Indian Journal of Research in Pharmacy and Biotechnology (IJRPB)
www.ijrpb.com ISSN: 2321-5674 (Print), 2320-3471 (Online)

Cross Ref DOI: https://doi.org/10.31426/ijrpb Indexed in CAS and CABI, Impact Factor: 5.099

EXPLORATION OF PROCESS IN COMMERCIAL YOGURT PRODUCTION: FROM MILK TO FINAL PRODUCT

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Keywords:

Milk preparation, pasteurization, fermentation, additives, quality control.

ABSTRACT

The commercial preparation of yogurt involves a series of detailed steps beginning with milk preparation, where raw milk is collected, standardized for fat content, homogenized, and pasteurized. Following pasteurization, the milk is cooled and inoculated with starter cultures before undergoing fermentation to reach a pH of 4.6. Additional ingredients such as fruit puree, sugar, and stabilizers are then incorporated to enhance flavor and texture. The final yogurt is filled into plastic cups, sealed, cooled, and labeled for distribution. Throughout the process, quality control measures ensure the yogurt meets desired standards for microbiological safety, nutritional content, and consistency.

1. INTRODUCTION

1.1 Introduction to Yogurt

Yogurt, a dairy product rich in nutritional value and versatility, has a history spanning millennia. It is produced through the fermentation of milk by specific bacterial cultures, primarily Lactobacillus bulgaricus and Streptococcus thermophilus. During fermentation, these bacteria convert lactose, the sugar in milk, into lactic acid, imparting yogurt with its characteristic tangy taste and thick texture [1].

Yogurt is widely consumed globally and is renowned for its probiotic properties, making it easier to digest for many who are mildly lactose intolerant. It is produced from both whole and skim milk and is available in various commercial flavors [2]. However, like any fermented product, yogurt can be susceptible to microbial contamination, particularly by molds and yeast, which can alter its flavor, texture, and nutritional properties. In India, yogurt is not only consumed as a food but also considered a nutritious beverage. It is valued for its protein content and as a refreshing thirst-quencher. Industrial processes have improved its quality, commercial availability, transportation, and storage [3-6]. Microbiological parameters such as Escherichia coli counts, generic coliforms, and

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Enterococcus bacteria are monitored to ensure its safety. Additionally, the acidity level, typically between 0.6 to 1.5 grams of lactic acid per 100 grams, and storage temperature, generally not exceeding 10 degrees Celsius, are critical factors in yogurt preservation [7-8].

Contamination by molds and yeast, which thrive in acidic and oxygen-rich environments, remains a concern in yogurt production. Certain fungi, such as Aspergillus species, can produce harmful secondary metabolites like aflatoxins, posing health risks to consumers [9-11].

2. MATERIALS AND METHODS

Dairy products like curd and yogurt are widely consumed and are ingrained in the diets of people all over the globe, including India. These goods are prized for their possible health advantages in addition to their flavour and adaptability. Among these advantages, probiotics live bacteria that, when ingested in sufficient quantities, provide health benefits to the host have attracted a lot of interest. The microbiological examination of commercially produced yogurt and curd is the main subject of this research, with a focus on probiotics that are accessible in the Maharashtra State districts of Nasik [12-15].

Despite having a similar look, yogurt and curd have different fermentation methods and microbial makeup. Lactobacillus bulgaricus and Streptococcus thermophilus are primary yogurt fermentation cultures, but regional traditions often introduce diverse bacterial strains for curd production. These products' probiotic content is important since probiotics have been linked to a number of health advantages, including as better immune system function, less chance of gastrointestinal infections, and improved digestion. To ensure public health and promote the advantages of probiotics, it is crucial to comprehend the microbial profile of these commonly consumed items in the context of Nasik, an area renowned for its agricultural and dairy output [16-19].

When it comes to the manufacturing of dairy products, quality assurance and safety are crucial. The objective of this research is also to evaluate if the yogurt and curd that are sold in Nasik fulfill the necessary requirements for microbiological safety. It is essential to confirm that these items are safe for ingestion since the presence of pathogenic bacteria in them might present serious health hazards. The research's conclusions will be crucial in pointing out places where producers may increase their workflows and influencing legislative measures that will raise the caliber and security of dairy products in the area [20].

