



# Nutritional Evaluation of Quality Protein Maize (QPM) Hybrid Cultivars for Broiler Chickens

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## Abstract

The study evaluated nutritional values of newly developed quality protein maize (QPM) hybrid cultivars (SQM 6172 and SQM 6192) for broilers. Proximate and amino acid composition of test maize, together with digestibility were determined. Responses of broilers to least-cost formulated QPM based diets (SQM 6172-based=QPM1 and SQM 6192-based=QPM2) in terms of production performance, carcass yield and economics of feeding were evaluated with reference to normal maize (NM). SQM 6172 and SQM 6192 had higher total essential amino acids compared to NM. Broilers fed QPM1 and QPM2 had economic advantage in terms of feed cost. Carcass yield of birds fed QPM hybrids was higher than NM. In formulating diets using QPM hybrids, influence of protein supplement and shelf-life must be considered to further qualify the nutritional and feeding values.

**Keywords:** broilers, least-cost diet, quality protein maize

## Introduction

Maize is one of the most important ingredients in poultry and swine diets. Considered as the “king” of cereals among feed ingredients, it is an excellent source of energy. On the other hand, the use of maize in monogastric diets is limited by the protein and amino acid content. In order to improve the amount of protein and amino acid in maize, researchers developed quality protein maize (QPM).

The value of QPM is mainly focused on its excellent amino acids profile. QPM populations developed by the International Maize and Wheat Improvement Center (Laude, 2007) have shown its adaptability in the country. Genes from these varieties have been

used by Institute of Plant Breeding (IPB) to develop feed grade yellow QPM.

Report indicates that yellow QPM open-pollinated cultivar developed by the IPB has potential as feedstuff for poultry and swine (Martin et al., 2012). Amino acids in QPM are more compared to normal maize (NM). Hence, inclusion of QPM in the diet reduces the amount of protein supplement and cost of diet. Feeding least-cost QPM-based diets support generally comparable production performance with feeding NM-based diets but generate higher net economic benefit.

The present challenge is having QPM cultivars with yield comparable to or higher

than normal maize. Theoretically, economic premiums from QPM utilization for normal feeding would be realized under such circumstances. The QPM used in the above mentioned report and that was planted in CLSU yields 4.0 tons per hectare (Salazar, 2010; personal communication).

QPM production can be enhanced through selection of superior lines and improved agronomic practices such as fertilization and planting density. Magulama and Sales (2010) reported that some QPM cultivars can compete in terms of yield with NM varieties but stressed that intensive testing is needed to determine their stability under different locations. It must be pointed out that cultivar (Pixley and Bjarnason, 2001) and agronomic practices (Worku *et al.*, 2007) influence nutritional content of QPM. Being the case,

screened QPM cultivars should be analyzed in terms of their proximate, amino acids and energy contents. More importantly, response to QPM-based diets in terms of production, product quality and economics of using QPM hybrid cultivars in the diet should be assessed.

It is in the abovementioned premises that the research project was undertaken, in support of the development of QPM hybrid cultivars for animal feeding. Its general objective was to assess the nutritional and feeding values of QPM hybrids for broilers. Specifically, it determined the nutritional profile of test maize and evaluated the effects of QPM hybrid-based diets on production performance, carcass yield and economics of feeding such diets compared to normal maize (NM)

## Materials and Methods

Test maize proximate analysis, amino acid and energy contents. QPM hybrid cultivars were grown in the experimental farm of CLSU using QPM hybrid varieties' seeds obtained from the University of Southern Mindanao. NM was procured from a local agricultural store. Representative samples of 500 g each of NM and QPM hybrids (SQM 6172 and SQM 6192) were sent for proximate analysis at the LQCC in Bocaue, Bulacan. The same amount of sample was sent to the Pacific Laboratory Services in Singapore for amino acid analysis through Near Infrared Reflectance (NIR) method.

The protocol for animal use in the study was reviewed and approved by the Institutional Animal Care and Use Committee (IACUC) of the Central Luzon State University with IACUC number 20170215-03.

