J. Agric. Sci. Mansoura Univ., 25 (11): 6721 - 6729, 2000.

PERFORMANCE OF JAPANESE QUAIL FED LOW PROTEIN CORN-SOY DIETS SUPPLEMENTED WITH SYNTHETIC AMINO ACIDS

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ABSTRACT

Two experiments were designed using 740 Japanese quail of one-day-old to study the effect of feeding low-protein diets supplemented with amino acids. In Experiment 1, low-protein diets (22% and 20% CP) were supplemented with essential amino acids (Met, Lys, Thr, Iso-Leu, and Val) to meet the recommended requirements (NRC, 1994) and compared with high protein diets (26% and 24% CP, as control diets). In Experiment 2, the same low protein diets used in Experiment 1 (22% and 20% CP) were used in this experiment but supplemented with only Met and Lys and compared with the 24% CP diet as a control diet.

Results of experiment 1 indicated that live body weight, and body weight gain of quail chicks fed the 22% or 20% CP diet were significantly improved when these diets were supplemented with Met, Lys, and Thr and were not significantly different from those fed the high protein diets (24% or 26% CP). However, feed conversion was not significantly affected by reducing CP in the diets. Addition of Iso-Leu and Val did not give any further improvement in either body weight or feed conversion. Adding amino acids (Met., Lys., Thr. and Iso-leu.) to diets containing 20% CP gave the best economic efficiency (E.E) and the reverse was noticed with diets containing either 22% or 20% CP without Iso-leu supplementation. In Experiment 2, body weight and feed conversion of quail chicks fed diets containing 22% or 20% CP supplemented with Met and Lys were not significantly different from those obtained from with the 24% CP diet and increased E.E by 4% and 6%, respectively.

It is concluded that performance of Japanese quail fed low-protein diets (22 or 20% CP) supplemented with amino acids was similar to that achieved with the high-protein diets (26 or 24% CP) and gave the best E.E.

Keywords: Japanese quail performance, low-protein diets, amino acids.

INTRODUCTION

High-protein diets (26-24% CP) are recommended for Japanese quail from 0-6 weeks of age for optimizing performance (Lepore and Marks, 1968; NRC, 1994). Recently, there is a tendency, to feed poultry corn-soybean diets low in crude protein and supplemented with essential amino acids. This is not only because they are safe and profitable diets but also to reduce nitrogen pollution related to poultry manure. However, diets formulated based on corn and soybean meal and low in crude protein are limited in some essential amino acids i.e., in order Methionine (Met), Lysine

(Lys), Threonine (Thr), Valine (Val) and Arginine (Arg) (Han *et al.,* 1992 and Fernandez, 1994).

There are attempts that have been made to feed broiler chicks low protein diets supplemented with amino acids. Bornstein and Lipstein (1975) compared a 19.7% CP diet (supplemented with Met and Lys) to a 23.1% CP diet supplemented with Met and found that chick growth and feed efficiency were equal for these two diets. Similar results were observed by Waldroup *et al.* (1976). Also, Parr and Summers (1991); and Han *et al*, (1992) reported that chicks fed low protein diets (ranged from 21 to 16.5% CP) supplemented with essential amino acids had similar growth rate and feed efficiency as those fed a 23% CP diet. The same observation was reported by Harms and Russell (1993) on laying hens. They found that maximum performance of laying hens can be obtained from low-protein diets supplemented with essential amino acids. Also, similar results were reported by Lopez and Lesson (1995 a and b) who indicated that it is possible to reduce CP intake of broiler breeder from 16 to 12% providing adequate intake of critical amino acids without adversely affecting egg production, hatchability or performance of their offsprings. It is interesting, however, to investigate whether Japanese quail would respond similarly or not to low-protein diets supplemented with amino acids.

Therefore, the present work was conducted to study the effect of feeding low-protein diets supplemented with amino acids on the performance of Japanese quail.

