《Research Note》

Effect of Moderate Excess Methionine on Growth, Feed Intake and Utilization of Energy and Nitrogen in Chicks

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It was reported by several workers^{1,2,3)} that dietary excess methionine adversely affected the growth rate of chicks. The mechanism by which body weight gain of chicks fed the methionine excess diet was decreased, however, has not been established. UEDA and TASAKI¹⁾ reported that the addition of 2.7% DL-methionine to the methionine adequate diet resulted in not only the severe depression in body weight gain and feed intake but also the decrease in energy and nitrogen utilization. Since the growth retardation of the chicks receiving the methionine excess diet was dependent on the levels of methionine added to the diet²⁾, the present experiment was designed to study the effect of moderate excess methionine on growth, feed intake and efficiencies of energy and nitrogen utilization.

Experimental

Day-old Single Comb White Leghorn male chicks were raised on a commercial chick starter for 7 days. On day 8, the chicks were individually weighed after 3-hour fasting and assigned to 12 groups of 2 chicks each and 1 group of 5 chicks so that the average starting body weight was similar for each group. Six replicates of 2 chicks each were fed each of the control and methionine excess diets from day 8 to day 20, and 5 chicks of the last group were killed with ethyl ether to determine the initial body composition. The composition of the control diet used here was as follows (in percent): isolated soybean protein, 25.78; cornstarch, 40.64; glucose, 20.00; corn oil, 4.00; cellulose, 3.00; mineral mixture⁴⁾, 5.63; vitamin mixture⁵⁾, + (0.75 g/kg diet); choline chloride, 0.20; L-methionine 0.50; and glycine 0.25. This diet contained 21.5% of crude protein and 0.81% of sulfur-containing amino acids. The methionine excess diet was made by adding 1.0% L-methionine to the control diet at the expense of cornstarch.

Feed and water were available freely throughout the 12-day experimental period. Body weight change and feed intake were recorded every other day, and excreta were collected in a tray containing 100 ml of 0.1% sulfuric acid during the last 2 days of the experimental period. On day 20, the chicks were weighed after 3-hour fasting and killed with ethyl ether to prevent the loss of blood.

Whole carcasses were frozen and minced with a meat grinder (Onoue Chopper No. 2, Onoue Co., Nagoya). The minced carcasses were refrozen with dry ice and minced again. This procedure was repeated twice and dried at 55°C for 48 hours. Excreta

were homogenized with an electric blender (Osterizer cycle blend, Oster Co., Milwaukee) after diluting to appropriate volume, and then dried at 55°C for 24 hours. Nitrogen in the diets, excreta and carcasses was determined by a Kjeldahl procedure and carcass protein was defined as nitrogen x 6.25. Carcass fat was extracted by ethyl ether using a Soxhlet apparatus and determined gravimetrically. Gains in fat and protein during the experimental period were estimated by reducing the initial values of body composition from the final ones on day 20. Average initial body weight of the chicks on day 8 was 78.0 g and they contained 5.8 g and 12.5 g of fat and protein, respectively. Energy gain was calculated from the gains in fat and protein using the values of 39.12 kJ (9.35 kcal)/g and 23.68 kJ (5.66 kcal)/g, respectively⁶). Caloric values of the diets and excreta were measured using an automatic bomb calorimeter (Shimazu CA-3, Shimazu Co., Kyoto). Metabolizable energy values were determined according to the method of HILL and ANDERSON⁷).

Results and discussion

The results of the present experiment were summarized in table 1. Additional supplementation of 1.0% L-methionine to the control diet significantly decreased body weight gain by 12.2% ($P < 0.05$). Feed intake of the chicks fed the methionine excess diet was also decreased by 9.4% ($P < 0.01$). In the previous experiment¹), the chicks fed the methionine excess diet containing additional 2.7% methionine decreased body weight gain and feed intake by 64.7 and 39.3%, respectively. The observation that the depression in body weight gain and feed intake in the present experiment was much less than that observed in the previous experiment¹) was attributed to the supplemented methionine

Table 1. Effects of moderate excess methionine on body weight gain, feed intake, efficiency of feed utilization, body composition, gains in fat, protein and energy, and utilization of energy and nitrogen (Mean $\pm$ SEM).

	Control	Met excess
Body weight gain (g/chick)	103.0 $\pm$ 3.8	90.4 $\pm$ 2.2*
Feed intake (g/chick)	194.6 $\pm$ 3.8	176.4 $\pm$ 2.3**
Efficiency of feed utilization (g/100 g)	52.9 $\pm$ 1.4	51.2 $\pm$ 1.1
Body composition		
Moisture (%)	70.4 $\pm$ 0.1	70.4 $\pm$ 0.2
Protein (%)	17.9 $\pm$ 0.3	17.9 $\pm$ 0.2
Fat (%)	8.1 $\pm$ 0.2	7.3 $\pm$ 0.3
Gain		
Fat (g/chick)	9.0 $\pm$ 0.8	6.8 $\pm$ 0.6*
Protein (g/chick)	20.0 $\pm$ 0.7	17.7 $\pm$ 0.4*
Energy (kJ/chick)	823.4 $\pm$ 40.2	686.2 $\pm$ 26.8**
Utilization		
Energy (%)	31.7 $\pm$ 1.3	28.6 $\pm$ 1.0*
Nitrogen (%)	47.7 $\pm$ 1.1	45.3 $\pm$ 1.0

*, ** Significantly different at $P < 0.05$ and $P < 0.01$, respectively.

level as reported by GRIMINGER and FISHER²⁾. Furthermore, efficiency of feed utilization was significantly decreased by feeding the severe methionine excess diet in the previous experiment¹⁾. In the present experiment, however, the efficiency of feed utilization of the chicks fed the moderate amount of excess methionine was almost the same as that of the control chicks. This result indicated that the growth retardation of the chicks fed the moderate methionine excess diet primarily resulted from the depression in feed intake.

