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Unsaponifiable Compounds and Phenols Content, Antioxidant and Antitrypsin Activities of *Prunus persica* Kernel Oil

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Abstract: Although peach kernels are rich in oil, there is a lack of information about its chemical and biological properties. Therefore, the purpose of this study was to determine the lipid profile, antioxidant capacity, and trypsin inhibitory propriety of peach oil extracted from two varieties (sweet cap and O'Henry) cultivated in Tunisia. The investigated peach kernel oil contains significant amount of unsaponifiable (2.1±0.5-2.8±0.2% of oil) and phenolic compounds (45.8±0.92-74.6±1.3 mg GAE/g of oil). Its *n*-alkane profile was characterized by the predominance of tetracosane *n*-C24 (47.24%) followed by tricosane *n*-C23 (34.43%). An important total tocopherol content (1192.83±3.1 mg/kg oil) has been found in sweet cap cultivar. Although rich in polyphenols and tocopherols, the tested oil did not display an inhibitory effect on trypsin. However, all peach oil samples showed effective antioxidant capacity and the highest values (86.34±1.3% and 603.50±2.6 µmol TE/g oil for DPPH test and ORAC assay, respectively) were observed for sweet cap oil. Peach oil has an excellent potential for application in the food and pharmaceutical industries as source of naturally-occurring bioactive substances.

Key words: peach oil, unsaponifiable matter, phenols, antioxidant, antitrypsin

1 Introduction

Recently, there is an increasing interest for unconventional oilseeds, such as *prunus* seeds, due to their valuable functional constituents with significant biological activities[1]. Among *prunus* species, *Prunus persica* kernels are an important by-product of the fruit processing industry which contain about 32 - 45% of non conventional oil. Peach kernel oil has the potential for application in the food industry and it can replace olive and grape seed oils in salads[2]. *Prunus persica* (peach) is the most important stone fruit crop in many regions, including Europe, North Africa and South Africa[3] and has the highest annual production in the world with ~25 million tons, followed by plums, apricot and almonds[4]. The fruit kernels generated annually in large quantities by fruit processing and they may serve as potential sources of oil which could be used for edible and other industrial applications[5]. In fact, growing population of the world leads to the higher demand for edible oils which required introduction of alternative unconventional sources of vegetables oils[1]. Currently, the focus of the food industry is to recover and exploited the valuable by-products from agricultural waste biomass[6].

Triacylglycerols are the major components of vegetable oils (95–98%), while phospholipids, phenolic compounds and unsaponifiable lipids such as sterols, tocochromanols and *n*-alkanes are the minor components. Other than health benefits, the minor constituents of vegetable oils determine the quality of the oil and provide a valuable marker for oil authentication[7,8]. The *n*-alkane profile could be used to distinguish between different vegetable oils and recent method has been developed for the determination of these minor compounds[9]. Therefore, the *n*-alkane com-

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position of numerous vegetable oils has been reported[10–12]. However, to the best of our knowledge no data has been published on the *n*-alkane composition of peach kernel oil. Dabbou *et al.*[13] described only the *n*-alkane profile of the oil extracted from peach flesh and peel. Furthermore, the contents and profile of tocochromanols, including tocopherols and tocotrienols, in vegetable oils are mostly affected by varietal and geographical factors. Tocopherols are present in high amounts in nuts and vegetable oils while tocotrienols are found predominantly in some seeds and grains[14]. Tocopherol is a fat-soluble vitamin naturally synthesized by plants and its daily intake is necessary for health promotion and disease prevention[15]. In addition to the strong antioxidant activity, all isoforms of tocochromanols possess anti-proliferative, pro-apoptotic, anti-angiogenic and anti-inflammatory properties[14–16]. Due to the positive correlation between dietary supplementation with tocopherols and the human health, it is of greatest importance to determine even the trace amounts of naturally occurring isoforms of tocochromanols in the different plant sources[17].

