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Evaluation of physicochemical characteristic of Persian mesquite grain (*Prosopis farcta*) oil

Afshin Jafarpour[1*], Amir Hossein ElhamiRad[1], Hossein Mirsaeedghazi[2]

[1]*Department of Food Science & Technology, Sabzevar Branch, Islamic Azad University, Sabzevar, Iran*

[2]*Department of food technology, Abouraihan College, University of Tehran, Pakdasht, Iran*

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Abstract

Prosopis farcta is one of prosopis species native to Asia whose origin is from India to Iran. In this study, three Persian mesquite grains has been study. Each oil sample was extracted by solvent. A series of physical and chemical tests including phospholipid, unsaponifiable matters, metals, free fatty acid contents, peroxide index, iodine values, color, induction period measurements and fatty acid composition were carried out on extracted oils. It was concluded that Garmsar farm (growing by itself in the farmland) sample has the highest amount of oil, unsaponifiable matters, iodine value and phospholipids, compared to other samples. Yazd region (growing by itself in desert) sample has the highest stability against oxidation. Mesquite seed oil samples growing by itself in the southern desert Garmsar has the highest iron content but the lowest free fatty acid contents and peroxide index than other samples.

* **Corresponding Author:** Afshin Jafarpour ✉ afjapo@gmail.com

Introduction

Mesquite or prosopis farcta is a short perennial foliage bush whose length often reaches 40-100 Cm. However, if no weed control program is performed in the farmland, this bush , in favorable conditions, can have a length of 2 meters and almost equal to the length of 3 meter has also been observed (Qasem, 2007). Well-developed roots and rhizomes of this plant can also penetrate to a depth of 15-20 meters of the soil. Its long and thin branches have short blades like those of rose. 9-13 pair of leaves grow on top of branches in twos opposite each other with length of each leaf being 1.8-3 Cm. Small yellow flowers appear from May to August. On each inflorescence 1-2 capsules of pulpy mesocarp are created which become black brown when fully matured (eFloras, 2010). Prosopis farcta loves clay and dry soils and deep alluvial soils with shallow groundwater surface. In salty soils under semi-desert conditions it flowers.

Prosopis farcta can be a suitable food for ruminants in dry seasons (Göhl, 1982). New shoots of the bush may be eaten by camels, sheep, and goats (eFloras, 2010). There is little information about food value of prosopis farcta. A report from 1920 suggests that its capsules contain 14.5% protein based on dry weight and 15.7% raw fiber. The grains contain 20.1% protein based on dry weight and 9.3% fiber (Anon, 1920). Also the grains include 19.3% mucilage composition (Shalaby, 1976a.) and its pericarp is full of tannin and contains 18.6% Gallotannin (Shalaby, 1976b.). Prosopis farcta with native Arabic name of Al-Yanboot is used as a renal stone, and also diabetes in the heights of Golan and the western casts of Jordan (Said, 2002). In 1987, Yaniv *et al.*, in a comprehensive phytology research on medicinal plants of Israel reported 16 species appropriate for remedy to diabetes. Eight cases including prosopis have been recognized as the most effective (Yaniv, 1987).

Prosopis farcta is one of prosopis species native to Asia whose origin is from India to Iran and it has been spread from this place to the other areas of Middle East, Turkey, Ukraine, North Coasts of Africa, and even to Algeria. In general, it can be said that this native plant is found from North Africa, Egypt, Tunisia, and almost Algeria and most areas of western south of Asia, from Kazakhstan to India, from Middle East to Asia Minor and even to U.S.A. Since Prosopis farcta is a plant that does not require special growing conditions and grows in poor soils and considering the lake of food resources for human and since this plant, has not been considered as a human food, in this research has been tried to study on mesquite seed oil as a part of its nutrient and with determination of its physicochemical properties the similarity between mesquite oil with other common oils in the human diet be determined so maybe in the future be considered as a source of edible oil supply.

Material and methods

Materials

3 samples of mesquite grain are prepared by completely randomized method from Garmsar and Yazd in Iran and coded according to table 1.

The grains after coming out of capsule-shape coat were milled separately. Each sample was placed in the extractor reservoir and its oil was extracted by industrial n-Hexane. This system which acts like Soxhlet extractor has a capacity of 20 liters of solvent and 5 kilos of grain.

