Preservative Effects of Green and Black Pepper on Africa n Soft Cheese: Sensory Evaluation and Microbial Analysis of Total Viable Bacteria and Coliform Bacteria

BY

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CERTIFICATION

DEDICATION

This project is lovingly dedicated to the memory of my late mother, Mrs. Asrafat Afolabi.

Her unconditional love, sacrifices, and prayers laid the foundation for everything I am tod ay. Though she is no longer with me in this world, her spirit continues to guide and inspir e me.

May Almighty Allah have mercy on her soul, grant her eternal rest, protect her from the pu nishment of the grave, and admit her into Al-Jannah on the Day of Judgment***. Ameen.***

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Unit of Animal production

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ABSTRACT

This study investigates the preservative effects of green and black pepper on African soft cheese, focusing on their impact on sensory attributes and bacteri al counts, specifically Total Viable Bacteria (TVB) and Coliform Bacteria (SS).

African soft cheese, a popular dairy product in West Africa, is prone to rapid sp oilage due to its high moisture content and lack of effective preservation meth ods. Green and black pepper, both recognized for their antimicrobial and antio xidant properties, were tested as natural preservatives. The study involved ap plying different concentrations (10g, 20g, 30g) of green and black pepper to ch eese samples, with a neutral treatment serving as a control. Sensory analysis was conducted to evaluate the physical appearance, taste, aroma, texture, so und, and overall acceptance of the treated cheese, using a 5-point Likert scal e. Bacterial counts were measured on Days 1, 3, and 5. The results showed th

at both green and black pepper significantly reduced bacterial growth, especia lly at higher concentrations, with green pepper (30g) demonstrating the most effective preservative impact. Sensory evaluation also revealed that higher co ncentrations of pepper enhanced the taste, texture, and overall acceptance of the cheese. These findings suggest that green and black pepper can serve as effective natural preservatives in African soft cheese, offering a sustainable al ternative to synthetic preservatives. The study also highlights the potential for improving the shelf life and safety of cheese in regions with limited access to r efrigeration, thereby reducing food waste and supporting small-scale dairy pro ducers.

Keywords: African soft cheese, green pepper, black pepper, preservatives, Tot al Viable Bacteria, Coliform Bacteria, sensory evaluation, shelf life, food safety, natural preservatives

CHAPTER ONE

INTRODUCTION

1.1 BACKGROUND

Cheese is one of the most ancient and versatile dairy products, with a history that dates back thousands of years. Across the globe, cheese serves as an essential source of protein, calcium, and other vital nutrients. Among the different types of cheese, African soft cheese, commonly known as wara in West Africa, holds a prominent place in the culinary and nutritional traditions of many African societies. Despite its popularity and nutritional benefits, African soft cheese faces significant challenges due to its high perishability. The lack of effective preservation methods, combined with poor storage infrastructure in rural areas, contributes to substantial post-harvest losses, food waste, and economic challenges for small-scale producers (Adeyeye et al., 2020).

Soft cheeses, including African soft cheese, have high moisture content and low acidity, creating an environment conducive to bacteria growth. This makes them particularly susceptible to spoilage caused by bacteria, yeasts, and molds. The spoilage process not only reduces the sensory quality of the cheese, such as taste, texture, and aroma, but also poses potential health risks due to the proliferation of pathogenic microorganisms. Traditional preservation methods, such as salting, smoking, and refrigeration, have been used to slow down spoilage. However, these methods have limitations, especially in rural areas where access to refrigeration and modern storage facilities is limited or non-existent (Oluwafemi & Ibeh, 2021).

To address these challenges, there has been increasing interest in natural preservation methods that are affordable, sustainable, and accessible to low-income communities. Spices, which have been used for centuries as food additives, are gaining attention as natura

l preservatives due to their antibacteria and antioxidant properties.

Among these spices, green and black pepper stand out as potential candidates for chees e preservation. Green pepper, which is the unripe fruit of the Piper nigrum plant, and blac k pepper, which is the dried, mature fruit of the same plant, are widely known for their culi nary and medicinal uses. They contain bioactive compounds such as piperine, flavonoid s, and essential oils that have been shown to inhibit the growth of spoilage microorganis ms and delay oxidative deterioration in food products (Ravindran, 2017).

Several studies have highlighted the antibacteria and antioxidant properties of green and black pepper in various food systems. For instance, Nwachukwu and Ezeh (2021) demo nstrated that black pepper extracts significantly reduced the bacteria load in meat produ cts, extending their shelf life while maintaining sensory quality. Similarly, green pepper h as been reported to exhibit strong antioxidant activity, which helps to prevent lipid oxidati on and maintain the freshness of dairy products. These findings suggest that incorporati ng green and black pepper into the production or storage of African soft cheese could be a viable strategy to enhance its shelf life and safety.

