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Research Article

FTIR analysis and study of some physicochemical parameters and antioxidant activity of *Opuntia ficus indica* seed oil from Tebessa region, Algeria

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Abstract

Opuntia ficus-indica is well-known in Algeria for its nutritional and therapeutic properties. Our study aims to determine the physicochemical properties, the functional groups and the antioxidant activity of cactus seed oil and thus contribute to the valorization of seeds. The extraction of prickly pear seed oil with cold-press provided a yield of 4.26± 0.93%. The evaluation of the its physicochemical parameters by the norms of AFNOR yielded the following results: density: 0.908± 0.00030 kg/dm; RI: 1.4714±0,00010; AV: 1.4± 0.09 mg KOH/g; IV: 114.08± 0.67 g I 2 /100 g; SV: 188.94± 0.58 mg KOH / g; ES: 187.54±0.49 mg KOH/g; PV: 1.56 g O_2 /g; chlorophyll number: 1.076 and Carotenoids number: 0.315. FTIR spectrum was used to determine the functional groups and type of associated vibrations in the extract oil, which was scanned in the range (4000-400) cm^{-1}. The FTIR results showed that the oil extract contains fatty acid methyl esters, revealing functional groups with ranges of properties, H- C = O, -(CH_2) n -, C-O, C = C and C = O in the spectrum. The analysis of antioxidant activity using DPPH and FRAP methods showed that the OFI seed oil had a significant activity in capturing free radicals (IC_{50}= 0.050 mg/mL), (EC50 = 0.123 mg/mL) respectively. We conclude from this current study that this oil can be used in folk medicine.

Keywords: antioxidant activity; FTIR; *Opuntia ficus indica*; physicochemical characteristics; seed oil

Introduction

Opuntia ficus indica (OFI) belongs to the family Cactaceae (El-Mustafa *et al*., 2014), native to the arid and semi-arid regions of Mexico, but has moved from Central and South America to the Mediterranean Basin, Africa, the Middle East, Asia and India (Shetty, 2012). In Algeria, OFI is grown on several hectares in Souk Ahras and Tebessa (Neffar *et al*., 2011). For use in human food as fresh fruit for livestock feed or for fencing (Chougui *et al*., 2013).

Opuntia species have been used in traditional medicine to treat chronic diseases, particularly diabetes, obesity, cardiovascular disease (Santos-Díaz *et al*., 2017), rheumatism, asthma, hypercholesterolemia, and hypertension (Osuna-Martınez *et al*., 2014). The plant has other biological activities including antioxidant, anticancer, anti-inflammatory, anti-allergic, hypocholesterolemic, and anti-aging activities (Benayad *et al*.,

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2014; Ammar *et al*., 2015; Barba *et al*., 2017; Fiad *et al*., 2020; Izuegbuna *et al*., 2019), these biological activities are due to the high level of active compounds such as polyphenols, vitamins (Belhadj Slimene *et al*., 2020), polyunsaturated fatty acids and amino acids (Al-Mustafa *et al*., 2014). Research by Andreu-Coll *et al*. (2020) and Khaled *et al*. (2020) shows that the seeds contain the highest concentration of bioactive compounds such as catechins, epicatechin, and ferulic acid. The oil extracted from the seeds is rich in tocopherols and unsaturated fatty acids with a predominance of linoleic acid (Kadda *et al*., 2021).

This study focused on the oil yield, physicochemical characteristics and antioxidant activity of cold-press OFI seed oil from Tebessa cultivars.

Materials and Methods

Plant collection and identification

During the prickly pear fruits harvest season, which represent the stage of full maturity of the plant, the fruits with a contrasting yellow-orange color, were picked at the end of ripening in August 2022 from the Ouenza region (southeast of Tebessa, Algeria). The plant was identified by Prof. Y. Halis Researcher in Scientific and Technical Research Center on arid regions.

To obtain OFI seeds, the fruits were washed with running water to remove impurities, then peeled to recover the pulp, after which we separated the seeds from the pulp using water and sieves while gradually reducing the pores by rinsing abundantly to get rid of the mucilage. Finally, flat and very hard seeds were obtained, which were dried in a well-ventilated place away from light.

