

Cost estimation for developed whey candy supplemented with pineapple pulp

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Abstract

Objective: This study emphasis on cost estimation of developed whey candy supplemented with pineapple pulp at low cost with abundant nutrients.

Methodology: To estimate the cost of whey candy several assumptions are with prime being 300 days of plant run and 1000 kg candy mix per day. The plant for manufacturing of whey candy would be operated in a single shift for 300 days. Various heads namely land and building, plant and machinery, manpower, administration, utilities, raw material, manufacturing, packaging, marketing, logistics etc. were taken into account while estimating the expenditure for the production of the whey candy in a running plant.

Findings: In 300 days 191910 kg whey, 42690 kg pineapple pulp, 218 kg sugar and 1500 kg stabilizer were used. ~ 39,99,000 number of candies prepared in 300 days. The final cost of production for whey candy was estimated at ₹3.41 per candy.

Application: This study can be utilized to encourage development of co product from byproducts of dairy which are not used so far though it has high nutritional value and has very low cost. This study also expands for the challenges to the new entrepreneurs being a prime sector of dairy.

Keywords: Whey, pineapple pulp, candy, assumption, emphasis, abundant.

1. Introduction

Milk and milk products are indispensable components of the food supply chain as milk is an excellent source of nutrients for humans. Near about 56% milk produced in India is converted into heat desiccated, fermented, and acid and enzyme coagulated products. During production of such coagulated and fermented product like cheese, paneer, channa, casein and shrikhand whey are separated out. Therefore whey can be defined as it is watery part of milk that remains during preparation of fermented or coagulated products in dairy industry. Studies revealed that whey contains 45-50 % of total milk solids, 70 % of milk sugars, and 20 % of milk proteins, 70-90 % of milk minerals and almost all water soluble vitamins present in milk [1]. It is generally thrown out due to fewer amounts of total solids than milk and disposal of untreated whey may cause environmental pollution problem [2-3]. It is being viewed as one of the major disposal problem of dairy industry as it imposes a very high Biological oxygen demand value which is being in the range of 30,000 to 50,000 mg/Lit and Chemical oxygen demand in the range of 60,000 to 80,000 mg/Lit . In India, the production of whey is estimated to about 4.84 million tons per annum, which consists of about 290 million kilograms of valuable milk nutrients [4]. Thus, utilization of whey in human food chain is now being magnificently favored. Now a days, whey and whey components are increasingly incorporated in various dairy and food products like beverages, soups, sports drinks, baked goods, etc.

Ice cream is a frozen dairy product made by suitable blending and processing of cream and other milk products, together with sugar and flavor, with or without stabilizer or color and with the incorporation of air during the freezing process [5]. Ice cream is very delicious frozen dessert and ice candy is an attractive form of it which is specially liked by the children [6]. Indian ice cream industry is one of the fastest growing segments of the dairy or food processing industry. Currently Ice cream market in India is estimated to be over INR 4,000 crores, and is growing at a rate of 15-20% year-on-year. It is projected that by 2019, the market will reach around INR 6,198 crores. India has a low per capita ice cream consumption of ice cream at 400 ml as compared with per capita consumption of ice cream of 22,000 ml in the United States and 3,000 ml in China.

With the improving cold chain infrastructure in the country coupled with increasing disposable income and the changing lifestyle, the sector has great potential for growth (Anon, 2017). Ice cream being a product relished by people from all age groups and also because of its characteristic low temperature production and storage, can serve as a matrix for many desirable, high temperature sensitive nutrients [7]. Recently, there has been a growing interest in the field of functional food and search for their potential to improve the immune system. Natural fruit pulp are believed to enhance natural resistance of the body against infection and their immune modulatory have been reported in several studies but due to their undesirable and sour or unacceptable taste their health benefits cannot be utilized, especially in case of children. Therefore, a matrix like ice cream, with its chilling exciting taste, can help in utilizing the potential therapeutic properties of fruits. Thus producing whey candy by incorporating fruit pulp like pineapple pulp can fill the gap in the market and also full the consumer demand. Further, there were enquiries from small and medium scale dairy plants for utilization of whey without applying membrane processes. In view of the increase in popularity of ice-cream in India year on year and need to develop a low cost nutritious ice cream, pineapple pulp supplemented whey candy was developed which can meet the demand of the modern health conscious consumer. After preparation of such a product, it becomes imperative to estimate various costs towards the production of pineapple pulp supplemented whey candy over plant scale.