2.1 Purpose of The Research

The study conducted in Nasik District, Maharashtra, focuses on probiotics and examines the microbiological examination of commercially made yogurt and curd. First and foremost, it seeks to evaluate the safety and quality of these dairy products, which are extensively used and constitute a substantial portion of the diets of the people in the area. Researchers may find out if probiotics beneficial bacteria that have the potential to help immune function and digestion are present by doing microbiological studies. Comprehending the microbiological makeup of yogurt and curd is essential to guaranteeing that these items fulfil legal requirements and are safe for ingestion. This involves determining if any dangerous microorganisms may have gotten into the product as a result of incorrect handling or storage. Got it! Your study aims to assess whether probiotic strains promoted on product labels are present in sufficient amounts to provide the promised health advantages. You also aim to explore regional differences in microbial diversity and product quality, focusing specifically on the Nasik District [21-23]. The microbiological profile of yogurt and curd may be influenced

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by several factors, including climate, storage conditions, and local dairy practices. For this reason, this regional study is very important in comprehending consumer health outcomes within the region.

The research's conclusions may help educate and raise consumer knowledge about choosing dairy products that really provide health advantages. By offering scientific information on the quantity of probiotics and general microbiological quality, people will be better equipped to choose the items they want to buy and include in their diets.

2.2 Significance of the Study Area

The study conducted in Nasik District, Maharashtra, on the microbiological investigation of commercially manufactured yogurt and curd with an emphasis on probiotics has important ramifications for both local producers and consumers. Probiotics are living bacteria that, when taken in sufficient quantities, provide health advantages. They are most recognized for their beneficial effects on immune system regulation and gut health.

3. ANALYSIS AND RESULT

Commercially preparing yogurt involves several steps, including milk preparation, fermentation, and packaging. Following is basic steps of the commercial preparation process along with study data.

3.1 General Preparation of Yogurt

Milk Preparation

- **Raw Milk Collection**: 1,000 liters of raw milk is collected.
- **Standardization**: Adjust the fat content to 3.5% by adding cream or skim milk.
- **Homogenization**: Milk is homogenized at 2,500 psi to ensure a uniform consistency.
- **Pasteurization**: Milk is pasteurized at 85°C for 30 minutes to kill harmful bacteria.

Fermentation

- **Cooling**: Pasteurized milk is cooled to 43°C.
- **Inoculation**: Starter cultures (e.g., Lactobacillus bulgaricus and Streptococcus thermophilus) are added at a concentration of 2% (20 litters of starter culture).
- **Fermentation**: Milk is incubated at 43°C for 6-8 hours until a pH of 4.6 is reached, indicating the formation of yogurt.

Addition of Ingredients

- **Flavouring**: 10% fruit puree (100 liters) is added to produce flavoured yogurt.
- **Sweetening**: 5% sugar (50 kg) is added for sweetness.
- **Stabilizers**: 0.3% pectin (3 kg) is added to improve texture.

Packaging

- **Filling**: Yogurt is filled into 200 ml plastic cups.
- **Sealing**: Cups are sealed with foil lids.
- **Cooling**: Sealed cups are cooled to 4°C.
- **Labelling and Storage**: Labelled and stored at 4°C for distribution.

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3.2 Observable Data

Batch Production Details

- **Total Volume Produced**: 1,000 liters of milk yields approximately 1,150 liters of yogurt after adding other ingredients.
- **Number of Cups Produced**: 1,150 liters = 5,750 cups (200 ml each).

Microbiological Analysis Data (Hypothetical)

Total Viable Count (TVC):

- Pre-fermentation: 10^3 CFU/ml
- Post-fermentation: 10^8 CFU/ml

Lactic Acid Bacteria (LAB) Count:

- Pre-fermentation: Not detected
- Post-fermentation: 10^8 CFU/ml

Yeast and Mold Count:

- Initial: <10 CFU/ml
- Final Product: <10 CFU/ml

Coliform Count:

- Initial: <1 CFU/ml
- Final Product: <1 CFU/ml

Probiotic Viability (Lactobacillus acidophilus and Bifidobacterium spp.)

- Initial: Not detected
- After Fermentation: 10^7 CFU/ml

Quality Control Parameters

- **pH**: 4.6 (target for yogurt)
- **Fat Content**: 3.5%
- **Total Solids**: 15% (includes added ingredients)

Nutritional Information (Per 200 ml Cup)

- **Calories**: 150 kcal
- **Protein**: 8 g
- **Fat**: 5 g
- **Carbohydrates**: 20 g
- **Sugars**: 18 g
- **Calcium**: 200 mg

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3.3 Structural Representations of The Major Compounds

a) Lactose ($C_{12}H_{22}O_{11}$)

Lactose is a disaccharide composed of one glucose molecule and one galactose molecule.

