Evaluation of Chemical Properties of Cold Pressed Ficus Carica Seed Oil

Hamide Filiz Ayyildiz\textsuperscript{1}, Raziye Nur Ozcicek\textsuperscript{2} and Huseyin Kara\textsuperscript{2,*}

\textsuperscript{1}Selcuk University, Faculty of Pharmacy, Department of Basic Pharmaceutical Sciences, 42075 Campus, Konya/TURKIYE
\textsuperscript{2}Selcuk University, Faculty of Science, Department of Chemistry, 42075 Campus, Konya/TURKIYE

*Corresponding Author Email: huskara@gmail.com

Received 30 April 2021, Revised 18 June 2021, Accepted 23 June 2021

Abstract

Free fatty acid (FFA), peroxide value (PV), conjugated diene and triene, chlorophyll, β-carotene, fatty acid composition, triglyceride, tocol (tocopherol and tocotrienol) compositions, sterol, wax and total polimeric compound amounts of cold pressed Ficus carica seed oil were evaluated by using chromatographic and spectrometric methods in this study. While the % free fatty acid of cold pressed ficus carica seed oil was 0.76±0.06, the peroxide value was found as 1.06 ± 0.09 meqO\textsubscript{2}/kg. It had also low content of conjugated diene and triene amounts, chlorophyll, wax and total polimeric compounds. The obtained results demonstrated that cold pressed ficus carica seed oil had rich in linolenic and linoleic, which are polyunsaturated fatty acids, and contained high amounts of LLnLn, LnLnLn, OLLn, LLL and PLLn triglycerides. Cold pressed ficus carica had high content of β-carotene (4114.9 ppm), total tocol (1006 ppm) and sterol (7250.83 ppm). The obtained results showed that ficus carica seed oil is a product with superior properties due to the high nutritional value and beneficial phytochemicals. Therefore this oil can be an alternative to vegetable oils and used as a medical product.

Keywords: Ficus carica seed oil, Cold pressed, Fatty acid composition, Tocol, Triglyceride composition, Sterol, Wax, Polymeric compounds.

Abbreviations

| Acronym | Description |
|---------|-------------|
| FFA | Free fatty acid |
| PV | Peroxide value |
| LLLn | Linoleic-Linolenic-Linolenic-Linolenic |
| OLLn | Olenic-Linolenic-Linolenic |
| PLLn | Palmitic-Linoleic-Linolenic |
| PLL | Palmitic-Linoleic-Linoleic |
| OOL | Oleic-Linolenic |
| POL+StLL | Palmitic-Oleic-Linolenic + Stearic-Linoleic |
| PPL | Palmitic-Palmitic-Linoleic |
| OOO | Oleic-Oleic-Oleic |
| StOL | Stearic-Oleic-Linoleic |
| TG | Triglyceride |
| Tocol | Tocopherol and tocotrienol |
| T | Tocopherol |
| T3 | Tocotrienol |
| AOCS | American Oil Chemists’ Society |
| CD | Conjugated diene |
| CT | Conjugated triene |
| GC-FID | Gas chromatography with Flame Ionization Detector |
| HPLC | High-performance liquid chromatography |
| COI | International Olive Oil Council |
| THF | Tetrahydrofuran |
| FAME | Fatty acid methyl esters |
| HPSEC | High pressure size exclusion chromatography |
Introduction

*Ficus Carica* which is cultivated in a wide geographical area extending from Turkey to Afghanistan, is a member of the Moraceae family and contains high amounts of carbohydrates, vitamins, dietary fiber, minerals and oils [1-3]. *Ficus Carica* seeds contain fixed oil between 21.54% -28.52% [4]. These seeds have valuable essential fatty acids, tocopherols & tocotrienols and triglycerides.

