

RESEARCH ARTICLE

Estimation of production cost for Indian artisanal sour buttermilk powder

Subhadip Manik¹, Ganga Sahay Meena¹✉, Yogesh Khetra¹, Ashish Kumar Singh¹, Richa Singh², Sumit Arora², Raghu H. V.³

Received: 22 October 2024 / Accepted: 30 April 2025 / Published online: 23 April 2025

© Indian Dairy Association (India) 2025

Abstract: The present investigation was aimed to estimate the production cost of Indian artisanal sour buttermilk powder that contains 53% protein. Additionally, it exhibits numerous techno-functional properties such as “instant” in wettability (3 s), excellent flowability (angle of repose=28.36°), water binding capacity (4.34 g/g of protein) and excellent emulsification stability (80.70%) along with essential amino acids, fatty acids and antioxidants. This study aimed to estimate its production cost with a numerous assumption. Main assumption was production of 1260.12 tons of Indian artisanal sour buttermilk powder in 300 days. Numerous heads such as raw material, packaging material, land and building, manufacturing, utility, manpower, marketing and distribution etc. were taken as a crucial factor during estimation of total production cost of Indian artisanal sour buttermilk powder. The calculated cost for 500 g pack and 1 Kg pack of this powder was Rs. 211.52 and Rs. 423.04, respectively.

Keywords: Artisanal, sour buttermilk powder, techno-functional, production cost.

Introduction

India is global leader in milk production with the annual production of 230.58 million tonnes during year 2022-23 (PIB, 2024). Presently, about 46% of the total milk production in India is either consumed

directly by producers (DAHD, 2021) or used to produce various dairy products such as curd (*dahi*), traditional butter (*makkhan*), clarified fat (*ghee*), artisanal buttermilk (*lassi* or *chhach*) for the household use (Halder et al., 2021). About 14% of total milk production is converted in fermented milk products by unorganized sector (MOFPI, 2023). In rural households, excess whole milk is subjected to prolong heat treatment, cooled, inoculated using previous run *dahi* or *chhach* and incubated to produce *dahi* that is further churned to yield *makkhan* (an intermediate product) which is subsequently heated during *ghee* preparation. As per Aneja et al. (2002), production of 1 Kg of *ghee* (from *makkhan*) by tradition method produces 15 to 20 Kg of artisanal sour buttermilk. As per De (2004), artisanal sour buttermilk contains 3.8% of total solids (TS), 1.29% of protein, 0.8% of fat, 1.2% of lactose, 0.4% of ash, and 0.44% of lactic acid, respectively. It has a brownish color aroused from the prolonged heat treatment of milk before its inoculation. It contains numerous curd particles and non-homogeneous consistency which is prone to deposition of curdy stuff and separation of watery portion on its top owing to its higher acidity (Pal & Rajorhia, 1985; Padghan et al., 2015). Additionally, the overall quality of the product varies greatly as function of differences in preparation techniques (Aneja et al., 2002). Recently, Manik et al. (2023) developed artisanal sour buttermilk powder via concentration of sour buttermilk up to 3.62× (12.86% of TS) using reverse osmosis (RO), a membrane-based process and subsequently converted its retentate / concentrate into artisanal sour buttermilk powder employing spray drying. The developed powder was “instant soluble (3 s wetting time)”, exhibited free flowing (angle of repose=28.36°) characteristics, excellent emulsion stability (80.70%). This powder also contained essential amino acids, fatty acids along with sound antioxidative properties.

As per MOFPI (2023), the global market size of fermented milk was \$264.77 billion in 2018 and is expected grow to \$396.87 billion by 2026, with a CAGR of 5.1% during 2019 to 2026. Furthermore, the *lassi* market in India was INR 47.5 billion in 2023 and expected to reach INR 217.5 billion by 2032 with a CAGR of 17.9% during 2024-2032 (IMARC Group, 2024a). Moreover, the size of the worldwide milk powder market was US\$ 34.6 billion in 2023 and

¹Dairy Technology Division, ²Dairy Chemistry Division, ³Dairy Microbiology Division, ICAR-National Dairy Research Institute, Karnal-132 001, Haryana, India

Ganga Sahay Meena (✉)

Dairy Technology Division, ICAR-National Dairy Research Institute, Karnal, Haryana, India

Email: gsiitkgp@gmail.com; Contact No: +91- 9996129094.

will reach to US\$ 57.2 billion with a CAGR of 5.6% from 2024 to 2032 (IMARC Group⁺, 2024b). Hence, there is a huge market of Indian artisanal sour buttermilk powder in India and abroad. Although, technical feasibility and the cost effectiveness from Indian artisanal sour buttermilk by employing RO as a means for concentration is still unknown. Therefore, current study was undertaken to calculate the manufacturing cost of artisanal sour buttermilk powder.

