Evaluation of PTR-MS analysis as rapid and non invasive tool for quality control in agroindustry: the effect of storage and packaging on anhydrous milk fat

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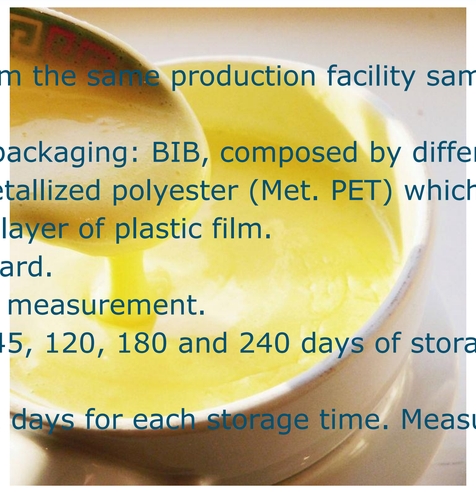
1. INTRODUCTION & OBJECTIVES

The growing awareness of consumers for food quality posed new challenges to the quality control (QC) programs of agroindustry. Among these the necessity of sensory evaluation and, at the same time, of rapid methods [1]. Proton Transfer Reaction-Mass Spectrometry (PTR-MS) is an accurate, high sensitivity, non-destructive, direct-injection technique that allows for the rapid characterization of food products and for the monitoring of processes in agroindustry without any pre-treatment [2]. PTR-MS and other techniques have been widely used in different researchers to investigate the different flavors and off-flavors originating from dairy ingredients leading to the identification of more than 230 VOCs [4-6]. The aim of this research was to to evaluate rapid PTR-ToF-MS analysis coupled to a Multipurpose Head-Space Automated Sampling (MHSAS) as a rapid tool for the quality control of anhydrous milk fat (AMF) that is increasingly used by in pastry, confectionery and ice-cream industry due to its convenient features. The effect of different type of packaging – Bag-in-Box (BIB) and cardboard packages (CT) – on the volatile profile and the quality of AMF has been investigated during a shelf life of 8 months at refrigerated storage (4°C). AMFs were valuated both during shelf life and accelerated shelf life (ASL) where AMF was exposed at 50°C for a total of 11 days.

2. MATERIAL AND METHODS:

Samples:

- 3 production lots from the same production facility sampled in differnt days.
- 2 different types of packaging: BIB, composed by different layers of polyethylene and metallized polyester (Met. PET) which are sealed and CT a cardoboard with a layer of plastic film.
- Fresh AMFs as standard.
- 5 replicates for each measurement.
- AMF analysed after 45, 120, 180 and 240 days of storage (4°C, RH controlled).
- Aging at 50°C for 11 days for each storage time. Measurements at day 0, 2, 4, 7, 9, 11.



Total of more than **2000** samples analysed

Instrumental measurements:

Volatile compounds analysis by PTR-ToF-MS coupled with autosampler

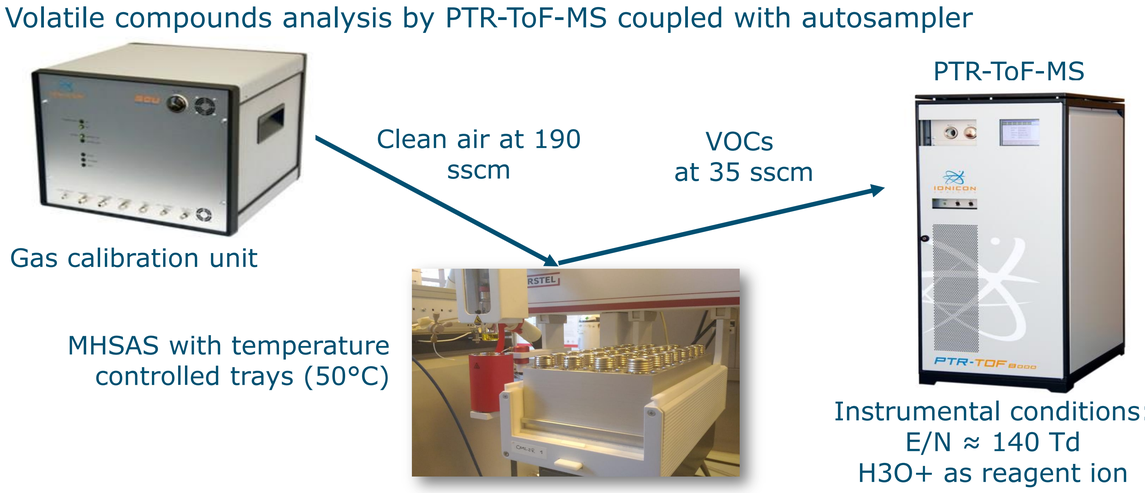


Fig. 1: Experimental set up. PTR-TOF-MS measure 1 sample/5 min

3. RESULTS:

- **129 mass peaks** were significantly different (p.value < 0.001) from blank (empety vials) at each time point.
- During storage the differences between the type of packaging and the fresh standards increased.
- Differences between lots were also observed.
- Good repeatability was obtained.

