Technology Manual

On

Processing Technology of Yak Milk Cottage Cheese (hard churpi) Processing

Funded by

National Mission on Himalayan Studies (NMHS)

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CHAPTER - I

Processing Technology of Yak milk Cottage Cheese Processing

1. Introduction

Yak milk cottage cheese, known for its rich and buttery flavor due to the high-fat content of yak milk, is a traditional dairy product from the Himalayan regions of Nepal, Bhutan, India, and Tibet. This nutritious cheese, high in protein, calcium, and essential fatty acids, is made by coagulating fresh yak milk using an acidic agent, draining the curds, and sometimes drying them to create a harder, chewy texture. It's used in various culinary applications, from soups and stews to traditional dishes like momos and thukpa. Beyond its culinary uses, yak milk cottage cheese holds cultural and economic significance, providing a vital source of nutrition and income for Himalayan communities, with the harder version being particularly valued for its extended shelf life.

To make hard chhurpi, fresh yak milk is boiled and then coagulated with an acidic agent like yak milk curds to form. These coagulum are separated from the whey using a cheesecloth and then pressed under a heavy weight to remove excess water. The pressed coagulum is cut into pieces and laid out to dry in a drying chamber, a process that can take several days. Once fully dried, the chhurpi becomes hard and dense, ideal for long-term storage, and enjoyed as a chewy, tangy snack.

To package hard chhurpi effectively, start by ensuring it is fully dried and cleaned to prevent mold growth and maintain hygiene. Use vacuum-sealed bags or food-grade plastic containers to keep the chhurpi fresh, with desiccants added to pouches to absorb any remaining moisture. Portion the chhurpi into uniform pieces, vacuum seal them to remove air, and package them with the product. Store the packaged chhurpi in a cool, dry place away from direct sunlight to preserve its quality. For distribution, use protective packaging to avoid damage during shipping and regularly check for signs of spoilage to ensure quality control. This process helps maintain the freshness and safety of hard chhurpi for extended periods.

Nutritional composition

Physico-chemical, nutritional quality characteristics and safety attributes of yak milk in the processing and Food Engineering department laboratory, College of Agricultural Engineering, and post-harvest technology (CAU) are presented in Table 1

Table 2 Nutrition content of Yak milk

Components	Yak milk
Fat (%)	4.7
Protein (%)	3.90
lactose (g/100g)	4.10
Solid, not fat (%)	8.0
Total solid (%)	12.05

1.2 Quality Characteristics & Safety

Physico-chemical, nutritional, microbiological quality characteristics and safety contribute to the development of yak milk cottage cheese(hard churpi) in the processing and Food engineering department laboratory, Collage of Agricultural Engineering and post-harvest Technology (CAU) presented in Table 2.

Table 2: Nutritional characteristics of the development of yak milk cottage cheese(Hard churpi)

Components	Yak milk cottage cheese (hard churpi)
Moisture (% w/w)	8-12
Protein (%)	63-69
Fat (%)	4-15
Carbohydrates (%)	4-15
Ash (%)	5-6

1.3 Processing, Packaging & Storage

The process description of the developed yak milk cottage cheese (hard churpi) is described in Chapter 3.

Primary packaging

- It should not contain any detachable part that presents a choking hazard, e.g., aluminum polymer film, polyethylene terephthalate, food container and glass gar etc.
- It should meet the fat, O_2 & moisture barrier properties requirements.

- The pouch should be free of damage, hermetically sealed, and free of impression or design on the sealing surface that would conceal or impair visual detection of seal defects.

Secondary packaging

- It should be able to resist puncture. The packaging materials should be HDPE bag with air tight liner and sealed.

Storage

- Yak milk cottage cheese (hard churpi) must be stored under dry, ventilated, and hygienic conditions at high altitude place only.
- The product should be store under cold storage condition for maintenance of product quality and for longer duration and preserve the flavor.

1.4 Use & USP

The yak milk cottage cheese (Hard Churpi) is a protein-based food essential for high-altitude areas in India, especially when the region is cut off due to heavy snowfall. The local communities consume yak milk cottage cheese (Hard Churpi) as a staple food during these times. Now a days Yak milk cottage cheese widely popular thought out the world.

