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Determination of total lipids from five underutilized wild edible fruits in Ahmednagar district, Maharashtra (India)

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Abstract

The determination of total lipids of five edible wild fruits of *Terminalia catappa* L., *Zizyphus mauritiana* Lam., *Limonia acidissima* L., *Elaeagnus conferta* Roxb and *Anacardium occidentale* L, (Cashew apple) has been described. The total crude lipid content has been determined using conventional as well as ultrasound assisted extraction technique. The effect of ultrasound for lipid solubility in methanol, methanol-chloroform and petroleum ether was extensively studied. The present study enlightened the food value and utility of underutilized edible fruits in Maharashtra, India.

Keywords: Underutilized wild fruits, crude lipids, extraction, ultrasound, nutritional analysis.

Introduction

Nutritious fruits have significant contribution in healthy lifestyle of growing population in India. There is essential to identify and explored the other wild edible underutilized fruits in order to fulfil the demand of nutritionally potential diet for growing population (Andersen et al., 2003; Sena et al., 1998). Wild fruits are considered as valuable source of essential micronutrients and provide necessary energy to human beings. Hence, worldwide researchers were studying the nutritional potential of these fruits (Cook et al., 2000; Lockeett et al., 2000; Ogle et al., 2001).

Literature survey revealed that several wild fruit plants were distributed in Maharashtra and various regions in India. On the other hand increase in urbanization and gradual exploitation of forests is resulting in disappearance of several wild species for different purposes. Some of the residents still using them as a supplementary food material and preserving for their future need. Due to declining popularisation of wild fruit plant species, special attention should be focus on maintenance and popularization this source of food supply. Hence, there is need to provide scientific and systematic knowledge of wild edible fruits for cultivation among people.

Lipids are heterogeneous group of biomolecules sparingly soluble or insoluble in water but soluble in organic solvent having biological functions such as structural component of cell membrane, storage and transportation of metabolic fluid, cell recognition and tissue immunity (Fayez Hamam, 2013). Lipids can provide energy and essential fatty acid for biological processes of living organisms and function as carrier for fat soluble vitamin. They are composition of fatty acids such as saturated and unsaturated fatty acids, short, medium and long chain fatty acids (Hausman et al., 2002; Budge et al., 2002). As far as importance of lipids in biochemical processes, it is essential to study the total lipid contents of food supplement such as fruits.

There are various techniques available for extraction of natural products among them ultrasound assisted extraction technique have found to be the most promising technique for the extraction of valuable natural products. The ultrasonic extractions involve mass transfer due to swelling and enlargement of pores of the cell wall and became effective interaction with the extracting solvent. When ultrasound passes through the liquid medium, lead to micro bubbles. By absorption of energy from sound waves, bubbles will grow in size and implode. The potential energy of the expanded bubble transforms into kinetic energy in form of a liquid jet, which directly strikes on the nearby plant cell. This imparts the release of chemical constituents into the surrounding solvent (Mandal V. et al., 2009; Paniwnyk L. et al 2001). However, conventional extraction processes were time consuming and consumption of thermal energy for longer time was required. In addition, ultrasonic device is less expensive and much easier in practice than that of microwave- assisted extraction and supercritical fluid extraction methods (Ma, Chen, Liu, & Ye, 2009; Salar Bashi et al., 2012). The application of ultrasound for extraction of different chemical components and natural products are well documented in literature (Ahmed et al., 2011; Teng et al., 2010; Zou et al., 2013; Da Porto et al., 2013; Yolmeh et al., 2014). In present article we have described the determination of lipid content of five wild edible fruit using conventional and ultrasonic irradiation method.

