Milk analysis as basis to incentivize and support safe and sustainable dairy products

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Summary

The objective of this paper is to describe how innovative milk analysis is used to contribute to incentivizing and supporting safe and sustainable dairy products. Milk processors provide financial incentives for dairy farmers to produce milk of the highest possible quality, which is based on and regularly monitored through analysis of bulk tank milk samples. Key parameters tested in the milk are fat, protein, somatic cell count (SCC), and total bacteria count. On top of that, dairy farmers do typically have access to so called dairy herd improvement (DHI) programs, where one milk sample of each lactating cow on a farm is collected and analyzed once per month. Parameters such as SCC, fat, protein, and urea are tested and used as indicators for animal health and nutrition. This, in turn, allows farmers to optimize the health and nutrition of their herd thus improving the quantity and quality of milk. Real-life examples from Europe describing the regulatory framework, examples of milk payment schemes, DHI programs, and dedicated milk testing laboratories will be used throughout the paper.

Keywords: milk quality, milk payment, sustainability.

Introduction

Milk is one of the most traded food commodities globally, and dairy farmers face increasing pressure to remain competitive, sustainable, and compliant with quality standards. The dairy sector is also under growing scrutiny to demonstrate progress in reducing environmental impact while ensuring food safety. A cornerstone of this effort is the routine analysis of milk, which not only supports safety and quality assurance but also provides a foundation for economically and environmentally sustainable production systems.

Milk payment systems based on quality parameters, supported by advanced testing infrastructures and regulatory frameworks, offer practical tools to align farmer behavior with broader sustainability objectives. This paper explores the role of milk analysis in these systems, focusing on examples from Europe and North America and highlighting how they incentivize safe and sustainable dairy production. The focus is on Europe and North America as these are key dairy export markets (Figure 1) and thus are required to provide dairy products of highest quality to the world market to be able to compete there. The use of DHI data, certified laboratory infrastructure, and forward-looking carbon footprint tracking are examined as key enablers.

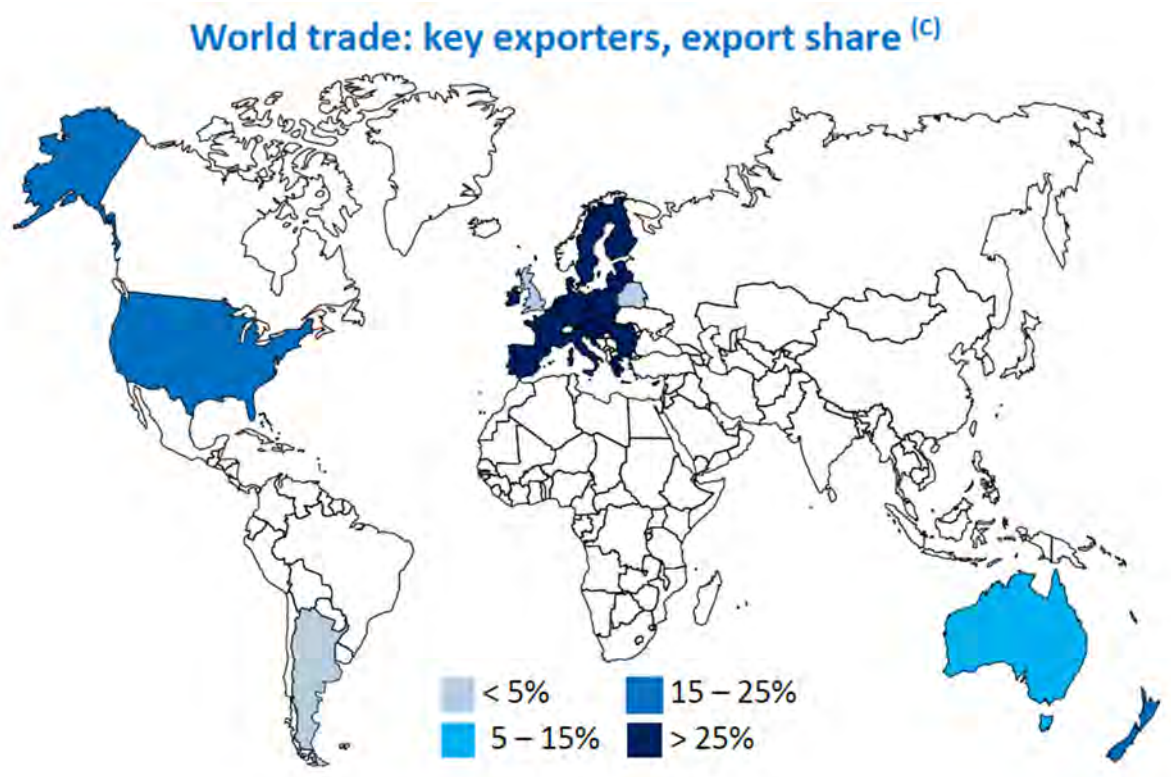

Figure 1. Export shares of key dairy exporters. Source: IDF World Dairy Situation Report 2023.

