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Development of Nutrient–Enriched Cookies Using Watermelon Seed Powder

S. Mohanapriya*, S. Angeline Esther Preethi, and P. Mahima

Department of Foods and Nutrition, RVS College of Arts and Science, Sulur, Coimbatore-641402, Tamil Nadu, India; mohanapriya@rvsgroup.com

Abstract

Cookies are a widely consumed snack that serves as an appropriate way to introduce essential nutrients to people of all ages. Seed powders are a valuable source of phytochemicals and nutrients that are often overlooked. Watermelon seeds are packed with protein, B vitamins, minerals like magnesium, potassium, and phosphorus, as well as phytochemicals. **Aim:** To develop nutrient-enriched cookies using watermelon seed powder. **Materials and Method:** To create a nutritious snack, the ingredients were carefully found, sun-dried for 4-6 days, powdered, and stored in an airtight container. Different proportions of the watermelon seed powder (10%, 20%, 30%, 40%) were added to the cookie mix separately. Through sensory evaluation using a 5-point hedonic scale, it was determined that cookies with 20% seed powder incorporation were well accepted by the panelists. **Results:** The nutrient analysis revealed that cookies with watermelon seed powder were high in carbohydrates and protein. Shelf-life testing, using sensory attributes and total microbial load testing, showed that the cookies remained fresh when stored in plastic airtight containers for 15 days. Despite a slightly higher cost, a popularization study among 30 adult participants indicated that the cookies were well-received and highly acceptable.

Keywords: Antioxidants, Cookies, Nutrients, Phytochemicals, Seeds, Watermelon Seeds

1. Introduction

Cookies are commonly consumed as snacks and are popular across all age groups. These baked products typically consist of three primary ingredients: flour, sugar, and fat. Due to their consistent quality and widespread acceptance, bakery products hold a significant position in the food industry and offer a promising platform for nutritional enhancement[1]. India has one of the largest biscuit industries globally, ranking second in terms of production[2]. Cookies are appreciated for their convenience, affordability, and ready-to-eat nature. In recent years, there has been growing interest in incorporating unconventional ingredients to improve the nutritional value of common foods. One such ingredient is watermelon seed powder, a byproduct of fruit processing, known for its high content of protein, healthy fats, and essential micronutrients[3]. This nutrient-dense ingredient also contains phytochemicals and antioxidants. Its potential health benefits include supporting heart health, boosting immunity, strengthening bones, improving metabolism, enhancing skin and hair quality, preventing osteoporosis, aiding wound healing, and reducing inflammation[4]. Watermelon seeds are also a good source of carbohydrates, proteins, dietary fiber, vitamins, and minerals. Cookies are often enjoyed with beverages and, in some cases, serve as weaning foods for infants. Freshly baked varieties are commonly available at bakeries and cafes.

2. Materials and Methods

2.1 Selection and Preparation of Watermelon Seed Powder

Watermelon seeds (*Citrullus lanatus*) were procured from the local market. The seeds were thoroughly cleaned to remove any impurities and sun-dried for 4–6 days to ensure adequate moisture removal, following standard seed processing methods described[5]. After drying, the seeds were ground into a fine powder using a commercial grinder. The powder was stored in clean polyethylene bags at room temperature until further use[6].

*Author for correspondence

2.2 Formulation of Cookies

Watermelon Seed Powder (WSP) was incorporated into the cookie dough at four substitution levels: 10%, 20%, 30%, and 40% (Table 1 and plate 1). The control batch (standard formulation) was prepared using 100% wheat flour. The ingredients for all formulations included wheat flour, sugar, butter, and baking powder. The cookie formulation process was substituting WSP for wheat flour to enhance the nutritional content of the product[7].

2.3 Sensory Evaluation

Sensory evaluation was conducted using a 5-point hedonic scale to assess five attributes: appearance, color, flavor, texture, and taste. The panel consisted of 30 final-year postgraduate students from the Department of Food Science and Nutrition, RVS College of Arts and Science, Sulur, Coimbatore. Each participant rated the cookie samples, and the results were statistically analyzed using mean and standard deviation[8].

2.4 Nutrient Analysis

The standard and the best-accepted sample (based on sensory evaluation) were selected for nutrient analysis. Carbohydrate content was estimated using Benedict's test, and protein content was analyzed using Lowry's method[9].

Table 1. Levels of incorporation

Product	Wheat flour (g)	Watermelon seed powder (g)
Standard	100	-
A	90	10
B	80	20
C	70	30
D	60	40

2.5 Shelf-Life Analysis

Shelf-life analysis was performed by storing the control and the best-performing sample in airtight containers under ambient conditions. Physical and microbial characteristics were evaluated on the 1st, 7th, and 15th days. Microbial load was assessed on the 1st and 15th days using the total plate count method[10].

2.6 Cost Analysis

A cost analysis was conducted to assess the economic feasibility of incorporating watermelon seed powder in cookie production. The total cost included raw material prices, labor, electricity, and packaging.

2.7 Popularization of the Product

The best-accepted cookie formulation, containing 20% watermelon seed powder, was introduced to a sample group of 30 adult men and women. Feedback was collected to evaluate consumer preferences and gauge market potential.

