RAMAIAH
College of Arts, Science & Commerce

AN INDUSTRIAL VISIT

To

DOMAINE SULA, RAMNAGAR

&

KMF DAIRY, MANDYA

On

05-July-2023

Submitted By

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Reg. No.: S2014428

Class: B.Sc., 6th semester

Microbiology

Submitted to:

Department of Microbiology

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RAMAIAH
College of Arts, Science & Commerce

Department of Microbiology

CERTIFICATE

Reg.No. S2014428

This is to certify that MEENAKSHI ANOOP of class B.Sc. Genetics, Biochemistry and Microbiology has satisfactorily completed the course of experiments in Industrial Microbiology and Microbial Technology (MBP-604) and has submitted a report on the Industrial Visit to **DOMAINE SULA**, **Ramanagara** and **KMF, Mandya** on **5th July 2023** for the fulfillment of B.Sc. 6th Semester Microbiology Practical Examination, prescribed by **Bengaluru City University** during the academic year 2022-2023.

Date:

Signature of faculty In-charge

Head of the Department

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ACKNOWLEDGEMENT

I would like to express my sincere gratitude to the Management of M S Ramaiah College of Arts Science and Commerce, Principal, Dr. Vatsala. G, Vice Principal, Dr. Pushpa H. and HOD, Department of Biotechnology and Genetics, Dr. Lakshmikanth R.N. for providing us with this invaluable opportunity to visit Domaine Sula, Ramanagara & Mandya District Co-Operative Milk Union Limited, Mandya. I am extremely thankful to our teachers Dr. Vinutha M. Dr. Yogesh, Dr. Ramesha, and Dr. Pavithra Kumari for accompanying us during the visit and making it a memorable one.

My sincere thanks to the resource person, Mr. Ramakrishna Marathe, Manager, Domaine Sula, and the Staff of KMF Dairy, Mandya for enriching us the knowledge on fermentation and production process and for spending their valuable time in guiding us through the visit. I would like to express my gratitude for arranging the various presentations and demonstrations that were a part of our visit. The opportunity to explore the facilities and interact with knowledgeable staff was truly invaluable for our group. It gave us a deeper understanding of your industry and the practical aspects of the concepts we have learned in our studies. We genuinely appreciate the time and resources invested in accommodating our group and ensuring the visit's success. Thank you for making our industrial visit a truly memorable and rewarding experience.

DOMAINE SULA

Entrance to the DOMAINE SULA

SULA VINYARD

An Industrial visit was organized by the Department of Microbiology, for the 6th-semester students of M S Ramaiah College of Arts, Science, and Commerce on 5th July 2023. This day was filled with Immense enthusiasm for the Microbiology students of M S Ramaiah College of Arts, Science, and Commerce as they eagerly waited for the SULA Vineyard, Ramanagar, Karnataka visit. Dr. Vinutha M, and Dr. Pavithra, Assistant professor, Department of Biotechnology/Genetics, Dr. Yogesh D, and Dr. Ramesha, Assistant professor, Department of Microbiology accompanied the students for the Industrial visit.

Introduction:

Sula Vineyards rebranded its Karnataka winery to Domaine Sula. Karnataka is the second-largest grape-producing region with emerging wine culture. Domaine Sula, a vineyard near Bengaluru encapsulates all things wine beautifully and depicts the rich heritage of Indian sustainable winemaking. The logo displays a sun rising from the vineyards, which depicts the proud Sula Sun spreading cheer with every sip. Located on the Bengaluru - Mysore highway, Domaine Sula is a perfect picnic spot for exploring wine tourism with attractions like wine-tasting sessions, winery tours, gourmet dining options, and lots of delicious wines. As the most loved and the best wine brand in India for over two decades, this is another step to build an even stronger connection with their patrons and popularize wine tourism in the country.

Over the last 20 years, Sula has grown and established itself as a pioneer, innovator, and leader in the Indian wine industry. From the sale of their first bottle of wine in 2000 to being the best wine brand in India, they've come a long way. They take pride in their winemaking process where time and patience are just as important as quality wine grapes. A labour of love, each bottle of Sula wine is nothing short of a work of art. Throughout their journey, they've achieved milestones and set new benchmarks with their carefully crafted range of wines.

They have vineyards in Nashik, Maharashtra, and Ramanagara that produce different kinds of wines.

