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APPLIED INFORMATICS IN QUALITY CONTROL USING ULTRASONIC MILK ANALIZER

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Abstract. ***Milk quality control is essential for farmers, processors and consumers. Physicochemical analysis of milk is essential to assess product quality and to understand the effects of different feeding regimes on milk composition. This article presents applied informatics in food engineering quality control to perform a comparative analysis of two distinct feeding types: dry mass feeding and green mass feeding, emphasizing significant differences in fat and protein percentages. In order to accurately check the quality of milk, the ultrasonic Ekomilk Milkana KAM98-2AM analyzer will be used.***

Keywords: quality control, milk, ultrasonic analyzer, physicochemical analyses, Ekomilk

1. INTRODUCTION

Milk quality control is crucial for farmers, processors, and consumers. As a staple food that is high in nutrients, milk should adhere to various regulations in order to be safe to eat. The Ekomilk Milkana KAM98-2A M milk analyzer is a piece of modern, effective equipment needed to swiftly and precisely assess the product's quality.

Using applied informatics in food engineering quality control, the purpose of this paper is the comparative analysis of two different types of feeding, more precisely dry mass feeding and green mass feeding, with significant differences observed especially in the percentage of fat and protein.

Considering the literature, the organoleptic properties and chemical makeup of cow's milk are strongly influenced by the method of feeding. Incorporating additional protein and essential fatty acids, the provision of fresh green mass can improve the nutritional composition of milk. Additionally, incorporating fresh green mass, such clover or alfalfa, might improve the composition of milk since it contains more vegetable protein [1-3].

Applied informatics plays a pivotal role in enhancing quality control processes within the dairy industry, particularly through the integration of ultrasonic milk analyzers.

These devices employ high-frequency sound waves to rapidly and non-destructively assess key physicochemical parameters, including fat content, protein levels, density, and adulteration indicators. Informatics systems facilitate real-time data acquisition, automated processing, and trend analysis, thereby improving accuracy, repeatability, and traceability across production stages.

By linking ultrasonic measurement technologies with advanced data management platforms, dairy processors can optimize decision-making, strengthen regulatory compliance, and ensure consistent product quality. Consequently, applied informatics serves as an essential framework for modern, technologically driven milk quality assessment.

2. MILK ANALYZER WORKFLOW

The cow farm presented in the experiment is consisting of 20 heads, located in a barn with a feeding front. The farm is organized on the free housing system, which means that the cows have freedom of movement inside the barn.

Being a modern shelter, the farm is efficient, hygienic and facilitates high milk production under optimal conditions. Depending on period, feeding is done with both green and dry mass.

Considering the literature, a balanced dry mass feeding recipe is formulated to ensure optimal nutrient intake while maintaining rumen health and productive performance. A representative ration may include approximately 35–40% high-quality forage dry mass, such as alfalfa hay or silage, to supply structural fiber. Concentrate components, comprising 45–50% of total dry mass, typically include ground corn, soybean meal, and energy-dense by-products to meet carbohydrate and protein requirements. The remaining 10–15% consists of mineral–vitamin premixes, buffers, and functional additives [1-3].

The integration of devices in field of food engineering such as Ekomilk analyzer represents a significant advancement in quality control. Also, the analyzer is directly related to applied informatics in the way it uses digital technologies for rapid and accurate analysis of milk.

The Ekomilk analyzer is a modern tool designed to perform quick and reliable measurements of milk parameters, making it highly valuable in both industrial and research contexts. This device increases production efficiency and guarantees adherence to stringent quality requirements by facilitating quick, accurate, and environmentally friendly evaluation of milk quality.

Considering the literature, Ekomilk analyzer determines the physicochemical properties of milk using the ultrasonic measurement method, a rapid and non-destructive analytical technique. In food engineering, Ekomilk analyzer supports several processes, presented in the following figure [4-8]:

Figure 1. Processes supported by Ekomilk

Considering the theoretical aspects presented in technical manual of the equipment, when an ultrasonic wave passes through the milk sample, its velocity and attenuation are influenced by factors such as fat content, protein concentration, lactose level, solids-non-fat, and density. These components alter the acoustic impedance of the liquid, which changes how the ultrasonic signal behaves. The analyzer measures these changes with high precision [4].

