



13-14 November 2025

TURNING WASTE INTO VALUE: EGGPLANT AND BELL PEPPER BY-PRODUCTS AS POTENTIAL INGREDIENTS FOR FOOD AND COSMETICS APPLICATIONS



Matilde Rodrigues^{1,2,3*}, M. Beatriz P.P. Oliveira², Celestino Santos Buelga³, José Pinela¹

¹ CIMO, LA SusTEC, Instituto Politécnico de Bragança, 5300-253 Bragança, Portugal

² LAQV/REQUIMTE, Departamento de Ciências Químicas, Faculdade de Farmácia, Universidade do Porto, 4050-313 Porto, Portugal

³ Grupo de Investigación en Polifenoles (GIP-USAL), Universidad de Salamanca, Facultad de Farmacia, E-37007 Salamanca, Espanha

* matilde.rodrigues@ipb.pt

• Introduction

The food industry generates tons of by-products every year, with negative economic and environmental impacts, requiring urgent changes in the production system and the agri-food value chain. Fruit and vegetables that do not meet market standards, as well as leaves, stalks, pits, and peels from processing, are often discarded, despite being valuable sources of bioactive compounds with potential applications in the food and pharmaceutical industries as natural health-promoting ingredients [1]. Eggplant and bell pepper plants at the end of their cycle are by-products rich in flavonoids and health-promoting properties, namely antioxidant potential, and can be incorporated into food products as functional ingredients [2].

• Methodology

This work was carried out with the aim of characterizing the profile of phenolic compounds in eggplant and bell pepper leaves. The plant samples were produced in the Bragança region, Portugal. Extracts were obtained by dynamic maceration using different solvent systems: 100% water (aqueous extract), 100% ethanol (ethanolic extract), and a hydroethanolic mixture (80:20 v/v, ethanol:water) (Fig.1). The phenolic composition was investigated by HPLC-DAD-ESI/MS [3].

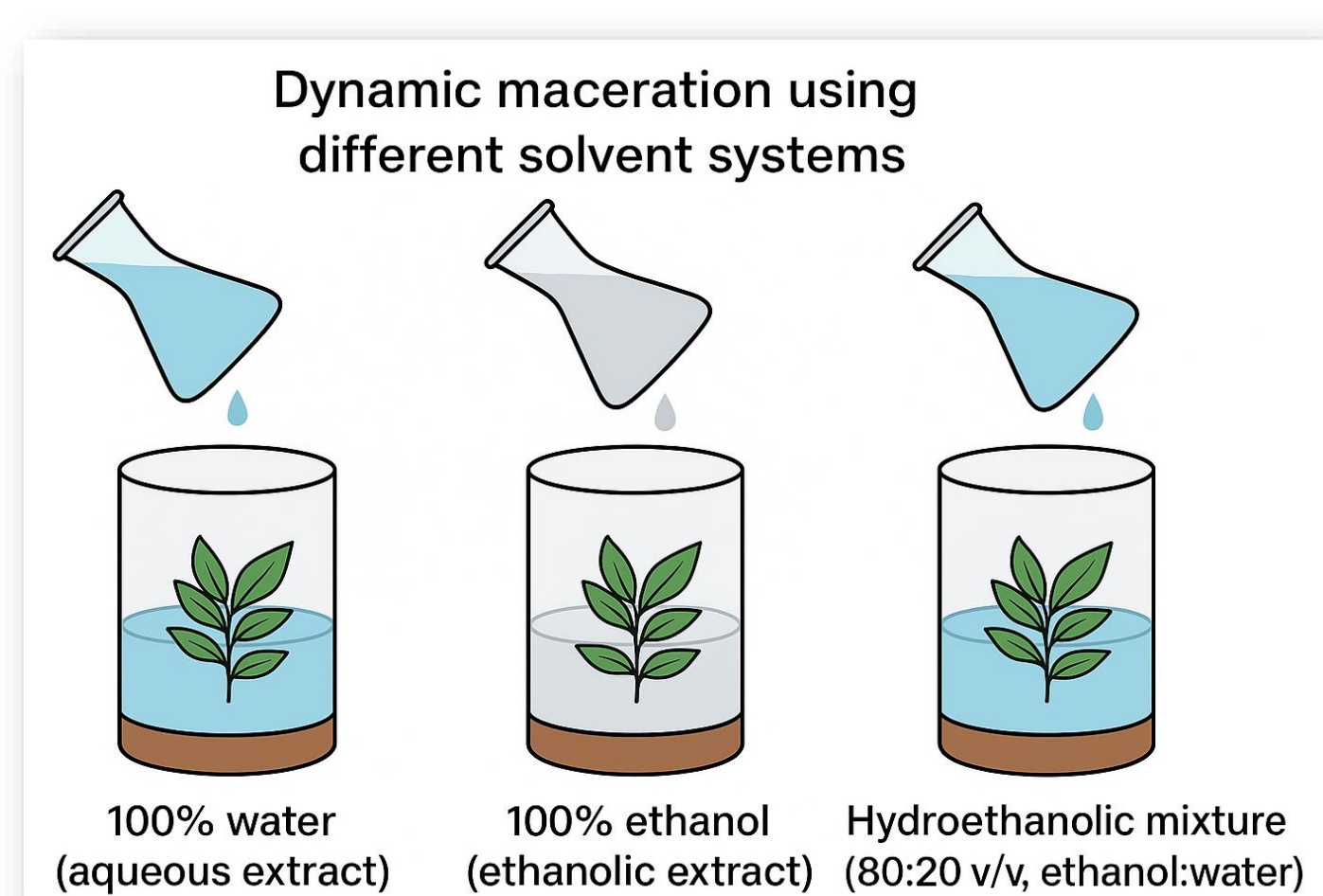


Figure 1. Extraction systems utilized.