MATERIALS AND METHODS

The present work was conducted at Animal Production Department, Faculty of Environmental Agricultural Sciences, Al-Arish, North Sinai, Suez Canal University. Two experiments were designed to study the performance of Japanese quail chicks when fed low-protein diets supplemented with amino acids (AAs). The chicks were wing-banded and housed in gas heated batteries. They were provided with 24 hr artificial light daily and kept under similar conditions of management throughout the experimental periods which lasted for 6 weeks of age.

Experiment 1

A total of 480 one-day old quail chicks were assigned into 8 experimental treatments and three replicates of 20 chicks each were used for each treatment. The experimental diets consisted of low-protein diets (22 and 20% CP) supplemented with different amino acids to meet the requirements recommended by NRC (1994), simultaneously and compared with high-protein diets (24 and 26% CP) which served as controls (Table 1). The experimental groups were fed up to 6 weeks of age on one of the following diets:

1) 26% CP with no amino acids supplementation.
2) 24% CP with no amino acids supplementation.
3) 22% CP with no amino acids supplementation.

4) 20% CP with no amino acids supplementation.
5) as 3 and supplemented with 0.05 Met, 0.10 Lys, and 0.08 Thr.
6) as 3 and supplemented with 0.05 Met, 0.10 Lys, 0.08 Thr and 0.05 Iso-Leu.
7) as 4 and supplemented with 0.10 Met, 0.24 Lys, and 0.17 Thr.
8) as 4 and supplemented with 0.10 Met, 0.24 Lys, 0.17 Thr, 0.15 Iso-Leu and 0.01 Val.

All diets were iso-caloric containing 2900 Kcal ME/Kg diet (Table 1). Feed and water were provided *ad libtium*. Feed intake and live body weight were recorded weekly and feed conversion (g feed: g gain) was calculated.

Table 1: Composition of the experimental diets.

Ingredients	26% CP	24% CP	22% CP	20% CP	Price (L.E) /ton
Yellow corn	42.00	50.00	57.03	64.07	480
Soy bean meal 44%	50.78	44.88	38.98	33.08	1080
Vegetable oil	4.72	2.54	1.37	0.18	1800
Limestone	0.95	9.28	0.92	0.90	30
Bone meal	0.96	1.03	1.10	1.17	750
Salt	0.30	0.30	0.30	0.30	150
Premix [1]	0.30	0.30	0.30	0.30	7500
DL-Methionine 99%	0.005	----	----	-----	16000
Total	100	100	100	100	
Price (L.E) /Ton[3]	866	804	750	700	
Calculated (%); CP	26.00	24.00	22.00	20.00	
ME, Kcal/Kg	2900	2900	2900	2900	
Ca	0.80	0.80	0.80	0.80	
P, available	0.30	0.30	0.30	0.30	
Met	0.40	0.37	0.34	0.32	
Met + Cys	0.81	0.76	0.70	0.65	
Lys	1.48	1.34	1.20	1.06	
Arg	1.76	1.60	1.44	1.28	
His	0.69	0.64	0.59	0.53	
Iso-Leu	1.12	1.03	0.93	0.83	
Leu	2.15	2.02	1.89	1.76	
Phy-Ala	1.26	1.16	1.06	0.96	
Tyr	1.10	1.01	0.92	0.82	
Thr	1.00	0.92	0.84	0.75	
Try	0.40	0.36	0.32	0.28	
Val	1.22	1.13	1.04	0.94	

[1] Supplied per Kg of diet; Vit. A, 12,000 IU; Vit D3, 2,000 IU; Vit E, 40 mg; Vit. K3, 4 mg; Vit. B1, 3 mg; Vit. B2, 6 mg; Vit. B6, 4 mg; Vit. B12, 30 micro g; Niacin, 30 mg; Folic Acid, 1.5 mg; Biotin, 80 micro g; Pantothenic Acid, 13.2 mg; Choline Chloride, 700 mg; Iron, 40 mg; Copper, 10 mg; Zinc, 70 mg; Selenium. 0.2 mg; Iodine, 1.5 mg; Cobalt, 0.25 mg.
[3] Prices per Egyptian pound (L.E) where 1 US $ = 3.42 L.E

