

Olive pomace powders: development and characterisation of new functional food ingredients

Tânia B. Ribeiro ^{a, b}, Ana L. Oliveira ^a, António A. Vicente ^c, João Nunes ^b, Manuela Pintado ^a

^a CBQF - Centro de Biotecnologia e Química Fina – Laboratório Associado, Universidade Católica Portuguesa, Escola Superior de Biotecnologia, Rua Arquiteto Lobão Vital, Apartado 2511, 4202 -401 Porto, Portugal. ^b Association BLC3 – Technology and Innovation Campus, Centre R&D, Rua Nossa Senhora da Conceição, 2, Lagares, 3045-155 Oliveira do Hospital, Portugal. ^c CEB - Centre of Biological Engineering, Universidade do Minho, Campus de Gualtar, 4710-057 Braga, Portugal.

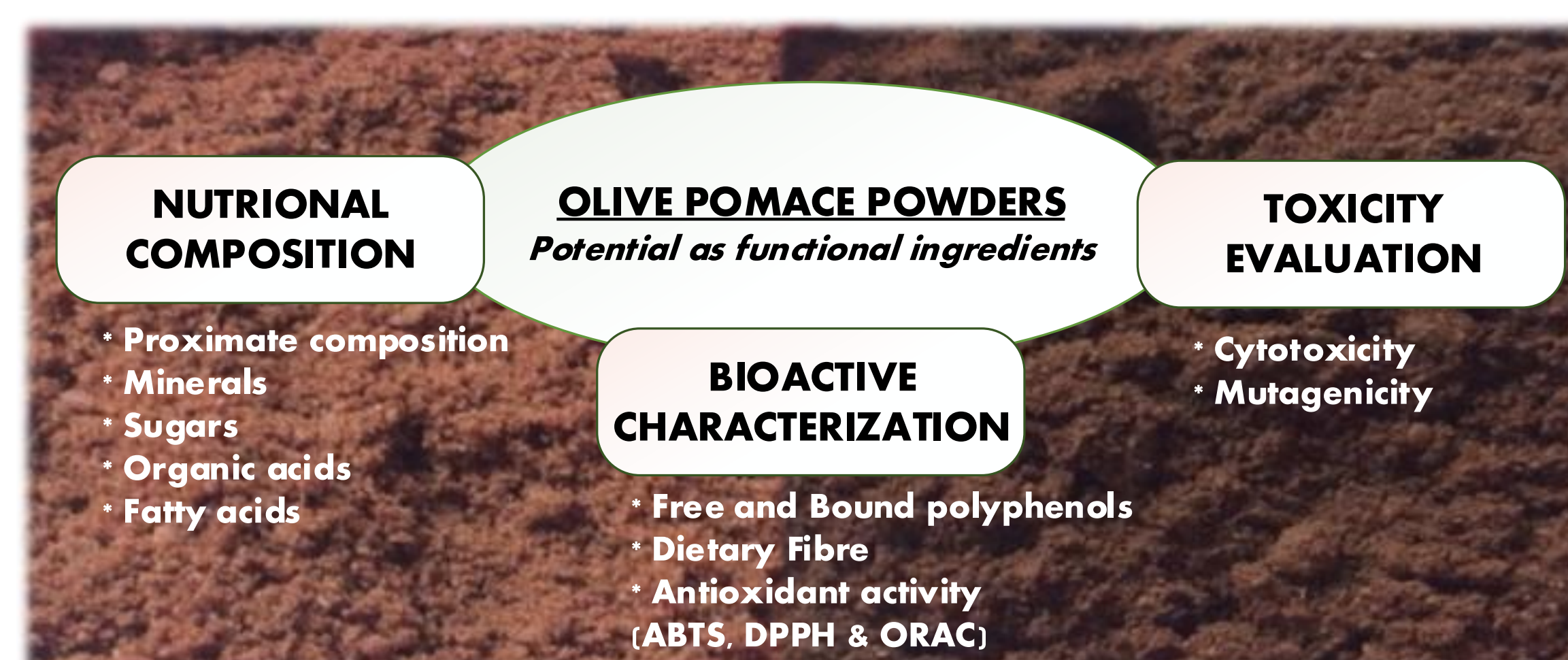