2. Materials and Methods

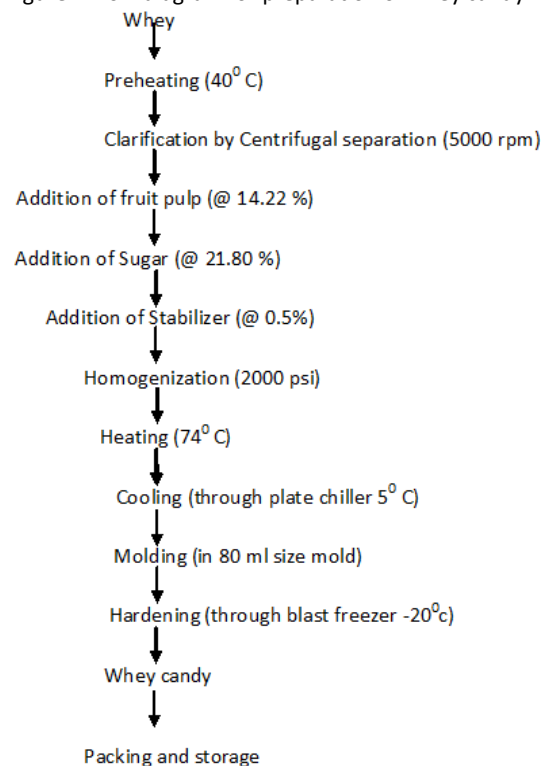
1. Whey: Whey was procured from local dairy industries in Kolhapur city and stored at 5° C
2. Pineapple pulp: Food grade pineapple pulp procured from Yashraj Agro Exports Pvt. Ltd., Pune, India.
3. Sugar and stabilizer: Powdered cane and Carboxyl-methyl cellulose (E466) were procured from local market of Kolhapur city.

3. Methodology

1. Preparation of whey candy

Whey candy was prepared as method suggested by [2] with certain modification.

Figure 1. Flow diagram for preparation of whey candy



Initially whey was preheated at 40^o C and allow for clarification through centrifugal separator at 5000 rpm. In clarified whey pineapple pulp @ 14.22 % and sugar @ 21.80 % were added. Also CMC stabilizer was used @ 0.5 % of whey. The mixture was allow to homogenize by passing through double stage homogenizer. The mix is now referred as whey candy mix. It was then heated up to 74^o C in batch pasteurizer. Upon cooling to 5^o C temp the mix was poured in 80 ml ice candy mold and passed it through continues blast freezer to harden it. Hardened candies were packed and transferred into deep freezer at -20^o C for storage as shown in Figure 1.

2. Techno-economic feasibility

Techno-economic feasibility evaluation for any new product is essential before the launch of the product in market. Therefore, the expense for production of the whey candy was estimated after its development. The cost analysis data available with the operational aspects of the plant at Shree. Sandeep Refrigeration unit, Kolhapur has been utilized for this purpose. The cost was estimated by following the guidelines suggested by [8-10].

3. Basic assumptions for estimation

In order to work out the cost of production of the whey candy, the following basic assumptions have been made and are stated here under:

1. It is estimated that the plant capacity would be 1000 kg whey candy mix per day. In which 639.70 kg whey, 142.30 kg pineapple pulp, 218 kg sugar and 5 kg stabilizer. ~13,330 number of candies prepared per day.
2. The plant for manufacturing of whey candy would be operated in a single shift for 300 working days in a year. In 300 days 191910 kg whey, 42690 kg pineapple pulp, 218 kg sugar and 1500 kg stabilizer were used. ~39,99,000 number of candies prepared in 300 days.
3. The raw material like whey would be procured through a contractor and to be delivered at the factory site in chilled condition.
4. Pineapple pulp would be procured in bulk quantity.
5. The finished product to be packaged whey candy pouch having final weight is 75 ml per candy. ~13330 candies can be produced in one day.
6. The product would be transported by refrigerated vehicles from the plant to the sale booths.
7. The demand is expected to be matching with the production and the product dispatch will be made on every alternate day. The cold storage capacity being 3 tones.
8. The losses were assumed to be 0.5%.

