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Seed Oil

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Effect of Extraction Method on Biochemical Properties and Oxidative Stability of Apricot Seed Oil

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ABSTRACT

In this study, apricot seed oil (ASO) was extracted by using either cold-press (CP-ASO) or solvent extraction (SE-ASO) method. The effect of the extraction methods on chemical composition, antioxidant activity, oxidative stability and color of apricot seed oil was determined. Oleic acid with more than 70% ratio was the major fatty acid. The concentration of tocopherol isomers was in the order of γ>α>δ>β for both types of oils. Lag phase formation of lipid hydroperoxides, thiobarbituric acid reactive substances (TBARS) and rancimat induction period of SE-ASO were greater than those of CP-ASO's. Results indicated that extraction method did not influence the fatty acid composition, TAG composition, total phenolic content and color values of apricot seed oils, but it had a significant effect on tocopherol content, antioxidant activity and oxidative stability of oils.

Keywords: Apricot seed oil, Solvent extraction, Cold-press oil, Oxidative stability, Antioxidant activity

Kayısı Çekirdek Yağının Biyokimyasal Özellikleri ve Oksidatif Stabilitesi Üzerine Ekstraksiyon Yönteminin Etkisi

ÖZ

Bu çalışmada, kayısı çekirdek yağı (ASO) soğuk pres (CP-ASO) ve solvent ekstraksiyonu (SE-ASO) yöntemleri ile ekstrakte edilmiştir. Kayısı çekirdek yağlarının kimyasal kompozisyonu, antioksidan aktivitesi, oksidatif stabilitesi ve rengi üzerine ekstraksiyon yönteminin etkisi araştırılmıştır. Oleik asit, %70'den büyük bir oranla en fazla bulunan yağ asidi olarak belirlenmiştir. Her iki yağ içindeki tokoferol izomerlerinin konsantrasyonu sırasıyla γ>α>δ>β olarak belirlenmiştir. SE-ASO'nun lipid hidroperoksit ve TBARS (2-tiobarbiturik asit reaktif madde) lag faz oluşumları ve indüksiyon periyodu CP-ASO'dan daha fazla olmuştur. Araştırma sonuçları yağ örneklerinin, yağ asidi kompozisyonu, TAG kompozisyonu, toplam fenolik içeriği ve rengi üzerine ekstraksiyon metodunun etkisi olmadığını göstermiştir. Ancak, yağların tokoferol içeriği, antioksidan aktivitesi ve oksidatif stabiliteleri üzerine ekstraksiyon yönteminin önemli seviyede etkisi bulunmuştur.

Anahtar Kelimeler: Kayısı çekirdek yağı, Solvent ekstraksiyonu, Oksidatif stabilite, Antioksidan aktivite

INTRODUCTION

Apricot is a member of Rosaceae family, and it has been cultivated widely around the worldwide. According to the report of Food and Agriculture Organization, Turkey is the world's leading apricot producer country with 795788 tons per year [1]. Apricot can be consumed as fresh, dried or can be processed to different products such as juice, jam and fruit molasses. Apricot seed is a by-product of apricot fruit production and is consumed as an appetizer (raw or roasted) [2, 3]. Recently, apricot seed oil has been widely used in cosmetic industry [3]. A

number of studies have been reported that apricot seed contains about 30-48% oil and the oil has contained 56-73% oleic, 20-32% linoleic fatty acids and 300-600 mg/kg oil total tocopherol [4, 5]. These data indicated that apricot seed oil is a good source of oleic, linoleic acid, and tocopherol. Both unsaturated fatty acids and natural antioxidants are important nutrients for human health; because they decrease the risk of heart diseases and cancer [6-8].