The chemical profile of peach kernel oil and its antioxidant activity depend on the varieties, ripeness, regions and extraction methods[18]. The fatty acid composition of peach oil has been widely reported[19–21], but there is very little information available about their minor constituents such as unsaponifiable and phenolic compounds. Also, there is a few published research articles about the biological activities of peach kernel oil[2, 22]. According to these authors, peach kernel oil possesses very important health promotion properties including antioxidant activity, prevention of the atherosclerosis in cardiovascular diseases and regulation of blood cholesterol and triglyceride concentrations. So, in order to improve the studies on peach oil, more attention should be paid to its minor components and their biological proprieties. Unconventional oils are of vital dietary and economic importance now and in future, therefore it seems necessary to gather more data and build up sufficient knowledge of missed information for many unconventional oilseed's sources[1]. Peach kernels are currently underexploited and different studies are being conducted to recover possible bioactive compounds from them in order to prevent economic losses and environmental pollution[3]. Therefore, the aim of this study was the determination of minor constituents as well as the antioxidant and trypsin inhibitory properties of oil extracted from *Prunus persica* kernel grown in Tunisia.

2 Materials and Methods

2.1 Plant materials and reagents

Peaches (*Prunus persica*) were hand harvested at ripening stage from two different varieties "Sweet cap" and 'O' Henry' cultivated in the region of Sidi Bouzid, Center-West of Tunisia (35° 2′ 0″ N, 9° 30′ 0″ E; at 313 m a.s.l.), during the 2022 season. The climate ant the sol proprieties of this region was described previously by Dabbou *et al.*[13]. The identification of plant material was accomplished by Pr. Moncef Harrabi, National Agronomic Institute of Tunisia (INAT, Tunisia). All solvents (petroleum ether, hexane, methanol, butanol) were of analytical grade and were obtained from Lab-Scan analytical Sciences (Poland). Standards (eicosanol, α, γ, and β-tocopherols), bovin trypsin, ABTS and potassium persulfate were purchased from Sigma-Aldrich, Co. (St. Louis, MO, USA). Potassium hydroxide pellets and anhydrous sodium sulfate were obtained from Appli-Chem (Darmstadt, Germany).

2.2 Oil extraction

Peach pits were recuperated and cracked to obtain the kernels, which were dried at 50℃ and then ground into a fine powder in a grinder. Powdered sample (100 g) was loaded into Soxhlet extractors and the oils were extracted with petroleum ether for 5 h. Pure oil was then concentrated using a rotary evaporator at 40℃.

2.3 Determination of total unsaponifiable content and analysis of *n*-alkanes

The unsaponifiable fraction were extracted and fractioned by thin layer chromatography as described previously by Harrabi *et al.*[11]. Briefly, unsaponifiable lipids were extracted by saponifying 5 g of oil with 50 mL of ethanolic KOH. After cooling, unsaponifiable matter was extracted using petroleum ether and was then dried and concentrated using N2.

For *n*-alkane analysis, the obtained unsaponifiable fraction was separated into subfractions on preparative silica gel thin-layer plates (silica gel 60G F254) and the band corresponding to hydrocarbon subfraction was recuperated, which was injected to GC-MS (Agilent 5977B; HP-5 column 30 × 0.25 mm, 0.25 μm film thickness) following the method of Harrabi *et al.*[11]. The *n*-alkane compounds were identified by analysis of their mass spectrum.

2.4 Analysis of tocopherols by HPLC

Tocopherols were analyzed according to the method described by Deiana and co-workers[23]. A volume of 100 μL of each oil sample was dissolved in 1 mL of hexane/butanol mixture (50:50 v/v) and homogenized. The separation of tocopherol isomers was carried out by high performance liquid chromatography (Alliance, water Technologies, e2695 series) equipped with a photodiode array detector (Waters, 2998), an Atlantis type column (4.6*150 mm, 5 μm) operating at 33℃ and an automatic sample injector (Waters Corp., Milford, MA). The mobile phase used was a mixture of methanol/acetic acid (95/5, v/v) with a flow rate of 1 mL/min. Tocopherols were detected at 290 nm wave-

length. The identification and quantification of different forms of tocopherols were carried out by the analysis of standards (α, γ and β-tocopherol) under the same conditions.

2.5 Determination of total phenolic content

Total phenolic content was determined as described by Wu *et al.*[2]. Briefly, oil sample (3 g) was extracted with 25 mL methanol, vortexed for 5 min, and then centrifuged at 4000 *g* for 10 min. The methanolic phase was separated and the color reaction was performed by adding the Folin–Ciocalteau reagent (0.25 N, 1 mL), sodium carbonate (0.8 mL) and distilled water (2 mL). The absorbance was then measured at 765 nm using UV/Vis scanning spectrophotometer (Model 2650, Labomed, Inc. U.S.A). The total phenolic content was expressed as mg of Gallic Acid Equivalent per g of oil (mg GAE/g).

