



Dairy

FOODS

BETTER DAIRY: A LOOK AT ENSURING QUALITY IN DAIRY FOODS

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Dairy Testing Technologies for Agility and Innovation

Emily Moore, Field Application Scientist at PerkinElmer, Inc.

We live in a wonderful world of diverse dairy products, from beverages to cultured products to delicious dairy desserts. But as we all know, changing consumer trends for foods that support 'healthier' and 'more active' lifestyles have pushed the industry to design novel, exciting products that match those demands.

To ensure the rapid development of these products, it is important to efficiently and accurately undertake analysis of their nutritional content and functionality. The insights gained from these testing steps can provide processors with the tools to ensure efficient processes and produce high-quality offerings.

As the dairy industry innovates, so does PerkinElmer. We're utilizing our longstanding expertise to provide new solutions to the table. In this article, we'll uncover how new testing processes and technologies for compositional and functional testing are helping to provide tomorrow's dairy products, today.



Courtesy of PerkinElmer

ENSURING QUALITY IN QUALITY CONTROL

Milk is a highly nutritious food, composed of water, fat, proteins, lactose and minerals. Monitoring the nutritional composition of collected milk is incredibly important for dairy processors at intake to ensure ingredient quality. Primarily, this is through utilizing protein, fat and lactose content of milk as a marker for dairy quality. As such, this also governs the price the dairy farm attains for its milk.

Fourier-Transform infrared (FT-IR) spectroscopy is a key technology in dairy analysis and is widely applied for measuring the aforementioned quality markers. PerkinElmer provides processors with its robust LactoScope™ technology to accurately monitor the compositional nature of their

incoming raw material and define payments to farmers faster. By evaluating the comprehensive spectral fingerprint produced by FT-IR technology, farmers and processors can intuitively characterize the nutritional composition and quality of their dairy products.

Using the LactoScope, you can measure many parameters like fat, protein and several physical properties, and screen for adulterants all in under a minute without the tedious sample preparation that is necessary with classical lab methods. For example, you can know the fat content of the skim milk or cream coming off the separator and respond right away with adjustments to hit the desired target values and standardization. Another example of the benefits of this rapid technology can be seen in dairy powder production. Here, the fat to protein ratio can be standardized in the milk before drying. This leads to consistent high-quality products and helping processors save money by reducing unintentional giveaway of higher fat content in your products.

Mid-infrared technologies work well for liquid dairy, as they are able to adopt thin films. But for solid dairy products, the shorter, more penetrating wavelengths in the near-infrared range provide better results. Understandably, NIR technology is finding use in increasing the efficiency of the solid and colloid dairy food production process, such as chocolate, creams, yogurt, and butter.



| Courtesy of PerkinElmer

MONITORING SOLID GOLD

Over the previous decades, the dairy sector has been increasing its efforts to transition towards using more sustainable processes. As a result, increasing process efficiency and optimization is a key driver for many dairy stakeholders – especially for dairy processors, looking to lower production waste and costs. To reduce waste in the dairy production process, processors must examine the composition of dairy products at key stages of the production process. This provides dairy processors with a higher level of control of their processes, which in turn leads to the production of competitive, sustainable and high-quality products. As such, there is a growing demand for in-line spectroscopy solutions throughout production chains.

Fat is an important parameter of the butter production process. Consequently, butterfat content is heavily regulated globally. Standard regulations generally state that butterfat must be in the form of an emulsion of fat and water, and that butter must be composed of 80-90% butterfat by weight. Within the EU for example, unsalted butter produced from cream or milk must meet a minimum butterfat content, by weight, of 82% and maximum water content, by weight, of 16%. And, the remainder composed of non-fat milk materials.

“Monitoring the nutritional composition of collected milk is incredibly important for dairy processors at intake to ensure ingredient quality.”

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In response, the composition of butter is regularly observed during production to help guarantee not only that products meet the regulation, but also to ensure that producers are not adding too much fat, creating costly products. Current

methods for testing fat content, however, are often time-consuming and involve costly wet-chemical methods. With PerkinElmer's DA 7350™ In-line NIR spectroscopy solution, dairy processors can rapidly monitor fat content and other parameters at all stages of the butter manufacturing process. Accordingly, process and plant operators can dramatically reduce in-process variation and adjust the process in time to avoid the production of out-of-spec products. In comparison to chemical analysis, in-line measurements help processors to better control costs, while minimizing the risk of production errors.

VISCOSITY ANALYSIS TO STREAMLINE FUNCTIONAL TESTING

The dairy sector is currently projected to grow at a rate of 1.8% per year over the next 10 years. To compete in the thriving marketplace, dairy producers are developing innovative dairy products with increasingly novel formulations. With more products available on the market, having the functional testing methods in place is essential to guarantee customer demands are met. The functionality of a product can dramatically influence both, the palatability and appearance of the product.

