



LOCALNUTLEG project is part of the PRIMA programme supported by the European Union's Horizon 2020 research and innovation programme

ONE PRESENTATION IN AN INTERNATIONAL CONFERENCE
REGARDING THE IDENTIFICATION AND OPTIMIZATION
RESULT

DELIVERABLE 2.8

PulpIng

Developing of **Pumpkin Pulp** Formulation using a
Sustainable **Integrated Strategy**





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Document Information

Deliverable Number	2.8
Deliverable name	One presentation in an international conference regarding the identification and optimization result
Contributing WP	WP2: Sustainable recovery of compounds with preserving capacity from pumpkin by-products
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1. Summary

PulpIng project aims at the development of a high-quality pumpkin pulp product enriched and preserved by added-value compounds obtained from pumpkin by-products, fostering an integrative and sustainable strategy. Obtaining extracts with high preservative capacity from pumpkin by-products, more specifically the seeds, peel and fibers, is the main goal of the WP2 – “Sustainable recovery of compounds with preserving capacity from pumpkin by-products”. This report regards the deliverable D 2.7 – “One presentation in an international conference regarding the identification and optimization result” of the WP2, that comprises the dissemination of work developed in Task 2.2 – “Optimization of sustainable and industrially feasible extraction processes of natural preservatives”.

2. Description

The present deliverable lists the oral and poster communications presented or accepted for presentation regarding the identification of bioactive compounds in the pumpkin byproducts. The results regarding the optimization of the extraction were accepted for presentation in the international conference “XXVI Encontro Galego-Portugués de Química” in November 2022.

2.1. Oral Communications

Leichtweis, M. G., Molina, A. K., Pereira, C., Pires, T. C. S., Bachari, K., Ziani, B. E. C., Ferreira, I. C. F. R., Barros, L. Bioactive properties of bio-residues from food industry: pumpkin seeds, peels, and fibrous strands. 2nd Meeting of the Group of Portuguese Chemists Abroad of the Portuguese Chemical Society. 10 June 2021. Lisbon, Portugal (ANNEX D2.8A).

Leichtweis, M. G., Molina, A.K., Pereira, C., Chaski, C., Polyzos, N., Petropoulos, S.A., Ferreira, I.C.F.R., Barros, L. Food industry by-products applied as pumpkin-based foodstuff preservatives. Chromatography helps in times of crisis. 17 December 2021. Lisbon, Portugal (ANNEX D2.8B).

Leichtweis, M. G., Molina, A. K., Pereira, C., Pires, T. C. S., Calhelha, R., Oliveira, M.B.P.P., Ferreira, I. C. F. R., Barros, L. Pumpkin by-products as a source of preservative compounds for food application: valorization of industrial bioresidues towards a sustainable system. XVI Encontro de Química dos Alimentos. 23-26 October 2022. Castelo Branco, Portugal (ANNEX D2.8C).

Leichtweis, M. G., Molina, A. K., Pereira, C., Pires, T. C. S., Calhelha, R., Neji, T., Oliveira, M.B.P.P., Ferreira, I. C. F. R., Barros, L. Subprodutos de abóbora como fonte de conservantes naturais para aplicação alimentar. IV Congresso Nacional das Escolas Superiores Agrárias. 3-4 November 2022. Santarém, Portugal (ANNEX D2.8D).

2.1. Poster Communications

Leichtweis, M. G., Molina, A. K., Pereira, C., Pires, T. C. S., Ferreira, I. C. F. R., Barros, L. Pumpkin bioresidues as sources of bioactive compounds for food application. 7th Portuguese Young Chemists Meeting (7PYCheM). 19-21 May 2021. Bragança, Portugal (ANNEX D2.8E).

Leichtweis, M. G., Molina, A. K., Pereira, C., Pires, T. C. S., Ferreira, I. C. F. R., Barros, L. Compostos bioativos de bio-resíduos de abóbora para aplicação em alimentos. Encontro com a ciência e tecnologia em Portugal (Encontro Ciência `21). 28-30 June 2021. Lisbon, Portugal (ANNEX D2.8F).

Leichtweis, M. G., Molina, A. K., Pereira, C., Chaski, C., Polyzos, N., Petropoulos, S.A., Ferreira, Isabel C.F.R., Barros, L. Food industry by-products applied as pumpkin-based foodstuff preservatives. Royal Society of Chemistry Poster 2022. Twitter Conference (On-line). 1 March 2022 (ANNEX D2.8G).

Leichtweis, M. G., Molina, A.K., Pereira, C., Calhelha, R. C., Bachari, K., Ziani, B.E.C., Ferreira, I.C.F.R., Barros, L. Valorização de cascas, sementes e fibras de abóbora no desenvolvimento de extratos bioativos para aplicação alimentar. Encontro com a ciência e tecnologia em Portugal (Encontro Ciência `22). Lisbon, Portugal. 16-18 May 2022 (ANNEX D2.8H).

Leichtweis, M. G., Molina, A. K., Pereira, C., Dias, M.I., Charikleia, V., Petropoulos, S.A., Oliveria, M.B.P.P., Barros, L. The identification of preservative compounds from pumpkin fruit peel for the development of a fruit pulp product. Innovation in Mediterranean Traditional Foods: novel products and processes (IMTF). Bragança, Portugal. 13-14 October 2022 (ANNEX D2.8I).

Leichtweis, M. G., Molina, A. K., Pereira, C., Pires, T. C. S., Calhelha, R., Neji, T., Oliveira, M.B.P.P., Ferreira, I. C. F. R., Barros, L. Evaluation of the potential preservative capacity of pumpkin (*Cucurbita maxima* Duchesne) by-products. 23-26 October 2022. Castelo Branco, Portugal (ANNEX D2.8J).

Leichtweis, M.G., Molina, A.K., Pereira, C., Dias, M.I., Pires, T.C.S., Calhelha, R.C., Bachari, K., Ziani, B.E.C., Oliveira, M.B.P.P., Ferreira, I.C.F.R., Barros, L. Natural compounds with preservative capacity obtained from by-products of pumpkin industrial processing. 2nd International congress on bioactive compounds (ICBC). 9-10 November 2022. Campinas, São Paulo, Brazil (ANNEX D2.8K).

Leichtweis, M.G., Molina, A.K., Pereira, C., Pires, T.C.S., Calhelha, R.C., Mohamed, M.H., Oliveira, M.B.P.P., Ferreira, I.C.F.R., Barros, L. Egyptian pumpkin by-product extracts as natural food preservatives. 17 November 2022. Lisbon, Portugal (ANNEX D2.8L).

Molina, A.K., Leichtweis, M.G., Pereira, C., Pires, T.C.S., Calhelha, R.C., Bachari, K., Ziani, B.E.C., Ferreira, I.C.F.R., Barros, L. Food preservative extracts from pumpkin by-products. 17 November 2022. Lisbon, Portugal (ANNEX D2.8M).



