

# Estimation of cost for preparation of *Danadar* from cow milk

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*Danadar* is a famous *Chhana* based traditional dairy product of West Bengal which is liked by almost every one. The marketing success of a new product exists on the economic feasibility of manufacturing process. Cost estimation for commercialization of any food product is very crucial. In view of this, an attempt was made to estimate the cost of the developed product through project evaluation, plant design, product pricing, process optimization and other techno economic studies. The cost of different components used in the manufacture of *Danadar* at Faculty of Dairy Technology, Nadia, W.B. was taken as on September, 2016. In order to arrive at a reasonable realistic cost of processing and that of the end product, certain assumptions were made. The cost of production of *Danadar* was worked out considering the costs of all the inputs (fixed and variable costs) for a production capacity of 1000 kg/day. It was assumed that the *Danadar* plant would be operated in one shift of 8 h each for 300 days in a year. The cost of the raw materials used, has been worked out on the prevailing market prices. The finished product would be packaged in PS tray within a cardboard box with a capacity of 500g. It was found that the product could be manufactured at Rs. 130.00 per kg (including packaging), which appeared to be reasonably competitive considering the prevalent market price of this traditional product.

**Key Words :** *Danadar*, Cost estimation

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## INTRODUCTION

Various traditional milk products like *Rasogolla*, *Gulabjamum*, *Sandesh*, *Burfi*, *Peda*, *Balusahi*, *Danadar*, *Misti dahi* etc. are made in our country since ancient times because of their social, economic, religious, medicinal and cultural activities. The sweetmeats that are available in the markets are mostly *Chhana*-based

milk products and palatable. It has a significant role in our culture. There is no such ceremony and festival which goes without sweetmeats. Among these, *Danadar* occupies a unique place in the local area of West Bengal.

*Danadar* is a popular *Chhana* based sweet. Indigenous milk products have a big potential of the emerging dairy industry in the organized sector. *Danadar* is usually sold in spherical form. It is golden and white in colour and has a semi hard to firm body with granular texture. *Danadar* was originated by Dwarik's sweet shop of Shyama Pukur Street in Kolkata.

The masses of India want a quality product which they can pay and get the value of the money and enjoy the product to the core for *Danadar* they need good quality and tasty *Danadar* to enjoy and they can buy at a reasonable rate. The marketing success of a new product exists on the economic feasibility of

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manufacturing process. Having established the optimized technology for manufacturing *Danadar*, the next logical step would be to estimate its cost of manufacture. Cost estimation for commercialization of any food product is very crucial. In view of this, an attempt was made to estimate the cost of the developed product through project evaluation, plant design, product pricing, process optimization and other techno economic studies. Depending on the process design principles, the raw materials and utilities, costs are calculated through material and energy balances and equipment costs are estimated on the basis of equipment sizing procedures. The labour cost is depended on the study of the equipment flow sheet and on the kind of equipments. For this purpose, cost data available with the operational aspects of the dairy plant at Kolkata has been utilized.

A study on techno economic feasibilities is of prime importance to estimate the cost before launching any product to the market. The cost was estimated by following the guidelines suggested by Marouli and Maroulis (2005) and Chauhan *et al.* (2007). The cost of different components used in the manufacture of *Danadar* was taken as on September, 2016. In order to arrive at a reasonable realistic cost of processing and that of the end product, certain assumptions were made. The assumptions were made for a *Danadar* making unit with rated capacity of 1000 kg of milk processing per day. It was assumed that the *Danadar* plant would be operated in one shift of 8 h each for 300 days in a year. The cost of the raw materials used, has been worked out on the prevailing market prices. The finished product would be packaged in PS tray within a cardboard box with a capacity of 500g.

## METHODOLOGY

### Technology for preparation of *Danadar* from cow milk :

The standardized method developed for the production of *Danadar* from cow milk involves standardization of cow milk to 3.5 per cent fat and 8.5 per cent SNF, heating the milk to 100°C with slow but continuous agitation, cooling the milk to 80°C, coagulation with 2.0 per cent citric acid solution, natural draining of whey for 15 min, grinding of *Chhana* to obtain a smooth paste, addition of ground sugar and *Suji* at the rate of 5.0 and 4.0 per cent by weight of *Chhana*, respectively, thorough mixing of the ingredients, kneading the contents

to a smooth paste, forming into round balls of 12 g each and cooking in 70 per cent sugar syrup for 40 min followed by soaking in another pan containing hot sugar syrup of the same concentration (70°C Brix) for 30 min. The balls were subsequently rolled over the ground sugar.

