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Popular Article

Utilization of Membrane Process in Cheese Industry

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Abstract

In the sphere of cheese production, membrane technology has emerged as a promising breakthrough for improving the efficiency and quality of cheese manufacturing. This review emphasizes the numerous membrane-based procedures, such as microfiltration, ultrafiltration and reverse osmosis and their application in cheese production. Membrane technology precisely manages the fractionation, concentration, and separation of milk components. Ultrafiltration and microfiltration are the two main membrane processes which are widely used in the cheese industry.

Key words: Cheese, Microfiltration, Ultrafiltration, Reverse osmosis, Membrane applications

Introduction

Cheese is a coagulated dairy product which is obtained by the curdling of milk. The process of manufacturing involves coagulation of milk, separating the curd from the whey and then further processing the curd to create different types of cheeses. The specific methods and ingredients used can vary, resulting in a wide variety of cheese textures, flavors and appearances (Johnson and Lucey, 2006)

Membrane technology is a non- thermal separation process which has wide range of application in dairy industry. The use of this technology had improved the process efficiency in cheese making as well as yield of product by the incorporation of whey proteins. The quality of cheese can be improved and the whey volume can be controlled by concentrating the cheese

milk (Kumar *et al*., 2013). They have also influenced the development of new cheeses in response to market demand.

Membrane applications in cheese manufacturing

Membrane separation is a pressure driven process in which a semi-permeable membrane is used to separate a liquid into two liquid streams with different compositions: the permeate, which flows through the membrane, and the retentate, which do not pass through the membrane. Microfiltration, ultrafiltration, nanofiltration and reverse osmosis are the different types of membrane separation units. Microfiltration (MF) is used for the removal of bacteria from the liquid stream. Ultrafiltration (UF) is a membrane separation process that selectively concentrates milk protein and fat. Nanofiltration process is mainly used for demineralization. Reverse osmosis (RO) is called as a concentration process in which water is removed as permeate. Among these four processes, UF and MF are most commonly used in the cheese industry (Pouliot, 2008).

Microfiltration

Microfiltration removes bacteria and spores from milk, whey, cheese brine and thereby extends shelf life without affecting the sensory attributes. The MF pre-treatment of cheese milk improves the firmness of curd, accelerate ripening and reduce the number of additives like $CaCl_2$(Kumar *et al*., 2013). The use of MF makes it possible to produce viscous milk retentates with high dry matter content. Semi-hard cheese of good sensory quality can be produced from the MF retentates with minimal curd treatment (Schreier *et al*., 2010). Due to the absence of flavor-producing organisms during ripening as a result of their filtration out in permeate during MF, cheese made from microfiltered milk may lack flavor development. The casein-enriched milk made by MF has better rennet coagulation characteristics and less whey particles and fat loss. Increasing the MF concentration factor results in higher moisture, calcium, protein and total solids recovery (Chen *et al*., 2019).

Ultrafiltration

In cheese making, Ultrafiltration can be used for protein standardization, production of concentrate and for the production of liquid pre-cheese. The protein content of the milk can be increased by UF leading to increase in the casein: protein ratio. From medium-concentrated retentates, a variety of cheeses have been produced, from soft to hard. In certain methods, cheese milk is condensed by UF to the curd's composition before rennet is added which causes less whey drainage and cheese vats are not necessary, leading to fewer requirements of processing equipment along with significant increase in cheese yield.

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A higher concentration degree can be obtained in Cottage cheese by using ultrafiltration. It increases the yield and calcium content of the final product. UF feta cheese has the same over all composition as that of traditional product but has a smooth texture due to the presence of high whey protein content. Processed cheese made by UF shows higher calcium concentration (Renner *et al*., 1991). The application of UF process for preparation of Quarg cheese saves 13-14% of skim milk use (Pedersen and Ottosen, 1992).

Cheese made using ultrafiltration sometime shows textural defects like sandiness, firmness, or crumbliness which is caused by the higher Ca salts which is resulted by use of UF retentate of pH 6.7. When milk is ultrafiltered at its usual pH (6.6–6.7), mineral salts (Ca, Mg and P) attached to casein micelles are concentrated in the same ratio as proteins. Due to this, there is an increase in buffering capacity of retentate, which will change the fundamental cheese making parameters. The defects can be removed by reducing the milk pH before or during UF by the growth of a lactic starter or by any approved acidifying agent. Acidification leads to solubilization of colloidal calcium and magnesium phosphate salts, which pass into the permeate (Mistry and Maubois,2017).

Reverse osmosis

Reverse Osmosis can be used to pre concentrate whole milk to increase the solids content to 20- 25% before manufacturing Cheddar cheese. For cottage cheese, an 8% skim milk volume reduction by RO can result in a 5% improvement in yield. In RO cheese there is a high quantity of residual lactose, which may cause lactic acid fermentation to resume after several days in the ripening. This adversely affects the organoleptic property of the final product and it is a major drawback for using Reverse osmosis in cheese production (Mistry and Maubois,2017).

Conclusion

The use of membrane technology in the production of cheese has greatly changed the dairy sector. Numerous advantages of membrane technologies include greater cheese yield, improved product quality and whey separation efficiency. With the use of these technologies composition, texture and flavor can all be better controlled, resulting in a broad variety of cheese variations. Although there are some drawbacks, such as fouling and high upfront expenditures, still membrane technology is a useful tool for cheese producers looking to innovate and gain a competitive edge.

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