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Estimation of production cost for ghee residue based snack

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Abstract

Ghee residue, a major by product of ghee manufacturing industry is rich in valuable milk nutrients. It also exhibits a wide potential to be used as antioxidant and flavouring agent for fat rich products. A large portion of ghee residue is discarded every day, because of not having gainful or proper technique to utilize it. The preparation of ghee residue based snack would, therefore offer a wide scope for utilization of valuable nutrients as well as product diversification. For commercialization of the ghee residue based snack, cost estimation plays an important role. The production cost of ghee residue based snack was, therefore estimated through project evaluation, plant design, product pricing, process optimization and other techno-economic studies. The production cost of ghee residue based snack was estimated as Rs. 11.00/ 25g.

Keywords: Ghee residue based snack, production cost

Introduction

The ghee manufactures have to deal with one of the major by-products i.e., ghee residue (Janghu *et al.*, 2014) [7]. Ghee residue is the solids-not-fat (SNF) present in the cream or butter appears in the form of small particles during fat clarification and obtained after molten ghee strained out. It is a moist, brownish sediment characterized by smooth to granular texture with glossy surface (Verma and Raju, 2008) [12]. In India, the annual production of milk is 165.4 million tons as per NDDB statistics 2016-17. About 30 - 35% of the milk produced in India is converted in to ghee (Gandhi *et al.*, 2013) [5]. Amount of ghee residue obtained was about 1/10th of the total ghee produced (Dairy India, 2007) [3]. Ghee residue is a source of valuable milk nutrients. Ghee residue is also a potent antioxidant and flavouring agent for fat rich dairy products. Ghee residue based product can therefore be considered of great economic importance. In view of this, an attempt was therefore taken to develop ghee residue based snack. The estimation of various costs during preparation of such a product over plant scale become very important for product commercialization. The most noteworthy aspects, considered for the cost estimation of the product in industrial scale included the fixed capital cost and the annual operating cost, paid during the installation period and during the operation, respectively (Marouli and Maroulis, 2005) [8]. The project evaluation, plant design, product pricing, process optimization and other techno-economic studies are the important aspects for cost estimation. Depending on the process design principles, the raw materials and utilities costs were calculated through material and energy balances and equipment costs were estimated on the basis of equipment sizing procedures. The labour cost was estimated through the study of the equipment flow sheet and on the kind of equipments (Marouli and Maroulis, 2005) [8].

2. Materials and Methods

The research work was carried out at Dairy Technology Division, W.B.U.A.F.S., Mohanpur, Nadia, West Bengal and all pilot scale trials were conducted in the Students' Dairy of the Institute. Source of raw materials, methodology of products manufacture and the process of cost estimation of the developed products are delineated hereunder.

2.1 Materials

The fresh, chilled cow milk (4% fat and 8.5% SNF) was procured from W.B.U.A.F.S., Mohanpur, Nadia. The milk was separated into cream (40% fat, 5.3% SNF) and skim milk (0.1% fat, 8.7% SNF). The ghee is prepared by direct cream method at Students' dairy of W.B.U.A.F.S., Mohanpur, Nadia, West Bengal. The final clarification temperature of cream was kept at 110-120°C for preparing ghee.

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The ghee residue produced during preparing ghee was collected by filtering through muslin cloth. The collected ghee residue was washed in boiled water followed by chilled water to recover as much ghee as possible from the residue and to improve sensorial properties. The treated residue was then stored in an air tight container for experimental purpose. Before carrying out experiments the ghee residue was standardized with ghee to 40% fat on dry mater basis and 70% moisture.

Rice flour, Skim milk powder (Sagar, Gujarat), Edible common iodised salt (Tata, Mumbai) and Baking powder (Tata I -Shakti, Mumbai), Coriander, aniseed, red chili powder, cumin seeds, black Pepper, cinamon, black

cardamon, condiment ginger powder and dried mango powder (Everest) were procured from the local market of Kalyani, Nadia, West Bengal. These spices and condiments were taken into appropriate amount, grounded by using mortar and pestle and mixed to prepare the spice mix powder.