Vegetable oils from oilseeds and fruits can be obtained by different extraction techniques such as press system and solvent extraction or combination of these methods [9]. Manufacturers may decide to the extraction technique according the cost of the techniques, material, usage purpose, availability and the others environmental factors. Cold-press technique is simple and not requires much energy. Also, heating and chemical treatments are not using in this technique that can provide advantages [10]. However, the productivity of this technique is lower than hot pressing and solvent extraction. On the other hand, cold-press oils contain more polar phenolic compounds and natural antioxidants [10-12]. Phenolic compounds and natural antioxidants are positively attributed to antioxidant activity and prevent to oxidative deterioration. The lipid oxidation is a major problem for food industry, because it is negatively effects on the nutritional quality and shelf-life of foods containing lipid. Synthetic and natural antioxidants are used to prevent lipid oxidation by scavenging and reducing the activity of free radicals [13]. Due to safety and health benefits, natural antioxidants are more popular in food, cosmetic and medical industry, and also consumers mostly prefer natural antioxidants. Because of many advantages, cold pressed oils are commercially available in markets, such as flaxseed cold press oil, safflower cold press oil, argan cold press oil, and almond cold press oil vs.

There is lack of information on the effect of the extraction methods of oils although it has been studied in details about physical and chemical composition of apricot seed oils. The aim of this study was extracted apricot seed oil using by cold-press and solvent extraction method and to investigate the effect of extraction techniques on the oil content, color, fatty acid, triacylglycerol, tocopherol composition, total phenolic content and also to examine the effect of extraction methods on the antioxidant activity and oxidative stability.

MATERIALS and METHODS

Materials

Apricot seeds of Hasanbey variety were supplied from a local apricot farm in Malatya region. A fatty acid methyl ester (FAME) mixture (37 components FAME mix), triacylglycerol (TAG) mixture (12 component TAG mix) were purchased from Supelco (Bellefonte, PA). 2,2-Diphenyl-1-picrylhdrazyl (DPPH), 2,2′-azino-bis (3-ethylbenzothiazoline-6-sulfonic acid (ABTS), Randomly methylated β-cylodextrin (RMCD), 2,2′-azobis (2-amino-propane) dihydrochloride (AAPH), Trolox and gallic acid were purchased from Sigma (St. Louis, MO). All other chemicals and reagents for analysis were analytical or HPLC grade (Sigma, Merck).

Sample Preparation, Oil Extraction and Determination of Total Oil Content

Total oil content was determined by AOCS 920.39 method [14]. Apricot seeds were removed manually from their shells. After cleaning and drying steps, apricot seeds were ground by using a grinder (Ika, Model M20, Werke Staufen, Germany). Cold-press oil was extracted using by a laboratory type oil-press (Cesalsan, Giresun, Turkey) at room temperature. To obtain solvent extraction oil, 10 g of the ground sample was weighed into a Soxhlet thimble and oil was extracted using with petroleum ether for 8 h. After extraction process, the solvent was removed by using a rotary evaporator (Buchi Model R-120, Flawil, Switzerland) at 40°C under a vacuum, and the residual solvent was removed under nitrogen flow. Cold press and solvent extraction oil were transferred into 10 mL dark glass bottles and kept at -20°C until they used. Each extraction was performed in triplicate and data are shown as mean values with a ± standard deviation.

Fatty Acid Composition

Fatty acid composition of the oils was determined according to the method described by Uluata et al. [15]. Approximately 40 mg of oil was methylated with 3 mL 8% HCl in methanol at 75°C for 2 h. After cooling, 2 mL hexane was added and centrifuged at 2000 rpm for 5 min and then upper phase was taken for analysis. Fatty acid methyl esters (FAMEs) were analyzed using an Agilent 7820A series gas chromatography system (Agilent Company, Santa Clara, CA) equipped with a capillary column (30m x 0.25mm i.d., x 0.2 µm), a flame ionization detector (FID), and an Agilent G4513A automatic injector. The oven temperature was initially 50°C and was maintained at 50°C for 1 min and then increased 175°C at 10°C/min, and kept at 230°C for 25 min. The injector and detector temperatures were at 280°C. The carrier gas was helium, the flow rate was 40 mL/min, and the split ratio was 1/50. FAMEs were identified by compare their retention times with those of the standard FAMEs mixture. Each measurement was performed in triplicate and results were shown as mean values ± standard deviation.