Materials and Methods

Indian artisanal sour buttermilk

Freshly produced samples of Indian artisanal sour buttermilk were procured from nearby places of Karnal district (29.6857° N, 76.9905° E), Haryana in early morning and pooled. After that, the samples were subjected to thermization (63 °C/ 15 s), cooled (to 40-45 °C), defatted via cream separation followed by filtration through a muslin cloth to remove any curd particles or foreign materials.

Reverse osmosis plant

Reverse osmosis (RO) plant was procured from Peterson Candy International Ltd., Reading, UK. It contains polyamide, AFC 99 membrane with a total membrane area of 0.9 m² and having a length of 1500 mm, height of 800 mm, dept of 700 mm and weight of 70 kg. RO plant was furnished with tubular module of Type B1 (length-1.2 m). It equipped with a triple plunger pump that has a contact surface of SS, 4 kW of power consumed motor and a flow of 22 L per min. Total 70 bar pressure can be generated in this plant however, the concentration process was carried out at 35 bar as this membrane can withstand this pressure only. Beyond this pressure problem of leakage was observed. The initial flux, final flux and flux mean of this study were 24, 10.67, and 15.07 L/m²/h, respectively. Furthermore, it contains a hold up volume of 6.5 L and can be operated up to 70 °C. The feed can be used pH range 3-11 and can provide a flux range of 15–60 LMH (L/m²/h).

Manufacturing of Indian artisanal sour buttermilk powder

Figure 1 shows different steps involved in processing and conversion of defatted Indian artisanal sour buttermilk into Indian artisanal sour buttermilk powder. The developed powder was further characterised in detail as reported by Manik et al. (2023).

Estimation of production cost for Indian artisanal sour buttermilk powder

As per Meena et al. (2017), techno-economic feasibility evaluation of the newly developed product is very much necessary before launching into market that's why estimation of manufacturing cost of this powder was performed. The cost estimation of manufacturing of Indian artisanal sour buttermilk powder was carried out as per the procedure mentioned by researchers

(Chavan, 2019; Rani et al., 2018; Meena et al., 2017 and Kumar, 2011). Following assumptions were made to calculate the cost of manufacturing in a realistic way.

Basic assumptions for cost estimation of Indian artisanal sour buttermilk powder

Several assumptions were conducted for the estimation of total production cost of Indian artisanal sour buttermilk powder as mentioned hereunder.

- The capacity for dairy plant to handle Indian artisanal sour buttermilk (0.72% fat and 3.41% SNF) was 1,00,000 Kg/day. The price for Indian artisanal sour buttermilk was assumed to be Rs. 10/Kg. Cost for utilities such as water, steam, electricity and refrigeration were assumed as per current market price.
- Plant will be operated in 3 shifts (8 h for each shift) for 300 days. Indian artisanal sour buttermilk will be defatted using cream separator and concentrated employing RO.
- The RO plant composed of with AFC-polyamide membrane. The total operation for RO plant was 24 h which consist with a processing time of 18 h and cleaning time of 6 h.
- Manufacturing of Indian artisanal sour buttermilk powder was performed as per Figure 1. The fat content recovered through defatting would be mixed with final concentrate.
- The capacity of spray drier was 20 T/ day and would be used for operation in 2 shifts to manufacture Indian artisanal sour buttermilk powder. Developed Indian artisanal sour buttermilk powder will be packed in 500 g metalized-polyester LDPE pouches.
- Total of 0.1% losses in Indian artisanal sour buttermilk powder sample and 0.5% losses in powder packaging material was assumed. Approximately 15% of overhead cost was assumed for manufacturing of Indian artisanal sour buttermilk powder including research and development and other expenses.

