Genetic Variation in the Physical Properties of Sweet Potato Starch

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Sweet potato starch, prepared from 44 genotypes adapted to Philippine conditions, showed wide variation and distinctly different pasting profiles in Rapid Visco-Analyzer (RVA) analysis at 11% and 7% starch concentration. At 11% starch concentration, the pasting profiles were type A, characterized by high to moderate peak with a major breakdown and low cold paste viscosity. At 7%, the pasting profile was generally type C, characterized by the absence of a distinct peak with none to very slight breakdown and high cold paste viscosity. However, differentiation among genotypes was better achieved from RVA pasting profiles at 11% starch concentration. Peak viscosity (PV) and hot paste viscosity (HPV) at 11% starch paste concentration had significant negative correlation with amylose content. PV, HPV, and setback ratio were significantly correlated to adhesiveness of the starch gel. Sweet potato starch generally had high swelling volume but low solubilities at 92.5 °C.

Keywords: *Sweet potato; starch; viscoamylography; Rapid Visco-Analyzer; gel texture; peak viscosity; amylose*

INTRODUCTION

Sweet potato (SP), *Ipomea batatas* (L.) Lam., is a creeping dicotyledonus plant belonging to the family *Convolvulaceae*. It has been a traditional starch source in China, Vietnam, Korea, and Taiwan but is only recently emerging as a commercially important starch in the Philippines with the establishment of three starch plants between 1995 and 1996. Two of the plants are located in Rosales and Calasiao, Pangasinan Province, with capacities ranging from 40 to 120 ton of roots/day. The other is located in Tanauan, Leyte Province, with a capacity intermediate between the two other plants. Consequently, the production and the marketing system of this crop in the surrounding towns is being restructured to support the requirements of the processing plants.

In starch pasting, a starch suspension in a concentration depending on the swelling and thickness of the starch paste is stirred over a programmed heating and cooling cycle, and the changes in viscosity are recorded. Widely used viscometers for pasting studies are the industry standard Brabender viscoamylograph (Brabender, Duisberg, Germany) (Dengate, 1984) and the more recent but well-accepted and broadly comparable Rapid Visco-Analyzer (Newport Scientific Pty. Ltd., Warriewood, Australia) (Deffenbaugh and Walker, 1989). Pasting parameters have been used by many researchers for the characterization of starches from different botanical sources and cultivars (Leelavathi et al., 1987; Bhattacharya and Sowbhagya, 1979) and for the effect of different chemical (Lim and Seib, 1993) and physical (Abraham, 1993; Stute, 1992) modifications.

Various studies (Madhusudhan et al., 1992; Tian et al., 1991; Shiotani et al., 1991; Takeda et al., 1986; Lii and Chang, 1978, 1991) on the Brabender pasting properties of sweet potato starch have described it [following the classification of Schoch and Maywald (1968)] as a typical root/tuber starch that is free swelling with a major breakdown (type A), cereal-like having a moderate peak with high viscosity on cooling (type B), or like a restricted swelling starch similar to cross-linked or native legume starches (type C). In these studies, the concentration of the starch slurry varied from 3 to 7% (w/v), whereas the concentration of starch in RVA studies is generally higher. Being a nontraditional source of starch, the characterization of genetic variation and interrelationships of sweet potato starch physical properties that can guide utilization is therefore essential. This study aimed to determine the variation in RVA pasting properties, gelatinization characteristics, and gel texture in selected genotypes of Philippine-adapted sweet potato.

MATERIALS AND METHODS

Starch Samples. Sweet potato roots of 44 genotypes (varieties and advanced breeding lines) adapted to Philippine conditions were provided by the Asian Sweet Potato and Potato Research and Development Program (ASPRAD) of the International Potato Center (CIP) in the Philippines (Collado et al., 1997). They were grown in field plots under normal agronomic practices in Tarlac, Tarlac Province, and harvested after 100 days cultivation.

