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A Novel Approach to Cheese Production Using *Musa paradisiaca* (Banana) Sap as a Plant –Based Coagulant

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Abstract:

The dairy industry's increasing need for plant-based substitutes has spurred research into new coagulants for cheese making. *Musa paradisiaca* (banana) sap was examined in this study as a natural plant-based alternative to conventional animal rennet. To encourage efficient coagulation, fresh banana sap was gathered and treated with a tiny quantity of calcium chloride to activate milk calcium ions. When making cheese, standardized cow milk was utilized, and by keeping the ideal pH of 7.0 and temperature at 52°C, curd successfully formed in 3–4 minutes. The findings showed that banana sap could effectively coagulate milk, providing a natural coagulant that shows promise for use in sustainable and vegetarian cheese making. This innovative strategy offers a more affordable, environmentally responsible, and moral substitute for traditional techniques, creating new avenues for innovation in the dairy industry.

Key words:*Musa paradisiaca* , banana sap , coagulate milk, vegetarian cheese, environmentally responsible, innovation, temperature.

Introduction :

Overview of *Musa paradisiaca*

The banana plant, or *Musa paradisiaca*, is an essential fruit crop in the *Musaceae* family. Bananas, an important staple fruit that provides vital nutrients, are native to Southeast Asia and are grown extensively throughout tropical and subtropical countries. In addition to the fruit, the stem, leaves, flower, and sap of the banana plant are all highly valuable in terms of nutrition, medicine, and the economy. Enzymes, phenolics, and natural coagulants are among the complex variety of bioactive components found in banana sap, a natural fluid that is secreted from the pseudo stem and other plant parts.

Traditional and Modern Uses of Banana Plant

In traditional medicine, several components of the banana plant have been used to cure conditions like inflammations, infections, and ulcers. Because of its fiber content and medicinal qualities, banana stems and blooms are used as functional ingredients in the food industry. The use of banana plant extracts in novel applications such as edible coatings, biodegradable polymers, and now cheese production has drawn recent biotechnology attention. An unexplored use that supports sustainable farming methods is the use of banana sap as a milk coagulant.

The Need for Novel Plant Based Milk Coagulants :

Concerns about animal welfare, allergies, religious dietary restrictions, and consumer demand for plant-based and vegetarian-friendly products have prompted the worldwide dairy sector to look more closely at alternatives to rennet generated from animals. The ability of plant proteases, which are derived from species such as Ficus, Cynara, and now maybe Musa, to coagulate milk by cleaving casein proteins to start the formation of curd, is being investigated. Finding efficient novel coagulants is crucial because many plant-based coagulants have drawbacks such bitterness or poor curd structure.

Potential of Banana Sap as a Novel Milk Coagulant :

Proteolytic enzymes found in banana sap have the potential to efficiently break down casein molecules in milk, causing milk to coagulate without the need for animal products “The Protease in banana sap mimic the action of chymosin ,leading to efficient milk coagulation ” . According to preliminary results, banana sap can produce high-quality cheese with good texture and curd strength if the right optimization is done, such as keeping the pH of the milk at neutral, adding calcium chloride to activate the calcium ions in the milk, and regulating the temperature and coagulation time.

Scope of the Present Study:

This study focuses on evaluating the coagulant potential of *Musa paradisiaca* (banana) sap for cheese preparation. By optimizing key parameters and assessing the curdling ability of banana sap, this research aims to present a novel, sustainable alternative to animal rennet, supporting the development of plant-based dairy innovations. This work lays the foundation for future studies on the enzymatic properties of banana sap and its commercial applications in dairy technology.

Materials and Methods :

Resources:

Cow Milk: To make cheese, fresh, complete milk was gathered.

Banana Sap: Fresh banana sap *(Musa paradisiaca*) was taken from the stem of the banana plant.

Calcium Chloride: To activate milk calcium ions, 0.1 g of calcium chloride was utilized.

Equipment includes a pH meter, muslin cloth, thermometer, and stainless steel vessel.

Techniques:

The process of extracting banana sap :

To avoid contamination, fresh banana stems were sliced, and the sap was promptly collected into a sterile container.

Making Milk:

Fresh cow's milk was taken and heated to 52°C while being constantly stirred.