Cost of RO plant

- Concentration of 99264.5 Kg defatted Indian artisanal sour buttermilk (0.18% fat and 3.37% SNF) after removal of 735.5 kg cream containing 73.6% of fat and 8.2% of SNF up to 72.69% volume reduction ratio (VRR) employing RO.
- Quantity of permeate during production of Indian artisanal sour buttermilk powder sample=99264.5 Kg/day i.e., 72,155.36 Kg of permeate (72.69% VRR, Manik et al., 2023)

- Calculation of flux mean (FM) was done using following formula as per St-Gelais et al. (1992)

$$FM = FF + [0.33 \times (IF - FF)] = 10.67 + [0.33 \times (24 - 10.67)] = 15.07 \text{ LMH}$$

Where, IF = initial flux and FF = final flux values

- Total membrane area

$$A = 99,264.5 / 15.07 = 6586.89 \text{ m}^2/\text{h} \sim 6587 \text{ m}^2/\text{h}$$

- During operation of RO plant for 18 h (2 shifts), requirement of membrane area=

$$6587 \text{ (m}^2/\text{h)} / 18 \text{ (h)} = 365.93 \text{ m}^2 \sim 366 \text{ m}^2$$

- Therefore, around 366 m² of membrane area required for effective handling of 99264.5 Kg of defatted Indian artisanal

sour buttermilk per day. Fifteen percent of safety margin (54.89 m²~55 m²) in membrane area would be considered as per previously reported by Meena et al. (2017) and total membrane area required for RO plant installation would be 421 m² (366+55=421 m²).

Cost of RO plant consisting with 421 m² of membrane area will be Rs. 2.45 crore (*i.e.*, assume cost for 1 m² membrane area would be Rs. 50000).

Detailed break-up of total production of Indian artisanal sour buttermilk powder

Capital requirements

During an annual production of 1260.12 tons Indian artisanal sour buttermilk powder *i.e.*, 4.20 tons/day, a capital investment estimation would be required and that mentioned in this section. Direct cost as well as indirect also was calculated on the basis of

