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Quail (*Coturnix coturnix japonica*) layer diets based on rice bran and total or digestible amino acids

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ABSTRACT

Objectives: To determine the egg production of quails as influenced by the type of diet, the method of expressing amino acid and interaction effects of these factors.
Methodology and Results: Two hundred and forty quail layers (8 weeks of age) were randomly distributed into four treatments with three replications of 20 birds per replication in a 2 × 2 factorial completely randomized design. The User Friendly Feed Formulation (UFFF) software was used to formulate diets. The total and digestible amino acid values for the different ingredients were obtained from Rhone Poulenc Amino Acid Recommendations for Poultry in Rhodiment Nutrition Guide (1993). The experimental diets consisted of formulations based on total and digestible amino acids (TAA; DAA); without and with 20% rice bran. The different parameters were determined from 9 to 17 weeks of age of the birds. Birds on diet with 20% rice bran had a lower feed intake but a better feed conversion ratio than those on diet that has no rice bran. A significant effect due to method of formulation was observed on feed consumption (10th week), egg production (13th week) and feed conversion ratio (15th week). Birds on diet formulated on TAA had a higher feed consumption rate, superior egg production, and a better FCR than those on diets formulated on DAA. Income over feed cost (IOFC) was comparable. No significant (P>0.05) differences on egg weight, egg mass and mortality of birds due to any of the dietary factors was observed. Interaction effects between method of formulation and type of diet was not significant (P>0.05) in any of these parameters.
Conclusion: The findings indicated that generally, quail layers diets may be formulated with or without rice bran and whether these diets are formulated based on TAA or DAA.
Key words: Digestible Amino Acids (DAA), Total Amino Acids (TAA), rice bran, formulation

INTRODUCTION

Quails have a high rate of production. Yet they are not commercially well known around the world and certainly deserve recognition. In the Philippines, demand for quail eggs is growing over supply because of the discovery of the rich taste of the quail egg. However, the prohibitive cost of some feed ingredients and commercially prepared feed mixtures is one of the most serious problems confronting poultry raisers. Hence, previous researchers Casartelli *et,al* 2005; Sarabmeet *et,al;*2006; Samli *et,al;* 2006) research in animal feeding has been geared towards finding potential substitutes for high cost feed ingredients and proper feed formulation techniques as a means of reducing cost and keeping production to the optimum level.

Rice bran (RB) is a by-product in rice milling and is an important low cost feed ingredient due to it protein and energy contents. However, its inclusion in poultry diets formulated based on total amino acids (TAA) leads to the use of large safety margins needed to ensure optimal amino acid nutrition of the birds, high cost, and inefficient use of nutrients leading to environmental pollution (Coon, 2004; Casartelli *et al*., 2005; Genetics, 2006; Liu, 2006, and Sarabmeet *et. al*, 2006).

One option available and that is more economical is dietary manipulation to improve egg- laying persistency using recent formulation techniques. To this end, formulation based on digestible amino acids was developed to reduce cost and increase the utilization of amino acids which has become the basis of poultry feed formulation. Digestible Amino Acid formulation of diet appears to be a promising solution judging on recent results (Maiorka *et al., 2005* and Casartelli *et al., 2006* ;) of studies on chicken. Little information of its application on quails is available, particularly in the formulation with rice bran.

MATERIALS AND METHODS

A total of 240 eight week-old Japanese quails (*Coturnix coturnix japonica)* obtained from a batch of quails raised in UAP Poultry in Central Luzon State University, Philippines in 2003, were randomly distributed into four dietary treatment of 20 birds per replication in a 2×2 completely randomized design (CRD) with three replications.

The diet formulated based on TAA and DAA contained 0% and 20% rice bran (Table 1). Thus, diet without rice bran had more corn (Table1) than those with rice bran. The energy content of all diets was 2800 Kcal/kg of metabolizable energy (ME). Values of the amino acids content of TAA in all diets were higher than the values used in DAA. At 8 weeks of age when birds were beginning to lay, they were gradually introduced to the experimental diets by mixing one-quarter, half, and three quarters with the layer mash until they were introduced finally to the experimental diets at the beginning of 9th week.

