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Effect of Dietary Crude Protein and Energy on Gaoyou Ducklings Growth Performance and Carcass Trait

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Abstract: The study was undertaken to assess dietary CP and ME concentrations for optimum growth performance and carcass characteristics of Gaoyou ducklings. In a 3×3 factorial arrangement, three hundred and sixty zero-day-old Gaoyou ducklings were randomly assigned to experimental diets with 11.70, 11.90 and 12.12 MJ of ME kg^{-1} of diet; each contained 18.0, 19.0 and 20.0% CP, respectively, from 0-28 days of age. Each dietary treatment had 4 replicates. Body weight and feed consumptions were measured at every weekend, from 0-28 days of age and carcass characteristics were evaluated at 28 days of age. The result showed that ducklings on a diet with 11.70 and 11.90 MJ of ME kg^{-1} at 0-28 days of age exhibited greater BW gain than this diet with 12.12 MJ of ME kg^{-1} ($p<0.01$), though BW gain was not different among 11.70 and 11.90 MJ of ME kg^{-1} of diet. Mean BW gain of birds fed 18.0, 19.0 and 20.0% CP diets was significantly different ($p<0.001$). Feed intake was influenced by dietary ME levels ($p<0.000$) also. Feed intake of birds fed 18.0% CP diets was higher than those of birds on 19.0 and 20.0% CP diets ($p<0.01$). Feed conversion ratios of birds fed on 11.70 and 11.90 MJ of ME kg^{-1} of diet were better than those fed on 12.12 MJ of ME kg^{-1} ($p<0.001$). Feed conversion ratios of birds fed on 18.0% CP diets were better than those fed on 19.0 and 20.0% CP diets. In the study, there were significant interactions between dietary CP and ME on growth performance. There was a direct relationship between dietary ME levels and eviscerated carcass percentage ($p<0.014$), abdominal fat percentage ($p<0.000$) and breast weight ($p<0.037$). But the half-eviscerated carcass percentage, eviscerated carcass percentage, breast and leg meat percentage were not influenced by dietary CP concentration. Thus, diets with 11.70 MJ of ME kg^{-1} and 18.0% CP were used more efficiently from 0-28 days of age by Gaoyou ducklings.

Key words: Gaoyou ducklings, crude protein, metabolizable energy, growth performance, carcass traits, China

INTRODUCTION

The Gaoyou duck originated from Anas bosch-as. Because this duck breed was good at laying dual-yolk egg, in the spring, this duck breed could be gain the 5% rate of laying dual-yolk eggs and to be well known by us. Duck is compact feather, light black bay plumage and blue beak, black claws. Adult weight was 2500 g. Half evisceration rate is 80%. Evisceration rate is 70%.

Ducks and chickens exhibit differences in growth rate and body composition. Bioavailable energy studies have shown significant differences in the dietary requirements and energy utilization of ducks and chickens. So, the research of King *et al*. (1997) suggested that ME values taken from chicken bioassay can't be extrapolated to duck. Because of energy and protein (amino acids) are the most critical dietary components for birds. Although, the requirements of protein and amino acids for meat-type ducklings have been established (Elkin, 1987), little information is available on the requirements of layer ducks (NRC, 1994). One of the reasons is because layer ducks are mainly reared in Asia. In China, there many layer ducks be raised, such as Shaoxing ducks, Jinding ducks, Tsalya ducks, Sanma ducks and Gaoyou layer ducks and so on. But we spent little time to research the nutrition requirement of these ducks for many reasons in the past years. In these years, some local studies have been conducted to determine the requirements of protein and energy for growing (Chen and Jiang, 1992) and Shaoxing layer Duck (Dai *et al*., 1999, 2001; Yin *et al*., 2000). Through, the Factorial analysis, Xu (2002) reported the net protein utilization ranged from 0.45-0.53 and increased with the advancing age of ducks and N requirement for maintenance was, on an average, 455 mg kg^{-1} $BW^{0.75}$ per day of Shaoxing duck.

