

Fatty Acid Composition of *Hibiscus trionum* L. (Malvaceae)

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Abstract: The genus *Hibiscus* plants have different uses, some are used as foods (*H. esculenta* L.), and some species as remedy in traditional medicine (*H. sabdariffa* L.) as well as a colorant for herbal teas. The only species that grows naturally in Turkey is *H. trionum* L. The plant especially infests soy and corn fields, and therefore it is considered to be a noxious weed. The plant is also found to be a host for Potato Virus Y (PVY) and Tomato Spotted Wilt Virus (TSWV). Infestation of the crop fields by this plant shows that it germinates easily. Since it produces many seeds, distribution of the plant is also quiet easy. Though, seed oil yield is low (4.7%) since linoleic acid composition of the seed oil is quiet high (67,5%), it can still be used as a source of unsaturated fatty acids. The other major fatty acids are palmitic, oleic and stearic acids in the studied seed oil.

Keywords: *Hibiscus trionum*; Malvaceae; seed oil; fatty acid, linoleic acid.

1. Plant Source

The genus *Hibiscus* L. consists of approximately 200 species in the tropic and subtropic regions of the world [1]. Fruits of some species are used as foods; their seeds are roasted, ground and used as coffee substitutes in Turkey (*H. esculenta* L.) [2], flowers of some species provide a soft drink that is highly appreciated all over the world for the particular sensation of freshness and also used as food or food ingredients such as jellies, syrups, beverages, puddings, cakes, wines and as a colorant for herbal teas (*H. sabdariffa* L.) [3-5], while some of them have been used as folk medicine because of various biological activities (antihypertensive, antiatherosclerotic, antioxidant, antihypercholesterolaemic, antinociceptive, antipyretic, antimutagenic, antifungal and antibacterial, chemopreventive,) (*H. sabdariffa* L.) [6-12]. One species that is mostly cultivated for ornamental purposes has also been shown to promote hair growth and aid in healing of ulcers (*H. rosa-sinensis* L.) [13].

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The other usages of *Hibiscus* species that are noteworthy are as follows: traditional usage of *H. cannabinus* L. for fibre production such as making ropes, sacs, canvases and carpets; yielding edible oil for first class cooking oil and margarine production [14]; producing a non-conventional oil for biodiesel production (*H. esculentus* L.) [15]; producing a low cost absorbent for use in the treatment of liquid wastes containing metal ions and oils (*H. cannabinus*) [16].

The only species that grows naturally in Turkey is *H. trionum* L. [17] known as Venice mallow, bladder ketmia, flower-of-an-hour or rosemallow; the plant is known to infest soy and corn fields and therefore considered to be a noxious weed. The plant is also found to be a host for Potato Virus Y (PVY) and Tomato Spotted Wilt Virus (TSWV) [18].

Infestation of the crop fields by this plant shows that it germinates easily. Since it produces many seeds, distribution of the plant is also quiet easy. Hence, in a study performed by Westra et al. (1996), it was reported that this species produced 3100 seeds per plant under competitive irrigated conditions [19]. Though there are many studies conducted on the fatty acid composition of various *Hibiscus* species and hybrids [22-29], as far as we are concerned, only one study is present on Chinese *H. trionum* [21]. Our aim is to compare the fatty acid composition of the species growing in Turkey first with the species growing in China and then compare it to other species and hybrids and to determine whether this plant can be used as an oil plant, or not.

Plant material was collected from Eskişehir, Turkey [B3: on the side of Atatürk Boulevard (former: Hasan Polatkan Boulevard), 39° 45' 847''N, 030° 30' 482'' E, at altitude 791 m, on 2/10/2005), and voucher specimen (AEF 23715) is kept at Ankara Üniversitesi Eczacılık Fakültesi Herbaryumu (AEF).

2. Previous Studies

We searched the literature for unsaturated fatty acid contents of some members and hybrids of the *Hibiscus* genus, and tabulated the percentile values for oleic and linoleic acids as major unsaturated fatty acids (Table 1).

