

## **INSTRUMENTAL METHODS FOR INVESTIGATING THE QUALITY OF MILK FROM DIFFERENT MANUFACTURERS**

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Providing the population with high-quality and safe food products is a priority task of the modern state, requiring reliable and rapid control of the chemical composition of raw materials and finished goods. Since traditional chemical methods for analyzing dairy products are often time-consuming and labor-intensive, the

implementation of modern instrumental methods (optical, electrochemical, etc.) significantly increases the accuracy and speed of food expertise. A comparative analysis of commercial products available on the market has immediate practical value for consumer protection, which determines the high relevance of this research.

The aim of the work is to carry out a comparative evaluation of the quality and physico-chemical parameters of milk from various commercial manufacturers using a complex of modern instrumental methods of analysis.

The objects of the study were samples of drinking milk from different brands represented in the retail trade network. To ensure a comprehensive analytical evaluation, the following instrumental methods and equipment were involved: potentiometric pH-metry (for precise determination of active acidity), refractometry (for quantifying total soluble solids and dry matter content), as well as photometric and ultrasound analytical methods to evaluate total fat and protein content, and to screen for potential product adulteration.

During the experimental work, a significant volume of analytical screening was completed. The experimental values of active acidity, refractive index, and density of the investigated milk samples were determined and visualized. The obtained instrumental data were systematically compared with the strict regulatory requirements of the current State Standards of Ukraine (DSTU).

Table 1. Analytical characteristics of the applied instrumental methods

Instrumental Method	Monitored Parameter	Main Analytical Advantage	Metrological Limitation
Potentiometric pH-metry	Active acidity (pH)	High precision, objective automated reading	Requires frequent sensor calibration
Digital Refractometry	Total soluble solids (%)	High speed, minimal sample volume	Non-specific for individual sugars
Ultrasonic Analysis	Fat and protein content	Simultaneous multi-parameter screening	High sensitivity to sample preparation

The results indicated that the majority of the tested commercial brands comply with the state quality standards. However, slight variations in the dry matter profile and total fat distribution among different manufacturers were observed, which can be attributed to the peculiarities of industrial technological processing and homogenization.

Special attention in the discussion was paid to the stage of analytical sample preparation of milk matrices, as fat globule dispersion and temperature stabilization substantially influence the reproducibility and accuracy of downstream instrumental measurements. A comparative evaluation of the metrological characteristics (reproducibility, limits of detection) of the applied instrumental tools proved their significant superiority over classical titrimetric procedures in terms of operational speed and laboratory throughput.

Conclusions. 1. The high efficiency of integrating electrochemical and optical instrumental methods for the multi-parameter quality control of commercial milk samples has been demonstrated.

2. The comparative analysis revealed that the evaluated dairy brands generally meet the legal requirements of DSTU, though they slightly vary in their solid-not-fat (SNF) profiles.

3. It has been shown that strict standardization of the sample preparation stage is a mandatory prerequisite for minimizing matrix effects and achieving high reproducibility in instrumental food analysis.

### References

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