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Aroma volatiles from two fruit varieties of jackfruit (*Artocarpus heterophyllus* Lam.)

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Abstract

The aroma volatiles from two fruit varieties of jackfruit (*Artocarpus heterophyllus*) growing in the Amazon were obtained by simultaneous distillation-extraction and analysed by GC–MS. The major components identified in the aroma concentrate of ''hard jackfruit'' variety were isopentyl isovalerate (28.4%) and butyl isovalerate (25.6%). The aroma concentrate of ''soft jackfruit'' was dominated by isopentyl isovalerate (18.3%), butyl acetate (16.5%), ethyl isovalerate (14.4%), butyl isovalerate (12.9%) and 2-methylbutyl acetate (12.0%). These results are compatible with the fruits morphological variation and their distinguished aromas, previously observed.

Keywords: *Artocarpus heterophyllus*; Moraceae; Jaca; Jackfruit varieties; Distinguished aroma volatiles

1. Introduction

The genus *Artocarpus* comprises about 50 species of evergreen and deciduous trees belonging to the Moraceae family. The species *Artocarpus heterophyllus* Lam. is assumed to have origin in India or Oceania and it is found as cultivated tree in all tropical countries. The tree is high up to 20 m and their fruits are known as ''jaca'' (jackfruit). The fruits can be eaten raw, salted as a pickle, cooked or as sweet (Cavalcante, 1991; Prance & Silva, 1975; Vaughan & Geissler, 1997). In Brazil, according the consistence and size of the fruits, the species are known as ''jaca-dura'' (hard jackfruit) and ''jaca-mole'' (soft jackfruit). The pulp of the former is harder in comparison with the latter that often is also called butter-jackfruit. On the other hand, the aroma of both fruits is very distinguishable. The hard jackfruit is bigger than the soft jackfruit while the latter is often more sweet and aromatic (Cavalcante, 1991). In the Amazon region it is cultivated only on a domestic scale. The leaves and stem barks have been used to treat anaemia, asthma, dermatosis, diarrhoea, cough and as an expectorant (Balbach & Boarim, 1992). The fruits, seeds and trunk wood have been described as containing chemical compounds with aphrodisiac properties (Ferrão, 1999; Le Cointe, 1947). The variation of carbohydrates and the distribution of free sugar and fatty acid composition of different parts of ripe jackfruit varieties has been reported (Chowdhury, Raman, & Mian, 1997; Rahman, Nahar, & Mosihuzzaman, 1999).

The aim of this work was to analyse the chemical composition of the aromas obtained from the two fruit varieties of *A. heterophyllus* for the understanding of the plant intraspecific variation and food chemistry contribution. The volatile compounds identified in specimens of jackfruits occurring in Kuala Lumpur and Malaysia were previously reported (Rasmussen, 1983; Swords, Bobbio, & Hunter, 1978; Wong, Lim, & Wong, 1992). Previously, we cannot find any literature citation related to the results presented here.

2. Material and methods

2.1. Plant material

The ripe hard jackfruit was collected from one specimen of *A. heterophyllus* located in the city of Belém, state of Pará, Brazil, December 1998, and the ripe soft

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jackfruit from another specimen existing in the Municipality of Igarapé-Açú, state of Pará, Brazil, November 1998. Both fruits were treated after they had fallen down. After removal of the skin and seeds, the fresh macerated pulps of both samples (100 g, each) were mixed with water (20 ml) and submitted to simultaneous distillation-extraction for 3 h, using a Chrompak Microsteam Distillation Extractor and pentane (2 ml) as organic mobile phase. Two extractions of each sample were performed and then analysed by GC–MS.

2.2. GC–MS and GC analysis

The identification of components was performed in a GC–MS Finnigan INCOS XL instrument, with the following conditions: a WCOT DB-5ms (30 m × 0.25 mm i.d.; 0.25 μm film thickness) fused silica capillary column; temperature programmed: 40–60 °C (2 °C/min), 60–260 °C (4 °C/min); injector temperature: 220 °C; carrier gas: helium, adjusted to a linear velocity of 32 cm/s (measured at 100 °C); injection type: splitless (1 μl of the pentane soln.); split flow was adjusted to 20:1; septum sweep was a constant 10 ml/min; EI-MS: electron energy, 70 Ev; ion source temperature and connections parts: 180 °C.

The quantitative data of volatile constituents was obtained by peak area normalization using a HP 5890 GC/FID instrument, operated under the same conditions, except for the carrier gas that was hydrogen produced by a Packard hydrogen generator.

