Oils of Nature

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Allured

Global Information Leader

Oils of Nature

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About This Book

This book, originally written in 1998, was the idea of my friend and colleague Carter LaVay. His concept was simple, to provide a resource to the cosmetic chemist to understand the chemistry of this important class of materials, written by a group of people he felt were qualified to undertake such a program. From the early days the book was popular, especially with students of cosmetic science.

In 2005, the book was published by Allured, in substantially the form it is presented today in electronic version. The book went out of print in January 2104. At that time all rights to the book reverted to the authors.

Since it is the belief of the authors that the need for this information is as great as it was in the days it was written, and that we want all interested people to have it as a resource **free of charge**.

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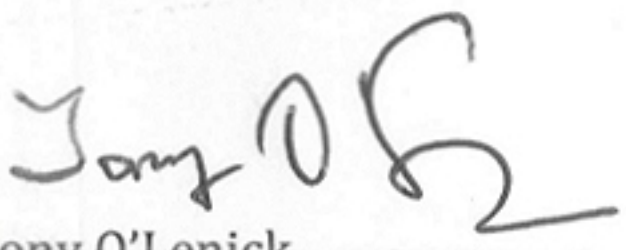

Tony O'Lenick
March 1, 2014

About the Authors

Anthony J. O'Lenick, Jr. is President of Siltech LLC, a silicone and surfactant specialty company he founded in 1989, now located in Dacula, Ga. Previously, he held technical and executive positions at Alkaril Chemicals Inc., Henkel Corporation and Mona Industries. He has been involved in the personal care market for more than 25 years.

Tony has published more than 45 technical articles in trade journals, contributed chapters to three books, and is the inventor on more than 250 patents. He has written two books, one on surfactants the other on silicone compounds. He received a number of awards for work in silicone chemistry, including the 1996 Samuel Rosen Award, given by the American Oil Chemists' Society; the 1997 Innovative Use of Fatty Acids Award, given by the Soap and Detergents Association; and the Partnership to The Personal Care Award, given by the Advanced Technology Group. Tony was a member of the Committee on Scientific Affairs of the Society of Cosmetic Chemists.

David C. Steinberg is President of Steinberg and Associates, a cosmetic consulting firm. David writes a column for *Cosmetics and Toiletries* magazine, and is a Fellow in the Society of Cosmetic Chemists. David is an Adjunct Professor at Farleigh Dickinson University and an instructor for the Society of Cosmetic Chemists. He is a past President of the Society of Cosmetic Chemists.

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Carter LaVay is the President and founder of Zenitech LLC, a specialty chemical company. Carter has many years of executive and marketing experience with companies including J.W. Hanson and GAF. Carter is the author of several chapters in books and the inventor on 12 United States Patents.

Preface to 2014 Edition

The importance of the topic to the cosmetic chemist has only grown since the work was first compiled. The desire to obtain naturally occurring materials that are sustainable and can be formulated into products toady's sophisticated consumer will accept has become the holy grail of our industry.

The quest for green products has not been without controversy. The exact definition of the terms organic, sustainable, green and others used in relation to this type of product remain largely unanswered.

Additionally, it has become more accepted concept that a truly Green formulation will develop over time, and likely not be produced instantly. While the concept of green products is straightforward, the ability for the formulator and the consumer to quantify the greenness of a given shampoo or other consumer product is elusive. Given a proper understanding, the consumer and formulator can make better informed better educated decisions as to making products with the best combination of green properties and formulation attributes. In other words, the need of the consumer and the need of the environment can be intelligently determined.

All too often, the determination of the greenness of a raw material or formulation was more an emotional rather than a scientific decision and required either an all or noting approach to environmental stewardship. Simply put materials are green or they are not. Unfortunately, the formulation of consumer products that are commercially acceptable require a trade off in optimizing the performance and greenness. Consumers demand many formulation benefits that cannot be achieved with all green ingredients. Some "non-green" products are required. The consumer then needs a systematic approach to develop a measurable metric for the level of greenness in a formulation and trade off some greenness for performance. This quest has resulted in the development of "Green Star Rating" system or simply "GSR". I suggest interested readers consult U.S. Patent Application 2009/0259409 for one approach.

One can expect over the next years there will be more progress in using this work entitled ***Oils of Nature***. We hope you find it an interesting and worthwhile reference.

Tony O'Lenick
March 1, 2014

Preface

The information in this book is compiled from publicly available sources, and is designed to provide timely, salient information on the composition of the various oils of nature available to formulators of personal care products. Within the scope of oils, we include oils, waxes and certain esters. Information on chemical data, source data, carbon distribution data and availability has been provided. However, the list is by no means exhaustive or all-inclusive; it is intended to be illustrative of the type of materials available. The use of oils in cosmetic products in Japan is subject to special regulations. We have included the status in Japan for each oil when available. We have also included geographic information for each oil that has an established geographic area.

The work is organized around two important functional properties: carbon number and unsaturation levels. The first is an indication of the average number of carbon atoms in the oil; the second is the amount of multiple bonds present. Taken together, these two give what we believe are the most important factors in selecting the proper raw material.

It is important to consider not only the oil described, but also its impact upon the performance of surfactants and other derivatives. For more information on surfactants, please refer to *Surfactants: Strategic Personal Care Ingredients*, written by A.J. O'Lenick and published in 2005 by Allured Publishing, www.allured.com.

Background

The skin and hair are major areas to which we may apply oil for a beneficial effect. The exact benefit of the oil application depends in great part upon the particular oil chosen.

Oils that have a very dry feel, which we classify as ultra light oils, find applications in sunscreen applications and massage oil where a non-greasy feel is critical to product aesthetics. This class of oils also finds application in aromatherapy.

Oils, Fats, Waxes and Butters

The terms oils, fats, butters and waxes have been misused over the years. The historical definition of wax has previously been given. Butters, oils and fats are all triglycerides. Fats have a titer point of more than 40.5° C, oils have a titer point of below 40.5° C. Butters have a titer below 40.5° C but above 20° C. Oils are liquid at room temperature, and we now use this word to describe any compound that is a liquid and is insoluble in water. As a result, Jojoba is referred to as an oil, despite the fact it is really a liquid wax.

Because oils, fats, butters and waxes are complex mixtures of homologues of similar chemical structures, it is difficult to obtain a true melting point. The term titer is therefore used to define the re-solidification point of the melted oil, fat, butter or wax. The procedure is to heat the product to be tested until it is completely liquid, then to cool it slowly by stirring. This is done until the temperature stays constant for 30 seconds, or begins to rise. The titer point is the highest temperature indicated by this rise.[1] As the lower molecular weight fractions melt, they act as solvents to dissolve the higher molecular weight products. This results in a very wide melting "range" for these compounds. For this reason, titer point is generally determined on fats, oils, waxes and butters.

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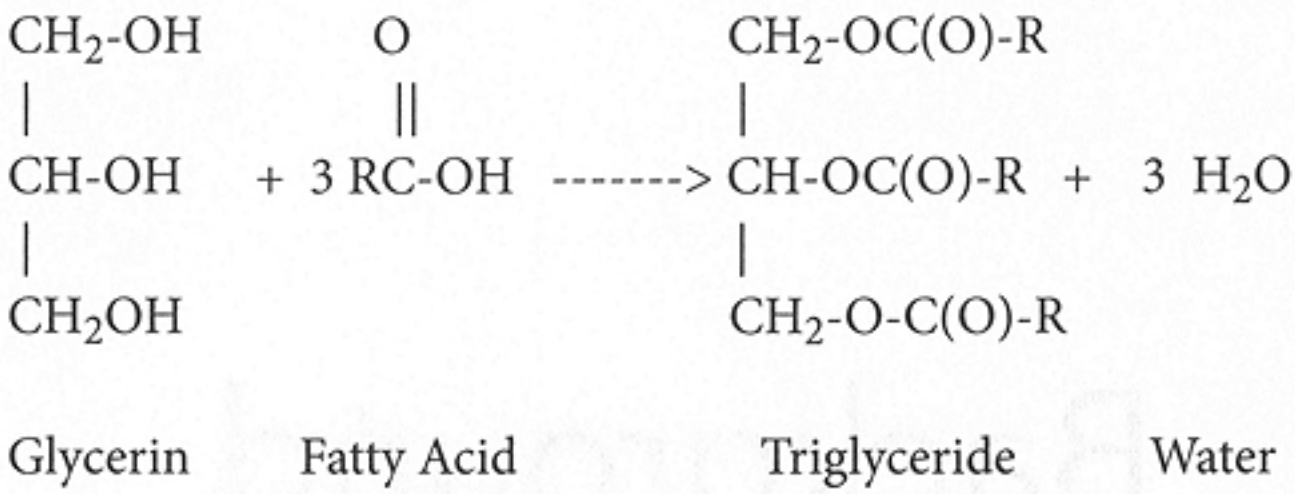
[1] Titer Point Method–AOCS method Tr 1a-64T

Triglycerides

Triglycerides are the tri-esters of glycerin with three equivalents of organic acid. Fatty acids are defined as those acids having alkyl or alkylene groups being C-5 and higher. The reaction is as follows:

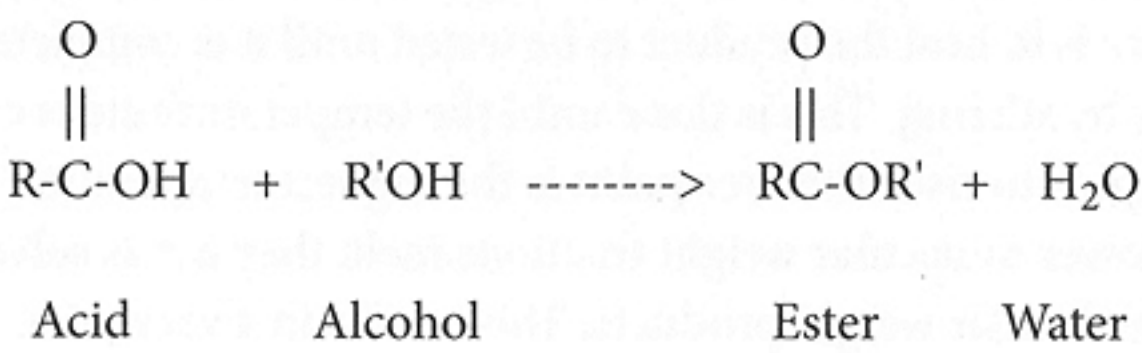


When the triglyceride is saponified to make a surfactant, such as soap, glycerin is liberated. When a wax is saponified, a fatty alcohol is liberated. Saponification is a general term to define the chemical reaction that breaks the ester linkage. This makes it possible to produce very different kinds of products using the two types of materials. Glycerin, produced as a by-product of saponification is water soluble and fatty insoluble. The fatty alcohol produced as a by-product of the saponification of a wax is water-insoluble and generally fatty-soluble. Triglycerides are commonly encountered as natural products. Plants use enzymatic systems to make triglycerides, effectively at ambient temperatures.

Wax Esters

Wax esters are defined as esters of long-chained acids that have been reacted with long-chained alcohols. Other chemicals are called waxes if they possess tactile properties similar to a true wax such as beeswax. Polishes are a major application area for this class of materials.

Wax esters have two fatty groups. One is contained in the alcohol portion of the molecule; the other is in the acid group. Esters are synthesized by the reaction of an organic acid with an organic alcohol. Esterification is the reverse of saponification, in that ester linkages are formed.



The fatty alcohol that is formed during saponification is not water-soluble; similarly, many naturally occurring waxes also contain other components, like

hydrocarbon resins, which are likewise water-insoluble and quite inert to chemical reaction. This needs to be considered when using these materials.

Drying Oils

Certain oils are rich in polyunsaturated groups, which have a tendency to "dry" or polymerize when exposed to air. These include linseed oil and tung oil. The process is an oxidative process, which results in a resin. The treatment of wood with linseed oil is an example. The oxidation is an exothermic process. When made into a suitable derivative, these oils can present a number of interesting options to the cosmetic chemist.

INCI Nomenclature

INCI names require the genus and species of the plants or insects that produce a given wax, oil, butter or fat and all products which are derived from the various oils, fats, butters and waxes. This is due, in part, to the European Union's use of the Latin names for ingredient listings. This information is very helpful to the formulator in understanding the source of the fatty portion of the surfactant.

Classification

In order to simplify the information, we have divided the raw materials that we discuss into two groups: those derived from animal sources and those derived from plant sources. Within each of these groups one finds additional classes depending upon the carbon distribution of the raw material.

It is also important to remember that although beeswax and related materials are classified as animal-derived, the insect responsible for the wax is not harmed in collecting the product of interest.

Carbon Number

In addition to classifying products by their sources (animal or plant) and by their chemistry (triglyceride or ester), we have classified them within these groups by carbon number and unsaturation level. Carbon number is the value obtained by multiplying the percentage of a component in a product by the number of carbon atoms in the component, then adding up all the components.

For example, if an oil had the following composition:

Component	% Weight
C16	20
C18	20
C18:1[†]	20
C20	40
Total	100

[†] Note: C18:1 is our short to indicate the presence of 1 double bond or unsaturation. So C18:1 would be oleic acid

The carbon number calculation would be as follows:

Component	(a) % Weight Component	(b) Carbon Atoms in (a)*(b)	Calculation
C16	20	16	3.2
C18	20	18	3.6
C18:1	20	18	3.6
C20	40	20	8.0
Total	100		18.4

Therefore for the Carbon number = 18.4

There are several types of oils that have very similar carbon numbers; consequently, we have classified them further by unsaturation. One can expect derivatives from oils having very similar carbon numbers and levels of unsaturation to have very similar, often identical functional properties. In this instance, the choice of which of the many oils to use depends upon the economics of the oil and the formulator's desire to name the oil for label and marketing purposes. As will become clear, there are many different fats, oils, waxes and butters which when derivatized result in compounds of strikingly similar carbon distributions, while having their source oil, wax, fat or butter being quite different. Thus, naming the material by the predominant species is not very enlightening to the formulator as to the source of the raw material.

It is also quite interesting that nature has provided many triglycerides that have very similar carbon numbers. In fact, of 38 triglycerides presented here, 31 have carbon numbers between 17 and 18! This also explains why the other important variable, unsaturation, is critical in choosing an oil for a specific application.

It is very interesting that there are only three triglycerides having a carbon number below 16. Since this is a key number for detergents, it becomes clear why coconut oil is so important to the surfactant industry.

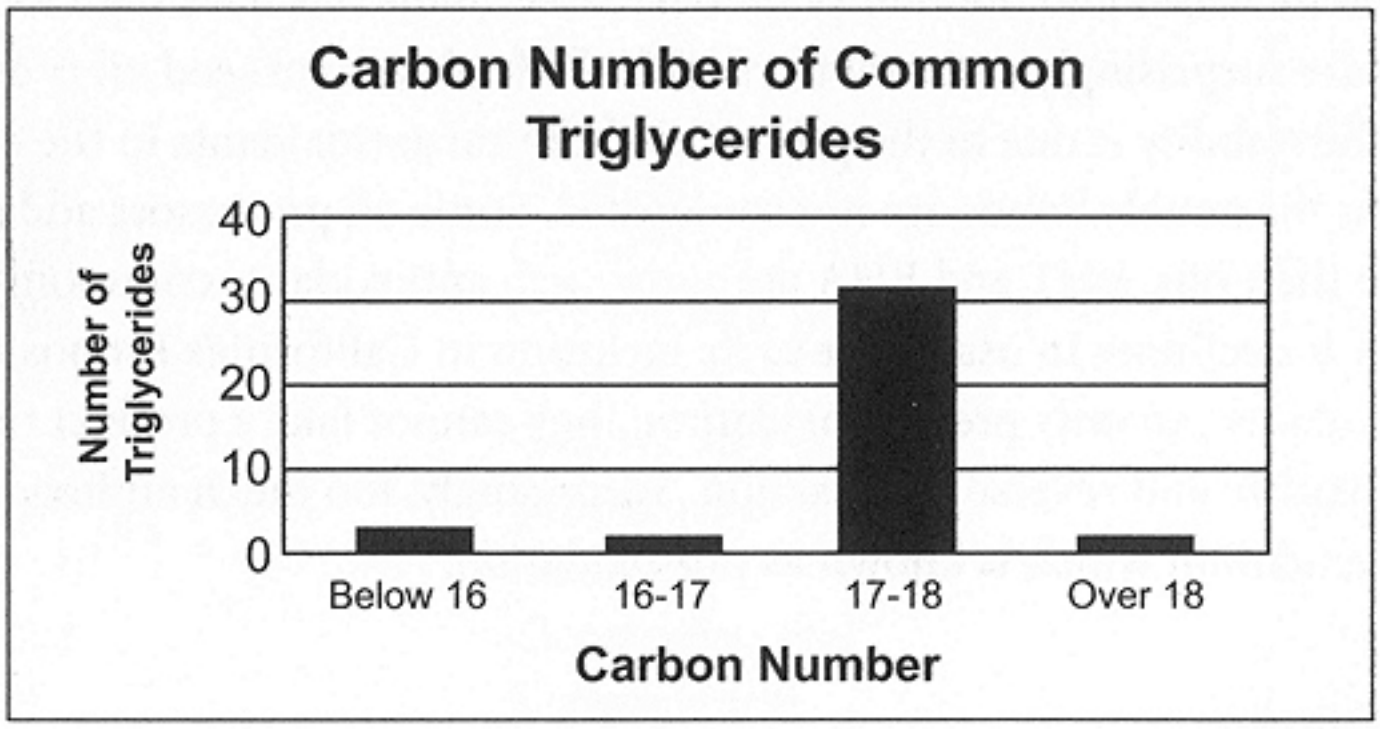
There has been a growing demand for products based upon oils having a carbon number over 18 (for example behenic derivatives). In order to get these products, one must choose a different class of oils. The selection of the oil is a major variable, which normally eludes the formulator, being made more commonly by the derivative manufacturer. Oil selection is assuredly one important factor in formulating cosmetic products.

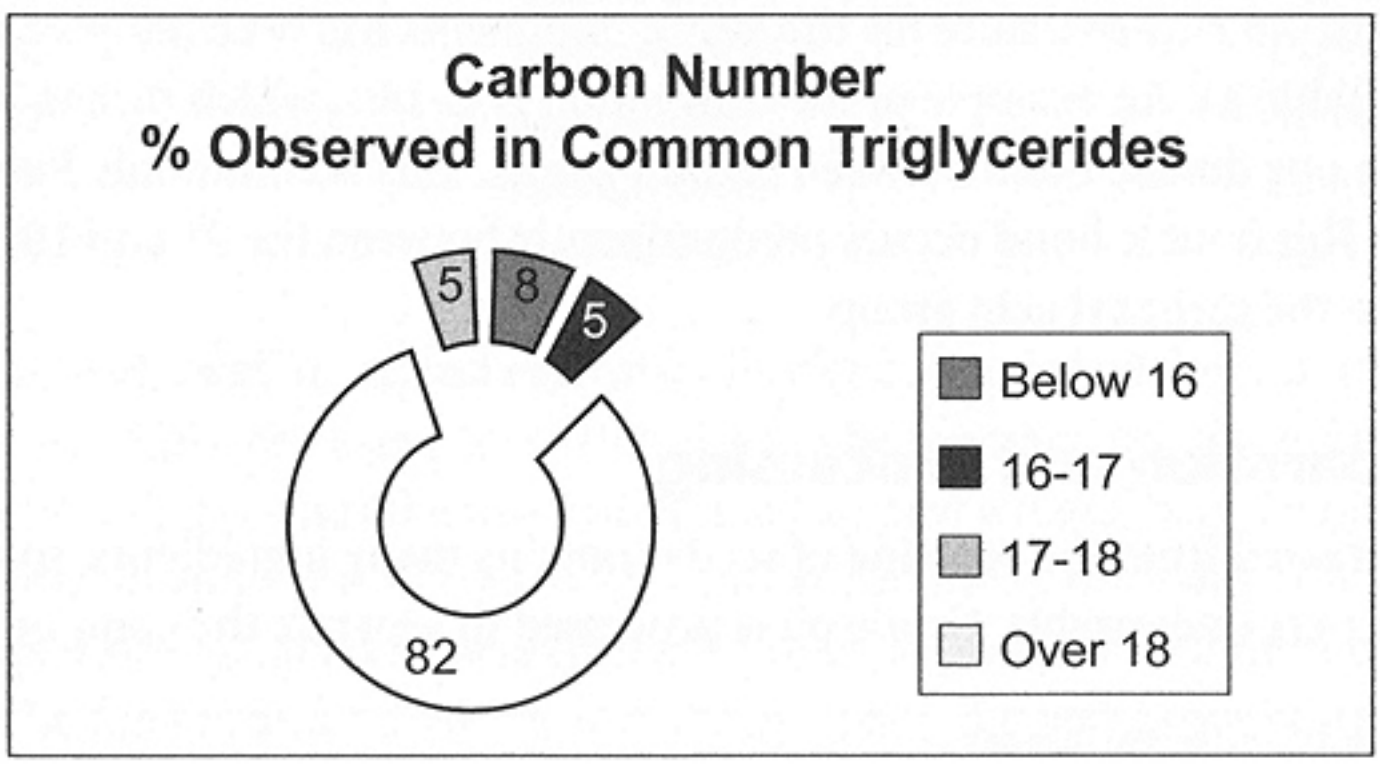
Effect of Carbon Number

One major factor that affects the functionality of both the oil itself and any potential derivative is the number of carbon atoms in the chain. Other factors

include the number and location of double bonds and the presence of additional functional groups. Generally, as one evaluates the tactile properties of an oil on the skin, the lower the molecular weight is, the less oily the feel of the compound will be. Conversely, the higher the molecular weight is, the greasier the feel will be. In surfactant preparation, detergent products and high-foaming products generally peak between a carbon number of 12 and 14. Conditioners and softeners have a carbon number of 16 to 18. Today there is a growing trend toward using materials with carbon numbers of 22 or more for conditioning. Since few oils offer these high carbon numbers, manufacturers often fractionate methyl esters to pure compounds or, alternatively, they hydrogenate unsaturated oils to make saturated compounds having high carbon numbers.

In general, double bonds lower the titer point of the triglyceride, resulting in a triglyceride that stays liquid at lower temperatures. Conjugated double bonds (i.e. those with only one carbon between two double bonds (-C=C-C=C-), are very effective in depressing titer point, but can present problems with rancidity, a process by which the double bond is oxidized and ultimately broken. This releases many different molecules, many of which have objectionable odors. Rancidity can be mitigated at times with the addition of antioxidants, prior to the start of the rancidity process.





Finally, upon additional processing, many oils, fats, butters and waxes lose their identity as oils and become known by the fatty names of the predominant species present after treatment. These processes include preparation of methyl esters, fractionation of the methyl ester and preparation of a fatty alcohol. For example, if olive oil is completely hydrogenated under high pressure, both reduction of the double bond and hydrogenolysis occur, leaving mostly stearyl alcohol, the predominant material in the mixture. In order to preserve the double bond, special catalysts are used.

Effect of Unsaturation

Iodine value is a measure of the unsaturation present in particular chemical. The higher the iodine value, the more double bonds there are in the molecule. The preferred method is known as the Wijs procedure.[2] This method measures the absorption of iodine monochloride by the material being analyzed and is very useful for non-conjugated double bonds. A rule of thumb for iodine values of less than ten, is that the percentage of mono-unsaturation roughly equals the iodine value. Therefore a wax with an iodine value of five can be predicted to have about 5% unsaturated species present. It is important to note that other components in the composition that can react with iodine monochloride can falsely increase the indicated amount of unsaturation. Generally, as the iodine value increases, the liquidity of the oil increases and the titer point decreases. Some oils have high iodine values but are surprisingly resistant to rancidity. Meadowfoam seed oil is one such product. The stability is due to the presence of natural antioxidants in the oil and the fact that the double bonds are not conjugated. Some oil processors add antioxidants to their oils. BHT and BHA are some such antioxidants commonly added to oil. BHA is declining in usage due to its inclusion in California's Proposition 65 list. Antioxidants can only prevent oxidation; they cannot take a product that has started to oxidize and reverse the reaction. Surprisingly, too much antioxidant can accelerate oxidation which is known as pro-oxidation.

Nomenclature

A shorthand nomenclature for the fatty components has been adopted in this book (see **Table 1**). An example of the convention is C-18:1, which means 18 carbon atoms with one double bond between carbon atoms. This is commonly known as oleic acid. This double bond occurs predominantly between the 9th and 10th carbon atoms from the carboxyl acid group.

Oil Preparation and Processing

Oil extracted from the pressing of seeds contains many ingredients, some desirable and others undesirable. Crude oil is processed to separate the components. We

[2] Wijs Iodine Method–AOCS method Tg 1a-64T

generally take for granted the process that allows for the transformation of a plant seed into clear, low odor oil suitable for cosmetic use. The plant chosen for use, as well as the processing used, determines the properties of the oil.

The oils covered in this book are referred to as "vegetable oils." This differentiates them from "essential oils," which are often aromatic oils obtained by steam extraction from a variety of plant parts, including flowers, leaves, peels and some seeds. The essential oils are not triglycerides like the vegetable oils, but usually "isoprenoids;" that is, they come from a different chemical pathway in plants. Plants store vegetable oils (triglycerides) as energy sources for seeds when they germinate.

Table 1. Table of Names

Designation	Traditional Name	Formula
C6	Caproic acid	$C_6H_{12}O_2$
C8	Caprylic acid	$C_8H_{16}O_2$
C10	Capric acid	$C_{10}H_{20}O_2$
C12	Lauric acid	$C_{12}H_{24}O_2$
C12:1	Lauroleic acid	$C_{12}H_{22}O_2$
C14	Myristic acid	$C_{14}H_{28}O_2$
C14:1	Myristoleic acid	$C_{14}H_{26}O_2$
C16	Palmitic acid	$C_{16}H_{32}O_2$
C16:1	Palmitoleic acid	$C_{16}H_{30}O_2$
C18	Stearic acid	$C_{18}H_{36}O$
C18:1	Oleic acid	$C_{18}H_{34}O_2$
C18:2	Linoleic acid	$C_{18}H_{32}O_2$
C18:3	Linolenic acid	$C_{18}H_{30}O_2$
C20	Arachidic acid	$C_{20}H_{40}O_2$
C20:1	Gadoleic acid	$C_{20}H_{38}O_2$
C22	Behenic acid	$C_{22}H_{44}O_2$
C22:1	Erucic acid	$C_{22}H_{42}O_2$
C22:2	Clupanodinic acid	$C_{22}H_{40}O_2$
C24	Lignoceric acid	$C_{24}H_{48}O_2$
C26	Cerotic acid	$C_{26}H_{52}O_2$
C28	Montanic acid	$C_{28}H_{56}O_2$
C30	Myricic acid	$C_{30}H_{60}O_2$
C32	Lacceroic acid	$C_{32}H_{64}O_2$
C34	Geddic acid	$C_{34}H_{68}O_2$

Steam works well to extract essential oils like coriander oil, but not for triglyceride oils. Triglyceride and wax ester oils can be squeezed out of seeds using a turning screw that presses the mashed up seed against a metal barrel with slits in the side. The oil and some fine particles squeeze out the narrow slits. The tool used for this operation is called an oil expeller, or seed oil press. The oil from the seed oil press can be filtered and called "virgin" oil, especially if it isn't heated up to obtain

more oil. The oil from the seed oil press can also be called crude oil. Alternatively, oil can be dissolved in solvent, followed by evaporating of the solvent leaving the extracted oil.

Seeds are often flaked to increase surface area. The seeds are processed into thin flakes before pressing or solvent extraction. The flaking improves oil yield by breaking open the small oil pockets in the seeds. Sometimes the seeds are heated before flaking so that the proteins in the seed won't break down the oil or other parts of the seed. The pre-heating is also called pre-conditioning. The oil comes out more easily if it is hot, but too much heat damages the oil quality.

