International Journal of Sciences: Basic and Applied Research (IJSBAR)

ISSN 2307-4531
(Print & Online)

http://gssrr.org/index.php?journal=JournalOfBasicAndApplied

Sensory Profile of Baked Purple Sweet Potato Cultivated from Three Different Locations

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Abstract

This study was aimed to observe the sensory profile of baked purple sweet potato cultivated in three different locations. Quantitative Descriptive Analysis (QDA) was used to describe the key sensory attributes of the baked purple sweet potato. Harvested purple sweet potatoes were stored at room temperature for seven and 30 days before baking. Fifteen sensory descriptors generated in the brainstorming session include purple, sweet, floury, caramel taste, after taste, bitter, sweet potato flavor, off flavor, caramel flavor, baked flavor, sticky, grainy, fibrous, moist, and soft. The results of this study indicated that the differences in purple sweet potato cultivation location affected the purple color, sweetness and stickiness of the baked purple sweet potato. Storage time affected the purple color, sweetness, and bitterness as well as the texture of the baked purple sweet potato. Principal component analysis (PCA) explained two principal components (PC1 and PC2), with diversity of 79.10% on sensory attributes.

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The main component PC1 explained 55.53% variation on sensory attributes associated with the sweetness, floury, caramel taste, bitterness, after taste, sweet potato flavor, off flavor, caramel flavor, baked flavor, and grainy. While PC2 explained 23.57% variation on sensory attribute associated with the purple color, stickiness, moistness, softness and fibrous.

Keywords: sensory profile, purple sweet potato, Quantitative Descriptive Analysis

1. Introduction

Sweet potato (*Ipomoea batatas* L) is an important crop beside rice, wheat, potatoes, corn and cassava. Sweet potato is easy to cultivate, it can grow on various soil types including marginal land. The plant is drought resistant. It requires low chemical fertilizers and has high productivity with a relatively short growing season of three to six months [1]. Based on the tuber flesh color, there are four types of sweet potatoes, as follows: cream, yellow, orange and purple sweet potatoes. Purple sweet potato is rich in anthocyanin which gives its attractive colors. Sweet potato cultivation widely spreads in West Java, Indonesia, such as in Cilembu-Sumedang, Banjaran-Bandung, and Pakembangan-Kuningan. These three locations are different in geographical and climatic characteristics. Cilembu village in Sumedang is located at 600 m above sea level with temperature average of 28 ° C. The village of Banjaran in Bandung is located at 650-700 m above sea level with average temperature of 29 ^{o}C. The altitude Pakembangan village in Kuningan is 400 m above sea level with temperature average of 31 °C. Several researchers previously reported that the geographical location and ambient temperature affect the growth and total anthocyanin content of potato [2, 3], bilberry [4], cherry [5], and soybean [6].

Sweet potato is usually stored before consumption or processed. Changes in sensory properties during storage are very important, and these changes may be desirable or undesirable [7]. Changes in texture and moistness during storage are considered desirable in the United States [8]. Previous research conducted on sweet potato includes: the relationship between carotenoids and sensory [9], a decrease in β-carotene during storage of sweet potato [10], biochemical changes during storage [11], the characteristics sensory of five sweet potato cultivars during storage [7], and sensory attributes and consumer acceptance of sweet potato [12]. No studies have been done on the effect of cultivations location on the sensory profile of baked purple sweet potato.

Quantitative Descriptive Analysis (QDA) is a type of sensory evaluation that help to explain the key sensory attributes of the sample being evaluated. Key sensory attributes are usually generated in a brainstorming session, followed by a discussion among panelists. The specific objective of this study is to develop suitable vocabulary to characterize the sensory properties of baked PSP, and use the resulting attributes to develop the sensory profile. PSP of Ayamurasaki varieties were obtained from farmers in Cilembu village in Sumedang, Banjaran village in Bandung and Pakembangan village in Kuningan. Principal component analysis was used to simplify the characterization of the main sensory attributes of baked PSP.

2. Materials and Methods

2.1. Purple sweet potatoes

Purple sweet potato (*Ipomoea batatas* L. Varieties Ayamurasaki) was harvested from three different locations: Cilembu-Sumedang (CS), Banjaran-Bandung (BB) and Pakembangan-Kuningan (BK) of West Java, Indonesia. Good PSPs were selected for research purposes.

2.2. Storage

Harvested PSPs were stored for seven days (identified as CS7, BB7, BK7) and 30 days (identified as CS30, BB30, BK30) before being baked. Storage was done at room temperature with air circulation, enough light and relative humidity of about 80%.

