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

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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, 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 stalk, 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 proprieties. 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 word 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 pumpkins cultivated in Tunisia were evaluated for their bioactive properties, more specifically, in terms of preservative capacity. For that purpose, the hydroethanolic extracts of the peel and the mix of seeds and fibers from the "Batati", "Karkoubi", and "Bejaoui" varieties were assessed. For the antioxidant 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-tumor cells of a primary culture of porcine liver (PLP2) 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*, *Salmonella 5 enterocolitica*, and *Yersinia enterocolitica*, in concentrations up to 10 mg/mL, and showed great antioxidant results, reaching values about just 2 times higher than the positive control Trolox. The highest antioxidant activity was presented by the seeds and fibers of "Karkoubi" and "Bejaoui", while for the "Batati" 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 "Batati"and of "Karkoubi" 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 porcine 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.

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