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Research Note

A Study on the Economics of Milk Processing in a Dairy Plant in Haryana

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Abstract

The economics of manufacturing of different dairy products, viz. ghee, full-cream milk, standardized milk, toned milk, double-toned milk, skimmed milk and ice-cream (processing only) have been reported. The study has been conducted in an ISO-9002 dairy plant situated in the north-eastern part of Haryana. It has been observed that all the products, except the double-toned milk are being produced above the recommended break-even level. A comparison of unit manufacturing cost with unit price received by the plant for different products has revealed that ice-cream manufacturing has been the most profitable proposition among different dairy products, and standardized milk has provided the maximum profit margin among the milk pouches manufactured during the study period, 2000-01. The double-toned milk has revealed a loss. Therefore, the study has suggested that the quantity of double-toned milk production should be raised at least equal to the recommended break-even level to avoid losses, if there is a market demand for this product or the resources of this product could be shifted to some other profitable products.

Introduction

Milk production is increasing at the rate of one per cent per annum in the world, while in India, it is increasing at the rate of more than 4.5 per cent. This increase in milk production and low-cost advantage have attracted the multinationals and other private entrepreneurs to establish milk plants in India. The number of milk plants in the cooperative and private sectors registered under Milk and Milk Product Order (MMPO) has increased from 509 in 1996 to 628 in 2002. Consequently, the total milk-handling capacity has increased from 55,909 thousand litres per day (LPD) to 72,979 thousand LPD during this period. India represents one of the largest and fastest growing

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world markets for milk and milk products due to the rising disposal income of 250 million middle class families. The demand for milk and milk products is income elastic as it is estimated that 10 per cent of the Indians with highest per capita income consume 30 per cent of the total milk production in India and 30 per cent of the lowest income people consume only 10 per cent of the total milk produced in India (Ganguli, 1995). India has attained the highest milk production status (84.5 million tonnes in 2001-2002; *Agricultural Statistics at a Glance*, 2002) in the world. To maintain this level and further increase milk production, expansion in the milk marketing structure is needed through a balanced development of the dairy industry. The price and quality of milk and milk products play an important role in increasing their demand. The consumer-producer equilibrium can be restored if plants operate at the minimum cost of processing.

The study by Raju (1980) had shown that the dairy industry had hardly attracted 7 per cent of the milk production in the country and the installed capacity of the plants remains unutilized even during the flush seasons by 32 to 35 per cent. The huge fixed investment made in the installation of dairy plants is shared by the small volume of milk, resulting in high cost of its processing. Due to the high cost of processing, the benefits to both the producer and the consumer are reduced. Cost-efficient production of milk in some countries and the protection mechanisms of many developed countries, combined with future developments in the global trade are likely to influence strongly the future shape of international dairying market (Creamer *et al*., 2002). Against this background, there is a need of regular cost estimates for milk and milk products processing and their break-even level of production. Despite the need, there have been very few studies (Venkatakrishna, 1975; Singh, 1979 ; Hedrik and Chandan,1980; Raju,1980) on this aspect; on the other hand, the technology has undergone a lot of changes during the past one decade. The recent study by Narnaware (2001) was on the cost of manufacturing milk products on an experimental plant. In this direction, the present investigation has reported the component-wise cost, process-wise cost and break-even level of milk and milk products in an ISO-9002 dairy plant.

Data and Methodology

An ISO-9002 dairy plant having installed capacity of 60,000 litres per day (LPD) situated in the north-eastern area of the Haryana state was selected for the study. The data for the period April 2000 to March 2001 on various aspects were collected from the records of the dairy plant, by interviewing the personnel working in the plant and by the observation method. During the study period, the dairy plant manufactured, ghee, ice-

cream, full-cream milk, standardized milk, toned milk, double-toned milk and skimmed milk.

For working out the economics of manufacturing of different dairy products, the plant under study was classified into two departments, namely, Main department and Auxiliary department. The former was directly related to the manufacturing of the dairy products, whereas the latter provided the services like steam generation, refrigeration, water supply, maintenance, quality control, etc. Items under direct expenses like raw materials, packaging material, fuel and spare parts, etc. were directly allocated to the main and auxiliary departments on the basis of their use. Fat and SNF (Solid Not Fat) losses were worked out by dividing the fat losses during processing with the fat content before processing and the equivalent amount of losses was included in the cost of raw materials (Belloin, 1988). Costs on services provided by the auxiliary department were apportioned to the main department by using the appropriate burden rates. Depreciation of the building/equipment was worked out by the straight-line method. While allocating and apportioning the expenses, due care was taken to identify the fixed and variable cost items for break-even analysis.