Metabolizable energy of the test maize in poultry was determined according to the method of Sibbald (1976). This was carried out using 16 cockerels (12 weeks old) with an average body weight of 1.00 kg. In addition, four cockerels were kept unfed which were used to estimate endogenous energy excretion. Each bird was kept in an individual cage (open-sided poultry house) with a feeder and waterer. Twelve cockerels were randomly assigned each for QPM1, QPM2 and NM. After acclimatization in the experimental area, the birds were fasted for 48 hr. Following this, the birds were individually force fed with 50 g finely ground test maize. Excreta were

quantitatively collected for 48 hr after forced feeding and dried in an oven at 80 °C for three days. After allowing it to equilibrate with atmospheric temperature and humidity, the excreta were weighed and ground and kept in an air-tight container at room temperature until analysis. The test maize and excreta samples were sent for gross energy analysis at the Animal Nutrition Analytical Service Laboratory, Animal Nutrition Division, Animal and Dairy Sciences Cluster, University of the Philippines, Los Baños, Laguna.

The apparent (AME) and true metabolizable energy (TME) of the maize were calculated, respectively, using the formula of Sibbald (1976) as follows:

$$AME = \frac{(GE_f \times F_i) - Y_f}{F_i}$$

$$TME = \frac{(GE_f \times F_i) - (Y_f - Y_e)}{F_i}$$

Where: GE<sub>f</sub> is the gross energy of the feedstuff (kcal/g);  
F<sub>i</sub> is the feed input (g);  
Y<sub>f</sub> is the energy excreted by the fed bird;  
and  
Y<sub>e</sub> is the energy excreted by the unfed bird

Formulation of diets and feeding trial. Broiler diets with QPM hybrids or NM (Table 1, Table 2 and Table 3) were least-cost

formulated using UFFDA (Pesti and Miller, 1993) to contain the same amounts of nutrients based on the high density diet recommended by PHILSAN (2003). The matrix values for nutrient content of test maize were based on the results of analyses. For the other

ingredients, values from PHILSAN (2003) were used. QPM hybrids and NM were assigned the same unit price. The diets were prepared bi-weekly to ensure freshness using an electrically operated feed mixer.

**Table 1.** Composition, calculated nutrient content and pertinent cost items of broiler diets with normal maize (NM), SQM6172 (QPM1) and SQM6192 (QPM2) based booster diets

Ingredient	NM	QPM1	QPM2
	-----%-----		
Normal Maize	59.40		
SQM 6172		61.28	
SQM 6192			62.03
Rice bran (D1)	3.00	3.00	3.00
Palm oil	2.44	1.15	0.89
Soybean meal (US)	26.83	26.16	25.61
Poultry by-product meal	5.00	5.00	5.00
Limestone (Fine)	1.09	1.19	1.19
Monocalcium phosphate	1.21	1.21	1.24
Salt	0.25	0.25	0.25
DL- methionine	0.20	0.19	0.19
Lysine HCl	0.12	0.11	0.13
Threonine	0.06	0.06	0.07
Poultry vitamin premix <sup>1</sup>	0.03	0.03	0.03
Poultry trace mineral premix <sup>2</sup>	0.15	0.15	0.15
Choline Chloride	0.10	0.10	0.10
Antioxidant	0.02	0.02	0.02
Toxin Binder (HSCAS)	0.10	0.10	0.10
TOTAL	100.00	100.00	100.00
Calculated analysis ('as is basis') <sup>3</sup>			
A.M.E., kcal/kg	3100.00	3100.00	3100.00
Crude fat (%)	5.90	4.74	4.42
Crude fiber (%)	2.39	2.25	2.46
Calcium (%)	1.00	1.00	1.00
Available phosphorus (%)	0.50	0.50	0.50
Crude protein (%)	21.00	21.00	21.00
Lysine (%)	1.12	1.12	1.12
Methionine (%)	0.50	0.50	0.50
Methionine + Cystine (%)	0.81	0.81	0.81
Threonine (%)	0.73	0.73	0.73
Tryptophan (%)	0.22	0.22	0.22
Cost/kg <sup>4</sup> , Php	21.60	21.12	21.06
Shadow price, Php		14.08	14.90
Marginal price change for use, Php		0.92	0.10

<sup>1</sup>Each kilogram contains: 45,000,000 IU vit. A; 9,000,000 IU vit. D<sub>3</sub>; 200,000 g vit. E; 15,000 g vit. K<sub>3</sub>; 150,000 g niacin; 9,000 g vit. B<sub>1</sub>; 30,000 g vit. B<sub>2</sub>; 19,000 g vit. B<sub>6</sub>; 0.15 g vit. B<sub>12</sub>; 81,522 g vit B<sub>5</sub>; 8000 g vit B<sub>9</sub> and vit. H<sub>2</sub>.