Grape vineyard

Wine production:

Wine is the transformation of sugars of grapes of yeast under anaerobic conditions into ethanol, CO_2, and small amounts of by-products such as D-glucose.

Basic steps involved in winemaking:

Step I: Harvesting of fruits:

- The grapes over there are grown using a grafting method that uses a European stem and an Indian Root. They grow in moderate climate conditions.
- Appropriate varieties of grapes are harvested around the months of January to March after a growth period from December to March.
- They must contain a high number of fermentable sugars.
- Grapes usually contain 5-25% total soluble sugar (Total soluble sugar).
- These grapes are manually excavated.

Excavation Machines

Step II: Crushing and extraction:

- Thus, obtained grapes are crushed and extracted mechanically and manually either at a Crushpad or mechanically by using a pneumatic press (for white wine) and a Crusher (for Red wine).
- This process releases juice and a little bit of pigment.
- The whole mass is known as Must.
- For white wine preparation, the skin is removed. The harvested fruits are de-seeded for white wine preparation which is not required for red wine preparation.
- In the case of red wine, the steam gives a vegetable-like aroma due to the presence of 2 methoxy-3-isopropyl pyrazine.
- In the case of red wine, the Must should be fermented.

Step III: Optimization:

- The must is optimized for two parameters, TSS and ph.
- The TSS is generally optimized between 17-22% and pH between 34, depending on the yeast strains to be used.
- KNS (potassium metabisulphite) may or may not be added at this stage, an antimicrobial compound against *Acetobacter* spp. and competitive yeast.
- It also acts as an antioxidant and antifungal agent.

Step IV: Primary fermentation:

- The optimized Must is inoculated with 2-10% of the inoculum of *Saccharomyces cerevisiae* and fermentation is carried out under optimum temperature in large fermenters.
- Red wine preparation= 22-27^{o}C for 3-5 days
- White wine preparation= 10-21^{o}C for 7-14 days
- During the fermentation, the content is mixed twice a day by punching the floating skin for proper aeration.
- It also helps in colour extraction.
- This fermentation allows rapid multiplication of yeast cells as well as sugar fermentation to ethanol, when the TSS is decreased by nearly about 9-10% then primary fermentation is terminated.

Fermenters

Step V: Pressing:

- The skin of must is taken out and pressed to release juice and alcohol.
- The liquid is again transferred into the tank.
- In the case of white wine, pressing is carried out before fermentation.
- During pressing colour of fruits and berries is extracted.

Step VI: Heat and cold sterilization:

- The main aim of this technique is to remove the tartrate crystals (wine diamonds or wine crystals).
- In the cold sterilization method, the fermented must is cooled to nearly freezing and kept for one to two weeks.
- During this period, the crystals get separated or stirred in the wall of the fermenter, and clear liquid is collected in the secondary fermenter tank.
- In the heat stabilization technique, it is gently heated between 50-60^{o}C for an hour and kept overnight.
- The proteins get decanted.
- The clear contents are pumped out and the remaining turbid substance is adsorbed onto bentonite.

Step VII: Secondary fermentation/Aging:

- It is carried out in stainless steel or oak barrel to accumulate flavour, there is no increase or decrease in alcohol content during this process.
- The stabilized, sterilized wine is now kept in Californian or French Oak barrels at 14^{o}C 19 humidity for 3-6 months under strictly anaerobic conditions usually in the case of sweet wine, the fermentation is terminated when sugar content is reduced to 4-6%.
- During secondary fermentation, the aroma is developed.

Aging of wine in Oak Barrels

Step VIII: Laboratory testing:

- After secondary fermentation, certain laboratory tests are conducted which include brix reading, brix pH, titrate-able acidity, residual sugars, free or available sulfur, total sulfur, volatile acidity, and alcohol percentage.

Step IX: Blending and refining:

- It is crucial to produce good quality wine with a special taste and aroma.
- In the blending process, spices, extracts of aromatic plants, essential oils, fruit juices, and other things are added in appropriate proportions to produce Fortified wines.
- Blending is kept trade secret in wineries (wine industry).
- In the fining process, tannins and microscopic particles are removed to make clear wine.
- For this purpose, wine is treated with gelatine, potassium caseinate, egg albumin, lysozymes, skimmed milk powder, etc. or it is filtered through a membrane filter or diatomaceous earth cellulose filter.
- Finally, wine is clarified to remove pectin which is achieved with the use of pectinase enzyme.

