COMPARISON OF DIFFERENT TYPES OF PROTEIN CONCENTRATES IN FEMALE JAPANESE QUAIL DIETS AND STUDY THEIR EFFECT ON PRODUCTION AND SENSORY CHARACTERISTICS

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ABSTRACT

This study aims to manufacture protein concentrates from the hydrolysates protein of poultry feathers and camel hair and comparing the effect of using these protein concentrates on some productive characteristics. The studied traits included the percentage of egg production, feed consumption, egg weight, egg mass, feed conversion efficiency, and total mortality. As well as the sensory characteristics of meat (colour, tenderness, juiciness, flavour and general acceptance). A total of 90 quail females aged 36 weeks were randomly assigned to three treatments (3 replicates for each treatment). The birds fed the following experimental diets: The first treatment (control diet containing 5% commercial protein concentrates). The second treatment (a diet containing hydrolysates protein manufacture from the feather of 5%). The third treatment (a diet containing hydrolysates protein manufacture of camel hair by 5%). The results showed significant differences (P ≤ 0.05) in the percentage of egg production, egg mass, and feed conversion efficiency. Except for feed consumption, weight of eggs and total mortality rate, the differences were not significant. As for the sensory qualities, the quail meat samples treated with the protein concentrates made of feathers and camel hair have a higher degree of flavour compared to the control treatment. Differences did not appear in the degree of general acceptance of the meat product of birds in various treatment. It can be concluded that the addition of protein hydrolysates from poultry feathers and camel hair to the diets of Japanese quail by 5% improve the productive performance of this bird and most meat qualities.
INTRODUCTION

Japanese quail is one of avian give rise to zoological farmed and has been used as a source of animal protein recently\(^1\). Protein is an important determinant of bird growth, especially in the first few weeks of life. Since protein sources are the most expensive compared to energy sources and other components of the diet, The goal of any breeder is to reduce the total cost of producing birds as forage ingredients account for more than 70% of the total cost. It necessary to reduce the cost of feed through the use of substitutes for imported protein concentrates\(^2\). Thousands of tons of waste from poultry and other animals, especially feathers, are dumped annually\(^3\). In recent years, the poultry industry has relied on the manufacture of poultry waste, especially feathers and feed poultry, but the problem facing the use of this waste in animal diets is the difficulty of digesting\(^4\). Keratin is the main protein of feathers or camel hair. It is known as a hydrophobic protein. It contains 56 hydrophobic amino acids out of 95, and the main amino acid is serine\(^5\). Keratin contains a percentage of praline, cysteine and a little lysine. The chemical inactivity of keratin is due to the presence of strong bilateral sulphur bonds, which must be destroyed by alkaline or acidic compounds\(^6\). A protein concentrates made of feathers is a good source of protein and can be used to replace large parts of other protein sources in poultry feed\(^7\). For this reason, researchers have used chemical methods using hydrochloric acid or sodium hydroxide to break down sulphur and transverse bonds to make digestible peptides easier and can be utilized. Senkoylu,\(^8\) noted that the improvement of the production performance of laying hens fed diets using the protein concentrates made of bird feathers. This is confirmed by\(^9\). The use of protein concentrates made of feathers by (3 and 6)% in the laying hens diet resulted in a significant increase in egg production, a significant improvement in feed conversion ratio and a significant decrease in feed intake as compared to the group of birds fed a standard diet. The objective of this study is to find out the possibility of benefiting from poultry feathers and camel hair as sources of low-cost nutritional protein to support poultry diets and alternative to a known expensive protein concentrates as well as reduce the chances of environmental pollution due to the discharge of these waste in large quantities.