<sup>2</sup>Each kilogram contains: 8.33 g copper, 0.998 g iodine, 66.672 g iron, 33.334 g manganese, 0.202 g selenium, 83.34 g zinc, and 0.33 g cobalt.

<sup>3</sup>Calculated analysis was based on book values from PHILSAN (2010)

<sup>4</sup>Price per kilogram of ingredients, in Php, used were: Normal maize – 15.00, quality protein maize variety 1 – 15.00, quality protein maize variety 1 – 15.00, rice bran (D1) – 12.00, coconut oil – 56.00, soybean meal (Argentina) – 23.00, limestone (fine) – 2.00, limestone (coarse) – 2.00, monocalcium phosphate – 40.00, DL-methionine – 500.00, salt – 6.00, vitamin premix – 730.00, mineral premix- 90.00, choline chloride – 60.00, ethoxyquin – 250.00, and toxin binder – 150.00.

**Table 2.** Composition, calculated nutrient content and pertinent cost items of broiler diets with normal maize (NM), SQM1672 (QPM1) and SQM6192 (QPM2) based starter diets

Ingredient	NM	QPM1	QPM2
	-----%-----		
Normal Maize	52.82		
SQM 6172		54.49	
SQM 6192			54.47
Rice bran (D1)	8.00	8.00	8.00
Palm oil	4.14	3.00	3.00
Soybean meal (US)	29.55	28.95	28.97
Poultry by-product meal	2.00	2.00	2.00
Limestone (Fine)	1.32	1.41	1.41
Monocalcium phosphate	1.19	1.19	1.19
Salt	0.30	0.30	0.30
DL- methionine	0.18	0.17	0.17
Lysine HCl	0.05	0.05	0.04
Threonine	0.05	0.05	0.05
Poultry vitamin premix <sup>1</sup>	0.03	0.03	0.03
Poultry trace mineral premix <sup>2</sup>	0.15	0.15	0.15
Choline Chloride	0.10	0.10	0.10
Antioxidant	0.02	0.02	0.02
Toxin Binder (HSCAS)	0.10	0.10	0.10
TOTAL	100.00	100.00	100.00
Calculated analysis ('as is basis') <sup>3</sup>			
A.M.E., kcal/kg	3100.00	3100.00	3100.00
Crude fat (%)	7.72	6.68	6.69
Crude fiber (%)	2.54	2.42	2.42
Calcium (%)	1.00	1.00	1.00
Available phosphorus (%)	0.44	0.44	0.44
Crude protein (%)	20.36	20.36	20.36
Lysine (%)	1.02	1.02	1.02
Methionine (%)	0.47	0.47	0.47
Methionine + Cystine (%)	0.76	0.76	0.76
Threonine (%)	0.69	0.69	0.69
Tryptophan (%)	0.22	0.22	0.22
Cost/kg <sup>4</sup> , Php	20.76	20.33	20.34
Shadow price, Php		14.99	14.99
Marginal price change for use, Php		0.01	0.01

<sup>1</sup>Refer to Table 1<sup>2</sup>Refer to Table 1<sup>3</sup>Refer to Table 1<sup>4</sup>Refer to Table 1

The feeding trial consisted of 108 Cobb broilers (3 days old) grown in the Contract Broiler Project of CLSU. Broilers were randomly assigned to treatments following a Completely Randomized Design. Each diet had three replications of 12 birds per replication. Birds were raised in open-sided conventional houses provided with wood plank divisions to separate treatment replicates. Feeding period for booster, starter and finisher diets were 1-14 days, 15-26 days and 27-33 days, respectively. Diets were offered in mash form. Care and management of broilers were in accordance

with the farm practices of CLSU Contract Broiler Project.