Sometimes the seeds are crushed and formed into pieces called "collets" that have lots of holes or openings. This step also is done before solvent extraction to make the oil easier to flow out. Solvent extracted oil with some solvent still in it is called the "miscella."

Crude oil usually can be good enough for chemical uses. A well-filtered "virgin" oil can be kept cold to remove any solid waxes that might crystallize out in a process called "winterization."

Many cosmetic applications require cold-pressed, virgin oil. On the other hand, some seeds are too low in oil to economically remove the oil by pressing. In any case, once you have the crude oil, you can move onto refining.

Refining is done by filtering the oil through clay or silica (like fine sand), which can remove color. In an operation called "degumming," alkali in water is added to the oil; some ingredients, especially fatty acids and one called "phospholipids," go into the water and settle out or are filtered out. Finally, steam can be passed through the oil to remove odor in an operation called deodorization. This step also breaks down oxygen attached to the oil, which might lower oil quality.

Hopefully, after all of this refining, the oil is light in color, has no odor, no oxygen breakdown products and no solid wax. The amount of oil you have left after refining is often related to the amount of crude oil you started with, or to the amount of oil in the seed by the "yield" of oil from each step in the process.

The oils that are commonly used in cosmetic products are complex mixtures of different triglycerides, but also contain various other useful components. For example, wheat germ oil can be processed to obtain highly desirable tocopherols. Solvent extraction or steam distillation would remove much of this material. The winterizing of oils, that is, cooling and filtration of solids from the liquid, results in a loss of the higher molecular weight fractions. Many times it is exactly these fractions that provide the unique skin feel or conditioning to the product. It should be clear that the different processes used in the oil preparation may be critical to its functionality.

Fractionation

There are many applications in which a pure compound, rather than a mixture called a composition, is desired for a particular application. In this case, the oil is

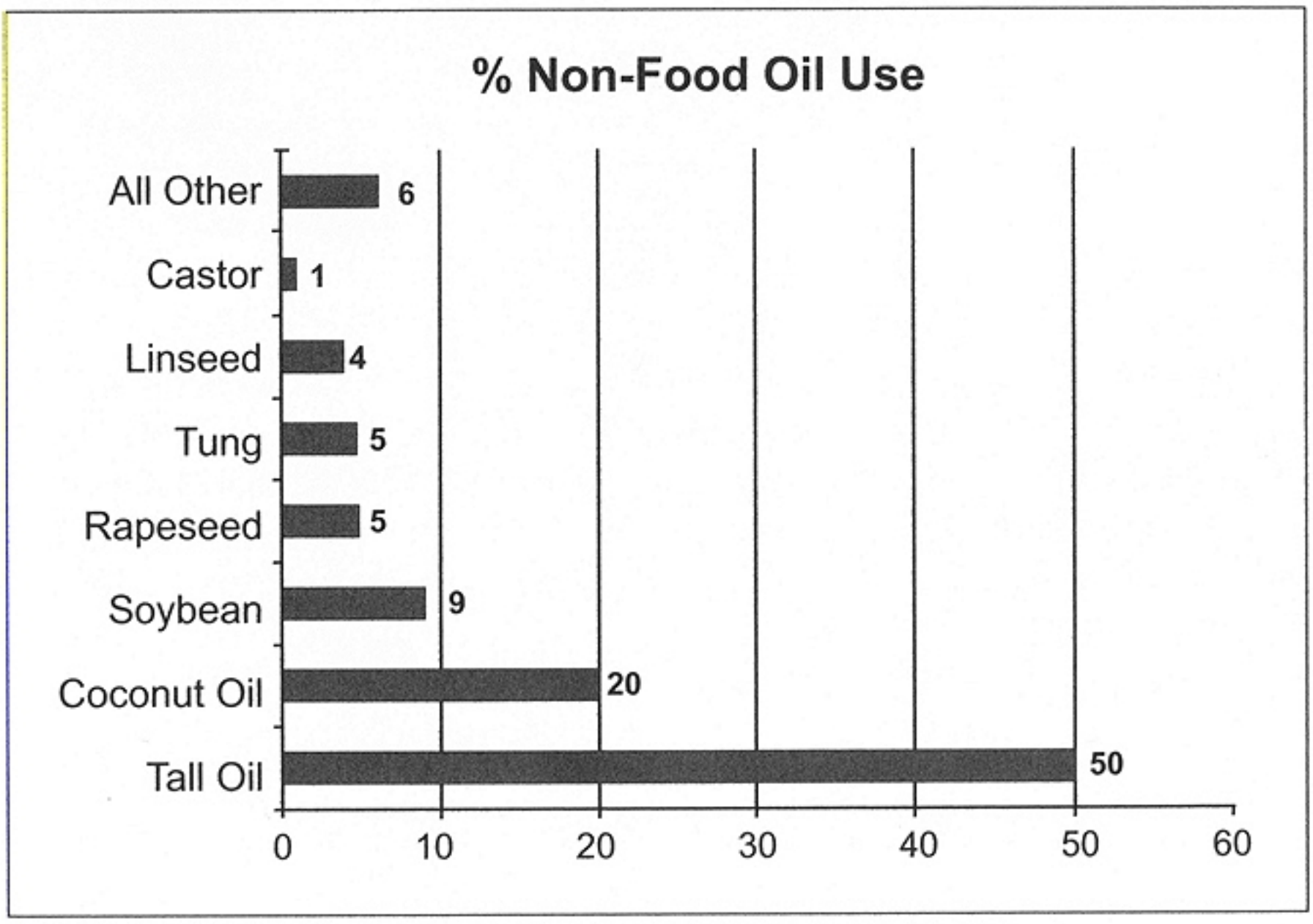
derivitized into a more volatile compound, most commonly a methyl ester, and then fractionately distilled into its components.

Triglycerides may easily be turned into methyl esters by reaction with methanol and catalyst (base catalysts are preferred). As the reaction proceeds, the reaction mixture turns hazy as glycerin is liberated. Once complete, the excess methanol is distilled off, glycerin is removed from the bottom after it settles, and the methyl ester is distilled into its fractions. This is the common process to produce "bio-diesel."

The methyl ester formed by the reaction, if not distilled is still referred to by the oil name (for example, methyl cocoate). However, once fractionated, the material is named by carbon distribution. Methyl cocoate is fractionated into methyl laurate, methyl myristate and so on. The triglyceride source is lost in the name of the methyl ester. The names for the common alkyl groups are shown in **Table 1**, page 7. Distillation is a major operation used to fractionate methyl ester mixtures obtained from oils into specifically defined methyl esters with the desired alkyl groups.

Surfactants

The term surfactant was coined as a contraction for surface-active agent, and has been used for many years. In order to have a product with surface activity, it is necessary to have at least two groups in the molecule, which are not soluble in each other. Most commonly, this means an oil or fatty-soluble group that is called the hydrophobic portion and a water-soluble group called the hydrophilic portion. If the ratio of each portion in the molecule is not balanced correctly, no surface



activity results. The most common source for the oil-soluble portion of a surfactant molecule is a natural oil and the most common natural oil used in the personal care market is derived from coconuts. The most commonly used oil industrially is tall oil, which has no food applications.

A recent trend has been to derivatize the oil, fat, butter or wax by reacting them with a silicone polymer. This results in unique, novel molecules having solubility in oil, water and silicone. The ability to predict the properties of these emulsifiers has been developed and presented in the 3D HLB system.

It should be clearly understood that structure dictates function in surfactants. The carbon number and unsaturation level in the starting hydrophobic raw material are major factors in determining surfactant attributes. The other is the functional group added in preparation of the surfactant. The following charts show the source of the many surfactants, traced back to the oils.

Group 1

Animal-Derived Triglycerides

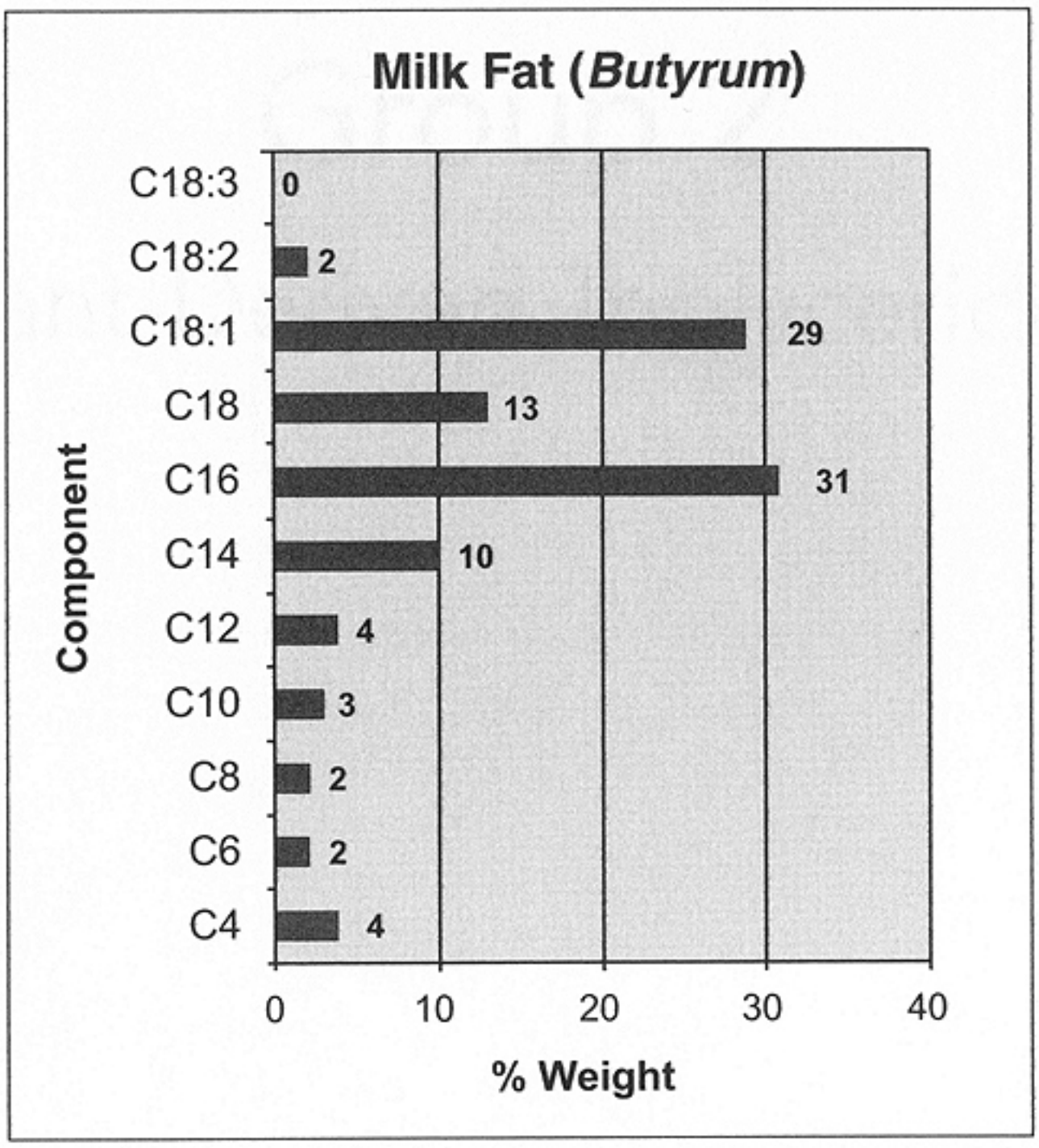
1.1 Milk Fat (*Butyrum*)

Carbon Number 15.5

1.1.1. Source

Milk Fat, also known as butter, is the hydrous triglyceride from cow's milk. It has a very wide distribution of fatty components.

1.1.2. Fatty Components



1.1.3. Properties

CAS Number:	8029-34-3	EINCS Number:	415-310-5
Iodine Value:	39	Titer Point:	22° C
Carbon Number:	15.5		

1.1.4. Commercial Availability

Milk Fat is an item of commerce.

1.1.5. INCI Status

Milk Fat is listed in the CTFA dictionary, both per se and in several derivatives, including silicone derivatives.

1.1.6. Status in Japan

Name: Milk Fat
Ingredient Code: 510057
Categories: Permitted in all categories (1-7) with no limits

Group 2

Plant-Derived Triglycerides

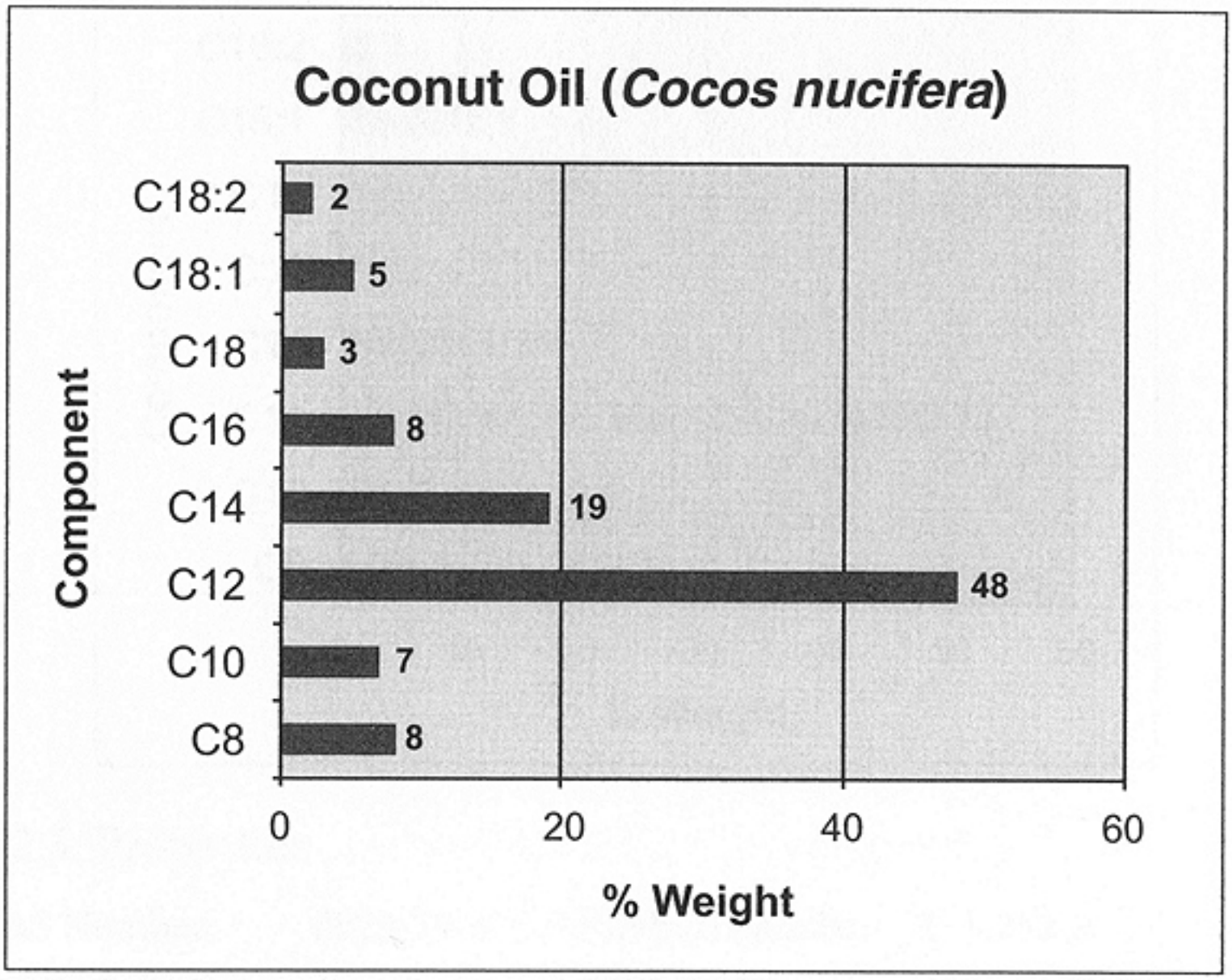
2.1 Coconut Oil (*Cocos nucifera*)

Carbon Number 12.8

2.1.1. Source

Coconut Oil, which comes from the seeds of *C. nucifera,* is the most abundant oil processed. It is the most common oil raw material used in the cosmetic industry. Geographically, is cultivated principally from Southeast Asia and the Philippines and is the major source of lauric acid (C-12).

2.1.2. Fatty Components



2.1.3. Properties

CAS Number:	8001-31-8	EINECS Number:	32-282-8
Iodine Value:	8	Titer Point:	22° C (free fatty acids)
Carbon Number:	12.84		

2.1.4. Commercial Availability

Coconut Oil is a commodity; the price fluctuates depending upon market conditions.

2.1.5. INCI Status

Coconut Oil is listed in the CTFA dictionary, both per se and in 162 derivatives. It is one of the most commonly encountered materials in the cosmetic industry.

2.1.6. Status in Japan

Name:	Coconut Oil
Ingredient Code:	500543
Categories:	All categories with no limits

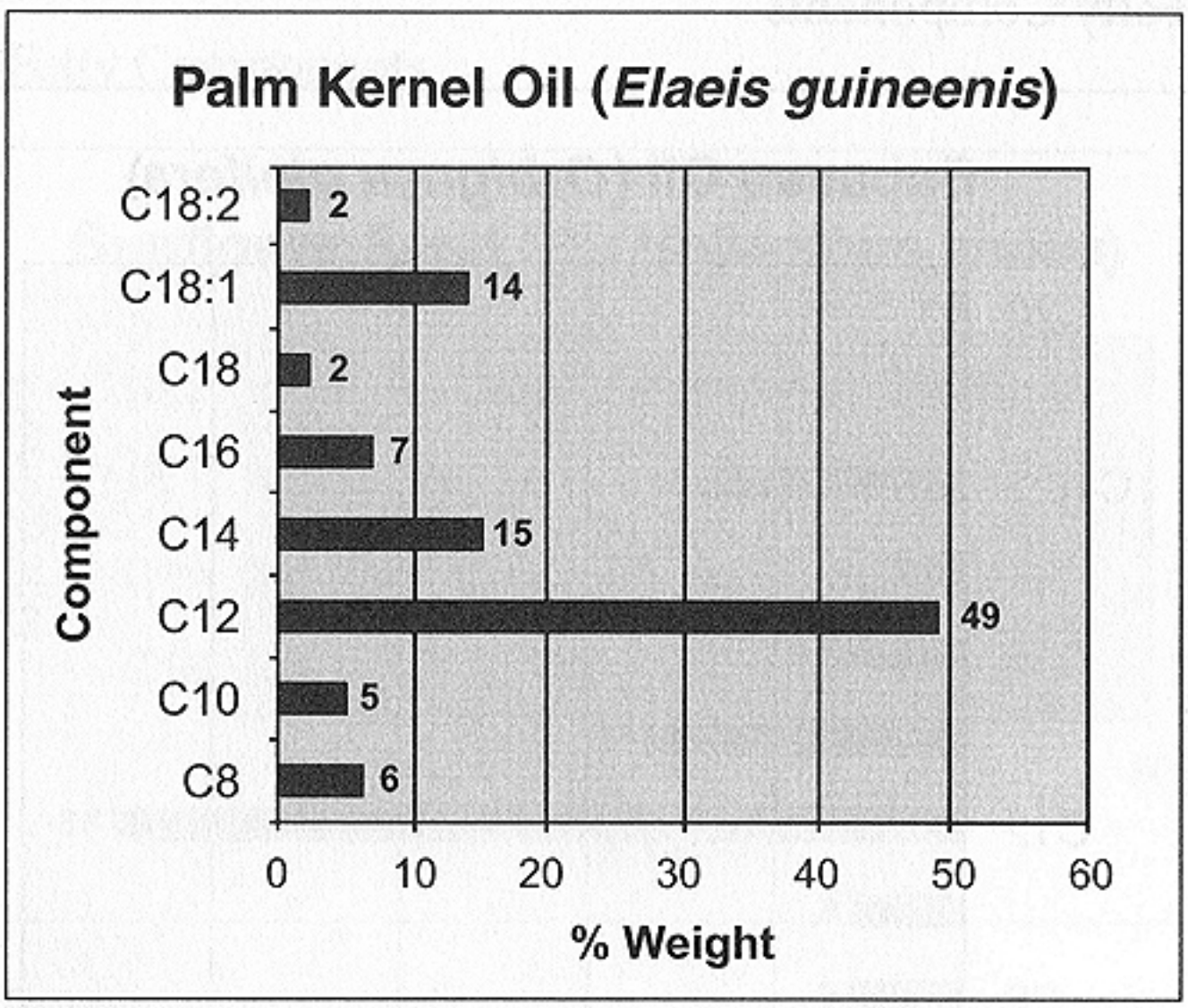
2.2 Palm Kernel Oil (*Elaeis guineenis*)

Carbon Number 13.3

2.2.1. Source

Palm Kernel Oil is a triglyceride derived from the seed of the coconut palm (*E. guineenis*). It comes from Southeast Asia.

2.2.2. Fatty Components



2.2.3. Properties

CAS Number:	8023-79-8	EINECS Number:	232-282-8
Iodine Value:	19	Titer Point:	24° C (free fatty acids)
Carbon Number:	13.3		

2.2.4. Commercial Availability

Palm Kernel Oil is an item of commerce.

2.2.5. INCI Status

Palm Kernel Oil is listed in the CTFA dictionary, both per se and in 19 derivatives.

2.2.6. Status in Japan

Name:	Palm Kernel Oil
Ingredient Code:	500078
Categories:	Permitted in categories 1-7 with no limits

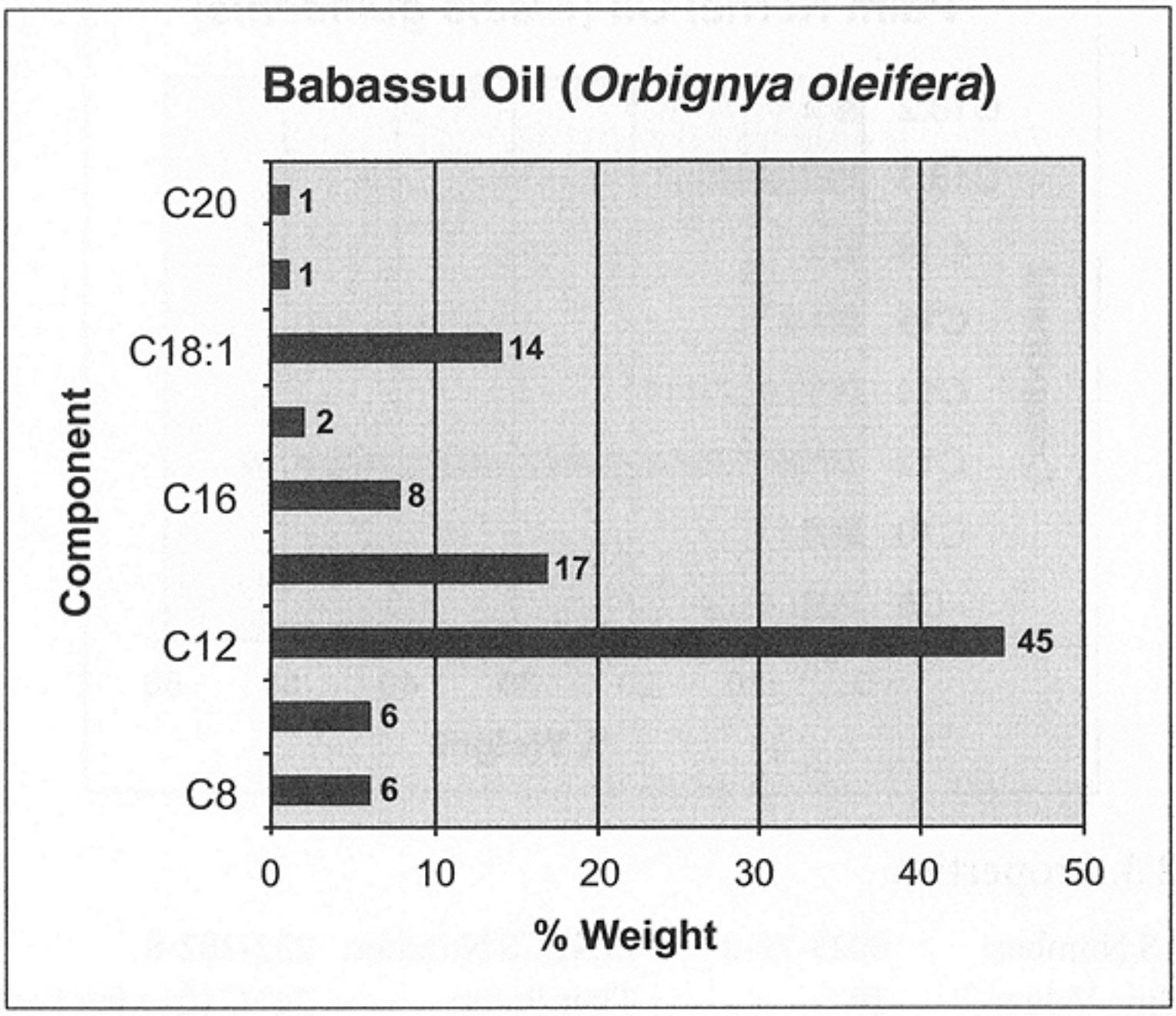
2.3 Babassu Oil (*Orbignya oleifera*)

Carbon Number 13.4

2.3.1. Source

Babassu Oil is derived from the tallest palm in Brazil (*Attelea martiana Martius*). Chemically, it is very similar to Coconut Oil, having a carbon distribution shifted slightly toward the higher molecular weights.

2.3.2. Fatty Components



2.3.3. Properties

CAS Number:	91078-92-1	EINECS Number:	293-376-2
Iodine Value:	15	Titer Point:	24° C (free fatty acids)
Carbon Number:	13.4		

2.3.4. Commercial Availability

Babassu Oil is available in limited commercial quantities.

2.3.5. INCI Status

Babassu Oil is listed in the CTFA dictionary in eight surfactant derivatives.

