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Determination of sugar content in pineapple waste variety N36

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Abstract

Pineapple waste is a by-product resulting from canning processing of pineapple that produce about 35% of fruit waste and lead to serious environmental pollution. Pineapple waste contains valuable nutrient components of simple sugar such as sucrose, glucose and fructose. Analysis of sugar content is important for further processing such as fermentation. The aim of this study was to determine the amount of sugar in different parts of pineapple waste (peel, core and crown) from variety N36. The selected pineapple waste for maturity indices 1, 2 and 3 was cut into small pieces before crushed in a food processor. The crushed waste was then filtered through muslin cloth followed by membrane filter 0.45µm to produce pineapple waste extract. Sugar content was determined using High Performance Liquid Chromatography. It was found that fructose content was significantly higher in core (2.24%) followed by peel (2.04%) and crown (0.87%). It was also found that glucose content was significantly higher in core (2.56%) followed by peel (2.18%) and crown (0.53%). Significant difference ($p < 0.05$) was found for sucrose content between pineapple core and peel extract with the value of 8.92% and 3.87%, respectively. However, sucrose was not detected in pineapple crown. It means that pineapple core extract had the highest values of fructose, glucose and sucrose compared to the other parts of pineapple waste extract. Besides, it was found that sucrose content was significantly higher in pineapple core for index 3 as compared to indices 1 and 2. Glucose and fructose was significantly higher in pineapple core for index 2 compared to indices 1 and 3.

Introduction

Pineapple (*Ananas comosus*) is a type of tropical plant believed to originate from East Area of South America and introduced to Malaya in the 16th century by Portuguese. Pineapple plantation continues to expand in peat soil area especially in Johor, Malaysia. Malaysia is one of the world major producers other than Thailand, Philippines, Indonesia, Hawaii, Ivory Coast, Kenya, Brazil, Taiwan, Australia, India and South Africa.

Pineapple variety N36 is a hybrid selected from a cross between 'Gandul' (Spanish) and 'Smooth cayenne'. This variety developed by Malaysian Agricultural Development Institute (MARDI) and mainly used for canned product. In Malaysia, N36 is the only variety planted in a big area with six thousand acres at Simpang Renggam, Johor, Malaysia.

Pineapple waste is a by-product resulting from the processing of pineapple that consist of peel, core and crown. The pineapple waste is either used as animal feed or disposed to the soil as a waste that can cause environmental problems. This waste still retains a considerable amount of soluble sugars, as well as high fiber and low protein contents (Correia *et al*., 2004).

Sugar is one of the biochemical components of fruit and its concentration will determine the quality of fruit. The sugar content might be differed according to maturity stages of fruit, species and soil condition. Amount of sugar is highly correlated with ripeness of most fruit (Ersoy *et al.*, 2007). The composition of fructose, glucose and sucrose play important role in determining the sweetness of pineapple fruit (Bartolome *et al.*, 1996; Shinjro *et al.*, 2004; Zhang *et al.*, 2010).

The aim of this study was to determine the amount of sugar in pineapple waste (crown, peel and core) of pineapple variety N36. Up to date, there is no data have been published regarding the sugar content in pineapple waste of such variety. This value added information would be useful for other purpose such as in fermentation process.

Materials and Methods

Raw materials

Pineapple variety N36 with different maturity indices of 1, 2 and 3 used in this study were obtained from Peninsula Plantation Sdn Bhd, Simpang

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Renggam, Johor, Malaysia. Pineapple were harvested in the morning and sent to the laboratory within the same day of harvest for further process. Pineapple was hand peeled and cored to obtain pineapple waste.

Sample preparation

The pineapple peel indices 1,2 and 3 was cut into small pieces. It was then crushed in food processor with ratio of pineapple peel to purified water 1:1 to obtain pineapple peel extract. The pineapple peel extract was filtered through muslin cloth and then it was centrifuged at 360 x g for 10 minutes to collect clear supernatant. Finally, clear pineapple peel extract was filtered through milipore 0.45 µm membrane filter. The filtrate was used for analysis of sugar. The same procedure was applied to produce pineapple crown and core extract.

Standard sugar solution

A series of standard solution 1%, 3%, 6%, 9% and 12% (w/v) of glucose, fructose and sucrose were prepared for developing standard curves of sugar. All of the standard solutions were dissolved in distilled water. Then it was filtered through Millipore 0.45 µm membrane filter. The amount of glucose, fructose and sucrose in samples were quantified by comparing the peak area.

Determination of sugar

Pineapple wastes were analysed for glucose, fructose and sucrose by High Performance Liquid Chromatography (Waters, USA) model 600 instrument with a Refractive Index detector model 2414. Sugar in pineapple waste was extracted into purified water and then filtered through 0.45 µm membrane filter. The chromatographic conditions are as follows:

Column: Carbohydrate High Performance 4µm (4.6 mm x 250 mm cartridge)
Column temperature: Room temperature (22°C)
Mobile phase: Acetonitrile : distilled water (90:10)
Flow rate: 1.3 ml/min
Injection volume: 20 µl
Duration of analysis: 15 min

Statistical analysis

All data were expressed as mean ± standard deviation. Data were analyzed using one-way ANOVA using SPSS 15.0. Duncan's multiple-range test was used to determine the difference between means. A significant difference was considered at the level of $p < 0.05$.