All chemicals used for this research experiments are made in German company of Merck.

Oil extraction

Measurement of the oil rate was performed in three replications for each sample according to Soxhlet method. The solvent used was n-Hexane and extraction time was 5 hours.

Determination of fatty acids

To determine the rate and composition of fatty acids, at first, the oil samples were methylated according to the guidelines of ISO 5509. Then methyl esters were identified by gas chromatography method of AOAC 96322.

To do this, gas chromatography system model Varian Star 3400 was used. Iodine value of the oil samples

was calculated by using the percent of fatty acids obtained through gas chromatography based on standard AOAC Cd1C-85 (AOAC, 1999).

Induction period measurements

Determination of the oil stability time to oxidation for 3-garam oil sample was performed by Rancimat Metrohm system model 743 at temperature of 110°C according to standard AOCS Cd 12-57 (AOCS, 1997).

Free fatty acid contents

The percent of free fatty acid was determined according to AOAC 94028 through oil titration by 0.1 and 0.01 normal Sodium hydroxide in the vicinity of phenolphthalein with three replications for each sample. Peroxide index was measured by method AOAC 965.33 for each sample in three replications (AOAC, 1999).

Color

The color of the oil samples was determined according to standard method AOCS Cc 13e -92 by Lovibond system with a cell of ¼ inch.

Phosphorus and phospholipid

Determination of the phosphorus and phospholipid values was performed based on the method presented by Cocks & Van Red (Cocks, 1966).

Unsaponifiables maters

Unsaponifiables in the oil was determined according to method AOAC 933.08.

Saponification of the oil was first done with ethanolic potassium hydroxide solution.

Extraction of the unsaponifiables was then carried out with petroleum ether for at least six times (AOAC, 1999).

Identification of sterols and tocopherols was performed according to method AOAC 970.51 by using thin layer chromatography (AOAC, 1999).

Metals

To measure the concentration of iron and copper, method AOAC 990.05 and method AOCS ca 15-75 were used in which at first, the sample being considered was incinerated, then a mixture of nitric acid and *hydrochloric acid was added to it and after preparing iron and copper standards, concentration of these metals was determined by atomic absorption system (AOCS, 2001).*

Results and discussion

Figure 1 shows the value of mesquite grain oil samples. The oil rate of mesquite grain being tested ranged from 4 to 9 percent.

The sample has grown in richer soil with more water, contain more oil percentage.

Figure 2 shows the color of the raw oil samples of mesquite grain with a ¼-inch cell.

Table 1. Code and harvest region of samples.

Samples	Harvest region
A	Desert of southern margin Garmsar (wild)
B	Desert of Yazd margin (wild)
C	Garmsar farm (growing by itself in the farmland)

The existence of red and yellow color in the oil often result from carotenoid pigments and the blue color results from chlorophyll pigment.

The oil samples color of mesquite grain being tested is yellow. So mesquite seed oil contains large amounts of carotenoids.

Figure 3 presents the composition and rate of fatty acids constituting glycerides in the mesquite grain oil samples. In the oil samples under test fatty acid Linoleic (52-59%), Oleic acid (23-28%), and Palmitic

acid (7-11%) constitute more than 90 percent of the fatty acids. The other fatty acids are Stearic (3-7%) and Linolenic (0.4-0.9%). The least fatty acid is *Lauric* and Cerotic and the most is Linoleic. Therefore, the fatty acid composition of mesquite seed oil is similar to sunflower oil. Mesquite seed oil contains large amounts of monoenoic, dienoic and saturated fatty acids and a small amount of polyenoic fatty acid. So mesquite seed oil is relatively resistant to heat.