Protein and moisture contents in the carcass were not changed by feeding the methionine excess diet, but fat content of the chicks fed the methionine excess diet tended to decrease, though statistical significance was not observed. This result was essentially the same as the result of the previous experiment¹⁾, regardless of severity of excess methionine. The chicks fed the methionine excess diet retained significantly less fat and protein than those fed the control diet ($P < 0.05$). Consequently, these chicks retained 16.7% less energy than the control chicks ($P < 0.01$).

Metabolizable energy value was not influenced by the methionine level in the diet as reported previously^{1,6)}, being 13.35 ± 0.08 and 13.51 ± 0.04 kJ/g for the control and methionine excess diets, respectively, and the metabolizability of dietary energy was calculated as 81.1% for both groups. Therefore, metabolizable energy consumption of the chicks fed the control and methionine excess diets for 12-day experimental period was in parallel with the feed intake of the respective group. In the view of the energy utilization, expressed as a ratio of retained energy to metabolizable energy consumption, the chicks fed the methionine excess diet utilized consumed metabolizable energy less efficiently than those fed the control diet ($P < 0.05$). The decreased energy utilization was also observed in the previous experiment¹⁾ and the depression rate was greater than that presented here. Whereas, the chicks fed the moderate excess methionine utilized dietary nitrogen as efficiently as those fed the control diet as shown in table 1. This result was distinct from that reported previously¹⁾ which showed that the efficiency of nitrogen was markedly decreased by feeding the severe methionine excess diet.

From the results observed in the present and the previous experiments¹⁾, it appeared that the efficiencies of energy and nitrogen utilization were modified by the methionine level supplemented excessively. These results suggest that the degree of excess methionine plays an important role in energy and nitrogen metabolism.

Summary

In order to study the effect of moderate excess methionine on growth, feed intake and efficiencies of energy and nitrogen utilization in chicks, 8-day-old Single Comb White Leghorn chicks were fed the methionine adequate control and moderate methionine excess diets for 12-day experimental period. Body weight gain and feed intake of the chicks fed the methionine excess diet were significantly decreased, whereas efficiency of feed utilization was not affected by feeding the methionine excess diet. Body composition was not different between both groups, but the chicks fed the methionine excess diet retained significantly less fat, protein and energy than those fed the control diet.

Although metabolizability of dietary energy was not altered by excess methionine, the efficiency of metabolizable energy utilization was decreased. Whereas, nitrogen utilization was not depressed by feeding the methionine excess diet.

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Literature

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ヒナの成長、飼料摂取量およびエネルギーと窒素の 利用に及ぼす軽度のメチオニン過剰飼料給与の影響

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メチオニン過剰飼料がヒナのエネルギーおよび窒素の利用性を低下させることは前報¹⁾で報告したが、過剰の程度は増体量の減少率が対照の 65%という極端なものであった。そこで本実験では軽度のメチオニン過剰飼料を用いて、ヒナの増体量、飼料摂取量および飼料のエネルギーと窒素の利用に及ぼす影響を調べた。供試ヒナは体重の均一な 8 日齢の白レグ雄を用い、1 群 2 羽の 12 群に分け、それぞれ 6 群ずつに対照飼料とメチオニン過剰飼料を給与して 12 日間飼育した。対照飼料の組成は飼料 1 kg 当り、大豆蛋白質 257.8 g, コーンスターチ 406.4 g, グルコース 200 g, コーンオイル 40 g, セルロース 30 g, ビタミン・ミネラル混合物 58.3 g, L-メチオニン 5.0 g およびグリシン 2.5 g とした。またメチオニン過剰飼料は対照飼料に 1.0%のL-メチオニンをコーンスターチと置きかえて添加した。飼育試験終了後、ヒナは屠体分析に供した。

ヒナの増体重および飼料摂取量はメチオニン過剰飼料

の給与によって有意に減少し、減少率はそれぞれ対照区の 12%および 9%であった。しかし飼料効率には差は認められなかった。屠体成分は脂肪含量に減少の傾向がみられたが有意な差ではなかった。また蛋白質および水分含量にも差はなかった。しかしメチオニン過剰飼料を摂取したヒナの脂肪、蛋白質およびエネルギーの蓄積量は増体重の差を反映して有意に低下した。飼料エネルギーの代謝率は両区において差はなかったが、代謝エネルギーの利用性はメチオニン過剰飼料を摂取したヒナでは有意に減少した。しかし飼料の窒素の利用性はメチオニン過剰で影響を受けなかった。

軽度のメチオニン過剰飼料の給与により、ヒナの増体重および飼料摂取量の減少の程度は前報¹⁾と比較して軽減され、また飼料のエネルギーおよび窒素の利用性の低下も緩和された。

(家禽会誌, **14**, 236~239, 1977)