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Extraction of Mango Kernel (*Magnifera indica*) Oil

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ABSTRACT

Background: Mango kernel oil is the edible oil present in the seed kernel of (*Mangifera indica)*. Mango kernel oil recognizes its application in the cosmetic industry, food and confectionery industry. This work aims at the process development of mango kernel oil making. Mango kernel contains about 15% good quality edible oil.

Methods: This study investigates variation of physicochemical characteristics between mango kernel oil extracted by cold press (CP) and Soxhlet extraction (SE) methods. Solvent extraction exhibited higher mango kernel oil yield (10.5%) as compared with the Cold press (4-5%).

Result: There were significant variation observed in saponification value 109.69-131.30 mg KOH/g, unsafonifiable matter 65-0.72%, iodine value 41.85-44.33 g of I/100 gm oil, acid value 2.94-5.21%, peroxide value 3.08-4.14 mg/g and free fatty acid 1.47-2.24% of mango kernel oil produced by both the methods.

Key words: Comparative extraction methods, Mango kernel oil, Quality characteristics.

INTRODUCTION

Mango (*Mangifera indica*) belongs to the *Anacardiaceae* family. It is a very popular fruit, often referred to as the king of fruits in the tropical world but when consumed or used in mango processing, the mango seeds are usually only scrap as waste (Puravankara *et al.,* 2000). When mango is consumed or processed commercially, processing mangoes generates about 40 to 60% of waste, 12 to 15% is peeled and 15 to 20% is pits. Depending on the mango variety, seeds makeup 10 to 25% of the total weight of the fruit. The kernel in the seeds accounts for 45 to 75% of the seeds and about 20% of the total fruit. However, over a million tonnes of mango seeds are processed as waste (Abdella *et al.,* 2007). Mango kernel oil can be defined as the oil fraction extracted from the mango seed; contains nearly 15% of oil (Bhalerao *et al.,* 1989). Mango kernel is a potential source of a wide range of bioactive compounds and antioxidants (Jafari *et al.,* 2014). Mango kernel oil is favourable and a safe source of edible oil and was found to be nutritious and non-toxic so that, it could be substituted for any solid fat without adverse effects. Mango kernel oil can be used in butterscotch toffee given that mango kernel oil and cocoa butter are almost uniform in several of their triglycerides, fatty acids and effects on taste, odour and texture of the toffee (Kittiphoom, 2012).

Two main processes mostly employed for oil extraction from seeds on industrial scale are cold pressing and solvent extraction (Soxhlet method). Soxhlet method, concern the use of n-hexane or petroleum ether extraction solvent, whereas gives higher oil yield but a higher temperature employed in this method may cause undesirable effects on the quality of oil. Cold pressing method of oil extraction, although with lower oil yield, is advantageous with regard to mild operational temperature conditions, process safety and product quality.

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The growing demand and awareness about the physical and nutritional properties of oils, the present work was therefore designed with the main objective to evaluate and compare the physicochemical properties and nutritional quality of mango kernel oil extracted by two different methods.

MATERIALS AND METHODS

The experiments were conducted at the session of 2020-2021 (January, 2021-October, 2021) at Shriram Residue Free centre, Phaltan, Satara, Maharashtra and Sona Analytical Research Laboratory, Satara, Maharashtra. All the reagents and chemicals used were analytical grade and were obtained from Sona Analytical Laboratory, Satara, Maharashtra. Sample of mango kernel were obtained from local market in Ratnagiri, Maharashtra and the specific variety of mango kernel is Alphanso.

The mango kernel (50 g) was placed in the thimble and about 300 ml of n-hexane and petroleum ether was poured into the round bottom flask. The apparatus was heated at different temperature such as 60°C and 70°C and permit to stay for 4 h under continuous extraction using Soxhlet

apparatus. At the end of the extraction, the resulting mixture containing the oil was distilled to recover solvent from the oil. The total yield obtained is expressed in percentage. The oil extraction from mango kernel by cold press method investigated for this study. In cold pressing, 10 kg kernel batch is used and oil was extracted by continuous pressing using wooden crusher without using any chemicals for around 5 h at a speed range of 20-25rpm/h and temperature in between 35-40°C. Physical properties included specific gravity, moisture, viscosity of oil, specific gravity, refractive index, melting point, smoke point and Flash point and pH was determined according to AOAC (1990). Determinations for Peroxide value, Iodine value and Saponification values, Unsaponifiable matter, Acid value and free fatty acid contents were carried out using Pena *et al.,* 1992 standard analytical methods. A one-way analysis of variance (ANOVA) is performed to calculate significant differences in treatment means and multiple comparisons of means to be done by the LSD (least significance difference) test. A probability value of $p<0.05$ is considered significant and only significant differences were considered unless stated otherwise.