Experiment 2

A total of 300 one-day-old Japanese quail chicks were assigned into five experimental treatments, each of which contained three replicates of 20 chicks each. Based on the results of experiment 1 which indicated no significant difference between the diet containing 26% CP and that containing 24% CP, the diet containing 24% CP was considered as a control diet. The experimental diets were:

1) 24% CP, as a control diet.
2) 22% CP with no amino acids supplementation.
3) 20% CP with no amino acids supplementation.
4) as 2 and supplemented with 0.05 Met. to meet the requirements recommended by NRC (1994).
5) as 3 and supplemented with 0.10 Met and 0.24 Lys. to meet the requirements recommended by NRC (1994).

The diets were formulated to be iso-caloric containing 2900 Kcal ME/Kg diet (Table 1). Feed and water were provided *ad libtium*. Live body weight, feed intake and feed conversion were determined with the same procedures as in Experiment 1.

Statistical Analysis:

Data were subjected to the ANOVA using the procedure of the General Linear Models (GLM) of SAS® software (SAS Institute, 1990). One way analysis of variance was used in both experiments using the following model:

$$Y_{ij} = \mu + T_i + e_{ij}$$

where: Y_{ij} = the observation of the parameter measured, μ = overall means, T_i = the effect of the treatment, e_{ij} = the random error term.

Differences among means at the probability of ≤ 0.5 were considered significant, and were separated by Duncan's multiple range test (Duncan, 1955).

RESULTS AND DISCUSSION

Experiment 1:

The results of experiment 1 are presented in Table 2. Live body weight and body weight gain of quail chicks received diets containing 22% CP or 20% CP with no amino acid supplementation were significantly ($P<0.05$) decreased compared with those fed the 26% CP diet (Table 2). On the other hand, quail chicks fed the 22 or 20% CP diet supplemented with Met, Lys, Thr or Met, Lys, Thr, Iso-Leu and Val achieved live body weight gain values not significantly different from those of the two control groups fed on the high protein diets (26 or 24% CP). This result in a good agreement with those reported by Parr and Summers (1991) and Han *et al*., (1992) who found that broiler chicks fed low protein diets (21 to 16.5% CP) supplemented with essential amino acids had a growth rate similar to that of

chicks fed a 23% CP diet. On the contrary, this finding disagreed with those of Pinchasov *et al*. (1990) and Colnago *et al*. (1991) who concluded that optimal performance of starter and grower broiler chicks could not be achieved with low-protein diets supplemented with crystalline amino acids.

Table 2:Effect of feeding low protein diets supplemented with amino acids on performance of 6-week Japanese quails, Experimnet 1.

Treatment	Live body weight (g)	Body weight gain (g)	Feed consump-tion (g)	Feed conversion (g/g)
T1, 26% CP	160 ± 2.8 ^{a}	149 ± 1.6^{a}	584 ± 4.1 ^{d}	3.90 ± 0.10
T2, 24% CP	150± 3.0 ^{abc}	139 ± 3.0^{ab}	567 ± 3.3 ^{d}	4.07 ± 0.13
T3, 22 CP	146 ± 1.47^{c}	135 ± 1.6^{b}	575 ± 7.0 ^{d}	4.25 ± 0.12
T4, 20% CP	146 ± 3.9 ^{bc}	135 ± 3.9^{b}	611±17.0^{abc}	4.51 ± 0.30
T5, 22% CP + Met, Lys, Thr	158 ± 2.1 ^{a}	148 ± 2.1^{a}	634 ± 5.5 ^{a}	4.27 ± 0.08
T6, 22% CP+ Met, Lys, Thr and Iso-Leu	153±2.4 ^{abc}	143 ± 2.5^{ab}	613±0.6 ^{abc}	4.28 ± 0.12
T7, 20% CP + Met, Lys, Thr	154± 4.4 ^{abc}	143 ± 4.4^{ab}	622±13.4 ^{ab}	4.34 ± 0.16
T8, 20% CP+ Met, Lys, Thr, Iso-Leu and Val	156±4.8 ^{a}	146±4.8^{a}	593± 3.3 ^{bcd}	4.00 ± 0.03
P ≤	0.03	0.02	0.004	0.249

a, b, ... Values with no common superscripts within the same column are significantly different.