4. Results and Discussion

1. Capital requirements

Total capital required for the manufacture of whey candy has been estimated in this section considering all direct and indirect costs involved. The direct and indirect costs that have been determined in this section are situation specific and wherever necessary apportioned costs have been considered under similar situations. The cost needs to be constantly updated from time to time as it is subject to price fluctuation and inflation.

2. Land and Building

Table 1 indicates the expense on land and building of the plant. The built-up area and the plot of land area taken were 750 sq. mtrs and 950 sq.mtrs, respectively. The price of plot of land was taken as 2,000 per sq.mtr and the cost of built-up area as 4,000 per sq. mtrs. Thus, the calculated cost of land was considered as 19.00 lakh and building cost as 30.00 lakh.

Table 1. Expense on land and building (a)

Particular	Size (m ²)	Rate per m ² (₹)	Estimated cost (₹)	Rate of depreciation (%)	Annual Depreciation (₹)
Land	950	2000	19,00,000.00	5	95000
Land development cost	-----	-----	50,000.00	5	2500
Building	750	4000	30,00,000.00	5	1500000
Total			49,50,000.00		2,47,500.00

The total cost of land and building including land development cost was 49.5 lakh. The depreciation cost on building was calculated (@ 5%) to be 2,47,500.00/-.

3. Equipment and Machineries cost

A comprehensive list of the major processing equipment used for manufacturing 13,330 candies daily, corresponding to 39,99,000 whey candies per annum is given in Table 2. The total cost for plant equipment and machineries was considered as 65.8 lakh. The total depreciation cost for these items was calculated as 4,64,500.00/-. The details of which are mentioned in Table 2. The costs shown are location specific for the estimation.

Table 2. Initial cost and depreciation on plant equipment and machinery (b)

Item	Capacity	No.	Rate (₹)	Estimated cost (₹)	Rate of depreciation (%)	Depreciation (₹)
Storage tank	500 L	2	3.20 lakh	6,40,000.00	10	64,000.00
Cream separator	200 L	1	40,000	40,000.00	10	4000.00
Batch pasteurizer	200 L/hr	1	4.17 lakh	4,17,000.00	10	41,700.00
Plate chiller	300 L/hr	1	1.90 lakh	1,90,000.00	10	19,000.00
Homogenizer	250 L/hr	2	2.1 lakh	4,20,000.00	10	42,000.00
Ice cream mixing tank	500 L	1	2.10	2,10,000.00	10	21,000.00
Continuous freezing machine	200 L/hr	1	5 lakh	5,00,000.00	10	50,000.00
Packaging machine		1	2.68 lakh	2,68,000.00	10	26,800.00
Cold storage room	10 X 15 ft	1	4.5 lakh	4,50,000.00	10	45,000.00
Crates		100	500	50,000.00	10	5,000.00
Steam Boiler	100kg/hr	1	1.7 lakh	1,70,000.00	15	25,500.00
Power generator	100 KVA	1	6.80 lakh	6,80,000.00	15	1,02,000.00
Water and steam line fittings	-----		50,000	50,000.00	5	2500.00
Laboratory equipment	-----		50,000	50,000.00	10	5000.00
Weighing scale	100 kg	2	5000	10,000.00	10	1000.00
Refrigerated vehicle		1	10 lakh	1,00,000.00	10	10,000.00
Total				42,45,000.00		4,64,500.00

4. Manpower expenses

In accordance with the manufacturing operations to be performed in a single operating shifts, the requirements of the personnel needed for the manufacture of 39,99,00 number whey candies per annum were computed. The persons directly involved in the production were plant operators and manufacturing labor. The total direct cost for labor and supervision was estimated at 9,36,000.00/- per annum (Table 3). The costs of personnel indirectly involved viz., administrative expenses in manufacture schedule have been estimated to be 9,84,000.00/- (Table 4).

