

The effect of selected antioxidants on the stability of pomegranate seed oil

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INTRODUCTION & AIM

Pomegranate seed oil (PSO) (Fig. 1) is a valuable source of bioactive compounds with health-promoting properties, but it is particularly susceptible to oxidation due to its high content of polyunsaturated fatty acids (PUFAs). **Oxidative stability** is one of the most important indicators of the quality and shelf life of edible oils. A common strategy to enhance oil stability is the application of **antioxidants**, which can effectively inhibit or slow down oxidative degradation.



Fig. 1



Fig. 2



Fig. 3

In this study, the effects of a plant-derived antioxidant-rich extract (**rosemary extract**) (Fig. 2) and a synthetic antioxidant (butylhydroxytoluene, **BHT**) (Fig. 3) on the stability of PSO were investigated. The oil samples were stored for two months at room temperature, in the absence of light, and under refrigerated conditions. The oxidation process was monitored to assess oil quality and stability using parameters such as peroxide value (PV), and the PDSC time corresponding to the maximum oxidative changes ($\tau_{\max}$).

METHOD

In the first stage of the study, the fatty acid (FA) composition of PSO was determined *via* gas chromatography (GC). During storage, changes in the oxidative stability of all prepared samples (PSO, PSO_{ext} and PSO_{BHT}) were monitored *via* pressure differential scanning calorimetry (PDSC) at 140°C, and changes in PV were measured *via* potentiometric titration.



Fig. 4 TA Instruments DSC Q20.



Fig. 5 TitraLab AT1000.

RESULTS & DISCUSSION

Fatty acid profile of pomegranate seed oil (GC)

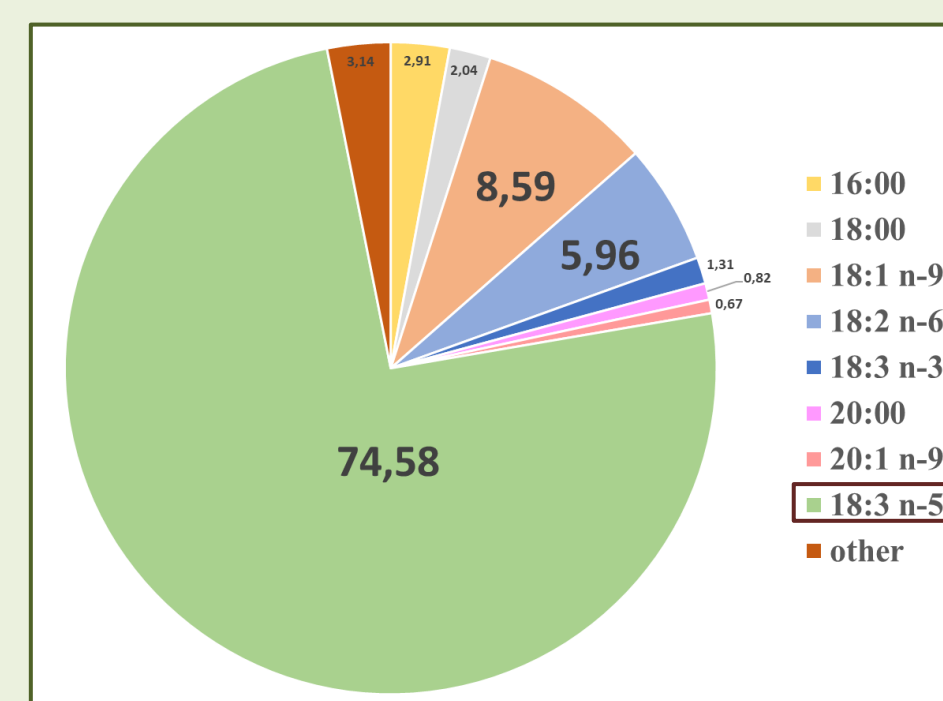


Fig. 6 Percentage of individual FA in PSO.

PSO was characterized by a high content of polyunsaturated FAs (~82%), particularly 18:3 n-5 – **punicic acid** (~74.6%).