Leichtweis, M.G., Molina, A.K., Pereira, C., Carochó, M., Charikleia, V., Spyridon, A.P., Oliveira, M.B.P.P., Ferreira, I.C.F.R., Barros, L. Recuperação de subprodutos da indústria alimentar para extração otimizada de compostos fenólicos. XXVI encontro Galego-Portugués de química. 16-18 November 2022. Santiago de Compostela, Spain (ANNEX D2.8N).

Leichtweis, M.G., Molina, A.K., Pereira, C., Dias, M.I., Carochó, M., Oliveira, M.B.P.P., Ferreira, I.C.F.R., Barros, L. Identificação e otimização da extração de compostos fenólicos de cascas de abóbora 'Butternut squash'. XXVI encontro Galego-Portugués de química. 16-18 November 2022. Santiago de Compostela, Spain (ANNEX D2.8O).



ANNEXES 2.8A – 2.8D

ORAL COMMUNICATIONS

ANNEX D2.8A

2nd Meeting of the Group of Portuguese Chemists Abroad of the SPQ



Programme and Book of Abstracts



Flash Communications Abstracts



Sociedade Portuguesa de Química



Bioactive properties of bio-residues from food industry: pumpkin seeds, peels, and fibrous strands

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The limitation of natural resources, together with current consumer trends and needs, demand the implementation of sustainable food systems, able to produce healthier products and fulfil circular economy principles. The food industry is under pressure to offer healthy, convenient, and ready-to-eat foods, able to meet daily nutritional needs, provide pleasure and satiety, and attend to consumers' growing expectations and safety issues [1]. Given its high nutritional value, pumpkin is one of the most important sources of sustenance of the poorest regions in the world. Nevertheless, during the industrial processing of this fruit, about 25% of the pumpkin is wasted, being this by-product mainly constituted by peels, seeds, and fibrous strands [2]. Through the present work, these bio-residues were assessed in terms of bioactive properties, namely the lipid peroxidation inhibition capacity (TBARS) and the anti-hemolytic activity (OxHLIA), as also the cytotoxicity against a primary culture of non-tumor porcine liver cells (PLP2), by the sulfurodamine B assay. Three pumpkin varieties grown in Algeria were studied, namely Cucurbita pepo (common pumpkin), Cucurbita moschata (butternut squash), and Cucurbita moschata (Musquée de Provence). Regarding the antioxidant activity, in the TBARS assay, the seeds stood out for all the varieties, with the best result being presented by the common pumpkin. The seeds of this variety showed an IC50 value of about 1.5 times lower than that of the positive control, Trolox. On the other hand, in the OxHLIA assay, the results were quite similar between the type of bioresidues and between the varieties. Despite their strong lipid peroxidation inhibition capacity, the seeds of the common pumpkin did not present anti-hemolytic properties. Regarding cytotoxicity, the effect of inhibiting non-tumor cell growth was not observed, even at the highest tested concentration (400 µg/mL), which is of great importance in food safety. These preliminary results are the basis for future studies aiming at the valorization of bioresidues from food industry, allowing its application as food additives, for preservative purposes.

The authors are grateful to the Foundation for Science and Technology (FCT, Portugal) for financial support through national funds FCT/MCTES to CIMO (UIDB/00690/2020), national funding by FCT, P.I., through the institutional scientific employment program-contract for C. Pereira and L. Barros contracts and A.K. Molina and M.G. Leichtweis PhD grants (2020.06231.BD and 2020.06706.BD, respectively). To FCT, P.I., within the scope of the Project PRIMA Section 2 - Multi-topic 2019, Puling (PRIMA/0007/2019).

[1] M. Yadav, S. Jain, R. Tomar, G. B. K. S. Prasad, H. Yadav, *Nutr. Res. Rev.* 2010, 23(2), 184.
[2] X. Rico, B. Guillón, J. L. Alonso, R. Yáñez, *Food Res. Int.* 2020, 132, 109086.

Publicação :: Aceite
Sociedade Portuguesa de Química <eventos@chemistry.pt>
reg.2448/2011 BR/4
Para: Maria Gabriela Leichtweis <mj.leichtweis@hotmail.com>

24/06/2021 09:38



Publicação :: Aceite

Caro(a) Dear Maria Gabriela Leichtweis,

Temos o prazer de informar que a sua publicação foi selecionada para Comunicação Oral Curta e será publicada no livro de resumos do(a) 2º Encontro do Grupo de Químicos no Estrangeiro da SPQ, Zogreb.

Participante: Maria Gabriela Leichtweis.

Título da Publicação: Bioactive properties of bio-residues from food industry: pumpkin seeds, peels, and fibrous strands

Tipo de apresentação: Comunicação Oral Curta

Mais informações sobre a apresentação serão disponibilizadas no devido tempo. Esteja atento ao seu e-mail e as atualizações na página do encontro.

Caso necessite de alguma informação adicional contacte por favor a comissão organizadora.

Sociedade Portuguesa de Química
Avenida da República, 45 3º Esq.
1050-167 Lisboa

ANNEX D2.8B



Certificado de comunicação

Certifica-se que o(a) Senhor(a)

Maria Gabriela Leichtweis

apresentou a Comunicação Oral intitulada

Food industry by-products applied as pumpkin-based foodstuff preservatives

no webinar Chromatography helps in times of crisis, no dia 17 de Dezembro de 2021.

PeFA Comissão Organizadora

Silvia M. Rocha

Presidente do Grupo de Cromatografia da Sociedade Portuguesa de Química



Chromatography helps in times of crisis

This research brings new insights in how to boost a circular economy and valorize food industry wastes in order to avoid losses in a crisis time, when hunger and health are topical subjects worldwide.

Sociedade Portuguesa de Química Chromatography helps in times of crisis

Food industry by-products applied as pumpkin-based foodstuff preservatives

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Pumpkin is traditionally cultivated and consumed worldwide, being the fruit and its by-products recognized by their nutritional and health benefits. In the current pandemic scenario and towards a circular economy, the development of a healthy and green technological food product was proposed using pumpkin pulp enriched with bioactive compounds obtained from pumpkin by-products. The seeds, rinds, and fibrous fractions of seventeen different pumpkin genotypes from Greece were assessed for their antioxidant properties (TBARS), while the pulp was evaluated in terms of ash, protein, fat, and carbohydrate contents by AOAC methods¹. The free sugars profiles were obtained by HPLC-RI.

All pumpkin by-products revealed great antioxidant properties, demonstrating their ability to inhibit lipid peroxidation and suggesting their potential application as sources of preservative compounds. All pulp samples recorded carbohydrates as the major compounds, with contents of about 67-86%, followed by protein (about 8-21%) and fat (about 0.4-1.1%). The ash content ranged from about 3.5 to 11%. Regarding free sugars, two predominant profiles were traced: one rich in fructose and glucose and low in sucrose, and another one with opposite prevalence (Figure 1). These results corroborate the great nutritional value of pumpkin genotypes from Greece and reveal the potential use of pumpkin by-products in the development of preservative solutions to maintain the pulp quality and safety over storage time, through the development of pumpkin-based food products.