Triacylglycerol Composition

Triacylglycerol composition of oils was determined according to the official method in Turkish Food Codex Communique on Olive oil and Pomace oil (Commonique number 2010/36) with minor modifications [16]. 0.2 g oil was weighed and dissolved with 20 mL n-heptane and then transferred into vials. An Agilent 7820 gas chromatography with equipped Agilent RTX-65 capillary column (30m x 20µm x 0.1µm) flame ionization detector at 390°C was used for this purpose. The oven temperature was initially at 200°C for 5 min and then increased to 370°C by using a 15°C/min, which was kept for 20 min. The carrier gas was helium. TAG

species were identified by compare with mixture of TAG standards. Three vials of each treatment were analyzed for TAG composition and results were shown as mean values ± standard deviation.

Tocopherol Composition

Tocopherol isomers were analyzed by using a HPLC system (Shimadzu) equipped with Inertsil ODS-3 normal phase column (250 mm x 4.6 mm, 5 μm), SPD-M20A photodiode-array detector (PID) [17]. The conditions of separation: mobile phase, n-hexane/isopropanol (96:4, v/v); flow rate: 1 mL/min, injection volume: 20 μL, column temperature: 30°C; and detector setting, 295nm. 1 g of oil sample was dissolved in 5 mL n-hexane, filtered through a 0.45-μm PTFE membrane filter and injected into a Schimadzu HPLC system. Each measurement was performed in triplicates and results were shown as mean values with a ± standard deviation. Tocopherols were quantified based on the peak areas compared with the external standards.

Determination of Total Phenolic Content and Antioxidant Activity

Methanolic extracts were prepared before the determination of antioxidant activity and total phenolic tests with an exception of ORAC assay. One gram of oil was weighed in a test tube and 1 mL 80% methanol in water was added. The tube was agitated with a vortex mixer for 60 seconds. The mixture was centrifuged at 4500 rpm at 5 min and upper phase was taken. The procedure repeated 3 times and upper phases were collected to analyze.

Total Phenolic Content

The total phenolic content was determined according to the method described by Gutfinger with minor modifications [18]. 600 μL of methanolic extracts were added to test tube containing 2.5 mL Folin-Ciocalteu reagent (diluted 1x10). All the content was mixed thoroughly, and after 3 minutes, 2 mL of 7.5% Na_2CO_3 was added and then mixed again. After 2 h of incubation time at room temperature, the absorbance of the sample was measured at 765 nm. The phenolic content was calculated according to the standard curve prepared with gallic acid. Each measurement was performed in triplicate and results were expressed as μg gallic acid equivalent/g oil.

DPPH Assay

The DPPH radical scavenging capacity of the oils was determined according to the method described by Bondet et al. [19]. 20 mg of oil sample was weighed in a test tube, then 80 μL ethyl acetate and 2.9 mL DPPH• free radical solution were added. The sample was agitated with a vortex mixer for 20 seconds. After 30 min of incubation in darkness at room temperature, absorbance was measured with UV-VIS spectrophotometer (Shimadzu 1700, Kyoto, Japan) at 520 nm. Trolox was used as a standard and the results were expressed as μg Trolox equivalent/100 g oil.

ABTS Assay

The radical scavenging capacity of the oils was also determined by ABTS method [20]. Radical stock solution was prepared by reacting 7.0 mM ABTS stock solution with 2.45 mM final concentration potassium per sulfate in dark for 16 h. The solution was diluted with ethanol by adjusting the absorbance to 0.700±0.020 at 765 nm. 100 μL of oil sample was diluted 10 fold with ethanol and 2.9 mL of ABTS+ solution was added. The solution was agitated with a vortex mixer for 20 seconds. The absorbance was measured after 6 min at 765 nm. Each measurement was performed in triplicate and results were expressed as μg Trolox equivalent /100g oil.