Edible oils are generally obtained from oilseeds using dehulling, solvent extraction, pressing and separation methods. During the production of these oils, various undesirable substances are formed due to temperature, humidity, pressure, use of solvents and the quality decreases [5-7]. Cold pressing is a method used instead of industrial applications and no heat is applied to the raw material as in the screw pressing process. Cold pressing doesn’t have a negative effect on the beneficial components of the edible oils. In addition, no organic solvents that would be chemical contaminants in the product are used in cold pressing [8,9]. Therefore, cold pressing oils contain more bioactive components such as lecithin (phospholipids), vitamins (tocopherols / vitamin E, etc.), phytosterols, lignin, squalene, organo minerals, lipoproteins [10,8,11,12,6].

Fatty acid composition, triglyceride (TG), tocol (tocopherol and tocotrienol) compositions, sterol, wax, total polymeric compounds, chlorophyll, β-carotene, peroxide value, conjugated diene and triene amounts for cold pressed oils are very important parameters for nutritional value, oil quality and shelf life [6,5,13]. In many previous studies, it has been found that *Ficus Carica* seed oil is an important source of linolenic acid, tocol and sterol, which have been proven to prevent many diseases such as obesity, cardiovascular and some cancer types [14-17].

The free fatty acid (FFA), peroxide number (PV), chlorophyll, conjugated diene and triene amounts are important oil components related to oxidative stability [13,18]. The amounts of these components are important criteria used for quality and consumability of oil [5]. The amounts of these ingredients must be within the limit values set by the Turkish Food Codex and relevant codex [19]. The goal of this study was to investigate chemical properties such as free fatty acid (FFA), peroxide value (PV), conjugated diene and triene, chlorophyll, β-carotene, fatty acid composition, triglyceride (TG), tocol (tocopherol and tocotrienol) compositions, sterol, wax, total polymeric compound amounts of cold pressed *Ficus carica* seed oil in Turkey. Although there are previous reports on the fatty acid, tocol and sterol compositions of cold pressed seed *Ficus carica* oil, this is the first study that reports the identification and quantification of triglyceride, wax and total polymeric compounds.

Material and Method

Materials

All chemicals and reagents for analysis were of analytical grade and purchased from Merck (Darmstadt, Germany) and BDH (Poole, UK). A fatty acid methyl ester (FAME) mix (37-component FAME blend), triglyceride standards kit (TRI19-1KT,) and tocopherol (α-T, β-T, γ-T, δ-T) and tocotrienols (α-T3, β-T3, γ-T3, δ-T3) standards were purchased from Supelco (Bellefonte, PA) and Sigma Alldrich. *Ficus carica* seed was obtained from İzmir, Turkey.

Oil Extraction by Cold Press Procedure

Dry seeds (1 kg) were extracted using cold pressing machine (Ecotoner 01, TOKULLAR Agro Products Ltd. Co., Antalya, Turkey). *Ficus carica* seed oil was
obtained in cold press machine at 2 mm head diameter, 70 °C temperature, 20 rpm engine speed.

**Determination of Free Fatty Acid (% FFA)**

The free fatty acid (% FFA) content of the oil sample was determined as % oleic acid using the standard AOCS Ca-5a-40 method [20]. Briefly, 1 g of sample was solved 15 mL of neutral ethyl alcohol and titrated with 0.01N NaOH solution along with phenolphthalein indicator until a pink color was formed. The %FFA amount was calculated by reading NaOH consumption. It was performed three times for each oil samples.

**Determination of Peroxide value (PV)**

The peroxide value (PV) was determined using the standard AOCS Cd-8b-90 method [20]. The peroxide value is defined as meqO₂/kg of oil and is a measure of the hydroperoxide content. Briefly, 1 g of sample was solved in 1 mL of chloroform and 1.5 mL of acetic acid and than 0.1 mL KI was added and left in the dark for 3 minutes. After, 25 mL of distilled water and 3 drops of 1% starch solution were added and titrated with 0.002 N adjusted Na₂S₂O₃ until the color became clear. It was performed in triplicate for each oil samples.

