NOTE ON A RAPID METHOD FOR THE ESTIMATION OF DAMAGED STARCH IN SOFT WHEAT FLOURS[1]

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A need was seen in our laboratory for a rapid, relatively simple procedure for estimating the relative concentration of "damaged" starch in soft wheat flours. At least four methods for damaged starch determinations are given in the literature (3,4,5,8), but none of these possessed the degree of rapidity and simplicity we desired. A rapid enzymatic procedure was developed at the laboratory which is well suited to our research program, where usually only small quantities of samples are available. The method is similar to that recently developed by Sandstedt and Mattern (8), and a comparison has been made of the two methods. This Note outlines the details of the method and demonstrates the association of results obtained with those using the Sandstedt-Mattern procedure.

Basically, the method is a modified form of the ferricyanide method for the determination of flour maltose values (1,2). The important modifications include a shortening of the digestion period to 15 minutes, a reduction of the sample size to 1.0 g. (at 14% moisture), and the addition of 0.10 g. Rhozyme 33[3]. A 100-ml. centrifuge tube is employed as the reaction vessel and a suitably adapted automatic stirrer is utilized to mix thoroughly the ingredients prior to digestion. The digestion step is carried on without shaking in an incubator at 30°C. The techniques of the procedure follow closely those given for the determination of flour maltose value. The maltose obtained may be converted to damaged starch by multiplying by the empirical factor 1.64 after correcting for the sample blank.

The conversion factor, 1.64, represents the reciprocal of the mean percentage maltose yield from a group of three gelatinized starches (Purkof, a semihard winter, Blackhawk, a soft red winter, and American Banner, a soft white winter wheat), which were prepared by autoclaving 3% starch suspensions for 2-hour and 4-hour periods. An average of 61.0 ± 0.43% maltose was obtained from the samples utilizing the procedure described above; the various autoclaving periods gave almost identical maltose values. Assuming that the mal-

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[3]Rhozyme 33 is a fungal (*A. oryzae*) diastatic enzyme preparation obtained from Rohm and Haas Co. It is standardized by the manufacturer at 5,000 SKB units per g. Mention of this product does not constitute endorsement by the U.S. Government over similar products or companies not named.

tose-starch conversion factor is essentially 1.0 with fungal enzyme systems (7), it is apparent that about 61.0% of the starch has been converted to maltose. This value compares favorably (considering the difference in digestion times) with an average conversion of about 67.9% after 5 to 20 hours of digestion, which may be derived from Perlin's work (6) on the heterogeneity in wheat starch.

The blank may be determined by omitting the enzymatic preparation and the digestion step from the procedure. It is not necessary to make a determination for each sample, since usually a uniform correction may be made within classes of wheat and milling techniques.

The rapid hydrolysis of damaged starch by the enzyme system employed is well illustrated by the digestion curves presented in Fig. 1. It may be seen from the curve for the autoclaved (gelatinized)

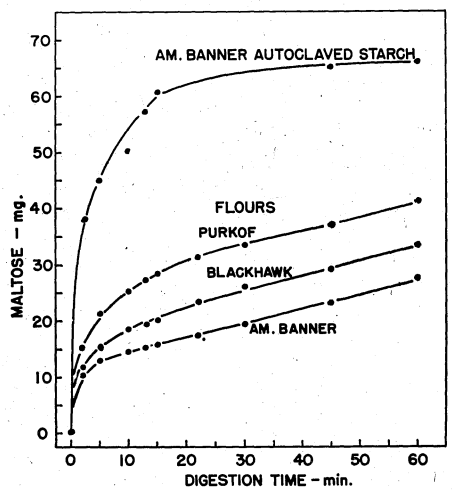

Fig. 1. Digestion time vs. maltose yield for 1.0-g. flour samples and 0.10-g. sample of American Banner 4-hour autoclaved starch.

starch that the hydrolysis curve started to level off after only 15 minutes. The striking similarity of all the curve patterns indicated that the hydrolysis of the damaged starch in flour was equally rapid and appeared to proceed without noticeable interference from other flour components.

A series of 40 flour samples representing ten varieties (one hard red winter, two semihard red winters, six soft red winters, one soft white winter) grown at four locations was used to compare the present method with that of Sandstedt and Mattern. A comparison of values

TABLE I

DAMAGED STARCH VALUES COMPARING THE PRESENT METHOD WITH THE SANDSTEDT-MATTERN PROCEDURE

SAMPLE	SANDSTEDT-MATTERN DAMAGED STARCH	PRESENT METHOD, DAMAGED STARCH
	%	%
Kharkof	4.2	4.2
Purkof	3.8	3.6
Kawvale	3.3	3.7
Clarkan	2.4	2.6
Trumbull	2.2	1.8
Fairfield	2.2	1.9
Thorne	2.1	1.9
Wabash	2.5	2.1
Blackhawk	3.5	2.3
American Banner	2.0	1.9

for one location is given in Table I. The data in the table are representative of the good agreement between the two procedures with regard to the magnitude of the damaged starch contents. As a rule, the Sandstedt-Mattern procedure produced higher values, but this was due in part to the fact that our values were uniformly corrected for the inherent reducing components of the samples (equivalent to 0.3% damaged starch). A very highly significant correlation coefficient of +0.89 (n = 40) was obtained between the two methods. The standard error for duplicate runs derived from the data was 0.15% for the present method and 0.23% for the Sandstedt-Mattern procedure.

It is believed that the procedure presented above has certain advantages in convenience, availability of reagents, and sample size, in addition to its precision. It should be pointed out, however, that the procedure has been applied mostly to soft wheat flours which are low in damaged starch and which have had no malt supplementation.

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