- Yak raw milk is seasonal and available in high-altitude areas where yak survived.
- The production process is simplified, safe, and hygienic operation.
- The dried yak milk cottage cheese (Hard churpi) has low water activity (a_w), which increases the shelf life upto 2 years and more.
- Yak milk cottage cheese (hard churi) is prepared safely and hygienically.
- This product has a hard, smooth texture and unique flavors.

Chapter - II

MATERIALS

The quality specifications and standards for the raw material and ingredients to be used in the yak milk cottage cheese (Hard Churpi) product preparation are described as follows:

2.1 Raw materials

Yak whole milk

Yak milk is a nutrient-dense dairy product predominantly found in the Himalayan regions, known for its rich, creamy texture and distinct flavor. It contains higher protein and fat levels than cow's milk, offering about 4-5 grams of protein and 4-7 grams of fat per 100 grams. Yak milk is also rich in essential vitamins and minerals, including calcium, phosphorus, vitamins A, D, and B. It benefits bone health, immune function, and overall nutrition. It is consumed directly as a beverage, and used to make various dairy products like curd, butter, and cheese. Yak milk holds significant cultural and economic importance for Himalayan communities, providing a vital source of nutrition and income.

Yak Curd

Yak milk curd is a rich and creamy dairy product traditional to the Himalayan regions, known for its distinctive flavor and high nutritional value. Made by fermenting yak milk, which has a higher fat content than cow's milk, it results in a thick, tangy curd. The preparation involves boiling fresh yak milk to kill any bacteria, cooling the temperature, and adding a starter culture, such as a small amount of previously made curd or commercial yogurt starter. The mixture is then left to ferment for 6-12 hours until it thickens. Yak milk curd is highly nutritious and rich in protein, calcium, and probiotics, making it beneficial for digestion and overall health. It is consumed on its own, used in traditional recipes, and holds significant cultural and economic importance for Himalayan communities.

Packaging materials

Polyethylene flexible film.

The packaging materials should be flexible and it should be barrier of water, oxygen and gas. The film can be used multilayer. The tin can also use for long time storage for transportation. The glass bottles can be use but the cover should be airtight and oxygen barrier. The minimum thickness is required 80-100 micrometer with multiple layer. The packaging material should be having a low WVTR and good tensile strength and sealable properties.

Secondary packaging materials

The secondary packaging materials should be bulk packaging material. The cartoon box, HDPE liner bag can also use. The sack oven may be used for bulk packaging of dried yak milk cottage cheese.

Chapter – III

PROCESS TECHNOLOGY

3.1 Process description

The figure 1 is showing the process flow diagram of the production of yak milk cottage cheese at commercial level.

