

SOME OLEAGINOUS SEEDS AND FRUITS.

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THE rapid increase in the cost of oils and fats during recent years has caused manufacturers to utilise every possible source of supply, and, as a result, a large number of oleaginous seeds and fruits are now crushed in this country and on the Continent (particularly at Marseilles) to produce oils and fats both for dietetic use and as candle, soap, and lubricating material.

In "Fatty Foods" (J. and A. Churchill, 1913) about fifty different vegetable oils and fats are described, by far the greater number of which are at present to be found on the market. Since the production of this work many other seeds and fruits have been sent to this country in the hope that they might find a market.

In view of the great difficulties which the analyst who may be called upon to examine or recognise what we might term lesser known oils and fats may encounter, we feel that it would be of value to place on record our analytical figures, together with a brief botanical and general description of a few of the large number of seeds and fruits which it has been attempted to utilise during the last few years. Some of these products are obtainable in large quantities, and some have already been crushed in bulk.

In one or two cases it will be noticed that the percentage of oil or fat contained in a given seed or fruit may appear to be too small to make it possible to effect a profitable commercial separation, but it should be borne in mind that the fatty matter is usually confined to one portion of the seed or fruit, such as the kernel or the pulp, and that by the removal of the non-fatty portion in the country of production a product may be obtained rich in oil and easy and economical to export.

Some of the very finest oils, which would command a high price, still remain unused, owing to the fact that they are to be found in kernels which are enclosed in such a thick or hard shell as to be impossible of removal in bulk without special machinery. Inventors have been very busy lately in suggesting and patenting machines for dealing with special nuts of this type, and as a result of their efforts consignments have actually arrived of kernels which a year or two ago had only been separated by hand.

Our thanks are due to Mr. J. Masters Hillier, of the Royal Botanic Gardens, Kew, who has kindly identified many of the specimens, and to Mr. L. H. Dyke Acland, who determined some of the constants given in the table.

*Native name of fruits or seeds	Balantites		Calophyllum tomentosum.	Galophyllum inophyllum.	Melia Azadirachta.	Fevillea cordifolia.	Telfairia pedata.	Canarium Luzonum.	Schleichera trijuga.	Sterculia foetida.	Anacardium occidentale.	Buchanania latifolia.	Cnocarpus distichus.	"Nuts, Maraquana
	Balanites Mangbamli.	Kernel Oil.												
Name of oil yielded ..	—	—	—	Dhomba nuts	Neem or margosa	Sequa, or Antidote Cacao	Jiconga nuts	Pili nuts	Nitas, beans, or Poutham Kai seeds Macassar oil	Kaloom-pang beans, or Beligno seed.	Cashew nuts	Chuddapah almonds, or Peru palm kernels Chironjili oil	—	—
Weight of 100 fruits or seeds, grms.	—	—	77	Dhomba oil	Neem or margosa	—	—	930	64	250	480	7·7	200	340
Oil content, per cent.:	—	—	—	70·1	43·6	57·6	60·9	72·2	71·9	52·0	44·8	61·0	7·1	—
In kernel ..	—	—	—	—	—	—	—	—	2·37	6·9	—	—	—	45·0
In pulp ..	—	—	—	—	—	—	—	—	41·3	27·0	13·5	—	6·7	20·0
In whole fruit or seed	1620	—	50·0	—	14·3	—	35·9	15·9	—	—	—	—	—	—
	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Melting-point, °C. ...	—	—	—	—	—	+34°	—	+29°	—	—	—	—	+36	—
Solidifying-point, °C. ...	—	—	+25°	+17°	+35° (turbidity point)	—	+6°	+14°	+20°	—	—	+18°	—	+4°
Saponification value ...	—	191·5	170·5	190·5	185·6	192·9	193·6	197·0	227·0	—	193·7	198·7	209·2	189·3
Refractive index (Zeiss scale at 40° C.)	51·8°	57°	72·7°	72·3°	54·1	77·1°	54·5°	48·6°	50·6°	63·2°	54·4°	49·3°	49·0°	49·7°
Iodine value (Wijs) ...	77·5	100·6	93·7	88·5	72·9	52·4	90·4	57·1	54·5	66·3	79·5	54·9	55·0	70·1
Free fatty acids (as oleic), per cent.	79·0	1·22	3·46	26·2	3·15	0·28	0·31	1·44	7·93	—	0·3	4·45	65·9	15·3
Unsaturation, per cent.	—	0·88	4·0	1·2	7·7	—	—	—	—	—	—	—	—	—
Reichert-Meissl value	—	—	—	—	8·27	—	—	—	16·0	—	—	—	2·15	—
Polsenske value	—	—	—	—	0·25	—	—	—	0·27	—	—	—	—	—
Kirschner value	—	—	—	—	4·86	—	—	—	14·5	—	—	—	—	—

* Only a few of the better known native names are quoted here.

