Nigerian Research Journal of Chemical Sciences **(ISSN: 2682-6054)**
Vol. 7, 2019

ISOLATION AND QUALITY INDICES OF *TAMARINDUS INDICA* SEED OIL

Mahmud, H., Nworie, C.E., Akanbi, O.P., Ochi, D.O.

Chemical Engineering Technology Department,

School of Engineering Technology, Auchi Polytechnic, Auchi, Edo State, Nigeria

Correspondence email: jabbal4luv@yahoo.com, ncyka2000@gmail.com

ABSTRACT

Evaluation of the quality indices of *Tamarindus indica* seed oil was carried out using solid liquid extraction method. Physicochemical properties of the oil were assessed using standard methods. The results of the analysis compared favourably to standard commercial edible oil. The oil extracted is a liquid at room temperature with colour of the oil varying from golden –yellow to brown when n-hexane, ethanol and blend of both solvent at ratio 1:1 were used as solvents. The yields were 3.4%, 4.98% and 1.7% respectively. The results of the chemical analyses revealed that acid value was 174g/kg, iodine value was 76.14, saponification value was 182mgNaOH, peroxide value was 80mEq/kgNaOH, and unsaponification matter was 26.50/kg. The physical properties for ethanol, n-hexane and blend of both were: pH- 3.90, 6.70 and 4.90 respectively. Refractive index- 1.621, 1.4078 and 1.5830 respectively. Colour- tonic brown, golden yellow and pale brown respectively. The results showed that edible oil can be extracted from tamarind seed using solid-liquid extraction method.

Keywords: Characterization, extraction, oil, seed, tamarind

INTRODUCTION

Tamarind (*Tamarindus Indica L*) is a fast growing tree which grows on different localities and prefers moist fertile valleys. It is widely grown in tropical and subtropical regions of the world. It is also found and consumed in the northern part of Nigeria where it is known as “Tsamiya”.

The tamarind tree is often known as hurricane resistance tree because it can tolerate verdant typhoon and cyclone as result of its strong and pliant branches and a deep and extensive root system, which solidly anchor it to the ground [1]. Tamarind is classified as tree crop under the kingdom plantea, leguminosea family, the genus is tamarindus and is a monotypic genus containing only one species known as tamarindus Indica.

Tamarindus also provide thousands of park, garden and roadside landscapes. The primary limitation of the tree is its slow growth, long time before fruit bearing and poor stem form. The tree can grow in wide range of soil, but thrives best in loamy soil and can stand harsh climate conditions. The varieties and yield of tamarind varies considerately in different countries depending on aquatic environmental and climate factors [2].

The fruit pulp has a sweet acidic taste due to combination of high content tartaric acid (2, 3-dihydroxybutanedoic acid) C_4 H_6 H_{6a} dihydroxy-dicarboxylic acid and reducing sugars. The pulp is used for seasoning, in preparing food, to flavour confections, curies and sauces, and a major ingredient in juices and other beverages. The vitamin B content of the fruit pulp is quite high, while carotene and vitamin C content are low. The presence of tannins and other dyeing matters in the seed taste make the whole seed unsuitable for consumption, but they become edible after soaking and boiling in water [3].

Tamarind seed is a by-product of the fruit pulp which is usually hard, red to purple-brown, with the seed chamber lined with parchment like membrane containing about 1-12 seeds in each pod. The seed stores relatively low vegetable oil which can be extracted by solvent extraction. The usefulness of the tamarind tree does not end with its fruits. Sometimes it is compared with coconut as another "tree of life". It is widely adaptable and easily managed. It produced many valued food medicine, wood and construction products. The tree is drought resistance and strong, it performs well as wind breaker, preventing soil erosion and protecting people, crops and animals in hash environments [4, 5]

The research into the isolation and quality indices of the oil from tamarind seed is of great importance for entrepreneurship and industrial applications particularly in the pharmaceuticals, paint, cosmetic, vanish, pulp and paper industries.

MATERIALS AND METHODS

Tamarind seeds were obtained from Birchi, Kaduna State, Nigeria. Carbon tetrachloride, potassium iodide, potassium thiosulphate, sodium hydroxide, sodium carbonate, acetic acid, ethanol, hexane, phenolphthanlein, chloroform, hydrochloric acid and sulphuric acid were supplied by Sigma-Aldrich, Germany.