MATERIALS AND METHODS

This study was carried out in the field of (Japanese quail) that belong to the Department of Animal Production / Agriculture College/ University of Basra, for the period from 15/03/2019
until 15/05/2019. A total of (90) birds of (36) weeks aged females Japanese quail, they were randomly assigned into three experimental treatments by 30 birds for each treatment (each treatment three replicates of 10 birds each). Birds were housed in cages. Cages dimension was (71 * 71 * 50 cm). Feeding groups included the first treatment (control) birds fed with commercial protein (5%). The second group fed with 5% protein extracted from poultry feathers. The third group fed with 5% protein extracted from camel hair. Lighting was given 16 hours a day.

**Preparation of protein decomposition of feathers and camel hair**

Dirt and dust were removed from feathers and camel hair and washed with distilled water and dried with air, the protein hydrolysates were prepared for each according to the method described by (15). The feather and camel hair powder were moistened with distilled water and placed in the autoclave individually at a temperature of 135 °C under a pressure of 35 lb for 60 minutes.

**Chemical analysis of protein decomposition**

Chemical analysis of protein decomposition samples was carried out in the laboratories of the Faculty of Marine Sciences. The analysis included protein, fat, fibber, ash, dissolved carbohydrates, and moisture as stated by Analytical Official Association of Chemists (2). The estimated energy represented (kcal/kg) in protein decomposition was determined according to the equation of (9) cited by (17). Yield product: The percentage of all protein concentrates extracted was calculated according to the following equation:

\[
\text{Yield product} = \left( \frac{\text{dried product weight}}{\text{sample weight}} \right) \times 100
\]

**Sensory evaluation**

At the end of the experiment (60 days), the birds were slaughtered manually. The method described by (13). Using the grilling method of Price and schweight (18). According to the scale of seven degrees as follows: (1-2= is acceptable, 3-4= Acceptable, 5= Average, 6=good, 7= very good). By ten (10) randomly selected experienced panellists in the Department of Animal Production College of Agriculture University of Basrah to assess the sensory qualities that included (colour, tenderness, juiciness, flavour, general acceptance).
Table (1): Composition of imported protein concentration, feather and Camel hair meal

IPC= Imported protein concentration; FM= feather meal; CHM Camel hair meal.

| Diet     | Dry matter (%) | ME (kcal/kg) | CP (%) | Fat (%) | Crude Fibbers (%) | Ash (%) | Yield (%) |
|----------|----------------|--------------|--------|---------|-------------------|---------|-----------|
| IPC      | 94             | 2800         | 49     | 12      | 10                | 8       | -         |
| FM       | 96.2           | 2375         | 85.15  | 5.80    | 4.85              | 4.20    | 17.9      |
| CHM      | 97.4           | 2240         | 90.20  | 3.60    | 3.30              | 2.90    | 17.8      |

Table (2): Compositions and chemical analysis of the diet used in the experiment

| Ingredients                  | Control Diet 1 | Diet 2 | Diet 3 |
|------------------------------|----------------|--------|--------|
| Yellow corn                  | 43.2           | 43.2   | 43.2   |
| Wheat                        | 22             | 22     | 22     |
| Wheat bran                   | 3              | 3      | 3      |
| Imported Protein concentrated (IPC) | 5              | 0      | 0      |
| Feather meal (FM)            | 0              | 5      | 0      |
| Camel hair meal (CHM)        | 0              | 0      | 5      |
| Soybean meal                 | 20.5           | 20.5   | 20.5   |
| Limestone                    | 5.5            | 5.5    | 5.5    |
| Oil plant                    | 0.5            | 0.5    | 0.5    |
| Iodide salt                  | 0.3            | 0.3    | 0.3    |
| Total                        | 100            | 100    | 100    |
| Metabolic energy (kcal/kg)   | 2910           | 2888.75| 2882   |
| Protein (%)                  | 19.2           | 21.01  | 21.26  |
| Crude Fibbers (%)            | 2.50           | 2.24   | 2.17   |
| Ash (%)                      | 6.06           | 5.87   | 5.81   |
| Methionine                   | 0.4456         | 0.3724 | 0.3522 |
| Lysine                       | 1.211          | 1.352  | 1.021  |
| Methionine + cysteine        | 0.766          | 0.728  | 0.742  |
| Calcium (%)                  | 2.5            | 2.5    | 2.5    |
| Phosphorus (%)               | 0.4228         | 0.4062 | 0.3956 |

Calculated nutrient levels in diets
Data collection

Egg production was recorded daily and feed consumption, egg mass, and egg weight were recorded at two weekly intervals. Feed conversion ratio (FCR) was calculated by determining the amount of feed consumed per one kg of egg.