3. Results and Discussion

3.1 Comparison of Mean Sensory Score for Standard and Watermelon Seed Powder Incorporated Cookies

Sensory evaluation is a scientific discipline used to evoke, measure, analyze, and interpret the characteristics of foods and materials as they are perceived by the senses of smell, taste, touch, and hearing. The sensory attributes of standard cookies and cookies incorporating watermelon seed powder were seen using a 5-point hedonic scale (Table 2). After conducting the sensory analysis, the scores given by the panel members were consolidated, and the mean scores of the samples were compared with



Figure 1. Plate 1 – watermelon seed powder incorporated cookies in different variation.

the standard. The results of the sensory analysis showed that the cookies with 20% incorporation of watermelon seed powder received the highest scores compared to the standard cookies. It was observed that cookies with 20% watermelon seed powder incorporation were preferred over the standard cookies, highlighting the potential for watermelon seed powder as a valuable ingredient in cookie formulation.

3.2 Nutrient Analysis

Nutritional Analysis evaluates the nutritional content of foods through certified methods. A comparison between Watermelon Seed Powder Cookies and Standard cookies reveals significant differences (Table 3). Watermelon Seed Powder Cookies have a lower carbohydrate content (54.5 g/100g) compared to standard cookies (62.8 g/100g), a reduction of approximately 13.2%. Additionally, they have a higher protein content (16.8 g/100g) versus 10.5 g/100g in standard cookies, an increase of about 60%. This makes them a healthier option for those seeking to boost protein intake and reduce carbohydrate consumption, benefiting health-conscious consumers, athletes, and individuals on low-carb or high-protein diets. Recipe developers might need to adjust other ingredients to maintain flavor and texture. Marketing could emphasize the nutritional benefits by labeling the cookies as "High-Protein" or "Low-Carb" to attract a broader audience looking for healthier snacks.

3.3 Microbial Analysis

Microbial analysis is a vital component of shelf-life assessment, focusing on the detection and quantification of microorganisms that can affect the safety and quality of food products. This analysis is essential for determining the shelf life of packaged food products, such as cookies, by monitoring the total microbial load over time. In the shelf life studies for standard cookies and those incorporating Watermelon seed powder, microbial analysis involves sampling the cookies at specific intervals, typically on the 1st, 7th, and 15th days after packaging (Table 4). The results showed that the microbial load was within the permissible levels.

Table 2. Mean sensory score for the standard and selected product

S. No.	Criteria	Score	Standard product	Selected product
1	Appearance	5	4.8±1.41	4.9±1.43
2	Color	5	4.9±0.48	4.9±1.44
3	Texture	5	4.8±1.43	4.8±0.47
4	Flavor	5	4.8±1.43	4.8±2.49
5	Taste	5	4.9±0.44	4.8±0.49

3.4 Shelf-Life Analysis

Shelf-life analysis is crucial for determining the duration during which a commodity can be stored without losing its suitability for use, consumption, or sale. It assesses this period for any packaged food product, ensuring that the food retains acceptable quality from both safety and sensory perspectives. The shelf life of food hinges on four main factors: formulation, processing, packaging, and storage conditions[11] In a shelf-life analysis of standard cookies and those with watermelon seed powder, the cookies were packed in airtight plastic containers and stored under controlled conditions. They were evaluated on the 1st, 7th, and 15th days for sensory attributes

Table 3. Nutrient analysis of the standard and selected product

S. No.	Nutrient	Standard cookies	Sample cookies (B)
1	Energy (kcal)	515.18	5.18.62
2	Carbohydrate (g)	62.8	54.5
3	Protein(g)	10.5	16.8
4	Fat(g)	28.2	29
5	Moisture (g)	2.10	4.99

Table 4. Microbial load of the standard and selected product on storage

Days	Variations	Total plate count /cfu /gram
DAY 1	Standard	< 10 CFU/G
	Sample B	< 10 CFU/G
DAY 2	Standard	< 10 CFU/G
	Sample B	< 10 CFU/G
DAY 3 Microbial load	Standard	< 10 CFU/G
	Sample B	< 10 CFU/G
	On the 14th day after sampling no contamination was found	
	No bacterial growth was observed	

and total microbial load. This process helps understand how different formulations, seed powder inclusion, and specific storage conditions affect the cookies' shelf life and overall quality.

3.5 Cost Calculation

The cost of the 100g watermelon seed powder cookies was Rs.137, whereas the standard cost Rs. 124. Incorporation of watermelon seed powder cookies increased the cost by Rs.13. Though the formulated watermelon seed powder incorporated products cost slightly higher than the standard product, the rich nutrients in the WSP might benefit the target population.

3.6 Popularization of the Selected Product

The watermelon seed powder incorporated into cookies was popularized among 30 adults. The questionnaire consisted of various questions designed to gather information on their preferences and knowledge about the benefits of these ingredients. According to the collected data, 22 out of 30 adults expressed a liking for cookies. Additionally, 21 adults were aware of the benefits of watermelon seed powder, which includes being rich in protein, magnesium, and healthy fats, and providing antioxidants that support immune health and skin vitality. Furthermore, 21 adults acknowledged the role of protein in overall health and muscle maintenance. Lastly, 23 out of the 30 participants recognized the health benefits of dietary fiber, such as improved digestion and reduced risk of chronic diseases. This data suggests a high level of awareness and positive reception among the adults regarding the nutritional advantages of the seed powders incorporated into the cookies.

4. Conclusion

The study shows that cookies with 20% watermelon seed powder were well- received and comparable to standard cookies. The nutrient content of the selected cookies was higher than the standard cookies. The cost of the sample was slightly higher than the standard cookies. The popularization study showed that majority of them liked the cookies and were ready to buy it. These watermelon seeds enhance the nutritional profile of various foods and can be used in baking as roasted snacks, and as ingredients in granola bars, in smoothies, and as salad toppings, making them a versatile and healthful to many diets. The utilization of the fruit seeds can be improved, and the wastages will be reduced.

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