EDIBLE OIL ENRICHMENT WITH CAROTENOIDS FROM CARROT WASTE

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INTRODUCTION

Edible oils include a large variety of products, representing an important source of essential fatty acids and liposoluble vitamins. However, polyunsaturated oils like sunflower oil, pumpkin seed oil or linseed oil are susceptible to oxidation, so their protection by enrichment with antioxidants represents a promising way to extend their shelf-life. Synthetic compounds such as butylhydroxyanisole, butylhydroxytoluene and tert-butyl-hydroquinone are widely used antioxidants for this purposes due to their low cost, high stability and efficacy. However, possible toxicological effects on human health have been observed and some countries banned their utilization. Recent research has focused on the utilization of fruit and vegetable by-products as potential sources of natural antioxidants. **Carrot** (*Daucus carota* L.) waste has attracted considerable attention due to the potential health benefits of its lipophilic bioactive compounds, mainly carotenoids. Carrot processing generates wastes in the form of peels and pomaces, which can create serious nutritional, economic and environmental issues. Consumption of carotenoids has been associated with various health benefits, including a reduced risk of age-related macular degeneration and cataract, some cancers and coronary heart disease.

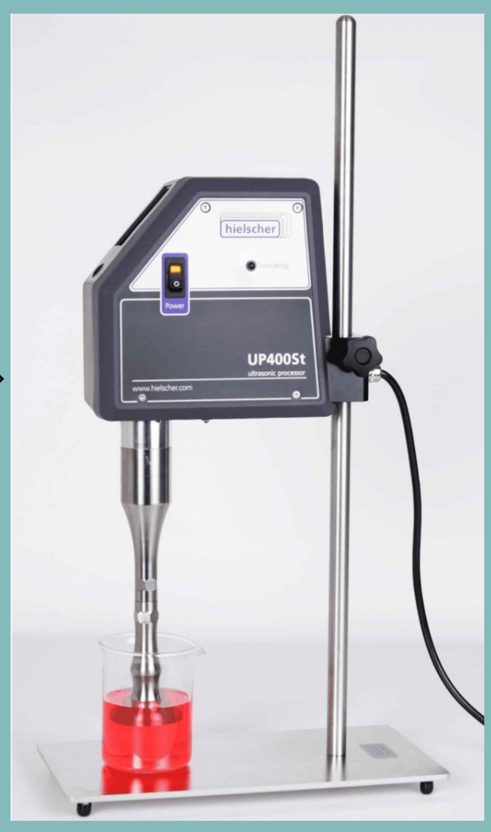
MATERIALS AND METHODS

Fresh carrot waste was obtained from the “Nectar” beverage industry (Bačka Palanka, Serbia), immediately packed, freeze-dried and stored at −20 °C until further use. In all experimental runs, 10 g of lyophilized carrot waste was mixed with 100 mL of selected edible oils (sunflower oil (SO), linseed oil (LO) and pumpkin seed oil (PO)) and exposed to ultrasonic probe (Hielscher UP400St) at different amplitude levels (20, 40 and 60%) until temperature of mixture reached 60 °C. The Shimadzu Prominence chromatography system with SPD – 20AV UV–Vis detector (Shimadzu, Japan) was used for HPLC analysis of carotenoids. Chromatography was performed in solvent gradient by varying the proportion of solvent A (20% (v/v) water and 80% (v/v) methanol) and solvent B (50% (v/v) acetone and 50% (v/v) methanol) at flow rates of 1 mL/min with the following gradient profile: 25% B 0–3 min; 75% B 3–6 min; 90% B 6–10 min; 100% B 10–18 min; 50% B 18–25 min; 25% B 25–32 min, according to the procedure previously described by Šeregelj et al., 2019. Analyzed samples were diluted in hexane and identified by matching the retention time and spectral characteristics against those of standards.


