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

Y. N. Min,*† S. S. Hou,†[1] Y. P. Gao,* W. Huang,† and F. Z. Liu*

*College of Animal Science and Technology, Northwest A&F University, Yangling, China 712100; and †State Key Laboratory of Animal Nutrition, Institute of Animal Sciences, Chinese Academy of Agricultural Sciences, Beijing, China 100094

ABSTRACT The study was undertaken to assess dietary CP and ME concentrations for optimum growth performance and carcass characteristics of goslings. In a 5 × 3 factorial arrangement, 360 one-day-old commercial generation Huoyan goslings were randomly assigned to experimental diets with 10.87, 11.37, 11.87, 12.37, and 12.87 MJ of ME/kg of diet; each contained 15.0, 17.5, and 20.0% CP, respectively, from 0 to 4 wk of age (WOA). Each dietary treatment was replicated 6 times. Body weight and feed consumption were measured, and carcass characteristics were evaluated at 4 WOA. The result showed that birds on a diet with 11.87, 12.37, and 12.87 MJ of ME/kg at 0 to 4 WOA exhibited greater BW gain than those on a diet with 10.87 and 11.37 MJ of ME/kg ($P < 0.01$), though BW gain was not different among 11.87, 12.37, and 12.87 MJ of ME/kg of diet. Mean BW gain of birds fed 17.5 and 20.0% CP diets was not different ($P > 0.05$), but they were higher than those on 15.0% dietary CP concentration ($P < 0.001$). Feed intake was not influenced by dietary ME levels ($P > 0.05$). Feed intake of birds fed 17.5 and 20.0% CP diets was higher than those of birds on 15.0% CP diets ($P < 0.01$). Feed conversion ratios of birds fed on 11.87, 12.37, and 12.87 MJ of ME/kg of diet were better than those fed on 10.87 and 11.37 MJ of ME/kg ($P < 0.001$). Feed conversion ratios of birds fed on 17.5 and 20.0% CP diets were better than those fed on 15.0% CP diets. Moreover, there were no significant interactions between CP and ME on growth performance. There was a direct relationship between dietary ME levels and eviscerated carcass percentage, abdominal fat percentage, and liver relative weight ($P < 0.01$). Breast and leg meat percentage were influenced by dietary CP concentrations significantly ($P < 0.001$). Thus, diets with 11.87 MJ of ME/kg and 17.5 to 20.0% CP were used more efficiently from 0 to 4 WOA by Huoyan goslings.

Key words: growth performance, carcass trait, crude protein, gosling, metabolizable energy

2007 Poultry Science 86:661–664

INTRODUCTION

The house goose belongs to Anatidae family, *Anser* genus. The goose originated from *Anser cygnoides.* The work of Roberson and Francis (1963) suggested that geese respond more to changes in energy concentration of the diet than to dietary protein levels. Allen (1983) suggested that dietary CP contents should be 200 g/kg from 0 to 4 wk of age (**WOA**), which was in accord with most previous work (Aikens et al., 1954; Waibel, 1958; Snyder, 1959; Saleyev, 1975). Roberson and Francis (1963) reported that White Chinese goslings grew more rapidly on a 24% protein level than on lower levels, but the advantage was lost when the geese were raised beyond the stage of rapid growth. Liang (2001) indicated that a dietary concentration of 13.80 MJ of ME/kg was the best for Roman White goslings from 0 to 3 WOA. Su and Ma. (1997) showed that when dietary CP decreased from 24 to 20% and ME from 11.76 to 11.37 MJ of ME/kg, there was no significant effect on BW gain. But when ME level was 10.93 MJ of ME/kg, growth rate was much lower.

However, Stevenson (1985) found no significant effect on the weight gain of Italian Legarth goslings fed on starter and grower diets with ME concentrations ranging from 11 to 13 MJ/kg. Moreover, the lack of response in weight gain of Embden geese fed on diets varying in protein concentration from 180 to 220 g/kg led Summers et al. (1987) to conclude that CP has not been a limiting factor in most goose nutrition studies.

In brief, most previous work on the requirements of dietary ME and CP has been drawn from growth performance. In our study, the effects of various concentrations of dietary CP and ME on growth performance and carcass characteristics of Huoyan goslings were evaluated. The objective of our study was to determine the dietary CP and ME requirement of goslings from 1 to 28 d of age in terms of growth performance and carcass quality.