Shen (1988) suggested that dietary CP contents should be 18.7% of kg for Tsalya duck from 0-4 Weeks of Age (WOA), which also reported that the Tsalya duck dietary ME level was 12.09 MJ of ME kg^{-1}. Chen (1999) study on the effect of dietary protein levels on nitrogen

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retention rate in growing shaoxing ducks, the result indicated the dietary protein level was 19.03% of kg. In the study, the effects of various concentrations of dietary CP and ME on growth performance and carcass characteristics of Gaoyou ducklings were evaluated. The objective of the study was to determine the dietary CP and ME requirement of ducklings from 0-28 days of age in terms of growth performance and carcass quality.

MATERIALS AND METHODS

Birds and dietary treatments: These zero-day-old Gaoyou ducklings (n = 360) of breeding generation were obtained (bought from Gaoyou Duck Group Breeding Ltd. Co., Jiangsu province, China).

These birds were randomly assigned to 9 dietary treatments in a 3×3 factorial arrangement. The dietary treatments fed at hatch to 28 days of age contained 11.70, 11.90 and 12.12 MJ of ME kg^{-1} of diet, each in combination with 18.0, 19.0 and 20.0% CP (Table 1). Each dietary treatment was replicated 4 times. The diets were fed in mash form and were provided *ad libitum*. Water was also provided freely throughout the experimentation period.

Table 1: The program of temperature and lighting in the raise room of Gaoyou duckling

0-7 days		8-28 days		
1-3 days	4-7 days	8-14 days	15-21 days	After 21 days
30-29°C	29-24°C	24-19°C	19-17°C	Normal
23 h constant lighting, the luminance was 185Lx		Until to 21 days of age for 16 h constant lighting, after 14 days reduced gradually to 5Lx		

Management of experimental bird husbandry: At 0 day of age, experimental birds were weighed individually and randomly assigned to pens with raised wire floors that each housed 10 birds.

The room temperature was maintained at 30°C in the first three days and then it was reduced gradually by 1 or 1.5°C every day, after which no artificial heating was provided (Table 2).

Ventilation within the holding room was maintained by natural ventilation. Body weight and feed consumption were measured at every weekend in the 28 days of age. Mortality was recorded as it occurred and the weights of dead birds were used to adjust Feed Conversion Ratios (FCR).

Sample collection: At 28 days of age, 8 birds from each treatment (total of the birds from the experiment) were randomly selected for evaluation of carcass traits. Feed and water were with-drawn 12 h before slaughter. Birds were then slaughtered and dissected to measure half eviscerated carcass (the carcass just be removed the giblets, trachea, crop and abdominal fat, not include the kidney) percentage, eviscerated carcass percentage, breast meat percentage, leg meat percentage and abdominal fat percentage.

Statistical analysis: Data were analyzed by the 2-way ANOVA procedure of SPSS 13.0 software (SPSS Inc.). Means were compared by Duncan's multiple-range test when probability values were significant ($p<0.05$).

Table 2: Composition of the experimental diets fed from 0-28 days of age

	Treatments								
Ingredient (%)	1	2	3	4	5	6	7	8	9
Corn (CP%)	61.15	58.44	56.98	63.94	61.28	59.82	66.78	64.18	62.65
Soybean meal	21.26	24.21	27.44	21.79	24.75	27.98	22.37	25.39	28.51
Wheat bran	10.62	10.35	8.690	7.340	6.980	5.320	3.900	3.490	1.940
Fish meal	2.200	2.300	2.200	2.200	2.300	2.200	2.200	2.200	2.200
Limestone	1.280	1.250	1.230	1.330	1.250	1.240	1.290	1.270	1.240
Dicalcium phosphate	1.120	1.120	1.130	1.040	1.120	1.130	1.120	1.120	1.130
Vitamin-mineral premix[1]	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Soybean oil	0.800	1.000	1.000	0.800	1.000	1.000	0.800	1.000	1.000
L-Lys-HCL	0.270	0.180	0.220	0.260	0.190	0.220	0.260	0.230	0.230
Salt	0.200	0.080	0.060	0.200	0.070	0.060	0.200	0.070	0.060
DL-Met	0.110	0.070	0.050	0.100	0.070	0.050	0.100	0.060	0.040
Calculated level									
ME, MJ kg^{-1} of diet	11.70	11.70	11.70	11.90	11.90	11.90	12.12	12.12	12.12
CP (%)	18.00	19.00	20.00	18.00	19.00	20.00	18.00	19.00	20.00
Lys (%)	1.100	1.110	1.200	1.100	1.110	1.210	1.100	1.150	1.220
Met + cystine (%)	0.690	0.690	0.690	0.690	0.690	0.690	0.690	0.690	0.690
Ca (%)	0.900	0.900	0.900	0.900	0.900	0.900	0.900	0.900	0.900
Available P (%)	0.380	0.390	0.390	0.370	0.390	0.380	0.380	0.380	0.380

