

**SUCROSE, REDUCING SUGARS, AND CAROTENOID CONTENT OF ACEH BESAR SWEET POTATO CULTIVARS (*Ipomoea batatas* L)****KANDUNGAN SUKROSA, GULA PEREDUKSI DAN KAROTENOID UBI JALAR VARIETAS LOKAL KABUPATEN ACEH BESAR, PROVINSI ACEH**

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INFO ARTIKEL

Submit: 20 Desember 2013
Perbaikan: 13 Januari 2014
Diterima: 17 Januari 2014

Keywords:

sweet potato, flesh color,
nutritional value

ABSTRACT

Sweet potato is considered as an important food crop and it is known as one of the most productive carbohydrate-producing crop. This crop requires less inputs and water in comparison to rice, corn, or potato. Its wide adaptation to various agro ecological conditions has made sweet potato as a promising crop for saving life particularly during food (rice) shortage. The crop contained higher vitamin (A) and minerals that could help women and children aged below five preventing certain diseases. However, the nutritional value of sweet potato is various from one cultivar to another. It was assumed that geographical and environmental factors would influence the nutritional value of the tubers. Therefore, the following study was investigating the nutritional value of local cultivars in Aceh Besar District. Total carotenoid content of sweet potato varied from 1.86 to 3.06 mg 100g-1 DM. The highest carotenoid was recorded by cv. Keupila from Saree Sub-district.

1. INTRODUCTION

Ninety eight percent of the world's sweet potatoes are grown in developing countries (Fuglie, 2003). Indonesia as one of developing countries considered sweet potato as important secondary crop (Heriyanto *et al.*, 1993, and Widodo *et al.*, 1993). Sweet potato that was considered as main source of carbohydrate after rice, corn, and cassava, was used as staple food only the eastern part of Indonesia such as Maluku and Papua. However, according to Zuraida *et al.* (2001), the central production of sweet potatoes is Java due to their intensive cultivation. Aceh is one of province in Indonesia on Sumatera that,

produce sweet potato with the highest production is found in Aceh Besar (Saree area).

Sweet potato is an important alternative source of carbohydrates beta-carotene, vitamin C, niacin, riboflavin, thiamin, and minerals such as phosphorus, calcium, and potassium as shown in Table 5 (Hartana, 2003; and Zuraida, 2003). Nutritional attribute of sweet potato varied depending on variety for example red to yellow flesh variety has high content of pro-vitamin A and iron (Zuraida, 2003).

The sugar composition of sweet potatoes is a fundamental component of their eating quality (Lewthwaite *et al.*, 1997). Sucrose is available as the major sugar in sweet potato (Purcell *et al.*, 1989; Lewthwaite *et al.*, 1997 and Toyama *et al.*, 2003) besides glucose and fructose (Lewthwaite *et al.*, 1997 and Toyama *et al.*, 2003). Both of these sugars are considered as reducing sugars. The levels of glucose, fructose, and sucrose in fresh sweet potatoes varied among genotypes (Picha, 1986; Van Den *et al.*, 1986; Zhang *et al.*, 2002).

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Carotenoid is responsible for the flesh color of cream, yellow, orange, or deep orange (Woolfe, 1992). Flesh color is an important quality factor (Zuraida, 2003). For many sweet potato consumers, flesh color is the factor in determining which variety to purchase (Huang *et al.*, 1999). Sweet potato varieties exist in many color of skin and flesh, varying from almost pure white through cream, yellow, orange, or pink to very deep purple (Bovell-Benjamin, 2007). Some white flesh varieties contain no β -carotene. The depth of color is likely a function of the concentration of β -carotene where β -carotene is high in yellow to deep orange flesh varieties.

The overall objective of this research is to evaluate the nutritional value of Indonesian sweet potato (*Ipomoea batatas*) varieties from Aceh. Sucrose, reducing sugars, and β -carotene will be analyzed to assess its potential in food processing and industry.

2. METHODOLOGY

A. Sample Preparation

Three varieties of sweet potato differed by its flesh color were collected from Saree, Aceh Besar District, Indonesia. The tubers were washed thoroughly after harvest, peeled, sliced with a thickness of 1-1.5 mm, freeze-dried by using a freeze-dryer (Eyela FD-550, Tokyo Rikakikai Co., LTD Japan). The dry material was grounded and shaved through 100-mesh before analysis.

B. Sucrose and Reducing Sugars

Exactly 0.75 grams of freeze-dried sample was weighed in a centrifuge tube and added with 8 ml of distilled water, 0.2 ml of Carrez I reagent and 0.2 ml of Carrez II reagent and shaken horizontally for 15 minutes. After centrifugation (Sorvall RC-5B Refrigerated Super speed Centrifuge, serial 820) at 7500 rpm for 15 minutes, the clear solution (supernatant) was filtered and used for sugar analysis using a HPLC (Merck KGaA, Darmstadt, Germany). The HPLC system consisted of a LiChrospher 100 NH₂ (5 μ m) 4x4 mm pre-column (No. 1.50966.0001, Merck KGaA, Darmstadt, Germany) combined with a LiChrospher 100 NH₂ (5 μ m) 4x250 mm separation column (No. 1.50834.0001, Merck KGaA, Darmstadt, Germany). Temperature of the column was set to 20°C and controlled by a thermostat (Knauer, Berlin, Germany). An acetonitrile: pure water solution (80:20, v/v) was used as mobile phase. The sugar fractions were detected using a differential refractometer at 198 nm (Knauer, Berlin, Germany).

