

BIOLOGICAL ACTIVITY OF *Satureja montana* L. ETHANOLIC EXTRACTS AND THEIR EFFECT ON OXIDATIVE STABILITY OF COLD PRESSED SUNFLOWER OIL IN LONG-TERM STORAGE CONDITIONS

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INTRODUCTION

- ▶ Medicinal plants represents a rich source of phytochemicals, many of which possess diverse biological activities.
- ▶ *Satureja montana* (winter savory), member of Lamiaceae family, is aromatic plant commonly used as flavouring agent and as a culinary herb in traditional cuisine.
- ▶ Numerous studies have confirmed the significant biological activity of winter savory extracts and essential oils, including antioxidant.
- ▶ In the deterioration of edible oils oxidation process play important role.
- ▶ Undesirable changes caused by oxidation cannot be avoided but they can be delayed through the use of suitable antioxidant.
- ▶ In that purpose, winter savory extracts (WSEs) were used in cold pressed sunflower oil (CPSO) in order to delay oxidative changes during long-term storage.



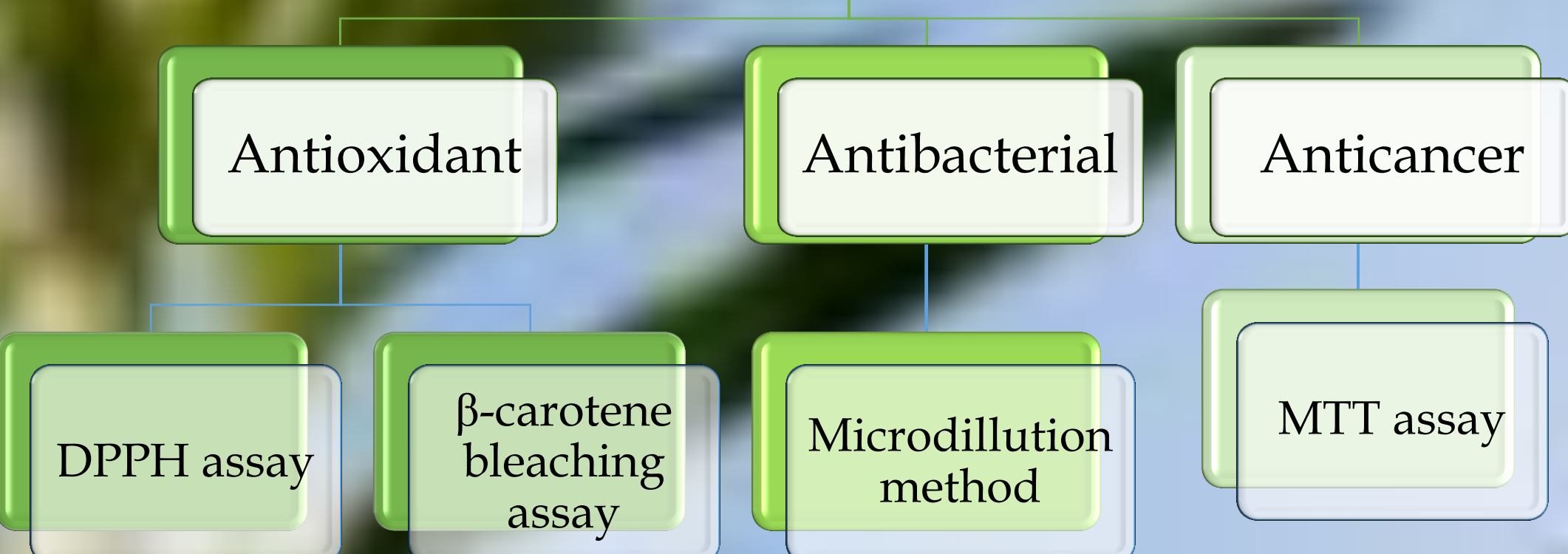
OBJECTIVES

- 1) to assess antioxidant, antibacterial and anticancer activities of WSEs
- 2) to monitor the changes of oxidative status during long-term storage conditions of CPSO with addition of WSEs at various concentrations

MATERIAL AND METHODS

- ▶ Dried winter savory aerial parts were obtained from the Institute for Medicinal Plant Research "Dr Josif Pančić" (Pančevo, Serbia) in 2016 (Serial No. 02810216). The plant material was ground into powder immediately before the extraction process. Two extraction techniques, Soxhlet extraction (SE) and ultrasound assisted maceration (UAM) were performed using 70 and 96% ethanol.
- ▶ Cold pressed sunflower oil was obtained from Uvita D.O.O. company (Debeljača, Serbia).