Preparation of Sweet Potato Starch. Tubers were washed thoroughly, shredded using a food processor, further macerated in a blender using 1:1 w/v of tap water for 2 min at medium speed, and filtered through cheesecloth. The residue was resuspended in water (1:0.5 w/v) with tap water and macerated in a blender for 2 min. This step was repeated once more, and the filtrate was mixed and passed through a 250-mesh sieve. Starch in the filtrate was allowed to settle for 2−3 h at RT (27−30 °C). The supernatant was decanted and

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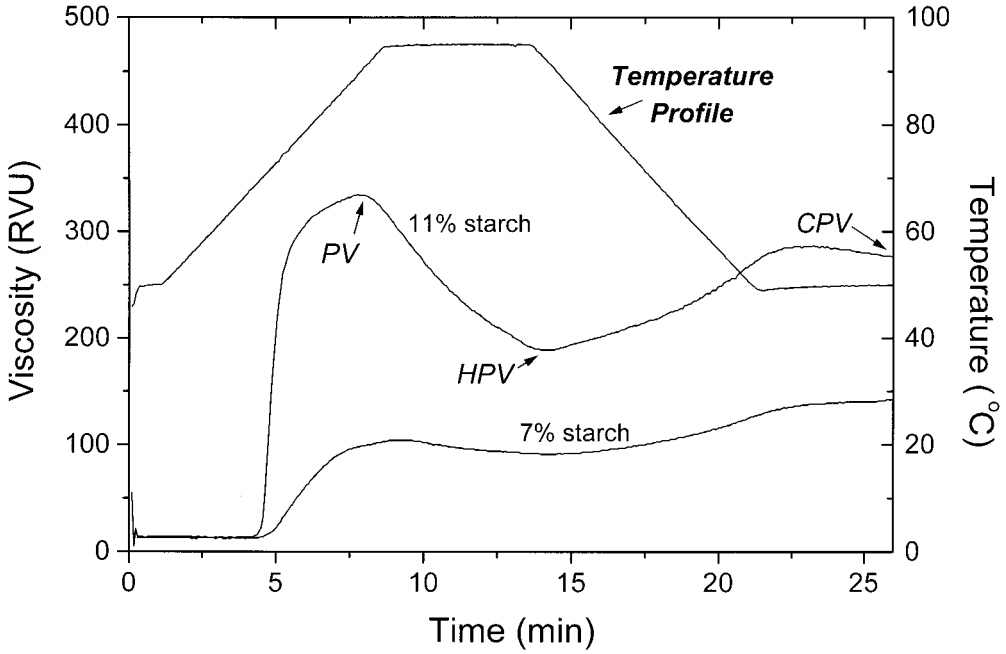

Figure 1. Typical sweet potato starch RVA pasting curve at 7% and 11% starch concentration showing parameters: peak viscosity (PV), hot paste viscosity (HPV), and cold paste viscosity (CPV).

discarded while the starch was resuspended in water and filtered through a 250-mesh sieve and kept in the refrigerator (about 7 °C) to settle. The last step was repeated without the sieving step. Tap water was used for starch extraction instead of distilled water to simulate realistic commercial practice in the Philippines. The relative effect on starch properties was assumed to be uniform across genotypes. The starch sediment was dried in a convection oven at 50 °C overnight, cooled to RT, equilibrated for 4 h before samples were packed, and sealed in polyethylene bags.

The sweet potato starch was analyzed for moisture content following Method 44-15 (AACC, 1995). Total starch content was measured by enzymatic assay based on the amyloglucosidase/α-amylase method (McCleary et al., 1994b) using a total starch determination kit (Megazyme International Ireland Ltd., Bray, Ireland) (McCleary et al., 1994a). Amylose/amylopectin ratio was measured using a concanavalin-A binding method (Yun and Matheson, 1990) with a test kit (Megazyme International Ireland Ltd., Bray, Ireland) shown to have greater than 0.99 correlation with iodine-based assay procedures (Gibson et al., 1997).

