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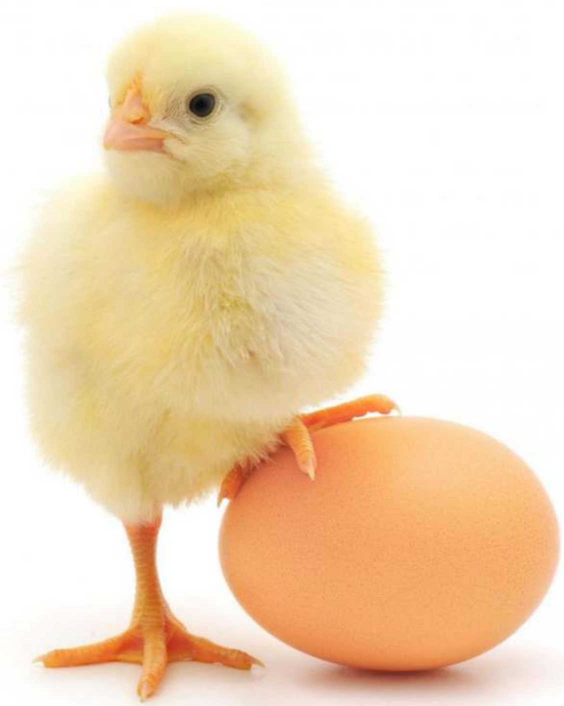

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# Effects of Dietary Protein and Energy on Growth Performance and Carcass Characteristics of Betong Chickens *(Gallus domesticus)* During Growing Period

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**Abstract:** The objective of this study was to investigate the requirements of protein and energy level of the Betong chicken during growing period (42-84 days of age). Total of 288 42-days old of Betong chickens were used in a 4 x 2 factorial experiment with a completely randomized design. Two factors are included in the experiment design: 1) four dietary protein levels (15, 17, 19 and 21% CP) and 2) two dietary energy contents (3,000 and 3,200 ME kcal/kg). The chicks were allocated in floored pen. Feed and water were provided to the chicks *ad libitum* through an experimental period. There was no significant interaction effect between protein and energy levels on growth performance and carcass yields of the birds. Dietary protein level of 19-21% CP and energy content of 3,000 ME kcal/kg were sufficient for the best performance and carcass quality of the Betong chicken. In conclusion, dietary protein levels of 19% CP and energy content of 3,000 ME kcal/kg are recommended for the birds.

**Key words:** Betong chicken, protein, energy, productive performance

## INTRODUCTION

The improvement in growth performance of the poultry has resulted in an excessive fat deposition that is undesirable for both producer and consumer. Therefore, there is a great attention to improve the carcass meat and reduce carcass fat deposition. Many nutritionists have attempted to reduce the carcass fatness by modification of feeding programs and nutrients concentration in the diet such as limiting feed intake, reduced energy consumption, variations of protein and energy levels as well as restriction of feed. Among them, carcass composition is the most easily influenced by the levels of protein and energy (Summers *et al.*, 1992; Leeson and Summers, 2000). However, it is generally known that the most important factor influenced to carcass composition is the potential genetics of the animal. Nordstrom *et al.* (1978) found that strain and sex have a greater influence on fat deposition than dietary energy level. Leclercq *et al.* (1980) have shown that family selection for abdominal fatness of siblings is an effective experimental means of producing lean and fat lines of chicken.

The Betong chicken is a meat type strain, which is popular in the Southern region of Thailand. Since the Betong is considered to produce high meat quality (low carcass fat and high lean meat). Moreover, the Betong meat is softer and the taste is better than other Thai native chicks, but it is not flabby as broiler's meat (Gongruttananun and Chotesangasa, 1996). Recently, the Betong is getting higher in demand from consumers. Nonetheless, information of nutrients requirement of the Betong are limited, particularly energy and proteins requirement. Our previous study on growth development of the Betong had showed that the growth pattern of the Betong chicken could be divided into starter (0-6 weeks of age), grower (6-12 weeks of age) and finisher periods (Nguyen and Bunchasak, 2005). At starter period, it was found that protein and energy requirement of 17-18% CP and 3,000 ME kcal/kg, respectively (Nguyen and Bunchasak, 2005). Thus, the object of this study was therefore aimed to investigate the protein and energy requirements of the Betong chicken during grower period.

