

Deformity of the Tongue Associated with Amino Acid Deficiencies in the Chick*

C. R. GRAU. (Introduced by H. J. Almquist.)

From the Division of Poultry Husbandry, University of California, Berkeley.

During the course of studies on the nutritive value of beef blood proteins,¹ it was observed that in some chicks being fed a diet deficient in isoleucine the distal end of the tongue was folded back onto the dorsal surface (Fig. 1). In some animals, it appeared superficially that the tip of the tongue had been cut off squarely, and it was only after loosening the tip from the surface with a probe that the true condition was seen. Microscopic examination of longitudinal sections of the tongue revealed that the limiting factor in the size of the turned-back portion was the length of the median cartilage. Subsequently,

the same condition was observed in chicks fed diets deficient in leucine and phenylalanine. A search of the literature has not as yet revealed previous mention of this condition.

The chicks used were White Leghorns of 5 to 30 days of age at the start of the experiments, and all were reared on a chick starting mash from the day of hatching. The basal diet used in this study was composed of purified ingredients; its exact description (except for the protein source) has been described previously.²

The results obtained with various amino acid deficiencies are presented in Table I. All chicks which were fed the deficient diets lost weight during the experiments, while those receiving supplements gained during the same period. From the table it is seen that the incidence of the condition closely follows the isoleucine deficiency of the blood meal diets. The physical character of the diet is apparently not the controlling factor, because experiments in which a mixture of amino acids was used to replace all protein indicated that leucine and phenylalanine deficiencies are causative agents, while lack of histidine, valine or threonine shows no effect. When zein was used as the protein source, and was supplemented with all necessary amino acids except tryptophane, no cases were observed.

Since all of these cases were associated with weight loss, the possibility of inanition or secondary deficiency causing the folded tongues became apparent. Starvation of chicks whose initial weights were 160 grams resulted in death within a week, presumably too soon to allow manifestation of the lesion. Feeding 12 chicks a diet devoid of protein prolonged life, but no folded tongues occurred. Similar groups fed 1% or 2% sardine meal

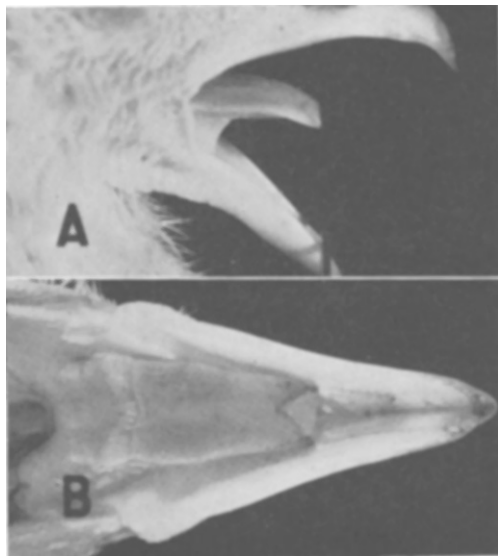


FIG. 1.

Gross appearance of affected tongue. A—Characteristic view showing squareness of tip. B—Dorsal view of tongue as it lies in the lower beak.

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¹ Grau, C. R., and Almquist, H. J., *Poultry Sci.*, 1944, **23**, 486.

² Almquist, H. J., and Grau, C. R., *J. Nutr.*, 1944, **28**, 325.

TABLE I.
Incidence of the Folded Tongue Deformity in Chicks.

Deficiency studied	Source of amino acids	Supplement	Duration of experiment, days	No. of chicks	Incidence, %
Isoleucine	Blood cell protein, 20%, + gelatin, 5%	None	12	4	50
"	" " " "	<i>dl</i> -isoleucine, 2%	12	8	0
"	" " " "	None	10	8	25
"	" " " "	Alfalfa leaf meal, 20%	10	8	0
"	" " " "	" " " " 10%	10	8	0
"	" " " "	None	11	20	45
"	" " " "	"	15	15	33
Leucine	Amino acid mixture	"	18	7	14
Phenylalanine	" " " "	"	18	2	50
Histidine	" " " "	"	19	4	0
Valine*	" " " "	"	12	8	0
Threonine	" " " "	"	14	4	0
Tryptophane	Zein + amino acids	"	18	5	0

* All chicks fed this diet were dead by the 14th day.

protein lost slightly less weight during a 32-day period, and, with one exception, there were no cases of the folded-tongue condition. The single chick which showed the deformity was fed the 2% protein diet, and had been on the diet 16 days before the tongue became deformed. With a casein diet low in protein (2.0%) and supplemented with small amounts of arginine, glycine, and cystine, no cases were observed. It appeared from these results that causing a loss in weight does not necessarily bring on the condition.

Next, 3 proteins known to be deficient sources of amino acids were compared to see if any deficient protein source fed at the 20% protein level could cause the condition. The proteins chosen were dried whole beef blood, zein, and gelatin; the first is deficient primarily only in isoleucine, the second in glycine, lysine, and tryptophane, and the third in tryptophane, the sulfur amino acids, threonine, isoleucine, and probably other amino acids. There were 10 chicks per group at the start of the experiment, with an average weight of 83 grams. The chicks were placed on the diets and observed daily. After 12 days the average weight losses ranged from 7 grams (for the blood meal) to 18 grams (for the gelatin). The incidence of the folded-tongue syndrome and of mortality are apparently independent results of feeding these

poor diets, for the mortality was essentially the same on all diets, while the folded-tongue incidence varied as follows (at 30 days): 90% for blood meal, 10% for zein, and 0% for gelatin. Edema was noted in some chicks on the blood-meal diets 1 to 3 days before death. This condition was most apparent in the tissue lying between the wattles.

Five chicks having folded tongues were placed on a chick starting ration which was known to be adequate for growth. After 9 days all tongues were apparently normal. When the birds were returned to the isoleucine-deficient diet previously used, no cases were observed at 7 days, but all had folded tongues at 13 days. These birds were again placed on the chick mash, and were observed frequently for the remainder of the experiment. There was no gross change for 4 days, but from the 5th day on, the folded portion gradually diminished in size until, by the 11th day, no trace could be seen.

Summary. A condition characterized by the folding-back of the tip of the tongue of chicks is described. A deficiency of isoleucine, leucine, or phenylalanine causes this syndrome, whereas deficiencies of protein or of several other amino acids have no effect. Gradual healing occurs about a week after chicks are placed on an adequate diet.