Step X: **Preservation:**

- Pasteurization technique and use of KMS (Potassium metabisulphite) are mainly used for preservation.
- It kills sugar utilizing micro-organisms.

Step XI: Bottling:

- Finally, wine is aseptically filled in a bottle and the bottle is corked, which is usually made with oak.
- Finally, the outside cork is sealed.
- The bottled wine can be directly consumed or preserved. Bottled wine is supposed to be stored at a temperature of 21°C and 76 humidity.
- White wine has a shelf life of 4 months and Red wine has 3 years.

Bottling Process and labeling

Distillation of wine:

- These are the alcoholic beverages/drinks obtained by the distillation of wine or fermented cereals.
- It may be aged or unaged (i.e., the distilled liquor).
- Distilled liquor is commonly called spirits.
- They consist of more than 40% ethanol.

Types of wines produced in SULA

There are five types of wines produced in Domaine Sula;-

- Red Wine (Cabernet sauvignon, Syrah, Zinfandel, Shiraz, Shiraz cabernet, Satori)
- White Wine (Sauvignon blanc, Chardonnay, Chenin blanc, Riesling, Viognier)
- Rosé Wine (Grenache rosé, Zinfandel rosé)
- Dessert Wine and
- Sparkling Wine

White Wine

Red Wine

Rosé Wine

Outcomes:

- Learned about the techniques of wine preparation.
- The students got to know about all the steps and fermenters used also the biochemicals and microbes used in the preparation of wine.
- Students got to know about different kinds of wines and their usage and features.

MANDYA DISTRICT CO-OPERATIVE MILK UNION LIMITED

Introduction: -

The industrial visit to Mandya district co-operative milk union limited (MANMUL) In Mandya was conducted on 05/07/2023. The objective of this visit was to gain insights into the operations of a cooperative dairy organization, understand its role in the dairy industry, and observe the processes involved in milk collection, processing, and distribution.

MANMUL is a prominent dairy cooperative located in Mandya, Karnataka, India. This was established in the year 1987. MANMUL plays a vital role in the socio–economic development of the region by supporting local farmers and promoting dairy farming as a sustainable livelihood.

Mandya milk union has jurisdiction of Mandya District, it covers 7 Taluks. It is one of the leading milk unions in the state of Karnataka. It was registered in the year 1987, Before registration Mysore and Tumkur milk union was procuring milk from Mandya district dairy co-operative societies. At the time of registration the union's milk procurement was 99000 liter per day through 410 dairy co-operative societies now the union is procuring 9.03 Lakh Kg per day through 1281 dairy co-operative societies (Highest Procurement 10.41 Lakh Kg per day).

MANMUL with its headquarters at Gejjalagere has got liquid milk plant of 10 lakh litres per day (Expandable up to 14LLPD) capacity, K.R.Pet Chilling centre has got 1.00 lakh litres, UHT plant of 1.07 lakh litres at Kumbalagudu and a powder plant of 45 MT capacity per day through the assistance of NDDB. The Milk Powder plant is successfully managing the extra milk conversion of the neighbouring District.

The Mandya Milk Union produces an average of 9.03 lakh kg per day of milk, with an average of 3.15 lakh litres of milk and 0.61 lakh kg of Curds and also products such as paneer, peda, butter, ghee, skim milk powder (SMP).

Location and Infrastructure: -

MANMUL is strategically located in Mandya, a district known for its agricultural activities and dairy farming. The cooperative has a well-established infrastructure comprising milk collection centres, processing units, storage facilities, and administrative offices.

MANMUL

Milk Collection Units: -

MANMUL operates a wide range of network of milk collection centres in Mandya and surrounding areas. These centres serve as collection points where farmers can deliver their milk. MANMUL follows a transparent and efficient milk collection process, ensuring fair prices for the farmers based on the quality and quantity of the milk supplied.

Milk Processing units: -

After collection, the milk is transported to MANMUL's processing unit after quality checks that are conducted in BMC checkpoints/centres. At these centres, milk

is checked for 4-5% fat content using a Lactometer based on which payments are made. The milk is then transported to Silos. The processing facility is equipped with modern machinery and technologies to handle large volumes of milk efficiently. The milk undergoes various stages of processing, including pasteurization, homogenization, and separation.

