



Development and Optimization of Pumpkin Pomace Enhanced Savory Crackers

Y. Noor E Nazneen

nazneenyellannur@gmail.com

Jawaharlal Nehru Technological
University, Oil Technological and
Pharmaceutical Research Institute,
Anantapur, Andhra Pradesh

Dr. A. Swaroopa Rani

bioswar2@gmail.com

Jawaharlal Nehru Technological
University, Oil Technological and
Pharmaceutical Research Institute,
Anantapur, Andhra Pradesh

G. Vikram Goud

vikramgoud.goud@gmail.com

Akshaya Patra Foundation,
Telangana

ABSTRACT

The development of functional food products using agro-industrial by-products such as pumpkin pomace is a sustainable and nutritious approach. This study focuses on the formulation of fiber-rich savory crackers enhanced with wet pumpkin pomace, blended with wheat flour and carom seeds. Pumpkin pomace, rich in dietary fiber and β -carotene, was incorporated to improve the nutritional profile without compromising sensory quality. The optimized formulation was evaluated for its physical, textural, and nutritional properties, including moisture, fat, ash, pH, protein, and fiber. Results indicated a significant enhancement in dietary fiber and protein, with acceptable sensory scores. This study supports the use of fruit and vegetable residues in mainstream food formulations to promote health, reduce food waste, and improve sustainability.

Keywords: Pumpkin Pomace, Savory Crackers, Dietary Fiber, Sustainable Snacks, Functional Foods.

INTRODUCTION

Pumpkin pomace-based savory crackers offer an innovative approach to creating healthy snacks that combine nutrition, sustainability, and sensory satisfaction. While crackers have long been enjoyed for their crunchiness and convenience, modern consumers increasingly seek snacks that provide health benefits and taste. Incorporating pumpkin pomace into crackers serves this double purpose by enhancing their nutritional value and supporting sustainable food production.

Pumpkin pomace, the residual pulp following juice or puree extraction, is often discarded, although it is rich in nutrients. The by-product is rich in dietary fiber, beta-carotene, and micronutrients. Its fibrous nature aids digestion and induces a sense of satiety, and the natural antioxidants present in it ensure cellular health. Through the inclusion of pumpkin pomace as a functional ingredient, the cracker's nutritional value is improved, and waste is reduced—hence it is a sustainable choice that is in line with prevailing health and environmental trends.

Refined wheat flour is the main ingredient of the product, giving it structure and contributing to the traditional texture of traditional crackers. Yet by incorporating pumpkin pomace, the product is enhanced aesthetically and sensorially in color, flavor, and texture. Its slightly sweet, earthy taste goes well with the light bitterness of whole spices such as carom seeds and turmeric. Carom seeds are highly prized for their digestive benefits and carry essential oils that provide antimicrobial and antioxidant

properties. Turmeric, being rich in curcumin, contributes health benefits and aesthetic appeal in the form of its vibrant golden color.

Butter is added to provide mouth feel, richness, and better sensory properties to the final product. Although butter is fatty, its use in small quantities contributes well to the eating experience and energy value of the final product. Salt is used to balance

the taste, while baking powder assists in achieving a crispy and light texture, which enhances the end product without requiring deep frying.

Together, the ingredients form a product that not only tastes and feels wonderful but also addresses the growing need for clean-label and healthy snacks. The use of a by-product such as pumpkin pomace addresses the sustainability and circular economy in food manufacturing. In addition, the use of natural spices and moderate fat renders the crackers suitable for a wide range of consumers, including children, adults, and elderly consumers looking for healthier snack options.

Overall, pumpkin pomace-enriched savory crackers represent a functional, flavorful, and sustainable innovation in snack foods. Their development marks a conscious shift towards harnessing underutilized food resources to produce value-added foodstuffs that meet contemporary nutritional demands without compromising taste or heritage.

MATERIALS AND METHODS

Raw Materials: pumpkin pomace, Whole wheat flour, Butter, Turmeric powder, Salt, Baking powder, Carom seeds

METHOD

Preparation of Pumpkin Pomace:

Fresh, mature pumpkins (*Cucurbita moschata*) were selected and thoroughly washed under running water to remove any dirt or surface contaminants. The pumpkins were then peeled manually, and the seeds were removed to isolate the edible pulp. The cleaned pulp was chopped into small pieces and pulped using a food processor or kitchen blender to obtain a coarse, moist paste. Care was taken not to add water during blending in order to retain the natural moisture content of the pumpkin. The resulting pulp, rich in fiber and nutrients, was referred to as wet pumpkin pomace. This pomace was collected and used immediately in the formulation of savory crackers to preserve its freshness and functional qualities.



Figure 1: Pumpkin Pomace

PROCEDURE

After selecting and weighing all required raw materials such as wheat flour, pumpkin pomace, carom seeds, salt, butter, and water, the preparation process begins by creaming the butter. The butter is whisked until it becomes light and fluffy, forming a smooth, creamy texture. Once creamed, the dry ingredients including wheat flour, salt, carom seeds, and the prepared pumpkin pomace are gradually added to the butter. These ingredients are mixed thoroughly to form a uniform dough. Water is then added slowly, only as needed to bind the mixture. The dough is gently kneaded by hand for a few minutes until it becomes soft, smooth, and pliable. After kneading, the dough is covered and allowed to rest for 10–15 minutes at room temperature to relax the gluten and improve dough handling. Once rested, the dough is rolled out evenly using a rolling pin to the desired thickness and then cut into uniform shapes using a knife or mold. The shaped crackers are transferred onto a baking tray and baked at 160–180°C for 10–15 minutes until they turn crisp and golden brown. After baking, the crackers are allowed to cool completely at room temperature on a wire rack to prevent moisture buildup. Finally, the cooled crackers are packed in airtight containers or suitable packaging materials to maintain freshness and extend shelf life.



