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 ISHIBASHI\(^1\) and LEVEILLE et al.\(^2-5\) The comparison of the former with the latter in-
dicates 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 period\(^6\) 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 previously\(^6-8\).

Lysine is essential for growth and laying\(^9\). 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 ni-
trogen balance as observed on the whole egg protein diet and 16 mg/kg body weight/day (equiv-
alent to 0.05% of the diet) for maintenance of nitrogen equilibrium\(^1)\). 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 roost-
ers by the nitrogen balance method and oxidation technique of lysine-\(^14\)C 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 ex-
periments. 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 mixture\(^1)\), 5.0% of cellulose powder, 5.0% of soybean oil, 1.8% of vitamin mix-
ture\(^1)\), 10.0% of amino acid mixture (\(-\)-lysine)\(^1)\) and 1.5% of lysine or glutamic acid. Four roost-
ers 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 µCi L-lysine-U-\(^14\)C per rooster was injected intraperi-
toneally. Expired carbon dioxide and excreta were collected for 8 hours\(^8\). At 8 hours after injec-
tion, 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 de-
scribed by WANG and NESHEIM\(^10\). The radioactivity was determined in a liquid scintillation spec-
trometer\(^8\).
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 $^{14}$C 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 $^{14}$C 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.
ISHIBASHI and KAMETAKA

OHNO and TASAKI\(^{11}\) 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 SCOTT\(^{12}\) 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.

References