Oil extraction

The extraction method chosen for our work is cold-pressure extraction, in which the seeds are passed through a screw press (IBG Monforts Oekotec), at a temperature of 30 °C, and this process does not require chemicals. This type of extraction is mainly used to produce virgin edible oils.

The resulting oil is filtered to reduce phospholipids, which is desirable from a carbonation point of view. The oil extraction yield (Y) was calculated according to Akbari *et al.* (2019), through the following equation:

$$Y\,(\%) = \frac{\text{mass of oil extracted(g)}}{\text{mass of seed powder used to make the extraction (g)}} X100$$

The oil is collected in a dark glass bottle, and stored in the refrigerator at 4 °C awaiting analysis.

Determination of the physicochemical characteristics of seed oils

Twelve (12) physicochemical parameters were studied, including pH, refraction index, rotational capacity, Mixing with ethanol, soluble impurities content, water content (H_2O%), Acid values, saponification index, Iodine index, Peroxide value, Ester index chlorophyll and carotenoids.

pH

The pH was measured directly in the sample using a pH meter form (Adwa AD1000)

Density

According to the methods (AFNOR, 1978), after cleaning the pycnometer with ethanol and acetone their empty weight corresponds: m0

Two grams of distilled water were put in the pycnometer for 30 min, then this mass was weighed at 20 °C, this weight represents: m_1

Two grams of oil were for 30 min in a water bath at 20 °C. The pycnometer filled with oil represents: m_2

The density is calculated by the following formula:

$D= (m_2\_m_0)/ (m_1\_m_0)$

Refractive Index (RI)

The refractive index of a material is one of the most important optical parameters. Each oil has a specific refractive index measured at a certain temperature, less than 2 mL of sample is necessary and the result is delivered in a couple of seconds (Hu *et al*., 2021).

Rotational capacity (RC)

Rotational capacity is the property that some chemicals exhibit in the plane polarization deviation of polarized light (Hagen *et al*., 2016).

In order to evaluate the rotation angles of OFI seed oil, we used a polar marker: KARL KOLB, fitted with a 1 cm cell filled with an ethanolic solution of oil at a rate of 0.2 g in 100 mL of solvent. The observed rotation angle is read directly on the instrument allowing to determine the value of the rotational force of our oil.

Insoluble impurity content

This process involves the quantitative determination of dust and other insoluble foreign matter in n-hexane. Where a test sample containing an excess of n-hexane is treated and then filtered the resulting solution, washing the filter and litter with the same solvent, drying at 103 °C and then weighing the content (ISO 663:2017)

Water content (H_2O%)

According to the method of Gortzi *et al*. (2008), it was measured by drying at 105 °C for 24 hours in an oven model memmert and weighting the difference between the dry and wet samples. The results were expressed in percent (%).

Acidity value (AV) measurement

It is determined using the standardized ethanol method NF T 60-204 (AFNOR, 1993). Approximately 10 g of the oil sample is weighed into the conical flask. The test portion is dissolved in approximately 100 ml of previously neutralized ethanol, carefully brought to near boiling point before use. Titration is carried out, stirring vigorously with the 0.1 N potassium hydroxide solution until the phenolphthalein turns pink.

Saponification value (SV) measurement

The saponification value is determined by taking 1.0 g of oil sample in a conical flask to which is added 15 mL 1 N KOH and 10 mL of distilled water and heated under a reserved condenser for 30-40 min to ensure that the sample was fully dissolved. After this sample was cooled, phenolphthalein was added and titrated with 0.5 M of HCl until a pink endpoint was reached. A blank was determined with the same time conditions (Zahir *et al*., 2014)

Iodine value (IV) measurement

The iodine number is defined as the number of grams of iodine fixed per 100 g of fat. It was determined according to Wijs' method (Wolff, 1968). According to the experimental protocol used, we add to the fatty substance in solution in chloroform an excess of iodine chloride, called Wijs' reagent. After a few minutes of

reaction, potassium iodide and water are added distilled. The released iodine is titrated with a titrated solution of sodium thiosulfate (0.1N) in the presence of starch paste.

