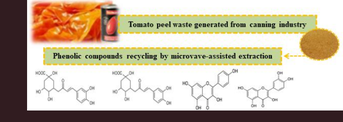
19. međunarodni znanstveno-stručni skup
Ružičkini dani
DANAS ZNANOST – SUTRA INDUSTRIJA
21. – 23. rujna 2022. | Vukovar, Hrvatska



EFFECT OF MICROWAVE-ASSISTED EXTRACTION ON THE RECOVERY OF POLYPHENOLS FROM TOMATO WASTE

Marina Tranfić Bakić[a], Sandra Pedisić[b], Zoran Zorić[b], Verica Dragović-Uzelac[b], Antonela Ninčević Grassino[b]

[a]Faculty of Chemistry and Technology, University of Split, Ruđera Boškovića 35, 21000 Split, Croatia

[b]Faculty of Food Technology and Biotechnology, University of Zagreb, Pierottijeva 6, 10000 Zagreb, Croatia

INTRODUCTION

Industrial processing of tomatoes generates significant amounts of waste, consisting mainly of tomato peels and seeds, but also leaves and stems. The management of tomato processing by-products is an important problem for tomato processing companies, as these wastes are released into the environment. However, modern environmentally sound technologies offer more efficient strategies for recycling these by-products and reusing them as a sustainable source of various nutrients and highly biologically active compounds such as polyphenols. In this context, the present study describes the application of microwave-assisted extraction (MAE) as an innovative technique for the isolation of polyphenols from tomato peel waste. The effects of solvents, temperatures, and times were evaluated by HPLC-DAD analyses with respect to the recovery of phenolic compounds