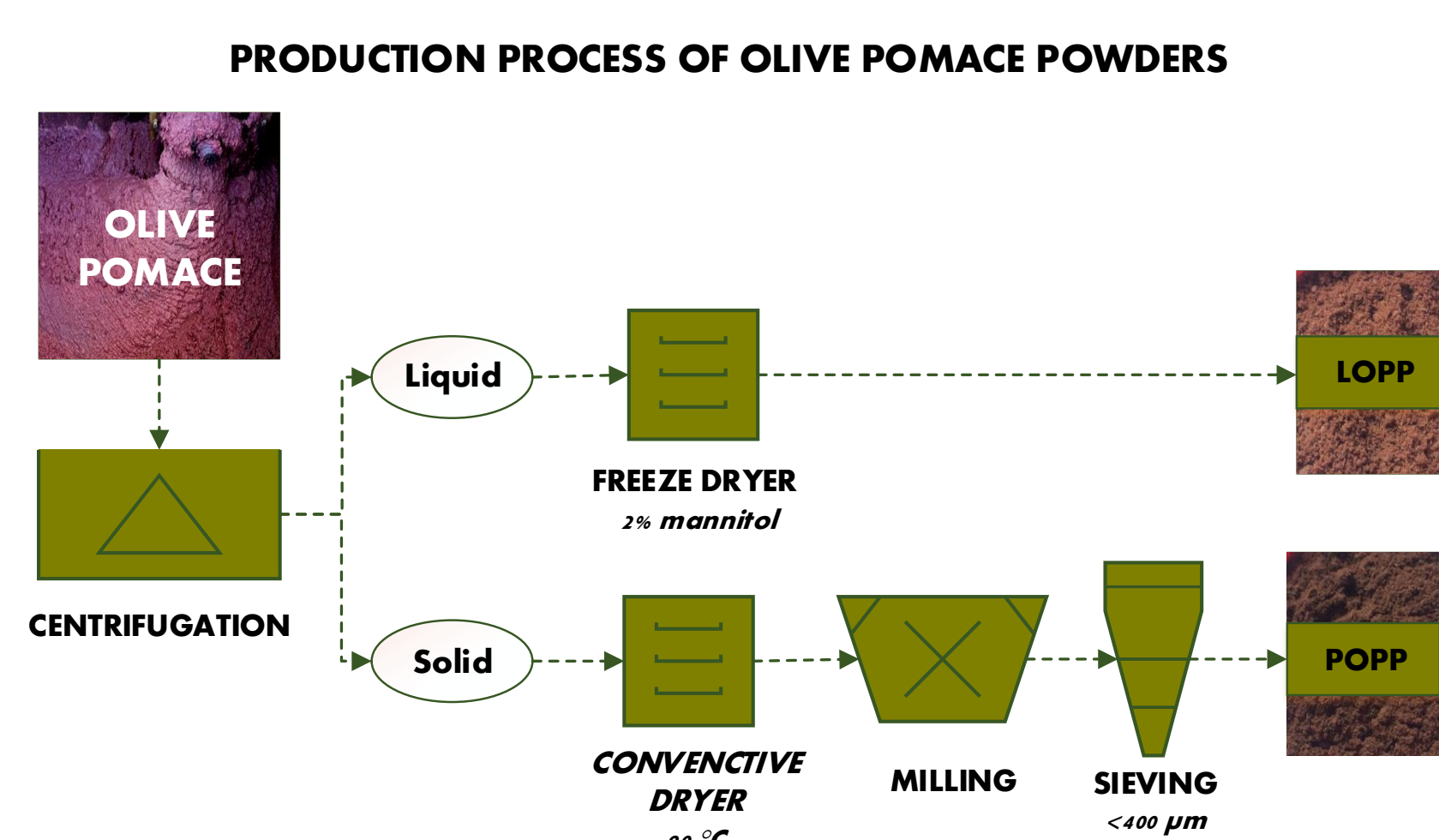
* tania.ribeiro@blc3.pt / tribeiro@porto.ucp.pt

Introduction

The development of new food ingredients from byproducts has been widely investigated. However, these processes often involve the use of organic solvents (classical methods) or have total operational costs (novel eco-friendly techniques). The obtention of powdered products without any extraction step is an excellent solution to achieve natural, safe and environmentally friendly value-added ingredients. Moreover, the powders may retain several functional compounds (e.g. fatty acids, fibre, minerals, polyphenols) together and in association ascribing multifunctional properties.