Peroxide value (PV) measurement

The peroxide index of a fatty substance is the number of micrograms of active oxygen of the peroxide contained in one gram of oil or the number of mill equivalents of active oxygen per kilogram of fatty substance and oxidizing potassium iodide with release of iodine under the conditions of the NF T 60-220 method (AFNOR, 1993).

Determination of Ester index (EI)

The ester index is the number of milligrams of potassium hydroxide necessary to saponify the esters contained in one gram of fatty substance. The esterification index is given by the following relationship:

Esterification index = Saponification index - Acid index (AOAC, 1984)

Determination of chlorophyll and carotenoids

The analysis of the pigments (chlorophylls and carotenoids) was determined according to Mínguez-Mosquera *et al*. (1991) method.

The absorbance of a flask filled up with7.50 g of oil mixed with 25 ml of pure cyclohexane was measured relative to that of the solvent at 670 nm for chlorophylls and at 470 nm for carotenoids. The pigment content was determined by the following formulas:

Chlorophyll content (mg/kg) = (A 670 x 106) / (613 x 100 x d)

Carotenoid content (mg/kg) = (A 470 x 106) / (2000 x 100 x d)

d: represents the thickness of the cell (1 cm)

Fourier transform infrared (FTIR) spectroscopy

Fourier transform infrared (FTIR) spectroscopy was used to identify the functional groups of OFI seed oil. Infrared spectra of the extract were recorded using a Jasco FT IR-4700 Fourier instrument. The analysis was performed as described by Cebi *et al*. (2020) using an attenuated total reflection (ATR) cell, in a spectral range of 4000-400 cm^{-1} with a resolution of 4 cm^{-1}.

Biological activities

DPPH radical scavenging assay

The varied extracts were tested for the antioxidant potential by using the technique outlined by Benouchenne *et al*. (2020) with some modification. Briefly, a 0.4 mM of DPPH solution was prepared in methanol, 160 µL of this solution was added to 40 µL of sample diluted in methanol at different concentrations. After 30 min of incubation in the dark, the absorbance was measured at517nm. The results were given as 50% inhibition concentration (IC50) and compared with Ascorbic acid. The low absorbance value indicates a higher free radical scavenging activity.

The following equation was used to calculate the capacity to trap the DPPH radical.

$$\text{inhibition (\%)} = \frac{\text{Absorbance of control} - \text{Absorbance of the sample}}{\text{Absorbance of control}} \text{X100}$$

Ferric reducing antioxidant power FRAP

This method is based on the ability of extracts to reduce ferric iron (Fe) to ferrous iron (Fe^{2+}), established by Ozgen *et al*. (2006). It consists of mixing 1 mL of each solution of extracts or the standard antioxidant (ascorbic acid) at different concentrations with 1 mL of phosphate buffer (0.2 M, pH 6. 6) and 1 mL of a 1% solution of potassium ferricyanide [$K_3Fe(CN)_6$]). The mixture obtained is incubated at 50 °C for

20 min, and then 1 mL of 10% trichloroacetic acid (CCl_3COOH) is added to stop the reaction. The total mixture was centrifuged at 3000 rpm for 10 minutes. After which, 1 mL supernatant was withdrawn from the test tubes and was mixed with 1 Ml of distilled water and 0.5 mL of 0.1% iron chloride ($FeCl_3$) solution. The absorbance of the reaction mixture is read at 700 nm against a blank, which contains all reagents except $FeCl_3$. The reducing power of iron in the samples tested compared to the standards used is calculated according to the following formula:

$$\text{Reducing power} = \frac{\text{Absorbance of FeCl3} - \text{Absorbance of FeCl3 in the presence of the extract or standard}}{\text{Absorbance of FeCl3}} X100$$

Data processing

The analysis of the results was carried out by Microsoft® Office Excel 2010, and Microcap Origin 6.0 Professional for the graphs.

Results

Yield estimation and determination of some physicochemical properties of the oil

We remember that the oil was extracted from the dry seeds of OFI by cold pressing; we got a yellow oil that smells good. We recovered a large amount of oil, and the yield obtained is estimated at 4.26 ± 0.93% (Table 1).