Carrot waste


Freeze dryer


Lyophilized carrot waste

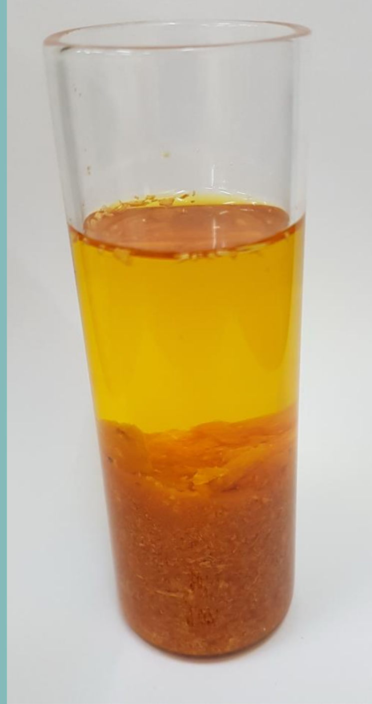


Ultrasonic probe

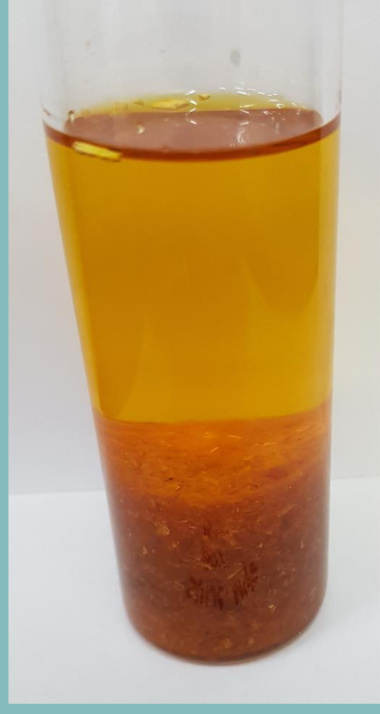
RESULTS

Sample	α-Carotene	β-Carotene	Lutein	Zeaxanthin	β–Cryptoxanthin
mg/kg					
SO	nd	nd	nd	nd	nd
SO 20% 30’	4.28 ± 0.02	19.33 ± 0.01	nd	nd	nd
SO 40% 4’19’’	6.17 ± 0.01	21.22 ± 0.03	nd	nd	nd
SO 60% 3’16’’	3.25 ± 0.01	17.56 ± 0.06	nd	nd	nd
LO	nd	nd	5.56 ± 0.02	0.73 ± 0.01	0.41 ± 0.01
LO 20% 24’	7.07 ± 0.00	25.63 ± 0.05	4.97 ± 0.04	0.56 ± 0.00	0.36 ± 0.02
LO 40% 5’	1.12 ± 0.01	13.71 ± 0.02	4.99 ± 0.02	0.51 ± 0.01	0.33 ± 0.01
LO 60% 2’	1.11 ± 0.01	12.14 ± 0.06	5.01 ± 0.03	0.53 ± 0.01	0.35 ± 0.01
PO	0.12 ± 0.00	0.51 ± 0.00	0.03 ± 0.00	2.38 ± 0.06	0.42 ± 0.02
PO 20% 24’	0.21 ± 0.01	1.21 ± 0.00	0.02 ± 0.00	2.21 ± 0.03	0.38 ± 0.06
PO 40% 5’28’’	0.19 ± 0.02	1.06 ± 0.05	0.03 ± 0.00	2.17 ± 0.05	0.37 ± 0.01
PO 60% 2’53’’	0.30 ± 0.01	1.35 ± 0.01	0.03 ± 0.00	2.29 ± 0.02	0.40 ± 0.02

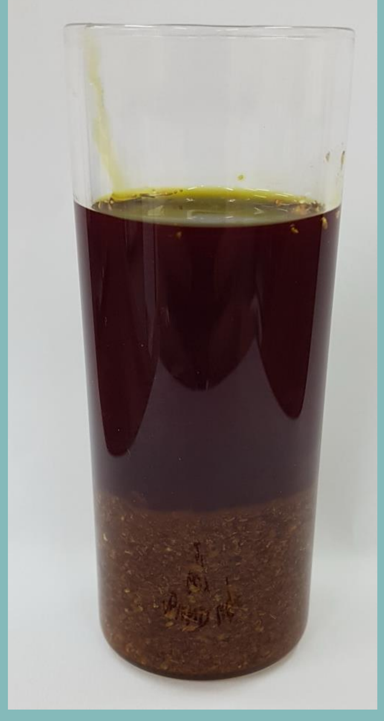
SO 20% 30’



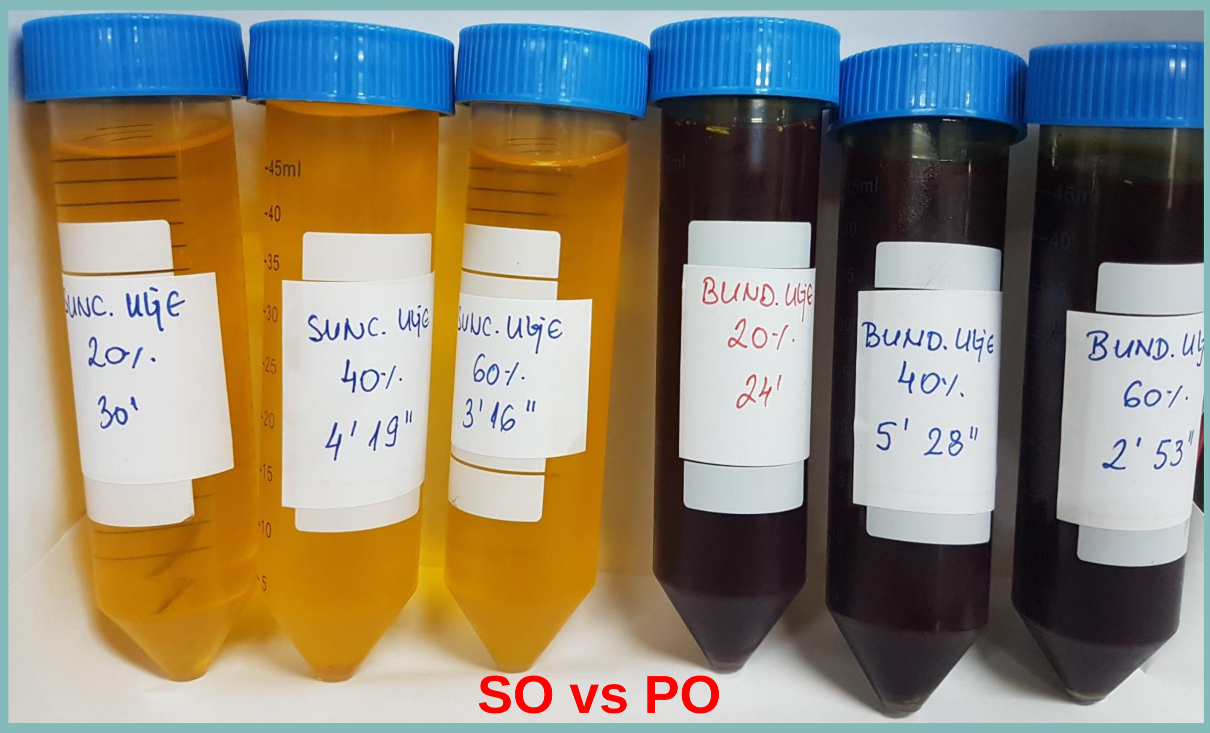
SO 60% 3’16’’