Olive pomace (OP) is semisolid underutilised biomass, but it is also a significant source of fibre and polyphenols with beneficial effects on human health. So, the main goal of this study was to develop a fractionation approach to achieve new food ingredients from OP, which may have greater health-promoting effects than dietary fibre and polyphenols themselves.

Methodology



Results and Discussion

NUTRITIONAL COMPOSITION

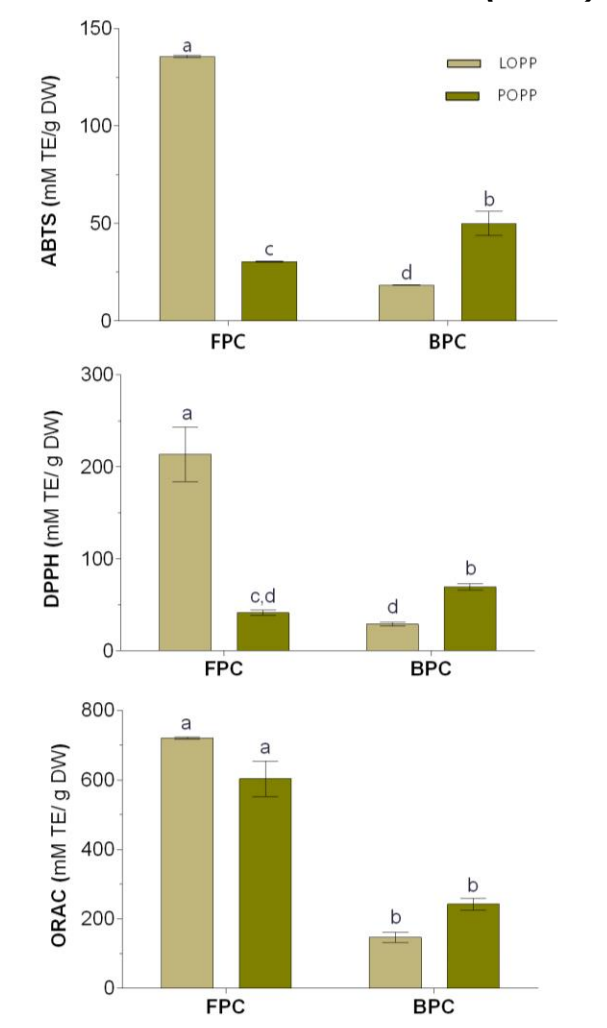
CHEMICAL COMPOSITION (g/ 100 g DW)				
	LOPP	POPP		
Proximate Composition	Moisture	3.37 ± 0.16 ^a	3.76 ± 0.16 ^b	
	Protein	1.12 ± 0.15 ^a	11.82 ± 0.09 ^b	
	Lipid	0.80 ± 0.04 ^a	19.95 ± 0.70 ^b	
	Ash	8.46 ± 0.54 ^a	2.19 ± 0.02 ^b	
Minerals	P	0.476 ± 0.00 ^a	0.159 ± 0.02 ^b	
	Mg	0.153 ± 0.00 ^a	0.050 ± 0.01 ^b	
	Ca	0.132 ± 0.00 ^a	0.165 ± 0.02 ^a	
	Na	0.017 ± 0.00	*	
Sugars	K	5.431 ± 0.11 ^a	1.756 ± 0.22 ^b	
	Glucose	12.57 ± 1.11 ^a	3.53 ± 0.28 ^b	
	Fructose	1.64 ± 0.14 ^a	0.41 ± 0.06 ^b	
	Mannitol	14.11 ± 1.24 ^a	0.89 ± 0.05 ^b	
Organic acids	Lactic	0.41 ± 0.02 ^a	0.12 ± 0.00 ^b	
	Formic	1.03 ± 0.07 ^a	0.45 ± 0.04 ^b	
	Acetic	0.26 ± 0.01 ^a	0.05 ± 0.00 ^b	
Fatty acids	Myristic	0.03 ± 0.00	ND	
	Palmitic	0.12 ± 0.02 ^a	3.37 ± 0.04	
	Stearic	0.02 ± 0.00 ^a	0.50 ± 0.01	
	Arachidic	*	0.11 ± 0.00	
	Unsaturated	Palmitoleic	0.01 ± 0.00 ^a	0.38 ± 0.00
		Oleic	0.52 ± 0.07 ^a	16.06 ± 0.19
		cis-Vaccenic	0.03 ± 0.00 ^a	0.78 ± 0.01
		Linoleic	0.04 ± 0.01 ^a	1.47 ± 0.02
α-linolenic	0.01 ± 0.00	0.17 ± 0.00		