## MATERIALS AND METHODS

**Animal and management:** Two hundred and eighty eight of Betong chickens (42-days old) were individual weighed and randomly divided into eight treatment groups with four replicates in each group and randomly allocated in floored pens. According to treatment groups (8 combinations), the chicks were arranged in 4 x 2 factorials in completely randomized design. Two factors are included in the experiment design: 1) four dietary protein levels (15, 17, 19 and 21% CP) and 2) two dietary energy contents (3,000 and 3,200 ME kcal/kg). Light and temperature were kept according to conventional rearing practice.

**Experimental diets:** All experimental diets were formulated to provide similar nutrients content according to the broiler's nutrients requirement for growing period suggested by NRC (1994), except protein and energy levels (Table 1). According to the experimental design, these diets were consisted four dietary protein levels

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Table 1: Feed ingredients and compositions of experimental diets

| | Treatments diets (%) | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Ingredients | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| Corn | 63.91 | 57.20 | 65.45 | 60.42 | 65.70 | 66.23 | 68.00 | 64.03 |
| Rice bran | - | - | 3.60 | 5.50 | 8.44 | 5.76 | 8.00 | 10.00 |
| Rough rice bran | - | - | - | - | - | - | 2.50 | 1.50 |
| Palm oil | 0.19 | 5.00 | - | 3.70 | - | 2.83 | - | 3.50 |
| Soybeanmeal (44% CP) | 26.35 | 29.20 | 22.80 | 20.70 | 18.40 | 16.00 | 14.55 | 13.40 |
| Fishmeal (55% CP) | 7.80 | 6.50 | 6.00 | 8.00 | 4.85 | 7.21 | 4.00 | 5.00 |
| Oyster shell meal | 0.75 | 0.81 | 0.95 | 0.81 | 1.11 | 0.90 | 1.26 | 1.11 |
| Dicalcium phosphate P 0.18 | 0.20 | 0.50 | 0.50 | 0.10 | 0.70 | 0.28 | 0.89 | 0.67 |
| Salt | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 | 0.30 |
| Premix* | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 | 0.50 |
| Total | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 | 100.00 |
| **Compositions** | | | | | | | | |
| CP (calculated) | 21.00 | 21.00 | 19.00 | 19.00 | 17.00 | 17.00 | 15.00 | 15.00 |
| CP (analyzed) | 21.15 | 21.55 | 19.55 | 19.05 | 17.37 | 17.45 | 16.01 | 16.35 |
| ME (calculated) | 3,000 | 3,200 | 3,000 | 3,200 | 3,005 | 3,200 | 3,000 | 3,200 |
| GE (analyzed) | 3,652 | 3,785 | 3,655 | 3,823 | 3,685 | 3,825 | 3,696 | 3,855 |
| Calcium (calculated) | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| Available P. (calculated) | 0.45 | 0.45 | 0.45 | 0.45 | 0.45 | 0.45 | 0.45 | 0.45 |

*Content per kg premix: Vitamin A 4,800,000 IU; Vitamin D3 960,000 IU; Vitamin E 3.20 g; Vitamin K3 0.80 g; Vitamin B1 0.4 g; Vitamin B2 0.6 g; Vitamin B6 1.2 g; Vitamin B12 0.0047 g; Pantothenic acid 3.8 g; Niacin 6 g; Folic acid 0.2 g; Biotin 0.036 g; Selenium 0.04 g; Iron 24 g; Manganese 24 g; Zinc 16 g; Copper 2.4 g; Iodine 0.14 g

(15, 17, 19 and 21 %CP) and two energy contents (3,000 and 3,200 ME kcal/kg), thus there were 8 combinations (four levels of protein in each energy level).

**Data record:** Body weight and feed consumption were recorded weekly. At 84 days of age, after final weighing, one male and one female from each replication that had body weight closed to the replicate mean were chosen to evaluate carcass quality. Before the evaluation, these chicks were banded and moved for an overnight without of feed (approximately 12 h) while water was offered *ad libitum*. The carcass weight, abdominal fat pad, liver, gizzard, heart, breast meat, thigh, wing and legs were immediately excised, weighed and recorded.