Starch Pasting Properties. The viscoamylographs of the starches were determined using a Rapid Visco-Analyzer model 3-D (RVA) (Newport Scientific Pty Ltd., Warriewood, Australia). Accurate 3.0- and 2.0-g (14% moisture basis) starch samples were used to make 11% and 7% concentrations when mixed with distilled water to make a total weight of 28 g in the sample canister. A programmed heating and cooling cycle was used at constant shear rate, where the sample was held at 50 °C for 1 min, heated to 95 °C in 7.5 min, held at 95 °C for 5.5 min, cooled to 50 °C in 7.5 min, and then held at 50 °C for 5 min. Duplicate tests were used in each case. The RVA pasting parameters of peak viscosity (PV), time from onset of increase in paste viscosity to the peak viscosity (P_{time}), hot paste viscosity (HPV) (the pasting viscosity after the holding time at 95 °C), and cold paste viscosity (CPV) (pasting viscosity at the end of the hold time at 50 °C) were recorded (Figure 1). The stability ratio (HPV/PV) and setback ratio (CPV/HPV) were also calculated. These ratios have been applied in previous studies (Collado and Corke, 1997; Bhattacharya and Sowbhagya, 1979) to relate pasting behavior to texture.

Swelling Volume. Swelling volume (Crosbie, 1991) was determined by weighing 0.350 g of starch (dry basis) into 125 × 16 mm Pyrex tubes to which 12.5 mL of water was added. The tubes were placed in a mixing unit equilibrated at 25 °C for 5 min, after which time they were transferred to a 92.5 °C waterbath and mixed in a prescribed mixing schedule for 30 min. Samples were cooled in ice water for 1 min, placed in a 25 °C for 5 min, and centrifuged at 1000*g* for 15 min. The height of the gel was measured and converted to volume of gel per unit dry weight of the sample. Solubility was calculated based on the dissolved sugar in supernatant analyzed through phenol−sulfuric method using D-glucose as standard (Dubois et al., 1956).

Texture of Starch Gel. A texture profile analysis (TPA) using a compression method developed by Bourne (1978) was done on the starch gel after the RVA amylograph determination. The RVA canister containing the cooked paste was covered with Parafilm, allowed to cool and set at RT (20−22 °C), stored at 4 °C overnight, and equilibrated at RT for 4 h after which a TPA with fracture using a Bakelite cylindrical probe with a 5 mm diameter was performed at three points in the gel to a distance of 10 mm at a speed of 1 mm/s. The textural characteristics of hardness and adhesiveness were noted. Hardness was defined as the maximum force in *g* to fracture the gel, while adhesiveness (gs) is the area of the curve as the probe moves back to initial location.

Thermal Characteristics. Gelatinization characteristics were determined using a Mettler DSC-20 differential scanning calorimeter (Mettler-Toledo AG Instruments, Naenikon-Uster, Switzerland). Starch samples (2.5 mg, dry basis) were placed in aluminum crucibles; distilled water was added to make a 1:3 (w/w) starch:water mixture; and the crucible was hermetically sealed. An empty crucible was used as reference. The gelatinization temperature parameters (in °C) of T_o (onset), T_p (peak), T_c (conclusion), and enthalpy (ΔH, J/g) were determined using the software provided.

Statistical Analysis. All analysis was done in duplicate. Genotype means were analyzed for significant differences. Where significant differences were found, LSD was used to separate means. Pearson correlations of the RVA pasting parameters at different starch concentration were conducted. Similarly Pearson correlation of textural properties of the starch gel with RVA viscoamylograph pasting parameters, swelling and solubility, and amylose content were calculated (SAS, 1988).