### Sample preparation for analysis :

The samples were drawn in presterilized plastic pot of the laboratory. All conical flasks, volumetric flasks, measuring cylinders, pipettes and burettes etc. used were made of *Borosil*.

### Sensory analysis :

Representative sample of *Danadar* was tested for sensory attributes as colour and appearance, flavour, body and texture and overall acceptability. The procedure adopted for sensory evaluation was Nine Point Hedonic scale.

### Chemical analysis :

Representative sample of *Danadar* was tested for moisture, fat, protein, carbohydrates and ash. The procedure as described in FSSAI: Part III-sec-1: 356-386 (2011) was followed for sampling and analysis.

The moisture content was determined by the gravimetric method as described in manual of FSSAI (2011). The total fat content was determined by Rose-Gottlieb method as described in (ISI 1981), SP: 18 (Part XI). The protein content of *Danadar* was estimated by the micro Kjeldahl method outlines by Jayram (1981). *Danadar* sample was analyzed for total solid and ash following the method described in IS: 2785 (1979). The total carbohydrates content was calculated by method of difference. For this purpose total fat, protein, and ash content of the *Danadar* was subtracted from total solids.

### Microbiological analysis :

The total viable, yeast and mold, coliform and staphylococcus counts in the samples were determined as per the methods suggested in APHA (1984).

### Texture analysis :

The TPA was done following the under mentioned specifications:

Texture profile analysis (TPA) was performed at ambient temperature with TA-XT plus texture analyser (Stable Micro System, Surrey, UK) and a 50 kg load cell.

The attributes evaluated were hardness, adhesiveness, chewiness, springiness, gumminess and cohesiveness. Each sample was compressed vertically in two consecutive cycles of 50% compression, 5 seconds apart using a flat plunger (SMS-P/75) and a heavy duty platform. The adopted test settings for this experiment are described below:

Pre-test speed	:	1.5 mm/second
Test speed	:	0.5 mm/second
Post-test speed	:	1.5 mm/second
Strain	:	50% compression
Interval (time)	:	5 seconds
Trigger type	:	Auto (Force)
Trigger force	:	25 g

The Texture-Analyzer having separate software (Texture Expert) for its operation was run under Windows environment (Windows 98). A microprocessor (IBM, Pentium II) has been coupled with Texture Analyzer to run the Texture Expert Programme. In the Texture Expert, result file has been programmed to calculate the Texture Profile Analysis (TPA) Data from the measurement. The textural parameters were directly calculated from Force-Time curve and microprocessor.

#### Statistical analysis :

The data obtained were statistically analyzed by using Design expert 7.0 software.

### OBSERVATIONS AND ASSESSMENT

After process optimization for preparation of *Danadar* from cow milk, the next step would be to estimate its cost of production. Cost estimation for production of *Danadar* from cow milk on commercial is very essential. In view of this, an attempt was taken to estimate the cost of the developed product through project evaluation, plant design, product pricing, process

optimization and other techno economic studies. Depending on the process design principles, the raw materials and utilities, costs are calculated through material and energy balances and equipment costs are estimated on the basis of equipment sizing procedures. The labor cost is depended on the study of the equipment flow sheet and on the kind of equipments. For this purpose, cost data available with the operational aspects of the dairy plant at Kolkata has been utilized.

#### Production cost of *Danadar* :

The costs of raw material, machine, labour cost were tabulated. The cost of different components used in the manufacture of *Danadar* was taken as on September, 2016. In order to arrive at a reasonable realistic cost of processing and that of the end product, certain assumptions were made. The assumptions were made for a *Danadar* making unit with rated capacity of 3100 kg of milk processing per day. It was assumed that the *Danadar* plant would be operated in one shift of 8 h each for 300 days in a year. The cost of the raw materials used, has been worked out on the prevailing market prices. The finished product would be packaged in PS tray within a cardboard box with a capacity of 500g.