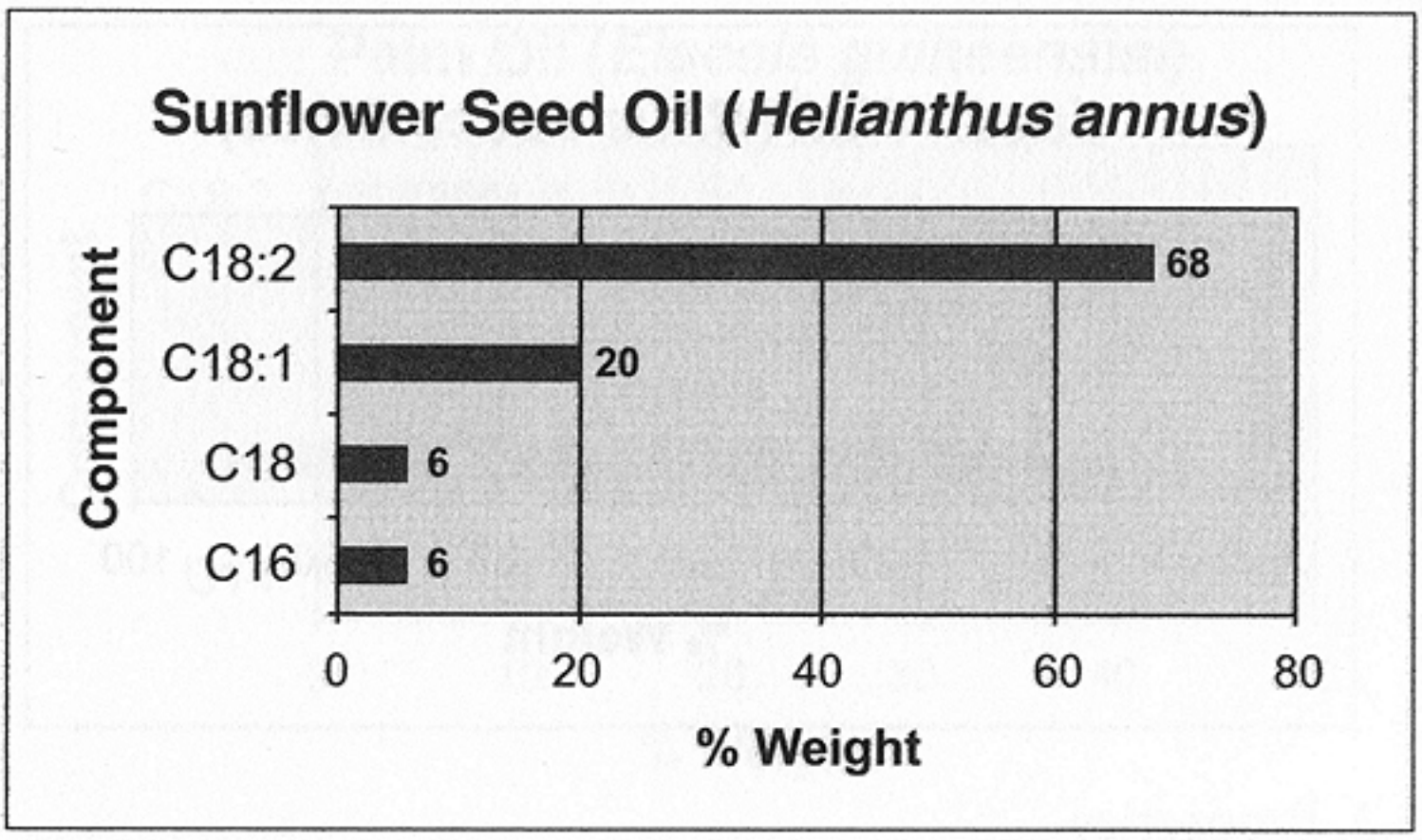
2.4 Sunflower Seed Oil (*Helianthus annuus*)

Carbon Number 16.0

2.4.1. Source

Sunflower Seed Oil is a triglyceride derived from the seeds of the sunflower (*Helianthus annus L.*). It was originally cultivated in North America by American Indians. It is now cultivated in North America, Russia, Europe, South America, India and China. It is a rather common plant.

2.4.2. Fatty Components



2.4.3. Properties

CAS Number:	8001-21-6	EINECS Number:	232-273-9
Iodine Value:	130	Titer Point:	18° C (free fatty acids)
Carbon Number:	16.0		

2.4.4. Commercial Availability

Sunflower Seed Oil is an item of commerce. It is used principally in food.

5. INCI Status

Sunflower Seed Oil is listed in the CTFA dictionary and is in six derivatives.

2.4.5. Status in Japan

Name:	Sunflower Seed Oil
Ingredient Code:	520923
Categories:	All categories with no limits, except eyeliners (category 8)

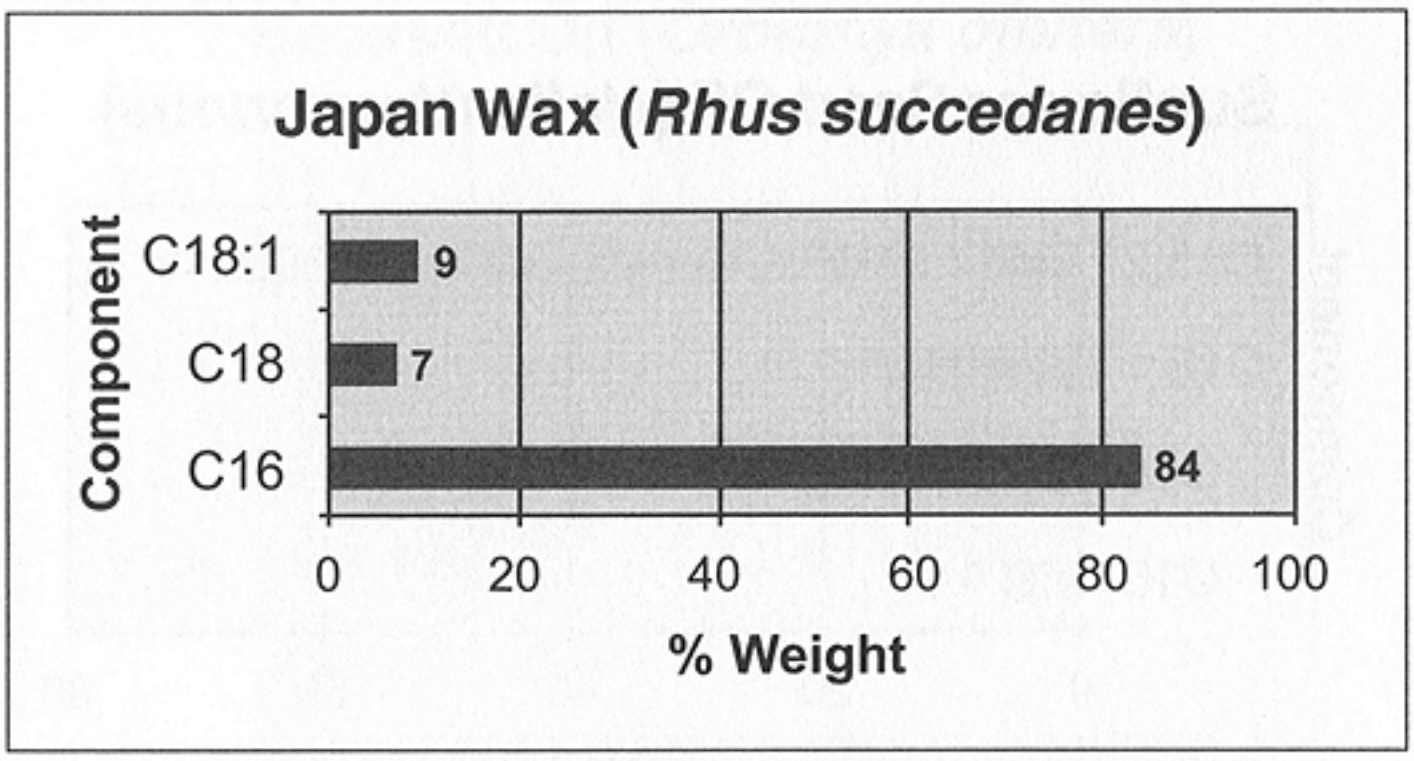
2.5 Japan Wax (*Rhus succedanes*)

Carbon Number 16.3

2.5.1. Source

Japan Wax is a triglyceride secreted by the insect *Coccus cerriferus*. It is obtained from the mesocarp of the fruit of *Rhus succedanes*. The wax is scrapped and refined much like beeswax is refined. It typically has 5% free fatty acid. Technically, Japan Wax is a fat.

2.5.2. Fatty Components



2.5.3. Properties

CAS Number:	8001-139-6		
Iodine Value:	6	Melting range:	46-52° C
Carbon Number:	16.3		

2.5.4. Commercial Availability

Japan Wax is an item of commerce.

2.5.5. INCI Status

Japan Wax is listed in the CTFA dictionary.

2.5.6. Status in Japan

Name:	Japan Wax
Ingredient Code:	500523
Categories:	All categories with no limits.

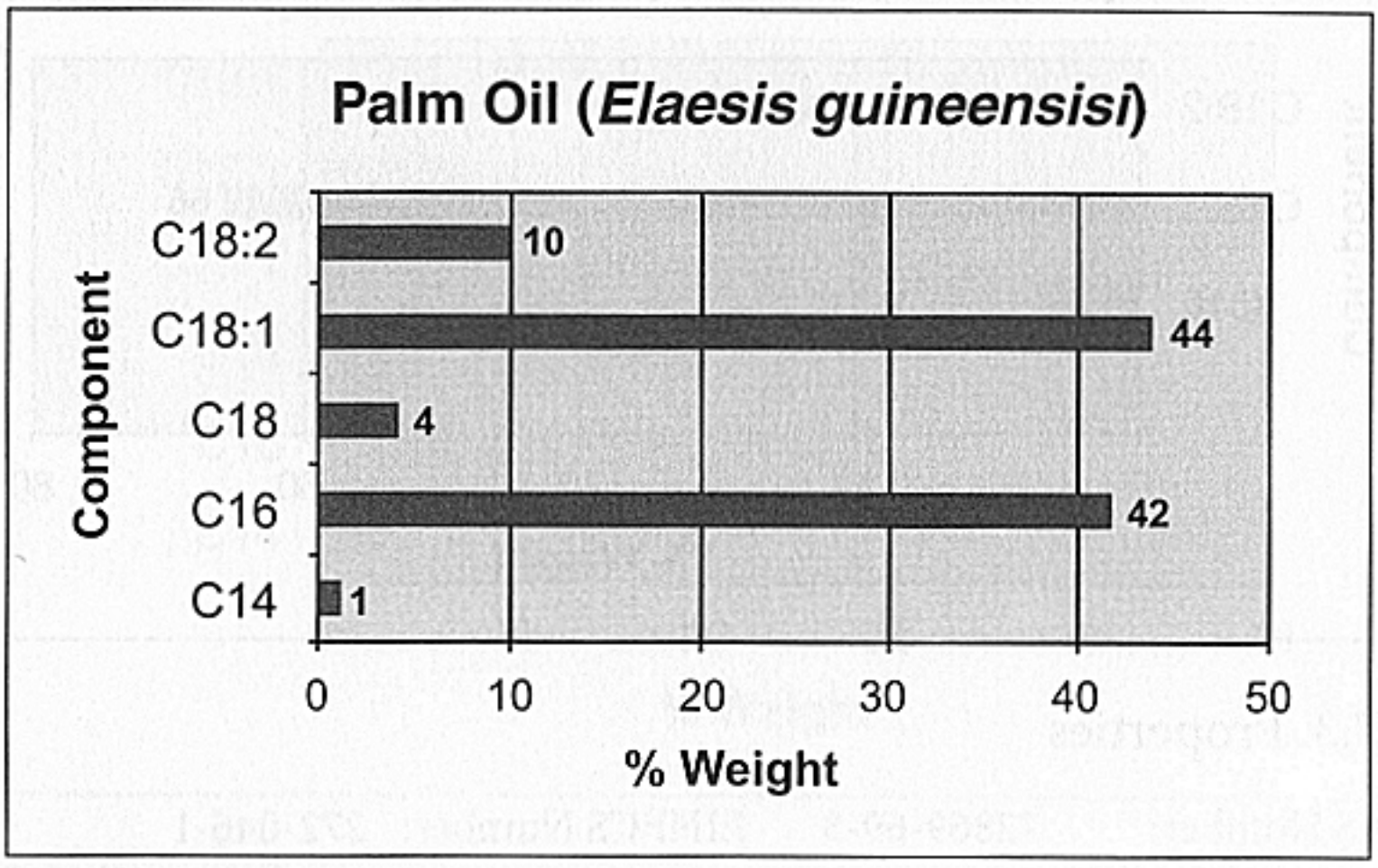
2.6 Palm Oil (*Elaesis guineensisi*)

Carbon Number 17.1

2.6.1. Source

Palm Oil is a triglyceride extracted from the fruit of *Elaeis guineensis Jacq*, which is among the most efficient oil-producing plants per acre in the world. Palm Oil is the principal source of palmitic acid for isopropyl palmitate.

2.6.2. Fatty Components



2.6.3. Properties

CAS Number:	8002-75-3	EINECS Number:	232-316-1
Iodine Value:	50	Titer Point:	43° C (free fatty acids)
Carbon Number:	17.1		

2.6.4. Commercial Availability

Palm Oil is an item of commerce.

2.6.5. INCI Status

Palm Oil is listed in the CTFA dictionary, both per se and in 38 derivatives.

2.6.6. Status in Japan

Name:	Palm Oil
Ingredient Code:	504271
Categories:	All categories with no limits, except eyeliners (category 8)

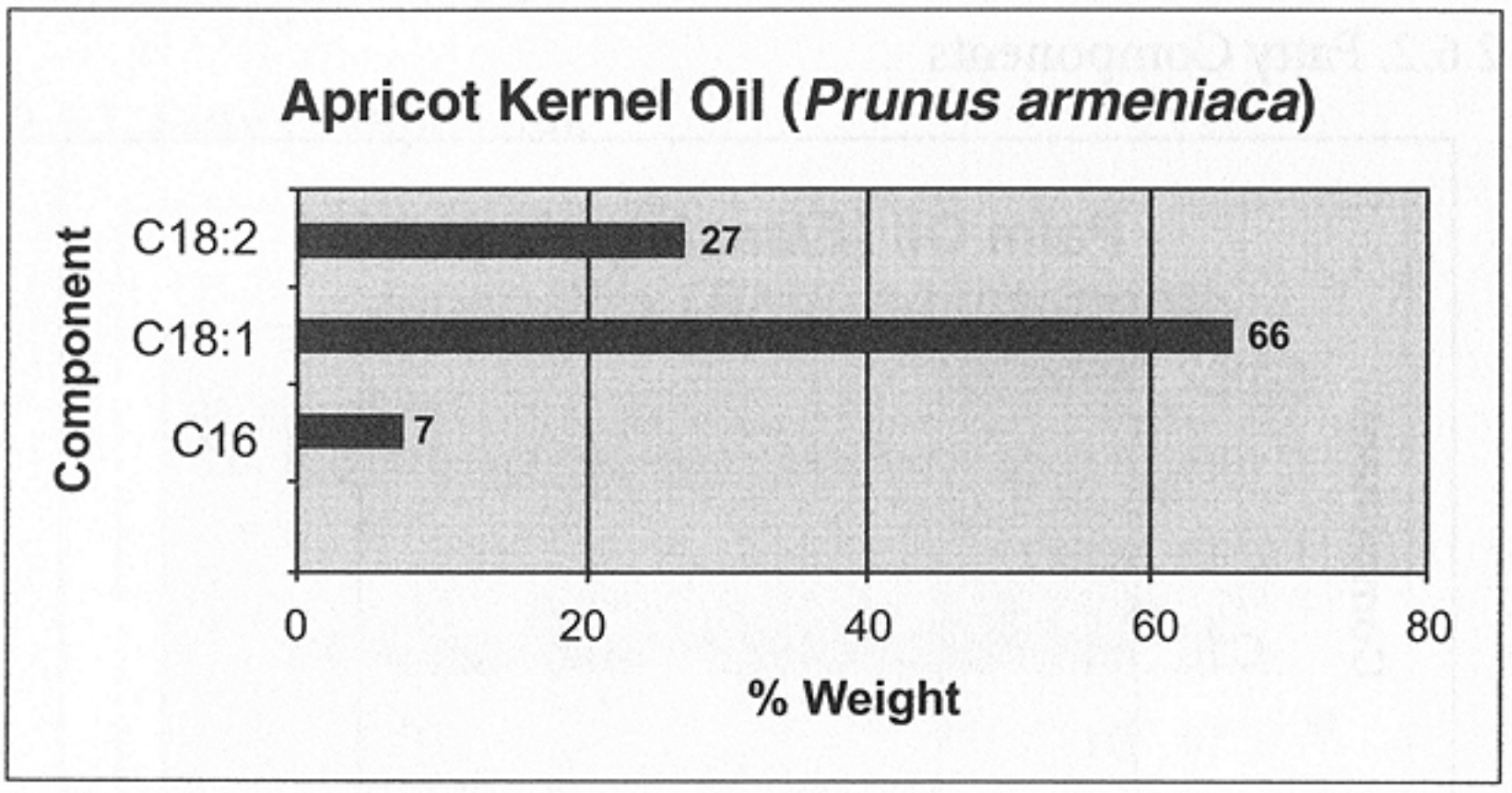
2.7 Apricot Kernel Oil (*Prunus armeniaca*)

Carbon Number 17.9

2.7.1. Source

Apricot Kernel Oil is a triglyceride extracted from the kernel of *P. armeniaca*.

2.7.2. Fatty Components



2.7.3. Properties

CAS Number:	72869-69-3	EINECS Number:	272-046-1
Iodine Value:	102	Titer Point:	43° C
Carbon Number:	17.9		

2.7.4. Commercial Availability

Apricot Kernel Oil is an item of commerce.

2.7.5. INCI Status

Apricot Kernel Oil is listed in the CTFA dictionary, both per se and in four derivatives.

2.7.6. Status in Japan

Name:	Apricot Kernel Oil
Ingredient Code:	100610
Categories:	All categories with no limits except eyeliners (category 8)

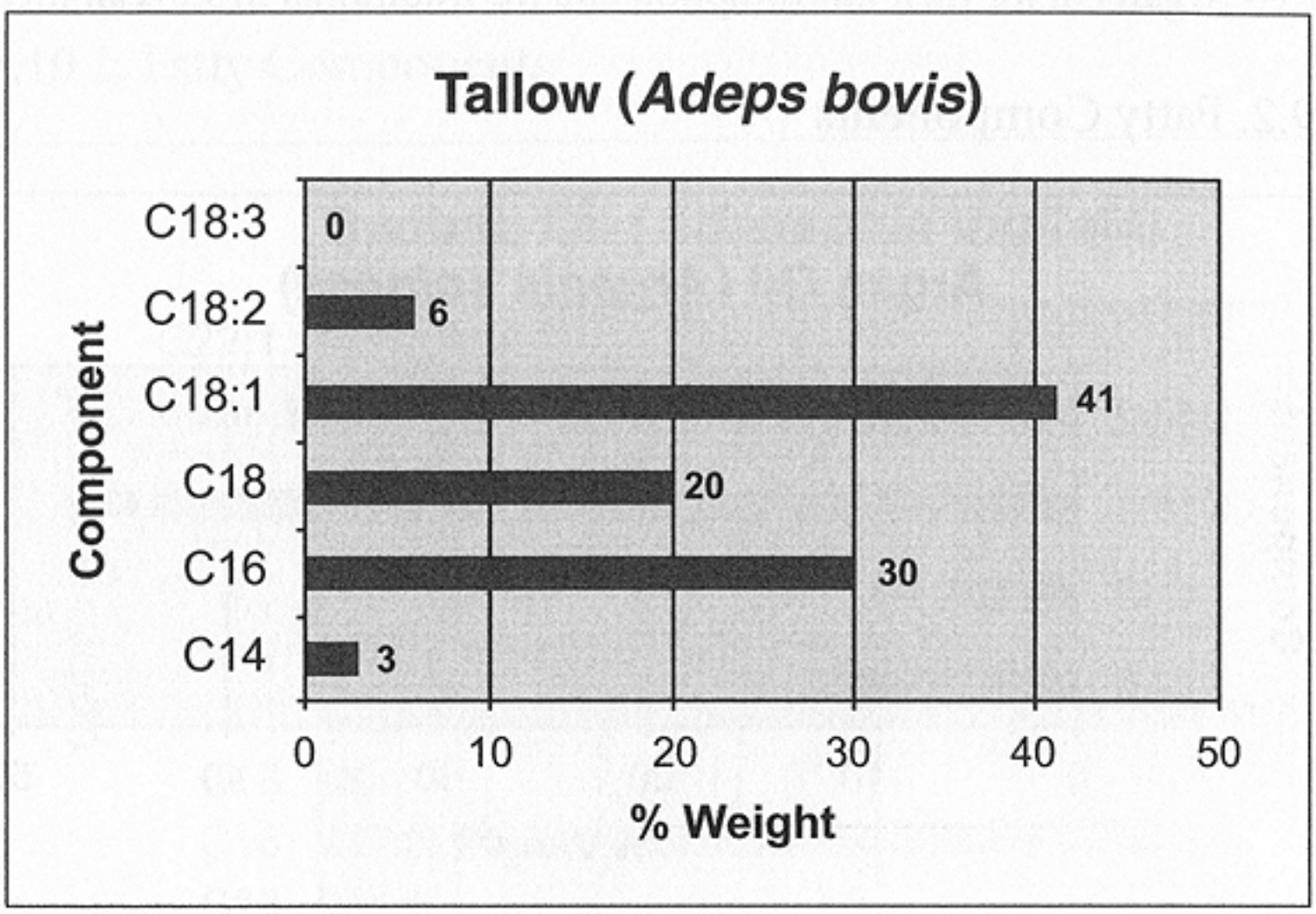
2.8 Tallow (*Adeps bovis*)

Carbon Number 17.3

2.8.1. Source

Tallow is the triglyceride also known as animal fat.

2.8.2. Fatty Components



2.8.3. Properties

CAS Number:	61789-13-7	EINECS Number:	263-035-2
Iodine Value:	45	Titer Point:	43° C (free fatty acids)
Carbon Number:	17.3		

2.8.4. Commercial Availability

Tallow is an item of commerce; it is a commodity.

2.8.5. INCI Status

Tallow is listed in the CTFA dictionary, both per se and in 126 derivatives.

2.8.6. Status in Japan

Name:	Beef Tallow
Ingredient Code:	002107
Categories:	All categories with no limits

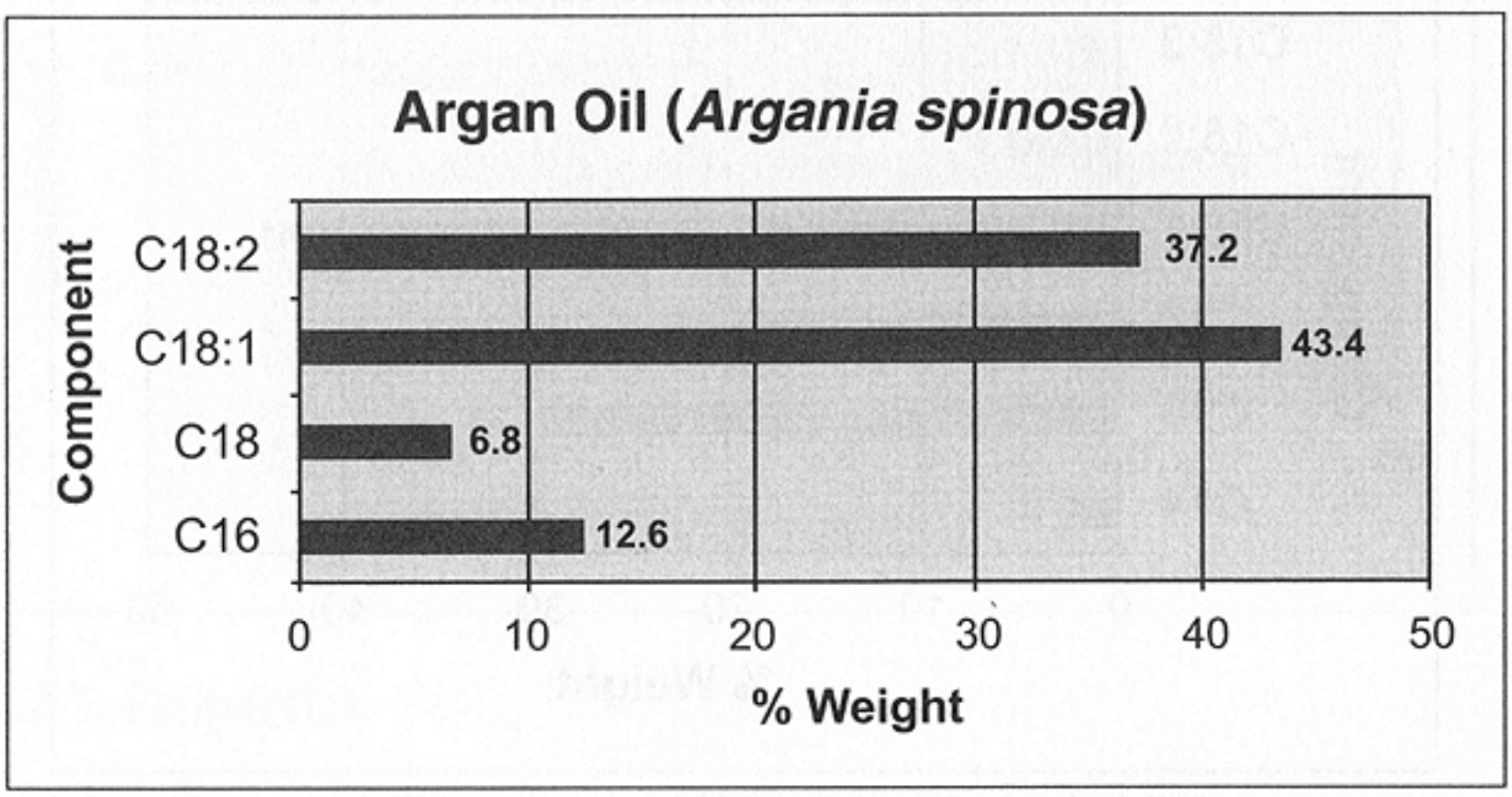
2.9 Argan Oil (*Argania spinosa*)

Carbon Number 17.4

2.9.1. Source

Argan Oil comes from the nuts of the Argan tree (*A. spinosa*). This tree grows only in the southwestern part of Morocco. The argan tree produces nuts from which a very nutritious oil is extracted. Berber women of this region have produced Argan Oil for their consumption and for traditional Moroccan medicine.

2.9.2. Fatty Components



2.9.3. Properties

CAS Number:	223747-87-3	EINECS Number:	273-313-5
Iodine Value:	100	Titer Point:	N/A
Carbon Number:	17.4		

2.9.4. Commercial Availability

Argan Oil is an item of commerce.

2.9.5. INCI Status

Argan Oil is listed in the CTFA dictionary both per se and in five derivatives.

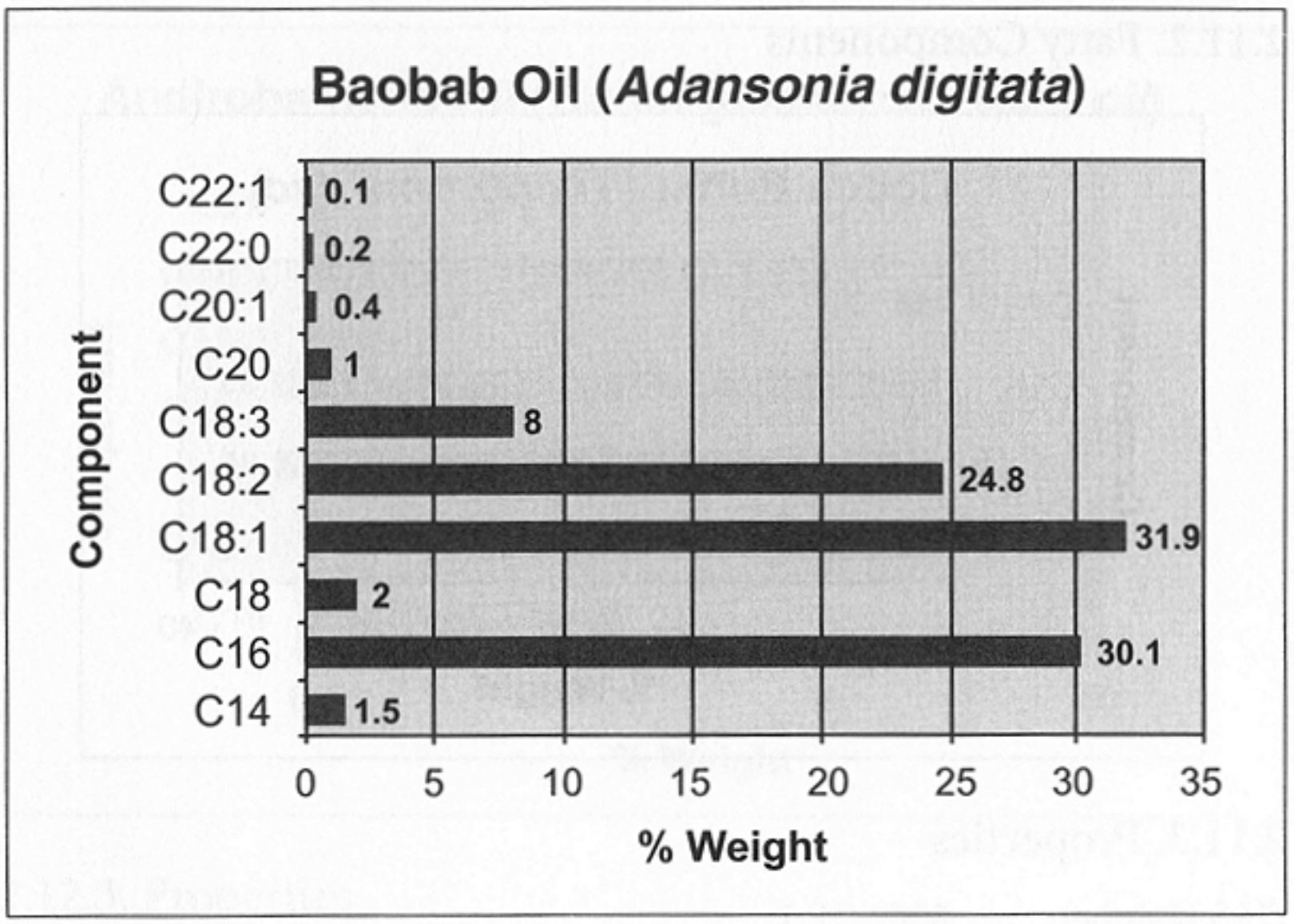
2.10 Baobab Oil (*Adansonia digitata*)

Carbon Number 17.4

2.10.1. Source

This is a rich, golden oil with a nutty scent. It is derived from the seeds of the Baobab tree, which is native to eastern and southern Africa. This natural oil has a wide carbon distribution and is rich in vitamins A, D, E and F.