Food grade 3-ply laminated film of polyethylene/aluminium foil/polyethylene (PE/Al foil/PE) (thickness 80µ) procured from the Baithakkhana market at Kolkata (West Bengal, India) were used as packaging materials for packaging of ghee residue-based snack.

2.2 Manufacturing Procedure of Ghee Residue Based Snack
Method of manufacturing process of ghee residue based snack is shown in the Figure 1.

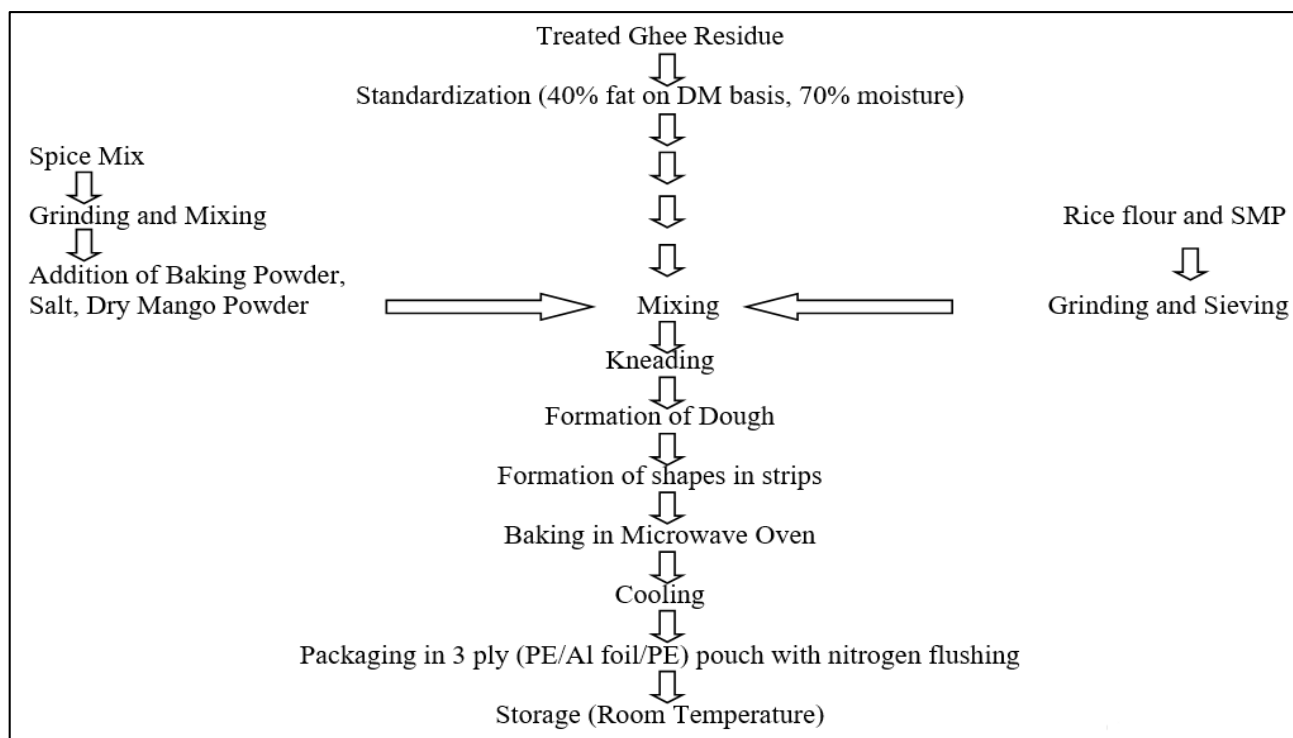


Fig 1: Process flow diagram for manufacturing procedure of ghee residue based snack