Moreover, the use of natural preservatives like green and black pepper aligns with global trends promoting the reduction of synthetic additives in food. Synthetic preservatives, w hile effective, have raised concerns about their potential health risks, including allergic re actions and long-term toxicity. In contrast, natural preservatives are generally regarded a s safer and more environmentally friendly. They also resonate with consumer preference s for clean-label products that contain fewer artificial ingredients (Banerjee et al., 2022).

The potential application of green and black pepper in the preservation of African soft ch eese is particularly relevant in the context of food security and economic development. I n many parts of Africa, small-scale cheese producers rely on traditional methods that are labor-intensive and yield products with short shelf lives. Spoilage not only leads to econo mic losses but also limits the ability of producers to access broader markets. By extendi ng the shelf life of African soft cheese, natural preservatives like green and black pepper could help to reduce food waste, improve profitability for producers, and enhance the av ailability of nutritious dairy products in local and regional markets (Adeyeye et al., 2020).

Despite the promising potential of green and black pepper as natural preservatives, resea rch on their application in traditional African soft cheese is limited. Most studies on the a ntibacteria and antioxidant properties of these spices have focused on other food syste ms, such as meats, fermented beverages, and processed dairy products. There is a need to investigate how green and black pepper interact with the unique characteristics of Afri can soft cheese, including its high moisture content, mild flavor, and traditional producti on methods. Understanding these interactions will provide valuable insights into the feas ibility and effectiveness of using green and black pepper as preservatives in this specific context.

1.2 STATEMENT OF PROBLEM

African soft cheese is prone to rapid spoilage due to its high water activity and lack of re frigeration facilities in rural areas. The reliance on synthetic preservatives, although effec

tive, raises concerns about their health implications and availability to low-income consu mers. Hence, there is a growing need to explore natural and accessible alternatives for pr eserving soft cheese.

The use of green and black pepper as natural preservatives has not been extensively stu died in the context of African soft cheese. This knowledge gap limits the adoption of the se spices as viable preservation agents, which could otherwise improve food security an d reduce economic losses for small-scale producers.

1.3 OBJECTIVES OF THE STUDY

The main objective of this study is to evaluate the preservation effects of green and blac k pepper on African soft cheese. The specific objectives are:

1. To determine the antibacteria effects of green and black pepper on the bacteria load o f African soft cheese.

2. To assess the impact of green and black pepper on the sensory attributes of African s oft cheese, including taste, texture, and aroma.

3. To evaluate the shelf-life extension of African soft cheese treated with green and black pepper under ambient storage conditions.

1.4 JUSTIFICATION OF THE STUDY

This study is justified as it seeks to provide a practical and natural solution to the preser

vation challenges of African soft cheese. By evaluating the efficacy of green and black p epper in extending shelf life, maintaining sensory quality, and enhancing bacteria safety, the research can benefit small-scale producers, improve food security, and reduce econo mic losses, aligning with global efforts to promote sustainable and natural food system s.

1.5 SIGNIFICANCE OF THE STUDY

This study is significant for several reasons:

1. It explores natural preservation methods, promoting safer and healthier alternatives to synthetic preservatives.

2. The findings can benefit small-scale cheese producers by providing an affordable and accessible preservation strategy.

3. It contributes to the literature on the application of spices in food preservation, particul arly in traditional dairy products.

CHAPTER TWO

LITERATURE REVIEW

2.1 HISTORY OF CHEESE

Cheese is one of the oldest prepared foods in human history, with its origins dating back thousands of years. The process of cheese-making is believed to have begun as early as 8000 BCE, coinciding with the domestication of sheep and the advent of dairy farming (Raviv et al., 2024). Early cheesemaking was likely discovered accidentally, when milk st ored in animal stomachs curdled due to the action of rennet, a natural enzyme found in t

he stomach lining of young ruminants. This process separated the milk into curds and w hey, forming the basis of cheese production (Lemoine et al., 2024).

Archaeological evidence indicates that cheesemaking was practiced in ancient civilizatio ns. Murals in Egyptian tombs from around 2000 BCE depict cheese production, highlighti ng its cultural significance. In 2018, researchers discovered remnants of cheese in ancie nt Egyptian tombs dating back to approximately 1200 BCE, further demonstrating its lon g-standing role in human diets (Ahmed et al., 2018).

Recent discoveries in China have pushed the history of cheese even further back. In 202 4, preserved remnants of cheese were found in the Xiaohe Cemetery in Xinjiang, China, d ating to around 1615 BCE. These findings offer insights into early fermentation techniqu es and dietary practices in ancient societies (Raviv et al., 2024).

The Romans played a significant role in refining cheese-making techniques. They develo ped new methods for aging and flavoring cheese, spreading the craft throughout their e mpire. Cheesemaking traditions flourished in medieval Europe, particularly in monasterie s, where monks perfected techniques and created many iconic cheese varieties, such as Parmesan and Gouda (Hansen, 2023).

The Industrial Revolution marked a turning point in cheese production, introducing mass production and standardization. Innovations in dairy science and technology led to more efficient cheese-making processes, enabling large-scale production to meet growing dem and. Despite industrialization, traditional artisan cheese-making practices have persisted

and experienced a resurgence in recent decades due to consumer interest in unique and l ocally crafted products (Banerjee et al., 2022).