RESULTS AND DISCUSSION

RVA Pasting Properties of Sweet Potato Starch. Previous studies (Madhusudhan et al., 1992; Tian et al.,

Table 1. RVA Pasting Parameters of Sweet Potato Starch from 44 Different Genotypes at 7% and 11% Concentration

	7% starch concentration			11% starch concentration		
	range	mean	SD	range	mean	SD
PV	66−132	108	4	250−463	362	47
HPV	61−108	94	5	114−242	191	27
CPV	84−186	149	5	187−352	286	30
stability	0.73−0.94	0.86	0.04	0.42−0.66	0.53	0.02
setback	1.38−1.80	1.59	0.07	1.38−1.60	1.51	0.05

1991; Shiotani et al., 1991; Takeda et al., 1986; Lii and Chang, 1978, 1991) have used a starch slurry concentration from 3 to 7% (w/v), whereas normal levels for the RVA are around 11%. As variation may be due to concentration, variety, and pH, direct comparisons with previous results would be difficult. In view of this, we used two starch concentrations for the RVA characterization, i.e., 7% and 11% w/w. The use of a lower concentration of starch would result in a general lowering of the paste viscosities and the softening of peaks and breakdown because of reduced friction due to a lesser number of swollen granules (Figure 1). For potato starch and wheat starch, the general profile is maintained, the distinct peak is evident, and the CPV of the 11% starch concentration is relatively consistent with CPV of the 7% starch concentration (our unpublished results). The sweet potato starch at 11% concentration consistently had higher PV than CPV, whereas at 7% concentration the PV was consistently lower than CPV (Figure 1).

The RVA concentration-dependent pasting parameters of the sweet potato starch in 7% starch concentration were, of course, all generally lower than 11% (Table 1). At 7% concentration, there was difficulty in locating the peak as well as the trough because of minimal breakdown observed. At 7% starch concentration, the mean PV was 108 RVU ranging from 66 RVU in OPS44 to 132 RVU in VSP-7 while the mean HPV was 94 RVU, which ranged from 61 RVU in V30-595 to 108 RVU in VSP-7 (Table 1; see list of genotypes in Table 2). Also at 7%, CPV had a mean of 149 RVU, which ranged from 84 RVU in V30-595 to 185 RVU in Adams 3; the stability ratio mean of 0.86 was high, ranging from 0.73 in V30-595 to 0.96 in 30 Inubi; and the mean setback ratio mean was 1.59, which ranged from 1.40 in 93-006 to 1.75 in no. 65 CIP (Table 1). Several studies found that sweet potato starch does not show a peak viscosity at 4−6% (w/v) concentration (Tian et al., 1991). However, Lii and Chang (1978) reported a moderate peak and a high setback on cooling with at a starch concentration of 7%.

Correlations of the pasting properties of the sweet potato starch at the two starch concentrations were determined (Table 3). The RVA pasting parameters in 11% starch concentration were generally very highly correlated to the corresponding RVA pasting parameter in 7% starch. The correlation coefficients for PV, HPV, CPV, and setback ratio were 0.84, 0.83, 0.89, and −0.80 ($p < 0.001$), respectively. However the correlation for stability ratio ($r = 0.46$, $p < 0.01$) was somewhat lower, again partly because it was difficult to locate the peak in 7% starch concentration for most of the genotypes.

Comparison of RVA viscoamylographs should be done only at the same starch concentration. Higher concentrations, where the RVA pasting parameters are more evident, make differentiation among genotypes easier. For rice, the use of higher paste concentration up to 12% was recommended for better differentiation among intermediate-amylose and low-amylose rices while lower paste concentration was used for high-amylose starches (Juliano, 1985). The amylose content of the sweet potato genotypes analyzed here ranged from 14.0 to 29.7%, which may be considered a wide range in the absence of specific amylose mutants, but is comparable to the intermediate-high range for rice.