[1]Provided the following per kilogram of diet: Cu, 10 mg; Fe, 120 mg; Zn, 90 mg; Mn,110 mg; Se, 0.3 mg; I, 0.5 mg; Cr, 0.15 mg; choline chloride, 600 mg; vitamin A, 14000 IU; vitamin D_3, 3250IU; vitamin E (DL-α-tocopherylacetate), 45 IU; vitamin K , 6 mg; thiamine, 4 mg; riboflavin, 9 mg; pyridoxine, 9 mg; vitamin B_{12}, 0.03 mg; pantothenic acid, 15 mg; nicotinic acid, 60 mg; folic acid, 1.5 mg and biotin, 0.2 mg

RESULTS

The effects of dietary CP and ME on growth performance are given in Table 3. There was no difference in BW gain from 0-28 days of age ducklings among ME levels of 11.70 and 11.90 MJ of ME kg^{-1} of diet ($p>0.05$) but the BW gain was obviously higher than at higher ME levels (12.12 MJ of ME kg^{-1} of diet; $p<0.01$). The BW gain was increased to the maximum when the diet contained 11.70 MJ of ME kg^{-1}. A significant difference in BW gain was observed from CP levels of 18.0-20.0%, with the CP levels increased the BW gain significantly decreased ($p<0.000$). Metabolizable energy levels had no effects on feed intake on the ME levels from 11.70-11.90 MJ of ME kg^{-1} ($p>0.05$) but feed intake had a downward trend, along with the increase of dietary ME levels. Feed intake was significantly influenced by dietary CP contents. Ducklings on 18.0% CP diet consumed more feed ($p<0.000$) than those on 19.0 and 20.0% CP diets. The FCR was not significantly different among ME levels ($p>0.05$). but the higher ME level (12.12 MJ of ME kg^{-1} of diet) was not better than those low ME levels (11.70 and 11.90 MJ of ME kg^{-1} of diet). The FCR of dietary ME levels (11.70, 11.90 and 12.12 MJ of ME kg^{-1} of diet) were not significantly different but the diet with low ME level (11.70 MJ of ME kg^{-1} of diet) was lower than high ME levels (11.90 and 12.12 MJ of ME kg^{-1} of diet). The CP levels did difference affect FCR ($p<0.000$).

The FCR increased step by step with the CP levels of diets increased. That is to say, FCR was better at low ME and CP levels in our study. There were significant interactions between CP and ME on growth performance, against the FCR.

As shown in Table 4, dietary ME levels had significant effects on eviscerated carcass percentage ($p<0.014$) and breast-meat ($p<0.037$), against half evisverated carcass percentage ($p>0.531$). Eviscerated carcass percentage was 65.553%, when the dietary ME level was 11.70 MJ of ME kg^{-1} of diet; it was higher than other ME levels.

Dietary CP levels had not significant effects on half eviscerated carcass percentage, eviscerated carcass percentage, breast-meat percentage and leg-meat percentage ($p>0.05$) and they increased by increasing dietary CP from 18.0-20.0% but the 19.0% CP level of diet was the best of all those CP levels of diets. There were significant interactions between CP and ME levels on eviscerated percentage ($p<0.05$). The effects of dietary ME levels on abdominal fat percentage reached a significant degree ($p<0.000$), when dietary ME level was 11.70 MJ of ME kg^{-1}, the abdominal fat percentage was 0.863% and it was >0.437% of the CP diet containing 12.12 MJ of ME kg^{-1}.