Plant species under investigation

Wild Fruit Species	Family	Vernacular name (Marathi)	Ecology and Uses
Terminalia catappa L.	Combretaceae	Deshi badam	*Terminalia catappa* L. is a large tropical tree in the leadwood tree family combretaceae. The leaves contain several flavonoids, tannins and saponine. Fruit are used in different herbal medicines for various purposes (Hnawia et al 2011).
Zizyphus mauritiana Lam.	Rhamnanceae	Bor	*Ziziphus mauritiana* Lam is native to temperate and subtropical region. It is a spiny evergreen shrub or small tree up to 15 m high, with trunk 40 cm or more in diameter. The fruit are applied on cuts and ulcers are employed in pulmonary ailments and fever. Fruit are mixed with salt and chilli pepper are given in indigestion and biliousness (Grice AC, 1996; Taraneh, E and Asna, U., 2012).
Limonia acidissima (L.)	Rutaceae	Kavath	It is a native and common to dry plain, apparently drought tolerant and best adapted to light soil. Wood apple is useful for curing scurvy and in relieving flatulence. Seedless pulp of fruit is beneficial for the treatment of dysentery, diarrhoea and piles (Rathayake et al, 2009; Bandara et al, 1988)
Elaeagnus conferta Roxb.	Elaeagnaceae	Ambal	*Elaeagnus conferta* Roxb., is native to temperate and subtropical regions of Asia. It is deciduous or evergreen shrubs or small trees. The fruits used as medicine for the treatment of indigestion. The fruit are rich in Ca, Fe, Mn and P (He F. J and MacGregor G.A., 2008)
Anacardium occidentale L.	Anacardiaceae	Cashew apple	The cashew apple is fleshy, soft, rich in nutrients and grows on the cashew seed. It can be consumed as fresh or cooked in curries, or fermented into vinegar. Other products such as chutneys and jams are also wellknown in countries like India and Brazil. Cashew apple juice helps to burn fats and increases the utilization of either fat or carbohydrates as a fuel (Strom, Stephanie 2014, 2015; Piyapong Prasertsri, et. al., 2013)

Materials and Methods

Fruit Sampling Techniques

Wild fruits of of *Terminalia catappa* L., *Zizyphus mauritiana* Lam., *Limonia acidissima* (L.), *Elaeagnus conferta* Roxb. and *Anacardium occidentale* L. were collected from Ratanwadi, Bhandardara, Shendi, Harischandragarh, Tal- Akole, Dist- Ahmednagar(MS), India in month of April 2016. The raw and ripened fruit samples were collected and dried under shade.

Preparation of the plant materials for chemical analysis

All fruit samples of *Terminalia catappa* L., *Zizyphus mauritiana* Lam., *Limonia acidissima* (L.), *Elaeagnus conferta* Roxb and *Anacardium occidentale* L. were dried in shade in order to remove residual moisture. The shade dried fruits were ground into powder using grinder, filtered and stored in polythene bags. The stored food powders were used as such for further lipid analysis.

Chemical Analysis

The experimental chemical analysis of all fruit samples were conducted in Research Laboratory, Department of Botany, Shri Muktanand College, Gangapur, Dist- Aurangabad by conventional extraction process using Soxhlet extractor and Sonicator. The solvents such as methanol, petroleum ether and chloroform were used.

Determination of crude lipid

Conventional method

The dried fruit powder (2 gm) was placed in a porous thimble of a Soxhlet extractor with cotton plug at its mouthed and thimble was placed in an extraction chamber which was suspended to previously weighed flask containing methanol, methanol-chloroform or petroleum ether. The whole assembly was adjusted and flask was heated using heating mental for 8-10 hrs to extract crude lipid. After the extraction, thimble was removed from the Soxhlet apparatus and the solvent was removed under reduced pressure to afford crude lipid. Furthermore, the flask containing lipid was placed in oven at 100ºC for 30 minutes to remove residual solvent, cooled in a desiccator and weighed. The amount of crude lipid was calculated and expressed as percentage crude lipid content (AOAC. 1990). The results were summarized in Table 1.

Ultrasound assisted method

To a dried fruit powder (2 gm) in a round bottom flask with 50 ml capacity, methanol, methanol-chloroform or petroleum ether (15 ml) was added. The above fruit suspension was placed in water bath and irradiated under sonication for 2 hrs. at ambient temperature. The suspension was filtered in previously weighed evaporating dish. Solvent was evaporated and weighed to find out crude lipids. Irradiation was continued till constant weight of flask was recorded. The amount of crude lipid was calculated and expressed as percentage crude lipid content.

Results and Discussion

In continuation to our ongoing research on applicability of wild weeds in India (Sharma et al., 2012, 2013, 2014, 2016) the determination of total lipid content of five wild edible plant viz. *Terminalia catappa* L., *Zizyphus mauritiana* Lam., *Limonia acidissima* (L.), *Elaeagnus conferta* Roxb and *Anacardium occidentale* L., was conducted by conventional method using Sohxlet extraction apparatus and ultrasound sonications with different solvents and solvent system such as methanol, petroleum ether and methanol-chloroform. It has been found that methanol-chloroform solvent system showed yield of crude lipids than methanol and petroleum ether (Sharma P. P. and Khilari V. J. 2016). This is because methanol-chloroform solvent system is a mixture of polar (methanol) and non-polar (chloroform) solvents, hence both neutral and polar lipids gets extracted (Haizhou Li et al 2004). However, only nonpolar lipids are soluble in non-polar solvent as petroleum ether. Although, petroleum ether gives lower yield but selectivity of lipid extraction is excellent as compared to methanol and methanol-petroleum ether solvent system. Because other chemical components like alkaloids also gets extracted in polar solvent system. Furthermore, the use of ultrasound has some advantages over traditional method in terms of time required for extraction and yield of crude lipids. The processes of cavitations in sonication method can accelerate the rate of extraction with in shorter period (2 hr). The results obtained by conventional method as well as ultrasound method were represented graphically in Figure 2 and Figure 3. The results obtained were suggested that ultrasound assisted extraction technique is more effective for lipid extraction in terms of lower extraction time and yield of residual lipids than conventional extraction technique. The total lipid content was further compared with some of the commonly consumable

