Effect of dietary protein levels on body growth and carcass fat and protein deposition in female Japanese quail

M. HASHIGUCHI* and Y. YAMAMOTO

University Farm, Faculty of Agriculture, Kagawa University, Sanuki-shi, Kagawa 769-2304, Japan
*Corresponding author: hasiguti@ag.kagawa-u.ac.jp

This study were performed to describe the patterns of body growth and carcass fat and protein deposition in female Japanese quail fed diets containing different amounts of protein. The experimental diets were formulated to contain 24%, 19% and 14% protein, and fed three groups of female quail from 7 days of age. The birds were weighed on every 7 days from 7 to 56 days of age, and then their carcass fat and protein were determined. Body weight at 14 days of age was decreased with decreased protein level in diets. No significant differences were observed in body weight between 24% and 19% protein group during the period from 21 to 56 days of age. However, the body weight of 14% protein group was lighter than that of 24% and 19% protein group during the period from 21 to 42 days of age, and was not different from that of other protein groups at 49 and 56 days of age. Estimated age at maximum body growth rate for Gompertz growth model was later in 14% protein group when compared with 24% and 19% protein group. Though the amount of carcass fat at 14 days of age was less in 24% group than in 19% and 14% groups, the amount at 28 days of age was higher in 24% group than in other groups. At 35 days of age, the amount of carcass fat was decreased with decreased dietary protein level, and thereafter no differences were observed in the amounts of carcass fat among 3 groups. The amount of carcass protein decreased with decreased dietary protein at 14 and 21 days of age, but was higher in 24% and 19% group than in 14% group. Thereafter no differences were observed in the amount of carcass protein among different protein groups.

Keywords: dietary protein; body growth; body composition; quail

Introduction

It is well known that dietary protein level influences the body growth and composition of domestic fowl. Feeding low protein diet depressed the growth in pullets (Kim and McGinnis, 1976; Hussein et al., 1996). In female Japanese quail, Hashiguchi et al. (1998) reported that feeding low protein diets lowered body weight at sexual maturity. Also, Annaka et al. (1993) and Marks (1993) indicated that body weight gain decreased linearly with decreasing dietary protein level in quail. Lilburn and Meyer-Miller (1990) suggested that body fat and protein depositions were increased and decreased, respectively, by decreasing dietary protein level in broiler breeder hen. Kirkpinar and Oguz (1995) stated that feeding low protein diets increased carcass fat content and decreased carcass protein content in female quail. The present study was performed to investigate the effects of low protein diets on the patterns of body growth and carcass fat and protein deposition in female Japanese quail.

Materials and methods

Female Japanese quail (Coturnix coturnix japonica) were used in this experiment. The female
quail were divided in three groups, which had 7 subgroups (8 quail in each subgroup) on the basis of weight at 7 days of age. The birds were maintained in temperature controlled environment and under 16 hr light and 8 hr dark. The experimental diets included a corn-soybean meal basal were formulated to contain 24%, 19% and 14%, each diet having the same metabolizable energy (12.34MJ/kg). The diets were fed the birds of 3 groups from 7 days of age. Feed and water were provided for ad libitum consumption. All procedure involving animals were approved by the Experimental Animal Care Committee of the Kagawa University.

Birds were weighed on every 7 days from 7 to 56 days of age, and then 5 birds near the average body weight from each group were selected and sacrificed by decapitation. After feathers were taken out, the body cavity was opened and reproductive organ, gastrointestinal tract and liver were removed. The carcass was frozen at 28 C until the composition was analyzed. The carcass was thawed, then minced and homogenized thoroughly in blender. Replicate samples were randomly taken from the homogenized carcass and analyzed for carcass fat and protein contents. Carcass fat content was measured gravimetrically. The fat of dried samples was extracted with diethyl ether and weighed after removing residual solvent and water (AOAC, 1990). Carcass protein content was determined following the Kieldahl method. The Gompertz equation was used to describe the growth of the birds as follows (Du Preez and Sales, 1997): \( W_t = A \exp(- \exp[- k(T - T_i)]) \) where \( W_t \) is the body weight at day \( T \), \( A \) is body weight at maturity, \( k \) is the growth rate constant and \( T_i \) is the age at maximum growth rate.