2.3. Baking preparation

As many as 150-200 g PSP was randomly selected from the storage pile, washed, dried and then baked at 200 °C for about 90 minutes. Sweet potato was baked, peeled, and cut into pieces with the thickness of 3 cm. Pieces of baked PSP were presented on a small round white plate to the panelists within 45 minutes after baking at a room temperature. Each plate was marked with three digit random numbers.

2.4. Quantitative descriptive analysis (QDA)

QDA was conducted to develop the sensory profile of baked PSP. The QDA panelist were selected, trained, and introduced to baked PSP. QDA panel selection was done in three stages: pre-screening, the test of ability to distinguish, and the personal interview. As many as 73 prospective panelists consisted of 53 students and 20 employees at the Department of Food Science and Technology were pre-screened [13]. Selected panelists were tested for aquity based on description and detection test. Based on personal interview as many as 12 panelists were selected to participate in the training phase. Finally six panelists were appointed as QDA panel for this study which consisted of two men and four women, ranging from 25-40 years of age.

All QDA panelists were introduced to baked PSP and requested to build vocabulary of their sensory profile. In principle, the QDA panelists were able to determine purple color, taste, flavor, and texture. Intensity ratings were conducted using an unstructured line scale with a length of 15 cm, in four replications and replicates performed on different days. A forty gram baked PSP samples were served on white paper plate and labeled with random three digit code then tested by panelists. Three samples were served per session with mineral water given between sessions. The tests were performed in the QDA laboratory at room temperature with enough air circulation and ventilation.

2.5. Data Analysis

All data were analyzed statistically, and microsoft office excel 2010 used for processing statistical data, including spider webs of QDA results. SPSS 16 was selected for testing differences between the respective average measured parameters. Principal component analysis (PCA) was performed using XLSTAT 2014 Addinsoft.

3. Results and Discussions

3.1. Generation of Descriptors

In four brainstorming sessions done by six panelists, 15 descriptors were generated to describe the sensory attributes of baked (PSP). The descriptors are as follows: purple, sweet, floury, caramel taste, after taste, bitter, sweet potato flavor, off flavor, caramel flavor, baked flavor, sticky, grainy, fibrous, moist, and soft. Purple is used to describe the color of sweet potato flesh. Sweet describes the sweetness of sugar or sucrose. Floury describes the taste which is starchy-like flour. Caramel taste describes the taste of caramel which is burnt sugar like taste. After taste describes bitter in pole tongue. Bitter describes the bitterness of the food tasted. Sweet potato flavor describes the distinctive flavor of baked sweet potato.

Off flavor describes the bad smell such as that caused by beetle *Cylas formycarius* Fab. Baked flavor describes the flavor of burning baked product. Sticky describes a smooth texture, and soft. Grainy describes the texture baked sweet potato when pressed on finger or sand like taste. Fibrous describes fiber like taste. Moist describes the texture of wet watery. Soft describe a soft texture. Descriptors chosen by panelist for this study are basically derived from the sensory attributes selected and agreed upon by all the panelists with the help of panel leader. All descriptors generated associated with color, taste, flavor, and texture attributes.

3.2. Sensory Profile of Baked PSP Cultivated from Different Locations

Sensory profile of baked PSP cultivated from different locations; which are Cilembu village in Sumedang, Banjaran village in Bandung and Pakembangan village in Kuningan, are presented in Figure 1 and Table 1. Figure 1 shows the sensory attributes that dominant in baked PSP from Cilembu - Sumedang are associated with purple color, sweet, sweet potato flavor and sticky. Prominent sensory attributes of baked PSP from Banjaran - Bandung are associated with purple color, sweet, sweet potato flavor, moist and soft. Prominent sensory attributes of baked PSP from Pakembangan - Kuningan are associated with purple color, floury and grainy.

Furthermore, based on data in Figure 1, we are able to characterize specific sensory of baked PSP according to 14 descriptors, excluding purple color, generated by QDA panelist. Specific sensory of baked PSP from Cilembu-Sumedang can be characterized by sweet, caramel taste, sweet potato flavor, caramel flavor, baked flavor, and sticky. While specific sensory of baked PSP from Banjaran-Bandung can be characterized by moist and soft. Specific sensory of baked PSP from Pakembangan-Kuningan can be characterized by floury, and grainy fibrous.

Based on ANOVA test, there is no significant difference ($P>0.05$) in purple color of PSP from Cilembu-Sumedang and PSP from Banjaran-Bandung, as well as PSP from Banjaran-Bandung and PSP from Pakembangan-Kuningan (Table 1). However, according to sensory data PSP from Cilembu-Sumedang has the greatest purple color followed by PSP from Banjaran-Bandung and PSP from Pakembangan-Kuningan.

