1st International Electronic Conference on Food Science and Functional Foods - 2020
Section: Nutraceuticals and Functional Foods

WROCŁAW UNIVERSITY OF ENVIRONMENTAL AND LIFE SCIENCES

The potential of spent barley as a functional food ingredient: comparison of dietary fiber and bioactivity

Joncer Naibaho[1], Małgorzata Korzeniowska[1], Aneta Wojdyło[1], Adam Figiel[1], Baoru Yang[2], Oskar Laaksonen[2], Maike Foste[3], Raivo Vilu[4], Ene Viiard[4]

[1] Wroclaw University of Environmental and Life Sciences, Poland; [2] University of Turku, Finland; [3] Fraunhofer Institut Freising, Germany; [4] Center of Food Fermentation Technologies, Estonia.

1. Introduction

Brewery spent grain (BSG)

- A waste from brewery industry [1,2]
- High dietary fiber, phenolic compounds and protein [2]
- Considerable potential to be used for functional food ingredient and nutraceutical [2]
- Those properties vary depending on [3,4]:
  - Type of the grain (climate, genetic, growth)
  - ❖ Analysis (extraction methods and solvent used
  - ❖ Brewery industries (procedures)

Research question: different breweries impact the BSG properties

2. Materials and Methods

2.1 Materials

Collection • 8 breweries (Poland, Germany, Estonia)

Drying • By convective drying to achieve a stable weight

Grinding • By a laboratory mill scale and shieved (385 µm)

Storage • Sealed in aluminium bags and kept in chiller ro

2.2 Analysis

Fiber composition: total, soluble and nonsoluble dietary fiber

Biological activity: TPC, FRAP and ABTS

3. Results and Discussion

3.1 Dietary fiber composition of BSG

BSG	Dietary fiber (%)		
	Soluble	Insoluble	Total
I	$3.982^{b} \pm 0.05$	$41.525^{ab} \pm 0.63$	$45.505^{cde} \pm 0.69$
II	$6.039^{ab} \pm 1.01$	$43.095^{a} \pm 0.06$	$49.135^{bc} \pm 0.95$
III	$9.724^{a} \pm 1.28$	$37.651^{bc} \pm 1.84$	$47.375^{cd} \pm 0.56$
IV	$9.588^{a} \pm 0.20$	$43.972^{a} \pm 0.39$	$53.560^{a} \pm 0.18$
V	$8.221^{ab} \pm 2.23$	$36.219^{c} \pm 2.21$	$44.440^{e} \pm 0.01$
VI	$5.96^{ab} \pm 1.31$	$38.015^{bc} \pm 0.49$	$43.975^{e} \pm 0.83$
VII	$7.105^{ab} \pm 0.96$	$43.856^{a} \pm 1.34$	$50.959^{b} \pm 0.37$
VIII	$7.721^{ab} \pm 0.27$	$40.589^{abc} \pm 0.28$	$48.310^{c} \pm 0.49$

Summary:

- SDF: 3.98 – 9.66%
- IDF: 36.37 – 43.97 %
- TDF: 43.97 - 53.56%

Other papers:

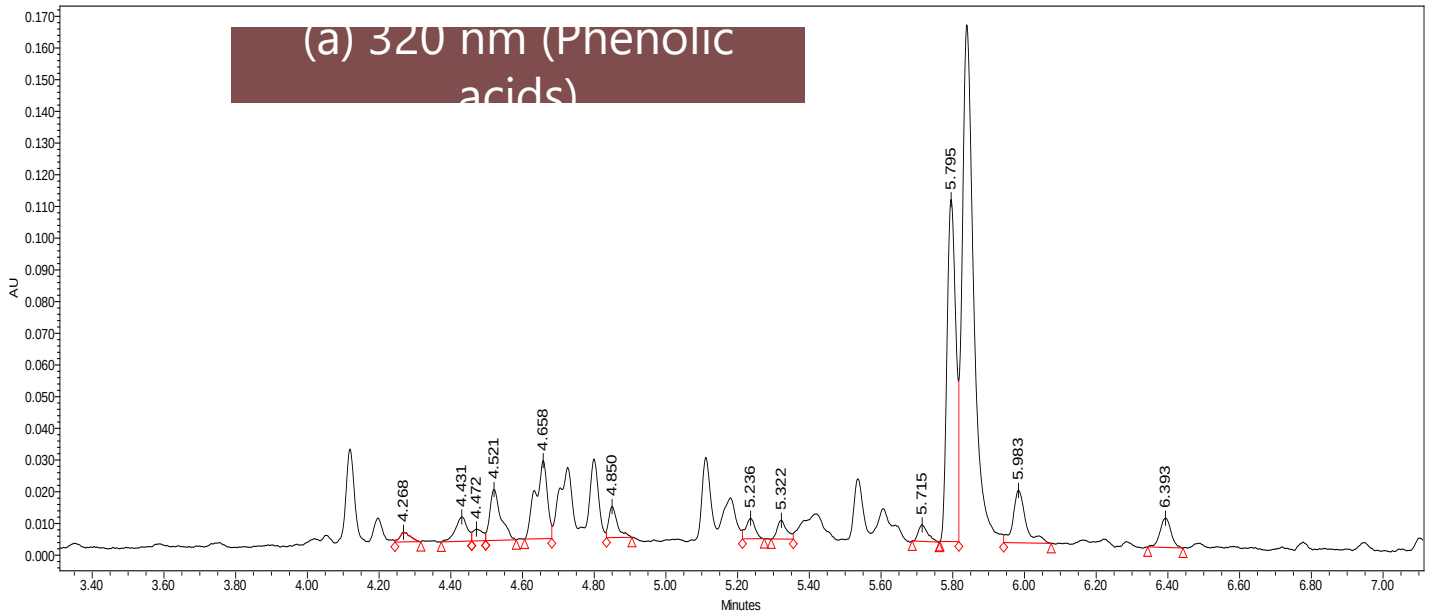
- SDF: 1.3% [5]
- IDF: 58.2% [5]
- TDF: 51-53% [6,7]

