Economic analysis in mechanized production of Khoa

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Abstract: India is the world's largest producer of milk and dairy products, accounting for about 13% of world's total milk production. Milk is perishable in nature, thus it cannot be stored for a long period. In order to preserve it, more than half of milk produced in India is converted into a variety of traditional value added milk products. Khoa is a concentrated milk product of great commercial importance and it is an essential ingredient for the preparation of a variety of indigenous milk based sweets. In the present study, the economic analysis in mechanized production of Khoa was carried out. The quality of raw milk was analyzed using Lacto scan milk analyzer. Steam jacketed pan (200 liters capacity) was used for production of Khoa. Uniform steam pressure of 1.5 kg cm^{-2} was maintained during the operation. About 11.50 kg of Khoa was obtained from 40 liters of cow milk (4% fat) by adding 10% (4 kg) of sugar. The prepared Khoa was sold for Rs 210 per kg. Net profit of 30.43% (Rs 49) per kg and benefit - cost ratio of 1.30 was observed.

Keywords: milk, Khoa, steam jacketed pans, economic analysis, benefit- cost ratio

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1 Introduction

India is the world's largest producer of milk and dairy products, accounting for about 13% of world's total milk production. Indian states, namely Uttar Pradesh (25.19 million tonnes), Rajasthan (16.93 million tonnes), Gujarat (11.69 million tonnes), Madhya Pradesh (10.77 million tonnes), Punjab (10.35 million tonnes) and Andhra Pradesh (9.65 million tonnes) are leading producers of milk. Milk is perishable in nature, thus it cannot be stored for a long period. In order to preserve it, more than half of milk produced in India is converted into a variety of traditional value added milk products. Khoa is an important indigenous dairy product in India which forms the base and filler for variety of milk confections such as peda, burfi, gulab jamun, halva etc (Kumar, 2013).

Khoa is prepared by different methods viz. traditional method, improved batch method, mechanized method and use of membrane technology depending on the location and quantity of milk. Khoa is a heat coagulated, partially dehydrated milk product obtained by heat desiccation of whole milk to 65% – 70% milk solids without the addition of any foreign Ingredients. Khoa is also known as khoya, khawa, khava, kava, palghoa, or mawa. Nearly six lakh tones of Khoa are manufactured annually in India, which is equivalent to 7% of India's total milk production (Rajarajan et al., 2007; Kulkarni and Hembade, 2009). The nutritive value of Khoa is very high (about 458 Kcal per 100 g of the product). It contains large quantities of muscle building proteins, bone forming minerals, and energy giving fat and

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lactose. The traditional method of Khoa making requires large quantities of energy. Khoa making involves intensive heating during the desiccation process of evaporating the large quantity of water present in the milk. The traditional method of Khoa making has a number of drawbacks such as limited capacity due to batch operation, non- uniform product quality, inefficient use of energy, more labor requirement due to lengthy process, and sometimes burning the milk solids occurs which lowers the quality of Khoa. The drawbacks of traditional method of Khoa making are overcome by various mechanical methods of Khoa making process (Kumar et al., 2010; Pal, 2008). In the present study, the economic analysis in mechanized production of Khoa was carried out. The objective of economic analysis was to determine the production cost and benefit-cost ratio in mechanized production of Khoa.

2 Materials and methods

2.1 Determination of quality of milk

Quality of milk was tested using Lacto scan milk analyzer. The function of the milk analyzer is to make quick analyses of milk fat, solids-not-fat (SNF) and lactose (90-120 samples per hour). After calibration, the sample holder was filled with milk to be tested. The analyzer sucks the milk, makes the measurement and returns the milk in the sample-holder. Figure 1 shows a detailed description of Lacto milk scan analyzer.

Figure1 Lacto scan milk analyzer

2.2 Mechanized production of Khoa

Khoa is a concentrated whole milk product obtained by condensing of milk in an open pan under atmospheric pressure. Figure 2 shows the process flowchart for preparation of Khoa. A stainless steel double jacketed steam heated pan as shown in Figure 3 was used to provide greater control of the heating process and to ensure non smoky heating of milk. Steam pressure of 1.5 kg cm^{-2} was maintained during the operation. About forty litres of cow milk (4% fat) was taken and the milk was allowed to boil in the pan. During boiling, the surface of the pan was scraped and milk was stirred vigorously by a stainless steel stirrer to avoid burning of milk solids. When the milk attained desired consistency (rabri stage); 10% of sugar was added and heating was slowed down by reducing the pressure to 1.2 kg cm^{-2} to prevent burning of solids on the surface, discoloration of the product, development of burnt flavour, hard body and coarse texture. The rate of stirring was increased during last stage to obtain good quality product. As soon as the product showed signs of leaving the sides of the pan, heating was stopped. Khoa was then transferred into stainless steel trays and allowed to cool at room temperature. Figure 4 shows various steps involved in mechanized preparation of Khoa. About 11.50 kg of Khoa was obtained from 40 litres of cow milk (4% fat) by adding 10% (4 kg) of sugar.