Gathering of data. Production performance of broilers in terms of mean body weight, feed intake, feed conversion ratio (FCR) and livability were determined for 33 days. The mean daily feed consumption was determined by dividing the balance of the feed allotment and feed left over in a given period by the number of bird-days in the same period. Feed intake for each period was computed by multiplying the respective values with the number of days within the period. The FCR was

obtained by dividing the mean feed consumed by the gain in weight for the same period.

At 33 days old, two sample birds from each sex and replication were randomly taken for carcass yield evaluation. Weight of the

birds was taken about five hours after feed withdrawal. Then the birds were bled, de-feathered, and eviscerated to separate carcass from the offal.

**Table 3.** Composition, calculated nutrient content and pertinent cost items of broiler diets with normal maize (NM), SQM1672 (QPM1) and SQM6192 (QPM2) based finisher diets

Ingredient	NM	QPM1	QPM2
	-----%-----		
Normal Maize	53.14		
SQM 6172		54.94	
SQM 6192			54.37
Rice bran (D1)	15.00	15.00	15.00
Palm oil	4.27	3.50	3.93
Soybean meal (US)	23.82	22.76	22.90
Poultry by-product meal			
Limestone (Fine)	1.16	1.18	1.19
Monocalcium phosphate	1.52	1.50	1.50
Salt	0.30	0.30	0.30
DL- methionine	0.19	0.19	0.19
Lysine HCl	0.12	0.13	0.13
Threonine	0.09	0.10	0.10
Poultry vitamin premix <sup>1</sup>	0.03	0.03	0.03
Poultry trace mineral premix <sup>2</sup>	0.15	0.15	0.15
Choline Chloride	0.10	0.10	0.10
Antioxidant	0.02	0.02	0.02
Toxin Binder (HSCAS)	0.10	0.10	0.10
TOTAL	100.01	100.00	100.01
Calculated analysis ('as is basis') <sup>4</sup>			
A.M.E., kcal/kg	3100.00	3100.00	3100.00
Crude fat (%)	8.56	7.87	8.27
Crude fiber (%)	2.19	2.22	2.22
Calcium (%)	0.87	0.87	0.87
Available phosphorus (%)	0.44	0.44	0.44
Crude protein (%)	17.20	17.20	17.20
Lysine (%)	0.88	0.88	0.88
Methionine (%)	0.44	0.44	0.44
Methionine + Cystine (%)	0.69	0.69	0.69
Threonine (%)	0.62	0.62	0.62
Tryptophan (%)	0.18	0.18	0.18
Cost/kg <sup>4</sup> , Php	19.38	19.06	19.20
Shadow price, Php		14.40	14.75
Marginal price change for use, Php		0.60	0.25

<sup>1</sup>Refer to Table 1

<sup>2</sup>Refer to Table 1

<sup>3</sup>Refer to Table 1

<sup>4</sup>Refer to Table 1

The dressing percentage was obtained by dividing the carcass weight (including the giblet) by the live weight of the birds then multiplied by 100. The relative weights of abdominal fat, legs, thigh, back, breast and wings were obtained by dividing

the weights of these cut up parts by the dressed weight of the birds.

The economic benefit of using QPM hybrid cultivars was assessed using income over feed cost. This was determined as the difference of sale value per bird and mean total cost of feed per bird. Sale value was

computed as mean final weight multiplied by the prevailing price per kg liveweight. Cost of feed consumed was calculated as the mean

total feed consumed for each kind of diet multiplied by the respective price of each diet.

## Result and Discussion

Proximate, calcium, phosphorus and metabolizable energy contents of quality protein maize cultivars. Table 4 presents the proximate composition, calcium, phosphorus and calculated apparent metabolizable energy

content of the maize cultivars. Compared to NM, both QPM cultivars had higher crude protein content than NM. The amount of other nutrients and energy were generally comparable among the maize cultivars.

