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COMPOSITE DAIRY FOOD PRODUCTS. (Composite dairy food products as a result of an integrative innovative technological process)

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Abstract

As discussed in the article, various types of fermented dairy food composites and integrated food compositions that can be produced even under domestic conditions while ensuring high quality and sterility are considered. Particular attention is given to the development and practical application of an original device intended for whipping food composites, including composite butter.

The article describes an apparatus for whipping and homogenization of food compositions and composite butter designed for the efficient processing of fermented dairy raw materials, primarily sour cream or cream, including products with reduced fat content. The possibility of using preliminarily fermented raw materials and components is also examined.

Special emphasis is placed on the ability of the device to effectively process not only pure sour cream, but also sour cream compositions containing various additives, predominantly of plant origin. The article additionally considers the modification of composite butter through the introduction of vegetable fats during the whipping process in order to regulate the balance between vegetable and animal fats in the final product.

The design features of the apparatus make it possible to flexibly adapt the system for the production of butter and food composites with various additives and in different production volumes. The universality of the device and the possibility of rapid reconfiguration for the processing of multicomponent food compositions are highlighted as significant operational advantages.

The article also examines the structural configuration of the mixer flask consisting of three composite elements, including original engineering components that significantly influence the whipping process and the quality of the resulting commercial products.

Particular attention is devoted to the technological process of producing butter from multicomponent fermented dairy matrices with varying fat content. The described process includes the sequential introduction of dairy and plant-based components into the mixer flask, hermetic sealing of the working chamber, installation of the mixer flask into the drive system, and con-

trolled positioning of the rotational axes during the whipping process.

Such an approach makes it possible to create multifunctional food-processing systems intended for the production of innovative composite dairy products with improved technological and nutritional characteristics.

Keywords: *Food products, Dairy food products, Composite dairy food products, Fermented dairy food products, Device for whipping food composites, Device for whipping food composites, including composite butter, Description of the original apparatus and principles of its practical application, Apparatus for whipping and homogenization of food compositions, Apparatus for whipping and homogenization of food compositions and composite butter, The apparatus is intended for the efficient whipping of these complex products from fermented dairy raw materials, Fermented dairy raw materials, primarily sour cream or cream, predominantly with low fat content, Initial products or components may be preliminarily subjected to fermentation, Possibility of efficient whipping of the product not only from pure sour cream, but also from sour cream with various additives, mainly of plant origin, Possibility of modification of composite butter through the introduction of vegetable-origin fats during the whipping process in order to change the balance of vegetable and animal fats in the butter*

Introduction

Principal differences of the whipping process for a food composite based on butterfat compositions compared to existing processes of similar purpose:

- the whipping process is carried out in a flask having the shape of a cylinder closed at both ends by hemispherical covers equipped with axial conical openings;
- the entire flask structure, consisting of a cylindrical shell with conical edge surfaces and two hemispherical covers having conical chamfers at their bases and coaxial conical openings along the axis, is assembled and hermetically sealed by introducing fixing and sealing elements into the conical openings of the covers previously aligned with the cylindrical shell through corresponding conical surfaces; these elements perform clamping, orientation, fixation, and sealing functions for the internal volume of the structure;
- due to these structural features, the whipping process obtains not only formal structural distinctions, but also significant technological advantages reflected in the quality of the final product and in the expansion of the technological capabilities of the butter-whipping process;
- the whipping chamber is designed as a detachable and reconfigurable structure;
- during the whipping process, controlled access to the internal volume is possible for the introduction of components, removal of waste products, or extraction of part of the processed composition;
- the conical openings of the hemispherical covers contribute to a more effective fragmentation and homogenization of the mixture during impact against the internal hemispherical surfaces, simultaneously performing activating, orienting, sealing, fixing, and technological gateway functions;
- the described construction makes it possible to use several interchangeable flask assemblies within one whipping apparatus, enabling rapid changes in the composition of the whipped mixture, including the characteristics and fat content of the fermented dairy matrix;
- hydrodynamic parameters of the whipping process are substantially improved due to the geometric configuration of the flask elements and the transformation of the whipped mass from cylindrical to spherical form during impact interactions;
- the described impact mechanism creates a kinetic diversity of forced changes in the volume and geometric configuration of the whipped mass under the influence of multiple force factors generated by the geometry of the flask and the kinematics of the whipping apparatus.

The photo shows some of the many different types of fermented dairy food composites and integrated food composites that can be produced even under domestic conditions while ensuring high quality and sterility.

Photo 1.

The presented testing results of the hemispherical cover models demonstrate that:

- their construction is technologically efficient;
- they possess high mechanical strength;
- they are convenient for maintenance;
- they satisfy hygienic requirements;
- they may be manufactured from various materials;
- different variants of hemispherical covers may be used with the same cylindrical shell configuration while preserving the compatibility of all connection elements.

Device for whipping food composites, including composite butter – description of the apparatus and principles of practical application.