The break-even quantity, steam requirement, electrical energy and refrigeration requirement were worked out as discussed below:

Break-even Output

$$TR = TC \quad \ldots(1)$$

$$P \times Q = TFC + (AVC \times Q) \quad \ldots(2)$$

$$(P \times Q) - (AVC \times Q) = TFC \quad \ldots(3)$$

$$(P - AVC) \times Q = TFC$$

$$Q = TFC/(P - AVC) \quad \ldots(4)$$

where, TR = Total revenue; TC = Total cost; P = Price of the product; Q = Break-even output ; TFC = Total fixed cost; and AVC =Average variable cost.

Steam Requirement

It was worked out using Eq. (6) (Ahmed, 1997):

$$\text{Steam requirement (kg)} = (M \times S \times T)/L \quad \ldots(6)$$

where, M = Quantity of product to be heated S = Specific heat T = Temperature difference ($T_1 - T_2$), and L = Latent heat.

Electricity Consumption

It was computed using Eq. (7):

Electricity consumption = (Hours × Watts) / 1000 = kW …(7)

Electricity under single-phase system = $(V_L \times I_L \times \cos ø) / 1000 = kW$

Electricity consumption was computed using the formula (Theraja, 1992):

$(\sqrt{3} \times V_L \times I_L \times \cos ø) / 1000 = kW$ …(8)

where, V_L = Line voltage; I_L = Line current, and cos ø = Power factor assumed as 0.8.

Refrigeration Requirement

It was calculated as per Eq. (9):

Refrigeration load = M × S × T (in kilo calories) …(9)

where, M = Quantity of product to be cooled; S = Specific heat, and T = Temperature difference ($T_1 - T_2$), °C.

Results and Discussions

The process-wise costs for different products were calculated by dividing the manufacturing costs of products into different major processes in consultation with the production manager of the plant. The information is presented below under different sub-sections.

Process-wise Costs of Milk and Milk Products

The process-wise costs worked out for different dairy products are presented below for each product manufactured during the study period.

Ghee

Ghee was manufactured by direct boiling of cream and was packaged after settling and clarification. The cost of ghee manufacturing worked out to be Rs 120.97 /kg (Table 1). The maximum cost (94.01%) was shared by the raw material. Out of the five processes of ghee manufacturing, the highest cost was on 'Packaging' (3.60%), followed by 'Boiling of Cream' (0.89%), 'Settling and Clarification' (0.74%), 'Storage' (0.63%) and 'Reception of Cream' (0.13%).

Ice-cream

For ice-cream, the plant received the raw material from the Mother Dairy and carried only the job work, for which it received processing charges. Its processing cost (Table 2) worked out to be Rs 8.35 / litre. Of the four processes of ice-cream manufacturing, the cost on 'Storage and Hardening' was the highest (53.29%), followed by 'Freezing and Filling' (24.43%), 'Mixing and Heating' (11.74%) and 'Homogenization/ Pasteurization' (10.54%).

Table 1. Processes-wise cost of ghee manufacturing: 2000-01

Items	Total annual expenditure (Rs)	Unit cost (Rs/ kg)	Cost (per cent)
Raw material	9607748	113.72	94.01
Reception of cream	13705	0.16	0.13
Boiling of cream	91386	1.08	0.89
Settling and clarification	75415	0.89	0.74
Packaging	367622	4.36	3.60
Storage	63950	0.76	0.63
Overall	10219826	120.97	100
Total quantity produced	84486 kg per annum		

Table 2. Process-wise cost of ice-cream processing: 2000-01

Items	Total annual expenditure (Rs)	Unit cost (Rs/ litre)	Cost (per cent)
Raw material *	-	-	-
Mixing and heating	309396	0. 98	11.74
Homogenization/ Pasteurization	278855	0.88	10.54
Freezing and filling	644417	2.04	24.43
Storage and hardening	1399986	4.45	53.29
Overall	2631654	8.35	100
Total quantity produced	314828 litres per annum		

* Mother Dairy supplied the raw material

Processing of Milk

The process-wise costs of full-cream milk, standardized milk, toned milk, double- toned milk and skimmed milk have been presented in Table 3.

Full-cream milk: The cost of its manufacturing worked out to be Rs 14.69/ litre, of which 91.98 per cent was on raw material. In different processes of manufacturing, the highest cost was on 'Packaging' (3.33%), followed by 'Pasteurization/Standardization' (1.53%), 'Separation' (1.31%), 'Storage' (1.16%), and 'Reception of milk' (0.63%).

Standardized milk: Its manufacturing cost worked out to be Rs 12.66/litre (Table 3) with major cost on raw material (91.79%). In processes of manufacturing, the highest cost was on 'Packaging' (3.55%), followed by 'Pasteurization/Standardization' (1.34%), 'Storage' (1.19%), and 'Reception' (0.71%).

