

Olívia R. Pereira^{1*}, Gleiciara Santos², Maria João Sousa¹

¹ Centro de Investigação de Montanha (CIMO), Instituto Politécnico de Bragança, Campus de Santa Apolónia, 5300-253 Bragança, Portugal; oliviapereira@ipb.pt; joaos@ipb.pt;

² School of Health Science, Polytechnic Institute of Bragança, Av. D. Afonso V, 5300-121, Bragança, Portugal; rgleiciara@gmail.com

*Correspondence: oliviapereira@ipb.pt Tel.: +351-273-330-950

Introduction

Hop (*Humulus lupulus* L.) is known worldwide as a raw material in beer production due its flavour and preservative values. The beneficial properties of the plant have been mostly associated to the female hop inflorescences (1) (Fig. 1).

Millions of tons of residues are produced in brewing process (Fig. 2). The nutritional and pharmacological characteristics of those by-products and of parts of the plant discarded in hop harvest, allow explore them as potential sources of functional ingredients (2).



Figure 1. Hop plant in the field and and female flower detail

Objectives

The present review addresses the potential use of hop part discards for cosmetic applications.

Results

Generally, in beer production occur chemical and biochemical reactions. During this process, spent grains, spent hops/ hot trub and spent yeast are produced (Fig. 3), constituting the main marketable by-products with potential interest for food, pharmaceutical, cosmetics, agriculture and chemical industries (2).



Figure 2. Female hop inflorescences, leaves and stalks

Large amounts of brewer's spent grain are discarded although its richness in valuable compounds such as proteins (more than 20%) and fiber and also lipids and fatty acids, carbohydrates, polyphenols (mainly hydroxycinnamic acids) and minerals. On other hand, leaves and stems as well as hops with small calibre, are discarded as a waste in the harvest of hop. These parts of plant have also been shown rich in compounds with high potential for several industries (2, 3). In addition to that, hop extracts has been used for skin aliments due its anti-inflammatory, antioxidant and antimicrobial effects, central for a cosmetic product (4).

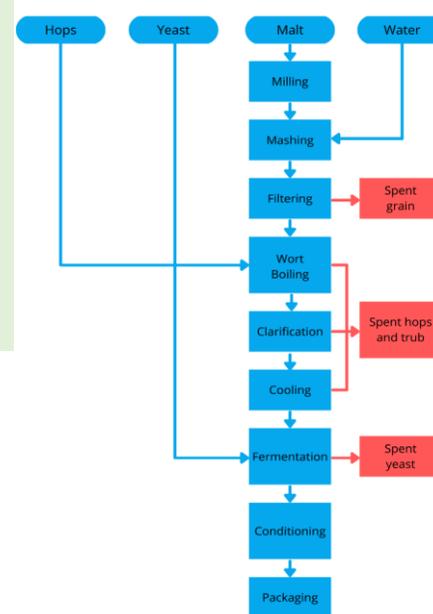


Figure 3. Beer Production Process. Adapted (2)

Conclusions

Obtention of functional compounds and develop new innovative products are a research direction of great interest from the perspective of food-health relation as well as from the environment protection and waste management perspective. The recovery and reuse of brewing industry by-products and of the waste remain after the hop harvest, seems to have great potential for cosmetic application.



References

- (1) McCallum JL, Nabuurs MH, Gallant ST, Kirby CW, Mills AAS. Phytochemical Characterization of Wild Hops (*Humulus lupulus* ssp. *lupuloides*) Germplasm Resources From the Maritimes Region of Canada. *Front Plant Sci.* 2019;10.
- (2) Anca Corina Fărcaș, Sonia Ancuța Socaci, Elena Mudura, Francisc Vasile Dulf, Dan C. Vodnar, M. T. and L. C. S., Additional, Rigau, J., Diaz, D., & Masuelli, M. (2017). Exploitation of Brewing Industry Wastes to Produce Functional Ingredients. *Intech, tourism*, 13.
- (3) Jackowski, M., Niedźwiecki, Ł., Jagiełło, K., Uchańska, O., & Trusek, A. (2020). Brewer's spent grains—valuable beer industry by-product. *Biomolecules*, 10(12), 1–18
- (4) Ivana B, Viktor L, Milanka L, Jelena M, Dusan S. Skin Ageing: Natural Weapons and Strategies. *Evidence-Based Complement Altern Med.* 2013;2013

Acknowledgments

The authors are grateful to the Foundation for Science and Technology (FCT, Portugal) for financial support by national funds FCT/MCTES to CIMO (UIDB/00690/2020).