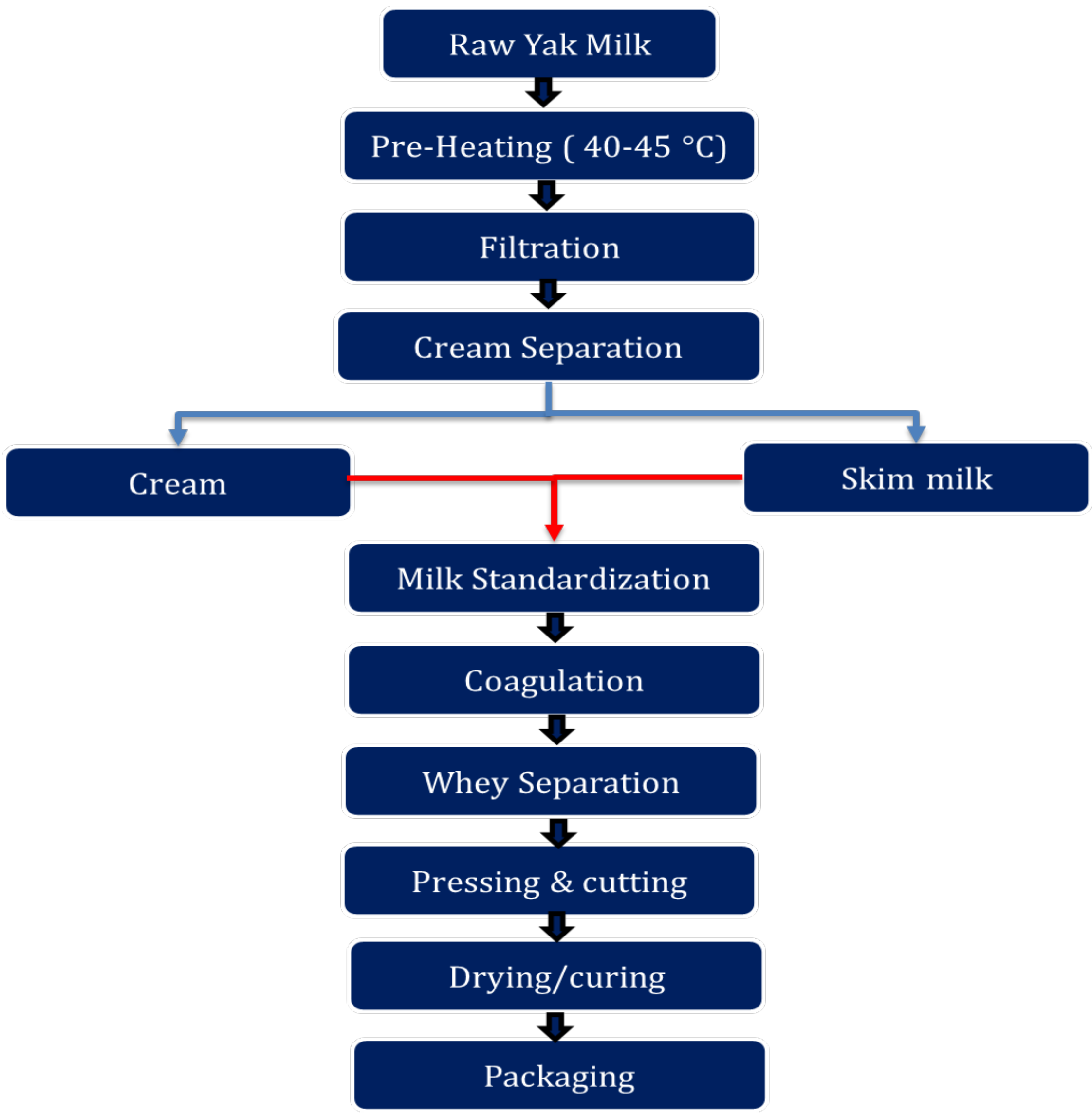

Fig. 1 Process flow diagram of Yak milk cottage cheese

3.1.1 Raw materials & ingredients procurement & storage

- The otherthan yak milk, ingredient/ raw materials are procured from authorized/certified & reliable sources.
- During procurement, the whole yak milk and raw materials are checked for visible impurities, any adulteration especially salt content and physical and chemical analysis.
- The storage area should be kept clean and dry with proper ventilation and lighting.
- The raw materials used for the preparation of the product should be handled with utmost safety and under hygienic conditions.
- The microbial load of raw materials like yak milk is controlled by processing and preservations.

3.1.2 Preparation of Yak curd

- Collect fresh yak milk. Ensure it is clean by straining it to remove any impurities.
- The yak milk is put into a large pot and brought to a boil over medium heat. Boiling helps to kill any harmful bacteria and prepares the milk for fermentation.
- The boiled milk to cool down to about 40-45°C temperature. You can use a thermometer to check the temperature. This is the ideal temperature for adding the starter culture.
- Add the starter culture (previously made curd) to the milk.
- Stir the milk uniformly.
- The inoculated milk into a clean container with a lid. Cover the container to maintain warmth and prevent any contamination.
- The culture added milk stored for 6-12 hours, depending on the ambient temperature. The milk will thicken and set into curd during this time.
- The curd has been set, so store it in cool place to slow down the fermentation process and preserve its freshness.
- Yak milk curd can be kept in the refrigerator for up to a week.

