

**FOSS**

ANALYTICS BEYOND MEASURE

**E-BOOK:  
ALL ABOUT  
SCREENING FOR  
MILK ADULTERATION**

**A GUIDE TO OPPORTUNITIES  
WITH ANALYTICAL SOLUTIONS**

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# Preface

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In recent years, analytical milk screening technology has developed in response to the growing need to test raw milk for adulteration before it enters the supply chain.

This guide introduces the milk screening concept that is now accessible to any size or type of business and gives an overview of the solutions available today.

We hope you find it useful in the ongoing fight against adulteration of the dairy supply chain.

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## Why screen?

Another tanker rolls up with a load of around 22,000 litres or 6000 gallons of raw milk ready for processing, but is there anything hiding in all that milk that we should stop before it gets into the supply chain?

Raw milk may suffer from dilution or contamination from chemicals added either intentionally or accidentally, for example, resulting from animal feed or from contamination of the tanker. The impurities are often well-masked and everything may seem fine until, in the late production stages, the impurity shows up as a nasty surprise such as a chemical taint or even a serious food safety risk.

This risk of milk adulteration is different around the globe, but even in regions where the vast majority of incoming milk is absolutely normal, those few problematic samples still need to be caught. With this in sight, various industry and national guidelines for protecting the supply chain are being brought in.

All well and good you can say in terms of good advice and guidelines, but what is it exactly that dairy producers are supposed to do? After all, performing a full diagnostic investigation of all incoming milk samples would simply be too costly and laborious and result in a long queue of tankers waiting to unload deliveries.

A screening approach with routine analytical equipment offers a practical solution. With screening, the milk sample is checked for anything abnormal. On those rare occasions that something does show up, the tanker load can then be put into a holding tank for further investigation, so avoiding far more costly implications further downstream in the process.

The screening is performed with standard equipment and at the same time as normal quality tests. In this way, it becomes an integrated part of everyday quality control without need for extra equipment, analysis time or special training.



## Case story – Mars protects

A milk analyser called MilkoScan™ Mars is helping UK dairy producer, Lanchester Dairies to screen raw milk deliveries and finished products for possible adulterants.

Situated on the Eastern slopes of the Pennine hills in Northern England, Lanchester Dairies was originally a dairy farm until it diversified into dairy production in the 1990's.

Previously, the dairy had an earlier FOSS analyser called the MilkoScan™ Minor that could just test for butterfat and added water. This was coming up for replacement

and with the need to do more to safeguard the supply chain, the new MilkoScan Mars offered a logical choice to broaden the scope of testing.

## Adulteration threats and new standards

Even though cases of accidental or deliberate adulteration of milk are very rare in the UK, producers need to be alert to the threat and, following a recent update of the British BRC quality control standard (issue 7), they also need to put in place measures to prevent contamination of the supply chain.

The increased scope of testing is now allowing the dairy to comply while also preparing for potential threats to the milk supply.

**“ WE COULD DO THE ADULTERANTS  
AND THE OTHER TWO TESTS, ALL IN ONE ”**

Lanchester Dairies, General Manager, Gary Halliday.

## Taking advantage of the latest milk testing technology

Lanchester Dairies produces around 30 million litres of drinking milk and cream per year making it a relatively small operation by UK standards. Nonetheless, the new analyser brings its quality control procedures into line with the best in the industry because it uses a powerful

form of Infrared technology called Fourier Transform Infrared (FTIR) that was previously only available in more sophisticated analysers used by larger dairy operations.

“ THERE IS NOT A LOT OF ADULTERATION OF MILK IN THE UK, BUT WE HAVE TO COMPLY WITH OUR LATEST BRC STANDARD WHICH LOOKS AT THREAT ANALYSIS AND ADULTERANTS,” SAID HALLIDAY. HE ADDED: “IT IS NOT THAT WE HAD A PROBLEM BEFORE, BUT NOW WE CERTAINLY HAVE MORE PEACE OF MIND”

The FTIR technology can sniff out any abnormalities in milk using a form of infrared fingerprinting where an Infrared spectrum for normal milk is compared with the spectrum of the sample being tested. It is also an accurate way of testing for added water and the butterfat content required for payment of deliveries and for quality control of finished products.