Figure 1: Profile A, rich in Fructose (I) and glucose (II); Profile B, rich in sucrose (III).

Acknowledgments: The authors are grateful to the Foundation for Science and Technology (FCT, Portugal) for financial support through national funds (PCT/MCTES to CIDM) (UIDB/00462/2020) national funding by FCT, I.P., through the institutional scientific excellence program contract for C. Pereira and L. Barros contracts and A.K. Molina and M.G. Leichtweis PhD grants (PD2020/13180 and 2020/08766/0), respectively. The project is funded by the General Secretariat for Research and Technology of the Ministry of Development and Investments and FCT, I.P. under the PRIMA Programme. PRIMA is an Art. 185 initiative supported and co-funded under Horizon 2020, the European Union's Programme for Research and Innovation (PRIMA Action 2 - Multi topic 2018: PulpIng (PRIMA/0007/2020) and Prma/2020-30).

References

1. AOAC Official Methods of Analysis of AOAC INTERNATIONAL, 20th ed., 2016.

Justification

The pandemic crisis brought the alert that more attention is needed to maintain human and planet health. Although pumpkin is known for its nutraceutical properties, its by-products are still little explored industrially and are rich sources of bioactive compounds that could be introduced in the formulation of pumpkin-based products.

ANNEX D2.8C



Certificado de participação

Certifica-se que (a) Senhor(a)

Maria Gabriela Leichtweis

estive presente no XVI Encontro de Química dos Alimentos em IPCB - Castelo Branco, de 23 a 26 outubro 2022

Por A Comissão Organizadora

Certificado de comunicação

Certifica-se que (a) Senhor(a)

Maria Gabriela Leichtweis

apresentou a Comunicação Oral intitulada

"Pumpkin by-products as a source of preservative compounds for food application: valorization of industrial bioresidues towards a sustainable system"

no XVI Encontro de Química dos Alimentos - na IPCB - Castelo Branco, de 23 a 26 outubro 2022

À Comissão Organizadora



BIO-SUSTENTABILIDADE E BIO-SEGURANÇA ALIMENTAR, INOVAÇÃO E QUALIDADE ALIMENTAR

23-26 de outubro de 2022

Castelo Branco

<https://xvieqqa.events.chemistry.pt/>



Pumpkin by-products as a source of preservative compounds for food application: valorization of industrial bioresidues towards a sustainable system

Leichtweis, M.G.¹; Molino, A.K.¹; Pereira, C.¹; Feres, T.C.¹; Calheta, R.C.¹; Oliveira, M.R.P.²; Ferreira, I.C.R.¹; Barros, L.¹

¹Centro de Investigação de Alimentos (CIA), Instituto Politécnico de Bragança, Campus de Santa Apolónia, 5300-293 Bragança; ²ARQUIMAT - Science Chemical Department, Faculty of Pharmacy, University of Porto, 4050-314 Porto, Portugal; ^{*}corresponding author

Considering the interest in replacing synthetic additives with healthier natural alternatives, bioresidues from industrial processes can be an alternative source of rich and cheap compounds to be explored for this. Parts of fruits and vegetables, such as peels, seeds, and leaves, which are often discarded, have been investigated due to their important amounts of high value-added compounds, as well as their potential to be recovered and incorporated into food products. Pumpkin industrialization fits into this scenario: in the pulp processing, large amounts of bioresidues are generated and still undervalued despite being rich in nutritional and bioactive compounds. In this work, the by-products of three varieties of Portuguese pumpkins were evaluated as source of preservative compounds, fostering the circular economy and the valorization of local products. For this purpose, the peel, seeds, and fibers of butternut squash, common pumpkin, and kabocha squash, grown in Bragança - Portugal, were evaluated in terms of their bioactive potential and their composition in tocopherols. For the antioxidant capacity assessment, the hydroalcoholic extracts were evaluated through five methods: three chemical (DPPH scavenging activity, reducing power, and β -carotene bleaching inhibition) and two biological (TBARS and OATPA) methods. The antibacterial and antifungal capacity of the extracts was tested against five strains of gram-negative bacteria, three gram-positive bacteria, and two strains of fungi with relevance in food, in the maximum concentration of 10 mg/mL. The cytotoxicity was tested in a primary culture of non-tumor porcine liver cells (PLP2), using the sulphorhodamine B (SRB) assay. The samples composition in terms of tocopherols was determined by HPLC coupled to a fluorescence detector. The evaluated pumpkin by-products presented great bioactivity. Regarding the antioxidant activity, the seeds stood out in both biological methods, being the butternut and kabocha varieties the best ones. In the chemical assays, the results were more heterogeneous, but it is possible to highlight the fibers as the samples presenting the best results, followed by the seeds and, then, the peel. Moreover, in terms of pumpkin varieties, the kabocha squash presented the best result in three of the five assays (DPPH, β -carotene, and TBARS), in the antimicrobial and antifungal activity, the fibers of butternut squash stood out inhibiting all the tested strains, followed by the fibers of common, and the seeds and the peel of kabocha, which revealed inhibiting capacity against seven bacteria and one fungal strain, in a lower concentration than the other samples. In fact, all samples have inhibited just one of the two fungal strains. None of the samples presented bactericidal nor fungicidal capacity at the tested concentrations and all samples inhibited at least three strains of bacteria. In addition, none of the tested samples showed hepatotoxic activity in a primary culture of non-tumor porcine liver cells (PLP2), at the maximum concentration tested of 400 μ g/mL, demonstrating their safety for food application. Furthermore, all samples presented α -tocopherol, which is the most biologically active isoform of vitamin E. None of the samples presented β -tocopherol and three samples presented the δ isoform. In the samples where α -tocopherol was found, it was the major one. The peel of common pumpkin presented the highest total tocopherol content. The fibers of kabocha were not assessed due the insufficient quantity of sample, since the content of fibers in this variety was very low. These results demonstrate the potential of pumpkin by-products to be exploited as a source of high value-added compounds with preservative capacity. As a next step, studies can be carried out on the recovery and application of these compounds in food products, in order to promote a sustainable system focused on a circular economy and the development of healthier food products.

Acknowledgements: The authors are grateful to the Fundação para a Ciência e Tecnologia (FCT, Portugal) for financial support through national funds PCT/ACTES to CIMO (UIDB/00692/2020), national funding by FCT, P.A., through the institutional scientific employment program contract for C. Pereira and L. Barros contract; and A.K. Molino and M.G. Leichtweis PhD grants (2020/021137 and 2020/010705), respectively; to FCT, P.A., within the scope of the Project PRIMA Section 2 - Multiple 2019: PulpIng (PRIMA/0007/2019).

