Original Research

Cost of Production of Low Fat Milk '*Coagulum*' Rings Incorporated With Optimized Level of Unripe Banana Powder and Banana Peel Powder

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Abstract

Milk coagulum can be efficiently utilized for the preparation of an acceptable ready to eat milk based snacks milk 'coagulum' rings. Besides nutritive value and sensory acceptability of food products, the cost factor also determines greatly its market feasibility. In the present study, the milk 'coagulum' rings were extended with pre-optimized level of fiber rich extenders namely unripe banana powder (11%) (T_1) and banana peel powder (6%) (T_2). It was observed that the incorporation of these extenders reduced the cost of production of milk 'coagulum' rings. The cost of production per Kg of product was ₹ 473.94, ₹ 433.27 and ₹ 446.38 for control, T_1 and T_2 respectively. Considering the sale price of ₹ 55.00 per 100g of product, a profit per 100g packet was the highest for T_1, a profit of ₹ 7.00, ₹ 11.00 and ₹ 10.00 each can be obtained from control, T_1 and T_2 respectively. Thus, it can be concluded that the formulation cost of product extended with 11% unripe banana powder was the lowest and the production of the same can be adopted effectively to generate income by unemployed entrepreneurs and to provide easy access of high quality milk coagulum based products at a lower cost.

Key words: Milk '*Coagulum*' Rings, Unripe Banana Powder, Banana Peel Powder, Cost Analysis

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Introduction

India is the leading milk producer in the world and the milk production had increased tremendously in the past few years (DAHD, 2017). Milk has been an important part of the Indian diet, but lack of cold chain system and transportation problem has always been the limiting factor in the efficient utilization of the produced. On the other hand, protein malnutrition has been a major problem in the country and the high cost of animal protein often is the bar for easy access to fluid milk and other animal protein source.

Although milk is rich in all nutrients such as protein, fat, vitamins and minerals, it has almost negligible content of dietary fiber. India produces about 19% of world's banana, and both the unripe banana pulp and banana peel are reported to have high fiber content (Menezes *et al*., 2011; Wachirasiri *et al*., 2009). The unripe banana pulp and banana peel is converted into powder form and can be incorporated as fiber rich extender in several products (Ovando-Martinez *et al*., 2009; Asif-Ul-Alam *et al*., 2014; Ramli *et al*., 2009). This will not only help in nutrient enrichment, but maybe useful in reducing the wastage of farm produced, value addition and shelf life extension of dairy product. Processing of animal and plant produce has thus the potential of solving major problems of agriculture surpluses, wastages, unemployment and uncertain prices. The change in lifestyle and food habits associated with urbanization results in increase demand for value added food products. Besides nutritive value and sensory acceptability of food products, the cost factors also determine greatly its market feasibility.

The present study was undertaken to incorporate pre-optimized level of extenders *viz*; unripe banana powder and banana peel powder in low fat milk *coagulum* rings (*MCR*) and further, the cost of production of the control was compared with those extended *MCR*.

Materials and Methods

Source of Raw Materials

Pasteurized milk (a combination of cow and buffalo milk) for pursuing this study was procured from Dairy Technology Section of Indian Veterinary Research Institute, Izatnagar, and Bareilly (U.P). Other ingredients like green and ripe banana, wheat flour, refined wheat flour (*maida*), refined salt (Tata Chemicals Ltd., Mumbai), baking powder, sugar, spice ingredients and colorless PET jar of 500g capacity etc. were procured from local market of Bareilly. The spice ingredients were freed from extraneous material, dried and grounded to fine powder. The ingredients were sieved through a fine mesh and mixed in suitable proportion to obtain the spice mix. The spice mix was stored in a sterilized plastic container for further use. Food grade chemicals were procured from Qualigens, Mercks, Hi Media and CDH.

Preparation of Unripe Banana Powder and Banana Peel Powder

Unripe banana powder (UBP) was prepared by cutting peeled banana in to 1 cm slices and dipping it in 0.3% (w/v) citric acid solution followed by drying at 50°C in an oven, grounded, sealed and stored at 25°C for further use (Rodrı´guez-Ambriz *et al.,* 2008; Agama-Acevedo *et al.,* 2012). Banana peel powder (BPP) can be prepared by separating peels from the pulp and washing, dipped in 0.5% (w/v) citric acid solution for 10 min, drained and dried in an oven and grounded in a Mill (Retsch AS200) to pass through 40 mesh screen (Alkarkhi *et al.,* 2010).

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Preparation of Milk 'Coagulum'

Milk '*coagulum*' was prepared by following the coagulation procedure of Bhattacharya *et al*. (1971) with alterations made as per the requirements of the experiment as shown below.