Within dairy processes viscosity, the resistance of a fluid to flow, is a vital parameter that must be studied and understood when designing new food production processes. For some dairy products, such as cream and cultured milk-based foods

and beverages, poor understanding of these factors can lead to spoiled or low-quality products. Measuring viscosity provides manufacturers with deep insight into a product's functional behavior, allowing them to understand factors such as pourability, meltability, its performance in dipping or coating procedures, or the ease with which it may be handled, or used in further processes. These parameters can

“The dairy sector is currently projected to grow at a rate of 1.8% per year over the next 10 years.”

be measured independently by various chemical and textural analysis methods. However, viscometers provide producers with an intuitive and versatile technology to measure a wide range of functionality in their products. PerkinElmer offers a range of Rapid Visco Analyser™ (RVA) models, to assist food manufacturers in accurately analyze the viscosity of products and rapidly predicting final product quality.



Courtesy of PerkinElmer

HIGH-QUALITY SOLUTIONS FOR HIGH-QUALITY PRODUCTS

Optimizing the production processes is a key goal for all stakeholders along the dairy production chain. To succeed in an increasingly competitive market, and manage evolving consumer demands high-quality solutions must be leveraged to optimize dairy processes. From raw milk to final dairy products, PerkinElmer is committed to providing the dairy industry with advanced technologies to detect fraud, control quality, and provide real-time intelligence to assist in product development, formulation, and optimization.

Interested in learning more? Check out our on-demand webinar with Dairy Foods to discover comprehensive dairy testing technologies for compositional and functional analysis.

[Watch here.](#) PE

Helping Ensure Quality and Safety at Every Step in Cheese Processing



Rethink the process

To continue to improve the microbial quality and safety of dairy products, the dairy industry needs a new perspective.

By Joy Waite-Cusic, Jared Johnson, Chris Curtin, Jovana Kovacevic, Stephanie Brown and Sheri Cole

The dairy industry has come a long way when it comes to the microbial quality of finished products. In general, the industry is doing a good job of staying out of the headlines. Nevertheless, food recalls and a recent listeriosis outbreak linked to soft cheese highlight that the industry can (and needs to) do better if the goal is to reduce product failures due to microbial contamination.

In all training related to HACCP, as well as the Preventive Controls for Human Foods rule, food processors are instructed to conduct hazard analyses by working through a process flow diagram and considering the risks of biological, chemical and physical hazards from the perspective of bulk product. The typical thought process asks how long the bulk product stays in one place with consideration of the environmental conditions (i.e., time and temperature) to evaluate the potential for microbial growth.



Courtesy of DavidBGray @getty

A NEW PERSPECTIVE

Given the level of automation and throughput of today's dairy industry, bulk product is in nearly constant movement, and any given drop of milk or piece of cheese stays in one place for only short periods during production. Therefore, the logical conclusion is that there are no major concerns about microbial growth in dairy products during typical production cycles.

There is validity to this thought process, and it allows the industry to identify the most egregious of food safety risks, but it also relies more on logic than established facts. To truly understand and then control the microbial safety and quality risks of dairy products, evidence suggests that the production cycles and processing environments should be considered from new perspectives.

Over the past few years, our team of Oregon State University food microbiologists has worked with members of the dairy industry to investigate seemingly sporadic microbial contamination problems. Examples have included coliform detection in finished cheese and high lab pasteurized counts in pasteurized milk.

We have also investigated microbial growth in raw milk tankers, and we are currently evaluating microbial accumulation and growth in milk “sock” filters. Each of these investigations has yielded important information about microbial growth in the production environment, which can guide manufacturers in making prudent decisions for targeted changes that balance production goals with those of the quality and safety programs.

To shift to a more holistic — yet practical — assessment of microbial safety and quality risks, we suggest the following approach:

1. Extract the process flow diagram from your food safety plan.
2. Instead of marking the time at each step from the perspective of the bulk product, indicate the time between cleaning/sanitation events for each production area and each equipment piece and/or food contact surface.
3. Reconsider the potential for microbial growth within this context. Time between cleaning/sanitation represents the maximum potential for microbial growth in residual

product and/or upon food contact surfaces during your production cycle. Microorganisms that grow between cleaning/sanitation cycles will come into contact with fresh bulk product that touches these surfaces.

4. Review your microbial testing and end-of-shelf-life results with this new perspective. If you are seeing an increase in the detection and/or counts of specific microbial populations in product later in the production day, then you likely have an area within your processing environment that is supporting significant microbial growth. You are far more likely to detect these problems in your quality program than in pathogen testing.

AN EXAMPLE FROM THE FIELD

In 2018, we were approached by a cheese processor that had been dealing with a sporadic problem of detecting coliforms in its finished cheese. The processor would have periods with “clean” cheese samples and then have periods with intermittent coliform detection.

Standard practice was to visualize its quality results with production date on the x-axis and coliform count on the y-axis. This approach did not yield any patterns.

To combat the problem, the processor implemented a number of changes to its production and sanitation schedule. These changes included increasing the temperature of

the pasteurizer and implementing an abbreviated cleaning step in a portion of its processing line during the middle of the production day. While the processor observed some improvement, these changes did not solve the problem.

