CHANGES IN THE KEY ODOUR-ACTIVE COMPOUNDS AND SENSORY PROFILE OF CASHEW APPLE JUICE DURING PROCESSING

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Abstract

Samples of cashew apple juice were collected in an industrial plant in order to monitor the juice key odour-active compounds at three different processing steps: extraction, pasteurisation and concentration. Volatile compounds were isolated by dynamic headspace technique and analysed by GC-MS and Osme GC-O method. Results were correlated to sensory descriptive data by multivariate analysis. Pasteurisation did not change very much the perception of cashew-like compounds, but did reduce compounds contributing to sweet, fruity, floral and green notes. Pasteurised cashew apple juice maintained fresh juice flavour intensities but a moderate cooked flavour. Evaporation, in its turn, drastically reduced key compounds while concentrated others, like occurred to a ketone, described as sickly sweet, and to a sulphur compound, yielding a juice characterized by cooked and sulphur flavours.

Introduction

The appeal of natural cashew apple (*Annacardium occidentale*, L.) juice is attributed to its high vitamin C content, averaging three to six times that of orange juice. Despite its high level of astringency, cashew apple shows good characteristics for industrialization owing to its fleshy pulp, soft peel, lack of seeds, high sugar content and strong exotic flavour. The volatiles composition of cashew apples from a specific genetic material (clone CCP76) was already assessed in a previous work (1) as well as the volatile profile of commercial cashew apple nectars (2). In the juice industry, concentration of fruit juice is necessary in order to reduce volume and stabilize the product, but many concentrated juices lack most of the aroma volatiles (3-5) which are lost or changed due to enzymatic activity, thermal influence and evaporation (6). The present study aimed to evaluate the changes in the odour-active compounds in cashew apple juice during a commercial juice concentration process and investigate how they influence its sensory properties.

Experimental

Materials. Cashew apple juice samples were withdrawn at three processing steps of a large scale Brazilian industrial plant, from the same batch: extraction, pasteurisation and concentration. Samples were stored at -18 °C prior analyses.

Volatiles collection and analysis. Volatiles from the headspace of cashew apple juice were swept by vacuum to a Porapak Q® trap for 2 h at room temperature and eluted with 300 μL dichloromethane (7). Compounds were separated on a CPWax 52CB column (50 m x 0.25 mm i.d. x 0.25 μm, Varian) and identified from linear Retention Indices and EI mass spectra (NIST 05 MS Library Database).

GC-Olfactometry. The relative importance of each odour compound was evaluated by the Osme time intensity GC-O method (8). Sniffing was performed in duplicate, by four trained judges, who reported intensity using a 9 cm time-intensity scale (software SCDTI, Unicamp, Brazil) and descriptors for any detected odour. Guaiacol was added in every run as an internal odour standard.

Sensory analysis. The aroma and flavour profile was developed by descriptive analysis, in duplicate, by a panel of 8 trained judges.

Statistical analysis. Data were submitted to ANOVA and the most discriminative descriptors were selected for multivariate correlation (PLSR-2) as an exploratory analysis to describe the relationships between sensory (mean scores) and olfactometric data (mean intensity).

Results

A total of 93 volatile compounds were detected by FID in cashew apple juice samples, of which 50 were odour-active. Sensory panel also perceived another 22 compounds with very low threshold that were not detected by instrumental means and were labelled as small letters. Table 1 lists the main odoriferous compounds which presented odour intensity greater than 1 in at least one processing step.

Table 1. *Main odour-active compounds in the cashew apple juice samples from industrial processing steps.*

