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**REAL-TIME MONITORING OF THE CURRENT VALUE
OF THE COW'S MILK CONDITION
(Comprehensive integrated quality indicator of cow's milk and
a device for its real-time identification. A device for monitoring
the current value of the cow's milk condition in accordance
with the concept of top-category expert – Liubov Skokova)**

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Abstract

The article discusses the development of a comprehensive integrated digital indicator of cow's milk quality and a series of devices for its real-time identification and monitoring. *Particular attention is given to the integral concept developed and proposed by Liubov Skokova, which combines artificial intelligence, artificial neural networks, and electromagnetic resonance spectroscopy for food quality control.* Within this framework, parameters such as frequency, amplitude, resistance, inductance, electrochemical characteristics, and dynamic milk-flow properties are used as an integrated equivalent of the current content and concentration of milk components. The article describes compact, energy-efficient devices designed for operation on dairy farms, in field conditions, and in stationary installations, including versions powered by solar energy and intended for rapid analysis.

Special emphasis is placed on the selective real-time identification of somatic cell concentration, fat and fatty acid content, lactose concentration, traces of blood, and indicators associated with mastitis detection. The proposed systems incorporate resonant sensors, milk-flow transformation units, aerodynamic gas-removal mechanisms, and integrated monitoring modules capable of evaluating multiple milk-quality parameters simultaneously. The article also examines methodological approaches for the detection of subclinical and clinical mastitis through the combined assessment of somatic cell counts, electrical conductivity, pH, density, viscosity, and fat content. The presented devices, systems, software solutions, and associated methods are highlighted as innovative technological developments with significant practical potential for modern dairy production and quality assurance, while demonstrating strong prospects for patent protection through combinatorial and integrative patent applications.

Keywords: *Comprehensive integrated quality indicator of cow's milk; Device for identification of the comprehensive integrated quality indicator of cow's milk; Digital indicator of the dynamic state of cow's milk, which, according to the criteria of frequency, amplitude, resistance, inductance, and the set of dynamic characteristics of milk flow, is an integral equivalent of the current content and concentration of components in cow's milk; Comprehensive Integrated Digital Indicator of the dynamic and electrochemical state of cow's milk*

Real-Time Device for Monitoring the Current State of Cow's Milk

The device is intended for the real-time monitoring and assessment of the current value of a comprehensive digital indicator of the dynamic quality state of cow's milk.

The Comprehensive Digital Indicator of the Dynamic State of Cow's Milk is an integral parameter that, based on the criteria of frequency, amplitude, resistance, inductance, and the set of dynamic characteristics of milk flow, serves as an integral equivalent of the current content and concentration of components in cow's milk, as well as the relationships, including biological interactions, among these components.

The device for the selective real-time identification of the Comprehensive Digital Indicator of the Dynamic State of Cow's Milk is a compact module designed for operation on dairy farms or in field conditions, with power supplied by solar panels.

The device has minimal energy consumption.

The device includes functionally interconnected systems for milk input, output, monitoring, and flow transformation, wherein the milk-flow transformation system incorporates an aerodynamic mechanism for removing gases from the milk flow.

The device may be configured for stationary applications as well as for rapid analysis.

Comprehensive Integrated Quality Indicator of Cow's Milk and a Device for Its Real-Time Identification

The Digital Indicator of the Dynamic State of Cow's Milk is a parameter that, based on the criteria of frequency, amplitude, resistance, inductance, and the set of dynamic characteristics of milk flow, serves as an integral equivalent of the current content and concentration of components in cow's milk.

The device for the selective real-time identification of this Comprehensive Integrated Digital Indicator of the Dynamic and Electrochemical State of Cow's Milk is a com-

pact device designed for operation on dairy farms or in field conditions, with power supplied by solar panels.

The device has minimal energy consumption.

The device includes functionally interconnected systems for milk input, output, monitoring, and flow transformation, wherein the milk-flow transformation system incorporates an aerodynamic mechanism for removing gases from the milk flow.

The device may be configured for stationary applications as well as for rapid analysis.

Dynamic Indicator of the Current Somatic Cell Count in Cow's Milk and a Device for Its Selective Real-Time Identification

The Digital Indicator of the Dynamic State of Cow's Milk is a parameter that, based on the criteria of frequency, amplitude, resistance, inductance, and the set of dynamic characteristics of milk flow, serves as an integral equivalent of the current content and concentration of somatic cells in cow's milk.

The device for its selective real-time identification is a compact device designed for operation on dairy farms or in field conditions, with power supplied by solar panels.