The RVA pasting profile of 11% sweet potato starch showed wide variation not only in PV but also in broadness of the peak, which can be characterized by another pasting parameter, the time elapsed from the onset of swelling (as reflected in the start of viscosity increase) to the time PV is reached (P_{time}) (Figure 2). The longer to P_{time}, the broader is the peak. The PV has a mean of 362 RVU ranging from 250 RVU in OPS44 to 463 RVU in VSP-7 (Table 1). The P_{time} has a mean of 2.03 min ranging from 1.10 min in V30-595 to 3.77 min in G88. The HPV has mean of 191 RVU, which ranged from 114 RVU in V30-595 to 242 RVU in Adams-3. The pasting profile of sweet potato starch is type A according to the Schoch and Maywald (1968) classification of starch that is characterized by moderate to high peak viscosity with a major breakdown and with low CPV with respect to the PV. The pasting profile peaks also varied in their broadness, as reflected in P_{time}, which was significantly correlated to stability ratio ($r = 0.63$, $p < 0.001$) (Table 4). A significant negative correlation of PV was also found with amylose content ($r = -0.89$, $p < 0.001$).

Swelling Volume and Solubility of Sweet Potato Starch. The swelling and solubility of starch permits comparison of relative bond strength at specific temperatures (Leach et al., 1959). The mean swelling volume of the sweet potato starch was 29.0 mL/g ranging from 24.5 mL/g in V30-595 to 32.7 mL/g in G88, while the mean solubility at 92.5 °C was 16.9% ranging from 12.1% in Inagahapon to 24.1% in Bureau (Table 2). Sweet potato starch is extensively utilized in starch noodle production in China, Taiwan, Korea, and Vietnam (Timmins et al., 1992; Jeong, 1992; Quach, 1992) so that a comparison with legume starch, which is considered to make superior noodles, is often made. The swelling power of legume starch at 90−95 °C, which ranged from 9.3 to 20 g/g (Singh et al., 1989; Gujska et al., 1994; Jin et al., 1994), was generally lower than that observed in sweet potato, which ranged from 16 to 24 g/g (Tian et al., 1991; Jin et al., 1994). Furthermore, the swelling volume of the genotypes evaluated here, although not directly comparable, appeared to be higher with a mean of 29.0 mL/g. This showed that associative bonding forces in sweet potato starch were generally weaker than in legumes. Swelling characteristics normally parallel solubility so that, in legumes, restricted swelling is accompanied by low solubilities. Solubilities at 90−95 °C in legumes ranged from 10 to 30% (Lineback and Ke, 1975; Singh et al., 1989; Gujska et al., 1994) while reported solubilities of sweet potato starch ranged from approximately 10−18% (Madamba et al., 1975; Jin et al., 1994) at the same temperatures. The solubilities in the genotypes we have evaluated were within this range and were comparable to solubilities of legume starch. The relatively high swelling of sweet potato is not accompanied by high solubilities. This characteristic was also observed by Leach et al. (1959) in potato and by Bhattacharya et al. (1972) in dwarf indica rice. It was speculated that the bonding forces

Table 2. Total Starch Content, Amylose Content, Swelling Volume, Solubility, and Starch Gel Texture