Peak nº	RI[a]	Compound	Odour description	Odour Intensity		
				Extr	Past	Conc
d	<1000	ND	fruity, sweet	4.29	2.40	2.05
e	<1000	ND	fruity, sweet	2.13	0.98	-
2	<1000	2-Butanone	cashew, fruity, fruit candy	1.88	2.98	-
4	<1000	5-Methyl-2-hexanone	cashew, sweet, fruit candy	1.54	3.48	0.61
g	<1000	ND	tutti-frutti, fruit candy	3.64	5.01	3.03
7	<1000	Ethyl propionate	cashew, sweet, fruit candy	4.35	1.74	2.26
12	<1000	NI	fruity, green	2.27	1.97	0.83
19	1038	Ethyl butyrate	fruity, sweet	3.24	2.72	-
21	1050	Ethyl 2-methylbutyrate	fruity, floral	1.44	2.37	-
23	1067	Ethyl isovalerate	cashew, fruity, fruit candy	1.67	3.67	0.66
h	1135	ND	fermented cashew, sweaty	4.13	4.56	-
37	1154	Ethyl crotonate	fruity, fruit candy	2.30	2.06	-
42	1178	Heptanal	plastic, glue	2.41	2.85	-
47	1207	3-Methyl-1-butanol	acid, herb, sweaty	1.41	1.52	-
i	1221	ND	green, metallic	2.85	2.76	-
51	1245	NI (sulphur compound)	butane gas, glue	-	-	1.63
54	1265	Isobutyl isovalerate	cashew, perfume, floral	1.26	-	0.83
58	1293	Ethyl 3-hexenoate	green	1.90	1.24	-
60	1312	(Z)-3-Hexen-1-ol	green, unripe fruit	3.62	3.91	-
65	1357	Allyl hexanoate	green, wax	2.44	2.81	-
l	1392	ND	perfume	2.17	-	-
70	1439	Ethyl octanoate	fruity, floral	1.80	0.88	-
76	1510	Benzaldehyde	acid, green	2.58	-	-
86	1650	2-Methyl butanoic acid	sweaty, fermented fruit	5.08	5.55	5.25
91	1996	NI (ketone)	sugar candy, sickly sweet	1.46	1.65	2.91

ND = not detected; NI = not identified.

The major odour-active compounds here detected were also found by other authors, with the same odour descriptions. Some examples are ethyl butyrate (1, 2), ethyl propionate (1), ethyl isovalerate (1, 2), benzaldehyde (1, 2), 2-methyl butanoic acid (1, 2) and (Z)-3-hexen-1-ol (1).

Most cashew-like compounds (2-butanone, 5-methyl-2-hexanone, ethyl isovalerate) increased their perception during processing until pasteurisation, possibly due to enzymatic activity, before heat treatment, over bounded compounds, increasing their concentration on the juice. Some contributing odorants (fruity, sweet, green) showed good stability; remaining unaltered or slightly decreasing after pasteurisation. On the other hand, Table 1 shows high losses of cashew-like perceptions, as well as for most contributors during concentration. Distinct behaviours were found for bad-smelling compounds: 2-methyl butanoic acid (sweaty, fermented) remained constant and a sulphur compound, which was not perceived in the unprocessed juice, showed up with moderate intensity. Compound labelled 91, a non-identified ketone with a sickly sweet smell, was concentrated during processing.

Sensory assessors developed a vocabulary of 7 aroma (cashew apple, sweet, fermented, artificial, acidic, green, floral) and 8 flavour descriptors (cashew, fermented, artificial, green, sulphurous, cooked fruit, and sweet and acid tastes) but only five showed significant difference among samples from various processing steps (Figure 1). The results of PLSR-2 carried out only with these five descriptors that could discriminate samples are in Figure 2, showing the multivariate relationships between sensory attributes and perception of odoriferous compounds. PC1 explained 79.2% of the samples variations, differentiating Concentration from the other samples. Concentrated juice was characterized by Acid and Sweet aroma, Cooked and Sulphur flavours while unprocessed juice (Extraction) and pasteurised sample showed higher Green aroma and Cashew flavour, typical fresh fruit sensory qualities.

Compound 91, described as sugar candy and sickly sweet, perceived in higher intensity in the concentrated juice, was associated to Cooked flavour and Sweet aroma whereas the unidentified sulphur compound 51 was related to the Sulphur flavour. Good news about concentration was that bad-odour compounds like heptanal (peak 42, plastic, glue) and peak h (fermented, sweaty) were probably lost during concentration, since they were not perceived in the concentrated juice. Also the smelly compound 2-methyl butanoic acid (peak 86, sweaty), the most intense odour rated by sensory panel, was not concentrated.

PC2 differentiated pasteurisation sample from the unprocessed juice, mainly due to volatile compounds. Extraction samples were characterized by higher perceptions of fruity and sweet compounds and ethyl propionate (peak 7, cashew-like), but pasteurised juice showed higher perceptions of three other cashew-like compounds (peaks 2, 4 and 23). However their volatile compositions yielded similar cashew flavour intensities for both samples. The biggest difference between them was that the sensory panel also perceived a moderate cooked flavour in the pasteurised sample.