Balanites Maughamii, Sprague. (Nat. Ord., *Simarubaceæ*).—The tree is a native of Portuguese East Africa, where it is said to be abundant in the Lebombo mountains, and known as "Manduro." Specimens of the tree and fruit have only recently been received in this country, and have been fully dealt with botanically by T. A. Sprague in the *Kew Bulletin, Misc. Inform.*, No. 4, 1913, who describes the fruit as "a drupe, oblong-ellipsoid, $1\frac{1}{2}$ to $1\frac{3}{4}$ inches long, 1 inch in diameter or rather more, with a deep basal depression and a smaller apical one, at the bottom of which are ten scars left by the pedicel and style respectively, longitudinally five grooved in the upper part; epicarp, crustaceous; mesocarp, fibrous and spongy; endocarp, woody, $1\frac{1}{2}$ to 2 inches thick. Seed-coat, buff-coloured." The above parts are present in the following proportions :

Epicarp + mesocarp (pulp)	56 per cent.
Endocarp	33 "
Kernel	11 "

The Imperial Institute, in their Report No. 88, publish some figures for the oil from the kernels. Oil is, however, contained in both the outer sticky pulp and in the kernels; the latter have a high content of a clear pale yellow valuable oil, which is, unfortunately, not likely to be obtained at present on a commercial scale owing to the difficulty of removing the spongy, sugary pericarp. The sticky pulp and the olive-green oil which it contains, have an overpowering smell of butyric acid, while the kernel oil has only a slight butyric odour.

Calophyllum tomentosum, Wight. (Nat. Ord., *Guttiferae*).—The exhibited seeds were received from India. In shape they are obliquely-ovoid and pointed at one end, $1\frac{1}{2}$ to 2 cm. long; in the dry state of a light-brown colour, but when fresh are said to be red. The shell of the seed is under 1 mm. in thickness and very brittle; it encloses the white endosperm, which is covered by a thin yellowish testa, the two latter comprising 72 per cent. of the weight of the seed. The extracted oil is of a pale yellowish-brown colour, having the consistency of vaseline and an unpleasant odour.

Calophyllum Inophyllum, L. (Alexandrian Laurel.) (Nat. Ord., *Guttiferae*).—A species of fairly wide distribution, especially near the coast, extending from India and Madagascar to Australia and the Pacific Coast. The whole fruit is about $3\frac{1}{2}$ cm. long by $2\frac{1}{2}$ cm. broad, but kernels only were received, these being roundish and pointed at one end, dark brown, soft and oily in texture. They have a peculiar, strong odour, suggestive of aniseed or fenugreek, which smell is tenaciously retained by the oil. The colour of the oil is a brownish olive-green. Lewkowitsch ("Chem. Tech. and Anal. Oils, Fats, and Waxes," 5th edition, vol. ii., p. 369) states that the oil is poisonous, but it is said elsewhere to be used by the natives of India for edible purposes. Possibly the oil which is referred to as poisonous was imperfectly freed from non-fatty solids. A general analysis of the seed and extracted meal has been made by A. Smetham (ANALYST, 1914, 39, 489).

Melia Azadirachta, L. (Nat. Ord., *Meliaceæ*). (Report on Improvement of Indian Agriculture, by J. A. Voelcker, pp. 105, 149, and 154.)—This tree is well known in India as the neem-tree, where it grows wild, though it is more often cultivated.

The sample was received from South America under the name of "Beni Seeds." The fruit is about $1\frac{1}{2}$ to 2 cm. long, ovate-oblong in shape, the pericarp being dark brown and wrinkled. Seed about 1 cm. long, containing an oil known as margosa or neem oil; whereas the pericarp, which is pulpy in the fresh state, yields resinous matter. To obtain the oil for examination, the whole fruit was crushed and extracted, and it was found that, on heating, the bulk of the resinous matter separated and a clear oil was obtained by filtration. As shown in the table, much unsaponifiable matter, however, still remained in solution.

Both the fruits and the oil obtained from them possess an intolerable garlic-like smell. The extracted oil was brown in colour, and although it deposits solid matter at 35° C., it never completely solidifies.

Fevillea cordifolia, L. (Nat. Ord., *Cucurbitaceæ*).—Tropical America and West Indies, the plant being often known as the Antidote Cocoon of Jamaica. Fruits roughly circular, yellowish-brown, disc-like, 5 cm. in diameter, containing a similar shaped seed, which does not exceed $\frac{1}{2}$ cm. in thickness. On the extreme edge of the seed-coat, which is yellowish and particularly smooth, are radially arranged ridges. The fat is of a pale cream colour and a firm plastic consistency; the smell is somewhat unpleasant, and the taste bitter. The exceptionally high refractive index—in fact, the highest given by practically any known fatty oil (excepting tung oil)—will be noted, being all the more extraordinary in view of the low iodine value and the marked drying properties which the oil exhibits. Unfortunately, our sample was too small to permit of further investigation.