Table 1. The oil extraction yield of OFI seeds

Type of measures	Analytical methods	Yield (%)	Color	Physical state of room temperature
Oil extraction	Cold-presse	4.26 ± 0,93	Yellow	Liquid

The results for the physicochemical properties of the oil from OFI seeds are presented in Table 2.

Table 2. Physicochemical characteristics of the oil extraction

Physicochemical parameters measured	Seed oil of OFI
pH	5.69
Refraction index (nD, 20 °C)	1.4714± 0,00010
Insoluble impurities content (g/100g)	1.22 ± 0,44
Water content (H_2O%),	0.325± 0,094
Density (kg/dm^3)	0.908± 0,00030
Acid values (mg KOH/g of oil)	1.4± 0,09
Saponification index (mg KOH/g of oil)	188.94± 0,58
Iodine index (g I 2 /100 g of oil)	114.08± 0.67
Peroxide value (meq O_2/Kg of oil)	1.56± 0.26
Ester index (mg KOH/g of oil)	187.54±0.49
Chlorophyll (mg/kg)	1.076
Carotenoids (mg/kg)	0.315

Results are expressed as mean ± standard deviation

FTIR analysis

FTIR analysis spectra of OFI oil extract are shown in Figure 1. In this study, oil analysis was performed using a FTIR spectrophotometer with wave number 400-4000 cm^{-1} and scanned in absorption form. The result of the FTIR analysis can confirmed that the sample contains functional groups, as the C-H stretch is shown in

Table 3 related to the C-H aliphatic fatty acid stretch. The strong density of about 1742.50 cm^{-1} shows the C-O stretching of esters typical, and thus are common in fatty acid methyl esters spectral. The peak at 1462.81 cm^{-1} correspond to the asymmetric stretching of -CH_3 present in the oil spectrum, in addition to other groups shown in the Table 3 and Figure 1.

Table 3. Frequencies of functional groups expected from OFI oil analysis

Wavelength number (cm^{-1})	Types of vibration	Assignment
3007.80	Asymmetrical stretching	=C-H (alkenes)
2921.75, 2953.92	Asymmetrical stretching	C-H
2852.57	Symmetrical stretching	C-H Methylene (alkane)
1742.50	Stretching	C = O ester carbonyl in triglycerides and FAME
1462.81	Asymmetric stretching	$-CH_3$
1377.14	Asymmetric stretching	$O-CH_2$
1158.36	Stretching	$O-CH_3$
1098.25	Stretching	C-O absorption
721.25	Bending of alkenes and Overlapping of rocking Vibration of methylene	=C-H olefinic (alkene) group and $-(CH_2)_n$ methylene groups (cis disubstituted alkenes and aromatic)

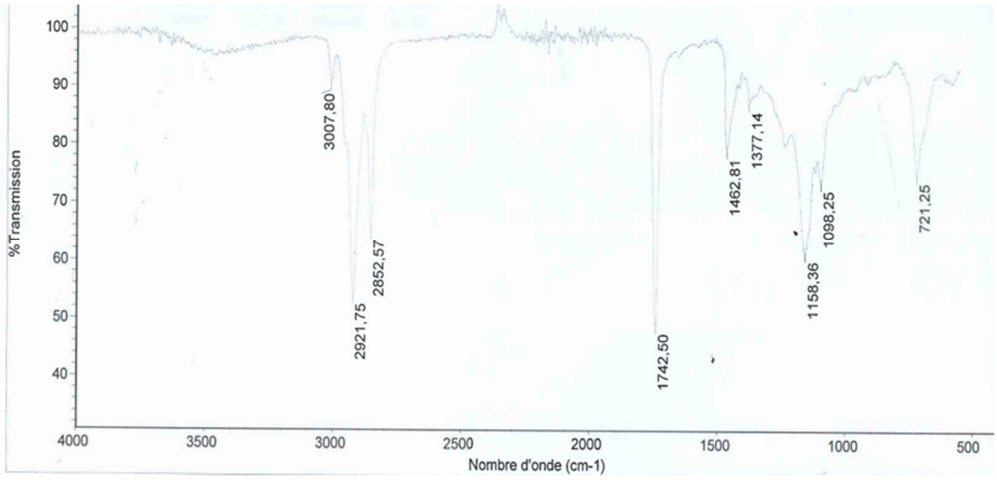

Figure 1. FTIR spectrum of OFI oil analysis

DPPH free radical-scavenging activity

The profiles of anti-radical activity shown in Figure. 2 yielded that the oil extracts of OFI had antioxidant activity, causing the reduction of DPPH • radical to its non-radical form DPPH-H; This results in a change from purple to yellow which has a visible absorption band at 517 nm.