Figure 2: Pumpkin Pomace Savoury Crackers

Physico-Chemical Analysis Procedures

Moisture Content: Determined using a digital moisture analyser set at 105°C until a constant weight was reached, following AOAC standard procedure.

Fat Content: Analysed using a Soxhlet extraction apparatus with petroleum ether solvent, according to the AOAC method.

Ash Content: Measured by incinerating the sample in a muffle furnace at 550°C until white ash was obtained.

Protein Content: Estimated using the Kjeldahl method with a nitrogen conversion factor of 6.25.

Fiber Content: Determined via acid and alkali digestion followed by incineration in a muffle furnace, as per the AOAC method.

pH: Measured by preparing a 10% slurry in distilled water and using a calibrated digital pH meter.

Carbohydrates: Calculated by difference: $100 - (\text{Moisture} + \text{Fat} + \text{Protein} + \text{Ash} + \text{Fiber})$.

TABLE-1: Sample Formulations Tested for Pumpkin Pomace Cracker

INGREDIENTS	VARIATION-1	VARIATION-2	VARIATION-3
Wheat flour	60g	50g	55g
Pumpkin pomace	20g	30g	25g
Butter	15g	10g	15g
Turmeric powder	1g	1.5g	2.5g
Salt	1.5g	1.5g	1.5g
Baking powder	0.5g	0.5g	0.5g
Carom seeds	2g	2g	2g

RESULTS AND DISCUSSION

Moisture Content

The optimized sample exhibited a low moisture content (1.85%), which is desirable for improving the shelf life and crispness of crackers. Moisture content affects microbial stability and overall textural properties. According to Bhat and Bhat (2020), moisture reduction contributes to longer shelf stability in baked goods. Pumpkin pomace, despite being a wet ingredient, was managed effectively through appropriate drying and baking conditions.

Fat Content

The fat content of 10.08% is considered moderate and beneficial for flavor and texture development. It aligns with findings by Sharma R, (2021), who demonstrated that fiber-based formulations retained acceptable fat levels without compromising sensory quality. The fat used (butter) likely enhanced palatability while maintaining a balanced nutritional profile.

Table-2: Physico Chemical Analysis

S.NO	PARAMETERS	OPTIMIZED VARIATION
1	Moisture%	1.85
2	Fat%	10.08
3	Ash	2.04
4	pH	6.29
5	Fiber%	2.04
6	Protein%	7.76
7	Carbohydrate%	67.10

Ash Content

Ash content (2.04%) reflects the mineral content of the final product. A higher ash value indicates the presence of essential minerals such as calcium, magnesium, and potassium from pumpkin pomace. Kumar V, (2020) also observed that the addition of vegetable pomace significantly improved the ash content in bakery products.

pH Value

The pH of 6.29 shows a mildly acidic nature of the crackers, which helps improve microbial safety without affecting taste. According to Bhat and Bhat (2020), the incorporation of fruit or vegetable pomace tends to slightly lower pH, contributing to shelf-life extension.

Crude Fiber Content

A significant increase in fiber (6.65%) was achieved through the inclusion of pumpkin pomace, making the crackers a healthier snack alternative. As reported by Vinod V, (2010), dietary fiber improves gastrointestinal health, regulates blood sugar, and enhances satiety. Similarly, Kumari and Grewal (2007) found that adding fiber-rich ingredients notably boosts the functional value of snacks.

Protein Content

Protein content was 8.70%, indicating improved nutritional density compared to conventional crackers. This could be attributed to the contribution of wheat flour and residual proteins in pumpkin pomace. Sharma S, (2018) reported similar protein enhancement in cereal-pomace formulations. Higher protein intake is crucial for muscle repair, immune response, and energy metabolism.

Carbohydrate Content

The carbohydrate content was 67.10%, which is slightly reduced compared to regular crackers due to the dilution effect of fiber and protein enrichment. As described by Thakur M, (2019), incorporating fiber-rich material reduces the available carbohydrate portion, which may contribute to a lower glycemic response.

Sensory Evaluation

The high sensory scores indicate good consumer acceptability. The color was enhanced by the natural orange hue of pumpkin pomace and turmeric, providing visual appeal. The aroma and taste were pleasant, characterized by the sweetness of pumpkin and the spicy notes from carom seeds. The texture was crispy and light, which aligns with the desired attributes of savory crackers. Yadav DN, (2020) also emphasized that incorporating vegetable pomace at optimal levels can improve product appeal while maintaining favorable sensory attributes. In this study, optimized levels ensured a balance between health benefits and sensory quality.

CONCLUSION

The present study demonstrates that wet pumpkin pomace, a fiber-rich agro-industrial by-product, can be effectively utilized in the formulation of savory crackers. The developed product exhibited enhanced nutritional quality, particularly in terms of dietary fiber and protein content, without compromising the physical or sensory attributes of the final product. The crackers also showed favorable moisture levels and stability, making them suitable for longer shelf life. The successful incorporation of pumpkin pomace highlights its potential as a sustainable, cost-effective ingredient in functional food development. This approach not only supports nutritional improvement but also promotes food waste reduction and environmental sustainability.

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