TECHNICAL NOTE

SusCatt - Increasing productivity, resource efficiency and product quality to increase the economic competitiveness of forage and grazing based cattle production systems

What do our cows eat? – Using technology to authenticate forage-based milk

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About

To this day, details of feeding regime are not mandatory declarations for dairy products sold in EU. However, they are very distinctive in terms of geographic area and the production process; both of which influence product quality. Indeed, consumers should be able to identify production chains, especially if seeking sustainable, animal-friendly diets.

Challenge

Comprehensive barcode labelling throughout the dairy supply chain would be useful for consumers, legislators, processors and producers. It would avoid mislabelling and frauds (even if unintentional) and allow tracing physical-chemical traits of any product to a given production chain.

We know that cows' feeding is the main factor that affects milk's nutritional quality. Milk composition (in terms of fatty acids, vitamins, organic acids, etc.) and flavour are strongly influenced by the botanical origin and conservation of the forage our animals eat.

Much research has focused on assessing the finer details of milk composition, to identify bioactive compounds as potentially useful markers of milk origin. This includes a study of the unique chemical fingerprints left by specific cellular metabolic processes - a metabolomics approach. This promising method provides a detailed picture of food composition, allowing simultaneous characterisation of many compounds in complex biological matrices and is proving useful as a rapid, accurate tool for milk authentication. More recently, DART-HRMS has been developed, coupling two cutting-edge analytical techniques (**D**irect **A**nalysis in **R**eal **T**ime and **H**igh **R**esolution **M**ass **S**pectrometry); allowing even quicker results with simple, accurate analysis.

The three main feeding systems are based on maize (top), cereals other than maize/hays (middle) and permanent meadow for hay (bottom). Photo: Dr. Severino Segato.

Objective

We evaluated the accuracy and reliability of DART-HRMS to assess the nutritional profile of milk from farms feeding different forages (maize silage and hays) and to identify useful, reliable biomarkers of milk origin.

What did we do?

The diets used on the farms involved were typical of the main agronomic dairy systems in the Pò Valley. They could be grouped into 3 systems, roughly described as: (1) maize silage, typical of intensive dairy farms; (2) hays and cereals other than maize, representing farms with some permanent meadow and downsizing maize monoculture by applying crop rotation to arable land; (3) hays, representing a system preserving permanent meadow and enhancing environmental sustainability.

In total, 14 specialized dairy farms, all in the Veneto region, were involved: 6 adopting the maize-based diet, 5 feeding other cereals and hays, and 3 using mainly hays. Over 2018, 70 raw bulk milk samples were collected (5 samples/farm) and analysed by using a DART-HRMS.

The statistical approach, based on a mid-level data fusion, identified the most informative chemical variables and proved that DART-HRMS has a powerful and reliable capacity to authenticate milk samples according to the feeding management.

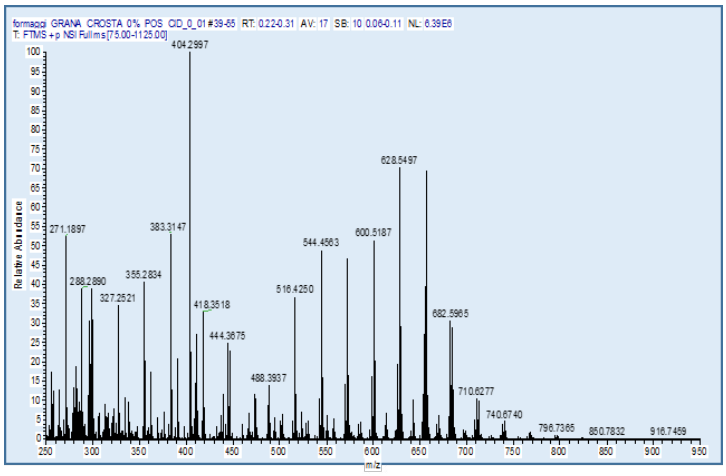
Results

A pool of 50 informative biomarkers were identified and correlated with the forage fed. The most relevant metabolites were: carbohydrates (lactate), amino acids (glutamate) and other hydrophilic compounds (hydroxycinnamic acid) for maize; phosphoric compounds (creatinine, methyl 2-furoate), fatty acids C18:2-, C20:2- and C22:2- and trace of low molecular weight substances such as norgramine for other cereals, fatty acid (palmitate), flavonoids and lipophilic compounds for the sole use of hays.

We found that DART-HRMS analysis is reliable to discriminate the forage-based systems in this on-farm study.

Conclusions

This study confirmed that the botanical origin and conservation of forages fed to cows strongly influence the milk metabolomic profile. As a consequence, it should offer a tool to allow authenticate dairy production chains according to the feeding regime adopted on the farms. DART-HRMS proved to be a fast, accurate and powerful tool to perform such analysis.



Fingerprinting of milk after acquisition by DART-HRMS analysis..


Cow's diet affects milk metabolomic profile. Photo: Dr Riuzzi Giorgia.

Imprint

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