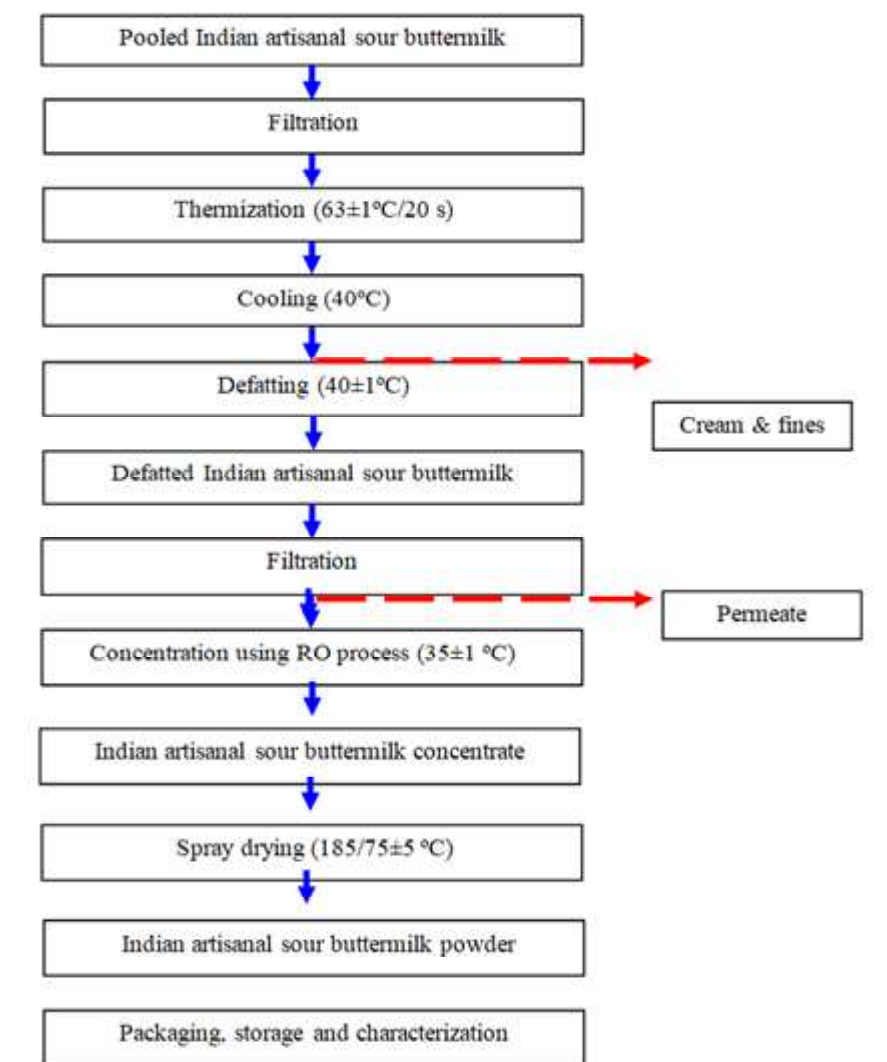


Fig. 1 Production process of Indian artisanal sour buttermilk powder

current scenario with an expectation in consistent. While, due to fluctuation in price and inflation, constant updating is highly recommended.

Cost of Land

The total land area for the manufacturing of Indian artisanal sour buttermilk powder was estimated around 4800 m². It would be around Rs. 1.32 crore (@ Rs. 2750/m² was assumed) and shown in Table 1. Meena *et al.* (2017) assumed the rate for land per m² was Rs. 2500.

Building

Estimated area for the construction of building was 5000 m² and construction rate was Rs. 5500/m² and shown in Table 1. Meena *et al.* (2017) assumed the rate of land per m² as Rs. 5500/m².

Equipment

Equipment required for manufacturing of 1260.12 tons Indian artisanal sour buttermilk powder per annum was estimated with

Table 1. Capital investment for civil works of dairy plant

Description	Size(m ²)	Rate per m ² (Rs)	Estimated cost (Rs in crores)
Cost of Land	4800	2750	1.32
Cost of civil Construction including production block with cold store, general store, laboratory, administrative block, road, hard park, internal electrification	5000	5500	2.75
Cost of Effluent Treatment Plant			0.50
Total Cost			4.57

Table 2: Capital investment for plant and machinery items (For Indian artisanal sour buttermilk powder

Item	Capacity	Quantity	Item	Capacity	Quantity
1. Buttermilk reception section			2. Buttermilk Processing Section		
Inline Strainer	STD	1	Buttermilk Transfer pump	10 KLPH	1
Buttermilk Pump	10 KLPH	1	Buttermilk pasteurizer	11 KLPH	1
Tanker	50mm×5	1			
Unloading hose	m		Cream separator	12 KLPH	1
pipe					
Tanker	10 KLPH	1	Multipurpose tank	10,000 L	3
Unloading pump					
Raw buttermilk	40,000	2	CIP equipment	2,000 L	1 set
storage tank					
Total Cost Rs. (Crores)		0.35	SS pipe and fittings for entire plant		1 set
			Total Cost Rs. (Crores)		3.07
3. Reverse osmosis membrane section			4. Buttermilk Powder plant section		
Membrane plant (Tubular module)	421 m ²	1	Buttermilk spray drying plant with nozzle atomizer	1100 SMP/h	1 set
Reverse osmosis plant		1	Powder bag filling and stitching machine		1 set
			Weighing balance 0-30 Kg		1
Retentate storage tank	20,000 L	1	Stainless steel Table		1

Total Cost Rs. (Crores)	2.51	Nitrogen packing machine for the packaging of Indian artisanal sour buttermilk powder	1
5. Service equipment section		Total Cost Rs. (Crores)	2.50
Refrigeration plant including cold store equipments/	1 set	Laboratory equipment and glassware	1 set
Nitrogen gas for packaging machine			
Steam boiler (husk/ oil fired) and other accessories	5000 Kg/h	1 set	Fire fighting equipment
Electricals including LT panel, MCC, cables, Cable trays, earthing, generator set (150 KVA) with accessories		1 set	Steam water mixing batteries
Water supply equipment including tube well		1 set	Cans for plant use
Pipe and fittings (MS/GI) for		1 set	Furniture and fixtures, Computers Rs.

depreciation cost and illustrated in Table 2. The calculated plant machinery cost and depreciation cost (Rs. 22.85 lakh at rate 5% of civil work+ Rs. 90.63 lakh at the rate of 7.5% for machinery and plant) was Rs. 12.08 and Rs. 1.13 crores, respectively.