2.6 Determination of antioxidant activity

The antioxidant capacity of the oil samples was evaluated using the DPPH and the ORAC assays. The DPPH test was performed according to the method reported by Kozłowska *et al.*[24]. Briefly, oil sample (50 mg) was dissolved in ethyl acetate (3 mL). Then, 0.25 mL of 1,1-diphenyl-2-picrylhydrazyl radical (DPPH) solution (1 mM) was added and vigorously mixed for 10 s in a vortex apparatus. After 20 min, the absorbance was measured at 515 nm using UV/Vis scanning spectrophotometer (Model 2650, Labomed, Inc. U.S.A) and the percent of inhibition was calculated using this equation:

$$\text{Inhibition}(\%) = \{(\text{Absorbance of the control} - \text{Absorbance of sample})/\text{Absorbance of the control}\} \times 100$$

The ORAC assay was carried out by the method described previously by Boudjou *et al.*[25]. Oil samples and Trolox standard (Sigma–Aldrich Canada Ltd.) were diluted with 75 mM phosphate buffer (pH 7.4) and then transferred into a 96-well microplate. 120 µL of fluoresceine was added each well of the 96-well plate, and the reaction was initiated by the addition of 60 µL AAPH [2,20-azobis (2-methylpropionamide) dichloride] (Sigma–Aldrich, St. Louis, MO). A microplate fluorescence reader (Biotech FL800) was used with excitation and emission wavelength at 485 and 530 nm, respectively. Measurements were taken every 2 min for 120 min and results were expressed as µmol Trolox equivalent/g of sample (µM TE/g oil).

2.7 Determination of antitrypsin activity

Total antitrypsin activity was determined as described by Anyasor *et al.*[26]. A mixture of 100 µL bovine trypsin (0.006 mg/mL), 350 µL Tris HCL buffer (25 mM, pH 7.4), and 50 µL of oil samples at different concentrations (0.5-1 mg/mL) was pre-incubated at 37℃ for 5 min. Then, 500 µL of N α-Benzoyl-DL-arginine 4-nitroanilide hydrochloride (BAPNA dissolved in dimethyl sulfoxide) was added as a substrate and the resulting mixture was incubated for 20 min at 37℃. The reaction was stopped by adding 2 mL of trichloroacetic acid (5%). In the presence of active enzyme, the hydrolysis of BAPNA releases *N*-Benzoyl-arginine and *p*-nitroaniline, which takes a yellow color. The absorbance is measured with a spectrophotometer at 420 nm. Diclofenac sodium was used as a positive reference. The percent inhibition of proteinase activity was calculated as: % Inhibition = (Absorbance of control − Absorbance of test sample/Absorbance of control) × 100.

2.8 Statistical analysis

Statistical analysis was carried out using the Proc ANOVA in SAS (Software version 8). Duncan's multiple range test was used. All experiments were done in triplicate. A value of $p < 0.05$ was considered as statistically significant (Deiana *et al.*[23]).

3 Results and Discussion

3.1 Total oil content

The oil content (expressed in g/100 g of dry weight of kernels) ranged from 34.5 ± 1.6% (O'Henry cultivar) to 44.1 ± 1.1% (sweet cap variety) and was significantly affected by the genotype (Table 1). In previous studies, significant differences in the oil yield of peach kernels (25-53.7%) have been related to the variety, the extraction technique and the geographic origin[2, 5, 18, 20]. Mezzomo *et al.*[18] have showed that Soxhlet method was more efficient than supercritical fluid extraction to remove oil from peach kernels. Similarly, apricot kernels are rich in unconventional oil (46.351.4%)[27]. Peach kernels have high oil content comparable with some oil-seed crops such as soybean (17–21%), cotton seeds (15–24%) and olive (20–25%)[5]. Thus, peach kernels might potentially serve as natural new source of oil, which is suitable as an alternative to conven-

Table 1 Total lipid, total unsaponifiable matter and total polyphenol contents of peach kernel oil.

