NOTE
Barley Starch. VII. New Barley Starches with Fragmented Granules

B. W. DeHAAS and K. J. GOERING, Department of Chemistry; and R. F. ESLICK, Department of Plant and Soil Science, Montana State University, Bozeman 59717

ABSTRACT

Franubet and Wafranubet are new barley varieties characterized by small, fragmented starch granules. Pasting characteristics and other properties of the starches were compared with those of Betzes and Nubet starches. The Franubet and Wafranubet starches are more resistant to attack by α-amylase than are barley starches with normal granule configurations. Both starches show normal swelling power, but waxy starches such as that from Wafranubet usually have higher swelling power values.

RESULTS AND DISCUSSION

The chemical compositions of the Betzes, hullless Betzes (Nubet), fractured hullless Betzes (Franubet), and waxy fractured hullless Betzes (Wafranubet) are given in Table I. As expected, the protein contents are high because no alkali was used in the starch separation. The values for ether extractables are lower than those usually found, but they are not unprecedented (Goering et al 1973).

The Nubet starch granules have the normal rounded shape of barley starches, but the Franubet granules are generally much smaller and have angular, irregular shapes (Fig. 1). All starch samples were isolated under conditions that were not expected to cause significant starch damage. The Franubet starch appears shattered or crushed. The term "fragmented" was adopted to describe the starch granules from Franubet, Wafranubet, and related lines.

Brabender amylograms of the starches are given in Fig. 2. The waxy starch, Wafranubet, which is typical of waxy barley starches, pastes about 20°C lower than normal barley starches. The properties of the starches are given in Table II. The percent solubles is appreciably higher for Wafranubet starch, but the swelling power is essentially the same for all barley starches in this series. Wafranubet thus differs in swelling power from other waxy barley starches that have much higher swelling power values than their nonwaxy counterparts (Goering et al 1973).

The iodine affinity of the Wafranubet starch is 0.9%, indicating amylose content of approximately 5%. The other iodine affinity values indicate that the starches are normal barley starches with 26–28% amylose. The pasting characteristics of the starches in the presence of CMC are shown in Fig. 3. Wafranubet starch is gelatinized in two stages: first between 70 and 75°C, and finally at 95°C. The higher temperature may be due to the presence of the amylose. The nonwaxy starches gelatinize slightly between 60 and 70°C, but principal pasting occurs at 92°C.

The effect of α-amylase on the various starches is illustrated in Fig. 4. The fractured starches were much more resistant to the action of α-amylase than was the Nubet starch. The high viscosity of the Wafranubet starch in the presence of HT-1000 was

<table>
<thead>
<tr>
<th>TABLE I: Chemical Composition of the Starches*</th>
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<tbody>
<tr>
<td>Sample</td>
</tr>
<tr>
<td>--------</td>
</tr>
<tr>
<td>Betzes</td>
</tr>
<tr>
<td>Nubet</td>
</tr>
<tr>
<td>Franubet</td>
</tr>
<tr>
<td>Wafranubet</td>
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</tbody>
</table>

*All figures adjusted to dry basis.

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Fig. 1. Photomicrographs of starch granules of Franubet and Nubet barleys.

Fig. 2. Brabender amylograms at 8% starch level plus 200 mg of mercuric chloride.

Fig. 3. Pasting curves of starches, 5.5% starch plus 0.8% carboxymethyl cellulose.

Fig. 4. Brabender amylograms at 7% starch level plus 0.0001% HT-1000.

TABLE II
Properties of the Starches

<table>
<thead>
<tr>
<th>Sample</th>
<th>Solubles (%)</th>
<th>Swelling Power</th>
<th>Iodine Affinity (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn</td>
<td>...</td>
<td>5.2</td>
<td>5.2</td>
</tr>
<tr>
<td>Betzes</td>
<td>5.4</td>
<td>7.8</td>
<td>5.2</td>
</tr>
<tr>
<td>Nubet</td>
<td>3.5</td>
<td>8.2</td>
<td>5.2</td>
</tr>
<tr>
<td>Franubet</td>
<td>6.4</td>
<td>8.0</td>
<td>5.6</td>
</tr>
<tr>
<td>Wafranubet</td>
<td>14.1</td>
<td>7.8</td>
<td>0.9</td>
</tr>
</tbody>
</table>

unexpected because other waxy barley starches have been very readily attacked by α-amylase (Goering and Eslick 1976, Goering et al 1980). The cooking curve of Washonupana (waxy, short awn, nude Compana) starch in the presence of HT-1000 is shown for comparison. Susceptibility to α-amylase cannot be correlated with granule size. The starches of Colocasia esculenta are characterized by small granules resistant to α-amylase (Goering and DeHaas 1972), but the starches of the small-granule cow cockle and of the medium-granule canary grass are readily liquified by α-amylase (Goering and Brelsford 1966, Goering and Schuch 1967). This relationship between structure and starch properties has been discussed by Goering (1978). An attempt to use the Wafranubet barley in the maltose syrup process (Goering et al 1980) was not successful because the barley-water slurry had poor handling characteristics, and starch conversion was poor.

The starches from Wafranubet and Franubet are unique among barley starches in their great resistance to attack by α-amylase, especially when compared with cornstarch and dashen (Colocasia esculenta) starches. It seems logical to examine this property when characterizing new starches. A correlation may exist between α-amylase susceptibility and the digestibility of starch used as animal feed.

LITERATURE CITED


CROSSLAND, L. B., and FAVOR, H. H. 1948. Starch gelatinization studies. II. A method for showing the stages of swelling starch during


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