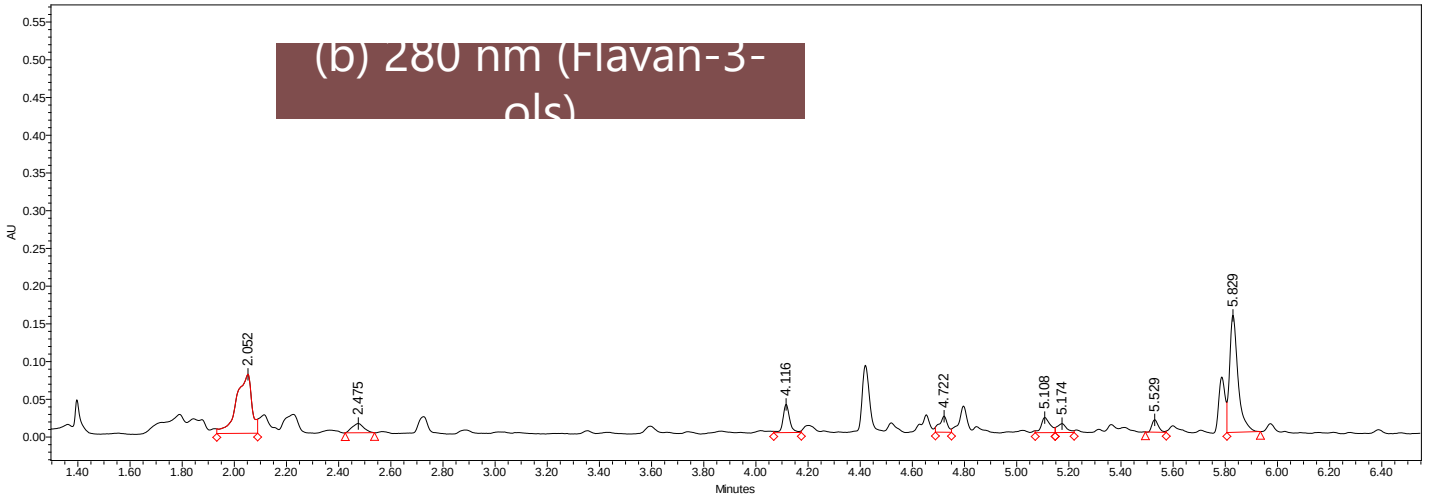
Factors impact fiber compositio

- Particle size [8]
- Source of the grain [3,4]

3.3 Polyphenolic compounds

1. Flavonols
2. Phenolic acids
3. Flavan-3-ols





3.3 Polyphenolic compounds..

	Polyphenolic (mg/kg)		
BSG	Flavonols	Phenolic acids	Flavan-3-ols
I	$10.06^{a} \pm 0.96$	$100.54^{a} \pm 5.07$	$824.95^{abc} \pm 62.69$
II	$13.78^{a} \pm 3.40$	$96.10^{a} \pm 9.33$	$886.41^{ab} \pm 68.16$
III	$12.693^{a} \pm 2.75$	$122.53^{a} \pm 16.99$	$1165.70^{a} \pm 18.56$
IV	$11.92^{a} \pm 0.86$	$68.97^{a} \pm 18.10$	$432.78^{bc} \pm 66.90$
V	$7.53^{a} \pm 0.30$	$104.13^{a} \pm 5.36$	$824.58^{abc} \pm 30.35$
VI	$13.56^{a} \pm 3.13$	$108.24^{a} \pm 14.9$	$527.07^{bc} \pm 11.51$
VII	$9.70^{a} \pm 0.10$	$115.28^{a} \pm 5.33$	$529.50^{bc} \pm 10.02$
VIII	$3.59^{a} \pm 0.30$	$65.77^{a} \pm 0.01$	$362.13^{c} \pm 16.75$

the differences in amount of phenolic compounds depend on the grain type, brewer process as well as environmental factors such as soil type, sun exposure and climate conditions during the plantation.

