Chemical and Nutritional Studies on the Seed Oil of *Acacia arabica*

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The seeds of *Acacia arabica* contain 5.2% oil. Physicochemical constants and fatty acid composition of the refined seed oil were determined. The seed oil was rich in linoleic acid (39.2%) and oleic acid (32.8%). Trace quantities of epoxy and hydroxy fatty acids were present in the seed oil. Nutritional evaluation of the refined seed oil was done by rat bioassay with peanut oil as control. The animals fed 10% seed oil showed poor growth performance and low feed efficiency ratio. The digestibility of the seed oil was 90% compared to 94% for peanut oil. The seed oil in the diet of rats for 4 wk did not produce any abnormal serum lipids or histopathological findings.

Exploration of lesser-known unconventional sources of oil is highly essential to alleviate the shortages of oils facing the world today. A few studies on some unconventional seed oils have been reported from our laboratory (1-5). As a part of our investigation, we have now evaluated *Acacia arabica* Wild. Syn. *A. nilotica* (Leguminosae) seed.

A. arabica is a spiny evergreen tree of moderate size naturalized all over Inida, and is capable of growing under a wide range of agroclimatic conditions. A mature tree can produce 150-200 kg green seed-bearing pods annually. Local farmers use the green seed-bearing pods in the ration of cattle, though this utilization is only a small fraction of the gross production. The deseeded pods containing 18-27% of tannins are used in village tanneries. The seed at present is a waste material. As the seed-bearing pods are consumed by the ruminants, information on seed composition and nutritional value is badly needed. The composition and food value of the deoiled seed cake have recently been reported (6). In this communication, we report the chemical and nutritional properties of the *A. arabica* seed oil.

EXPERIMENTAL PROCEDURES

Plant material. The mature pods of *A. arabica* were collected from the local forests of Hooghly district (WB), India, and seeds were removed from the air-dried pods.

Extraction and characterization of the seed oil. The powdered seeds were extracted with petroleum ether (60-80°C) in a Soxhlet apparatus. The crude oil was refined according to the AOAC method (7) and bleached with activated earth (2%) and carbon (0.2%). The physicochemical constants were determined by conventional methods (8). The oil was qualitatively examined for the presence of hydroxy, epoxy and cyclopropene fatty acids by the turbidity (9), picric acid (10) and Halphen (11) tests, respectively. The refined oil was treated with diazomethane to esterify the free fatty acids and then transesterified with methanol containing 10% sodium methoxide. The methyl esters were purified on 0.5 mm layers of Silica Gel G with a mixture of petroleum ether (40-60°C) and diethyl ether (90:10, v/v). Methyl esters were used for determining the fatty acid composition by GLC (Perkin-Elmer F 11) with a 15% DEGS column on chromosorb WHMDS (12). Infrared spectra (IR) of the oil and its methyl esters wre obtained with a Beckman Model 221 IR spectrophotometer in KBr disc, and ultraviolet (UV) absorption was measured in CCl_4 on a Beckman 26 UV-visible spectrophotometer. Thin-layer chromatography (TLC) of the oil and its methyl esters was done separately on 0.25 mm Silica Gel G coated glass plates with n-hexane, diethyl ether and acetic acid (79:20:1). The plates were sprayed with concentrated sulfuric acid for detection. The methyl esters of castor and sal oils were used for reference.

Nutritional evaluation of the seed oil. Twelve male albino rats of local strain (inbred in our laboratory), age 20-24 days and weighing about 50-60 g, were divided into two groups of 6 animals each and individually caged. The animals in each group were fed a stock standard diet containing 10% oil (13). Other ingredients of the diets were (g/kg): casein 200, starch 400, sucrose 200, cellulose powder 50, salt mixture 40 and vitamin mixture 10. One group of animals was fed on 10% peanut oil diet and another on 10% refined *A. arabica* seed oil diet. The animals received their assigned diet and water *ad libitum* for 4 wk. Food intakes were recorded daily, and body weights weekly. Feed efficiency ratio (FER), which represents the weight gain per unit food intake, was calculated. Digestibility of the oil was determined by estimating the oil intake and oil excreted through urine and feces (14). At the end of 4 wk, the animals were sacrificed; blood was collected, and total lipids (15), phospholipids (16), free fatty acids (17) and cholesterol (18) were determined. Key organs such as liver, heart, kidney and reproductive were subjected to histopathological examination under the microscope.

RESULTS AND DISCUSSION

Physicochemical characteristics and fatty acid composition of the seed oil are shown in Table 1. The Halphen

TABLE 1

Physicochemical Constants and Fatty Acid Composition of *A. arabica* Seed Oil[a]

Oil constants	
Unsaponifiable matter (%)	2.4
Saponification value	194.4
Acid value (%)	3.4
Iodine value	105.6
Refractive index (25°C)	1.4723
Fatty acids (wt %)	
Palmitic (16:0)	14.6
Stearic (18:0)	6.2
Oleic (18:1)	32.2
Linoleic (18:2)	39.2
Linolenic (18:3)	3.1
Others	5.1

[a]Average of 4 samples.

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TABLE 2

Growth Rate and Serum Lipids of Rats Fed Peanut Oil and *A. arabica* Seed Oil for Four Weeks[a]

Parameters studied	Oil sources	
	Peanut oil	Refined *A. arabica* seed oil
Body wt gain (g/28 days)	48.3 ± 4.6	36.2 ± 2.8*
FER[b]	24.3 ± 2.4	18.2 ± 2.1*
Digestibility of fat (%)	94	90
Serum:		
Total lipids (mg/100 mL)	125.4 ± 8.3	122.6 ± 5.4
Phospholipids (mg/100 mL)	78.2 ± 3.6	72.3 ± 3.4
Cholesterol (mg/100 mL)	62.8 ± 4.3	67.3 ± 3.9
Free fatty acids (m mol/L)	0.32 ± 0.02	0.32 ± 0.04

[a]Values are mean ± SEM for 6 animals.

[b]Feed efficiency ratio = body wt gain/food intake × 100.

*Levels of significance (Student's t-test) with respect to peanut oil group, $P < 0.01$.

test was negative indicating the absence of cyclopropene fatty acids. The UV and IR spectra showed no conjugated or *trans* unsaturation, respectively. Positive turbidity and picric acid tests indicated the presence of epoxy and hydroxy fatty acids in the seed oil. TLC of the methyl esters of the seed oil showed only faint spots corresponding to epoxy and hydroxy fatty esters, suggesting their presence in trace quantities. IR spectra also showed light characteristic bands for epoxy and hydroxy fatty acids. The seed oil contained a large amount of unsaturated fatty acids, and was rich in linoleic acid (39.2%) and oleic acid (32.8%). The results of the short feeding study are shown in Table 2. The rats fed 10% refined seed oil showed poor growth performance and low FER compared to those fed 10% peanut oil. Digestibility of the seed oil was 90% compared to 94% for peanut oil. The serum lipid parameters of the animals fed refined seed oil were within the normal biological range. No histopathological abnormalities were found in any organ of the rats fed refined seed oil. Thus, the refined seed oil is apparently non-toxic to lower animals such as rats. Owing to low oil content of the seed and inferior nutritive value of the seed oil, the seeds of *A. arabica* should not be considered for commercial exploitation as a source of dietary fat.

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