UNTRADITIONAL SOURCES OF ENERGY IN DIETS FOR JAPANESE QUAILS : 2. LAYING QUAILS

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Abstract

One hundred and sixty-eight laying Japanese quails 8 weeks of age were distributed into 7 triplicate groups (7x3x8), and reared up to 20 weeks of age in quails egg production battery type cages under similar management conditions. Seven laying quail diets were formulated in which the first one was corn-soybean diet and served as the control (T1). In the other diets, 50% of corn in the control diet was replaced by either tapioca (T2) or crushed macaroni (T3), while, all corn in the control diet was replaced (100%) by either mixture (1:1) of tapioca + crushed macaroni (T4), tapioca (T5), crushed macaroni (T6), or mixture (1:1:1) of corn + tapioca + crushed macaroni (T7). All diets were adjusted to be isonitrogenous of about 20% CP and iso-caloric of about 3000 Kcal ME/Eg.

Results showed that the group T7 in which corn, tapioca and crushed macaroni (1:1:1) were used as the main source of energy gave the highest average of egg production percentage, followed by T4, T5, T2, T3, T6, and finally, the control group (T1) which resulted in the lowest value. No significant differences were found between treatments in the averages of egg weight, egg mass, feed consumption, fertility and hatchability. Feed conversion of T7 exhibited the best value, while, the other treatments followed the same trend as that of egg production.

It could be concluded that, tapioca and crushed macaroni each alone or in combination are excellent untraditional sources of energy in laying quail rations, taking in consideration the economical point of view.

INTRODUCTION

Energy and protein are considered the most principal items in poultry nutrition. Yellow corn (YC) is the main source of energy in formulating poultry rations. Its price is increasing because of the limited world yield in covering the demands for both humans and livestock. So, it is important to search for other alternative cheap sources of energy which can solve this problem. It should be born in mind that the cost of the unit weight of the formulated diets should be as low as possible to earn higher profits. Crushed macaroni and tapioca meal seemed to be such alternative cheap materials which might be used as source of energy.

Crushed macaroni (CM) is a by-product of macaroni factories which forms about 3-5% of macaroni production. It is formed mainly of wheat flour providing a substitute for corn or other cereal grains in poultry feeding. Ghazalah *et al.* (1993), showed that CM contains appreciable amounts of nutrients being 11.82% CP, 1.32% EE, 0.79% ash, 0.63% CF and 85.44% NFE, while, its feeding value in term of ME for poultry was 3739 Kcal/kg. Regarding the use of CM in ponltry ratans, Malak (1988) reported that CM could successfully replace all YC in starter, grower and finisher rations for turkey. Ghazalah *et al.* (1993) found that, using CM to completely replace YC in starter, grower and finisher broiler diets resulted in superior chick growth performance than that of corn-soybean control diets. Abbas *et al.* (1994) showed that, macaroni by-product might successfully replace YC in broiler rations up to 100% without any adverse effect on growth performnce, carcass characteristics and economic efficiency. Abd-El Malak and Abbas (1997) showed that, CM could completely repace YC in growing quail diets.

Tapioca (TP, cassava root meal) has been proposed recently as a substitute for YC in Egypt. Earlier studies have shown that TP is a satisfactory replacement for corn in eiter broiler or layer diets. The chemical composition of TP had been reported by El-Sherbiny *et al.* (1986) being 97.01% OM, 3.1% CP, 0.89% EE, 4.09% CF, 2.99% ash and 88.93% NFE, while, the feeding value in term of ME for poultry was 3134 Kcal/kg. Regarding the use of TP in poultry rations, Ademosun and Eshiett (1980), using B-Hyline laying hens, confirmed that, using TP up to 60% in rations gave similar results as those of the control. Stevenson (1984, 1985) found that, with Hisex White and Brown Leghorn, the use of 50% TP instead of YC in layer rations did not show any adverse effect on egg production and egg quality. Abd-El Malak and Abbas (1997) showed that TP can replace 50% of YC in growing quail diets without any adverse effect on growth performance.