Toned milk: Its manufacturing cost was found as Rs 10.85/ litre (Table 3), with maximum on raw material. Of different processes of manufacturing, the highest cost was on 'Packaging' (3.78%), followed by 'Separation'

Table 3. Process-wise costs of different types of milk manufacturing: 2000-01

Items	Total annual expenditure (Rs)	Unit cost (Rs/ litre)	Cost (per cent)
Full-cream Milk			
Raw material	135813208	13.51	91.98
Reception of milk	1005427	0.10	0.69
Separation	1942520	0.19	1.31
Pasteurization/Standardization	2265138	0.23	1.53
Packaging	4919948	0.49	3.33
Storage	1711191	0.17	1.16
Overall	147657432	14.69	100
Total quantity produced	10054280 litres per annum		
Standardized Milk			
Raw material	16353965	11.62	91.79
Reception of milk	126665	0.09	0.71
Separation	253331	0.18	1.42
Pasteurization/Standardization	239257	0.17	1.34
Packaging	633329	0.45	3.55
Storage	211109	0.15	1.19
Overall	17817659	12.66	100
Total quantity produced	1407398 litres per annum		
Toned Milk			
Raw material	31293973	9.94	91.62
Reception of milk	220380	0.07	0.64
Separation	472243	0.15	1.38
Pasteurization/Standardization	440760	0.14	1.29
Packaging	1290798	0.41	3.78
Storage	440760	0.14	1.29
Overall	34158914	10.85	100
Total quantity produced	3148287 litres per annum		
Double-tonned Milk			
Raw material	170562699	8.62	91.12
Reception of milk	1187211	0.06	0.64
Separation	2374423	0.12	1.27
Pasteurization/Standardization	2572291	0.13	1.37
Packaging	7914742	0.40	4.23
Storage	2572291	0.13	1.37
Overall	187183658	9.46	100
Total quantity produced	19786856 litres per annum		
Skimmed Milk			
Raw material	3211539	6.51	89.54
Reception of milk	24666	0.05	0.69
Separation	49332	0.10	1.38
Pasteurization/Standardization	54266	0.11	1.51
Packaging	187463	0.38	5.23
Storage	59199	0.12	1.65
Overall	3586465	7.27	100
Total quantity produced	493324 litres per annum		

(1.38%), 'Pasteurization/Standardization' (1.29%), 'Storage' (1.29%), and 'Reception of milk' (0.64%).

Double-toned milk: Its manufacturing cost worked out to be Rs 9.46/ litre with maximum on raw material (91.12%). In manufacturing, the highest cost was on 'Packaging', followed by Pasteurization/Standardization', Storage, 'Separation' and 'Reception of milk'.

Skimmed milk: Its manufacturing cost was found as Rs 7.27/litre (Table 3) with maximum on raw material. Amongst processes of manufacturing, the highest cost was on 'Packaging', followed by 'Storage', 'Pasteurization/ Standardization', 'Separation' and Reception of milk.

Break-even Quantity of Different Dairy Products

The break-even quantities for each dairy product have been summarized in Table 4. The break-even quantity for ice cream could not be worked out because the price of the raw material was not known as it was supplied by the Mother Dairy. It was found that all the products were being produced in quantities higher than the break-even level, except the double-toned milk. It was, therefore, suggested that the quantity of double-toned milk should be increased at least to the worked out break-even level to avoid losses in its manufacturing.

Profit Margins of Different Dairy Products

The highest profit margin was in ice-cream (Table 5), followed by ghee. Amongst different types of milk, standardized milk provided the maximum profit, followed by the full-cream milk and toned milk.

Conclusions and Policy Implications

The study has revealed that all the products, except the double-toned milk are being produced above the calculated break-even levels. The comparison of unit manufacturing cost with unit price received by the plant for different products has shown that ice-cream manufacturing is the most

Table 4. Break-even quantity of different dairy products: 2000-2001

Name of product	Break–even quantity worked out	Actual quantity produced
Full-cream milk (litre)	33,33,859	1,00,54,280
Standardized milk (litre)	42,958	1,11,169
Toned milk (litre)	13,42,944	31,48,287
Double-toned milk (litre)	47,72,298	20,91,250
Skimmed milk (litre)	4,38,472	4,93,324
Ghee (kg)	56,930	84,486

Table 5. Profit margins in manufacturing of different dairy products: 2000-01

Name of product production	Unit cost of by plant	Price received of the plant	Profit margin
Full-cream milk (Rs/litre)	14.69	15.30	0.61
Standardized milk (Rs/litre)	12.66	13.30	0.64
Toned milk (Rs /litre)	10.85	11.30	0.45
Double-toned milk (Rs/litre)	9.46	9.30	(-) 0.16
Skimmed milk (Rs/litre)	7.27	7.30	0.03
Ghee (Rs/kg)	120.97	122.62	1.65
Ice-cream (Rs/litre) (Processing only)	8.35	11.43	3.08

profitable proposition. The standardized milk has been found most profitable among all types of milk pouches. The double-toned milk has revealed a loss of Rs 0.16 per litre. Therefore, the study has suggested that the double-toned milk production should be raised at least to the break-even level to avoid losses in this product, if there is a market demand for it, or the resources of this product could be shifted to some other profitable products.

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