

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

LEICHTWEIS^{1,2,a}, M.G.; MOLINA^{1,2,b}, A.K.; PEREIRA^{1,2,c*}, C.; DIAS^{1,2,d}, M.I.; PIRES^{1,2,e}, T.C.S.; CALHELHA^{1,2,f}, R.C.; BACHARI^{3,g}, K.; ZIANI^{3,h}, B.E.C.; OLIVEIRA^{4,i}, M.B.P.P.; FERREIRA^{1,2,j}, I.C.F.R.; BARROS^{1,2,k}, L.

¹ Centro de Investigação de Montanha (CIMO), Instituto Politécnico de Bragança, Portugal; ^amariagabriela@ipb.pt; ^bamolina@ipb.pt; ^{c*}carlap@ipb.pt; ^dmaria.ines@ipb.pt; ^etaniampires@ipb.pt; ^fcalhelha@ipb.pt; ^jiferreira@ipb.pt; ^klillian@ipb.pt

² Laboratório Associado para a Sustentabilidade e Tecnologia em Regiões de Montanha (SusTEC), Instituto Politécnico de Bragança, Portugal

³ Centre de Recherche Scientifique et Technique en Analyses Physico-Chimiques-CRAPC, Bou Ismaïl – Algeria, ^gk.bachari@mesrs.dz, ^hziani.ensa@gmail.com

⁴ REQUIMTE - Science Chemical Department, Faculty of Pharmacy, University of Porto – Portugal, ⁱbeatoliv@ff.up.pt

Keywords: Preservative compounds; Pumpkin by-products; Circular economy

Summary: The search for cheap and suitable sources of natural compounds with functional properties as an alternative for the replacement of synthetic additives is growing. Part of this occurs in the food industry, which is under pressure to offer healthier products, but still convenient and durable. However, great potential can be found inside the industry itself, once large amounts of fruits and vegetables are discarded during food processing. These wastes comprise leaves, seeds, skin, bagasse, and juices, which are rich in high value-added compounds that present functional and bioactive properties. The present work purposed to explore the by-products of pumpkin industrial processing as source of natural compounds with preservative capacity for food application. For this purpose, pumpkin peel, seeds, and fibers were evaluated. These by-products were obtained from the pumpkin varieties “Butternut squash”, “Gold nugget pumpkin”, and “Musquée de Provence” grown in Algeria. The preservative capacity of their extracts was assessed by two biological antioxidant methods, more specifically the lipid peroxidation inhibition capacity (TBRAS) and the inhibition of oxidative hemolysis (OxHLIA), and the antimicrobial assessment, tested against eight strains of bacteria, and two strains of fungi with relevance in food safety. As a first validation of safety for food application, the

cytotoxicity was evaluated in a primary culture of non-tumor porcine liver cells (PLP2). Furthermore, the phenolic composition analysis was performed by HPLC-DAD-ESI/MS. The pumpkin by-products presented great preservative capacity. All samples showed microbial inhibition capacity and high antioxidant activity, especially the seeds of “Butternut squash” and “Gold nugget pumpkin”. Despite the second one did not present anti-hemolytic properties, probably due to the interference of its fat content, it presented a TBARS IC₅₀ value lower than the control Trolox. These samples also presented better antibacterial activity than the remaining by-products, protecting against seven of the eight bacterial strains tested. All samples inhibited at least two strains of bacteria and one of two fungal strains, and none of them presented bactericidal nor fungicidal capacity, at the maximum concentration tested of 10 mg/mL. Regarding the cytotoxicity, none of the samples showed toxicity in the primary culture of non-tumor porcine liver cells (PLP2), up to the maximum concentration tested of 400 µg/mL. Interestingly, the peel of “Butternut squash” presented the most heterogeneous phenolic profile, with O-glycosylated flavonoids as the major compounds, specially isorhamnetin-O-dideoxyhexosyl-hexoside ([M-H]⁻ at *m/z* 769). Other type of compounds, such as citric acid ([M-H]⁻ at *m/z* 191) and 4-O-(6'-O-glucosyl-4"-hydroxybenzoyl)-4-hydroxybenzyl alcohol ([M-H]⁻ at *m/z* 405), have also been tentatively identified among all varieties and by-products.

These results revealed pumpkin by-products as cheap and promising sources of preservative compounds for food application, fostering more sustainable food supply chain and promoting natural ingredients that add functional properties to the product with benefits to consumer health.

Enter the project / scholarship number (FAPESP, CAPES, CNPQ, etc.):

The authors are grateful to the Foundation for Science and Technology (FCT, Portugal) for financial support through national funds FCT/MCTES (PIDDAC) to CIMO (UIDB/00690/2020 and UIDP/00690/2020) and SusTEC (LA/P/0007/2020); national funding by FCT, P.I., through the institutional scientific employment program-contract with C. Pereira, M.I. Dias, and L. Barros 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: Pulping (PRIMA/0007/2019).