No publications for using CM or TP are available, each alone or in combination in feeding laying Japanse quajls. Therefore, the present study aimed at investigating the possibility of using TP and CM each alone or together to replace YC in laying quail diets, and their effect on laying quail performance, egg quality, fertility and hatchability taking in consideration the economic efficiency.

MATERIALS AND METHODS

Birds and managements

A total number of 168 laying Japanese quails 8 weeks of age were kept simultaneously under similar manageable and environmental conditions in quail egg production battery type cages. The birds were randomly distributed into 7 groups of 24 birds each (i.e. 3 replicates X 8 quails). The quails were exposed to artificial light for 16 h daily. Feed and water were offered ad. lib. Data of egg production % (EP), g egg weight (EW), g egg mass and g feed intake (FI) were recorded from 8 to 20 weeks of age for evaluating laying quail performance. An economic study was also carried out using input-output analysis.

Experimental diets

Seven laying quail diets (Table 1) were formulated, in which the first one served as the control diet (T1) and contained mainly YC and soybean meal. In the other diets 50% of YC in the control diet was replaced by either TP (T2) or CM (T3), while, all YC in the control diet was completely replaced (100%) by either mixture (1:1) of TP + CM (T4), TP only (T5), CM only (T6) or mixture (1:1:1) of YC + TP + CM (T7). All diets were adjusted to be iso-nitrogenous of about 20% CP and iso-caloric of about 3000 Kcal ME/Kg, as recommended by N.R.C. (1984). The experimental diets were chemically analyzed according to the methods of A.O.A.C. (1990).

Fertility and hatchability

At the end of the experiment, male quails were transferred to the female cages. After ten days, fertile eggs were collected for 7 days and put in an incubator for 3 times. Fertility and hatchability were then calcultated.

Egg quality

Representative samples of 18 eggs were collected from each treatment throughout three fortinght periods in order to determine egg quality in term of shape index (SI), yolk index (YI), yolk colour score (YCS), hugh unit (HU), shell weight (SW) and shell thickness (ST).

Statistical analysis

Data of quail performance, egg quality, fertility and hatchability were statis-

Table 1. Composition of the experimental diets.

Ingredients	T1	T2	T3	T4	T5	T6	T7
Yellow corn	61.00	27.19	30.00	-	-	-	19.10
Tapioca	-	27.19	-	28.22	48.48	-	19.10
Crushed macaroni	-	-	30.00	28.22	-	62.00	19.10
Soybean meal (44%)	21.51	26.80	18.50	24.90	31.30	16.00	23.38
Layer conc.**	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Vegetable oil	2.80	4.35	3.15	4.00	5.90	2.80	3.70
Lime stone	4.10	3.95	4.10	4.00	3.80	4.10	4.00
Bone meal	0.30	0.30	0.30	0.37	0.30	0.30	0.30
Wheat bran	-	-	-	-	-	4.32	1.01
Vit. & Min. Mixture*	0.10	0.10	0.10	0.10	0.10	0.10	0.10
L-Lysin Hcl	0.12	0.02	0.19	0.07	-	0.24	0.10
Dl-Methionine	0.7	0.10	0.11	0.12	0.12	0.14	0.11
Total	100	100	100	100	100	100	100
Chemical analysis:							
Crude protein %	20.05	20.02	20.21	20.24	20.09	20.45	20.10
Crude fiber %	3.16	3.62	2.84	2.32	3.98	2.28	3.18
Ether extract %	6.09	6.61	5.44	5.56	7.33	4.06	5.95
Calculated values:							
ME Kcal/Kg	3006	3000	3003	3011	3008	3012	3003
Calcium%	2.52	2.52	2.52	2.56	2.52	2.52	2.53
Phosphorus %	0.56	0.55	0.56	0.55	0.55	0.56	0.55
Lysine %	1.15	1.15	1.16	1.15	1.21	1.15	1.16
Methionine %	0.45	0.46	0.46	0.45	0.46	0.46	0.45
Met. + Cys.%	0.76	0.76	0.76	0.76	0.76	0.76	0.76