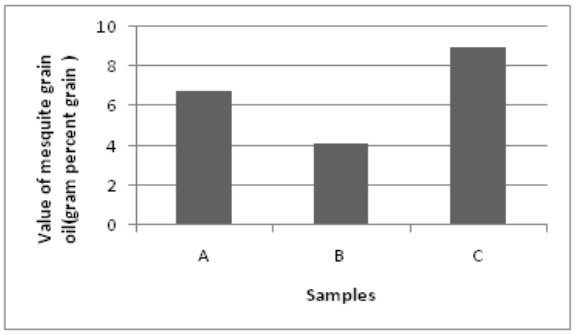

Fig. 1. Oil rate of mesquite grain samples**.**

The existence of high amount of Oleic acid in mesquite oil sample, besides providing an ideal source of energy production, prevents heart diseases. Linoleic acid which exists by 52-59% in mesquite grain samples on the one hand prevents fats from depositing in the arteries and on the other, causes good cholesterol to increase. This fatty acid is a vital one for human and a balancing agent for meeting human needs in each age. The rate of Linolenic acid in the mesquite grain oil (0.4-0.9%) is much less than of soya oil (7-10%). this same fact causes the mesquite grain oil to have higher oxidative stability than that of soya oil.

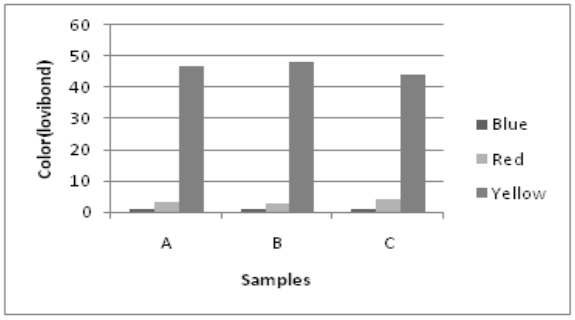

Fig. 2. Color of mesquite grain oil sample (1/4 inch cell)**.**

Considering figure 5, iodine value of the mesquite grain oil is between 118 -121. The least iodine value is related to the sample B and the most of it is related to sample C.

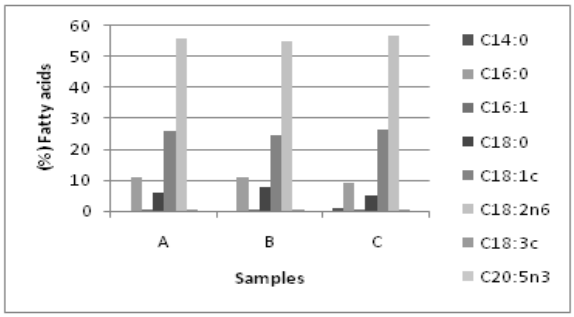

Fig. 3. Composition of fatty acids constituting mesquite grain oil.

Iodine value of this oil compared to that of common vegetable oils like soya oil (117-141), sunflower oil (113-143), corn oil (109-133), and cotton oil (99-133) shows that this oil regarding unsaturation is similar to most common eating oil (Belitz, 2009).

Since decreasing unsaturation degree causes oxidation resistance to increase, relative low degree of iodine value of mesquite grain oil will indicate relative oxidative stability of this oil.

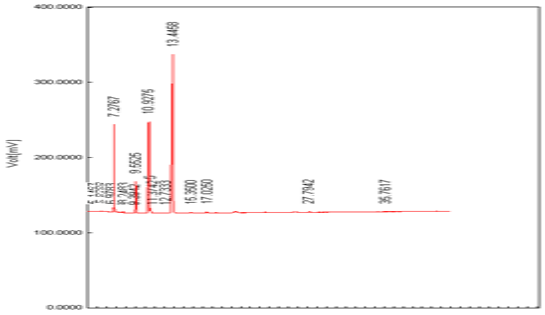

Fig. 4. A sample of gas chromatograph for mesquite grain oil**.**

Figure 6 shows stability time of mesquite grain raw oil samples to oxidation. Considering figure 6, stability time of mesquite grain oil samples to oxidation is 5.6-5.9 h/110°C which is a good oxidative stability compared to stability time of olive oil being 3-4 hours and hazelnut oil being 0.37-1.73 hours.

Therefore, it is good oil for cooking. Regarding figure 6, sample C has the least stability time and sample B has the most one.

Figure 7 shows acidity or free fatty acids of mesquite

grain oil samples.

Hydrolysis of fats can be done in storage of fruits and oil seeds and transportation of them.