2.3 Techno-Economic Feasibility

The cost estimation for commercialization of any product is highly reliant on the evaluation of techno-economic feasibilities. The manufacturing cost of ghee residue based snack was estimated following the guidelines suggested by Prajapati *et al.* (1991a) [10], Prajapati *et al.* (1991b) [11]; Chauhan *et al.* (2007) [1] and Choudhery *et al.* (2007) [2], Giri and Kanawjia, (2013) [6] and Debnath *et al.* (2017) [4]. The cost of different components used in the manufacture of ghee residue based snack was taken as on January, 2018. In order to get a reasonable realistic production cost of the product, certain assumptions were made. The assumptions were made for a ghee making unit. It was assumed that the ghee making unit would be operated in two shifts of 8 hr. each for 300 days in a year. It was also assumed that the production was of 80% of the installed capacity. In this project, it was assumed that the ghee making unit would be an extension of an existing dairy plant from where pasteurized, standardized cow milk would be taken for ghee making. Ghee was prepared by direct cream method. The amount of the ghee residue obtained during ghee production was assumed as 12% of the total ghee produced. The cost of the raw materials used, had been worked out on the existing market prices. The ghee residue based snack would be packaged in 25 g 3-ply laminated

(PE/Al foil/PE) pouch.

3. Results and Discussions

3.1 Capital Requirements

The rated capacity of a viable unit would be 1000 Kg of ghee residue based snack /day. Total working days per year have been taken as 300 d. The capital required for the manufacture of products includes all direct and indirect costs.

3.2 Land and Building Cost

The plant should be located in a suitable place where raw materials would be easily available. In addition, the plant should be well connected by transport to the raw materials' source as well as to the distributors/retailers. An effluent treatment plant should be located in the plant to make sure that the effluent is rendered harmless and non-toxic as per requirements of the population control board. It was assumed that an industrial area of 7500 m² would be sufficient for the project. The shed would house all facilities for the production and packaging of the product as well as for its storage. Built up area was estimated to be 750 m². The cost of land was estimated at the rate of Rs. 750.00 / m². The cost of built-up area is represented in Table 1.

Table 1: Cost of land and building

Items	Rate (Rs./m ²)	Quantity (m ²)	Total cost (Rs.)
Land (Assuming land=10 times of building area)	750	7,500	56,25,000
Building			
Production area	2,500	375	9,37,500
Storage room	2,500	150	3,75,000
Boiler and refrigeration area	2,000	100	2,00,000
Office	3,000	50	1,50,000
Toilet	3,000	25	75,000
Effluent treatment plant	2,000	50	1,00,000
Total building			18,37,500
Total (Land and building)			74,62,500

3.3 Plant and Machinery Cost

The plant and machinery required for the production of ghee residue based snack included milk storage tank, milk cans, weighing balance, milk pump, plate heat exchanger (PHE), milk pasteurizer with accessories, ghee boiler, ghee clarifier, snack forming machine, nitrogen gas flushing snack

packaging machine, boiler, refrigeration unit, generator etc. The list of required equipments with capacity and there costs and depreciation costs are represented in Table 2. The installation and erection cost at the rate of 7.5% of equipment cost was calculated.