Feed consumption of chicks fed the 22% CP diet supplemented with Met, Lys and Thr was significantly higher than that of their counterparts fed on the high-protein control diets (26 or 24% CP). Whereas chicks fed the 20% CP diet with no supplemental amino acids consumed more feed compared with the two control groups. Even though the difference among groups in feed conversion were not statistically significant, chicks fed the 20% CP diet with no amino acid supplementation exhibited the worst feed conversion ratio compared to that obtained with the high-protein control diets. This is in line with that reported previously by Colnago *et al*. (1991) and Han *et al*. (1992) who found that feed efficiency of 1-3 week broiler chicks was significantly impaired when CP was reduced in the diets from 23% CP to 19% CP. Nevertheless, Han *et al*. (1992) found that feed efficiency was significantly improved when the 19% CP diet was supplemented with amino acids. Mortality rate was within the normal range, postmortem investigation indicated no relationship between treatments and mortality rate.

Regarding the economic efficiency (E.E), calculation were carried out according to prices of feed ingredients, and live weight of quail chick dominated during conducting the experiment (Table 4). The results indicated that the addition of amino acids (Met, Lys, Thr and Iso-leu) to diets containing 20% CP gave the best E.E and the reverse was noticed with diets containing either 22% or 20% CP without Iso-leu supplementation. However, the lowest E.E was recorded with diets containing 22% CP with no amino acid supplementation. Diets containing 26% CP gave a comparable E.E for diets containing 22% CP supplemented with Met, Lys and Thr.

Experiment 2:

Table 3 presented the performance of Japanese quail of experiment 2. Based on the results of experiment 1 which indicated no significant difference between the performance of the two groups fed on the control diets containing either 26% or 24% CP, the 24% CP diet served as a control in experiment 2. Live body weight and body weight gain of chicks fed the low protein diets (22 or 20% CP) were numerically decreased compared with those obtained from the control diet. However, when these diets were supplemented with Met or Lys at the same level to meet the quail chick's requirement, the chicks compensated for live body weight and body weight gain and the differences were disappeared. This confirmed the results of experiment 1. Feed consumption was not influenced by reducing crude protein in the diets. Feed conversion was slightly impaired with low protein diets (22 or 20% CP) but when these diets were supplemented with Met or Met and Lys, feed conversion was improved and did not differ from that obtained with the control diet. These results are in a good agreement with those reported by Bornstein and Lipstein (1975) who found that performance of broiler chicks fed a 19.7% CP diet supplemented with Met and Lys was equal to that obtained with a 23% CP diet. Mortality rate in the second experiment was within the normal range.

Table 3: Performance of Japanese quails, 6-weeks of age, fed low protein corn-soybean diets supplemented with amino acids, Experimnet 2.

Treatment	Live body weight (g)	Body weight gain (g)	Feed consumption (g)	Feed conversion (g/g)
T1, 24% CP	168 ± 3.1	158 ± 3.1	575 ± 2.3	3.64 ± 0.07
T2, 22% CP	160 ± 6.8	148 ± 6.2	574 ± 2.7	3.88 ± 0.19
T3, 20% CP	155 ± 2.8	144 ± 3.1	571 ± 2.1	3.96 ± 0.07
T4, 22% CP + Met	167 ± 3.9	157 ± 3.4	580 ± 7.3	3.70 ± 0.06
T5, 20% CP + Met, and Lys	165 ± 4.5	154 ± 4.5	569 ± 3.2	3.70 ± 0.11
P ≤	0.238	0.204	0.380	0.256

Results of economic efficiency (E.E) from quail chicks fed the experimental diets are summarized in Table (4). Adding Met or Met and Lys to diets containing either 22% or 20% CP increased E.E by 4% and 6%, respectively. However, diets containing 22% or 20% CP without amino acid supplementation gave the lowest E.E relative to the control diet.