Oxidative stability of pomegranate seed oil (PDSC)

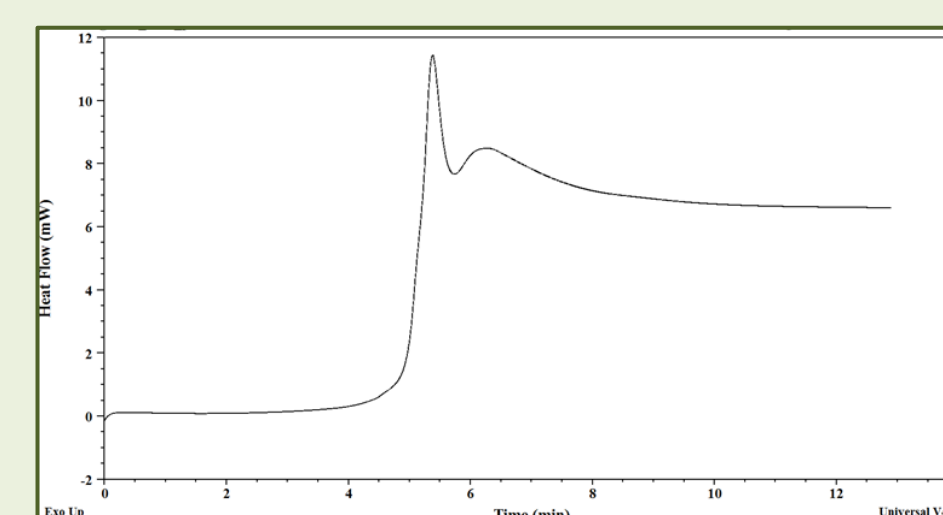


Fig. 7 Representative PDSC oxidation curve of PSO obtained at 140°C.

PSO exhibited **very low oxidative stability**, as evidenced by its short $\tau_{\max}$ at 120°C (4.66 min).

Table 1. PDSC oxidation time ($\tau_{\max}$) of PSO without and with added antioxidants: immediately after opening, and after one and two months of storage at room temperature.

Oil sample	$\tau_{\max}$ [min]					
	after opening		after month of storage		after 2 months of storage	
	I peak	II peak	I peak	II peak	I peak	II peak
PSO	4.66 ± 0.18	5.46 ± 0.10	4.53 ± 0.56	5.34 ± 0.56	4.48 ± 0.15	5.30 ± 0.18
PSO _{ext}	6.75 ± 0.90	7.70 ± 0.91	7.19 ± 0.13	8.09 ± 0.14	7.28 ± 0.13	8.24 ± 0.11
PSO _{BHT}	5.30 ± 0.12	6.13 ± 0.21	5.27 ± 0.10	6.09 ± 0.21	5.06 ± 0.61	5.97 ± 0.61

Table 2. PDSC oxidation time ($\tau_{\max}$) of PSO without and with added antioxidants: immediately after opening, and after one and two months of storage at refrigerated temperature.

Oil sample	$\tau_{\max}$ [min]					
	after opening		after month of storage		after 2 months of storage	
	I peak	II peak	I peak	II peak	I peak	II peak
PSO	4.66 ± 0.18	5.46 ± 0.10	4.53 ± 0.56	5.34 ± 0.56	4.48 ± 0.15	5.30 ± 0.18
PSO _{ext}	6.75 ± 0.90	7.70 ± 0.91	7.19 ± 0.13	8.09 ± 0.14	7.28 ± 0.13	8.24 ± 0.11
PSO _{BHT}	5.30 ± 0.12	6.13 ± 0.21	5.27 ± 0.10	6.09 ± 0.21	5.06 ± 0.61	5.97 ± 0.61

Primary oxidation of pomegranate seed oil (PV)

Table 3. Peroxide value of PSO without and with added antioxidants: immediately after opening, and after one and two months of storage at room and refrigerated temperatures.

Oil sample	PV [meq O ₂ /oil]				
	after opening	after month of storage		after 2 months of storage	
		4°C	20°C	4°C	20°C
PSO	1.98 ± 0.18	1.38 ± 0.14	3.37 ± 0.01	3.69 ± 0.23	7.17 ± 0.01
PSO _{ext}	1.29 ± 0.14	1.19 ± 0.08	1.90 ± 0.07	1.38 ± 0.18	3.15 ± 0.13
OPG _{BHT}	1.59 ± 0.27	1.32 ± 0.17	2.46 ± 0.44	2.82 ± 0.53	5.24 ± 1.40

CONCLUSION

The addition of both antioxidants (rosemary extract and BHT) had a beneficial effect on PSO stability, which was reflected in the values of $\tau_{\max}$ and PV. However, the natural antioxidant proved to be more effective in this regard, particularly at room temperature.