**Statistical analysis:** The data were analyzed by two-way ANOVA using General Linear Model (GLM). Data in percentage was tested for normally distributed before analysis of variance. A probability level of $p<0.05$ was considered significant. Significant treatment means were further analyzed by using Duncan's multiple range tests.

## RESULTS AND DISCUSSION

There was no significant interaction effect between protein and energy levels on any parameters observed on the Betong chicken. Therefore, only main effects of protein levels and energy contents were considered to determine the requirements of dietary protein and energy levels on growth performance and carcass quality of the Betong chicken.

**Growth performance:** Table 2 shows the growth performance and feed utilization of the Betong chicks during 42-84 days of age. Dietary protein levels significantly increased growth performance and improved FCR ($p<0.05$). The best body weight gain occurred at the chicks fed the highest protein levels (21% CP); although the chicks fed with 19% CP was not significantly differ among experimental groups (Fig. 1). In contrast, the chicks fed the lowest levels of protein diet used largest amount of feed for gain ($p<0.05$), meanwhile FCR tends to improve with increasing of protein level. There was no difference in feed intake, but protein intake was significantly increased ($p<0.05$) with dietary protein level increased. However, there was no significant different of dietary proteins on Protein Conversion Ratio (PCR) and energy intake (Table 2). Increasing dietary energy content from 3,000-3,200 ME kcal/kg leads to improve body weight gain from 838-910 g/b and increased energy intake from 9,097-10,126 ME kcal/kg ($p<0.01$). However, energy levels did not show significant effect on feed intake, FCR, CP intake and PCR of the experimental birds.

Increasing dietary protein significantly improved growth performance of the Betong chicks, since body weight was closely related with protein contents in the diet ($R^2 = 0.99$) (Fig. 1). The results are agreed with several investigators who showed that increased dietary protein content resulted in an improvement of growth performance (Jackson *et al.*, 1982; Smith and Pesti, 1998; Temim *et al.*, 2000). Parsons and Baker (1982) also reported a significant linear reduction in both rate and efficiency of gain of broilers chicks when dietary protein level was decreased from 24-16%. Sterling *et al.* (2002) found that broiler chicks fed low protein diet grew slower than the chicks fed higher protein diet. The growth performance of the Betong chicken in present study is also agreed with the performances of other Thai indigenous chicken at 6-16 weeks of age (Choprakarn

Table 2: Effects of dietary protein and energy levels on growth performance and feed utilization of Betong chicks at growing period (42-84 days of age)

| CP (%) | Weight gain (g/b) | Feed intake (g/b) | FCR (Feed:gain) (g/g) | ME intake (kcal/b) | CP intake (g/b) | PCR[1] (Protein:gain) (g/g) |
|---|---|---|---|---|---|---|
| 15 | 844.57[b] | 3,390 | 4.03[a] | 9,833 | 508.60[b] | 0.60 |
| 17 | 852.35[b] | 3,176 | 3.75[ab] | 9,857 | 540.03[b] | 0.64 |
| 19 | 882.57[ab] | 3.042 | 3.45[b] | 9,421 | 577.98[ab] | 0.66 |
| 21 | 918.32[a] | 2,992 | 3.26[b] | 9,297 | 620.22[a] | 0.68 |
| P-value | 0.0256 | 0.1926 | 0.0376 | 0.4104 | 0.0147 | 0.4115 |
| **ME (kcal)** | | | | | | |
| 3,000 | 838.06[b] | 3,032 | 3.63 | 9,097[b] | 543.11 | 0.65 |
| 3,200 | 910.85[a] | 3,268 | 3.61 | 10,126[a] | 580.31 | 0.64 |
| P-value | 0.0003 | 0.0969 | 0.8909 | 0.0023 | 0.1237 | 0.7422 |
| ME*CP | 0.4434 | 0.3221 | 0.6284 | 0.1772 | 0.3327 | 0.6468 |

[a-b-c-d]Means followed by different superscripts within a column are significantly different. [1]PCR = Protein Conversion Ratio