**Determination of Conjugated Diene and Triene Amounts**

Conjugated diene (CD) and triene (CT) amounts of *ficus carica* seed oil were determined according to The European Communities official method using double-beam path UV-visible spectrophotometer [21]. 0.05 g oil sample which dissolved in 10 mL isooctane was filled into the sample cuvette. Absorbance values were read at 232 and 270 nm wavelengths by a Shimadzu UV-1800 spectrophotometer (Shimadzu Europe GmbH, Germany) and were used to calculate the conjugated diene (CD) and triene (CT) amounts.

**Determination of Chlorophyll and β-carotene amounts**

Chlorophyll and β-carotene amounts in sample of *ficus carica* seed oil were determined using a dual-beam a Shimadzu UV-1800 spectrophotometer (Shimadzu Europe GmbH, Germany) [22]. The oil sample which dissolved in isooctane was filled into the sample cuvette without any pre-treatment and spectrum scanning was performed.

\[
\text{chlorophyll(ppm)} = \frac{(b - \frac{(a + c)}{2}) \times 1000}{0.1}
\]

\[
\text{β-carotene(ppm)} = \frac{d \times 1000}{0.261}
\]

a: Absorbance at the starting point of the chlorophyll peak at 650 nm
b: Absorbance at the peak of the chlorophyll peak at 650 nm
c: Absorbance at the end point of the chlorophyll peak at 650 nm
d: Absorbance at the peak of β-carotene peak at 450 nm

**Fatty Acid Compositions Analysis by GC-FID**

1 g of oil was derivatized with 1 mL of 2 N methanolic KOH solution for 10 min at room temperature. Later 7 mL of n-hexane was added for extraction of fatty acid methyl esters and the mixture was shaken vigorously for 1 minute. The upper phase of the solution, which was centrifuged at 2000 G for 10 minutes, was taken and dried with 1g of Na₂SO₄ [23-26].
Fatty acid composition of the oil was determined by using an Agilent 7890 series gas chromatography-flame ionization detector (GC-FID) onto an HP-88 column (100 m, 0.25 mm, 0.25 μm, Agilent Technologies, USA). 1 μL Fatty acid methyl esters (FAME) were injected at a split ratio of 100:1. The carrier gas was hydrogen at a flow rate of 1.3 mL/min. The oven temperature was programmed as follows: initial oven temperature of 50 °C was held for 10 minutes and increased to 250 °C at 4 °C/minute and was held at 250 °C for 10 minutes. Injector and detector temperatures were kept at 250 °C. The identification of FAMEs was based on retention times compared to those of the standard FAME mix. Fatty acid analysis were performed three times and the mean values were reported as a percentage.

**Triglyceride Composition Analysis by HPLC**

The triglyceride composition of the oils was determined by an Agilent 1200 series HPLC system consisted of UV detector set at wavelengths of 215 nm. 1 g of oil was dissolved in 10 mL acetone and injected into the ACE 5 C18 column (250 x 4 mm, 5 μm particle size, Advanced Chromatography Technologies, Aberdeen, Scotland). An isocratic elution system with acetone-acetonitrile (1:1) mixture was used at a flow rate of 1.5 mL/min [20,26].

**Tocols (Tocopherols and Tocotrienols) Analysis by HPLC**

The tocols were analyzed by an Agilent 1200 series HPLC system consisted of FLD detector adjusting 295 nm for excitation and 320 nm for emission. 1 g of oil was dissolved in 10 mL of hexane and injected into the LICHROSPHER (5μm Si 100 250x4.0mm) column. An isocratic elution system with n-hexan/isopropanol (96:4) mixture was used at a flow rate of 1.0 mL/min [6]. The tocols were measured by the linear calibration curve with respect to peak areas compared to external standards.

**Sterol Composition Analysis by GC-FID**

Sterol analysis were carried out by the International Olive Oil Council (COI) official method [27]. Briefly, 500 μL of α-cholestanol (100 mg/L) used as internal standard was placed in a 50 mL flask and the solvent was removed. After than, 5 g of oil sample and 50 mL of 1N ethanolic KOH were added flask. The saponification was carried out by boiling at 90 °C for 1 hour under reflux. The saponified part was extracted with 100 mL of water and 100 mL of diethyl ether and, the separated organic phase was washed 3 times with 50 mL of water. At the end of the washing process, the solvent of the organic phase separated from the aqueous phase was removed. The sample, whose solvent was removed, was re-dissolved in 1 mL of chloroform. 200 μL was taken from the dissolved part and solvent was removed. 250 μL anhydrous pyridine and 250 μL BSTFA silylation reagent were added on it. The mixture was subjected to silylation at room temperature for 5 minutes and at 60 °C for 20 minutes.