Data on feed consumption, egg production, feed efficiency; egg quality, egg mass, and mortality were calculated on a weekly basis (from the 9th to 17th week). Economic analysis was based on income over feed cost.

The analysis of data was performed using analysis of variance for factorial experiment in a completely randomized design. Mean separation was done in cases where variables were found to have significant difference using least significant difference. Both analyses was done using SPSS version 10.01 for windows '98 NT.

RESULTS AND DISCUSSION

Significant difference in feed consumption due to the dietary factor was observed only at 10th week for rice bran and 13th week for method of formulation. No significant interactions were observed between these factors. The birds fed on diet without rice bran had significantly ($P<0.05$) higher feed intake of 2.09% over birds on diet with 20% rice bran only in the 10th week. Higher intake (2.42%) was observed on birds that fed on the diet formulated based on TAA than those fed on DAA. This was evident in all measurement periods but significant difference was noted only on the 13th week It can be concluded that amino acid deficiency affects appetite since birds consumed more of the feed that had higher amino acid content. This agrees with an observation by Ferket and Gernat (2006).

There were no significant ($P > 0.05$) differences on egg production between diets with rice bran and without rice bran throughout the study. Significant ($P<0.05$) effect of the method of feed formulation on egg production was observed only in the tenth week. Evidently, the diet which corn was partly substituted with rice bran supported comparable egg production with diet without rice bran. This indicated that the use of rice bran partly replaced corn in the formulation, which resulted in comparable utilization of nutrients (Table 1).

Table 1: Composition and calculated analysis of the experimental layer diets formulated with and without rice, bran based on total amino acid (TAA) or digestible amino acid (DAA)

INGREDIENTS	TAA		DAA	
	0% Rice Bran	20% Rice Bran	0% Rice Bran	20% Rice Bran
Ground yellow corn	52.45	32.82	54.58	30.64
Molasses	2.00	2.00	2.00	1.00
Rice Bran, D_1	0.00	20.00	0.00	20.00
Soybean meal, 48% CP	23.88	24.23	24.28	23.00
Copra meal	6.46	3.00	5.00	5.60
Limestone	4.58	4.95	4.57	4.98
Fish meal, Peruvian	3.00	3.00	3.00	3.00
Vegetable oil	1.00	3.98	0.37	4.81
Tricalpos	1.41	0.87	1.41	0.86
Biofos	4.00	4.00	3.70	4.99
DL methionone	0.13	0.12	0.10	0.12
Lysine HCL	0.11	0.06	0.01	0.01
Iodized Salt	0.50	.050	0.50	0.50
Vitamin Premix*	0.15	0.15	0.15	0.15
Mineral Premix*	0.12	0.12	0.12	0.12
Toxin Binder	0.10	0.10	0.10	0.10
Choline	0.10	0.10	0.10	0.10
Calculated Aanalysis (“As is basis”)				
ME, Kcal/Kg	2800.00	2800.00	2800.00	2800.00
Crude fat, %	2.93	4.95	2.90	5.05
Crude fiber, %	2.92	3.33	2.81	3.55
Calcium, %	3.20	3.20	3.20	3.20
Available phosphorus %	0.35	0.35	0.35	0.35
Crude protein, %	20.00	20.00	16.00	16.00
Methionine, %	0.47	0.47	0.39	0.40
Methionine +cystine, %	0.70	0.70	0.68	0.68
Lysine, %	1.15	1.15	0.96	0.96
Tryptophan, %	0.24	0.24	0.20	0.21
Valine, %	0.96	0.81	0.81	0.70
Arginine, %	1.36	1.39	1.23	1.28
Threonine, %	0.76	0.77	0.68	0.66
Leucine, %	1.61	1.36	1.59	1.24
Isoleucine, %	0.76	0.69	0.73	0.62
Phenylalanine, %	0.88	0.78	0.84	0.70
Histidine, %	0.44	0.40	0.43	0.37
Sodium, %	0.20	0.22	0.20	0.22
Choline chloride, %	0.34	0.35	0.34	0.35
Linoleic Acid, %	1.97	2.04	2.04	2.01

