Comprehensive Foreign Material (FM) Characterization Employing Multiple Analytical Techniques

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Introduction

- The presence of foreign materials (FMs) in products is a serious issue that can lead to recalls, damage to a company's reputation, and even potential harm to consumers.
- Foreign materials can be classified into two groups:
  - Extraneous: not native to the product
    - Glass, metal, plastic, ink on a tablet, etc.
    - Material clogging a filter, etc.

Discoloration on salami

Que

  - Intrinsic: product-related
    - Unwanted conglomerations, ingredient precipitation/crystallization, charring during processing, etc.
- Eurofins has developed a portfolio of analytical techniques for isolation and characterization of FMs from various sources to provide a complete picture of a sample's composition.
- This comprehensive approach provides the data that a business needs to manage their response and perform risk assessment.

Isolation

- Dissection

- Centrifugation to collect particles from liquids
- Filtration to isolate and visualize

- Solvent extraction (e.g. for discoloration)

Analytical Techniques and Applications

Microscopy

- **Optical:**

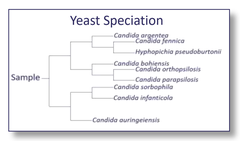
identify morphological characteristics, colorization.

Human Hair (200x)

- **SEM-EDS:** high resolution imagery for surface features with scans identifying surface elemental composition.

Other

- **Physicochemical analysis:** determine sample moisture, and organic/inorganic proportions based on residue on ignition.
- **Microbial screening:** identify and/or quantify microbes (e.g. yeast, mold, *E. coli*).



- **ELISA/ICT Assay:** screen for or quantify proteins of interest (e.g. human hemoglobin).

ELISA Plate/Reader

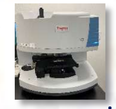
Suspected blood residue

- **DNA testing:** speciation for biological specimens.

Spectroscopy

- **FTIR:** obtain spectra to identify organics and select inorganics) by measuring absorption of IR.

- **MicroFTIR:** collect FTIR spectra of tiny particles or object/filter surfaces.



- **Raman:** obtain spectra of materials by measuring light scattering.
- **ICP-OES/ICP-MS:** investigate trace and major metals including heavy metals (e.g. Hg, As).

Chromatography

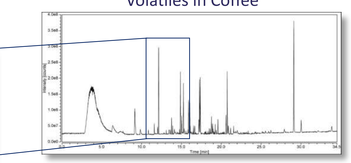
- **LC with MS/UV/ELSD/RI detection:** investigate non-volatile components (e.g. organic acids, dyes, sugars).

Dyes in a Purple Drink

- **GC with MS/FID/TCD detection:** investigate volatile components.

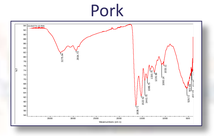
Compound	RT (min)	Odor/Aroma
Methyl-pyrazine	11.28	Nutty, roasted
2,5-dimethyl-pyrazine	12.31	Nutty, roasted
2,6-dimethyl-pyrazine	12.41	Nutty, roasted
4-propyl-pyridine	13.40	Green, fatty
2,3,5-trimethyl-pyrazine	13.74	Nutty, roasted
Acetic acid	14.27	Sour, acidic
1-(acetyloxy)-2-propanone	14.50	Fruity
Furfural	14.56	Bready, baked
Benzaldehyde	15.65	Almond, cherry

Volatiles in Coffee

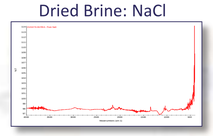


Brined Pork FTIR

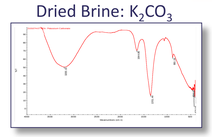
Pork



Dried Brine: NaCl



Dried Brine: K_2CO_3



Conclusions

- The presence of foreign materials in a product is a serious issue that can lead to recalls, damage to a company's reputation, and even potential harm to consumers.
- Eurofins has developed a portfolio of analytical techniques for isolation and characterization including microscopy, spectroscopy, chromatography, physicochemical analysis, etc.
- This comprehensive approach allows for analysis of complex samples from a variety of sources and provides a complete picture of a foreign material's composition.

Abbreviations

- ELISA: enzyme-linked immunosorbent assay
- ELSD: evaporative light scattering detector
- FID: flame ionization detector
- FM: foreign material
- FTIR: Fourier Transform Infrared Spectroscopy
- GC: gas chromatography
- ICP-OES: Inductively coupled plasma-optical emission spectrometry
- ICP-MS: inductively coupled plasma-mass spectrometry
- ICT: immuno-chromatographic test
- IR: infrared
- LC: liquid chromatography
- MS: mass spectrometry
- UV: ultraviolet
- RI: refractive index
- SEM-EDS: Scanning electron microscopy-energy dispersive X-ray spectroscopy
- TCD: thermal conductivity detector