The apparatus for whipping and homogenization of food compositions and composite butter is intended for the efficient processing of complex products based on fermented dairy raw materials, primarily sour cream or cream, including products with reduced fat content. Initial products and components may be preliminarily subjected to fermentation.

Preliminary testing demonstrated the possibility of efficient whipping not only of pure sour cream, but also of sour cream compositions containing various additives predominantly of plant origin.

Such additives may include:

- carrot juice;
- carrot puree or paste;
- tomato juice;
- tomato paste;
- cucumber brine;
- cucumber puree;
- avocado puree;
- kiwi puree;
- sweet pepper puree;
- various zucchini purees;
- fruit purees including apple, plum, peach, pear, apricot, pineapple, and tropical fruit and vegetable purees;
- combinations of the listed additives with dill, garlic, onion, and lemon;
- prune pulp;
- preserves made from chokeberry, sea buckthorn, and other medicinal berries;
- berry purees including strawberry, wild strawberry, blueberry, blackcurrant, raspberry, mulberry, viburnum, gooseberry, and others.

The above list may be expanded through the use of fruits and vegetables from different geographical regions in various combinations.

Modification of composite butter is possible through the introduction of vegetable fats during the whipping process in order to regulate the balance between vegetable and animal fats in the final product.

To expand the application range of the butter-whipping device, its design allows flexible reconfiguration for the production of butter compositions with different additives and in various production volumes.

The versatility of the apparatus, including the possibility of rapid reconfiguration for whipping composite butter with different components, constitutes one of its principal operational advantages.

The mixer flask consists of three structural elements, among which the following components exert the greatest influence on whipping efficiency and the characteristics of the resulting commercial products:

- the cylindrical shell of the mixer flask containing conical recesses for hermetic sealing, centering, and volumet-

ric orientation of the flask geometry within three-dimensional space;
- the upper hemispherical cover containing two coaxial conical surfaces intended for centering, orientation, and sealing of the internal flask volume while allowing the introduction of components through the axial fixation system;
- the lower hemispherical cover containing three coaxial conical surfaces intended for centering, orientation, sealing, and removal of technological waste products generated during the whipping process.

The process of producing high-quality homogenized butter without additives includes the following operations:

After cleaning from the previous production cycle, the flask and hemispherical covers are preliminarily aligned along the conical surfaces, mounted within the frame, and compressed axially until complete alignment of all conical interfaces is achieved.

The required volume of sour cream or fermented cream is then introduced into the internal volume of the flask through the upper fixation system.

The sealing plug is closed and rotation of the frame with the flask is initiated. The sour cream moves along the internal axis of the flask and impacts the hemispherical covers during each half-rotation of the frame.

After completion of the whipping cycle, the system is stopped, the flask is positioned vertically, and the lower valve is opened for removal of technological by-products formed during the whipping process.

The fixation systems are then released, the flask is removed, the covers are detached, and the whipped butter is extracted from the cylindrical shell. The three structural components are subsequently cleaned and replaced with a new interchangeable set.

When additives or additive combinations are required, all components are introduced according to the described technological scheme.

The possibility of flexible introduction of components depending on process time, product readiness, temperature changes, or chemical-technological indicators substantially expands the operational and technological capabilities of the apparatus.

Process and apparatus for whipping animal composite butter from multicomponent raw materials containing plant-based and animal-origin components integrated into a fermented dairy matrix in various proportions:

The invention relates to a process for whipping animal butter predominantly from multicomponent raw materials based on a fermented dairy matrix with any fat content, including reduced fat content.

The process includes:
- formation of the initial material within the internal volume of the mixer flask through sequential introduction of the fermented dairy matrix and plant-based and animal-origin additives;
- installation of the mixer flask into the drive frame and hermetic sealing of the internal volume through axial fixation of the hemispherical covers;
- mounting of the drive frame within the rotating support structure while maintaining a defined angle between the axis of the flask and the axis of spindle rotation throughout the whipping process;
- reciprocating movement of the processed material along the flask axis with periodic impact interaction against the hemispherical surfaces during each half rotation of the spindle system;
- repeated reversal of the movement direction of the processed material;
- accumulation of kinetic energy during each change in movement direction;
- removal of technological waste products;
- depressurization and removal of the flask from the frame;
- removal of the hemispherical covers and extraction of the whipped product from the cylindrical shell.

The apparatus for whipping animal butter from multicomponent raw materials based on a fermented dairy matrix and plant-based and animal-origin additives consists of permanent and interchangeable elements. Permanent elements include spindles mounted within a drive bracket and connected to a mixer drive frame. The cylindrical shell of the mixer flask contains conical recesses into

which corresponding conical protrusions of the hemispherical covers are inserted.

The apparatus for whipping animal butter from a fermented dairy low-fat matrix with plant-based and animal-origin additives includes permanent and interchangeable elements connected through rotational and reciprocating kinematic mechanisms.

The described process involves repeated impact interaction of the multicomponent mixture with hemispherical surfaces limiting the internal cylindrical volume of the detachable flask. The reciprocating movement and kinetic acceleration continuously change direction relative to the rotational phase of the detachable mixer flask.

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