2.10.2. Fatty Components



2.10.3. Properties

CAS Number: 8007-02-1
Iodine Value: 89 mg KOH/gm Titer Point: N/A
Carbon Number: 17.4

2.10.4. Commercial Availability

Baobab Oil is an item of commerce.

2.10.5. INCI Status

Baobab Oil is not yet listed in the CTFA dictionary.

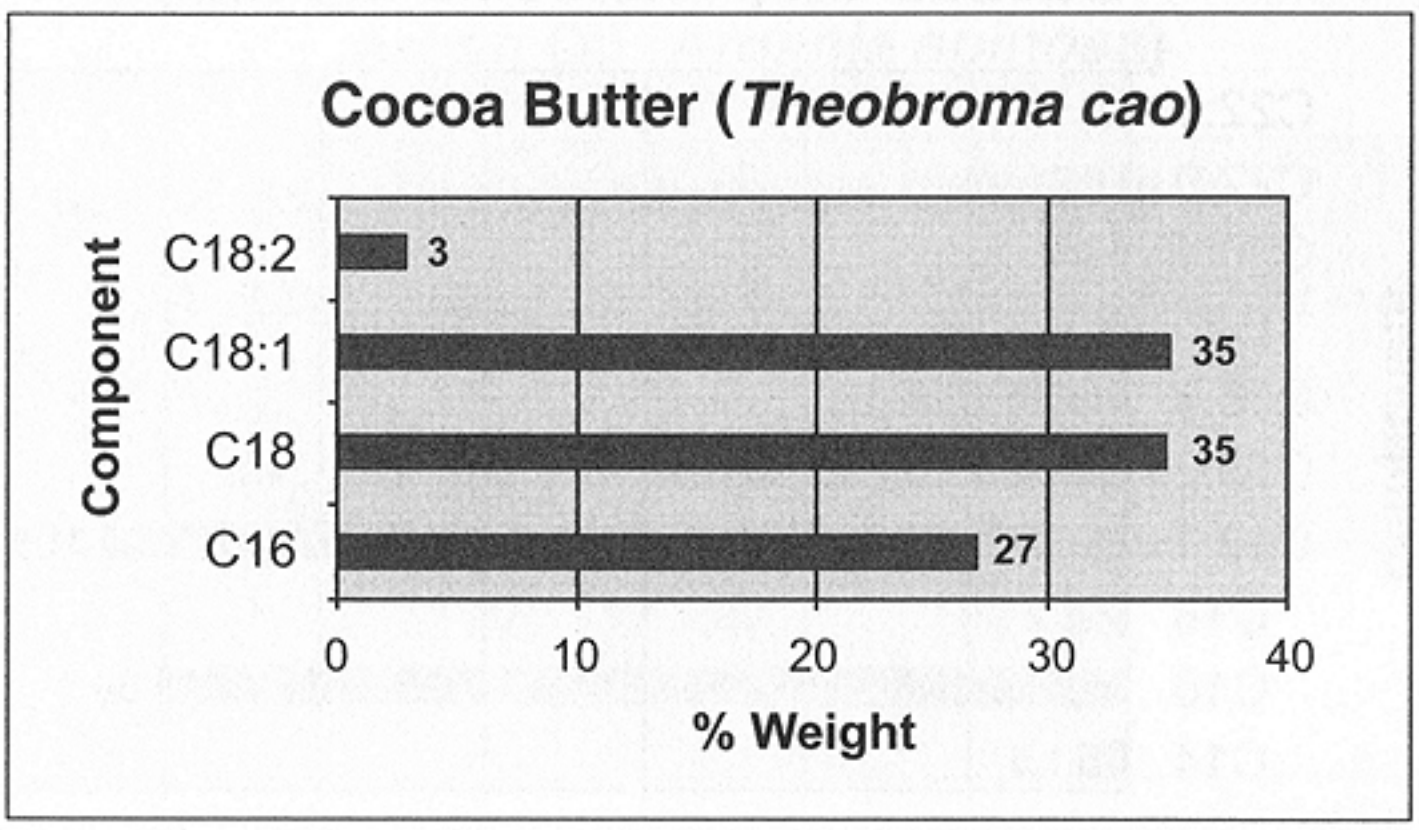
2.11 Cocoa Butter (*Theobroma cao*)

Carbon Number 17.5

2.11.1. Source

Cocoa Butter is a triglyceride obtained from the cocoa bean (*Theobroma cacoa L.*). The species was originally found along the Amazon River. It is now grown commonly along the equator where there is abundant rainfall. Cocoa Butter is the ingredient that gives chocolate its characteristic melting properties and unique texture. "Pure prime pressed" denotes the highest possible quality of cocoa butter used in the food industry.

2.11.2. Fatty Components



2.11.3. Properties

CAS Number:	8002-31-1		
Iodine Value:	37	Melting Point:	32° C (free fatty acids)
Carbon Value:	17.5		

2.11.4. Commercial Availability

Cocoa Butter is an item of commerce.

2.11.5. INCI Status

Cocoa Butter is listed in the CTFA dictionary, both per se and in three derivatives; silicone derivatives are available. Cocoa Butter is a commonly used skin care ingredient.

2.11.6. Status in Japan

Name:	Cocoa Butter
Ingredient Code:	001194
Categories:	All categories with no limits

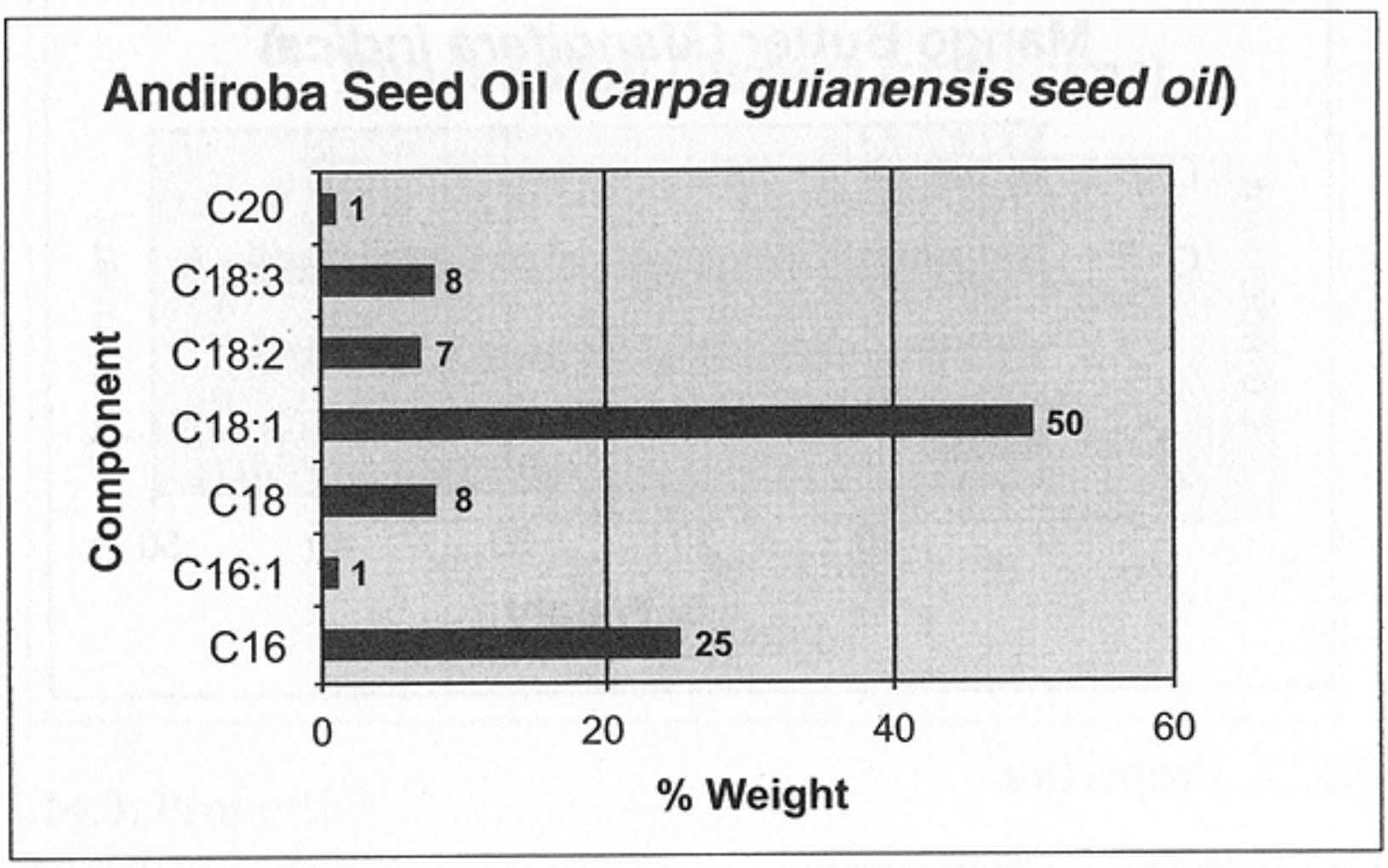
2.12 Andiroba Seed Oil (*Carpa guianensis seed oil*)

Carbon Number 17.5

2.12.1. Source

Andiroba Seed Oil, a triglyceride derived from *C. guianensis seed oil*, comes from the Brazilian Rain Forest. It is said to have anti-inflammatory properties and the ability to repel insects.

2.12.2. Fatty Components



2.12.3. Properties

CAS Number: 482-89-3
Iodine Value: 75
Carbon Number: 17.5

2.12.4. Commercial Availability

Andiroba Seed Oil is a new item of commerce.

2.12.5. INCI Status

Andiroba Seed Oil is not yet listed in the CTFA dictionary.

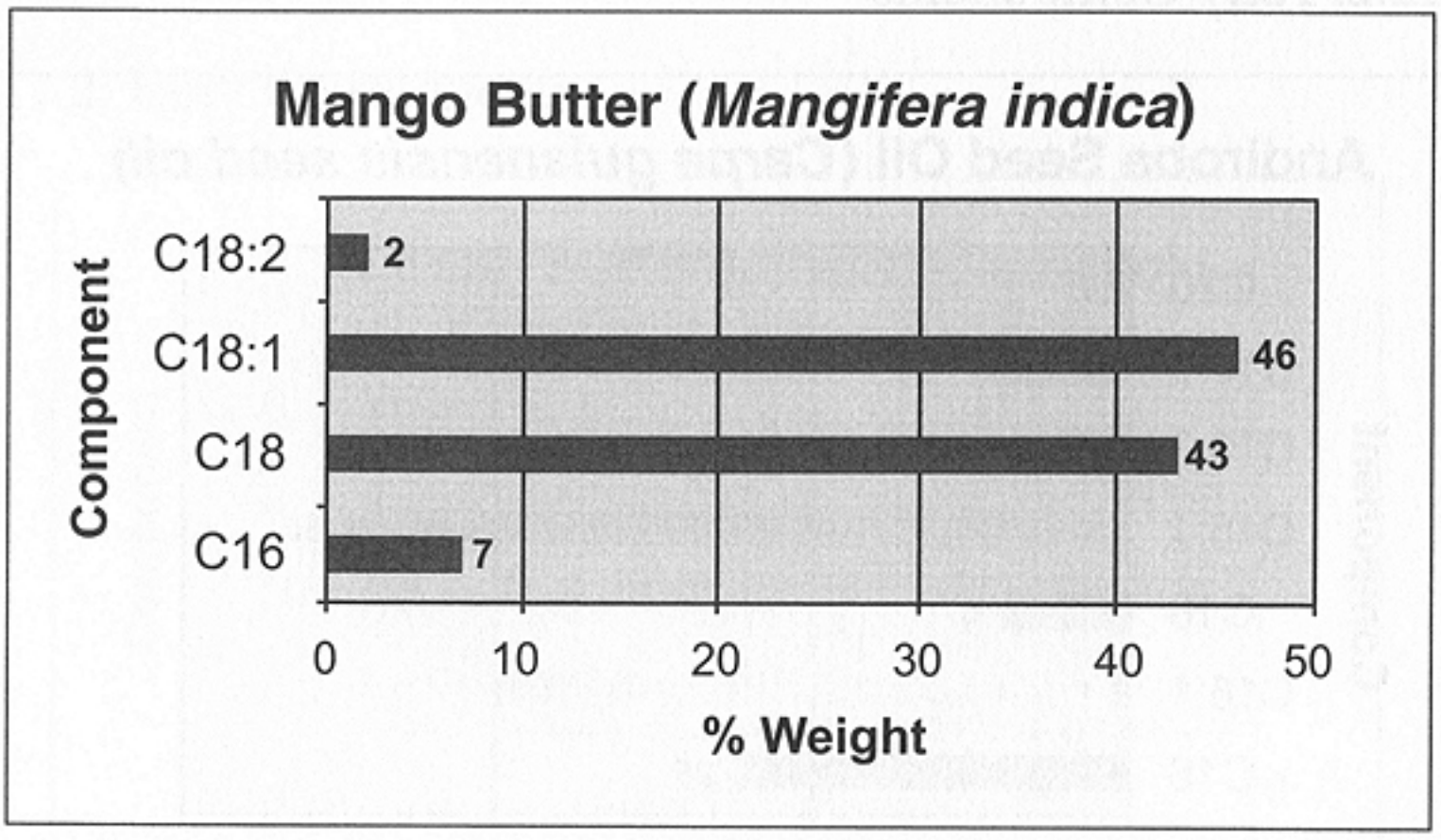
2.13 Mango Butter (*Mangifera indica*)

Carbon Number 17.5

2.13.1. Source

Mango Butter is derived from *M. indica*. It comes from India, and is said to be a good skin emollient.

2.13.2. Fatty Components



2.13.3. Properties

CAS Number: 90063-86-8
Iodine Value: 43
Carbon Number: 17.5

2.13.4. Commercial Availability

Mango Butter is an item of commerce.

2.13.5. INCI Status

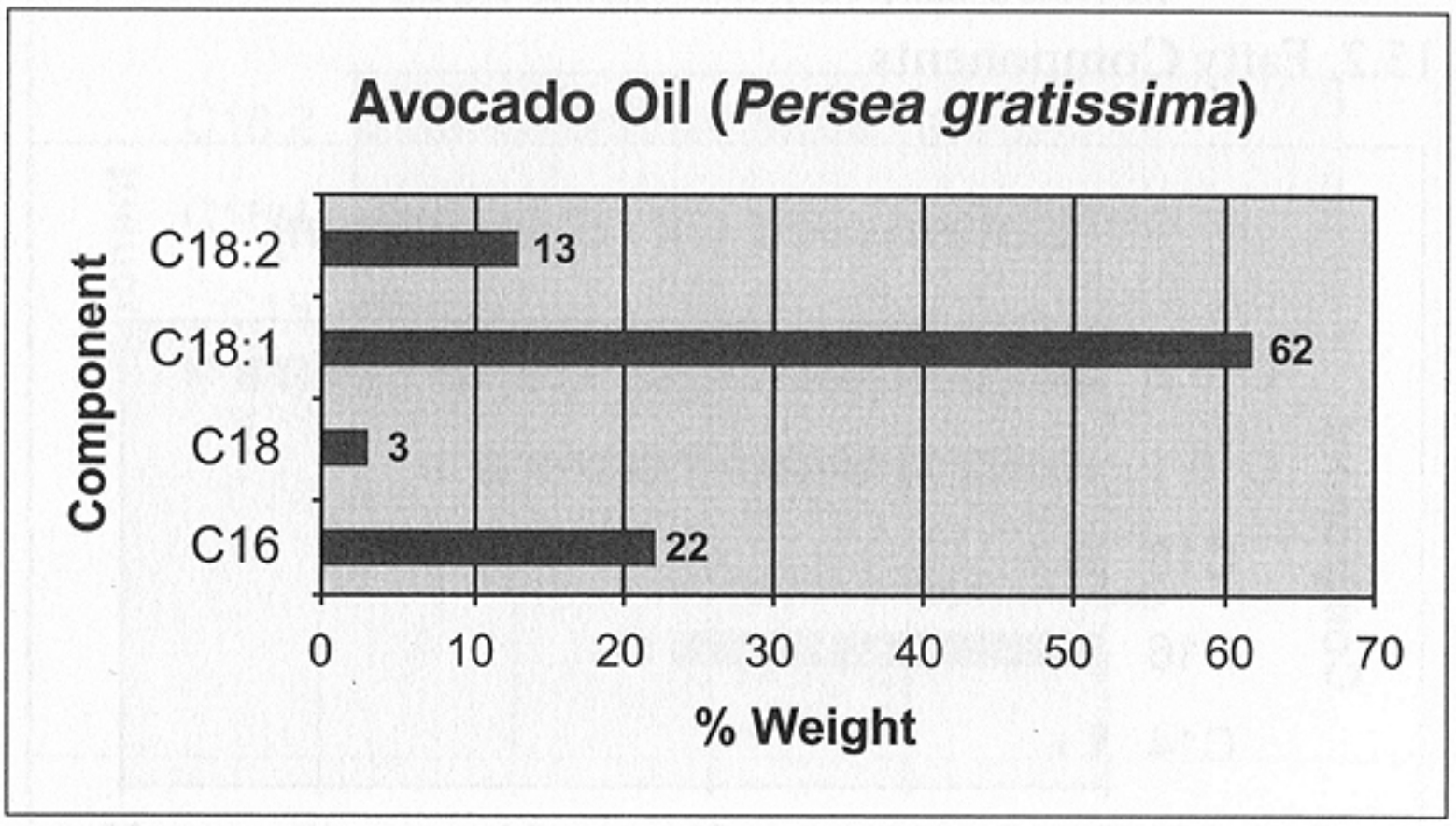
Mango Butter is listed in the CTFA dictionary, as are several derivatives.

2.14 Avocado Oil (*Persea gratissima*)
Carbon Number 17.6

2.14.1. Source

Avocado Oil is a triglyceride coming from the pressing of the dehydrated fruit of the avocado (*P. grantissima*). The pulp of the fruit contains a great deal of oil (70% by weight).

2.14.2. Fatty Components



2.14.3. Properties

CAS Number:	8024-32-6	EINECS Number:	232-274-4
Iodine Value:	75	Titer Point:	8° C (free fatty acids)
Carbon Number:	17.6		

2.14.4. Commercial Availability

Avocado Oil is an item of commerce.

2.14.5. INCI Status

Avocado Oil is listed in the CTFA dictionary, both per se and in 12 derivatives. Silicone derivatives are available.

2.14.6. Status in Japan

Name:	Avocado Oil
Ingredient Code:	500009
Categories:	All categories with no limits

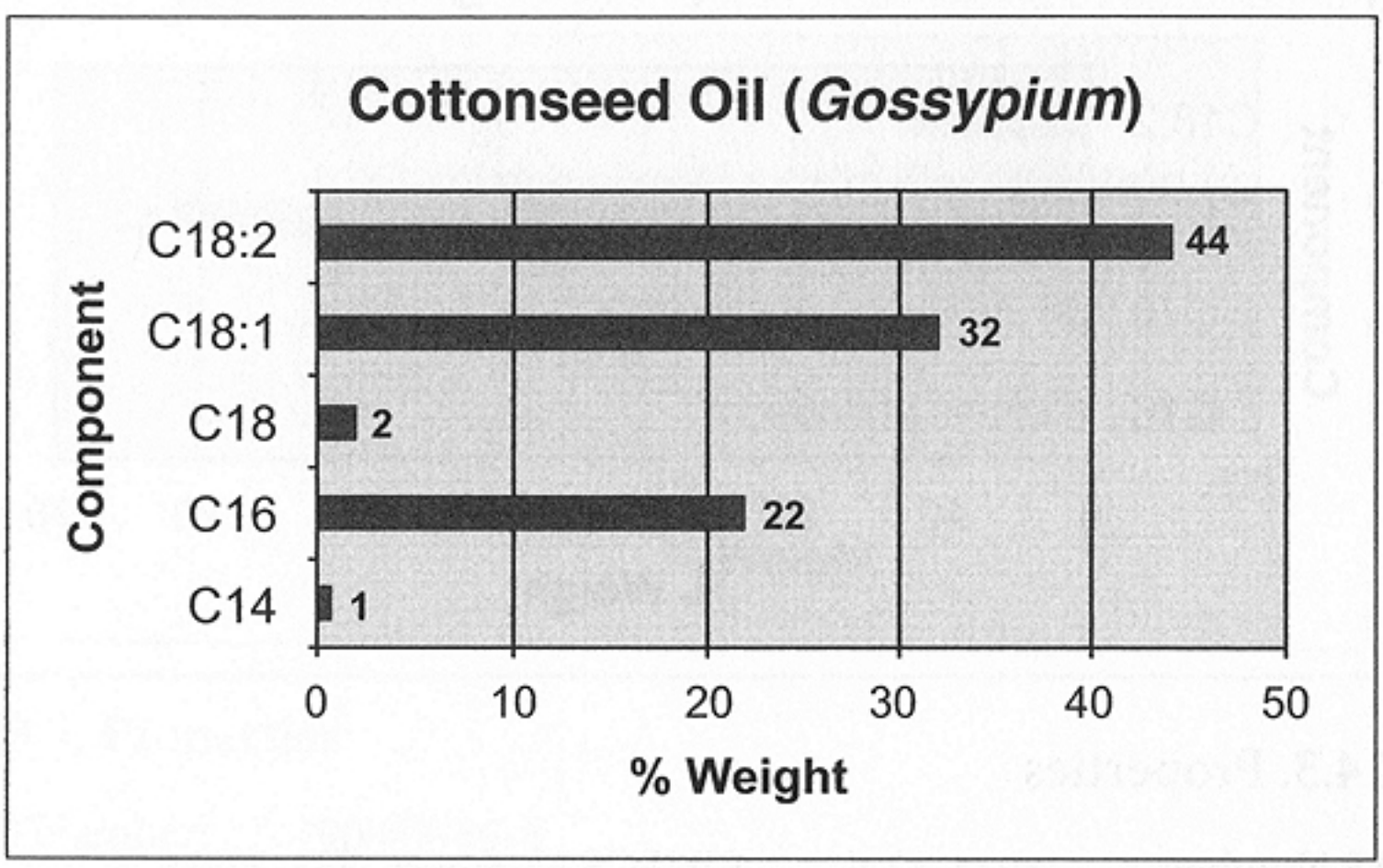
2.15 Cottonseed Oil (*Gossypium*)

Carbon Number 17.6

2.15.1. Source

Cottonseed Oil is a triglyceride derived from cotton (*Gossypium hirsutum*). Cotton, like soybean, is a very important crop in that the crop has both a protein and a fatty component. However, unlike soybean, the fiber cotton is very useful in textile applications. Cotton is widely grown and has been utilized for many years. Cottonseed Oil is used widely in mayonnaise.

2.15.2. Fatty Components



2.15.3. Properties

CAS Number:	8001-29-4	EINECS Number:	232-280-7
Iodine Value:	108	Titer Point:	33° C (free fatty acids)
Carbon Number:	17.6		

2.15.4. Commercial Availability

Cottonseed Oil is an item of commerce.

2.15.5. INCI Status

Cottonseed Oil is listed in the CTFA dictionary, both per se and in four derivatives.

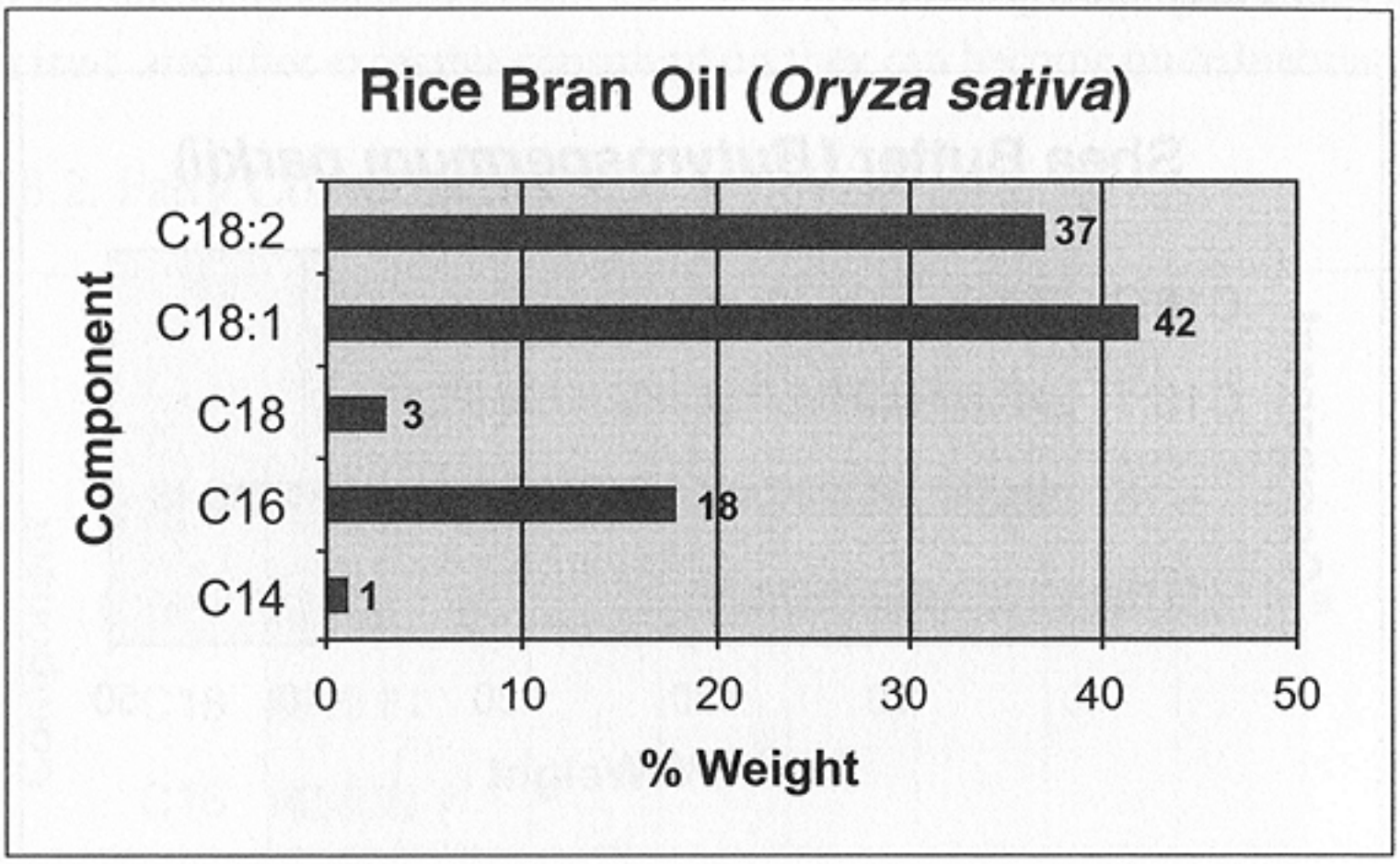
2.16 Rice Bran Oil (*Oryza sativa*)

Carbon Number 17.6

2.16.1. Source

Rice Bran Oil is a triglyceride extracted from rice. It comes from Japan.