Results and Discussion

The sugar content in pineapple waste detected by HPLC were frucose, glucose and sucrose. Results of each pineapple waste indices 1, 2 and 3 are shown in Table 1. The amount of sugar in pineapple waste varied at different stages of maturity. From these results, the amount of fructose and glucose showed the highest value in the second stage of maturity while sucrose percentage was found to be the highest in the third stage of maturity. Fructose content in the crown extract had highest values in index 3 of maturity with 0.87% followed by indices 2 and 1 (0.83% and 0.78%) respectively. In pineapple peel extract, fructose content in indices 1 and 2 was significantly higher with 2.04 % and 1.98% followed by index 3 (1.82%). It was also found that fructose content in pineapple core extract was significantly higher in indices 2 and 3 (2.24% and 2.22%), respectively followed by index 1 (2.00%).

The amount of glucose was lower at the begining stage of maturity and was increased at the second maturity stage, then it was declined at the third stage. There is no significant difference in glucose content of pineappple crown extract between each index. Glucose content in pineapple peel extract are similar in indices 1 and 2 of maturity with 2.18% and decreased to 1.68% in index 3. Amount of glucose in pineapple core extract was significantly higher in index 2 with 2.56% at the 5% level followed by index 3 (2.32%) and index 1 (2.31%).

The sucrose content in pineapple waste was increased as the maturity stage increases. However, in this study sucrose was not detected in the crown extract. The amount of sucrose was significantly high in index 3 with 3.87% at the 5% level followed by indices 2 and 1 (3.04% and 2.58%) respectively in pineapple peel extract. Sucrose content in pineapple core were 8.92%, 8.37% and 8.53% for indices 3, 2 and 1 respectively. Previous study done by Dhar *et al*. (2008) reported that sugar concentration was higher in stage 3 of ripening.

Pineapple core extract had highest values of fructose, glucose and sucrose as compared to the other parts of pineapple waste extract for all indices of maturity. It also found that, fructose and glucose contents were significantly higher in pineapple core extract for index 2 as compared to indices 1 and 3. Sucrose was significantly higher in pineapple core extract for index 3 as compared to indices 1 and 2.

From the results obtained, sucrose is the major sugar present in the pineapple waste. Masniza *et*

Table 1. Sugar content of pineapple crown, peel and core extract for Indices 1, 2 and 3

Sugar	Fructose (%)			Glucose (%)			Sucrose (%)		
Index	1	2	3	1	2	3	1	2	3
Crown	0.78 ± 0.01^{bC}	0.83 ± 0.04^{abC}	0.87 ± 0.02^{aC}	0.48 ± 0.03^{cC}	0.51 ± 0.05^{cC}	0.53 ± 0.02^{cC}	ND	ND	ND
Peel	1.98 ± 0.16^{aB}	2.04 ± 0.07^{aB}	1.82 ± 0.02^{bB}	2.18 ± 0.09^{cB}	2.18 ± 0.08^{cB}	1.68 ± 0.02^{dB}	2.58 ± 0.08^{gB}	3.04 ± 0.08^{fB}	3.87 ± 0.03^{eB}
Core	2.00 ± 0.07^{bA}	2.24 ± 0.05^{aA}	2.22 ± 0.07^{aA}	2.31 ± 0.10^{dA}	2.56 ± 0.09^{cA}	2.32 ± 0.07^{dA}	8.37 ± 0.09^{gA}	8.53 ± 0.08^{fA}	8.92 ± 0.09^{eA}

Means within each row with different superscript are significantly different at $p \leq 0.05$.
Lower case letters indicate the effect of different indices on fructose, glucose and sucrose content.
Means within each column with different superscript are significantly different at $p \leq 0.05$.
Capital letters indicate the effect of different pineapple parts on fructose, glucose and sucrose content.

*ND = not detected

al. (2000) reported that pineapple contain 12-15% sugar of which two-third is in the form of sucrose and the rest were glucose and fructose. Bartolome *et al.* (1995) also stated that in pineapple, the sucrose content was approximately two-third of the total sugar. The amount of sugar varies in fruits and may depend on its stage of maturity at the harvesting time, soil condition and variety of fruit. Sugar content has not always related to colour stage as agronomic and production factors will also affect sugar development (Wijesinghe and Sarananda, 2002).

Conclusion

Pineapple core extract contain significantly high in fructose, glucose and sucrose compared to other parts of pineapple waste (peel and crown). Sucrose content was higher in pineapple core extract for index 3 compared to indices 1 and 2. Glucose and fructose was higher in pineapple core extract for index 2 compared to indices 1 and 3. Sucrose is the major sugar found in pineapple core and peel extracts.

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