Utility expenses

The assigned costs for various utility services, such as steam, water, and electricity, were taken into account when estimating the total direct expenses. Table 3 illustrated the individual utility service items that were determined as per Meena et al. (2017). The total estimated cost for utilities was Rs. 7.03 crores per annum as shown in Table 3.

Expenses on raw material and packaging material

The quantity of Indian sour buttermilk was required for manufacture of 1260.12 tons Indian artisanal sour buttermilk powder was estimated and presented in Table 2. As per current market situation, Rs. 10/- was assumed to provide cost for Indian artisanal sour buttermilk and that was calculated as Rs. 3.0 crores

per annum. Additionally, the assumed total packaging cost per annum was estimated and that would be Rs. 1.26 crore (Table 4).

Expenses on manpower

During the manufacture of Indian artisanal sour buttermilk powder, the manpower will be work in three shifts and was calculated (Table 5). The estimated cost for total manpower would be Rs. 1.00 crores that includes labour expenses of Rs. 64.80 lakh, supervisor expenses of Rs. 10.8 lakh and administration expenses of Rs. 24.48 lakh as shown in Table 5.

Expenses on laboratory and cleaning and sanitization

Dairy machinery, equipment, tanks, and piping must be thoroughly cleaned and sanitized in order to produce safe Indian artisanal sour buttermilk powder sample, for which detergent and sanitizers are required. The required total expenses for laboratory were computed as Rs. 6.00 lakh as 0.2% of cost raw material and cleaning and sanitizing material were calculated as Rs. 3.00 lakh as 0.1% of cost of raw material (Table 6).

Expenses on marketing and distribution

As per Kumar (2011) and Meena *et al.* (2017), the total expenditure of marketing and distribution were calculated by assuming the rate of 10 and 15% of manufacturing cost. The calculated cost for plant overhead and marketing and distribution were Rs. 6.44 crores and Rs. 4.29 crores (Table 6).

Estimation of total manufacturing cost for Indian artisanal sour buttermilk powder

The total cost for annual production of 1260.12 tons Indian artisanal sour buttermilk powder was mentioned in this section. Cost related to direct and indirect ways were estimated and shown in Table 6. The cost required for annual production of 1260.12 tons of Indian artisanal sour buttermilk powder was Rs. 53.57 crores. Additionally, total manufacturing cost which includes the total sum of cost of the raw material, packaging material, utilities,

manpower, laboratories and detergents is only 73.53% which was found less than the cost assumption for soluble MPC 70 (78.48%), reported by Meena *et al.* (2017). Moreover, major contributors for direct production cost were cost of raw material, packaging, manpower and utility. While, around Rs. 3.46 crores of total fixed charges have been computed which included fixed charges of Rs. 1.99 crores at 12% rate of total fixed capital and working capital, Rs. 1.13 crores of depreciation cost and Rs. 33.31 lakh of insurances and taxes as per 2% of capital investment as shown in Table 6.

Therefore, the calculated cost for 500 g of pack of Indian artisanal sour buttermilk powder was observed to be Rs. 211.52 and Rs. 423.04 for 1 Kg pack of Indian artisanal sour buttermilk powder by excluding applicable taxes. The estimated cost for

Table 3: Charges on power utilities (For Indian artisanal sour buttermilk powder)

Item	Requirement		Rate (Rs.)	Annual Cost (Rs.)
	Daily	Annual (300 Days)		
Steam (@2Kg/ Kg of powder) Indian artisanal sour buttermilk powder = 4200.40-42.00 (1% powder loss) = 4158.39 Kg (From 27102.13 Kg Indian artisanal sour buttermilk concentrate [12.86% TS] + 735.5 Kg of cream = 27837.63 Kg concentrate solution)	10316.78	3095034	Rs. 2/Kg steam	Rs. 61.90 lakhs
Fuel oil [@ 1 L/ 2.5 Kg of powder]	1663.356	499006.8	Rs. 95/ L	Rs. 4.74 Crores
Electricity (KWh)[@ 1 KW/3.5 Kg of powder+@1 KW/20 L milk+(@ 45 KWh/h in NF Plant)]	7268.111429	2180433.429	Rs. 7/Unit	Rs. 1.52 Crores
RO Water for CIP in NF plant	4000	1200000	Rs. 1/L	Rs. 12 lakh
Refrigeration (1 TR=3.517KWh) 10 T for cream and retentate= 10 TR/ day	10	3000	Rs. 34 per TR	Rs. 1.02 lakh
Water (@1.5 L/Kg of powder+@1L/L of Indian artisanal sour buttermilk)	106237.585	31871275.5	Rs. 6/1000 L	Rs. 1.91 lakh
Total Rs.				7.03 Crores