3.1.3 Preparation of Standardized Yak Milk Cottage Cheese (Hard Churpi)

- Collect fresh yak milk. Strain the milk to remove any impurities and ensure it is clean and aseptic conditions.
- Pour the yak milk into a large a jacketed tank and bring it to a heat upto 40-45°C. Preheating help to decrease the viscosity and easy to separation of yak cream.
- The yak skim milk should be standardized by adding the cream or whole yak milk. Before addition the fat content should be checked and balance the fat 1.5-2%. The standardized milk is heated upto 90 °C for 15-20 seconds.

- Add the yak milk curd slowly to the milk, stirring gently. Continue adding until the milk curdles and separates into curds and whey. Before addition of yak curd check the acidity and temperature. The acidity should be near 1% LA and temperature should be warm for maintaining coagulation process and heat stress. The coagulated milk should cook for 3-5 minutes for release of moisture and whey should be greenish and clear. Then coagulated milk is strained out of the whey by the muslin cloth.
- Transfer the coagulum, still wrapped in the cloth, to a flat surface. After pressing out additional moisture using the pressing machine, This presses coagulum should retained about 6-8 hours for complete removal of whey water from the coagulum.
- After pressing the coagulum, cut them into small, uniform pieces or desired shape and sizes. Spread the pieces out on a clean surface in a well-ventilated drying chamber for drying and removing the surface moisture. Alternatively, you can smoke the pieces over a fire for a unique flavor. The cubes should be cured in the smoky and warm area. The cub can be cured in the curing chamber at 48-50 °C for 6-7 days.
- Once fully dried cottage cheese (Hard Churpi), store it in airtight containers or pouches to maintain its quality and prevent moisture absorption.
- The process and material flowchart for the preparation of yak milk cottage cheese (Hard churpi) are presented in Figure 2.

