Odour-active compounds in paper products

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Introduction

Paper and cardboard materials are produced predominantly as packaging materials. As consumers do not accept packaging affected with a strong odour, the absence of off-odours is a prerequisite for their use. A contamination of cardboard packed foods with malodours may additionally cause negative effects on food quality. Several cardboard volatiles and odorants have previously been identified [1-3] but a comprehensive study on odour-active compounds in cardboard has not yet been performed. To close this gap, the intense cardboard odorants were identified by GC-sniffing techniques and identification experiments.

Materials and Methods

Cardboard (20 g) was cut into squares (5 x 5 mm), moistened with tap water (5 mL), and extracted with dichloromethane (200 mL) for 16 h. The volatiles of the extract were isolated by Solvent Assisted Flavour Extraction (SAFE)-distillation [4],). Aroma Extract Dilution Analysis (AEDA) was performed according to [5] and the odorants were identified by comparing the odour quality, linear retention index and mass spectrum (MS-EI) with the properties of reference compounds. Aroma Profile Analysis (APA) was performed according to [6].

Results

A commercially available cardboard was selected for the investigation. The material exhibited a typical cardboard odour and it was described as cardboard-like, musty, and woody (Figure 1). The odour intensity increased distinctly after moistening. This effect was correlated with higher intensities of the detected attributes and the fatty and mouldy notes (Figure 1).

To gain insight into the molecular reasons for cardboard odour, an extract containing the volatile cardboard fraction was screened for odour-active compounds. By using the GC-sniffing technique, the volatiles were separated during gas chromatography, the eluting compounds were split at the end of the capillary and transferred to a detector and a sniffing port, at which odorants were detected by sniffing (Figure 2). Using this approach, a total of 60 odorants were perceivable in the cardboard extract during sniffing.

The relative odour-activity of the odorants were determined by preparing defined solutions of the original extract (1:2, v/v) and analysing them again by GC-sniffing (AEDA). The highest odour activity among the odorants was evaluated for vanillin, which was detected in the highest diluted solution (1:1024, v/v - corresponds to a Flavour-Dilution-(FD)-factor 1024, Figure 3). Within a FD-range of 128 – 512, γ-nonalactone, (E)-2-nonenal, 2-methoxy-phenol, δ-decalactone, *trans*-4,5-epoxy-(E)-2-decenal, 4-methylphenol, and 4-ethylphenol were identified as additional intense odour-active compounds. To our knowledge, all compounds – with the exception of (E)-2-nonenal [3] – were identified for the first time in cardboard.

Conclusions

The results show that a series of odour-active compounds with high odour potencies are already present in conventional cardboard. It is most likely that cardboard contains the identified odorants in high amounts due to their high odour impact evaluated by AEDA. The odorants adsorbed to the dry cardboard matrix can be liberated into the air, e.g. by water, causing the described odour intensity increase. These results are the basis to monitor the quality of cardboard products by using the identified odorants as quality markers and to control cardboard production with respect to odour.

References

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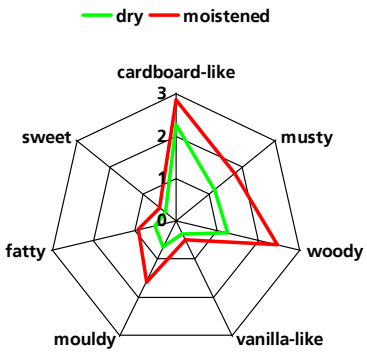

Figure 1: Aroma Profile Analyses of dry and moistened cardboard

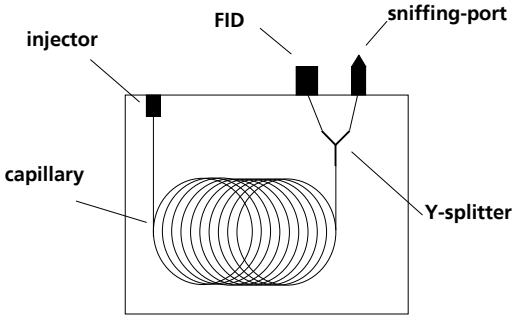

Figure 2: Set-up of a GC/olfactometric system for GC/sniffing analyses

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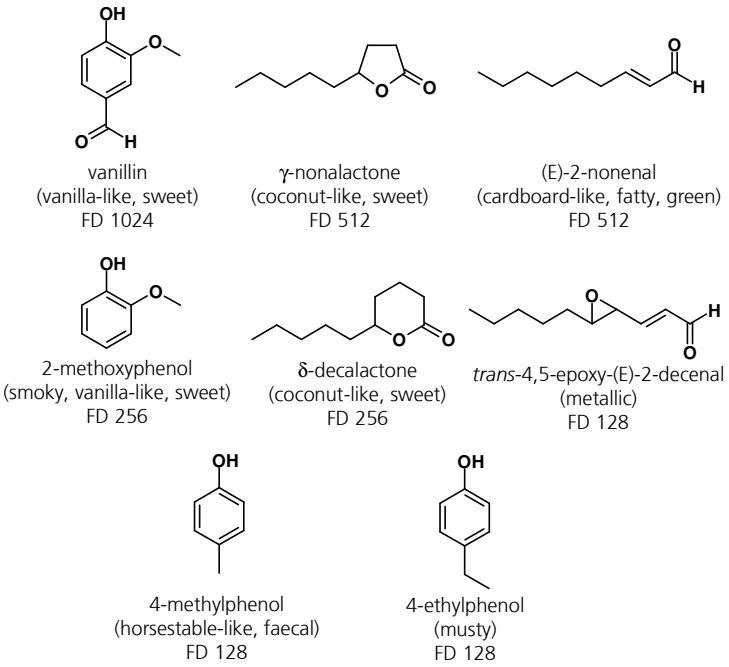

Figure 3: Intense odor-active compounds in cardboard

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