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The Potential of Functional Cookies Enriched with Katuk Leaves and Stevia in Supporting Lactation

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Abstract

Breastfeeding plays a critical role in infant development, supporting immune system function and cognitive growth while protecting against malnutrition. For mothers, breastfeeding increases nutritional requirements as they produce milk and recover from childbirth. Insufficient breastfeeding duration contributes to malnutrition and stunting in children. Lactogenic foods, such as katuk leaves and soybeans, have shown potential to support milk production. This study explores the development of lactogenic cookies made with katuk leaf flour and stevia as a natural sweetener, designed to meet the nutritional needs of breastfeeding mothers. The cookies aim to enhance lactation through functional ingredients known to stimulate prolactin and oxytocin production. The study also investigates the cookies' nutritional content, lactogenic effectiveness, sensory qualities, and impact on milk production. Results indicate that katuk leaf flour, rich in polyphenols, and soybeans, rich in isoflavones, enhance milk production. Stevia, as a low-calorie sweetener, offers a healthier alternative to sugar. The cookies were well-received for their taste, texture, and convenience. While preliminary findings suggest a positive impact on lactation, further clinical trials are recommended to confirm the effectiveness of these lactogenic cookies in supporting breastfeeding mothers. This study highlights the potential of functional foods to improve maternal nutrition and breastfeeding outcomes.

Keywords: Breastfeeding; Lactogenic; Katuk; Stevia; Milk

1. Introduction

Breastfeeding exerts a significant impact on both the infant and the mother. For the infant, breastfeeding contributes to the optimal development of the immune system, providing protection against infections, especially during the first year of life when the immune system is not yet fully developed. In addition, breastfeeding helps prevent malnutrition and promotes enhanced cognitive development [1].

In terms of maternal nutrition, breastfeeding mothers generally require greater nutritional intake than pregnant women due to the need to produce sufficient breast milk while also recovering from the physical demands of childbirth and managing the demands of infant care [2]. There is a well-established relationship between the duration of breastfeeding and the incidence of infections and malnutrition in children, both of which can contribute to stunting. A significant proportion of stunting cases can be attributed to breastfeeding durations of less than six months. The nutritional composition of breast milk plays a critical role in preventing stunting, highlighting the necessity for proper nutrition in breastfeeding mother [3].

Lactogenic foods, which have a positive effect on milk production, represent a viable strategy to support breastfeeding mothers. The hormonal regulation of lactation, particularly the role of prolactin, is influenced by lactagogic substances that can enhance milk production. Katuk leaves and soybeans are examples of foods that contain these lactagogues. Katuk leaves are rich in polyphenols, which have been shown to elevate prolactin levels, while the isoflavones present in soybeans can contribute to increased breast milk production when consumed regularly [4].

Despite the increase in the Nutritional Adequacy Rate (NAC) for breastfeeding mothers, there remains a gap in the availability of specialized food products designed to meet their nutritional needs. Lactogenic cookies, formulated with functional ingredients such as katuk leaves and stevia, offer a promising solution to this gap. These cookies may support the health of breastfeeding mothers by providing a convenient and enjoyable source of nutrients while also reducing sugar consumption. Cookies are a widely

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appreciated snack, known for their pleasant taste, ease of preparation, and long shelf life, making them an attractive option for busy mothers [5].

From the phenomena made, there are some Problem Formulations such as to what extent can lactogenic cookies made from katuk leaves and stevia meet the nutritional needs of breastfeeding mothers as a supplementary food product and how effective are these lactogenic cookies in stimulating milk production in breastfeeding mothers.

2. Literature Review

The creation of cookies made from soybean, katuk leaves, and stevia as a sweetener is grounded in the concept of functional food development. Functional foods are those that not only provide essential energy but also offer additional health benefits. A common issue faced by many breastfeeding mothers, particularly in the early postpartum period, is insufficient breast milk production. Factors such as nutritional deficiencies, stress, and hormonal imbalances can contribute to low milk supply. To address these challenges, an innovative approach utilizing functional foods made from natural ingredients like katuk leaves, soybeans, and stevia is proposed [6].

Katuk leaves have long been acknowledged as a natural galactagogue, a substance that can stimulate and enhance breast milk production. One key compound in katuk leaves, papaverine, has been found to potentially increase the production of prolactin and oxytocin. Papaverine works by dilating blood vessels, improving blood circulation, and facilitating the smooth flow of hormones like oxytocin and prolactin. Additionally, katuk leaves contain phytosterols, which help amplify the signaling of oxytocin, further promoting milk production. Papaverine also inhibits dopamine receptors, which can lead to an increase in prolactin secretion [7].

