

HARMONY IN PROGRESS:

**INTEGRATING SCIENCE, TECHNOLOGY,
AND
SOCIAL INNOVATION
FOR SUSTAINABLE DEVELOPMENT GOALS**



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YST006 - ORANGE PEEL CEREAL BARS

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ABSTRACT

This project introduces a cereal bar enriched with 6% orange peel powder, designed to enhance nutritional value while contributing to sustainable food innovation. Fruit peels, particularly from citrus fruits, are often discarded despite containing fibre, vitamin C, and bioactive compounds. By incorporating orange peel powder into a cereal bar, this innovation provides a solution for food waste valorisation and functional snacking. The 6% orange peel powder cereal bar was formulated using rolled oats, chia seeds, peanut butter, and honey, without synthetic additives. The bar was evaluated through physicochemical, nutritional, and sensory analyses. The product showed improved chewiness and vitamin C content compared to the control formulation. Sensory evaluations revealed that the 6% formulation had an acceptable level of bitterness while maintaining desirable taste and texture. This product is practical for busy, health-conscious consumers and offers a new use for underutilised fruit by-products. The innovation demonstrates a feasible method to reduce food waste while introducing a nutritious, appealing cereal bar to the functional food market. The successful incorporation of orange peel into cereal bars presents a novel approach in food innovation and functional product development in Malaysia.

Keywords – orange peel powder, cereal bar, functional food, food innovation, sustainability

INTRODUCTION

The loss of valuable nutrients from the disposal of fruit peels is distinguished as waste contributing to environmental pollution (Faulisi et al., 2024) that could be harnessed for functional food development. Despite their rich content of fibre, antioxidants, and bioactive compounds, fruit peels are usually used in the cosmetic industry (Ali et al., 2022) and remain underutilised in food applications. Furthermore, the disposal of fruit peels leads to missed opportunities for sustainable and nutritional enhancement, and at the same time, it leads to more reliance on synthetic ingredients and a lack of environmentally friendly practices (Faulisi et al., 2024). Currently, research on the incorporation of orange peel into cereal bar formulations remains limited. Cereal bars have appeal to a wide range of consumers, with major sectors including athletes, health-conscious people, and teenagers (Gill & Ashish, 2019). Tailoring cereal bars to fit the demands of groups of consumers is crucial for commercial success. For example, high-protein cereal bars are particularly tempting to gym-goers looking for muscle recovery and performance development, whereas fibre-rich or low-calorie products are the most suited for those who are looking to

maintain a healthy lifestyle (Gill & Ashish, 2019). With that, understanding the specific needs of these groups allows producers to design food products that resonate with their target audience, improving the market appeal (Verma et al., 2022).

OBJECTIVE

- i. To develop cereal bars formulated with orange peels.
- ii. To determine the nutritional composition and consumer acceptability of cereal bars formulated with orange peels.

DESCRIPTION OF THE PROJECT

Orange peels were obtained from local sources, ensuring that they were fresh and devoid of evident flaws or contamination. The peels were properly cleaned with running water to eliminate dirt, pesticides, and other contaminants. Blanching the peels in hot water at 90°C for 5 minutes (Sankalpa et al., 2017) reduced microbial burden and deactivated enzymes. The samples were dried in a dehydrator at 60°C (Özcan et al., 2020) until a consistent weight was obtained (M'hiri et al., 2015). The dried peels were crushed to a fine powder and sieved through a 0.425 mm mesh. The orange peel powder was kept in sealed containers. The 6% OPP cereal bar was prepared using 35% rolled oats, 25% honey, 25% peanut butter, 9% chia seeds, and 6% orange peel powder. Dry and wet ingredients were mixed separately, then combined and baked at 120°C for 20 minutes (Kaur et al., 2018). After cooling, the bar was cut and stored in airtight containers.



Figure 1: Cereal bar formulated with 6% orange peel powder.

To evaluate the effect of orange peel powder incorporation, the nutritional composition and sensory characteristics of the cereal bar were assessed. The nutritional analysis showed that the formulated 100 g cereal bar contained 10.58% protein, 16.25% fat, 2.07% ash, 63.84% total carbohydrate, 443.9 kcal total energy, and 4.38 mg vitamin C. Sensory evaluation was conducted using a 9-point hedonic scale involving untrained panellists who rated attributes such as colour, aroma, taste, texture, chewiness, and overall acceptability. The results indicated that the cereal bar received a mean overall acceptability score of 7 (like moderately), with the highest scores of 6 (like slightly) and 7 (like moderately) reported for attributes colour, aroma, chewiness, firmness, and sweetness, while the aftertaste was rated at 6 (like slightly) on the scale.

NOVELTY

This innovation introduces a novel and sustainable approach by incorporating orange peel, a commonly discarded by-product, into cereal bars, converting waste into a functional food ingredient. While orange peel has been widely used in cosmetics, its use in food products, particularly cereal bars, remains scarce. To the best of current knowledge, no commercial cereal bar in Malaysia has utilised orange peel powder. The 6% concentration was selected to balance nutritional benefits with sensory acceptability, offering higher vitamin C and fibre-related functionality without overwhelming bitterness. This innovation contributes to sustainability, zero-waste food processing, and aligns with the global movement towards clean-label, eco-conscious consumer products.

CONCLUSION

This study successfully achieved all objectives by formulating cereal bars with orange peel powder and evaluating their nutritional composition and consumer acceptability. The addition of orange peel powder notably affected product characteristics. The 6% orange peel powder cereal bar successfully demonstrated functional and nutritional enhancement without compromising sensory quality. The formulation delivered improved chewiness and vitamin C content while maintaining consumer acceptability. Its development highlights the potential of upcycling fruit waste into health-oriented food products. This innovation offers a practical and market-ready solution for health-conscious consumers and represents a scalable step toward sustainable food product development in Malaysia. Therefore, incorporating orange peel powder into cereal bars offers a promising strategy for valorising fruit by-products.

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