MATERIALS AND METHODS

Birds and Dietary Treatments

Straight-run 1-d-old Huoyan goslings (n = 360) of commercial generation were obtained (bought from Dongfeng

Received May 30, 2006.
Accepted November 25, 2006.
[1]Corresponding author: houss@263.net

Table 1. Composition of several of the experimental diets fed from 0 to 4 wk of age

	Treatment				
Ingredient, %	1	7	8	9	15
Corn (% CP)	60.20	71.40	66.30	60.00	56.70
Soybean meal	14.90	18.40	26.10	33.40	34.70
Wheat bran	14.00	3.50	1.50	1.90	—
Alfalfa meal	7.40	3.00	2.10	0.20	—
Soybean oil	—	—	0.40	0.90	5.00
Limestone	0.99	1.06	1.05	1.08	1.05
Dicalcium phosphate	1.20	1.30	1.30	1.25	1.30
Salt	0.30	0.30	0.30	0.30	0.30
Vitamin-mineral premix[1]	1.00	1.00	1.00	1.00	1.00
Antioxidant	—	—	0.02	0.02	0.02
Calculated level					
ME, MJ/kg of diet	10.87	11.87	11.87	11.87	12.87
CP, %	15.00	15.00	17.50	20.00	20.00
Ca, %	0.80	0.80	0.80	0.80	0.80
Available P, %	0.34	0.34	0.34	0.34	0.34
Met, %	0.22	0.24	0.27	0.30	0.30
Met + cystine, %	0.55	0.49	0.56	0.63	0.63
Lys, %	0.68	0.71	0.88	1.05	1.06

[1]Provided the following per kilogram of diet: Cu, 10 mg; Fe, 60 mg; Zn, 60 mg; Mn, 80mg; Se, 0.3 mg; I, 0.2 mg; Cr, 0.15 mg; choline chloride, 1,000 mg; vitamin A (retinyl acetate), 10,000 IU; vitamin D_3, 3,000 IU; vitamin E (DL-α-tocopheryl acetate), 20 IU; vitamin K_3, 2 mg; thiamine, 2 mg; riboflavin, 8 mg; pyridoxine, 4 mg; vitamin B_{12}, 0.02 mg; pantothenic acid, 20 mg; nicotinic acid, 50 mg; folic acid, 1 mg; and biotin, 0.2 mg.

Breeding Ltd. Co., Hebei province, China). These birds were randomly assigned to 15 dietary treatments in a 5 × 3 factorial arrangement. The dietary treatments fed at hatch to 4 WOA contained 10.87, 11.37, 11.87, 12.37, and 12.87 MJ of ME/kg of diet, each in combination with 15.0, 17.5, and 20.0% CP (Table 1). Each dietary treatment was replicated 6 times. The diets were fed in mash form and were provided ad libitum. Water was also provided freely throughout the experimentation period.

Management of Experimental Bird Husbandry

At 1 d of age, experimental birds were weighed individually and randomly assigned to pens with raised wire floors that each housed 4 birds. The room temperature was maintained at 30°C for the first week and was reduced gradually by 2.5°C every week, after which no artificial heating was provided. The birds received 23 h of constant lighting throughout the experiment. Ventilation within the holding room was maintained by thermostatically controlled exhaust fans. Body weight and feed consumption were measured at 4 WOA. Mortality was recorded as it occurred, and the weights of dead birds were used to adjust feed conversion ratios (**FCR**).

Processing Procedure

At 28 d of age, 8 birds from each replicate (total of the birds from the experiment) were randomly selected for evaluation of carcass traits. Feed and water were withdrawn 12 h before slaughter. Birds were then slaughtered and dissected to measure eviscerated carcass percentage, breast meat percentage, leg meat percentage, abdominal fat percentage, and liver relative weight.

Statistical Analysis

Data were analyzed by the 2-way ANOVA procedure of SAS software (SAS Institute, 1996). Means were compared by Duncan's multiple-range test when probability values were significant ($P < 0.05$).

RESULTS

The effects of dietary CP and ME on growth performance are given in Table 2. There was no difference in BW gain from 0 to 4 WOA goslings among ME levels of 11.87, 12.37, and 12.87 MJ of ME/kg of diet ($P > 0.05$), but the BW gain was obviously higher than at lower ME

Table 2. Effect of ME and CP on growth performance of 28-d-old goslings

Item	Feed intake, g	BW gain, g	Feed conversion ratio, g:g
ME, MJ/kg of diet			
10.87	83.59	38.37[b]	2.17[a]
11.37	85.99	37.45[b]	2.23[a]
11.87	85.77	41.80[a]	2.06[b]
12.37	84.03	41.17[a]	2.04[b]
12.87	82.14	41.42[a]	1.99[b]
SEM	7.51	3.47	0.12
CP levels, %			
15.0	78.68[b]	36.70[b]	2.15[a]
17.5	86.73[a]	41.56[a]	2.08[ab]
20.0	87.50[a]	42.46[a]	2.07[b]
SEM	8.10	4.28	0.12
		P-value	
ME	0.5849	0.0061	0.0001
CP	0.0001	0.0001	0.0541
ME × CP	0.4332	0.5165	0.0674

[a,b]Means within a column that do not share a common superscript are significantly different ($P < 0.05$).