Silos at KMF Dairy, Mandya

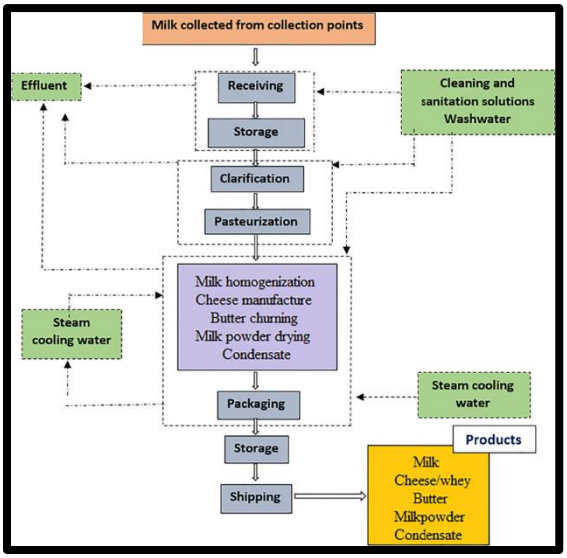
Product Manufacturing: -

MANMUL produces a wide range of dairy products, including milk, curd, ghee, and milk–based sweets. The processing unit is equipped with dedicated production lines for each product. Stringent quality control measures are implemented to ensure the production of hygienic and high–quality dairy products.

Pasteurization is done and the pasteuriser here works for 8 hours continuously. Pasteurisation involves: -

- Low Temperature Short Time (63 °C (145 °F) maintained for 30 minutes)
- High Temperature Short Time (72°C (162 °F), and holding for 15 seconds)
- Ultra High Temperature (120–150 °C (280–302 °F) for 1-2 seconds)

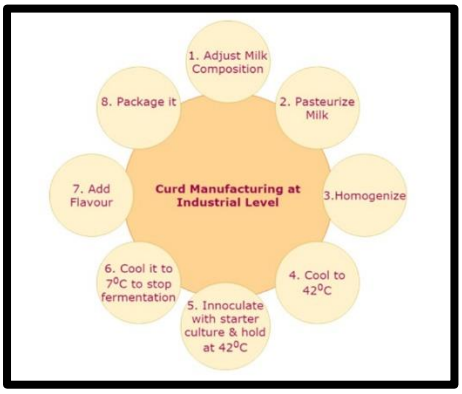
I - For milk processing, to the secured milk, ~8.2% SNF is added depending on the final fat content. This is then screened in compartments and undergoes pasteurisation. In this, conductivity parameters are maintained.



Milk Processing

II - For curd production, the *Lactobacillus* genus is used as a mother culture. 3.1% fat and 10% SNF content is maintained in Curd production. 3.3 lakh L of milk is used for the production of 75,000 L of curd.

- **Preparation: -**



Curd Preparation

1. **Adjust milk composition and blend ingredients**: skimmed milk powder is usually added to improve solids content and the texture of the final product.
2. **Pasteurise milk**: milk is heated to 90˚C for five minutes, which denatures the protein in it. This helps to increase viscosity and improve mouthfeel (texture).
3. **Homogenise**: this step disperses any fat present and helps to dissolve milk powders while improving mouthfeel.

4. **Cool milk**: milk is then cooled to 38-42˚C, the optimum temperature range for the growth of microorganisms.
5. **Inoculate with starter cultures**: use a blend of *Streptococcus thermophilus* (ST) and *Lactobacillus bulgaricus* (LB). They consume milk sugar (lactose) and convert it to lactic acid and distinctive yogurt flavour compounds.
6. **Hold**: for optimum growth of bacteria, the temperature should be held uniformly for four to six hours to ensure a nice, thick flavoursome product.
7. **Cool**: once a pH of 4.5 is reached, the yoghurt coagulum needs to be cooled to less than 30˚C to stop excess acid production.
8. **Add flavours and fruit**: after mixing these into the yoghurt, it is important the mixture is chilled without disturbing it to give maximum texture and flavour.
9. **Package**: the majority of yoghurts are packed in plastic tubs, but some luxurious and high quality products are packed in glass jars. Storage: packed yoghurt, in whatever form, should be stored and transported at less than 10˚C, but preferably below 5˚C. This slows down the biological and biochemical reactions and hinders the growth of potential contaminants, such as yeasts and mould.