After we were introduced to the problem, we toured the facility, asked many questions, reviewed historical data and collected samples of in-process product to verify or nullify assumptions. We looked at the historical data in new ways: We categorized samples as qualitatively present/absent and evaluated microbial load based on timing during the production day. We then collected in-process samples and used traditional cultural methods and molecular approaches to analyze microbial load at the beginning, middle and end of the day.

From the historical and newly generated data, we were able to identify one specific part of the production environment that supported significant coliform growth. In this case, coliforms were growing to fairly high cell counts — five log colony-forming units (CFU)/swab — on drain belt surfaces of the draining and matting conveyor during 18 hours of production. This increase correlated with the detection of coliforms in finished product at levels of 10-1,000 CFU per gram.

Once this hotspot of coliform growth was identified, the next question was, “Where were the coliforms coming from to cause this growth each day?”

Two sources seemed plausible: very low levels from raw milk that survived heat treatment or very low levels surviving cleaning and sanitation (e.g., cleaning in place) within the draining and matting conveyor. We were able to confirm the presence of low levels of coliforms in both the heat-treated milk and on sanitized belts of the draining and matting conveyor.

THE TAKEAWAY MESSAGE

In the example described above, reevaluating a food safety plan considering the timing since the last cleaning/sanitation event helped us identify a “hot spot” in the production environment that supported the growth of coliforms and other bacterial subpopulations. These hot spots have a high likelihood of impacting the microbial quality and safety of finished dairy products. Areas that can support rapid microbial growth — such as the drain belt of the draining and matting conveyor — should be identified, and management of these areas that can turn into “hot spots” should be a priority in revised food safety and quality programs. **DF**

This article was jointly written by a team from Oregon State University. Joy Waite-Cusic is associate professor of food safety systems. Jovana Kovacevic is assistant professor and extension specialist, food microbiology. Jared Johnson is a graduate research assistant/ Ph.D. candidate. Chris Curtin is assistant professor of fermentation microbiology. Stephanie Brown is a food safety specialist. Sheri Cole is assistant professor, dairy extension and sustainable food manufacturing.



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<https://www.perkinelmer.com/product/indiscope-milk-analyzer-f2000000>



Perten Instruments

Application Note DA Dairy Powders

Analysis of dairy powders for moisture, protein, fat, lactose, alkalinity, and ash using the DA 7250 SD

INTRODUCTION

Analysis of dairy powders is of great importance to both the production plants producing them and to those using them as ingredients. By accurately controlling many constituents, the producer can experience significant savings by optimizing production to meet specifications. The dairy powder user can avoid mistaken deliveries as well as formulate products to meet functional and compositional requirements.

The Near Infrared Reflectance (NIR) technique is particularly suited for measurement of dairy powders, but past instrument limitations have not allowed users to reap the full benefits of NIR. Sample presentation requirements such as glass cups that had to be filled properly and were difficult to clean made analyses laborious, time consuming and error-prone.

DA 7250 SD

The DA 7250 SD is a proven NIR instrument designed for use in the food industry. Using novel diode array technology it

