FIELD MUSEUM OF NATURAL HISTORY
FOUNDED BY MARSHALL FIELD, 1893

PUBLICATION 276

BOTANICAL SERIES VOL. IX, No. 2

A STUDY OF SOME CHARACTERISTICS OF VEGETABLE OILS

BY

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A STUDY OF SOME CHARACTERISTICS OF VEGETABLE OILS

JAMES B. MCNAIR

A number of years ago it occurred to the writer that there might be a relationship between the melting point of an oil of a plant and the temperature of its environment. The idea was suggested by the fact that in general the melting points of marine animal oils are lower than the melting points of the oils of land animals. In accordance with this idea tropical plants should have oils of higher melting points than those of plants of temperate climates; seeds may have oils of lower melting points than those contained in seed coverings; plants of tropical origin may retain their high melting-point oils in temperate climates; and oil properties may be of value in species identification.

In the tissues of most plants there are small particles of oil that may serve as reserve food for the plant or its seedlings. The most common storage place for oil is the seed, where oil is almost always present in at least a small amount, and in some cases it may be the dominant form of stored food. Oil is, however, not confined to seeds, but occurs also in the flesh of fruits (olives, oil palm fruits), in rootstocks and tubers (potato, iris, and sedges), and in bulbs (onion).

DATA AND DEFINITIONS USED

Data of approximately 318 oils, fats, and waxes have been assembled and reclassified for this article from Volume II of the sixth edition of Julius Lewkowitsch's *Chemical Technology and Analysis of Oils, Fats and Waxes*, published in 1922.

In the present article oils are classified in four groups: drying, semi-drying, non-drying, and fats. In order that the classification used may be better understood these four groups are defined as follows:

Drying oils are so called because they absorb oxygen from the air and dry to an elastic skin when exposed to the air in a thin layer. Linseed oil is a good example. The drying power is directly proportional to the size of the iodine value; consequently the best drying oils are those which absorb the greatest amount of iodine. The drying oils likewise have the lowest melting points of the oils here considered. Chemically they are glycerides of fatty acids

belonging to the linolenic and linolic groups, oleic acid forming only a small proportion of the liquid fatty acids.

Semi-drying oils have melting points and iodine values that lie between those of the drying oils and the non-drying oils. They differ chemically from drying oils by an almost complete absence of linolenic acid, while they are differentiated from non-drying oils by a larger content of linolic acid. The proportion of linolic acid decreases as the iodine value decreases. Cotton seed, maize, and sesame oils are examples of this group.

Non-drying oils have higher melting points and lower iodine values than those exhibited by the members of the drying and semi-drying oils. Linolenic acid is completely absent and linolic acid is present in small quantities only. Olive and castor oils are examples of this group.

Vegetable fats are oils that are solid in temperate climates. They present, however, a variety of gradations from the soft, buttery mass of laurel oil to the hard, waxlike Japan tallow. As the hardness of the fats increases approximately in direct proportion to the decrease of the content of glycerides of oleic and linolic acids, the iodine value would most appropriately determine, in the absence of other more striking chemical characteristics, the order in which the individual fats may be enumerated. Examples of fats are cacao butter, coconut oil, Japan wax, and myrtle wax.

Vegetable waxes as a group have higher melting points and lower iodine numbers than any of the oils here considered. They are not glycerides, but are chemical mixtures of fatty esters of higher monohydric aliphatic and phytosterol alcohols. Waxes are distinguished from fats by the fact that waxes are esters of monohydric alcohols while fats are esters of the trihydric alcohol, i.e, glycerol. Carnauba and palm waxes are examples.

Some 318 oils have been studied. Of these 318 oils, 62 are drying oils of low melting point, 83 are semi-drying oils of higher melting point, 71 are non-drying oils of still higher melting point, and 102 are fats.

OILS IN SEED KERNELS AND SEED COVERINGS

Oils are chiefly found accumulated in seeds. In fact, practically all the oils considered in this article come from this source. However, it may be well at this point to discuss the properties of the oils from seed kernels in contrast to the oils from seed coverings.

If it is true that the environment in which an oil is produced should influence its melting point, i.e., that oils produced in tropical plants should have higher melting points than those produced in cold climates, then it might be expected that oils found in seed coverings should have higher melting points than oils found in seed kernels of the same plant. It is understood that the diurnal fluctuations in air temperature to which the seed covering is subjected cause the daily maximum temperature of the seed covering to be greater than the daily maximum temperature of the seed kernel. In the tropics, where the minimum temperature is higher and the diurnal and seasonal fluctuations in temperature are less than in the temperate zone, the melting points of the seed covering

PHYSICAL AND CHEMICAL PROPERTIES OF OILS FROM KERNELS AND SEED COVERINGS

Family	Plant	Oil Source	Sp. Gr. (15° C.)	Sapon. Value	Iodine Value	Class
Euphorbiaceae	Sapium sebiferum	covering,	.915 –.918	179.0–205.7	19.0 – 37.7	fat
		kernel	.9458	203.8–210.4	145.6 –160.7	drying
Anacardiaceae	Rhus laurina	covering	.9011	157.1	11.44	fat
	Rhus succedanea	covering	.975	217.5–237.5	4.2 – 15.1	fat
	Rhus diversiloba	covering	.9896	220.6	8.79	fat
	Rhus glabra	kernel	.9257–.9259	190.8–193.8	126.9	semi-drying
Oleaceae	Olea europaea	covering,	.916 –.9196	188.7–203.0	77.28– 91.7	non-
		kernel	.9184–.9191	182.3–183.8	86.99– 87.8	drying
Palmae	Elaeis guineensis	covering,	.9209–.9245	196.3–205.5	53.0 – 57.44	fat
		kernel	.9119	246.3–250.0	10.3 – 17.5	fat
	Astrocaryum vulgare	covering,	.916	196.5–197.2	74.8 – 75.7	fat
		kernel		242.5–243.3	10.4 – 11.2	fat

and seed kernel oils would be more nearly equal, as well as higher than the melting points of the temperate oils. This may be influenced by the size and structure of the fruit. In agreement with this theory the oils from the seed coverings of the Chinese tallow tree (*Sapium sebiferum Roxb.*) and various species of sumac (*Rhus*) have higher melting points than their corresponding seed kernel oils. However, in the cases of the African oil palm (*Elaeis guineensis* Jacq.) and the Tucum palm (*Astrocaryum vulgare* Martens) the kernel oils have higher melting points than oils of the seed coverings;

but it should be noted that all of these oils are from tropical plants and that the kernel oils have higher melting points than the kernel oils of temperate plants. In the case of the olive, another tropical plant, both oils are similar.

WAXES ON STEMS AND LEAVES

Vegetable waxes are for the most part exudations of plant leaves and stems, and mostly occur in small quantities. Of a total of twenty waxes considered four are found on plants growing in temperate climates and twelve are from tropical or sub-tropical plants.

These waxes occur in the Gramineae, Palmae, Moraceae, Papaveraceae, Saxifragaceae, Linaceae, Euphorbiaceae, Malvaceae, Bombacaceae, Asclepiadaceae, and Compositae.

OILS IN RELATION TO SPECIES

Iodine numbers, saponification values, and specific gravities of the various oils may shed some light on specificity.

The attached tables may be of value in qualitative analysis and an aid to the determination of any oil on the list. For instance, we may have an oil of unknown origin with a saponification number of 114.5, an iodine number of 132.6–157.5, and a specific gravity number of .924–.927 at 15°C. Referring to the list of iodine numbers we find that it may be the oil of *Couepia grandifolia, Lepidium sativum, Manihot Glaziovii, Hevea brasiliensis, Helianthus annuus, Glycine hispida, Guizotia abyssinica, Aleurites ricinodendron, Amoora Rohituka, Juglans regia, Papaver somniferum,* or any of some forty-nine other plants. However, when we note the determined saponification number of 114.5 we find the number of plants that will correspond is restricted to *Linum usitatissimum* and *Papaver somniferum.* As *Linum usitatissimum* does not have an iodine value within the specified range, the oil must be of *Papaver somniferum,* provided, of course, the source plant is among those listed.

OILS IN RELATION TO GENERA

There is close agreement between the oils of the different species of a genus. For instance, in the genus *Trifolium:*

Trifolium agrarium: sp. gr. at 15°C., 0.9290; N_D 30°C., 1.4757; sap. v. 188.4; iod. v. 75.9; solid. pt. —15°C. *Trifolium hybridum:* sp. gr. at 15°C., 0.9250; N_D 30°C., 1.4757; sap. v. 187.2; iod. v. 65.9; solid. pt. —14°C. *Trifolium incarnatum:* sp. gr. at 15°C., 0.9170; N_D 30°C., 1.4723; sap. v. 181.3; iod. v. 61.6; solid. pt. —9°C. *Tri-*

folium repens: sp. gr. at 15°C., 0.9170; N_D 30°C., 1.4745; sap. v. 189.4; iod. v. 68.5; solid. pt. —16°C.