Sterols in the oil were determined by using an Agilent 7890 series gas chromatography-flame ionization detector (GC-FID) onto HP-5MS (30 m x 0.25 mm x 0.25 μm, Agilent Technologies, USA) column. The silylated sterols were injected at a flow rate of 1 μL. The carrier gas was hydrogen at 1.0 mL/min. The oven temperature was programmed as follows: initial oven temperature of 100 °C was held for 0 minutes and increased to 300 °C at 5 °C/minute and was held at 300 °C for 20 minutes. Injector and detector temperatures were kept at 250 °C and 325 °C, respectively.
Wax Composition Analysis by GC-FID

Wax analysis were carried out by the International Olive Oil Council (COI) official method [27]. Briefly, 15 g of silica gel, that was slurried in hexane, was filled into the glass column and the was cleaned by passing 30 mL of hexane through the column. Mixture of 500 mg oil sample, 500mL lauryl arachidate used as internal standard and 100 µL of 1% Sudan-I used as indicator was dissolved in 2 mL hexane. The prepared mix solution was transferred to the column and was eluted with the hexane/ethyl ether (99:1) mobile phase in ~ 10-15 drops in 10 s. The elution process was continued until the red colored Sudan-I indicator was seen at the end of the column. The eluted part was collected in beaker. The sample, whose solvent was removed, was re-dissolved with 2 mL of n-heptane.

Waxes in the oil were determined by using an Agilent 7890 series gas chromatography-flame ionization detector (GC-FID) onto RTX-5 (15 m x 0.18 mm x 0.20 µm) column. The waxes were injected at 1 µL. The carrier gas was helium at a flow rate of 2.4 mL/min. The oven temperature was programmed as follows: initial oven temperature 80 °C was held for 0 minutes, increased to 200 °C at 28 °C/minute for 1 minute, was kept at 340 °C at 2.8 °C/minute and was held at 340 °C for 25 minutes. The injector temperature was programmed as follows: on-column inlet temperature was raised to 80 °C for 0 minutes and increased to 320 °C at 40 °C/minute. The detector temperature was kept at 350 °C. The flow rates of dry air and hydrogen gas were 300 and 30 mL/min, respectively.

Total Polymeric Compounds Analysis by HPSEC

The total polymeric compounds were analyzed by using an Agilent 1200 series HPLC system consisted of refractive index (35°C) detector. 1 g of oil sample was dissolved in 10 mL of tetrahydrofuran (THF) and injected into guard HPSEC column (PL-Gel 100 A °) (5 cm x 7.6 mm id, 5 µm) and HPSEC column (PL-Gel 100 A °) (30 cm x 7.6 mm id, 5 µm). An isocratic elution system with tetrahydrofuran was used at a flow rate of 1.0 mL/min. Results were reported as a percentage [28].

Data Analysis

All experiments were replicated at least three times. The statistical evaluation of the results was carried out using Microsoft Excel, 2007. Statistical significance was declared at P< 0.05.

Results and Discussion

Ficus carica seed was found to contain 26.44 % fixed oil. The obtained result was in agreement with previous report by Hssaini et al. [4].

Free fatty acid (FFA) and peroxide value (PV) are accepted as important quality indicators in the production, storage and consumption of vegetable oils. FFA and PV contents were % 0.76±0.06 oleic acid and 1.06±0.09 megO₂/kg oil, respectively. In the edible oils communiqué published by the Turkish Standards Institute, peroxide values should be maximum 15 meqO₂/kg oil for extra virgin and cold pressed oils [19]. When the obtained FFA and PV contents were examined, it was seen that these values were appropriate in terms of the consumability of the oil.