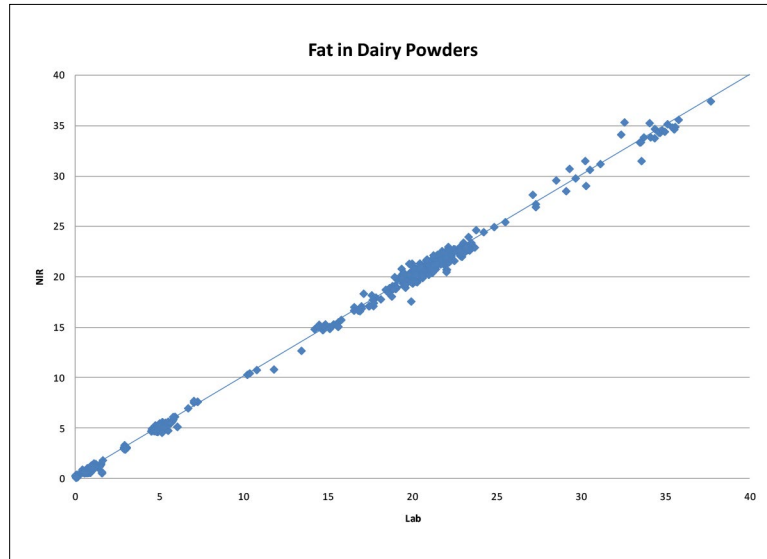


Courtesy of PerkinElmer

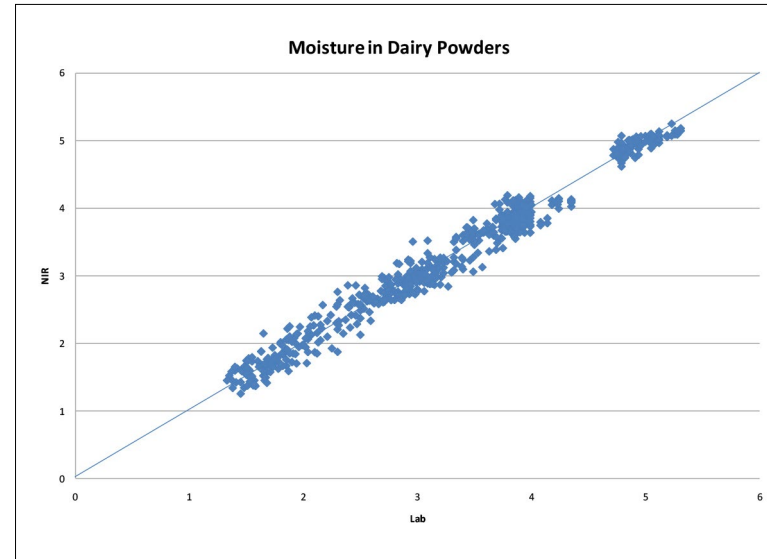
performs a multi component analysis in only 6 seconds with no sample preparation required. During this time a large number of full spectra are collected and averaged. As the sample is analyzed in an open dish, the problems associated with sample cups are avoided and operator influence on results is minimal. Disposable petri dishes can be used, eliminating the need for cleaning between samples. The stainless steel sanitary design of the instrument makes it hygienic and easy to clean.

EXPERIMENTAL

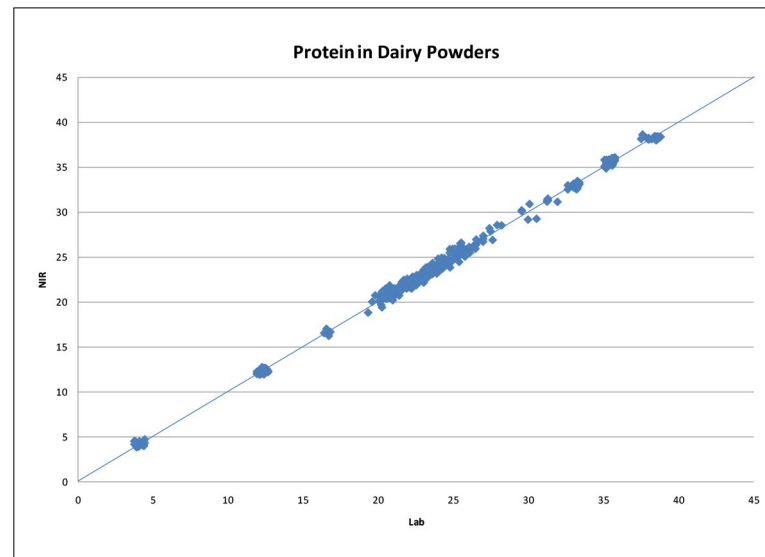
More than 600 samples of various dairy powders from multiple processing plants in the USA and Canada were analyzed in the DA 7250. The variety of powders included Whey Protein Concentrate, Non-fat Dry Milk, and Butter



Fat is accurately and readily measured across a wide range of values. Fat effects product taste and functionality.



Proper moisture levels affect the profitability of the plant as well as the quality of the product. Incorrect moisture levels can cause clumping.



Different protein level dairy powders are required to provide specific functionality in formulated products. The DA 7250 can verify shipments quickly.

Milk Powder. The reference chemistry was supplied by the customers with the samples.

Calibrations were developed using Partial Least Squares (PLS) regression. Standard Normal Variant Transform and Savitsky-Golay 1st Derivative were used as data pre treatments to improve the calibration models.

RESULTS AND DISCUSSION

The DA 7250 results are very accurate when compared to the results from the reference methods. Statistics for the respective parameters are presented in the table below and graphs are displayed on previous page.

Parameter	Range	Samples	R
Moisture	1.3-5.3	600+	0.99
Protein	3.8-38.7	500+	0.99
Fat	0-37.6	600+	0,99
Lactose	36.8-79	300+	0.99
Alkalinity	1-320	200+	0.91
Ash	4.8-10.2	300+	0.95

The differences between the DA 7250 and the reference method are of the same magnitude as typical



| Courtesy of PerkinElmer

differences between two different reference labs. The DA 7250 is more precise than the reference methods meaning that replicate analyses are generally more repeatable and representative.

In summary it is concluded that the Diode Array 7250 can analyze dairy powders for the aforementioned constituents. The ease-of-use and flexibility - it can analyze cheese, butter etc. as well - make it ideal for use at dairy plants worldwide. **PE**



The NEW LactoScope 300

The LactoScope family of FT-IR milk and dairy analyzers will help you tighten safety margins, achieve more consistent product quality, and reduce costs for labor and reagents.

LactoScope 300

- Compact and competent
- Low viscosity dairy products
- 45 seconds analysis

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Keep an eye on quality

Proper monitoring of dairy products' quality throughout shelf life will verify the products meet the expectations of consumers.

By Tedd Wittenbrink

In an uncertain world, there is one certainty in the dairy business: a lack of quality means a lack of business.

Consumers believe that the products they buy from the dairy case are safe for their families to consume, and for the most part, they are correct. The dairy industry has a long history of providing safe, wholesome products to customers.