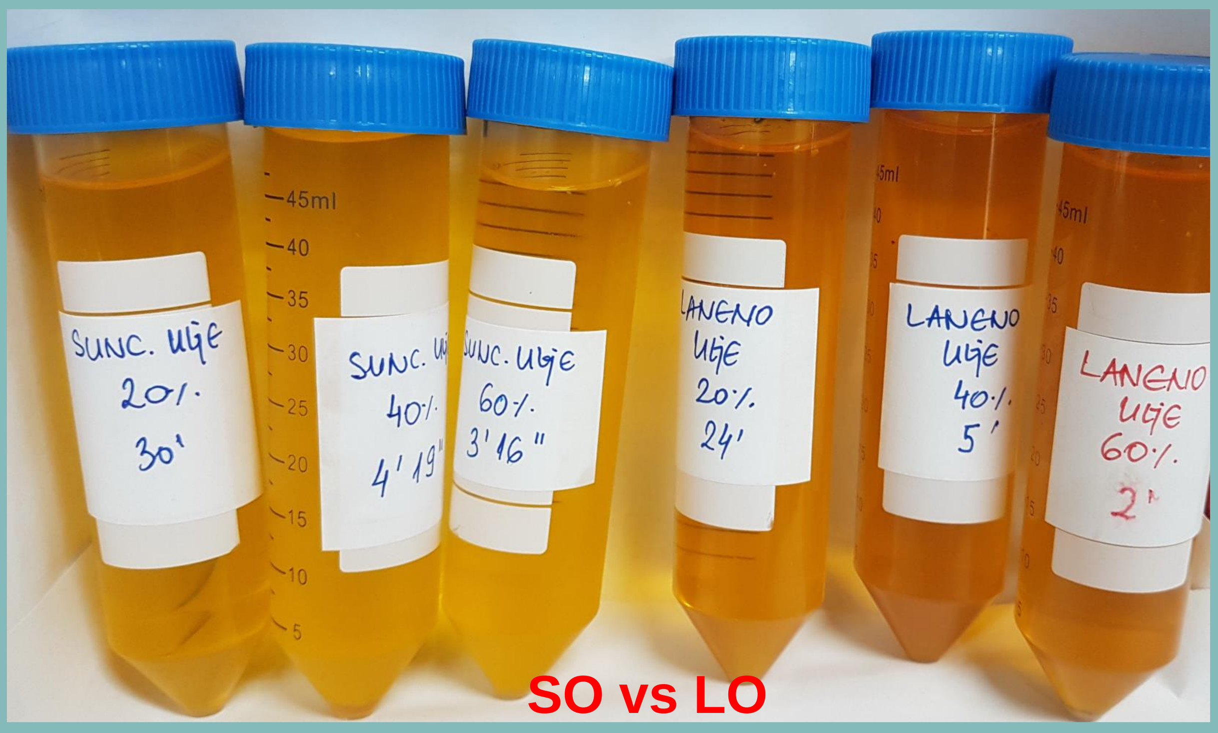


PO 60% 2’53’’



PO 20% 24’





CONCLUSION

Carrot waste contains high amounts of residual bioactives with currently low commercial value. Enrichment of edible oils with α-carotene and β-carotene contributed to stability towards oxidation reactions and provided high-quality value-added oil. The most efficient enrichment of sunflower oil was at 40% amplitude level. In case of linseed oil, the highest enrichment was achieved at 20% especially for β-carotene (25.63 mg/kg), while in case of pumpkin seed oil the most convenient amplitude was 60%.Unfortunately, the contents of lutein, zeaxanthin and β-cryptoxanthin in linseed and pumpkin seed oils slightly decreased with applying ultrasound.

KEYWORDS: carrot waste, carotenoids, lyophilization, ultrasound probe

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