Lysine Requirement of the Adult Rooster

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The amino acid requirements of adult roosters determined by a nitrogen balance method have been reported by ISHIBASHI¹⁾ and LEVEILLE *et al.*²⁻⁵⁾ The comparison of the former with the latter indicates three qualitative differences besides small quantitative differences in amino acid requirements. In contrast to the results by LEVEILLE *et al.* the data by ISHIBASHI indicated that 1) phenylalanine was replaceable with tyrosine for maintenance of nitrogen equilibrium for a long period⁶⁾ and both 2) histidine and 3) lysine were essential for maintenance of nitrogen equilibrium. The re-examination for the first and the second indications were conducted and the results confirmed were reported previously⁶⁻⁸⁾.

Lysine is essential for growth and laying⁹⁾. The lysine requirement was estimated to be 40 mg/kg body weight/day (equivalent to 0.13% of the diet) for maintenance of the same level of nitrogen balance as observed on the whole egg protein diet and 16 mg/kg body weight/day (equivalent to 0.05% of the diet) for maintenance of nitrogen equilibrium¹⁾. On the other hand, LEVEILLE *et al.* reported that the lysine requirement was no greater than 29 mg/kg body weight/day and the animals were not in negative nitrogen balance even in the complete absence of lysine from the diet.

Studies reported herein were designed to reinvestigate the lysine requirement of adult roosters by the nitrogen balance method and oxidation technique of lysine-¹⁴C to carbon dioxide *in vivo* and *in vitro*.

Eleven-month-old White Leghorn roosters weighing 1.90 to 2.20 kg were used in these experiments. This strain had been improved for earlier maturity and smaller size than usual in the National Institute of Animal Industry in Japan. The diets used contained 70.8% of corn starch, 5.0% of mineral mixture¹⁾, 5.0% of cellulose powder, 5.0% of soybean oil, 1.8% of vitamin mixture¹⁾, 10.0% of amino acid mixture (-lysine)¹⁾ and 1.5% of lysine or glutamic acid. Four roosters were assigned to each treatment. Food and water were offered *ad libitum* for 10 days and excreta were collected during the last 4 days for nitrogen analysis.

At 10:00 A.M. on the 10th day, 2.21 μ Ci L-lysine-U-¹⁴C per rooster was injected intraperitoneally. Expired carbon dioxide and excreta were collected for 8 hours⁸⁾. At 8 hours after injection, all roosters were sacrificed by cutting subclavian artery. Then *in vitro* oxidation of lysine by the liver, kidney and small intestine homogenates was determined in the same way described by WANG and NESHEIM¹⁰⁾. The radioactivity was determined in a liquid scintillation spectrometer⁸⁾.

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Fig. 1. Effects of dietary lysine levels on body weight changes (A), nitrogen balance (B) and recovery percentage of ¹⁴C of dose in respiratory carbon dioxide and in excreta (C).

The results obtained were summarized in Fig. 1. The body weight from the 4th day to 10th day after feeding the experimental diets remained almost unchangeable in the range of daily variation. Nitrogen balance resulted in negative on the lysine-free diet and the lysine requirement for nitrogen equilibrium was not more than 0.25% of the diet.

Generally speaking, when an amino acid is present in suboptimal amounts in the diet, a large proportion of this amino acid will be used for protein synthesis. As its dietary supply exceeds the animal needs for protein synthesis, increased use of its carbon skeleton for alternative processes may be expected.

As shown in Fig. 1-(C), the recovery percentage of ¹⁴C of injected dose in respiratory carbon dioxide remained at 6.1% on both the zero and 0.25% of dietary lysine level and thereafter increased rapidly with the increment of dietary lysine level. These results indicate that the lysine requirement of roosters may not be larger than 0.25% level of the diet. The recovery percentage of ¹⁴C in excreta did not increase significantly.

The radioactivity of carbon dioxide liberated by tissue homogenates increased linearly with the incremental level of dietary lysine without any clear-cut break point as observed in respiratory studies. From the data obtained by this nitrogen balance method and oxidation technique, it may be concluded that lysine is essential for maintenance of adult roosters and its requirement is 0.25% or not greater than 0.25% level of the diet.

The effect of dietary lysine levels on the concentration of plasma free lysine was not determined in these studies.

OHNO and TASAKI¹¹⁾ reported that the plasma lysine concentration remained constant as the dietary lysine level rose from 0.21 to 0.63%, but increased linearly with the further increase of the dietary lysine level from 0.63 to 1.47%. From the above results, they concluded that a lysine level greater than 0.63% was in excess of the amount needed by 8-month-old cockerels fed a 3% casein diet. This higher estimation than our results shown in the above experiments may be partly due to the age of roosters used as ZIMMERMAN and SCOTT¹²⁾ already suggested. They reported that the lysine requirement was 0.83, 0.70, 0.67 and 0.59% of the diet for 2-, 3-, 4- and 5-week-old chicks, respectively.

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