Telfairia pedata, Hook. (Nat. Ord., *Cucurbitaceæ*).—Tropical Africa. In the natural state these seeds are embedded horizontally in a large fleshy fruit, 3 feet long and 8 to 10 inches in diameter. Seeds much compressed, roughly triangular in shape, about 3 cm. from apex to centre of base, sometimes a little concave on one side. They are easily recognised by the tough fibrous interwoven matting which firmly encloses the seed, but is quite distinct from the outer layer of the seed-coat (epicarp), the latter being hard, yellowish, and having reticulate markings. There is a black, firm mesocarp, a softish white endocarp, and a thin greenish skin covering the endosperm. The above parts are present in the following proportions:

Outer fibrous layer	..	...	...	...	...	10 per cent.
Inner layers of shell (<i>i.e.</i> , epicarp, mesocarp, and endocarp)	31	..				„
Oily yellow kernel + green skin	..	...	...	...	59	„

The oil extracted from the kernels, known as Koëme oil, although liquid at ordinary temperatures, in due course gives a copious deposit of "stearine." When freshly extracted the oil is of a pale yellow colour, but when viewed by reflected light exhibits a red to greenish fluorescence. This fluorescent effect is destroyed by light. The oil is almost odourless, and has only a very slight bitter taste. Both the seeds and the oil are said to be eaten by the natives, but, according to Bontoux (Lewkowitsch, 5th edition, vol. ii., p. 333), toxic substances may be contained in the oil if expressed together with the pulp of the fruit.

Canarium luzonicum, Miquel. (Nat. Ord., *Burseraceæ*).—A native of the Philippine Islands. This species yields most of the elemi (a fragrant gum-resin) exported from Manila, and is locally known as "Brea blanca." The seed only was received.

It is elliptic, very pointed at each end, $4\frac{1}{2}$ to 6 cm. long, about 2 cm. broad, 1 to 3 celled, and triangular in cross-section. The endocarp is very hard and woody, 3 to 4 mm. in thickness, and amounts to 22 per cent. of the weight of the seed. Considerable quantities are said to be available for shipment, but the large proportion of useless shell renders the cost of the kernel very high, so that it would be necessary to decorticate them before any large export trade could be commenced. These kernels have a pleasant, fresh taste, like that of sweet almonds, and yield a fat of soft consistency, which has only a very slight, though pleasant, taste and smell. *Canarium commune* has very similar seeds, the oil from which is known as "Java almond oil"; in both these cases the seeds are used by the natives as substitutes for sweet almonds. With suitable machinery the removal of the shell should not be difficult, and if this can be effected, both the kernels and the oil would prove useful and valuable products, the former having a high protein content.

Schleichera trijuga, Willd. (Nat. Ord., *Sapindaceae*).—This genus is confined to India (Central Provinces, West Peninsula, and Burma) and the Malayan region, where the nuts are variously known as "Kusambi nuts," "Pacca," etc. The tree is the lac-tree of Kosumba ("Ceylon oak"), and the oil is there known as kon or kusum oil, being said to be the original Macassar oil. Fruit $1\frac{1}{2}$ to 2 cm. long, usually echinate, ovate-oblong or spherical, dark reddish-brown. Seeds 1 or 2 in number, 1 to $1\frac{1}{2}$ cm. long, testa light yellowish-brown; they are said (Brandis, "Indian Trees," p. 190) "to be enclosed in a succulent arillus of pleasantly acid taste." The endosperm, in the dried condition, is yellow. A pale straw-coloured, semi-solid oil is contained in the kernels, which, it will be noted, gives a very high Reichert-Meissl value, and also a high Kirschner value. These figures, taken in conjunction with the low Polenske value, might render the oil difficult to detect if used as a butter adulterant, were it not for a peculiar colour reaction noticeable on saponification with alcoholic potash, and for certain other analytical differences.

Sterculia foetida, L. (Nat. Ord., *Sterculiaceae*).—A widely distributed tree in tropical and subtropical regions, where the seeds have many vernacular names. In this country they are commercially known as "Java olives." The seeds, which are enclosed in a long, narrow pod, consist of (1) a greenish papery epicarp, amounting to 4 per cent. of the whole; (2) a soft brown mesocarp, amounting to 19 per cent.; and (3) a hard, black, shining endocarp, amounting to 27 per cent. The kernel (amounting to 50 per cent.), which entirely fills the seed cavity, is almond-like in consistency and texture. These kernels are said to be eaten by the natives.

