Comparison of functional properties of normal and amylose-free starches from different crops

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Introduction

In 2006, an amylose-free starch mutant was identified in a S1 cassava genotype (AM 206-5) at CIAT. This spontaneous mutation was already described in 2007 [1]. Waxy starch from this mutation and from potato were analyzed and compared with "normal" starches from three commercial cassava cultivars (CM 523-7; MPER 183 and MTAI 8) and from potato. Different functional and biochemical properties using standard laboratory approaches were analyzed in this study.

Results

Tables 1-3 and Figures 1-2 present the most relevant results of this study. A remarkable characteristic is the low syneresis value observed in the amylose-free cassava starch (Figures 1-2). Peak viscosity was higher in the waxy starch compared with the normal cassava starch, but the opposite was observed in potato (Table 2). Paste clarity of the potato starches were much higher (Table 1). In addition, waxy starches from cassava and potato showed a contrasting performance regarding swelling index and solubility (Table 3).

Table 1. Physico-chemical properties of different types of starch (normal or waxy) of potato and cassava.

	Amylose content (%)	Paste Clarity (%)	λ Max
Normal starches			
Potato	27.7 (±0.5)	88 (±0.8)	591
CM 523-7 (Cassava)	19.8 (±1.3)	50 (±3.5)	593
MPER 183 (Cassava)	19.5 (±1.8)	51 (±3.8)	590
MTAI 8 (Cassava)	16.5 (±0.6)	47 (±0.8)	592
Waxy starches			
Potato	7.7 (±0.83)	92 (±1.4)	550
Cassava (AM 206-5)	0	61 (±0.7)	535

Table 2. Pasting characteristics from different types of starch (normal or waxy) of potato and cassava.

Sample identification	Pasting temp. (°C)	Peak viscosity (cP)	Breakdown (cP)	Setback (cP)	Consistency (cP)
Native starches					
Potato	65.2 (±0.06)	2550(±15)	1204 (±29)	-1082 (±2)	108 (±5)
CM 523-7	63.3 (±0.12)	1006 (±14)	500 (±22)	-364 (±8)	137 (±14)
MPER 183	64.8 (±0.12)	979 (±12)	482 (±15)	-267 (±10)	215 (±8)
MTAI 8	63.7 (±0.00)	876 (±13)	455 (±0)	-338 (±4)	117 (±4)
Waxy starches					
Potato	65.9 (±0.12)	2491 (±49)	1287 (±30)	-1268 (±35)	13(±3)
Cassava	67.4 (±0.00)	1119 (±11)	631 (±8)	-595 (±12)	37 (±4)

Table 3. Solubility and swelling values of different types of starch (normal or waxy) of potato and cassava. Analyses were made at three different final temperatures (60, 75 and 90 ºC)

Sample identification	Solubility (%db)			Swelling index ($g*g^{-1}$)		
	60ºC	75ºC	90ºC	60ºC	75ºC	90ºC
Normal starches						
Potato	2.5 (±0.66)	5.2 (±0.24)	6.0 (±0.21)	13.8 (±0.06)	35.8 (±1.72)	51.1 (±2.92)
CM 523-7	3.1 (±0.27)	5.6 (±0.08)	7.1 (±0.41)	22.9 (±1.42)	36.4 (±0.53)	42.4 (±2.62)
MPER 183	2.4 (±0.37)	5.5 (±0.34)	7.3 (±0.28)	14.9 (±0.86)	34.5 (±3.3)	40.3 (±2.60)
MTAI 8	2.3(±0.12)	5.3 (±0.17)	7.6 (±0.07)	18.2 (±1.15)	37.2 (±2.87)	37.0 (±0.54)
Waxy starches						
Potato	0.4 (±0.15)	1.9 (±0.06)	n.a.	11.4 (±0.67)	86.6 (±3.67)	n.a.
Cassava	0.6 (±0.07)	5.2 (±0.62)	8.8 (±0.35)	4.5 (±0.67)	48.2 (±1.59)	54.7 (±1.63)

n.a. = not available because of difficulties in separations

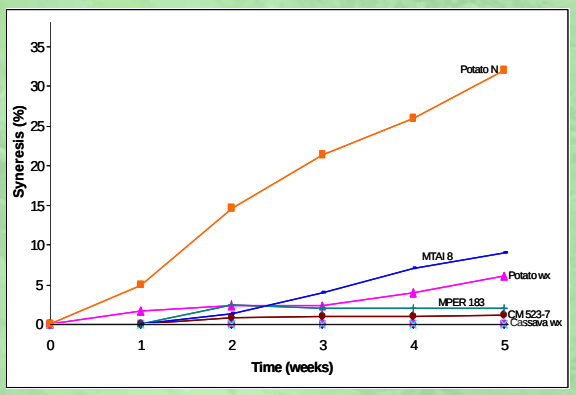

Figure 1. Refrigeration stability for up to five weeks of gels from different types (normal or waxy) of starches from potato and cassava (three commercial clones). Syneresis in waxy starch from cassava was negligible.

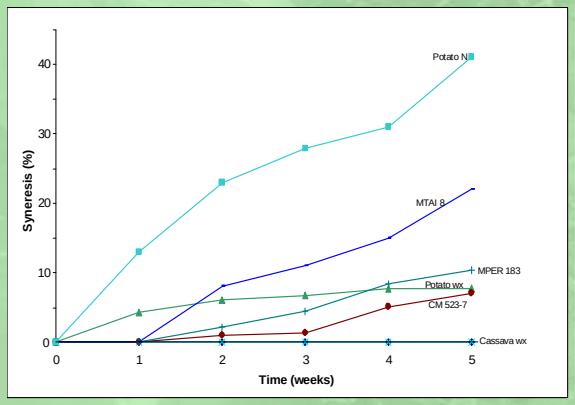

Figure 2. Freeze/thaw stability for up to five weeks of gels from different types (normal or waxy) of starches from potato and cassava (three commercial clones). Syneresis in waxy starches from cassava was negligible.

References

[1] Ceballos H, Sánchez T, Morante N, Fregene M, Dufour D, Smith AM, Denyer K, Pérez JC, Calle F, C. Mestres C. 2007. Discovery of an Amylose-free Starch mutant in cassava (*Manihot esculenta* Crantz). Journal of Agricultural and Food Chemistry 55(18): 7469-7476.