- Ferulic acid
- P-coumaric acid
- Caffeic acids
- And their derivatives[9]

3.4 Antioxidant activity

BSG	Antioxidant	
	ABTS*	FRAP**
I	0,086	0,106
II	0,091	0,155
III	0,154	0,253
IV	0,152	0,249
V	0,105	0,204
VI	0,184	0,306
VII	0,172	0,278
VIII	0,241	0,200

*mmol Trolox/100 g dw; **µmol TE/100 g dw

- AA depends on extraction methods and solvent used [9]
  - ✓ Extraction: ultrasound-assisted extraction
  - ✓ Solvent: Methanol 87%
- From another papers:
  - ✓ BSG extract has higher AA compared to synthetic antioxidant and almost the same with BHA [10]

4. Conclusion

- As it was expected, the BSG potentially to be used as a functional food ingredients

- Different properties were observed: dietary fiber composition, polyphenolic content and antioxidant capacity

References

1. Garcia-Garcia G, Stone J, Rahimifard S: **Opportunities for waste valorisation in the food industry e A case study with four UK food manufacturers**. *J Clean Prod* 2019, **211**:1339–1356.
2. Nigam PS: **An overview: Recycling of solid barley waste generated as a by-product in distillery and brewery**. *Waste Manag* 2017, **62**:255–261.
3. Santos M, Jiménez JJ, Bartolomé B, Gómez-Cordovés C, del Nozal MJ: **Variability of brewer's spent grain within a brewery**. *Food Chemistry* 2003, **80**:17–21.
4. Qin F, Johansen AZ, Mussatto SI: **Evaluation of different pretreatment strategies for protein extraction from brewer's spent grains**. *Industrial Crops and Products* 2018, **125**:443–453.
5. Ktenioudaki A, O'Shea N, Gallagher E: **Rheological properties of wheat dough supplemented with functional by-products of food processing: Brewer's spent grain and apple pomace**. *Journal of Food Engineering* 2013, **116**:362–368.
6. Nocente F, Taddei F, Galassi E, Gazza L: **Upcycling of brewers' spent grain by production of dry pasta with higher nutritional potential**. *LWT* 2019, **114**:108421.
7. Stojceska V, Ainsworth P: **The effect of different enzymes on the quality of high-fibre enriched brewer's spent grain breads**. *Food Chemistry* 2008, **110**:865–872.
8. Angioloni A, Collar C: **Physicochemical and nutritional properties of reduced-caloric density high-fibre breads**. *LWT - Food Science and Technology* 2011, **44**:747–758.
9. McCarthy AL, O'Callaghan YC, Neugart S, Piggott CO, Connolly A, Jansen MAK, Krumbein A, Schreiner M, FitzGerald RJ, O'Brien NM: **The hydroxycinnamic acid content of barley and brewers' spent grain (BSG) and the potential to incorporate phenolic extracts of BSG as antioxidants into fruit beverages**. *Food Chemistry* 2013, **141**:2567–2574.
10. Barbosa-Pereira L, Bilbao A, Vilches P, Angulo I, LLuis J, Fité B, Paseiro-Losada P, Cruz JM: **Brewery waste as a potential source of phenolic compounds: Optimisation of the extraction process and evaluation of antioxidant and antimicrobial activities**. *Food Chemistry* 2014, **145**:191–197.

1st International Electronic Conference on Food Science and Functional Foods - 2020
Section: Nutraceuticals and Functional Foods

WROCŁAW UNIVERSITY OF ENVIRONMENTAL AND LIFE SCIENCES

Thank you ...

Joncer Naibaho[1], Małgorzata Korzeniowska[1], Aneta Wojdyło[1], Adam Figiel[1], Baoru Yang[2], Oskar Laaksonen[2], Maike Foste[3], Raivo Vilu[4], Ene Viiard[4]

[1] Wroclaw University of Environmental and Life Sciences, Poland; [2] University of Turku, Finland; [3] Fraunhofer Institut Freising, Germany; [4] Center of Food Fermentation Technologies, Estonia.