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Published in:
Expression of multidisciplinary flavour science

Publication date:
2010

Document version
Early version, also known as pre-print

VOLATILE COMPOUNDS AND AMINO ACIDS IN CHEESE POWDERS MADE FROM MATURED CHEESES

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Abstract

Three types of cheese powder made from well-matured cheeses were analysed for their content of volatile compounds and amino acids. The cheese powder types could be distinguished according to their amino acid and volatile compound profiles. The amino acids glutamic acid and GABA are likely to contribute directly to the taste of a food application.

Introduction

Cheese powder is used as a natural flavour ingredient in industrial applications such as biscuits, sauces, ready meals and processed cheese. In addition, cheese powders produced from well-matured cheeses have the potential to boost the cheese flavour of food products and may replace flavour enhancers such as sodium glutamate and yeast extract. Introductory sensory tests of three different cheese powders, made from well-matured cheeses, in tomato soup, showed that they influenced the flavour of tomato, cheese, sourness and richness, in three different ways. However, limited information is available regarding flavour constituents of cheese powder (1), hence the aim of the present study was to characterise the differences in composition of volatile compounds and amino acids in three types of cheese powders made from well-matured cheeses.

Experimental

Cheese powders. Three types of cheese powder based on minimum 50% smeared type cheese (eight samples), minimum 50% hard cheese (five samples) and minimum 50% Blue type cheese (two samples), respectively (Lactosan A/S, Ringe, Denmark) were made by melting and spray drying a mixture of well-matured cheeses. All cheese powders were produced at different days from recipes comprising between 5 and 13 assorted cheeses, with a variation between batches of the same cheese powder type depending on availability of cheeses on the market.

Dynamic headspace sampling and GC-MS analysis. Volatile compounds were isolated by dynamic headspace sampling on Tenax TA traps using 30 grams of cheese powder, 110 ml of water and 1.00 ml of internal standard (4-methyl-1-pentanol). The collected volatiles were thermally desorbed and analysed by GC-MS with a J & W Scientific DB-Wax column (1). Tentative identifications were carried out by probability-based matching with mass spectra in the G1035A Wiley library

(Hewlett-Packard). Calculations were based on peak areas divided by area of internal standard. The dynamic headspace samplings were performed in duplicate.

Amino acids with HPLC. Free amino acids were analysed by reversed phase HPLC. For primary amino groups derivatisation was made using *o*-phtaldialdehyde, and for the secondary amino group of proline, fluoroenylmethyl chloroformate was used (2).

Results

Using principal component analysis the three types of cheese powders could be distinguished according to their content of amino acids and volatile compounds (48% explained variation), however large variations occurred between batches within each cheese powder type (Figure 1).

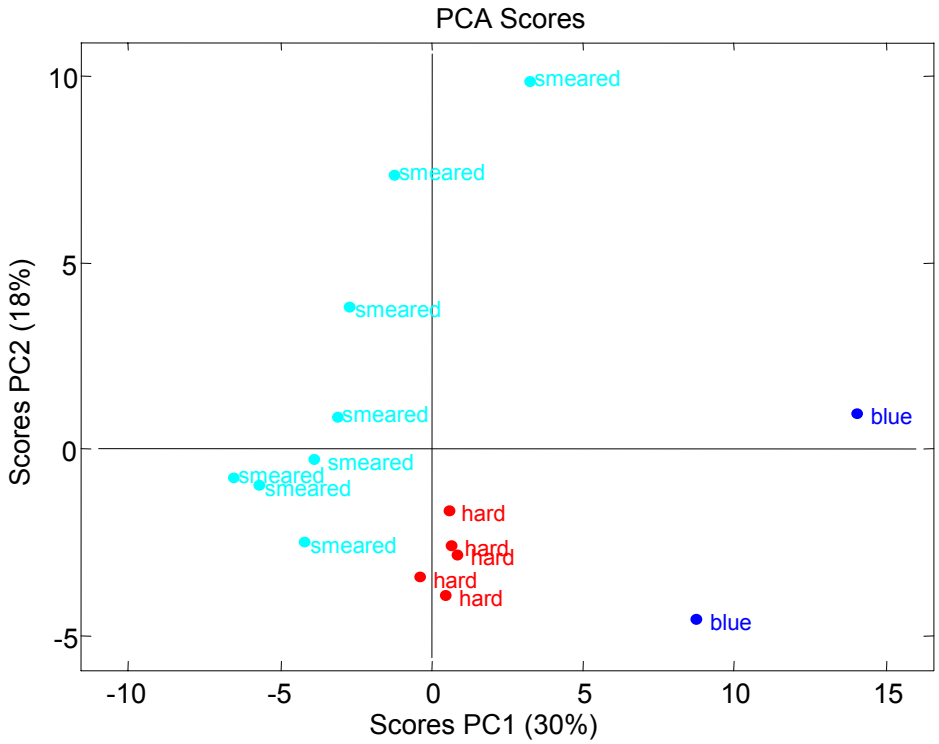

Figure 1. *PCA scores plot of all amino acids and volatile compounds identified in the three types of cheese powder made from smeared, hard and blue type well-matured cheeses, respectively.*