Quality control represents fundamental aspect of food engineering, ensuring that food products meet safety standards, nutritional requirements, and consumer expectations.

In milk industry, rapid and precise analysis of milk composition is important for monitoring product quality, adjusting processing parameters, and guaranteeing compliance with regulations.

In the following diagram is presented a simplified representation of the ultrasonic measurement system inside the Ekomilk analyzer, such as [4]:

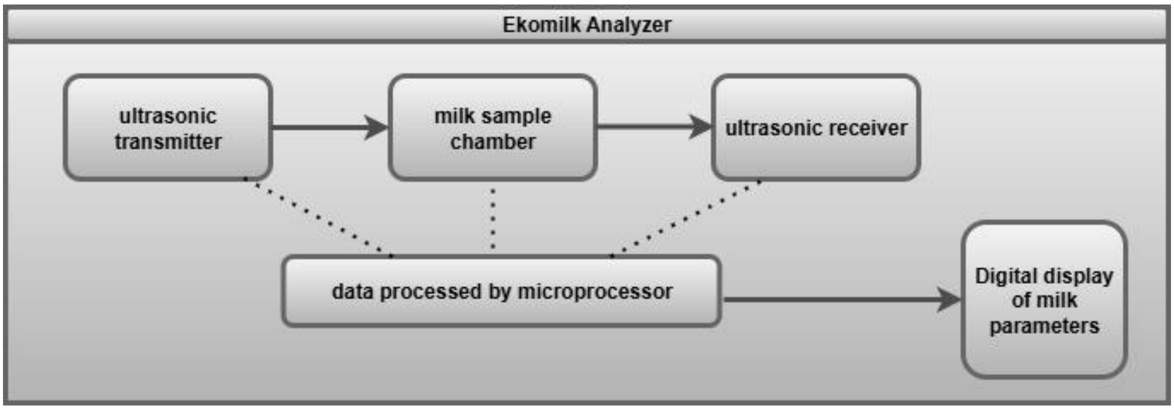

Figure 2. Ekomilk Milkana KAM98-2AM Analyzer

The analysis process is presented in several essential stages, as mentioned in specialized technical literature [4]:

- Sample collection – a small amount of milk is used, homogenized.
- Temperature stabilization – the device brings the sample to an optimal analysis temperature
- Ultrasonic wave transmission – a transducer emits sound waves through the sample.
- Data processing – sensors capture changes and send data to the computing unit.
- Results display – in 90 seconds, the values are displayed on the screen or printed.

Like it is mentioned in literature, Ekomilk uses an electronic transducer to generate ultrasonic waves and another electronic transducer to receive the transmitted signal after it passes through the milk.

Applied informatics intervenes in the acquisition of data, numerical processing, storage of information and display of results in an easy-to-interpret form.

The microprocessor analyzes time and strength of the received signal, which applies calibration algorithms to calculate milk parameters such as [4-6]:

- Fat percentage
- Solids-non-fat (SNF)
- Protein content
- Lactose concentration
- Density
- Added water percentage

In the following figure is presented the result of a printed test generated by Ekomilk Milkana KAM98-2AM:

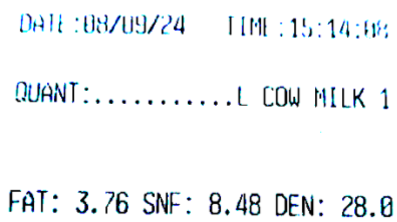

Figure 3. Ekomilk Milkana KAM98-2AM printed test result

This method is useful since it does not require any chemical reagents, provides results in seconds, and maintains the sample for future testing. Furthermore, it is environmentally friendly and ideal for routine quality control in dairy processing factories, laboratories, and research facilities.