OILS IN RELATION TO FAMILIES

Oils are found in at least 83 (30 per cent) of the plant families out of the 277 families listed by Engler and Prantl.

Within the smaller families the oils of the respective genera and their species are in close agreement as in the Cruciferae, Cucurbitaceae, Lauraceae, Myristicaceae, Pinaceae, Polygalaceae, Rutaceae, Sapindaceae, Sapotaceae, Simarubaceae, Solanaceae, and the Umbelliferae.

In the large families the oils of the different genera are usually in close agreement when grouped according to tribes. For instance:

Leguminosae

Subfamily I. Mimosoideae: (F)[1] Parkia, (ND) Pentaclethra
Subfamily II. Caesalpinioideae: (SD) Caesalpinia
Subfamily III. Papilionatae:

Tribe 3. Genisteae: (SD) Cytisus, (SD) Spartium, (ND) Lupinus
Tribe 4. Trifolieae: (ND) Trigonella, (ND) Trifolium, (ND) Ornithopus, (ND) Melilotus, (ND) Medicago
Tribe 5. Loteae: (ND) Lotus, (ND) Anthyllis
Tribe 6. Galegeae: (ND) Galega, (D) Robinia, (D) Caragana, (D) Amorpha
Tribe 7. Hedysareae: (ND) Arachis, (ND) Onobrychis
Tribe 8. Vicieae: (SD) Vicia, (SD) Cicer, (SD) Pisum, (SD) Lens
Tribe 9. Phaseoleae: (SD) Voandezia, (SD) Cajanus, (SD) Dolichos, (SD) Canavalia, (SD) Mucuna urens, (SD) Vigna, (SD) Phaseolus Mungo, (SD) Phaseolus lunatus, (SD) Phaseolus inamoenus, (SD) Phaseolus coccineus, (SD) Phaseolus vulgaris, (D) Glycine
Tribe 10. Dalbergieae: (F) Dipteryx, (F) Pongamia

Gramineae

Tribe 1. Paniceae: (D) Panicum
Tribe 2. Maydeae: (SD) Zea
Tribe 3. Oryzeae: (ND) Oryza
Tribe 6. Andropogoneae: (SD) Sorghum
Tribe 7. Phalarideae: (SD) Phalaris
Tribe 12. Hordeae: (SD) Secale, (SD) Triticum, (SD) Hordeum

Cucurbitaceae

Tribe 1. Cumerineae: (F) Hodgsonia, (ND) Telfairia, (F) Luffa, (SD) Acanthosicyus, (SD) Cucumis, (SD) Citrullus, (SD) Cucurbita, (SD) Bryonia
Tribe 3. Elaterieae: (SD) Echinocystis

Guttiferae

Tribe 2. Moronobeae: (F) Symphonia, (F) Pentadesma
Tribe 3. Garcinieae: (F) Garcinia
Tribe 4. Calophylleae: (ND) Calophyllum, (ND) Mesua

[1]The abbreviation D = drying oil, SD = semi-drying oil, ND = non-drying oil, and F = fat.

OILS OF TROPICAL AND SUBTROPICAL PLANTS

Of the 83 plant families known to contain oils, 40, or 48.1 per cent, are mainly tropical or subtropical in habitat. According to these statistics, therefore, oils are more frequently found in tropical and subtropical than in plants of temperate regions.

Of the 62 drying oils, 25, or 40 per cent, are from tropical and subtropical plants. Drying oils are therefore not as frequently met with in tropical plants as in plants grown elsewhere.

Of the 83 semi-drying oils, 41, or 49 per cent, are from tropical plants.

Of the 71 non-drying oils, 42, or 59 per cent, are from tropical plants.

Of the 102 fats, 101, or 99.97 per cent, are from tropical plants.

From these data it may be concluded that tropical and subtropical plants are more likely to have fats (highest melting-point oils) than non-drying, semi-drying, or drying oils (lower melting-point oils).

The percentages of drying oils, semi-drying oils, non-drying oils, and fats increase among tropical plants as follows: drying 7.86 per cent, semi-drying 12.89 per cent, non-drying 13.2 per cent, and fats 31.76 per cent.

CHARACTER OF OILS IN RELATION TO CLIMATE OF HABITAT

HABITAT	DRYING OILS		SEMI-DRYING OILS		NON-DRYING OILS		FATS	
	No.	%	No.	%	No.	%	No.	%
Tropical	25	7.86	41	12.89	42	13.2	101	31.76
Temperate	37	11.63	42	13.20	29	9.12	1	00.03
Total	73	19.49	133	26.10	90	22.32	105	31.67

OILS OF NON-TROPICAL AND NON-SUBTROPICAL PLANTS

Of the 83 plant families known to contain oils, 15, or 18.0 per cent, are mainly temperate in habitat.

Of the 62 drying oils, 37, or 59 per cent, are from plants growing in temperate climates. Of the 83 semi-drying oils, 42 are from temperate plants. Of the 71 non-drying oils, 29 are from plants growing in temperate zones.

Of the 102 fats only one is from a plant growing in a temperate climate.

From these data it may be concluded that plants growing in temperate climates are more likely to have drying oils (lower melting-point oils) than semi-drying or non-drying oils and fats (higher melting-point oils).

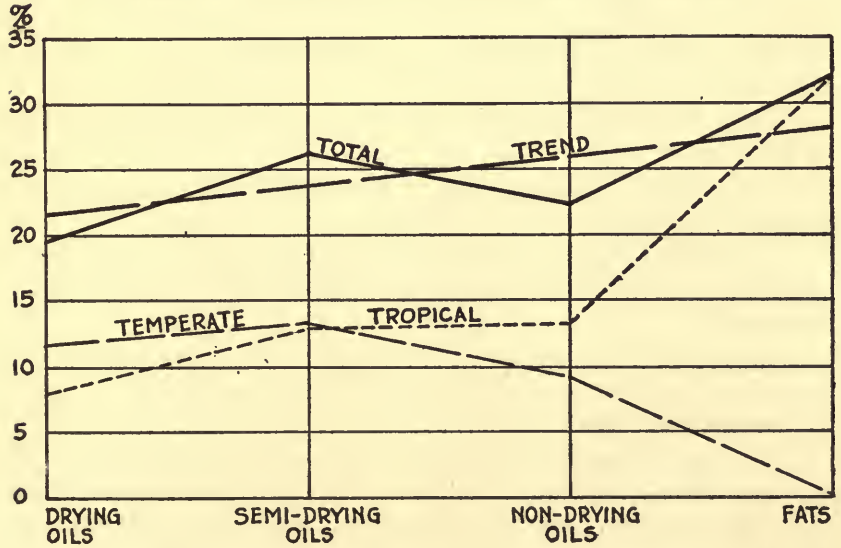
The percentages of drying, semi-drying, non-drying oils, and fats increase in plants growing in temperate habitats as follows: fats .03 per cent, non-drying oils 9.15 per cent, drying oils 11.63 per cent, and semi-drying oils 13.2 per cent.

Drying and semi-drying oils are therefore of more frequent occurrence in plants growing in temperate climates than in tropical plants.

OILS IN RELATION TO PLANT ORIGINS

As to a possible relation between the melting points of oils and tropical origin the following families with high melting-point oil are

CHARACTER OF OILS IN RELATION TO CLIMATE OF HABITAT



of interest (non-drying oils and fats): Cyperaceae, Palmae, Myristicaceae, Betulaceae, Ulmaceae, Olacaceae, Chenopodiaceae, Lardizabalaceae, Lauraceae, Moringaceae, Tropaeolaceae, Simarubaceae, Burseraceae, Meliaceae, Polygalaceae, Anacardiaceae, Hippocastanaceae, Sapindaceae, Vitaceae, Bombacaceae, Sterculiaceae, Ochnaceae, Caryocaraceae, Theaceae, Guttiferae, Dipterocarpaceae, Flacourtiaceae, Caricaceae, Rhizophoraceae, Combretaceae, Arali-

aceae, Sapotaceae, Oleaceae, Salvadoraceae, Loganiaceae, Asclepiadaceae, Verbenaceae, Bignoniaceae, Rubiaceae, Caprifoliaceae.

It is noted that the majority of these families are mainly tropical in their distribution, notable exceptions being Cyperaceae, Betulaceae, and Chenopodiaceae.

SUMMARY

There may be a relationship between the melting point of a fat or oil of a plant and the temperature of its environment. Such a relationship is known to exist in the case of oils of marine and terrestrial animals.

Oils are found in at least 83 (30 per cent) plant families out of 277 listed by Engler and Prantl.