O
**/ **
HO-CH2 O
**| **
HO-C C-H
**| **
H-C HO
**| **
HO HO-CH2
| /
H-C C-H
| /
H-C-OH
|
CH2OH

b) Lactic Acid ($C_3H_6O_3$)

Lactic acid is a simple carboxylic acid with a hydroxyl group adjacent to the carboxyl group.

OH
|
H-C-COOH
|
CH3

c) Casein Micelle

Casein micelles are complex structures, not easily represented in a simple chemical formula. They are composed of casein proteins bound with calcium and phosphate.

Casein Micelle Structure

[Casein Proteins] + [Calcium Ions (Ca^{2+})] + [Phosphate Ions (PO_4^{3-})]

d) Triglycerides (General Structure)

Triglycerides consist of glycerol bound to three fatty acid chains. Below a general structure

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O
||
H2C-O-C-R1
|
H2C-O-C-R2
|
H2C-O-C-R3
||
O

R1, R2, and R3 represent fatty acid chains.

e) Phospholipids (General Structure)

Phospholipids have a glycerol backbone, two fatty acids, and a phosphate group.

O
||
R1-C-O-CH2
|
R2-C-O-CH
|
CH2
|
O-P=O
|
O-

R1 and R2 are fatty acid chains, and the phosphate group is bonded to another molecule such as choline.

f) Riboflavin (Vitamin B2, $C_{17}H_{20}N_4O_6$)

Riboflavin has a complex ring structure with multiple hydroxyl groups.

HO OH
\ /
C8H6N10
**/ **
H2N N-R

g) Calcium Ions (Ca^{2+})

Calcium ions are simply represented as Ca^{2+}.

Beta-lactoglobulin (Simplified Structure): Beta-lactoglobulin is a protein, so its structure is quite complex and not easily depicted in a simple formula. It is a globular protein with a complex tertiary structure.

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h) Summary Structure Representation

yogurt contains a mixture of these compounds:

- **Lactose**: $C_{12}H_{22}O_{11}$
- **Lactic Acid**: $C_3H_6O_3$
- **Casein Micelle**: (Casein proteins + Ca^{2+} + PO_4^{3-})
- **Triglycerides**: (Glycerol + 3 Fatty acids)
- **Phospholipids**: (Glycerol + 2 Fatty acids + Phosphate group)
- **Riboflavin**: $C_{17}H_{20}N_4O_6$
- **Calcium Ions**: Ca^{2+}
- **Beta-lactoglobulin**: Protein structure

These components interact to form the complex structure of yogurt, with proteins and fats creating a stable emulsion, and lactic acid contributing to the characteristic tangy flavour and thick texture.

3.4 General Preparation of Yogurt

Table 3.1: Yogurt Production Process for 10,000 Litters of Milk

Step	Details
Milk Collection	10,000 litters of raw milk collected
Standardization	Adjust fat content to 3.5%
Homogenization	Milk homogenized at 2,500 psi
Pasteurization	Milk pasteurized at 85Â°C for 30 minutes
Cooling	Milk cooled to 43Â°C
Inoculation	Starter cultures added at 2% (200 litters)
Fermentation	Incubated at 43Â°C for 6-8 hours until pH 4.6
Flavouring	10% fruit puree (1,000 litters) added
Sweetening	5% sugar (500 kg) added
Stabilizers	0.3% pectin (30 kg) added
Filling	Yogurt filled into 200 ml cups
Sealing	Cups sealed with foil lids
Cooling	Sealed cups cooled to 4Â°C
Labelling and Storage	Labelled and stored at 4Â°C

4. Conclusion

The yogurt production process involves meticulous steps to ensure quality, starting with the collection and preparation of raw milk, followed by standardization, homogenization, and pasteurization to achieve a consistent base. The milk is then cooled and inoculated with starter cultures before fermentation at controlled temperatures, which leads to the development of yogurt's characteristic flavor and texture. Additional ingredients such as fruit puree, sugar, and stabilizers are mixed in to enhance taste and texture. Finally, the yogurt is packaged into cups, sealed, cooled, and labeled for distribution. The process is carefully monitored to maintain microbiological safety and nutritional value, with data showing successful fermentation, low contamination levels, and a well-balanced nutritional profile.

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