Table 4: Requirement and cost of raw material (For Indian artisanal sour buttermilk powder)

Sr. No.	Items	Requirement		Rate (Rs/Kg)	Annual Cost (Rs.)
		Daily	Annual (300 days)		
1	Sour buttermilk	100000	30000000	10	30.00 Crores
Total cost Rs.					30.00 Crores
2	Annual cost of Packaging material				
Annual packaging material requirement= 4200.40 kg (daily Indian artisanal sour buttermilk powder production) *300(total plant run time) *2(500 g pack size) = 2520240+0.5% (12601.2) i.e. Total 2532841.2~2532842 units		Cost of pouch= Rs. 5 / pouch. Total cost= 2532842*5		Rs. 1.26 Crores	

Table 5: Man Power Cost for the production of Indian artisanal sour buttermilk powder

Sr. No.	Staff	Number	Monthly Salary (Rs.)	Total Monthly Salary (Rs.)	Annual Cost (Rs. in lakhs)
1	Labourers (6×3)	18	9000	162000	19.44
2	Skilled Worker (3×3)	9	15000	135000	16.20
3	Mechanics/ electrician (2×3)	6	18000	108000	12.96
4	Boiler Attendants (1×3)	3	18000	54000	6.48
5	Lab analysts (1×3)	3	18000	54000	6.48
6	Lab attendants	3	9000	27000	3.24
Sub-total (A)				540000	64.80
Operational Supervisors					
7	Shift Supervisors (1×3)	3	30000	90000	10.80
Sub-total (B)				90000	10.80
Administrative Expenses					
1	Plant Manager (1×3)	1	70000	70000	8.40
2	Clerk-cum-Accountant (1×2)	2	20000	40000	4.80
3	Store Keeper (1×2)	2	20000	40000	4.80
4	Attendant (1×2)	2	9000	18000	2.16
5	Security staff (2×2)	4	9000	36000	4.32
Sub-total (C)				204000	24.48
Grand Total (A+B+C) Rs. (Crores)					1.00

Table 6. Detailed break-up cost of Indian artisanal sour buttermilk powder (Capacity 1260.12 Kg/day)

Sr. No	Cost component	Rates	Per annum (Rs.)
Manufacturing Cost			
a	Direct product cost		
i	Raw materials	Table 4	30.00 Crores
	Annual packaging material requirement=4200.40 (daily Indian artisanal sour buttermilk powder production) * 300(total plant run time) *2(500 g pack size) = 2520240+0.5% (12601.2) i.e. Total 2532841.2~2532842 pouches	Rs.5 per pack, Table 4	1.26 Crores
iii	Manpower cost	Table 5	1.00 Crores
iv	Power and utilities	Table 3	7.03 Crores
v	Laboratory charges	0.2% of cost of raw material	6.00 lakhs
vi	Cleaning and sanitizing material	0.1% of cost of raw material	3.00 lakhs
Total			39.39 Crores
b	Fixed charges		
i	Interest on total fixed capital and working cost	12% of total fixed capital and working capital	1.99 Crores
ii	Depreciation on capital investment		1.13 Crores
iii	Insurance and taxes	2% of the capital investment	33.31 lakh
Sub-total (b)			3.46 Crores
Manufacturing cost (A=a+b)			42.85 Crores
MARKETING AND DISTRIBUTION			
B			
i	Plant overhead cost	15 % of manufacturing cost	6.42 Crores
ii	Marketing and distribution	10% of manufacturing cost	4.29 Crores
Total (b)			10.71 Crores
Total cost (Rs.) Per annum (A+B)			53.57 Crores
Total cost of Indian artisanal sour buttermilk powder (per 500 g pack=2532842)			Rs. 211.52/-
The cost of Indian artisanal sour buttermilk powder (per Kg)			Rs. 423.04/-

manufacturing of Indian artisanal sour buttermilk powder was nominal and calculated as per current market situation.