The oil extract from the seeds, at a concentration of 100 µg/ml., showed the highest effective percentage in removing DPPH with an inhibition percentage of 84%, which is lower than that of the standard used (ascorbic acid) with an inhibition rate of 92%.

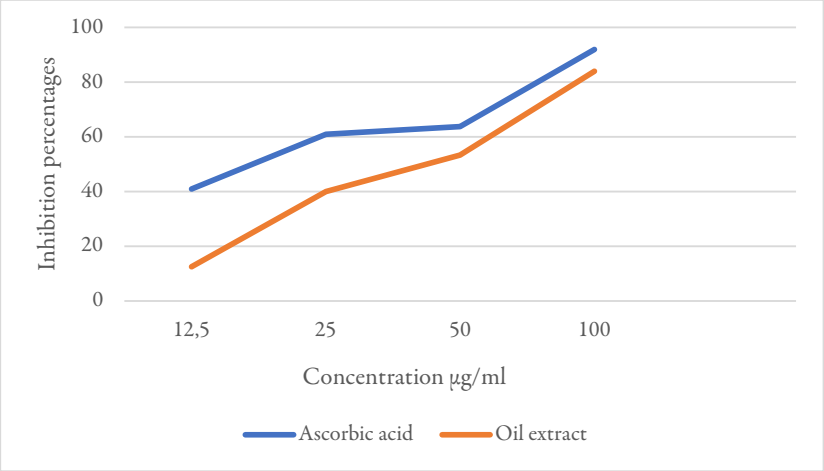

Figure 2. DPPH Free radical scavenging activities of 0FI oil extracts and ascorbic acid

The IC_{50} inhibitory concentration is inversely proportional to the antioxidant capacity of a compound; it expresses the quantity of antioxidant required to reduce the concentration of the free radical by 50%. The smaller the IC_{50} value, the greater the antioxidant activity of a compound. The IC_{50} values for the oily and control extract are shown in Figure 3. An oil extract shows very important antioxidant activity (IC_{50}= 0.050 mg/mL) but remains weak compared to that of DPPH-restoring ascorbic acid with an IC_{50} of 0.019 mg/mL. According to these results, ascorbic acid remains the most effective antioxidant compared to the oil extract of the studied plant.

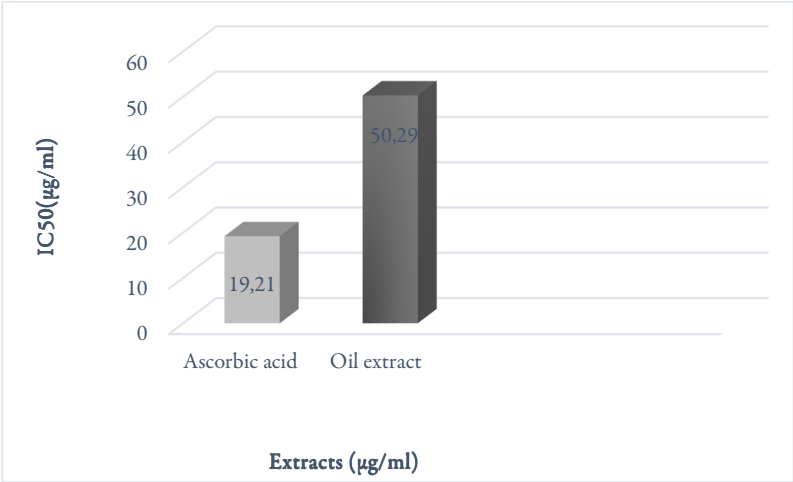

Figure 3. IC_{50} values of ascorbic acid and oil extracts

Iron reducing power test: FRAP (Ferric reducing antioxidant power)

By this test, the ability of the oil extract of OFI to transform ferric iron into ferrous iron was evaluated. This mechanism is known as an indicator of electron-donating activity, characteristic of anti-oxidant capacity. Potassium Ferricyanide is reduced to Ferro-cyanide by polyphenols. In fact, the combination of ferric ions with Ferro-cyanide leads to forming a complex of a green colour, which absorbs UV at 700 nm. Furthermore, there is a proportionality relationship between the measured OD and the antioxidant activity ((Hinneberg *et al.*, 2006).). The reducing power of iron by the oil extract is illustrated in Figure 4.