fruits(http://www.weightchart.com/nutrition/food-nutrient-highest-lowest.aspx?nn= 204&h=True &ct=Fruits% 20and%20 Fruit%20Juices). The comparative results were represented in Table 2. This indicates the lipid potential dried wild fruits under investigation are moderate to high.

Table 1 Determination of crude lipid contents of some wild fruit samples using conventional method

Plant Name	Family	Common Name	Lipid Content (%)*			Lipid Content (%)*		
			Conventional Method			Ultrasound Method		
			MeOH Extract	MeOH-$CHCl_3$ Extract	Pet. Ether Extract	MeOH Extract	MeOH-$CHCl_3$ Extract	Pet. Ether Extract
Terminalia catappa L.	Combretaceae	Deshi badam	0.45	**1.32**	0.27	0.62	**1.92**	0.38
Zizyphus mauritiana Lam.	Rhamnanceae	Bor	1.20	**1.88**	0.90	1.28	**2.51**	0.86
Limonia acidissima (L.)	Rutaceae	Kavath	0.98	**3.12**	1.46	1.02	**3.30**	1.50
Elaeagnus conferta Roxb	Elaeagnaceae	Ambal	1.31	**3.76**	2.53	1.58	**4.82**	2.62
Anacardium occidentale L.	Anacardiaceae	Cashew Apple	0.28	**0.84**	0.78	0.41	**1.22**	0.70

***Lipid contents of dry fruits**

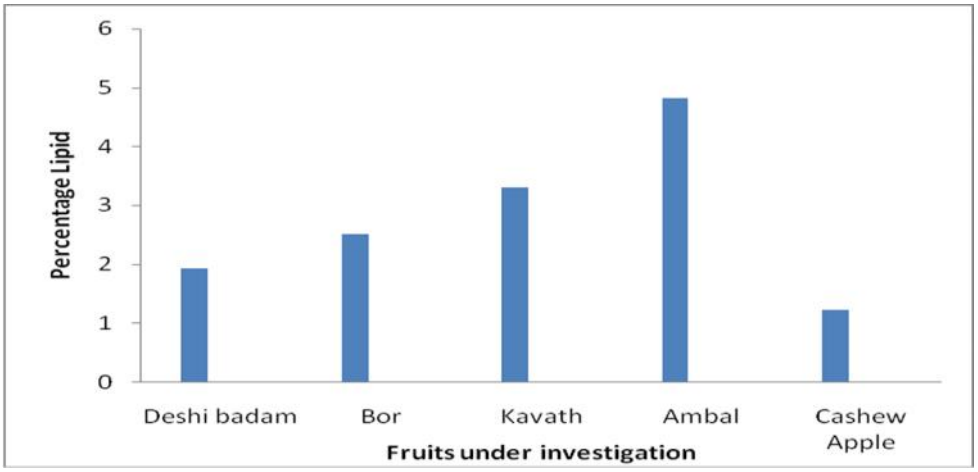

Figure 1. Graphical representation of total lipid content in five underutilized wild fruits.