Milk payment and regulatory frameworks

Across much of Europe, milk processors use quality-based payment systems to reward farmers for producing superior milk. Commonly monitored parameters include fat and protein content, somatic cell count (SCC), and total bacterial count. These indicators are used to calculate bonuses or penalties applied to the milk price received by farmers.

In the European Union, legal requirements and standardization support the use of certified milk analyzers. For instance, the MicroVal certification ensures that milk analysis instruments comply with recognized international standards for accuracy and reliability. This framework ensures consistency in quality assessments and fosters trust in the payment system.

Milk processors must initiate procedures to ensure milk quality. Based on this regulatory requirement, many would have multi-tier milk payment schemes. Base prices are adjusted based on the results of BTM/payment testing, with additional premiums or deductions reflecting the composition and hygiene of the milk. This creates a strong financial incentive for farmers to invest in quality assurance and herd health to obtain best possible milk prices and economy.

Table 1. Overview on average annual dairy cow performance in selected countries. The 3 columns to the right indicate information on DHI (dairy herd improvement testing) including a annual milk yield increase comparing to average cows. Data source: http://my.icar.org, all data from 2022.

Country	Dairy cows	Herds	Cows/herd	Milk yield (kg cow/year)	Cows recorded in DHI (%)	Milk yield of recorded cows (kg cow/year)	Milk yield increase compared to average cows (%)
Australia	1,340,000	4,420	303	6,203	36.6	7,069	14.0
Canada	977,800	9,952	98	9,982	61.4	10,852	8.7
Chile	325,000	4,800	68	7,100	46.7	8,205	15.6
Denmark	557,831	2,319	240	10,291	91.1	10,543	2.4
France	3,504,000	49,000	72	7,516	56.2	8,878	18.1
Germany	3,809,717	52,895	72	8,557	87.2	9,127	6.7
Japan	836,600	12,300	68	8,971	60.5	11,146	24.2
Netherlands	1,570,673	14,729	107	9,086	93.5	10,301	13.4
Poland	2,037,279	200,942	10	7,425	39.6	9,037	21.7
South Korea	389,988	5,932	66	8,813	66.1	10,714	21.6
Taiwan	64,516	521	124	7,719	44.5	8,732	13.1
USA	9,450,000	29,858	315	10,862	44.1	11,150	2.7<

Milk testing infrastructure and laboratory networks

Europe and North America have developed robust milk testing infrastructures supported by standardized procedures and accredited laboratories. These labs process thousands of samples daily using automated high-throughput instruments and are integral to both regulatory compliance and advisory services. This high level of efficiency ensures timely feedback to farmers and milk processors and facilitates benchmarking and targeted interventions at herd level.

In addition to traditional parameters, labs increasingly analyze milk for emerging indicators such as fatty acid profiles. These may help to provide additional insights into cow health, nutrition, and the environmental footprint of milk production.

Dairy Herd Improvement (DHI) programs and on-farm impact

DHI programs are long-established systems designed to support farmers in managing individual animal performance and milk quality. Typically, one sample from each lactating cow is collected monthly. These samples are tested for parameters including fat, protein, SCC, and urea nitrogen. Results feed into herd management software and support decisions on feeding, reproduction, and culling.

Participation in DHI programs is strongly correlated with improved performance outcomes. Data from the ICAR database (Table 1) reveal that cows enrolled to DHI programs have higher average annual milk production compared to average cows. Regular access to individual cow data enables, among other things, proactive health and nutrition management and early detection of metabolic disorders.

The structured nature of DHI systems also facilitates the implementation of breeding strategies targeting traits related to sustainability, such as feed efficiency and reduced methane emissions. In countries where DHI participation is high, these programs serve as a foundation for national genetic improvement strategies.

Sustainability and environmental metrics

The dairy sector is undergoing a shift toward low-carbon production models. Several major cooperatives and processors have developed carbon footprint calculators and defined science-based emission reduction targets.

A European based cooperative is a leading example. This company aims to reduce farm-level emissions by 30% by 2030, supported by a data-driven model that includes milk testing, carbon audits, and farmer support programs. Through this approach, the cooperative incentivizes sustainable practices such as optimized feeding, manure management, and energy use.

Milk analysis plays a pivotal role by enabling the quantification of parameters that influence emissions. For example, fatty acid profiles in milk can be used to assess rumen efficiency, which is linked to methane production. This integration of milk testing with sustainability metrics opens up new opportunities for value-based milk pricing and climate-smart farming.

Conclusions

Milk analysis is a cornerstone of both dairy quality assurance and sustainability. By linking analytical data to financial incentives and herd management systems, the dairy sector has created a powerful model to drive safe, efficient, and environmentally responsible production. As demonstrated based on above examples, this model delivers

measurable benefits for farmers, processors, and society. Future efforts should focus on scaling these practices globally and integrating emerging sustainability indicators into standard milk testing regimes to replicate successes achieved in e.g. Europe and North America more broadly.