C. Total Carotenoids

Total carotenoids were determined according to Wellburn (1994). Approximately 0.5 g of freeze-dried sweet potato was weighted and put into a centrifugal glass vessel. 5 ml of methanol was poured to the sample and mixed for 1 minute with a vortex. The vessel was shaken for 10 minutes and centrifuged (Sorvall RC-5B Refrigerated Super speed Centrifuge serial 820) at 3500 rpm for 15 minutes. The supernatant (clear fraction) was transferred into 25 ml glass flask. This process was repeated for 3-4 times. By the end, the flask was filled with methanol up to the 25 ml marked line. Absorbance of the extract was read using spectrophotometer (Hewlett Packard S 453) at three different wavelengths 470, 653 and 666 nm respectively. Methanol was used as the blank. Total carotenoids (C_{total} in mg 100 g⁻¹) was calculated following the equation:

$$1. C_a = (15.65 \times A_{666}) - (7.34 \times A_{653})$$

$$2. C_b = (27.05 \times A_{653}) - (11.21 \times A_{666})$$

$$3. C_c = \frac{(2000 A_{470}) - 2.86 C_a - 1292 C_b}{221}$$

$$4. C_{total} = \frac{(25 \times C_c)}{\text{Sample Weight (g)}}$$

D. Statistical Analysis

Data was presented as an average of three replications. Analysis of variance (ANOVA) was employed for statistical analysis. Tukey test was used to determine the significant differences among treatment means ($p < 0.05$).

3. RESULTS AND DISCUSSIONS

A. Sucrose and Reducing Sugars

This study found that sugar composition (sucrose and reducing sugars) was various from genotype to genotype. Sucrose ranged from 6.88 to 17.88 g 100 g⁻¹. Reducing sugars ranged from 1.86 to 3.06 g 100 g⁻¹ (Table 1).

The sugar level decreased or increased depends on harvest time, curing, storage or further process properties such as boiling, baking, roasting, frying, and steaming (Zuraida, 2003). Generally, correlation between sugar and dry matter was negative (Kellock, 1995). The correlation between dry matter content and sucrose in this study was not significant ($p > 0.05$). The correlation between dry matter and reducing sugars was negative ($r = -0.306$, $p < 0.05$), that could be affected by harvest time. Widodo *et al.* (1993) reported that sugar content decreased 120 days after planting and then increased 150 days after planting.



Name: Keupilagadung
Flesh color: White purple



Name: Keupilarujak
Flesh color: Orange



Name: Keupila
Flesh color: Cream

Figure 1. Flesh colour variety of sweet potato collected in Aceh Besar, Indonesia

Table 1. Sugars content of different sweet potato cultivars (g 100 g⁻¹ DM)

Local Name	Mean		Standard Deviation	
	Sucrose	Reducing sugars	Sucrose	Reducing sugars
KeupilaGadung	17.18 ^a	1.86 ^a	0.29	0.09
KeupilaRujak	10.21 ^{bc}	1.86 ^a	0.21	0.49
Keupila	6.88 ^b	3.06 ^b	0.59	1.41

Mean value followed by different letter is significantly different (p<0.05) using Tukey test.

B. Total Carotenoid

The depth of color of sweet potato flesh is likely a function of β -carotene. The three sweet potato cultivars had wide range of color from pure white through cream, white purple, light orange until orange, mainly due to different carotenoid content. The content of carotenoid was varied between 0.02 mg 100g⁻¹ DM and 7.47 mg 100g⁻¹ DM. The highest was cv. Keupila and the lowest was cv. Keupila Gadung from Saree area. The content of carotenoid in this study was in accordance to the study of Mouka *et al.* (2007).

4. CONCLUSIONS

The concentration of sugars in sweet potato tuber is an important parameter for processing. Keupila Gadung and Keupila Rujak was the cultivar with lower sucrose and reducing sugars than Keupila cultivar. However, the content of sucrose and reducing sugars was much higher than the recommended concentration for fried products. Material intended for chips and French-fry should contain maximum 0.13 and 0.44 g reducing sugars 100g⁻¹ DW, respectively. For this reason, those cultivars were neither suitable neither for chips nor French-fried. Material containing high sugar was mostly used for boiling, baking or roasting based products. Furthermore, the content of carotenoid would have consequent to the color of end product. Processor was advised to utilize the natural color of sweet potato considering the benefit of carotenoid as antioxidant for human health.

Table 2. Carotenoid content of different sweet potato cultivars (mg 100g⁻¹DM)

Local Name	Mean ^z	Std. Deviation
Keupilagadung	0.02 ^a	0.00
Keupilarujak	0.8 ^{abc}	0.48
Keupila	7.47 ^e	1.07

^zDry matter basis (mg/100 g DM) is means of three replicates

Mean value followed by different letter is significantly different (p<0.05) using Tukey test

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