Heating of milk to 90°C with constant stirring followed by cooling at 80°C
↓
Coagulation with citric acid solution (2%)
↓
Removing of whey by straining using muslin cloth
↓
Holding for 30 min to allow whey to drip
Preparation of milk 'coagulum' rings
Blending of milk coagulum in Atta kneader (2-3 min)
↓
Addition of binders, spices, salt, sugar etc.
↓
Continue blending for another 2- 3 min
↓
Molding into shape of a ring
↓
Cooking in convection followed by microwave
↓
Drying in hot air oven at 50°C for 12 h.
↓
Sensory evaluation and sample analysis

Result and Discussion

Raw Material Cost

Raw materials are the basic ingredients in the manufacture of any products. Cost will fluctuate, both in frequency and in magnitude in present existing marketing scenario. These fluctuations may generate an inaccurate base for profitability analysis, pricing decisions, product development, or future production planning. Furthermore, it also affects every aspect of value chain and it becomes critical to understand. The costs of ingredients/Kg and total raw material are presented in Table 1 and Table 2 respectively.

Table 1: Cost of the ingredients used in the development of milk *coagulum* ring

	Name of Ingredients	Cost (₹/Kg)
1	1.5% milk *coagulum*	150
2	Wheat flour	30
3	Refined wheat flour	30
4	Spice mix	500
5	Banana peel powder	50
6	Unripe banana flour	100
7	Sugar	40
8	Salt	15
9	Baking powder	300
10	Citric acid	400

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Table 2: Cost of raw materials required for preparation of 100 kg formulation (per day processing)

Ingredients	Control (1.5% milk coagulum		Treatment (11%Unripe banana flour)		Treatment (6% Banana peel powder)	
	Quantity (Kg)	Cost (₹)	Quantity (Kg)	Cost (₹)	Quantity (Kg)	Cost (₹)
Milk *coagulum* (1.5% milk fat)	85.4	12,810	70.7	10,605	77.4	11,610
Wheat flour	5	150	5	150	5	150
Refined wheat flour	5	150	5	150	5	150
Unripe banana flour	-	-	11	1100	-	-
Banana peel powder	-	-	-	-	6	300
Salt	1	15	1	15	1	15
Sugar	0.8	32	0.8	32	0.8	32
Spices	1.3	650	1.3	650	1.3	650
Baking powder	1.5	450	1.5	450	1.5	450
Total	100	14,257	100	13,152	100	13,357

The economics was worked out with the following technical assumptions:

1. Per day production of *MCR* is 100 Kg
2. The unit remains in production 300 days in a year i.e. 25 days in a month, therefore monthly production target of *MCR* is 100 Kg X 25 = 2500 kg/month.
3. Cost of ingredients is calculated on the basis of prevalent market rate in the local market.
4. To estimate the accurate cost of production of *MCR* under commercial conditions, the expenditure incurred in terms of recurring items including labour charges, water and electricity charges, depreciation on machineries, rent, capital investment and its interest, non-recurring charges including cost of machines, equipment and utensils has been taken into consideration.
5. Income is considered from the sale of *MCR*
6. Cost of milk per litre: ₹ 30/Litre
7. Yield of milk coagulum from milk = 20% (200g/l of milk)
8. Cost of 1 Kg (200g/l X 5) milk coagulum = 5 X ₹ 30 = ₹150/-
9. Labour cost per labourer is ₹ 350/- for skilled labour and ₹ 200 for unskilled labour.
10. Cost of electricity is ₹ 6.0/unit.
11. Market sale price of *MCR*: ₹ 55.00/100g

Depreciation Cost of Processing Equipments

Depreciation cost is a systematic and rational process of distributing the cost of tangible assets over the life of assets and presented in Table 3.

Depreciation @10% per annum = 362300/-

Depreciation cost/day = 36230/-

= ₹ 362.30/annum

=Rs. 120.77/day (300 working days/annum)

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Table 3: Depreciation cost of equipment used for processing of milk *coagulum* rings

Equipment	No. of items required	Rate (Rate/item)	Total (₹)
Processing equipment			
Cream separator	1	50,000	50,000
Hot air oven	1	50,000	50,000
Microwave oven	1	10,000	10,000
Electric atta kneader	1	2,500	2,500
Weighing balance	1	5,500	5,500
Cooling equipment			
Refrigerator (500 l)	2	20,000	40,000
Split A.C (1.5 ton)	3	30,000	90,000
Utilities			
Gas burner setup	1	1,500	1,500
Gas cylinder	2	1,400	2,800
Geyser	1	10,000	10,000
Utensils and furniture (knives, muslin cloth, tables etc.)	-	-	100,000
Total			**362,300**

Electricity Charges

The cost of electricity incurred for processing of 100 kg of product can be calculated as shown in Table 4.

Therefore the cost of electricity = 76.1KWh × ₹ 6/ KWh= ₹ 456.6 ~ ₹ 457/day

Table 4: Cost of electricity

Equipment	Watts X hr	KWh
Cream separator	1000 x 1	1.0
Refrigerator	150 x 2 x 20	6
Hot air oven	150 x 1 x 20	3
Microwave oven	250 x 2	0.5
Geyser	2000 x 6	12
Fans/weighing/mixer	500 x 10	5
Electric grinder/mixer	300 x 2	0.6
Air conditioners	2000 x 3 x 8	48
Total units		76.1

Labour Charges

The labor cost can be calculated as:

Skilled labour = ₹ 350x2 = ₹ 700/day

Unskilled labour = ₹ 200x3 = ₹ 600/day

Total labour cost = ₹ 1300/day

Packaging Cost

MCR should be aerobically packaged in PET jar of 500g capacity. The cost of one PET jar is ₹ 5/- and for packing of 100 kg of products (100 g each), 1000 PET jars are required. Therefore, cost of packaging material is ₹ 5000/day.