* < LOD. Results are the means of three determinations ± standard deviation. Different letters in the same line are significantly different by t-Student test (p < 0.05).

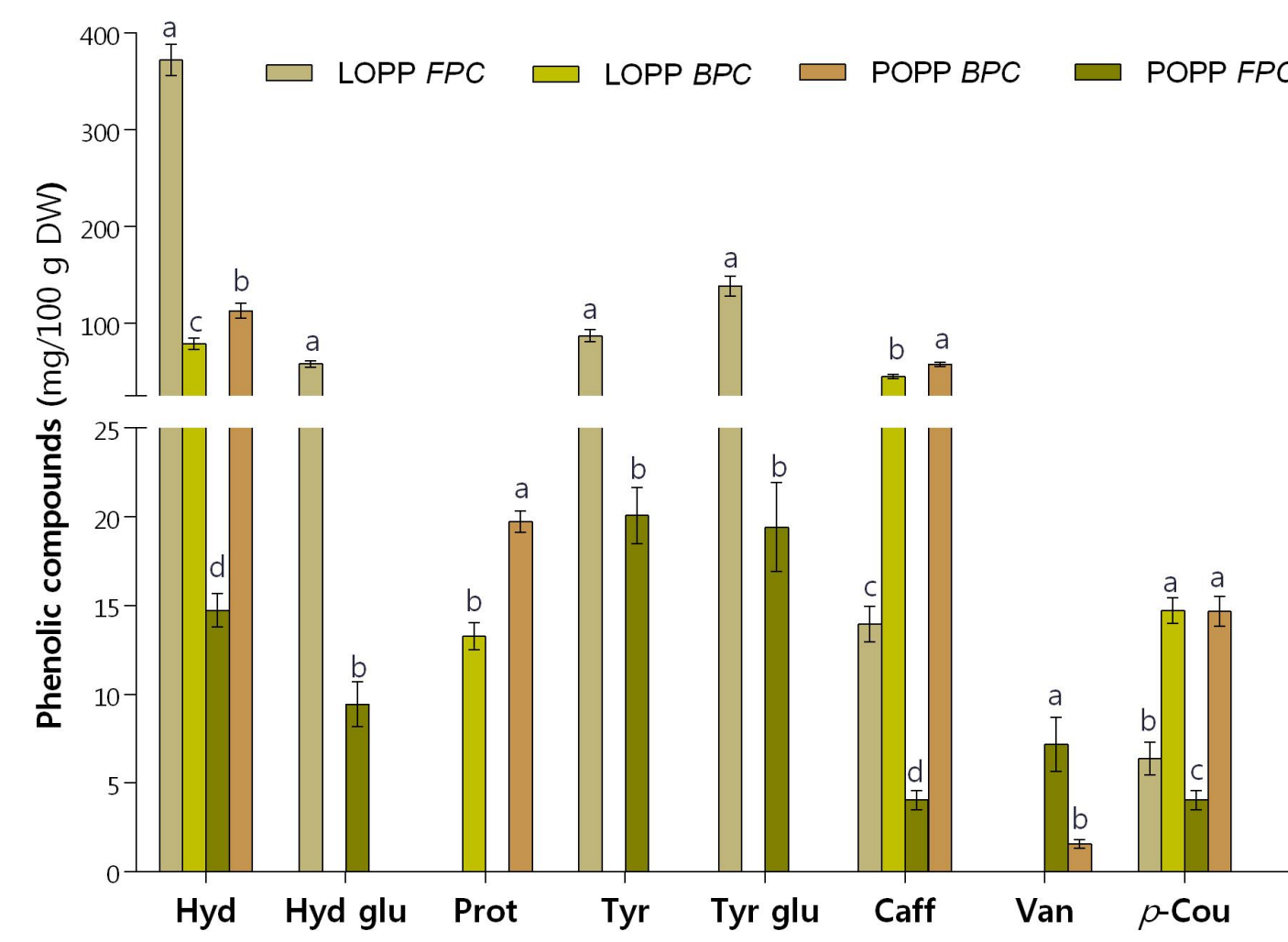
BIOACTIVE CHARACTERIZATION

TOTAL PHENOLIC COMPOUNDS AND DIETARY FIBRE COMPOSITION				
Total phenolic compounds mg GAE/g DW			Dietary Fibre g/ 100 g DW	
FPC	BPC	TDF	IDF	SDF
LOPP	30.49 ± 1.42 ^a	4.97 ± 0.36 ^a	9.20 ± 1.18 ^a	9.20 ± 1.18 ^a
POPP	4.48 ± 0.23 ^b	8.48 ± 0.39 ^b	62.06 ± 0.54	52.17 ± 0.01

ANTIOXIDANT ACTIVITY (AOX)



POLYPHENOLIC PROFILE