* Each 2.5 Kg of Vit. & Min. Mixture contain: Vit. A 12 000 000 IU, Vit. D3 2 000 000 IU, Vit. E 10 000 mg, Vit. K3 2 000 mg, Vit. B1 1000 mg, Vit, B2 4000 mg, Vit. B6 1500 mg, Vit. B12 10 mg, Niacine 50 000 mcg, Pantothenic acid 10 000 mg, Choline chloride 500 000 mg, Copper 10 000 mg, Iodine 1000 mg, Iron 30 000 mg, Manganese 55000 mg, Zinc 55 000 mg and Selenium 100 mg.

** Layer concentrate (LOHMANN) contains: 78% Meat meal (55%CP), 14% Fish meal (72%CP), 3.2% Dicalcium phosphate, 2.1% Sodium chloride, 1.8% Vit. & Min. Premix, 0.6% DL-Metionine and 0.3% propionic acid.

tically analyzed using the general linear model programme of S.A.S. (1985).

RESULTS AND DISCUSSION

Chemical composition

The chemical analysis of the experimental diets are shown in Table 1. The determined chemical analysis were nearly similar to those calculated particularly in CP values. It could be pointed out that the diets were adjusted to satisfy nutrient requirements of laying quails according to N.R.C. (1984). Therefore, any differences in laying quail performance would be attributable to the differences in the nutritional qualities of the tested materials (i.e. TP & CM) which were incorporated in the experimental diets on expense of YC.

Laying quail performance

Data of laying Japanese quail performance fed on the experimental diets used in the present study are presented in Table 2 .

The best EP value was obtained with the quails of T7 which received a mixture of YC, TP and CM in equalized ratios (1:1:1) instead of YC as the main source of energy. The group T4 which received a mixture of TP and CM (1:1) gave relatively inferior EP value followed by those T5 (100% TP), T2 (50% TP), T3 (50% CM), T6 (100% CM) and latterly T1 (the control group) which resulted in the lowest EP value. Statistically, there were no significant differences between all treatments except T7 which was significantly similar to T2, T3, T4 and T5.

It seemed likely that, the dietary treatments did not affect either EW or FI since no significant differences were detected between all treatments in these parameters as shown in Table 2.

The best feed conversion (FC) value was, however, obtained by T7 which significantly surpassed that of the control group. The other treatments (T2 & T6) recorded intermediate FC values without significant differences between them.

Mortality was normal and without clear trend. The viability of all birds during the experimental period was also good idicating that the dietary treatments did not affect the viability of laying quails.

Concerning fertility and hatchability, the dietary treatments did not show any significant effect on such parameters (Table 2).

Generally, the results revealed that, TP and CM each solely or together (in a ratio of 1:1) could successfully replace YC either partial or complete substitution. This is, perhaps, due, firstly, to the chemical composition of the experimental diets which were nearly similar and satisfying nutrient requirements of laying quails. Secondary, the carbohydrate content of YC being 86% (El-Sherbiny *et al.* 1986) was close to those of TP being 82% (El-Sherbiny *et al.* 1986) was close to those of TP being 82% (El-Sherbiny *et al.* 1986) and CM being 85% (Ghazalah *et al.* 1993) who confirmed that the digestibilities and feeding values of such materials are nearly similar to those of YC. The beneficial results of T7 in which YC, TP and CM were used (1:1:1) as source of energy may be due to the presence of an associative effect among such ingredients, and/or that carbohydrates of TP and CM are easier in digestion and absorption than those of YC. However, this point needs confirmation in separate research. In this respect, Abd-El Malak and Abbas (1997), in a pervious research used TP and CM in growing quail rations at the same levels used herein, and found that CM could completely (100%) replace YC, while, TP could partially (50%) replace YC in growing quail diets without any adverse effect on its performance.