2.16.2. Fatty Components



2.16.3. Properties

CAS Number:	68553-81-1	EINECS Number:	232-409-7
Iodine Value:	105	Cloud Point:	7° C (free fatty acids)
Carbon Number:	17.6		

2.16.4. Commercial Availability

Rice Bran Oil is an item of commerce.

2.16.5. INCI Status

Rice Bran Oil is listed in the CTFA dictionary.

2.16.6. Status in Japan

Name:	Rice Bran Oil
Ingredient Code:	520433
Categories:	All categories with no limits, except eyeliners (category 8).

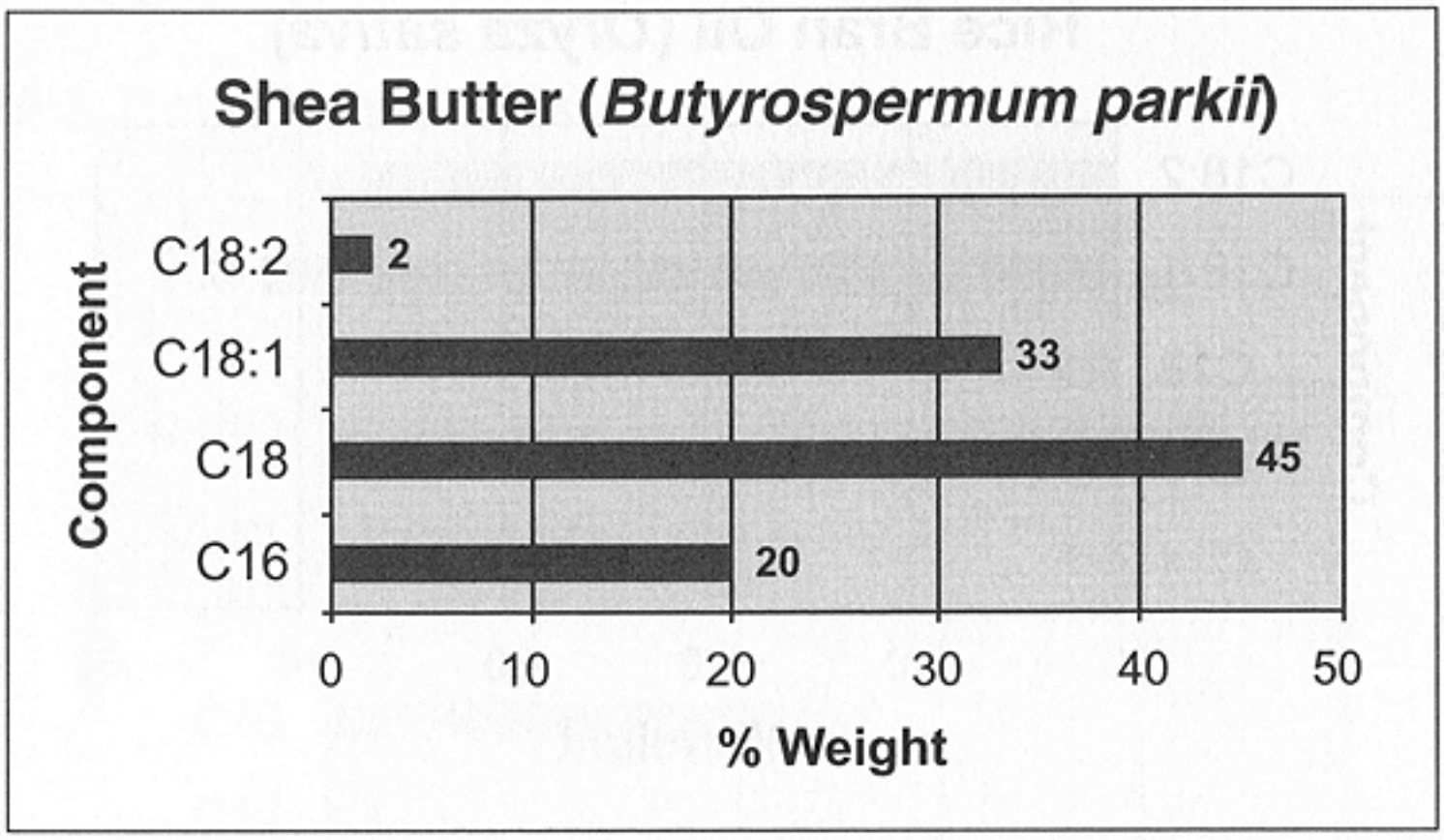
2.17 Shea Butter (*Butyrospermum parkii*)

Carbon Number 17.6

2.17.1. Source

Shea Butter is a triglyceride derived from a tree (*Butyrospermum parkii*) that is native to India.

2.17.2. Fatty Components



2.17.3. Properties

CAS Number:	977026-99-5	EINECS Number:	293-515-7
Iodine Value:	3	Titer Point:	50° C
Carbon Number:	17.6		

2.17.4. Commercial Availability

Shea Butter is an item of commerce.

2.17.5. INCI Status

Shea Butter is listed in the CTFA dictionary, as are a number of its derivatives. Silicone derivatives are also available. A number of recent patents claim cold pressed Shea Butter as a source of a number of important skin actives.

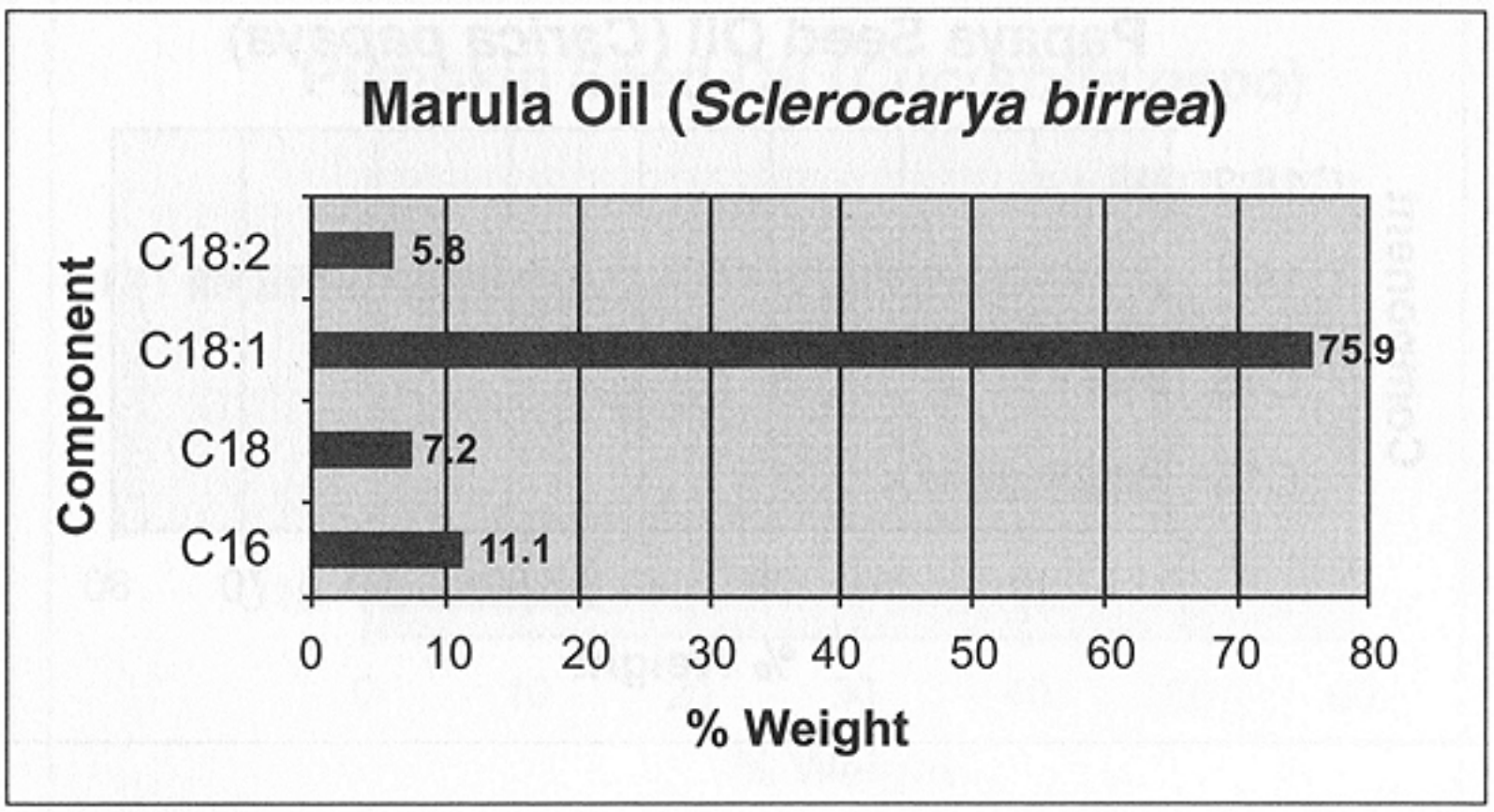
2.18 Marula Oil (*Sclerocarya birrea*)

Carbon Number 17.6

2.18.1. Source

Marula trees are indigenous to southern Africa and parts of west and east Africa. *Sclerocarya* means "hard nut," and *birrea* is derived from the word birr, the common name used in Senegal. The plum-sized fruit is sweet-sour in flavor and is commonly eaten fresh and used to prepare juices. Elephants enjoy eating this fruit, and after excessive consumption they can become quite inebriated.

2.18.2. Fatty Components



2.18.3. Properties

CAS Number:	N/A		
Iodine Value:	75	Titer Point:	50° C
Carbon Number:	17.6		

2.18.4. Commercial Availability

Marula Oil is an item of commerce.

2.18.5. INCI Status

Marula Oil is not yet listed in the CTFA dictionary.

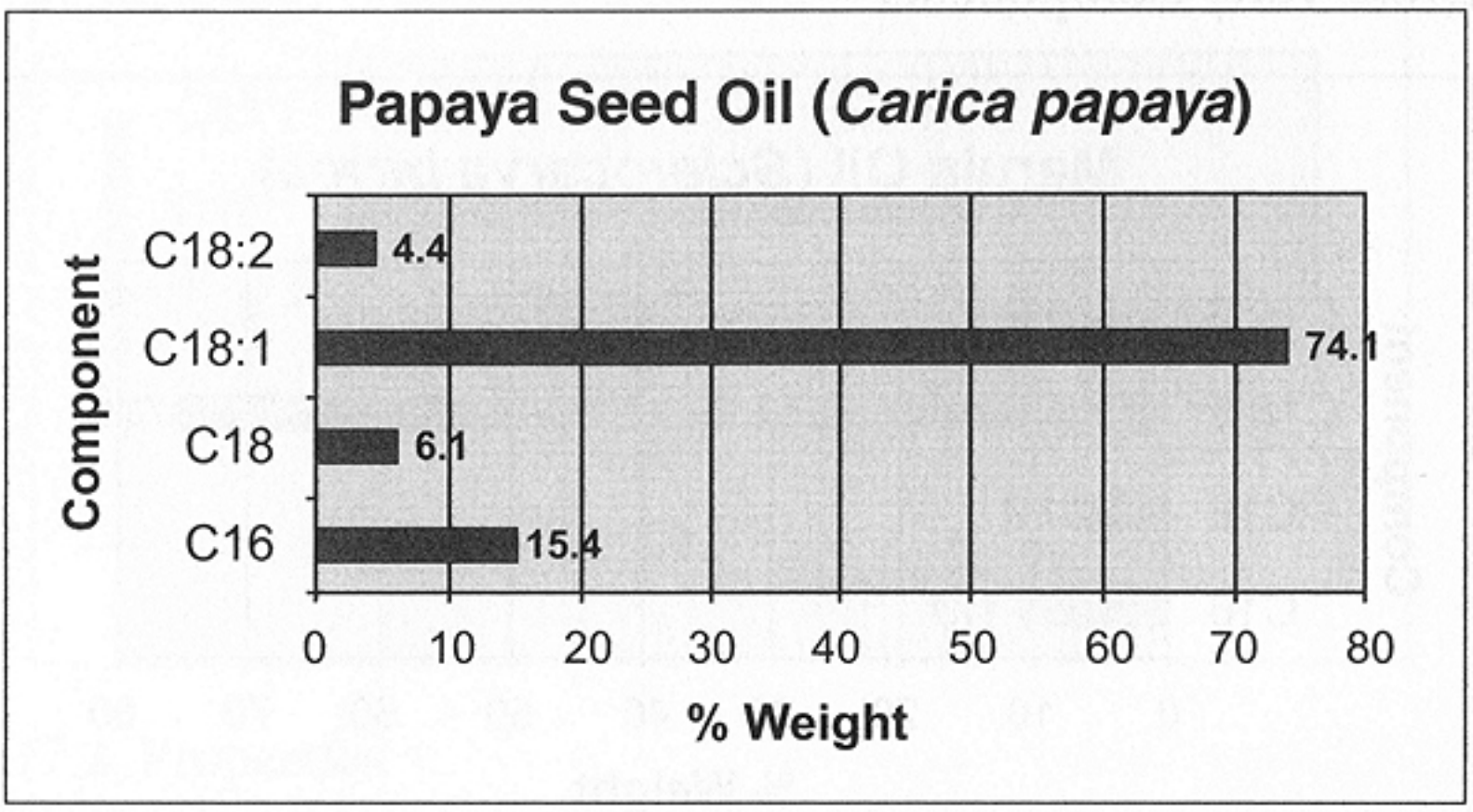
2.19 Papaya Seed Oil (*Carica papaya*)

Carbon Number 17.7

2.19.1. Source

Papaya Seed Oil is the oil obtained from the plant *C. papaya*. This oil has a slight orange color. The plant is grown in Kenya and Uganda. Papaya Seed is a very oxidatively stable oil due to the presence of natural antioxidants. It has general moisturizing properties when applied to skin.

2.19.2. Fatty Components



2.19.3. Properties

CAS Number:	N/A		
Iodine Value:	70	Titer Point:	N/A
Carbon Number:	17.7		

2.19.4. Commercial Availability

Papaya Seed Oil is an item of commerce.

2.19.5. INCI Status

Papaya Seed Oil is not yet listed in the CTFA dictionary.

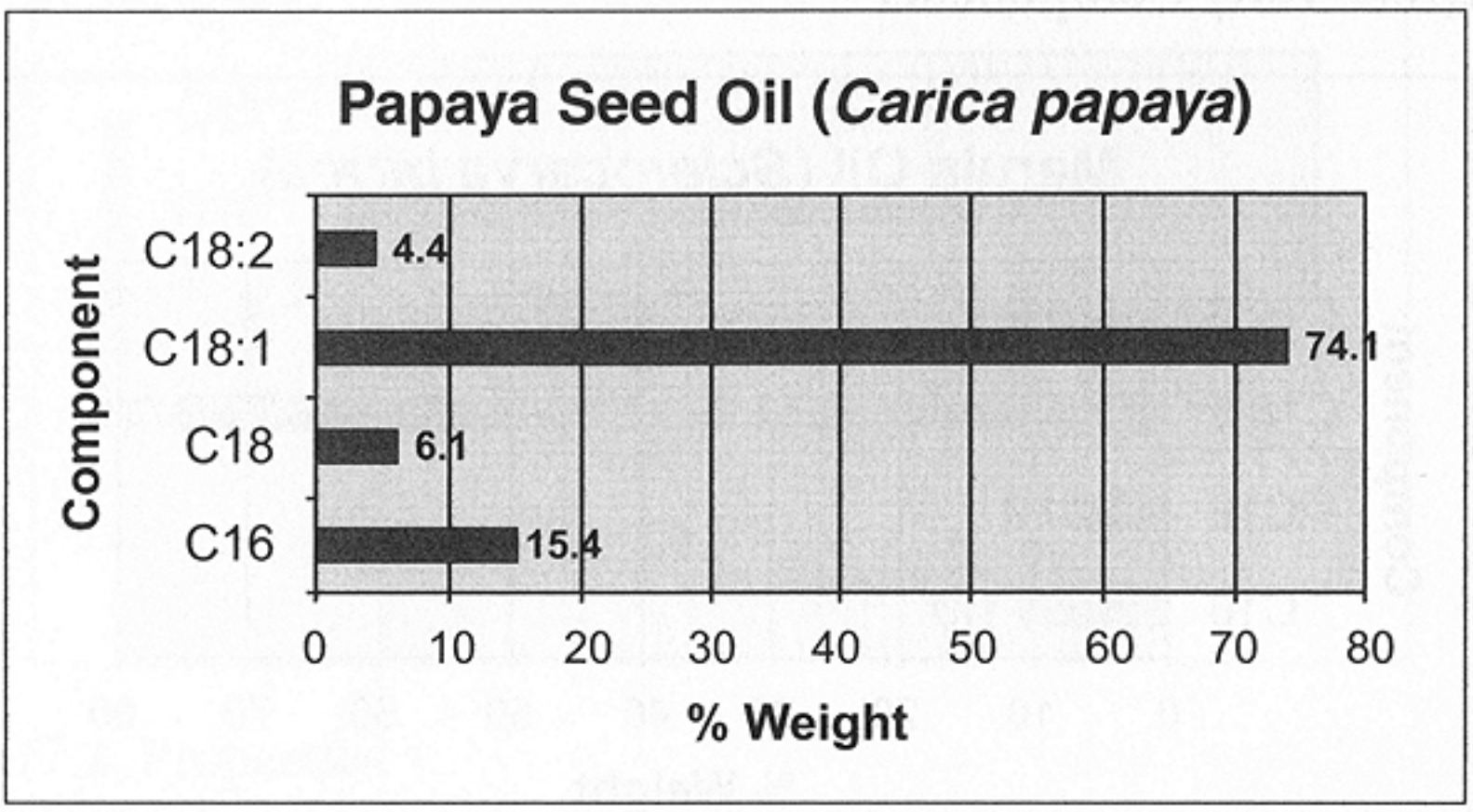
2.19 Papaya Seed Oil (*Carica papaya*)

Carbon Number 17.7

2.19.1. Source

Papaya Seed Oil is the oil obtained from the plant *C. papaya*. This oil has a slight orange color. The plant is grown in Kenya and Uganda. Papaya Seed is a very oxidatively stable oil due to the presence of natural antioxidants. It has general moisturizing properties when applied to skin.

2.19.2. Fatty Components



2.19.3. Properties

CAS Number:	N/A		
Iodine Value:	70	Titer Point:	N/A
Carbon Number:	17.7		

2.19.4. Commercial Availability

Papaya Seed Oil is an item of commerce.

2.19.5. INCI Status

Papaya Seed Oil is not yet listed in the CTFA dictionary.

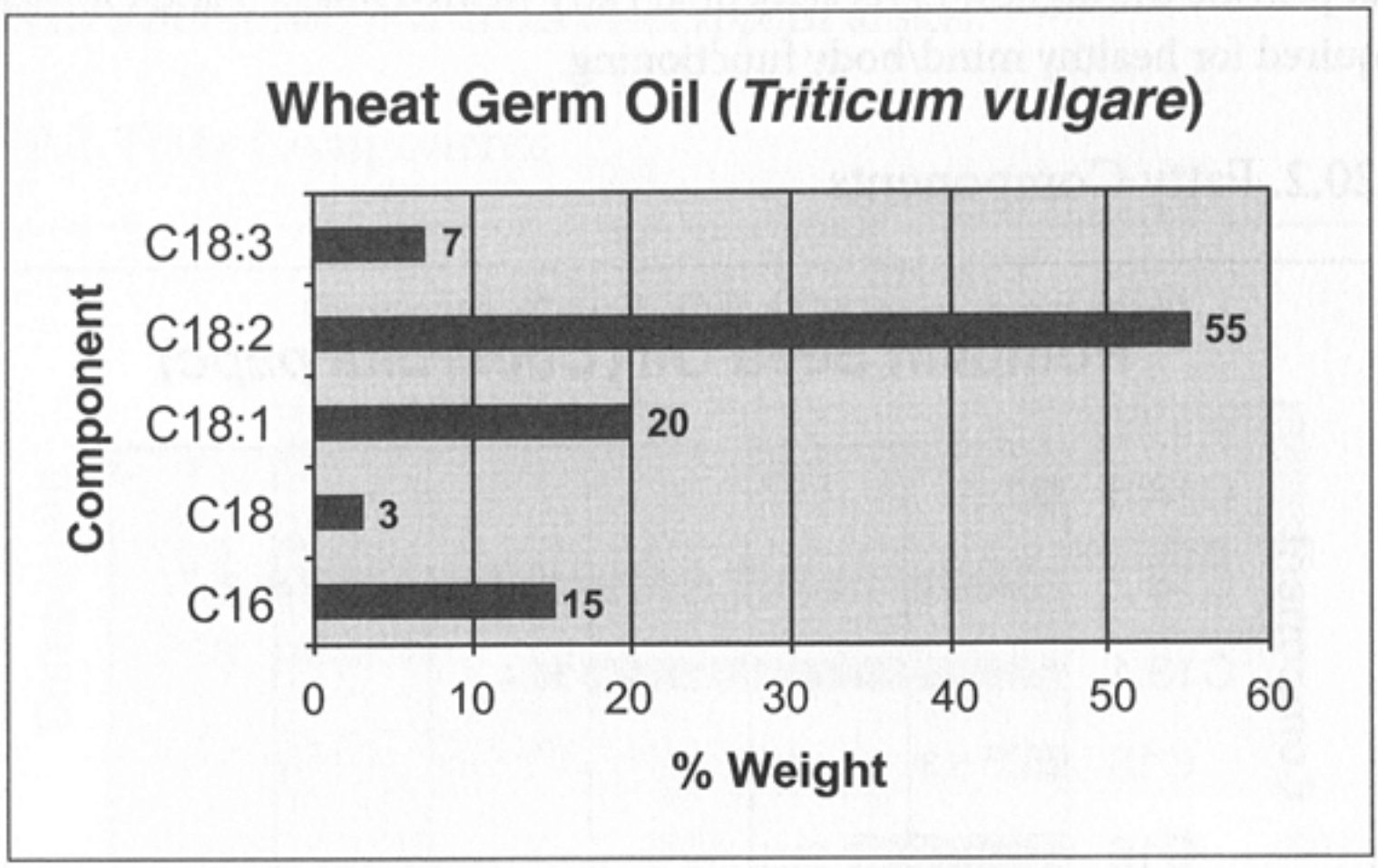
2.21 Wheat Germ Oil (*Triticum vulgare*)

Carbon Number 17.7

2.21.1. Source

Wheat Germ Oil is a triglyceride derived from the extraction of wheat germ.

2.21.2. Fatty Components



2.21.3. Properties

CAS Number: 8046-25-1
Iodine Value: 130
Carbon Number: 17.7

2.21.4. Commercial Availability

Wheat Germ Oil is an item of commerce.

2.21.5. INCI Status

Wheat Germ Oil is listed in the CTFA dictionary, as are 16 of its derivatives. Silicone derivatives are also available.

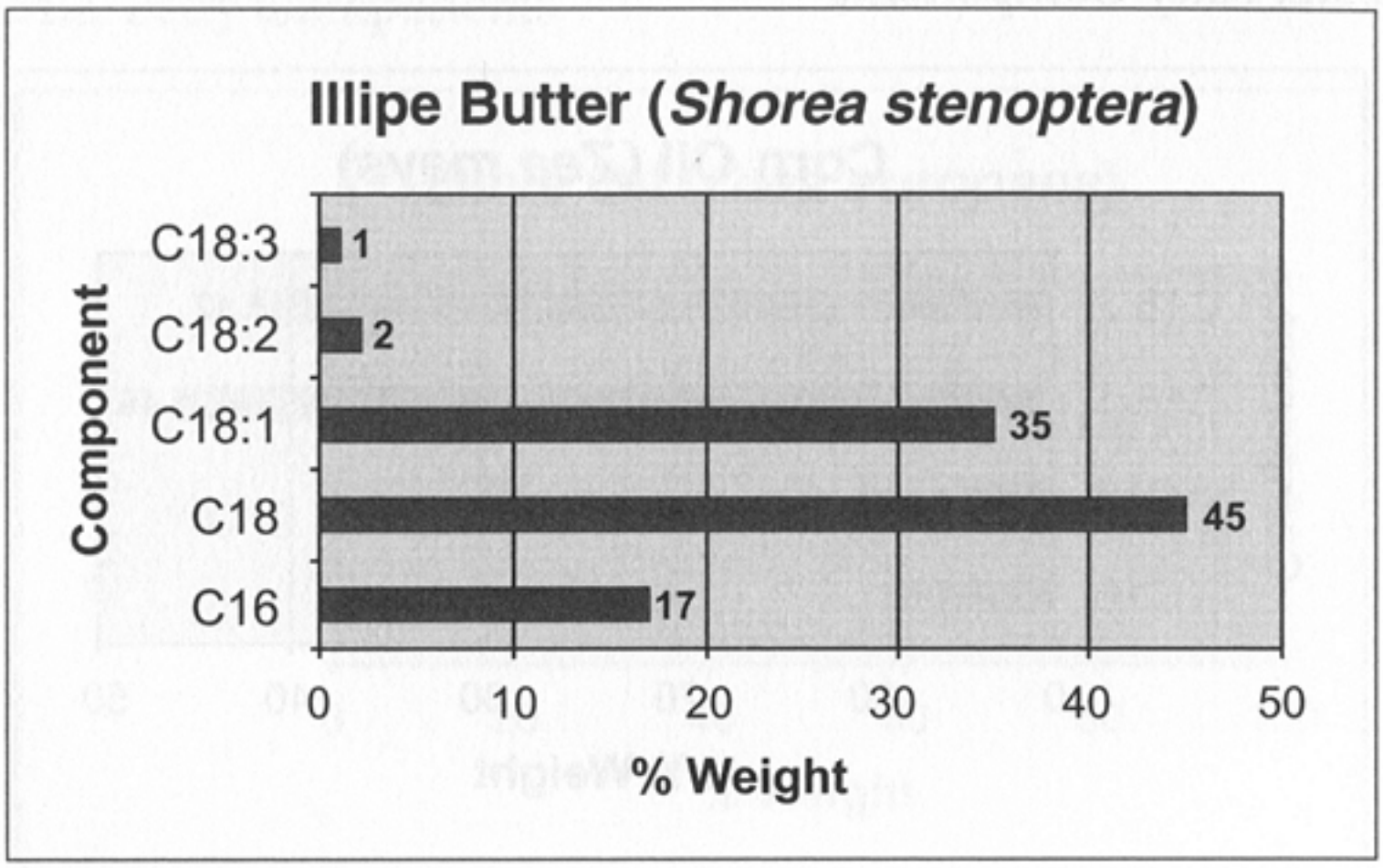
2.22 Illipe Butter (*Shorea stenoptera*)

Carbon Number 17.7

2.22.1. Source

Illipe Butter is a solid fat derived from the fruit of the tree *B. latifola*. It is often used as a substitute for Cocoa Butter.

2.22.2. Fatty Components



2.22.3. Properties

CAS Number:	68424-60-2	EINECS Number:	270-311-6
Iodine Value:	35	Titer Point:	26-30° C
Carbon Number:	17.7		

2.22.4. Commercial Availability

Illipe Butter is an item of commerce.

2.22.5. INCI Status

Illipe Butter Oil is listed in the CTFA dictionary along with several derivatives, including silicone derivatives.