III - For butter and ghee production, the milk procured runs through a separator that separates cream. This cream is then passed on to a continuous Butter Making Machine that forms butter with 80% fat content. The butter is then clarified to form ghee which is passed to a 120°C heat settling tank.

1. **Milk & cream**: Collected from cows. Butter can also be produced from the milk of buffalo, camel, goat, ewe, and mares. Cream is separated from the milk. The cream can be either supplied by a fluid milk dairy or separated from whole milk by the butter manufacturer. The cream should be sweet (pH greater than 6.6), not rancid, not oxidized, and free from off flavors. The cream is pasteurized at a temperature of 95°C or more to destroy enzymes and micro-organisms.

2. **Ripening:** Sometimes, cultures are added to ferment milk sugars to lactic acid and desirable flavor and aroma characteristics for cultured butter. This is more common in European butters.

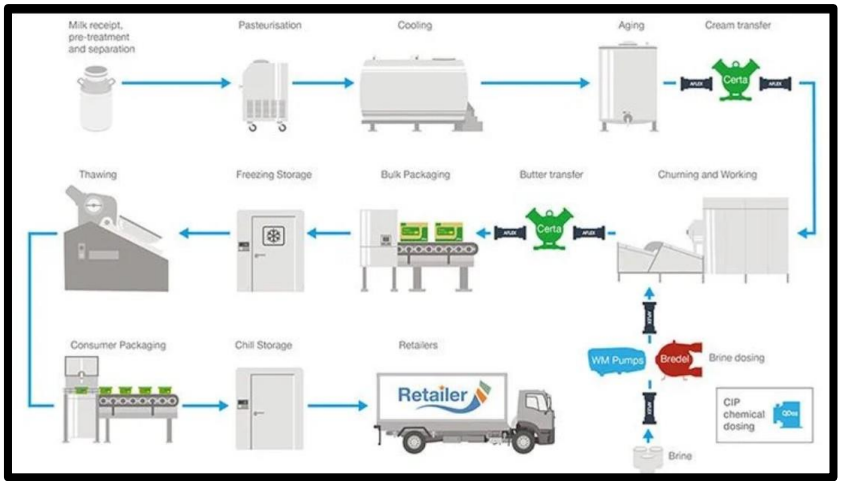
3. **Aging:** Cream is held at cool temperatures to crystallize the butterfat globules, ensuring proper churning and texture of the butter. In the aging tank, the cream is subjected to a program of controlled cooling designed to give the fat the required crystalline structure. As a rule, aging takes 12 - 15 hours. From the aging tank, the cream is pumped to the churn or continuous butter maker via a plate heat exchanger which brings it to the requisite temperature.

4. **Churning:** Cream is agitated, and eventually butter granules form, grow larger and coalesce. In the end, there are two phases left: a semisolid mass of butter, and the liquid left over, which is the buttermilk.

5. **Draining & washing:** Thus the cream is split into two fractions: butter grains and buttermilk. In traditional churning, the machine stops when the grains have reached a certain size, whereupon the buttermilk is drained off. With the continuous butter maker, the draining of the buttermilk is also continuous. After draining, the butter is worked to a continuous fat phase containing a finely dispersed water phase. It used to be common practice to wash the butter after churning to remove any residual buttermilk and milk solids but this is rarely done today. This washing process would ensure that all the buttermilk is washed out of the butter. Otherwise, the butter would not keep and go rancid.

6. **Salting & working:** Salt is used to improve the flavour and the shelf-life, as it acts as a preservative. Further, the butter is worked to improve its consistency.

7. **Packing & storage:** The butter is finally patted into shape and then wrapped in waxed paper and then stored in a cool place. As it cools, the butterfat crystallizes and the butter becomes firm. Whipped butter , made by whipping air or nitrogen gas into soft butter , is intended to spread more easily at refrigeration temperatures.



Butter Production

IV- The butter and ghee produced are further used in the production of sweets such as **Pedas and Khova** in machines that have a 4-tonne capacity. **Skimmed Milk Powder (SMP)** is also produced by removing condensate water from milk. These solid particles are also used in the production of sweets. **Paneer** is produced and uses 100-200 tonnes of milk. Citric acid is used for its production.