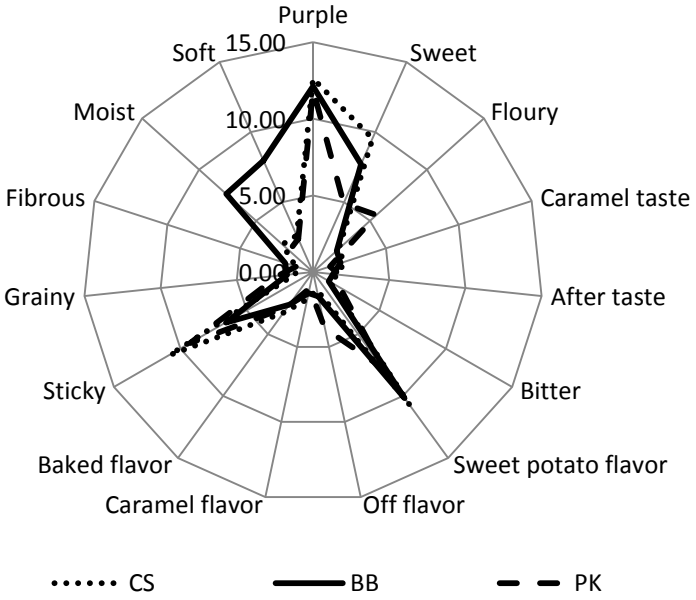

Figure 1: Sensory profile of PSP cultivated from three different locations: Cilembu - Sumedang (CS), Banjaran – Bandung (BB), and Pakembangan - Kuningan (PK).

Table 1: Sensory profile of baked PSP*

Sensory Attribute	Cultivation Location		
	Cilembu-Sumedang	Banjaran-Bandung	Pakembangan-Kuningan
Purple	12.62±0.49a	12.11±0.76 ab	11.9±1.51b
Sweet	10.98±0.93a	8.7±0.85b	6.68±0.90c
Floury	2.23±0.31b	2.07±0.28b	5.55±0.69a
Caramel taste	2.01±0.25a	1.89±0.24a	1.15±0.14b
After taste	0.61±0.02b	0.33 ±0.14c	0.77±0.20a
Bitter	0.19±0.19c	0.31±0.17b	1.02±0.23a
Sweet potato flavor	10.69±0.89a	10.17±0.94b	7.72±0.85c
Off flavor	0.36±0.05c	1.63±0.24b	3.76±0.54a
Caramel flavor	1.89±0.23a	1.35±0.17b	1.07±0.13c
Baked flavor	3.27±0.36a	2.76±0.25b	2.52±0.35c
Sticky	10.80±1.32a	9.25±0.95b	6.58±1.28c
Grainy	1.16±0.16c	1.34±0.17b	2.22±0.27a
Fibrous	1.14±0.17c	1.60±0.24b	1.90±0.14a
Moist	2.69±0.37b	7.62±0.79a	2.05±0.26c
Soft	2.66±0.32b	7.88±0.82a	2.30±0.23c

*PSP stored seven days after harvest before baking

Note: a, b, and c shows significant difference (P>0.05) at the same row

In general the result show that baked purple sweet potato harvested from Cilembu-Sumedang specifically has richer sensory attributes than those harvested from Banjaran-Bandung and Pakembangan-Kuningan. It seems harvest location including its soil and climate characteristics influences the sensory profiles of baked purple sweet potato.

Correlations between sensory attributes were analyzed. Pairs of sensory attributes that show high correlation are as follows: moist and soft (0.990), off flavor and after taste (0.974), off flavor and bitter (0.935), sweet potato flavor and caramel taste (0.907), caramel flavor and baked flavor (0.887), and sweet potato flavor and floury (0.884).

3.3. Sensory Attribute Changes as Affected by Raw Material Storage

Storing of harvested purple sweet potato seven and 30 days before baking affected the sensory profile of the baked products as shown in Figure 2. In general, longer storage time slightly reduces the purple color, sweet potato flavor, and stickiness. In the other way, the sweetness, after taste, bitterness, and off flavor increases. Baked purple sweet potato from Cilembu-Sumedang is more moist and softer in longer storage compared to those from Banjaran–Bandung and Pakembangan-Kuningan.