Conjugated diene and triene amounts of ficus carica seed oil were found to be 0.02 and 0.03, respectively. When the obtained results were evaluated, it has been observed
that values were compatible with PV analysis and very low.

Chlorophyll and carotene contents are among the most important parameters affecting the shelf life of oils. The amount of chlorophyll and β-carotene in *ficus carica* seed oil was determined as a result of spectrum scanning between 200-800 nm and found to be 25 ppm and 4114.9 ppm, respectively. The results showed that the amount of β-carotene was high and amount of chlorophyll was low in cold pressed *ficus carica* seed oil.

The fatty acid composition of the cold pressed *ficus carica* seed oil was shown in Table 1. A total of 13 different fatty acids were determined in cold pressed *ficus carica* seed oil. The obtained results showed that cold pressed *ficus carica* seed oil was rich source of polyunsaturated fatty acids. The linoleic (33.74%) and linolenic acid (34.05%) were major fatty acids in *ficus carica* seed oil, which were similar to previous reported by Güven et al. [29] and Hssaini et al. [4]. Oleic acid (C18:1), a member of monounsaturated fatty acids, was found to be 19.61% in *ficus carica* seed oil, which were agreement with previous reports [3,29,4]. It also contained saturated fatty acids such as palmitic acid (8.00 %) and stearic acid (3.72%).

The results of the triglyceride composition analysis for cold pressed *ficus carica* seed oil was given in Table 1. Triglycerides are the most concentrated energy source in the diet and serve as carriers for fat-soluble vitamins such as A, D, E and K [25]. The most abundant triglycerides in cold pressed *ficus carica* seed oil were LLnLn, LnLnLn, OLLn, LLLn and PLLn. The LLnLn (20.44 %) was found to be major triglyceride in *ficus carica* seed oil. LnLnLn, LLLn, LLL,OLLn and PLLn containing linolenic and linoleic acid were determined for 17.59, 13.57, 4.84, 16.63 and 9.02%, respectively, of the total triglycerides.

Although studies on *ficus carica* seed oil have been comprehensively searched in the literature, no studies have been found about triglyceride composition analysis. Therefore, this study is the first for triglyceride composition of *ficus carica* seed oil. For this reason, our study gives more information about the composition of triglycerides in *ficus carica* seed oil compared to the reported many studies [3,29,4].

**Table 1. Fatty acid and triglyceride compositions of cold pressed *ficus carica* seed oil.**

| Fatty Acid Composition (%) | Triglyceride Composition (%) | Present Study |
|---------------------------|-----------------------------|---------------|
| C16:0                     | 8.00 ± 0.02                 |               |
| C16:1                     | 0.05 ± 0.01                 |               |
| C17:0                     | 0.07 ± 0.00                 |               |
| C18:0                     | 3.72 ± 0.01                 |               |
| C18:1 cis                 | 19.61 ± 0.01                |               |
| C18:2 cis                 | 33.74 ± 0.06                |               |
| C20:0                     | 0.44 ± 0.00                 |               |
| C18:3n3                   | 34.05 ± 0.01                |               |
| C20:2                     | 0.05 ± 0.01                 |               |
| C22:0+C20:3n6             | 0.12 ± 0.00                 |               |
| C23:0                     | 0.03 ± 0.03                 |               |
| C24:1                     | 0.10 ± 0.01                 |               |
| C22:6                     | 0.01 ± 0.02                 |               |

Note: Values are shown as mean ± standard deviation.
Table 2. Tocol and sterol compositions of cold pressed *ficus carica* seed oil.