References:
1. P.M. Lima, C.C. Diniz, L.S. Pinho, L.J. Pinho-Carvalho, M. Thomazini, J.C.F. Moraes, C.S. Faviero-Trindade, Food Res. Int. 148 (2022) 110527. 10.1016/j.foodres.2022.110527

ANNEX D2.8D

IV CNESA - Programa sessões paralelas

ALIMENTAR

SESSÃO 1 INOVAÇÃO E VALORIZAÇÃO

4 NOVEMBRO

	MODERADORES: CLEMENTINA SANTOS (IPB) E ISABEL AFONSO (IPVC)	ANFITEATRO 2
11:00-11:10	<u>Elsa Ramalho</u> , Evla Mutlu, Gözdegül Baser, Paula Whyte and Anne-Maria Saarela	IPB
	PROJETO ERASMUS+ - ETHICAL FOOD ENTREPRENEURSHIP: DESENVOLVIMENTO DE UM GUIA PARA EDUCADORES EM INOVAÇÃO DE ALIMENTOS ÉTICOS	
11:15-11:25	<u>Raquel Guiné</u> , Daniela V. T. A. Costa, Selda Çelik, Sofia Florença, Manuela Ferreira, Ana Paula Cardoso, Sunmeye Çetin, Orsina Amaro da Costa	IPV
	ESTUDO COMPARATIVO SOBRE O CONSUMO DE PRODUTOS ALIMENTARES SUSTENTÁVEIS EM PORTUGAL E NA TURQUIA DURANTE A PANDEMIA DE COVID-19	
11:30-11:40	Sandra Rodrigues, Lia Vasconcelos, Ana Laila, Iasmin Ferreira, Etelvina Pereira, <u>Alfredo Teixeira</u>	IPB
	UTILIZAÇÃO DE BAGAÇO DE AZEITONA NA ALIMENTAÇÃO DE PORCOS DÍSARO. EFEITO NAS CARACTERÍSTICAS FÍSICO-QUÍMICAS E SENSORIAIS DO MÚSCULO LONGISSIMUS	
11:45-11:55	<u>Ana Ribeiro</u> , Miguel Elias, Bárbara Teixeira and Rogério Mendes	IPS
	EFEITO DA ÉPOCA DE CAPTURA, ADIÇÃO DE TRANSGLUTAMINASE E DE FIBRA DE GLUCOMANANO NAS PROPRIEDADES FÍSICAS DE FIAMBRES DE ROBALO DE AQUICULTURA	
12:00-12:10	<u>Maria João Carvalho</u> , José Manuel Ferro Palma, Silvana Ferro Palma, João Dias and Liliana Fidalgo	IPBeja
	GLUTEN-FREE BREADS: NUTRITIONAL, RHEOLOGICAL AND TEXTURAL PROFILE	
12:15-12:25	<u>Paula Correia</u> , Clara Vougo, Catarina Coelho, Raquel Guiné and Cristina Costa	IPV
	PRODUÇÃO DE FARINHA DE LARVAS E PUPAS DE ZANGAO	
12:30-12:40	<u>Yolkan Aytaç</u> , Nehed Small, Vitor Martins, Sorala I. Falcao, Paula Rodrigues and Miguel Vitas Boas	IPB
	NUTRITIONAL COMPOSITION, BIOACTIVITY AND MICROBIOLOGICAL STABILITY OF BEE BREAD DURING THE PRESERVATION PROCESS	
12:45-12:55	Beatriz Azeias, Diogo Ferreira, <u>Lara Campos</u> , Pedro Esperança, Carla Rodrigues, Ana C.A. Veloso and Marta Henriques	IPC
	EXTRATOS DE BORRAS DE CAFÉ COM ATIVIDADE BIOATIVA PARA PRODUÇÃO DE HIDROGÉIS	

IV CNESA - Programa sessões paralelas

ALIMENTAR

SESSÃO 2 INOVAÇÃO E VALORIZAÇÃO EM HORTOFRUTÍCOLAS

4 NOVEMBRO

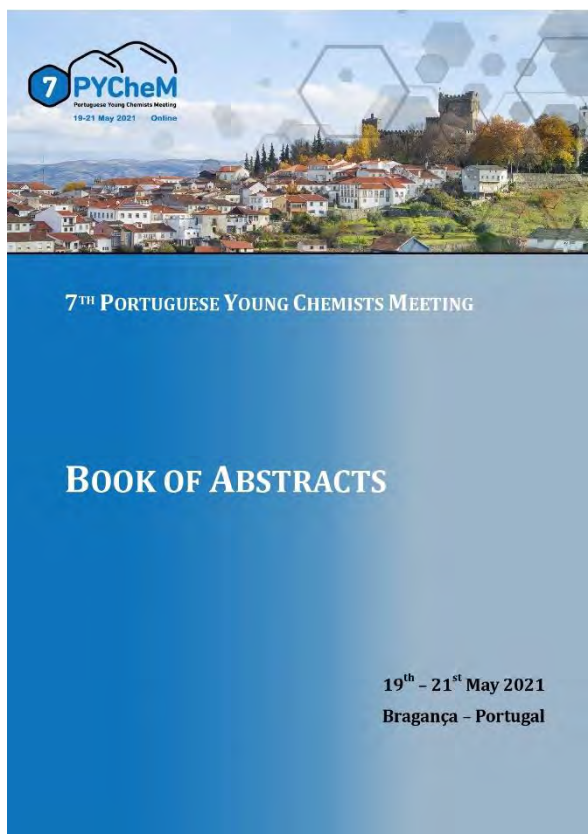
	MODERADORES: GORETI BOTELHO (IPC) E MARIA DA GRAÇA CARVALHO (IPP)	AUDIÓFÓIO
15:45-15:55	<u>Márcia Rodrigues</u> , Ana Luísa Vora, Jonava Petrovic, Maria Inês Dias, António Nogueira, Marina Sokovic, Isabel C. F. R. Ferreira, José Pinela and Lilian Barros	IPB
	COMPOSIÇÃO NUTRICIONAL E ATIVIDADE ANTIOXIDANTE E ANTIMICROBIANA DA FRAMBUESA VERMELHA	
16:00-16:10	Jéssica Domingues, Ana Patrícia Guedes, Márcio Meira, Nuno Vieira E Brito, Ana Paula Vale and Isabel Afonso	IPVC
	VALORIZAÇÃO DE FRUTOS SILVESTRES AUTÓCTONES NO ALTO MINHO. COMPOSIÇÃO CENTESIMAL DO MEDRONHO (FRUTUS UNEDIO L.)	
16:15-16:25	<u>Maria Gabriela Leichtweis</u> , Adriana K. Molina, Carla Pereira, Tania C.S. Pires, Ricardo Calheta, Neji Tarchoun, M. Beatriz P.P. Oliveira, Isabel C.F.R. Ferreira and Lilian Barros	IPB
	SUBPRODUTOS DE ABÓBORA COMO FONTE DE CONSERVANTES NATURAIS PARA APLICAÇÃO ALIMENTAR	
16:30-16:40	M. Gabriela Basto de Lima, <u>Sara Sousa</u> , Délio Raimundo, Ana Neves, Marília Henriques, Adelaide Oliveira and Margarida Oliveira	IPS
	DESIDRATAÇÃO OSMÓTICA: UMA TECNOLOGIA EMERGENTE APLICADA À FILEIRA HORTOFRUTÍCOLA	
16:45-16:55	<u>Elsa Ramalho</u> , Khalil Hmida, Asma Ben Salem, J.S Diaz and Ermelinda L. Pereira	IPB
	APLICAÇÃO DE REVESTIMENTOS COMESTÍVEIS EM CASTANHA (CASTANEA SATIVA): EFEITO NAS PROPRIEDADES FÍSICO-QUÍMICAS E MICROBIOLÓGICAS	
17:00-17:10	<u>Marta Vitas Boas</u> , Susana Mendes, Isabel Valin and Isabel Afonso	IPVC
	ANÁLISE DOS PRINCIPAIS PARÂMETROS DE QUALIDADE EM VINHOS OBTIDOS DE CASTAS MINORITÁRIAS DA REGIÃO DOS VINHOS VERDES	
17:15-17:25	<u>Nuno Ferreira</u> , José Alberto Pereira, Paula Baptista, António Peres and Nuno Rodrigues	IPB
	ESTABELECIMENTO DE GRUPOS HOMOGÊNEOS DE EXEMPLARES DE OLIVEIRAS CENTENARIAS ATRAVÉS DE PARÂMETROS MORFOLÓGICOS DE FRUTOS E ANÁLISE SENSORIAL E ESPECTROSCÓPIA FTIR DOS AZEITES	
17:30-17:40	<u>Daniela Puga</u> , José Alberto Pereira, Francisco Dias and Nuno Rodrigues	IPB
	ATIVIDADE ANTIOXIDANTE DE AZEITES DAS DOP "TRÁS OS MONTES", "BEIRA INTERIOR" E "ALENTEJO INTERIOR": ESTUDO COMPARATIVO	
17:45-17:55	<u>Fátima Peres</u> , Carla Inês, Joedna Campos, Conceição Vitorino, Cecília Gouveia, José Pragana and António Cordeiro	IPCB
	COMPOSIÇÃO EM ÁCIDOS GORDOS E FENÓIS TOTAIS DE AZEITES DE CULTIVARES TRADICIONAIS PORTUGUESAS	