4. Results of Principal Component Analysis (PCA)

PCA was used to describe a variety of data in much simpler presentation as group of data [14]. In Figure 3 the first two principal components explain 79.10% variation in the data; where, the first component (PC1) explains 55.53% of the variation (eigenvalue 8.24) and second component (PC2) explains 23.57% variation (eigenvalue 3.53). Eigen value is a number that describes the main components diversity (F). The relationship between sensory attributes and the main components can be seen by the location of the sensory attributes. Figure 3 also indicates that characteristics of baked PSP from Cilembu-Sumedang (CS) based on sensory attributes were : sticky, purple, sweet, sweet potato flavor, caramel flavor, and caramel taste. For baked PSP from Banjaran-Bandung (BB) sensory attribute were dominated by caramel flavor, caramel taste, baked flavor, moist, soft, and fibrous; while sensory attribute of baked PSP from Pakembangan-Kuningan (PK) were dominated by floury, and grainy. This information is somewhat similar to that explained in Table 1.

Figure 3 shows the combined F1 and F2 biplot results of principal component analysis of sensory attributes. Biplot is a combination of loading plots and score plots. Sensory attributes which can be explained by the principal components PC1 (F1) 55.53% were the sweet potato flavor, caramel flavor, caramel taste, baked flavor, sweet, bitter, off flavor, after taste, grainy, and floury. Sensory attributes which can be explained by the principal component PC2 (F2) 23.30% were sticky, purple, moist, soft and fibrous.

5. Discussion

Previous researchers found that during storage, brown spots causes a bitter taste [15], after taste [16] was more pronounced as after cooked. According to [11] sweet potato starch content decreased during storage of 0-180 days, alpha-amylase activity increased during the first 2 months of storage. The decrease in starch content

associated with α-amylase activity during the first 60 days of storage (r = 0.80, P = 0.06). Glucose and sucrose concentration increased at the beginning of storage and then remained constant after 5 weeks of storage. According to [7] storage affects the sweetness of sweet potato and chesnut but does not affect the texture. The content of anthocyanin PSP decreases with storage time [17].

PSP Cilembu-Sumedang grows in colder local environment than PSP in Banjaran-Bandung and Pakembangan-Kuningan, West Java Indonesia. According to previous research, potato anthocyanin was affected by variety and soil-climatic condition [18, 19]. Low temperature and high light intensity induce anthocyanin synthesis [19]. Sensory differences between cultivars of sweet potato are mainly determined by the texture component [7].

