Note on the Amino Acid Composition of the Protein in Commercial Corn Starch

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During feeding experiments in which corn starch formed a major part of the diet, a question was raised regarding the amino acid composition of the protein in starch. The starch supplied for these experiments was a regular commercial corn starch that had been modified to reduce its viscosity slightly and then agglomerated. The protein content (N X 6.25) was 0.29% and the moisture content was 11.2%.

Conditions used for the hydrolysis of the proteins in the starch were those found useful for other corn wet-milling products (16 hr., 110°C., 6N hydrochloric acid), except that the proportion of acid to sample was increased. A high ratio of hydrochloric acid to starch (1,000 ml. per g.) was used in the hope of minimizing the reaction between amino acids and starch hydrolysis products (1). A total of 1.05 g. starch was hydrolyzed in six glass pressure flasks. The headspace in the flasks was flushed with nitrogen before closing. The hydrolysates were filtered, taken just to dryness in a vacuum rotary evaporator, combined, slurried in 50 ml. water, brought to dryness, reslurried, and again evaporated. The hydrolysate was filtered before the last evaporation. The residue, which contained a small amount of insolubles, was dissolved in 1N hydrochloric acid and made up to 10 ml. The amino acid composition was determined on the Technicon automatic amino acid analyzer. The technique employed was essentially that suggested by Technicon Chromatography Corporation for use with a 75-cm. column containing type C-2A Chromobeads Resin. Duplicate samples of starch were hydrolyzed and both hydrolysates were analyzed twice.

The results are given in Table I, along with the average values obtained on the

TABLE I. AMINO ACID COMPOSITION OF CORN STARCH PROTEIN[a]

Amino Acid	Corn Starch Protein			Average Corn Endosperm Protein
	Average	Range		
		High	Low	
Glycine	4.7	5.3	4.2	2.5
Alanine	7.3	8.0	6.4	8.5
Valine	6.6	7.6	5.8	4.7
Leucine	9.6	10.8	8.6	16.2
Isoleucine	3.6	4.6	1.2	3.8
Phenylalanine	5.1	6.0	4.5	6.1
Serine	3.9	4.7	3.0	4.7
Threonine	3.2	4.7	2.4	3.1
Proline	8.4	10.5	7.3	8.7
Tyrosine	4.7	5.0	4.3	5.3
Aspartic acid	7.4	8.9	6.5	5.9
Glutamic acid	16.7	18.2	14.8	22.9
Lysine	5.2	5.5	5.1	1.6
Histidine	2.9	3.7	2.1	2.1
Arginine	5.2	5.6	4.7	3.1

[a]All values expressed as g. amino acid per 100 g. protein (N X 6.25).

analysis of six samples of corn gluten protein taken from the same plant at which the corn starch was made. No corrections have been made for the decomposition of serine (2), threonine (2), or tyrosine (3) during hydrolysis. Concentrations of cystine, methionine, and tryptophan cannot be determined under the conditions used in these experiments.

Even though only a partial amino acid composition is available, it is apparent that the protein in corn starch is of quite different amino acid composition from that of the principal endosperm protein (corn gluten). The concentration of basic amino acids, particularly lysine, is much greater than in corn gluten. Both leucine and glutamic acid form smaller percentages of the total amino acids in starch protein than in gluten.

The protein in corn starch is probably laid down within the plastid during starch synthesis (4). Judging from the amino acid composition of starch protein, gluten protein comprises only a small percentage of the total. The separation of endosperm protein from starch during commercial corn wet-milling is apparently far more complete than heretofore appreciated. If reasonable amounts of tryptophan and the sulfur amino acids are assumed to be present, the nutritional quality of the residual starch protein should be superior to that of corn endosperm protein.

The foregoing data indicate that purified or semipurified diets containing large amounts of starch will also contain a small amount of reasonably high-quality protein. This should be considered in nitrogen utilization studies with corn starch containing diets.

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