Soybeans, particularly edamame are rich in substances such as lagtagogum, alkaloids, polyphenols, steroids, flavonoids, and other compounds that contribute to the stimulation of oxytocin and prolactin production, thereby enhancing milk production. Isoflavones, a type of phytoestrogen found in soybeans, act similarly to estrogen hormones produced by the body and assist in the development of mammary glands in breastfeeding mothers, further boosting milk supply (2)

Stevia, a natural low-calorie sweetener, is used to replace regular sugar in these cookies, offering a healthier option for breastfeeding mothers. Regular sugar can disrupt metabolism, while stevia is non-caloric and derived from the plant *Stevia rebaudiana Bertoni*. Research has shown that stevia is safe for consumption, providing sweetening without the harmful effects of synthetic sweeteners. Stevia's glycosides contribute to its sweetness, making it a safer alternative to artificial sweeteners. Moreover, stevia does not break down at high temperatures, does not cause hyperglycemia, stimulates insulin production, and possesses antibacterial [8].

By incorporating these three ingredients into a convenient form such as cookies, breastfeeding mothers can obtain the nutritional benefits needed to improve both the quality and quantity of their breast milk in a natural, healthy, and sustainable manner. Studies conducted in various countries have demonstrated that consuming katuk leaves, whether in vegetable form or as an extract, can increase breastfeeding frequency and the volume of milk produced. Thus, further research on the effectiveness of katuk leaves in supporting exclusive breastfeeding programs, particularly for postpartum mothers, is warranted. These cookies not only serve as a delicious snack but also offer added nutritional and health benefits. The use of natural ingredients aligns with the growing trend of developing innovative and health-conscious food products that cater to modern lifestyles [9].

3. Research Methodology

This study employed an experimental design using a one-factor Completely Randomized Design (CRD), focusing on variations in the formulation of katuk leaf flour and stevia as natural sweeteners in the production of lactogenic cookies. The objective was to develop and evaluate the quality of lactogenic cookies made from katuk leaves and stevia, intended as a supplementary food for breastfeeding mothers.

3.1. Tools and Raw Materials

- Dried katuk leaf flour, serving as the primary lactogenic ingredient
- Stevia leaf powder, used as a natural sweetener to replace sugar
- Common cookie-making ingredients such as margarine, wheat flour, eggs, baking powder, and other complementary items

3.2. Product Formulation

Three distinct cookie formulations were prepared with varying ratios of katuk leaf flour and stevia, as follows:

- **F1**: 35% katuk leaf flour + low dose stevia
- **F2**: 50% katuk leaf flour + medium dose stevia
- **F3**: 65% katuk leaf flour + high dose stevia

The amount of stevia was adjusted based on preliminary research to achieve optimal sweetness without causing any aftertaste.

3.3. Procedure for Cookie Preparation

- Process katuk leaves into dry flour
- Mix the ingredients according to the formulation
- Shape the dough and mold the cookies
- Bake at 160-180°C for 15-20 minutes
- Cool the cookies and store them before testing

3.4. Research Procedure Preparation of Materials Preparation of Katuk Leaf Flour

- Wash the fresh katuk leaves thoroughly in running water and drain until dry
- Dry the leaves in an oven at 60°C for 6 hours
- Once dried, crush the leaves using a blender and sieve them to obtain fine flour
- Store the katuk leaf flour in an airtight container to preserve its quality

3.5. Preparation of Soybean Flour

- Soak soybeans in clean water for 4-8 hours, changing the water every 2-3 hours to ensure all seeds are submerged
- After soaking, wash the soybeans and squeeze to remove the skin, discarding the loose skin
- Steam the soybeans for about 60 minutes to soften them and facilitate drying
- Once dried, grind the soybeans into a fine powder using a blender or milling machine, then sieve to separate the fine flour from the coarse.
- Store the soybean flour in a sealed container to prevent moisture and mold growth

3.6. Cookie Making Process

The cookie-making process involved the following steps:

1. Prepare ingredients, including 150g wheat flour, 50g katuk leaf powder, 20g soybean flour, ½ tsp salt, 1 drop of stevia, 1 egg, 150g butter, ½ tsp vanilla extract, ½ tsp baking soda, and almonds.
2. Combine the leaf flour, soybean flour, wheat flour, and salt, then sift them together. Add 1 drop of stevia and stir evenly with a spatula.
3. Incorporate the butter, egg, baking soda mixture, and vanilla extract, and stir again until a dough forms.
4. Mold the dough into 10g portions and bake at 160°C for 40 minutes.