Statistical analysis

The data from the experiment were analysed by using the Complete Randomized Design (CRD) were executed to a one-way ANOVA within the statistical program SPSS as the following model:

\[ y_{ij} = M + T_i + e_{ij} \]

Where \( y_{ij} \) = the value of each trait.

\( M \) = the common mean

\( T_i \) = the effect of the nutritional treatment \( i=3 \)

\( e_{ij} \) = the experimental error

Mean were compared by Least Significant Difference Test at \( P \leq 0.05 \).

RESULTS

Egg production, feed conversion ratio, egg mass were significantly \( p \leq 0.05 \) affected by treatments (Table 3). Egg production of the FM and CHM treatments groups was superior to the control group: 85.92, 87.66 vs. 82.29 %, respectively. The feed conversion ratio of the control treatment was the highest and lowest in FM and CHM treatments groups: 2.98 vs. 2.82, 2.76 g/g respectively. Egg mass was significantly \( P \leq 0.05 \) highest in the transactions that were fed on the diet with FM and CHM as compared with the control group: 641.29, 652.22 vs. 609.18 g, respectively. There were no statistically significant differences between control and other treatment in feed consumption, percentage of mortality and egg weight.
The results of sensory testing are as shown in Figure 1. Colour, tenderness, juiciness, and general acceptance there were not significantly different from those of other treatments. Flavor in the, FM and CHM treatments were significantly (p≤0.05) Improved than of the Control.

Table (3). Effects of feather meal and camel hair meal and imported protein concentration on quail performance (36 to 45 wk. of age).

| diet   | HDP (%) | FC (g/hen/60day) | EW (g) | EM (g/hen per60 d) | FCR (g of feed/g of egg) | Mortilaty (%) |
|--------|---------|------------------|--------|--------------------|--------------------------|---------------|
| IPC    | 82.29a  | 1812.73          | 12.34  | 609.18b            | 2.98b                    | 0.067         |
| FM     | 85.92a  | 1809.33          | 12.44  | 641.29a            | 2.82a                    | 0.033         |
| CHM    | 87.66a  | 1144.6v          | 12.40  | 652.22a            | 2.71v                    | 0.067         |
| SEM    | 0.852   | 6.63v            | 0.043  | 7.381              | 0.038                    | 0.018         |
| P      | 0.003   | 0.763            | 0.673  | 0.013              | 0.023                    | 0.729         |

IPC= Imported protein concentration; FM= feather meal; CHM= Camel hair meal; HDP = hen day production; EW = egg weight; FC = feed consumption (g/60 day); FCR = feed conversion ratio (g of feed consumed per g of egg produced); EM = egg mas (g/hen per60 day); SEM = standard error of means; a,b,c means in the same column having different superscript are significantly different (P≤ 0.05)

Figure 1. Effects of feather meal and camel hair meal and imported protein concentration on Sensory evaluation of quail meat.