Watch the interview with General Manager, Gary Halliday from Lanchester Dairies.

# What to watch out for?

What are the most commonly used substances for deliberate adulteration of milk? And how are they used by criminals?

**UREA** - is used to improve whiteness, increase the consistency of milk and for levelling the content of Protein.

**SUCROSE** - is added to increase the total solids in the milk after diluting it with e.g. water.

**POTASSIUM NITRATE** - is an oxidizing agent and hence acts as a preservative. Pond water also contains appreciable quantities of nitrates and such water is sometimes added by producers or vendors in some regions of the world.

**SODIUM BICARBONATE** - is a neutraliser which is added to milk to neutralize acidity in milk caused by bacteria.

**FORMALDEHYDE** - is used for killing bacteria to get a better price for the milk. It is very toxic. In the early 1900s, it was frequently used by dairies in some parts of the world as a method of pasteurisation!

Besides these known adulterants, there can be many more, for example, due to accidental contamination with cleaning fluids. Learn more about how to spot known and unknown adulterants on page 13.



# Why we can rely on milk screening technology – what is FTIR?

## FTIR for screening

Screening for adulteration is based on decades of development of renowned FOSS Fourier Transform Infrared (FTIR) technology, widely recognised as the most powerful and reliable method for routine testing of milk.

FTIR technology can sniff out any abnormalities in milk using a form of infrared fingerprinting where an Infrared spectrum for normal milk is compared with the spectrum of the sample being tested. It is also an accurate way

of testing for added water and the butterfat content required for payment of deliveries and for quality control of finished products.

## **What is Fourier Transform Infrared?**

The FTIR measurement principle is based on an interferometer using a so-called Fourier transformation to generate the spectrum from the data. The method is easy, fast and accurate, combining high sensitivity with a full spectrum, enabling instrument standardisation and the use of calibrations for multiple instruments.

FTIR spectroscopy is particularly useful for homogenous, liquid samples, making it the preferred infrared absorption spectroscopy method for samples such as milk. For example, applications for MilkoScan Mars include raw milk testing, milk and cream standardisation



for consistent final products based on parameters such as fat and protein and screening for adulteration to help safeguard quality.

## FTIR or NIR?

FTIR spectroscopy is in principle very similar to Near Infrared (NIR) spectroscopy, but works across longer wavelengths.

Additionally, many special optical components and materials are used. The benefit of the longer wavelengths is that more specific chemical information is typically obtained from the samples.

A comparison of NIR and FTIR is provided in this video in relation to applications in the dairy industry. Called 'Directions in dairy analysis', the video includes interviews with experts from FOSS who explain the technology and the considerations to be made when selecting an infrared analytical instrument.



FTIR and NIR technology and application for testing liquid and solid samples.



