Integrated System Approach for Manufacture of Heat Desiccated Traditional Indian Dairy Products

P. S. Minz, B. Kumar, I. K. Sawhney, Ravi Prajapati and Piyush Lanjewar

Dairy Engineering Division, National Dairy Research Institute, Karnal-132001.
Email: raviprajapati168@gmail.com

ABSTRACT

Introduction

The concept of in-line production of traditional Indian dairy products involves the integration of different equipments, wherein, each of the equipment would contribute to specific unit operation requirement. Each of the equipment has advantages and disadvantages associated with in-line design framework, different processing parameters, capacities and suitability for integration. Another important aspect was to have open end design of in-line system. This facilitate addition of equipments to the in-line system as per requirement. The basic configuration of in-line system is scraped surface heat exchanger and conical process vat. In-line system consisted of scraped surface heat exchanger (SSHE) and conical process vat (CPV). SSHE with high heat transfer coefficient was used for carrying out initial concentration of milk. CPV with variable heating surface was used for carrying out remaining unit operations and enables better control over heating. Using response surface methodology (RSM), in-line system was optimized for production of heat desiccated products like *khoa, burfi, basundi and rabri.*

Objective

The current methods of manufacture of Indian traditional dairy products are primitive and based on techniques that essentially remain unchanged over ages. The small scale operations are associated with inefficient use of energy, poor hygiene and non uniform product quality (Patil, 2002). Therefore there is a need to mechanize the production process. The concept of in-line production of traditional Indian dairy products involves the integration of different equipments, wherein, each of the equipment would contribute to specific unit operation requirement.

Methodology

A number of equipments were identified and selected on the basis of suitability for integration into in-line system. Each of the equipment has advantages and disadvantages associated with in-line design framework, different processing parameters, capacities and suitability for integration. Another important aspect was to have open end design of in-line system. This facilitates addition of equipments to the in-line system as per requirement (Minz *et al*., 2013). The basic configuration of in-line system is scraped surface heat exchanger (SSHE) and conical process vat (CPV) as shown in Figure 1. Operational parameters of the equipments were optimized by Response Surface Methodology (RSM) using Design Expert software 8.0 Statease Inc. The machine parameters considered were SSHE rpm (50-200), SSHE steam pressure (2-5 kg/cm^2) and CPV steam pressure (1-3 kg/cm^2). Various responses were total solids (%), fat (%), textural attribute and sensory scores (flavour, body and texture, colour and appearance and overall acceptability). Texture profile analysis was done using Texture Analyzer TA-XT2i (Stable Micro systems, UK).

