COMMUNICATION TO THE EDITOR

Effect of Sodium Chloride on the Pasting of Wheat Starch Granules

DEAR SIR:

In the course of investigations on the pasting characteristics of wheat starch, some effects of sodium chloride were observed which appear noteworthy. These observations suggest that salts might be used to regulate the swelling of starch and that useful information about this phenomenon might be obtained by studying the properties of starch swollen in the presence and absence of moderate amounts of salts.

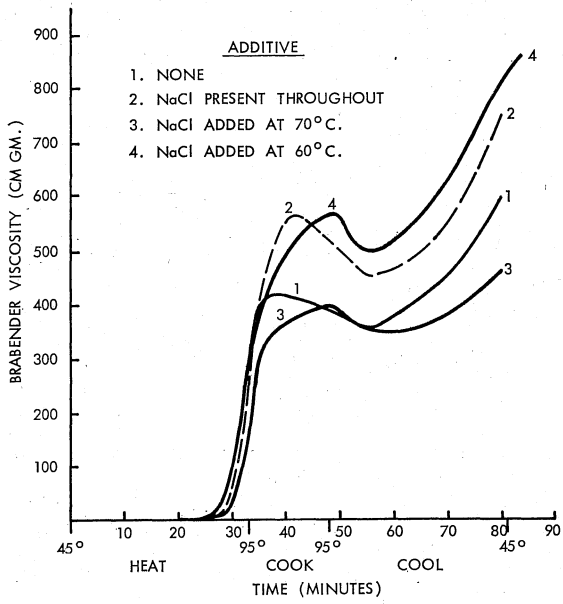

Fig. 1. Effect of 2.5% NaCl solution on the pasting of Starbake (9%).

When a suspension of wheat starch[1] is heated in 2.5% (0.43*M*) sodium chloride solution in a Brabender Visco/amylo/graph, the peak viscosity is markedly increased (Fig. 1, curves 1 and 2). We associate this increase with enhanced maintenance of "granule integrity," i.e., the granule swells to a greater extent or remains intact for a longer

[1] Starbake, a registered trademark of Hercules Powder Co.

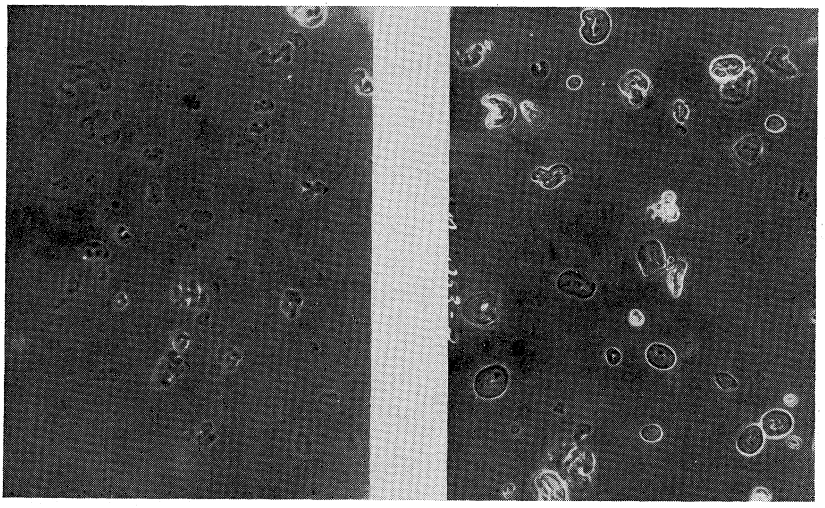

Fig. 2. Photomicrographs of Starbake heated to 95°C. in water (left) and 2.5% NaCl solution (right) (124×).

time before fragmentation occurs. This observation is borne out by microphotographs shown in Fig. 2 and, also, by the enhanced cook-out in the presence of sodium chloride.

When the sodium chloride is added at 70°C., the peak viscosity is not enhanced, even though more time is required to achieve the peak viscosity (Fig. 1, curve 3). When the sodium chloride is added at 60°C., the peak viscosity is enhanced; also, more time is required to achieve the peak viscosity (Fig. 1, curve 4).

We associate these findings with the presence of crystalline areas within the starch granule having binding forces of varying strength or having different accessibilities. When the wheat starch granule swells, it does so in two stages: 1) a small amount of swelling between 60° and 70°C. involving disruption of weakly bound or readily accessible areas (step A), and 2) subsequent rapid swelling at 80°–95°C. involving disruption of more strongly bound or less accessible areas (step B). Upon continued heating, the swollen granule fragments (step C). This fragmentation involves forces or areas other than those involved in steps A and B. The two-step gelatinization of wheat starch has been described (1, p. 323), as has the crystallinity within the starch granule (1, p. 320). Also, the presence of crystalline areas having binding forces of different strengths has been postulated for substances such as sodium carboxymethyl cellulose (2).

The interpretation of these findings is complicated because the viscosity measured is the result of many processes, e.g., swelling, deformation, fragmentation, solubilization. However, the sodium chloride appears primarly to affect the weak forces or readily accessible areas involved in step A; sodium chloride apparently inhibits "opening up" of these areas. Sodium chloride also appears to have a secondary effect in either delaying swelling (step B) or altering the course of fragmentation (step C).

Sodium chloride in this concentration does not alter the pasting curve of waxy maize starch; however, it does increase the peak viscosity of corn starch pastes. The effect of moderate concentrations of salt in raising the viscosities of wheat and rye flours was reported recently (3).

A Brabender Visco/amylo/graph, Model VAV1, was used in these studies. The experimental conditions were: 1) 700 cmgm. cartridge; 2) 450 g. in bowl; 3) 75 r.p.m.; 4) cycle: 45°, 10 min.; 95°, 15 min.; cool to 45°C.

Literature Cited

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