Table 3. Cost of manpower directly involved in the manufacture of whey candy (c)

S. No.	Staff	No.	Monthly salary(₹)	Monthly cost(₹)	Annual cost(₹)
1	Labors	6	4000	24,000.00	2,88,000.00
2	Skilled workers	2	5000	10,000.00	1,20,000.00
3	Mechanic/Electrician	2	7,500	15,000.00	180,000.00
4	Boiler attendants	1	7,500	7,500.00	90,000.00
5	Lab analyst	1	7,500	7,500.00	90,000.00
6	Lab attendant	1	4000	4000.00	48,000.00
7	Technical Supervisors	1	10,000	10,000.00	1,20,000.00
	Total			78,000.00	9,36,000.00

Hence, the total annual manpower cost has been estimated to be 19,20,000.00/-. Labor and supervision charges are specific for the situations considered and are proportional to the volume of production. Since these charges are likely to depend on the complexity of plant, extent of automation and manufacturing practices, these need to be calculated for the specific situations.

Table 4. Cost of manpower indirectly involved in the manufacture of whey candy (d)

S. No.	Staff	No	Monthly salary	Monthly cost (₹)	Annual cost (₹)
1	Factory Manager	1	30,000	30,000.00	3,60,000.00
2	Assistant Manager	1	20,000	20,000.00	2,40,000.00
3	Clerks	1	5000	5000.00	60,000.00
4	Store keeper	1	7,500	7,500.00	90,000.00
5	Accountant	1	7,500	7,500.00	90,000.00
6	Attendants	1	4000	4000.00	48,000.00
7	Security staff	1	4000	4000.00	48,000.00
8	Driver	1	4000	4000.00	48,000.00
	Total			82,000.00	9,84,000.00

5. Fixed expenses and interest

The total capital investment comprises of interest on fixed capital and working capital. The working capital was calculated on the basis of cost of raw materials for one month of production, one month salary of the staff and one month expenses on utilities involved in the production of whey candy. The total fixed and working costs and their interest was considered 12% [8] are given in Table 5. The total interest on these capitals was computed to be 11,91,723.72/-per annum.

Table 5. Interest on capital

S. No.	Particulars	Amount (₹)	Annual interest @ 12% (₹)
1	Fixed capital (Land ,building, plant and machinery)	9,195,000.00	11,03,400.00
2	Working capital(Value of raw material, salaries and utilities for one month)	7,36,031.00	88,323.72
	Total		11,91,723.72

6. Expense on raw materials

The quantity of various raw materials at current prevailing rates required for manufacturing 39,99,000 whey candy per annum was worked out and it may be observed from Table 6 that the total cost of raw materials worked out to be 53,04,660.00/-per annum.

Table 6. Expenses on raw materials (for 1000 kg/day) (e)

S. No.	Item	RequirementDaily (kg)	(kg)Annual	Rate /kg (₹)	Annual cost (₹)
1	Whey	639.70	191910	1	1,91,910.00
2	Sugar	218	65400	37	24,19,800.00
3	Pineapple pulp	142.30	42690	55	23,47,950.00
4	Stabilizer	5	1500	230	3,45,000.00
	Total				53,04,660.00

7. Expense on packaging material

Proper and attractive packaging not only helps in retaining the quality attributes, but also promotes sale of the product. In this costing exercise, 75 ml ice candy pouch (for packing 100% of the whey candy produced) and 780 gm of corrugated box (for bulk packaging i.e. 10 no of whey candy) were envisaged for retail selling of the product. The total cost of packaging for 39,99,000 whey candies was reckoned to be 18,01,800.00/- (Table 7).

Table 7. Cost of packaging materials (f)

S. No.	Type of packaging materials	Daily	Annual	Rate /piece (₹)	Annual cost (₹)
1	Ice candy printed pouches (75 ml)	13330	39,99,000	0.30	1,199,700.00
2	Corrugated box (780 gm)	1338.00	4,01,400.00	1.5	6,02,100.00
	Total				18,01,800.00

8. Expense on utilities

To estimate the total direct cost, the apportioned costs for various utility services viz. electricity, steam and water were considered. The estimate of electricity requirement is given in Table 8-9. Individual items of utility services were determined and itemized in Table 8. It may be seen that the total cost of utilities worked out to be 4,48,650.00/- per annum. The extent of various utility services depends upon the efficiency of the plant. The cost of utilities, therefore, varies from plant to plant and thus needs to be figured out for a given situation. Expense on detergents and chemicals under this category, the expenditure incurred on common detergents such as caustic soda, teepol etc. were estimated to be 7,000.00/-annually. The estimate for detergents is presented in Table 10.