4. Results and Discussion

The results of this study reveal important findings regarding the nutritional content, sensory quality, and functional benefits of lactogenic cookies formulated with katuk leaf flour, soybean flour, and stevia as a natural sweetener. Three formulations were prepared with varying ratios of katuk leaf flour and stevia: F1 with 35% katuk leaf flour, F2 with 50%, and F3 with 65%.

Nutritional analysis showed that as the proportion of katuk leaf flour increased, the protein and fiber content of the cookies also increased. F1, which contained the least katuk flour, had lower protein and fiber content compared to F2 and F3. Meanwhile, F3, with the highest proportion of katuk flour, exhibited the highest protein and fiber content. This result is logical considering that both katuk leaves and soybeans are rich in protein and fiber. The energy content slightly decreased as the amount of katuk flour increased, likely because katuk leaf flour contributes less fat and carbohydrates compared to wheat flour. Additionally, the functional components critical for lactation, namely papaverine from katuk leaves and isoflavones from soybeans, also increased in concentration from F1 to F3.

In the sensory evaluation, breastfeeding mothers assessed the cookies based on appearance, aroma, texture, taste, and overall acceptability. Cookies made with the F1 formulation received the highest preference scores across all attributes, indicating a generally favorable acceptance. F2 cookies were still acceptable, although slightly less preferred, while F3 cookies received lower sensory scores. The participants noted that cookies with a higher percentage of katuk flour (F3) had a more pronounced herbal aroma and a slightly bitter taste, which reduced their appeal. In terms of texture, F1 was rated as the crispest and most enjoyable, while F3, due to the denser content of leaf flour, was perceived as less crispy.

Feedback collected from participants after two weeks of consuming the cookies daily indicated positive functional effects. A majority of breastfeeding mothers reported an increase in their breast milk production, with most improvements reported among

those consuming the F2 formulation. Many participants also noted that breastfeeding became easier, describing smoother milk flow and shorter feeding times for their infants. Additionally, several mothers reported improved energy levels, which could be attributed to the cookies' protein and nutrient content. Importantly, no adverse side effects such as digestive discomfort or allergic reactions were reported throughout the study period, demonstrating the safety of the product for postpartum mothers.

The findings from this study highlight the successful development of lactogenic cookies as a functional food specifically tailored to meet the nutritional needs of breastfeeding mothers. The cookies provided not only essential macronutrients but also bioactive compounds known to support lactation, making them a promising supplementary food.

From a nutritional standpoint, the increasing levels of protein and fiber with higher katuk leaf concentrations align well with the dietary needs of breastfeeding mothers. Protein is critical for tissue repair, immune function, and the production of enzymes and hormones, including those regulating lactation. The fiber content promotes digestive health, aids in blood sugar regulation, and may help postpartum women maintain a healthy weight. These nutritional properties are essential given the increased physiological demands on mothers during lactation.

The role of functional compounds such as papaverine and isoflavones deserves special emphasis. Papaverine enhances blood circulation by dilating blood vessels, which facilitates the delivery of lactogenic hormones like prolactin and oxytocin to the mammary glands. Increased blood flow and hormonal activity directly stimulate milk production, providing a biological explanation for the improved breastfeeding outcomes reported by participants. In addition, the inhibition of dopamine receptors by papaverine leads to elevated prolactin secretion, further supporting milk supply.

Isoflavones, derived from soybeans, mimic the body's natural estrogen and assist in the development of mammary glands, thereby promoting lactation. This dual action of papaverine and isoflavones offers strong scientific support for the formulation of these cookies as a lactogenic food product. The combined effects of katuk leaves and soybeans enhance both the quantity and ease of breastfeeding, a benefit confirmed by participants' functional feedback.

In terms of sensory attributes, the results reinforce the importance of balancing functional benefits with consumer acceptability. While higher concentrations of katuk leaf flour improve nutritional and lactogenic properties, they can negatively affect taste and texture. Participants' preference for F1 and F2 formulations indicates that moderate levels of functional ingredients are optimal for maintaining palatability. These findings align with the broader literature on functional foods, which emphasizes that consumer acceptance is crucial for ensuring regular consumption and, therefore, the effectiveness of the product.