IPC= Imported protein concentration; FM= Feather meal; CHM= Camel hair meal
DISCUSSION

Significant improvement in egg production, egg mass and feed conversion ratio in treatments use feather and camel hair hydrolysate in bird diets can be attributed to the high crude protein content in these diets leading to the development of the reproductive system. The conversion of keratin in feathers and camel hair hydrolysate makes it useful for feeding poultry. Exposing feather and camel hair to steam temperatures, pressure, or chemical treatments leads to denaturation of the protein and the breakage of the peptide chains into a form that digestive enzymes can act on\(^6\). This is confirmed by Appleby et al. \(^5\); their changes in keratin form under the influence of heat, which facilitate the work of digestive enzymes and thus improves their nutritional qualities, which reflected in digestibility improvement. The majority of essential amino acids, particularly lysine and methionine, these acids are available with a balance \(^7\) Abd El-Maksoud et al. \(^3\) confirmed the significant effect of different crude protein levels on layer performance, where egg mass and egg production increased with increasing protein levels for laying hen diets. Besides, Mousav et al. \(^16\) observed a linear increase in hen-day egg production with an increase in crude protein. A similar finding was reported by \(^20\). this proved that feather meal does not have any effect on mortality of chicks.

The flavour of the quail meat used in the experiment was more desirable when using the protein hydrolysate of feathers and camel hair was very good while the use of commercial protein obtained a medium degree and the reason is that the commercial protein contains fish powder in its composition, which affected the flavour of the meat.

CONCLUSIONS

The findings of this study suggested that the use of 5% feather or camel hair in the diet of female Japanese quails are recommended for laying period.
مقارنة أنواع مختلفة من المركبات البروتينية في علاق اناث السمان الياباني ودراسة تأثيرها في بعض الصفات الإنتاجية والحسية

صبح كاظم مرزوق الحمو

الخلاصة

تهدف هذه الدراسة إلى تصنيع المركبات البروتينية من المتخلل البروتيني لريش الدواجن ووبر الجمال، ومقارنة تأثير استخدام هذه المركبات البروتينية في علاقات طيور السمان على بعض الصفات الإنتاجية التي تتمثل بنسبة إنتاج البيض والoufl المستهلك ووزن البيض وكفاءة التحويل الغذائي والصفات الحساسية للحم تتمثل باللون والطراوة والعصيدة والنكهة والقبول العام واستخدام في الدراسة 90 من إناث السمان بعمر 26 أسبوعاً وزعتم عشوائياً على ثلاثة معاملات بواقع ثلاثة مكررات لكل مكرر 10 طيور ذكر الطيور بالمعاملات التجريبية التالية: المعاملة الأولى (علاقة سبعة تحتوي على المركز البروتيني التجاري بواقع 5%)، المعاملة الثانية (علاقة تحتوي على المتخلل البروتيني المصدر من الريش بواقع 5%), المعاملة الثالثة (علاقة تحتوي على المتخلل البروتيني المصدر من الوبر بواقع 5%). أشارت نتائج التحليل الإحصائي إلى وجود فروق معنوية (P<0.05) في نسبة إنتاج البيض وكفاءة التحويل الغذائي. أما العلاقة بين الوزن، فوجدت عيّنات لحم السمان المعالمة بالمركز البروتيني المصدر من الريش والوبر درجة أعلى في صفة النكهة مقارنة بمعالمة السيطرة ولم تظهر اختلافات في درجة القبول العام للحم المنتج من الطيور في المعاملات المختلفة. يمكن الاستنتاج بأن إضافة المتخللات البروتينية المصنعة من ريش الدواجن ووبر الجمال إلى علاقات الإنتاج لطائر السمان الياباني بنسبة 5% تعمل على تحسين الأداء الإنتاجي لهذا الطائر في معظم الصفات.
REFERENCES

1. Al-Salhie , K. Ch. K., Al-Hummod, S. K. M. & Abbas, R. J. (2017). Effect of Supplementation Different Levels of Vitamin E and Pumpkin Seed Oil to the Diet on Productive, Physiological and Reproductive Performance of Japanese Quail. Basrah J. Agric. Sci., 30 (2): 50-58

2. A.O.A.C.(2001). Official methods of analysis 13th Ed Association of Official Analysis Chemists, Washington D.C.

3. Abd El-Maksoud, A., S.E.M. El-Sheikh, A.A. Salama and R.E. Khidr,(2011). Performance of local laying hens as affected by low protein diets and amino acids supplementation. Egypt. Poult.Sci., 31: 249-258.

