietary replacement of RM by QPM up to 75% level. However, serum cholesterol decreased significantly in the dietary group where RM was replaced by QPM at 100% level compared to all other dietary groups. The concentration of HDL cholesterol was significantly higher in diets where RM was replaced by QPM at 50 or 100% level compared to RM-based diet.

The carcass traits such as dressed weight and giblet weight were not influenced by the replacement of RM by QPM or supplementing Lys to RM-based diet (Table 7). The abdominal fat content lowered significantly by dietary replacement of RM by QPM at 50% level or higher compared to RM-based diet or

Table 5. Effect of dietary replacement of RM with QPM on performance of broiler chickens.

	0–21 days			0–40 days		
Treatment	Body-weight gain	Food consumption	Feed conversion ratio	Body-weight gain	Food consumption	Feed conversion ratio
RM (100)	584[b]	752	1.29	1865[c]	3096[b]	1.66[a]
RM (75) + QPM (25)	638[a]	793	1.26	1987[b]	3180[ab]	1.60[ab]
RM (50) + QPM (50)	639[a]	795	1.24	2061[a]	3256[a]	1.58[b]
RM (25) + QPM (75)	648[a]	817	1.25	2045[a]	3292[a]	1.61[ab]
QPM (100)	636[a]	815	1.29	2055[a]	3247[a]	1.58[b]
RM (100) + lysine	644[a]	820	1.27	2023[ab]	3257[a]	1.60[ab]
SEM	5.61	10.88	0.01	10.27	27.34	0.01
P value	0.003	0.333	0.714	0.001	0.043	0.05

Note: Means with different superscripts in a column differ significantly.

25% replacement of RM by QPM. The abdominal fat content was intermediate in the RM-based diet supplemented with synthetic Lys. However, the breast weight was influenced significantly in the diet where RM was replaced by QPM at 50% level or higher. Though breast meat yield was increased by dietary replacement of NM by QPM at 25% level or supplementing synthetic Lys to RM-based diet, the improvement was not significant. But, the breast meat yield increased significantly by dietary replacement of RM by QPM at 50% level or higher.

4. Discussion

The findings of the study revealed that protein, lysine, and tryptophan contents of QPM were 8.61, 54, and 32% higher than RM, respectively. Several other researchers have also reported higher protein quality of QPM over RM (Paes & Bicudo 1995; Osei et al. 1999; Onimisi et al. 2009). It has been reported that some unintended compositional changes occur besides lysine and tryptophan in QPM (Prasanna et al. 2001). In the QPM sample received by us, some other amino acids such as histidine, arginine, and threonine increased, while a decline was observed for leucine. Decrease in leucine is desirable as it makes leucine–isoleucine ratio more balanced, which in turn helps to liberate more tryptophan for niacin biosynthesis. The AME content of QPM and RM was similar and the values obtained were within the range as reported by other workers (Osei et al. 1999; Tyagi et al. 2008). The digestibility of amino acids such as lysine and threonine was significantly higher in QPM compared to RM. Concomitant to the findings of the present study, Bai (2002) reported higher digestibility of lysine (77.85%) in QPM compared to RM (74.20%).

In the present study RM was replaced by QPM at graded levels to evaluate the beneficial effect of QPM, if any, on the performance of the bird. It was observed that dietary replacement of RM with QPM at 50% or higher improved the performance (both weight gain and FCR), breast meat yield, and serum biochemical profiles (protein and HDL cholesterol), and reduced the abdominal fat content and serum cholesterol. It was also seen that dietary inclusion of QPM at $\geq$50% level in the diet was

Table 6. Effect of dietary replacement of RM with QPM on serum biochemical parameters of broiler chicken.

Treatment	Protein (g/dl)	AST (IU/l)	ALT (IU/l)	Total cholesterol (mg/dl)	HDL cholesterol (mg/dl)
RM (100)	3.26[c]	76.76	53.21	220.2[a]	89.6[b]
RM (75) + QPM (25)	3.42[bc]	77.56	53.20	204.2[a]	102.3[ab]
RM (50) + QPM (50)	3.59[ab]	75.84	51.91	209.5[a]	107.6[a]
RM (25) + QPM (75)	3.58[ab]	74.12	51.45	205.3[a]	103.6[ab]
QPM (100)	3.73[a]	77.28	52.96	177.8[b]	111.3[a]
RM (100) + lysine	3.59[ab]	74.92	52.45	208.9[a]	104.8[ab]
SEM	0.04	0.59	0.42	4.9	2.68
P value	0.002	0.748	0.612	0.001	0.504

Note: Means with different superscripts in a column differ significantly.
AST, aspartate amino transferase; ALT, alanine amino transferase; HDL, high density lipoprotein.

