In Search of a New Vegetable Oil

A. Nag* and K. B. De

Chemical Engineering Department, Indian Institute of Technology, Kharagpur 721 302, India

Terminalia bellirica Roxb., commonly known as Bahera in India and commercially as belliric myrobalan, may become the olive of the East and is a fairly abundant plant in the tropical Indian subcontinent. The raw flesh of the fruit can be converted to fodder. The seed oil content (about 47% by weight of dry kernel) appears very promising as a vegetable oil for edible purpose and can be hydrogenated or used for soap production.

Keywords: *Edible oil, Terminalia bellirica Roxb.*

INTRODUCTION

Insufficient quantities of edible oil in the developing world, for example in India (5 million tonnes yearly), have become a major economic and nutritional problem. The need for edible oil in these countries must be met by imports unless new resources or substitutes are found which are sufficiently abundant within regions that have proper transportation facilities. With this background a search was made on five such tropical seeds of perennial plants: *Terminalia bellirica* Roxb., *Bauhinia variagata*, *Putranjiva* Roxb., *Pongamia glabra*, and *Mimusops elangi*. The result of such a successful attempt with *T. bellirica* Roxb. is reported here. The results are similar to those of others (Eckey, 1954), while the values of the other four seeds need to be authenticated and are not yet communicated.

Fairly common in tropical Asia, *T. bellirica* Roxb. is commonly known as Bahera and belliric myrobalan (Chopra et al., 1962; Eckey, 1954). After 5 years and onward, these plants will yield nearly 500 kg of raw fruit per plant. The fleshy fruit pulp usually contains 6.1% moisture, 21.4% tannin, and 44% other water extractables. Tannin has a market in tanneries. The main objective of this work was to determine the major characteristics of the seed oil. Some information about the composition of this oil was available in 1954 (Eckey). Information on hydroxylated and higher molecular weight fatty acids was not available.

MATERIALS AND METHODS

One hundred twenty Bahera fruits (total weight 570 g) were washed with dilute potassium permanganate and dilute copper sulfate solution [approximately 1% (v/w) each] to reduce natural fungal growth. The fruits were then dried in sunlight (final weight 500 g). The dry fruits were broken by hammering and the seeds collected. The seed kernels were similarly collected by cracking the hard nut of the Bahera seed. The seed kernels (59 g) were dried at 70–80 °C for about 6 h. After the drying operation, nuts were ground into powder. Finally, the weight of the dried powder meal was about 51 g. The oil was extracted from the moisture-free meal with petroleum ether (bp 40–60 °C) using Soxhlet. By use of alcoholic potash, determination of free fatty acid was done at room temperature, and saponification values were determined similarly after refluxing. The acetyl value was also checked. The iodine value was determined by using Wij's solution (iodine monochloride in glacial acetic acid solution) (Hilditch, 1947). The composition of fatty acids was determined after saponification and esterification, by gas–liquid chromatography. About 3 g of oil was taken in a 250-mL flask, and 100 mL of 0.5 N ethanolic potassium hydroxide was added; the mixture was refluxed for 1 h, cooled to room temperature, and then neutralized with concentrated hydrochloric acid. The liberated fatty acids were extracted with chloroform and dried over anhydrous sodium sulfate, and chloroform was removed by distillation on a water bath. About 0.5 g of fatty acid mixture was placed in a 100-mL flask and 0.2 mL of thionyl chloride was added and refluxed for half an hour on a water bath. Excess thionyl chloride was removed by distilling with 10 mL of dried benzene. The acid chloride mixture was then boiled under reflux with 10 mL of anhydrous methanol on a water bath for half an hour. The reaction mixture was poured on water, and methyl esters were extracted with chloroform and dried on anhydrous sodium sulfate. The analysis of methyl esters was done by measuring the peak areas by gas–liquid chromatography (Model AIMIL-NUCON, series 5700; temperature of analysis, 195 °C; flow rate, 40 mL/min; carrier gas, nitrogen).

Table 1

	oil of *T. bellirica* Roxb.	olive oil
free fatty acid	1.9–2.01	0.3–1
saponification value	209.2	185–196
acetyl value	<0.5	nil
iodine value	76	79–81
palmitic	18.2	7.5
stearic	8.2	2.8
oleic	56.2	75.5
linoleic	10.8	6.6
others	6.6	7.6

RESULTS AND DISCUSSION

The oil concentration in the seed was about 47% by weight of dry kernel. Other values are presented in Table 1 and compared with those obtained from olive oil (Vitro et al., 1991).

One very interesting point to note here is that the oil has only about 10% of the constituent (stearic) saturated fatty acid. The iodine value is fairly high, and the free fatty acid content is higher than that of olive oil but within the allowable limit (Eckey, 1954) for edible oil. The absence of hydroxylated and other objectionable fatty acids was noted. There is every reason to believe this oil could be used as an edible one, since it has properties very similar to those of olive oil. The values reported earlier (Eckey, 1954) are not universal: the

* Author to whom correspondence should be addressed.

0021-8561/95/1443-0902$09.00/0

oil content and relative composition of the fatty acids vary depending on the source of seeds from plants of different geographical and ecological regions.

Total nitrogen (12.24%) in oil cake was determined according to the Kjeldahl and Dumas methods. The defatted oil cake was boiled with distilled water; after filtration, the insoluble protein was separated and dried, and nitrogen estimation was again performed (7%). The oil cake is rich in (soluble and insoluble) proteins and has a minor carbohydrate content. The oil cake can be developed into some useful feed or fodder. Details of the oil cake contents, composition, and biological values are not reported here for lack of extensive animal assays; our major focus was on the oil content.

Considering the high oil content (47% by weight of the dry kernel) of the seed, it appears very promising for several commercial exploitations.

LITERATURE CITED

Chopra, R. N.; Mayer, S. L.; Chopra, I. C. *The glossary of Indian Medicinal Plants*, 1st ed.; Council of Scientific and Industrial Research: India, 1962.

Eckey, E. W. *Vegetable fats and oils*; Reinhold: New York, 1954.

Hilditch, T. P. *The Chemical Constitution of Natural Fats*; Wiley: New York, 1947.

Vitro, M. D.; Lascarag, J. M.; Solozabal, R.; Renobales, M. Enzymic hydrolysis of animal fats in organic solvents at temperatures below their melting points. *J. Am. Oil Chem. Soc.* **1991**, *68* (5), 324–327.

Received for review October 25, 1993. Revised manuscript received May 9, 1994. Accepted June 7, 1994.[⊗]

[⊗] Abstract published in *Advance ACS Abstracts,* July 15, 1994.