Some 318 oils have been studied from these 83 families: 62 are drying, 83 are semi-drying, 71 are non-drying, and 102 are fats.

Oils found in seed coverings may have higher melting points than oils of seed kernels.

Waxes are found more abundantly on tropical plants than on plants of temperate climates.

There is close agreement between the oils of the different species of a genus.

The physical and chemical properties of oils may be more or less definitely correlated with specificity.

Tables of iodine numbers, saponification values, and specific gravities of over 300 oils are included. These may aid in differential analysis.

The oils of most of the smaller families are in close intrafamilial agreement, while those of the larger families are often in better agreement considered in tribal groups.

Tropical and subtropical plants are more likely to have fats and non-drying oils than semi-drying or drying oils, i.e., tropical and subtropical oils have higher melting points than the oils of temperate climates.

As to the possible relation between high melting-point oils and tropical origin a list of 40 families is given. Of this list three are mainly temperate in habitat.

SAPONIFICATION VALUES OF OILS, FATS AND WAXES

2.49	Attalea funifera
46.76– 60.0	Pedilanthus Pavonis
50.3 – 51.3	Raphia Ruffa
62.9 – 63.1	Euphorbia antisyphlitica
63.0(?)	Coriandrum sativum
65.8	Philadelphus coronarius
78.4 – 88.3	Corypha cerifera
101.51–162.0	Linum usitatissimum
113.0(?)	Pyrus communis
114.5	Papaver somniferum
140.0	Euphorbia stenoclada
142.8	Euphorbia xylophyl-loides
153.0 –191.0	Myristica officinalis
156.2	Picramnia carpinterae
157.0	Acer platanoides
157.1	Rhus laurina
159.6	Vohemaria Messeri
165.1 –177.5	Coffea arabica
165.58–191.6	Pistacia vera
166.2 –170.6	Strychnos nux-vomica
167.9	Saccharum officinarum
168.5	Fraxinus excelsior
170.0(?)	Laurus indica
170.1(?)	Sapindus rarak
170.14	Ceiba pentandra
170.3 –177.8	Sinapis alba
170.4	Eruca sativa
170.8	Hyoscyamus niger
170.9	Nasturtium Nasturtium-aquaticum
171.3(?)	Ribes rubrum
171.3 –180.1	Brassica Napus
171.52	Asclepias gigantea
171.6	Brassica campestris
171.8 –192.3	Butyrospermum Parkii
172.1	Brassica juncea
172.1	Sorghum cernuum
172.26–175.3	Brassica sp. (Jamba oil)
172.3	Medicago sativa
172.8	Crataegus Oxyacantha
172.9 –178.5	Brassica campestris
173.0 –183.1	Ximenia americana
173.4	Armoracia rusticana
173.4 –212.01	Sterculia foetida
173.6	Lecythis ollaria
173.8 –181.6	Raphanus sativus
174.0 –176.0	Raphanus Raphanistrum
174.4	Eruca sativa
174.4 –180.3	Brassica oleracea
174.5 –193.05	Poga oleosa
174.7 –178.9	Brassica Rapa
175.1(?)	Galega officinalis
175.2	Onobrychis sativa
176.0	Anethum graveolens
176.3	Garcinia tonkinensis
176.5	Petroselinum sativum
176.7 –186.6	Ricinus communis
176.8	Ptychotis ajowan
177.3	Sinapis chinensis
178.0 –183.0	Hydnocarpus edulis
178.0 –185.1	Pongamia glabra
178.0 –186.4	Lepidium sativum
178.1	Tilia americana
178.1	Apium graveolens
178.2	Sinapis dissecta
178.22	Mucuna urens
178.3	Carum Carvi
178.3 –178.4	Pimpinella Anisum
178.4 –191.4	Secale cornutum
179.0 –205.7	Stillingia sebifera
179.1 –192.6	Aleurites moluccana
179.3	Cuminum Cyminum
179.4	Sinapis arvensis
179.4	Daucus Carota
179.4 –193.5	Oryza sativa
179.5	Crambe maritima
179.5	Palaquium sp. (Surin fat)
179.6	Kickxia elastica
179.7 –197.8	Prunus Cerasus
179.8	Acer Pseudo-platanus
179.9	Eriobotrya japonica
180.0	Barbarea praecox
180.3(?)	Cheiranthus Cheira
180.5	Vicia sativa
180.7 –194.6	Lophira alata
181.0 –205.0	Ceiba pentandra
181.2	Foeniculum officinale
181.2	Isatis tinctoria
181.3	Trifolium incarnatum
181.4	Acanthosicyos horrida
181.75–187.7	Cydonia vulgaris
181.9 –203.0	Pentaclethra macro-phylla
182.0	Coriandrum sativum
182.0 –190.0	Sinapis nigra
182.3 –183.8	Olea europea var. sativa (seed)
182.3 –198.2	Prunus Armeniaca
182.4	Lens esculenta
182.5	Amorpha fruticosa
182.5 –188.6	Mimusops Djave
182.6	Cicer arietinum
182.8 –190.3	Triticum sp.
183.0	Tamarindus indica
183.1	Anthriscus Cerefolium
183.1	Vicia sepium
183.2	Pithecoctenium echina-tum
183.4	Trigonella Foenum-graecum
183.6 –192.0	Lycopersicum esculen-tum

183.8 Setaria italica
184.0 Phalaris canariensis
184.1 Voandezia subterranea
184.5 Pisum sativum
184.5 Parkia africana
184.5 –198.9 Payena oleifera
184.6 –187.7 Moringa oleifera
184.7 Vicia Faba
184.7 –191.6 Ricinodendron africanum
184.8 Tilia parvifolia
185.0 Lallemantia iberica
185.0 Lupinus luteus
185.0 Funtumia elastica
185.0 Sterculia appendiculata
185.0 Dialyanthera otoba
185.1 –196.0 Elaeococca vernicia
185.3 Ornithopus sativus
185.6 Vigna Catjang
185.6 –196.9 Melia Azadirachta
185.6 –197.0 Arachis hypogaea
185.6 –206.1 Hevea brasiliensis
185.8 –188.0 Myagrum sativum
186.0 –194.6 Bassia butyracea
186.0 –202.0 Datura Stramonium
186.2 Lupinus angustifolius
186.5 Canavalia ensiformis
186.5 –197.5 Joliffa africana
186.58 Carica Papaya
186.6 –191.7 Stearodendron Stuhlmannii
186.6 –193.3 Carthamnus tinctorius
186.7 Thuja occidentalis
186.7 –202.9 Citrullus Colocynthis
186.8 –192.6 Canarium pachyphyllum
186.8 –191.5 Garcinia indica
187.0 –192.0 Cucumis Chate
187.2 Trifolium hybridum
187.4 –188.5 Bassia longifolia
187.5 Dolichos Lablab
187.5 Phaseolus Mungo
187.6 Manniophyton fulvum
187.8 –190.3 Argemone mexicana
187.8 –195.8 Luffa aegyptiaca
187.9 Melilotus albus
187.9 –194.6 Strophanthus hispidus
188.0 Pinus cembra
188.0 Diospyros virginiana
188.0 Vicia Faba
188.0 –193.0 Sesamum indicum
188.0 –194.0 Helianthus annuus
188.1 Caryodendron orinocense
188.1 –198.5 Prunus domestica
188.2 Cajanus bicolor
188.3 Acrocomia sclerocarpa
188.3 –195.5 Thea sasangua
188.3 –196.2 Bassia villosa
188.4 Torreya nucifera
188.4 Citrus Limonia
188.4 Melampyrum arvense
188.4 Trifolium agrarium
188.4 –190.2 Cucurbita Pepo
188.5 Cephalotaxus drupacea
188.5 –190.5 Jessenia polycarpa
188.6 Cupressus sempervirens
188.6 Linaria reticulata
188.6 –192.6 Manihot Glaziovii
188.6 –195.3 Couepia grandifolia
188.7 Phaseolus inamoenus
188.7 –191.9 Vateria indica
188.7 –203.0 Olea europea var. sativa (pulp)
188.8 Limonia Warneckei
188.9 –192.2 Guizotia abyssinica
189.3 Pinus monophylla
189.0 Anthyllis vulneraria
189.0 –196.8 Papaver somniferum
189.2 Phaseolus vulgaris var. albus
189.2 Parthenocissus quinquefolia
189.2 –190.0 Echinops ritro
189.1 –192.5 Prunus Persica
189.2 Phaseolus lunatus
189.4 Carthamnus Oxyacantha
189.4 Trifolium repens
189.5 Rubus fruticosus
189.5 Trigonella Foenum-graecum
189.5 Trifolium repens
189.5 –191.5 Bassia Mottleyana
189.5 –195.4 Prunus Amygdalus
189.6 Pinus montana
189.6 Phaseolus coccineus
189.6 Carya ovata
189.7 Coula edulis
189.7 –191.8 Citrullus vulgaris
189.7 –192.3 Amoora Rohituka
189.7 –192.6 Zea Mays
189.7 –200.2 Canarium polyphyllum
189.8 Juglans Sieboldiana
189.8 Pinus sylvestris
189.8 –192.0 Aleurites cordata
189.9 Trifolium pratense var. perenne
189.9 –192.4 Adansonia Grandidieri
190.0 Nicotiana Tabacum
190.0 –193.0 Cannabis sativa
190.1 Vaccinum Vitis-idaea
190.2 –192.7 Linum usitatissimum
190.3 Omphalea megacarpa
190.4 Vaccinium Myrtillus
190.5 Cucumis Melo
190.5 Celosia cristata
190.5 Pinus Picea
190.5 Hedera Helix
190.5 –191.7 Adansonia digitata
190.6 Caragana arborescens
190.6 –192.5 Glycine hispida
190.7 Lotus corniculatus
190.8 –193.8 Rhus glabra
190.9 Petroselinum sativum
190.9 –193.4 Perilla nankinensis

