



Fostering the Transition to Sustainable Food Systems:
Embracing Novelty and Overcoming Challenges

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ABSTRACT BOOK

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Advancing Circular Nutrition: The Development of a Freeze-dried Snack based on Broccoli Stalk Powder

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Aim:

The upcycling of agri-food by-products presents a sustainable strategy for reducing waste and creating value-added products. This study aimed to develop a freeze-dried snack incorporating broccoli stalks, an often discarded by-product, and to characterise its nutritional composition, microbiological quality, physicochemical properties and bioactive potential.

Method:

Broccoli stalks were freeze-dried, milled into a powder, and incorporated into a snack formulation that was subsequently lyophilised. Nutritional profile (moisture, total protein, total fats, ash, total carbohydrates and dietary fibre) was determined using AOAC methods. Microbiological quality was assessed by enumerating mesophiles in Plate Count Agar, yeasts and molds in Potato Dextrose Agar, and enterobacteria in Violet Red Bile Glucose Agar. Physicochemical properties (pH, water activity, texture and colour) were analysed over 4-months of storage. Bioactive potential was evaluated by quantifying total phenolic content (using Folin–Ciocalteu method) and measuring antioxidant activity (via ABTS assay) and antidiabetic activity (through α -glucosidase inhibition assay).

Results:

The developed snack demonstrated high dietary fibre content (33.73 g/100 g) and substantially high protein levels (24.30 g/100 g). Microbial loads remained below 10^4 CFU/g, indicating adequate microbiological safety. Over four months of storage, a gradual decrease in pH was observed (from 6.39 to 5.90), accompanied by an increase in water activity (from 0.21 to 0.32). Texture analysis indicated an increase in both hardness (from 11.33 kg to 14.72 kg) and crispiness (from 43.75 kg·s to 45.54 kg·s), measured by texturometer (Texture Profile Analysis). Despite the slight increase in water activity, the product became firmer and crunchier over time. The reported colour variations (0 vs. 4 months) — ΔE of 15.20 on the exterior and 14.42 on the interior — were not sufficient to significantly affect the product's visual appeal. Furthermore, the snack exhibited notable total phenolic content (2.121 mg gallic acid equivalents/g), along with substantial antioxidant (6.088 μ mol Trolox equivalents/g) and antidiabetic activity (73.95% α -glucosidase inhibition).

Conclusion:

The lyophilised snack developed from broccoli stalks demonstrated a favourable nutritional profile, with adequate microbiological quality and promising antioxidant and antidiabetic properties. These findings support the incorporation of vegetable by-products in the formulation of sustainable, functional foods aligned with circular economy principles.