**Table 4.** Proximate composition, apparent metabolizable energy (AME), Calcium (Ca) and Phosphorus (P) analyzed by PNE Adisseo NIR Service and Lipa Quality Control Center (in parenthesis) of test maize

Parameter	NM	SQM 6172	SQM 6192
Dry matter, %	90.87(89.87)	92.55(91.60)	91.68(91.60)
Ash, %	1.48(1.55)	1.23(42)	1.35(1.35)
Crude protein, %	8.50(9.36)	8.97(9.32)	9.75(9.56)
Crude fiber, %	2.34(2.01)	2.40(2.55)	2.05(1.55)
Crude fat, %	4.06(4.45)	3.92(5.28)	4.12(4.98)
Nitrogen free extract, %	83.61(82.03)	83.48(81.42)	83.73(82.55)
AME, kcal/kg	3563.33	3653.16	3705.28
AMEn, kcal/kg	3454.39	3537.55	3588.57
AME, Poultry, kcal/kg	(3744.30)	(3787.12)	(3775.11)
Calcium, %	(0.17)	(0.16)	(0.11)
Total P, %	0.38	0.32	0.35
Phytic acid	0.28	0.23	0.25
Available P, poultry, %	0.10	0.09	0.10

The amount of protein is a primary interest in the QPM cultivars. The amount of protein in both QPM cultivars was higher than that in NM. The values though, irrespective of the maize cultivars, were not atypical for values from various literatures. For QPM, crude protein content of 10.53% (Amonelo and Domingo, 2008) and 12.19% (Martin *et al.*, 2012) of DM was obtained for a cultivar developed by the IPB at UPLB. Crude protein content of parent lines of SQM 6192 and SQM 6172 grown at the University of Southern Mindanao was 8.32% and 9.03%, as is basis, respectively (Magulama, 2015). The values obtained in the present work showed that SQM 6192 (9.56%) had greater crude protein content than SQM 6172 (9.32%) which is the opposite of what was obtained in the University of Southern Mindanao. Location may affect metabolizable energy and proximate composition, such as

crude protein content, in hybrid maize (Alamu *et al.*, 2022). Differences in management practices such as fertilization may also affect crude protein content of maize hybrids (Li *et al.*, 2010).

Higher dry matter content was obtained from QPM hybrid cultivars compared to NM for samples used especially in the on-farm trial. The observed comparable amount of energy among the maize cultivars is consistent with earlier reports on the nutritional contents of QPM (Martin *et al.*, 2012; Zhai and Zhang, 2007; and Burgoon *et al.*, 1992).

Digestible amino acids in quality protein maize cultivars. The amount of digestible amino acids for poultry is presented in Table 5. The amount of most amino acids, including lysine and tryptophan, was nearly comparable for both QPM cultivars and were higher than that for NM

**Table 5.** Digestible amino acid content of the quality protein maize cultivars for poultry

Amino Acid	NM	SMQ 6172	SQM 6192
	-----%-----		
Lysine	0.19	0.22	0.23
Methionine	0.16	0.17	0.18
Cystine	0.17	0.18	0.18
Threonine	0.33	0.35	0.35
Tryptophan	0.21	0.21	0.22
Valine	0.07	0.07	0.07
Isoleucine	0.37	0.38	0.37
Leucine	0.24	0.23	0.23
Phenylalanine	0.83	1.04	0.96
Histidine	0.39	0.42	0.40
Arginine	0.22	0.22	0.21

Data showed that SQM 6172 and SQM 6192 possess the important attributes of quality protein maize. Foremost characteristic of the QPM hybrids is the high amount of crude protein and amino acids, specifically lysine and phenylalanine. However, the levels of these nutrients in the hybrid cultivars only approximate the values obtained from QPM developed by the IPB in an earlier research work (Martin, 2012). The amount of protein and thus the amino acids is affected by soil fertility (Worku *et al.*, 2007). It was unclear how this could have influenced the low amount of these nutrients in the present work. The AME in for poultry and swine of the test maize were comparable with the 3,300 kcal/kg for NM

(local) from PHILSAN (2010). However, the AME for swine was lower than the 3,350 kcal/kg from the same reference (PHILSAN, 2010).

Caloric value of QPM hybrid cultivars.  
The GE and metabolizability of QPM hybrid varieties (SQM 6172 and SQM 6192) and NM using different determination methods are shown in Table 6. The GE value of QPM was slightly higher than that of NM based on Atwater's Physiological Value and bomb calorimetry. Likewise, the calculated amount of AME for both swine and poultry were slightly higher in QPM than in the NM. The same trend was noted in the determined AME and TME in poultry.