The oil is of a somewhat viscous nature, of a pale yellow colour, and without any pronounced taste or smell, only a trace of "stearine" being deposited on prolonged standing. It is of interest to note that this oil solidifies on heating to about 250° C., and also that it gives a Halphen colour reaction nearly as strong as cottonseed oil. Lewkowitsch, ("Oils, Fats, and Waxes," 4th edition, vol. iii., p. 102), has prepared and examined a sample of what he terms "polymerised sterculia oil."

The oil obtained from these kernels would be suitable for many purposes, and might prove excellent as a salad oil.

Anacardium occidentale, L. (Nat. Ord., *Anacardiaceae*).—The tree abounds in Brazil, Central America, and West Indies, and is also cultivated in the Tropics. The

seed is brown and kidney-shaped, about 3 cm. long. It consists of—(1) A cellular pericarp, amounting to 70 per cent., which, when freshly cut, exudes a brownish resinous, vesicant juice, which even in small quantities causes most painful blisters on the skin. Formerly advantage was taken of this property to torture slaves by rubbing it on the skin. (2) A kidney-shaped kernel, amounting to 30 per cent. (covered by a thin yellow skin), commonly known on the market under the name of “cashew,” or “promotion nuts.” They are very pleasant to eat and much used in confectionery, whilst the fact that they are always slightly burnt is due to the necessary burning off of the outer portion. The oil yielded by the pericarp is almost black in colour, retains the blistering properties, and, though it has an iodine value of 250, is a non-drying oil. We have only once received it as a commercial sample, but it is said to be utilised by bookbinders in South America.

The kernel oil is not often separated owing to the high price fetched by the kernels themselves. It is a pale yellow colour, possessing a not unpleasant taste and smell.

Buchanania latifolia, Roxb. (Nat. Ord., *Anacardiaceæ*).—India and Burma. Known in this country as “Peru palm kernels.” Fruit, a drupe, black, $\frac{1}{2}$ inch in diameter, but the material investigated by us consisted of small, soft, kernel-like bodies, under 1 cm. in length, and covered with a thin brown coat. They have a very pleasant taste, being somewhat like pistachio nuts in flavour. These kernels are much prized by the natives both as a sweetmeat and for the Chironjii oil obtained from them. The oil is of a very pale straw colour, and has a pleasant taste and smell.

Enocarpus distichus, Mart. (Nat. Ord., *Palmæ*).—South America. The fruit of this tree is a subglobose or ovate, blackish-brown berry. Beneath the outer, brittle layer is a very characteristic fibrous one enclosing the extremely hard seed. A soft brownish-green fat of lard-like consistency and low melting-point was obtained from these seeds, and was found both in the hard seed as well as in the fibrous shell.

“*Marquaqua Nuts*.”—Under this name the authors have recently received an interesting seed (?) from Portuguese East Africa, and though it has not been found possible to identify it at present, it seems desirable to place the figures on record. It is composed of (1) an outer oily covering, having the appearance, consistency, and colour of a date; (2) a thin, firm shell, enclosing (3) the stony semi-transparent endosperm, in which the embryo is seen to be embedded at one end. In the fresher specimens the endosperm is pale yellowish colour, but in the older ones frequently brown. The specimens were about 3 cm. long by 2 cm. broad, and 0.7 cm. thick. The oil is of a dark, golden-yellow colour, somewhat viscous, with no very pronounced taste or smell.

DISCUSSION.

Mr. J. A. L. SUTCLIFFE said that in the case of a sample of sterculia oil which he had examined he had found the acetyl value to be 45 and the specific gravity 0.930, which differed considerably from the figures given by Bontoux. In viscosity the sample was between rape oil and castor oil, the efflux time being 700 seconds, as compared with about 500 for rape oil and about 1,300 for castor oil. Indeed, the oil was not unlike castor oil in some of its features, but was of course quite different in its edible properties.

Mr. E. M. HAWKINS said that he had been informed that the pulp of marquaqua nuts was used for food by the natives.

Dr. LANDER said that he thought some information was desirable as to the comparative utility of these oils—whether, for instance, they were commonly used by the natives either as human or as animal food. He believed he was right in saying that in the case of *Melia* some parts at any rate of the plant were poisonous.

Mr. BOLTON, in reply, said that in their view a “nice” oil would be one that was easily obtained from the seed, that saponified easily and contained but little unsaponifiable matter, that could certainly be used for soap-making and possibly for edible purposes. The question of edibility was of course a difficult one, certain oils being distinctly poisonous or exercising marked physiological effects. This was not in all cases due to the oil itself. It was, for instance, possible, though it was certainly difficult, so to refine castor oil that it possessed no medicinal properties at all. They hoped that these figures might be of some assistance in recognising the oils referred to, and the botanical descriptions might help in identifying the seeds. The country of origin had been given wherever possible. *Melia* seeds would certainly not be used for food, on account of their very strong odour, but possibly this might be sufficiently removed to enable the oil to be used for soap-making.

