Journal of the Rubber Research Institute of Sri Lanka, (1996) **78**, 52-59

AN INVESTIGATION ON OIL OF RUBBER SEED (HEVEA BRASILIENSIS)

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(Accepted 16 January 1996)

ABSTRACT

Oil from seeds of Hevea brasiliensis traditionally used as thickening agent for saurce preparation was isolated, and its physical and chemical characteristics determined. Saponification yielded saturated and unsaturated fatty acids which were separated by preferential crystallization using organic solvents. Methanol, Ethanol, Hexane and Acetone were found effective solvents in this regard. Gas liquid chromatography (GLC) revealed large amounts of C18 fatty acids as well as traces of other fatty acids. The iodine values show that the solvents used in this study gave excellent yields of fatty acids with acetone being the most effective as a crystallization solvent to oil ratio 3:1 at 5 oC.

Key words: rubber seed oil

INTRODUCTION

Rubber tree (*Hevea brasiliensis*) is indigenous to Brazil and is cultivated in India, Sri Lanka, Bangladesh and Malaysia (Alam *et al.*, 1982, Assuncao *et al.*, 1984). The plant is equally found in the Western Coast of Africa and in Nigeria (Stosic and Kaykay, 1981, Uzu *et al.*, 1986). The plant which is widely used as a natural source of rubber and its seed have been found to be rich in oil. although there are variations in the oil content of the seed from different countries, the average oil yield has been reported to be about 40% (Hilditch et al., 1951). Similarly the fatty acid composition is fairly constant irrespective of the oil source (Udomsakdhi *et al.*, 1974). The oil has found little or no economic importance except for scanty reports on its possible uses in soap, alkyd resin and lubricating oil industries (Udomsakdhi *et al.*, 1974, Sthapitanonda *et al.*, 1981, Alam *et al.*, 1982, Njoku and Ononogbu, 1995). Several nutritional studies have advocated its use as an edible oil (Kumar and Sampath, 1979, Stosic and Kaykay, 1981, Achinewhu, 1986, Nwokolo and Bragg, 1986, Ravindran and Ravindran 1988, Ghandhi *et al.*, 1990) but the high lipase activity and residual cyanide which is common in most plants (oil) in the Eurphorbiaceae family have been a

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limiting factor for their uses in nutrition (Mallika *et al.*, 1991).

In Nigeria, the seeds after milling and drying are used as emulsifiers (saurce thickners) in may traditional preparations (Uzu *et al.*, 1986) yet the oil is not used for any nutritional purpose. Aqueous extraction of oil has been a traditional practice in Nigeria, and it is possible that during the use of rubber seed as saurce thickners, there might be residual rubber seed oil being part of the food constituent, suggesting its use as part of edible oil used unconsciously for saurce preparation in Nigeria. It is possible that cultural believe plays a major role in food acceptability in many tropical countries, hence the unacceptability of this oil in nutrition even when the seeds are edible. This study is therefore aimed, at finding out other uses of the oil especially the constituent phospholipids and fatty acids in other allied industries as well as highlight some important nutritional uses of these constituents of the rubber seed oil.

MATERIALS AND METHODS

Fresh seeds of rubber (*Hevea brasiliensis*) were collected from the Faculty of Agriculture, University of Nigeria, Nsukka Rubber Plantation, and their identity authenticated by the taxonomical section of the Department of Botany, University of Nigeria, Nsukka. A voucher specimen was deposited with the Herbarium of the Department of Pharmacognosy, University of Nigeria, Nsukka Nigeria.

The seeds were dried in the sun, (moisture content 5.0% and powered using the hammer mill. The powder thus obtained (100 g) was extracted with petroleum ether (40-60°C) in a soxhlet apparatus *in vacuo*.

The oil was taken up in ether, washed with warm water, dried over anhydrous sodium sulphate, filtered and the solvent removed in vacuo to afford a light yellow oil in 42% yield (42 g) which was analysed by standard methods of AOAC (Anon, 1975). Partial refining (dewaxing and deguming) was carried out to extract gum. Phospholipids were estimated according to the method of Totani et al (1982), Gossypol by the AOCS method (Anon, 1973). Saponification of the oil and fractionation of the fatty acids were performed by the solvent crystallization method described by El-Zanati and Khedr (1991). The oil (100 g) was saponified with alcoholic potassium hydroxide and the resulting soap hydrolysed with 10% dilute sulphuric acid to liberate the free fatty acids which were then washed with warm water until free from mineral acids. Solvent crystallization was carried out to separate the fatty acids into fractions. Several organic solvents were tried in order to determine the most suitable.

A sample (50 g) of the oil was dissolved in the solvent of different acid to solvent ratio ranging from 1:1 to 1:5 (w/v). The solutions formed were cooled at Ca 5oC for 24 hours to complete crystallization of the acids. The crystals were recovered by filtration. Further crops were obtained from the mother liquor by distillation and chilling of the concentrates. The degree of unsaturation and saturation were determined by evaluation of the iodine values. The composition of both the original oil and the separated phases were determined using both thin layer chromatography and GLC according to AOCS method ce 2-66 (Anon, 1973) using 14% boron triflouride solution.

RESULTS

The physicochemical properties of the oil are presented in Table 1. the oil content was high, so also were the acid value, iodine value, peroxide value, saponification value and the unsaponifiable matter. The viscosity, refractive index, specific gravity, flash, fire and smoke points were also high. The gum and phospholipid levels were equally high. Gossypol was absent.