191.0	Calophyllum inophyllum
191.0	Cannabis sativa
191.0 –192.0	Ungnadia speciosa
191.0 –194.5	Gossypium sp. (cotton)
191.1	Lactuca Scariola var. oleifera
191.1 –196.3	Fagus sylvatica
191.2	Shorea aptera
191.3	Torreya californica
191.3	Pinus Gerardiana
191.3	Morus alba
191.5	Melia Azedarach
191.5	Cucurbita maxima
191.5 –195.2	Ricinodendron Rautanenii
191.8	Pinus Cembra
191.8	Hesperis matronalis
191.8 –202.0	Theobroma Cacao
191.9	Thea japonica
191.9	Thea sinensis
192.0	Pentadesma Kerstingii
192.0	Chisocheton Cumingianus
192.0	Plukenetia conophora
192.0	Maclura pomifera
192.0	Pinus Abies
192.0 –192.5	Cornus sanguinea
192.12	Argania sideroxylon
192.3	Rubus idaeus
192.4	Robinia Pseudoacacia
192.4	Oncoba echinata
192.6	Cytisus Laburnum
192.6	Pinus Pinea
192.7	Picramnia Lindeniana
192.8	Madia sativa
192.8	Pinus monophylla
192.8	Lupinus albus
192.8 –197.1	Corylus Avellana
192.9 –215.6	Croton Tiglium
193.0	Parthenocissus quinquefolia
193.0	Bryonia dioica
193.2	Jatropha Curcas
193.4	Medicago sativa
193.4	Illicium religiosum
193.4	Echinocystis oregana
193.4 –194.1	Asparagus officinalis
193.4 –202.0	Bertholletia excelsa
193.48	Perilla frutescens
193.5 –194.3	Colophonia mauritiana
193.6	Buchanania latifolia
193.7	Fragaria vesca
193.7 –196.37	Citrus Aurantium
193.8 –197.3	Juglans regia
193.8	Illicium verum
193.8	Polygala Senega
193.8	Nephelium lappaceum
193.9	Thea sasanqua
194.0	Prunus Laurocerasus
194.0	Jatropha mahafalensis
194.0 –196.5	Citrullus vulgaris
194.1	Balanites aegyptiaca
194.15	Sterculia chica
194.5	Nigella sativa
194.5	Aesculus Hippocastanum
194.6	Gynandropsis pentaphylla
194.6	Moronobea coccinea
194.6	Blighia sapida
194.74	Garcinia morella
194.9 –197.1	Cucurbita maxima
195.0	Anacardium occidentale
195.0	Lycopodium
195.2	Oenothera biennis
195.2	Citrus aurantifolia
195.2	Abelmoschus esculentus
195.2 –196.9	Cucumis sativus
195.5	Vitis vinifera
195.6 –197.2	Carapa guianensis
195.7 –196.2	Cucurbita Pepo
195.98	Citrus Limonia
196.0	Secale cereale
196.3 –205.5	Elaeis guineensis
196.42	Calotropis gigantea
196.5	Daphne Cnidium
196.5	Moquilea tomentosa
196.5 –197.2	Astrocaryum vulgare
196.6	Lappa minor
196.8 –209.3	Sambucus racemosa
197.0	Gynocardia odorata
197.0	Canarium oleosum
197.0	Canarium luzonicum
197.0	Pentadesma butyracea
197.0 –210.0	Laurus nobilis
197.1	Martynia louisiana
197.25	Basiloxylon brasiliensis
197.6	Hodgsonia Kadam
197.6 –199.5	Caryocar butyrosum
198.0	Carya Pecan
198.0	Trichilia emetica
198.1	Carapa grandiflora
198.2	Citrullus vulgaris
198.4	Datura Metel
198.5	Skaphium lanceatum
198.5	Xanthophyllum lanceatum
198.6	Spartium junceum
199.3	Quercus agrifolia
199.5	Aegiphila obducta
199.8	Myrtus communis
200.3 –213.0	Hydnocarpus Kurzii
201.5	Croton Elliotianus
201.5	Palaquium oblongifolium
201.5	Trichilia subcordata
202.0 –203.0	Nerium Oleander
202.0	Pyrus Malus
202.8	Vernonia anthelmintica
203.0	Hyptis spicigera
203.0 –204.0	Terminalia Catappa
203.1	Citrullus Naudinianus
203.5 –208.1	Hydnocarpus Wightiana
203.6	Trichilia emetica
203.7 –205.8	Mesua ferrea

203.8 –210.4	Stillingia sebifera
205.0	Magnolia hypoleuca
205.7 –217.0	Myricacerifera
205.9	Pithecolobium dulce
206.2 –212.0	Hydnocarpus anthelminticus
208.0	Sorbus Aucuparia
208.0	Arbutus Unedo
209.2	Oenocarpus distichus
210.98	Phoenix dactylifera
211.0	Betula alba
213.9	Mimusops elengi
215.02	Myristica canarica
215.3 –227.0	Schleichera trijuga
216.2	Chorisia Peckoltiana
217.5 –237.5	Rhus sylvestris
218.8 –220.3	Virola bicuhyba
220.6	Rhus diversiloba
221.5	Virola guatemalensis
223.5(?)	Celastrus senegalensis
224.4	Magnolia hypoleuca
224.72	Cyperus esculentus
227.4 –234.6	Areca catechu
229.2	Luffa acutangula
234.8	Apeiba sp.
235.0 –235.6	Irvingia Oliveri
238.5	Scyphocephalium ochocoa
239.5 –240.2	Myristica platysperma
241.2 –250.0	Irvingia spp.
241.39	Machilus Thunbergii
242.2	Allophylus racemosa
242.36	Salvadora oleoides
242.5 –243.3	Astrocaryum vulgare
244.0	Myristica surinamensis
244.7	Litsea zeylanica
245.2	Salvadora persica
246.2	Mauritia vinifera
246.3 –250.0	Elaeis guineensis
246.4	Akebia quinata
251.0	Polygala butyracea
251.0 –268.4	Cocos nucifera
252.4 –256.5	Attalea cohune
255.0	Myristica angolensis
255.6	Lindera sericea
256.6 –349.0	Attalea excelsa
262.2	Telfairia occidentalis
268.2	Lepidadenia Wightiana
270.0(?)	Capsicum annuum
273.6	Lindera praecox
277.3	Ulmus campestris
280.0	Hordeum vulgare
282.0	Lindera triloba
283.8	Cinnamomum Camphora
339.6(?)	Citrus aurantifolia

SPECIFIC GRAVITY OF OILS, FATS AND WAXES AT 15° C.

