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Waste to Worth: Characterization of Apple Pomace Powder and Its Incorporation into a Sustainable Snack

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Aim:

This study aimed to develop a snack using apple pomace powder, with a focus on its nutritional composition, physicochemical properties, and bioactive potential, as a sustainable strategy for reducing waste in the food industry and concomitantly add value to food.

Method:

Apple pomace was dried, milled and analysed for its proximate composition (moisture, total protein, total fat, ash, total carbohydrates and dietary fibre) using AOAC methods. Its bioactive potential was evaluated through total phenolic content (Folin-Ciocalteu method), antioxidant capacity (ABTS assay), antidiabetic properties (α -glucosidase inhibition assay), and prebiotic activity (modulation of growth - colony-forming units (CFU) and acidification (pH) by *Lactobacillus* cultures). Apple pomace powder was incorporated into a novel food product (apple sticks) formulated with apple sauce, honey, egg, and baking powder. This novel product was analysed for physicochemical parameters (water activity, texture, and colour) and bioactive potential as described above.

Results:

Apple pomace powder displayed low fat (1.1 g/100 g), high sugar (48.8 g/100 g), and high dietary fibre (32.3g/100 g) contents, being a valuable source of minerals (potassium, calcium, and magnesium). Its moisture content was consistently maintained at 8.6 g/100 g, ensuring optimal shelf-life. Furthermore, this powder showed promising biological activities in terms of total phenolic content (1.491 mg GAE/g), antioxidant (7.58 μ mol TE/g), and antidiabetic (72.47% of α -glucosidase enzyme inhibition) properties. Additionally, it supported *Lactobacillus* growth ($>10^8$ CFU/mL) at 2% and 6% concentrations, suggesting its prebiotic potential. The developed apple sticks demonstrated enhanced bioactivities with a twofold increase in total phenolic content (2.954 mg GAE/g) and antioxidant (15.58 μ mol TE/g) activity, likely due to synergistic effects with apple sauce. Colour analysis revealed warm, red-yellow tones. Water activity value was above the designated threshold (threshold value: aw < 0.85), indicating potential microbiological safety. Product's texture was chewy and lacks crunchiness due to the intrinsic moisture of the ingredients, particularly the apple.

Conclusion:

Apple pomace powder is a nutritious, sustainable, and versatile ingredient for developing functional foods. Indeed, its incorporation into snack formulation such as apple sticks, enhances bioactive value while exemplifying an effective approach to upcycling agro-industrial residues into value-added products.