**Table 6.** Gross energy, energy metabolizability and dry matter digestibility of quality protein maize hybrid varieties SQM 6172 (QPM1) and SQM 6192 (QPM2) and normal maize (NM) used ('as is basis')

Parameters	NM	SQM 6172	SQM 6192	P-value
Gross energy				
Bomb calorimetry, kcal/kg	3837.00	3792.00	3784.00	0.424
Atwater's Physiological value, kcal/kg	4102.00	4172.00	4117.00	-----
Poultry				
AME, kcal/kg	2891.00 <sup>**</sup>	2789.00 <sup>**</sup>	2761.00 <sup>**</sup>	0.620
TME, kcal/kg	3448.00 <sup>**</sup>	3346.00 <sup>**</sup>	3318.00 <sup>**</sup>	0.620
DMD, %	92.91	89.92	89.34	0.549

AME - Apparent metabolizable energy

TME - True metabolizable energy

DMD - Dry matter digestibility

<sup>\*\*</sup>Determined value following method of Sibald (1976)

The data indicated comparable GE and energy metabolizability for QPM varieties and NM. On the other hand, the study and Celestino *et al.* (2012) reported a slightly higher value for QPM. This appeared to be related to the higher

amount of crude fat in the former than in the latter as noted earlier by Sullivan *et al.* (1989). Study of Zhai and Zhang (2007) showed that GE and metabolizability of energy of QPM was not statistically different with NM,

which conformed to the results of the present study. Moreover, digestibility of the QPM hybrids did not differ statistically with that of NM. This result is similar to the findings of Celestino et al. (2012).

Production Performance of broilers fed quality. Broilers fed QPM hybrids and NM showed no difference in their performance parameters as shown in Table 7. Numerically lower feed intake of birds fed with QPM1 somehow indicated that SQM 6172 had better nutritional quality than NM because other parameters were not adversely affected by the lower feed intake. As mentioned earlier, the high digestibility of amino acids in QPM could have been the factor for the improved performance of the young broilers. However, this effect was not consistently demonstrated in the study. There was no difference noted between the performance of broilers fed with QPM hybrid cultivars and NM based diets. This result can be associated with the isonutrient formulation of the diets regardless of the test maize used.

Similar findings in support of better feed consumption of broilers fed QPM based diets were reported. Amonelo and Roxas (2007) showed that broilers fed with QPM based diet had body weight gain comparable to those in the NM based diet, of the same nutrient density. However, the birds fed with QPM based diet consumed less feed resulting in lower FCR than those fed with NM based diet. On the other hand, these results were not reflected in the on-station trial as the FCR of birds fed QPM hybrid cultivars were comparable with those fed NM based diets.

Carcass yield. As shown in Table 8, carcass parameters from broilers fed with QPM hybrid cultivars diets did not differ from those fed with NM in terms of percentage giblets, thigh, drumstick, wings, back and fat pad. On the other hand, results showed a significantly higher carcass yield for broilers fed QPM2 diets compared to NM. However, lower breast yield was observed for QPM1 and QPM2 compared to NM.

**Table 7.** Mean performance of broilers fed with normal maize (NM), SQM1672 (QPM1) and SQM6192 (QPM2) based diets

Parameter	MAIZE			SEM	PROB.
	NM	QPM1	QPM2		
Body weight (g)					
10 days	213.33	223.89	222.78	11.09	0.770
21 days	636.25	634.03	654.58	32.61	0.889
28 days	1068.47	1032.64	1074.58	39.06	0.727
33 days	1502.22	1453.61	1505.00	50.06	0.729
Feed intake/bird (g)					
0-10 days	209.72	260.42	223.33	23.93	0.364
0-21 days	1039.58	1043.06	1056.53	28.72	0.909
0-28 days	1927.50	1888.47	1898.75	42.54	0.804
0-33 days	2861.81	2780.42	2869.72	28.24	0.121
FCR					
0-10 days	0.99	1.16	1.01	0.10	0.450
0-21 days	1.64	1.64	1.62	0.05	0.900
0-28 days	1.81	1.83	1.77	0.04	0.620
0-33 days	1.91	1.92	1.91	0.07	0.999
Livability (%)	100.00	100.00	100.00	0.10	0.450