Khova is made from both cow and water buffalo milk. Khova is made by simmering full-fat milk in a large, shallow iron pan for several hours over a medium fire. The gradual evaporation of its water content leaves only the milk solids. The ideal temperature to avoid scorching is about 80 °C (180 °F). Another quick way of making khoa is to add full-fat milk powder to skimmed milk and mix and heat until it becomes thick. This may, however, not have the same characteristics as traditionally made khova.

Skimmed Milk Powder production:

Separation
The conventional process for producing milk powders starts with taking the raw milk received at the dairy factory and pasteurizing and separating it into skim milk and cream using a centrifugal cream separator.

Preheating
The successive milk powder processing step is "preheating," The standardized milk is heated to temperatures between 75 and 120 °C. Preheating causes a controlled denaturation of the whey proteins in the milk, and it destroys bacteria, inactivates enzymes, generates natural antioxidants, and imparts heat stability.

Evaporation
Evaporation is used to concentrate whole milk, skim milk, whey, whey protein concentrates and permeate from membrane filtration modules. Water is evaporated using indirect heating. Product and heating medium (steam) are kept separate from one another utilizing a special steel sheet. The heat released during the condensing of the moisture is transferred to the product via the partition. Evaporation also constitutes the preliminary stage of the drying of the said products.

Spray drying
Spray drying involves atomizing the milk concentrate from the evaporator into fine droplets. This is done inside a large drying chamber in a hot air flow (up to 200°C) using either a spinning disk atomizer or a series of high-pressure nozzles. The milk droplets are cooled by evaporation, and they never reach the temperature of the air. The concentrate may be heated before atomization to reduce its viscosity and increase the energy available for drying.

Secondary drying
Secondary drying takes place in a fluid bed or in a series of such beds, in which hot air is blown through a layer of fluidized powder removing water to give a product with a moisture content of 2-4%. Safety measures must be taken to prevent fires and to vent dust explosions should they occur in the drying chamber.

Packaging and storing of milk powder
Milk powders are immensely more stable than fresh milk, but protection from moisture, oxygen, light, and heat is needed to maintain their quality and shelf life. Milk powders readily take up moisture from the air, leading to a rapid loss of quality and caking or lumping.

Milk powder is packed into either plastic-lined multi-wall bags or bulk bins. Whole Milk Powders are often packed under nitrogen gas to protect the product from oxidation, maintain their flavor, and extend their keeping quality.

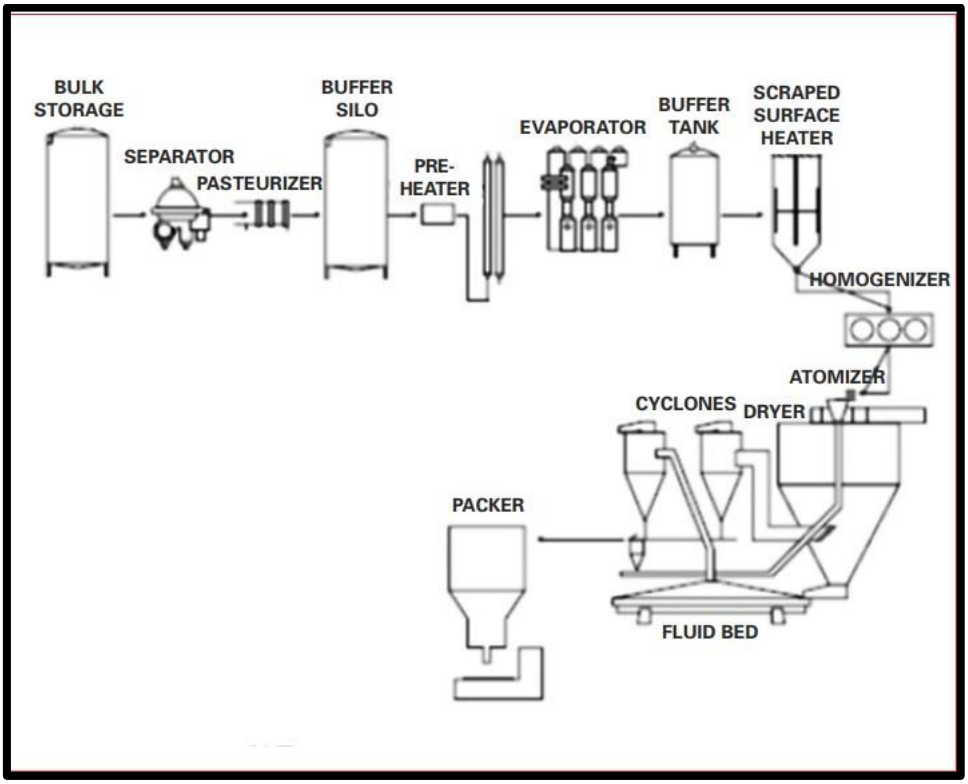
The packaging is chosen to provide a barrier to moisture, oxygen, and light. Bags generally consist of several layers to provide strength and the necessary barrier properties.