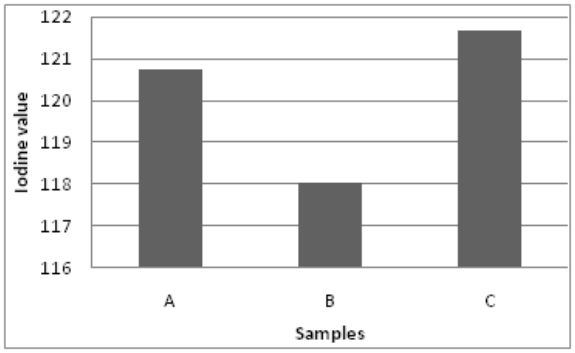

Fig. 5. Iodine value of mesquite grain oil sample**.**

Contamination of the seed with plant pests, lipase enzyme of the seed, secondary contaminations with lipase enzyme-producing microorganisms and the rate of humidity absorption by the seed during storage can be causes of increasing oil acidity.

High percent of free fatty acids in the samples indicates unfavorable storage conditions for these seeds.

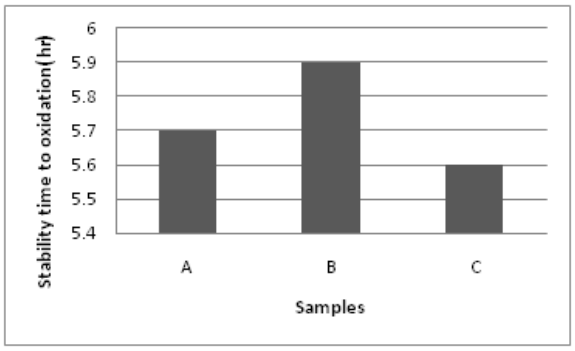

Fig. 6. Stability time of mesquite grain oil samples to Oxidation.

High humidity of reservoir or inappropriate storage temperature as well as high humidity of the grain cores before intensifies hydrolysis of the oil triglycerides. Moreover, inappropriate harvest conditions or late harvesting of grains intensify hydrolysis (Belitz, 2009).

Considering figure 7, sample C and sample A had the least and the most percent of free fatty acids based on Oleic acid, respectively.

Figure 8 presents peroxide index in term of milliequivalent gram of peroxide per kilo of oil samples. Unsaturated bonds existing in all oils and fats constitute active centers which may react with oxygen. This reaction results in oxidation products. Hydro peroxide are primary products of oxidation and generally unstable. They are decomposed into secondary products of oxidation the most important of which are aldehydes and ketones.

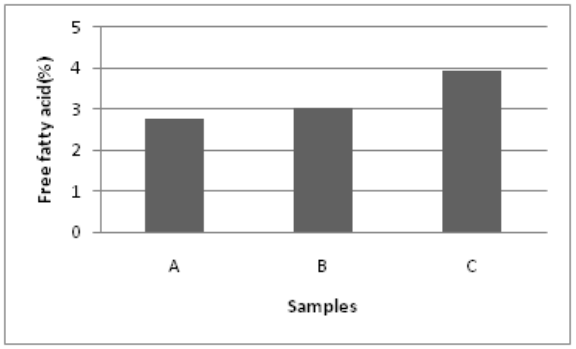

Fig. 7. Percent of free fatty acids in mesquite grain samples**.**

Since peroxide is easily distinguished in fats, peroxide number is often used for measurement and progress of oxidation. Considering figure 8, sample A has the least peroxide index among oil samples that concerning the similarity of thermal process condition, its reason is lower degree of unsaturation compared to sample C and lower rate of iron and copper in this sample compared to the other samples. Figure 9 shows the rates of phospholipid in mesquite grain oil samples in terms of mg/100g.

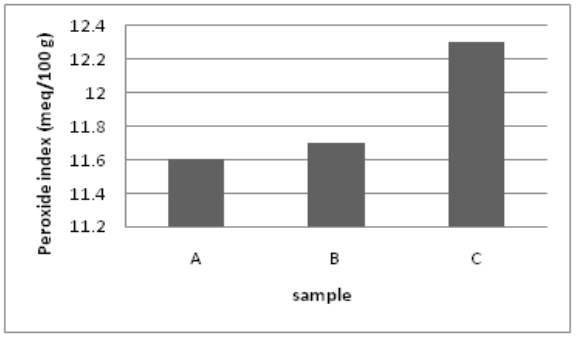

Fig. 8. Peroxide index of mesquite grain oil samples.

Phosphorus concentration is an indicator for measurement of phospholipids concentration in such a way that calculating the rate of phosphorus we can multiply it by 30 and obtain the quantity of phospholipid.

