The chemistry of passion fruit

Introduction

The passion fruit is a native of tropical America and was noted by the Spanish in Brazil in the 1500's. There are more than 400 species of which at least 50 or more are edible.

The two main commercial varieties are *Passiflora edulis* L. a purple fruit and *P. edulis f. flavicarpa* a yellow variety.
Australia is the largest single market for passion fruit and the bulk is used for blending with other juices and in softdrinks.

Chemistry

Sugars

The total carbohydrate content is around 15-20 % with slight variations between the purple and yellow varieties.
The breakdown (in percent) is given as:

	fructose	**glucose**	**sucrose**
purple	33.5	37.1	29.4
yellow	29.4	38.1	32.4

with a trace of 7 others.

Acids

Both yellow and purple have a high acid content (pH around 3) and the breakdown has been given as:

meq/100g	citric acid	malic acid	lactic acid	malonic acid	succinic acid	ascorbic acid
purple	13.1	3.86	7.49	4.95	2.42	0.05
yellow	55	10.55	0.58	0.13	trace	0.06

The sugar/acid ratio is sometimes used as a measure of sweetness and there is a significant difference between the purple and yellow varieties, 5:1 compared to 3:8, so that the purple is generally considered to be sweeter.

Pigments

In 1963, it was determined that the colour of the passion fruit was not due to anthocyanins and only trace amounts of flavones were found as well.
In 1972, further work identified the major carotenoid pigments in the purple variety, which included:

- alpha-carotene
- beta-carotene
- gamma-carotene
- phytofluene
- beta-apo-12'-carotenal
- beta-apo-8'-carotenal
- cryptoxanthin
- auroxanthin
- mutatoxanthin

Alkaloids

In 1975, 7 alkaloids were detected and 4 were identified as harman(e), harmol, harmin and harmalin. Pharmacological tests showed that the juices had slight sedative effects. Harman(e) (CAS 486-84-0, Molform= C 12 H 10 N 2) is shown below.

harmane

Volatiles

By 1972, over 165 compounds had been detected in the volatiles of the juice of the yellow variety. The highest quantities being C2-C8 esters of the C2-C8 fatty acids. Other volatiles included the degradation products of carotenoids, sulfur-containing components and some unusual aliphatic esters.

D.J. Casimir and F.B. Whitfield in 1978 introduced the concept of the "flavour impact value" and from the over 300 volatile flavour components that they detected, identified 22 as having passion fruit flavour. Using linear regression methods they were able to reproduce the natural flavour by combining 15 of these volatiles and calculated each chemicals contribution to the flavour profile.

Flavour-Impact Values

Compound	***Flavour impact value***	***Concentration in juice (ppm)***	***Contribution to flavour profile(%)***
6-(but-2'-enylidene) 1,5,5-trimethylcyclohex-1-ene	79	1.1	30
(Z)-hex-3-enyl butanoate	41	0.8	11
hexyl butanoate	6.8	4.1	9
ethyl (Z)-oct-4-enoate	62	0.4	8
beta-ionone	410	0.05	7
edulan I	23	0.8	6
ethyl (Z)-octa-4,7-dienoate	239	0.06	5
Linalool	30	0.05	5
Ethyl hexanoate	1.3	7.6	3
heptan-2-ol	1.7	5.3	3
(Z)-hex-3-enol	26	0.3	3
S compounds	76	0.1	3
hexanol/ nonan-2-one	1.8	4.0	3
Rose oxide	45	0.2	2
methyl butanoate	0.7	8.3	3

A simulated GC of the headspace vapours of yellow passionfruit is available as a JSpecView display.
A fascinating distinction between the yellow and purple passionfruit was found on studying the presence of chiral compounds. For example, heptan-2-ol from the purple was found to be 92% (R) while in the yellow was 82% (S)-enantiomer. This suggested that different pathways and/or enzymes were involved in their formation.

References

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