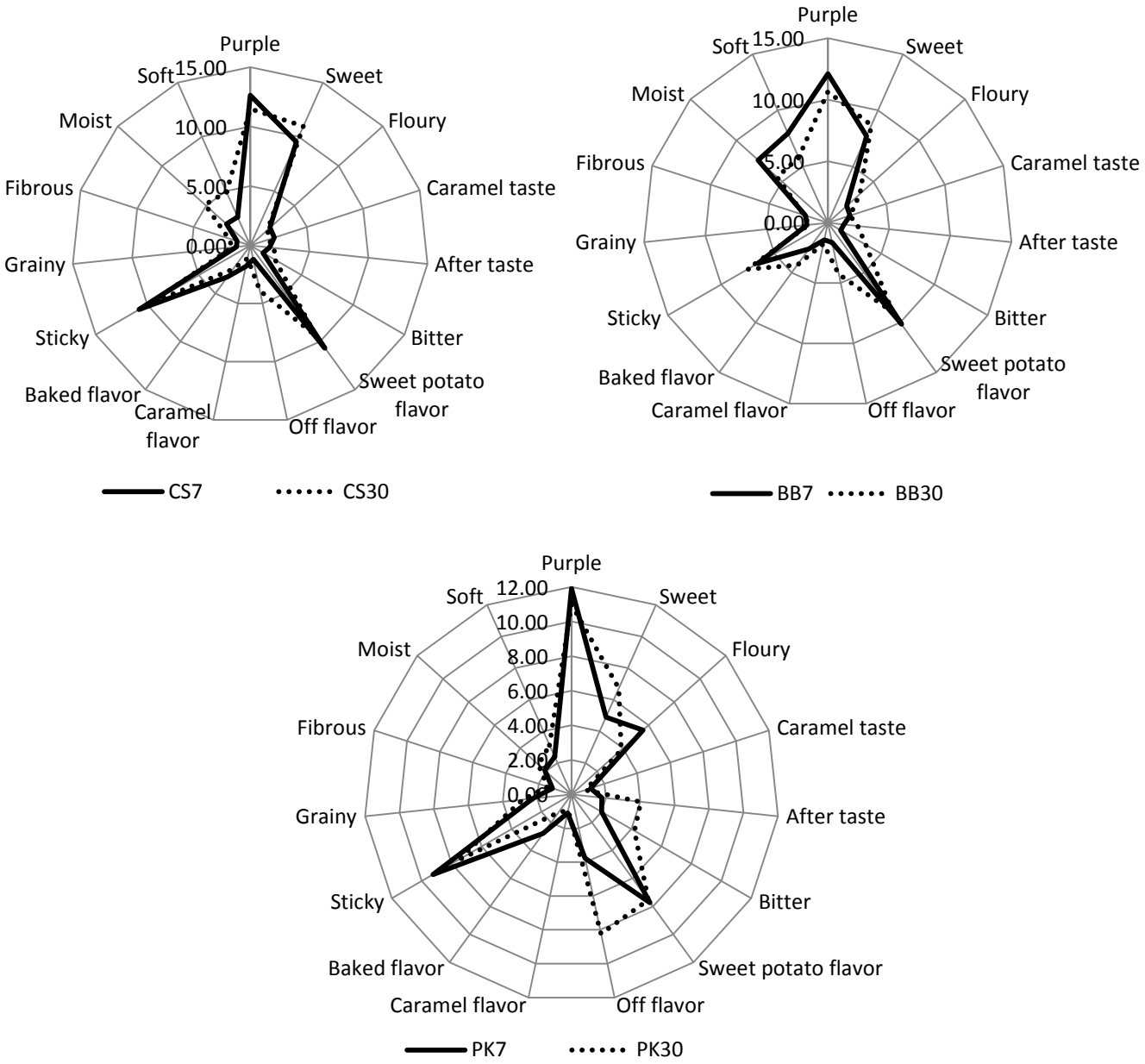

Figure 2: Sensory profile of baked purple sweet potato as affected by raw material storage for seven and 30 days. CS (cultivated in Cilembu-Sumedang), BB (Banjaran-Bandung), PK (Pakembangan-Kuningan. Storage time in days is indicated by number 7 and 30.

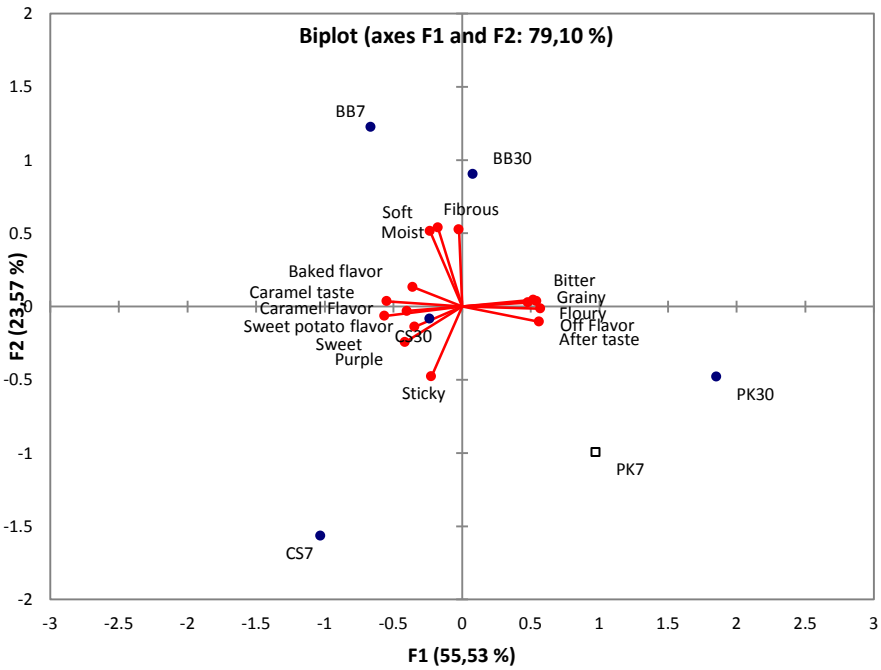

Figure 3: Relationship among sensory attributes of baked purple sweet potato from different cultivation locations. Storage time in days is indicated by number 7 and 30

6. Conclusion

This study used QDA to describe the key attributes of the sensory baked PSP. As many as fifteen descriptors were generated to describe the sensory attributes of baked sweet potato: purple, sweet, floury, caramel taste, after taste, bitter, sweet potato flavor, off flavor, caramel flavor, baked flavor, sticky, grainy, fibrous, moist, and soft. The differences in PSP cultivation location affected the purple color, sweetness, and stickiness of the baked PSP. Storage time affects the purple color, sweetness, and bitterness as well as the texture of the baked PSP.

Acknowledgements

The authors would like to thank the Directorate General of Higher Education, Ministry of Education and Culture, Republic of Indonesia, for funding this research through doctoral dissertation research grant 2014.

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