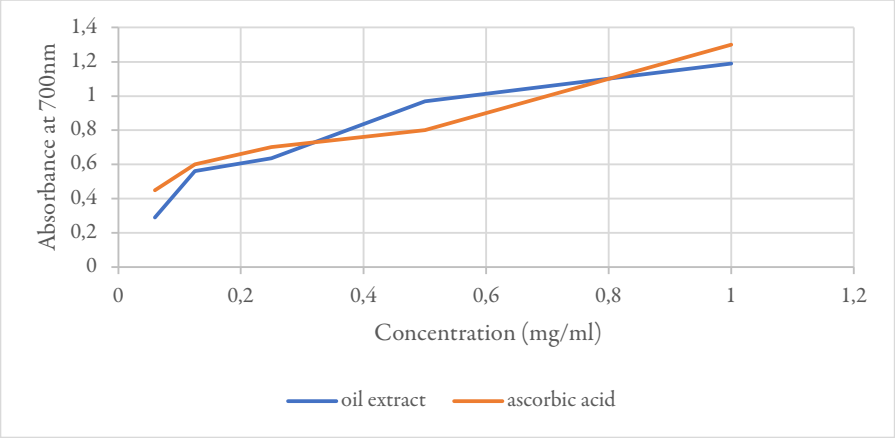

Figure 4. Iron-reducing power of ascorbic acid and oil extracts

Through the experimental results shown in Figure 4, it was found that there is a competitive relationship between increasing the concentration and the reversibility of different extracts, due to the presence of reversible compounds (antioxidants) such as vitamin C. They were the basis of reference for this study, showing good reversibility of many free radicals. The highest absorption value was 1.3 at a concentration of 1 mg/ml, while the highest absorption value was estimated for the oily extract 1.19 at the same concentration. Compared with standard, the EC50 of oil (EC_{50}: 0.123 mg/mL) are very closer to ascorbic acid (EC_{50}: 0.063mg/mL) (Figure 5).

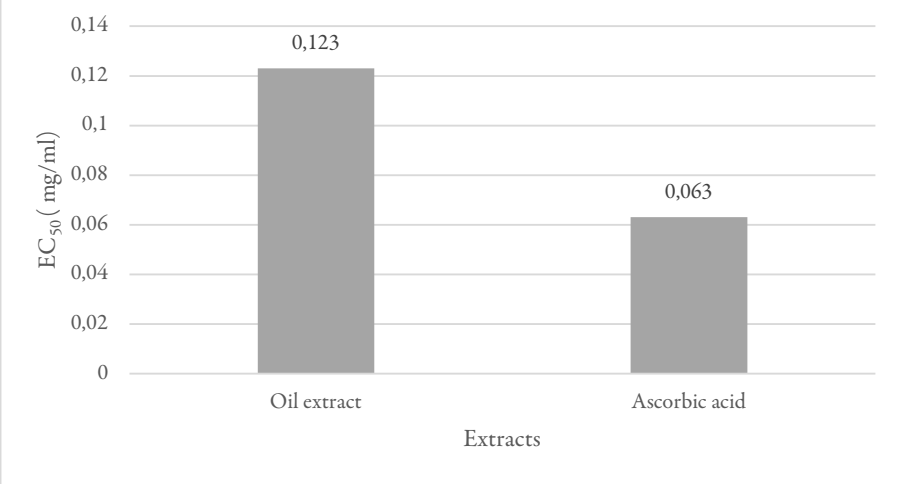

Figure 5. EC_{50} values of ascorbic acid and oil extracts

Discussion

Yield assessment seed oil extraction

The extracted oil is yellow in colour. This indicates that they contain pigments that allow them to obtain this color. Our results showed that the seed oil content from OFI in the Tebessa region was estimated at 4.26 ± 0.93%, a value close to that reported by Nounah *et al.* (2021), where the productivity of OFI in the Sidi Ifni region of Morocco was estimated to be (4.1%), but it is considered low compared to the productivity obtained by de Wit *et al.* (2017), whose oil contents in cultivars ranged between 5.65% and 8.09% in South Africa.