0.832 –0.836	Raphia Ruffa
.8594– .9177	Butyrospermum Parkii
.865	Mucuna urens
.866	Polygala butyracea
.867	Salvadora persica
.868	Attalea funifera
.868 – .871	Attalea cohune
.8686	Attalea excelsa
.8715	Virola bicuhyba
.8916	Lepidadenia Wightiana
.8943– .9175	Bassia villosa
.895(?)	Lecythis ollaria
.898	Oncoba echinata
.9002	Luffa acutangula
.9011	Rhus laurina
.9072	Torreya californica
.9072– .9171	Sambucus racemosa
.9083– .998	Linum usitatissimum
.9092– .9285	Prunus Cerasus
.9099– .9225	Fagus sylvatica
.9119	Elaeis guineensis
.912	Carapa guianensis
.912	Ribes rubrum
.9125	Picramnia Lindeniana
.9126– .916	Sinapis alba
.9127– .920	Moringa oleifera
.9127–	Garcinia tonkinensis
.9127	Garcinia indica
.9128– .9225	Canarium commune
.9137	Sorbus Aucuparia
.9137– .9167	Mimusops Djave
.9143	Citrullus vulgaris
.9147	Canarium polyphyllum
.9148	Brassica campestris
.9149	Melia Azadirachta
.915 – .921	Jatropha Curcas
.915	Adansonia digitata
.915	Vateria indica
.915 – .918	Stillingia sebifera
.915 – .9158	Brassica sp. (Jamba oil)
.9155– .917	Corylus Avellana
.9156	Caryocar tomentosum
.9158	Brassica juncea
.9158	Blighia sapida
.9158	Trichilia emetica
.9158– .9558	Bassia butyracea
.916 – .9196	Olea europea var. sativa
.916	Astrocaryum vulgare
.916	Thea japonica
.916 – .9213	Prunus domestica
.9161	Jessenia polycarpa
.9162	Quercus agrifolia
.9163	Thea sasanqua
.9164	Pentaclethra macrophylla
.9165– .920	Arachis hypogaea
.9165– .9178	Raphanus sativus
.9165– .9248	Ximenia americana
.9169	Canavalia ensiformis
.917	Trifolium incarnatum

.917	Trifolium repens
.917 – .920	Brassica Rapa
.917	Bassia Mottleyana
.917 – .927	Thea sasanqua
.9172	Canarium pachyphyllum
.9172– .921	Brassica Napus
.9175	Vicia Faba
.9175– .9186	Raphanus Raphanistrum
.9175– .921	Brassica campestris
.9175– .923	Datura Stramonium
.9176	Voandezia subterranea
.9177	Eruca sativa
.9177– .9195	Prunus Amygdalus
.9178	Thea sinensis
.9179	Phaseolus vulgaris var. albus
.918	Bertholletia excelsa
.918 – .9185	Telfairia pedata
.918 – .9215	Prunus Persica
.9184	Carya Pecan
.9184	Cicer arietinum
.9184– .9191	Olea europea var. sativa
.9184– .922	Citrullus vulgaris
.9185– .9188	Pistacia vera
.9186	Coula edulis
.9187	Adansonia Grandidieri
.9187	Crambe maritima
.919	Hodgsonia Kadam
.919 – .923	Sinapis nigra
.919 – .926	Cucurbita maxima
.9191	Chelidonium majus
.9191– .9219	Lophira alata
.9192– .9256	Trichilia emetica
.9193	Pisum sativum
.9195(?)	Rhamnus cathartica
.9198	Phaseolus coccineus
.9198	Eruca sativa
.9198– .9226	Brassica oleracea
.920	Dialyanthera otoba
.920 – .9238	Lepidium sativum
.920 – .926	Aleurites moluccana
.920	Balanites aegyptiaca
.9203	Chisocheton Cumingianus
.9204	Prunus Armeniaca
.9205	Nasturtium Nasturtium-aquaticum
.9206	Mauritia vinifera
.9208	Lens esculenta
.9208	Arbutus Unedo
.9209– .9245	Elaeis guineensis
.921 – .9225	Cornus sanguinea
.921 – .926	Luffa aegyptiaca
.9212	Medicago sativa
.9213	Jatropha mahafalensis
.9214	Barbarea praecox
.9214	Scyphocephalium ochocoa
.9215	Ornithopus sativus
.9215– .922	Zea Mays
.9219	Citrullus vulgaris
.922	Onobrychis sativa
.922	Cydonia vulgaris
.9221	Sinapis dissecta
.9222– .9279	Glycine hispida
.9224– .926	Myagrum sativum
.9225	Datura Metel
.9226	Strychnos Nux-vomica
.9228	Sinapis arvensis
.923	Sinapis chinensis
.923	Anthyllis vulneraria
.923 – .926	Sesamum indicum
.923 – .924	Cucumis sativus
.923	Prunus Laurocerasus
.923 – .925	Cucurbita Pepo
.923 – .925	Gossypium sp. (cotton)
.9232	Armoracia rusticana
.9232	Pimpinella Anisum
.9232	Nicotiana Tabacum
.9235	Lupinus angustifolius
.9235	Lupinus luteus
.9235	Lupinus albus
.9235	Melia Azedarach
.9235– .9236	Ceiba pentandra
.9236	Apium graveolens
.9237	Daphne Cnidium
.9238	Torreya nucifera
.9238– .9258	Manihot Glaziovii
.9239	Vicia sativa
.9239– .9302	Hevea brasiliensis
.924	Pimpinella Anisum
.924	Cheiranthus Cheira
.924	Cucumis Chate
.924	Schleichera trijuga
.924 – .926	Helianthus annuus
.924 – .927	Papaver somniferum
.9241	Virola guatemalensis
.9243	Petroselinum sativum
.9244	Diospyros virginiana
.9244	Myrtus communis
.9245	Delphinium elatum
.9245	Morus alba
.9245– .9374	Triticum sp. (wheat)
.9247– .9259	Argemone mexicana
.9248	Juglans Sieboldiana
.9248	Nigella sativa
.9248– .9263	Guizotia abyssinica
.9249	Cucurbita maxima
.9249	Strophanthus hispidus
.925	Cephalotaxus drupacea
.925	Myristica surinamensis
.925	Trifolium hybridum
.925 – .927	Secale cornutum
.925 – .931	Cannabis sativa
.9251	Isatis tinctoria
.9252	Linaria reticulata
.9255	Payena oleifera
.9256	Cuminum Cyminum
.9256	Rubus fruticosus
.9256– .9265	Juglans regia
.9257– .9259	Rhus glabra
.9259	Cocos nucifera
.926	Laurus indica
.926	Aesculus Hippocastanum

.926 – .928 Cucurbita Pepo
.9262 Dolichos Lablab
.9264 Illicium verum
.9265 Garcinia morella
.9265 Anthriscus Cerefolium
.9266 Croton Elliotianus
.9267 Ptychotis ajowan
.9267– .9277 Carthamnus tinctorius
.9268 Carum Carvi
.9268 Cajanus bicolor
.9268 Pinus Picea
.9269 Arctium Lappa
.927 Pentadesma butyracea
.9275 Apeiba
.9275 Setaria italica
.9276 Cucumis Melo
.9276 Phaseolus inamoenus
.928 Asparagus officinalis
.928 Galega officinalis
.9281 Cajanus bicolor
.9282 Phaseolus lunatus
.9282 Sorghum cernuum
.9283 Oenothera biennis
.9284 Coriandrum sativum
.9285– .9286 Madia sativa
.9286 Ricinodendron Rautanenii
.9288– .932 Echinops ritro
.9289 Citrullus Colocynthis
.929 Sterculia foetida
.929 Funtunia elastica
.929 Trifolium agrarium
.929 Medicago sativa
.9295 Illicium religiosum
.9295 Tilia pravifolia
.9296 Daucus Carota
.9298 Stearodendron Stuhlmannii
.9298 Vigna Catjang
.930 Pinus Cembra
.9301 Vaccinium Vitis-idaea
.9304 Foeniculum officinale
.9307 Pinus Gerardiana
.9315 Irvingia spp.
.9315– .9335 Hesperis matronalis
.931 – .9386 Amoora Rohituka
.9316 Pinus Cembra
.9316– .941 Linum usitatissimum
.9317 Rubus idaeus
.9318 Pinus montana
.932 Gynocardia odorata
.9326 Pinus sylvestris
.9327 Kickxia elastica
.9328 Dialyanthera otoba
.9329 Salvadora oleoides
.933 Pinus monophylla
.933 – .935 Elaeococca vernicia
.9331 Vaccinium Myrtillus
.9332– .953 Laurus nobilis
.9336 Palaquium sp.
.9336 Phaseolus Mungo
.9337 Cinnamomum Camphora
.9342 Perilla frutescens
.9345 Fragaria vesca
.9346 Carapa grandiflora
.935 Trigonella Foenum-graecum
.9352 Anethum graveolens
.9355– .9382 Ricinodendron africanum
.936 Plukenetia conophora
.936 Aleurites cordata
.936 – .993 Pedilanthus Pavonis
.9369 Pongamia glabra
.937 Lotus corniculatus
.937 – .939 Perilla nankinensis
.9371 Lallemantia iberica
.938 Tilia americana
.938 Melilotus albus
.938 Telfairia occidentalis
.939 Hyoscyamus niger
.939 Euonymus europaea
.9403 Allophylus racemosa
.9406 Crataegus Oxyacantha
.9417 Machilus Thunbergii
.9426 Amorpha fruticosa
.9435 Celastrus senegalensis
.9437 Croton Tiglium
.9437 Symphonia globulifera
.945 – .996 Myristica officinalis
.9458 Stillingia sebifera
.9458 Myristica angolensis
.9468 Dipteryx odorata
.9471 Trigonella Foenum-graecum
.9492 Litsea zeylanica
.9495 Oryza sativa
.951 – .9525 Coffea arabica
.9518 Bassia longifolia
.953 Buchanania latifolia
.9577 Vicia Faba
.958 Hydnocarpus Kurzii
.959 – .960 Hydnocarpus anthelmintica
.9591– .9679 Ricinus communis
.9594 Ulmus campestris
.9625 Euonymus verrucosa
.9637 Polygala Senega
.964 – .976 Theobroma Cacao
.965 Hydnocarpus Wightianus
.9656 Aegiphila obducta
.9656 Triticum spp. (wheat)
.967 Eriobotrya japonica
.968 Saccharum officinarum
.9694 Couepia grandifolia
.9694 Pithecolobium dulce
.9697– .986 Euphorbia antisyphlitica
.9717 Mimusops elengi
.975 Rhus succedanea
.9786 Ongokea Klaineana

