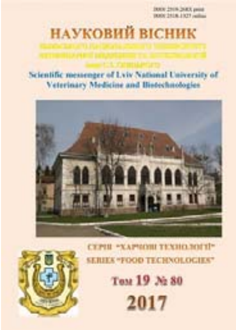

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The latest technologies of milk processing

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The paper describes the use of membrane pasteurization methods for milk processing (ultra- and microfiltration-separation of pressure limits 0.1). The processing problem is crucial in the production of industrial milk, it solves new technologies for the production of cheese from ultra high-temperature processing of raw materials with the latest technologies for the use of materials (SCHREIBER and HUBER) This extreme heat treatment has been proven for inactivated bacterial concentrates or bactofugs, which are produced by purifying bacteria – bactofugate. The indirect process of UHT and VT treatment is less intense to disinfect microorganisms, because it needs to be heated, pasteurized with an uninterrupted process of UVT. This definition is the processing of industrial milk is valid toda.

Key words: *processing, production, industry, cottage cheese, industrial milk, baktofuga.*

Новітні технології обробки молока

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У статті викладено використання мембранних пастеризаційних методів обробки молока (ultra- і microfiltration – separation межі тиску 0.1.). Проблема обробки є вирішальною в заготівлі індустріального молока. Її вирішенням є використання новітніх технологій для виробництва сиру. Воно полягає в ультра високотемпературній обробці сировини при новітніх технологіях використання матеріалів (SCHREIBER і HUBER). Ця екстремальна термічна обробка була доведена для інактивованих бактерійних концентратів або бактофуг, які виробляються шляхом очистки від бактерій – бактофугату. Непрямий процес УВТ та ВТ обробки менш інтенсивний для знезараження мікроорганізмів, тому що потрібно підігрівати, пастеризувати з безперебійним процесом УВТ. Таке визначення для обробки індустріального молока є актуальним сьогодні.

Ключові слова: *обробка, виробництво, промисловість, сичужний сир, індустріальне молоко, бактофуга.*

Новые технологии переработки молока

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В статье изложены использования мембранных пастеризационных методов обработки молока (ultra- и microfiltration – separation пределы давления 0.1). Проблема обработки является актуальной в заготовке индустриального молока. Она решается с помощью применения новых технологий, которые заключаются в использование ультра высокотемпературной

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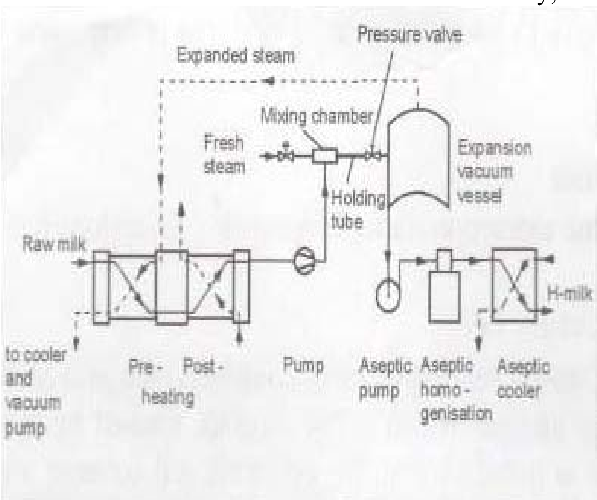
обработки сырья при новейших технологиях материалов (SCHREIBER и HUBER) для производства сыра. Эта экстремальная термическая обработка была доказана для инактивированных бактериальных концентратов после бактофугирования, путем очистки от бактерий – бактофугата. Косвенный процесс УВТ и ВТ обработки менее интенсивный для обеззараживания микроорганизмов, так как нужно подогревать, пастеризовать с бесперебойным процессом УВТ. Предлагаемый процесс обработки индустриального молока есть эффективным и актуальным сегодня.

Ключевые слова: *обработка, производство, промышленность, сычужный сыр, индустрия.*

Ultra high heat treatment. During the UHT (Ultra high temperature) treatment, nearly all bacteria and spores are destroyed due to an intensive heat treatment (140 °C/3...4s). In UHT milk, mesophilic spore formers can occur, producing spores with an extreme heat-resistance. These germs are marked with the term HRS (= heat-resistant spore forms). Their spore formation is very low (1:1 000); furthermore, they show only a low metabolic activity. Carbohydrates are not attacked, protein-cleaving enzymes (proteases) are barely detectable, but they are not very active (Molska, 1988; Kazumoto and Tetsuo, 1988; Tverdoxleb et al., 1991; Kosikowski and Mistry, 1997; Usuinee et al., 1998; Boucher et al., 2006).