• Results and discussions

Thus, the extraction performed with the ethanol/water mixture (80:20, v/v) proved to be the most efficient. Consequently, the results obtained from this extraction are presented (Fig.2 and Fig.3), as it yielded a richer and more diverse composition of phenolic compounds.

Peak	Tentative identification	Content (mg/g extract)
1	cis-3-O-Caffeoylquinic acid	6.8 ± 0.2
2	trans-3-O-Caffeoylquinic acid	1.18 ± 0.03
3	cis-5-O-Caffeoylquinic acid	1.78 ± 0.05
4	trans-5-O-Caffeoylquinic acid	1.60 ± 0.04
5	5-O-Feruloylquinic acid	0.187 ± 0.005
6	Quercetin-O-dihexoside	1.29 ± 0.01
7	Quercetin-O-dihexoside	0.94 ± 0.01
8	Quercetin-O-dihexoside	1.00 ± 0.01
9	Kaempferol-O-dihexoside	1.16 ± 0.01
10	Kaempferol-O-dihexoside	1.00 ± 0.01
11	Kaempferol-O-dihexosyl-O-hexoside	0.95 ± 0.01
12	Kaempferol-O-dihexoside	0.94 ± 0.02
13	Kaempferol-O-dihexoside	0.94 ± 0.02
14	Kaempferol-O-hexoside	0.93 ± 0.01
15	Isorhamnetin-O-hexoside	0.95 ± 0.01
Σ Phenolic acids		11.3 ± 0.3
Σ Flavonoids		10.1 ± 0.1
Σ Phenolic compounds		21.4 ± 0.3

Figure 2. Phenolic profile of eggplant aerial parts.

Peak		HBPP (mg/g extract)
1	cis-3-O-Caffeoylquinic acid	6.66 ± 0.09
2	trans-3-O-Caffeoylquinic acid	1.77 ± 0.03
3	5-O-Caffeoylquinic acid	0.80 ± 0.02
4	Eriodictyol-O-hexoside	tr
5	Luteolin-O-hexosyl-O-pentoside	2.30 ± 0.03
6	Luteolin-O-hexosyl-O-pentoside	1.39 ± 0.01
7	Luteolin-O-hexosyl-O-pentoside	1.55 ± 0.02
8	Luteolin-O-malonyl-pentosyl-hexoside	2.43 ± 0.03
9	Luteolin-O-malonyl-pentosyl-hexoside	10.1 ± 0.1
10	Luteolin-O-malonyl-pentosyl-hexoside	2.36 ± 0.03
11	Luteolin-O-malonyl-pentosyl-hexoside	2.90 ± 0.04
12	Luteolin-O-malonyl-pentosyl-hexoside	2.03 ± 0.03
13	Apigenin-O-malonyl-pentosyl-hexoside	2.45 ± 0.04
14	Apigenin-O-malonyl-pentosyl-hexoside	2.49 ± 0.06
15	Apigenin-O-malonyl-pentosyl-hexoside	2.04 ± 0.04
Σ Phenolic acids		9.2 ± 0.2
Σ Flavonoids		32.1 ± 0.4
Σ Phenolic compounds		41.3 ± 0.6

Figure 3. Phenolic profile of bell pepper aerial parts.

• Conclusions

The extracts demonstrated a rich phenolic composition, with a predominance of caffeoylquinic acids as well as O-glycosylated derivatives of quercetin and kaempferol, compounds likely responsible for their bioactive potential. Overall, these findings underscore eggplant and bell pepper by-products as a renewable, sustainable and cost-efficient source of ingredients with potential applications in food and cosmetic formulations.

Acknowledgements: The authors are grateful to the Fundação para a Ciência e a Tecnologia (FCT) through national funds FCT/MCTES (PIDDAC): CIMO, UIDB/00690/2020 (10.54499/UIDB/00690/2020) and UIDP/00690/2020 (10.54499/UIDP/00690/2020); SusTEC, LA/P/0007/2020 (10.54499/LA/P/0007/2020); project UID/50006 - Laboratório Associado para a Química Verde - Tecnologias e Processos Limpos; and national funding by FCT, through the individual research grant (2024.04986.BD) of M. Rodrigues.

References:

- [1] M. Cano-Lamadrid, L. Martínez-Zamora, et al., Food Biosci. 72 (2025) 107453.
- [2] M. Añibarro-Ortega, V. López, S. Núñez, et al., Ind. Crops Prod. 214 (2024) 118546.
- [3] M. Añibarro-Ortega, J. Pinela, A. Ćirić, et al., Food Bioprod. Process. 124 (2020) 307-319.