| Tocopherol and tocotrienol (ppm) | Sterol (ppm) |
|----------------------------------|--------------|
|                                  | Present Study | Güven et al. [29] | Baygeldi et al. [31] | Present Study | Güven et al. [29] |
| α-T                             | 23.87±0.35    | 157              | 460               | Campesterol  | 51.47±1.16       | 194.71 |
| β- T                            | ND           | -                | -                | Stigmasterol | 3660.42±3.01    | 141.97 |
| γ- T                            | 955.4±4.36   | 4267             | 3918.9           | β- Sitosterol | 2398.00±2.31    | 4326.05 |
| δ- T                            | 20.73±4.05   | 147              | 76.5             | 5-Avenesterol | 834.80±0.83     | 1312.21 |
| α-T3                            | 2.79±0.16    | --               | -                | Stigmastadien | 54.5±1.23       | 83.35  |
| β- T3                           | 3.24±0.46    | -                | -                | Total        | 7250.83±8.59    | 6516.20 |
| γ- T3                           | ND           | -                | -                |              | 4014.4          |        |
| δ- T3                           | ND           | -                | -                |              | 6.03±0.60       |        |
| Total T                         | 1000±2.23    | 4571             | 4014.4           |              | 6516.20          |       |
| Total T3                        | 6.03±0.60    | -                | -                |              | 6516.20          |       |
| Total Tocol                     | 1006±0.60    | 4571             | 4014.4           |              |                  |       |

*ND: Not detected

Tocopherols and tocotrienols (Tocol) which found naturally in vegetable oils are important antioxidants. The oxidative stability of oils is directly related to the presence of these compounds [30]. Tocol values for cold pressed *ficus carica* seed oil sample were given in Table 2. Cold pressed *ficus carica* seed oil had γ-tocopherol with 955.4 ppm as the basic component. The α-tocopherol (23.87 ppm) and δ-tocopherol (20.73 ppm) were prominent tocols in cold pressed *ficus carica* seed oil. Cold pressed *ficus carica* seed oil also contained small amounts of α-tocotrienol (2.79 ppm) and β-tocotrienol (3.24 ppm). Total tocol content in cold pressed *ficus carica* seed oil (1006 ppm) was found lower than that reported by Güven et al. [29] (4571 ppm) and by Baygeldi et al. [31] (4041.4 ppm). β-tocopherol, γ-tocotrienol and δ-tocotrienol were not detected in cold pressed *ficus carica* seed oil.

Sterol composition values for cold pressed *ficus carica* seed oil were given in Table 2. Cold pressed *ficus carica* seed oil contained stigmasterol with 3660.42 ppm as the major sterol. It has been determined that the β-sitosterol content, which is the most found in vegetable oils, was 2398.00 ppm in oil. Cold pressed *ficus carica* seed oil also contained 5-avenesterol (834.80 ppm), stigmastadien (54.54 ppm) and campesterol (51.47 ppm). When the obtained sterol composition results were examined, the total sterol amount was 7250.83 ppm, which was similar to previous reported by Güven et al. [29] (6516.20 ppm).

Waxes (generally C36-C50) formed by esterification of long-chain fatty acids and alcohols are known to reduce the freezing point of oils, create a crystalline structure, and reduce their light transmission and solubility [32]. Wax composition chromatogram and values for cold pressed *ficus carica* seed oil were given in Fig.1 and Table 3, respectively. Cold pressed *ficus carica* seed oil contained C₄₀ with 76.56 ppm and C₄₂ 213.83 ppm. C₄₄ and C₄₆ waxes were absent in cold pressed *ficus carica* seed oil. When the results of the wax composition obtained were examined, the total amount of wax in cold pressed *ficus carica* seed oil was 290.39 ppm. Although studies on *ficus carica* seed oil have been comprehensively searched in the literature, no studies have been found about wax composition analysis. Therefore, this study is the first for wax composition of *ficus carica* seed oil.
Table 3. Polymeric Substance and Wax Compositions of Cold Pressed Ficus Carica Seed Oil.

| Wax Composition (ppm) | Polymeric Substance (%) |
|-----------------------|-------------------------|
| C_{40} 76.56±12.54    | Polymeric 0.01±0.01    |
| C_{42} 213.83±34.51   | Triacylglycerol 96.92±0.18 |
| C_{44} ND              | Diacylglycerol 1.62±0.24 |
| C_{46} ND              | Monoacylglycerol 0.52±0.03 |
| Total 290.39±48.13    | FFA 0.94±0.04          |

