

Amino Acid Balance at Super-normal Dietary Levels.* (17370)

H. J. ALMQUIST.

From The Grange Company, Modesto, Calif.

It has been pointed out that the same relative proportions of indispensable amino acids to each other must be established to secure the maximal gain possible by the chick on a particular diet, whether the amino acids are supplied as mixtures made up from the single amino acids, as hydrolyzed proteins, or as intact proteins. These findings were based primarily upon protein levels at an approximate optimal value of 20% of the diet.¹ Recently it was shown by Grau that the lysine required to supplement sesame protein for maximal growth of the chick at any protein level from 5 to 30% of the diet was almost directly proportional to the protein level.² The present studies were conducted to investigate the relation of dietary protein level to methionine requirement of the chick.

Experimental. S. C. White Leghorn, New Hampshire and New Hampshire-Barred Rock Cross cockerel chicks, were fed for one or 2 weeks a practical starting mash, then closely

selected for weight and vigor, divided into groups of 10 to 15 each, and placed on the experimental diets. The soybean meals used were solvent-process meals of known good quality, and with only very slight urease activities. The diets were made up as indicated in Table I.

The chicks were kept for 2 weeks on the experimental diets. Supplements of DL-methionine, and results obtained are indicated in Table II.

Recent analyses of soybean meals for methionine, and, in particular, one thorough study,³ have shown that modern soybean meals cannot be expected to provide much more than approximately 1.5% methionine, as calculated on the crude protein (% N $\times$ 6.25) basis. More than 0.10% but not more than 0.20% added methionine was needed to permit maximal gain at the 20% protein level. The addition of 0.20% methionine brought the total up to 0.50%, which is the previously estimated minimum requirement standard for chicks.¹ This requirement had been estimated by the use of S. C. White Leghorn chicks. The present data show that this estimate holds equally well for New Hampshire and New Hampshire-Barred Rock Cross chicks. On the other hand, McGinnis and Evans⁴ have suggested that New Hampshire chicks may require less methionine than White Leghorns.

The 30% protein diets were not completely supplemented by an addition of 0.20% methionine. It is probable that very nearly 0.30% added methionine, (0.75% total methionine) but not more, was required to permit maximal rates of gain with the 30% protein diets. Evidently, the amount of total methionine needed to support the maximal rate of gain was proportional to the total protein level.

TABLE I.
Composition of Basal Diets.*

	I	II
Soybean meal	408 g	617 g
Bonemeal	50 g	50 g
Limestone	10 g	10 g
Paper pulp	20 g	0 g
Salt	10 g	10 g
Animal protein factor conc.	11 g	11 g
Cystine	1.1 g	1.1 g
Riboflavin	4.4 mg	4.4 mg
Ca. pantothenate	11.0 mg	11.0 mg
Niacin	44.0 mg	44.0 mg
Thiamin	4.4 mg	4.4 mg
Choline chloride	660 mg	660 mg
Vit. E	11.0 mg	11.0 mg
Vit. A, U.S.P. units	11,000	11,000
Vit. D, A.O.A.C. units	1,100	1,100
Glucose to	1 kg	1 kg

* Vitamin quantities indicated are in addition to those present in the soybean meal.

† Supplied by Lederle Laboratories through the kindness of Dr. T. H. Jukes.

* Presented at the Informal Poultry Nutrition Conference, Detroit, April, 1949.

¹ Almquist, H. J., *J. Nutrition*, 1947, **34**, 543.

² Grau, C. R., *J. Nutrition*, 1948, **36**, 99.

³ Kuiken, K. A., and Lyman, C. M., *J. Biol. Chem.*, 1949, **177**, 29.

⁴ McGinnis, J., and Evans, R. J., *J. Nutrition*, 1947, **34**, 725.

TABLE II.
Relation of Protein and Methionine Levels to the Rate of Gain in Chicks.

Protein in diet, %	Methionine added to diet, %	Total methionine in diet, %	Daily rate of gain		
			S.C. White Leghorn, %	New Hampshire, %	New Hampshire- Barred Rock cross, %
20	0	.30	6.3*	7.1*	7.2
20	.10	.40	6.7	7.6*	7.7
20	.20	.50	7.0*	8.0*	7.9
20	.30	.60	7.0	7.9*	7.9
30	0	.45	6.2*	8.2*	—
30	.10	.55	—	8.4*	—
30	.20	.65	6.7	8.5*	8.2
30	.30	.75	7.2*	8.6*	8.5
30	.40	.85	7.2	8.6*	8.4

* Average growth rate of duplicate pens.

These results are analogous to those with sesame meal and lysine.²

The results discussed above seem sufficient to justify an extension of the concept previously stated by the writer,¹ that the proportions of indispensable amino acids to each other remain relatively the same for maximal efficiency of utilization under varying conditions of level and source of the amino acids. This concept now includes levels of protein intake considerably above what is usually considered the normal requirement for maximal rate of gain.

Since maximal protein efficiency, as indicated by growth rate, is closely related to proportions of amino acids in the diet, even at super-normal protein levels, it would appear, as previously suggested,¹ that "the proportions of amino acids reaching the synthetic regions in the animal are determined largely by the proportions in the diet." The balance of indispensable amino acids in the nitro-

genous increments reaching these cells is more important than the gross protein intake.

Amino acid imbalance in chick diets is not fully correctable by feeding more of the same imbalanced protein. This fact has a bearing on chick assay diets for "animal protein factor," in which approximately 70% soybean meal is used. Even with best qualities of soybean meals, these diets are methionine deficient, and when a material is added which contains both "animal protein factor" and an effective quantity of methionine, as in the case of fish meals, the growth response observed is a resultant of a dual supplementation.

Summary. The methionine requirement of the chick for maximal rate of gain on a 30% protein diet is approximately 0.75% of the diet. This value is in direct proportion of the protein levels to the established methionine requirement of 0.50% in a 20% protein diet.

Received August 4, 1949. P.S.E.B.M., 1949, 72.

Rapid Measurement of the Oxygen Saturation of Whole Blood Samples with the Millikan Oximeter.* (17371)

ELTON WATKINS, JR. (Introduced by W. B. Youmans.)
(With the technical assistance of Katherine S. Gullixson.)

From the Departments of Physiology and Biochemistry, University of Oregon Medical School, Portland, Oregon.

During cardiac catheterization it is frequently desirable to obtain a rapid estimation of blood oxygen saturation in order to orient abnormal locations of the catheter and to de-

termine the uniformity of multiple samples. With this purpose in mind, Groom, Wood, Burchell and Parker¹ have developed a whole blood cuvette oximeter which requires a spec-