Table 2: Cost for Plant and Machinery

Item particulars	Capacity	No.	Rate (Rs.)	Initial value (Rs.)	Scrap value (Rs.)	Life span	Annual depreciation (Rs.)
Weighing balance	0-300 kg	1	50000	50000	5000	20	250
Dump tank	1000lt	1	55000	55000	5500	25	220
Milk pump (1HP)	5000lt/h	2	20000	40000	4000	20	200
Plate chiller	1000lt/h	1	200000	200000	20000	20	1000
Raw milk storage tank	10000lt	1	100000	100000	10000	25	400
Plate heat exchanger	5000lt/h	1	500000	500000	50000	25	2000
Cream separator	5000lt/h	1	1000000	1000000	100000	25	4000
Cream storage tank	5000lt	1	75000	75000	7500	25	300
Skim milk storage tank	10000lt	1	100000	100000	10000	25	400
Cream pump (3HP)	5000lt/h	1	35000	35000	3500	20	175
Cream pasteurizer	1000lt/h	1	250000	250000	25000	25	1000
Milk can (Aluminum)	40lt	10	3000	30000	3000	25	120
Pasteurizer with accessories	5000lt/h	1	1000000	1000000	100000	20	5000
Ghee pump	1000lt/h	1	20000	20000	2000	20	100
Ghee kettle (ghee boiler)	1000lt	1	200000	200000	20000	25	800
Ghee pump (0.5 HP)	500lt/h	2	20000	40000	4000	20	200
Ghee settling tank	1000lt	1	150000	150000	15000	25	600
Ghee clarifier	500lt/h	1	250000	250000	25000	25	1000
snack forming machine	180-200 kg/hr	1	300000	300000	30000	20	1500
Ghee storage tank	1000lt	1	150000	150000	15000	25	600
Pouch filling machine (single head)	1000 pouches/h	1	500000	500000	50000	25	2000
nitrogen gas flushing snack pkg machine	100pouches/h	1	40000	40000	4000	20	200
Steam boiler	300kg/h	1	100000	100000	10000	25	400
Power generator-	125 KVA	1	1000000	1000000	100000	25	4000
Cold store and refrigeration unit		1	1000000	1000000	100000	20	5000
Water storage tank	20000lt	1	200000	200000	20000	25	800
Pipe fitting accessories			250000	250000	25000	25	1000
Light commercial vehicle		1	350000	350000	35000	20	1750
Electric connection (transformer cable, control panel, D panel, mcc panel)	150 KV		1500000	1500000	150000	20	7500
Microwave Bakery Oven	0.4 Kw		250000	250000	25000	20	1250
Miscellaneous			250000	250000	25000	20	1250
Total			9918000	9985000	998500	685	45015.00

3.4 Utility Cost

To estimate utility cost, requirement of electricity, steam, fuel and water were considered (Table 3). The total power requirement worked out to 450 units/day. It was assumed that the cost of power was Rs. 6.00/unit. Total requirement of water (soft) was about 30,000 l/day. Provision should be

made for storage tank. The requirement for steam was 150 kg/h or 1434 kg/day. It was assumed that the cost of water and steam was Rs. 0.01/l and Rs. 2.00/kg, respectively. It was assumed that for generator 20 l light diesel oil (LDO) would be used daily and the cost of LDO was Rs.83.00/l.

Table 3: Cost of utilities

Items	Daily use	Annual use	Rate (Rs.)	Annual cost (Rs.)
Electricity, unit	450	135000	6	810000
Steam, Kg	1,434	430200	2	860400
Fuel, lt	20	6000	83	498000
Water, lt	30,000	9000000	0.01	90000
Total				2258400

3.5 Manpower Cost

The manpower required for manufacturing of 1000 kg of ghee residue based snack per day in two shifts is listed in Table 4.

The total cost for labour, supervision and administrative expenses per annum are shown in Table 4.

Table 4: Cost of man power

Items	Salary (Rs.)	No. of persons required	Total salary / month (Rs.)	Total salary/annum (Rs.)
Operational supervisors				
Shift supervisors	21,000	3	63,000	7,56,000
Operating labour				
Lab analysts	10,500	3	31,500	3,78,000
Lab attendant	5,000	2	10,000	1,20,000
Electrician	10,500	2	21,000	2,52,000
Boiler attendant	10,500	2	21,000	2,52,000
Skilled worker	7,500	3	22,500	2,70,000
Unskilled worker	5,000	15	75,000	9,00,000
Administrative				
Plant Manager	45,000	1	45,000	5,40,000
Clerk-cum-accountant	10,500	1	10,500	1,26,000
Store keeper	10,500	1	10,500	1,26,000
Attendant	5,000	1	5,000	60,000
Security staff	5,000	4	20,000	2,40,000
Total salaries			3,35,000	40,20,000

3.6 Expenses on raw materials and packaging

The quantity of various ingredients required for

manufacturing of the product was computed and shown in Table 5.