RESULT AND DISCUSSION

Total oil yields

The total oil yields are in cold press and soxhlet extraction, the solvent of n-hexane provided highest total oil yield *i.e*. 10.6- 10.5%, follow by petroleum ether have 9.40- 9.46% ,cold press extraction have 4 to 5% yield. The interaction between solvent and solutes, both solvent polarity and their boiling temperature may contribute mean factors on the extraction efficacy and yield, as well as composition of mango kernel oil. It can be seen that most of the values fall within the ranges published in the literature (Nzikou *et al.,* 2010).

There was no significant difference observed for Refractive index, Melting point and Flash point of the oil extracted by two methods also there was significantly difference in moisture content, specific gravity, viscosity, smoke point and pH of the oil extracted by two methods such as cold press and solvent extraction. The results for physical properties of cold pressed and Soxhlet extracted mango kernel oil are given in Table 1.

Physical properties

The moisture content of mango kernel oil was 0.14- 0.34%. This result is acceptable because to produce good quality oil, the moisture content is higher in solvent extraction by n-hexane at 60°C and lower moisture content obtained in Cold press is 0.14. Similarly results were obtained in the studies conducted by (Nadeem *et al.,* 2015). The specific gravity of mango kernel oil for cold press method was 0.89 while that from Soxhlet extraction method was 0.90. This reflects that molecules of the mango kernel oil from the traditional method are slightly more closely packed than those from Soxhlet extraction method; similarly results were obtained in the studies conducted by (Abdelaziz, 2018). At 40°C the viscosities of mango kernel oil by cold press, solvent extractions are 38.85 to 40.47MPa, respectively. Similarly results were obtained by (Saiprabha *et al.,* 2011). The refractive index values of 1.465 and 1.466 were obtained mango kernel oil by cold press, solvent extractions, respectively. It can be related to the degree of unsaturation and therefore used for sorting fats and oils that are suspected to be adulterated (Abdelaziz, 2018). The melting point of mango kernel oil was 39.13°C in cold press and in solvent extraction it range from 38.93 to 39.33 respectively. Similarly results were obtained in the studies conducted by (Saiprabha *et al.,* 2011). The flash point of oil is the temperature at which the vapour over the liquid will ignite upon exposure to an ignition source. The flash point of mango kernel oil was in cold press is high compared to solvent extraction method *i.e*. 357.66°C and in solvent extraction using different solvent it varies from 261.66 to 265°C. The smoke point also refer to a burning point, smoke point value can vary greatly depending on factors such as volume of oil utilized, the size of container etc. in cold press the smoke point of mango kernel oil was 246.33°C and in solvent extraction using different solvent smoke point varies from 249.33 to 254.33°C. The pH value of oil was determined by pH meter. The effect of pH on the oxidative stability of oil. Most of the bacterial growth takes place at pH 6.5 to 7. pH value of the mango kernel oil is slightly acidic but neutral in case of refined oil Surface pH of the oil was ranging from 3.73 to 5.34 respectively. Similarly results were obtained in the studies conducted by (Ajayi and Oderinde, 2002 and Saiprabha *et al.,* 2011).

Chemical properties

The effect of extraction procedure on the chemical characteristics of the oil saponification value, unsaponifiable matter, iodine value, acid value, peroxide value and free

Table 1: Physical properties of mango kernel oil (Alphanso variety).