The process of coagulation :

To improve coagulation by activating calcium ions, 0.1 g of calcium chloride was added to the milk. As per the experimental design, banana sap (sample) was introduced right away in varying amounts.

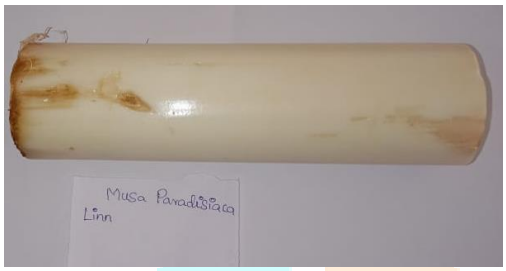
The pH was maintened throughout the whole process to about 7.0 and the mixture was kept at 52°C. It took three to five minutes to see coagulation.

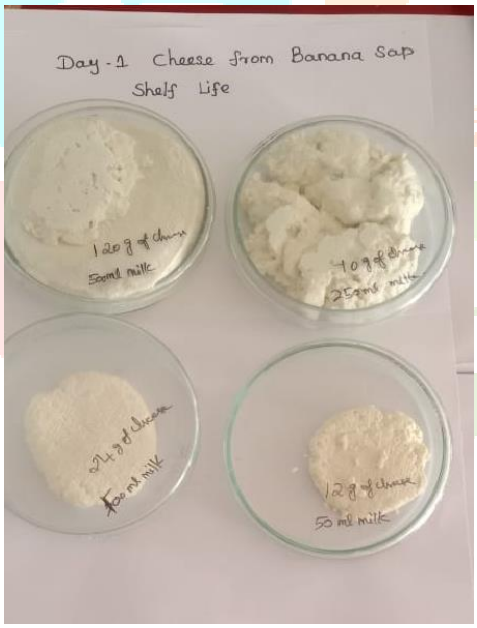
Curd Gathering:

Once the coagulation was complete, the curd (cheese) was separated with a muslin cloth and let to drain for a few hours in order to extract the whey.

Calculating Yield:

The yield was computed using the initial volume of milk and the weight of the finished cheese product.





Result and Discussion :

Cheese was formed when cow milk was successfully coagulated using a plant-based coagulant made from *Musa paradisiaca* (banana sap). Throughout the storage term, the made cheese demonstrated good physical, sensory, and textural stability. Over the course of 15 days, the banana sap-based cheese's quality and freshness were observed in a refrigerator setting (4–6°C).

There was no noticeable microbial development or spoiling during the first 17 days, and the cheese kept its texture, color, and odor. The cheese was fit for consumption and showed no outward signs of deterioration. However, following day 17, on days 18 and 19, little spots started to show up on the cheese's surface, signifying the beginning of microbial spoiling or decline of quality.

The natural microbial load, moisture content, and This finding implies that, without the use of chemical preservatives, the rennet cheese made from banana sap has a shelf life of roughly 17 days when kept in a refrigerator. The coagulation process and the initial preservation of the cheese were greatly aided by the natural enzymes found in banana sap, particularly protease (chymosin-like activity).

lack of effective preservation systems may be the cause of the slow spoiling after 17 days. Future research might concentrate on extending the shelf life by using natural antibacterial agents or better packaging techniques.

According to the current research, banana sap can be used as a new, plant-based, and efficient substitute for conventional animal rennet in the manufacture of cheese, providing a fresh strategy for the creation of vegetarian and environmentally friendly dairy products.

Table :1

Cow milk	Banana sap	Yield of cheese
50 ml	5 ml	12g
100 ml	10 ml	24g
250 ml	25 ml	70g
500 ml	50 ml	120g

Conclusion :

The current study effectively showed that banana sap, or *Musa paradisiaca*, can function as a plant-based coagulant for the manufacture of cheese. Under ideal conditions of pH 7.0 and 52°C, the enzymatic activity—specifically, the presence of chymosin-like protease—played a major impact in coagulating cow milk in 3–4 minutes. In terms of texture, yield, and firmness, the resulting cheese was on par with conventional animal rennet cheeses. By providing a sustainable, vegetarian, and inventive substitute for traditional rennet, the use of banana sap as a natural coagulant encourages ecologically friendly practices in the dairy industry. Additional research on nutritional analysis, sensory assessment, and storage stability may aid in growing the commercial uses of cheese made from banana sap.

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