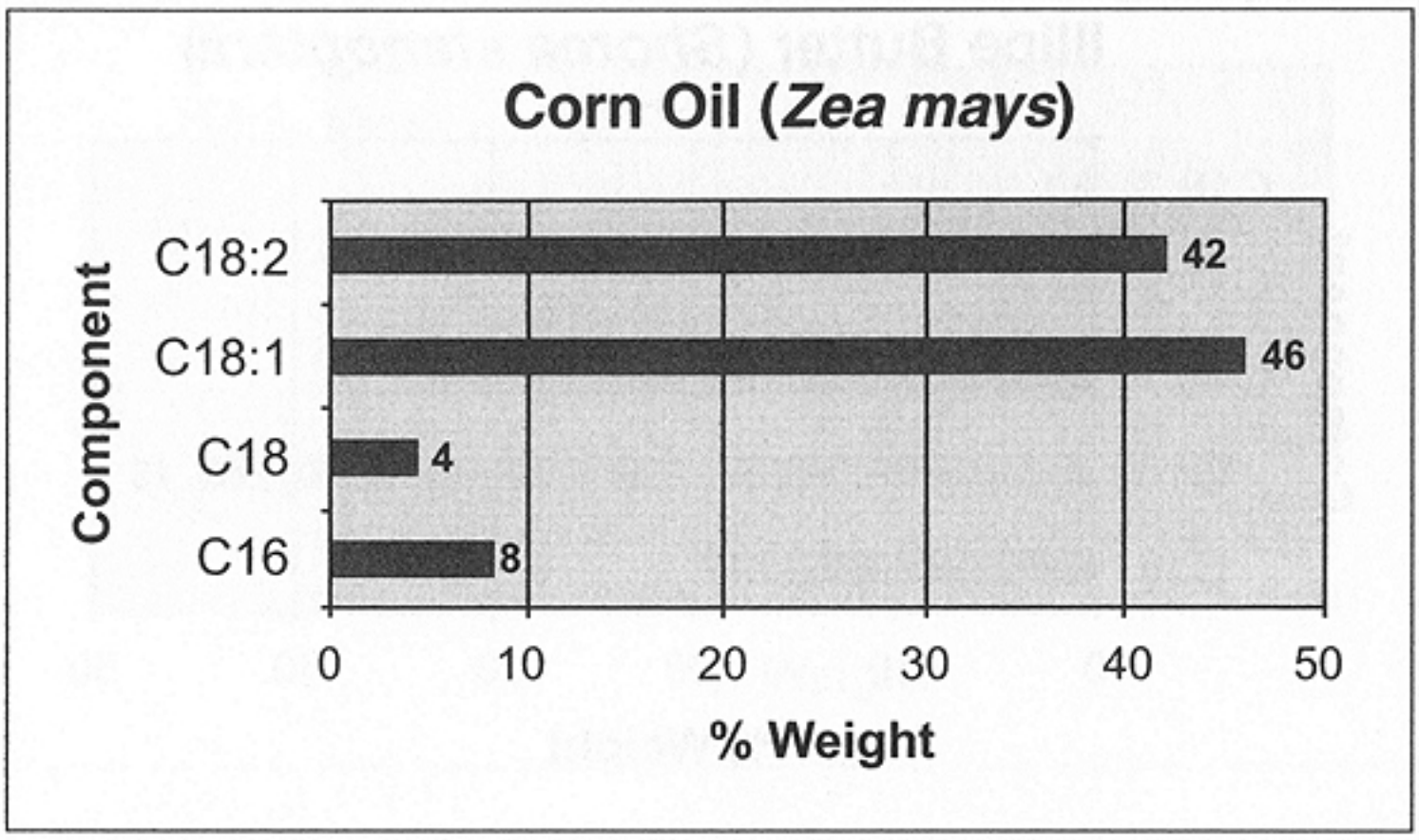
2.23 Corn Oil (*Zea mays*)

Carbon Number 17.8

2.23.1. Source

Corn Oil is a triglyceride derived from the wet milling of corn (*Z. mays, Graminae*). It is cultivated in all the temperate areas of the world. Corn Oil's major use is in foods.

2.23.2. Fatty Components



2.23.3. Properties

CAS Number:	8001-30-7	EINECS Number:	232-281-2
Iodine Value:	123	Titer Point:	17° C (free fatty acid)
Carbon Number:	17.8		

2.23.4. Commercial Availability

Corn Oil is an item of commerce.

2.23.5. INCI Status

Corn Oil is listed in the CTFA dictionary, both per se and in eight derivatives.

2.23.6. Status in Japan

Name:	Corn Oil
Ingredient Code:	002275
Categories:	All categories with no limits

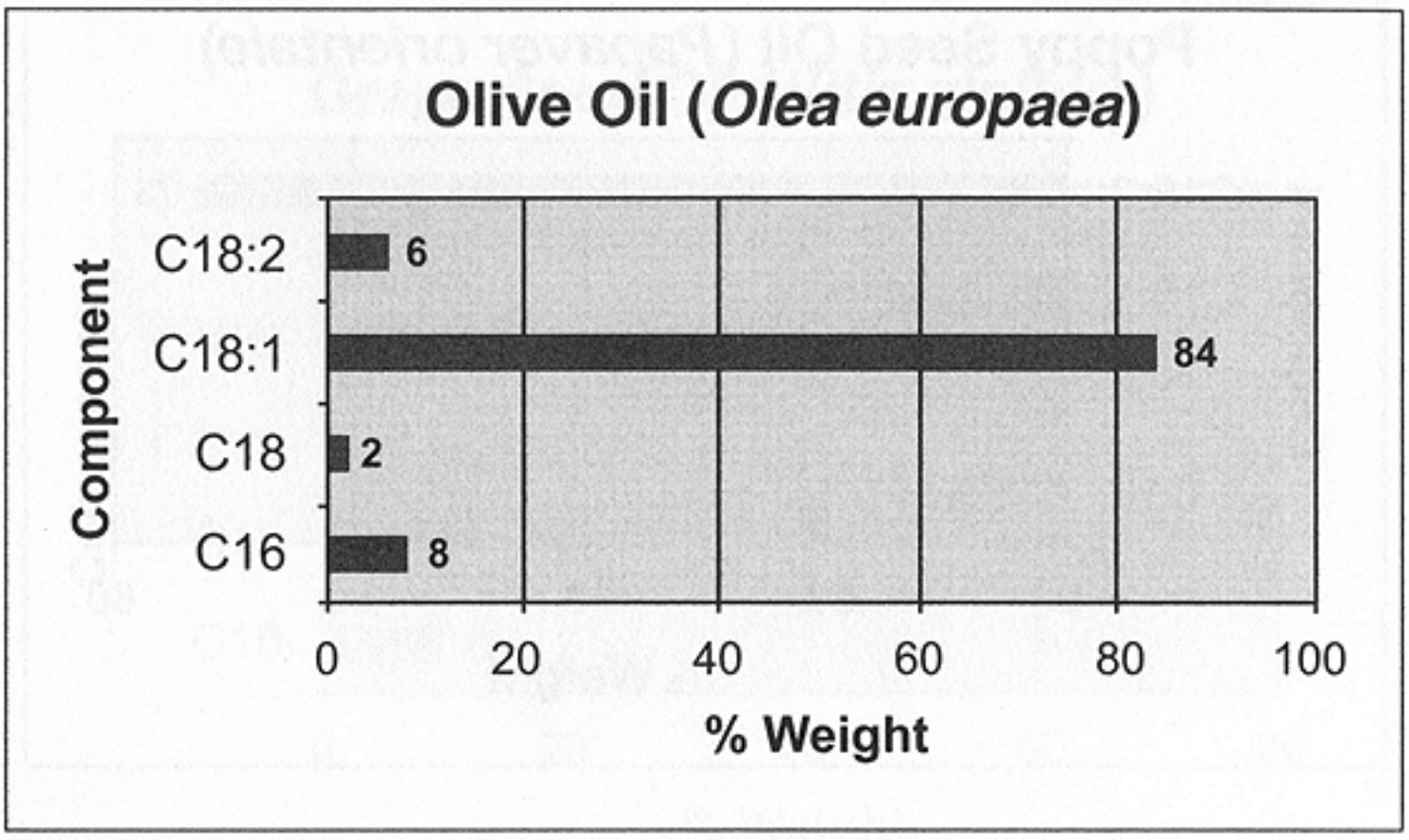
2.24 Olive Oil (*Olea europaea*)

Carbon Number 17.8

2.24.1. Source

Olive Oil is a triglyceride that has occupied a unique position in civilization: it is the oldest oil known to man. It is produced throughout the area that was once the Roman Empire.

2.24.2. Fatty Components



2.24.3. Properties

CAS Number:	8001-25-0	EINECS Number:	232-277-0
Iodine Value:	84	Titer Point:	20° C (free fatty acid)
Carbon Number:	17.8		

2.24.4. Commercial Availability

Olive Oil is available as an item of commerce. Olive Oil has been used for many years in the cosmetic industry and is a very important raw material.

2.24.5. INCI Status

Olive Oil is listed in the CTFA dictionary, both per se and in 21 derivatives, including silicone derivatives.

2.24.6. Status in Japan

Name:	Olive Oil
Ingredient Code:	001191
Categories:	All categories with no limits

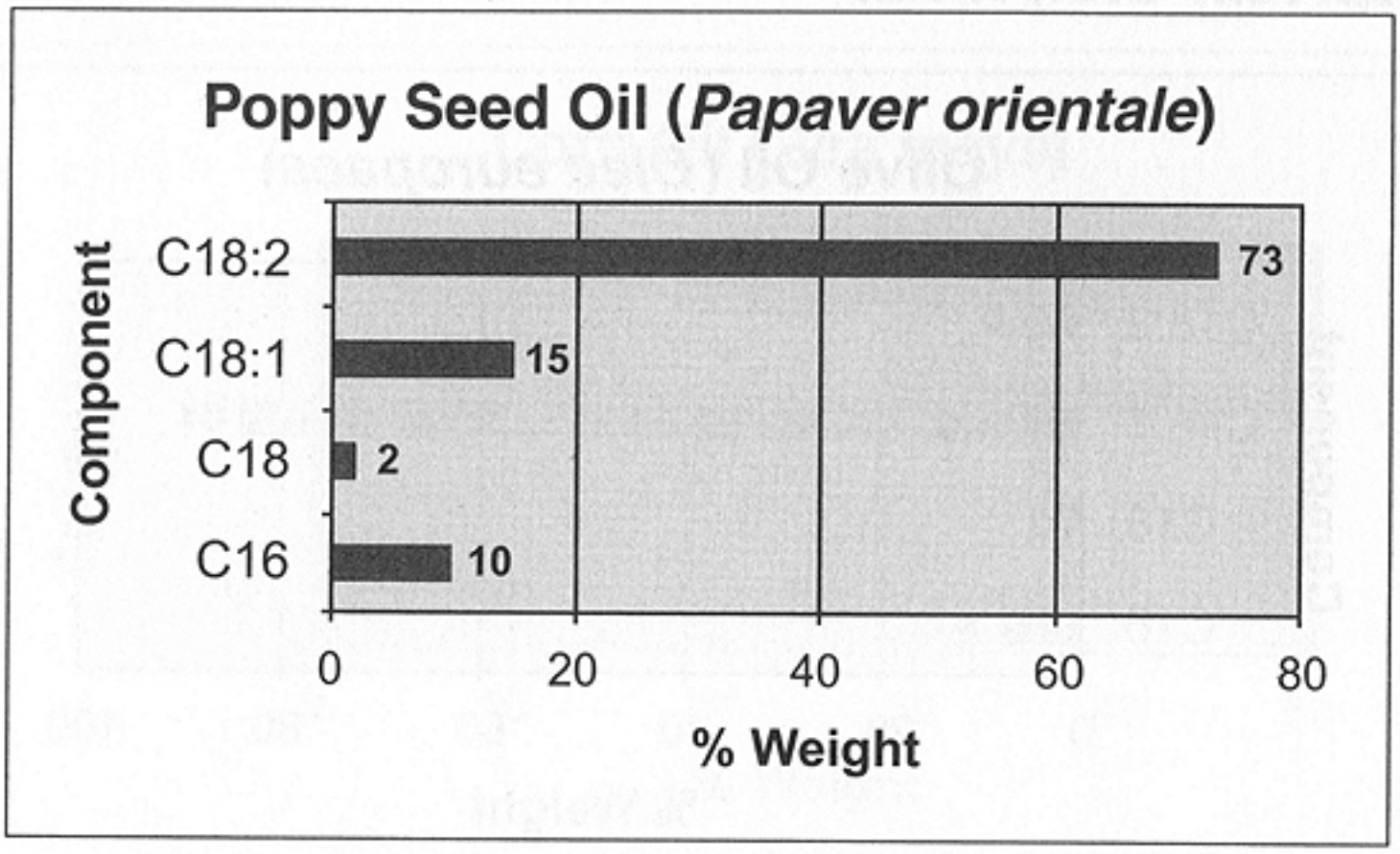
2.25 Poppy Seed Oil (*Papaver orientale*)

Carbon Number 17.8

2.25.1. Source

Poppy Seed Oil is a triglyceride derived from the poppy (*P. orientiale*). It was originally cultivated in Asia Minor, but is now produced in Europe.

2.25.2. Fatty Components



2.25.3. Properties

CAS Number:	8002-11-7		
Iodine Value:	138	Titer Point:	-17° C (free fatty acid)
Carbon Number:	17.8		

2.25.4. Commercial Availability

Poppy Seed Oil is an item of commerce.

2.25.5. INCI Status

Poppy Seed Oil is not currently listed in the CTFA dictionary.

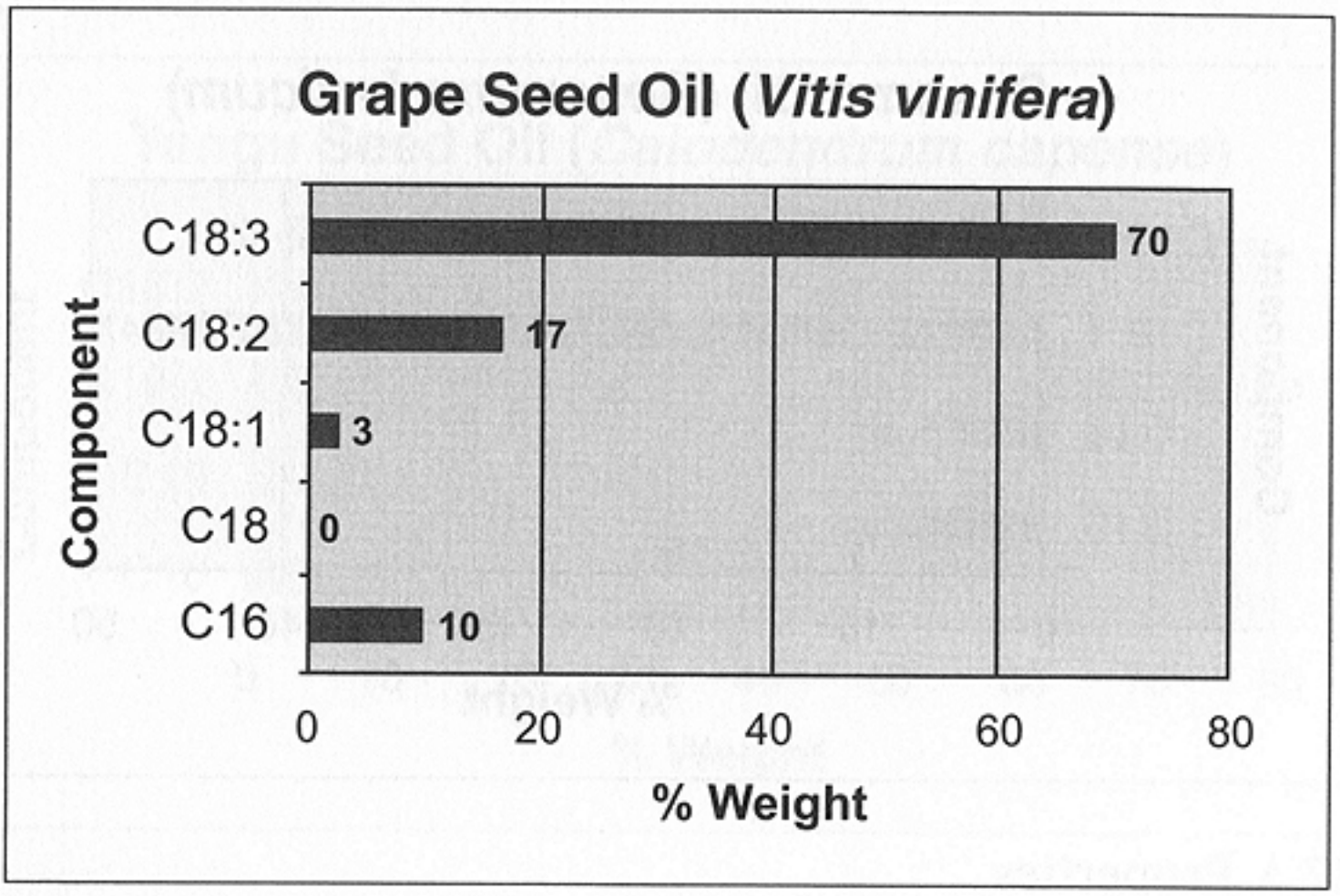
2.26 Grape Seed Oil (*Vitis vinifera*)

Carbon Number 17.8

2.26.1. Source

Grape Seed Oil is a triglyceride derived from grapes (*V. vinifera*). It is cultivated in many areas of the world, but originated in countries along the Mediterranean coast (Italy, France, Turkey, Greece and Yugoslavia).

2.26.2. Fatty Components



2.26.3. Properties

CAS Number:	8024-22-4	EINECS Number:	287-896-9
Iodine Value:	135	Titer Point:	-3° C (free fatty acid)
Carbon Value:	17.8		

2.26.4. Commercial Availability

Grape Seed Oil is an item of commerce.

2.26.5. INCI Status

Grape Seed Oil is listed in the CTFA dictionary, as are several derivatives.

2.26.6. Status in Japan

Name:	Grape Seed Oil
Ingredient Code:	520938
Categories:	All categories with no limits, except eyeliners (category 8).

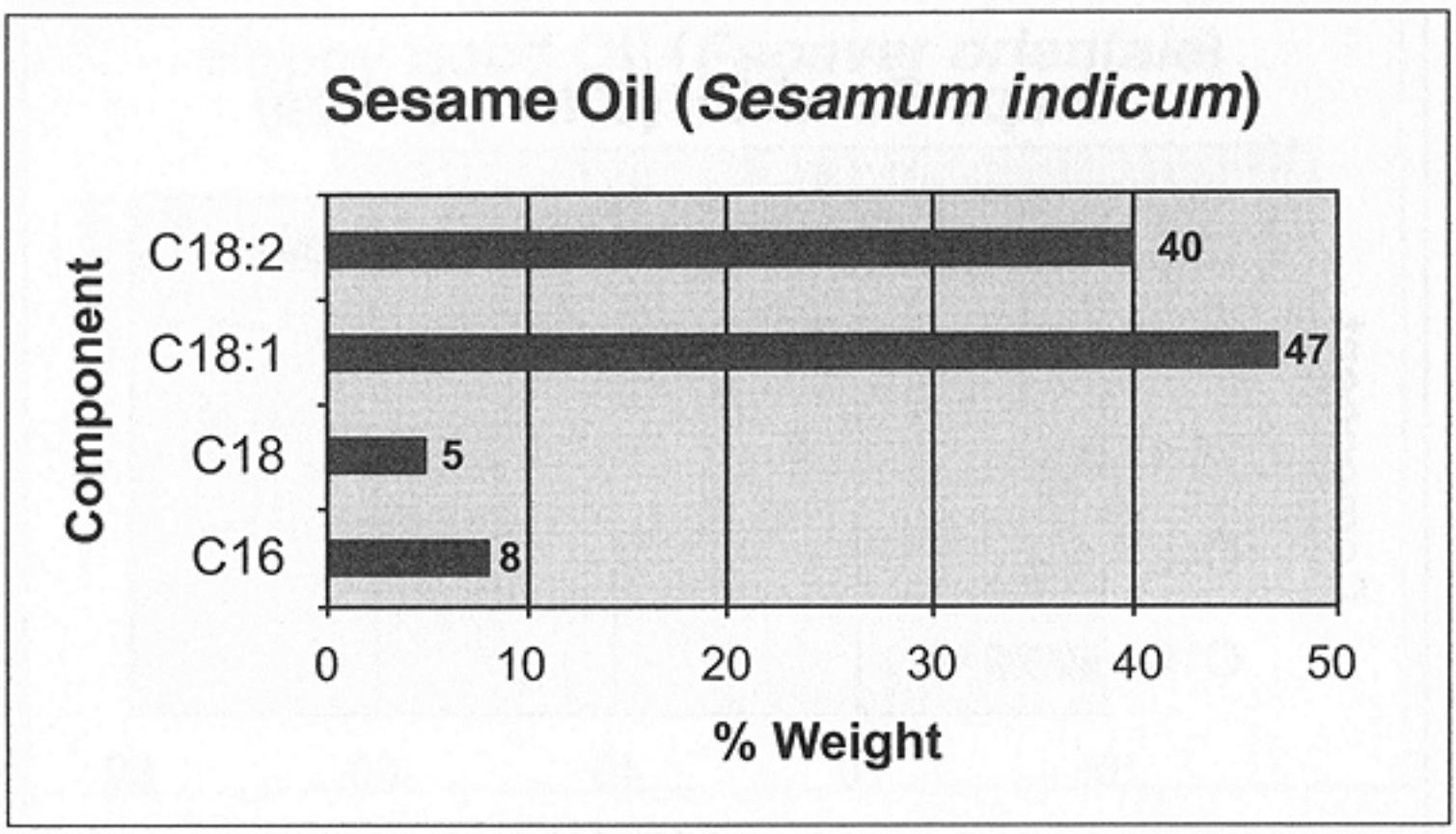
2.27 Sesame Oil (*Sesamum indicum*)

Carbon Number 17.8

2.27.1. Source

Sesame Oil is a triglyceride derived from *S. indicum*. It is cultivated in Africa, Europe, China, Central and South America, and the southern United States. It is one of the world's oldest crops.

2.27.2. Fatty Components



2.27.3. Properties

CAS Number:	8008-74-0	EINECS Number:	232-370-6
Iodine Value:	110	Titer Point:	22° C (free fatty acid)
Carbon Number:	17.8		

2.27.4. Commercial Availability

Sesame Oil is a common item of commerce.

2.27.5. INCI Status

Sesame Oil is listed in the CTFA dictionary, both per se and in derivatives.

2.27.6. Status in Japan

Name:	Sesame Oil
Ingredient Code:	001249
Categories:	All categories with no limits

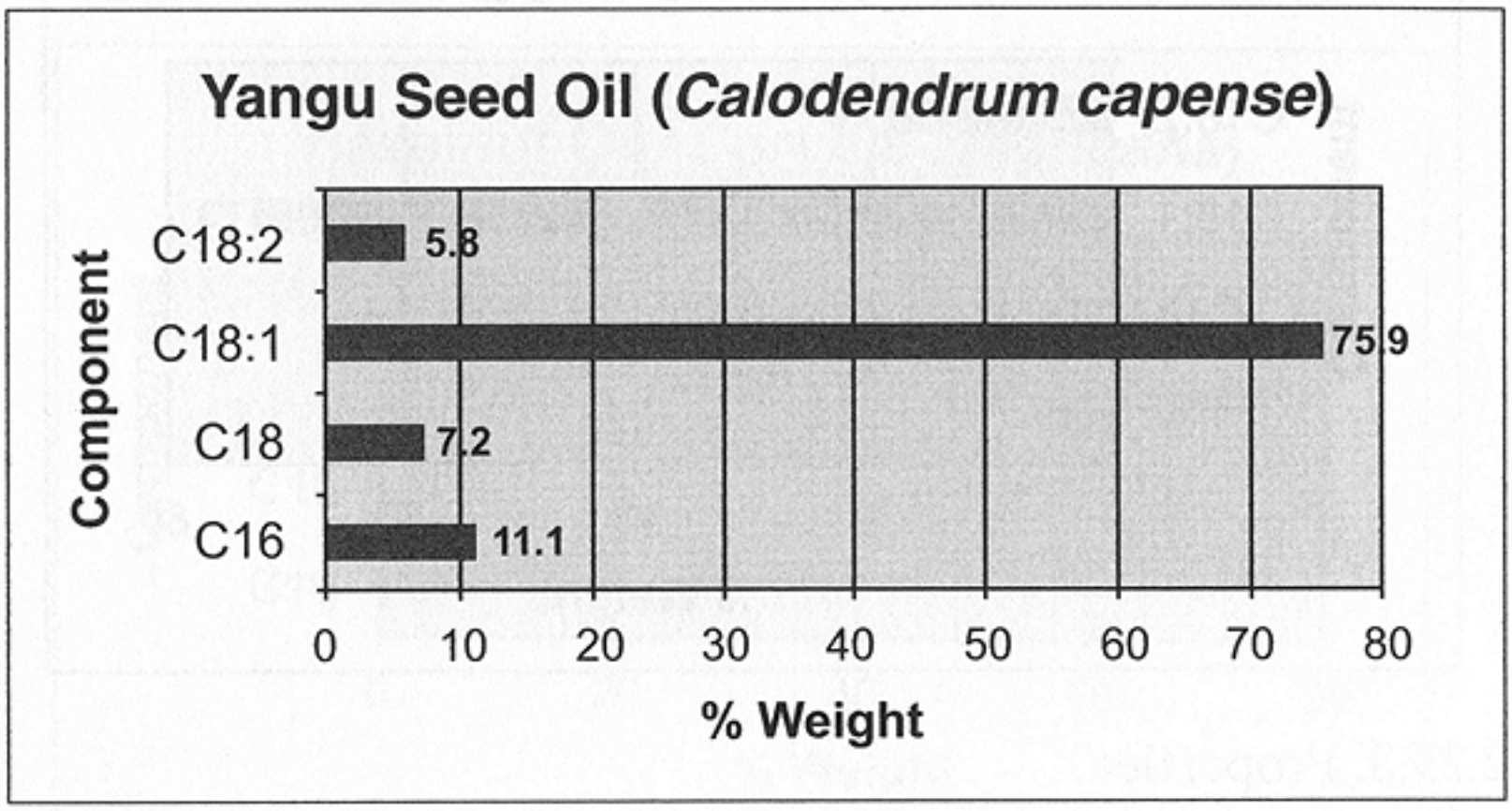
2.28 Yangu Seed Oil (*Calodendrum capense*)

Carbon Number 17.8

2.28.1. Source

Yangu Seed Oil is the oil from the seed of the plant *Calodendrum capense*. It is a light-yellow oil with a neutral odor. Yangu Seed Oil comes from Kenyan and Ugandan highlands. It is an interesting oil with intrinsic UV light screening properties; it also serves as a skin moisturizing compound.

2.28.2. Fatty Components



2.28.3. Properties

CAS Number:	N/A		
Iodine Value:	77	Titer Point:	N/A
Carbon Number:	17.8		

2.28.4. Commercial Availability

Yangu Seed Oil is an item of commerce.

2.28.5. INCI Status

Yangu Seed Oil is not yet listed in the CTFA dictionary.