In general, cashew apples odour-active volatile compounds showed good stability to initial industrial processing steps and pasteurisation, being the sensory properties of the processed (pasteurised) juice very similar to those of a fresh juice. Traditional concentration, however, had a great effect on cashew-like and contributing volatiles, resulting in a juice with acid aroma and cooked and sulphur flavours.

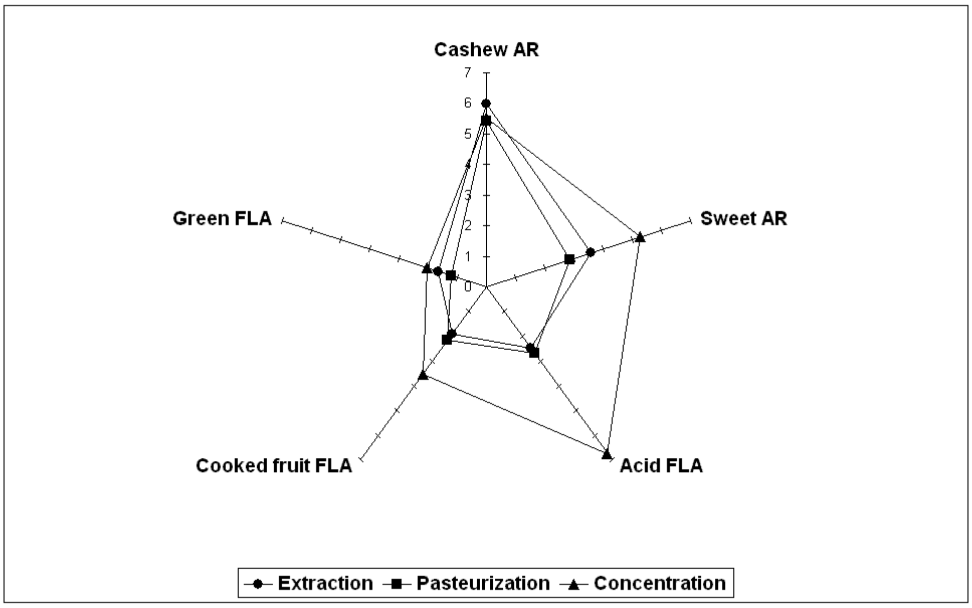

Figure 1. *Flavour attributes of cashew apple juice which showed significant difference among different processing steps (AR = aroma; FLA = flavour).*

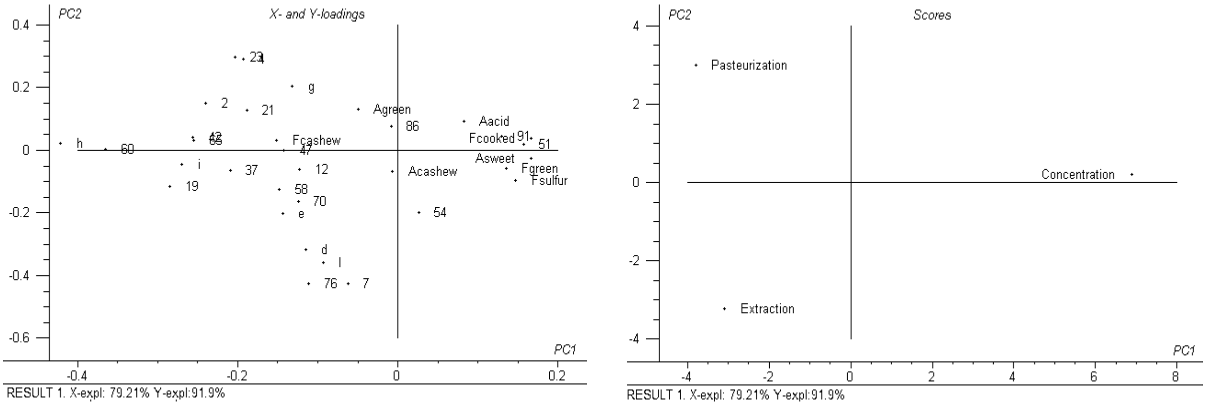

Figure 2. *Scores (a) and Loadings (b) for PLS regression for the cashew apples juice samples from industrial processing steps.*

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