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Novel methodology to assess genotoxicity in Food Contact Materials (FCM)

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According to the Food Contact Materials Regulation (EC1935/2004), materials and articles in contact with food should not release constituents into the food at levels harmful to human health. Packaging migrating substances may include intentionally added substances (IAS) and non-intentionally added substances (NIAS). The IAS refers to known substances used in the manufacture of the FCM while NIAS are often unknown substances found in the FCM. As reported, NIAS can represent more than half of the substances found in a migration mixture and the evaluation of their safety is difficult to carry out, requiring the identification of the toxicologically most relevant unknown chemicals in the materials.

According to regulatory recommendations, exclusion of mutagenicity in FCM is required. Consequently, the identification of genotoxic/mutagenic chemicals in FCM extracts and migrates is needed. Standard tests such as the Ames assay are recommended for the detection of mutagenicity in pure chemicals but not suitable for this type of application due to inadequate limit of detection (LOD). In this context, a novel procedure combining high-performance thin-layer chromatography (HPTLC) with genotoxicity bioassays (SOS Umu-C assay) has been successfully developed. Moreover, such an approach is likely to facilitate the identification of active substances.

This HPTLC-Umu-C assay was applied to assess the genotoxic potential of paper-based packaging materials as case study. Paper-based samples, spiked or not with a reference genotoxic compound, were tested using this methodology. The bioactive bands were both analyzed with LC-HRMS for chemical identification and evaluated with the AMES assay to detect DNA-damaging properties.

The compounds responsible for the genotoxic activity were identified and their mutagenic effect assessed using the Ames-MPF assay. These results demonstrate the power of the approach integrating HPTLC-Umu-C, Ames assay and LC-HRMS to address the genotoxic potential of FCMs. This approach will likely become a significant contributor not only for packaging safety but also for other food related as well as environmental and cosmetics fields.

Keywords:
HPTLC, genotoxicity, bioassays, mutagenicity, LC-HRMS.