ORAC Assay

The free radical scavenging activity of the oils was measured using oxygen radical absorbance capacity assay (ORAC) [21, 22]. ORAC analyzing was carried out with an automated plate reader (Synergy HT Multi-Mode Microplate Reader; BioTek Instruments, Winooski, VT) with a 96-well plate. The excitation wavelength was 485/20 nm and the emission wavelength was 528/20 nm. For this test, 0.5 g of oil sample was dissolved in 20 mL acetone. An aliquot of the sample mixture was properly diluted with 7 % RMCD solvent (w/v) prepared in acetone-water mixture 50% (v/v) and then was shaken at room temperature for 1 h an orbital shaker at 400 rpm for the use in ORAC assay. All reagents were prepared in 75 mM phosphate buffer solution (pH 7.4). Stock solutions of fluorescein (6.3 x 10^{-8} M), AAPH (1.28 x10^{-2} M) and Trolox (standard, 0-100 μM) were prepared fresh. To each well, 150 μL of sodium fluorescein working solution and 25 μL of blank (phosphate buffer pH 7.4), or 25 μL of Trolox standards or 25 μL of sample was added. The plate was then allowed to equilibrate by incubation for a minimum of 30 min at 37°C. Reactions were initiated after pipetting each well with 25 μL of AAPH solution for a final reaction. The fluorescence was then monitored kinetically with data taken every minute for a duration of 2 h. ORAC values were expressed as μmole of Trolox equivalents (TE) per 100 g of oil using a Trolox standard curve prepared with 0 and 100 μM Trolox.

Oxidative Stability Studies

Peroxide value (PV) and thiobarbituric acid reactive substances (TBARS) were determined as lipid oxidation primary and secondary products, respectively. Also Rancimat analysis was examined to determine induction period. 0.5 g of oil put in 2 mL tubes and incubated at 60ºC for 35 days for oxidation. The peroxide value was measured using the AOCS Cd 8-53 official method [23]. Moreover for TBARS value was determined according to the method described by Uluata et al [15]. 0.05 g oil samples were weighed and dissolved in 25 mL 1-butanol. This mixture (5 mL) was transferred into a dry test tube, and then 5 mL of fresh TBA reagent (200 mg TBA in 100 mL of 1-butanol) was added to it. The contents were mixed and heated in a water bath at 95°C for 1 h. The absorbance of the resultant colored complex was measured at 532 nm using a Shimadzu

1017 spectrophotometer. 1,1,3,3-tetramethoxypropane was used as standard for determining TBARS value because it is a precursor of malonaldehyde (MA). Each measurement was performed in triplicate and results were expressed as mmol MA equiv/g oil.

The induction periods of the oil samples were determined by the Metrohm Rancimat apparatus model 743 (Metrohm, Switzerland) [24]. Oil samples (4.0 g) were weighed in the reaction vessel glassware. The conductimetry cells were filled with deionized water up to 90 mL. Firstly, samples were heated to 110°C and then air was passed through the heated oil at the rate of 20 L/h. The induction period was determined automatically by the device and expressed in hours.

Color Measurement

The color of the samples was determined by measuring CIE L* (lightness), a* (redness) b* (yellowness) values with a Minolta Chromameter (CR-100, Minolta, Japan). Results were directly obtained from the measuring device.

Statistical Analysis

Data were analyzed by analysis of variance (ANOVA) using SPSS 20 (SPSS Inc., Chicago, IL). The differences between mean values were compared t-test and Duncan's multiple-range test with level of significance of $p \leq 0.05$.

RESULTS and DISCUSSION

Total Oil Content and Fatty Acid Composition

Total oil content was determined 35.6% in CP-ASO and 45.9 % in SE-ASO (Table 1). The main fatty acids of CP-ASO and SE-ASO were oleic, linoleic and palmitic acid (Table 1). Oleic acid amount in SE-ASO (72.1%) was higher than that of CP-ASO (70.4%), whereas linoleic acid amount in CP-ASO (21.7%) was higher than that of SE-ASO (19.9%). Palmitoleic and stearic acid were determined less than 1.5% in both oil samples (Table 1). The other fatty acids were determined in trace amounts (< 1 %, data not shown). Results were similar to the previous studies [4, 5]. There was insignificant difference for fatty acid composition in CP-ASO and SE-ASO. Thus, these data also showed that extraction method did not have any significant effect on fatty acid composition between the oil samples. In previous studies, grape seed oil [25], safflower oil [9], nut oil [26] were extracted by using different extraction processes and those results also indicated that extraction method had no effect on fatty acid composition.

