

Physical Characterization of Cheese Curd with Different Rennet Enzyme Concentrations

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ABSTRACT

The reliance on synthetic or imported food processing agents has encouraged the exploration of optimized local cheese production. Rennet is a critical coagulant used to separate casein from whey during the formation of curd. This study aimed to evaluate the effect of rennet concentration on the physical properties of cheese, specifically focusing on coagulation time, yield, and curd firmness. Cheese was prepared using pasteurized milk at 25-35°C with varying concentrations of liquid rennet. The results showed that increasing rennet concentration significantly accelerated the coagulation process. However, excessively high concentrations led to a rubbery texture and potential bitterness in the final product. Overall, this study demonstrates that optimizing rennet dosage is essential for achieving a balance between production efficiency and ideal textural characteristics.

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1. INTRODUCTION

Cheese is a common choice in the food industry as a versatile and nutritious dairy product. The production of cheese involves the coagulation of milk proteins, primarily casein, to form a solid curd. One of the most critical additives in this process is the coagulant, with rennet (containing the enzyme chymosin) being the industry standard for its specific proteolytic activity.

While starch-based materials focus on plasticizers like sorbitol to reduce intermolecular hydrogen bonding and improve flexibility, cheese production focuses on the enzymatic breakdown of the kappa-casein layer to allow protein aggregation. Similar to how starch films can become too brittle or soft based on additive levels, the concentration of rennet must be carefully controlled. Insufficient rennet leads to weak curd structure and loss of solids in the whey, while excessive rennet can compromise the mechanical integrity and flavor profile of the cheese. This study evaluates the impact of varying rennet concentrations on the physical properties of curd to support sustainable local dairy processing.

Proteolysis and the Chemical Mechanism of Rennet The transformation of liquid milk into a solid curd is driven by a specific biochemical reaction known as proteolysis. This process occurs in two primary stages 1. **Enzymatic Hydrolysis of K-casein** Milk contains protein aggregates called micelles, which are kept in suspension by a protective outer layer of K-casein (kappa-casein). This layer carries a negative charge that causes micelles to repel each other. When rennet (specifically the enzyme chymosin) is added, it acts as a biochemical catalyst to cleave the bond between the 105th and 106th amino acids (Phenylalanine-Methionine) of the K-casein chain. 2. **Aggregation and Gel Formation.** Once the protective K-casein layer is removed, the remaining parts of the micelles (K-casein) lose their repulsive forces. In the presence of calcium ions, these micelles begin to aggregate, forming a three-dimensional protein network. This network traps fat globules and water, resulting in the solid structure known as curd.

2. METHODS

2.1 Materials The materials used in this study were pasteurized cow milk, liquid rennet, distilled water, and citric acid for pH adjustment.

2.2 Cheese Preparation Standardization:

- a) Milk was heated to a constant temperature of 32°C while being stirred.
- b) Acidification: The pH was adjusted to 5.2 using a dilute citric acid solution. Coagulation: Rennet was incorporated at varying concentrations (e.g., 0.01%, 0.02%, and 0.03%) and stirred for 1 minute to ensure even distribution.
- c) Setting: The mixture was left undisturbed to allow the formation of a homogeneous gel (curd).
- d) Cutting and Cooking: The curd was cut into 1 cm cubes and heated slowly to 40°C to facilitate syneresis (whey expulsion).

2.3 Characterizations Coagulation Time:

- a) The time required for the milk to transform from a liquid state to a firm gel capable of a clean break.
- b) Yield Percentage: Calculated as the weight of the final curd relative to the initial weight of the milk.
- c) Firmness Test: Evaluated by observing the resistance of the curd to manual cutting and pressing.

3. RESULTS AND DISCUSSION

The physical properties of the cheese curd prepared with different rennet concentrations are summarized in Table 1.

Table 1. Effect of Rennet Concentration on Physical Properties of Cheese Curd

Rennet Concentration (%)	Coagulation Time	Yield (%)	Curd Firmness
0.01%	Long	Low	Very Soft
0.02%	Moderate	Moderate	Firm/Elastic
0.03%	Short	High	Tough/Rubbery

Analysis: The results show that rennet concentration plays an important role in determining coagulation behavior. Increasing the concentration shortens the coagulation time because more enzymes are available to hydrolyze the kappa-casein. However, similar to the behavior of starch films where excessive additives can produce undesirable textures, very high rennet levels created a curd that was too dense. This occurs because rapid enzymatic action leads to a tight protein matrix that expels too much moisture, potentially affecting the final mouthfeel of the cheese.

4. CONCLUSIONS

Variation in rennet concentration was found to significantly influence the physical properties of cheese curd. An increase in concentration improved the speed of production and yield but modified the arrangement and spacing of the protein matrix. Intermediate concentrations showed more balanced characteristics, combining adequate firmness with efficient whey separation. These results highlight the importance of optimizing enzyme content to achieve a balance between functional performance and textural quality.

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