3. RESULTS AND DISCUSSION

Considering this article to be an incipient case study, ten samples were chosen to be analyzed. According to this research, milk samples were taken, during August-October 2025, one sample each week, to capture milk parameters influenced by the type of feeding, such as feeding at the feeding front with dry mass – five weeks and feeding grazing green mass – five weeks.

The experimental period was as follows:

- Sample 1 taken on 18th August, 2025 – green mass feeding
- Sample 2 taken on 25th August, 2025 – green mass feeding
- Sample 3 taken on 1st September, 2025 – green mass feeding
- Sample 4 taken on 8th September, 2025 –green mass feeding
- Sample 5 taken on 15th September, 2025 – green mass feeding
- Sample 6 taken on 22th September, 2025 –dry mass feeding
- Sample 7 taken on 28th September, 2025 – dry mass feeding
- Sample 8 taken on 6th October, 2025 – dry mass feeding
- Sample 9 taken on 13th October, 2025 – dry mass feeding
- Sample 10 taken on 20th October, 2025 – dry mass feeding

Table 1. Test results for ten samples

Sample	Fat (FAT)	Solid non fat (SNF)	Density (DEN)	Added water (AWM)	Freezing point (FP)	Protein (PROT)
1	3.71	8.39	27.8	0	54.8	3.33
2	3.7	8.79	29.3	0	57.7	3.32
3	3.76	8.3	27	0	54.5	3.44
4	3.75	8.48	28	0	55.7	3.41
5	3.78	8.4	27.5	0	56.8	3.45
6	4.16	8.5	27.8	0	56.1	3.23
7	4.03	8.3	27	0	54.5	3.14
8	4.18	8.53	28	0	55.9	3.23
9	3.77	8.4	27.7	0.71	55.2	3.18
10	4.5	8.68	28.2	0	56.7	3.2

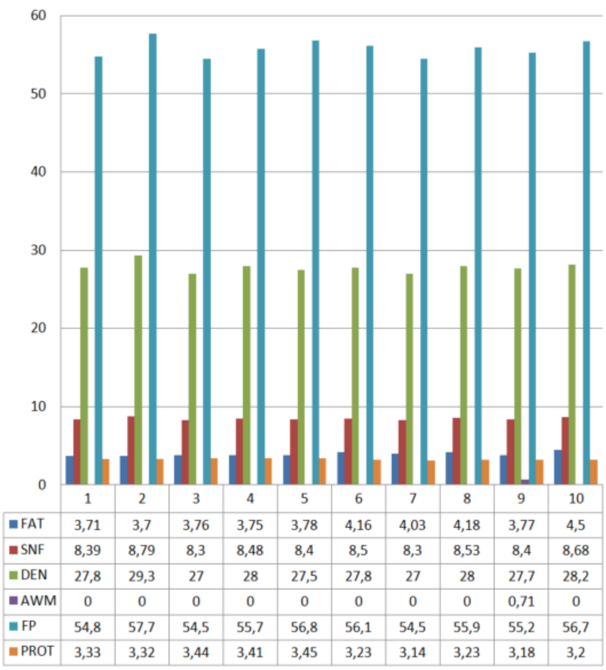

Figure 3. Test results for ten samples

The results of ten samples taken in ten weeks are presented in the table 1 and figure 3.

According to Table 1, the results emphasize that for the last five weeks when the feeding was with dry mass the fat was higher. In the case of green feed, fat decreases but protein remains high. Considering a temperature drop, an example of added water, resulting from condensation in the cooling tank, was presented, being considered a false positive.

In Figure 4 may be seen a comparison between the fat content of milk from the dry mass feeding period and the fat content of milk from the green mass feeding period. A difference can be observed during the dry mass feeding period, with the fat content being higher than during the green mass feeding period.

Also, in Figure 5 a comparison can be observed between the protein of milk from the period of dry mass feeding, respectively the protein of milk from the period of green mass feeding. A difference can be observed in the period of green mass feeding, the protein being higher than in the period of dry mass feeding.

