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MANAGEMENT OF BUTTER PRODUCTION PROCESS BASED ON AUTOMATION AND INFORMATION AND COMMUNICATION SYSTEMS

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ABSTRACT

Butter is a food product made from milk, which mainly consists of milk fat and has a unique, characteristic taste, smell and plastic structure. In addition to fat, milk contains proteins, milk sugar, phosphatides, vitamins, minerals and many other substances, which can change the composition and quality of the finished product. Modern information communication in the production and storage of butter the use of processes allows to keep the composition and quality of oil stable during the storage process.

Key words: *Technological process of milk processing, plate heat exchanger, milk and cream pasteurization process, homogenization process, modern intellectual sensors, information and communication systems.*

INTRODUCTION

Butter contains milk fat, protein and lactose, as well as fat-soluble vitamins A (retinol), D (calciferol), E (tocopherols) and β-carotene, and water-soluble B (thiamine) and B2 (riboflavin) is a valuable food product due to the presence of vitamins in addition to minerals. Aromatic components of butter: diacetyl, volatile fatty acids, fatty acid esters, lecithin, protein, fats, lactic acid. Carotene (a coloring substance) gives the oil a yellow color. The nutritional value of ghee is increased by its phospholipids, especially lecithin, which is included in ghee along with the shell of fat globules. Low melting point of milk fat is 27..34 °C and hardening is 18...23 °C. Butter is divided into the following types: ghee (fat content 98%), Vologda (81.5 ... 82.5% fat), amateur (fat content 77.0 ... 78.0%) , farmer (71.0. ..72.5% fat), sandwich (61.5% fat), chocolate (62.0% fat), Yaroslavl (52.0% fat) [1,2].

Due to its taste and smell, butter is used together with many food products, improving their digestibility (the digestibility of milk fat - 97.0%, solids - 94.1 %). The energy value of butter is 20.0...37.6 MJ/kg.

METHODS

Currently, there are various technologies for the production of butter, which are used in production today. Butter is produced by processing cream and increasing the fat level of cream. Mechanical processing of cream in 2 ways; It is prepared in continuous and occasional processing methods. We mainly produce butter through continuous processing. One of the main technological parameters that must be controlled in the production of ghee, cooling of cream and physical cultivation is temperature. For cream pasteurization, type 1 cream is immediately pasteurized at 85-90 ^{o}C, type 2 at 92-95 ^{o}C for 30 minutes. After pasteurization, the cream should be rapidly cooled to 4-7 ^{o}C. At this temperature, the glycerides in the fat crystallize, the fat changes from a liquid state to a thick state, and as a result, the formation of fat grains improves during creaming. 50% of the glycerides in the cream crystallize during cooling, so the cream is physically ripened [3,4]. Physical maturation of cream is carried out for 5 hours at 4-6 ^{o}C in spring and summer, up to 7 hours at 5-7 ^{o}C in autumn-winter. The temperature of the cream should be 7-12 ^{o}C in spring-summer, 8-14 ^{o}C in autumn-winter. For making sandwiches, making creams in pastries and more. By processing milk, obtaining butter from it has been widely implemented. Butter contains many nutrients, enzymes and acids that are useful for humans (Figure 1).

Figure 1. Butter formation

Butter contains the following useful substances necessary for human health: amino acids, useful enzymes, essential fatty acids, riboflavin, thiamin, B6, B12, folate, phosphorus, zinc, potassium, magnesium, calcium. The maximum preservation of these substances in the composition of cream directly depends on the process of pasteurizing it at the required temperature [5,6]. If the cream is pasteurized at a temperature lower than the required temperature depending on the type of milk, bacteria harmful to human health will remain in the cream, and the butter made from it is considered unfit for consumption.

The pasteurization process begins with the pouring of fat cream and skimmed milk into the balancing tank (1). Depending on the type of butter produced in the balancing tank, the fat content of the cream to be pasteurized is prepared. Then the cream ready in the tanker is sent to the plate heat exchanger (3) using a pump (2). There, the cream is sent to the homogenization device (4) for partial homogenization after its temperature rises a little. Since the fat content of the cream to be homogenized should be a maximum of 18%, regular cream, for example, cream with a fat content of 40%, should be diluted with skim milk before homogenization. The power of the homogenizer is carefully calculated and set at a certain flow rate. In the partial homogenization mode, the homogenizer is also connected to the skim milk line so that it always has enough product to function properly. Milk with a standardized fat content is poured into the heating part of the heat exchanger, where it is pasteurized. The required holding time is provided by a separate holding tube (5). The pasteurization temperature is constantly recorded. After that, the pasteurized cream is immediately sent to another part of the heat exchanger for cooling, where it is first cooled with cold water and then with ice water to normal temperature, and then sent to the storage tanks.