In another study performed on the same species growing in China, stearic, oleic and linoleic acid contents of the seeds were found to be 2.23%, 12.30% and 63.61%, respectively [21]. Though oleic acid content of the seeds of the species growing in Turkey is lower, linoleic acid content is found to be higher with a percentage value of 67.5.

3. Present Study

57.53 g seed material, ground as a coarse powder, was placed into a Soxhlet apparatus and extracted with petroleum ether for 4 hours. After extraction is completed, the solvent was evaporated in a rotary evaporator and 2.7 g (4.7%) seed oil was obtained. Methyl esters of fatty acids from the extracted oil were prepared according to the method of Metcalfe *et al.* [20] and were examined by GC-MS analysis.

GC-MS analysis was carried out on Agilent 6890N Network GC system combined with Agilent 5973 Network Mass Selective Detector (GC-MS). The capillary column used was an Agilent 19091N-136 (HP Innowax Capillary; 60.0 m x 0.25 mm x 0.25 µm). Helium was used as carrier gas at a flow rate of 3.3 mL/min with 1 µL injection volume. The analysis of the sample was conducted according to the established temperature program: GC oven temperature was kept at 100°C for 2 minutes and adjusted to 170°C at a rate of 5°C/min and, kept constant at this temperature for 15 minutes. Then was increased to 215°C at a rate of 5°C/min and kept at this temperature for 15 minutes. Finally, was increased to 240°C at a rate of 3°C/min and kept constant at this temperature for 10 minutes. The injections were performed in split mode (35:1) at 250°C. Detector (MSD) and injector temperatures were 260°C and 250°C, respectively. Pressure was 50.0 psi. Run time was 78.33 min. Temperature for FID was set as 250 °C. MS parameters were as follows; scan range (*m/z*): 35-450 atomic mass units (AMU) under electron impact (EI) ionization (70 eV). Three injections were

performed and the averages of fatty acid percentages were taken. Retention times of the fatty acid components of seeds were compared with the corresponding original fatty acids from GC, and identification of mass spectra of individual components was achieved by comparison with Wiley and Nist databases.

The composition of the seed oil that yielded total fatty acids of 99.9% is as follows: myristic acid (0.5%), palmitic acid (16.2%), stearic acid (4.1%), oleic acid (9.4%), linoleic acid (67.5%) and linolenic acid (2.2%). When the composition of the seed oil was analyzed, the major fatty acid was found to be linoleic acid with a high percentage (67.5%). In another study performed on the same species growing in China, stearic, oleic and linoleic acid contents of the seeds were found to be 2.23%, 12.30% and 63.61%, respectively [21]. Though oleic acid content of the seeds of the species growing in Turkey is lower, linoleic acid content is found to be higher with a percentage value of 67.5.

When we especially compare the amounts of linoleic acid, we can see that our species has a comparable amount, and in some cases, more of this unsaturated fatty acid. Due to low yield (4.7%) of the seeds of *H. trionum*, the plant may not seem reasonable as an oil source. But, Vakulin (1935) reported a much higher value in his study on the seeds of Russian and German *H. trionum* (23.8% and 21.77% respectively) [30]. Though these yields may not still be considered feasible for cultivation, since it easily grows in cultivated areas, even on roadsides, and distributes easily due to its many seeds, its cultivation will be cost-efficient and easy, and since the oil is rich in unsaturated fatty acids, it may provide a good source for these fatty acids or it can be used in nutraceutical or cosmetic preparations as Holser and Bost mentioned [29]. It may even be used in biodiesel production [15] and in the production of low cost absorbent for use in the treatment of liquid wastes containing metal ions and oils [16] just like other member of the genus. Therefore, by finding further medicinal and commercial uses for this species, we may even be able to improve the reputation of this weed.

