

Revealing the Potential Brewer's Spent Yeast: Sustainable Innovations for Alternative Protein Development and Waste Reduction in the Agri-Food Sector



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rethink food resources, losses, and waste 2024

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Introduction

Brewer's spent yeast (BSY), a major brewing by-product, accumulates annually, posing environmental challenges [1]. Research highlights BSY's potential as a sustainable alternative protein source in animal feed and human food. With the market expected to reach \$2.17 billion by 2030, BSY offers a promising solution for waste reduction and protein replacement. However, more research is needed to optimize its use in human food products, particularly regarding flavor, texture, and processing. Valorizing BSY supports circular economy principles, transforming it into functional, high-protein ingredients for various applications.

Objectives

This **study aims to valorize BSY** by producing differentiated functional extracts. These extracts, along with other relevant by-products (such as tomato flour and wheat germ), will be used **to formulate protein-rich snacks**. An innovative green process was employed to promote sustainable practices in the agri-food sector and introduce novel, natural ingredients for developing alternative protein food products.

Methods & Results

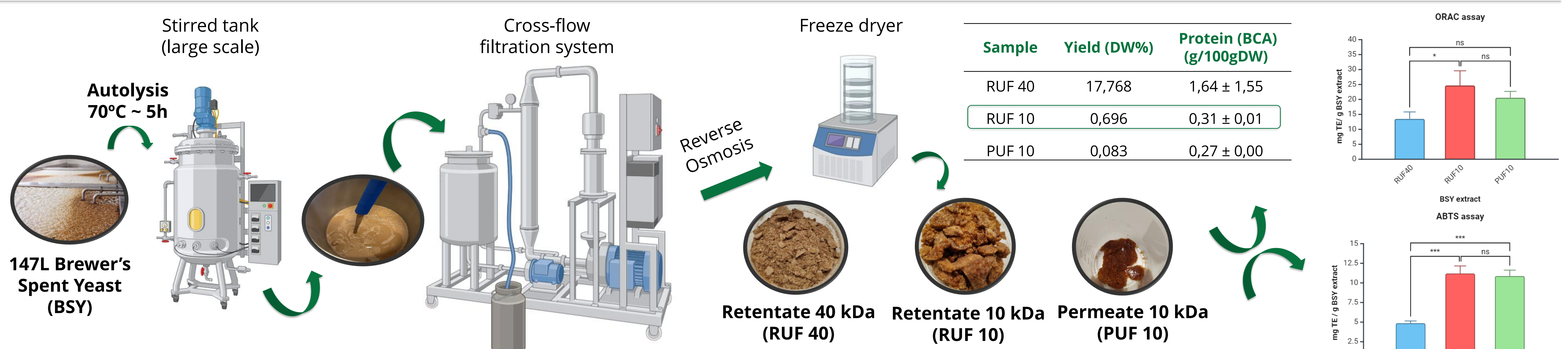


Figure 1 - Schematic representation of the autolysis and filtration process of BSY. Yield (%), protein quantification and antioxidant capacity (ORAC and ABTS assays) of the different BSY extracts. Data are shown as the mean ± SD from three replicates. * represent the significant difference at $p < 0.05$. ns: non-significant.

Table 1 - BSY by-product proximate composition.

BSY Proximate Composition (g/100g D.W.)	
Moisture	84.1 ± 0.05
Ash	5.52 ± 0.02
Proteins	43.6 ± 0.45
Lipids	2.51 ± 0.01
Carbohydrates	48.4 ± 0.48
Total Dietary Fiber	0.47 ± 0.59

Table 2 - Development of control crackers (C) and prototypes with varying RUF10 content (P0%, P2%, and P6%) based on BSY characterization and Ref. [2] cracker formulation.

Parameters	C (%)	P0(%)	P2 (%)	P6 (%)
Moisture (%)	15.77±6.95 ^a	13.49±1.97 ^a	18.07±0.95 ^a	19.79±6.97 ^a
Protein (g/100gDW)	10.39±0.61 ^b	23.61±1.053 ^a	24.88±1.31 ^a	26.52±1.77 ^a
Water Activity (a_w)	0.76±0.07 ^a	0.64±0.05 ^{ab}	0.68±0.03 ^{ab}	0.60±0.04 ^b
L*	86.97±4.05 ^a	54.81±1.89 ^b	61.08±1.34 ^b	56.45±2.35 ^b
a*	5.39±0.33 ^b	11.52±1.97 ^a	11.38±0.86 ^b	11.01±1.28 ^b
b*	20.73±0.25 ^{bc}	23.15±0.91 ^{ab}	24.57±1.50 ^a	19.60±0.86 ^c
Diameter (cm)	5.57±0.27 ^a	5.47±0.15 ^a	5.99±0.21 ^a	5.80±0.22 ^a
Thickness (cm)	0.85±0.09 ^a	0.61±0.13 ^{ab}	0.75±0.12 ^{ab}	0.55±0.06 ^b
Weight (g)	10.63±0.60 ^a	8.753±0.87 ^{ab}	10.12±2.39 ^{ab}	7.12±0.33 ^b
Density (g/cm ³)	0.44±0.05 ^a	0.37±0.06 ^{ab}	0.36±0.07 ^{ab}	0.27±0.01 ^b
Hardness (N)	68.40±10.94 ^a	108.20±27.20 ^a	94.60±28.60 ^a	15.24±11.70 ^a
Fracturability (mm)	2.18±0.50 ^b	2.25±1.17 ^b	6.57±1.06 ^a	3.15±0.23 ^b

Ingredients	C (%)	P0(%)	P2 (%)	P6 (%)
Wheat Flour	60.5	24.0	22.0	18.0
Yeast	1.5	1.5	1.5	1.5
Salt	1.0	1.0	1.0	1.0
Sugar	1.0	1.0	1.0	1.0
Vegetable Oil	7.5	7.5	7.5	7.5
Water	28.5	22.0	22.0	22.0
Tomate Flour (<250 µm)		4.0	4.0	4.0
Thyme		0.1	0.1	0.1
RUF 10			2.0	6.0
Wheat Germ Flour		38.9	38.9	38.9

Table 3 - Physical, chemical and textural properties of developed crackers. Data are shown as the mean ± SD from three replicates. Different letters represent the significant difference at $p < 0.05$.



Figure 2 - Prototypes of developed crackers.

Conclusions

The RUF10 fraction showed a significant increase in antioxidant activity compared to RUF40 and a better production yield than PUF10. Crackers formulated with varying RUF10 concentrations exhibited notable differences in physicochemical properties. The protein content in crackers P6 was notably, but this resulted in reduced water activity and increased firmness, as indicated by lower fracturability. Future work should focus on understanding the peptide profile of yeast fractions and analyzing the antioxidant activity within the food matrix, providing deeper insights into the functional properties of BSY-derived products in food applications. In conclusion, the incorporation of BSY fractions successfully enhanced the nutritional profile, aligning with sustainability goals and offering a viable alternative for protein-rich food products.

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References:

- [1] Mala, T., Piayura, S., & Itthivadhanapong, P. (2024). Characterization of dried pineapple (Ananas comosus L.) peel powder and its application as a novel functional food ingredient in cracker product. *Future Foods*, 9, 100322.
- [2] Batista, Ana Paula, Alberto Niccolai, Ivana Bursic, Isabel Sousa, Anabela Raymundo, Liliana Rodolfi, Natascia Biondi, and Mario R, Tredici, 2019, "Microalgae as Functional Ingredients in Savory Food Products: Application to Wheat Crackers," *Foods* 8 (12).