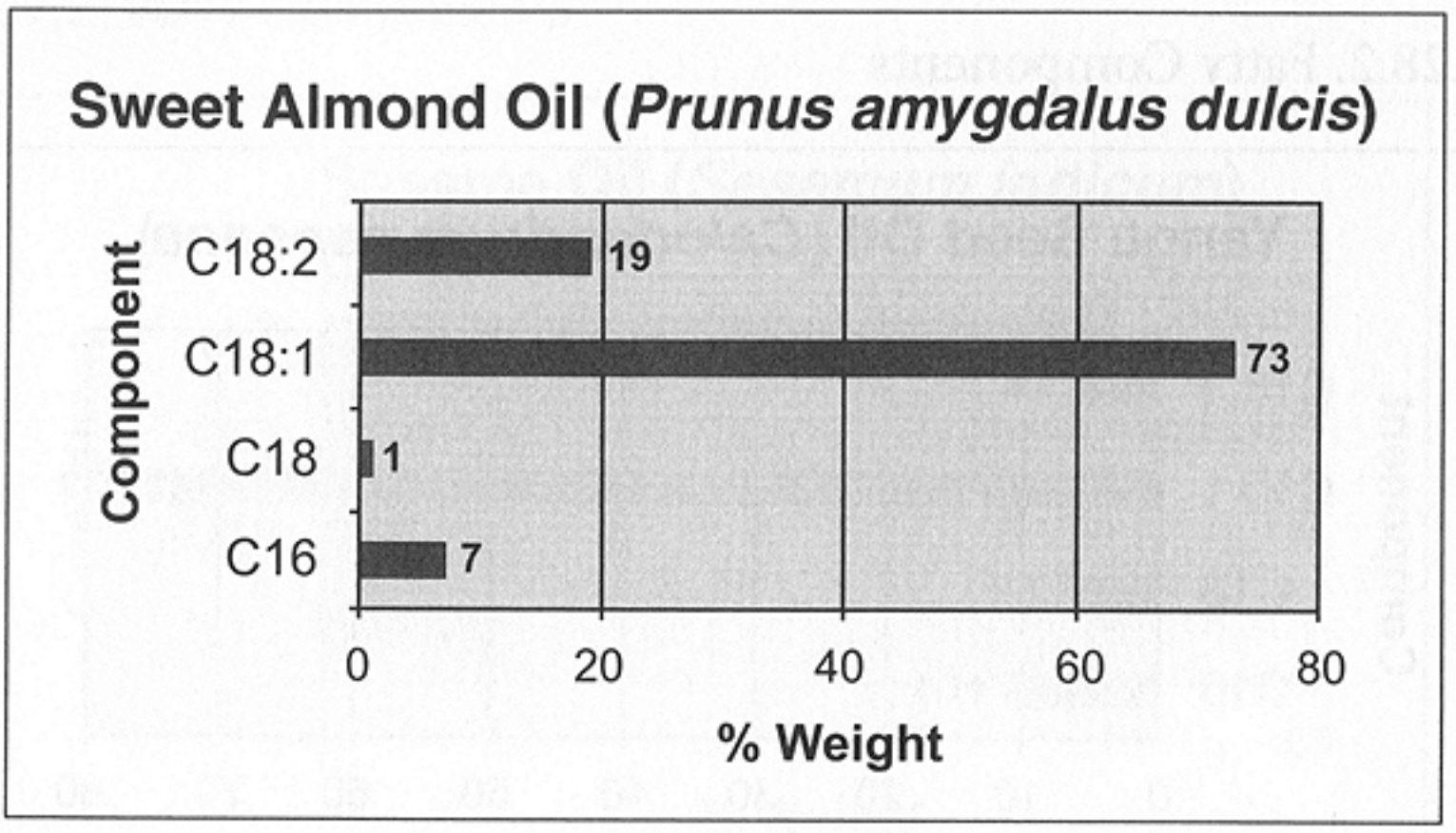
2.29 Sweet Almond Oil (*Prunus amygdalus dulcis*)

Carbon Number 17.9

2.29.1. Source

Sweet Almond Oil is a triglyceride derived from the almond (*P. amygdalus*). It is cultivated in all the temperate areas of the world.

2.29.2. Fatty Components



2.29.3. Properties

CAS Number:	8007-69-0	EINECS Number:	291-061-4
Iodine Value:	102	Titer Point:	10° C (free fatty acid)
Carbon Number:	17.9		

2.29.4. Commercial Availability

Sweet Almond Oil is an item of commerce.

2.29.5. INCI Status

Almond Oil is listed in the CTFA dictionary, both per se and in derivatives, including silicone derivatives.

2.29.6. Status in Japan

Name:	Almond Oil
Ingredient Code:	100405
Categories:	All categories with no limits

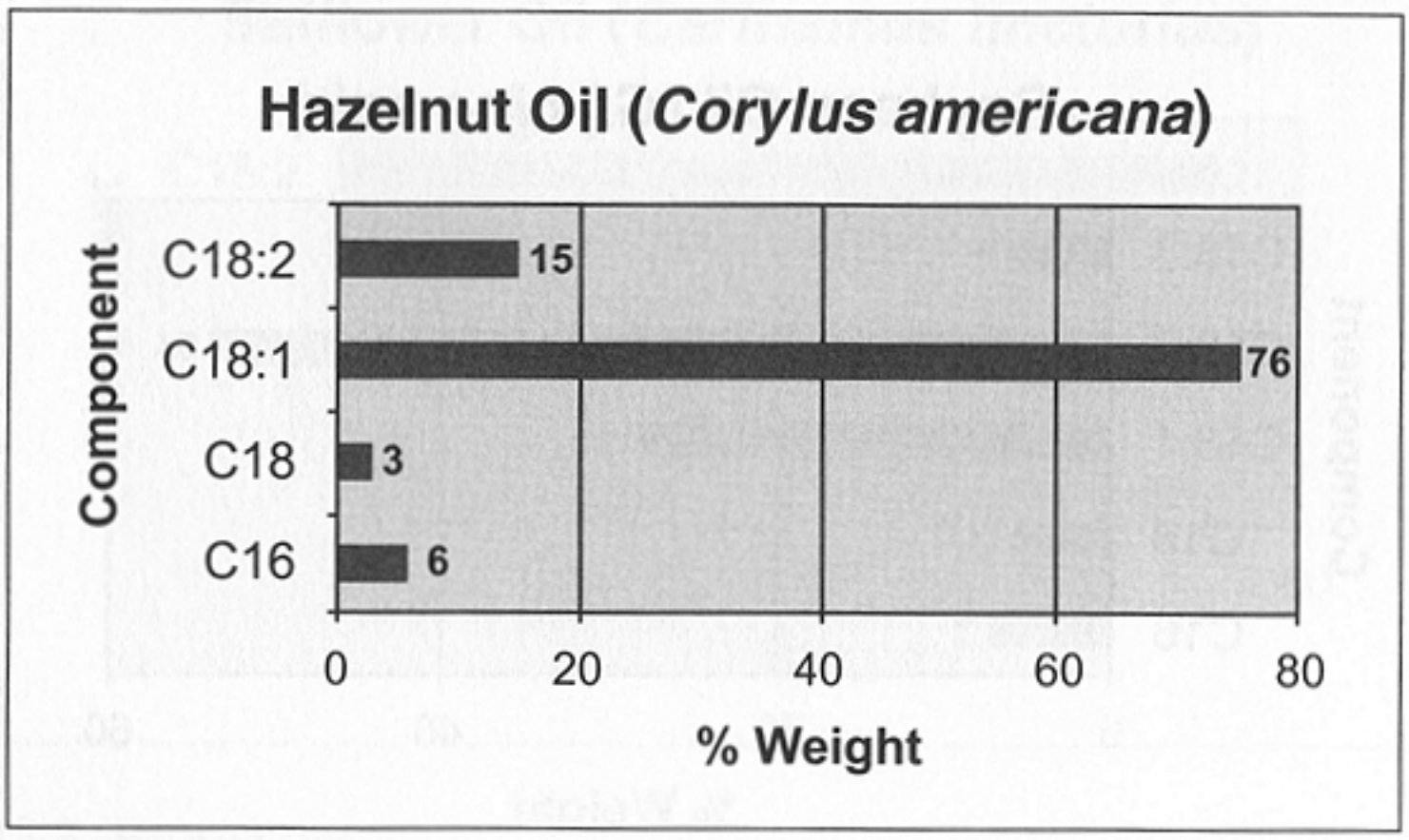
2.30 Hazelnut Oil (*Corylus americana*)

Carbon Number 17.9

2.30.1. Source

Hazelnut Oil is a triglyceride derived from the nut of the hazelnut tree (*Corylus americana*). It is cultivated in Europe, principally Italy, Spain and Turkey. Hazelnut Oil contains natural preservatives and antioxidants, which render the oil very stable.

2.30.2. Fatty Components



2.30.3. Properties

CAS Number:	84012-21-5	EINECS Number:	281-667-7
Iodine Value:	86	Titer Point:	-19° C (free fatty acid)
Carbon Number:	17.9		

2.30.4. Commercial Availability

Hazelnut Oil is an item of commerce.

2.30.5. INCI Status

Hazelnut Oil is listed in the CTFA dictionary, both per se and in derivatives.

2.30.6. Status in Japan

Name:	Hazelnut Oil
Ingredient Code:	520951
Categories:	All categories with no limits

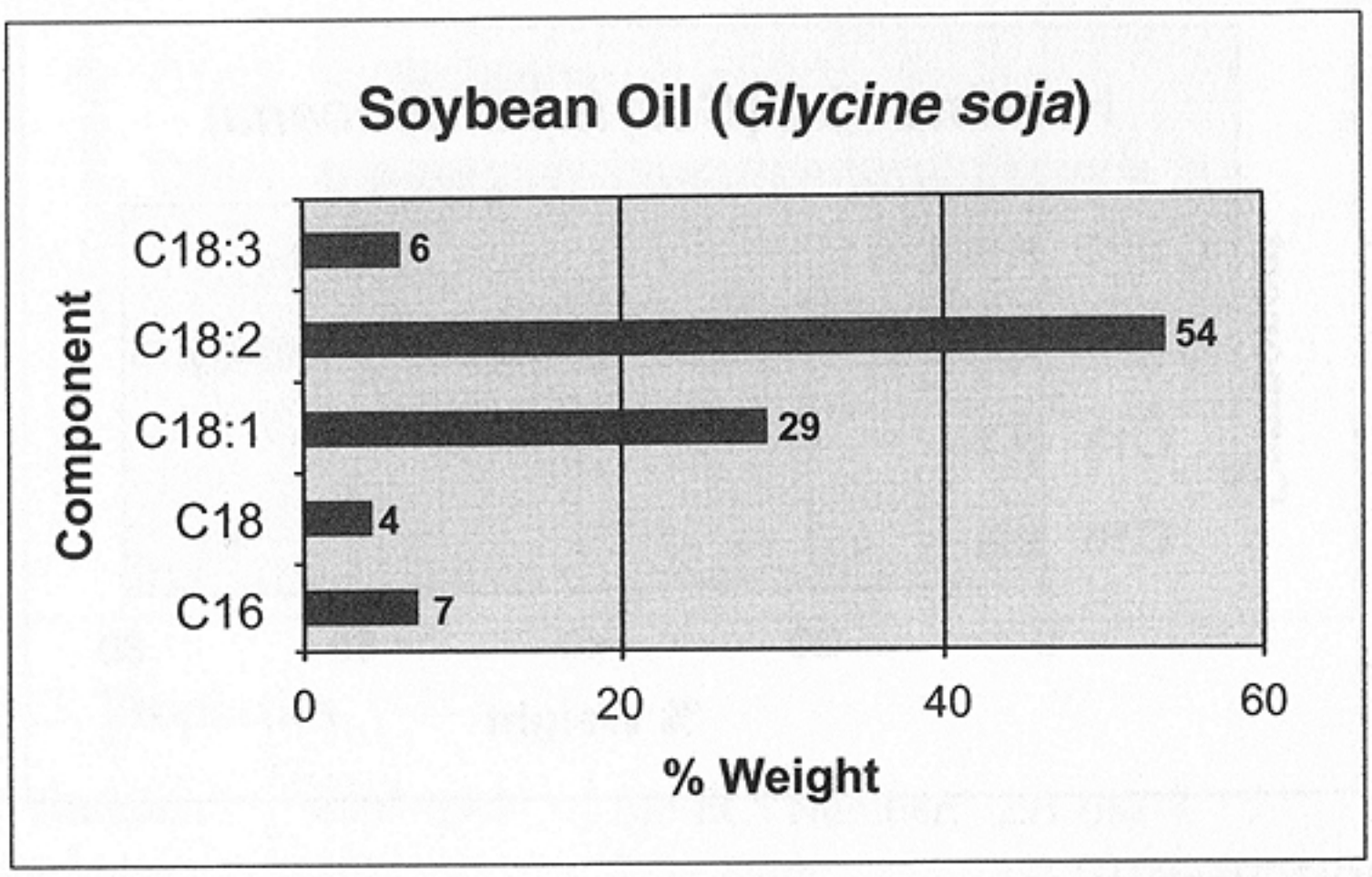
2.31 Soybean Oil (*Glycine soja*)

Carbon Number 17.9

2.31.1. Source

Soybean Oil is a triglyceride derived from the soybean (*Glycine max L.*). The soybean originated in China, as far back as 2,300 BC. Later on, it was cultivated widely in North America, most specifically in the United States, where it remains a major food crop today.

2.31.2. Fatty Components



2.31.3. Properties

CAS Number:	8001-22-7	EINECS Number:	232-274-4
Iodine Value:	130	Titer Point:	21° C (free fatty acids)
Carbon Number:	17.9		

2.31.4. Commercial Availability

Soybean Oil is a commodity. It is an item of commerce.

2.31.5. INCI Status

Soybean Oil is listed in the CTFA dictionary, both per se and in derivatives.

2.31.6. Status in Japan

Name:	Soybean Oil
Ingredient Code:	001390
Categories:	All categories with no limits

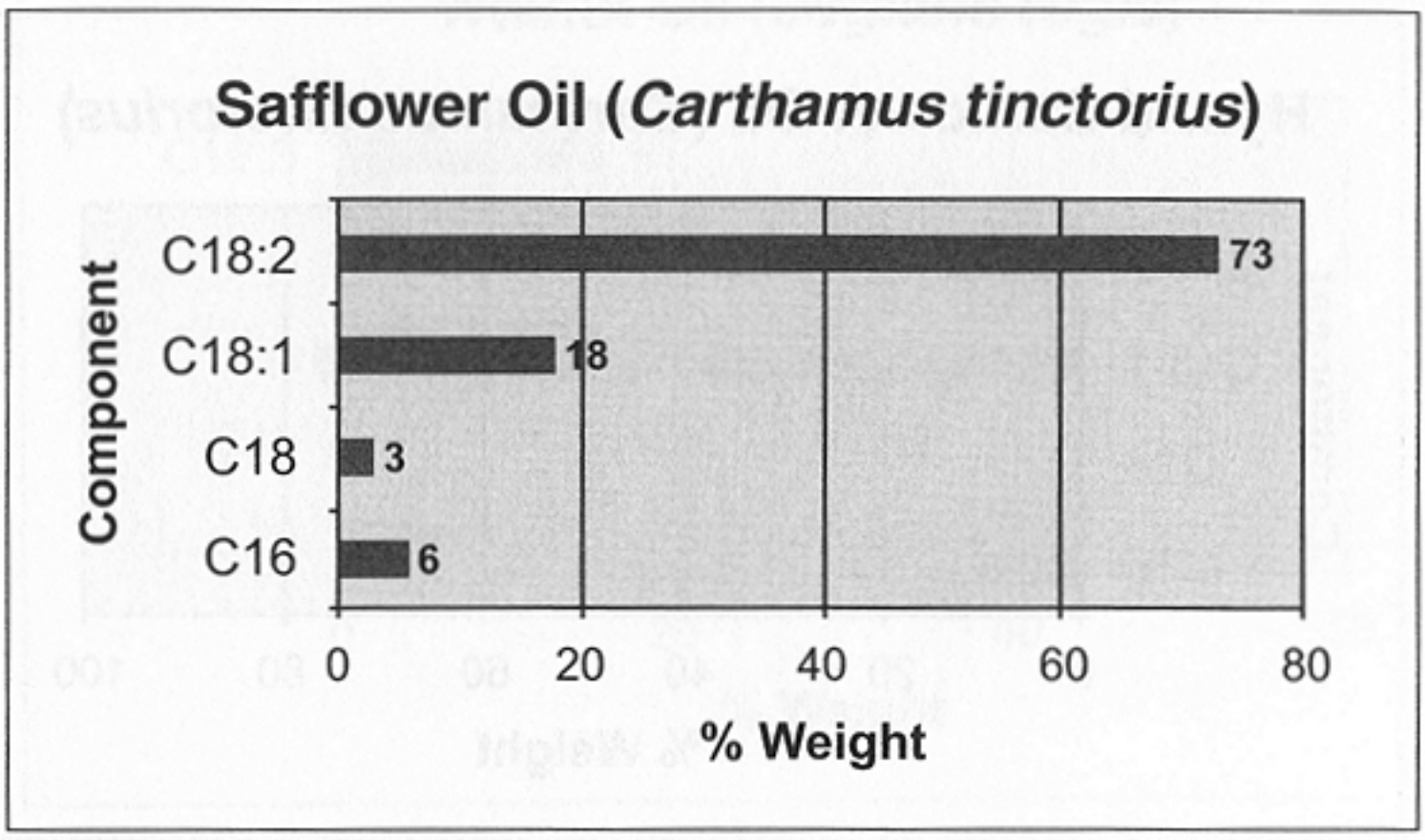
2.32 Safflower Oil (*Carthamus tinctorius*)

Carbon Number 17.9

2.32.1. Source

Safflower Oil is a triglyceride derived from the species *C. tinctorius*. It originates in the Orient, but the United States production has been selected to maximize the polyunsaturate content.

2.32.2. Fatty Components



2.32.3. Properties

CAS Number:	8001-23-9	EINECS Number:	232-276-6
Iodine Value:	145	Titer Point:	16° C (free fatty acids)
Carbon Number:	17.9		

2.32.4. Commercial Availability

Safflower Oil is an item of commerce.

2.32.5. INCI Status

Safflower Oil is listed in the CTFA dictionary, both per se and in derivatives.

2.32.6. Status in Japan

Name:	Safflower Oil
Ingredient Code:	500186
Categories:	All categories with no limits

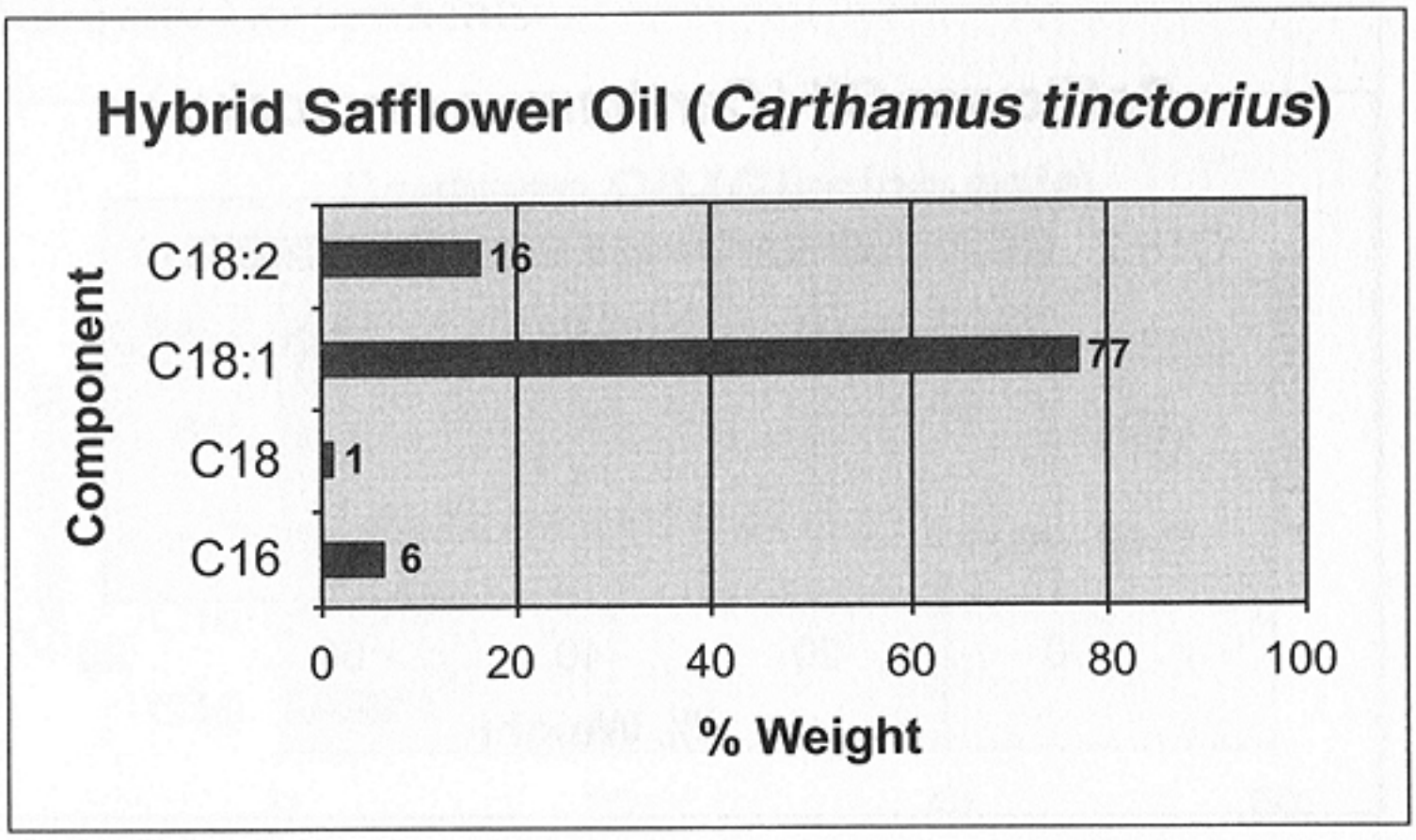
2.33 Hybrid Safflower Oil (*Carthamus tinctorius*)

Carbon Number 17.9

2.33.1. Source

Hybrid Safflower Oil is a triglyceride derived from the species *C. tinctorius*. This is the high oleic species. It originates in the Orient, but the United States production has been selected to maximize oil content.

2.33.2. Fatty Components



2.33.3. Properties

CAS Number:	8001-23-8	EINECS Number:	232-276-6
Iodine Value:	140	Titer Point:	16° C (free fatty acids)
Carbon Number:	17.9		

2.33.4. Commercial Availability

Hybrid Safflower Oil is an item of commerce.

2.33.5. INCI Status

Hybrid Safflower Oil is listed in the CTFA dictionary, both per se and in derivatives.

2.33.6. Status in Japan

Name:	Hybrid Safflower Oil
Ingredient Code:	523105
Categories:	Categories 1-7 with no limits

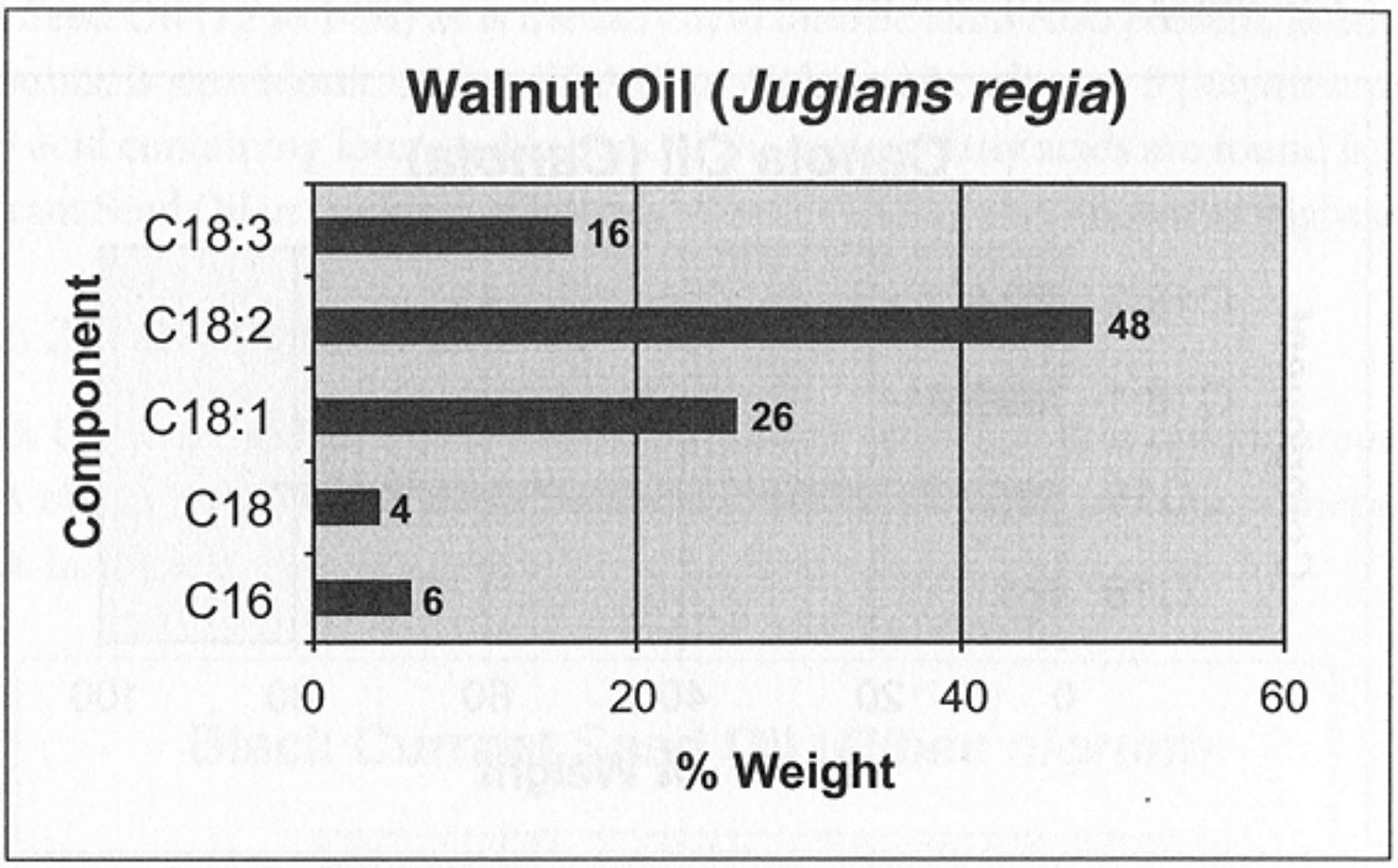
2.34 Walnut Oil (*Juglans regia*)

Carbon Number 17.9

2.34.1. Source

Walnut Oil is a triglyceride derived from the walnut (*Juglans regia*). It originated in Persia and is now cultivated in Europe, primarily in southern France.

2.34.2. Fatty Components



2.34.3. Properties

CAS Number:	8024-09-7	EINECS Number:	84604-00-2
Iodine Value:	150	Titer Point:	22° C (free fatty acid)
Carbon Value:	17.9		

2.34.4. Commercial Availability

Walnut Oil is an item of commerce.

2.34.5. INCI Status

Walnut Oil is not listed in the CTFA dictionary.