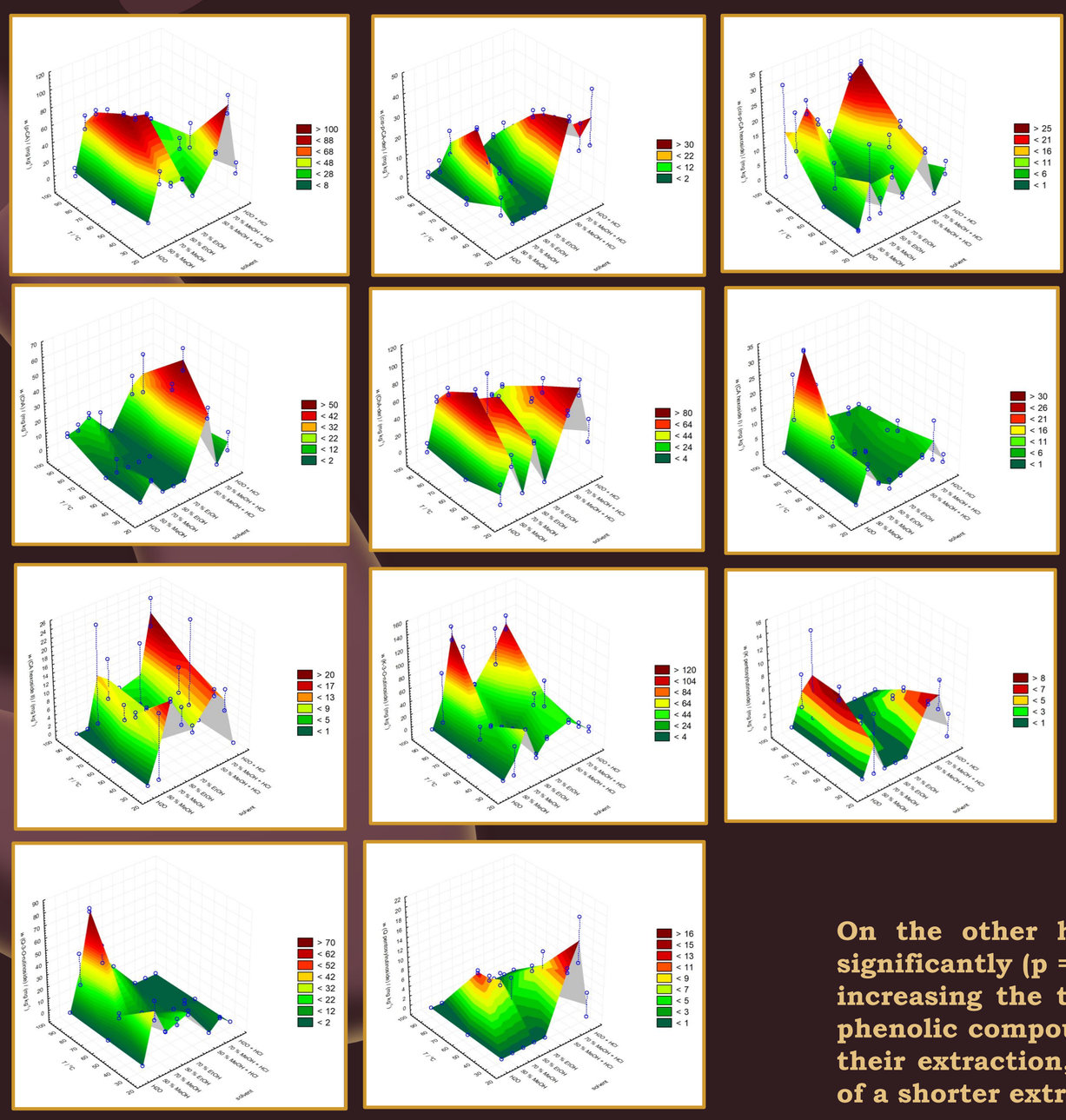
MATERIALS AND METHODS

MAE was performed with water and aqueous solution of HCl (1%, *v*/*v*), methanol (50% and 70%, *v*/*v*), with or without addition of 1% HCl and ethanol (50% and 70% *v*/*v*), at times of 5 and 10 min and temperatures of 25, 55, and 90 °C

After extraction, HPLC analysis of the individual phenolic compounds in the tomato peel extracts was performed using a liquid chromatograph (Agilent Technologies Series 1260) with a quaternary pump and a diode array detector (DAD). Results are expressed as mg of phenolic compounds per kg of tomato peels.

RESULTS AND DISCUSSION

The individual phenolic compounds (Fig. 1), namely the phenolic acids and their derivatives: *p*-coumaric acid (*p*-CA), cis-*p*-coumaric acid derivative (cis-*p*-CA -der), *p*-coumaric acid hexoside (cis-*p*-CA hexoside), chlorogenic acid (ChA), chlorogenic acid derivative (ChA-der), caffeic acid hexoside I (CA hexoside I) and caffeic acid hexoside II (CA hexoside II), and the flavonols quercetin pentosylrutinoside (Q-pentosylrutinoside), quercetin 3-O-rutinoside (Q-3-O-rutinoside), kaempferol pentosylrutinoside (K-pentosylrutinoside), and kaempferol 3-O-rutinoside (K-3-O-rutinoside), were quantified by HPLC-DAD.



The results showed that among phenolic acids and their derivatives, *p*-CA (3 to 111.5 mg kg^{-1}) and ChA der (10.5 to 109 mg kg^{-1}) were predominant, compared with ChA (6 to 62 mg kg^{-1}) and cis-*p*-CA-der (1 to 47.5 mg kg^{-1}). Among the other derivatives, cis-*p*-CA hexoside (0.5 to 29 mg kg^{-1}), CA hexoside I (1.5 to 31 mg kg^{-1}), and CA hexoside II (9 to 25 mg kg^{-1}) were found in lower amounts. Among the flavonols, K-3-O-rutinoside was found in the highest amounts, 8.5 to 142.5 mg kg^{-1}, depending on the solvent, temperature and time used. Q-3-O-rutinoside was also found in considerable amounts (3 to 78 mg kg^{-1}), compared with Q-pentosylrutinoside (4.5 to 21 mg kg^{-1}) and K-pentosylrutinoside (2.5 to 13 mg kg^{-1}).

The obtained mass fractions of phenolic compounds depend on the extraction conditions, focusing on the interaction between the selected temperature and solvent (Fig. 1). For example, the addition of 1% HCl to 50% or 70% methanol ensures good recovery of most phenolic acids and their derivatives. However, with 50% and especially 70% methanol, some flavonols, such as K-3-O-rutinoside, could be better recovered. In addition, special attention should be paid to temperature at MAE, since an increase in temperature can strongly affect the degradation of cis-*p*-CA -der and Q-pentosylrutinoside and the increase in the amounts of cis-*p*-CA hexoside, CA hexoside I, and K-3-O-rutinoside.

On the other hand, increasing the extraction time from 5 to 10 minutes significantly ($p = 0.044719$) affected the content of cis-p- CA hexoside. However, increasing the time did not significantly affect the recovery of other isolated phenolic compounds. Therefore, the extraction time of 5 minutes is suitable for their extraction, according to the main advantage of MAE, i.e., the application of a shorter extraction time.

Figure 1. Influence of solvents and temperature (25, 55 and 90 °C) and time on mass fractions of individual phenolic compounds extracted from tomato peel waste by MAE.

CONCLUSION

This study demonstrated that tomato peel waste from the canning industry can be used as a sustainable, cost-effective source for the extraction of polyphenols with minimal time (5 min) using MAE. Of the extraction parameters evaluated, temperature and solvent have a significant effect on the yield of phenolic compounds. Different combinations of these parameters result in the isolation of different amounts of individual phenolic compounds. Therefore, further MAE extractions of tomato peel waste should be performed combining temperature and solvent type to isolate one or more target compounds with similar structures and properties.

ACKNOWLEDGEMENTS

The authors are grateful to Giovanni Paolo Buoninconti from Benincasa S.r.l., Angri (SA) canning industry for providing the tomato peel waste.