.988	Argania Sideroxylon
.9896	Rhus diversiloba
.990 – .999	Corypha cerifera
.995	Virola sebifera
.995	Myrica cerifera
1.0115	Ficus ceriflua
1.019	Cannabis sativa
1.4718	Pinus monophylla
1.4737	Anacardium occidentale
1.486	Pinus Pinea
1.4869	Picramnia carpinterae
1.4935	Thuja occidentalis
1.4997	Cupressus sempervirens

IODINE NUMBERS OF OILS, FATS AND WAXES

1.03– 3.9	Myrica cerifera
1.72	Scyphocephalium ochocoa
2.28– 11.54	Lepidadenia Wightiana
3.2	Vohemaria Messeri
3.34– 5.2	Irvingia spp.
3.6 – 17.35	Attalea excelsa
4.2 – 15.1	Rhus sylvestris
4.5	Cinnamomum Camphora
4.98– 6.3	Myristica platysperma
5.3	Euphorbia xylophylloides
5.9	Euphorbia stenoclada
5.9	Salvadora persica
6.7 – 6.8	Irvingia Oliveri
7.48	Salvadora oleoides
7.7 – 10.7	Raphia Ruffa
8.0 – 10.0	Cocos nucifera
8.79	Rhus diversiloba
9.5 – 18.5	Virola bicuhyba
9.61– 17.0	Linum usitatissimum
10.3 – 17.5	Elaeis guineensis
10.4 – 11.2	Astrocaryum vulgare
11.0 – 13.7	Attalea cohune
11.44	Rhus laurina
11.68	Lindera triloba
12.3 – 24.3	Areca catechu
12.4	Virola guatemalensis
13.2 – 13.5	Corypha cerifera
13.8	Myristica surinamensis
14.0 – 20.0	Pedilanthus Pavonis
15.0	Shorea aptera
15.6	Attalea funifera
19.0 – 37.7	Stillingia sebifera
20.53	Lindera praecox
22.6	Cannabis sativa
25.0 – 34.2	Garcinia indica
25.2	Mauritia vinifera
26.64	Myristica canarica
26.9	Acrocomia sclerocarpa
32.3	Ulmus campestris
32.8 – 41.7	Theobroma Cacao
33.42	Gossypium spp.
34.3	Palaquium oblongifolium
35.06– 57.6	Euphorbia antisyphlitica
36.6	Xanthophyllum lanceatum
36.6	Skaphium lanceatum
37.82– 39.63	Vateria indica
38.4	Nephelium lappaceum
39.4	Allophylus racemosa
39.9	Trichilia subcordata
40.1	Luffa acutangula
40.1 – 85.7	Myristica officinalis
41.2 – 46.5	Bassia butyracea
41.85– 49.5	Caryocar tomentosum
41.9	Stearodendron Stuhlmannii
42.3	Pentadesma butyracea
42.31	Palaquium spp.
43.4	Telfairia occidentalis
44.0	Trichilia emetica
45.9	Pentadesma Kerstingii
46.5	Litsea zeylanica
48.3 – 69.1	Schleichera trijuga
48.7	Eriobotrya japonica
49.1	Blighia sapida
50.1 – 64.0	Bassia longifolia
50.7	Carica Papaya
50.7	Pithecoctenium echinatum
52.0	Philadelphus coronarius
52.31	Phoenix dactylifera
52.5	Polygala butyracea
52.6 – 67.85	Bassia latifolia
52.95– 59.74	Canarium polyphyllum
53.0 – 57.44	Elaeis guineensis
53.9 – 66.0	Adansonia Grandidieri
54.0	Dialyanthera otoba
54.0 – 67.2	Butyrospermum Parkii
55.0	Oenocarpus distichus
55.46	Garcinia morella
56.0 – 57.2	Mimusops Djave
56.6	Pithecolobium dulce
56.8	Picramnia Lindeniana
57.1	Canarium luzonicum
57.3	Buchanania latifolia
57.65	Paullinia trigona
58.5 – 72.1	Carapa guianensis
58.62– 63.4	Payena oleifera
59.61– 61.25	Canarium pachyphyllum
60.0	Saccharum officinarum
60.25	Melia Champaca
61.4	Chorisia Peckoltiana
61.6	Trifolium incarnatum
61.6	Lupinus albus
61.8	Galega officinalis
62.3	Cyperus esculentus
63.0	Canarium oleosum
63.2 – 65.0	Bassia Mottleyana
63.9	Picramnia carpinterae

64.15 Aegiphila obducta
64.2 Symphonia globulifera
64.7 – 65.6 Canarium commune
65.0 Trichilia emetica
65.1 Sapindus rarak
65.29 Lindera sericea
65.4 Myristica angolensis
65.9 Trifolium hybridum
66.0 – 80.5 Laurus nobilis
66.0 – 96.0 Hodgsonia Kadam
66.08 Machilus Thunbergii
66.5 Mimusops elengi
67.7 Onobrychis sativa
68.3 Lupinus luteus
68.5 Trifolium repens
69.0 Ornithopus sativus
69.4 – 79.3 Strychnos Nux-vomica
69.44 Ceiba pentandra
69.6 – 72.9 Melia Azadirachta
69.8 – 72.5 Lophira alata
70.0 Lotus corniculatus
70.52 Asclepias gigantea
71.0 Vernonia anthelmintica
71.1 – 74.5 Secale cornutum
71.4 Melilotus albus
71.6 Anthyllis vulneraria
71.64 Lecythis ollaria
72.2 –112.6 Moringa oleifera
73.02–101.6 Strophanthus hispidus
73.4 Jessenia polycarpa
73.75 Tropaeolum majus
74.8 – 75.7 Astrocaryum vulgare
75.2 Limonia Warneckei
75.9 Trifolium agrarium
76.14– 87.0 Sterculia foetida
76.4 Basiloxylon brasiliensis
76.7 – 77.8 Adansonia digitata
77.28– 91.7 Olea europea var. sativa
77.3 – 94.0 Pongamia glabra
77.9 Apeiba sp.
78.38 Akebia quinata
78.4 – 81.8 Polygala Senega
78.9 Sterculia chica
78.9 Medicago sativa
80.0 – 85.0 Ximenia americana
80.1 Petroselinum sativum
80.4 Thea japonica
80.78 Chisocheton Cumingianus
81.0 Lycopodium
81.4 – 90.6 Ricinus communis
81.44–110.6 Sambucus racemosa
81.5 Moquilea tomentosa
81.5 – 82.0 Ungnadia speciosa
81.8 Terminalia Catappa
81.88 Secale cereale
81.9 Trigonella Foenum-graecum
82.0 Vicia Faba
82.3 Thea sasanqua
82.4 Sterculia appendiculata
82.5 – 90.8 Hydnocarpus anthelminticus
83.2 Lupinus angustifolius
83.3 –105.0 Arachis hypogaea
83.36 Coula edulis
83.6 Betula alba
83.61– 87.8 Pistacia vera
83.65–179.5 Couepia grandifolia
83.7 Carapa grandiflora
83.9 – 90.2 Corylus Avellana
84.0 Anacardium occidentale
84.2 –100.7 Joliffa africana
84.27 Calotropis gigantea
84.5 Capsicum annuum
85.24–129.0 Eriodendron anfractuosum
85.4 Dryopteris Filix-mas
85.7 – 99.5 Pentaclethra macrophylla
85.89– 91.2 Coffea arabica
86.0 Calophyllum inophyllum
86.1 Canavalia ensiformis
86.2 Garcinia tonkinensis
86.7 Celastrus senegalensis
86.99– 87.8 Olea europea var. sativa
87.1 Tamarindus indica
88.0 Nerium Oleander
88.0 – 90.49 Thea sasanqua
88.3 Coriandrum sativum
88.5 –102.5 Hydnocarpus Wightianus
88.7 – 89.1 Mesua ferrea
88.7 –133.4 Cucurbita maxima
89.53 Magnolia hypoleuca
89.9 Caesalpinia Bonducella
89.7 – 93.3 Poga oleosa
89.94 Hydnocarpus edulis
90.0 Parthenocissus quinquefolia
90.0 Hordeum vulgare
90.4 –108.7 Prunus Armeniaca
90.4 –104.4 Hydnocarpus Kurzii
90.42 Thea sinensis
90.6 Illicium religiosum
91.2 –104.0 Prunus domestica
91.6 Parkia africana
91.65–107.0 Oryza sativa
91.8 Hedera Helix
91.8 Cuminum Cyminum
92.1 – 97.68 Sinapis alba
92.5 –109.7 Prunus Persica
92.7 Crambe maritima
92.8 –122.6 Prunus Cerasus
92.85–112.4 Raphanus sativus
93.0 Acer Pseudo-platanus
93.0 –101.26 Prunus Amygdalus
93.1 Illicium verum
93.6 –101.9 Brassica oleracea
94.4 Dolichos Lablab
94.7 Torreya californica
94.8 Apium graveolens