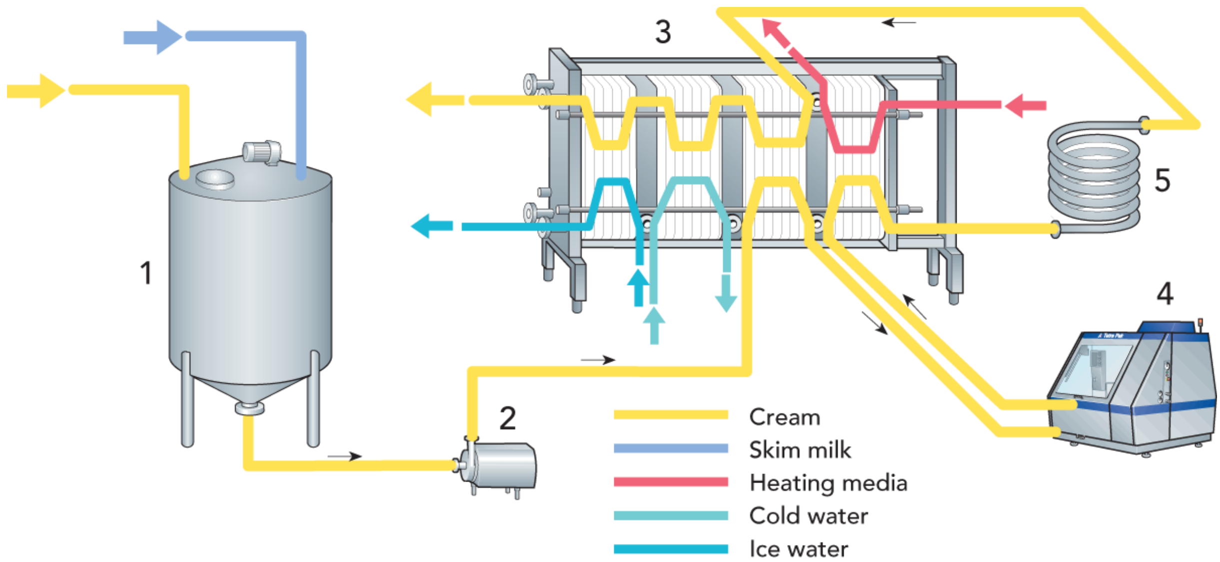

Figure 2. Pasteurization of cream. 1-Balance tank, 2- Product feed pump, 3- Plate heat exchanger, 4- Homogenizer,5- Holding tube.

Hot water heating systems. Hot water or saturated steam at atmospheric pressure can be used as the heating medium in pasteurizers. Hot steam, however, is not used because of the high differential temperature. The most commonly used heating medium is therefore hot water, typically about 2 – 3 °C higher than the required temperature of the product.Steam is delivered from the steam boiler at a pressure of 600 – 700 kPa (6 – 7 bar). This steam is used to heat water, which in turn heats the product to pasteurization temperature.The water heater in Figure 3 is a closed system consisting of a specially designed, compact and simple cassette-type plate heat exchanger (3) equipped with a steam regulating valve (2) and a steam trap (4).The service water is circulated by the centrifugal pump (5) via the heater (3) and the heating section of the pasteurizer.The function of the expansion vessel (7) is to compensate for the increase in the volume of the water that takes place when it is heated [7]. The system also includes pressure and temperature indicators as well as safety and ventilation valves (8).

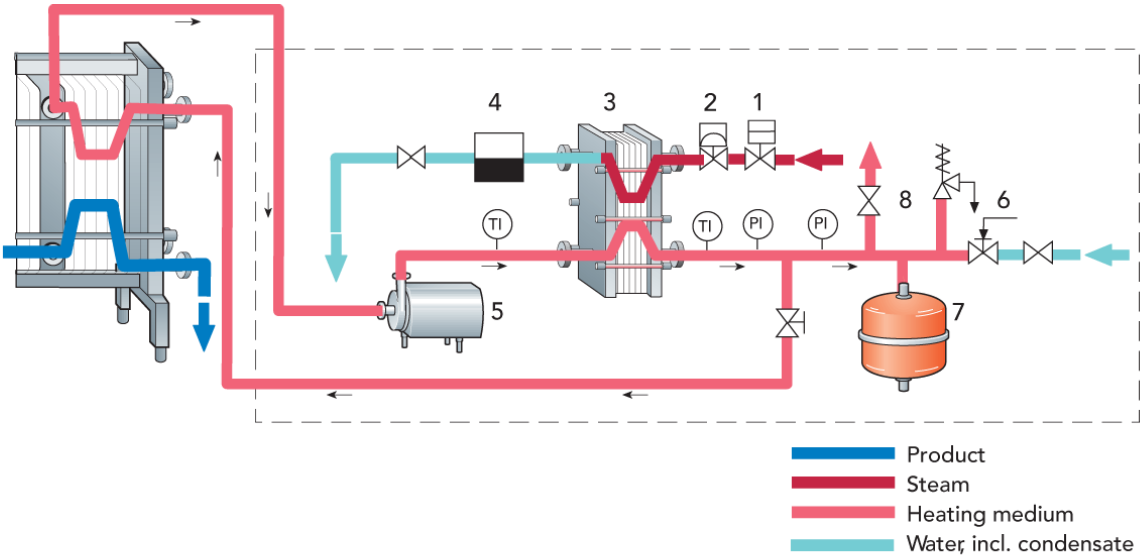

Fig. 3.Principle of the hot water system connected to a pasteurizer.