The device has minimal energy consumption.

The device includes functionally interconnected systems for milk input, output, monitoring, and flow transformation, wherein the milk-flow transformation system incorporates an aerodynamic mechanism for removing gases from the milk flow.

The device may be configured for stationary applications as well as for rapid analysis.

Dynamic Comprehensive Indicator of the Current Fat Concentration in Cow's Milk and a Device for Its Selective Real-Time Identification

The Digital Indicator of the Dynamic State of Cow's Milk is a parameter that, based on the

criteria of frequency, amplitude, resistance, inductance, and the set of dynamic characteristics of milk flow, serves as an integral equivalent of the current content and concentration of fat or fatty acids in cow's milk.

The device for its selective real-time identification is a compact device designed for operation on dairy farms or in field conditions, with power supplied by solar panels.

The device has minimal energy consumption.

The device includes functionally interconnected systems for milk input, output, monitoring, and flow transformation, wherein the milk-flow transformation system incorporates an aerodynamic mechanism for removing gases from the milk flow.

The device may be configured for stationary applications as well as for rapid analysis.

Dynamic Comprehensive Indicator of the Current Lactose Content in Cow's Milk and a Device for Its Selective Real-Time Identification

The Digital Indicator of the Dynamic State of Cow's Milk is a parameter that, based on the criteria of frequency, amplitude, resistance, inductance, and the set of dynamic characteristics of milk flow, serves as an integral equivalent of the current lactose content in cow's milk.

The device for its selective real-time identification is a compact device designed for operation on dairy farms or in field conditions, with power supplied by solar panels.

The device has minimal energy consumption.

The device includes functionally interconnected systems for milk input, output, monitoring, and flow transformation, wherein the milk-flow transformation system incorporates an aerodynamic mechanism for removing gases from the milk flow.

The device may be configured for stationary applications as well as for rapid analysis.

Comprehensive Integrated Mastitis Indicator in a Cow and a Device for Its Real-Time Identification

The Digital Indicator is a parameter that, based on the criteria of frequency, amplitude, resistance, and inductance, serves as an integral equivalent or indicator of the occurrence of mastitis in a cow.

The device for its real-time identification is a compact device designed for operation on dairy farms or in field conditions, with power supplied by solar panels.

The device has minimal energy consumption.

The device includes functionally interconnected systems for milk input, output, monitoring, and flow transformation, wherein the milk-flow transformation system incorporates an aerodynamic mechanism for removing gases from the milk flow.

The device may be configured for stationary applications as well as for rapid analysis.

The aforementioned Comprehensive Integrated Digital Indicator of the Dynamic and Electrochemical State of Cow's Milk and the Presence of Mastitis, together with the device for its real-time measurement, have, as a patent application entitled "Device, Program, System, and Associated Method of Application," been recognized as fully patentable on the basis of an extensive patent search and may be protected through a combinatorial and integrative patent application.

Device for Non-Contact Monitoring of Cow's Milk Condition Parameters

The device includes systems for introducing milk for monitoring, removing the milk flow from the monitoring zone, and a sensor-based electronic integrated monitoring module with an interface.

The device may include a signal identification system and a unit for the accelerated comparison of identified signals with a reference standard.

The aforementioned device, program, system, and associated method of application have, on the basis of an extensive patent search, been recognized as fully patentable and may be protected through a combinatorial and integrative patent application.

Device for Simultaneous Monitoring of Multiple Cow's Milk Condition Parameters During Transportation

The device is available in two configurations.

The first configuration is intended for installation on tanker containers for monitoring milk quality during transportation and

during the transfer of milk for dairy product processing.

The second configuration is intended for installation on flexible or rigid pipelines through which milk is directed to storage tanks. This configuration may additionally include real-time temperature measurement functions.

The aforementioned device, program, system, and associated method of application have, on the basis of an extensive patent search, been recognized as fully patentable and may be protected through a combinatorial and integrative patent application.

Device for Rapid Analysis of Cow's Milk Quality

The device is a mobile compact instrument with an internal chamber into which milk (or any other liquid) is introduced for analysis.

A sensor selectively tuned to a specific parameter of milk or any other liquid is positioned around the chamber.

The device does not require adjustment or calibration and incorporates multiple levels of protection.

The aforementioned device, program, system, and associated method of application have, on the basis of an extensive patent search, been recognized as fully patentable and may be protected through a combinatorial and integrative patent application.

Device for Selective Rapid Analysis of Cow's Milk Quality Parameters

The device is a mobile compact instrument with an internal chamber into which milk (or any other liquid) is introduced for analysis.