From a microbiological point of view, UHT milk would be an ideal raw material for a cheese dairy, as starter culture could propagate without any inhibition; however denaturation of protein, especially whey protein, is so significant that rennet coagulation despite technological means would be very difficult. Therefore, UHT treatment for cheese milk and prepared concentrates is used only in some very exceptional cases.

Utilisation of membrane separation methods (ultra- and microfiltration – separation limits 0.1 jam) enable new technologies for the manufacture of cheese from UHT-based new material (Schreiber and Huber). This extreme heat treatment has been proven useful for the inaptivation of bacterial concentrates or bactofugates, which are generated during bactofugation and during microfiltration. The indirect UHT process is less energy-intensive due to heat recovery compared to the direct UHT process.



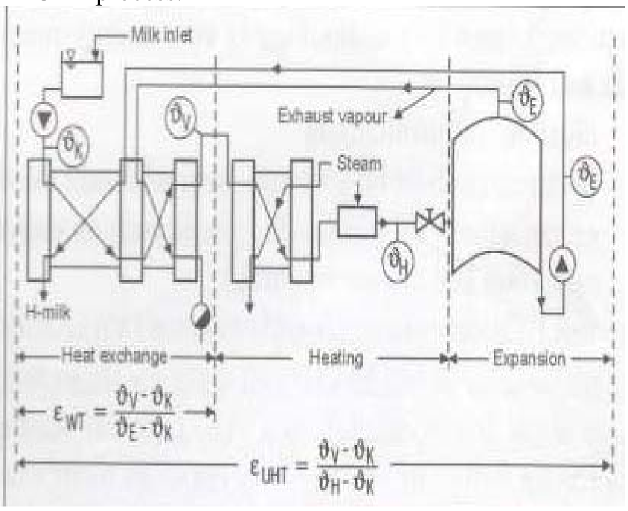


Fig. 1. Schema of a UHT plant with direct Fig. 2.2 Schema of a UHT plant with indirect heating (Kessler, 1996) heating (Kessler, 1996):

V_V = Preheating of milk

V_k = Temperature of store milk

V_h =UHT-milkheating temperature

Speeds, being greater than the speed of sound in a surrounding medium, are considered ultrasound. Speed of sound depends on equilibrium density and material properties of the surrounding medium. In air. speed of sound is 331 mis,whereas in water it is 1464 m/s. In liquids it can be calculated based on the following formula:

Cs = Speed of progressing waves of sound in a liquid medium

$Cs = \sqrt{1/C \times \rho 0}$ C = Compression module

ρ0 = Density equilibrium.

Rogenhofer et al. made a comparative study between transsonic inactivation and pasteurisation. This new technology is based on the principle of an increased compressibility of homogeneous doublephase flows compared to compressibility of liquids or gases only. A transsonic device is separated into 3 sections in the interior. The first two sections are linked by holes via compressed air tubes to feed tanks. By injecting steam via a small nozzle into the first cavity, a vacuum is generated, as well as in the second cavity. Due to this vacuum, the inlet valve opens (after it has been deblocked) and medium is sucked in on its own. A diffuser, oriented against the flow and acting as a homogenisation nozzle, limits the third cavity. Steam and medium (to be treated) are blended with each other into a double-phase mixture at the lowest cross section of the device inlet. An immense velocity is reached, resulting in pressure pulses, leading to an implosion of the steam phase. Another hydraulic flow status is generated, and heated liquid (milk) subsequently leaves the device under elevated pressure. This operational step combines basic unitoperations such as pasteurisation, homogenisation and in addition transportation (pumping effect by pressure differential), sucking (formation of vacuum), blending and dosing.

Such a transsonic germ inactivation of milk is at least equal to a heat treatment in a heat exchanger. Germ and enzyme reduction as well as whey protein denaturation are similar to a large extent, as a comparative study has shown. Homogenisation shows not only a disintegration of fat globules, but also a loosening of protein structure. Consequences are a slight reduction of rennet coagulation time and a softer gel, linked to a significantly reduced liquid separation (syneresis). Fat transfer (milk —» cheese) is higher though, but transfer of fat-free dry matter is slightly reduced.