Table 1: Oleic and linoleic acid percentages of some *Hibiscus* species and hybrids

<i>Hibiscus</i> species or hybrids	Oleic acid (%)	Linoleic acid (%)	Reference
	34.0	14.6	[22]
<i>H. sabdariffa</i>	34.6-39.8	30.1-37.45	[23]
	28.67	40.10	[24]
	12.30	37.19	[25]
<i>H. esculentus</i>	17.4	47.5	[26]
	29.09	30.1	[27]
<i>H. cannabinus</i>	26.94-43.42	28.60-49.75	[28]
<i>H. surattensis</i> L., <i>H. vitifolius</i> L., <i>H. hirtus</i> L., <i>H. punctatus</i> Dalzell, <i>H. zeylanicus</i> L., <i>H. micranthus</i> L., <i>H. solandra</i> L'Her	5.9-24.8	43.9-67.6	[29]
<i>Hibiscus</i> hybrids	0.00-48.37	0.00-64.9	[30]
<i>Hibiscus</i> hybrids	14.0-32.9	46.5-64.0	[31]

References

- [1] M Hickey, C. King (1997). *Common Families of Flowering Plants*, Cambridge University Press, UK, pp. 49.
- [2] S. Çalışır, M. Özcan, H. Hacısferoğulları and M.U. Yıldız (2005). A study on some physico-chemical properties of Turkey okra (*Hibiscus esculenta* L.) seeds, *J Food Eng.* **68**, 73-78.