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Cost of Water

Water is the basic necessity and most essential nonfood ingredient in any processing plant and it is required at each step of product processing. The cost of water can be reduced by obtaining municipal water supply and an amount of ₹ 25/day will be sufficient as the cost of water.

Building Rent

A building in a semi urban area/locality, which has sufficient space to hold the entire unit processing and for setting up a small scale product processing unit with all required facilities will cost around ₹10,000 per month. Working days in a month are 25. So the rent comes to about ₹400/day.

Maintenance Costs

The day-to-day materials in use are detergent, soap, sanitizers etc. These are required to maintain the equipment, building and premises hygienically and would cost approximately ₹250 per day.

Marketing Costs

Marketing costs include the commission to be paid for wholesalers, agents, retailers and transportation costs and come to be about 10%, the cost of bulk packaging and transportation to around to around 3% of retail prices of the finished products. Therefore, the total marketing cost works out to be 13% of the retail price of the products.

Total Expenditure

The sum of all above cost account for total cost for the processing of 100 kg formulation of *MCR* per day is shown in the Table 5. The cooking yield was around 52.89%, 54.15% and 53.63% for control, treatment 1 and treatment 2 respectively. However, a safety margin of 1-2% is to be considered to compensate for losses that might occur during various steps of processing, packaging and marketing. Thus, final yield of 52, 54 and 53% can be considered practical.

Retail Cost

Cost of production of *MCR* was calculated by taking into account the cost of formulation, overhead production cost and dealer commission. The overhead production cost for production of milk rings was estimated by considering cost of raw materials, charges for labor, rent, electricity, water, dealer commission and marketing cost. The cost of production of 100 Kg *MCR* of control, unripe banana powder and banana peel powder incorporated *MCR* are given in Table 5 and the production cost per Kg was calculated on the basis of cooking yield, the highest obtained for control followed by T_2.

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Table 5: Cost (₹) of 100 kg formulation of 'Milk *coagulum* rings'/day

Particulars	Control	Treatment 1 (11% Unripe banana powder)	Treatment 2 (6% banana peel powder)
Raw material cost	14,257	13152	13357
Cost of machineries (Depreciation cost)	120.77	120.77	120.77
Cost of electricity	457	457	457
Packaging cost	5,000	5,000	5,000
Labor cost	1300	1300	1300
Building rent	400	400	400
Maintenance cost	250	250	250
Cost of water	25	25	25
Total processing expenditure (₹)	21809.77	20704.77	20909.77
Transportation cost (3%)	654.29	621.14	627.29
Dealer commission (10%)	2180.98	2070.48	2090.98
Marketing cost (13%)	2835.27	2691.62	2718.27
Total expenditure (₹)	24645.04	23396.39	23628.04
Yield percentage	52	54	53
Cost of production of 1 Kg *MCR* (₹)	473.94	433.27	446.38
Cost of production of 100g *MCR* (₹)	47.40 (≈₹48/-)	43.32 (≈₹44/-)	44.64 (≈₹45/-)

Product Yield

Weight of the batter prepared and the weight of the final product after cooking and drying were recorded to calculate the product yield as follows-

$$Product\ Yield(\%) = \frac{Weight\ of\ the\ RTE\ MCR}{Weight\ of\ the\ batter\ used} \times 100$$

The cost of production of T_1 was the lowest i.e. 440 per kg. The total income was calculated by difference of sale price of 100g of *MCR* and the cost of its production and shown in Table 6.

Table 6: Income and total profit from milk *coagulum* rings

Group	Income/100g	Income/Kg	Total profit/day	Total profit/month
Control	7	70	7000.00	175,000.00
T_1	11	110	11000.00	275,000.00
T_2	10	100	10000.00	250,000.00

The income per kg of *MCR* was the highest for T_1 and was calculated as ₹110.00 per Kg of *MCR*. Assuming the production capacity of the unit as 100 Kg per day, a total profit of ₹275,000.00 can be generated in a month from the production of *MCR* extended with 11% unripe banana powder (T_1).

Total income (₹) = Total sale price- Total cost of production
MCR (control) = 55-48= 7
MCR (with unripe banana powder) = 55-44 = 11
MCR (with banana peel powder) = 55-45 = 10

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Conclusion

Many of the agricultural waste and by-products are often a good nutrient source. Unripe banana powder and banana peel powder being a rich fiber source, value addition of milk products with fiber rich extenders enables producers to deliver nutrient enriched products at a reduced cost. The incorporation of unripe banana powder and banana peel powder as fiber rich extender at 11% and 6% respectively lowers the production cost of *MCR* as compared to the control. Therefore, the above mentioned scheme can be utilized to generate income by unemployed youth or can be taken up at industrial level to provide easy access of high quality milk protein to the mass population. Thus, unripe banana powder and banana peel powder can be successfully incorporated to reduce the formulation cost of the *MCR* and other dehydrated milk products.

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