Key aroma compounds in meat bouillons: Comparison between industrial and traditional preparation processes

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Abstract

Sensory evaluation of traditionally prepared and industrially manufactured meat bouillons showed a striking difference in their flavour profiles. Notably, the latter were less intense in chicken or beef signature flavours. In order to gain an insight into the molecular basis responsible for these aroma differences, traditionally prepared and commercially available products were screened for aroma compounds by applying comparative aroma extract dilution analysis (cAEDA). In general, traditionally prepared samples showed much higher FD-factors for α,β-unsaturated aldehydes, e.g., (*E*)-2-nonenal and (*E*,*E*)-2,4-decadienal, resulting in boiled, fatty aroma notes, whereas commercial samples revealed high FD-factors for organic acids, leading to sour, sweaty odours.

Introduction

The increasing consumer demand for organic, natural and authentic culinary products, free from taste enhancers or artificial antioxidants, has led to a surge in "all-natural" meat bouillons in the markets.

Sensory evaluation (Figure 1) of meat bouillons prepared at industrial-scale showed different flavour profiles when compared to bouillons prepared in a traditional manner.

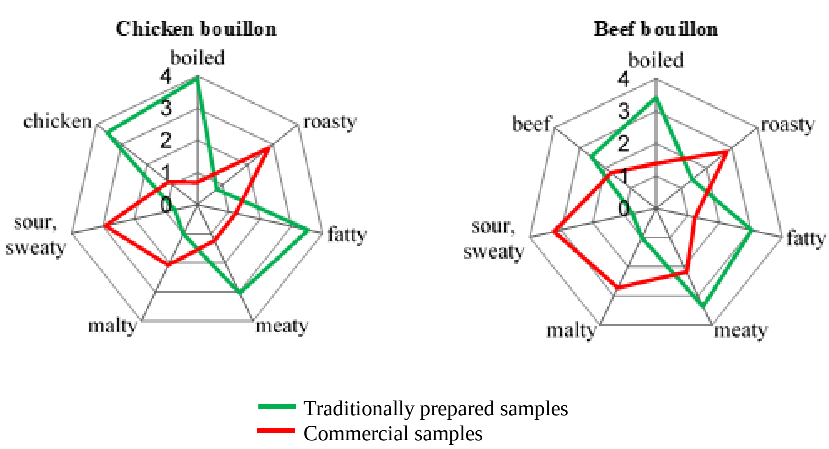

Figure 1: Aroma profiles of beef and chicken bouillons. Commercial samples (C) versus traditionally prepared samples (TP). Scale: 0 = aroma not detectable; 4 = strong aroma.

Traditionally prepared chicken and beef bouillons showed much stronger meaty, fatty and boiled aroma notes whereas commercial samples revealed a more sour, malty and roasted aroma. In general, traditionally prepared samples were much more intense in

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chicken or beef signature flavours. These differences might be caused by aroma losses, degradation upon processing or low quality of the raw materials.

While aroma compounds of traditionally prepared chicken [1, 2] and beef bouillons [1, 2, 3] have been well studied, no data were available regarding the difference in aroma compared to commercial products. In order to gain more insight into the molecular composition responsible for this aroma difference, the aim of the present study was to identify the key aroma compounds by applying aroma extract dilution analysis (AEDA).

Experimental

Commercial (C) meat extracts were prepared according to instructions on the packet. Traditionally prepared (TP) standards were produced by experienced kitchen chefs using beef or chicken meat and water.

Volatile compounds were isolated using high vacuum distillation (SAFE) after liquid extraction (diethyl ether). The distillate was concentrated (200 µl) and odour-active compounds were located by AEDA. Structural identification of aroma compounds was achieved by comparison of their mass spectra (EI), retention indices and odour characteristics with data of reference compounds analysed in parallel. Differences between TP and C samples were evaluated using comparative AEDA.

Results and discussion

Aroma-active compounds in traditionally prepared samples

The results of the identification experiments in combination with the FD factors revealed 2-acetyl-1-pyrroline, 2-furfurylthiol, methional and (*E*)-2-nonenal as important aroma contributors in traditionally prepared boiled chicken and beef (Tables 1 and 2). The highest FD factor in chicken bouillon was found for (*E,E*)-2,4-decadienal (FD 1024), whereas this compound was of minor importance (FD < 4) in beef. For beef, FD-factors for furaneol (sweet, caramel-like aroma) were much higher, whereas for chicken more fatty aroma notes, e.g., (*E*)-2-decenal, (*E,E*)-2,4-nonadienal, were identified. These results are in good accordance with literature data [1, 2, 4]. Interestingly, 2-methyl-3-furanthiol and bis(2-methyl-3-furyl)disulphide were not identified by AEDA in beef or chicken. These sulphur compounds were evaluated as important contributors for beef and chicken aroma by Gasser, 1990 [1], whereas in other studies [4, 5] their influence was rated rather low. In contrast to some literature studies on beef aroma [2, 6], 12-methyltridecanal, which was identified as an important species-specific odorant was not detected in this study.