Physicochemical characteristics of OFI seeds oil

Iodine value (IV)

OFI seed oil from Tebessa shows a high IV (114.08) due to its high content of unsaturated fatty acids. The value in this study is higher than those reported by Khémiri and Bitri (2019) which was estimated 108.52 (cactus pear seed oils). De Wit *et al*. (2021) reported slightly higher iodine values ranging between 120.58 (Tormentosa) and 127.43 (Zastron), and it is lower than that of OFI and *O. megacantha* in Morocco (132.81-132.73) (Ettalibi *et al*., 2021). De Wit *et al*. (2017) showed that the iodine index could show the stability of the oil, because a high degree of unsaturation indicates a high susceptibility to oxidation. We conclude that lower iodine value indicates greater resistance to oxidation due to increased saturation.

Peroxide value (PV)

PV is a very useful criterion for assessing the first stages of oxidative deterioration of an oil. The value of the peroxide index found in this study is of the order of 1.56 ± 0.26 meq O_2/Kg, this value is a good indicator of the relative oxidation stability of the extracted oil. Our results show that the high iodine value and oxidation stability of the seed oil support the good qualities of edible oil.

Saponification index (SI)

The saponification index of a fatty substance is higher if the carbon chain of the fatty acid is short, the SI of the obtained oil was estimated as (188.94 ± 0.58 mg KOH/g) which is close to that of cottonseed oil (189-198), and sunflower (188-194), which are commonly used in food (Aïssi, 2009). The saponification value determined is similar to that reported by Zine *et al*. (2013) (186.63), and is higher than that obtained by R'bia *et al*. (2017) (175.20).

Density

The density of the obtained oil was estimated as 0.908 which is close to that determined by Özcan and Al Juhaimi (2011) (0.907), and it is higher than that reported by R'bia *et al*. (2017) (0.805) in its results.

Acidity

Acidity is related to the amount of free fatty acids, which informs about the quality of conservation of an edible oil. The values of the acid for the samples of OFI oil is 1.4 mg KOH / g. This value is comparable with that reported by R'bia *et al*. (2017); Khémiri and Bitri (2019).

Pigments contents

The chlorophyll content (1.076 mg/kg) of the oil studied is strictly greater than that of carotenoids (0.315 mg/kg). The chlorophyll content is less than 2 ppm. This low content is desired to avoid the pro-oxidant action of chlorophyll pigments and to ensure good preservation of the oils (Boulfane and Coll, 2015).

The chlorophyll and carotenoid contents of this oil is close to those reported by Marhri *et al*. (2022) (1.52 mg/Kg- 0.61 mg/Kg), and it is lower than those found by other studies (El Mannoubi *et al*., 2009) (2.403 mg/Kg -8.01 mg/Kg) (Khémiri and Bitri, 2019) (10. 52mg/Kg - 4.75mg/Kg).

Ester index (EI)

The EI value of OFI oil, estimated at (163.50 ± 0.19) mg KOH/g oil, is close to the saponification index value (186.59 ± 0.63) mg KOH/g oil.

FTIR

Fourier transforms infrared (FTIR) spectroscopy is an ideal method for analysis of complex mixtures such as edible fats and oils and other secondary metabolites extracted from specific part of plants (Muchtaridi *et al*., 2019).

The major functional groups identified here are the frequency of 3007.80 cm^{-1} that indicates the presence of the unsaturated olefin double bond group with a medium intensity (Zhang *et al*., 2012). This was closely followed by the saturated aliphatic groups of 2921.75 cm^{-1} with its asymmetrical stretching and strong intensity as well as 2852.57 cm^{-1} with its associated symmetrical stretching and strong intensity (Coates, 2000). The IR regions of 2953.92 ;2852.57, 1742.50 cm^{-1} are attributed to the fatty acid chain length and the absorption of free fatty acids (FFAs) occurring within the range of 1720–1700 cm^{-1}, which is used to estimate the hydrolysis of triglycerides to FFAs (Bertran *et al*., 1999).