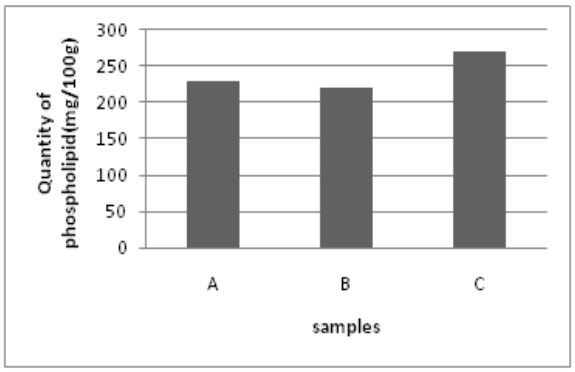

Fig. 9. Quantity of phospholipid in mesquite grain oil samples

The existence of phospholipids or the same phosphatides in the oil causes high quantity of triglycerides to be emulsified with water and eliminated in the process of refining and producing oil.

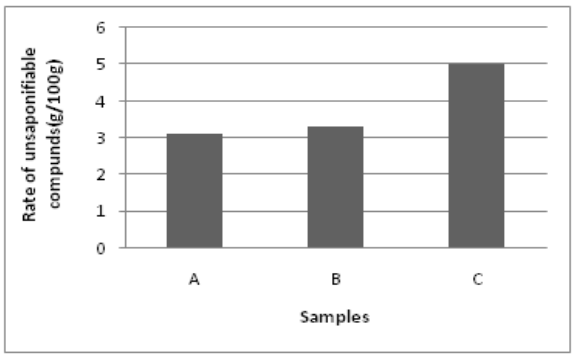

Fig. 10. Rate of unsaponifiable compounds of mesquite grain oil samples.

Phospholipids, because of their amino group, under high temperature of the process participate in a reaction like Millard reaction with aldehydes resulted from oxidation of unsaturated fatty acids and cause the oil to be opaque. Phosphatides can also reinforce the act of tocopherols. Considering figure 9, sample C has the most phosphorus and phospholipid rates and sample B has the least of them.

Figure 10 shows the rate of unsaponifiable matters in terms of g/100g of the oil samples being tested. All oils and fats have some compounds which are not soaped due to alcoholic base. These compounds are called unsaponifiable matters. *Unsaponifiable* matters of the oils are sterols, 4-methylsterol, terpenoid alcohol, tocopherol, dimer compounds and hydrocarbons.

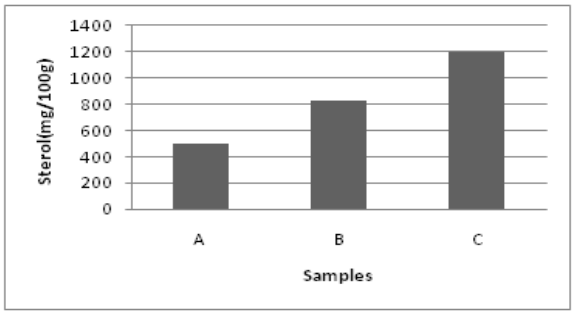

Fig. 11. Value of sterol in mesquite grain oil samples.

Considering figure 10, sample C has the most value of these compounds and sample A has the least value of them.

Identification of the elements constituting unsaponifiable compounds was performed by thin layer chromatography. On the chromatography page unsaponifiable compounds create areas of sterol, 4-methylsterol, triterpene alcohol, delta, gamma, beta and alpha tocopherols, dimer compounds created during oxidation, and hydrocarbons, in order. The most plentiful sterol is β-sitosterol constituting about 50 percent of total sterol. Among tocopherols alpha tocopherol is also the most and delta tocopherol is the least.

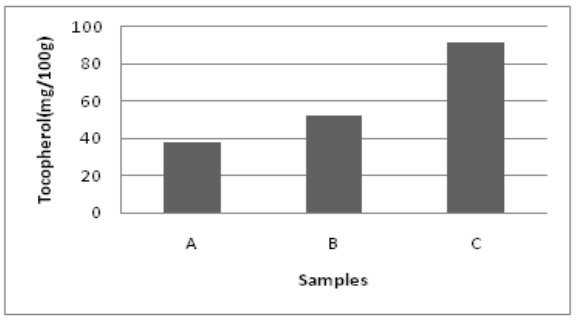

Fig. 12. Value of tocopherol in mesquite grain oil samples.

