

# Determination of MOSH and MOAH in bakery bags and worst-case estimation of the underlying migration potential into pastry products

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## Introduction

The mineral oil compounds MOSH, mineral oil saturated hydrocarbons, and MOAH, mineral oil aromatic hydrocarbons, were brought into public focus in the last years especially by their migration from paper based food packaging into food items. Dry food with long shelf life as well as fatty food after short time contact are affected [1,2]. Major sources for the contamination of food contact papers are mineral oil based printing inks especially used in newspapers and recycled fibers as mineral oils cannot be removed during paper recycling [3]. As MOAH are assumed to be carcinogenic due to their structural similarity to polycyclic aromatic hydrocarbons the migration of those substances into food items should be avoided [4]. The aim of the study was to analyze various bakery bags for its MOSH and MOAH contents and the investigation of the potential migration into pastry.

## Method

Thirty bakery bags of the Bavarian market were collected, cut up small and statically extracted with a mixture of ethanol and n-hexane. The n-hexane phase can be separated by solvent extraction with ultrapure water. The extracts were quantitatively analyzed for MOSH and MOAH content using online-coupled HPLC-GC-FID (HPLC: 1260 Infinity, Agilent Technologies; GC: Master GC, DANI; application by Axel Semrau). Quantification was based on internal standards.

The mineral oil concentrations in the bakery bags were assessed on the criteria of the third draft of the mineral oil ordinance: concentrations of MOSH and MOAH in paper based packaging should not exceed 24 mg/kg and 6 mg/kg, respectively. The necessary mineral oil fractions are  $C_{16}$  to  $C_{25}$  (dry food) and  $C_{16}$  to  $C_{35}$  (other food, e.g. fatty) [5].

The mineral oil contents found in the investigated bakery bags were used for estimating the worst-case migration into pastry. Worst case migration implies total mass transfer from the bakery bag into pastry. For calculations the average weights of bakery bags and cruller of 5.7 and 90 g, respectively, were used. Recommended values of the German Federal Institute of Risk Assessment (BfR) and limit values according to the third draft of the mineral oil ordinance were used for the assessment: MOSH values in food should not exceed 12 mg/kg ( $C_{10}$ - $C_{16}$ ), 4 mg/kg ( $C_{16}$ - $C_{20}$ ) and 2 mg/kg ( $C_{20}$ - $C_{35}$ ), respectively. MOAH values in food should not be above 0.5 mg/kg ( $C_{16}$ - $C_{35}$ ) [5,6].

## Results

Figures 1 and 2 show that all investigated bags were found to contain MOSH with up to 416 mg/kg (mean 108 mg/kg) and MOAH with up to 45 mg/kg (mean 15 mg/kg). From the observed chromatographic patterns of

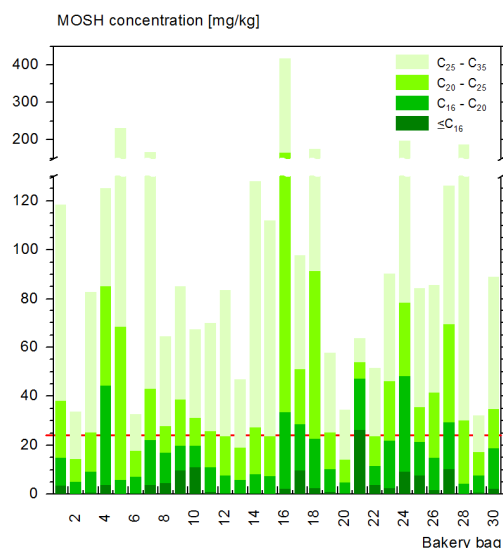


Figure 1: MOSH concentration in mg/kg in the investigated bakery bags; red line: MOSH threshold in paper based packaging of 24 mg/kg

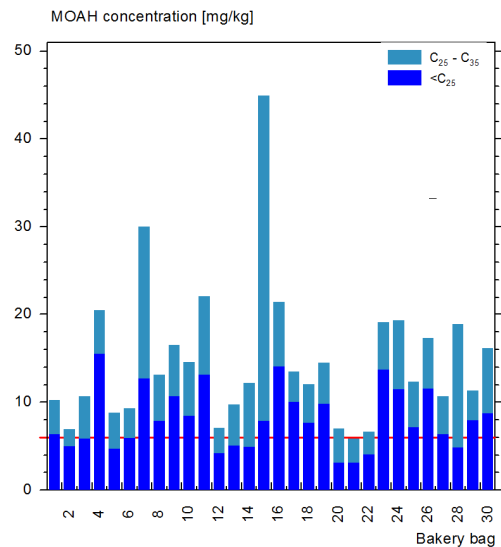


Figure 2: MOAH concentration in mg/kg in the investigated bakery bags; red line: MOAH threshold in paper based packaging of 6 mg/kg

the analyzed bags the usage of mineral oil based printing inks can be assumed. Additionally, Diisopropyl-naphthalene as an indicator for the usage of recycled fibers could be found in some samples.

In case of wrapping dry products (e.g. rolls) 22 of the 30 bakery bags were above the threshold for MOSH and 19 of them above the threshold of MOAH. In case of fatty products all bags exceeded the threshold of MOSH and 29 of them the threshold of MOAH.

For the worst-case migration recommended values of the BfR for the MOSH fractions  $C_{10}$ - $C_{16}$  and  $C_{16}$ - $C_{20}$  were not exceeded. The limit values according to the third draft of the mineral oil ordinance (MOSH fraction  $C_{20}$ - $C_{35}$ , MOAH fraction  $C_{16}$ - $C_{35}$ ) were estimated to be exceeded up to twelve times (MOSH) and six times (MOAH), respectively. Only four bakery bags showed values under the intended thresholds. It is expected that migration under realistic conditions into pastries would be significantly lower as short time contact limits mass transfer. In 2015 Stiftung Warentest confirmed these results [7].

## Conclusions

Bakery bags can contain MOSH and MOAH due to printing inks and the usage of recyclates. Despite high MOSH and MOAH values and estimated exceeded values in bakery products according to the worst-case migration calculations, in reality short time contact limits the mass transfer significantly and lowers the migration potential. However, the usage of recyclates and mineral oil based printing inks should be avoided.

## References

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