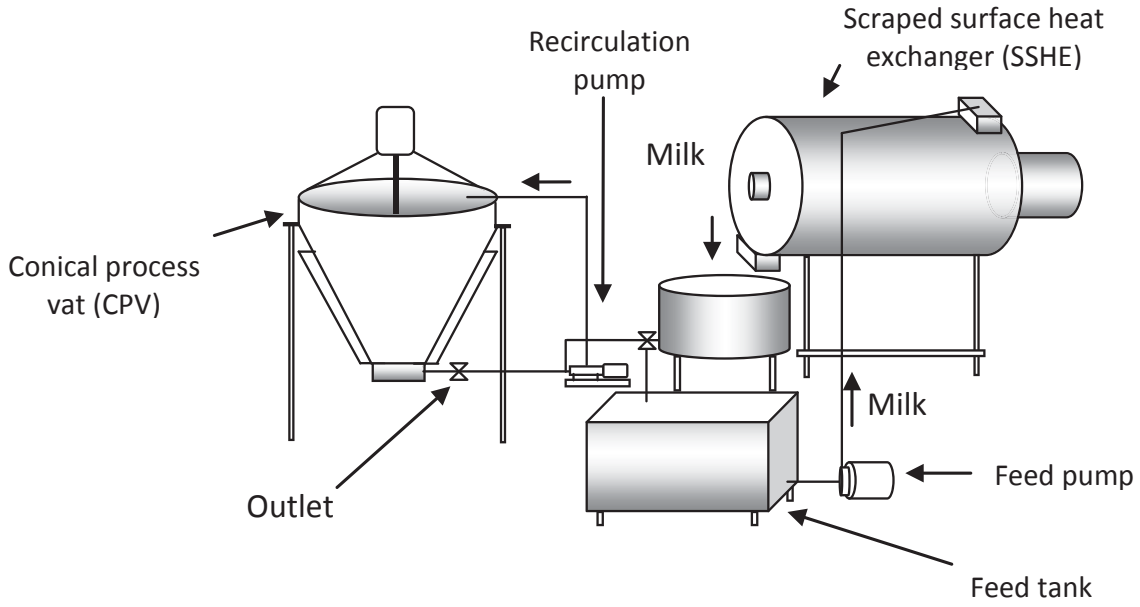

Fig. 1 In-line system

Result and Discussion

Khoa

Optimum parameters for khoa production were predicted as 4.96 kg/cm^2 steam pressure, 200 rpm scraper speed of SSHE, 45% TS concentration along with 1 kg/cm^2 steam pressure of conical process vat. Sensory score viz. flavour (50), body and texture (35), colour and appearance (15) were 44.63, 32.10, and 12.60 respectively. Average textural attributes like hardness, gumminess, chewiness, adhesiveness, springiness, cohesiveness value were 3.415N, 0.808 N, 0.234 Nmm, 0.534 Nmm, 0.257 mm and 0.241 respectively. The TS of the product was 62-64%.

Burfi

Using RSM, optimum parameters for *burfi* production were predicted as 1.5 kg/cm^2 steam pressure (after sugar addition), 50%TS concentration of milk for sugar addition stage and 8 rpm of rotor of continuous cooling system which will give maximum sensory and textural score among all combinations. The TS of *burfi* was in range of 72-75% having 17-18.5 % fat. It was observed that *burfi* produced by optimized parameters had average textural attributes score for hardness (3.86 N), gumminess (0.54 N), chewiness (0.108 Nmm), adhesiveness (0.652 Nmm), springiness (0.152 mm), cohesiveness (0.344). Average sensory score for flavour (50), body & texture (35), colour & appearance (15) were 37.76, 29.09 and 12.27 respectively.

Rabri

Optimum parameters for rabri production were predicted as 29.90% TS initial concentration, 39.41% TS final concentration before addition of sugar, CCL/SCM ratio 0.16 along with 0.75 kg/cm^2 steam pressure in CPV during removal of CCL. Rabri produced by using optimized operating parameters gave average 9 point hedonic sensory score viz. flavour, body and texture, colour and appearance and overall acceptability as 7.97, 7.93, 8.23 and 8.067 respectively. The TS and fat content of the optimized sample was 44% and 14.4% respectively. The average textural attributes score for firmness and stickiness value were 0.354 N and -0.0528 N respectively.

Basundi

Optimized parameters were SSHE speed 165 rpm, SSHE steam pressure 4 kg/cm^2 and CPV steam pressure 3 kg/cm^2. Predicted sensory score viz. flavour (45), body and texture (35), colour and appearance (15) and packaging (5) were 42.97, 33.6, 13.24 and 4.87 respectively. Viscosity, TS and fat content of the optimum sample were 67.58 mPas, 31.4% and 11.5% respectively.

Conclusion

The developed in-line system meets the requirement of small and medium entrepreneurs handling 500 to 2000 litres of milk per day for manufacture of various Indian dairy products with the same set of equipments. The integrated in-line system has been designed to take advantage of each equipment for production of multiple products like *khoa, burfi, rabri,* and *basundi*.

References

Patil, G. R. (2002). Present status of traditional dairy products. Indian dairyman, 54(10): 35-46.

Minz, P. S., Kumar, B. and Sawhney, I. K. 2013. Application of in-line Design Configuration for Manufacture of Indian Traditional Dairy Products. NDRI Newsletter, 18(2):11-12.