What then differentiates one dairy brand from another in terms of quality? The short answer is consistency and shelf life. Certainly, the consumer has a wide range of products to choose from in the dairy case. Yet many consumers have strong opinions about which dairy product is superior. Often that opinion is based on the consistency of the product and how long it will “keep” in their refrigerator.

So it is imperative that dairy processors monitor the quality of their dairy products throughout the shelf life to verify the

products are meeting the expectations of customers. Let's look at some of the tried-and-true methods for monitoring the quality of our dairy products.

1. **Quality starts with the raw milk.** Raw milk quality is best monitored organoleptically (which we will discuss in a subsequent column) and with a microscope. The quality of the raw milk can be determined prior to receiving by conducting a direct microscopic count (DMC) using a good-quality microscope. Raw milk with a DMC of <50,000 clumps/milliliter is considered good-quality raw milk. Alternately, a preliminary incubation count may be conducted by holding the sample for 18 hours at 55 degrees Fahrenheit and performing a standard plate count (SPC). Counts of < 50,000 colony-forming units/milliliter are considered acceptable.
2. **Keep it clean.** Most spoilage in today's products is caused by psychrotrophic bacteria. Of note are the “traditional” gram-negative *Pseudomonas* spoilage organisms and the gram-positive spore-forming *Bacillus* spoilage organisms. Both organisms grow at refrigerated temperatures, so the first step in reducing spoilage is to adequately clean all processing equipment using a cleaning and sanitizing program that is monitored with charts, concentration checks, visual inspections and verification testing such as ATP.

3. **Keep it cold.** Colder temperatures throughout the processing and storage process mean better quality. While the Pasteurized Milk Ordinance (PMO) still uses 45 degrees Fahrenheit as a standard, we know that for quality products, that temperature is too high. As a rule of thumb, the colder we can store milk, the longer the shelf life and the better the quality. Psychrotrophic bacteria grow well at temperatures over 40 degrees Fahrenheit. Each degree of temperature over 40 degrees Fahrenheit decreases shelf life by about one day. Monitor the temperatures at each step of storage in your process to maintain temperatures under 40 degrees Fahrenheit.
4. **Keep it moving.** Some facilities store milk for extended periods of time, exceeding the PMO 72-hour tank cleaning requirement by transferring raw milk to another tank. Milk only deteriorates when it leaves the cow. The goal is to move milk from the cow to the store shelf as quickly as possible. Monitor the time of storage and use the milk quickly.
5. **Monitor the shelf life of your products.** Accurate and systematic shelf-life testing is necessary. Coliform counts and SPC testing on fresh product will NOT indicate the shelf life of your products. Coliform counts are used as post-pasteurization contamination indicators — and are beneficial in determining sanitation and good

“The dairy industry has a long history of providing safe, wholesome products to customers.”

manufacturing practices issues — but generally will not predict shelf life. To predict shelf life, a stress test such as the Mosely test can be run. This procedure of holding finished product for seven days at 45 degrees Fahrenheit and then conducting an SPC can give us a picture microbiological contamination and potential spoilage of our products. It is also recommended that samples of finished products be stored at 45 degrees Fahrenheit until the end of code to verify that the products really do stand up to their reported shelf life.

A robust monitoring program of these four parameters will go a long way toward customer satisfaction and meeting the consumer's definition of quality. **DF**

Tedd Wittenbrink is technical director, Merieux NutriSciences.

Confidently Analyze Milk and Dairy Products

Leveraging FT-IR instruments to enhance the analysis of milk and dairy products.

PROVIDING INDUSTRY-LEADING CAPABILITIES FOR DAIRY ANALYSIS

Milk processors and dairies across the globe are challenged every day with ensuring the consistency of incoming raw materials and making fair payment to suppliers. Quick and accurate compositional analysis of key components of raw milk and other dairy products is of paramount importance in these industries for enhancing value and ensuring quality of final products. The supply of a skilled and well-trained staff to ensure proper verification of incoming and final products is also crucial to optimize processes and maximize profits. The LactoScope™ is designed to address the needs of dairies and processors of all sizes to quickly and accurately analyze the key components of raw milk and other dairy products. A state-of-the art FT-IR (Fourier- Transform Infrared Spectroscopy) instrument with modern optics and simple to use but powerful software enables the LactoScope to test raw, standardized and processed milks, whey, cream and other dairy products. The instrument incorporates the latest mid-infrared (MIR) technology for quick measuring time of

30-45 seconds with a typical accuracy of under 1% CV. The instrument's modular construction minimizes the vibration of the FT-IR bench, and its integrated design provides efficient use of laboratory space. The LactoScope has a low cost of ownership, minimum downtime, and worldwide support for all its users.

“In today’s world of complex operations in process environments, every function must work in sync towards the common goals of improving productivity.”