*ND: Not detected

In order to determine the total polymeric compound content of cold pressed *ficus carica* seed oil sample, analysis was carried out using HPSEC columns in HPLC device. The polymeric and non-polymeric substances in the oil were allowed to exit the column on the basis of size exclusion. The total polymeric compound chromatogram and amount for cold pressed *ficus carica* seed oil sample was given in Fig.2 and Table 3, respectively. The obtained results showed that cold pressed *ficus carica* seed oil had trace amount of polymeric compound with 0.01%, diacylglycerol with 1.62%, monoacylglycerol with 0.52% and FFA with 0.94%. Although studies on *ficus carica* seed oil have been comprehensively searched in the literature, no studies have been found about polymeric compound analysis. Therefore, this study is the first for polymeric compound of *ficus carica* seed oil.

**Conclusion**

Free fatty acid (FFA), peroxide value (PV), conjugated diene and triene amounts, chlorophyll, β-carotene, fatty acid composition, triglyceride (TG), tocol (tocopherol and tocotrienol) compositions, sterol, wax and total polymeric compounds are important parameters for determination of chemical properties of edible seed oils. The current results show that cold pressed *ficus carica* seed oil has low content of FFA, PV, conjugated diene and triene, chlorophyll, wax and total polymeric compounds while it has high content of linolonic acid, β-carotene, tocol (tocopherol and tocotrienol) and sterol which have high nutritional value and beneficial phytochemicals. It is also good sources of LLnLn, LnLnLn, OLLn, LLLn and PLLn containing linolenic and linoleic acid which are polyunsaturated fatty acids. In conclusion, this study was showed that *ficus carica* seed oil can be used as a vegetable and medical oil with superior properties.

**Conflict of Interest**

Authors would like to certify that the work described has not been published previously and is not under consideration for publication elsewhere. Furthermore, authors have no any actual or potential conflict of
interest including any financial, personal or other relationships with other people or organizations within three years of beginning the submitted work that could inappropriately influence, or be perceived to influence, their work.

Acknowledgment

This study, a part of M.Sc. work entitled "Examination of The Properties of Fig and Rosehip Seed Oils Obtained by Cold Pressing Method", was supported by Selcuk University Coordinators of Scientific Research with SU-BAP 17201003 project numbers. The authors wish to thank the principal of Selcuk University and Scientific Research Projects Coordination.

