SENSORY EVALUATION OF COMMERCIAL APPLE JUICES AND RELATION TO SELECTED KEY AROMA COMPOUNDS

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Abstract

Commercial apple juice samples of 23 different brands were analysed for their hedonic value as well as for the concentrations of four selected key aroma compounds ((E)-β-damascenone, hexanal, (E)-2-hexenal, dimethyl sulphide). Results showed that juices with good hedonic values were rather high in (E)-2-hexenal and hexanal and low in dimethyl sulphide, whereas juices with poor sensory scores were either low in hexanal and (E)-2-hexenal or high in dimethyl sulphide. Throughout all samples, naturally cloudy juices showed higher concentrations of cooked apple-like smelling (E)-β-damascenone than filtrated samples.

Introduction

The consumption of fruit juices in Europe amounts to approximately 25 L per capita and year (1). In addition to orange juice, apple juice makes up a major part of it, particularly in Germany, the world's leading country in fruit juice consumption (40 L per capita and year).

Our recent research on the key aroma compounds of apple juice (2) revealed cooked apple-like smelling (E)-β-damascenone and grassy smelling hexanal as the odorants with the highest odor activity values. Omission tests applied on an apple juice reconstitute containing 15 odorants, namely (E)-β-damascenone, hexanal, diacetyl, acetaldehyde, dimethyl sulphide, (Z)-1,5-octadien-3-one, (E)-2-hexenal, (Z)-3-hexenal, ethyl 2-methylbutanoate, methional, 1-octene-3-one, 1-butanol, methyl 2-methylbutanoate, 1-hexanol, and linalool, additionally showed the major importance of apple-like smelling (E)-2-hexenal for the overall flavour of apple juice. On the other hand, dimethyl sulphide, exhibiting an asparagus-like smell, may cause an undesired vegetable-like off-flavour in apple juice when present in higher concentrations.

The aim of the following work was to assess the hedonic values of commercial apple juices in the market by sensory evaluations and compare the results to the concentrations of the key odorants (E)-β-damascenone, hexanal, (E)-2-hexenal, and dimethyl sulphide.

Experimental

Apple juice samples of 23 different brands were purchased from local supermarkets in the Munich area (Germany). Samples included clear and cloudy juices, juices from concentrate and NFC-juices, as well as conventionally produced ones and those with bio-label. Prices ranged from 0.55 to 3.73 €/L.
Hedonic scoring was performed by 16 trained panelists using a scale adopted from German school marks ranging from 1 to 6 with 1 = very good, 2 = good, 3 = satisfactory, 4 = fair, 5 = poor, 6 = unsatisfactory.

Concentrations of (E)-\(\beta\)-damascenone, hexanal, (E)-2-hexenal and dimethyl sulphide were determined by stable isotope dilution analyses using \([^{2}\text{H}_6]\)-(E)-\(\beta\)damascenone, \([^{2}\text{H}_4]\)-hexanal, \([^{2}\text{H}_2]\)-(E)-2-hexenal, and \([^{2}\text{H}_6]\)dimethyl sulphide as internal standards. Standards were added to the juice samples before work-up. Determination of dimethyl sulphide was achieved by headspace-SPME in combination with a GC-GC-MS-system (3). Using the same GC-GC-MS-system, (E)-\(\beta\)-damascenone, hexanal and (E)-2-hexenal were quantified after solvent extraction, isolation of volatiles by SAFE distillation (4), and liquid injection.

Results

Hedonic scores (Figure 1) ranged from 2.1 (good) to 4.9 (poor). Naturally cloudy juices showed greater variance in the hedonic value (2.1 - 4.9) than clear juices (3.3 - 4.1). Concentrations of (E)-\(\beta\)-damascenone, hexanal, (E)-2-hexenal and dimethyl sulphide (Figure 2) were highly variable among the 23 apple juices analysed.

A direct correlation of hedonic scores to the concentrations of any individual aroma compound was not observed. But, juices with good hedonic values predominantly showed rather high concentrations of (E)-2-hexenal and hexanal and low concentrations of dimethyl sulphide, whereas most juices with rather bad sensory scores were either low in hexanal and (E)-2-hexenal or high in dimethyl sulphide. However, samples not following that rule (e.g. 7, 17) indicate that further aroma-active compounds have an additional influence on the overall hedonic value.

A clear correlation was found between filtration and (E)-\(\beta\)-damascenone concentration (Figure 2, topmost diagram). Naturally cloudy apple juices showed considerably higher concentration values (9-17 \(\mu\)g/L) than clear samples (1-6 \(\mu\)g/L). Since (E)-\(\beta\)-damascenone is not present in raw apple juices, but formed during juice pasteurization (5), this observation indicates that a major part of its precursors is removed during the filtration process.

Figure 1. Sensory evaluation of the hedonic value of 23 commercial apple juices.
Figure 2. Concentrations of selected key odorants in 23 commercial apple juices.
References