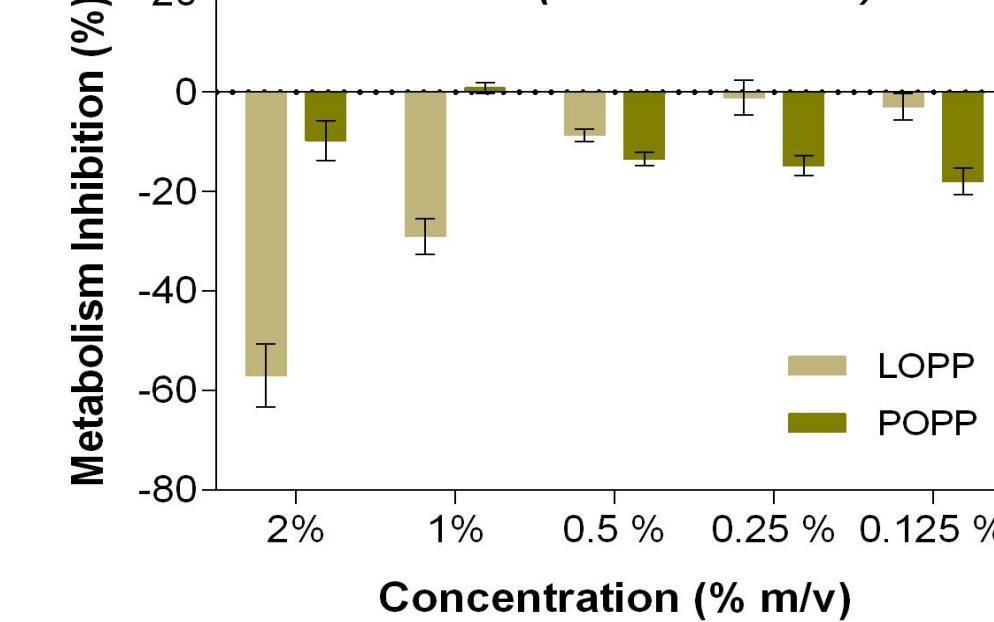
FPC: Free phenolic compounds extract; BPC: Bound phenolic compounds extract; TDF – Total dietary fibre; IDF – insoluble dietary fibre; SDF – Soluble dietary fibre. Results are the means of three determinations ± standard deviation. Different letters in the same column are significantly different, as determined by the t-Student test (p < 0.05). Hyd – Hydroxytyrosol; Hyd glu – Hydrotyrosol glucoside; Prot – protocatechuic acid; Tyr – tyrosol; Tyr glu – tyrosol glucoside; Caff – caffeic acid; Van – Vanillin; p-Cou – p-coumaric acid; Lut – luteolin