ACKNOWLEDGMENT

The authors wish to thank S. Bootwalla and J. Fickler, Feed Additives Division, Degussa Huels Co., for providing the synthetic amino acids used in this study.

REFERENCES

Bornstein, S., and B. Lipstein (1975). The replacement of some of the soybean meal by the first limiting amino acids in practical broiler diets. 1. The value of special supplementation of chick diets with methionine and lysine. Br. Poultry Sci., 16:177-188.

Colnago, L., A. M. Penz, Jr, and L. S. Jensen (1991). Effect of response of starting broiler chicks to incremental reduction in intact protein on performance during growing phase. Poultry Sci., 70(Suppl. 1): 153. (Abstr.)

Duncan, D. B. (1955). Multiple range and F tests. Biometrics 11:1-42.

Fernandez, S. R., S. Aoyagi, Y. Han, C. M. Parsons and D. H. Baker, 1994. Limiting order of amino acids in corn and soybean meal for growth of chick. Poultry Sci., 73:1887-1896.

Han, Y., H. Suzuki, C. M. Parsons and D. H. Baker (1992). Amino acid fortification of a low-protein corn and soybean meal diet for chicks. Poultry Sci., 71:1168-1178.

Harms, R. H. and G. B. Russell (1993). Optimizing egg mass with amino acids supplementation of low-protein diet. Poultry Sci., 72:1892-1896.

Lepore, P. D., and H. L. Marks (1968). Protein requirements of growth selected lines of Japanese quail. Poultry Sci., 47:1688-1689.

Lopez, G. and S. Lesson (1995a). Response of b roiler breeders to low protein diets. 1. Adult breeder performance. Poultry Sci., 74:685-695.

Lopez, G. and S. Lesson (1995b). Response of broiler breeders to low protein diets. 1. Offspring performance. Poultry Sci., 74:696-701.

National Research Council (1994). Nutrient Requirement of Poultry. 9th rev. ed. National Academy Press, Washington, DC.

Parr, J. F., and J. D. Summers, (1991). The effects of minimizing amino acid excesses in broiler diets. Poultry Sci., 70:1540-1549.

Pinchasov, Y., C. X. Mendonca, and L. S. Jensen, (1990). Broiler chick response to diets supplemented with synthetic amino acids. Poultry Sci., 69:1950-1955.

SAS Institute (1990). SAS® Institute User's Guide: Statistics, 1990. Edition SAS Institute Inc., Cary, NC.

Waldroup, P. W., R. J. Mitchell, J. R. Payne and K. R. Hazen (1976). Performance of chicks fed diets formulated to minimize excess levels of essential amino acids. Poultry Sci., 55:243-253.

الاداء الانتاجى للسمان اليابانى المغذى على العلائق المكونة من الذرة و الصويا و المنخفضة فى محتواها من البروتين الخام و الممدة بالاحماض الامينية

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صممت تجربتين على 740 كتكوت سمان يابانى، عمر يوم لدراسة الاداء الانتاجى للسمان اليابانى حتى 6 اسابيع من العمر عندما يغذى على علائق منخفضة فى محتواها من البروتين الخام و مضاف اليها الاحماض الامينية. فى التجربة الاولى تم استخدام علائق منخفضة فى البروتين الخام (22، 20% بروتين خام) و مضاف اليها الاحماض الامينية ميثيونين، ليسين، ثريونين، ايزوليوسين، الفالين، و تم مقارنتها بالعلائق المرتفعة فى محتواها من البروتين الخام (26، 24% بروتين خام) كعلائق مقارنة. و فى التجربة الثانية: تم استخدام نفس العلائق المنخفضة فى البروتين الخام (22، 20% بروتين خام) و التى استخدمت فى التجربة الاولى و لكن تم اضافة فقط الاحماض الامينية ميثيو نين و ليسين و تم مقارنة هذة العلائق بعليقة تحتوى على 24% برو تين خام كعليقة مقارنة.