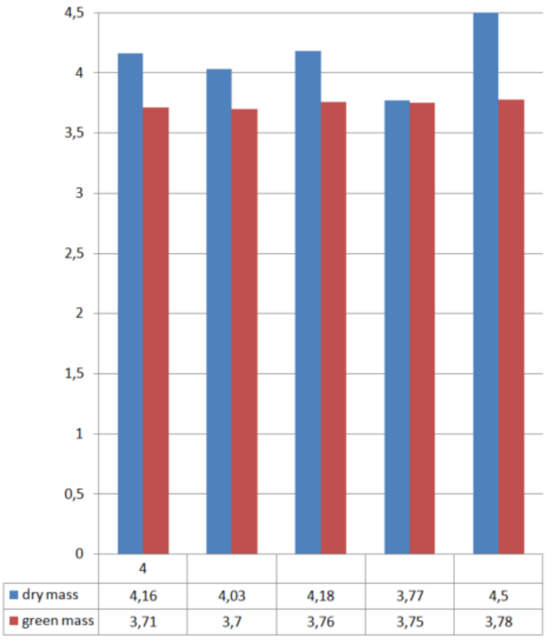

Figure 4. Comparison between milk fat content from the dry and green mass feeding

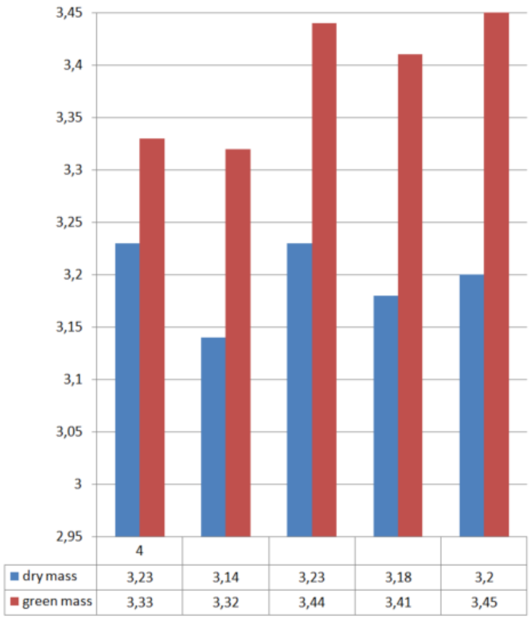

Figure 5. Comparison between milk protein content from the dry and green mass feeding

Therefore, monitoring parameters for the well-being of raw materials is essential in any branch of industry. Moreover, monitoring milk parameters using the Ekomilk Milkana KAM98-2A M analyzer represents an advanced and efficient solution for fast and accurate quality analysis.

4. CONCLUSIONS

Applied informatics in milk quality control is highlighted by the use of modern analyzers such as Ekomilk, which integrate digital technologies for data collection and processing. Applied informatics allows for rapid interpretation of physicochemical parameters and secure storage of information. By using dedicated software, the results can be monitored, compared and integrated into quality management systems.

Ekomilk Milkana KAM98-2A M analyzer is a piece of contemporary, effective equipment needed to swiftly and precisely assess the product's quality. It collects data on the composition of milk, such as fat, protein, lactose and density, and these data are processed using computer algorithms.

Applied informatics intervenes in data acquisition, numerical processing, information storage and display of results in an easy-to-interpret form. Also, the associated software allows for process automation, reduction of human errors and integration of results into quality management systems in the food industry

The method is based on the principle that ultrasonic waves propagate through milk at a speed and intensity that depend on the milk's composition and physical characteristics.

After analyzing the samples, differences were found depending on the type of feeding. Evaluating the product's quality and comprehending how various feeding types affect milk composition depend on the physicochemical analysis of cow's milk. The type of feed has a major impact on the chemical composition characteristics of milk. A balanced combination of green forage and concentrated feed is recommended for high-quality milk production.

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