

## What are the methods of analysis of lactose in milk and dairy products?

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### 1. The methods of analysis of lactose in milk and dairy products

The **analysis of lactose**, a disaccharide sugar found primarily in milk, can be conducted using several methods, each with its own strengths and applications. Here are some common methods:

**High-Performance Liquid Chromatography (HPLC):** This technique is widely used for the precise and accurate quantification of lactose in various dairy products. HPLC can separate, identify, and quantify lactose in the presence of other sugars.

**Enzymatic Methods:** These methods involve using enzymes like lactase to break down lactose into glucose and galactose, which can then be measured. These methods are specific to lactose and are used in quality control in the dairy industry.

**Near-Infrared Spectroscopy (NIR):** NIR is a non-destructive and rapid method used for analyzing lactose content in dairy products. It's particularly useful for online monitoring in industrial settings.

**Nuclear Magnetic Resonance (NMR) Spectroscopy:** NMR can be used to identify lactose and its concentration in milk and milk products. It's a non-destructive method that provides detailed information about the molecular structure of lactose.

**Polarimetry:** Since lactose is an optically active substance, polarimetry, which measures the rotation of polarized light by lactose molecules, can be used to determine its concentration.

**Gas Chromatography (GC):** Although less common for lactose analysis due to the requirement for derivatization of lactose, GC can be used for accurate quantification in certain specialized applications.

Each method has its specific applications, advantages, and limitations. The choice of method depends on the accuracy required, the nature of the sample, the presence of interfering substances, and the need for high-throughput analysis.

### 2. Advantages and disadvantage of the methods

#### A. High-Performance Liquid Chromatography (HPLC)

**Advantages:** HPLC is known for its high precision and accuracy, making it ideal for quantifying lactose in complex matrices like dairy products. It can separate lactose from other sugars effectively, ensuring specificity. This method also provides good sensitivity and reproducibility.

**Disadvantages:** The main drawback of HPLC is its cost, as it requires expensive equipment and skilled operators. Additionally, the preparation of samples can be time-consuming, and the process is not as rapid as some other methods.

#### B. Enzymatic Methods

**Advantages:** Enzymatic methods are highly specific to lactose, which minimizes interference from other components in dairy products. They are relatively simple and cost-effective, making them suitable for routine quality control in the dairy industry.

**Disadvantages:** These methods can be less accurate if the enzymatic reaction is not fully complete or if there are other interfering substances in the sample. They are also less suitable for samples with very low lactose concentrations.

#### C. Near-Infrared Spectroscopy (NIR)

**Advantages:** NIR is a rapid and non-destructive method, allowing for quick analysis without damaging the sample. It's ideal for online monitoring and control in industrial settings. NIR requires minimal sample preparation and can analyze a large number of samples quickly.

**Disadvantages:** The accuracy of NIR can be affected by the presence of other components in the sample. It also requires initial calibration and validation against a reference method, like HPLC. It is also a method that does not work for low lactose products.

#### D. Nuclear Magnetic Resonance (NMR) Spectroscopy

**Advantages:** NMR provides detailed information about the molecular structure of lactose, which can be useful for more than just quantification. It is a non-destructive technique and does not require extensive sample preparation.

**Disadvantages:** NMR spectroscopy is an expensive technique requiring specialized equipment and expertise. It is less sensitive compared to methods like HPLC, making it less suitable for detecting low concentrations of lactose.

## E. Polarimetry

**Advantages:** Polarimetry is a simple and quick method for detecting lactose based on its optical activity. It requires minimal sample preparation and no specialized reagents.

**Disadvantages:** This method is less specific and can be influenced by other optically active substances present in the sample. It is also less sensitive and not suitable for low lactose concentrations.

## F. Gas Chromatography (GC)

**Advantages:** GC provides high accuracy and can be used for the precise quantification of lactose, especially when specific derivatization techniques are employed.

**Disadvantages:** GC requires the derivatization of lactose, which adds complexity and time to the sample preparation process. It also requires expensive equipment and skilled operators, similar to HPLC.

## 3. Summary of the advantages and disadvantages of various lactose analysis methods

Method	Advantages	Disadvantages
HPLC	High precision, accuracy, specificity	Costly, requires skilled operators, time-consuming preparation
Enzymatic Methods	High specificity, cost-effective, simple	Less accurate with low concentrations, potential interference
NIR	Rapid, non-destructive, minimal preparation	Less accurate with other components, requires calibration. Does not work with low lactose products
NMR Spectroscopy	Detailed molecular information, non-destructive	Expensive, less sensitive, requires expertise
Polarimetry	Simple, quick, minimal preparation	Less specific and sensitive, affected by other substances
Gas Chromatography (GC)	High accuracy, precise	Requires derivatization, costly, needs skilled operators

## 4. The CDR FoodLab® enzymatic method

The [CDR FoodLab® method for lactose analysis in milk and dairy products](#) involves enzymatically splitting lactose into glucose and galactose, followed by a reaction that forms a pink colored complex, measurable at 505 nm. The intensity of this color is directly proportional to the lactose concentration in the sample.

This approach has been validated against standard methods like HPLC, demonstrating excellent correlation and accuracy. For more info read the article [Analysis of lactose on milk](#):

[Correlation report between the CDR FoodLab® method and the reference method](#)

## A fast and simple method



This enzymatic method is developed by the research laboratories of CDR and have been specifically devised to maximize ease of use and reduce testing time.

It significantly reduces the time needed for analysis compared to traditional methods like HPLC, with results obtainable in approximately 10 minutes.

Reagents come in disposable pre-filled vials ready to use, then operators do not have to handle toxic or carcinogenic compounds. There is no need of a dedicated laboratory or to wash either containers or traditional glassware.

Thanks to its easiness also people without chemical skills are able to carry out this test in total autonomy.

It is versatile, allowing for use with both liquid and solid samples, with minimal sample preparation required for solids.

The test works equally well on low-lactose products as well as on lactose-free products.

Likewise, we have not encountered any interference problems with flavored milks (chocolate or strawberry for example).