Shipments of milk powder should never suffer prolonged exposure to direct sunshine, especially in tropical countries. During transshipment, a few hours at elevated temperatures (> 40°C) can undo many weeks of careful storage.

Agglomerated milk powder
The manufacture of agglomerated milk powder initially follows the standard evaporation and drying process.

However, during spray drying, small particles (fines) of milk powder leaving the dryer are recovered in cyclones and returned to the drying chamber near the atomizer.

The wet concentrate droplets collide with the fines and stick together, forming larger irregular-shaped "agglomerates." Agglomerated milk powder disperses in water more rapidly and is less dusty and easier to handle than standard milk powder.



Skim Milk Powder preparation

Packaging and Distribution: -

Once the products are manufactured, they are packed in appropriate containers to maintain their freshness and extend their shelf life. MANMUL uses modern packaging materials and techniques to ensure product safety and hygiene. The packaged products are then distributed to various retail outlets, cooperatives, and institutional customers through an efficient distribution network.

There are 5 different types of packaging used here: -

- LDPE films
- PET Jars
- Tins
- Stand in Pouches and

- Tetra packs

Packaging unit

The entire plant is monitored by SCADA (Supervisor Control and Data Acquisition) system.

They also have many Quality Assurance labs that perform tests such as alcohol and acidity testing, butterfat content testing, freezing point testing, MBRT, COB, purity, adulteration testing, etc.

Products Available:-

Milk: (Homogenised, Pasteurised, Toned, UHT milk, Skimmed milk.)

Curd

Butter: (Salted and Unsalted)

Buttermilk

Ghee

Paneer

Sweets: (Ice cream, Milk Peda, Peda, Barfi and Khova)

Nandini Products

Cooperative structure and benefits: -

MANMUL operates on a cooperative model, where farmers are the primary stakeholders. The cooperative provides farmers with various benefits, including fair milk prices, access to veterinary services, technical support, and financial assistance. By promoting cooperative farming practices, MANMUL empowers farmers and contributes to their overall welfare.

Social Impact and Sustainability: -

MANMUL actively engages in social welfare initiatives, focusing on the education and well–being of farmers and their families. The cooperative also promotes sustainable agricultural practices, including organic farming techniques, waste management, and water conservation.

Conclusion: -

The industrial visit to MANMUL provided valuable insights into the functioning of a cooperative dairy organization. We observed the efficient milk collection process witnessed the advanced milk processing techniques and understood the importance of fair-trade practices in supporting farmers.

MANMUL's commitment to quality, social welfare, and sustainable practices was evident throughout the visit. The cooperative's role in promoting dairy farming as a viable livelihood option and its positive impact on the local community was commendable.

The visit offered a comprehensive understanding of the cooperative model in the dairy industry and highlighted MANMUL's significant contribution to the region's socio–economic development. It was an enriching experience that provided practical knowledge and real–world exposure to cooperative dairy operations.

Summary:

It was a great privilege to observe the companies in action and see how their organization effectively addresses the challenges of the industry. Each industry was well-organized, informative, and thoughtfully designed to cater to the diverse interests and backgrounds of our group members. The attention to detail and the efforts put forth by them in planning our visit were truly impressive.

The industrial visit has undoubtedly enriched our knowledge and understanding of the industry. We are confident that the insights gained from this visit will have a positive impact on our academic and professional pursuits. The company's commitment to excellence and innovation has inspired us, and we look forward to incorporating these learnings into our future endeavours.