Figures 11 and 12 show the values of sterol and tocopherol in mesquite grain oil samples, respectively. Considering figures 11 and 12 sample C has the most value of sterol and tocopherol and sample A has the least values of them.

Figure 13 shows the values of iron and copper in mesquite grain oil samples in terms of ppm.

Iron and copper play a very effective role in oxidation

acceleration. These metals show their effect through breakdown of hydroperoxide.

Also, heavy metals may directly attack on fatty acid and transform it into free radical or single oxygen. Metal existing in vegetable oils like other plant products can be derived from the soil or enter into the oil due to its contact with metal equipment. Raw vegetable oils usually have 0.1-0.3 ppm copper and 1-5 ppm iron.

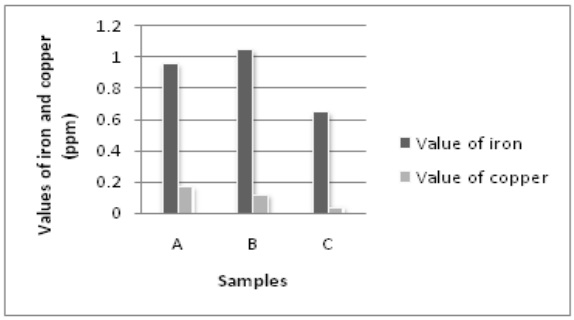

Fig. 13. Values of iron and copper in mesquite grain oil samples.

It is noteworthy that values of metals in the oil are dependent on the plant genetic. Considering figure 13, sample B has the most iron and sample C has the least and sample A and C have the most and the least copper, respectively.

Conclusions

Regarding the mentioned matters, economic exploitation of mesquite grain has some advantages for example utilization of mesquite grain oil with high use quality and increase of rural communities' income and improvement of natives' economic status in desert areas

References

American Oil Chemists' Society. 1997. AOCS official method.

Anon. 1920. Feeding value of the pods and seeds of Prosopis stephaniana. Bulletin of the Imperial institute **18,** 478-481.

AOCS Annual Meeting & Expo. (2001). AOCS Archives Meeting Abstracts.Association of Official Analytical Chemists, (1999).Official methods of analysis of the AOAC, Arlington, USA.

Belitz MD, Grosch W. 2009. Food chemistry (2rd Ed.). Berlin Heidelberg: springer-verlag, **188(190),** 663-664 P.

Cocks LV, Van Red C. 1966. Laboratory handbook for oil and fat analysis. London, UK: Academic Press, 32-37.

EFloras. 2010. eFloras, a collection of on-line floras from around the world. Harvard University

Göhl B. 1982. Les aliments du bétail sous les tropiques. FAO, Division de Production et Santé Animale, Roma, Italy.

Qasem JR. 2007. Chemical control of Prosopis farcta (Banks and Sol.) Macbride in the Jordan Valley. Crop Protection **26,** 572-575. http://dx.doi.org/10.1016/j.cropro.2006.04.025

Said O, Khalil K, Fulder S, Azaizeh H. 2002. Ethnopharmacological survey of medicinal herbs in Israel, the Golan Heights and the West Bank region. Journal of Ethnopharmacology **83,** 251-265. http://dx.doi.org/10.1016/S0378-8741(02)00253-2

Shalaby AF, Ghanem SS, Etman MA. El-Habibi AM. 1976b. Phytochemical studies on the flora of Egypt. 3. Phenolic compounds of Prosopis stephaniana (Willd.) Kunth. Egyptian Journal of Botany **19,** 119-126

Shalaby AF, Ghanem SS, Etman MA, El-Habibi AM. 1976a. Phytochemical studies on the flora of Egypt. 1. Sugars and mucilage of Prosopis stephaniana (Willd.) Kunth. Egyptian Journal of Botany **19,** 1-15.

Yaniv Z, Dafni A, Friedman J, Palevitch D. 1987. List of medical plant in Israel. Journal of Ethnopharmacology **19,** 145-151. http://dx.doi.org/10.1016/0378-8741(87)90038-9