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Volatile Components of Coconut Fresh Sap, Sap Syrup and Coconut Sugar

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Abstract: Volatile components of coconut fresh sap, sap syrup and coconut sugar were analyzed using GC-MS and identified by matching the mass spectra obtained with those present in the "NIST62 LIB" Library. The most abundant volatile components in the fresh sap, sap syrup and coconut sugar were 2-butanol and acetic acid. Twelve volatile components were identified and there were different amounts of volatile components found in the morning and afternoon tapping of fresh sap and its processed products.

Keywords: Volatile components, coconut fresh sap, sap syrup, coconut sugar

INTRODUCTION

Coconut sap, known as nira (Indonesia), toddy (Sri Lanka), maprau (Thailand), lagbi (North Africa), is the raw material in the production of coconut sugar (Nathanael, 1970; Anonymous, 1980; Purnomo, 1992). Coconut sugar in Indonesia is produced at cottage level and the indigenous production technology of coconut sugar has been reviewed by Hori *et al.* (2001a) and Purnomo and Suryoseputro (2001).

Furthermore, Purnomo (1992) and Purnomo and Suryoseputro (2001) reported that coconut sugar has been widely used as an ingredient in traditional Indonesian cooking, food and beverages. It is also one of the major ingredients of Indonesian sweet soya sauce (kecap manis), as well as in the Indonesian intermediate moisture meat (dendeng). The coconut sugar gives a specific taste and flavour to the end products.

Apriyantono *et al.* (1996) reported that some of the volatile components typical of Mailland reaction products found in sweet soya sauce apparently originated from coconut sugar as one of the main ingredients. They also predicted that the volatile components derived from the coconut sap, as well as during it's processing into coconut sugar.

In view of the specific flavour of coconut sugar, which makes it a special ingredient in some Indonesian cuisines, snacks, beverages and sweet soya sauce, it was of interest to investigate the volatile components of fresh sap, sap syrup and coconut sugar.

MATERIALS AND METHODS

Materials

Fresh sap, sap syrup and coconut sugar samples were obtained from the coconut plantation and coconut sugar processor in Srengat village, Blitar, East Java. The samples were taken at random after morning and afternoon tapping, and then processed into sap syrup (75° Brix) and coconut sugar. Sodium metabisulphite of 1000 ppm concentration was added as preservative during the processing of fresh sap into syrup and coconut sugar.

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Methods

Volatile components of fresh sap (50 ml), sap syrup (50 ml) and coconut sugar (5 g in 50 ml distilled water) were extracted using Likens-Nickerson apparatus with diethylether as the extraction solvent. The extracts were dried with anhydrous sodium sulphate and then concentrated using a rotary evaporator followed by flushing using nitrogen until the volume was about 0.5 ml (Apriyantono *et al*., 1996).

The GC-MS analyses of the extracts were performed using a set of GC-MS Shimadzu QP-5000 (Japan) with a CBP-5 column of 50 m at temperatures of 80° - 250° (10°C / minutes). The injector temperature was 260°C with mode split 1 : 60. Helium was used as a carrier gas at a pressure of 14 Kpa and the ion source working in electron impact(EI) mode at 70 eV was held about 180°C (Alli *et al.*, 1990; Apriyantono *et al*., 1996).

The identification was done by matching the mass spectra obtained with those present in the "NIST62.LIB" Library. It was then confirmed by matching their Linear Retention Indices (LRI) values with those already published in the literature. The internal standard used for quantification of volatile using GC-MS was 1,4 – dichlorobenzene (Apriyantono *et al.*, 1996).

RESULTS AND DISCUSSION

Results

The major volatile components identified in the fresh sap, sap syrup and coconut sugar were 2-butanol and acetic acid. Dodecanoic acid was found in sap syrup and coconut sugar, whilst 1,4 dimethyl-6,1-butyl acetate was found in smaller amounts. N,N dimethyl-2-(diphenyl-methoxy)-ethylamine and methylpyrazine were identified in coconut sugar only. In fresh sap, 2 methylcyclohexane and cyclohexiloctane are volatile components that were found only in fresh sap. Only twelve volatile components were found in fresh sap, sap syrup and coconut sugar from Srengat village, Blitar, East Jawa.

Acetic acid was identified both in the morning and afternoon fresh sap, sap syrup and coconut sugar produced from these fresh sap. Some of the volatile components in the fresh sap decreased in concentration and in some cases not detectable in the sap syrup and coconut sugar. 2-butanol in fresh sap for example was in the range of 60.26 – 68.37% but decreased in the sap syrup to between 45.35 and 51.02%, and in the coconut sugar it was reduced to as much as 29.98 – 31.23%.