References

1. Duman E, Şimşek M, Özcan MM. J Agric Processes Techol 24 (2018) 75.
2. Vemmos SN, Petri E, Stournaras V. Scientia Horticulturae 160 (2013)198. https://doi.org/10.1016/j.scienta.2013.05.036
3. Nakilcioğlu-Taş E. Journal of Agricultural Sciences 25 (2019)232. https://doi.org/10.15832/an Kutbd.398268
4. Hssaini L, Hanine H, Charafi J, Razouk R, Elantari A, Ennahli S, Hernández F, Ouaabou R. OCL 27 (2020)1. https://doi.org/10.1051/octl/2020003
5. Ayyildiz HF, Topkafa M, Kara H, Sherazi STH. International Journal of Food Properties 18 (2015)2064. https://doi.org/10.1080/10942912.2014.962657
6. Topkafa M. Analytical methods 8 (2016)4220. https://doi.org/10.1039/C6AY00709K
7. Fine F, Brochet C, Gaud M, Carre P, Simon N, Ramli F, Joffre F. European Journal of Lipid Science and Technology 118 (2016)680. https://doi.org/10.1002/ejlt.201400400
8. Parker TD, Adams D, Zhou K, Harris M, Yu L. Journal of food science 68 (2003)1240. https://doi.org/10.1111/j.1365-2621.2003.tb09632.x
9. Matthäus B, Brühl L. Food/Nahrung 47 (2003)413. https://doi.org/10.1002/food.200390092
10. De Sousa Ferreira Soares G, Gomes VdM, dos Reis Albuquerque A, Barbosa Dantas M, Rosenhain R, Souza AGd, Persun DC, Gadelha CAdA, Costa MJdC, Gadelha TS (2012). The Scientific World Journal 2012:1-6
11. Parry J, Hao Z, Luther M, Su L, Zhou K, Yu LL. Journal of the American Oil Chemists’ Society 83 (2006)847. https://doi.org/10.1007/s11746-006-5036-8
12. Ramadan MF. Industrial Crops and Products 43(2013)65. https://doi.org/10.1016/j.indcrop.2012.07.013
13. Topkafa M, Ayyildiz HF, Kara H (2021). Journal of the Iranian Chemical Society:1-10
14. Simon JA, Chen Y-H, Bent S. The American journal of clinical nutrition 89 (2009)1558S. https://doi.org/10.3945/ajcn.2009.26736E
15. Brouwer IA, Katan MB, Zock PL. The Journal of nutrition 134 (2004)919. https://doi.org/10.1093/jn/134.4.919
16. Fekete K, Győrei E, Lohner S, Verduci E, Agostoni C, Deesi T. Obesity Reviews 16 (2015)488. https://doi.org/10.1111/obr.12280
17. Žilić S, Dragišić JM, Maksimović V, Maksimović M, Basić Z, Crevar M, Stanković G. Helia 33 (2010)75. https://doi.org/10.2298/hel1052075z
18. Topkafa M. Journal of the Iranian Chemical Society 17 (2020)3383.
19. Republic of Turkey MoAAF (2012) Türk Gıda Kodeksi Bitki Adı ile Anilan Yağlar Tebliği. https://www.resmigazete.gov.tr/eskiler/2012/04/20120412-7.htm.

20. Society AOC (1998) Official methods and recommended practices of the American Oil Chemists’ Society. American Oil Chemists Society USD.

21. R. Regulation, H. "Commission Regulation (EEC) No. 2568/91 of 11 July 1991 on the characteristics of olive oil and olive-residue oil and on the relevant methods of analysis Official Journal L 248, 5 September 1991." Offic. JL 248 (1991)1.

22. AB ALS (1995) Methods for Analysis Application General Manual MA 0901. Alfa Laval Separation AB, Tumba, Sweden.

23. Tsimidou M, Boskou D Spices, herbs and edible fungi. Elsevier, Amsterdam, (1994) 273.

24. Suzuki R, Noguchi R, Ota T, Abe M, Miyashita K, Kawada T. Lipids 36 (2001)477. https://doi.org/10.1007/s11745-001-0746-0

25. Topkafa M, Kara H, Sherazi STH. Journal of the American Oil Chemists' Society 92 (2015)791. https://doi.org/10.1007/s11746-015-2652-1

26. Topkafa M, Ayyildiz HF. International Journal of Food Properties 20 (2017)198. https://doi.org/10.1080/10942912.2016.152481

27. COI (2003) Determination Of Vaks Content By Capillary Column Gas Chromatography. International Olive Oil Council.

28. Arslan FN, Kara H, Ayyildiz HF, Topkafa M, Tarhan I, Kenar A. Journal of the American Oil Chemists' Society 90 (2013)1179. https://doi.org/10.1007/s11746-013-2266-4

29. Güven N, Gökyer A, Koç A, Temiz NN, Selvi S, Koperal B, Deniz B, Dedeoğlu SBÖ, Büyükhelvacığil HF, Büyükhelvacığil R. Journal of Pharmacy and Pharmacology 7(2019)541. doi: 10.17265/2328-2150/2019.10.003

30. Yu L, Haley S, Perret J, Harris M, Wilson J, Qian M. Journal of agricultural and food chemistry 50 (2002)1619. https://doi.org/10.1021/jf010964p

31. Baygeldi N, Küçükerdönmez Ö, Akder RN, Çağındı Ö. Progress in Nutrition 23 (2021) IN PRESS

32. Martini S, An M. Journal of the American Oil Chemists’ Society 77 (2000)1087. https://doi.org/10.1007/s11746-000-0171-9