Table 1. Fatty acid composition (%) of oil samples cold-press and solvent extraction apricot seed oils

Fatty acids(%)	CP-ASO*	SE-ASO
C16:0	6.1±0.13c	6.4±0.04c
C16:1	0.6±0.03d	0.5±0.06d
C18:0	1.2±0.08d	1.1±0.07d
C18:1	70.4±0.49a	72.1±0.21a
C18:2	21.7±0.53b	19.9±0.65b
ΣSFA	7.3±0.1	7.5±0.1
ΣSFA	71.0±0.3	72.6±0.11
ΣSFA	21.7±0.53	19.9±0.65
Oil Content(%)	35.6±0.97	45.9±0.34

Each value is the mean±SD of triplicate determination. Different letters in the column indicate a significant difference ($p \leq 0.05$) between means.

TAG Composition

Physical and chemical compositions of oils are mostly related to fatty acid and TAG composition [27]. Major TAG species detected in CP-ASO were OOO (39.8%), OOL (24.4%), OLL (10.4%), POS (9.7%), POO (9.1 %) (Table 2). Similarly, TAG species in SE-ASO were OOO (39.9%), OOL (24.2%), OLL (10.2%), POS (10.1%), POO (9.2 %) (Table 2). The primary TAG species in both oil samples was OOO, which is also the main TAG species in olive oil and hazelnut. Results were mostly similar with the previous studies [4, 5]. The variations in data could be due to variety of fruit, growing conditions or climate. These data indicates that there is no significant difference in terms of TAG composition between CP-ASO and SE-ASO.

Table 2. TAG composition (%) of oil samples cold-press and solvent extraction apricot seed oils

TAG species (%)	CP-ASO*	SE-ASO
POS	9.7±0.01c	10.1±0.02c
POO	9.1±0.02c	9.2±0.01c
POL	2.5±0.15d	2.4±0.07d
SOO	2.1±0.15d	1.9±0.11d
OOO	39.8±1.04a	39.9±1.20a
OOL	24.4±0.38b	24.2±0.61b
OLL	10.4±0.08c	10.2±0.01c
LLL	1.9±0.01d	1.8±0.02d

*Each value is the mean ±SD of triplicate determination. Different letters in the rows indicate a significant difference ($p \leq 0.05$) between means.

Tocopherol Composition

Tocopherol is a lipid soluble antioxidant and vegetable oils are important source of tocopherol [6]. In this study, tocopherol isomers were examined in CP-ASO and SE-ASO samples (Table 3). α-, β-, γ- and δ-tocopherol amount in CP-ASO were 39.6, 9.2, 498.5 and 15.1 mg/kg oil, respectively. Similarly, α-, β-, γ- and δ-tocopherol amount in SE-ASO were 27.4, 11.3, 318.9 and 17.2 mg/kg oil, respectively. γ-Tocopherol was determined the main and the highest tocopherol isomer and α- tocopherol was determined the secondary tocopherol isomer in both oils ($p < 0.05$). δ-and β-tocopherol was determined in lower than the other isomers. The amount of γ- and α- tocopherol in CP-ASO

was nearly 1.5-fold higher than that of SE-ASO. β- and δ- tocopherol in SE-ASO was higher than that of CP-ASO (p<0.05). Total tocopherol content of CP-ASO was higher than that of SE-ASO (p<0.05). Similar results were found for SE-ASO with the previous study [4, 5]. Also, these data showed that there was a significant difference in tocopherol isomers between two oils (p<0.05); it could be that tocopherol isomers have different polarity because of their number of methyl groups, so they have different solubility [28].

Table 3. Tocopherol content (mg/kg oil) of cold-press and solvent extraction apricot seed oils

Tocopherol isomer	CP-ASO*	SE-ASO
α-tocopherol	39.6±2.20b	27.4±1.22b
β-tocopherol	9.2±0.31d	11.3±0.11d
γ-tocopherol	498.5±17.0a	318.9±17.2a
δ-tocopherol	15.1±0.21c	17.2±0.24c
Total tocopherol	562.4±5.1	374.8±4.7

*Each value is the mean ±SD of triplicate determination. Different letters in the rows indicate a significant difference (p≤0.05) between means. The rows without letters indicates no statistically significant differences between mean.