Varieties	Oil content (%)	Unsaponifiable matter (%)	TPC (mg GAE/g)
Sweet Cap	44.1 ± 1.1[a]	2.1 ± 0.5[a]	74.6 ± 1.3[a]
O'Henry	34.5 ± 1.6[b]	2.8 ± 0.2[a]	45.8 ± 0.92[b]

Values are represented as means ± SD of triplicates. Mean values in the same column with different are significantly different at $p < 0.05$.
Oil content expressed as g/100 g of dry seeds. Unsaponifiable content expressed as g/100 g of oil. Total polyphenol content (TPC) expressed as mg GAE/g of oil.

tional oil sources[2]. Considering the annual generation of peach kernels from fruit processing industry, their use for the production of oil could respond to the higher demand of vegetable oils in food industry and bring economic gains[3, 18]. According to Natić *et al.*[4] kernel oil from *prunus* species can be used as a food supplement, in the cosmetics industry, and many other applications.

3.2 Total unsaponifiable lipid content

Unsaponifiable lipids are important constituents of plant seed oils due to their numerous nutritional and health benefits[28]. Although these minor lipids greatly influence the organoleptic quality and stability of the oil, few studies concerning the profile of unsaponifiable lipids of peach oil have been published. In this study, the total unsaponifiable lipid content of the tested oils varied from $2.1 \pm 0.5\%$ to $2.8 \pm 0.2\%$ (Table 1), which is higher than those reported previously for peach kernels from Pakistan (0.78-0.89%)[19] and Bulgaria (0.7%)[29]. The difference in total unsaponifiable content might be due to differences in variety and environmental factors. Furthermore, the method of extraction of total oil have also a significant effect on the extraction efficiency of unsaponifiable compounds[6]. Due to its richness in unsaponifiable lipids, peach oil has the potential for application in the industry. Currently, there is an extensive demand of these valuable compounds in food and pharmaceutical industries and it is important to optimize their recovery[7, 28].

3.3 Hydrocarbon composition

Vegetable oils contain *n*-alkanes, endogenous aliphatic saturated hydrocarbons, ranging from *n*-C21 to *n*-C35, with odd chain lengths predominance[9]. Considering the fact that the *n*-alkane profile provides a valuable marker for oil authentication, several studies are being conducted to characterize the hydrocarbon composition of vegetable oils however, to the best of our knowledge no data has been published on the *n*-alkane composition of peach kernel oil. However, different studies reported the *n*-alkane profile of peach fruit and its parts (mesocarp, pulp, skin)[13, 30–32]. In the present study, the hydrocarbon fraction was free of squalene and only three compounds were detected in the tested oil samples: docosane (*n*-C22), tricosane (*n*-C23) and tetracosane (*n*-C24). The mass spectrum of tetracosane was shown in Fig. 1. The aliphatic structure of linear saturated hydrocarbons was confirmed by the regular losses of the CH_2 group and the base peak at *m/z* 57 attributable to the loss of $-(CH_2)_3-CH_3$. As shown in Fig. 2, the peach oil was characterized by the predominance of tetracosane *n*-C24 (47.24%) followed by tricosane *n*-C23 (34.43%) and docosane *n*-C22 (18.32%). Similarly, *n*-C24 was the major component in the avocado oil followed by *n*-C25 and *n*-C23[8]. In contrast, previous studies revealed that vegetable oils such as olive oil, milk thistle oil, tomato seed oil, are characterized by an odd-long-chain carbon number predominance[9, 11]. The three most represented *n*-alkanes in olive oil were *n*-C23, *n*-C25 and *n*-C24[12].

Our results revealed that *n*-alkane composition of peach kernel is different to that of flesh and peel of peach reported by Dabbou *et al.*[13]. Those authors detected different hydrocarbons in the flesh and peel of peach extracts including *n*-nonane, *n*-decane, dimethylnonane, 2-methyldecane, 2,6-dimethylundecane, 6-methyldodecane, tridecene, and 3-methyltetradecane, which their levels depend