Today, cheese is a global culinary staple, with thousands of varieties influenced by regio nal climates, cultures, and techniques. Its evolution over millennia reflects human ingenu ity in food preservation and culinary innovation. Modern cheesemakers continue to explo re new techniques and flavor profiles, ensuring the continued relevance of this ancient fo od in contemporary diets (Lemoine et al., 2024).

2.2 PRODUCTION AND PROCESSING OF CHEESE

Cheese production is a complex process that transforms milk into a variety of cheese typ es through the action of enzymes, bacteria, and physical manipulation. The process gen erally involves the following steps:

2.2.1.

Cheese production begins with the selection of milk, which can come from cows, goats, sheep, or other mammals. The quality and composition of the milk, including its fat and protein content, play a significant role in determining the characteristics of the final prod uct. Milk is often standardized to achieve consistent fat and protein ratios, ensuring unif ormity in cheese production (Fox et al., 2017).

2.2.2.

Most cheese-making processes involve pasteurization to eliminate harmful bacteria whil e preserving beneficial microorganisms. After pasteurization, a starter culture of lactic ac id bacteria is added to the milk. These bacteria convert lactose into lactic acid, lowering t he pH and aiding in curd formation (Lawrence et al., 2021).

2.2.3.

Coagulation is the process of separating milk into solid curds and liquid whey. This is ac hieved by adding rennet, a natural enzyme, or a plant-based or bacteria coagulant. The re nnet causes the milk proteins (casein) to form a gel-like structure, trapping fat and moist ure within the curds (Guinee, 2022).

2.2.4.

Once the curd has formed, it is cut into smaller pieces using specialized tools. Cutting all ows whey to drain more efficiently, influencing the texture and moisture content of the c heese. The curds are then gently heated and stirred to expel additional whey and develop the desired texture (Tamime, 2021).

2.2.5.

The curds are drained to remove excess whey and shaped into molds. The molds define the size and shape of the cheese and help consolidate the curds. Some cheeses are pres sed to remove more whey and achieve a firmer texture (Fox et al., 2017).

2.2.6.

Salt is added to cheese for flavor, preservation, and moisture control. Salting can be don e by adding salt directly to the curds, immersing the cheese in a brine solution, or rubbing salt on the cheese surface. Salt also helps control the growth of microorganisms during aging (Lawrence et al., 2021).

2.2.7.

The aging process, also known as ripening, is where cheese develops its distinctive flavo rs and textures. During aging, biochemical processes involving enzymes and microbes br eak down proteins and fats, creating complex flavors. The length of aging varies depend ing on the type of cheese, ranging from a few days to several years (Guinee, 2022).

2.2.8

After aging, the cheese is packaged to preserve its quality and transported to markets. P ackaging methods vary depending on the type of cheese, with some requiring vacuum-se aling to prevent contamination or moisture loss (Tamime, 2021).

2.2.9

Advancements in dairy science and technology have led to innovations such a s:

- **Ultrafiltration**: Concentrating milk before coagulation to increase yiel d.
- **Automation**: Using robotic systems to improve efficiency and consist ency in large-scale production.
- **bacterial Rennet**: Developing plant-based and bacteria coagulants to address dietary and ethical concerns (Fox et al., 2017).

2.3 HEALTH BENEFITS OF PEPPER

Pepper, particularly black and green varieties, has been recognized for its numerous healt h benefits for centuries. These benefits stem from the bioactive compounds found in pe pper, such as piperine, antioxidants, vitamins, and minerals. Below are some of the key h ealth benefits of pepper:

1.

Pepper, especially black pepper, contains a variety of antioxidants, including flavonoids, carotenoids, and vitamin C. These antioxidants help neutralize harmful free radicals in th e body, reducing oxidative stress and lowering the risk of chronic diseases such as heart disease, cancer, and diabetes (Das & Bhat, 2021).

2.

The active compound in black pepper, piperine, has been shown to possess anti-inflamm atory effects. It inhibits inflammatory markers in the body, which can help reduce inflam mation associated with conditions like arthritis, asthma, and other inflammatory disorde rs (Sahu et al., 2021).

3.

Pepper is known to stimulate the secretion of digestive enzymes, which can e nhance digestion. It increases the hydrochloric acid levels in the stomach, aidi ng in the breakdown of food and absorption of nutrients. This can help reduce symptoms of indigestion, bloating, and gas (Liu et al., 2021).

4.

Piperine in black pepper has thermogenic properties, which can increase meta bolic rate. It has been shown to stimulate fat-burning processes, making it pot entially useful for weight management and fat loss (Nayak et al., 2020). This makes pepper a common ingredient in weight loss supplements.

5.

One of the most significant health benefits of pepper is its ability to enhance the bioavail ability of other nutrients. Piperine has been found to increase the absorption of essential