

# Mineral Oil Contaminants in Food (Online-Meeting)

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Mitigation

## Results from the German FEI research project

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Due to the extensive use of mineral oil and products made from it, there are numerous sources of input for mineral oil products or their degradation products in food. Mineral oil components (MOH) are divided into the group of mineral oil saturated hydrocarbons (MOSH) and the group of mineral oil aromatic hydrocarbons (MOAH). Polycyclic aromatic hydrocarbons (PAH) are also included in the MOAH.

MOH are often found at a much higher level in edible oils than in other foods. According to current knowledge, the input sources are distributed along the entire production chain. Therefore, a systematic investigation of these input paths and their contributions to the overall contamination of edible oils with MOH is necessary in order to develop and implement appropriate minimization options. In addition, the minimization of MOH in food products is a great challenge for manufacturers. Results from different laboratories often show limited comparability, so that a reliable basis for important decisions is missing. The actual validated analytical CEN-method 16995:2017 can only be used up to a concentration of 10 mg/kg with sufficient repeatability and reproducibility.

In order to improve the analytical method several comparative laboratory tests were carried out with 12 other experienced laboratories. The improved method could be submitted to the joint committee of DIN and DGF, the GA-Fett, for German standardization and was successfully validated in a round robin test statistically evaluated according to ISO standards. The precision data thus obtained allow a recommendation of this method up to a concentration range of 1 mg/kg. This represents a significant improvement in the comparability of the results.

Common lubricants and additives used in food production and technical products were collected for further characterization and a better identification of contamination sources. The samples were analysed in a first step by a gas chromatographic method for boiling range, maxima and special distribution patterns. In a subsequent step, interesting samples were further characterized using comprehensive GCxGC-MS technique.

In order to investigate the contribution of the sources, various samples from the entire production chain were measured. Although the data do not allow a representative statement for the entire German oilseed production, they show that the agricultural production processes of rapeseed, sunflower and linseed including storage and transport in Germany are free of MOAH and almost free of MOSH inputs. Even when applying MOH-containing crop protection products, some of which are used, no translocation into the seed could be detected. Samples with increased MOSH and MOAH contents were found in imported sunflower seed, only. It is highly probable that these contaminations were caused by transport, storage and handling processes.

Rapeseed contained significantly higher levels of MOH on the pods than in seeds protected in the pods until maturity. Therefore, seed cleaning was of great importance in minimizing MOH. The use of plastic materials in the processing route leads to the introduction of monomers (e.g. polyethylene and polypropylene - monomers and oligomers), which as POSH can influence the measured contents of

MOH. Furthermore, samples of extraction solvents from seed extraction were investigated. Here, a significant input of MOH was shown by commercially available extraction solvents, which were used for extraction in a circulation system and were subsequently recovered by distillation. To minimize the discharge of extraction solvent into the environment, large refineries have to recover residual extraction solvent from the exhaust air. In this process, the exhaust air was passed in counter current direction to a white oil in a packed column. This white oil absorbed extraction agent from the exhaust air. The extraction agent was then distilled off again to regenerate the white oil and returned to the cycle. For this reason, extraction agent from the circulation system also contained residues of the white oil, which entered the product during further extraction.

The pressing of hulled and intact rape and sunflower seed was performed with samples with and without MOH addition to investigate the entry or fate of contamination. During pressing, entries may occur due to leaking oil presses. In presses, the bearing of the drive shaft must be sufficiently shielded from the interior of the press chamber. The fate of the added MOH was balanced and proved the high affinity of the MOH to oil. Peeling the seeds could significantly reduce the MOH content in the trials.

Press and extraction oils with and without MOH addition obtained from the oil extraction experiments were refined at pilot scale and the MOSH/POSH and MOAH contents were determined at each process stage. The data obtained in this way showed that apart from the deodorization process step, no significant change in the MOH content occurred.

The treatment of edible oil with MOH addition with different absorber materials (silicates, zeolites and activated carbons), with varying process parameters (reaction temperature, duration and vacuum), could not achieve a quantitatively significant reduction of MOH. The reason for this seemed to be the alkylation of most compounds. By means of GCxGC-MS, a reduction by treatment with activated carbon could be detected in the fractions of the MOAH with decreasing degree of alkylation. The reason for this might be the increase in fat solubility of the MOAH compounds through alkylation. Also, a reduction of individual substance classes of the MOSH fraction could not be achieved due to the good solubility of these compounds in edible oil.

Experiments for the controlled crystallization of waxes (winterization) also showed no significant reduction in MOSH or MOAH. Virgin sunflower oils with added MOH as well as oils with specifically adjusted wax contents were investigated. Reasons for the insufficient reduction may be the very good solubility of these substance classes as well as a too low adsorption capacity on wax surfaces.

The reduction of MOH by deodorization showed the greatest potential. In the test series, up to 97 % of the original MOH could be removed. The deodorization temperature was the most influential factor here. However, the process time was also of importance. The discharge of MOH was limited by its boiling range. Experiments to determine the influence of the stripping steam quantity on the MOH discharge did not yield clear results. Comparable results were obtained with both single-stage and two-stage deodorization. For reasons of product safety, the formation of trans fatty acids, 2-, 3-MCPD esters and glycidyl esters under the given process conditions was investigated in parallel to the discharge of mineral oil. Optimal parameters were identified regarding both, best possible reduction of MOH and avoidance of new process contaminants. Both, single-stage and two-stage deodorization yielded comparable results depending on the setting of the process parameters.