- [3] E. Prenesti, S. Berto, P.G. Daniele and S. Toso (2007). Antioxidant power quantification of decoction and cold infusions of *Hibiscus sabdariffa* flowers, *Food Chem*, **100**, 433-438.
- [4] K.R. Christian, M.G. Nair and J.C. Jackson (2006). Antioxidant and cyclooxygenase inhibitory activity of sorrel (*Hibiscus sabdariffa*), *J. Food Compos. Anal.* **19(8)**, 778-783.
- [5] M. Rasdhari, T. Parekh, N. Dave, V. Patel and R. Subhash (2008). Evaluation of various physico-chemical properties of *Hibiscus sabdariffa* and *L. casei* incorporated probiotic yoghurt, *Pak. J. Biol. Sci.* **11(17)**, 2010-2018
- [6] M.H. Faraji and A.H.H. Tarkhani (1999). The Effect of Sour Tea (*Hibiscus sabdariffa*) on essential Hypertension, *J. Ethnopharmacol.* **65**, 231-236.
- [7] C.C. Chen, J.D. Hsu, S.F. Wang, H.C. Chiang, M.Y. Yang, E.S. Kao, Y.C. Ho and C.J. Wang (2003). *Hibiscus sabdariffa* extract inhibits the development of atherosclerosis in cholesterol fed rabbits, *J. Agr. Food Chem.* **51**, 5472-5477.
- [8] B.H. Ali, N.A. Wabel and G. Blunden (2005). Phytochemical, pharmacological and Toxicological aspects of *Hibiscus sabdariffa* L.: A review, *Phytother. Res.* **19**, 369-375.
- [9] E. O. Farombi and A. Fakoya (2005). Free radical scavenging and antigenotoxic activities of natural phenolic compounds in dried flowers of *Hibiscus sabdariffa* L., *Molecular Nutr. & Food Res.* **45**, 1120-1128.
- [10] J.Y. Liu, C.C. Chen, W.H. Wang, J.D. Hsu, M.Y. Yang and C.H. Wang (2006). The protective effects of *Hibiscus sabdariffa* extract on CCl₄-induced liver fibrosis in rats, *Food Chem. Toxicol.* **44**, 336-343.
- [11] V.M.N. Garcia, G. Rojas, L.G. Zepeda, M. Aviles, M. Fuentes, A. Herrera and E. Jiménez (2006). Antifungal and antibacterial activity of four selected Mexican medicinal plants, *Pharm. Biol.* **44(4)**, 297-300.
- [12] Y.C. Chang, K.X. Huang, A.C. Huang, Y.C. Ho and C.J. Wang (2006). *Hibiscus* anthocyanins-rich extract inhibited LDL oxidation and oxLDL-mediated macrophages apoptosis, *Food Chem. Toxicol.* **44**, 1015-1023.
- [13] N. Adhirajan, T.R. Kumar, N. Shanmugasundaram and M. Babu (2003). In vivo and in vitro evaluation of hair growth potential of *Hibiscus rosa-sinensis* Linn., *J. Ethnopharmacol.* **88**, 235-239.
- [14] R. Coetzee, M.T. Labuschagne, and A. Hugo (2008). Fatty acid and oil variation in seed from kenaf (*Hibiscus cannabinus* L.), *Ind. Crop. Prod.* **27**, 104-109.
- [15] F. Anwar, U. Rashid, M. Ashraf and M. Nadeem (2010). Okra (*Hibiscus esculentus*) seed oil for biodiesel production, *Appl. Energ.* **87**, 779-785.
- [16] M.R. Othman, H.M. Akil and J. Kim (2008). Carbonaceous *Hibiscus cannabinus* L. for treatment of oil and metal-contaminated water, *Biochem. Eng. J.* **41**, 171-174.
- [17] J. Cullen (1967). Flora of Turkey and the East Aegean Islands, Volume 2 ed: P.H. Davis, Edinburgh University Press, Edinburgh, UK, pp. 402.
- [18] M. Arli-Sökmen, H. Mennan, M.A. Sevik, O. Ecevit (2005). Occurrence of viruses in field-grown pepper crops and some of their reservoir hosts in Samsun, Turkey, *Phytoparasitica*, **33**, 347-358.
- [19] P. Westra, C.H. Pearson, R. Ristau and F. Schweissing (1996). Venice mallow (*Hibiscus trionum*) seed production and persistence in soil in Colorado, *Weed Technol.* **10(1)**, 22-28.
- [20] D.D., Metcalfe, A.A. Schimita, J.R. Pelka (1966). Rapid preparation of fatty acid esters from lipids for gas chromatographic analysis. *Anal. Chem.* **38**, 514-515.
- [21] X. Hou, Y. Gong and A. Ebudoula (2006). Analysis of physical-chemical properties and fatty acid compositions of *Hibiscus trionum* L. seed oil, *Shipin Kexue*, **27(11)**, 455-457.
- [22] M.U. Ahmad, S.K. Husain, I. Ahmad and S. M. Osman (1979). *Hibiscus sabdariffa* seed oil: A reinvestigation, *J. Sci. Food. Agr.* **30(4)**, 424-428.
- [23] W.K.A. Ahmet and J.F. Bertram (1982). The fatty acid composition of *Hibiscus sabdariffa* seed oil, *J. Sci. Food. Agr.* **33(12)**, 1305-1309.
- [24] R. Mohammed, J. Fernandez, M. Pineda and M. Aguilar (2007). Roselle (*Hibiscus sabdariffa*) seed oil is a rich source of γ -tocopherol, *J. Food. Sci.*, **72(3)**, S207-S211.
- [25] L Li, X. Wu and G. Li (2009). Extraction of roselle seed oil and analysis of its fatty acids composition, *Zhongguo Youzhi*, **34(2)**, 75-78.
- [26] C.D. Andras, B. Simandi, F. Örsi, C. Lambrou, D. Missopolinou-Tatala, C. Panayiotou, J. Domokos and F. Doleschall (2005). Supercritical carbon dioxide extraction of okra (*Hibiscus esculentus* L.) seeds, *J. Sci. Food. Agr.* **85**, 1415-1419.
- [27] K.S. Rao and G. Lakshiminarayana (1985). Fatty Acid Compositions of seed oils of seven *Hibiscus* species of Malvaceae, *JAOCs*, **62(4)**, 714-715.

- [28] R.A. Holser and G.A. Bost (2002). Extraction of lipid components from seeds of perennial and woody *Hibiscus* species by supercritical carbon dioxide In: Trends In New Crops and New Uses, *ed:* J. Janick & A. Whipkey, ASHS Press, Alexandria, VA, pp. 550–555.
- [29] R.A. Holser and G.A. Bost (2004). Hybrid *Hibiscus* seed oil compositions, *JAOCS*, **81**, 795-797.
- [30] D. Vakulin (1935). *Hibiscus* as a source of oil, *Masloboino-Zhirovoe Delo*. **11**, 496.

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