Studies of using CM or TP in laying quails are rare. However, Abd-El Malak (1988), Ghazalah (1993) and Abbas *et al.* (1994) showed that CM could successfully replace YC in poultry diets. Ademosun and Eshiett (1980), Stevenson (1984) and Stevenson (1985) showed that TP could replace 50-60% of YC in laying hen diets without any adverse effect on egg production.

Egg quality

The results of quail egg quality are presented in Table 3. For all instances, it could be noticed that, except YCS, all parameters under study recorded nearly similar values, and the slight differences which were observed among treatments did not show clear cut trend. It could be concluded that, using TP and CM, either solely or in combination to partially or completely replace YC in laying quail rations have no noticeable effect on either SI, YI, HU or ST. However, it was observed that replacing YC by TP in the diet resulted in lower YCS than all other treatments which varied significantly according to the inclusion rate of TP and CM. This may be due to the deficiency of pigments (i.e. xanthophyll or carotin) in such materials which were

Table 2. Effect of dietary treatments on the performance of laying Japanese quails.

Item	T1	T2	T3	T4	T5	T6	T7
Average EP %	59.64b	62.43ab	61.93ab	64.57ab	63.43ab	61.28b	66.64a
Average EW g	11.03a	11.24a	11.25a	11.18a	11.03a	11.31a	11.01a
Average EM	6.60a	7.04a	6.99a	7.24a	6.99a	6.94a	7.36a
Av. FI/hen/day g	28.88a	29.48a	29.64a	29.55ab	30.01	30.05a	29.34a
Average FC*	4.38a	4.19ab	4.24ab	4.08ab	4.29ab	4.33ab	3.99b
Fertility %	74.30a	74.11a	75.05a	75.10a	74.83a	75.02a	75.16a
Hatchability %	82.13a	82.11a	84.22a	83.12a	82.48	83.11a	84.18a
Mortality rate %	-	-	4.17	4.17	-	4.17	-

* EM (g) / FI (g).

Means with different superscripts are significantly different (P>0.05).

Table 3. The effect of dietary treatments on the values of egg quality of laying Japanese quails.

Item	T1	T2	T3	T4	T5	T6	T7
Shape index	0.787a	0.753b	0.875a	0.790a	0.762b	0.790a	0.803a
Yolk index	0.453a	0.437a	0.432a	0.442a	0.427a	0.442a	0.442a
Yolk colour score	5.50a	4.33b	5.50a	3.17c	1.33d	4.33b	2.67c
Hugh unit	79.53a	78.90a	83.27a	78.27a	79.72a	81.33a	80.20a
Shell weight (%)	15.54a	15.71a	15.31a	15.77a	15.37a	15.99a	15.30a
Shell thickness (mm)	0.225a	0.213a	0.218a	0.223a	0.215a	0.225a	0.215a

Means with different superscripts are significantly different (P>0.05).

clearly reflected on pigments content of TP-diet (T5) and CM-diet (T6). These results are in line with Hamed and Jalaludin (1972) who observed that egg yolk became progressively whiter when TP increased from 20-60% in layers diet. Abd-El Salam (1994) with LSL layers used 50% TP instead of YC and found that the yolk had paler colour than that of the control ration which contained YC.

Economic efficiency

Input-output analysis was carried out to determine the economic efficiency (EF) of the dietary treatments in the present study (Table 4). The results showed that, except T5, the EE of all treatments was better than that of the control. This is logic because the price of the used materials (TP & CM) was lower than that of YC which was reflected on the diet cost. However, when assuming that the EE of the control group equals 100, the relative EE of T7 exhibited the best value (123.24) followed by T4 (119.72), T6 (116.90), T3 (112.68), T2 (103.52), T1 (100.00) and finally T5 which recorded the lowest value (98.60).

As a general conclusion, when laying quail performance and the economic efficiency are taken in consideration, a mixture of YC, TP and CM (1:1:1) could be used as an excellent source of energy in laying quail rations rather than the use of TP and CM each solely or in combination.