# How to spot known and unknown adulterants with targeted and untargeted screening models

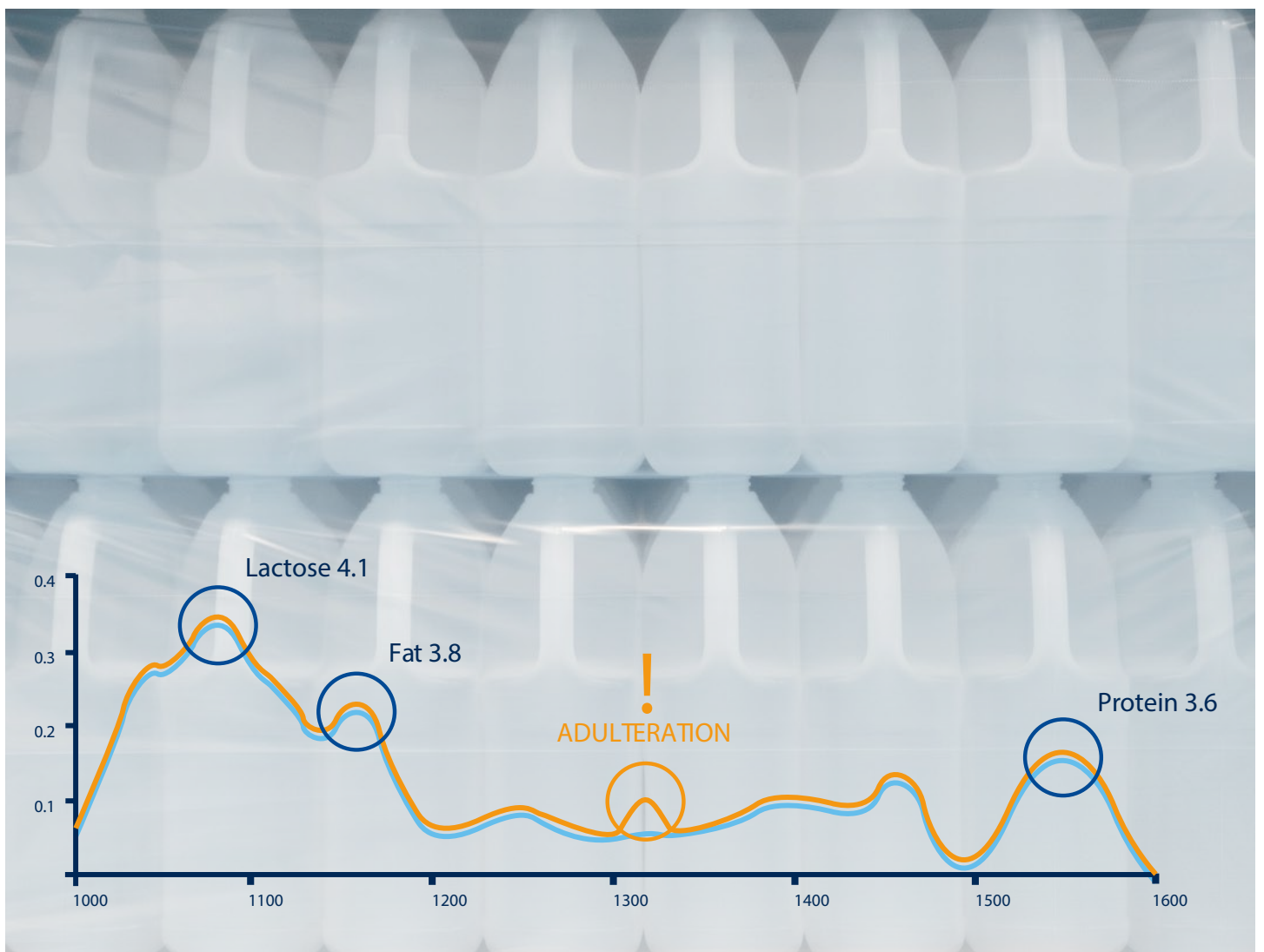
Milk can be screened using two types of screening models called untargeted and targeted models.

## Untargeted models

An untargeted model can be used to screen for any abnormalities in the raw milk. This could be due to

deliberate adulteration where different substances are added to the milk to increase quantity and thereby payment, or, due to accidental adulteration where for example, cleaning agent is mixed with the milk.

With an untargeted model, a sample of milk is tested against a profile for normal milk. A warning is given if there is a mismatch. This alerts you to the need for further investigations to determine the nature of the abnormality.



## Targeted models

Targeted models can be used to quantify the content of known adulterants such as hydroxyproline, sodium nitrite, melamine, maltodextrine and cyanuric acid. It can only predict the concentration of the adulterant for which it was developed. If there is a need to monitor other known adulterants, specific targeted models will have to be used for each of these.

With a targeted model, a sample of milk is tested against a profile for normal milk adulterated with a known substance. A warning is given if there is a match and a measurement of the quantity of adulterant is given.



Learn more about screening models: FOSS expert explains targeted and untargeted models.

# 7 key facts about milk screening with FOSS MilkoScan™ instruments

## 1. Screen and save at the same time

While you are screening for adulteration, you can also test milk or cream for quality parameters that help you to improve both quality and yield in your dairy process.