Conclusion

Economic feasibility analysis revealed a production cost of Rs. 423.04 per kg for Indian artisanal sour buttermilk powder, demonstrating its affordability and viability for large-scale production. The process not only valorizes a traditional by-product but also develop a novel ingredient for the dairy and food industries, contributing to environmental sustainability and economic empowerment of rural farmers. Hence, the manufactured Indian artisanal sour buttermilk powder had potentiality for application as ready to serve instant Indian artisanal sour buttermilk powder and can be used as an ingredient in formulation of new processed foods.

Acknowledgement

Authors would to thank Director, ICAR-NDRI, Karnal and Haryana State Council for Science, Innovation and Technology (HSCSIT), Panchkula for providing fund and support.

Funding

Haryana State Council for Science, Innovation and Technology (HSCSIT), Panchkula (Project number: HSCSIT/R&D/2021/539)

Conflicts of Interest

The authors declare no conflict of interest.

References

- Aneja RP, Mathur BN, Chandan RC, Banerjee AK (2002) Fat-rich Products. In Technology of Indian milk products: Handbook on process technology modernization for professionals, entrepreneurs and scientists (pp. 196). Dairy India Yearbook.
- DAHD (2021) Annual Report 2021-22. Department of Animal Husbandry and Dairying, Government of India, 2021-22. Retrieved from <https://dahd.nic.in/sites/default/files/Annual%20Report%20English.pdf>. (Accessed on 1 August 2024).
- De, S. (2004). Indian Dairy Products In: Outlines of Dairy Technology, Oxford University Press, New Delhi, pp. 463-464.
- Halder K, Sahu JK, Naik SN, Mandal S, Bag, SK (2021) Improvements in makkhan (traditional Indian cultured butter) production: a review. J Food Sci Technol 58(5):1640-1654.
- IMARC Group (2024a) Lassi market in India size, share, growth and industry report [Data set]. Available online: <https://www.imarcgroup.com/lassi-market-india> (Accessed on 1 September, 2024).
- IMARC Group (2024b) Milk powder market report by Product Type (whole milk powder, skimmed milk powder), function (emulsification, foaming, flavouring, thickening), application (infant Formula, Confectionery, Sports and Nutrition Foods, Bakery Products, Dry Mixes, Fermented Milk Products, Meat Products, and others), and region 2024-2032 [Data set].
- Kumar S (2011) Studies on the preparation of Dairy Whitener employing Ultrafiltration Ph.D. Thesis. National Dairy Research Institute (Deemed University), Karnal, India.
- Manik S, Meena GS, Singh AK, Khetera Y, Singh R, Arora S, Vishweswaraiah RH (2023) Valorization of Sour Buttermilk (A Potential Waste Stream): Conversion to Powder Employing Reverse Osmosis and Spray Drying. Membranes 13:799. <https://doi.org/10.3390/membranes13090799>.
- Meena GS, Singh AK, Gupta VK, Jayswal D, Parmar PT, Gupta HR (2017) Estimating cost for production of soluble milk protein concentrate 70 (MPC 70). Indian J Dairy Sci, 70(3):342-350.
- MOFPI (2023) In Conversation Fermented Milk Special. PMFME E-Newsletter. Available online: <https://pmfme.mofpi.gov.in/pmfme/newsletters/enewsnoventember1.html> (Accessed on 1 August 2024).
- Padghan PV, Mann B, Rajeshkumar, Sharma R, Kumar A (2015) Studies on bio-functional activity of traditional lassi. Indian J Tradit Knowl 1:124-131.
- Pal D, Rajorhia GS (1985) Buttermilk utilization in dairy Industry. Indian Dairyman 9:397-403.
- PIB (2024) World Milk Day (June 01): Achievement of the department of animal husbandry and dairying (ministry of fisheries, animal husbandry and dairying). (n.d.). Gov.In. Retrieved July 20, 2024, from <https://pib.gov.in/PressNoteDetails.aspx?NoteId=151889&ModuleId=3>
- St-Gelais D, Haché, S, Gros-Louis M (1992) Combined Effects of Temperature, Acidification, and Diafiltration on Composition of Skim Milk Retentate and Permeate. J Dairy Sci 75:1167-1172