95.2	Abelmoschus esculentus
95.2 –103.5	Brassica sp. (Jamba oil)
95.3 –104.6	Brassic Napus
95.4	Aesculus Hippocastanum
95.94	Argania Sideroxylon
96.1 –112.5	Triticum sp.
96.4 –100.0	Brassica Rapa
97.26–104.0	Citrus Aurantium
98.3 –104.9	Jatropha Curcas
98.3 –106.2	Bertholletia excelsa
98.6	Nasturtium Nasturtium-aquaticum
98.89	Sorghum cernuum
99.0	Foeniculum officinale
99.2	Brassica campestris
99.6	Vicia Faba
99.7	Oncoba echinata
99.72	Eruca sativa
99.8	Coriandrum sativum
99.8	Phaseolus lunatus
100.0	Acer platanoides
100.0 –101.0	Cornus sanguinea
100.4	Lens esculenta
100.7	Quercus agrifolia
100.8	Vigna Catjang
100.9 –120.5	Gossypium sp. (cotton)
101.0	Manniophyton fulvum
101.3	Pinus monophylla
101.4 –121.7	Brassica campestris
101.7 –109.0	Croton Tiglium
101.72–133.5	Lepidium sativum
101.8	Eruca sativa
101.8	Brassica juncea
102.6	Sinapis arvensis
102.7	Cajanus bicolor
103.0 –115.0	Sesamum indicum
103.3	Sinapis chinensis
104.0	Mucuna urens
104.8	Melampyrum arvense
105.0	Raphanus Raphanistrum
105.0	Balanites aegyptiaca
105.1	Daucus Carota
105.3	Pimpinella Anisum
105.6	Sinapis dissecta
106.0 –107.0	Citrullus vulgaris
106.0	Carya Pecan
106.0	Pisum sativum
106.8	Carya ovata
106.9 –125.0	Lycopersicum esculentum
107.2	Vicia sativa
107.25	Citrus Limonia
107.5	Myrtus communis
108.0	Pinus monophylla
108.5	Caryodendron orinocense
108.51	Luffa aegyptiaca
108.6	Pimpinella Anisum
108.8	Ptychotis ajowan
108.9	Prunus Laurocerasus
109.2	Citrus Limonia
109.2	Magnolia hypoleuca
109.5	Petroselinum sativum
110.2	Anthriscus Cerefolium
111.0	Tilia americana
111.0	Vicia sepium
111.2 –120.1	Fagus sylvatica
111.3	Phaseolus Mungo
111.8	Jatropha mahajalensis
111.8	Isatis tinctoria
112.0	Voandezia subterranea
113.0 –113.2	Datura Stramonium
113.0 –120.2	Cydonia vulgaris
113.5 –126.0	Sinapis nigra
115.2 –115.6	Triticum sp.
115.5	Phalaris canariensis
116.2	Datura Metel
116.5	Echinocystis oregana
116.6	Acanthosicyos horrida
116.8	Diospyros virginiana
117.0 –128.5	Cucumis Chate
117.1 –121.8	Citrullus vulgaris
117.5 –119.5	Madia sativa
117.6 –118.5	Cucumis sativus
117.6 –137.0	Manihot Glaziovii
117.6 –139.3	Hevea brasiliensis
118.3	Pinus Gerardiana
118.5	Cicer arietinum
118.6	Nicotiana Tabacum
118.6	Laurus indica
118.9	Phaseolus inamoenus
119.0	Nigella sativa
119.5	Gynandropsis pentaphylla
119.6	Anethum graveolens
119.7	Trifolium repens
119.7	Omphalea megacarpa
119.7 –130.7	Cucurbita Pepo
119.7 –135.0	Helianthus annuus
119.91–122.5	Argemone mexicana
120.3	Citrullus Naudinianus
120.4 –129.3	Citrullus Colocynthis
120.5	Pinus Abies
120.9	Pinus Pinea
120.9	Pinus Picea
121.0	Pyrus communis
121.0	Cucurbita maxima
121.0 –130.8	Zea Mays
122.5	Martynia louisiana
123.7	Citrullus vulgaris
123.9	Tilia parvifolia
124.0 –143.0	Glycine hispida
124.3	Trifolium pratense var. perenne
124.58	Cheiranthus Cheira
126.0	Citrus aurantifolia
126.0 –129.6	Cucurbita Pepo
126.1	Daphne Cnidium
126.3	Celosia cristata
126.6 –133.8	Guizotia abyssinica
126.9	Rhus glabra

127.6		Lactuca scariola var. oleifera
128.5		Sorbus Aucuparia
128.5		Carum Carvi
128.6	–134.8	Aleurites ricinodendron
128.9		Caragana arborescens
129.5		Fraxinus excelsior
130.3		Cephalotaxus drupacea
130.4		Setaria italica
130.4	–130.7	Vitis vinifera
130.9		Kickxia elastica
131.7		Cytisus Laburnum
131.7	–134.86	Amoora Rohituka
132.1	–151.7	Juglans regia
132.6	–157.5	Papaver somniferum
133.3		Cucumis Melo
133.7		Amorpha fruticosa
134.0		Spartium junceum
134.0		Maclura pomifera
135.0		Pyrus Malus
135.1		Cupressus sempervirens
135.1		Bryonia dioica
135.1	–142.4	Myagrum sativum
135.49		Carthamnus Oxyacantha
135.6		Melia Azedarach
135.7		Phaseolus vulgaris var. albus
137.1	–140.0	Asparagus officinalis
137.3		Barbarea praecox
137.8		Trigonella Foenum-graecum
138.0		Hyoscyamus niger
138.0	–139.0	Funtumia elastica
138.1	–141.2	Echinops ritro
138.5		Croton Elliotianus
138.64	–149.93	Carthamnus tinctorius
140.0		Linaria reticulata
141.2		Phaseolus coccineus
141.4		Parthenocissus quinquefolia
142.2		Torreya nucifera
143.3		Armoracia rusticana
143.3		Morus alba
145.6	–160.7	Stillingia sebifera
145.7		Pinus montana
147.1		Pinus sylvestris
147.7	–148.2	Aleurites Ricinodendron
147.8		Rubus fruticosus
147.8		Arbutus Unedo
148.0	–166.0	Cannabis sativa
148.9		Oenothera biennis
149.0	–161.3	Elaeococca vernicia
149.7	–161.5	Humulus Lupulus
151.6	–171.7	Aleurites cordata
152.5		Papaver somniferum
152.5		Ribes rubrum
152.8		Gynocardia odorata
152.8		Crataegus Oxyacantha
153.6		Lappa minor
153.9		Citrus aurantifolia
154.2		Medicago sativa
154.8		Thuja occidentalis
154.9	–155.3	Hesperis matronalis
155.0		Rhamnus cathartica
155.0	–164.0	Aleurites moluccana
156.3		Pinus Cembra
156.5		Juglans Sieboldiana
159.2		Pinus Cembra
161.0		Robinia Pseudoacacia
162.1		Lallemantia iberica
167.2		Vaccinium Myrtillus
169.2		Vaccinium Vitis-idaea
170.0	–201.0	Linum usitatissimum
171.0		Hyptis spicigera
174.8		Rubus idaeus
177.3	–204.0	Plukenetia conophora
180.3		Fragaria vesca
193.3	–195.0	Perilla nankinensis
196.45		Perilla frutescens

OIL GROUPS

Taxaceae §
- Cephalotaxus (D)
- Torreya (ND)
- Torreya (D)

Pinaceae *
- Pinus (D)
- Thuja (D)
- Cupressus (D)

Gramineae §
- Paniceae
  - Panicum (D)
- Maydeae
  - Zea (SD)
- Oryzeae
  - Oryza (ND)
- Andropogoneae
  - Sorghum (SD)
- Phalarideae
  - Phalaris (SD)
- Hordeae
  - Secale (SD)
  - Triticum (SD)
  - Hordeum (SD)