There is another major absorbance near 1742.50 cm^{-1} due to the ester carbonyl functional group of the triglycerides. The CH asymmetrical bending vibration of 1462.81 cm^{-1} can be ascribed to $-CH_3$ methyl of the alkane group. The frequency of 1418.02 cm-1 corresponded with the in plane bending of the vinyl C – H or cis = C – H bond of the olefinic group (Coates, 2000; Zhang, 2012) and it is associated with a strong intensity. The peak at 1377.41 cm^{-1} can be attributed to the glycerol group $O-CH_2$ (mono-, di- and triglycerides), which is present in the refined oil spectrum and should be absent in the FAME spectrum (Dube *et al*., 2004)

The frequency stretch of 1296.27 cm^{-1} to 1031.21 cm^{-1} was assigned to the C – O ester carbonyl group with its characteristic strong intensity and stretching vibration. The bands of 1236.53 and 1158.36 cm^{-1} have been proved to be related to the proportion in the sample of saturated acyl groups (Guillen *et al*., 1997).

The frequency of band 1098.25 cm^{-1} does not generally suffer large variations except in oil samples rich in oleic acyl groups. As the oxidation process advances, the frequency of this band diminishes and reaches a minimum value (Liang *et al*., 2013). The frequency range of 997.58– 602.42 cm^{-1} was ascribed to the = C – H trans or cis – disubstituted alkene group. Thus, it can be said that the functional groups present here are CH_2 and CH_3 of the saturated aliphatic compounds, the C = O of the dimerized carboxylic acid group, the C – O ester carbonyl group and the trans or cis – disubstituted alkene group (Oyerinde and Bello, 2016).

Antioxidant activity

According to the literature, the results of our antioxidant activity are much lower (IC_{50}= 0.050 mg/mL) than those reported by other authors, where Berraaouan *et al*. (2015) demonstrated the antioxidant activity of cold-pressed OFI oil with the DPPH assay (IC_{50}= 0.96 mg/ml). Karabagias *et al*. (2020) showed that pure prickly pear seed oil has a high anti-oxidation activity with a percentage of (84 ± 0.010%), which is similar to that obtained. In addition, the present results are consistent with those of Ramírez *et al*. (2017), who reported significant antioxidant activity with respect to seed oil obtained from two Mexican prickly pear.

OFI seed oil obtained, showed high reducing power with lower EC50 than the oil extracted from different spice seeds of *O. microdasys* (1.11 mg/mL) and *O. macrorhiza* (0.60 mg/mL); Produced by Chahdoura *et al*. (2015). In another study, Chougui *et al*. (2015) showed that prickly pear peels were more resistant to oxidation than the reference with vitamin E.

Conclusions

We conclude from the physical and chemical study that cold-pressed OFI seed oil can be converted into edible oil with relative oxidation stability (peroxide value = 1.56 ± 0.26 meq O_2/Kg),), and low acidity (1.4 mg KOH/g), which indicates a low decomposition point for high content of unsaturated fatty acids (high iodine value 114.08). The low content of chlorophyll (1.076 mg/kg) ensures that the oils are well preserved.

FTIR spectroscopy specifically indicates the presence of the olefinic group with a frequency (3007.80 cm^{-1} and 1418.02 cm^{-1}), and the triglyceride group is shown in the carbonyl region (1742.50 cm^{-1}).
OFI Seed Oil exhibits good antioxidant power and is useful in many diets, in pharmacology and in the cosmetic industry.

More studies are needed to identify the main compound responsible for the antioxidant activity of prickly pear seeds.

Authors' Contributions

The AB took the lead in methodology, evidence organization, resource sourcing and oversight, DM participated in the design and also provided critical feedback on the manuscript and assisted in its revision and editing.

Both authors read and approved the final manuscript.

Ethical approval (for researches involving animals or humans)

Not applicable.

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Conflict of Interests

The authors declare that there are no conflicts of interest related to this article.

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