Sample Preparation

The good seeds were soaked in water for 6 h and then washed to remove the fibrous materials. The seeds were then sun- dried for seven days. The dry seeds were weighed and grounded using a crusher grinding machine, and the crushed seeds weighed. The ground tamarind seeds were then sieved into four particle sizes; 850, 600, 425 and 300µm respectively.

Extraction of the Tamarind Seed Oil

50 g of one of the particle sizes was wrapped and placed into the extraction unit of the soxhlet apparatus. 200 ml of n-hexane was measured into the flask (solvent heating section). The soxhlet apparatus was assembled by connecting the condenser water inlet hose to cool water source and the outlet to a container to prevent pressure build-up, support condensation of solvent and prevent escape of solvent from the equipment. Extraction commenced and the voltage of the heating mantle with respect to the solvent in use (n-hexane 69 ^{o}C) was regulated [6]. As heating commenced, the solvent was heated to boiling point and the solvent went into vapour phase, passing through the steam throat to the condensing unit where it condensed back into liquid phase which then dropped on the sample in the muslin, leaching out the oil and forming a mixture of oil and solvent known as the "miscella". The miscella was automatically flushed back into the boiling solvent in the flash through a hollow and narrow downspout as a result of capillary action caused due to miscella height in the extraction unit. After extraction was realized for an hour, the heating mantle was switched off and the raffinate in the muslin was removed and dried and the weight was noted.

Solvent recovery was then carried using the soxhlet apparatus with the oil in the round bottom flask and pure solvent collected in the extraction unit. The extraction oil was poured into a sample container and placed in a dessicator to cool for 30 min before taking the weight of the tamarind oil. The volume of recovered solvent was also noted. The same procedure was carried out for other solvent and seed particle sizes.

Determination of Physico-Chemical Properties of the Oil

The properties determined using standard methods [7] were acid value, saponification value, density, peroxide value, unsaponifiable matter, refractive index, viscosity, $_{P}$H value, iodine value, specific gravity, colour and yield.

RESULTS AND DISCUSSION

Extraction of the Tamarind Seed Oil

Based on the results obtained from oil extracted from tamarind seed using different solvents, shown in Table 1 ethanol gave the highest volume of oil and yield of 2.49 ml and 4.98% respectively for 300 µm particle size of seed sample. About 2.35 ml and 4.70% were obtained for the blended solvent (ethanol and hexane) and the lowest was obtained from n-hexane in which 1.74 ml and 3.48% volume of oil and yield was obtained for 300 µm particle size.

The feed to solvent ratio variation from Table 2 shows that using 4.25 µm particle size and 300 ml ethanol solvent at 0.15 feed to solvent at 0.15 feed to solvent ratio gives a relatively high volume and yield of oil (2.13ml and 5.48% respectively) for one hour extraction time at constant temperature.

Table 1: Results from Extraction Process

Solvent used	Volume of solvent (ml)	Dried sample size (microns)	Weight of sample (g)	Volume of Extract (ml)	Extraction Time (min)	Temperature of solvent (°C)	Yield of oil (%)
n-Hexane	200	850	50	1.20	60	60	2.40
	200	600	50	1.45	60	60	2.90
	200	425	50	1.55	60	60	3.10
	200	300	50	1.74	60	60	3.48
Ethanol	200	850	50	1.50	60	60	3.00
	200	600	50	1.90	60	60	3.80
	200	425	50	2.14	60	60	4.28
	200	300	50	2.49	60	60	4.98
Ethanol + n-Hexane	200	850	50	1.40	60	60	2.80
	200	600	50	1.70	60	60	3.40
	200	425	50	1.95	60	60	3.90
	200	300	50	2.35	60	60	4.70

Table 2: Feed to solvent ratio extraction values

Solvent Used	Dried Sample size	Volume of Solvent	Mass of solvent (g)	Weigh t of sample	Feed to solven	Volum e of extract	Weigh t of Extrac	Extractio n Time (min)	Bp of solven t (c)	Densit y of solven	Yield of oil (%)