With the MilkoScan™ Mars instrument, the available tests are: fat, protein, lactose, total solids, solids non fat and freezing point depression.

With the MilkoScan™ FT3, the available tests are: fat, protein, lactose, total solids, solids non fat, freezing point, titrable acidity, density, free fatty acids, citric acids, casein, urea, sucrose, glucose, fructose and galactose.

## **2. You don't need a sophisticated laboratory**

An instrument like the MilkoScan Mars is small and weighs only 10.5 kilograms. The dimensions are 345x280x285 mm (WxDxH) so it can fit in any laboratory or any dry and vibration-free room. The MilkoScan FT3 is larger and more sophisticated, but is designed to withstand general use by any operator in a typical production control room.

## **3. There are no hidden costs for calibration adjustment**

Just like any machine, all analytical instruments are subject to wear. With some, you may need to compensate for this by making adjustments to the calibration using calibration samples which can easily cost around 600 US dollars or equivalent. The calibration samples can only be used once and a typical dairy business may need to use them every two weeks.

With the MilkoScan instruments, the equipment automatically compensates for wear avoiding the cost of calibration samples.



MilkoScan Mars product video



MilkoScan FT3 product video

#### **4. There are no training costs**

Place the sample and push the start button - need we say more? Please see our product videos to get an idea of what it takes to make a measurement with either MilkoScan Mars or MilkoScan FT3.

#### **5. It costs more than ultrasonic technology, but offers much higher value for money**

The price of the MilkoScan instruments is higher than ultrasonic instruments, but you get a lot more for your money when screening for adulteration.

The ultrasonic technology can only measure the fat content and the rest of the components are calculated based on the fat result. Therefore, the accuracy and range is not as good as the MilkoScan. In addition, the MilkoScan uses FTIR technology which is approved by AOAC and IDF while ultrasonic is not.

## **6. It is just as reliable in any size**

The smaller MilkoScan Mars screens for adulteration using the same FTIR technology as used in the more powerful MilkoScan FT3 milk analyser, built on the legacy of the well-known MilkoScan FT1 and MilkoScan FT2 solutions found in dairies around the world. These larger MilkoScan instruments have a flow system to ensure that a representative sample is analysed.

The MilkoScan Mars does not have such a flow system, but it can still analyse with a good repeatability by measuring a larger volume of the sample in order to ensure a good sample representation. The larger volume is achieved by letting the sample flow through the measurement system while performing a number of FTIR scans. Due to fast scanning FTIR interferometers, it is possible to perform e.g. 20 scans within a very short period of time. In this way, it is possible to obtain a repeatability that is comparable to that of the larger MilkoScan models such as the next generation MilkoScan FT3.

## 7. Screening can help everyone

Milk adulteration is often accidental, for example, if cleaning fluid used to clean milk tankers gets into the milk.

Sadly though, deliberate milk adulteration for financial gain is a growing problem. And the cost of this is borne by the whole industry through reduced sales and tarnished public image.

Whether the adulteration is accidental or deliberate, screening can help to save costs throughout the entire dairy industry.

# MilkoScan™ instrument comparison

MilkoScan™ Mars



MilkoScan™ FT3



## ANALYSIS TIME

1 minut

<30 seconds

## SAMPLE TYPES

Raw and processed milk, cream

Compositional analysis of liquid and semi-solid dairy products such as milk, cream, whey, yoghurt, creme fraiche, chocolate milk, milk and whey concentrates and more

## PARAMETERS

Fat, protein, lactose, Total Solids, Solids non-fat, Freezing Point (milk only)

Global calibrations: fat, protein, lactose, total solids, solids non fat, freezing point, titrable acidity, density, free fatty acids, citric acids, casein, urea, sucrose, glucose, fructose and galactose

## DIMENSIONS

(W x D x H)  
345 x 280 x 285 mm

Weight  
10.5 kg

(W x D x H)  
750 x 450 x 408 mm

Weight  
43 kg