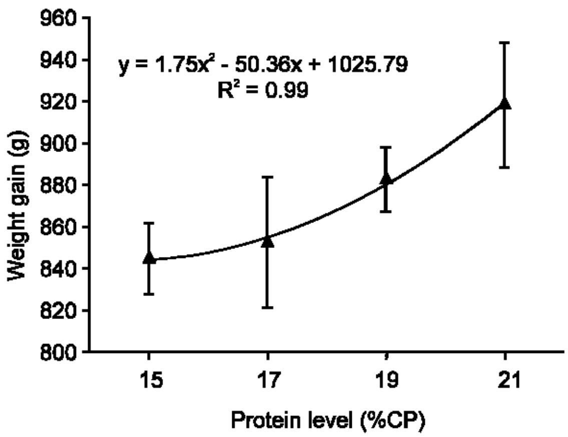


Fig. 1: Means of Betong weight gain of the experimental birds affected by four levels of protein diet (%CP) during 42-84 days of age. Vertical bars indicated ±SEM

*et al*., 2002). When applied dietary protein levels of 23, 27 and 31% CP on broilers, Brown and Cartney (1982) found the significant effect on FCR, while total amount of feed intake was similar. This observation also supported our significant result in FCR.

The feed intake is similar among treatments throughout the experimental period. However, when dietary energy increased from 3,000-3,200 kcal ME/kg, the energy intake was also significantly increased. Morris (1968) found that the hen tended to over consume energy on high nutrient density diets. This indicates that the chicks were over consuming on energy and therefore eating toward dietary protein levels (Brown and McCartney, 1982). In present study, this is indicated the significant effect of protein levels on FCR and CP intake, but not of energy levels.

**Carcass yield:** Relative carcass part yields of Betong were calculated based on carcass weight. Varying protein levels did affect only the abdominal fat yield of the Betong ($p<0.01$). The abdominal fat of the chicks fed with dietary protein lower than 19% CP were significantly increased ($p<0.01$) (Table 3). On the other hand, dietary protein levels did not show significant effect on carcass weight, breast meat, thigh, wing and legs and giblet yields. The results are agreed with Leeson *et al.* (1996a); Smith and Pesti (1998) and Renden *et al.* (1992) who found that levels of protein in diet did not affect carcass yield and protein deposition. Since, abdominal fat yields of chick fed 19 or 21% CP were not significantly differed between each other, Leeson and Summers (2000) also reported that except very low protein diets are used, dietary protein levels have no effect on the quality of protein deposited in the carcass. In addition, Summers *et al*., 1992; Smith and Pesti, 1998; Leeson and Summers, 2000 showed that abdominal fat pad was negatively related to dietary protein levels.

Dietary energy level significantly affected carcass part yield of the Betong chicken. Higher dietary energy significantly increased carcass weight (1,168 vs 1,146) ($p<0.05$), decreased wing and legs yield and giblets yield ($p<0.05$) and increased abdominal fat yield ($p<0.01$). However, there was no significant effect of dietary energy on breast meat and thigh meat (Table 3). The effect of dietary energy on broilers carcass has been found by Leeson *et al.* (1996a,b) who showed that growth rate was reduced, carcass fatness was increased while breast meat yield was not affected when dietary energy was reduced. The significant effects of energy content in the yields of wing and legs weight and the yield of giblets might due to the fact that carcass composition is easily influenced by the balance of energy to protein in the diet. And the fact that dietary energy to protein ratio is the most widely nutritional factor that affects carcass component (Leenstra and Cahaner, 1991; Wang *et al*., 1991; Marks, 1990).

Figure 2 shows the combination of responses of the Betong chicken to dietary protein levels during 42-84 days of age. It consists of four economical factors as body weight gain, FCR, PCR and abdominal fat. As seen in Fig. 2, when dietary protein levels increased from 15-17% CP, the body weight gain was slightly improved,

