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Bioactivity of *Apium petroselinum* and *Portulaca oleracea* Essential Oils as Natural Preservatives

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Dear Editor,

Nowadays, essential oils are used in different products such as food as natural antioxidants, antibacterial and flavoring compounds (1). Essential oils are used as a replacement for chemical preservatives such as butylated hydroxytoluene (BHT) and tertiary butyl hydroquinone (TBHQ) that can threaten human health as cancer promoters (2). Nearly 3000 different essential oils are known today, and 300 are available and used commercially (3). They are obtained from aromatic plants and their various parts including roots, stems, leaves, flowers, fruits and seeds (4). The aim of this study was to evaluate the antioxidant activity and antibacterial effects of *Apium petroselinum* and *Portulaca oleracea* essential oils on food spoilage bacteria. *A. petroselinum* and *P. oleracea* were purchased from the local grocery stores of Shahrekord city and authenticated by standard botanic work at the Medical Plants Research Center of Shahrekord University of Medical Sciences, Iran. Essential oils were then extracted by steam distillation for three hours using a Clevenger-type apparatus and dried by adding anhydrous sodium sulfate and stored at 4°C, before being used for the assay. Total phenolic contents in the obtained essence were examined by the Folin Ciocalteu method and the results were expressed as milligrams of gallic acid equivalents (GAEs)/gram of essential oil. The total antioxidant capacities of their essential oils were assayed using β-carotene and linoleic acid (5).

Cultures of *Alcaligenes faecalis* (PTCC 1624), *Providencia rettgeri* (PTCC 1512), *Serratia marcescens* (PTCC 1621), *Klebsiella oxytoca* (PTCC 1402), *Staphylococcus aureus* (PTCC 1169), *Shigella dysenteriae* (PTCC 1188) and *Listeria monocytogenes* (PTCC 1163) were purchased from the Iranian Research Organization for Science and Technology (IROST). The micro-dilution method in sterile 96-microwell plates was used to obtain the minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC) (6). Each experiment was done in triplicates. Based on the obtained results, the two essential oils demonstrated antioxidant and antibacterial activities. The most sensitive bacteria were *A. faecalis* and *S. dysenteriae,* which are Gram-negative bacteria (Table 1). The results obtained in this work are in agreement with pervious studies. Earlier studies have reported that various bacteria such as *S. dysenteriae*, *E. coli*, *Helicobacter pylori* and *S. aureus* were sensitive to essential oils and extracts of the above mentioned plants (7, 8). However, the Gram-negative bacteria were more resistant than Gram-positive species, due to restricted diffusion of the hydrophobic compounds by the hydrophilic cell wall structure containing lipo-polysaccharide (LPS) (9). In conclusion, the study results suggest that replacement of synthetic preservatives with natural additives as a good source of healthy compounds, namely phenols (10), can be useful in the food industry to increase shelf life of food products.

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Table 1. Antioxidant and Antibacterial Characteristics of *Apium petroselinum* and *Portulaca oleracea* Essential Oils [a]

	Apium petroselinum	Portulaca oleracea	BHTa
Total Phenolic Content (mg GAEs/g)	8.18 ± 0.45	7.8 ± 0.2	-
Antioxidant Capacity, %	45 ± 1.52	56.5 ± 4.19	90.6 ± 3.30
Antibacterial activity			
Alcaligenes faecalis			
MIC mg/mL	1.562	6.25	-
MBC, mg/mL	3.125	12.5	-
Providencia rettgeri			
MIC, mg/mL	6.25	12.5	-
MBC, mg/mL	12.5	25	-
Serratia marcescens			
MIC mg/mL	3.125	12.5	-
MBC, mg/mL	6.25	25	-
Klebsiella oxytoca			
MIC, mg/mL	12.5	12.5	-
MBC, mg/mL	25	25	-
Staphylococcus aureus			
MIC, mg/mL	12.5	12.5	-
MBC, mg/mL	25	25	-
Shigella dysenteriae			
MIC, mg/mL	1.562	6.25	-
MBC, mg/mL	3.125	12.5	-
Listeria monocytogenes			
MIC, mg/mL	12.5	6.25	-
MBC, mg/mL	25	12.5	-

[a] Abbreviations: GAEs, gallic acid equivalents; BHT, butylated hydroxytoluene; MIC, minimum inhibitory concentration; MBC, minimum bactericidal concentration

Authors' Contributions

Reza Sharafati-Chaleshtori developed the original idea and the protocol, abstracted and wrote the manuscript. Reza Sharafati-Chaleshtori, Mahmoud Rafieian-Kopaei and Elham Salehi contributed to the development of the protocol, abstracted data, and prepared the manuscript.

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