Table 4. Effect of dietary treatments on the economic efficiency of Japanes quails.

Item	T1	T2	T3	T4	T5	T6	T7
Total feed intake kg	2.426	2.476	2.490	2.482	2.521	2.524	2.464
Price of Kg feed PT	85.33	85.75	80.42	80.92	87.95	76.66	82.65
Total feed cost PT	207.01	212.32	200.25	200.84	221.72	193.49	203.65
Total egg number/hen	50.10	52.44	52.02	54.24	53.28	51.48	55.98
Price of one egg PT	10.00	10.00	10.00	10.00	10.00	10.00	10.00
Total price of eggs PT	501.00	524.40	520.20	542.40	532.80	514.80	559.80
Net revenuePT	293.99	312.08	319.95	341.56	311.08	321.31	356.15
Economic efficiency (EEF)	1.42	1.47	1.60	1.70	1.40	1.66	1.75
Relative EEF* (%)	100.00	103.52	112.68	119.72	98.60	116.90	123.24

* Assuming that EEF of the control equals 100.

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إستخدام مصادر غير تقليدية للطاقة في علائق السمان الياباني
٢- السمان البياض

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إستخدم في هذا البحث عدد ١٦٨ سمانة بياضة عمر ٨ أسابيع قسمت إلي ٧ معاملات (كل معاملة ٢٤ سمانة - ٣ مكررات X ٨ أفراد) غذيت علي علائق التجربة حتي عمر ٢٠ أسبوعا ووضعت في بطاريات سمان بياض تحت ظروف تربية واحدة وغذيت علي ٧ علائق كالاتي :

المعاملة الاولي م١ : عليقة المقارنة تحتوي علي ذرة صفراء وكسب فول صويا كمصدر رئيسي للطاقة والبروتين .

المعاملة الثانية م٢ : أستبدل ٥٠٪ من الذرة الصفراء في عليقة المقارنة بالتبيوكا.

المعاملة الثالثة م٣ : أستبدل ٥٠٪ من الذرة الصفراء في عليقة المقارنة بكسر المكرونة .

المعاملة الرابعة م٤ : أستبدل ١٠٠٪ من الذرة الصفراء بالتبيوكا وكسر المكرونة بنسبة ١:١.

المعاملة الخامسة م٥ : أستبدل ١٠٠٪ من الذرة الصفراء بالتبيوكا.

المعاملة السادسة م٦ : أستبدل ١٠٠ ٪ من الذرة الصفراء بكسر المكرونة.

المعاملة السابعة م٧ : أستبدل ١٠٠٪ من الذرة الصفراء بخليط من الذرة الصفراء والتبيوكا وكسر المكرونة بنسبة ١ : ١ : ١.

كل العلائق كانت متساوية تقريباً في نسبة البروتين حوالي ٢٠٪ والطاقة التمثيلية ٣٠٠٠ كيلو كالوري / كجم .

وقد أظهرت نتائج التجربة أن م٧ (ذرة صفراء - كسر مكرونة - تبيوكا بنسبة ١ : ١ : ١) تفوقت علي جميع المعاملات من حيث أنتاج البيض يليها م٤ ، م٥، م٢، م٣، م٦، بينما أعطت م١ (مجموعة المقارنة) أقل مستوي في أنتاج البيض. لم يكن هناك أي فروق معنوية بين المعاملات في كل من متوسط وزن البيضة - وزن البيضة الناتج - الغذاء المستهلك - نسبة الخصوبة والتفريخ. أعطت أيضاً م٧ أعلي كفاءة تحولية تليها م٤، م٢، م٣، م٥، م٦ بينما أعطت مجموعة المقارنة م١ أقل القيم.

وعموماً فأن البحث يخلص إلي إمكانية أحلال كسر المكرونة والتبيوكا كمصادر أقتصادية للطاقة في علائق السمان البياض.