*Each 4.5kg of vitamins and mineral premix contain: Vit A-5,000,000 iu, Vit-- D_3; Vit E—2.5g; Vit B_1—1.8g; VitB_2—4g; Niacin --40g; VitB_6—0.05g; VitB_{12}—0.0001g; Ca-d-Pantothenate—5g; Biotin—0.0001; Choline—570g; Folic—0.09g; Copper—3g; Cobalt—0.8g; Iron—40g; Manganese—97.5g; Zinc—40g; Iodine—1.5g; Seleniumg; D_1—Methionine—23g; Lysine—20.46g; Endox—40g .

Table 2: Mean feed consumption, egg production; and feed conversion ratio of Japanese quail layers measured as influenced by diets with or without rice bran (RB) formulated based on total amino acids (TAA) or digestible amino acids (DAA)

RB		Feed Consumption		Egg Production		Feed Conversion Ratio	
		10wk	13wk	10wk	13WK	10th	15th
0%	TAA	26.83	26.66	94.29	88.22	0.34	0.32
	DAA	26.14	24.12	92.62	87.38	0.34	0.42
20%	TAA	25.00	25.78	94.76	80.71	0.32	0.29
	DAA	23.80	23.49	85.47	82.24	0.33	0.32
Significance of Main Effects							
RB		***0.016****	***0.456***	***0.186***	***0.712***	***0.003*****	***0.04****
0%		26.49[a]	25.39	93.45	84.80	0.35[a]	0.37[a]
20%		24.40[b]	24.64	90.12	81.48	0.33[b]	0.31[b]
MF		***0.184***	***0.043***	***0.045***	***0.711***	***0.16***	***0.03****
TAA		25.91	26.22[a]	94.52[a]	81.46	0.33	0.31[a]
DAA		24.97	23.80[b]	89.05[b]	84.81	0.34	0.37[b]
RB×MF		***0.071***	***0.897***	***0.137***	***0.840***	***0.070***	***0.140***

Values in italics are probabilities (P).

This is in agreement with the work of Samli *et al.,* (2006) where an inclusion level of twenty-five percent rice bran was previously satisfactory for laying chickens. The egg production of quails fed with the diet formulated based on TAA was numerically superior to the diet formulated based on DAA in all periods and was statistically significant (P<0.05) on the tenth week, irrespective of diet with or without rice bran. Birds performance were low when diets were formulated based on digestible amino acids probably because of the low amino acids levels (Table 1) that were used in order to attain the requirements of digestible amino acids. Although synthetic amino acids (lysine and Methionine) were supplemented to fulfill Methionine, Methionine + cysteine, lysine, tryptophan and threonine requirements, the low inclusion level (lysine-0.01. and DL methoinine 0.10, 0.12) in the diets determined low levels of isoleucine and valine. This might have caused lower intake of these amino acids and the consequent deficiencies compared to the birds fed diets formulated based on total amino acid requirements. The present research work agrees with the work of Casartelli *et al*., (2005) where results obtained on chicken showed better egg production on diet formulated on TAA than DAA

Significant (P<0.05) effect of type of diet and formulation on FCR was observed at 10 and 15 weeks of age. An interaction effect of the dietary factor was not statistically significance (P>0.05) on the 10th week. At 15 weeks, FCR value was better in the diet with rice bran than without and the diet formulated based on TAA than diets based on DAA. The lower FCR value in diet with rice bran reflected the lower feed intake without a concomitant reduction in egg production. This indicated that any of the anti nutritional factors in rice bran that decreases nutritive value and prevent villi from absorbing available nutrients in the small intestines of birds, did not have adverse effect on the quail at the level used in the present study. This is supported by Samli et al., (2006) in his research work on improving the utilization of rice bran in diets of broiler chicken and ducks. Overall, there was no consistent effect of method of formulation on FCR although inferior FCR value for diet with rice bran was seen in the 10th week, some measurement periods showed values numerically better in this group than its counterparts. As presented in the preceding section, birds in the DAA consumed lesser feeds and produced fewer eggs. On this basis, it seemed that the feed intake was a big factor affecting FCR of the birds. A report by Casartelli et al., (2005) indicated that total amino acid recommendations promoted better bird responses in FCR than digestible amino acid recommendations