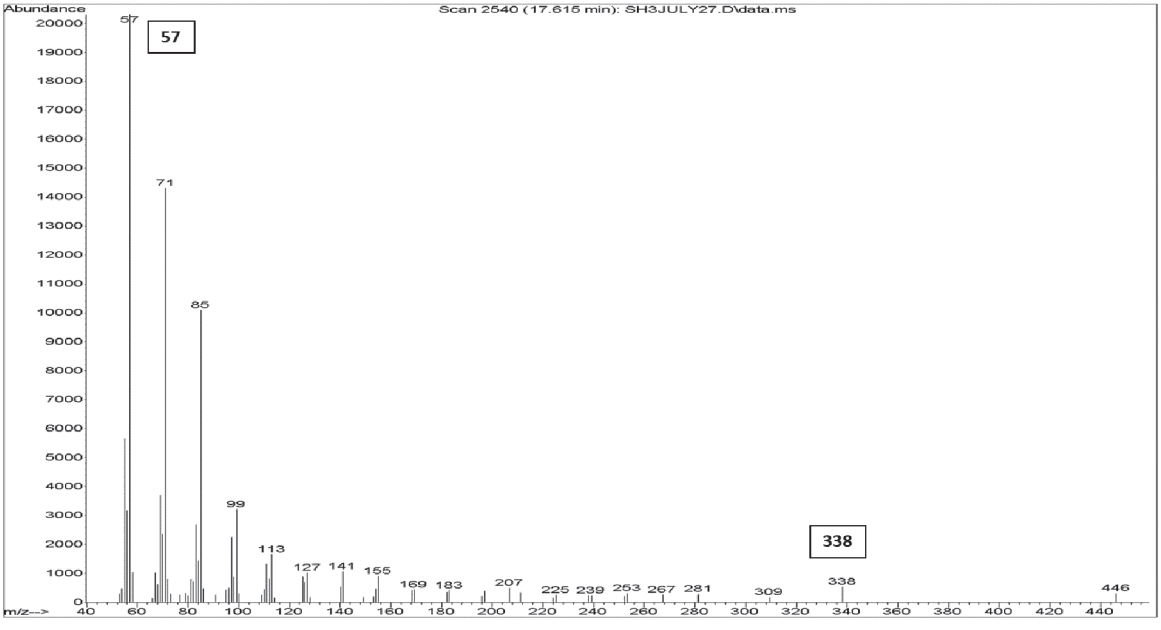


Fig. 1 Mass spectrum of tetracosane *n*-C24 ($C_{24}H_{50}$, *m/z* = 338) detected in the peach kernel oil by GC-MS.

on cultivar and the period of harvest. The *n*-alkane profile of vegetable oils is influenced by different factors including variety, organ, stages of ripening and geographical origin[9, 11, 33]. *n*-Alkanes are endogenous to plants and are probably deriving from the elongation of fatty acids followed by their decarboxylation[9]. The predominance of alkanes with an odd carbon number strongly suggests that the fatty acid precursors lose only one carbon during their conversion to alkanes. According to Guo *et al.*[34], the even/odd or odd/even predominance occurring in short-chain *n*-alkanes of plant epicuticular wax might be correlated with their growing environments.

3.4 Tocopherol composition

Tocochromanols, tocopherols and tocotrienols, are naturally occurring lipophilic bioactive antioxidants which are very important in the human diet[15]. Chemically synthesized α-tocopherol is not biochemically equivalent to the natural form[35], therefore it is of utmost importance to determine even the trace amounts of naturally occurring forms of tocopherol in different plant sources. Figure 3 show the HPLC chromatogram of tocopherols for the tested peach oils. The total tocopherol content (TTC) of the tested peach oils was influenced by variety factor and varied from 862.28 ± 2.6 to 1192.83 ± 3.1 mg kg^{-1} of oil (Fig. 4). The obtained values are higher than those reported previously for peach kernels from Pakistan[19] (360-386.9 mg/kg), Egypt[36] (520 mg/kg) and Turkey[5] (62.9 mg/kg). According to Ayerdi-Gotor *et al.*[37], the effect of the environment, mainly temperature, seems to be a key factor in the tocopherol content of the oil. Peach kernels are rich in tocopherols and their TTC was higher than that of many conventional oils including sunflower[37] (261-734 mg/kg), but lower than that in sacha inchi oil[38] (1890.71 mg/kg). However, in apricot oil, the total tocopherol content ranged to from 30.43 to 70.69 mg/100 g of oil[39]. Conventional vegetable oils contain concentrations of total tocopherols[40] in the range of 200-1000 mg/kg.