MODELS TO SUIT THE DIFFERENT NEEDS OF INDIVIDUAL DAIRY OPERATIONS

Versatile Liquid Dairy Products Analyzer

The LactoScope FT-A is our most versatile mid-infrared analyzer capable of testing a wide range of dairy product: milks, creams, whey, concentrates, ice-creams and yoghurt mixes. The latest hardware innovations allow to easily test the most challenging dairy products, such as creams with up to 55% fat and other viscous products. With a typical accuracy under 1% CV, a measuring time of 30 seconds, low cost of ownership and minimal downtime, this instrument is the preferred choice of the large processors and dairy laboratories.

PRODUCTS	LACTOSCOPE	
	FT-A	FT-B
Raw milk	•	•
Skimmed milk	•	•
Whey	•	•
Pasteurized UHT milk	•	•
Cream < 40% fat	•	•
Cream < 55% fat	•	
Yogurt with starter culture just added	•	
Ice cream (white mix)	•	
Whey concentrate (max 38% total solids)	•	
Whey protein concentrate (max 38% total solids)	•	
Skimmed milk concentrate (max 38% total solids)	•	
Open for customer application development	•	

SPECIFICATIONS	
Components	Fat, protein, lactose, totals solids, solids non fat. Added water, true protein, casein, NPN-CU, free fatty acids, citric acid, density and pH.
Repeatability (typical)	CV ≤ 0.25%
Accuracy (typical)	CV ≤ 1% (on cow milk bulk tank samples)
Typical sample intake volume	10 ml
Sample intake temperature	4°C-42°C (35.5°F - 107.5°F)
Power supply	100-120 V, 60 Hz; 220-240 V, 50 Hz; 400 VA
Standards and approvals	EMC Directive 2014/30/EU; Low Voltage Directive:2014/35/EU; IDF 141/ISO 9622 compliant; AOAC 972.16 compliant

Milk Analyzer

The LactoScope FT-B with a typical accuracy under 1% CV and a measuring time of 45 seconds per sample, the FT-B mid-infrared analyzer is designed to answer the needs of the small-medium dairies and milk collection points. It can test milks, whey and creams with up to 40% fat. It has a low cost of ownership, and minimal downtime.

TECHNOLOGY THAT DELIVERS

Our patented technology ensures you get the most out of your dairy analysis, regardless of your application.

Patented Dynascan™ interferometer in the FT-IR Spectrophotometer

- The LactoScope spectrometer incorporates PerkinElmer's Dynascan™ interferometer, the OpticsGuard™ technology and molecular sieve as an optic compartment desiccant.
- The automatic clean cycles and zeros maintain the sample pumping unit and the measuring cell in optimal conditions, therefore improving the overall reliability and accuracy of the instrument.
- Sample pre-heat and homogenization standardize the temperature and particle size of the fat globules before measurement.
- Full-spectrum analysis enables quantification of all components.
- The LactoScope includes the calibrations to analyze raw, standardized and processed milks, whey, and cream.

RESULTS 24/7 BY NETPLUS

- The Intuitive Results Plus software provides rapid implementation with minimal training, is designed to make analysis as rapid and secure as possible and is compatible with LIMS systems.
- The PerkinElmer NetPlus™ cloud solution enables remote configuration and monitoring of the LactoScope. Using NetPlus the LactoScope can easily be set up in a master/satellite network.

SERVICE AND SUPPORT

In today's world of complex operations in process environments, every function must work in sync towards the common goals of improving productivity. And that's the overarching goal of OneSource® Laboratory Services, too. We deliver solutions that cover all aspects of operations and can be customized for specific workflows – and business outcomes – you're driving towards. Simply put, OneSource is the one service organization with the requisite understanding of your needs around service and support, delivering a customized systems approach to your success. With a full measure of insight and expertise, our consultants can pinpoint the issues and inefficiencies and engineer the right solutions to solve your scientific and business challenges. From relocation services to everyday instrument repair and service, to preventive maintenance to method development services and scientific staffing, OneSource Laboratory Services can help streamline your processes and get your workforce back to its main order of business. [PE](#)

High Throughput Screening of Aflatoxin M₁ in Milk Samples by Automated ELISA Platform



INTRODUCTION

Aflatoxins are a group of naturally occurring mycotoxins produced by molds such as *Aspergillus flavus* and *Aspergillus parasiticus*, which have detrimental effects on humans, animals, and crops resulting in illness and economic losses. Aflatoxin M₁ is a metabolite of aflatoxin B₁ commonly found in dairy products. Presence of aflatoxin M₁ occurs when dairy cattle ingest feed contaminated with aflatoxin B₁. Aflatoxins are known to be carcinogenic and it is important to monitor the supply of dairy and dairy based products for contamination. As both aflatoxins B₁ and M₁ are carcinogenic in humans, the action level of 0.5 parts per billion of aflatoxin M₁ in milk is strictly enforced by the United States Food and Drug Administration (FDA). EU imposed an action limit of 0.05 parts per billions of aflatoxin M₁ in milk.

