COMMUNICATION TO THE EDITOR

Increase of the Viscosity Values of Gums during Storage of Rye Flour

DEAR SIR:

It is well known that during storage of flours various processes take place, resulting in certain changes in flour components and in activity of existing enzymatic systems. These changes often substantially influence the physicochemical and colloidal behavior of flours and resulting doughs, and may be favorable or unfavorable, with regard to further technology (1).

In one of our studies we followed the changes of rye gums and of rye gluten during short-time storage of rye flour at 18°–40°C. Gums were isolated from flours inactivated by threefold boiling in 80% ethanol. The inactivated flours were extracted with water. The extracts were deproteinized by zinc sulfate (0.5*M* solution) and potassium ferrocyanide (0.25*M* solution), and centrifuged. The supernatants were dialyzed against water. Gums were precipitated with ethanol, washed with acetone and ether, and dried on a water bath. Gluten was isolated by washing doughs prepared from wedge proteins which were isolated by the method of Hess (2).

The changes in colloidal properties of gums were followed on the basis of viscosity measurements of 1.0% water solutions carried out in Höppler's Rheoviscosimeter at 20°C. and shearing force 20 g.cm.$^{-2}$ or 30 g.cm.$^{-2}$. The changes in properties of glutens were estimated on the basis of swelling power as described by Berliner and Koopmann (3). The results are shown in Table I.

It is obvious that gluten properties were altered but very slightly, as can be judged on the basis of swelling capacity. On the other hand, considerable changes in viscosity of gum solutions were observed. The viscosity of gum solutions increased significantly, the rate of increase depending on time and temperature of flour storage. The only exception observed was in flour 2, 40°C., but this was probably due to an erroneous working procedure.

The increase in viscosity values is believed to be proof of increase of degree of polymerization of gums during storage. As far as we are informed, no analogous results have been described concerning changes of soluble polysaccharides during storage of flours. The changes stated are very significant, especially with respect to rye flour, the gums of which considerably influence the properties of the resulting dough (4,5).

The reaction mechanism of the viscosity increase of gums cannot be explained at present. Since gums were isolated from inactivated material and consequently were not exposed to the action of gum-

TABLE I

VISCOSITY VALUES OF 1% SOLUTIONS OF GUMS, AND SWELLING POWERS OF GLUTENS, ISOLATED FROM RYE FLOURS STORED AT VARIOUS TEMPERATURES

FLOUR NO.	STORAGE TEMPERATURE	STORAGE TIME	VISCOSITY OF 1% SOLUTION OF GUMS: SHEARING FORCE		SWELLING POWER OF GLUTEN
			20 g.cm.$^{-2}$	30 g.cm.$^{-2}$	
	°C.	hr.	cp.	cp.	ml.
1	20	72	347.8	...	9
	30		538.0	...	10
	35		1,020.0	...	8–9
	40		1,372.8	...	11
	20	185	1,374.0	512.5	..
	30		1,506.0	527.8	8
	35		1,428.9	656.7	9–10
	40		1,546.7	1,172.3	8–9
2	18	216	1,289.7	463.7	7
	20		1,672.2	835.9	7–8
	30		1,964.9	899.5	9–10
	40		1,066.4	377.5	9–10

degrading enzymes during the isolation procedure, the increase of viscosity could not have resulted from the decrease of activity of these enzymes during storage.

Two possible explanations may be suggested:

1) Stepwise polymerization of gums, depending on time and temperature during storage. This polymerization may or may not be biochemically catalyzed.
2) Stepwise splitting of native complexes originally present in flour and containing fractions of gums of high molecular weight. This process, too, depends on time and temperature, and may or may not be biochemically catalyzed.

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