ANNEXES 2.8E – 2.8O

POSTER COMMUNICATIONS

ANNEX D2.8E



Title: Livro de Resumos do 7th Portuguese Young Chemists Meeting

Authors: Maria Inês Dias, Carla Pereira, José Pinela, Bruno Melgar

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2

PC17

PUMPKIN BIORESIDUES AS SOURCES OF BIOACTIVE COMPOUNDS FOR FOOD APPLICATION

M. G. Leichtweis, A. K. Molina, C. Pereira, Tânia C. S. Pires, Isabel C.F.R. Ferreira, L. Barros
 Centro de Investigação de Montanha (CIEM), Instituto Politécnico de Bragança, Campus de Santa Apolónia, 5300-255 Bragança, mlg@ipb.pt

According to FAO data, in Europe, almost half of fruit and vegetable production is lost or wasted [1]. Part of this occurs in the industry during processing stages of these commodities, resulting in large amounts of waste in the form of peels, seeds, liquid, and molasses [2]. Nevertheless, these residues are rich in organic matter, phytochemicals, and compounds with nutraceutical properties [3]. Focusing on the valorisation of these residues, which compounds have commercial potential and aiming at promoting a circular economy, the present work focused the evaluation of the bioactive properties of the bioresidues generated in pumpkin pulp production. For this purpose, the peel, seeds, and fibrous strands of three pumpkin varieties grown in Portugal (winter squash, common pumpkin, and kabocha squash) were evaluated in terms of antioxidant capacity, through 3 chemical (DPPH scavenging activity, reducing power and β -carotene bleaching inhibition) and 2 biological (TBARS and OxH.IA) methods. Additionally, their cytotoxicity was assessed through the *in vitro* sulforhodamine B (SRB) assay, tested in a primary culture of cells prepared from porcine liver.

Regarding the antioxidant activity evaluation, all the samples presented great antioxidant capacity, showing IC_{50} values ranging from about 50 times higher than the positive control, Trolox, to about 14 times lower than Trolox. The fibrous strands and seeds showed better antioxidant capacity than the peels, with the fibrous strands revealing great antioxidant capacity in the employed chemical methods, and the seeds in the biological ones. In terms of pumpkin varieties, the kabocha squash presented the best result in 3 of the 5 assays (DPPH, β -carotene, and FBARS). Regarding cytotoxicity, the effect of inhibiting non-tumour cell growth was not observed for any of the samples, even at the highest concentration (400 μ g/mL), which is of great importance for considering their inclusion into foodstuff. These preliminary results showed a great potential for the exploration of pumpkin bioresidues to develop natural additives with antioxidant properties to be included in food products, fostering the circular economy.

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Acknowledgments

The authors are grateful to the Foundation for Science and Technology (FCT, Portugal) for financial support through national funds (P2/O2/1.1/F5/18/0009/2020), através funding by FCT, P.T., through the national scientific employment program-cofinanced by C. Pereira and L. Barros contracts and A.K. Molina and M.G. Leichtweis PhD grants (2020/06231-DD and 2020/07766-BD, respectively). To FCT, P.L. within the scope of the Project PRIMA, Section 2 - Multi-stage 2019, PulpIng (PRIMA/0007/2019).



Participation Certificate

This is to certify that

Maria Gabriela Leichtweis

has attended the 7th Portuguese Young Chemists Meeting held in Bragança, Portugal, in 19 a 21 maio 2021.

The Organizing Committee

Maria Inês Dias

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ANNEX D2.8F



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COMPOSTOS BIOATIVOS DE BIO-RESÍDUOS DE ABÓBORA PARA APLICAÇÃO EM ALIMENTOS

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COMPOSTOS BIOATIVOS DE BIO-RESÍDUOS DE ABÓBORA PARA APLICAÇÃO EM ALIMENTOS

M. G. Leichtweis, A. R. Molino, C. Pereira, J. Tavares, S. Pires, Isabel C. R. Ferreira, J. Barros
Centro de Investigação de Montanha (CIMO), Instituto Politécnico de Trás-os-Montes e Alto Alentejo, 5306-153 Trás-os-Montes, Portugal; gpl@iptr.pt

Introdução
Devido ao seu alto valor nutritivo, a abóbora é uma das fontes de nutrientes mais importantes das regiões mais pobres do mundo. No entanto, durante o processamento industrial deste fruto, cerca de um quarto da abóbora é desperdiçada [1], sendo este subproduto constituído principalmente por cascas, sementes e fios fibrosos. De facto, as grandes quantidades de resíduos gerados durante as etapas de processamento de frutos e vegetais constituem, entre outros fatores, a perda ou desaparecimento de quase 50% da matéria prima ao longo de toda a cadeia de abastecimento, na Europa [2].

