Note on Amylograph Viscosities of Wheat Flours and their Starches during Storage

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The effects of aging on pasting characteristics of wheat flour have been little explored. We have examined the natural aging of two commercial flours during 4 years' storage. We also report pasting behavior of several experimental wheat flours during accelerated aging at 50° C., and behavior of starches and defatted starches derived from them. Wheats of Australian and New Zealand breeding having distinct pasting characteristics are contrasted.

MATERIALS AND METHODS

Our amylograph methods for flours have been previously described for the enzyme-active (1) and inactivated (2) states. Starches have been assayed similarly, using 50 g. plus 440 ml. water.

Australian commercial flour was milled from a soft wheat by N. B. Love Industries Pty. Ltd., New South Wales, in June 1968. It had 8.2% protein and 0.48% ash (14% moisture basis). The New Zealand commercial flour was milled by Zealandia Milling Co. Ltd., Christchurch, in April 1968 and had 9.8% protein and 0.62% ash. These flours were stored in metal cans at laboratory temperature (15° to 20° C.) and as controls at −25° C.

Experimental flours were milled to 78% extraction on an Allis-Chalmers laboratory mill. After blending thoroughly, the flours were weighed into screw-capped glass jars for storage.The experimental wheats were blends from breeders' trial plots of New Zealand cultivars Hilgendorf 61 and Aotea and Australian cultivars Gamenya and Raven, all harvested in New Zealand in February 1971.

Starches were hand-washed from these experimental flours, repeatedly washed in tap water and then distilled water to retain only prime starch, and air-dried at 44° C. Starches were defatted at room temperature by three extractions with excess 2-methoxyethanol, 24 hr. each time, and finally washed three times with distilled water before air-drying at 44° C. All starches were allowed to reach atmospheric equilibrium at 20° C. before weighing into glass jars and storing similarly to the flours.

Results for two unnamed breeders' lines of wheat, also examined because of contrasted pasting abilities, are not presented in the figures but they show the same trends as the named cultivars of higher and lower pasting ability.

RESULTS AND DISCUSSION

Commercial Flours (Fig. 1)

In general, peak amylograph viscosity increased with aging time, both for active and inactive enzyme states. The data indicate that the aging effect is not attributable to a decline of amylase activity but involves changes in other components such as starch. Storage at −25° C. held the pasting ability nearly

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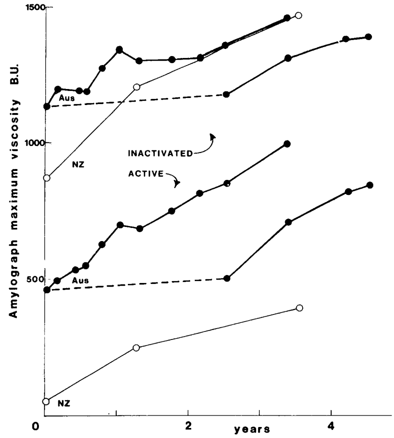

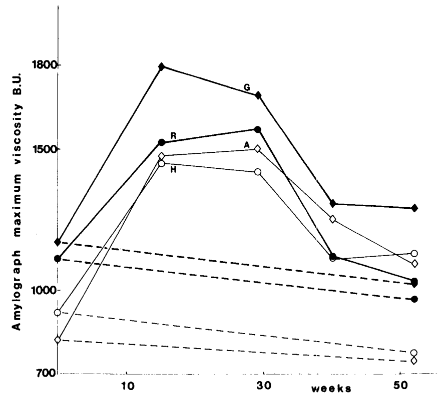

Fig. 1 (left). Effect of storage time on amylograph peak viscosities of two commercial flours. Upper three curves are for acid-inactivated slurries, lower three for active slurries. Heavy lines and filled circles are for Australian flour, light lines and open circles New Zealand flour. Solid lines indicate storage at room temperature, dashed lines at −25°C.

Fig. 2 (right). Effect of storage time on inactivated amylograph peak viscosities of four experimental flours. G and R indicate Australian cultivars Gamanya and Raven; A and H New Zealand cultivars Aotea and Hilgendorf 61. Solid lines indicate storage at 50°C., dashed lines at −25°C.

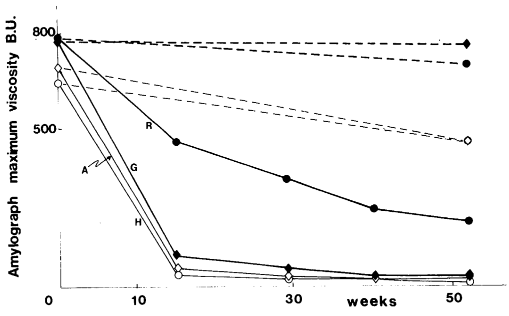

Fig. 3. Effect of storage time on inactivated amylograph peak viscosities of native wheat starches. Symbols as in Fig. 2.

constant. After removal from the freezer, viscosity increases paralleled the original room temperature increases. Relatively low viscosities for both the enzyme-active and inactivated New Zealand flour also suggest that increases in viscosity with aging were not primarily a function of decreasing amylase activity. In the absence of enzyme, however, pasting ability increased with age more markedly for the New Zealand than for the Australian flour, so that after 3 years they were of similar pasting ability.

Experimental Flours (Fig. 2)

For flours stored at 50° C. during 1 year, peak viscosity reached a plateau after

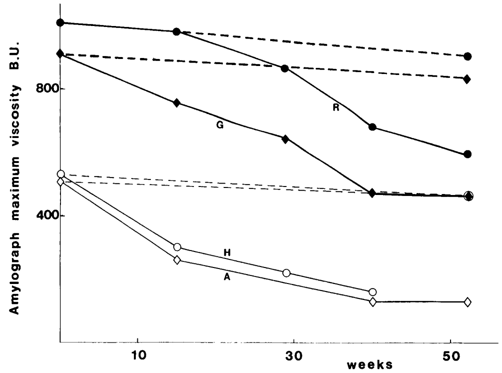

Fig. 4. Effect of storage time on inactivated amylograph peak viscosities of defatted wheat starches. Symbols as in Fig. 2.

about 20 weeks, then declined to near the original value after 40 to 50 weeks. The initial differences in pasting abilities of Australian and New Zealand cultivar experimental flours were maintained during frozen storage at −25° C., but were lost after 50 weeks at 50° C. It is noteworthy that storage time had a similar effect on the commercial flours.

Native Wheat Starches (Fig. 3)

We expected the starches to respond similarly to the flours from which they were derived. However, pasting abilities of all but Raven decreased dramatically in the first 15 weeks and thereafter remained low. Viscosity of Raven continued to decrease throughout the 50 weeks. The initial differences in pasting abilities of Australian and New Zealand cultivars were increased by storing at −25° C.

Defatted Wheat Starches (Fig. 4)

Initial differences between amylograph viscosities of defatted starches from Australian and New Zealand cultivars were maintained during frozen storage and during the slow decline of pasting strength at 50° C. storage. Thus defatting lessened the dramatic decrease in pasting ability of the starches during storage. Defatting increased the pasting strength of the Australian starches but decreased that of the New Zealand starches.

A recent publication by Miller et al. (3) suggests that pasting ability is a function of the part of the granule that exudes into the surrounding hot medium. Thus the known protein and lipid coatings of the granules in a flour may account for the differing behaviors of flours and starches, and the equally well-known interaction between amylose and lipids may account for the differing behaviors of starch granules in the native and defatted states. We suggest that the difference in pasting abilities between flours of Australian and New Zealand wheat cultivars is attributable to properties of the starches rather than to readily extractable protein or lipid.

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