Palmae ‡
- Phoenix (ND)
- Corypha (W)
- Mauritia (F)
- Raphia (W, F)
- Ceroxylon (W)
- Klopstockia (W)
- Jessenia (ND)
- Euterpe (SD)
- Oenocarpus (F, SD Kernel)
- Areca (F)
- Elaeis (F)

Attalea (F)
Cocos (F)
Acrocomia (F)
Astrocaryum (F)

Liliaceae §
Asparagus (D)

Myricaceae ‡
Myrica (F)

Juglandaceae *
Juglans (D)
Carya (SD)

Betulaceae *
Corylus (ND)
Betula (ND)

Fagaceae *
Fagus (SD)
Quercus (ND)

Ulmaceae §
Ulmus (ND)

Moraceae ‡
Morus (D)
Maclura (D)
Ficus (W)
Humulus (D)
Cannabis (D, W)

Olacaceae ‡
Ongokea (D)
Ximenia (ND)
Coula (ND, F)

Chenopodiaceae §
Bassia (F)

Amaranthaceae ‡
Celosia (D)

Ranunculaceae *
Nigella (SD)
Delphinium (SD)

Lardizabalaceae
Akebia (ND)

Magnoliaceae * ‡
Magnolia (SD)
Illicium (SD)

Myristicaceae
Virola (F)
Scyphocephalium (F)

Lauraceae ‡
Cinnamomum (F)
Persea (F)
Machilus (F)
Tetranthera (F)
Lepiadenia (F)
Litsea (F)
Lindera (ND)
Laurus (F, SD)

Papaveraceae *
Chelidonium (SD)
Argemone (D)
Papaver (W, D)

Cruciferae *
Barbarea (SD)
Nasturtium (SD)
Cheiranthus (D)
Armoracia (SD)
Hesperis (D)
Eruca (SD)
Sinapis (SD)
Brassica (SD)
Lepidium (SD)
Myagrum (D)
Isatis (SD)
Crambe (SD)
Raphanus (SD)

Capparidaceae † ‡
Gynandropsis (SD)

Resedaceae †
Reseda (D)

Moringaceae ‡
Moringa (ND)

Saxifragaceae *
Philadelphus (W)
Ribes (D)

Rosaceae *
Chrysobalaneae
Moquilea (ND)
Couepia (D)
Pruneae
Prunus (ND)
Rubeae
Rubus (D)
Potentilleae
Fragaria (D)
Pomeae
Cydonia (ND)
Sorbus (D)
Pyrus (SD)
Eriobotrya (F)
Crataegus (D)

Leguminosae §
Ingeae
Pithecolobium (F)
Mimoseae
Parkia (F)
Pentaclethra (ND)
Amherstieae
Tamarindus (SD)
Caesalpinieae
Caesalpinia (SD)
Genisteae
Lupinus (ND)
Spartium (SD)
Trifolieae
Trigonella (ND)
Medicago (D, ND)

Melilotus (ND)
Trifolium (ND, SD)
Ornithopus (ND)

Loteae
Anthyllis (ND)
Lotus (ND)

Galegeae
Amorpha (D)
Galega (ND)
Robinia (D)
Caragana (D)

Hedysareae
Onobrychis (ND)
Arachis (ND)

Dalbergieae
Pongamia (F)
Dipteryx (F)

Vicieae
Cicer (SD)
Lens (SD)
Vicia (SD)
Pisum (SD)

Phaseoleae
Cajanus (SD)
Glycine (D)
Canavalia (SD)
Mucuna (SD)
Phaseolus (SD)
Voandezia (SD)
Vigna (SD)
Dolichos (SD)

Tropaeolaceae
Tropaeolum (ND)

Linaceae
Linum (D, W)

Zygophyllaceae † ‡
Balanites (SD)

Rutaceae ‡
Limonia (F)
Citrus (SD)

Simarubaceae ‡
Simaruba (F)
Brucea (ND)
Irvingia (F)
Picramnia (F)

Burseraceae ‡
Canarium (ND, F)

Meliaceae ‡
Melieae
Melia (F, D)

Trichilieae
Chisocheton (ND)
Amoora (D)
Carapa (F)
Trichilia (F)

Polygalaceae §
Polygala (ND, F)
Xanthophyllum (F)
Skaphium (F)

Euphorbiaceae ‡
Plukenetia (D)
Euphorbia (W)
Pedilanthus (W)
Croton (SD, D)
Manniophyton (SD)
Caryodendron (SD)
Ricinus (ND)
Aleurites (D)
Elaeococca (D)
Jatropha (SD)
Hevea (D)
Manihot (D)
Omphalea (SD)
Stillingia (D, F, seed coat)

Anacardiaceae ‡
Anacardium (ND)
Buchanania (F)
Pistacia (ND)
Rhus (F, SD, seed kernel)

Celastraceae *
Euonymus (SD)
Celastrus (ND)

Aceraceae *
Acer (D?)

Hippocastanaceae
Aesculus (ND)

Sapindaceae ‡
Paullinia (F)
Allophylus (F)
Sapindus (ND)
Schleichera (F)
Nephelium (F)
Blighia (F)
Ungnadia (ND)

Rhamnaceae §
Rhamnus (D)

Vitaceae †
Vitis (ND)
Parthenocissus (SD)

Tiliaceae ‡
Apeiba (ND)
Tilia (SD)

Malvaceae ‡
Abelmoschus (SD)
Gossypium (W, SD)

Bombacaceae ‡
Adansonia (F)
Eriodendron (SD, W)

Sterculiaceae ‡
Theobroma (F)
Sterculia (ND)
Basiloxylon (F)

Ochnaceae ‡
Lophira (F)

Caryocaraceae
Caryocar (F)

Dipterocarpaceae ‡
Shorea (F)
Vateria (F)

Theaceae † ‡
Thea (ND)

Guttiferae ‡
Moronobeae
Symphonia (F)
Pentadesma (F)
Cariniceae
Garcinia (F)
Calophylleae
Calophyllum (ND)
Mesua (ND)

Flacourtiaceae ‡
Oncoba (F)
Hydnocarpus (F)
Gynocardia (D)

Caricaceae † ‡
Carica (F)

Combretaceae ‡
Terminalia (ND)

Thymelaeacae §
Daphne (SD)

Myrtaceae ‡
Myrtus (SD)

Lecythidaceae ‡
Bertholletia (SD)
Lecythis (ND)

Rhizophoraceae ‡
Poga (ND)

Onagraceae *
Oenothera (D)

Araliaceae ‡ *
Hedera (ND)

Umbelliferae *
Anthriscus (SD)
Cuminum (SD)
Apium (SD)
Petroselinum (SD)
Pimpinella (SD)
Anethum (SD)

Cornaceae *
Cornus (ND)

Ericaceae *
Arbutus (D)
Vaccinium (D)

Sapotaceae ‡
Payena (F)
Mimusops (F)
Palaquium (F)
Araganum (ND)
Mimusops (F)

Ebenaceae † ‡
Diospyros (SD)

Oleaceae * ‡
Fraxinus (SD)
Olea (ND)

Salvadoraceae
Salvadora (F)

Loganiaceae ‡
Strychnos (F)

Apocynaceae ‡
Kickxia (D)
Funtumia (D)
Nerium (ND)
Strophanthus (ND)

Asclepiadaceae ‡
Asclepias (W)
Calotropis
Cynanchum (W)

Verbenaceae ‡
Aegiphila (F)

Labiatae *
Lallemantia (D)
Perilla (D)
Hyptis (D)

Solanaceae ‡
Hyoscyamus (D)
Capsicum (SD)
Lycopersicum (SD)
Datura (SD)
Nicotiana (SD)

Scrophulariaceae §
Linaria (D)
Melampyrum (ND)

Bignoniaceae ‡
Pithecoctenium (F)

Pedaliaceae † ‡
Sesamum (SD)

Martyniaceae ‡
Martynia (SD)

Rubiaceae ‡
Coffea (ND)

Caprifoliaceae †
Sambucus (ND)

Cucurbitaceae ‡
Hodgsonia (F)
Telfairia (ND)
Acanthosicyos (SD)
Luffa (SD, F)
Bryonia (SD)
Citrullus (SD)
Cucumis (SD)

Cucurbita (SD)
Echinocystis (SD)

Compositae §
Vernonia (ND)
Helianthus (D)
Guizotia (D)
Madia (D)
Echinops (D)
Lappa (D)
Carthamnus (D)
Mogumia (W)
Lactuca (SD)

* Temperate † Subtropical ‡ Tropical § Widely distributed

D=Drying SD=Semi-drying ND=Non-drying F=Fat W=Wax