Table 3. Effect of ME and CP on carcass traits of 28-d-old goslings (%)

Item	Eviscerated carcass	Breast meat	Leg meat	Abdominal fat	Liver
ME, MJ/kg of diet	(% of live weight)				
10.87	71.48[c]	1.21	12.27	1.27[b]	3.20[a]
11.37	72.23[bc]	1.24	12.74	1.24[b]	3.13[a]
11.87	74.47[a]	1.25	12.09	1.40[b]	2.55[c]
12.37	74.09[ab]	1.26	13.13	1.92[a]	2.76[b]
12.87	74.42[a]	1.27	12.72	1.85[a]	2.84[b]
SEM	3.07	0.24	0.68	0.49	0.33
CP, %					
15.0	72.61	1.11[b]	11.95[b]	1.58	3.06[a]
17.5	74.17	1.29[a]	12.63[ab]	1.53	2.64[b]
20.0	73.40	1.34[a]	13.20[a]	1.52	2.95[a]
SEM	3.07	0.24	0.68	0.49	0.34
	P-value				
ME	0.0050	0.8957	0.0912	0.0001	0.0001
CP	0.1284	0.0002	0.0008	0.8504	0.0001
ME × CP	0.7857	0.7093	0.0340	0.9094	0.0001

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

levels (10.87 and 11.37 MJ of ME/kg of diet; $P < 0.01$). The BW gain was increased to the maximum when the diet contained 11.87 MJ of ME/kg but changed little at higher levels. No significant difference in BW gain was observed from CP levels of 17.5 to 20.0%, but it was significantly higher than the BW gain from lower CP levels of 15.0% ($P < 0.001$). Metabolizable energy levels had no effects on feed intake ($P > 0.05$), but feed intake had a downward trend, along with the increase of dietary ME levels. Feed intake was also influenced by dietary CP contents. Birds on 17.5 and 20.0% CP diets consumed more feed ($P < 0.001$) than those on 15.0% CP diets; feed consumption of goslings receiving diets containing 17.5 or 20.0% CP was not different ($P > 0.05$). The FCR was significantly different among ME levels ($P < 0.001$). The FCR of high ME levels (11.87, 12.37, and 12.87 MJ of ME/kg of diet) were not significantly different, but they were significantly lower than low ME levels (10.87 and 11.37 MJ of ME/kg of diet; $P < 0.001$). That is to say, FCR was better at high ME levels. The CP levels did not affect FCR ($P > 0.05$). There were no significant interactions between CP and ME on growth performance.

As shown in Table 3, dietary ME levels had significant effects on eviscerated carcass percentage ($P < 0.01$). Eviscerated carcass percentage was 74.47% when the dietary ME level was 11.87 MJ of ME/kg of diet; it was higher than other ME levels. Dietary CP levels had significant effects on breast meat percentage and leg meat percentage ($P < 0.01$), and they increased by increasing dietary CP from 15.0 to 20.0%. There were significant interactions between CP and ME levels on leg meat percentage ($P < 0.05$). The effects of dietary ME levels on abdominal fat percentage reached a significant degree ($P < 0.001$); the abdominal fat percentage was 1.40%, and it was lower than 1.85% of the ME diet containing 12.87 MJ of ME/kg. This indicated that there was an upward tendency due to increasing dietary ME; this kind of result further confirmed the positive relations among dietary ME levels and abdominal fat percentage. At the same time, abdominal fat percentage declined by increasing dietary CP content. Liver relative weight was affected by dietary ME and CP levels as well as their interactions; moreover, lower CP and ME levels caused heavier liver relative weight.

DISCUSSION

Dietary CP and ME levels played a vital role in BW gain, feed intake, and FCR. In the current experiment, dietary ME concentration did not affect feed intake. The result of this research also indicated that no significant difference was observed for BW gain from 11.87 to 12.87 MJ of ME/kg of diet. The heaviest BW gain, 41.80 g, came from the ME diet containing 11.87 MJ of ME/kg. The optimal ME concentration, 11.87 MJ of ME/kg of diet, was almost consistent with the report of Stevenson (1985) and a little higher than 11.6, 11.37, 11.04, and 10.0 to 10.5 MJ of ME/kg of diet (Saleyev, 1975; Lin, 1986; Wang et al., 1999). The result was lower than 13.80 MJ of ME/kg, reported by Liang (2001).

