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PhD Dissertation

Entitled

CHARACTERIZATION OF THE PROBIOTIC PROPERTIES OF YEAST STRAINS ISOLATED FROM DIFFERENT FOOD SOURCES AND UNRAVELING THE POTENTIAL NUTRITIONAL BENEFITS OF FERMENTED DATE PALM POMACE WITH SELECTED PROBIOTIC CANDIDATES: UNTARGETED METABOLOMICS AND CARBOHYDRATE METABOLITES OF IN VITRO DIGESTED FRACTION

by

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Abstract

Utilizing fermentation with probiotics offers a promising opportunity to leverage agricultural by-products, such as date palm pomace (DPP), in order to drive forward sustainable food production endeavors. This dissertation aimed to (1) isolate yeast from fermented food products as well as to characterize their probiotic properties; (2) investigate the physiochemical properties of fermented DPP by selected yeast isolates; (3) evaluate the health benefits of non-fermented and fermented DPP samples both pre and post-digestion (bioaccessible portions); and (4) analyze the untargeted metabolites and carbohydrates metabolites in the bioaccessible portions. The yeast isolates showed remarkable survivability in acidic environment while bile salt tolerance increased with incubation time. Out of 105 isolates obtained, the 12 promising isolates were selected for further screening of their probiotic characteristics. All 12 yeast strains had good cell surface properties and showed the capability to hydrolyze investigated bile salts, display heat resistance, possess potent antimicrobial activity, facilitate cholesterol removal, and engage in EPS production. The ability to adhere to the HT-29 cell line was an average of 6.3 Log_{10} CFU/mL after 2 h. The study identified 12 yeast isolates through ITS/5.8S ribosomal DNA sequencing. Four distinctive isolates, namely *P. cecembensis*, *I. orientalis, S. cerevisiae*, and *P. kudriavzevii*, were selected for fermenting DPP. The fermentation of DPP resulted in the abundance of malic acid and the identification of 42 volatiles, with different predominance observed in the samples. Twenty phenols were determined by U-HPLC in fermented DPP, with (-)-epicatechin being the most abundant. Bioaccessibility studies revealed that fermented DPP samples exhibited improved α-amylase inhibition compared to non-fermented and undigested samples. *In vitro* cytotoxicity assays showed a more potent inhibitory effect of fermented DPP against MCF-7 and Caco2 cell lines compared to non-fermented DPP. Two yeast isolates, *I. orientalis and P. kudriavzevii*, were used to analyze untargeted metabolites and carbohydrate metabolites. The untargeted metabolomics analysis identified C5-branched dibasic acid metabolism and biosynthesis of secondary metabolites as the most prominent pathways in fermented samples by *P. kudriavzevii and I. orientalis, respectively*. Moreover, The LC-QTOF analysis of bioaccessible carbohydrate metabolites revealed the presence of two phytochemical groups, alkaloids and terpenoids, in the *I. orientalis* sample and three terpenoid metabolites in the *P. kudriavzevii* sample. This research provides an understanding of the physiochemical properties and metabolic pathways involved in fermented DPP, contributing to the development of functional foods.

Keywords: Date pomace, antioxidant, antidiabetics, cytotoxicity, phenolic compounds, untargeted metabolites.