A sensor selectively tuned to a specific parameter of milk or any other liquid is positioned around the chamber.

The device does not require adjustment or calibration and incorporates multiple levels of protection.

The aforementioned device, program, system, and associated method of application have, on the basis of an extensive patent search, been recognized as fully patentable and may be protected through a combinatorial and integrative patent application.

Non-Contact Milk Level Sensors for Storage Tanks

The device monitors the level of milk (or any other liquid) within a dedicated section of a pipeline connected to the tank in which the liquid level is being monitored.

The device is available in several configurations.

It may be installed inside the liquid-containing tank, outside the tank, and may incorporate various sensor designs.

The aforementioned device, program, system, and associated method of application have, on the basis of an extensive patent search, been recognized as fully patentable and may be protected through a combinatorial and integrative patent application.

Device for Comprehensive Monitoring of Milk Level in Storage Tanks with Simultaneous Evaluation of the Integrated Milk Quality Indicator at That Level

The device monitors the level of milk (or any other liquid) within a dedicated section of a pipeline connected to the tank in which the liquid level is being monitored.

The specified section of the pipeline simultaneously functions as a resonant sensor configured for monitoring and evaluating the integrated quality indicator of milk (or any other liquid) and as a level sensor.

The device may also simultaneously monitor various physical characteristics of milk or other liquids, such as conductivity, density, and acidity level.

The aforementioned device, program, system, and associated method of application have, on the basis of an extensive patent search, been recognized as fully patentable and may be protected through a combinatorial and integrative patent application.

Device for Comprehensive Monitoring of Milk Level in Storage Tanks with Simultaneous Assessment of the Somatic Cell Count in Milk at That Level

The device monitors the level of milk (or any other liquid) within a dedicated section of a pipeline connected to the tank in which the liquid level is being monitored.

The specified section of the pipeline simultaneously functions as a resonant sensor configured for monitoring the somatic cell count and as a level sensor.

The device may also simultaneously monitor various physical characteristics of milk or other liquids, such as conductivity, density, and acidity level.

The aforementioned device, program, system, and associated method of application have, on the basis of an extensive patent search, been recognized as fully patentable and may be protected through a combinatorial and integrative patent application.

Device for Comprehensive Monitoring of Milk Level in Storage Tanks with Simultaneous Assessment of Fat Content in Milk at That Level

The device monitors the level of milk (or any other liquid) within a dedicated section of a pipeline connected to the tank in which the liquid level is being monitored.

The specified section of the pipeline simultaneously functions as a resonant sensor configured for monitoring fat concentration and as a level sensor.

The aforementioned device, program, system, and associated method of application have, on the basis of an extensive patent search, been recognized as fully patentable and may be protected through a combinatorial and integrative patent application.

Device for Comprehensive Monitoring of Milk Level in Storage Tanks with Simultaneous Assessment of Lactose Content in Milk at That Level

The device monitors the level of milk (or any other liquid) within a dedicated section of a pipeline connected to the tank in which the liquid level is being monitored.

The specified section of the pipeline simultaneously functions as a resonant sensor configured for monitoring lactose concentration and as a level sensor.

The aforementioned device, program, system, and associated method of application have, on the basis of an extensive patent search, been recognized as fully patentable and may be protected through a combinatorial and integrative patent application.

Device for Comprehensive Monitoring of Milk Level in Storage Tanks with Simultaneous Assessment of Blood Trace Content in Milk at That Level

The device monitors the level of milk (or any other liquid) within a dedicated section of a pipeline connected to the tank in which the liquid level is being monitored.

The specified section of the pipeline simultaneously functions as a resonant sensor configured for monitoring blood concentration and as a level sensor.

The aforementioned device, program, system, and associated method of application have, on the basis of an extensive patent search, been recognized as fully patentable and may be protected through a combinatorial and integrative patent application.\

Device for Comprehensive Monitoring of Milk Level in Storage Tanks with Simultaneous Sequential Assessment of the Concentration of Basic Components in Milk at That Level

The device monitors the level of milk (or any other liquid) within a dedicated section of a pipeline connected to the tank in which the liquid level is being monitored.

The specified section of the pipeline simultaneously functions as a resonant sensor configured for parameter monitoring and as a level sensor.

The aforementioned device, program, system, and associated method of application have, on the basis of an extensive patent search, been recognized as fully patentable and may be protected through a combinatorial and integrative patent application.