			starch		starch gel texture	
genotype	total starch (%)	amylose (%)	SSV	solubility	hardness	adhesiveness
CN94625	97.2	24.5	28.8	19.20	20.9	−13.6
CN94132	96.3	20.6	30.6	20.2	17.8	−13.4
CN148989	97.9	16.7	28.4	16.9	24.0	−21.2
CN1425170	98.1	17.6	31.9	20.1	34.3	−3.6
BPISP2	97.5	22.1	30.2	19.6	20.1	−11.7
Miracle	97.2	20.3	32.5	13.1	18.3	−33.6
26 Pariados	97.4	16.1	26.8	16.8	22.8	−35.6
13b Tres Colores	96.5	23.4	30.0	18.4	17.1	−38.8
Binicol	97.0	16.4	29.2	17.4	18.8	−25.3
30 Inubi	95.1	17.3	29.8	17.8	24.3	−35.5
Adams 3	93.7	15.2	28.5	17.0	26.5	−26.5
P5	96.1	20.6	31.6	21.0	20.5	−37.5
P16	98.6	19.4	29.5	18.1	21.5	−28.2
no. 46 CIP	97.1	15.2	30.0	18.8	20.7	−13.5
NTA1023	97.7	14.9	28.0	16.4	23.1	−5.3
12 Tres Colores	96.4	19.7	27.1	13.4	19.9	−18.5
Binoras 23	98.2	20.3	29.0	17.3	17.8	−21.1
Inubi Zam	97.0	20.6	31.8	21.4	21.2	−26.0
Catanduanes	97.2	16.7	28.1	16.5	23.5	−43.5
Taiwan	94.6	15.2	29.4	17.7	31.7	−52.0
Bureau	96.3	17.6	32.2	24.1	15.8	−16.5
no. 65 CIP	97.7	13.2	27.5	14.8	26.1	−5.6
L002	95.5	17.0	26.1	14.7	21.8	−18.6
NPSP	96.4	21.1	27.9	15.3	20.2	−39.9
PNG L6	97.9	18.0	27.6	15.4	23.9	−5.8
UPLSP2	97.8	22.4	24.7	12.5	16.0	−19.6
UPLSP5	97.0	14.0	27.3	14.2	21.9	0.0
46-12A	96.8	15.7	27.2	13.7	23.8	−11.0
89-2-10	98.9	29.7	32.5	14.6	18.4	−52.3
88ws623	98.2	18.8	27.5	14.4	21.1	3.0
G88	97.5	26.5	32.7	14.9	18.0	−13.5
25-11A	97.9	25.4	29.5	18.1	16.0	−19.6
G-139-21	97.2	15.7	25.2	12.4	22.5	−28.4
93-006	96.2	28.5	29.5	17.8	31.6	−31.1
VSP-6a	96.4	15.7	30.1	19.3	21.5	−19.4
VSP-6b	96.6	15.9	28.4	17.4	22.5	−28.4
V37-151	96.7	14.8	28.3	16.6	26.2	−16.1
OPS44	96.7	29.7	29.9	19.3	36.1	−37.8
VSP-7	95.9	12.9	30.1	19.6	19.9	−2.2
V30-595	97.2	28.3	24.5	13.2	25.6	−50.5
OP101-R89	96.5	18.0	30.9	20.6	20.6	−31.6
OPS101	96.0	15.7	29.5	18.1	22.0	−37.9
Inagahapon	97.0	16.9	26.4	12.1	37.1	−41.8
UPLSP4	98.0	17.6	27.6	15.3	24.1	−30.5
mean	96.9	19.1	29.0	16.9	22.7	−24.1
LSD (0.05)	0.6	0.3	0.6	1.5	2.5	3.8

Table 3. Correlations among RVA Pasting Parameters of 11% and 7% Sweet Potato Starch Concentration in Distilled Water (N = 44 Genotypes)[a]

	11% starch				
7% starch	PV	HPV	CPV	stability	setback
PV	0.84***	0.77***	0.64***	0.06	−0.77***
HPV	0.83***	0.91***	0.84***	0.31*	−0.79***
CPV	0.89***	0.92***	0.81	0.23	−0.86***
stability ratio	−0.17	0.51***	0.64***	0.46**	−0.03
setback ratio	−0.80***	−0.80***	−0.57***	0.08	−0.77***

[a] *, **, and *** refer to significance at $p < 0.05$, 0.01, and 0.001, respectively.

in these starches may be tenuous but were comparatively extensive, immobilizing the starch substance within the granule even at high levels of swelling. As reviewed by Tian et al. (1991), sweet potato amylose appears to be more branched than that from cassava, potato, wheat, or maize. The mean amylose was 19.1%, which ranged from 13.2% in no. 65 CIP to 29.7% in 89-2-10. There was no significant correlation between swelling volume and amylose content of the starch. The amylose content was significantly correlated to PV, HPV, CPV ($r = -0.89$, −0.72, and −0.60; $p < 0.001$, respectively) but not to stability ratio ($r = 0.10$, $p > 0.10$). The lack of correlation between swelling volume and pasting parameters (Table 4) contradicts results obtained for cereal starches such as wheat (Crosbie, 1991). However, pasting is a dynamic process at high shear, whereas the swelling test is essentially static. A high swelling starch such as sweet potato may be expected to respond differently to these two types of test.

