

# Physico-chemical properties of root, flour and starch of bitter and sweet cassava varieties

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## Abstract

Cassava (*Manihot esculenta* Crantz) is typically classified by high and low cyanide content present in fresh roots as “bitter” and “sweet” type, respectively. Rather the cyanide content, this study aimed to evaluate physico-chemical properties of root, flour and starch between bitter and sweet types. Two commercially utilized varieties of the bitter type including Rayong 5 and Kasetsart 50 were planted in the same identical field as three varieties of the sweet type including Rayong 2, Hanatee and MKUL 36-Y002. Only the cyanide contents in root could be used to identify cassava into two groups as the high cyanide type (Rayong 5 and Kasetsart 50) and the low cyanide type (Rayong 2, Hanatee and MKUL 36-Y002). The starch content in roots of bitter cassava (83 to 84% dry basis) was slightly higher than the sweet one (79 to 82% dry basis). The chemical composition of flour and starch from bitter and sweet types was similar except that the fiber and ash content in sweet cassava flour were higher than the bitter one. The viscosity properties of flour and starch were depending on variety and did not relate to bitter-sweet type. The other properties of extracted starch including the amylose content (17 to 18%) and size (DPn ≈ 2100), paste clarity (64% Light transmittance of 1% solution), gel texture (Young’s Modulus of elasticity = 24 to 29 k.Pa), were not significantly different ( $p > 0.5$ ).

## Materials and methods

Two varieties of bitter cassava (Rayong 5 and Kasetsart 50) and three varieties of sweet cassava (Hanatee, Rayong 2 and MKUL 36 – Y002) were planted in the same identical field at Kasetsart University (Sri Racha Campus, Choburi province). The roots were then harvested at 10.5 months after planting. Fresh roots were used for preparing flour by dry milling and starch by wet milling method.

### Analysis

- Chemical composition by AOAC method (AOAC, 1990; 1995)
- Cyanide content by enzymatic method (O’Brien et al., 1991)
- Apparent amylose content and size by High Performance Size Exclusion Chromatography (Govindasamy et al., 1992)
- Paste viscosity by a Rapid Visco Analyzer (Sriroth et al., 1998)
- Paste clarity (1% starch solution) as % Light Transmittance (Craig et al., 1989).
- Texture properties by Texture Analyzer (TA500, Lloyd Instruments, England)

All data were analyzed by Analysis of Variance (ANOVA) with Least Significant Difference (LSD) at 95% confidence level.

## Results



Fresh Root



Raw cassava



Boiled cassava

Rayong 5      Kasetsart 50      Rayong 2      Hanatee      MKUL36-Y002

Figure 1 Appearance of fresh roots, raw and boiled cassava flesh of different bitter and sweet cassava types  
Bitter type : Rayong 5, Kasetsart 50  
Sweet type : Rayong 2, Hanatee, MKUL 36-Y002



Cassava flour



Cassava starch

Rayong 5      Kasetsart 50      Rayong 2      Hanatee      MKUL36-Y002

Figure 2 Gels of cassava flour and starch prepared from different bitter and sweet cassava types  
Bitter type : Rayong 5, Kasetsart 50  
Sweet type : Rayong 2, Hanatee, MKUL 36-Y002

Sample	Variety	Protein (% dry basis)	Fat (% dry basis)	Fiber (% dry basis)	Ash (% dry basis)	N-free extract	Cyanide (mgHCN equivalent kg <sup>-1</sup> dried sample)
Root	B-Rayong 5	2.33 a	0.28 a	2.07 b	2.86 a	92.46	93 b
	B-Kasetsart 50	2.84 a	0.30 a	1.95 b	2.94 a	91.97	215 a
	S-Rayong 2	3.05 a	0.33 a	2.26 b	3.86 a	90.5	70 c
	S-Hanatee	3.06 a	0.31 a	3.00 a	3.49 a	90.14	55 c
	S-MKUL 36-Y002	2.82 a	0.29 a	3.11 a	3.22 a	90.56	38 c
Flour	B-Rayong 5	1.79 b	0.16 a	0.79 b	1.41 c	95.85	0.73 b
	B-Kasetsart 50	2.27 b	0.14 a	0.91 b	1.41 c	95.27	3.00 a
	S-Rayong 2	3.21 a	0.15 a	1.33 a	2.02 a	93.29	2.94 a
	S-Hanatee	2.05 b	0.14 a	1.24 a	1.90 a	94.67	1.66 ab
	S-MKUL 36-Y002	2.13 b	0.17 a	1.25 a	1.57 b	94.88	0.99 b
Starch	B-Rayong 5	0.18 a	0.05 a	0.17 a	0.11 b	99.49	0.68 a
	B-Kasetsart 50	0.21 a	0.04 a	0.15 a	0.08 b	99.52	0.78 a
	S-Rayong 2	0.17 a	0.04 a	0.17 a	0.15 a	99.47	0.78 a
	S-Hanatee	0.18 a	0.04 a	0.17 a	0.09 b	99.52	0.72 a
	S-MKUL 36-Y002	0.27 a	0.04 a	0.15 a	0.10 b	99.44	0.63 a