In the tested oil samples, the most abundant tocopherol isomer was α-tocopherol (59.79-76.73%) followed by γ + β-tocopherol (23.29-40.20%). Similarly, the α-tocopherol was detected as the major isomer of peach kernels from Pakistan (46.67-48.7%) and Turkey (59.3%)[5, 19]. However, γ-tocopherol and γ-tocotrienol were detected as the major

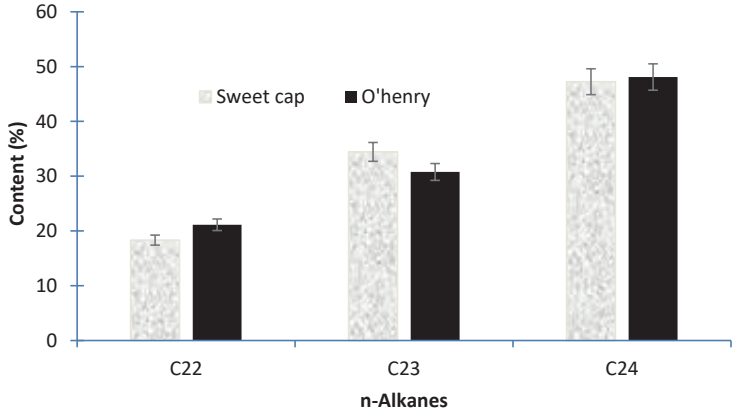


Fig. 2 *n*-Alkane composition of peach kernel oil.

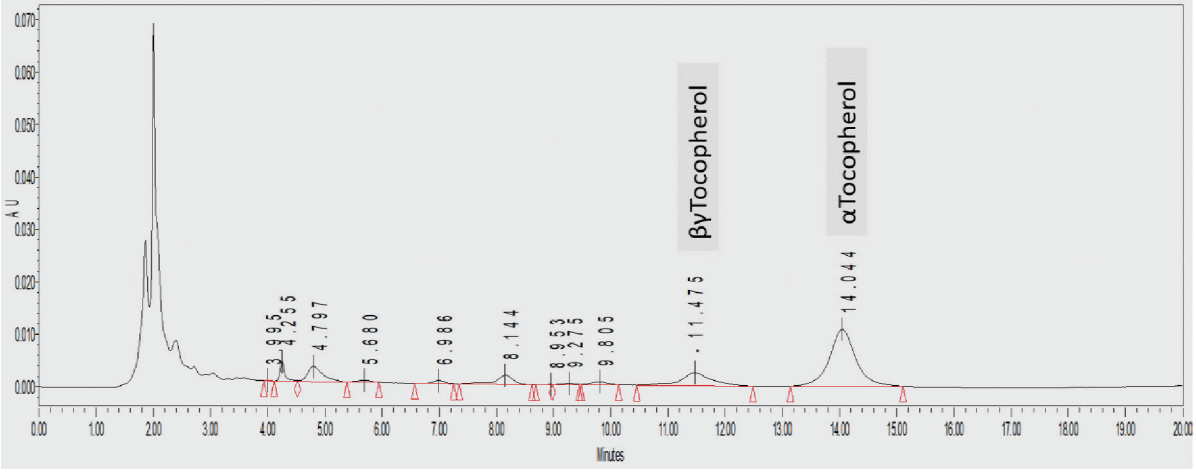


Fig. 3 HPLC chromatogram of tocopherol of peach kernel oil.

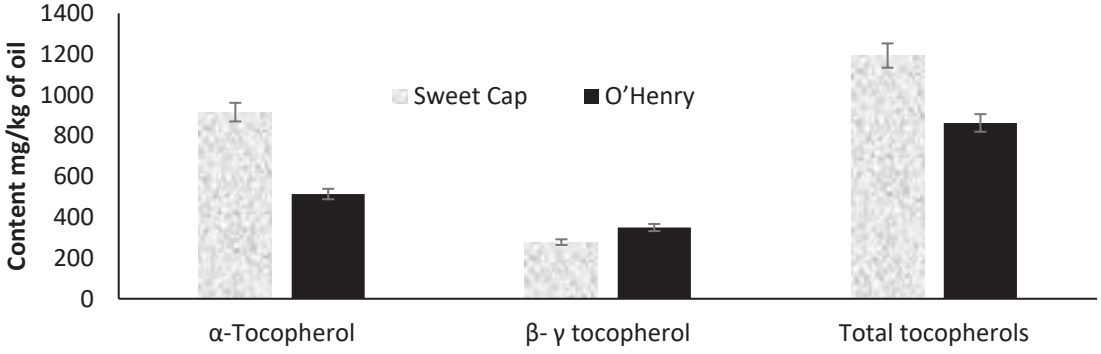


Fig. 4 Tocopherol content of peach kernel oil.