Texture of the Starch Gel. The mean hardness of the starch gel was 22.6 g, ranging from 16.0 g in 25-11A to 37.1 g in Inagahapon while the mean adhesiveness was −24.1 gs, ranging from −0.02 gs in UPLSP5 to −52.3 gs in 89-2-10 (Table 2). The adhesiveness correlated significantly with PV ($r = 0.46$, $p < 0.01$), HPV ($r = 0.41$, $p < 0.01$), and setback ratio ($r = -0.58$, $p < 0.001$). Adhesiveness was also significantly correlated to amylose content ($r = -0.35$, $p < 0.05$).

In a study of starch noodles from sweet potato, RVA pasting parameters of 11% starch such as P_{time} ($r = 0.64$,

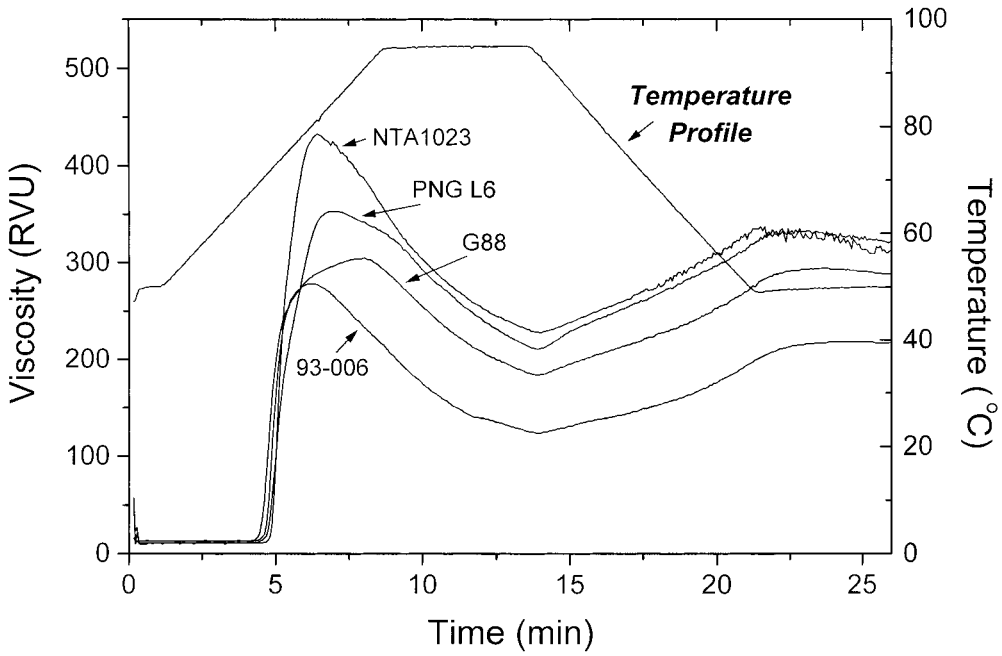

Figure 2. Representative RVA pasting profiles of four genotypes of sweet potato starch at 11% starch concentration.