The chemical composition values with different letters in each column of root, flour and starch are significantly different ( $p \leq 0.05$ )

Table 2 Texture profile analysis (TPA)\*, as determined by a Texture Analyzer, of raw and boiled cassava prepared from different cassava types (B = Bitter type, S = Sweet type).

Variety	Hardness 1 (N)		Coheaveness		Springiness (mm)		Gumminess (Nm)	
	raw	boiled	raw	boiled	raw	boiled	raw	boiled
B-Rayong 5	128 a	49 a	0.20 a	0.16 a	2.61 a	2.40 a	24.67 a	9.63 a
B-Kasetsart 50	100 b	35 b	0.17 a	0.14 a	2.92 a	2.61 a	15.55 b	5.22 b
S-Rayong 2	89 b	31 b	0.11 b	0.11 a	2.69 a	2.83 a	9.96 c	3.75 bc
S-Hanatee	102 b	13 c	0.20 a	0.10 a	3.01 a	2.52 a	19.87 b	1.59 c
S-MKUL 36-Y002	129 a	26 b	0.20 a	0.13 a	3.09 a	2.90 a	25.82 a	4.85 bc

\*A compression test (30% deformation, speed of 20 mm.min<sup>-1</sup>) of samples (1.1 x 1.5 cm in diameter and height)

The values with different letters in each column of flour and starch are significantly different ( $p \leq 0.05$ )

Table 3 Values of Young’s Modulus of Elasticity of gel prepared from cassava flour and starch of different cassava types (B = Bitter type, S = Sweet type).

Variety	Young’s Modulus of Elasticity (k. Pa)	
	Cassava flour	Cassava starch
B-Rayong 5	27.46	23.77
B-Kasetsart 50	36.00	24.38
S-Rayong 2	36.47	24.79
S-Hanatee	60.07	23.44
S-MKUL 36-Y002	40.06	28.77

\*A compression test (40% deformation, speed of 20 mm.min<sup>-1</sup>) of samples (1.5 x 1.5 cm in diameter and height)

Table 4 Paste properties of cassava flour and starch obtained from different cassava types (B = Bitter type, S = Sweet types).

Sample	Variety	Pasting temperature (°C)	Peak viscosity (RVU)	Trough viscosity (RVU)	Final viscosity (RVU)	Breakdown (RVU)	Paste clarity (%Light Transmittance at 650 nm)
		Flour	B-Rayong 5	70.67 c	247 a	124 ab	160 ab
B-Kasetsart 50	73.17 ab	205 b	62 c	84 c	143 a	n. d.	
S-Rayong 2	73.00 b	209 b	113 b	149 b	96 c	n. d.	
S-Hanatee	74.17 a	234 a	141 a	186 a	93 c	n. d.	
S-MKUL 36-Y002	74.00 ab	243 a	123 ab	167 a	119 b	n. d.	
Starch	B-Rayong 5	69.67 c	375 b	142 b	211 c	233 bc	67.77 a
B-Kasetsart 50	72.33 a	398 a	151 a	219 abc	247 a	66.97 ab	
S-Rayong 2	71.17 b	387 ab	147 ab	216 bc	241 ab	65.45 ab	
S-Hanatee	71.83 ab	358 c	152 a	231 a	206 d	58.38 c	
S-MKUL 36-Y002	72.33 a	379 b	151 a	224 ab	228 c	64.65 b	

The values with different letters in each column of flour and starch are significantly different ( $p \leq 0.05$ ).

n. d. = not determined

## Conclusion

Cyanide content present in fresh roots can be used as a clear cut for categorizing cassava types. Other properties such as paste and texture properties of root, flour and starch are remarkably depending on genetic factor and may be substantially diversified by the environmental condition of planting and harvesting.

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