Not significant ( $p>0.05$ )

**Table 8.** Mean carcass yield of broilers fed with normal maize (NM), SQM1672 (QPM1) and SQM6192 (QPM2) based diets

Parameter	MAIZE			SEM	PROB.
	NM	QPM1	QPM2		
Carcass yield, %	69.21 <sup>b</sup>	69.63 <sup>ab</sup>	70.70 <sup>a</sup>	0.38	0.025 <sup>*</sup>
Cut up parts, %					
Breast	34.09 <sup>a</sup>	31.87 <sup>c</sup>	32.97 <sup>b</sup>	0.35	<0.001 <sup>**</sup>
Thigh	27.27	27.86	27.87	0.33	0.357
Drumstick	15.49	16.22	15.87	0.25	0.132
Wings	11.47	11.77	11.21	0.20	0.156
Back	10.34	10.78	10.47	0.28	0.519
Fat pad, %	1.32	1.49	1.61	0.13	0.288

<sup>ns</sup>Not significant ( $p > 0.05$ )<sup>\*</sup>Significant ( $p < 0.05$ )<sup>\*\*</sup>Highly Significant ( $p < 0.01$ )<sup>abc</sup>Means in row with different superscripts are significantly different

In isonutrient diets, Amonelo and Roxas (2007) also did not find any difference in the carcass parameters of the broilers fed diets with QPM and NM. Results on the breast meat yield were in contradiction with the observation of Panda et al. (2010) that noted higher breast meat yield in broilers fed with QPM based diet than those fed with NM based diet only when the latter was not supplemented with lysine. It is unclear as to how the breast meat yield was affected by the diet even if the diets were formulated as isonutrient.

Income over feed cost of broilers fed quality protein maize hybrids. Income over feed cost (IOFC) was not significantly different

between the QPM hybrid cultivars and NM based diets (Table 9). There was lower cost of feed for birds fed QPM1, but birds fed NM had numerically higher sale value compared to those fed QPM1. Thus, the IOFC did not differ significantly among birds fed with the test diets even with significantly lower feed cost for birds fed QPM1.

Lower cost of feed per kg diet was observed for QPM1 hybrid cultivar-based diets that reduced the cost of feed consumed for birds fed QPM1. Cost per kg feed was reduced in QPM1 and QPM2 diets through the reduction of soybean meal (2.85% lower for QPM1 and 3.36% lower for QPM2 compared to normal maize).

**Table 9.** Mean income over feed cost (IOFC) per bird from broilers fed with normal maize (NM), SQM1672 (QPM1) and SQM6192 (QPM2) based diets

Item	MAIZE			SEM	PROB.
	NM	QPM1	QPM2		
Liveweight, kg	1.50	1.45	1.51	50.06	0.729 <sup>ns</sup>
Sale value/bird, Php <sup>1</sup>	112.67	109.02	112.88	3.75	0.729 <sup>ns</sup>
Total feed consumed/bird, g	2861.81	2780.42	2869.72	28.24	0.121 <sup>ns</sup>
Cost of feed consumed/bird, Php <sup>2</sup>	58.91 <sup>a</sup>	56.19 <sup>b</sup>	57.96 <sup>ab</sup>	0.59	0.044 <sup>*</sup>
IOFC, Php	53.76	52.83	54.91	3.73	0.926 <sup>ns</sup>

<sup>ns</sup>Not significant ( $p > 0.05$ )<sup>\*</sup>Significant ( $p < 0.05$ )<sup>ab</sup>Means in a row with different superscripts are significantly different<sup>1</sup>Price per kg liveweight is Php 75.00<sup>2</sup>Cost of feed was calculated based on amount starter, grower and finisher feeds consumed and the respective prices of feeds

## Conclusion

Dietary inclusion of QPM hybrid cultivars than that of NM in broiler diets permitted the reduction of soybean meal in all diets. This resulted in significantly lower feed cost for QPM1 based diets compared to normal maize. These findings indicated that QPM hybrid cultivars SQM 6172 and SQM 6192 are

potential feed grains for broiler diets. Further research works should be considered in line with methods of formulating diets with QPM, the effects of protein supplement, and the shelf-life of the grain.

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