



EFFICACY OF DIFFERENT SOLVENTS FOR EXTRACTION OF ANTIOXIDANT PHENOLIC COMPOUNDS FROM BREWER'S SPENT GRAINS

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Introduction. Brewers' spent grains (BSG) are the most abundant solid by-products generated during the brewing process. Although some studies suggest possibilities of reusing this material for industrial applications (1); BSG is still traditionally supplied to local farmers for elimination, and the development of economically viable technologies for valorization of this material has been encouraged. The aim of this study was to extract antioxidant phenolic compounds from BSG. Different solvents were evaluated for this purpose, and the antioxidant potential as well as the contents of phenols, flavonoids, reducing sugars and proteins in the produced extracts were determined.

Methods. Methanol, ethanol, acetone, ethyl acetate, hexane, and water were the solvents used for extraction of antioxidant phenolic compounds from BSG. Methanol, ethanol and acetone were used in the pure form (absolute) and also in mixtures with water to obtain different concentrations (80%, 60%, 40%, and 20% v/v), while ethyl acetate and hexane were used only in the pure form. For the extractions, 1 g of BSG was mixed with 20 ml of solvent, and the mixture was maintained during 30 min in a water-bath with magnetic agitation at 80 °C when using water, and at 60 °C when using the organic solvents, due to their lower boiling point. After this time, the produced extracts were filtered through filter paper and 0.22 µm membranes, and analyzed to determine their antioxidant potential as well as the contents of phenols, flavonoids, reducing sugars and proteins, as described elsewhere (2). Triplicate extractions were made for each solvent.

Results. The extraction solvent was a factor of great influence on the recovery of antioxidant phenolic compounds from BSG (Table 1). Acetone:water mixtures, especially at 60% v/v, were highly efficient to extract these compounds. The antioxidant capacity of the produced extract was strongly correlated to the content of flavonoids present in the sample (Fig. 1).

Conclusions. Acetone 60% v/v was the best solvent to extract antioxidant phenolic compounds from BSG. This study is the first attempt for recovering antioxidant phenolic compounds by solvent extraction of BSG, and the present findings contribute to ascertain the potential of BSG for applications in food, cosmetic and pharmaceutical industries, since antioxidant phenolic compounds could be recovered from BSG and used as a natural and inexpensive alternative to synthetic antioxidants.

Table 1. Composition and antioxidant potential of the extracts produced by extraction of brewer's spent grains (BSG) with different solvents.

Solvent (% v/v)	Composition *				Antioxidant potential **	
	Phenols	Flavonoids	Protein	Sugars	DPPH	FRAP
H ₂ O	3.59 ab	0.02 a	0 a	27.5 bc	3.33 abc	0.88 ab
Methanol						
100	3.90 ab	0.75 bc	0 a	25.07 b	12.69 e	1.07 bc
80	6.46 bc	1.02 c	4.29 c	33.45 c	12.25 de	2.31 d
60	4.57 ab	0.33 ab	3.44 bc	32.4 bc	10.40 cd	2.04 cd
40	3.89 ab	0 a	0 a	29.0 bc	7.59 bcd	0.79 ab
20	2.90 a	0 a	0 a	22.96 b	2.51 abc	0.45 a
Ethanol						
100	4.60 ab	2.54 d	1.87 bc	4.75 a	5.03 abc	1.29 bc
80	5.54 b	4.61 f	7.48 d	23.05 b	12.02 de	2.88 d
60	7.13 bc	2.59 d	9.29 e	24.18 b	16.91 e	2.87 d
40	6.18 bc	0.98 c	1.55 ab	25.19 b	1.64 ab	1.30 bc
20	4.26 ab	0 a	0 a	22.57 b	0 a	0.94 ab
Acetone						
100	5.66 b	1.03 c	0 a	6.33 a	13.45 e	0 a
80	5.37 b	2.12 d	1.01 ab	32.1 bc	20.55 f	2.75 d
60	9.90 d	2.02 d	3.32 c	37.6 d	18.53 f	4.15 e
40	6.26 bc	1.33 c	2.40 bc	36.74 d	13.01 e	2.53 d
20	5.94 b	0.51 abc	2.27 bc	33.52 c	7.46 bcd	1.66 bc
Hexane	4.44 ab	2.92 e	0 a	3.35 a	2.02 abc	0.24 a
Ethyl Acetate	2.14 a	0 a	0 a	3.61 a	5.4 abcd	0 a

* Phenols (mg GAE/g BSG); Flavonoids (mg QE/g BSG); Protein (mg/g BSG); Sugars (mg/g BSG). ** DPPH inhibition (%); FRAP (mM FE(II)/g BSG). For each column, letters equals indicate that the means difference is not significant at $p < 0.05$.

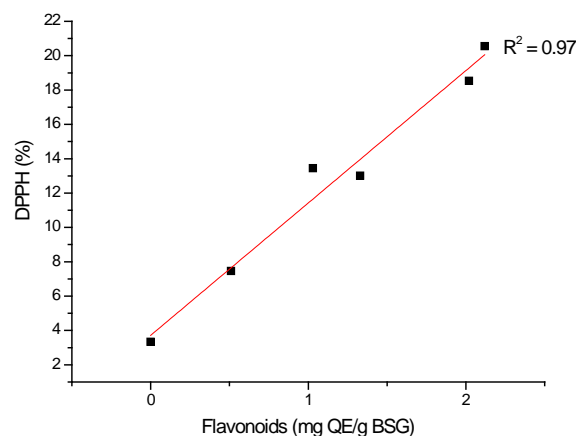


Fig.1 Correlation between antioxidant activity by the DPPH method and flavonoids content in the BSG extracts obtained with acetone.

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References

- Mussatto SI, Dragone G, Roberto IC. (2006). *J. Cereal Sci.* 43:1-14.
- Martins S, Aguilar CN, Teixeira JA, Mussatto SI. (2012). *Sep. Purif. Technol.* 88:163-167.