Device for Comprehensive Monitoring of Milk Level in Storage Tanks with Simultaneous Assessment of the Concentration of Multiple Basic Components in Milk at That Level

The device monitors the level of milk (or any other liquid) within a dedicated section of a pipeline connected to the tank in which the liquid level is being monitored.

The specified section of the pipeline simultaneously functions as a resonant sensor configured to monitor parameters and component concentrations in milk or any other liquid and incorporates multiple sensors,

each configured to monitor a specific parameter, with each sensor simultaneously serving as a level sensor.

The aforementioned device, program, system, and associated method of application have, on the basis of an extensive patent search, been recognized as fully patentable and may be protected through a combinatorial and integrative patent application.

Device for Modifying the Turbulence Level of Milk Flow

The device is intended for the conversion and dynamic transformation of a turbulent milk flow, creating within it a localized laminar-flow zone in which milk monitoring is performed using a resonant sensor.

In addition, during flow transformation, the device releases air from the milk flow and stabilizes its hydrodynamic characteristics.

The aforementioned device, program, system, and associated method of application have, on the basis of an extensive patent search, been recognized as fully patentable and may be protected through a combinatorial and integrative patent application.

Device for Preparing Milk Flow for Real-Time Monitoring of Condition Parameters

The device is intended for the conversion and dynamic transformation of milk flow, creating a localized laminar-flow zone in which milk monitoring is performed using a resonant sensor.

The aforementioned device, program, system, and associated method of application have, on the basis of an extensive patent search, been recognized as fully patentable and may be protected through a combinatorial and integrative patent application.

Device for Real-Time Monitoring of Gas Content in Milk

The device is a resonant sensor that detects changes in a set of parameters in milk depending on the concentration of air or any other gas contained within it.

The device may simultaneously monitor the degree of pipeline filling through which the milk flow is moving and the level of turbulence of the milk flow within the pipeline.

The aforementioned device, program, system, and associated method of application have, on the basis of an extensive patent search, been recognized as fully patentable and may be protected through a combinatorial and integrative patent application.

Milk Aeration Process Control System with Real-Time Monitoring of Air Content in Milk

The milk aeration process control system with monitoring of the air-content level in milk incorporates feedback from a resonant sensor and adjusts the parameters of compressed air according to the concentration of air in the milk.

The system includes a resonant sensor, an interface, and a converter that transforms signals from the sensor into control signals for the compressed-air source, through which the pressure and flow rate of the compressed air are adjusted.

The system also incorporates an aerodynamic function for introducing air into the milk.

The aforementioned device, program, system, and associated method of application have, on the basis of an extensive patent search, been recognized as fully patentable and may be protected through a combinatorial and integrative patent application.

On the Methodology for Monitoring a Cow's Condition for the Presence of Subclinical Mastitis and Mastitis with Evident Clinical Signs:

The primary parameter indicating the presence of mastitis is the somatic cell count in milk.

In cases of subclinical mastitis, which occurs much more frequently, monitoring the somatic cell count alone is generally insufficient. It is necessary to monitor a number of additional parameters that, together with an elevated somatic cell count, characterize the condition associated with so-called subclinical mastitis.

In such cases:

- Milk viscosity decreases.
- The chloride-sugar index increases.
- Electrical conductivity increases.
- pH increases to 6.83–7.19.

- Density decreases to 1.024–1.025 (compared to the normal value of 1.027).
- Fat content decreases.

Milk samples will be supplied in three specimens from each milking of a single cow – the initial stage of milking, the middle stage of milking, and the final stage of milking.

The samples differ from one another in all constituent parameters, such that milk from the initial stage of milking is the least concentrated, while milk from the final stage of milking is the most concentrated.

For the first series of experiments, the following is proposed:

1. Comparison of the three milk samples with one another using the integrated indicator.
2. Addition of sugar to the samples.

3. Addition of glucose to the samples.
4. Monitoring of electrical conductivity.
5. Monitoring of pH.
6. Monitoring of fat content.
7. Monitoring of viscosity.
8. Monitoring of density.
9. Addition of carbamide (urea).
10. Addition of blood.

(Based on these results, an analytical report should be prepared and coordinated with leading institutes and university laboratories.)

The three samples should be stored at room temperature for 1 day, 3 days, and 5 days, after which the tests should be repeated.

All of the above experiments may be conducted prior to the receipt of specialized laboratory instruments intended for verification testing.

List of References and Patent Applications

Apparatus and Method for Fluid Monitoring. United States Patent Application No. 20120029845 A1. Published February 2, 2012.

Determination of Attributes of Liquid Substances. United States Patent Application No. 20130173180 A1. Published July 4, 2013.

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