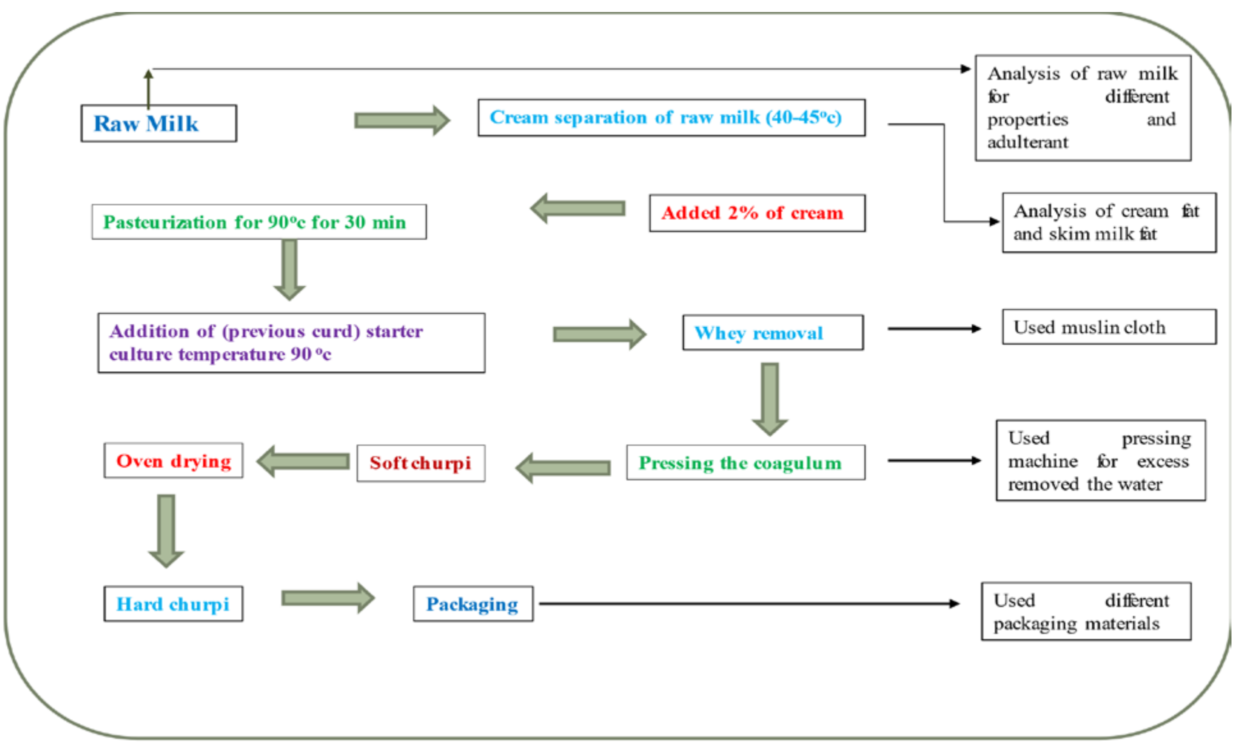

Figure 2 Process and material flow chart for preparation of yak milk cottage cheese (hard churpi)

3.1.4 Coagulation Process

The coagulation process of cottage cheese yak milk (Hard Churpi) involves several key steps to transform fresh yak milk, which is heated to around 40-45°C for cream separation. After separating the cream, to maintain the 2% fat in the skim milk, then heated to 90-95°C. Previous yak milk curd is added, and the mixture is massaged and heated for 5 minutes to ensure proper coagulation and firm texture development. The whey is drained off, and the curds are pressed to remove additional moisture and shape the cheese.

3.1.5 Pressing Process

The pressing process of yak milk cottage cheese (Hard Churpi) is essential for achieving its firm texture and shape. After coagulation, the drained excess whey is placed into a cheesecloth or muslin cloth and then set in a cheese mold or pressing machine. Gradual pressure is applied to the coagulum, initially lightly and then increased over time, to expel additional whey without crushing the coagulum. This pressing process typically lasts several hours to overnight.

3.1.6 Drying Process

The drying process of yak milk cottage cheese (Hard Churpi) involves placing the pressed cheese on a clean, ventilated surface in a dry environment, typically around 50-55°C with a velocity of 1.2-1.7. This process can take several days, allowing the cheese to develop a hard, durable texture. Regular inspections ensure the cheese is drying correctly and maintaining its quality. Proper drying is essential for creating Hard Churpi's characteristic hardness and long shelf life.

3.1.7 Post processing of Yak milk dried cottage cheese

The dried yak milk cottage cheese can also be coated with sugar for sweat taste. The product should boiled in slow flame with whey for long time. The process is continue until the whole water evaporated. After the coated sample can be dried and packed in suitable packaging materials.

3.1.8 Packaging and Storage

After cured the yak milk cottage cheese should be packed in the packaging materials. During the packaging, the air should not present and remove head space air from the packets.

3.2 Precautions to be taken during processing

3.2.1 Raw material

i. It should be ensured that yak milk conforms to quality specifications.

ii. During storage, raw yak milk and other ingredients, whether in clean containers, must be protected against contamination. The milk can should be dipped in to chilled water for preservations. Good housekeeping practices and monitoring in storage areas. Particular care should be taken to prevent contamination and temperature of yak milk.

3.3.2 Manufacturing operation

i. All processing and packaging operations should be conducted in a manner that minimizes the potential for microbial growth and contamination. Yak milk cottage cheese (Hard churpi) product processing can control these through the proper cleaning and sanitizing of equipment, protecting the product from foreign matter contamination, and applying proper food handling practices. It may be necessary to have separate processing lines and or rooms to eliminate cross-contamination of potential.
ii. Boiling should be should destroy harmful microorganisms. These steps must be validated as a kill of microorganisms. Contamination after pressing and drying must be avoided. Processed areas may accomplish such control.
iii. During mixing of whole yak milk and cream, the temperature should not exceed 75 °C with the rotated agitator.
iv. The fat content should be uniformly mixed and heated at a particular time and temperature
v. The heat the milk, then transfer it to another tank. Add the yak milk curd and boil it at 90°C, mashing until proper coagulation is achieved.
vi. The coagulum is transferred to the pressing machine should be carefully filled. The muslin cloth should be cleaned and having some strength to bear the pressure and weight.
vii. Since milk particles are in contact with equipment and in contact with external environment, enabling microorganisms to grow, proper cleaning and sanitization of all handling and processing equipment is essential.