Table 4. Correlations of Starch Gel Texture, Swelling Volume, Solubility, and Amylose Content with RVA Pasting Parameters at 11% Starch Concentration (N = 44 Genotypes)[a]

	hardness	adhesiveness	swelling vol	solubility	PV	P_{time}	HPV	CPV	stability ratio	setback ratio
hardness	-									
adhesiveness	−0.20	-								
SSV	−0.18	−0.02	-							
solubility	−0.09	0.07	0.66***	-						
PV	0.03	0.46**	−0.04	0.08	-					
P_{time}	−0.29	0.19	0.08	−0.18	−0.10	-				
HPV	−0.06	0.41**	−0.17	−0.26	0.75***	0.31*	-			
CPV	−0.16	0.25	−0.13	−0.26	0.59***	0.32*	0.94***	-		
stability ratio	−0.18	0.03	−0.17	−0.48**	−0.18	0.63***	0.51***	0.64***	-	
setback ratio	−0.08	−0.58***	0.13	0.13	−0.80***	−0.26	−0.80***	−0.57***	−0.16	-
amylose	0.06	−0.35*	−0.22	0.00	−0.89***	0.07	−0.72***	−0.60***	0.10	0.75***

[a] *, **, and *** refer to significance at $p < 0.05$, 0.01, and 0.001, respectively.

$p < 0.05$), HPV ($r = 0.73$, $p < 0.01$), CPV ($r = 0.83$, $p < 0.01$), CPV, and stability ratio ($r = 0.95$, $p < 0.01$) were found to be significantly correlated to the firmness of the noodle using a nondestructive compression test (Collado and Corke, 1997). In this study, lower correlations of RVA pasting parameters with textural attributes of the gel were found as compared to the noodle study, which may be due to differences in sample preparation and the type of the test conducted. A compression test with fracture was conducted on the starch gel in this study, and there was a difference in moisture concentration in the gels, compared to the cooked starch noodles in the previous study.

Thermal Characteristics of the Sweet Potato Starch. There was considerable variation in gelatinization temperatures and enthalpy among the genotypes (Table 5). The mean T_o was 64.6 °C, ranging from 61.3 °C in BPISP2 to 70.0 °C in 89-2-10, the mean T_p was 73.9 °C ranging from 70.2 °C in BPISP2 to 77.0 °C in 25-11A, and the mean T_p was 84.6 °C ranging from 80.7 °C in BPISP2 to 88.5 °C in 25-11A. The mean gelatinization range (T_r) was 20.1, which was lowest in 89-2−-0 with 16.1 and highest in 46-12A with 23.0, while the ΔH mean was 12.9 J/g ranging from 10.6 in 88ws623 and G88 to 15.9 in 25-11A. Starches that differ in gelatinization temperature and enthalpy have different

Table 5. Gelatinization Characteristics of Sweet Potato Starch from 44 Different Genotypes

	range	mean	SD	LSD
T_o	60.8−70.0	64.6	2.0	3.12
T_p	69.2−77.0	73.9	1.8	2.45
T_c	81.7−88.5	84.6	2.0	4.29
T_r	16.1−24.5	20.1	1.6	0.90
ΔH	10.5−15.8	12.9	1.3	2.74

cooking characteristics that affect industrial processes (Lund, 1984). Low gelatinization temperature and heat stability of β-amylase were identified as having an important role in high maltose content in heated sweet potato (Takahata et al., 1995). Correlations of thermal and pasting parameters were generally low and nonsignificant (data not shown).

CONCLUSIONS

The RVA pasting profiles of the sweet potato starch at 11% and 7% were distinctly different but were significantly correlated. At 11% the RVA pasting profile was type A, while at 7% the pasting profile was more type C. The RVA pasting parameters at 11% gave better differentiation among genotypes. These findings were consistent with the observation of Bhattacharya and

Sowbhagya (1978) that no starch is inherently characterized by high or low breakdown or by a positive or negative setback because any starch can show any or all of these characteristics depending on the starch concentration. Very often the time−temperature profiles are at the discretion of the investigator, thus reported results are not repeatable or comparable unless critical information such as amylograph model type, shear rate, starch concentration, and time−temperature profile is given. In cases such as the present study, we feel that the reporting of starch behavior at two different concentrations gives additional insight into the likely processing behavior in different types of products. In some products, quality may be highly related to viscosity at higher concentration [e.g., starch noodles reported by Collado and Corke (1997)], whereas in other cases the lower concentration may be more directly indicative of quality (such as in thickening applications).

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