Table 8. Electricity requirements (g)

S. No.	Particulars	kWh	Total working hours	(units/ day)	kWh/ Annum
1	Cream separator	1.5	4	6	1800.00
2	Batch pasteurizer	12	4	48	14,400.00
3	Plate Chiller	4	3	12	3,600.00
4	Homogenizer	3 (2 no)	8	48	14,400.00
5	Freezer	3	5	15	4,500.00
6	Packaging machine	2	4	8	2,400.00
7	Fan, A/C, Tube light, etc.			50	15,000.00
8	Lab equipment			20	6,000.00
	Total			207	62,100.00

Table 9. Charges on power and utilities (h)

S. No.	Particulars	Requirements Daily	Annual	Rate (₹)	Annual cost (₹)
1	Electricity	213 kWh	62100 kWh	6.5 / kWh	4,03,650.00
2	Water	3000 Ltr.	90,0000 Ltr.	10/ 1000 Ltr.	9000.00
3	Fuel	40	12,000	3.0	36,000.00
	Total				4,48,650.00

Table 10. Cost of detergents and chemicals (i)

S. No.	Item	Annual cost (₹)
1	Caustic soda, teepol, etc.	3000.00
2	Glass wares/chemicals	4000.00
	Total	7,000.00

9. Marketing expense

The total marketing expense of 18,81,972.02/-has been calculated on the basis of 16% [8] of the manufacturing cost.

10. Total manufacture expense

The various direct, indirect and fixed costs involved in the production of whey candy per annum are elucidated in the preceding sections. The total of direct, indirect and fixed costs is shown in Table 11.

11. Net manufacturing cost

The total manufacturing cost was calculated to be ₹1,36,44,239.10/- per annum and the total production 39,99,000 candies per annum including 0.5% losses (Table 12). The cost of production of the whey candy was estimated at ₹3.41 per candy. Under commercial conditions at higher scale of handling, the cost of production is expected to be lower.

Table 11. Total cost of developed ice cream

S. N	Component	Rates	Annual cost (₹)
	A. Direct costs		
1	Raw materials	Table 6	53,04,660.00
2	Packaging	Table 7	18,01,800.00
3	Manpower (labor and supervision)	Table 3	9,36,000.00
4	Utilities	Table 9	4,48,650.00
5	Laboratory Charges	0.2% of cost of raw material	10,609.32
	Sub-total		85,05,719.32
	B. Indirect costs		
1	Manpower (Administrative)	Table 4	9,84,000.00
2	Estimated expenditure on detergents, glass wares and chemicals	Table 10	7,000.00
	Sub-total		9,91,000.00
	C. Fixed costs		
1	Depreciation	Table 1, Table 2	7,12,000.00
2	Interest	Table 5	11,91,723.72
3	Maintenance (equipment, building, etc.)		50,000.00
4	Insurance and taxes	2% of total fixed capital investment	23,832.79
5	Plant overheads	15% of total manpower cost	2,88,000.00
	Sub-total		22,65,555.79
D	Manufacturing Cost	(D=A+B+C)	1,17,62,275.1
E	Marketing and Distribution	16% of manufacturing cost	18,81,964.02
	Total cost (₹) per annum (D+E)		1,36,44,239.10

Table 12. Net manufacturing cost

Item	Particular
Total manufacturing costs	1,36,44,239.10
Total production (Whey candy no per annum)	39,99,000.00
Estimated cost of production of whey candy for one candy	3.41

5. Conclusion

Cost analysis was performed for developed whey candy by assuming that 1000 kg of production daily and 300 days per annum. With this consideration 13,330 candies can be prepared daily and with 0.5 % loss the cost for a single whey lolly is ₹3.41 which affordable for all income groups with good nutritional composition.

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