3.3.3 Critical steps

i. **Standardization**

Standardization of milk fat and SNF are required to be done to eliminate hardness and flavor and taste of Yak milk cottage cheese. The proper amount of fat and SNF is highly required for the maintaining of flavor, texture and taste of yak milk cottage cheese. Lower fat may produce hardened the yak milk cottage cheese which might be due proteins. The product would also having a less buttery flavours. The killing of pathogenic bacteria depends on the temperature of the boiling process.

ii. **Coagulation**

The operation should be properly handled with a temperature that should not exceed 90 °C. The higher temperature is reduced the quality in terms of hardness and consumers rejected. The acidity of yak curd is also important in the coagulation process. The acidity of milk should not be more the 1 % LA. The higher acidity of curd is reduced the binding properties of cheese particles. The coagulum should not be cook for longer time. Longer time may leach more water from coagulum and became harder. The less cooking time also reduced the yield of product and crack the surfaces. The cooked coagulum should be meshed and reduce the smallest particles.

iii. **Pressing** Critical limits include pressure and duration (6-12 hours) to achieve the desired firmness and texture due to excess moisture released. The presses coagulum should be positioned into a uniform size and it should be free from the holes.

iv. **Drying/curing**

The yak milk cottage cheese (hard churpi) is dried to a critical limit at 50 ° with an air velocity of 1.2 to 1.7 m/s. during the curing it ensure that the yak milk cottage cheese samples should not produce crack on the surfaces. The higher temperature is produced case hardening in the samples. If you using the lower temperature below 45° it might be take a more time and increases the growth of yield and mold on the surface.

v. **Packaging**

The packaging materials should be barrier of moisture and oxygen. The packaging materials should not be produced foggy surface. The air should not be retain inside the pouch. The head space in pouch or packaging materials should be minimum and compactable with packaging materials.

Chapter - IV

PILOT SCALE PRODUCTION UNIT

4.1 Building

The interior layout of the pilot plant building (10 m X 5.5 m, 450 sq. m) according to the GMP norms is presented in Figure 3 for the production capacity of 200 lite of milk per day in 8 hours sift.