ELISA assays are widely used for the detection of aflatoxins M₁ in milk for regulatory conformance owing to the high sensitivity, selectivity, and ease of use of the method. In the following study we demonstrate the accuracy and precision of

Courtesy of PerkinElmer

the MaxSignal® Aflatoxin M₁ ELISA kit (Cat# FOOD-1060-05) at the EU MRL of 0.05 ppb and the US MRL of 0.5 ppb. We also provide data showing the limit of detection (LOD) of the kit. Further, we show the variability between performance of manual ELISA and DS2 automated ELISA platform. We also show the correlation of MaxSignal method performance with the official AOAC reference method (AOAC 2000.08). Lastly, we show that the assay is effective at quantitating aflatoxin M₁ in both full fat and de-fatted milk samples well under the action limits imposed by US FDA and EU.

EXPERIMENTAL

Materials and Methods

Milk samples, shown to be free of Aflatoxin M₁ by the reference method (AOAC 2000.08)¹, were used in this study. The experiments were performed with the MaxSignal Aflatoxin M₁ ELISA Kit. The spike solution provided in the kit was used to create all the contaminated samples mentioned in the study.

RESULTS AND DISCUSSION

Accuracy and Precision

Milk samples were tested at ND (none detected), 0.05, 0.2, and 0.5 ppb. For each concentration, 2 milk samples were used with each milk sample being tested in 6 replicates. For 0.5 ppb samples, the spiked sample was diluted 1:2 in water for the quantitation to fall within the range of the standard curve. The concentrations for these samples were then corrected for the dilution factor to determine the actual concentration.

Results were evaluated for accuracy (recovery of 60-140%) as well as for precision (%CV <20%)

Sensitivity (LOD)

LOD was established using blank sample matrices. A population of ten replicates of blank samples were used for the LOD measurement. The LOD of a method is defined as the lowest concentration that can be reliably measured. The LOD is defined as the mean+3*StDev reported for the negative/blank samples.

Method comparisons

The performance of the manual ELISA method and DS2 automation method was compared to establish the performance of DS2 analysis. The validation design outlined in accuracy and precision studies was adopted

Table 1. Table 1 summarizes the accuracy and precision results.

	Blank	0.05 ppb	0.2 ppb	0.5 ppb
Mean reported concentration (ppb)	0.012	0.061	0.207	0.562
Mean recovery (%)	-	122%	104%	112%
%CV	17.60%	13.12%	4.22%	3.48%

Table 2. Table 2 represents the results from LOD determinations.

	Mean Reported Concentration (ppb)	Standard Deviation	LOD (ppb)
Blank Milk	0.016	0.002	0.023

Table 3. The results indicate a good correlation between the established manual method of ELISA and the DS2 automated method.

Spike Level (ppb)	Meal recovery (Manual)	Mean recovery (DS2)	Variation in methods
0.05	122%	129%	5.43%
0.2	103%	108%	4.63%
Mean blank (ppb)	0.012	0.008	

» High Throughput Screening of Aflatoxin M1 in Milk Samples by Automated ELISA Platform

Table 4. Table 4 summarizes the correlation between ELISA method and reference method.

Spike Level (ppb)	MaxSignal method (n=10)	Reference Method (AOAC 2000.8) (n=3)	Variation in methods (%)
Blank	0.011 ppb	0.08 ppb	6.90%

Table 5. Table 5 summarizes the results of sample variability testing.

	Mean recovery (0.2 ppb)	CV (0.2 ppb)	Mean (blank samples)	CV (blank samples)
Full Fat	111%	6.48%	0.017ppb	12.49%
De-fatted	106%	4.70%	0.016ppb	15.65%

for this purpose. A variation of <20% was established as good correlation between the manual method and DS2 automation method. The variation was calculated as the difference between mean spike recovery between the methods compared to the manual method.

A correlation study for the ELISA method was carried out with the official reference method for M1 testing (AOAC 2000.8). The results show a CV less than indicating a very good correlation between the methods.

Full fat vs. De-fatted milk

Milk from the same source was tested to compare performance of the assay in samples that contained their original fat content and samples that had been de-fatted. De-fatting was done by centrifugation at 4000 x g for 5 minutes. The upper, fat layer was then removed.

CONCLUSION

MaxSignal Aflatoxin M1 ELISA demonstrates effective detection of aflatoxin M1 in milk samples at both the EU and US MRLs. Further, the kit shows good compatibility with the DS2 automated ELISA platform. The DS2 allows for higher throughput than traditional ELISA methods with a large reduction in technician hands on time. The assay is able to detect aflatoxin M1 in full fat milk equally as well as in de-fatted milk allowing technicians to chose to skip the defatting step, saving valuable time. Finally, the ELISA method shows good correlation with the official reference method and could be used in lieu of reference method for screening of contaminated milk samples. **PE**

REFERENCES

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LactoScope

The LactoScope™ is designed to address the needs of dairies and processors of all sizes to quickly and accurately analyze the key components of raw milk and other dairy products. A state-of-the-art FT-IR (Fourier-Transform Infrared Spectroscopy) instrument with modern optics and simple to use but powerful software enables the LactoScope to test raw, standardized and processed milks, whey, cream and other dairy products. The instrument incorporates the latest mid-infrared (MIR) technology for quick measuring time of 30-45 seconds with a typical accuracy of under 1% CV.