Table 3: Effect of ME and CP on growth performance of 28-days-old Gaoyou ducklings (g, g:g)

Item ME (MJ kg^{-1})	Feed intake	BW gain	Feed conversion ratio
11.70	61.05[a]	23.61[a]	2.59
11.90	60.34[a]	22.26[a]	2.71
12.12	56.75[b]	20.06[b]	2.83
SEM	0.32	0.56	0.10
CP (%)			
18	72.65[a]	31.30[a]	2.32[a]
19	55.39[b]	20.06[b]	2.76[b]
20	50.09[c]	14.56[c]	3.44[c]
SEM	0.32	0.56	0.10
p-value			
ME	0.000	0.001	0.105
CP	0.000	0.000	0.000
ME×CP	0.000	0.003	0.295

Table 4: Effect of ME and CP on carcass traits of 28-old Gaoyou ducklings (%)

Item ME MJ kg^{-1} of diet	Half-eviscerated carcass	Eviscerated carcass	Breast meat	Leg meat	Abdominal fat
(Slaughter body weight (%))					
11.70	79.378	65.553[a]	3.357[a]	21.447	0.863[a]
11.90	79.533	63.460[b]	2.611[b]	21.966	0.358[b]
12.12	78.437	64.130[ab]	2.910[ab]	22.120	0.437[b]
SEM	0.740	0.491	0.200	0.337	0.083
CP (%)					
18.0	79.338	63.802	2.829	21.792	0.473
19.0	79.288	65.021	2.992	21.937	0.598
20.0	78.721	64.320	3.056	21.805	0.587
SEM	0.740	0.491	0.200	0.337	0.083
p-value					
ME	0.531	0.014	0.037	0.344	0.000
CP	0.808	0.223	0.712	0.945	0.504
ME×CP	0.118	0.022	0.211	0.905	0.008

[a-c]Means within a column that do not share a common superscript are significantly different ($p<0.05$)

This indicated that the high dietary ME level would decreased the feed intake of Gaoyou duck and this result was that the abdominal fat weight of duck also decreased; this kind of result further confirrmed the negative relations among dietary ME levels and abdominal fat percentage.

And the effect of dietary CP content on the abdominal fat percentage was not like this. The diet with 19.0% CP could gain the maximum abdominal fat weight. In a word, the optimal dietary ME and CP levels were critical factors in Gaoyou duck.

DISCUSSION

Dietary CP and ME levels played a vital role in BW gain, feed intake and FCR. In the current experiment, dietary ME concentration affected feed intake. The result

of this research also indicated that no significant difference was observed for BW gain from 11.70-11.90 MJ of ME kg^{-1} of diet. The heaviest BW gain, 23.61 g, came from the ME diet containing 11.70 MJ of ME kg^{-1}. The optimal ME concentration, 11.70 MJ of ME kg^{-1} of diet, was almost consistent with the report of He (1994) and a little <12.09 and 12.75 MJ of ME kg^{-1} of diet (Shen, 1988; He, 1994). The ducklings fed diets containing 11.70 of ME kg^{-1} of diet consumed about 4.78 g day^{-1} more feed than those fed diets comprising 12.12 MJ of ME kg^{-1}. Maybe this indicated that birds consume feed to primarily meet their energy requirement. Birds on high-energy diets, often due to relatively high fat content, have, on average, lower feed consumption due to the reduced rate of passage of digesta through the gastrointestinal tract. The observation is consistent with other birds report (Nahashon *et al*., 2006) that feed intake decreased linearly as dietary energy increased. Nahashon *et al*. (2005) has also suggested that as dietary energy increases, birds satisfy their energy needs by decreasing feed intake.

The optimum requirements of CP for ducklings differed in different studies, results generally ranging from 16-22%, between 18.70 and 19.03% were the conclusion of most investigators (Shen, 1988; Chen and Jiang, 1992; He, 1994). Under the condition of the present experiment, BW gain and FCR were significantly different from CP levels of 18.0-20.0%; the result was <22%, reported by NRC (1994) and <21.23% for ducklings from 0-3 WOA, reported by He (1994). On the other hand, the current experiment also indicated that the interactions between dietary CP and ME levels had significant effect on ducklings growth performance ($p<0.05$). In the study, as the CP level increased, the feed intake decreased linearly very significantly. This showed that the optimal dietary CP level of the ducklings to meet the better growth performance on 0-28 days of age was 18%. This is the same with Chen and Jiang (1992), who considered that the interaction had significant effect on the daily weight gain of ducklings.