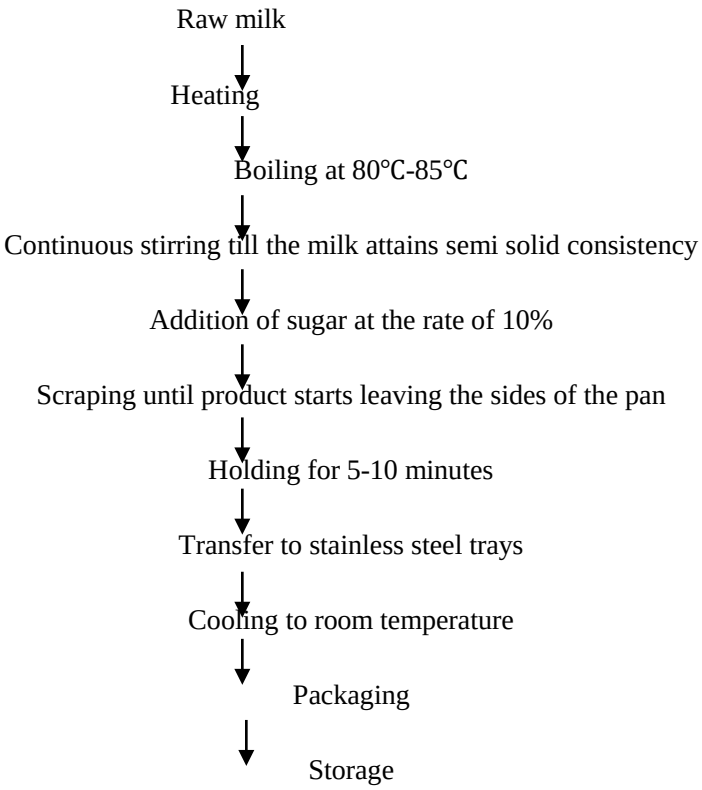

Figure 2 Steps involved in preparation of Khoa

a) Khoa pan b) Stirrer c) Control valve d) Pressure gauge e) Steam inlet

Figure 3 Steam jacketed pan

(a) Pouring of milk in Khoa pan (b) Stirring of milk in Khoa pan (c) Scraping the sides of Khoa pan (d) Formations of semi solid Khoa (e) Final product of khoa (f) Khoa after cooling

Figure 4 Steps in preparation of Khoa in steam jacketed pan

2.3 Economical analysis

Economic analysis is the combination of gains and losses of any goods. Many researchers have attempted to analyze the economics of milk production in India (Karmakar and Banerjee, 2006; Reddy et al., 2004). Economical analysis for mechanized production of Khoa was carried out. In order to determine the cost economics, the cost was divided into two categories ingredient cost and operational cost. Ingredient cost includes the precise cost of each ingredient used for preparation of Khoa. Operational cost includes labour charges, transportation cost and cost of fuel required for steam generation in the boiler. The benefit-cost ratio was determined using Equation 1.

$$\text{Benefit-Cost ratio} = \frac{Selling\ cost\ of\ Khoa\ (Rs.)}{Actual\ cost\ (Rs.)} \quad (1)$$

3 Results and discussion

3.1 Quality of raw milk

The quality of cow milk was tested with lacto scan analyzer. Table 1 shows the mean temperature, fat, density, lactose and SNF content of raw milk. The average values of temperature, fat, lactose and SNF of cow milk were observed as 29.6 ^{o}C, 4.05%, 3.83% and 8.25% respectively.

Table 1 Quality of raw milk

Parameter	Sample 1	Sample2	Average
Temperature(℃)	28.30	30.90	29.60
Fat (%)	4.00	4.10	4.05
Lactose (%)	3.99	3.68	3.83
SNF (%)	8.40	8.10	8.25

3.2 Economical analysis

The economic analysis was carried out by taking into account the cost of raw materials used as well as the operational cost in mechanized production of Khoa.

Table 2 Economic analysis in mechanized production of Khoa

Inputs	Quantity	Unit cost (Rs)	Total cost (Rs)
Ingredient cost			
Milk	40 L	27	1080
Sugar	4 kg	40	160
Operational cost			
Labour	2	150	300
Fuel (Fire wood)	60 kg	3.57	214
Transportation	-	-	100
Total cost	-	-	1854
Total Khoa obtained			11.50 kg
Cost per kg of Khoa			Rs 161.21 (Rs 161 approx)
Selling price per kg (as per market rate)			210/-
Net profit per kg			49/-
Benifit cost ratio			210/161=1.30

Table 2 shows the details of economic analysis in mechanized production of Khoa. Production cost of Khoa was observed as Rs 161 per kg. The prepared Khoa was sold at the same cost as that of the local market rate (Rs 210 per kg). Moreover, a net profit of 30.43% (Rs 49 per kg) and benefit-cost ratio of 1.30 was observed. About 11.50 kg of Khoa was obtained from 40 litres of cow milk (4% fat) by adding 10% (4 kg) of sugar. The final moisture content of Khoa was found to be 19.12% w.b. The prepared Khoa was found to be rich in flavour, colour and texture compared to Khoa available in local market. Therefore, preparation of value added dairy products has a potential to increase the net returns of dairy farmers and improve the overall economic conditions of rural India.

4 Conclusions

About 11.50 kg of Khoa was obtained from 40 litres of cow milk (4% fat) by adding 10% (4 kg) of sugar. The final moisture content of Khoa was found to be 19.12% w.b. From economical analysis, the production cost per kg of Khoa was observed as Rs 161/- . Moreover, a net profit of 30.43% (Rs 49 per kg) and benefit-cost ratio of 1.30 was observed. Therefore, Khoa preparation can be treated as one of the easiest way of preserving raw milk in rural areas and a source of income generation for the farmers.

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