Turning agri-food by-products into functional ingredients: sustainable innovations for waste reduction

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Background: The food industry generates significant by-products, contributing to environmental challenges and resource inefficiencies. In response, there is growing interest in valorising these by-products, recognising their potential as sources of valuable compounds with economic and nutritional benefits [(1)]. Among these, brewer's spent yeast (BSY) and okara are promising residues rich in proteins, fibres, and other bioactive compounds [(2, 3)]. These by-products align with sustainability and circular economy principles, making them ideal candidates for transformation into high-value food ingredients.
Methods: This study focused on valorising BSY and okara by-products through integrated processing to obtain alternative protein-rich ingredients. Pre-treatment methods such as drying, milling, and thermal hydrolysis were employed to optimise the extraction of nutrients and bioactive compounds to enhance the functional properties of the resulting ingredients. The extracted ingredients were comprehensively characterised for their protein content, fibre composition, antioxidant activity, and techno-functional properties. Subsequently, salty cracker prototypes were developed by incorporating these functional ingredients. The physicochemical properties of the crackers were evaluated, including texture (assessed via texture profile analysis), colour (measured using the CIELAB system), and water activity. These analyses aimed to determine the suitability of the ingredients for food applications and their impact on the final product quality.
Results: The developed functional ingredients exhibited high nutritional value, particularly in protein and dietary fibre content. Crackers formulated with these upcycled ingredients demonstrated desirable textural properties, supporting their potential as sustainable, health-promoting snacks.
Conclusion: This research underscores the feasibility of using food industry by-products as valuable functional ingredients for innovative food applications. By integrating BSY and okara into cracker formulations, this study promotes resource efficiency, contributes to sustainability goals, and aligns with the principles of the circular economy in food production.
Keywords: Food by-products, functional ingredients, sustainable food innovation.

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