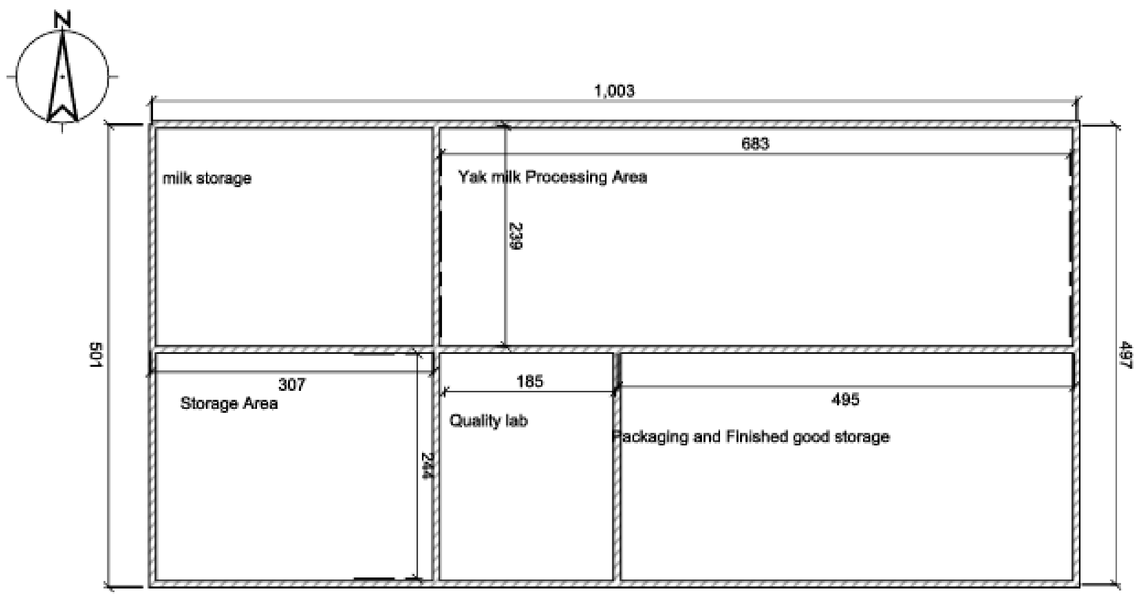

Figure 3. (a) Building layout of Yak milk processing unit

Figure 3. Optional (b) Building layout of Yak milk processing unit

4.1.1 Requirements for building interiors

i. Each room should have different light flux according to GMP/GHP norms.
ii. There should be no cross contamination between raw material to finished products.
iii. Separate rooms should be provided for primary and secondary packaging of finished products.
iv. Processing room should be cleaned and ventilated for safe hygienic production of Yak milk products.
v. For hygienic entry, processing room is provided with change room facility, washing station and air shower.
vi. Separate room for packing material storage and dehumidifier facility for raw material and finished product.
vii. Process should have laboratory for chemical and microbiological analysis.

4.2 Equipment layout design

The machinery layout and the process flow for the batch, operations, including processing, packaging, etc., in the manufacturing line, are presented in Figures 4.