Of the 80 volatile compounds identified in the cheese powders (data not shown) 26 differed significantly between the cheese powder types (Table 1). The smeared type cheese powders had the significantly highest level of 2,5-dimethyl-5-trimethylpyrazine, as well as of dimethyl trisulphide and phenol that are characteristic compounds of smear ripened cheeses, and of which dimethyl trisulphide is expected to contribute to the aroma character of this cheese powder type (3). The hard type cheese powders had low to medium levels of most volatile compounds. The blue type cheese powders were characterised by the highest levels of most volatile compounds, including methyl ketones, esters and lactones, many of which are known compounds of blue cheese and are expected to contribute to the aroma characteristic of this cheese powder type (3). Similar results were obtained in (1).

Table 1. *Average levels of volatile compounds (arbitrary units, peak areas divided by internal standard x1000) with significant different levels (P<0.05) in the three types of cheese powder.*

Volatile compound	Smeared type (*n*= 8)	Hard type (*n*= 5)	Blue type (*n*= 2)
Dimethyl trisulphide	89a[1]	31b	23b
Methyl propanethioate	3b	0b	93a
Octanal	19b	19b	34a
Decanal	33b	30b	96a
Diacetyl and 2-pentanone[2]	301b	358b	569a
3-Penten-2-one	19ab	8b	32a
2-Hexanone and hexanal[2]	104b	140ab	203a
2-Heptanone	473b	570b	3013a
2-Octanone	15b	18b	86a
2-Nonanone	227b	375b	2635a
8-Nonen-2-one	23b	44b	317a
2-Undecanone	19b	32b	279a
Ethyl acetate	23b	27b	124a
Methyl hexanoate	14b	21b	94a
Pentyl butanoate	32b	33b	101a
2-Methyl-butyl-hexanoate	11b	15b	043a
Methyl decanoate	2b	7b	42a
1-Butanol	9b	7b	23a
2-Heptanol	52b	75b	172a
2-Nonanol	13b	25b	79a
Phenol	246a	123b	46b
γ-Pentalactone	2b	3b	9a
γ-Hexalactone	1b	2b	43a
γ-Heptalactone	2b	5b	11a
2,5-Dimethyl-5-ethylpyrazine	11a	2b	0b
Trimethylbenzene	1b	6ab	9a

[1] Within each volatile compound values with different letters are significantly different.
[2] Co-eluting compounds.

The concentration of 16 of the 23 identified amino acids differed significantly between the three cheese powder types (Table 2). The content of leucine and glutamic acid were highest in all samples. Smeared cheese type and hard cheese type powders had the highest total content of free amino acids as well as of more of the individual amino acids, indicating that the cheeses used were more mature.

Especially glutamic acid but also aspartic acid are of interest due to their umami taste (4), however, they did not vary significantly between cheese powder types. Literature is contradictory about the taste sensation of the glutamic acid breakdown product γ-aminobutyric acid (GABA), which has been shown to contribute to sour and umami as well as astringent sensations. The taste characteristic and taste threshold of α-aminobutyric acid (AABA) has not been well established, but due to its structural resemblance with glutamic acid it may also be of importance.

GABA, glutamic acid, aspartic acid, alanine, leucine, methionine and isoleucine had taste activity values (TAV) > 1 in all the cheese powders (data not shown) (4); but considering the level of 2-6% cheese powder used in food applications, only

glutamic acid and GABA are likely to contribute directly to the taste. However, interactions between the amino acids and other constituents might affect their taste qualities and taste threshold levels.

Table 2. *Average concentration of amino acids in the three types of cheese powder.*

Amino acid	Concentration (mmol/kg)		
	Smeared type (*n*= 8)	Hard type (*n*= 5)	Blue type (*n*= 2)
Leu	45a[1]	39a	29b
Glu	37	36	28
Val	34a	29a	17b
Pro	32a	28a	17b
Ala	25a	19b	11c
GABA	24a	15b	1.9c
Lys	23	26	26
Ile	20a	18a	11b
Phe	18a	16a	11b
AABA	18a	10b	1.6c
Gly	14a	13a	6.4b
Met	10	8.4	8.0
Asp	8.1	11	10
His	5.7	6.7	6.2
Thr	5.5	7.1	5.3
Cit	5.5	5.3	4.8
Tyr	5.4b	5.9b	7.7a
Orn	5.3a	4.4ab	2.5b
Gln	5.2b	7.4a	8.8a
Ser	5.1b	8.5a	7.6a
Asn	2.7b	5.4a	5.4ab
Trp	2.3a	1.7b	2.1ab
Arg	0.4b	2.0a	3.6a
Total free amino acids	351a	323a	231b

[1] Within each amino acid values with different letters are significantly different (P<0.05).

Sensory evaluations of the effects of the different types of the mature cheese powders applied in foods will be performed and the taste threshold value and taste properties of GABA and AABA should be further evaluated in order to determine their contribution to umami or other taste properties.

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