4. Ajayi, H. I. and Iyayi, E. A. (2014). Ileal nutrient digestibility and performance in broiler chickens Anim. Sci. 12(2): 9-15.

5. Appleby, M. C.; Hughes, B. O. & Elson, H. A. (1992). Poultry production systems, Behavior, Management and Welfare, CAB International Wallingford Oxon 108E UK.

6. Chrry, J. P.; Young, C. T. and Shewfelt, A. C. (1975). Characterization of protein isolated keratinous material of poultry feathers. J. Food Sci., 40:331-335.

7. Hasni, M. S., H. A. Sahito and Memon, M. A.(2014). Effect of Feeding Various Levels of Feather Meal as afed graded levels of feather meal. Ibadan Journal of Agricultural Research. 10 (1): 78-87.

8. Haryanto, A., M. Purwaningrum, M. Andityas and Wijayanti, N. (2017). Effect of Chicken Feather Meal on the Feed Conversion Ratio and Blood Lipid Profile of Broiler Chickens. Asian J. Poult. Sci., 11 (2): 64-69.

9. Janssen, W. M. M. A. (1989). European table of energy values for feedstuffs. 3rd. ed. Spelderholt Center for Poultry Research and Information Services, Bekbeergen, The Netherlands.
10. Jerrold, E. W., James, H. M., Jessie, A. M. and Walter, S. (2003) Potential of Chicken Feather Fiber in Wood MDF Composites, EcoComp2003, and Queen Mary Univ. Of London, p1-6.

11. Kida, K.; Morimura, S.; Noda, J.; Nishide, Y.; Imai,T. and Dtagiri, M. (1995). Enzymatic hydrolysis of the horn and hoff of cow and buffalo J. Fermentation and Bioengineering (Japan) 8:478-484.

12. Lee, S. M., H. S. Lim, N. Namgung, B. H. Lee and Paik ,I. K.(2010). Taurine Enrichment of Eggs with Feather Meal and Pyridoxine. Asian-Aust. J. Anim. Sci. 23(5):622-629.

13. Levie, A. (1970). The meat hands book 1st Ed. The AVI Publishing Co. Connecticut, West port.

14. Mokrejs, P., P. Svoboda, J. Hrncirik, D. Janacova and V. Vasek, (2011). Processing poultry feathers into keratin hydrolysate through alkaline-enzymatic hydrolysis. Waste Manag. Res. 29: 260-267.

15. Morris, W. C. and Balloum, S. L. (1973). Evaluation of five differently processed feather meals by nitrogen retention, net protein values xanthin dehydrogenase activity and chemical analysis. Poultry Sci., 45: 4140-4148.

16. Mousavi SN, Saeed K, Ghasemi-JirdehiAbdollah, and Farhad F (2013). Investigation on the effects of dietary protein reduction with constant ration of digestible sulphur amino acids and threonine to lysine on performance, egg quality and protein retention in two strains of laying hens. Italian J.

17. NRC., 1994. Nutrients Requirements of Poultry. 9th Rev. Edn., National Academic Press, Washington, USA. ISBN-13:9780309596329, Pages: 156.

18. Price, J.F. and sehweigert, B.S(1971) The science of meat and meat products W.H .Freeman and Co., San Francisco.

19. Senkoylu, N. H. E. Samli, H. Akyurek, A. Agma, and Yasar, S. (2005). Performance and Egg Characteristics of Laying Hens Fed Diets Incorporated with Poultry By-Product and Feather Meals.J. Appl. Poult. Res. 14:542–547.
20. Xavier, S. A. G., J. H. Stringini, A. B. de Brito, M. A. Andrade, M. B. Cafe, N. S. M. Leandro. (2011). Feather and blood meal in pre-starter and starter diets for broilers. R. Bras. Zootec., 40(8): 1745-1752.