Objetivos
Avaliar as propriedades bioativas dos bio-resíduos gerados na produção de polpa de abóbora, com foco na valorização destes resíduos e na promoção de uma economia circular.

Metodologia
Os bio-resíduos de três variedades de abóboras cultivadas em Portugal foram avaliadas em termos das propriedades bioativas, mais especificamente, atividades antioxidante e citotóxica.

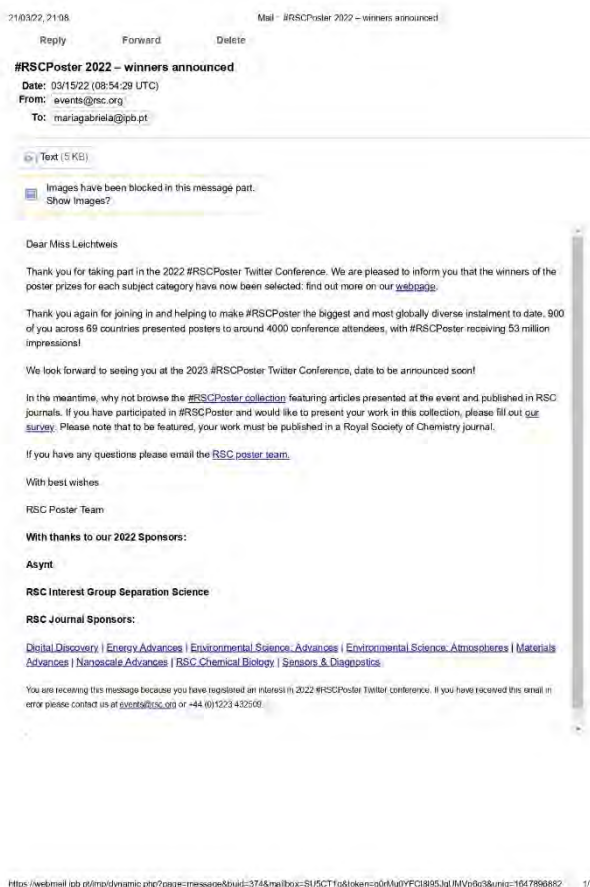
Resultados
Em relação à avaliação da atividade antioxidante, todas as amostras apresentaram grande capacidade antioxidante. No ensaio TBARS, as sementes destacaram-se em todas as variedades analisadas, alcançando valores de IC₅₀ cerca de 5,4 a 1,2 vezes menores que o controlo positivo, Trolox. Já no ensaio de OxHLIA, os resultados variaram conforme os tipos de bio-resíduos e os respetivos variedades. Neste ensaio, o melhor resultado foi apresentado pelas sementes da variedade "Burtemui" e pelas sementes da variedade "Kabocha". Em relação à citotoxicidade, não foi observado efeito de inibição do crescimento de células não tumorais, mesmo a maior concentração testada (100 µg/mL), o que é de grande importância na segurança alimentar.

Conclusão
Esses resultados preliminares são a base para estudos futuros com vista à valorização de bio-resíduos da indústria alimentar, permitindo a sua aplicação como aditivo alimentar, para fins conservantes.

Agradecimentos
Os autores agradecem à Fundação para a Ciência e a Tecnologia (FCT, Portugal) e aos fundos nacionais PCT/MCTES pelo apoio financeiro ao CIMO (18/03626/2020). Financiamento nacional pela FCT (P2), ao abrigo da subárea de contratação de empresas científicas inovadoras. Apoio financeiro de C. Pereira e J. Barros e apoio de doutoramento de M.G. Leichtweis (2020.06251.BD) e A.R. Molino (2020.06251.BD). A FCT, PL, no âmbito do projeto PRIMA, Secção 1.2, Valorização 70195-PulpIng (PRIMA/00077/2019).

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ANNEX D2.8G



FOOD INDUSTRY BY-PRODUCTS APPLIED AS PUMPKIN-BASED FOODSTUFF PRESERVATIVES

M. G. Leichtweis¹, A. K. Molina¹, C. Pereira^{2*}, C. Chaski², N. Polyzos², S. A. Petropoulos², Isabel C.F.R. Ferreira¹, L. Barros¹

Centro de Investigação de Montanha (CIEM), Instituto Politécnico de Bragança, Campus de Santa Apolónia, 5300-253 Bragança, *carla@ipb.pt

Introduction

Pumpkin is traditionally cultivated and consumed worldwide, being the fruit and its by-products recognized by their nutritional and health benefits. In the current pandemic scenario and towards a circular economy, the development of a healthy and green technological food product was proposed using pumpkin pulp enriched with bioactive compounds obtained from pumpkin by-products.

Methodology

The seeds, rinds, and fibrous placenta of seventeen different pumpkin genotypes from Greece were assessed for their antioxidant properties (TBARS), while the pulp was evaluated in terms of ash, protein, fat, and carbohydrate contents by AOAC methods¹. The free sugars profiles were obtained by HPLC-RI.

Results

All pumpkin by-products revealed great antioxidant properties, demonstrating their ability to inhibit lipid peroxidation and suggesting their potential application as sources of preservative compounds. All pulp samples recorded carbohydrates as the major compounds, with contents of about 67-86%, followed by protein (about 8-21%) and fat (about 0.4-1.1%). The ash content ranged from about 3.5 to 11%. Regarding free sugars, two predominant profiles were traced: one rich in fructose and glucose and low in sucrose, and another one with opposite prevalence (Figure 1).

Conclusion

These results corroborate the great nutritional value of pumpkin genotypes from Greece and reveal the potential use of pumpkin by-products in the development of preservative solutions to maintain the pulp quality and safety over storage time, through the development of pumpkin-based food products.

Figure 1. Profile A, rich in fructose (I) and glucose (II); Profile B, rich in sucrose (III).

Acknowledgments

The authors are grateful to the Foundation for Science and Technology (FCT, Portugal) for financial support through national funds (FCT/MCTES to CIEM) (U.12049/2020) national funding by FCT, P.L., through the institutional scientific employment program contract of C. Pereira and L. Barros contracts and A.K. Molina and M.G. Leichtweis PhD grants (2020/065114P and 2020/06706 (EU) respectively). The project is funded by the Center for Research and Technology of the Ministry of Development and Investments and FCT, PT, under the PRIMA Programme. PRIMA is an A4.185 initiative supported and cofunded under Horizon 2020, the European Union's Programme for Research and Innovation (PRIMA) Sections 2 - Multi-specific 2019 - Priority 1 (PRIMA-010172016 and PRIMA2019-01).