isomers in the peach oil form Egypt (97.7%) and Spain (77.32), respectively[3, 41]. The considerable variability in the data could be attributed to different factors such as the variety, the method of oil extraction, and the amount of γ-tocopherol methyl-transferase enzyme which converts γ-tocopherol to α-tocopherol. The γ-tocopherol content of apricot kernels ranged from 47.63 mg/100 g (v/w) to 27.15 mg/100 g depending on maturation[42]. In general, vegetable oils rich in polyunsaturated fatty acids (PUFA) often contain high levels of γ-tocopherol, while those having more monounsaturated fatty acids than PUFA such as peach oil are distinguished by a high α-tocopherol conten[43]. Tocopherols act as free radical scavengers in membranes and lipoproteins[44] and α-Tocopherol is the most active isomer in humans with 100% vitamin E activity[15]. Tocopherol and tocopherol acetate have the most widespread use in cosmetic products and commonly added to food or forage[17].

3.5 Total polyphenol contents

Phenolic compounds enhance the stability and nutritive value of oil[6]. Although, the total polyphenol content (TPC) is an interesting parameter for the valorization of vegetable oils, there is limited information on the TPC of peach oil. In the present work, the TPC of the tested peach oils were 45.8 ± 0.92 and 74.6 ± 1.3 mg GAE/g of oil for Sweet Cap and O'Henry cultivars, respectively. Our results revealed that TPC of the peach oil obtained by Soxhlet-petroleum ether extraction is interesting in comparison with other oilseeds such as walnut (11 mg GAE/g), almond (23 mg GAE/g), peanut (42 mg GAE/g) and milk thistle (10.28 mg/g)[11, 44]. The total phenol content of apricot kernel ranged from 54.41 mg GAE/100 g to 59.61 mg GAE/100 g, which could be decreased due to the microwave heating[45]. According to Mezzomo *et al.*[18], the TPC of peach oil varied from 0.18 to 128 mg GAE/g of oil and are strongly influenced by the method of oil extraction depending on. They conclude that the higher TPC values were observed in the oils obtained by Soxhlet using ethanol (128 ± 5 mg GAE/g) and maceration with hexane (93 ± 5 mg GAE/g). However, Wu *et al.*[2] revealed that the peach kernel oils extracted by Soxhlet using different solvents (petroleum ether, ethyl ether, chloroform and hexane) resulted in low phenolic contents (3.82-4.15 mg GAE/g). Similarly, Kozlowska *et al.*[24] reported that plant seed oils extracted with chloroform/methanol mixture (bipolar solvents) had a higher total polyphenol content than those extracted with *n*-hexane (nonpolar solvent). Furthermore, variations in TPC of peach leaves and stems were observed depending on the cultivar and stage of maturation[46]. Dithiothreitol, rutin and caffeic acid were detected as the major phenolic compounds in the peach oils[2].

Table 2 Antioxidant capacity of peach kernel oil.

Varieties	DPPH test	ORAC test
Sweet Cap	86.34 ± 1.3[a]	603.50 ± 2.6[a]
O'Henry	57.58 ± 2.1[b]	154.18 ± 1.76[b]

Values were expressed as means ± SD of triplicate experiments. Mean values in the same column with different are significantly different at $p < 0.05$.
DPPH (1,1-diphenyl-2-picrylhydrazyl radical) values are expressed as percentage of inhibition of DPPH by the oil.
ORAC (Oxygen Radical Absorbance Capacity) values are expressed as μmol Trolox equivalent/g of sample (μM TE/g).