Table 7. Effect of dietary replacement of RM with QPM on carcass traits (% live weight) of broiler chickens.

Treatment	Dressed yield	Giblet	Abdominal fat	Breast
RM (100)	75.82	4.22	1.92[a]	18.44[b]
RM (75) + QPM (25)	75.29	4.16	1.77[a]	18.87[ab]
RM (50) + QPM (50)	75.83	4.05	1.19[b]	19.44[a]
RM (25) + QPM (75)	75.67	4.12	1.17[b]	19.49[a]
QPM (100)	75.39	4.05	1.15[b]	19.35[a]
RM + lysine	75.24	4.20	1.48[ab]	18.91[ab]
SEM	0.26	0.05	0.11	0.12
P value	0.524	0.845	0.054	0.051

Note: Means with different superscripts in a column differ significantly.
RM, regular maize; QPM, quality protein maize.

found to be superior than RM-based diet supplemented with lysine to meet the requirement. Similar to the findings of the present study, Bai (2002) and Onimisi et al. (2009) reported significantly higher weight gain and feed efficiency of broiler chickens due to dietary replacement of RM with QPM. Contrary, Tyagi et al. (2008) did not find any significant difference on body-weight gain, feed conversion, and nutrient utilization efficiencies by feeding QPM diet to broiler chickens. These variations noticed on the performance could be attributed to variation in nutrient composition amongst the QPM cultivars used in different studies. These variations noticed on the performance could be attributed to the compositional changes in the QPM used by the various workers. It is worthy to mention here that the QPM that was used in this study contained not only higher protein but also higher amino acids such as lysine and tryptophan. It is well known that lysine is crucial in protein synthesis for growth of tissues. Lysine is also involved in the cross-linking process of bone collagen and in the biosynthesis of carnitine and elastin (Civitelli et al. 1992; Flodin 1997). Similarly, tryptophan is an essential amino acid and the biological precursor of the B-vitamin, niacin. It is further reported that biological value of normal maize protein is 45% compared to 80% in high-lysine maize (Graham et al. 1980). Our data (unpublished) on nutrient digestibility indicated higher digestibility of crude protein and calcium in QPM-based diet compared to RM-based diet. Further, the data on amino acid digestibility mentioned above showed higher apparent digestibility values of essential amino acids like lysine and threonine. Thus, the improved performance noticed in the present study could be attributed not only to higher amino acid content but higher bioavailability resulting in higher performance of QPM group (Onimisi et al. 2009).

One important observation of the present study was that dietary replacement of RM by QPM at 50% level produced similar result to that of complete replacement (100% QPM). Further, diets incorporated with QPM at all the levels of replacement were not supplemented with synthetic lysine. Dietary replacement of RM by QPM at 25% level did not elicit optimum performance probably due to lower level of lysine contributed by the diet than the required one. However, when replaced at 50% or higher level, it resulted in comparable performance/better performance as that of RM-based diet supplemented with synthetic lysine. It is noteworthy to point out here that besides lysine some other factors present in QPM might be responsible for producing the desired performance. Besides dietary nutrient composition, its availability is crucial for regulation of muscle metabolism and development in the body which in turn influence growth (Grizard et al. 1995). Lysine is known to be the first critical and limiting amino acid in maize and second limiting amino acid in broiler chicken diet based on maize soybean meal. Lysine is crucial in protein synthesis for growth of tissues and also important in the absorption of calcium from the intestinal mucosa (Civitelli et al. 1992) and involved in the cross-linking process of bone collagen and in the biosynthesis of carnitine and elastin (Flodin 1997). The higher levels of leucine and isoleucine in normal maize are known to interfere in protein synthesis (Onimisi et al. 2009). QPM had less leucine and isoleucine than normal maize, which reduces the preponderance of leucine. The lower ratio of leucine to isoleucine observed in QPM may also have contributed to the better performance observed in the QPM diet. Dietary lysine concentrations have a large influence on breast muscle development (Kerr et al. 1999). It has been reported that low-lysine diet not only leads to poor performance but also reduces breast muscle yield (Kidd 2004; Bastianelli et al. 2007). This could be the reason that higher breast meat yield was observed in the dietary group where QPM was replaced with RM at 50% or higher level.

5. Conclusions

In the present study majority of the parameters (body-weight gain, feed conversion ratio, serum protein concentration, and breast meat yield) improved by dietary replacement of RM by QPM at 50% level or higher. Thus, it is concluded that feeding value of QPM was higher than RM in broiler chickens.

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