References

[1] AOAC Official Methods of Analysis of AOAC INTERNATIONAL, 20th ed., 2016.

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Maria Gabriela Leichtweis

participou no Ciência 2022 - Encontro com a Ciência e Tecnologia em Portugal, que decorreu de 16 a 18 de maio de 2022 no Centro de Congressos de Lisboa, participated in the Ciência 2022 - Science and Technology in Portugal Summit, from the 16th to the 18th May 2022, which took place at the Lisbon Congress Centre.

com a apresentação do poster intitulado:

VALORIZAÇÃO DE CASCAS, SEMENTES E FIBRAS DE ABÓBORA NO DESENVOLVIMENTO DE EXTRATOS BIOATIVOS PARA APLICAÇÃO ALIMENTAR

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VALORIZAÇÃO DE CASCAS, SEMENTES E FIBRAS DE ABÓBORA NO DESENVOLVIMENTO DE EXTRATOS BIOATIVOS PARA APLICAÇÃO ALIMENTAR

M. G. Leichtweis¹, A. K. Mairal², C. Pereira¹, R. C. Calheta¹, K. Bechtel¹, D.F.C. Zan¹, J.C.F.B. Feresio¹, J. Ramel¹
¹Centro de Investigação de Montanha (CI.MO), Instituto Politécnico de Bragança, Campus de Santa Apolónia, 5300-253 Bragança;
²Centre de Recherche Scientifique et Technique en Analyse Physico-Chimiques (CRAPC, Box 1504), Algérie, sciencetech.gov.dz

Introdução
 Na Europa, quase metade da produção de frutas e hortaliças é perdida ou desperdiçada [1], principalmente nas etapas de processamento, através da geração de grandes quantidades de cascas, sementes, líquido, bagaço, etc. No sentido de melhorar esse cenário, o sistema alimentar circular visa utilizar o que antes era considerado um desperdício como um recurso [2]. Nesse contexto, os biorresíduos da indústria alimentar têm vindo a revelar ser uma boa fonte de compostos de valor acrescentado com grande potencial de aplicação em produtos alimentares como conservantes e agentes bioativos, substituindo aditivos sintéticos.

Metodologia
 Cascas, sementes e fibras de três variedades de abóbora cultivadas em Portugal ('Butternut', abóbora comum e 'Kabocha') e três variedades cultivadas na Argélia ('Butternut', 'Gold nugget' e 'Mosaïque de provinces') foram estudadas. Estes biorresíduos foram avaliados em termos da sua capacidade antioxidante, através de dois métodos de base biológica, nomeadamente a capacidade de inibição da peroxidação lipídica (TBARS) e a atividade anti-hemolítica (OxHLIA), e de citotoxicidade, através do ensaio da sulforodamina B (SRB), numa cultura primária de células hepáticas não tumorais (HEP2).

Resultados
 Em relação à avaliação da atividade antioxidante, todos os amostras apresentaram grande capacidade antioxidante, exceto as sementes de abóbora 'Gold nugget' da Argélia, que não apresentaram propriedades anti-hemolíticas, apesar de apresentarem maior capacidade de inibição da peroxidação lipídica. De facto, as sementes destacaram-se em todas as variedades de abóbora no ensaio TBARS, enquanto no ensaio OxHLIA os resultados foram mais lineares entre o tipo de biorresíduo e entre as variedades. Um relação à citotoxicidade, nenhuma das amostras revelou propriedades citotóxicas à máxima concentração estudada (100 µg/ml), o que é de extrema importância para evitar problemas de segurança alimentar.

Conclusão
 Estes resultados preliminares são a base para estudos futuros com vista à valorização destes biorresíduos da indústria alimentar, especialmente para o desenvolvimento de aditivos naturais com propriedades antioxidantes para serem incluídos em produtos alimentares, fomentando a economia circular.

Agradecimentos
 Os autores agradecem à Fundação para a Ciência e a Tecnologia (FCT, Portugal) e aos fundos nacionais FCI 2014-2020 pelo apoio financeiro ao CI.MO (U.180209967/2019) financiamento nacional pelo FCI. Pêlo apoio financeiro do comitê gestor de serviços científicos institucionais, pelas concessões de C. Pereira, R.C. Calheta e J. Ramel e bolsas de doutoramento de M.G. Leichtweis (2020.06231.BD) e A.K. Mairal (2020.06231.BD). A FCT, Pêlo apoio financeiro do projeto PRIMA Seedcall 2 - 2018/2019: DOPING (PRIMA-3007516).

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ANNEX D2.8I



Title:
Innovation in Mediterranean Traditional Foods: novel products and processes

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Luana Fernandes, Alexandre Gonçalves and Lillian Barros

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Sofia Nunes

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<https://imtf.morecolab.pt>



The identification of preservative compounds from pumpkin fruit peel for the development of a fruit pulp product

Maria G. Leichtweis^{1,2}, Adriana K. Molina^{1,2}, Carla Pereira^{1,2*}, Maria Inês Dias^{1,2*}, Charikleia Vassilou¹, Spyridon A. Petropoulos¹, M. Beatriz P.P. Oliveira⁴, Lillian Barros^{2,5}

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² Laboratório Associado para a Sustentabilidade e Tecnologia em Regiões de Montanha (SusTEC), Instituto Politécnico de Bragança, Portugal
³ Department of Agriculture Crop Production and Rural Environment, University of Thessaly, Volos, Greece
⁴ REQUIMTE - Science Chemical Department, Faculty of Pharmacy, University of Porto - Portugal,
⁵ www.lisboa.ucp.pt

The food industry is facing a growing demand for ready-to-use or ready-to-cook products with a long shelf life and increased nutritional value to meet consumers' needs. However, there is also a growing concern about the widespread use of synthetic additives, which have been alarmingly correlated with adverse health effects. In this context, the opportunity to use the by-products generated during the industrial processing of pumpkin fruit to obtain a natural extract with preservative properties and to incorporate it in a fruit pulp product is being explored. In a preliminary study where pumpkin peels, seeds, and fibers were assessed, the peels showed the strongest bioactive properties, being thus selected to obtain the preservative extract in this work. To identify the bioactive molecules of the pumpkin peels, HPLC-DAD-ESI/MS was applied to the extracts of four genotypes. One to five different phenolic compounds were found in the tested samples, with (-)-epicatechin ([M-H]⁻ at m/z 289) as the major compound detected in all of the extracts. These results suggest the possibility of using a natural preservative obtained from this fruit by-product in a new pumpkin pulp formulation.

Keywords: By-products; Phenolic compounds; Pumpkin; Sustainability.