Comparison of commercial and traditionally prepared samples

Comparative AEDA showed significant differences between traditionally prepared and commercial samples, in good accordance with sensory results. Commercial chicken and beef samples presented higher FD factors for organic acids, e.g., acetic acid, butanoic acid, 2-methylbutanoic acid (Tables 1 and 2), resulting in significantly increased sour and sweaty aroma notes (Figure 1).

In contrast, FD factors of α,β-unsaturated aldehydes, e.g., (*E*)-2-octenal, (*E*)-2-nonenal, (*E,E*)-2,4-nonadienal and (E,E)-2,4-decadienal for chicken and (*E*)-2-octenal, (*E*)-2-nonenal and (*E,Z*)-2,6-nonadienal for beef were considerably lower for the commercial samples. The highest differences were found for (*E*)-2-nonenal (FD 256 compared to FD 32 in chicken, FD 128 compared to FD 16 in beef) and (*E,E*)-2,4-decadienal (FD 1024 compared to FD 32 in chicken). These aldehydes are well known to contribute to the characteristic boiled, fatty aroma of meat and they are responsible for the typified aroma notes, in particular for boiled chicken [1]. Therefore, these aroma qualities were clearly lower in the aroma profiles of the commercial samples (Figure 1). Lower FD factors for pyrazines and 2-acetylthiazole were observed in the traditionally prepared sample. This may be a reason for significantly lower roasted aroma notes, whereas increased FD factors for 2-/3-methylbutanal may be correlated with increased malty odour notes in the commercial samples.

Table 1: AEDA of chicken bouillons: traditionally prepared samples (TP) compared to commercial samples (C) (selected results).

Compound	*Odour quality*	*TP*	*C*
2-/3-methylbutanal	malty	8	64
1-octen-3-one	mushroom-like	32	8
2-acetyl-1-pyrroline	roasty	128	128
2,3,5-trimethylpyrazine	roasty, earthy	16	64
(*E*)-2-octenal	fatty	32	8
2-furfurylthiol	roasty, coffee-like	128	16
3-ethyl-2,5-dimethylpyrazine	earthy, roasty	32	128
methional	cooked potato-like	128	256
acetic acid	vinegar-like	8	32
(*E*)-2-nonenal	fatty	256	32
(*E*)-2-decenal	fatty	16	n.d.
butanoic acid	sweaty, sour	8	128
2-methylbutanoic acid	sweaty, sour	n.d.	32
2-acetylthiazole	roasty	32	64
(*E*,*E*)-2,4-nonadienal	fatty, fried	64	16
(*E*,*Z*)-2,4-decadienal	fatty	16	n.d.
(*E*,*E*)-2,4-decadienal	fatty, fried	1024	32
hexanoic acid	sour, sweaty	8	32
furaneol	sweet, caramel-like	32	64
phenylacetaldehyde	flowery	8	16

Table 2: AEDA of (selected results) for beef bouillons: Traditionally prepared samples (TP) compared to commercial samples (C).

Compound	*Odour quality*	*TP*	*C*
2-/3-methylbutanal	malty	16	64
2,3-pentanedione	butter-like	8	n.d.
1-octen-3-one	mushroom-like	32	4
2-acetyl-1-pyrroline	roasty	256	256
(*E*)-2-octenal	fatty	16	8
2-furfurylthiol	roasty, coffee-like	128	16
3-ethyl-2,5-dimethylpyrazine	earthy, roasty	64	128
acetic acid	vinegar	16	64
methional	cooked potato-like	128	256
2,3-diethyl-5-methylpyrazine	earthy, roasty	32	64
(*E*)-2-nonenal	fatty	128	16
(*E*,*Z*)-2,6-nonadienal	cucumber-like	16	n.d.
butanoic acid	sour, sweaty	32	128
2-methylbutanoic acid	sweaty, sour	n.d.	32
2-acetylthiazole	roasty	64	128
β-ionone	violet-like	16	8
furaneol	sweet, caramel-like	256	512

In conclusion, key aroma compounds responsible for the differences in flavour profiles of industrially manufactured and traditionally prepared meat bouillons were identified by comparative AEDA. During industrial processing, on the one hand, a loss of α,β-unsaturated aldehydes, responsible for characteristic boiled, fatty aroma notes was observed, e.g., (*E*,*E*)-2,4-decadienal, whereas on the other hand organic acids, e.g., butanoic acid, responsible for sour, sweaty odours were increasing. Preliminary results (data not show) indicate that the concentration process is a critical step for aroma development. To obtain a closer insight into specific processing parameters, different model studies will be performed. The study shows the importance of identifying and monitoring character impact compounds. Additionally, manufacturing steps should be adapted in the best possible manner to obtain an authentic meat bouillon character.

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