The iodine values of the saturated and unsaturated fatty acids from different proportion of solvent to oil ratio are presented in Table 2. All the solvents exhibited marked variations in their ability to crystallize fatty acids present in the oil. The result of the % yield of saturated (SFA) and unsaturated acid (USFA) acid obtained after extraction are shown in Table 3. Acetone rather than other solvents gave higher yields of both saturated and unsaturated fatty acids. High molecular weight fatty acids were detected in the rubber seed oil.

DISCUSSION

The results of this study show that rubber seed is a good source of oil. The oil yield from the kernel averaged 42% which is comparable to earlier yields reported on rubber seed oil from different tropical countries (Hilditch *et al.*, 1951, Udomsakldhi et al., 1974, Jayappa *et al.*, 1981, Achinewhu, 1986, Attah and Ibemesi, 1990, Ghandhi *et al.*, 1990). It was also comparable to oil yields from other plant members of the Eurphorbiaceae family - castor 50%, Tung oil 33%, chinese tallow 53%, Jatropha 60% (Vaughan, 1970). The phospholipid levels reported in this work is comparatively high and compares well with those of soyabean (Totani *et al.*, 1982) and may justify the use of this plant as a cheap source of emulsifier needed in may nutritional and pharmaceutical industries (Jahansson and Bergenstahl, 1995).

The gum level was equally high, and may serve equally as a cheap local source of this material needed in tabletting of drugs (Udeala and Uwaga, 1981). the flash and fire points are noteworthy and could be important if the oil is to be used in the lubricating industry. Tables 2 and 3 illustrate the changes in weight of solid phase saturated fatty acids (SFA) and liquid phase unsaturated fatty acid (USFA) indicating that at lower solvent to oil ratio, excess SFA may be retained in the pore structure of the crystallized phase resulting in a deficiency of the separation process. This was further investigated by the determination of the iodine value with respect to the unsaturated phase. The high cost, factor due to the use of high concentration of solvent favours the 3:1 ratio as the optimal ratio and compares favourably with earlier work on rice bran oil and Monodora myristicea oil (El-Zanati and Khedr, 1991, Njoku *et al.*, 1995).

It is evident from Tables 3 and 4 that the % palmitic, stearic, oleic, linoleic, linolenic are relatively high. From the utilization viewpoint and using the classification of Bailey (1951), the oil of rubber seed could be classified as a semi-drying oil, and hence could be used in the industries as an excellent oil. It is equally possible to speculate that the oil could be used in both pharmaceutical and veterinary practices, as along chain fatty acids have been

found to inhibit both bacteria and fungi growth (Kabara, 1984) as well as recent speculation on in vitro inhibition of Africa trypanosomes (Wood, 1975). In general, the rubber seed oil is a potential oil especially for the industries, as further research on its nutritional potentials is still a subject of many research investigations.

Table 1. *Physicochemical properties of rubber seed oil*

State at room temperature	liquid
Colour	golden yellow
Viscosity	40.29
Refractive index	1.4656
Specific gravity	0.9201
Smoke point	250
Flash point	300
Fire point	340
Acid value	8.0
% Free fatty acid (as oleic)	4.0
Peroxide value	0.9
Saponification value	192.6
Iodine value	140
% Unsaponifiable matter	1.2
Phospholipid	5.78 mg 100 ml^{-1}
Gossypol	trace
% gum	68

Table 2. *Iodine value of saturated fatty acid (SFA) and unsaturated fatty acid (USFA) from different proportions of solvent to oil*

	Solvent ratio	SFA	USFA
Hexane/oil	1:1	32.0	103.25
	2:1	38.2	96.44
	3:1	46.0	97.71
	4:1	32.8	100.25
	5:1	18.0	101.52
Ethanol/oil	1:1	50.0	100.52
	2:1	68.6	100.15
	3:1	72.0	101.52
	4:1	48.0	102.00
	5:1	20.0	104.52
Acetone/oil	1:1	48.7	102.5
	2:1	48.7	104.05
	3:1	52.8	107.56
	4:1	68.0	114.21
	5:1	36.0	119.15
Methanol/oil	1:1	15.2	94.52
	2:1	18.4	96.44
	3:1	24.0	97.18
	4:1	28.5	98.18
	5:1	15.0	98.29

Table 3. *Percentage yield of saturated fatty acid (SFA) and unsaturated fatty acid (USFA) obtained after extraction with different solvents*

Hexane		Ethanol		Acetone		Methanol	
SFA	USFA	SFA	USFA	SFA	USFA	SFA	USFA
0.95	21.9	0.7	19.5	2.5	26.9	1.25	14.1

Table 4. *Percentage yield of fatty acid composition of the oil (GLC)*

Fatty acids	% by weight
Myristic acid	0.1
Palmitic acid	8.0
Palmitoelic acid	0.3
Stearic acid	8.2
Oleic acid	24.8
Linoleic acid	36.7
Linolenic acid	20.9
Arachidic acid	0.3
Arachidoleic	0.2
Behenic	0.1

ACKNOWLEDGEMENT

The authors are grateful to International Development Research Centre (IDRC), Canada for research grant on rubber seed oil. The authors are equally grateful to POS Pilot Plant Corporation, Saskatoon, Canada for providing laboratory space to Dr. O U Nijoku for training on fats and oil technology where part of this work was carried out. And finally to Myles N Mariarchuk Senior Analyst - Analytical Section, POS Pilot Plant for technical assistance.

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(Received 28 August 1995)