Treatments	Moisture content (%)	Specific Gravity (kg/m^3)	Viscosity at 40°C (MPa)	Refractive Index	Melting point (°C)	Flash Point (°C)	Smoke Point (°C)	pH
Cold press	0.14^a	0.89a	38.85^a	1.465^a	39.13^a	357.66^a	246.33^a	3.74^a
S.E @ 60°C (n-Hexane)	0.34^b	0.90^b	40.29^b	1.464	39.33^b	263.00^b	251.33^b	4.91^b
S.E @ 70°C (n-Hexane)	0.33^b	0.90^b	40.47^c	1.466	39.00^c	265.00^c	254.33^c	5.34^a
S.E @ 60°C (P. Ether)	0.33^b	0.90^b	39.69^d	1.465	38.93^d	261.66^d	249.33^d	3.73^c
S.E @ 70°C (P. Ether)	0.15^c	0.90^b	40.13^b	1.464	39.06^c	263.00^b	252.00^b	4.27^b

Values with different letters in the same column are significant different at $P<0.05$.

Table 2: Chemical properties of mango kernel oil (Alphanso variety).

Treatments	Saponification value (mg KOH/g of oil)	Unsafonifiable matter (%)	Iodine value (g of I/ 100g of oil)	Acid value (%)	Peroxide value (mg/g oil)	Free Fatty acid (%)
Cold press	131.30[a]	0.65[a]	41.85[a]	2.94[a]	3.08[a]	1.47[a]
S.E @ 60°C (n-Hexane)	108.48[b]	0.71 [b]	44.24[b]	4.07[b]	4.12[b]	2.03[b]
S.E @ 70°C (n-Hexane)	137.17[c]	0.72[b]	44.33[b]	4.34	4.14[b]	2.17[c]
S.E @ 60°C (P. Ether)	109.69[b]	0.69[c]	43.05[c]	5.21[c]	3.66[c]	2.60[d]
S.E @ 70°C (P. Ether)	115.76[d]	0.71 [b]	43.16[d]	4.49[d]	3.78	2.24[c]

Values with different letters in the same column are significant different at P<0.05.

fatty acid is shown in Table 2. The saponification value of the extracted mango kernel oils was different and ranged from 108.48-131.30 mg KOH/g oil. This could be explained by the polarity of the solvent used and the extraction method. Similarly result obtained by (Kittiphoom and Sutasinee, 2013). In cold press extraction the unsaponifiable matter of mango kernel oil was 0.65% and in solvent extraction it range from 0.69- 0.72%. Similarly result obtained by (Abdella *et al.,* 2007). Iodine value measures the degree of unsaturation of a particular vegetable oil. In cold press extraction the iodine value of mango kernel oil was 41.85 g of I/ 100 g and in solvent extraction it range from 43.05-44.33 g of I/100 gm which is slightly high at 70°C. Similarly result obtained by (Mohamed and Girgis, 2005 and Kittiphoom, 2012). The average acid value of mango seed kernel oil is 2.94 in cold press extraction which is relatively smaller and in solvent extraction it varies from 4.07-5.21 respectively in use of different solvents. Similarly result obtained by (Saiprabha *et al.,* 2011). Peroxide value is one of the most widely used testing for oxidative rancidity in oils. Peroxide value of mango seed kernel oil has been found to be 3.08 mg/g oil in cold press extraction and in the solvent extraction using different solvents it varies from 3.66 to 4.14 mg/g. This value is close to the values reported by (Saiprabha *et al.,* 2011). The free fatty acid from mango kernel oil obtained from petroleum ether solvent was higher than the n-hexane solvent and cold press extraction. In solvent extraction using petroleum ether it vary from 2.24-2.60% and in n-hexane it range from2.03-2.17% also in cold press it represent 1.47%. Similarly result obtained by (Kittiphoom and Sutasinee, 2013).

CONCLUSION

Mango (variety is Alphanso) kernel oils were extracted by organic solvents (petroleum ether and n-hexane) and cold press extraction and evaluated for their characterization and quality analysis. After analysing the physicochemical properties, the results showed that these oils are rich in oleic acid. The effects of various extraction solvents significantly influenced the physicochemical properties of the oil and the phenolic composition and antioxidant properties of the extracted oils. The results suggest that the oil extracted with 10.5% n-Hexane is of better quality than 9.5% petroleum ether and cold extraction (4-5%). n-Hexane is widely used for extraction in the food industry because it evaporates easily from extracts. The results of the present study provide useful information for the food and essential oil industries.

Conflict of interest: None.

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