

Use of MIR from milk for the authentication of farmers' practices

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Consumers increasingly want transparent information about how food is produced. In the dairy sector, claims related to production systems, sustainability and origin can add value to milk and dairy products. However, verifying these claims requires reliable, rapid and cost-effective authentication methods. Traditional laboratory analyses are often expensive and time-consuming, limiting their use in routine quality control. FT-MIR (Fourier-transform mid-infrared) spectroscopy offers a practical alternative because it is already widely used in dairy laboratories for milk composition analysis.

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The study evaluated whether FT-MIR spectroscopy combined with chemometric models could authenticate milk production characteristics.

Bulk milk samples were collected from 65 dairy farms located in France, Germany, Switzerland and Ireland during summer and winter. A total of 355 milk samples were analysed after quality control procedures.

Farms represented a wide range of production systems, from low-input grass-based systems to highly intensive farms relying on maize silage. Spectral information was combined with farm management data to develop prediction models for farming intensification and season of production.

Main results

- The strongest results were obtained for identifying the season in which milk was produced.
- Seasonal classification achieved a balanced accuracy of 91%.
- Summer and winter milk could be reliably distinguished based on their FT-MIR spectra.
- The method successfully captured compositional differences linked to feeding strategies and seasonal production conditions.
- Classification of farming intensification was more variable, with balanced accuracy ranging from 52% to 78%.
- Indoor versus outdoor management could not be reliably predicted with the available dataset.

These findings demonstrate that FT-MIR spectroscopy can be effectively used to verify certain production-related claims, particularly those related to seasonality

Practical recommendations

Dairy processors, certification bodies, dairy cooperatives and quality-control laboratories can use FT-MIR spectroscopy as a rapid screening tool to verify seasonal production claims.

Because FT-MIR instruments are already available in many milk-testing laboratories, implementation requires limited additional investment. Prediction models can be integrated into existing milk-testing workflows, allowing routine verification of production claims without additional sample preparation or laboratory procedures.

Limitations and future opportunities

The authentication of farming intensification remains challenging because production systems often overlap in management practices and feeding strategies. Further model refinement and larger datasets are needed before these classifications can be routinely implemented.

Future developments may combine FT-MIR spectra with complementary indicators such as fatty acid profiles, farm metadata or other analytical measurements to improve authentication accuracy and expand the range of production claims that can be verified.

Benefits for practitioners

Implementation of FT-MIR authentication tools can:

- Strengthen consumer confidence in dairy products.
- Support product differentiation based on production characteristics.
- Improve verification of sustainability and quality-label claims.
- Enhance traceability within dairy supply chains.
- Reduce costs compared with many conventional authentication methods.
- Provide rapid results suitable for routine testing and decision-making.

Key message

FT-MIR spectroscopy provides a rapid, non-destructive and cost-effective method for authenticating seasonal milk production. As the technology is already established in dairy laboratories, it offers an immediately applicable solution to strengthen transparency, traceability and trust in dairy supply chains.