Spectrophotometric methods used for investigation of total phenolic compounds and antioxidant activity of commercial edible oils

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INTRODUCTION

Edible oils are widely used in the food industry due to their nutritional properties and their influence on the smell and taste of food products. Olive oil, especially extra virgin olive oil (EVOO) has nutritional and sensory characteristics that make it unique and a basic component of the Mediterranean diet. Its importance is mainly attributed to its richness in polyphenols, which act as natural antioxidants and may contribute to the prevention of several human diseases [Szydłowska-Czerniak et al.2015 ; Cioffi et al. 2020] .

EXPERIMENTAL

Extraction of the phenolic fraction

The method described by the International Olive Council (2007) was conducted for extraction of the phenolic fraction from sample oils. 2 g of oil were weighed in a test tube with a screw cap. The whole was mixed with 5 ml of methanol/water (80/20; v/v) for 1 min. The mixture was then isolated in an ultrasonic bath for 15 min at room temperature and centrifuged at 4500 rpm for 25 min. The methanolic phase was removed and stored for later uses [Meznia et al. 2018]. Each oil sample was extracted in duplicate.

Total phenolics content determination

Folin-Ciocalteu colorimetric method was used for TPC determination in oil samples according to Szydłowska-Czerniak et al. (2015). Briefly, 1.0 mL of each oil extract and 0.5 mL of FC reagent were transferred into a 10 mL calibration flasks. The mixtures were hand shaken for 3 min, and 1 mL of saturated sodium carbonate solution (22.0%) was added and made up to the mark with deionized water. After 1 h, solutions were centrifuged and absorbance at 765 nm was measured against a reagent blank (0.5 mL of FC reagent + 1 mL of saturated sodium carbonate solution made up to 10 mL with deionized water).
Quantification was done on the basis of a standard curve of gallic acid. Results were expressed as milligram of gallic acid per 100 g oil (GA/100 g).

Antioxidant activity

The DPPH (1,1-diphenyl-2-picrylhydrazyl) radical-scavenging activity of the extracts was evaluated as described by Szydłowska-Czerniak et al. (2011) with some modifications. Succinctly, 1.0 ml of each methanolic extract (or Trolox standard solutions in the concentration range 1.0–250.0 µg/ml) was added to 1.0 ml of methanol and 3.9 ml of DPPH* methanolic solution (6 x 10^{-5} mol/L). The mixture was shaken and left in darkness for 15 min. Antioxidant capacity was measured by recording the absorbance at 517 nm. Methanol was used as the blank. All determinations were performed in triplicate.

The DPPH radical scavenging activity was calculated as follows:

DPPH radical scavenging activity (%) = $(A_{control} - A_{sample})/A_{control}$ x 100

Acontrol - absorbance of DPPH radical + methanol
Asample - absorbance of DPPH radical + oil extracts (or standard solutions)

A calibrated Trolox standard curve was also made. We also expressed the results in terms of Trolox equivalent antioxidant capacity (TEAC) as mg Trolox/100 g oil of each sample).

The UV-Vis spectra of the obtained solutions were measured using a Specord 200 Plus spectrophotometer (Analytik Jena, Germany) in a 1 cm quartz cell.

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ABSTRACT

In this work 55 commercial edible oils (41 samples of olive oil and 14 of sunflower oils) were investigated for total phenolic content (TPC) and antioxidant activity (AA) point of view. The Folin-Ciocalteu colorimetric method was used for TPC determination in oil samples and spectrophotometric DPPH (2,2-diphenyl-1-picrylhydrazyl) method for AA, respectively. The DPPH values obtained DPPH for methanolic extract of olive oils ranged between 4.72-31.40 mg Trolox/100g and 2.06-3.96 mg Trolox/100g for sunflower oils. The TPC was between 4.65-26.39 mg gallic acid/100g for olive oils and 0.28-0.91 mg gallic acid/100g for sunflower oils.

RESULTS AND DISCUSSION

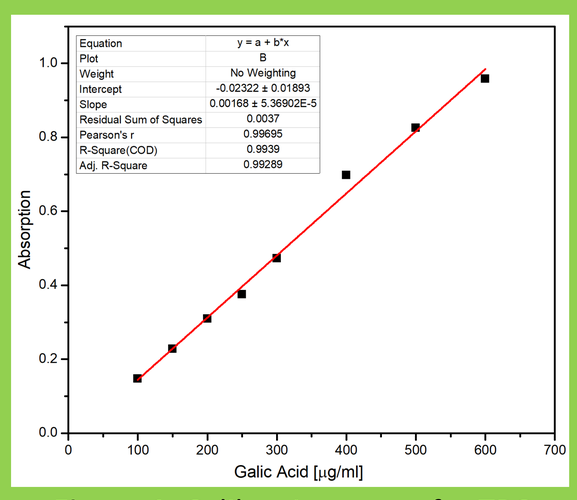

Figure 1. Calibration curve for TPC.

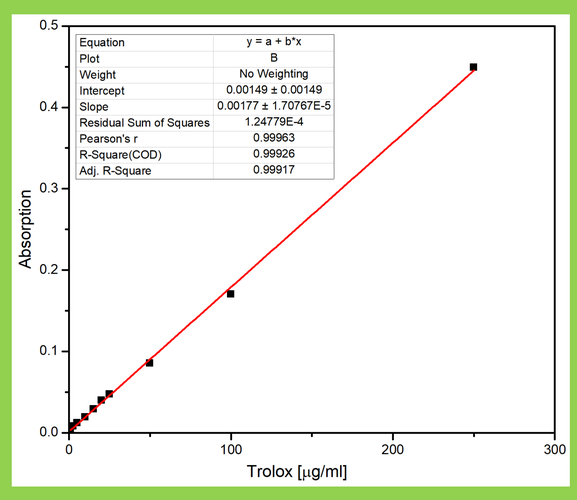

Figure 2. Calibration curve for DPPH method.