	(microns)	(m)		(g)	t Ratio	(ml)	t (g)			t (g/ml)	
Ethanol	425	250	197.25	25	0.13	1.51	1.16	60	69	0.789	4.64
	425	300	236.70	35	0.15	2.13	1.76	60	69	0.789	5.03
	425	350	276.15	50	0.18	2.51	2.21	60	69	0.789	4.42

Characterization of the Tamarind Seed Oil

At room temperature, the refractive index of the oil extracted using n-hexane, ethanol and n-hexane + ethanol blend are 1.4078, 1.6210 and 1.5830 respectively (Table 3). The refractive index of the oil extracted using n-hexane falls within the range for the standard value [8] 1.4600-1.4700). That of the ethanol and the blended solvent have higher values as a result of impurities contained in the crude tamarind oil extracted and other viable factors.

Table 3: Physical analysis of the Tamarind seed oil

PROPERTY (at 25 °C)	Solvent used for extraction			Standard value for edible oil
	Ethanol	n-Hexane	Ethanol+n-Hexane (1:1)	
Oil colour	Tonic Brown	Golden yellow	Pale Brown	Standard
Refractive Index	1.6210	1.4078	1.5830	1.4600- 1.4700
pH Value	3.90	6.70	4.90	4.5-5.2
Density	1.3g/ml	0.89g/ml	0.91g/ml	0.89-1.33g/ml
Specific Gravity	0.98	0.90	0.93	0.91-1.30
Yield	4.02%	2.97%	3.7%	6.2-7.6%
Viscosity		4.2970cp		2800cp

Table 4: Chemical analysis of the Tamarind seed oil

PROPERTY	VALUES	Standard value for Edible oil
	n-hexane oil extract	
Saponification value (mg NaOH/g)	182	190-266.6
Iodine Value	76.14	75-118.4
Acid Value(g/kg)	174	180-292.6
Usaponifiable Matter(g/kg)	26.50	31.30
Peroxide Value(m eq/Kg NaOH)	80	98.90

The pH also varies according to solvent used for extraction. The pH of n-hexane extract is 6.70 which meant that it is slightly acidic. The pH of ethanol and blended solvent are 3.90 and 4.90 respectively showing that the oil obtained using this solvent are acidic. This is as a result of some gum components present in the mass of the tamarind seed to dissolve in ethanol and unable to dissolve in n-hexane. The average yield obtained for the oil for each of n-hexane, ethanol and the blended solvent are 2.97%, 4.02% and 3.70% respectively. The value varies according to seed source, seed treatment and storage, growth condition and extraction techniques and methods [6, 8].

The variation in some physical and chemical parameters for the oil is as a result of solubility of the gum present in the mass of the seed in ethanol. The gum altered the colouration of the oil, pH, density, refractive index, yield etc. and other chemical properties (Table 3 and 4). The colour of oil obtained from n-hexane solvent is golden yellow like that of groundnut oil which is the standard [9, 10]. The ethanol and the blended solvent were tonic brown and pale brown respectively. D-colourization is employed. The saponification value of the oil extracted using n-hexane solvent is 182 mgNaOH/g, which conformed to those from literature that ranged from 190-266.6 mgKOH/g [6]. The iodine value is 76.14 which fall within the range 75-118.4 for standard edible oils. Acid value for the n-hexane extracted oil is 174g/kg which is below the standard range 180-292.6 g/kg. Unsaponifiable matter and peroxide values are 26.50g/kg and 80mEq/kgNaOH for the tamarind oil extracted. However those from literature are 31.30g/kg and 98.90mEq/kgKOH respectively. Variations in these chemical values are as a result of impurities and other operation conditions [11-13].

CONCLUSION

From the analysis carried out on the extracted tamarind seed oil, comparing the result obtained to that of theoretical values, it shows that the oil extracted using n-hexane solvent falls within the category of edible oil. Domestically, it can be used as cooking oil also for frying in homes. Industrially, it can be used in paints, varnishes, soap, lubricating and pharmaceutical industry. Those obtained from ethanol and blended solvent were acidic, with brown colouration and contained gums which have to be neutralized, de-coloured and de-gummed before it can be utilized.

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