In the study, increasing dietary ME was associated with decreased the Half eviscerated carcass, eviscerated carcass, breast meat and abdominal fat percentage. Only the leg meat percentage was step up to 22.120%. The current study also indicated that eviscerated carcass percentage, breast meat percentage, leg meat percentage and abdominal fat percengtage were highest from ducklings fed 20.0% CP than those fed 18.0% CP. This conclusion was be similar with Chen and Jiang (1992). From the study, we known that the optimal dietary protein levels were be best for the growth rates and carcass composition of the Gaoyou ducklings from 0-28 days of age under the CP 18.0% level. The result was agreed with Shen (1988) and Chen and Jiang (1992).

The index of animal growth performance is often considered as a classical indicator on the requirements of animal dietary CP and ME. But it is not always able to reflect the requirements of the best carcass components of an animal therefore, it is necessary to further consider the carcass traits of an animal. Based on this study, we considered breast and leg meat percentage as well as abdominal fat percentage as the sensitive carcass characteristic indexes on the research of dietary CP and ME requirements.

CONCLUSION

The optimal dietary ME requirement of ducklings from hatch to 28 days of age is 11.70 MJ of ME kg^{-1} and the CP requirement of ducklings during the period is 18.0%. The result was higher than the Shaoxing duck and Tsalya duck.

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REFERENCES

Chen, A.G. and Z.J. Jiang, 1992. Effect of dietary protein on growth of *Shaoxing ducklings*. J. Zhejiang Agric. Univ., 18: 69-73.

Chen, A.G., 1999. Effects of dietary protein levels on nitrogen retention rate in growing *Shaoxing ducks*. J. Zhejiang Agric. Univ., 25: 291-295.

Dai, X.J., J.X. Liu, D.L. Fang and Y.M. Wu, 1999. Effect of metabolizable energy content on production level for *Shaoxing ducks*. Acta Agric. Zhejiangensis, 11: 88-91.

Dai, X.J., J.X. Liu, D.L. Fang and Y.M. Wu, 2001. Metabolizable energy requirements for *Shaoxing ducks* in laying period. J. Shanghai Jiaotong Univ. Agric. Sci., 19: 267-270.

Elkin, R.G., 1987. A review of duck nutrition research. World Poult. Sci. J., 43: 84-106.

He, J.H., 1994. A study on dietary nutrients density for ducklings. Acta Vet. Zootech. Sinica, 25: 311-316.

King, D., D. Ragland and O. Adeola, 1997. Apparent and true metabolizable energy values of feedstuffs for ducks. Poult. Sci., 76: 1418-1423.

Nahashon, S.N., N. Adefope, A. Amenyenu and D. Wright, 2005. Effect of dietary metabolizable energy and crude protein concentrations on growth performance and carcass characteristics of French guinea broilers. Poult. Sci., 84: 337-344.

Nahashon, S.N., N. Adefope, A. Amenyenu and D. Wright, 2006. Effect of varying metabolizable energy and crude protein concentrations in diets of pearl gray guinea fowl pullets 1. Growth performance. Poult. Sci., 85: 1847-1854.

NRC. (National Research Council), 1994. Nutrient Requirements of Poultry. 9th Edn., National Academy Press, Washington, DC., USA.

Shen, T.F., 1988. Nutrient requirements of egg-laying ducks. Asian-Aust. J. Anim. Sci., 13: 113-120.

Xu, N.Y., Y.M. Wu, X.J. Chen and L. Jian-Xin, 2002. Investigation on requirement of crude protein for maintenance in *Shaoxing ducks*. Anim. Feed Sci. Technol., 98: 167-174.

Yin, Z.Z., D.Y. Yu and C.L. Zhu, 2000. Study on the optimum dietary protein level for laying *Shaoxing ducks*. J. Zhejiang Univ. Agric. Life Sci., 26: 451-454.