The optimum requirements of CP for goslings differed in different studies, results generally ranging from 17.67 to 24%, among which 20.0% were the conclusion of most investigators (Aikens et al., 1954; Snyder, 1959; Saleyev, 1975; Allen, 1983; Su and Ma, 1997). Under the condition of the present experiment, BW gain and FCR were not significantly different from CP levels of 17.5 to 20.0%; the result was lower than 22.01%, reported by Lin (1986), and less than 19.65 and 21.16% for goslings from 0 to 3 WOA, reported by Chen (2003). On the other hand, the current experiment also indicated that the interactions between dietary CP and ME levels had no significant effect on gosling growth performance ($P > 0.05$). This is contrary to Chen (2003), who considered that the interaction had significant effect on the daily weight gain of goslings.

Liang (2001) showed that for Roman White geese, increasing dietary ME was associated with increased abdominal fat percentage, which was in accord with our study. Goslings from 0 to 4 WOA were able to obtain ideal growth rates and carcass composition under the CP 20.0% level (Nitsan et al., 1983; Summers et al., 1987). The current study also indicated that eviscerated carcass percentage, breast meat percentage, as well as leg meat percentage were highest and the abdominal fat percentage was lower from goslings fed 20% CP than from those fed 15% CP. But Stevenson (1985) found that among feed with AME of 11, 12, and 13 MJ of ME/kg, the energy levels did not affect the breast and leg meat percentage as well as abdominal fat percentage for goslings from 0 to 4 WOA. The result was in agreement with the current study in breast and leg meat percentage but contrary to abdominal fat percentage. Different breeds and dietary CP levels are likely to lead to different results.

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.

In conclusion, the optimal dietary ME requirement of goslings from hatch to 28 d of age is 11.87 MJ of ME/kg, and the CP requirement of goslings during the period is 17.5 to 20.0%. The result was lower than the feeding standard of NRC (1994).

ACKNOWLEDGMENTS

Our research was sponsored by a grant (2006 BAD14B06) from the Ministry of Science and Technology of the People's Republic of China.

REFERENCES

Aikens, J. R., W. G. Hunsaker, A. B. Morrison, and H. S. Gutteridge. 1954. The protein requirements of Pilgrim goslings. Pages 110–121 in Proc. 10th World's Poult. Congr., Edinburgh, Scotland. World's Poult. Sci. Assoc., Suffolk, UK.

Allen, N. K. 1983. Nutrition of growing geese. Rev. Avicole (France) 93:97–98.

Chen, W. L. 2003. Studies on Gosling Yolk Sac Nutrition and the Optimum Levels of Energy and Protein for 0-3 Week-Old Gosling. Yangzhou Univ., China.

Liang, Y. D. 2001. Nutrition requirements of growing geese. Requirements of growing geese. Guangxi Xumu Yu Shouyi 17:10–12.

Lin, Z. Z. 1986. The experiment of dietary CP levels for Huoyan goslings. Xumu Yu Shouyi 3:113–115.

Nitsan, Z., A. Dvorin, and I. Nir. 1983. Protein, essential amino acids and glycine requirements of the growing gosling (*Anser cireneus*). Br. Poult. Sci. 50:455–461.

NRC. 1994. Nutrient Requirements of Poultry. 9th rev. ed. Natl. Acad. Press, Washington, DC.

Roberson, R. H., and D. W. Francis. 1963. The effect of energy and protein levels for the ration on the performance of White Chinese geese. Poult. Sci. 42:867–871.

Saleyev, P. 1975. Ways of increasing goose meat production in the USSR. World's Poult. Sci. J. 31:276–287.

SAS Institute. 1996. SAS User's Guide: Statistics. Version 7.0 ed. SAS Inst. Inc., Cary, NC.

Snyder, E. S. 1959. Duck and goose raising. Ontario Dept. Agric. Bull. 432.

Stevenson, M. H. 1985. Effects of diets of varying energy concentration on the growth and carcase composition of geese. Br. Poult. Sci. 26:493–504.

Su, X. X., and X. Y. Ma. 1997. Study on the energy requirement and dietary metabolic level of meat-type geese. J. Econ. Anim. 1:39–44.

Summers, J. D., G. Hurnik, and S. Leeson. 1987. Carcass composition and protein utilization of Embden geese fed varying levels of dietary protein supplemented with lysine and methionine. Can. J. Anim. Sci. 67:159–164.

Waibel, P. E. 1958. The feeding of geese and their potential in meat production. Feedstuffs 30:18. (Abstr.)

Wang, Y. M., L. Wang, W. Q. Yang, J. C. Song, and S. Z. Li. 1999. Requirements of feeding energy and protein for meat-using young white goose. Xi Nan Nong Ye Xue Bao 2:103–111.