Antioxidant Activity and Total Phenolic Content

Phenolic compounds have a great impact on the stability, sensory and nutritional characteristics. Also, phenolic compounds contribute to the antioxidant capacity of oils. TPC in SE-ASO (26.9 µg gallic acid /g oil) was higher than that of CP-ASO (24.9 µg gallic acid /g oil) (Table 4) (p<0.05).

Three different methods have been used for the determination of antioxidant activity of the oils; these are DPPH, ABTS and ORAC assays and these methods are widely used to estimate antioxidant activity. For DPPH test, CP-ASO (238.9 µg Trolox/g oil) had higher radical scavenging capacity than SE-ASO (137.5 µg Trolox/g oil) (Table 4). Similarly, ABTS-scavenging capacity of

CP-ASO (168.8 µg Trolox/g oil) was higher SE-ASO's radical scavenging capacity (151.2 µg Trolox/g oil) (Table 4). In contrast, for ORAC assay, radical scavenging capacity of SE-ASO (162.6 µmol/100 g oil) was determined higher than CP-ASO value (110.6 µmol/100 g oil) (Table 4). DPPH and ABTS-scavenging capacity of SE-ASO results are agree with previous result [3], ABTS and DPPH and ORAC scavenging capacity of the samples was reported in here first time. Although these oils had similar total phenolic content, they showed different antioxidant capacity. It could be phenolic type has also effect on antioxidant capacity [29].

Lipid Oxidation

Lipid oxidation was monitored with lipid hydroperoxide, TBARS and Rancimat analysis. While the lag phase of the lipid hydroperoxides formation in SE-ASO was 30 days, it was determined in 22 days for CP-ASO (Figure 1). We observed similar trend in TBARS lag phase for CP-ASO and SE-ASO (Figure 2). Also, the induction period of the oils were determined by Rancimat apparatus. SE-ASO had higher induction period (20.1 h) than CP-ASO (15.1 h) (Figure 3). Fatty acid composition, oxygen, antioxidant and environmental conditions (light, e.g.) are primary factors for lipid oxidation. If the oils have high amount of polyunsaturated fatty acid, they are highly susceptible to oxidative deterioration [30]. However, there was not a significant difference for the fatty acid composition between in two oils. Also, antioxidant compound, such as tocopherol is an important antioxidant component that prevents lipid oxidation [31]. α- and γ- tocopherol of CP-ASO > those of SE-ASO, but β- and δ- tocopherol of SE-ASO > those of CP-ASO, but it was unclear which tocopherol isomer was more effective on the oxidative stability of oil. Overall, all oxidation tests results indicated that SE-ASO was more oxidatively stable than CP-ASO.

Table 4. Antioxidant activity, total phenolic content and color values of cold-press and solvent extraction apricot seed oils*

Parameter	CP-ASO	SE-ASO
ABTS (µg Trolox/g oil)	168.8±0.13a	151.2±0.04b
DPPH (µg Trolox/g oil)	238.9±0.03a	137.5±0.06b
ORAC (µmol/100 g oil)	110.6±2.14b	162.6±2.58a
TPC (µg gallic acid/g oil)	24.9±0.34	26.3±0.15
L^*	73.8±0.19	73.4±0.01
a^*	-4.8±0.04	-3.8±0.11
b^*	19.5±0.22	16.7±0.09

