B.M.R. of the rat in doses up to 500 mg per kg of body weight, while ortho thyroxin was found to have an activity of 1/25 to 1/50 of that of thyroxin.

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Lysine Requirement of the Chick.

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In a continuation of studies on the quantitative amino acid requirements of the young chick for optimum rate of growth, evidence has been obtained on the level of lysine needed in the diet. The diet used was the same as that reported previously,[1] except for differences in the proteins and amino acids added. Calculations of amino acid levels in the diets are based upon the amino acid composition of proteins as summarized by Calvery.[2] Such calculations are, of course, subject to revision in the event that any of the cited values should be greatly altered in the future. The fact that lysine is required by the chick has been previously indicated.[3]

The initial experiment was conducted with zein since this protein contains no appreciable amount of lysine. After some failures in preliminary trials, the manifold deficiencies of zein were corrected by addition of pure amino acids and satisfactory rates of growth of

TABLE I.
Growth-promoting Effects of Lysine Additions to the Zein Chick Diet.

l-(+)-lysine added, %	Avg gain per chick, g	Gain per day, %
0.0	— 6.2	—1.7
0.4	+ 1.0	+0.2
0.8	+33.1	+6.4
Positive control diet	+40.7	+6.9

Each group contained 5 chicks with an average starting weight of 57 g. The experiment lasted 7 days. The positive control diet contained an equal weight of casein in place of zein. No methionine, threonine, tryptophane or lysine was added.

1 Almquist, H. J., and Mecchi, E., PROC. SOC. EXP. BIOL. AND MED., 1941, **48**, 526.

2 Calvery, H. O., *Chemistry of the Amino Acids and Proteins* (edited by C. L. A. Schmidt), Charles C. Thomas, publisher, Baltimore, Maryland, first ed., p. 217.

3 Buckner, G. D., Peter, A. M., Wilkins, R. H., and Hooper, J. J., *Ky. Agr. Exp. Sta. Bul.*, 1919, **220**.

chicks were obtained. The final basal diet contained zein 30, arginine monohydrochloride 0.5, dl-methionine 0.2, dl-threonine 0.3, l-tryptophane 0.4, and glycine 1.0% as the sole sources of amino acids.

The results in Table I show that chicks receiving no lysine in the diet slowly lost weight, that 0.4% lysine in the diet was barely sufficient for maintenance of weight and that 0.8% lysine in the diet permitted a rate of growth which was slightly less than that of chicks receiving casein in place of zein (lysine level of diet approximately 1.8%).

Because of the necessity of many pure amino acid supplements to the zein diet and the corresponding high cost of this diet, experiments were next attempted with edestin, a protein which appeared complete for the chick in all respects except for lysine and possibly methionine. Edestin is known to be a good source of threonine[4] concerning the distribution of which almost no quantitative data are available.

Diets were prepared as before using as sources of amino acids, edestin 25, glycine 1.0, and dl-methionine 0.4%. The calculated lysine content of this diet was 0.55%. It was expected to be inadequate for optimum growth of the young chick, and so proved. The strict necessity of the methionine addition was not tested. It was not found necessary to add threonine, arginine or tryptophane. l-(+)-lysine monohydrochloride was added to the diet in amounts to adjust the total lysine content to the levels indicated in Table II. The results of this second experiment are in agreement with those of the first in showing that a level of more than 0.8% lysine was needed for the highest rate of growth. The results also suggest that the optimum level of lysine is probably not more than 0.9% in the diet.

In a third experiment, combinations of edestin with casein and with zein were used to provide various lysine levels in the diet, as

TABLE II.
Growth-promoting Effects of Lysine Additions to the Edestin Chick Diet.

Total l-(+)-lysine in diet, %	Avg gain per chick, g	Gain per day, %
0.55	+19.6	+3.3
0.65	+29.2	+4.7
0.75	+39.0	+5.9
0.85	+47.9	+6.7
0.95	+48.2	+6.8

Each group contained 5 chicks with an average starting weight of 55 g. The experiment lasted 10 days.

[4] Rose, W. C., *Physiol. Rev.*, 1938, **18**, 109.

calculated from tables of amino acid composition of proteins.[2] Glycine was added where necessary to keep its level in the diet at 1% or more. Similarly, methionine (dl) was added to maintain a level of at least 0.75% of the natural form. Diet III-A, contained edestin 20 and casein 10%, diet III-B contained edestin 25 and casein 5%, diet III-C contained edestin 30%, and diet III-D contained edestin 25 and zein 5%. The calculated lysine levels in these diets are, respectively, 1.04, 0.85, 0.66, and 0.55%.

The results of the third experiment (Table III) also indicate that a maximum growth response would have been attained at approximately 0.9% lysine in the diet. Group III-D gained very slowly at the lowest level of lysine, but immediately accelerated to a nearly optimum rate of gain when lysine was added to the diet. This, as well as the results of the earlier experiments, indicates that the only growth-limiting deficiency in these diets, effective during the interval of the experiments, was that of lysine. The lysine level required for the maximum rate of growth of the young chick is approximately 0.9% of the diet. This level is indicated by calculations from tables of amino acid analyses, by additions of pure lysine to the diet and by both jointly.

Most of the amino acids used in this work were generously provided by Merck and Co., Inc.

Summary. The l-(+)-lysine requirement for optimum growth of the young chick is approximately 0.9% of the diet.

TABLE III.
Growth-promoting Effects of Various Levels of Lysine as Provided by Combinations of Proteins in the Chick Diet.

Group	Total l-(+)-lysine in diet, %	Avg gain per chick, g	Gain per day, %
III-A	1.04	+72.4	+7.0
III-B	0.85	+70.5	+6.9
III-C	0.66	+27.6	+3.4
III-D (1 to 8 days)	0.55	+ 8.4	+2.6
III-D (9 to 14 days)	0.85	+33.6	+6.5

Each group contained 5 chicks with an average starting weight of 57 g. The experiment lasted 11 days in the case of the first 3 groups.

After a period of slow growth for the first 8 days, Group III-D was given supplementary lysine in the diet, to a total level of 0.85%, and kept on this diet for 6 more days.