1. Steam shut-off valve
2. Steam regulating valve
3. Heat exchanger
4. Steam trap
5. Centrifugal pump
6. Water regulating valve
7. Expansion vessel
8. Safety and ventilation valves

- TITemperature indicator
- PIPressure indicator

Pasteurizer cooling system. As already noted, the product is cooled mainly by regenerative heat exchange. The maximum practical efficiency of regeneration is about 94 – 95%, which means that the lowest temperature obtained by regenerative cooling is about 8 – 9 °C. Chilling the milk to 4 °C for storage therefore requires a cooling medium with a temperature of about 2 °C. Ice water can only be used if the final temperature is above 3 – 4 °C. For lower temperatures, it is necessary to use brine or alcohol solutions, to avoid the risk of freezing cooling media. The coolant is circulated from the dairy refrigeration plant to the point of use, as shown in Figure 4. The flow of coolant to the pasteurizer cooling section is controlled to maintain a constant product outlet temperature [8,9]. This is done by a regulating circuit consisting of a temperature transmitter in the outgoing product line, a temperature controller in the control panel and a regulating valve in the coolant supply line. The position of the regulating valve is altered by the controller in response to signals from the transmitter.The signal from the transmitter is directly proportional to the temperature of the product leaving the pasteurizer. This signal is often connected to a temperature recorder in the control panel and recorded on a graph, together with the pasteurization temperature and the position of the flow diversion valve.

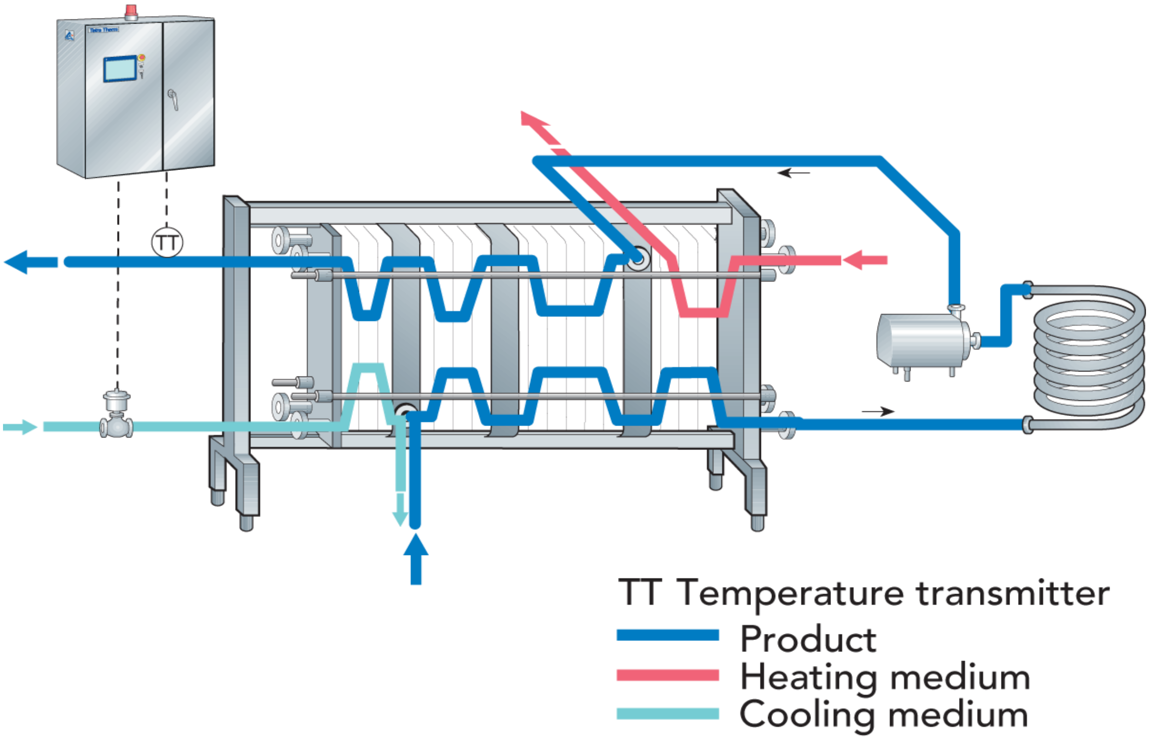

Fig. 4. Cooling system for pasteurizer.

CONCLUSION

Increasing the volume of production is related to the modernization of the technological system in the production process. In other words, the process is applied to the production of the latest modern control measuring instruments and a modern control system. The use of new intelligent sensors and control measuring devices in the production of dairy products improves the quality of the produced product by ensuring the smooth running of the process. If the temperature is not kept at the specified values during pasteurization of the cream, it leads to deterioration of the quality of butter. The use of modern intellectual sensors and information and communication systems helps to organize the pasteurization process correctly and with high accuracy. In the process of pasteurization, heated water or steam is used as a heating agent. It is very important to accurately adjust the consumption of the heating agent for the correct pasteurization process. Therefore, it is appropriate to use modern intelligent sensors in the process of butter production and to use information and communication systems in its management.

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