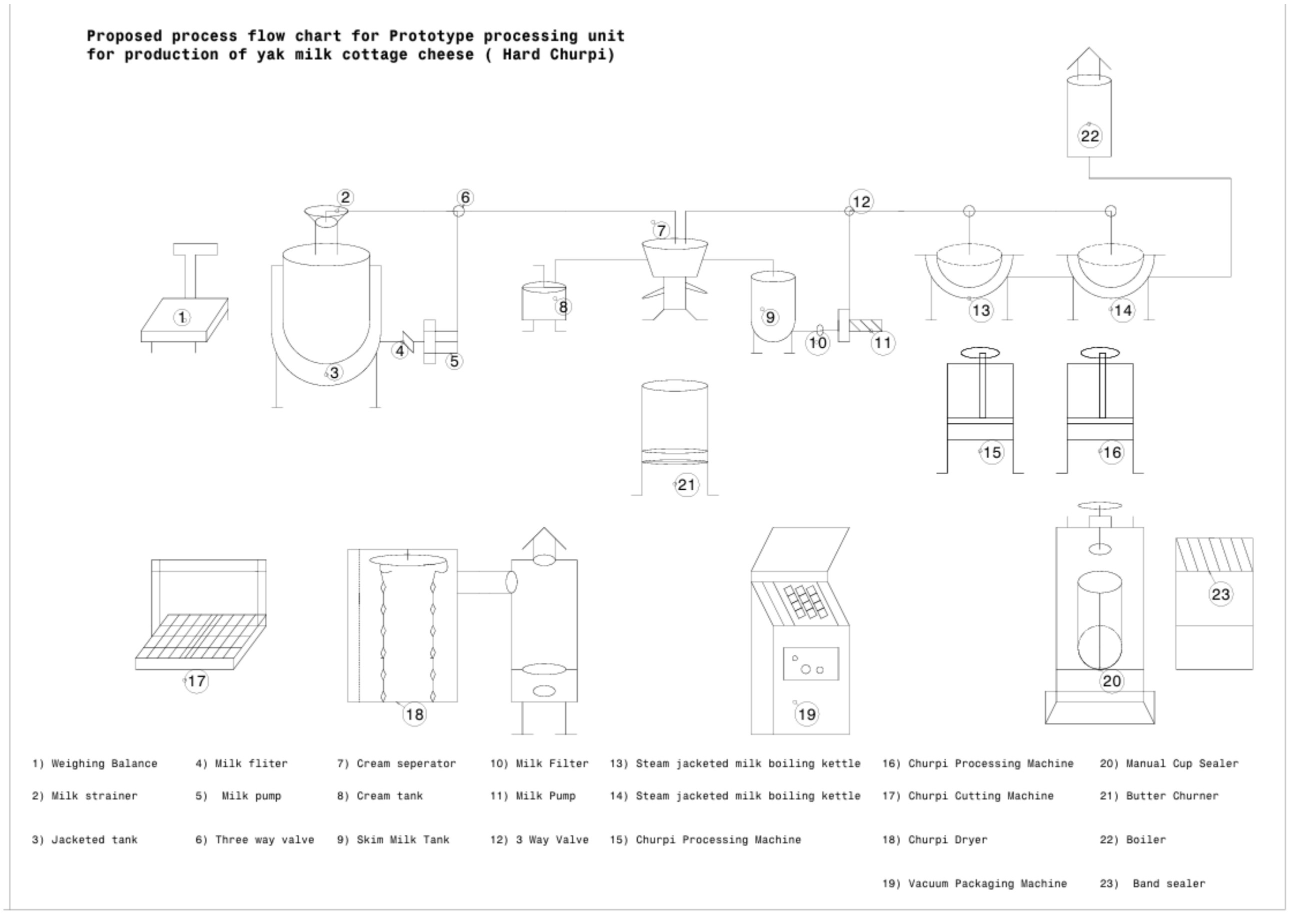

Figure 4 . Yak milk cottage cheese (hard churpi) process flow diagram for batch processing unit

4.3 Equipment and its specifications

Equipment and accessories required to be provided with the production capacity of 50 kg per batch (one shift of 8 hours operation) are as follows (Table 3):

Table 9 : Pilot plant equipment & accessories for production of Yak milk cottage cheese (hard churpi)

S. No.	Equipment / Accessory	Technical specification
1.	Weighing balance	Capacity:50 kg
2.	Storage cans with strainer	Capacity 40L , SS, 4 Nos.
3.	Batch pasteurizer	Capacity 200 , SS, 1 nos. Jacketed kettle, temperature controller
4.	Milk Transfer Pump with inline milk filter	Capacity 200 LPH SS Qty 2
5.	Plate heat exchanger (optional)	Capacity 200 LPH SS
6.	Milk coagulation tank	Capacity 100L , SS, 1 nos jacketed with tilting facility
7.	Multipurpose vat	Capacity 100 L
8.	Cottage cheese (Churpi) pressing machine and cutting machine	Capacity 10 L qty 2 nos
9.	Yak milk cottage cheese dryer or curing chamber or smoking chamber	Capacity: 50 Kg hot air
10.	Vacuum packaging machine	Capacity : 50- 2000g
11.	Butter churner	Capacity: 50-60 liter
12.	Ghee clarifier	Capacity: 50-100 kg
13.	Band sealer	Capacity 50-100 pouch per minute
14.	SS tanks	3 Nos Capacity:50-100 liter
15.	Milk analyzer and testing kits	1 nos
Utility		
16.	Steam boiler (wood, yak dung or diesel)	Capacity :150-200 kg pressure 3 kg/cm2
17.	DG Set	7.5 KVA
18.	Trolleys for material handling	For material transfer.
19.	Pipeline for the utilities	
20.	Remote Control Panel & Electric	
	Total Cost (₹)	**Aprox 12-14 Lakhs**

Chapter - V

QUALITY ASSURANCE

5.1 Good Manufacturing Practice (GMP)

Good manufacturing practice (GMP) is adopted in building construction, building layout, construction of equipment, and during the production stages. There is no cross-contamination involved in raw material and finished product handling; natural light as well as light flux are used according to the desired raw material storage, packaging material storage, production area, finished storage area, and office area.

5.2 Hazard Analysis & Critical Control Point (HACCP)

Initially, prerequisite programs such as good manufacturing practice (GMP), personal hygiene, standards operating procedures, and personnel training, among others, are put in place to build a solid foundation for the development of Hazard Analysis and Critical Control Points (HACCP). Before the application of the seven HACCP principles, five preliminary tasks have been accomplished. Seven HACCP principles are applied, and they include hazard analysis, CCP identification, establishing critical limits, monitoring procedures, corrective actions, verification procedures, record keeping & documentation in the identification of hazards associated with the production of yak milk cottage cheese (Hard churpi).

5.3 Testing & Evaluation

Using standard procedures, raw materials/ingredients / finished products should be routinely analyzed/tested for physio-chemical, nutritional, sensory quality, and microbiological safety.