Table1. Antioxidant activity and total phenolics content of the studied oils.

Nr. crt.	Oil samples	Total phenolic content [mg GA/100g]	Antioxidant activity [mg Trolox/100g]
1	EXTRA VIRGIN OLIVE OIL	19.44 ± 0.74	23.86 ± 0.36
2		13.87 ± 0.13	18.27 ± 1.11
3		12.26 ± 1.06	4.87 ± 0.13
4		12.22 ± 0.35	14.28 ± 0.30
5		10.37 ± 0.40	5.74 ± 0.09
6		10.58 ± 0.04	14.98 ± 0.35
7		8.72 ± 0.60	9.58 ± 0.08
8		10.83 ± 0.10	17.38 ± 0.11
9		14.55 ± 0.33	14.14 ± 1.44
10		7.49 ± 0.07	10.04 ± 0.94
11		13.27 ± 1.27	22.91 ± 0.21
12		7.98 ± 0.25	6.55 ± 0.15
13		11.22 ± 1.08	18.53 ± 0.93
14		13.72 ± 0.14	23.04 ± 0.69
15		5.35 ± 0.21	6.20 ± 0.05
16		20.25 ± 0.29	24.39 ± 0.26
17		0.40 ± 0.04	3.59 ± 0.70
18		0.27 ± 0.05	3.81 ± 1.03
19		11.35 ± 1.28	13.80 ± 2.33
20		4.77 ± 0.08	4.72 ± 0.63
21		17.49 ± 0.44	21.50 ± 1.20
22		14.17 ± 0.11	14.98 ± 2.97
23		9.51 ± 0.23	10.76 ± 1.38
24		7.55 ± 0.01	6.28 ± 0.37
25		13.27 ± 0.07	16.03 ± 0.34
26		19.79 ± 0.67	22.88 ± 0.42
27		14.94 ± 0.15	17.63 ± 0.32
28		17.96 ± 1.01	21.25 ± 0.56
29		13.14 ± 0.47	21.97 ± 1.15
30		16.95 ± 0.63	25.13 ± 1.15
31		14.38 ± 0.85	9.53 ± 1.39
32		9.06 ± 0.55	12.95 ± 0.28
33		14.54 ± 0.31	17.57 ± 0.45
34		20.95 ± 1.69	21.84 ± 2.70
35		8.965 ± 0.02	7.65 ± 0.85
36		26.39 ± 0.52	31.40 ± 3.49
37		12.45 ± 0.39	9.83 ± 0.37
38		13.38 ± 0.93	17.77 ± 0.42
39		21.16 ± 0.28	26.17 ± 0.53
40		4.76 ± 0.13	5.43 ± 0.22
41		15.70 ± 0.91	17.52 ± 1.99

Nr. crt.	Oil samples	TPC [mg GA/100g]	AA [mg Trolox/100g]
1	SUNFLOWER OIL	0.53 ± 0.01	3.96 ± 0.89
2		0.48 ± 0.02	3.64 ± 0.33
3		0.28 ± 0.01	3.30 ± 0.75
4		0.67 ± 0.11	3.88 ± 0.07
5		0.49 ± 0.02	2.73 ± 0.28
6		0.55 ± 0.03	3.77 ± 1.72
7		0.51 ± 0.03	2.06 ± 0.36
8		0.73 ± 0.02	2.39 ± 0.66
9		0.51 ± 0.03	2.99 ± 1.22
10		0.45 ± 0.03	3.32 ± 0.25
11		0.45 ± 0.03	2.43 ± 0.25
12		0.75 ± 0.05	3.55 ± 0.18
13		0.59 ± 0.07	3.03 ± 0.13
14		0.91 ± 0.01	3.29 ± 0.23

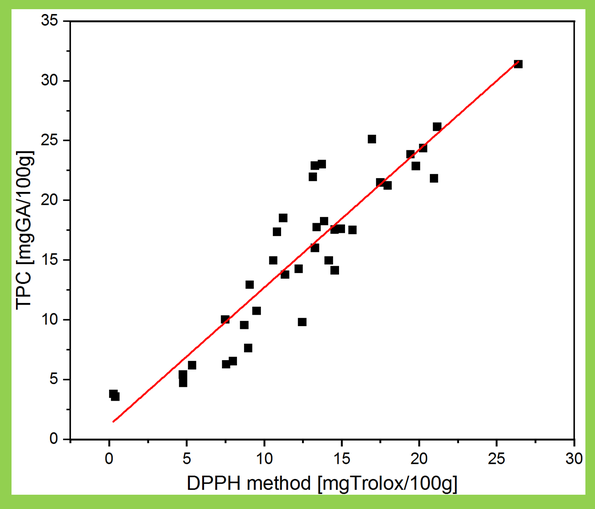

Figure 3. Correlation between TPC and DPPH values of olive oils.

CONCLUSIONS

- ✓ Antioxidant activity (AA) and levels of the total phenolic content (TPC) in olive oils and sunflower oils were determined.
- ✓ A significant different phenolic compound concentration and antioxidant activity was determined between oil samples (olive and sunflower oils) .
- ✓ Regression analysis was performed to calculate the correlation between the total content of polyphenols and antioxidant activity of the studied oils.
- ✓ A good and significant correlation among total phenolic content and antioxidant activity was observed in the olive oils (r = 0.83526) .
- ✓ Sunflower oils are less rich sources of total phenolic compounds and no correlation with AA was observed.