Discussion

In this study, only 12 volatile components were identified, whilst Apriyantono *et al.* (1996) reported that around 70 volatile components were identified in coconut sugar. They also noted that the major volatile components in coconut sugar were dodecanoic acid, acetic acid, 2-undecanone-decanoic acid, 2-nonanone and 2-furfural. It was assumed that those components were derived from the coconut sap and many of which are formed during the cooking of fresh sap for about four hours to produce coconut sugar.

The differences in volatile components identified in the coconut sugar samples in this study compared to that of Apriyantono *et al.* (1996) is possibly due to the different composition of the fresh sap used as raw material to produce the coconut sugar in addition to the possible difference of cooking methods. Hori *et al.* (2001b) reported that the composition of the substances in fresh sap varied depending on the coconut variety, stage of maturity of the inflorescence of coconut tree, climatic condition as well as soil fertility status.

It is also assumed that the differences of both natural (such as jack fruit bark or mangosteen fruit skin) and chemical preservatives (such as sodium metabisuphite or limestone ($Ca(OH)_2$) solution) used during sap tapping also affected the components of fresh sap syrup and coconut sugar. The heating

Table 1: Volatile components of fresh sap, sap syrup and coconut sugar

Components	A (%)		B(%)		C (%)	
	1	2	1	2	1	2
Acetic acid	30.43	25.83	26.47	24.56	21.54	35.05
Dodecanoic acid	nd	nd	0.34	21.59	nd	12.41
1,4 dimethyl-6-1. butyl-acetate	1.11	0.91	10.26	0.40	15.50	1.76
2 methylcyclohexane	6.39	0.66	nd	nd	nd	nd
Cyclohexiloctane	1.81	4.23	nd	nd	17.01	nd
2-butanol	60.26	68.37	51.02	45.35	31.23	29.98
N,N dimethyl 2-(diphenylmetoxi)-ethylamine	nd	nd	nd	nd	13.26	9.31
Methylpyrazine	nd	nd	nd	nd	1.46	1.81
2,3 dimethylpirazine	nd	nd	0.77	nd	nd	nd
4,6 dimethyl-5-cyclo-hexo pyrimidine	nd	nd	nd	2.25	nd	nd
2-Furan	nd	nd	6.73	1.97	nd	nd
Cyclohexane	nd	nd	4.41	3.56	nd	nd

A_1 fresh sap tapped in the morning
A_2 fresh sap tapped in the afternoon
B_1 sap syrup (75∞Brix) preserved with 1000 ppm $Na_2S_2O_5$ obtained from morning tapped fresh sap
B_2 sap syrup (75∞Brix) preserved with 1000 ppm $Na_2S_2O_5$ obtained from afternoon tapped fresh sap
C_1 coconut sugar made from sap syrup B_1
C_2 coconut sugar made from sap syrup B_2

nd : not detected

method, temperature and time of boiling are also assumed to affect the quality of sap syrup and coconut sugar. Widyaningsih (1983), Purnomo (1992) and Sumarmin (1994) also reported the effect of different natural and or chemical preservatives used during fresh sap collection on the quality of coconut sugar in terms of flavor, taste, texture and color.

The reduction in the amount of some volatile components found in the sap syrup and coconut sugar was possibly due to the heat treatment and the possible interaction between sugar components and amino acids in fresh sap during processing. The mechanisms of changes are not fully understood and hence further studies are needed. Alli *et al.* (1990) and Akochi *et al.* (1997) reported that methyl-; 2,6 dimethyl-; ethyl; 2,3 dimethyl- and 2-ethyl 3-methylpyrazine were detected after heating maple syrup at 105°C for 120 minutes. Furthermore, Akochi *et al.* (1997) also noted that the presence of sucrose, fructose and trace amounts of amino acids were the precursors that participate in the formation of alkylpyrazines in foods.

Fresh sap of coconut contains a small amount of protein, fat, minerals and vitamins as well as sugar components. These could possibly interact during heat processing and form some of the volatile components and non-enzymatic browning intermediates as well as Maillard products. Fernandez (1983), as cited by Jatmika *et al.* (1990) found glutamic acid, threonine, aspartic acid and serine as major amino acids in fresh sap, whilst proline, methionine, triptophane, and histidine were < 4.00mg/100 g fresh sap. Itoh *et al.* (1982) reported that fresh sap of coconut contain sucrose, ash, protein, vitamin C and acids, such as succinic acid, and citic acid.

Therefore, the sap syrup and coconut sugar has the capacity as a sweetener with an enjoyable caramel and exquisite coconut flavor. The distinct role of volatile components which gave a blend of caramel and coconut flavor distinguished the sap syrup and coconut sugar from cane sugar, caramel, maple syrup or other sugar caramels.

CONCLUSION

The volatile components identified in fresh sap, sap syrup and coconut sugar were 2-butanol and acetic acid. There were 12 volatile components identified in fresh sap, sap syrup and coconut sugar from this region.

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