TOXICITY EVALUATION

AMES TEST (MUTAGENICITY)

Dose (µg/plate)	Revertant colonies/plate		Mutagenicity index*	
	LOPP	POPP	LOPP	POPP
10	20.3 ± 8.6	21.7 ± 3.5	0.12	0.13
25	18.0 ± 2.7	20.3 ± 5.0	0.11	0.12
50	20.3 ± 2.5	18.0 ± 4.4	0.12	0.11
100	18.3 ± 6.4	17.7 ± 5.7	0.11	0.11
250	15.3 ± 5.5	18.3 ± 2.5	0.09	0.11
500	14.5 ± 2.1	12.5 ± 2.1	0.09	0.07
1000	25.0 ± 2.8	27.5 ± 9.1	0.15	0.16
Blank control	18.0 ± 2.5			
Control 20 µg/plate	168.0 ± 54.0			

XTT TEST (CYTOTOXICITY)



Results are the means of three determinations ± standard deviation. Control: Quercetin, * MI, mutagenicity index: number of revertant colonies per treated plate/number of revertant colonies per quercetin control plate.

- LOPP exhibited a high AOX, a significant amount of potassium (5.4% DW) and more than 5 mg of hydroxytyrosol and derivatives/g DW.
 - >1 g (daily) would provide the amount of hydroxytyrosol and derivatives needed to protect LDL particles from oxidative damage, according to the health claim (EFSA).
 - The higher amount of potassium also has favourable effects to cardiovascular health, i.e. reduction of blood pressure and decrease the risk of the stroke.
- POPP exhibited a considerable amount of TDF, mainly IDF with significant amount of BPC linked.
 - IDF could be fermentable and increase the amount of beneficial bacteria/short-chain fatty acids, at same time that BPC could act as antimicrobial and antioxidant agent in the gut.
- Toxicity assays demonstrated that OP ingredients are safe.

Conclusions

The olive pomace powders could be applied as safe functional ingredients to fortify food products as a source of dietary fibre, phenolics, but also of fatty acids and minerals with health benefits to the consumer.

References: (1) G. Baniyas, C. Achillas, C. Vlachokostas, N. Moussiopoulos and M. Stefanou, *J. Sci. Food Agric.*, 2017, 97, 1686–1697. (2) S. Dermeche, M. Nadour, C. Larroche, F. Mouti-Mati and P. Michaud, *Process Biochem.*, 2013, 48, 1532–1552. (3) G. Rodríguez-Gutiérrez, F. Rubio-Senent, A. Lama-Muñoz, A. García and J. Fernández-Bolaños, *J. Agric. Food Chem.*, 2014, 62, 8973–8981. (4) A. Lama-Muñoz, G. Rodríguez-Gutiérrez, F. Rubio-Senent and J. Fernández-Bolaños, *Food Hydrocoll.*, 2012, 28, 92–104. (5) N. C. Icyer, O. S. Toker, S. Karasu, F. Tomuk, F. Bozkurt, M. Arici and O. Sagdic, *LWT - Food Sci. Technol.*, 2016, 70, 24–32. (6) J. Mata Sánchez, J. A. Pérez Jiménez, M. J. Díaz Villanueva, A. Serrano, N. Núñez and J. López Giménez, *Renew. Energy*, 2015, 78, 566–572. (7) Xie P-J, Huang L-X, Zhang C-H, Zhang Y-L. Phenolic compositions, and antioxidant performance of olive leaf and fruit (*Olea europaea* L.) extracts and their structure– activity relationships. *J Funct Foods*. 2015; 16:460–71. (8) C. M. Oliveira, A. S. Barros, A. C. Silva Ferreira and A. M. S. Silva, *Food Res. Int.*, 2015, 75, 337–347.

Acknowledgements: Tânia I. B. Ribeiro thanks the Fundação para a Ciência e Tecnologia (FCT), Portugal for the PhD Grant SFRH/BDE/108271/2015 and the financial support of BLC3 Association – Technology and Innovation Campus. This work was supported by National Funds from FCT - Fundação para a Ciência e a Tecnologia through project UID/Multi/50016/2019.