*Each value is the mean±SD of triplicate determination. Different letters in the rows indicate a significant difference (p≤0.05) between means. The rows without letters indicates no statistically significant differences between mean.
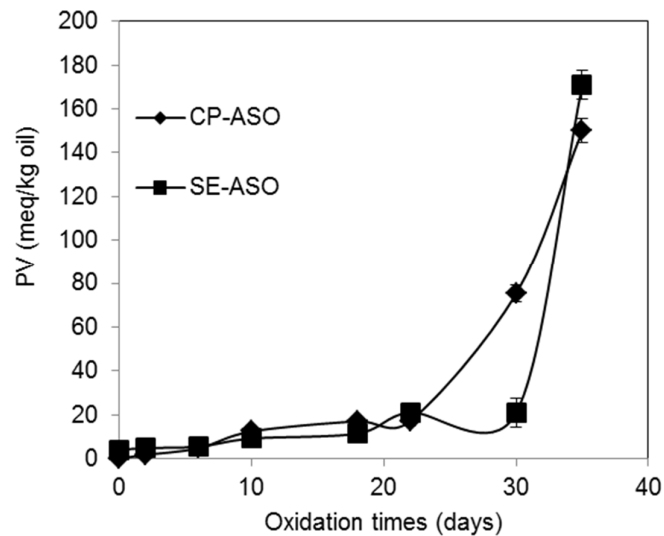
Figure 1. Lipid hydroperoxide formation in cold-pressed apricot seed oil (CP-ASO) and solvent extraction apricot seed oil (SE-ASO) at 60°C.
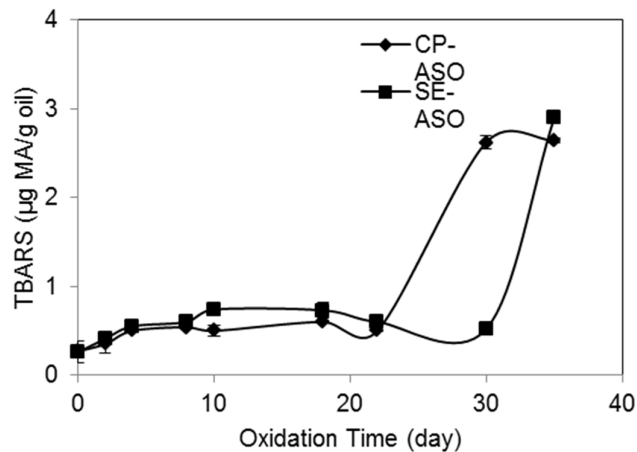

Figure 2. TBARS formation in cold-pressed apricot seed oil (CP-ASO) and solvent extraction apricot seed oil (SE-ASO) at 60°C.

Color

Color of oils is the important critical factor for their application in food and cosmetic products. $a*$(redness), $b*$ (yellowness) and $L*$ (lightness) values are presented in Table 4. However, $a*$ value of CP-ASO (-4.8) was slightly higher than that of SE-ASO (-3.8), similarly $b*$ value of CP-ASO (19.5) was higher than that of SE-ASO (16.7), there were statically insignificant differences (p>0.05) (Table 3). $L*$ value of CP-ASO and SE-ASO were 73.8 and 73.4 respectively. There was not statistically significant also, $L*$ value of CP-ASO and SE-ASO (p>0.05). The color determination result indicated that extraction method did not effect on the color of apricot seed oil.
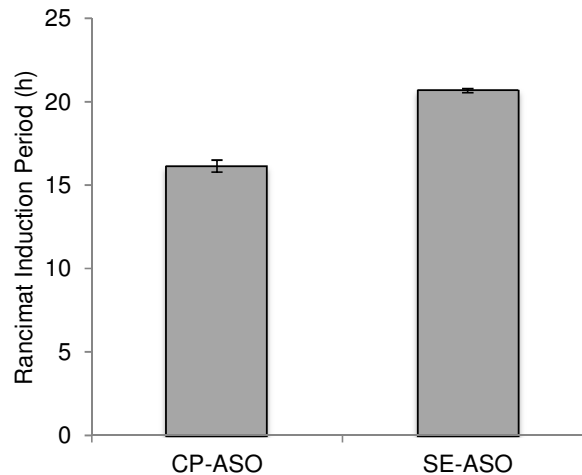
Figure 3. Rancimat induction period of the cold-pressed apricot seed oil (CP-ASO) and solvent extraction apricot seed oil (SE-ASO) at 110ºC. Letters on the bar was indicated that a significant difference ($p \leq 0.05$) between means.

CONCLUSION

In conclusion, yield productivity of cold pressing was lower than solvent extraction method. But, CP-ASO and SE-ASO have > 35% total oil content and with this value, they can be considered as alternative sources of oil. However, these data indicated that extraction method did not show any effect on fatty acid composition, TAG composition, total phenolic content and color, but it had effect on tocopherol content, antioxidant activity and oxidative stability in apricot seed oil. These data provided significant information about effect of the extraction technique and for future studies is needed to investigate how the oxidative stability of cold press oil can be extend.

Acknowledgements

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