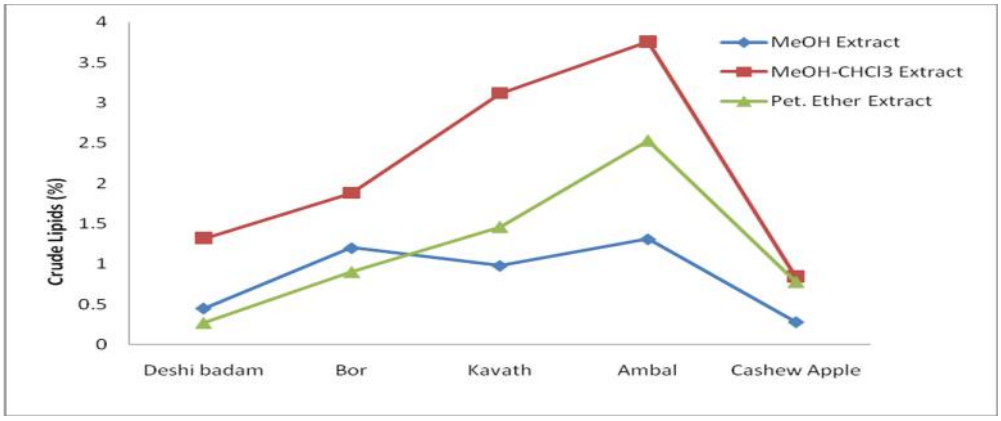

Figure 2. Graphical representation of Lipid extraction using conventional method

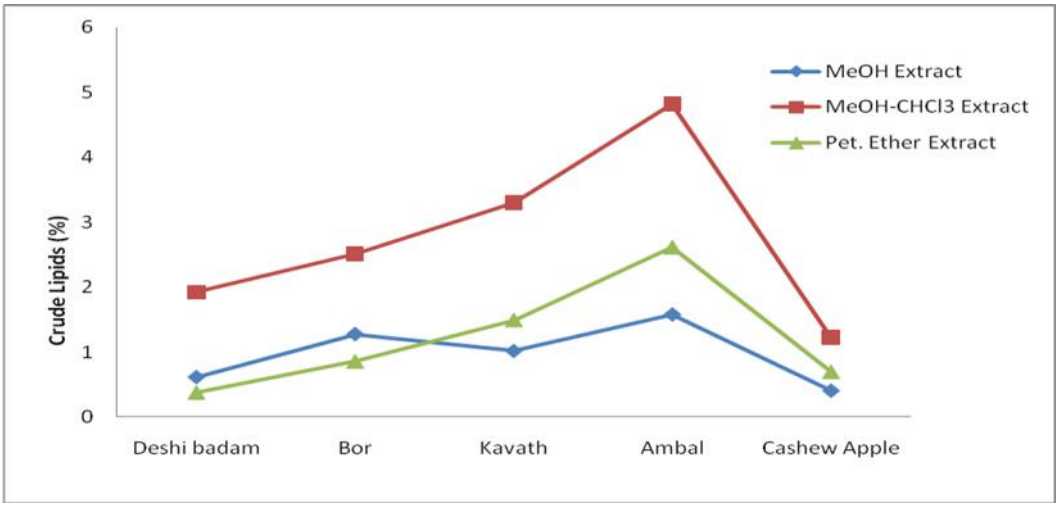

Figure 3. Graphical representation of Lipid extraction using ultrasound method

Table 2. Comparative study of total lipids of commonly consumable fruits and wild fruits under investigation:

Sr.No	Common name of the fruit	Total fats (%)[a]
1.	Bananas, dehydrated, or banana powder	3
2.	Bananas, raw	1
3.	Guavas, common, raw	2
4.	Figs, dried, uncooked	2
5.	Sapotes, (marmalade plum), raw	2
6.	Custard-apple, (bullock's-heart), raw	1
7.	Jackfruit, raw	1
8.	Oranges, raw, with peel	1
9.	Strawberries, raw	1
10.	**Deshi badam**	**1.92**
11.	**Bor**	**2.51**
12.	**Kavath**	**3.30**
13.	**Ambal**	**4.82**
14.	**Cashew Apple**	**1.22**

[a]Total fat content data cited from http://www.weightchart.com/nutrition/food-nutrient-highest-lowest.aspx?nn=204&h=True&ct=Fruits%20and%20Fruit%20Juices

Conclusion

Determination of lipid content of five wild edible fruit of *Terminalia catappa* L., *Zizyphus mauritiana* Lam., *Limonia acidissima* L., *Elaeagnus conferta* Roxb and *Anacardium occidentale* was conducted using conventional and ultrasonic irradiation method. The extraction was carried out using methanol as polar solvent, methanol-chloroform as polar-nonpolar solvent system and petroleum ether as nonpolar solvent. The results obtained were suggested that ultrasound assisted extraction technique is more effective for lipid extraction in terms of lower extraction time and yield of residual lipids than conventional extraction technique. The total lipid content was further compared with some of the commonly consumable fruits (http://www.weightchart.com/nutrition/food-nutrient-highest-lowest.aspx?nn= 204&h=True& ct=Fruits%20 and%20Fruit%20Juices). The comparative results were represented in Table 2. This indicates the lipid potential wild fruits under investigation are higher. Hence it will be more beneficial than commonly consumable fruits when fat rich supplement was required.

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