3.6 Antioxidant capacity of peach oil and its inhibitory effect on trypsin

The DPPH and ORAC assays have been used to evaluate the antioxidant activity of the studied oil samples. As shown in Table 2, all the oil samples showed strong antioxidant activity. This result is in agreement with previous studies that showed an important antioxidant activity for peach oil[2]. In the present study, the Sweet Cap oil exhibited higher DPPH scavenging effect (86.34 ± 1.3%) than the O'Henry oil (57.58 ± 2.1%). Also, the ORAC values were higher for Sweet Cap (603.50 ± 2.6 μmol TE/g oil) compared to O'Henry cultivar (154.18 ± 1.76 μmol TE/g oil). The observed ORAC values for kernel peach oil, were higher than those reported for peanut seed oil (106 μmol TE/100 g oil)

and extra-virgin olive oil (1150 μmol TE/100 g oil)[47], but lower than those reported for faba bean seed oil (2.18–2.63 μmol TE/mg oil)[48].

In this study, the stronger antioxidant capacity of sweet cap oil compared to O'Henry oil may be due to the differences in their contents of bioactive minor compounds. In fact, sweet cap oil was found to have the highest content of tocopherol and polyphenol, suggesting that those bioactive compounds could be essential for the potent antioxidant activity of peach oil. In previous study, sweet cap leaf extracts also exhibited an important antioxidant activity comparing to those of other peach cultivars such as Early Maycrest, O'Henry, Flordastar and Rubirich[46]. According to Wu *et al.*[2], the antioxidant capacity of peach oil was significantly influenced by the solvent type used for the extraction of oil. They suggested that large proportions of unsaturated fatty acid and high content of phenolic compounds contribute to considerably strong antioxidant activity of peach oil. Kozłowska *et al.*[24] reported a good correlation between the phenol content of seed oils and their antioxidant activity, but other studies report a poor correlation[49]. In general, the antioxidant capacity of seed oils appears to be related to the synergic action of different compounds such as tocopherols, sterols, and unsaturated fatty acids[2, 49, 50].

On the other hand, proteases are target enzymes for inflammation management and development of therapeutic approaches against arthritis[51]. Therefore, several studies has been carried out to evaluate the antiprotease capacity of different plant extracts[26, 46, 47]. To the best of our knowledge no data has been published on the antitrypsin capacity of peach oil. In this study, our results revealed that the tested peach oil samples exhibited a poor trypsin inhibitory activity which does not exceed 5% even at high concentration of 600 μg/mL. So, it is suggested that polyphenols present in the tested oil did not display an inhibitory effect on trypsin. Conversely, a positive correlation was revealed between the trypsin inhibitory activity of the plant extracts and their polyphenol content[52, 53]. According to Anyasor *et al.*[26], the hexane extract of *Costus afer* leaf has a high trypsin inhibitory capacity (IC50 = 212.77 μg/mL) close to that of diclofenac (IC50 = 193.05 μg/mL), which could be linked to the presence of terpenoids (naphthalene derivatives), phenols, phytols and polyunsaturated fatty acids. Purpurin, anthraquinone, present in ayurvedic oils, could inhibit also trypsin activity by 70%[51]. Most protease inhibitors block the active site[54, 55] and play an important role in regulating the activity of proteolytic enzymes. The antiprotease capacity of plant extracts was significantly influenced by the solvent type used for the extraction[26, 53].

4 Conclusion

Peach kernels, by-products, could be used as a sustainable resource of unconventional oil rich in various important compounds. The current study is the first to characterize the *n*-alkane and trypsin inhibitory effect of peach oil. Our results revealed that peach oil had *n*-alkane composition different from other vegetable oils, confirming that those minor components are a valuable marker for oil authentication. Peach oil exhibited potential antioxidant capacity which could be linked to its richness in tocopherols and polyphenols. Although rich in polyphenols, peach oil did not display an inhibitory effect on trypsin, which contradicting the propose of these compounds as trypsin inhibitors. Peach oil might could serve as natural antioxidant agents for application in the food industries and pharmaceutic. Further studies are needed to potentially exploit peach oil for the development of nutraceuticals and functional foods. The recovery and exploitation of by-products for industrials is a major economic and environmental challenge that continues to grow.

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Author Contributions

Cyrine Landolsi: Biochemical analysis, Data curation, Writing. Olfa Ben Salem-Berrabah: Biochemical analysis. Moncef Feki: Visualization. Saoussem Harrabi: Supervision, Methodology, Writing-review & editing, Farah Hosseinian: Supervision, Methodology, Writing-review & editing.

Conflicts of Interest

The authors declare no conflict of interest.

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