The various assumptions were made to estimate the cost of *Danadar* produced by optimized process is enumerated in the following sections.

#### Capital requirements :

Total capital required for the manufacture of *Danadar* 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 conditions. The cost needs to be constantly updated from time to time as

**Table 1 : Cost of raw material (Rs.)**

Raw material	Unit	Rate (Rs.)	Quantity (kg)	Cost (Rs.)
Cow milk (4.5,8.5)	Kg	26	3100	80600
Sugar	Kg	32	28	896
Suji	Kg	35	22	770
Citric acid	Kg	60	6.2	372
Packaging material	Pc	6	2000	12000
Total				94638
Operational loss 2% of raw and pack material cost				1892.76
Total cost /day				96530.76
Total cost /annum				28959228

it is subject to price fluctuation and inflation.

### Land and building :

The total cost of land and building were computed for preparation of *Danadar* from cow milk to be Rs. 7337500. The comprehensive list of the major processing equipments used for manufacturing 1000 kg *Danadar* / day corresponding to 300000.kg *Danadar* per annum is given in Table 4. The total depreciation cost of these items was calculated and the details of which are given in Table 7. The total cost of equipment was computed to be Rs. 4678000 and its erection includes Rs. 280680.

### Manpower expenses :

In accordance with the manufacturing operations to be performed in single operating shifts, the requirements of the personnel needed for the manufacture of 300000 kg *Danadar* per annum were computed. The persons directly involved in the production were supervisor, skilled and unskilled labors. The total cost of man powers was computed to be Rs. 1356000.

### Fixed expenses and interest :

The total capital investment comprises of interest on fixed capital and working capital. The total fixed and

working cost was computed to be Rs. 12296180 and 32844828, respectively.

### Expenses on raw materials :

The quantity of various raw materials at current prevailing rates required for manufacturing 300000 kg *Danadar* per annum was worked out and it may be observed from Table 1 that the total cost of raw materials worked out to be Rs. 28959228 per annum.

### Expenses on utilities :

To estimates 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 3. It may be seen that the total cost of utilities worked out to be Rs. 2529600 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.

### Expenses on detergents and chemicals :

Under this category, the expenditure incurred on common detergents such as caustic soda, teepol etc were estimated to be Rs. 24791 per annum. The estimate for

**Table 2 : Cost of man power (Rs.)**

Items	Salary (Rs.)	No. of persons required	Total salary (Rs.)	Total salary /annum (Rs.)
<b>Operational supervisors</b>				
Shift supervisors	15000	1	15000	180000
<b>Operating labour</b>				
Lab analysts	9000	1	9000	108000
Lab attendant	5000	1	5000	60000
Electrician	9000	1	9000	108000
Boiler attendant	9000	1	9000	108000
Skilled worker	7500	2	15000	180000
Unskilled worker	5000	4	20000	240000
Clerk-cum-accountant	10500	1	10500	126000
Store keeper	10500	1	10500	126000
Security staff	5000	2	10000	120000
Total salaries			113000	1356000

**Table 3 : Cost of utility (Rs.)**

Items	Daily use	Annual use	Rate (Rs.)	Annual cost (Rs.)
Electricity, unit	450	135000	6	810000
Steam, Kg	2,000	600000	2	1200000
Fuel, l	20	6000	83	498000
Water, 1000 l	30,000	9000000	2	18000
Refrigeration kJ/100000kJ	60000	18000000	20	3600
Total				2529600

detergents is presented in Table 7.

### Total manufacturing expenses :

The various direct, indirect and fixed costs involved in the production of *Danadar* per annum are elucidated in the preceding section. The total of direct, indirect and fixed costs is shown in Table 7.

### Net Manufacturing cost :

The total manufacturing cost was calculated to be Rs. 38963016. The cost of production of the *Danadar*

was estimated as Rs.130/kg or Rs. 3.25 per Pc of *Danadar* from cow milk of 25 g each.