Ultrasound treatment

Sound at a frequency of > 20 kHz is considered ultrasound. It leads to a dispersion of many substances. Ultrasound technology is very energy-intensive, but is very versatile and is used in cleaning of installations disintegration of fat globules, also of casein micelles enhancement of various processes such as enzyme extraction during important conversions (coagulation and cheese ripening) inactivation of bacteria and enzymes.

At frequencies of 15... 25 kHz cell walls are destroyed, reason being cavitations combined with generated large shear forces, leading to a very high temperature increase within a few seconds. Caused by this enormous inflow of energy, the cytoplasm membrane is detached from the cell wall, cell contents are ejected, and cells die. A microwave treatment can be done both in a discontinuous or continuous mode, where the latter one is the preferred method. Effects of ultrasound depend on several criteria:

- Technical/technological
- Product specific
- Exposure time pH-value – viscosity
- Intensity Fat content-temperature

Design of sonotron, construction of device.

Pressure In particular, the following tendencies exist:

Tab. 1

Effects of product data on effects of ultrasound

Product-Data	Effect *weak*	*good*
H-value Viscosity Fat content Temperature	pH 7 high high > 10...< 70 °C	pH ~6.8 and>pH 7.1 low Low ~10 °C and ~ 70 °C

Adequately tempered and standardised (fat content and others), milk is exposed to 18...20 kHz and > 2 000 W. Subject to conditions, 30 s are sufficient, sometimes several minutes are required. During this time, localised pressure can increase up to 100 MPa and spontaneous temperatures of up to 134 °C can be reached. Under increasing pressure, especially in combination with increased temperature, germ inactivation increases. Gram-negative germs are more sensible than gram-positive ones and cocci. Heat-stable spores of Bacillus cereus, Bac. stearothermophilus and Bac. coagulans are destroyed at 20 kHz, 30 bars and 112 °C. Peroxidase, lipoxidase and polyphenoloxidase are inactivated. According to Roiner, cheese yield and consistency can be improved. However, fat is impaired, leading to taste defects such as «tallowy» and «cooked taste».

Centrifugal milk degermination (Bactofugation).

Pasteurisation does not inactivate spores of Clostridia, causing *late bloating* in hard and semi-hard cheese. Germination of these pathogens is – as strange as it is – induced by these heat treatment processes. Above mentioned groups of cheese can only be manufactured from high quality milk with < 1 spore/ml. After feeding of milk cows with improperly prepared silage, milk with >35 lactate fermenting spores of Clostridia can occur. Spores represent only 8% of all species of Clostridium, but a relative high percentage decomposes protein and does ferment lactose, negatively affecting cheese quality.

Tab. 2

Distribution of clostridia in raw milk and their metabolic properties

Percent of strains %	Species Clostridium (Cl.)	Metabolic properties
35	Cl. sporogenes	Proteolytic
12	Cl. perfringens	Proteolytic
11	Cl. butyricum	Lactolytic
8	Cl. tyrobutyricum	Lactate fermenting
7	Cl. tetanomorphum	
6	Cl. beijerinckii	
4	Cl. pasteurianum	
4	Cl. fertium	
2	Cl. novyl	
~11	Non-assigned	

Germination of spores can be inhibited by addition of *nitrate*; however, during decomposition of nitrate, traces of carcinogenic nitrosamine can develop. This was reason enough to limit utilisation of nitrate to 0.15 g/1 cheese milk in some countries or even to prohibit it.

Microorganisms, mainly spores, can be separated from milk due to their higher density (*Cl. tyro- butyricum* 1.32 g/cm^3, *Bacillus spores* 1.305 g/cm^3, *vegetative bacterial cells* 1.07...1.115 g/cm^3), as milk has a specific gravity of 1.033 g/1 at 20 °C, which is reduced to 1.005 g/ml at 80 °C. A proven temperature is 58...60 °C, sometimes it has been increased to 70 °C Sedimentation velocity of bacteria from milk can be calculated as per the formula of Stokes:

$$v = \frac{D^2 \times \Delta p}{18 \times n} \times g, \qquad (1)$$

V = Sedimentation velocity (m/s)

D = Diameter of germs (m)

Δp = Specific weight differential between milk and bacteria (kg/m^3)

g = Acceleration (m/s^2)

n = Dynamic viscosity of milk (kg/ms)

The article analyzes the classification of starter cultures in wet industrial sector effect on cheese ripening. The issue of dairy cultures in the area requires further research.

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