اوضحت نتائج التجربة الاولى ان وزن الجسم الحى و الزيادة فى وزن الجسم لكتاكيت السمان المغذاة على العلائق 22 او 20% بروتين خام تحسنت تحسنا ملحوظا عندما اضيفت الى هذة العلائق الاحماض الامينية ميثيونين و ليسين و ثريونين و لن تختلف جوهريا عن تلك الناتجة من الكتاكيت المغذاة على العلائق المرتفعة فى محتواها من البروتين الخام (24، 26% بروتين خام). بينما لن تنخفض الكفاءة التحويلية انخفاضا ملحوظا عندما انخفضت نسبة البروتين فى العلائق. اضافة الاحماض الامينية الايزوليوسين و الفالين اى العلائق المنخفضة فى البروتين لم تعطى اى تحسن فى وزن الجسم او الكفاءة التحويلية. فى التجربة الثانية: وزن الجسم او الكفاءة التحويلية لكتاكيت السمان المغذاة على العلائق المحتوية على 22 او 20% بروتين خام و المضاف اليها الاحماض الامينية ميثونين و ليسين لم تختلف معنو يا عن تلك المتحصل عليها من العليقة المحتوية على 24% بروتين خام.

Table (4): Economical efficiency (E.E) and relative economical efficiency (REE) for quail chicks fed on the experimental diets.

Treatments	Body weight (kg)	Price/ kg body wt. (LE)2	Total revenue/ chick (LE)	Total feed intake/ chick (kg)	Price/ kg feed (LE)1	Total feed cost/ chick	Fixed chick (LE)	Total cost/chick (LE)	Net revenue/ chick (LE)	Economic efficiency (EE)3	Relative (EE)4 %
Experiment 1:											
T1, 26% CP	0.160	10	1.60	0.584	0.866	0.506	0.5	1.006	0.594	0.590	104
T2, 24% CP	0.150	10	1.50	0.567	0.804	0.456	0.5	0.956	0.544	0.569	100
T3, 22% CP	0.140	10	1.40	0.575	0.750	0.431	0.5	0.931	0.469	0.504	87
T4, 20% CP	0.146	10	1.46	0.611	0.700	0.428	0.5	0.928	0.532	0.573	101
T5, 22% CP + Met, Lys & Thr	0.158	10	1.58	0.634	0.782	0.496	0.5	0.996	0.584	0.586	103
T6, 22% CP + Thr and Iso-leu	0.153	10	1.53	0.613	0.790	0.484	0.5	0.984	0.546	0.555	98
T7, 20% CP + Met, Lys & Thr	0.154	10	1.54	0.622	0.794	0.494	0.5	0.994	0.546	0.549	97
T8, 20% CP + Met, Lys, Thr, Iso-leu and Val	0.156	10	1.56	0.593	0.795	0.471	0.5	0.971	0.589	0.606	107
Experiment 2:											
T1, 24% CP	0.168	10	1.68	0.575	0.804	0.462	0.5	0.962	0.718	0.746	100
T2, 22% CP	0.160	10	1.60	0.594	0.750	0.430	0.5	0.930	0.670	0.720	97
T3, 20% CP	0.155	10	1.55	0.571	0.700	0.400	0.5	0.900	0.650	0.722	97
T4, 22% CP + Met	0.167	10	1.67	0.580	0.758	0.440	0.5	0.940	0.730	0.776	104
T5, 20% CP + Met, and Lys	0.165	10	1.65	0.569	0.742	0.422	0.5	0.922	0.728	0.790	106

1. According to the price of different ingredients available in ARE.
2. According to the price at the experimental time.
3. Net revenue per unit total costs.
4. Assuming that the relative E.E of the control group equals 100.