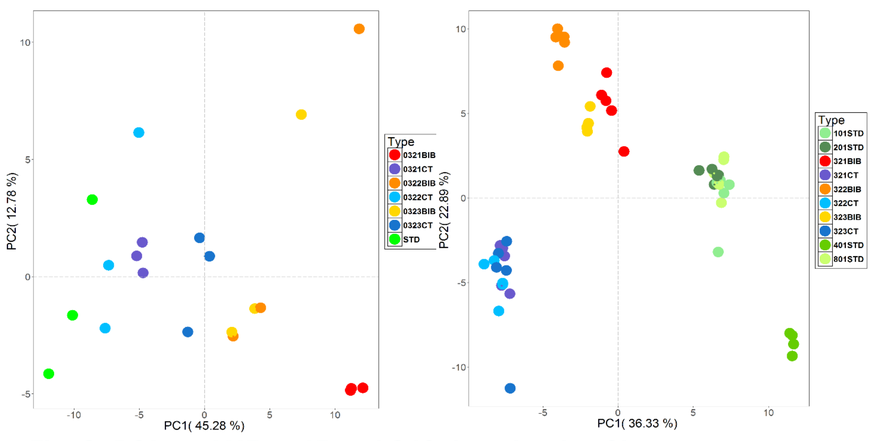


Fig. 2: PCA on AMF at 45 and 240 days (at day 0).

- More than **40 VOCs** were tenatively identified as key components of butter aroma or as contaminants;
- CT samples have an higher number of peaks subjected to significant variations then BIB samples during the accelearted shelf life.

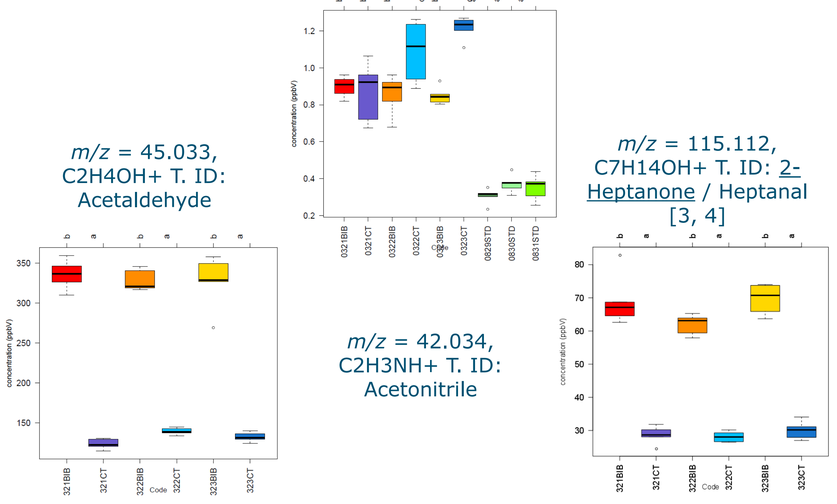


Fig. 3: Boxplots at 180 days (day 0) of 3 relevant mass peaks

- Peak intensity increase (in more than **50 peaks**) and decrease (in more than **10 peaks**) significantly (p.value < 0.0003) during accelerated shelf life.
- During aging the differences in concentrations decrease for all samples due to oxidation brought by thermal treatment at 50°C.

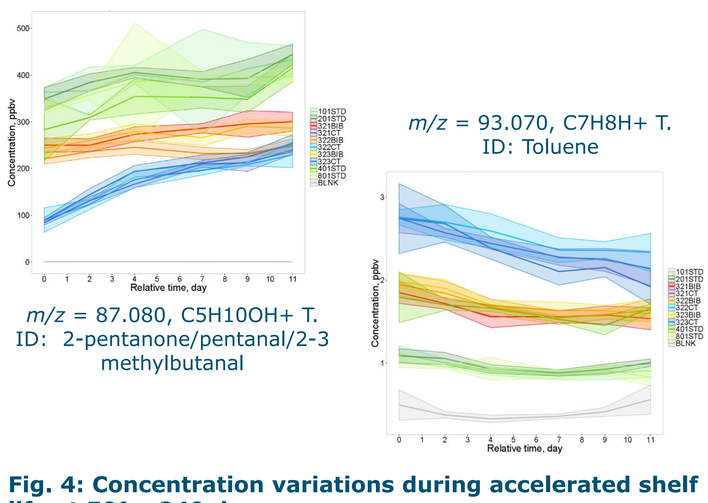


Fig. 4: Concentration variations during accelerated shelf life at 50°c, 240 days.

4. CONCLUSIONS:

1. PTR-ToF-MS coupled with a MHSAS was verified as a promising tool to get a rapid and non invasive VOCs fingerprint of AMF: a discrimination based on the type of packaging used for the storage was achieved.
2. Changes in the VOCs profile duraing storage were observed together with different trends during accelerated shelf life.
3. Differences in butter key aromatic compounds determined by the different type of packaging (BIB, CT, Fresh standards) were characterized. BIB seems to have a better perfomance then CT since some of the contaminants and oxidation products had a lower concentration in BIB.

5. FUTURE DIRECTIONS:

- Comparison of PTR-MS data with other characterization methods:
  - ❑ Sensory data;
  - ❑ SPME GC-MS data;
  - ❑ Instrumental data like Rancimat, AMF acidity and the number of peroxides;
  - ❑ SRI analysis.
- Modelling through the correlation of instrumental and sensory data by PLS-DA analysis.

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6. REFERENCES:

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