Acknowledgments: The authors are grateful to the Foundation for Science and Technology (FCT, Portugal) for financial support through national funds: FCI/AMCI-ES (P/INIA/C) to CIMO (01818/2019/2020 and 01819/2020/2020) and SusTEC (LA/P/007/2018); national funding by FCI, I+D, through the institutional scientific employment program contract with C. Pereira, M. Inês Dias, and L. Barros and A.K. Molina and M.G. Leichtweis PhD grants (2020.04.023, 82 and 2020.06/06.83, respectively). To FCT, I+D, within the scope of the project PRIMA Section 2 - Multi-topic 2019: PulpIng (PRIMA/0007/2019). This work was also funded by the General Secretariat for Research and Technology of Greece and PRIMA foundation under the project Valuetarm (Tarma 2019-11).

ANNEX D2.8J



Certificado de participação

Certifica-se que o(a) Senhor(a)

Maria Gabriela Leichtweis

estive presente no XVI Encontro de Química dos Alimentos em PCB - Castelo Branco, de 23 a 26 outubro 2022

Por A Comissão Organizadora

Certificado de comunicação

Certifica-se que o(a) Senhor(a)

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apresentou a Comunicação em Palete Híbrida

Evaluation of the potential preservative capacity of pumpkin (*Cucurbita maxima Duchesne*) by-products

no XVI Encontro de Química dos Alimentos, na PCB - Castelo Branco, de 23 a 26 outubro 2022

A Comissão Organizadora:



BIO-SUSTENTABILIDADE E BIO-SEGURANÇA ALIMENTAR, INOVAÇÃO E QUALIDADE ALIMENTAR

23-26 de outubro de 2022

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Evaluation of the potential preservative capacity of pumpkin (*Cucurbita maxima Duchesne*) by-products

Leichtweis MG^{1,2}, Mollou AG,¹ Pereira C,² Pires T, C², Calhau R,¹ Neji Tarcisou,³ Oliveira MRP^{2,7} Ferreira KCR,⁴ Barros L¹

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Large amounts of fruits and vegetables are lost or wasted along the food supply chain. This occurs at the harvest level, for not meeting the sales standard, in the failure of transport and logistics, at the household level due to underutilization and discards, and many others.¹ A considerable portion of this waste generation is from the food processing industry, which has different leftovers such as peels, seeds, bagasse, leaves, fibers, and stalks, that are generally not recovered for reuse. Despite little explored and with low commercial value, these bioresidues and by-products have been shown to contain important high value added compounds.² These compounds, such as polyphenols, alkaloids, flavonoids, carotenoids, etc., are originated in the secondary metabolism of the plant, therefore generally presenting bioactive and functional properties. The potential of recovery of these compounds and their application in foodstuff as natural additives has been increasingly demonstrated in the literature.³ The present work proposed to evaluate the by-products obtained in the pumpkin industrial processing as a source of preservative compounds. Pumpkin seeds are consumed as snack in some regions; however, this part of the fruit, as well as the peel and fibers, are poorly utilized, being a cheap and promising matrix to be explored. In this sense, the by-products of pumpkin cultivated in Tunisia were evaluated for their bioactive properties, more specifically, in terms of preservative capacity. For that purpose, the hydroalcoholic extracts of the peel and the mix of seeds and fibers from the "Bataïl", "Kerkouli", and "Béjaoui" varieties were assessed. For the antimicrobial activity evaluation, the cell-based method of the inhibition of lipid peroxidation (TBARS) was applied. The antibacterial and antifungal activity was tested against 10 microorganisms of interest in food preservation. Moreover, non-sterile cells of a primary culture of gastric cancer (PCJ2) were used to assess the cytotoxicity through the sulforhodamine B (SRB) colorimetric assay. Through this study, all the samples presented great preservative potential, since they protected at least 5 of the 10 tested strains of microorganisms, such as *Aspergillus brasiliensis*, *Staphylococcus aureus*, *Escherichia coli*, *Saccharomyces cerevisiae*, and *Termonium esterocorallizans*, at concentrations up to 10 mg/mL, and showed great antioxidant results, reaching values about 100-2 times higher than the positive control Trolox. The highest antioxidant activity was presented by the seeds and fibers of "Kerkouli" and "Béjaoui", while for the "Bataïl" variety, the results were quite similar between the peel and the mix of seeds and fibers. Regarding the antimicrobial activity, the peel presented better results than the seeds and fibers in the antibacterial assay, and the opposite was noticed in the antifungal evaluation. All the mix samples protected against the 2 tested strains of fungi; the peel of "Bataïl" and of "Kerkouli" inhibited 6 of 8 bacterial strains, and none of the samples presented bactericidal nor fungicidal effect. Furthermore, the safety of food application of the samples was verified by the absence of toxicity in the primary culture of non-tumor canine liver cells (PLP2), at the maximum concentration tested (400 µg/mL). These results corroborate the purpose of valuing pumpkin by-products as a source of natural preservative compounds with interest for application in food products, thus promoting the replacement of synthetic additives by a natural alternative obtained from underexplored matrices.

Acknowledgments: The authors are grateful to the Foundation for Science and Technology (FCT, Portugal) for financial support through national funds (PCT/MCTES to CIAM) (UIDB/06690/2020); national funding by FCT, P.L., through the institutional scientific employment program contract for C. Pereira and L. Barros contract and A. K. Molina and M. G. Leichtweis PhD grants (2020/01624-BJ and 2020/01796-BJ, respectively); to FCT, P.L., within the scope of the Project PRIMA-Sector 2 - FIBIT (ref: 2018-PulpIng (PRIMA/050/2018)).

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153865 NATURAL COMPOUNDS WITH PRESERVATIVE CAPACITY OBTAINED FROM BY-PRODUCTS OF PUMPKIN INDUSTRIAL PROCESSING	✓ Approved

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ANNEX D2.8L

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Resumo Cabeçalhos Texto simples

Buenos días Maria Gabriela Leichtweis,

Le informamos que su comunicación titulada "*Recuperação de subprodutos da indústria alimentar para extração otimizada de compostos fenólicos*" en formato *Póster / Poster* ha sido aceptada para su presentación en el **XXVI Encontro Galego Português de Química**

Atentamente

Comisión Organizadora



Químicos de Galicia

ASOCIACIÓN DE QUÍMICOS DE GALICIA

SOCIETATE PORTUGUEZA DE QUÍMICA

encontro@colquiiga.org

<https://www.encontrogalegoportugues.org/>

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ANNEX D2.80




COMUNICACIÓN ACEPTADA



De Secretaría Colegio de Químicos

Para mariagabriela@ipb.pt

Data 2022-10-26 10:10

 Resumen  Cabeçalhos  Texto simples

Buenos días María Gabriela Leichtweis,

Le informamos que su comunicación titulada “ *Identificação e otimização da extração de compostos fenólicos de cascas de abóbora ‘Butternut squash’*” en formato *Póster / Poster* ha sido aceptada para su presentación en el **XXVI Encontro Galego Português de Química**

Atentamente

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