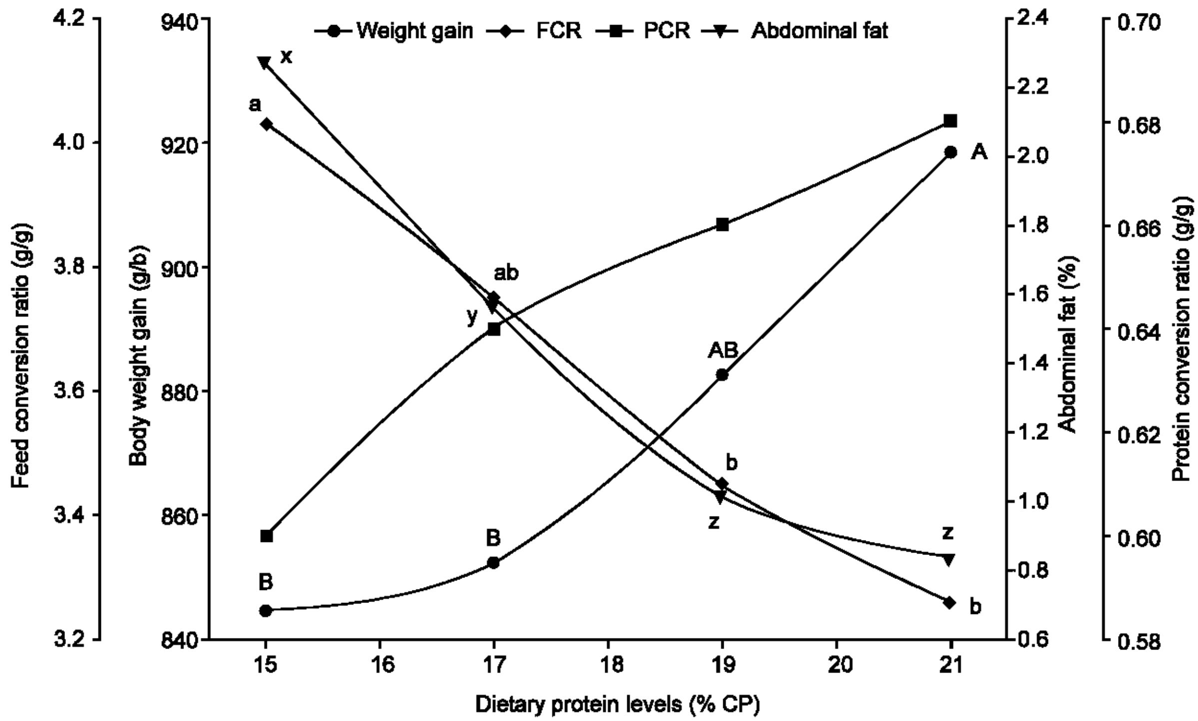


Fig. 2: Response of the Betong chicken to dietary protein levels during grower period

Table 3: Effects of dietary protein and energy contents on carcass yields of Betong chicken at 84 days of age

| | (% Carcass weight) | | | | | |
|---|---|---|---|---|---|---|
| CP (%) | Carcass weight (g)[1] | Breast meat | Thigh | Wing and leg | Abdominal fat | Giblets[2] |
| 15 | 1,141 | 11.12 | 25.84 | 15.13 | $2.27^{a}$ | 15.13 |
| 17 | 1,150 | 11.47 | 26.12 | 14.99 | $1.56^{b}$ | 14.99 |
| 19 | 1,189 | 12.09 | 25.76 | 14.97 | $1.01^{c}$ | 14.97 |
| 21 | 1,187 | 12.00 | 26.55 | 15.08 | $0.83^{c}$ | 15.08 |
| P-value | 0.0914 | 0.0913 | 0.2798 | 0.9251 | 0.0001 | 0.9251 |
| **ME (kcal)** | | | | | | |
| 3,000 | $1,146^{a}$ | 1169 | 26.11 | $15.27^{a}$ | $1.06^{b}$ | $15.27^{b}$ |
| 3,200 | $1,186^{b}$ | 1165 | 26.03 | $14.81^{b}$ | $1.78^{a}$ | $14.82^{a}$ |
| P-value | 0.0177 | 0.9017 | 0.7779 | 0.0241 | 0.0003 | 0.0241 |
| ME*CP | 0.0880 | 0.6074 | 0.0938 | 0.6170 | 0.1999 | 0.6170 |

[a-b-c]Means followed by different superscripts within a column are significantly different.

[1]Carcass = Carcass weight after bleeding and removing feathers. [2]Giblets = Liver + heart + gizzard

then it was rapidly increased from 17-21% CP ($p<0.05$); the FCR was dramatically significantly decreased from 15-19% CP and then slightly responded from 19-21% CP. The result of abdominal fat was similar to the FCR; in contrast, the PCR was increased as protein levels increased. These results suggest that when dietary protein levels varying from 15-21% CP, the protein levels of 19% CP is the most benefit to the Betong performance.

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