### Conclusion:

The cost of production of *Danadar* was worked out considering the costs of all the inputs (fixed and variable costs) for a production capacity of 1000 kg/day. It was found that the product could be manufactured at Rs. 130.00 per kg (including packaging) or Rs. 3.25 per Pc of *Danadar* of 25 g each, which appeared to be reasonably competitive considering the prevalent market

**Table 4 : Cost of equipments (Rs.)**

Item particulars	Capacity	No.	Rate (Rs.)	Initial value (Rs.)	Scrap value (Rs.)	Life (years)	Annual depreciation (Rs.)
Weighing balance	100 kg	1	7500	7500	750	20	37.5
Weighing balance	5kg	1	5500	5500	550	20	27.5
Dump tank	1000lt	1	55000	55000	5500	25	220
Milk pump (1HP)	1000lt/h	2	20000	40000	4000	20	200
Plate chiller	1000lt/h	1	65000	65000	6500	20	325
Raw milk storage tank	5000lt	1	250000	250000	25000	25	1000
Milk can (Aluminum)	40lt	10	3000	30000	3000	25	120
Pasteurizer	1000lt/h	1	480000	480000	48000	20	2400
Cream separator		1	125000	125000	12500	20	625
Double jacketed kettle	500lt	3	250000	750000	75000	20	3750
Double jacketed kettle	200lt	2	160000	320000	32000	20	1600
Channa coagulation Vat	600 lt	2	250000	500000	50000	20	2500
Whey Storage Tanks	5000lt	1	250000	250000	25000	25	1000
Batch and price printing machine		2	15000	30000	3000	25	120
Steam boiler	300kg/h	1	100000	100000	10000	25	400
Power generator-	125 KVA	1	540000	540000	54000	25	2160
Cold store and refrigeration unit		1	500000	500000	50000	20	2500
Water storage tank	20000lt	1	200000	200000	20000	25	800
Pipe fitting accessories			150000	150000	15000	25	600
Light commercial vehicle		1	15000	15000	1500	20	75
Electric connection (transformer	150 KV		170000	65000	6500	20	325
Cable, control panel, D panel, mcc panel)							
Computer	1	1	40000	40000	4000	10	400
Furniture				10000	1000	20	50
Fire fighting			5,000	5000	500	25	20
Laboratory equipment				100000	10000	25	400
Exhaust fan		5	5000	25000	2500	25	100
Miscellaneous		1	20000	20000	2000	20	100
Total (Rs.)				4678000	467800	590	21855

**Table 5 : Total working capital (Rs.)**

Manpower cost (Rs.)	Utility charges (Rs.)	Raw material cost (Rs.)	Total working cost (TWC) (Rs.)
1356000	2529600	28959228	32844828

**Table 6 : Total fixed charges (Rs.)**

Equipment cost (Rs.)	Installation and erection @Rs.6% of equipment cost (Rs.)	Land and building cost (Rs.)	Total Fixed Charge (TFC) (Rs.)
4678000	280680	7337500	12296180

**Table 7 : Total production cost (Rs.)**

A. Manufacturing cost/annum	Rs.
(a) Direct product cost	
Raw material	28959228
Man Power	1356000
Power, fuel, water (calculated)	2529600
Maintenance and repair, @5% of fixed capital	614809
Laboratory charges, @0.2% of cost of raw material (excluding cost of packaging material and operational loss)	49582.8
Cleaning and sanitizing machine, @0.1% of cost of raw material (excluding packaging material and operational loss)	24791.4
Total (Direct product cost)	33534011.2
(b) Fixed charges	
Interest on total capital investment (15% of TFC and TWC of 3 months)	3322444.26
Depreciation on capital investment :	
Building@2.5%:(30 years)	6114.583333
Equipment	21855
Insurance and taxes (@2% of TFC)	245923.6
Total (Fixed charges)	3596337.443
A. Manufacturing cost (a+b)	37130348.64
B. Advertisement, marketing and distribution @5% of manufacturing cost/annum	1856517.432
C. Cost of whey (Rs. 55/kg TS)	9900
D. Cost of ghee (450/kg)	13950
Total cost/annum (A+B-C-D)	38963016.08
Cost /1000kg/day	129876.7203
Cost/kg	129.8767203
Cost/pc	3.246918006 (3.25)

price of this traditional product.

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