Statistical analysis for data was performed by one-way ANOVA. Individual treatment differences were tested by Duncan’s multiple range test. Statistical significance were accepted when \( P<0.05 \).

**Results and discussion**

Figure 1 shows changes in body weight of female Japanese quail fed low protein diets. Body weight at 14 days of age was decreased with decreased protein level in diets and was statistically significant different among 3 groups. No significant differences were observed in body weight between 24% and 19% protein group during the period from 21 to 56 days of age. However, the body weight of 14% protein group was lighter than that of 24% and 19% protein group during the period from 21 to 42 days of age, and was not different from that of other protein groups at 49 and 56 days of age. Preez and Sales (1997) stated that body growth curve is useful in gaining knowledge about the growth of bird. In this study, when body weights during the growth were fitted Gompertz equation, the estimated age at maximum body growth rate was later in 14% protein group when compared with 24%
and 19% protein groups (Table 1). Therefore, the present results indicated that dietary protein changed the pattern of body growth in female Japanese quail. As shown Figure 2, though the amount of carcass fat at 14 days of age was lower in 24% group than in 19% and 14% group, the amount at 28 days of age was higher in 24% group than in other groups. At 35 days of age, the amount of carcass fat was decreased with decreased dietary protein levels and was significantly varied among 3 groups. During the period from 42 to 56 days of age, no differences were observed in the amounts of carcass fat among 3 groups. Thus, in this study carcass fat content was higher in 24% group than in 14% group at 28 and 35 days of age, but did not vary among groups from 42 to 56 days of age. These results is not

Table 1 Body growth curve parameter for female Japanese quail fed low protein diets.

<table>
<thead>
<tr>
<th>Protein level (%)</th>
<th>Mature body wt (g)</th>
<th>Growth rate constant</th>
<th>Age at maximum body growth rate (days)</th>
<th>R²</th>
</tr>
</thead>
<tbody>
<tr>
<td>24</td>
<td>141.9 ± 3.3</td>
<td>0.072 ± 0.004</td>
<td>17.34 ± 0.54</td>
<td>0.998</td>
</tr>
<tr>
<td>19</td>
<td>140.3 ± 4.1</td>
<td>0.071 ± 0.005</td>
<td>18.05 ± 0.68</td>
<td>0.997</td>
</tr>
<tr>
<td>14</td>
<td>156.4 ± 14.7</td>
<td>0.048 ± 0.007</td>
<td>25.08 ± 2.47</td>
<td>0.993</td>
</tr>
</tbody>
</table>

Figure 2 Effect of low protein diets on the carcass fat content of female Japanese quail.

Figure 3 Effect of low protein diets on the carcass protein content of female Japanese quail
similar to reports that feeding low protein diets increased carcass fat content in female quail (Kirkpinar and Oguz, 1995) and in broiler breeder hen (Lilburn and Meyer-Miller, 1990). It is well known that lipid metabolism is accelerated by estrogen secreted from ovary in birds. Hashiguchi et al. (1998) reported that ovary growth was delayed by low protein diets in female Japanese quail. Therefore, ovary function may be related with the body fat deposition of female quail at 28 and 35 days of age. The carcass protein content of female quail fed low protein diets is shown in Figure 3. The amount of carcass protein at 14 and 21 days of age decreased dietary protein level and was significantly varied among different protein groups. At 28, 35 and 42 days of age, the amount of carcass protein was higher in 24% and 19% group than in 14% group and thereafter no differences were observed in the amount of carcass protein among different protein groups. These results suggested that low protein diet depressed the body protein deposition of female quail until the birds reached at age near mature.

References