The mean egg weight, egg mass and mortality rate of Japanese quail layers recorded at all periods is presented in Table 3. Neither the mean egg weight nor mean egg mass was significantly (P<0.05) affected by rice bran, amino acid formulation or the interaction effect of all the dietary factors. This indicated that none of the dietary factors compromised egg size, egg mass or mortality rate. As such, their effects were mainly number of eggs produced. Total eggs produced were comparable in layers fed with diets containing rice bran (116pieces) and without rice bran (115 pieces). On the other hand, significant (P<0.05) differences due to method of feeding sale value of eggs produced in diets with rice bran was ₽ 69.49 compared to ₽ 69.01 in diets without rice bran. The total approached statistical significance (₽ = 0.07) between the diet with and without rice bran. The cost of diet without rice bran was higher (₽0.38) than the diet with rice bran. Income over feed cost was lower by P0.86 in diet without rice bran (₽38.42) than diet with rice bran (₽39.28).

A significant effect due to the method of formulation was observed in terms of total eggs produced as well as sale value of eggs. The birds fed with diet based on TAA produced more and the sale value of their eggs was higher than their counterparts. Feed cost was comparable. The income over feed cost for diet formulated based on TAA was numerically higher but not statistically significant compared with diet formulated on DAA.

Table 3: Mean egg produced, feeds consumed and income over feed cost (IOFC) for the period 9 to 17 weeks of age of Japanese quail layers as influenced by diets with and without rice bran (RB) formulated based on total amino acids (TAA) or digestible amino acids (DAA)

RB	FORMULATION (MF)	TOTAL EGGS (PCS)	PRODUCED VALUE (₽)	FEEDS CONSUMED AMT (kg))	COST (₽)	IO F C (₽)
0%	TAA	116	69.76	3.48	31.08	38.67
	DAA	114	68.27	3.45	30.11	38.16
20%	TAA	119	71.62	3.43	31.23	40.40
	DAA	112	67.36	3.18	29.19	38.17
Significance of Main Effect						
RB		*0.695*	*0.695*	*0.071*	*0.059*	*0.376*
0%		115	69.01	3.47	30.59	38.42
20%		116	69.49	3.31	30.21	39.28
MF		*0.040**	*0 .040**	*0.094*	*0.060*	*0.175*
TAA		118[a]	70.69[a]	3.46	31.15	39.54
DAA		113[b]	67.81[b]	3.32	29.65	38.16
RB x MF		*0.271*	*0.271*	*0.177*	*0.462*	*0.379*

Values in italics are probabilities
Values in a particular dietary factor with different superscript (ab) are significantly different
Sales value per piece of egg is ₽0.60.
Cost of layer diet (see Table 1)

Based on the above results (Table 3), the economic effect of diets with or without rice bran and formulated based on TAA or DAA was comparable. The lack of significant interaction further showed that there is no specific dietary factor (type of diet and formulation) that should be considered to affect economic efficiency of feeding quail layers.

This study has revealed that rice bran that is left around rice producing areas as waste in Uganda and its neighboring countries contain nutrients that are comparable to that of maize used as the main basal diet for poultry birds. There is the need therefore to sensitize both commercial and local poultry producers to capitalize on this by-product to supplement poultry diet as a way of reducing feed cost and maximizing income. Government in Uganda and across its boarders should endeavor to promote quail production, which is cheaper in terms of capital investment that allows citizens under poverty line to meet their protein requirements needed for children's normal growth and maintenance requirement for the adults.

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