Assessment of bioactivities



Addition of WSEs in CPSO

- ▶ WSEs were added in CPSO at various concentration (250, 500 and 1000 ppm)
- ▶ Control samples:
 - Positive: synthetic antioxidant butylated hydroxytoluene (BHT) (200 ppm)
 - Negative: CPSO without any additive

Analysed parameters of oxidative status:

- ✓ Peroxide value (PV)
- ✓ Anisidine value (AnV)
- ✓ Conjugated dienes (CD)
- ✓ Conjugated trienes (CT)

Storage conditions:

- ✓ Room temperature
- ✓ Without light
- ✓ Six months
- ✓ Monthly shaking and opening only for sampling

RESULTS

Type of extract/standard*	DPPH (% of inhibition)	β-CB test (% of inhibition)
SE ₇₀	56.55 ± 1.73	67.05 ± 1.79
SE ₉₆	34.31 ± 1.86	65.44 ± 2.24
UAM ₇₀	51.50 ± 1.00	63.21 ± 1.40
UAM ₉₆	30.35 ± 0.42	61.37 ± 2.27
BHT	34.31 ± 0.43	56.29 ± 1.44
BHA	43.33 ± 0.87	57.70 ± 1.91

*concentration of the tested extracts and standards was 0.1 mg/mL

In both assays, extracts showed remarkable antioxidative properties which were equal or stronger than those of BHT and BHA. Also, regardless the extraction method and assay applied, the 70% ethanol extracts proved to be more potent than 96% ethanol ones.

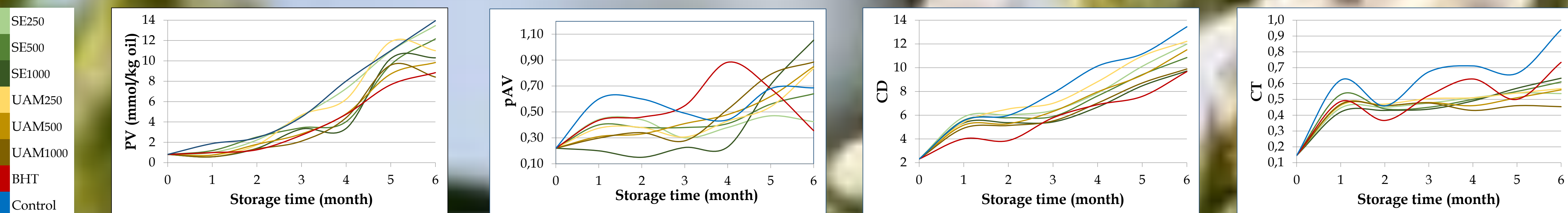
Type of extract	G (+) bacteria		G (-) bacteria	
	<i>S. aureus</i> ATCC 25923	<i>L. monocytogenes</i> ATCC 1911	<i>E. coli</i> ATCC 25922	<i>S. enterica ser. Typhimurium</i> ATCC 14028
	Minimal inhibitor concentration (MIC) (mg/mL)			
SE ₇₀	0.0781	0.1562	5	1.25
SE ₉₆	0.0781	0.1562	5	2.5
UAM ₇₀	0.0781	0.1562	5	2.5
UAM ₉₆	0.1562	0.3125	10	2.5

Tested Gram-negative bacteria were more resistant than Gram-positive with MIC=1.25-10 µg/mL and 0.0781-0.3125 µg/mL, respectively. As in antioxidative assays, UAM₉₆ was the weakest extract while the SE₇₀ extract proved to be the strongest one.

Tested tumor cell lines were:

- PC-3 (prostate)
- HT-29 (colon)
- HeLa (cervix)

In applied concentration range (10 - 100 µg/L) WSEs didn't show anticancer activity (IC₅₀>100 µg/L).



Considering that the tested CPSO is highly susceptible to oxidation due to its high linoleic acid content (75.8%), it can be concluded that WSEs are good antioxidants at all applied concentrations but whose effect is weaker than BHT. The formation of both primary and secondary oxidation products is present in all samples. The values of the tested parameters of oxidative status after six months are the lowest in the case of UAM₁₀₀₀ extract and the sample with added BHT.

CONCLUSIONS

- ✓ WSEs showed excellent antioxidant and antibacterial potential but the anticancer effect was absent in applied concentration range.
- ✓ Based on obtained results, winter savory may be considered as an interesting agent for delaying of oxidative deterioration of oil especially cold pressed oils, which are characterized by a lack of oxidative stability.