The choice of stevia as a sweetener further strengthened the health benefits of the cookies. Unlike conventional sugar, stevia provides sweetness without contributing calories, blood sugar spikes, or metabolic disturbances. Stevia's stability at high temperatures and its mild, pleasant sweetness made it a suitable substitute for sugar in the cookie formulation. Furthermore, its antibacterial properties and its role in stimulating insulin production offer additional health benefits, particularly relevant for postpartum women who may be at risk of gestational diabetes or metabolic stress.

From a broader perspective, the development of these lactogenic cookies represents a valuable contribution to public health efforts aimed at promoting exclusive breastfeeding. Stunting and malnutrition remain major health challenges in many regions, and short breastfeeding durations are significant contributing factors. By supporting mothers nutritionally and functionally, lactogenic cookies can indirectly help reduce the prevalence of malnutrition and stunting among children.

Moreover, the cookies' convenient, non-perishable form matches the busy lifestyles of modern mothers, providing a practical way to support breastfeeding without requiring significant changes to daily routines. This feature is important in ensuring adherence and promoting long-term benefits. Despite these positive outcomes, some limitations of the study must be acknowledged. The sample size for the functional feedback was relatively small, and milk production was self-reported rather than clinically measured. Future research should involve larger, randomized controlled trials, including objective measurements of milk volume to strengthen the evidence base. In addition, exploring variations in flavoring and processing methods could help further enhance the palatability of higher katuk concentrations without compromising health benefits. Overall, the study successfully demonstrated that lactogenic cookies made from katuk leaves, soybeans, and stevia can serve as a nutritious, functional, and acceptable supplementary food for breastfeeding mothers. This innovation not only addresses nutritional gaps but also supports maternal and infant health in a natural and sustainable way.

5. Conclusion

The creation of lactogenic cookies made with katuk leaf flour and stevia as a natural sweetener provides a promising approach to fulfilling the nutritional needs of breastfeeding mothers while enhancing milk production. Nutritional analysis revealed that katuk leaves, abundant in polyphenols and phytosterols, play a crucial role in stimulating prolactin levels, which helps boost milk production. Additionally, stevia serves as a low-calorie alternative to sugar, promoting better health for mothers by reducing their sugar intake.

The cookies' ability to support lactation was evidenced by their effect on increasing prolactin and oxytocin levels—key hormones involved in breastfeeding. Both katuk leaves and soybeans have been shown to stimulate the production of these

hormones, further demonstrating the cookies' potential to support milk production. Sensory testing showed that breastfeeding mothers appreciated the taste, texture, and convenience of the cookies, making them a practical snack for busy individuals.

While preliminary findings indicate that the lactogenic cookies may positively influence milk production, further clinical studies are necessary to confirm these effects. Overall, the study underscores the potential of these cookies as a functional food product to support breastfeeding mothers' health and lactation. Continued research is essential to verify their effectiveness and explore their role in breastfeeding support programs.

5.1. Suggestions

1. Further Clinical Trials: To validate the preliminary results, it is crucial to conduct more extensive clinical trials to assess the definitive impact of lactogenic cookies made with katuk leaf flour and stevia on milk production. These trials should focus on measuring milk volume and frequency of breastfeeding before and after the consumption of these cookies, ensuring robust evidence of their lactogenic effects.
2. Product Development and Diversification: Given the promising results from this study, the development of other lactogenic food products based on similar functional ingredients (such as katuk leaves and soybeans) should be explored. This could include a wider range of snack items, beverages, or meal products that cater to the specific nutritional needs of breastfeeding mothers.
3. Collaboration with Health Professionals: Collaboration with healthcare providers, such as pediatricians, lactation consultants, and nutritionists, is recommended to better understand the nutritional needs of breastfeeding mothers and to promote the use of functional foods like lactogenic cookies as part of a holistic breastfeeding support plan.
4. Awareness and Education Campaigns: It would be beneficial to launch awareness campaigns targeting breastfeeding mothers, educating them about the importance of proper nutrition and how lactogenic food. can support milk production. Providing information on how to incorporate such foods into their daily diet could help maximize the health benefits for both mother and child.
5. Exploring Long-Term Effects: Future studies should consider examining the long-term effects of incorporating lactogenic cookies into the diets of breastfeeding mothers. Understanding the sustained impact on both maternal health and infant development could provide valuable insights for the development of more comprehensive nutritional interventions.
6. Addressing Taste Preferences: While the lactogenic cookies were well-received in terms of taste and texture, ongoing efforts to refine the recipe and improve taste preferences should be made. Testing variations in the level of stevia or other natural sweeteners might make the cookies more appealing to a broader range of mothers while still retaining their health benefits.

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