Table 5: Cost of raw material

Items	Rs./kg or No.	Ghee residue based snack	
		Qty(kg or No.)	Total cost (Rs.)
Cow Milk (4% fat, 8.5% SNF)	40	42000	1680000.00
Rice flour	40	388.1	15524.00
Skim milk powder	220	139.7	30734.00
Salt	18	13.6	244.80
Dry mango powder	350	38.8	13580.00
Spice mix	644	16.7	10754.80
Baking powder	280	15.5	4340.00
3-ply laminated (PE/Al foil/PE) pouch for 500g ghee	1.75	3216	5628.00
3-ply laminated (PE/Al foil/PE) pouch for 25g chips	1.75	40	70.00
Total			1760875.60
Operation loss @2% of raw material and packaging material			35217.51
Total cost / day(Rs.)			1796093.11
Total cost / annum (Rs.)			526553280.00

3.7 Marketing Cost

The institutional buyers as well as direct consumer market were considered. The ghee residue based snack was produced in consumer packs. The thumb rate provides 20% commission shared between distributors, stockists and retailers. The computed manufacturing cost is represented in Table 8.

3.8 Total Production Cost

It has been estimated that cost for land and building (Table 1), and, plant and machinery (Table 2) for 1000 kg of ghee residue based snack were Rs. 74,62,500.00 and Rs. 99,85,000.00, respectively. The total fixed charge was of Rs. 1,81,96,375.00 included land and building, plant and machinery, and, installation and erection cost (Table 6).

Annual expenditure for man power (Table 4), utilities (Table 5), maintenance and repair (Table 8) were Rs. 40,20,000.00, Rs. 22,58,400.00 and Rs. 9,09,818.75, respectively. The raw material cost (Table. 6), laboratory charges, and, cleaning and sanitizing cost (Table 8) for ghee residue based snack were Rs. 5,38,82,933.60, Rs. 10,53,106.56 and Rs. 5,26,553.23, respectively. Ghee and skim milk obtained during manufacturing of ghee residue based snack were sold at the rate of Rs. 500/ kg of and Rs. 28.00/ kg, respectively. The cost of production was Rs. 10.72 (\approx 11.00)/ 25 g product.

Table 6: Total fixed cost (TFC)

Item	Cost (Rs.)
Cost of land and building (Rs.)	7462500.00
Cost for Plant and Machinery (Rs.)	9985000.00
Installation and erection @ of 7.5% of equipment cost (Rs.)	748875.00
TFC (Rs.)	18196375.00

Table 7: Total working capital (TWC)

Item	Cost (Rs.)
Cost of man power (Rs.)	40,20,000
Cost of utility (Rs.)	2258400
Cost of raw material (Rs.)	538827933.60
TWC (Rs.)	545106333.60

Table 8: Production cost (Rs.) of ghee residue based snack

Item	Cost (Rs.)
Raw material cost (Rs.)	538827933.60
Man Power cost (Rs.)	4020000.00
Utility cost (Rs.)	2258400.00
Maintenance and repairing cost @5% of fixed capital (Rs.)	909818.75
Laboratory charges @0.2% of cost of raw material (excluding packaging and operational cost) (Rs.)	1053106.56
Cleaning and sanitizing cost @0.1% of cost of raw material (excluding packaging and operational cost) (Rs.)	526553.28
a. Total (Direct product cost) (Rs.)	547595812.19
Interest on total capital investment (16.5% of TFC and TWC of 3 months) (Rs.)	25488038.14
Depreciation on capital investment on building@ 2.5% for 30 years (Rs.)	6218.75
Depreciation on capital investment on equipment (Rs.)	45015.00
Insurance and taxes @2% of TFC (Rs.)	363927.50
b. Total (Fixed charges) (Rs.)	25903199.39
A. Manufacturing cost (a +b) (Rs.)	573499011.58
B. Advertisement, marketing and distribution @20% of manufacturing cost/annum (Rs.)	114699802.32
C. Ghee cost (assuming Rs.500/kg)/annum (Rs.)	241200000.00
D. Cost of skim milk (Rs.)	318276000.00
Total cost/annum (A+B-C-D)	128722813.89
Cost / 1000kg/day (Rs.)	429076.05
Cost / 25g (Rs.)	10.73 (11.00)

4. Conclusion

The estimated expense for 25 g ghee residue based snack production is Rs. 11.00. The development of ghee residue based snack will offer opportunity to utilize valuable nutrients of ghee residue and for product diversification Consumer awareness and demand for nutritious as well as convenient product can surely help the recently developed ghee residue based snack to attract sale.

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