Harnessing Agrifood By-Products for Sustainable Protein Development: A Focus on Circular Economy and Agriculture

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Introduction

The food industry generates substantial amounts of food waste with significant environmental impact,

Brewer spent yeast (**BSY**) is a relevant byproduct of the brewing process, typically amounting to 2.0 to 4.0 kilograms per 100 litters of beer produced,

It is imperative for industries to devise innovative solutions for managing these by-products.

Objective

The present work aimed to valorise **BSY by-product** into **high-value products** suitable for diverse food applications.

We employed an innovative green extraction process to obtain BSY extracts enriched with bioactive compounds:

Value-added products

- Proteins & Peptides
- Fiber
- Polyphenols
- β-Glucans

Methodology

1. The proximate composition was analysed according to AOAC official methods. Dietary fiber was determined by the enzymatic gravimetric method (*Megazyme* kit).

2. Following the washing treatment (1:2 v/w, 5000 rpm, 4 °C), the solid fraction underwent an autolysis process at 70°C for 5 hours.

3. We utilized tangential membrane filtration techniques to produce various BSY extracts, employing membrane molecular weight cut-offs of 50 kDa and 10 kDa.

4. Size exclusion high-performance liquid chromatography (SE-HPLC) analysis was performed and bioactivity evaluation considering both antioxidant (ORAC, ABTS) and antimicrobial properties (MIC) .

Results

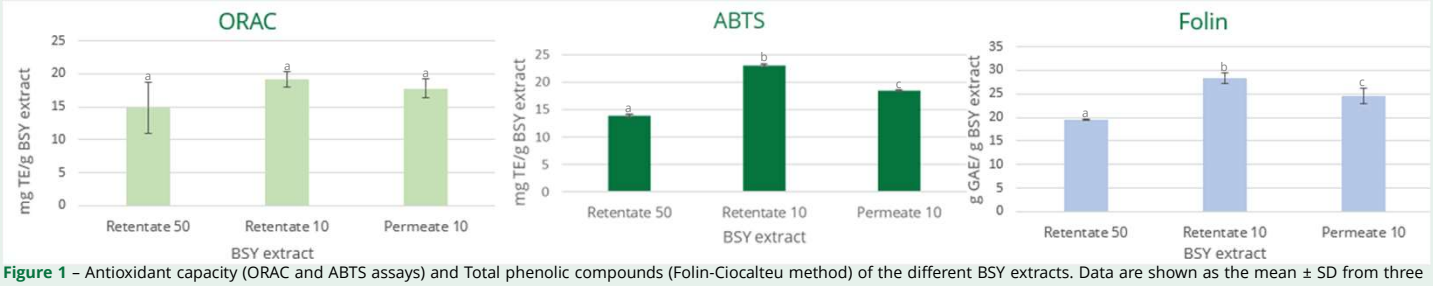

Figure 1 – Antioxidant capacity (ORAC and ABTS assays) and Total phenolic compounds (Folin-Ciocalteu method) of the different BSY extracts. Data are shown as the mean ± SD from three replicates. Different letters represent the significant difference at $p < 0.05$.

Results indicated that both methods revealed **strong antioxidant characteristics** in all BSY extract fractions.
ORAC analysis showed no significant differences between samples, but ABTS analysis did show ($p<0.05$), highlighting the higher antioxidant activity in the Retentate 10 kDa extract. This result correlates with the amount of phenolic compounds present in each fraction.

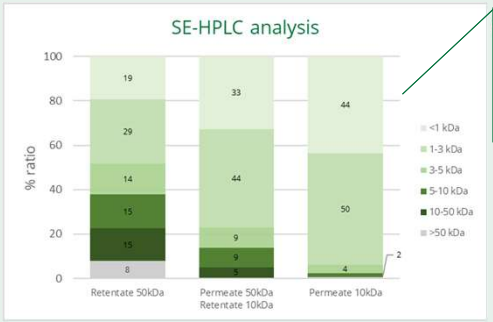

Figure 2- SE-HPLC of BSY extracts profile.

Results indicate **variability in peptide fractions' molecular sizes** across samples, providing insights into the composition and properties of the hydrolysates.
The permeate 10kDa fraction predominantly contained the highest proportion of smaller peptides (<1 kDa and 1-3 kDa)

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

The BSY by-product show a **high content** in **proteins** and total carbohydrates.

The MIC of all BSY extract fractions was assayed, demonstrating **no complete growth inhibition** up to a concentration of **40 mg /mL** for each fraction.

Conclusion

High-protein BSY extracts suitable for potential applications into functional food matrices were successfully produced.

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