3. Results and discussion

Individual components were identified by comparison of both mass spectrum and their GC retention data with those of authentic compounds previously analysed and stored in the data system. Other identifications were made by comparison of mass spectra with those in the data system libraries and cited in the literature (Adams, 2001; Jennings & Shibamoto, 1980). The retention indices were calculated for all compounds using a homologous series of *n*-alkanes under the same operational conditions of analyses. The identified volatile constituents and their percentages are listed in Table 1. The retention indices were arranged in order of GC elution on DB-5ms column.

The major components identified in the aroma concentrate of hard jackfruit were isopentyl isovalerate (28.4%) and butyl isovalerate (25.6%), followed by palmitic acid (8.3%) and ethyl isovalerate (6.2%). The aroma concentrate of soft jackfruit was dominated by isopentyl isovalerate (18.3%), butyl acetate (16.5%), ethyl isovalerate (14.4%), butyl isovalerate (12.9%) and isopentyl acetate (12.0%), followed by isopentan-1-ol (5.0%). Between themselves, the aroma concentrates showed other distinguishable compounds that were detected at low percentage (below 2.0%). We identified 39 volatile compounds in the two fruit varieties of jackfruit, of which 22 have been previously reported (Rasmussen, 1983; Swords et al. 1978; Wong et al. 1992), but no citation was made about the varieties used to compose them. Thus, it is not possible to discuss our results in relation to earlier work. We have in mind that the aroma of jackfruit varieties is due to the predominance of esters. It can be noted that 24 esters were identified in the two jackfruit aromas. The esters butyl acetate and ethyl isovalerate presented major values in the soft jackfruit aroma (16.5 and 14.4%) when compared with the hard jackfruit aroma (4.4 and 6.2%). On the other

Table 1
Volatile constituents of two fruit varieties of *A. heterophyllus*

Constituents	Retention index[b]	Hard jackfruit (%)	Soft jackfruit (%)
Propyl acetate[a]	748		0.9
Methylcyclohexane	755		0.8
Isopentan-1-ol	758		5.0
Methyl isovalerate[a]	793		0.5
Ethyl butanoate[a]	798	1.3	2.2
Butyl acetate[a]	810	4.4	16.5
Ethyl 2-methylbutanoate	845		0.2
Ethyl isovalerate[a]	856	6.2	14.4
Hexanol[a]	866	0.2	1.9
Isopentyl acetate[a]	876		12.0
2-Methylbutyl acetate	879	0.5	
Propyl butanoate	900		0.3
Propyl isovalerate[a]	949		2.4
Butyl butanoate[a]	993	1.8	1.4
Decane	998		0.1
Octanal[a]	1000		0.4
Isobutyl isovalerate[a]	1004	3.0	0.8
Hexyl acetate	1008		0.3
Butyl isovalerate[a]	1047	25.6	12.9
Isopentyl butanoate[a]	1059		1.6
Octanol[a]	1070		1.1
Pentyl butanoate	1091	2.0	
Isopentyl isovalerate[a]	1101	28.4	18.3
3-Phenylpropanal[a]	1160	0.7	0.1
Butyl hexanoate[a]	1190	1.4	0.6
Decanal	1205		0.4
3-(Methylthio)-hexan-1-ol[a]	1206	1.9	
Octyl acetate[a]	1210		0.4
3-Phenylpropan-1-ol[a]	1225	0.2	
Hexyl isovalerate	1240		0.3
Isopentyl hexanoate[a]	1250	1.4	0.4
Decanol	1270	0.3	0.6
3-Phenylpropyl acetate	1364		0.2
Dodecanal	1408	0.8	0.2
Dodecanol	1470	0.3	
2-Phenylethyl isovalerate[a]	1488	0.2	0.1
Myristic acid	1760	0.3	
Palmitic acid	1961	8.3	
Ethyl hexadecanoate	2000	0.3	

[a] Previously reported in jackfruit (Rasmussen, 1983; Swords et al. 1978; Wong, et a.l, 1992).
[b] On DB5ms column.

hand, the esters isopentyl isovalerate and butyl isovalerate showed to be the most significant constituents in the hard jackfruit aroma (28.4 and 25.6%) if compared with the soft jackfruit (12.9 and 18.3%). The palmitic acid (8.3%) was detected only in the aroma concentrate of hard jackfruit while isopentyl acetate (12.0%) and isopentan-1-ol (5.0%) were found only in the aroma concentrate of soft jackfruit.

The chemical composition suggest that the two morphological variation of jackfruit are also represented by two different chemotypes belonging to *A. heterophyllus* species.

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