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Avoid common QA and QC mistakes

Suppliers reveal best practices and common errors in QA/QC testing.

Quality assurance (QA) and quality control (QC) testing are essential parts of any dairy production process. These tests confirm any products leaving a dairy plant meet the company's standards and food safety requirements — helping to ensure customer satisfaction and avoid any costly product recalls.

Dairy Foods spoke with Devin Darrell, international process account manager for Matthew, N.C.-based CEM Corp., and Sharad Tripathi, global market manager, dairy for Waltham, Mass.-based PerkinElmer Inc., about common mistakes and best practices in QA/QC testing processes in the dairy industry.

Dairy Foods: What are the biggest mistakes that dairy processors make in terms of QA/QC testing?

Devin Darrell: Recently we have seen a lot of dairy labs forget about the importance of accuracy in testing. As new technologies constantly come out to make tests faster,



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cheaper and simpler, which are all hugely beneficial to labs, lab managers must remember the original reason for each analysis and how better accuracy leads to better quality product and better profit for producers.

Sharad Tripathi: One of the most common mistakes that the dairy processors [make] is not providing adequate routine training to their staff — [especially] to the newly hired employees — and largely depending on their seasoned employees. If any of these senior staff member[s] has developed a bad habit, that's passed on from one to another and becomes a trend. [Other common mistakes include] allowing unrestricted access to the laboratory by non-laboratory personnel and misunderstanding of the products' specifications and quality standards.

Dairy processors could enhance their QA/QC efforts by addressing some common purchase-decision mistakes. One of those mistakes is selecting an instrument based solely on price. Another common challenge at a typical QA/QC instrumentation lab is to manage all of the data produced by these instruments.

Dairy Foods: What steps could processors take to avoid these issues?

Darrell: The first step is making sure there is clear communication between the lab performing the test and the manufacturers who rely on its results. This will ensure that both groups understand the importance of the data they provide and receive, as well as better setting expectations for which technology benefits — like speed, accuracy and ease of use — should be prioritized.

Tripathi: Labs should develop a structure to offer training to its staff [on a] routine basis, [especially in] new-hire training programs, that document is exactly what the SOPs are ... and what they are required to learn.

Travel in and out of the lab increases the risk of environmental contamination, hence access to the lab should be restricted to authorized staff. And when lab personnel bring in samples, they should follow a strict set of protocols to eliminate the risk of tracking in contaminants.

Ensure that all members of the team understand the standards of quality and products' specifications through a briefing and do routine inspection, as well as team rotation, to make sure the teams involved are meticulous enough.

When lab managers buy equipment or an instrument, they also need someone for application and technical support. Buying the products without proper post-sales support can complicate things. Of course, the instrument cost is one of the important parameters [that] affects the purchase decision, but many dairy processors look only at the initial cost of the instrumentation or system, failing to think about operating and integration costs, as well as ROI.

Oftentimes these laboratories work under a strict regulatory environment and [follow] guidelines like GLP/GMP, etc. And as a good manufacturing practice, these industries [want] to follow the compliance policy similar to FDA's 21 CFR Part 11, which is an indispensable feature. Having an automated electronically controlled data management system is very essential for such labs, as they no longer have to manually archive data from all the desktops attached to analytical instruments. [An] electronically controlled data management system can work as an automated archival system for all the analytical data generated in the laboratory and ensures against theft or data loss from crashed hard disks.

Dairy Foods: What is the “ideal” QA/QC testing protocol for dairy processors? Is there a certain order of operations that you recommend?

Tripathi: State and local regulatory agencies are responsible for the enforcement of sanitation requirements on dairy farms and in processing plants. Maximum handling of products takes place during the storage and transportation stages, which may increase the chances of contamination. Hence, dairy processors conduct quality and safety tests of the procured raw milk to ensure that they are of standard quality. Safety and quality tests are also performed after the end product is ready and before final packaging to prevent early spoilage and deliver quality products to consumers.

[My] suggestion [is] that dairy processors strictly adhere with the guidelines suggested by various regulatory bodies and quality and food safety management system[s] such as ISO 22000 or ISO 9001, with HACCP certifications from certifying bodies shortlisted by the International Accreditation Forum and other regulatory bodies.

Darrell: With the variety of dairy products being produced, there is no single protocol to follow. But each processor must be sure to follow sample preparation techniques to ensure every test is performed on a sample that is well representative of the large batch. Without proper sample

“Having an automated electronically controlled data management system is very essential for such labs, as they no longer have to manually archive data from all the desktops attached to analytical instruments.”

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storage and preparation, any result should be considered questionable and suspect.

After that, each parameter required for testing should be prioritized and considered individually. Even if using multi-component analysis technologies, higher emphasis must be applied on the parameters that are most critical to production quality and profitability. Finally, finding technologies that are capable of testing at every stage of production with efficacy allows producers to maintain more control of their product, ensuring best testing practices and true quality control. **DF**