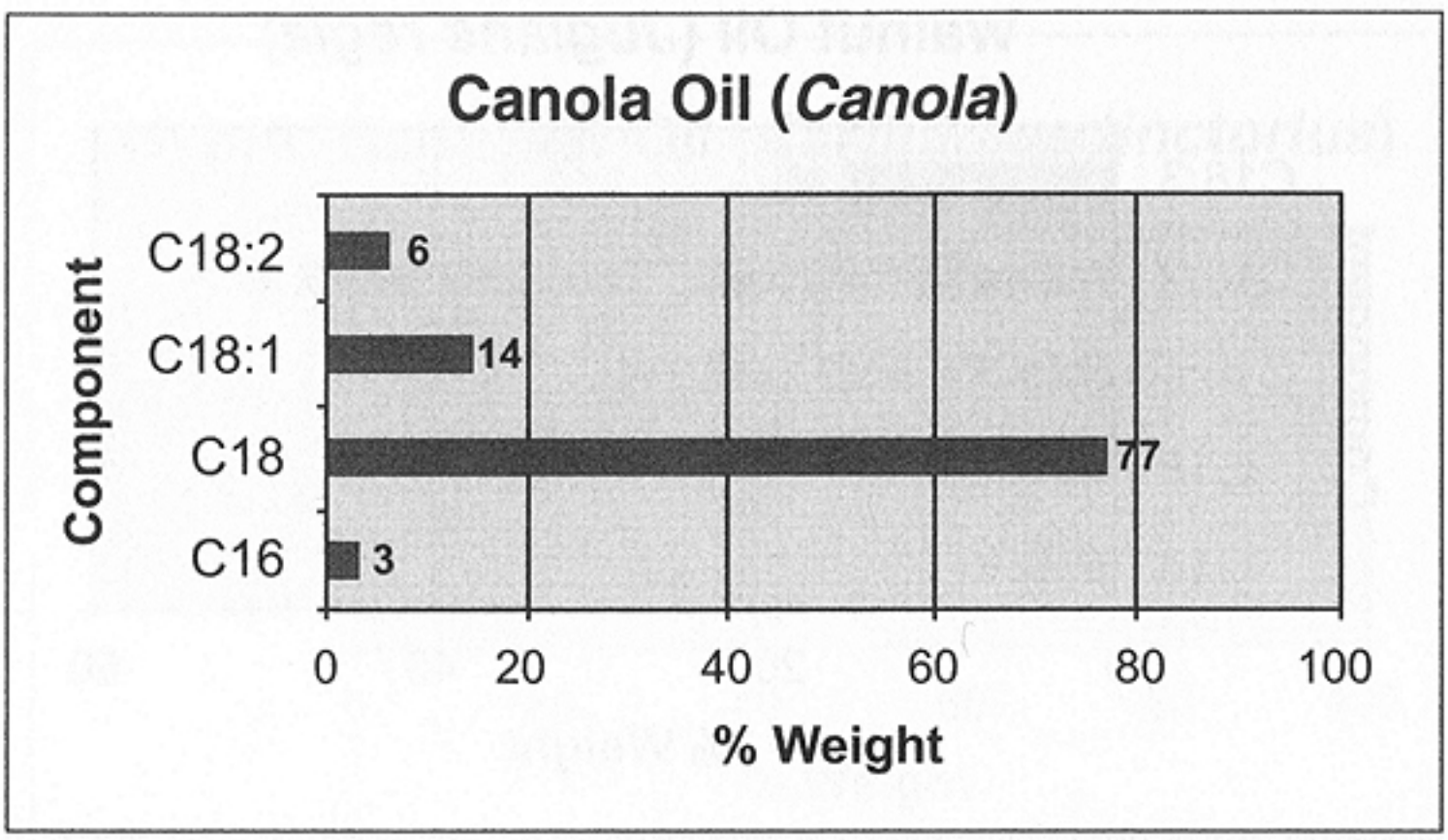
2.35 Canola Oil (*Canola*)

Carbon Number 17.9

2.35.1. Source

Canola Oil is a triglyceride produced from genetically modified rapeseed to change the principal fatty acid from C-22 to C-18. It was developed in Canada and is now widely available throughout the world.

2.35.2. Fatty Components



2.35.3. Properties

CAS Number:	120962-03-0	EINECS Number:	232-313-5
Iodine Value:	92	Titer Point:	43° C
Carbon Number:	17.9		

2.35.4. Commercial Availability

Canola Oil is an item of commerce, used primarily in food.

2.35.5. INCI Status

Canola Oil is listed in the CTFA dictionary, both per se and in derivatives.

2.36 Black Currant Seed Oil (*Ribes nigrum*)

Carbon Number 17.9

2.36.1. Source

Black Currant Seed Oil comes from the seeds of the plant *R. nigrum*. It is a rich source of the n-6 (omega-6) polyunsaturated fatty acid gamma-linolenic acid (GLA). Black Currant Seed Oil contains about 15 to 20% GLA. The n-3 (omega-3) polyunsaturated fatty acid alpha-linolenic acid (ALA) is also present in Black Currant Seed Oil (12 to 14%) as is the fatty acid linoleic acid. Also present, in smaller amounts, is stearidonic acid or SDA (2 to 4%), an 18 carbon n-3 polyunsaturated fatty acid containing four double bonds. The various fatty acids are found in Black Currant Seed Oil in the form of triacylglycerols (TAGs), also known as triglycerides.

2.36.2. Fatty Components

Black Currant Seed Oil contains a minimum of 14% GLA. It is unique among GLA oils in that it contains both the omega-3 (12% alpha-Linolenic) omega-6 (45% Linoleic).

2.36.3. Properties

CAS Number:	68606-81-5		
Iodine Value:	141	Titer Point:	N/A
Carbon Number:	17.9		

2.36.4. Commercial Availability

Black Currant Seed Oil is an item of commerce.

2.36.5. INCI Status

Black Currant Seed Oil is not yet listed in the CTFA dictionary.

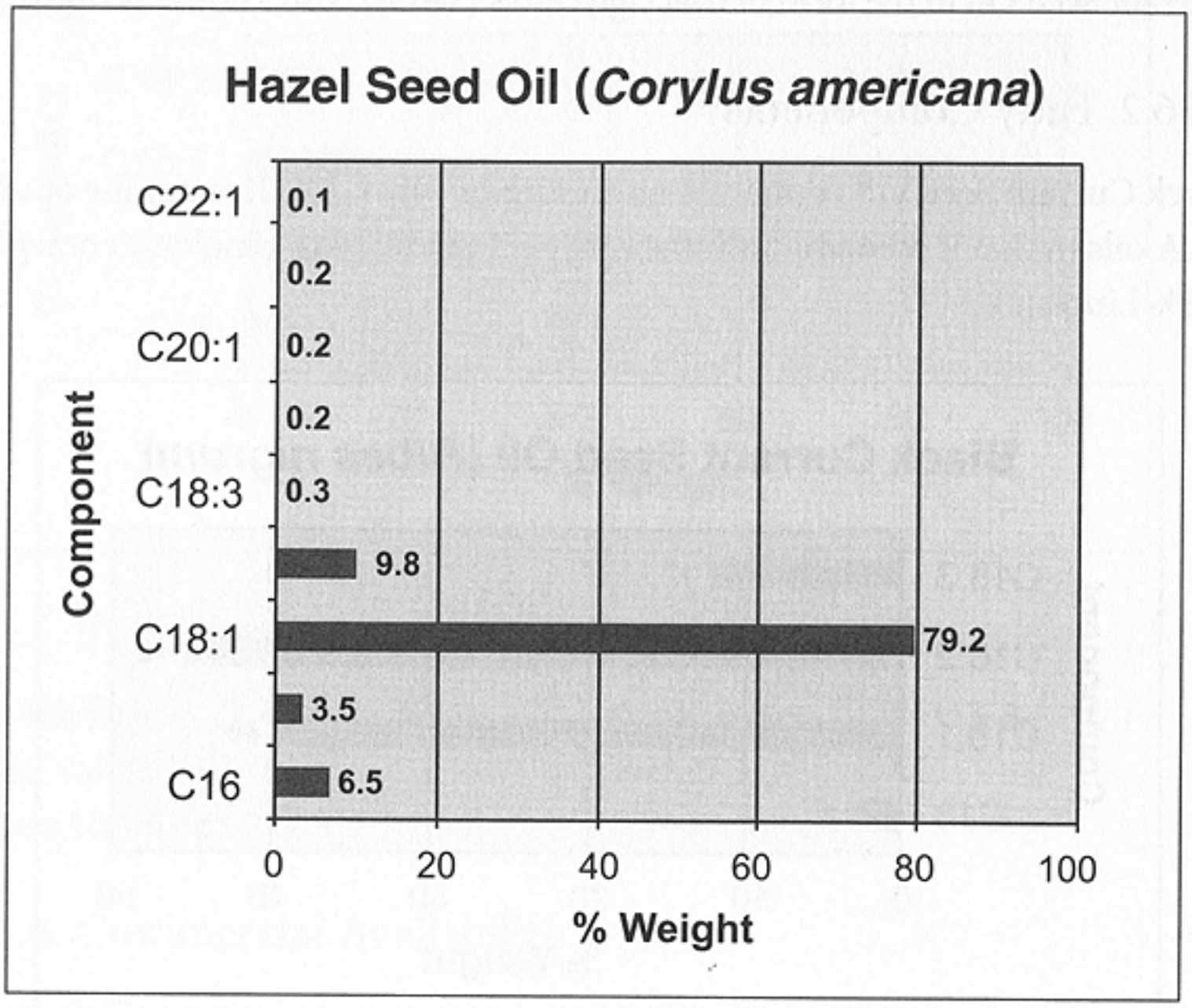
2.37 Hazel Seed Oil (*Corylus americana*)

Carbon Number 17.9

2.37.1. Source

The hazelnut (*Corylus americana*), belongs to the *Betulaceae* family. It is a deciduous shrub, or small tree, with stems measuring between one and five meters. It grows in Europe, Turkey, North Asia and the United States. The hazelnut's hard and smooth brownish outer shell contains an edible nut; it is from this nut that the oil is obtained.

2.37.2. Fatty Components



2.37.3. Properties

CAS Number:	84012-21-5	EINECS Number:	281-667-7
Iodine Value:	84	Titer Point:	N/A
Carbon Number:	17.9		

2.37.4. Commercial Availability

Hazel Seed Oil is an item of commerce.

2.37.5. INCI Status

Hazel Seed Oil is listed in the CTFA dictionary, as are several derivatives.

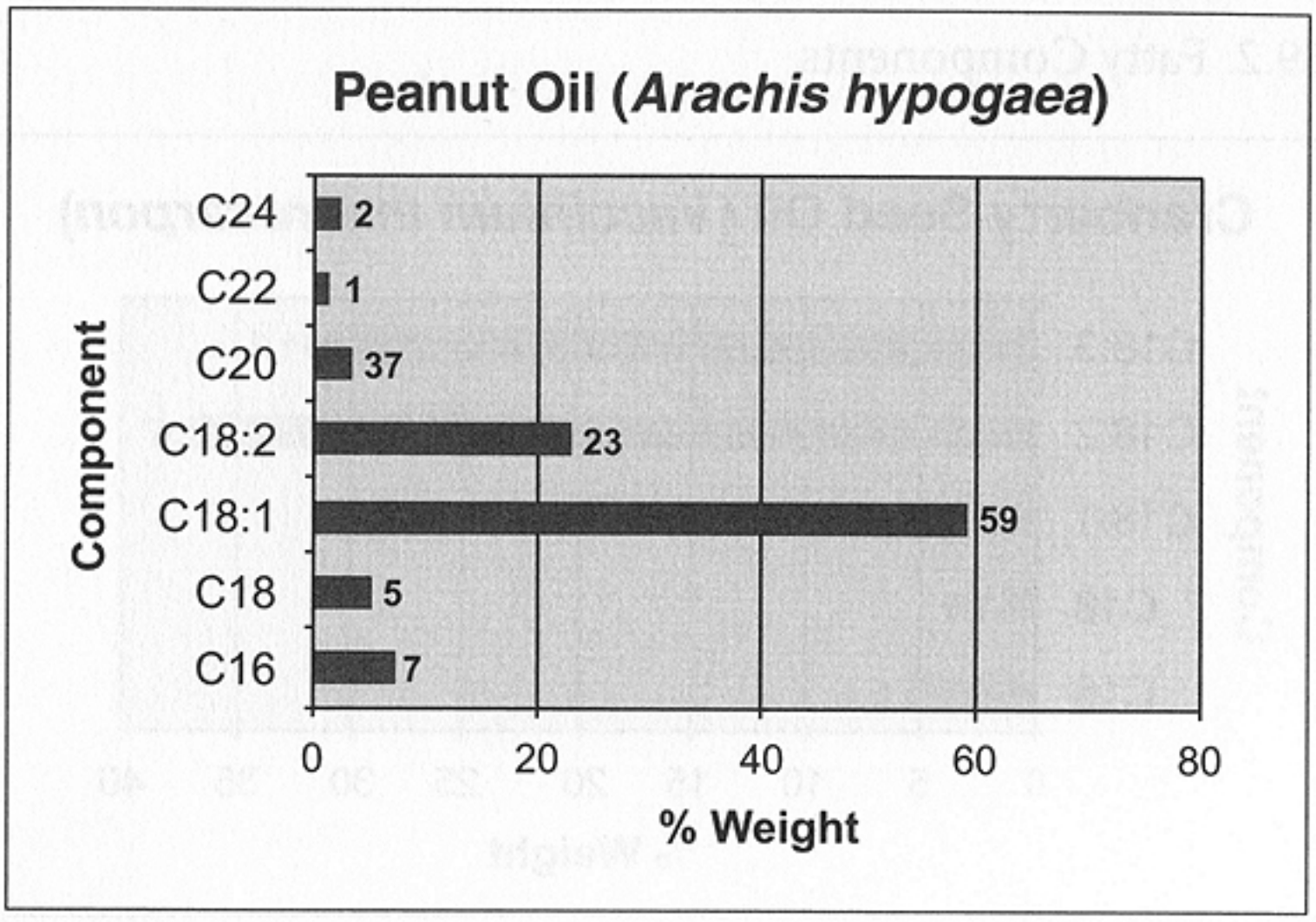
2.38 Peanut Oil (*Arachis hypogaea*)

Carbon Number 18.0

2.38.1. Source

Peanut Oil is a triglyceride derived from peanuts (*Arachis hypogea L.*). Since peanuts are easy to grow, the oil is cultivated in many areas of the world.

2.38.2. Fatty Components



2.38.3. Properties

CAS Number:	8002-03-07	EINECS Number:	232-296-4
Iodine Value:	98	Titer Point:	30° C (free fatty acid)
Carbon Number:	18.0		

2.38.4. Commercial Availability

Peanut Oil is an item of commerce. It is used predominately in cooking.

2.38.5. INCI Status

Peanut Oil is listed in the CTFA dictionary, both per se and in derivatives.

2.38.6. Status in Japan

Name:	Peanut Oil
Ingredient Code:	002376
Categories:	All categories with no limits

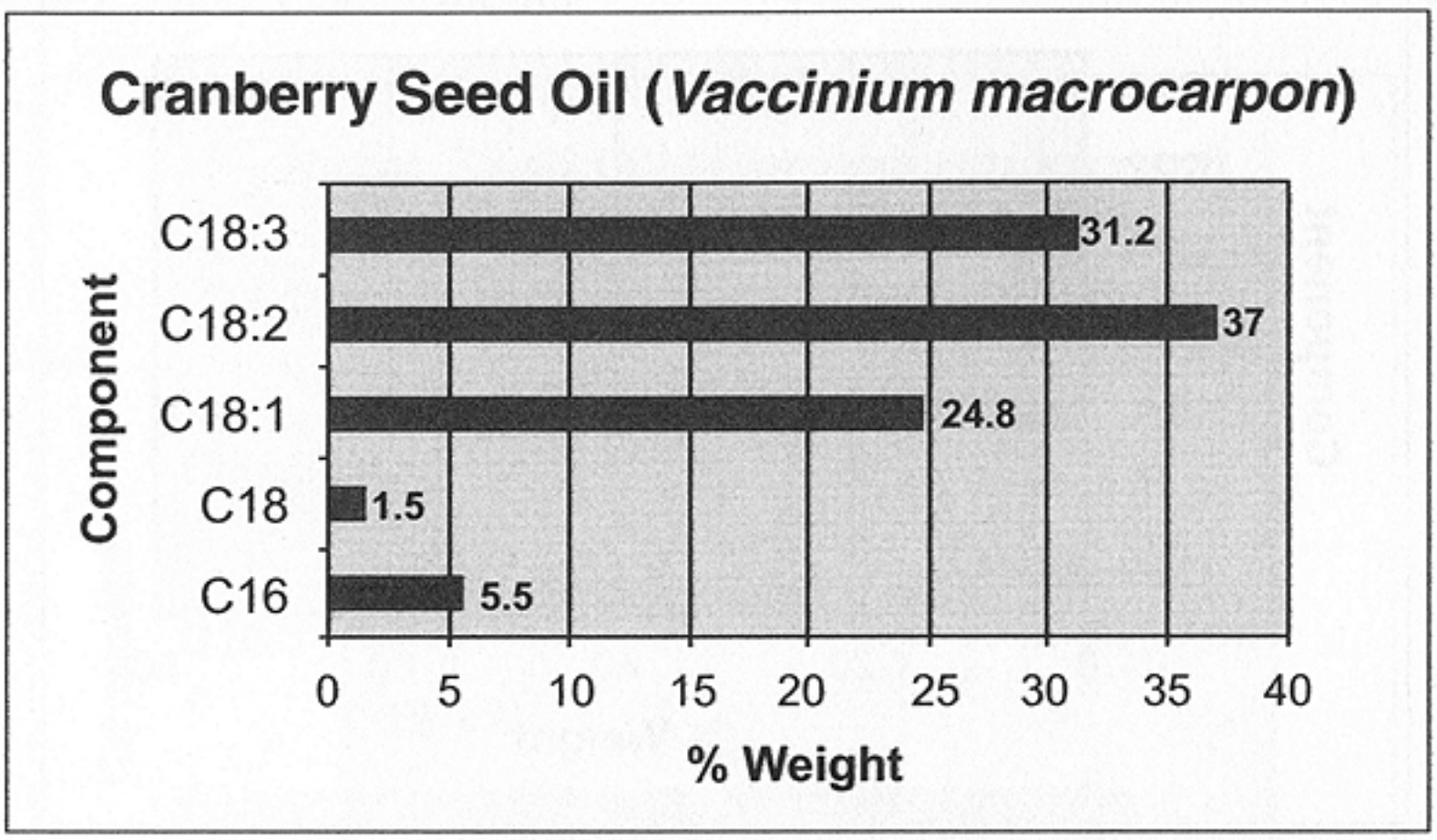
2.39 Cranberry Seed Oil (*Vaccinium macrocarpon*)

Carbon Number : 18.0

2.39.1. Source

The North American cranberry, *Vaccinium macrocarpon*, *Aiton*, is a member of the family *Ericaceae* that is composed of about 1350 species. The North American cranberry industry has a long and distinguished history. Native peoples used cranberries as food, in ceremonies and medicinally.

2.39.2. Fatty Components



2.39.2.1. Active Components

Cold pressed Cranberry Seed Oil also contains the following very critical "active" components:

Compound	**mg/kg**
Campesterol/brassicasterol	66.0
Stigmasterol	68.0
Beta-sitosterol	1319.0
Phosphatidylinositiol	9.9
Phosphatidylcholine	202.0
Alpha-tocopherol	341.0
Gamma-tocopherol	110.0

2.39.3. Properties

CAS Number: 381718-27-0
Iodine Value: 164 Titer Point: N/A
Carbon Number: 18.0

2.39.4. Commercial Availability

Cranberry Seed Oil is an item of commerce.

2.39.5. INCI Status

Cranberry Seed Oil is not yet listed in the CTFA dictionary.

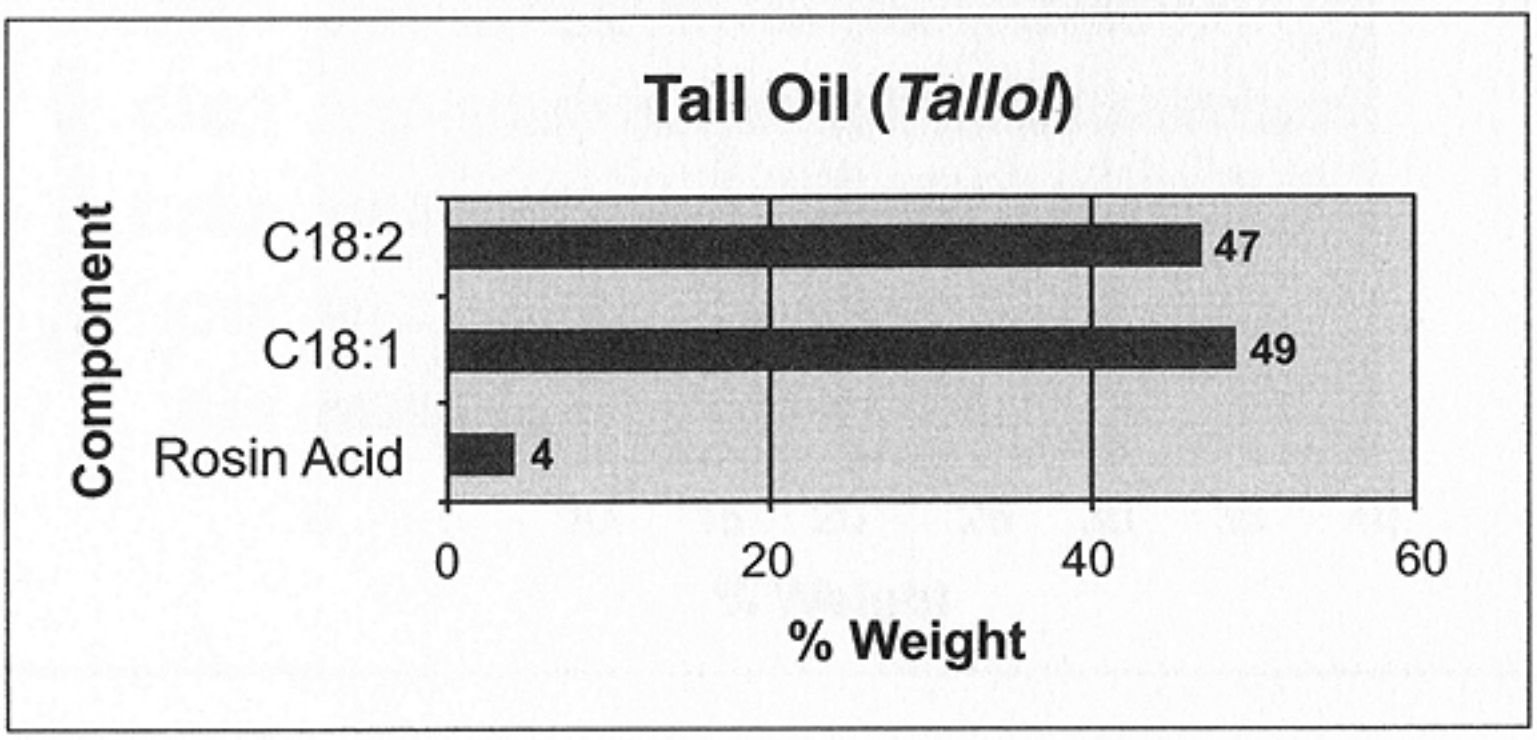
2.40 Tall Oil (*Tallol*)
Carbon Number 18.0

2.40.1. Source

Tall Oil is an acid derived from wood, and is a by-product of the wood pulp industry.

2.40.2. Fatty Components

Crude Tall Oil contains about 42% rosin acids. Rosin acids are a group of poly-cyclic carboxylic acids consisting of abietic acid, dihydroabetic acid, neoabetic acid, palustric acid, pimaric acid and iso-pimaric acid. The light fractions of tall oil (heads) consist mainly of palmitoleic acid. The fatty acids found in refined, distilled Tall Oil (TOFA) are C18:2 and C18:1, as shown in the following table:



2.40.3. Properties

CAS Number:	8002-26-4	EINECS Number:	232-304-6
Iodine Value:	130	Titer Point:	4° C (free fatty acid)
Carbon Number:	18.0		

TOFA is the major feedstock to produce dimer acids, via a clay catalyzed Diels Alder reaction.

2.40.4. Commercial Availability

Tall Oil fatty acid is a common item of commerce.

2.40.5. INCI Status

Tall Oil fatty acid is listed in the CTFA dictionary, both per se and in 20 derivatives.

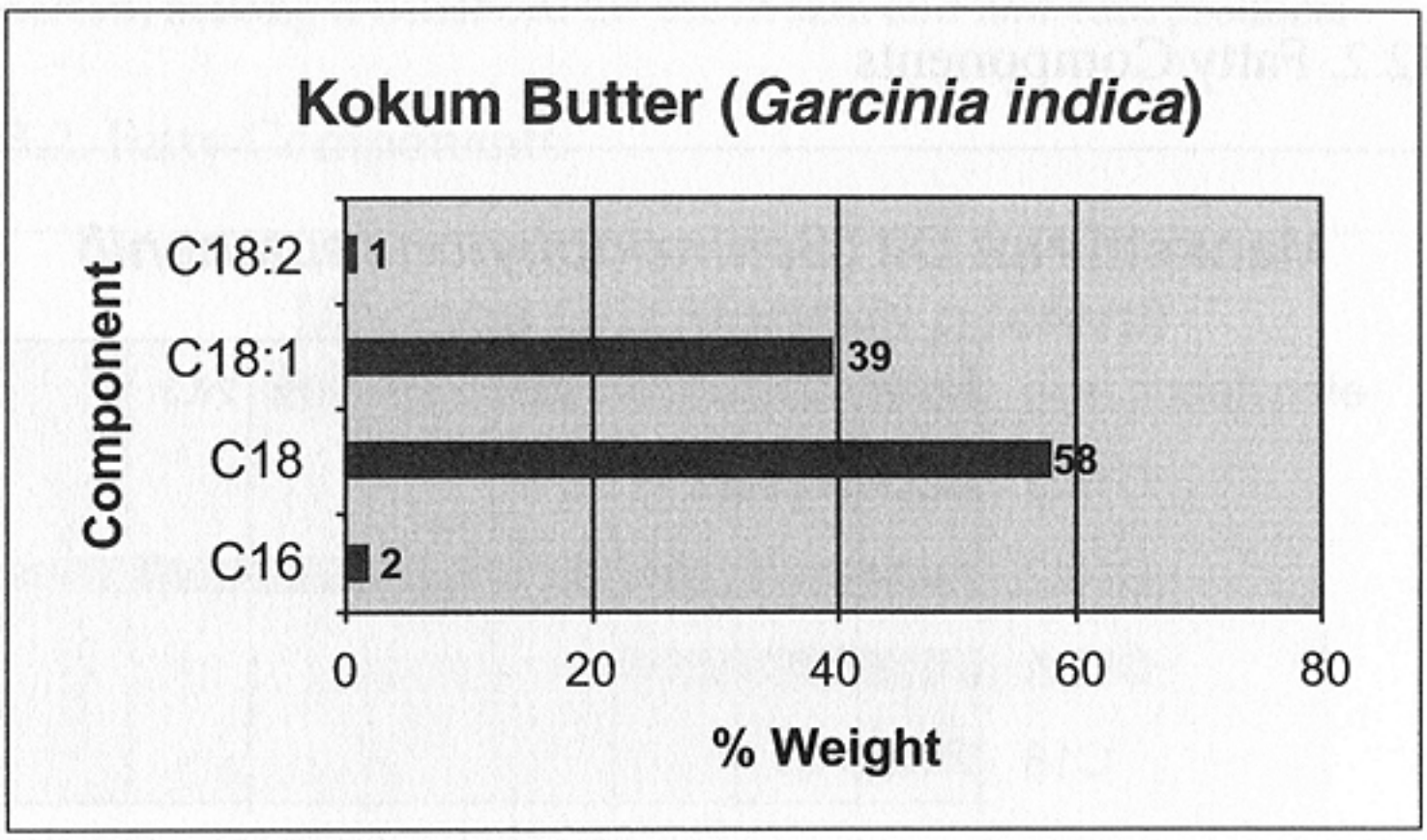
2.41 Kokum Butter (*Garcinia indica*)

Carbon Number 18.0

2.41.1. Source

Kokum Butter, derived from *G. indica*, comes from India. It is said to be a natural emollient and moisturizer, and is used in hair and skin care.

2.41.2. Fatty Components



2.41.3. Properties

CAS Number:	8496-02-6	EINECS Number:	283-622-7
Iodine Value:	31		
Carbon Number:	18.0		

2.41.4. Commercial Availability

Kokum Butter is an item of commerce.

2.41.5. INCI Status

Kokum Butter is not listed in the CTFA dictionary.

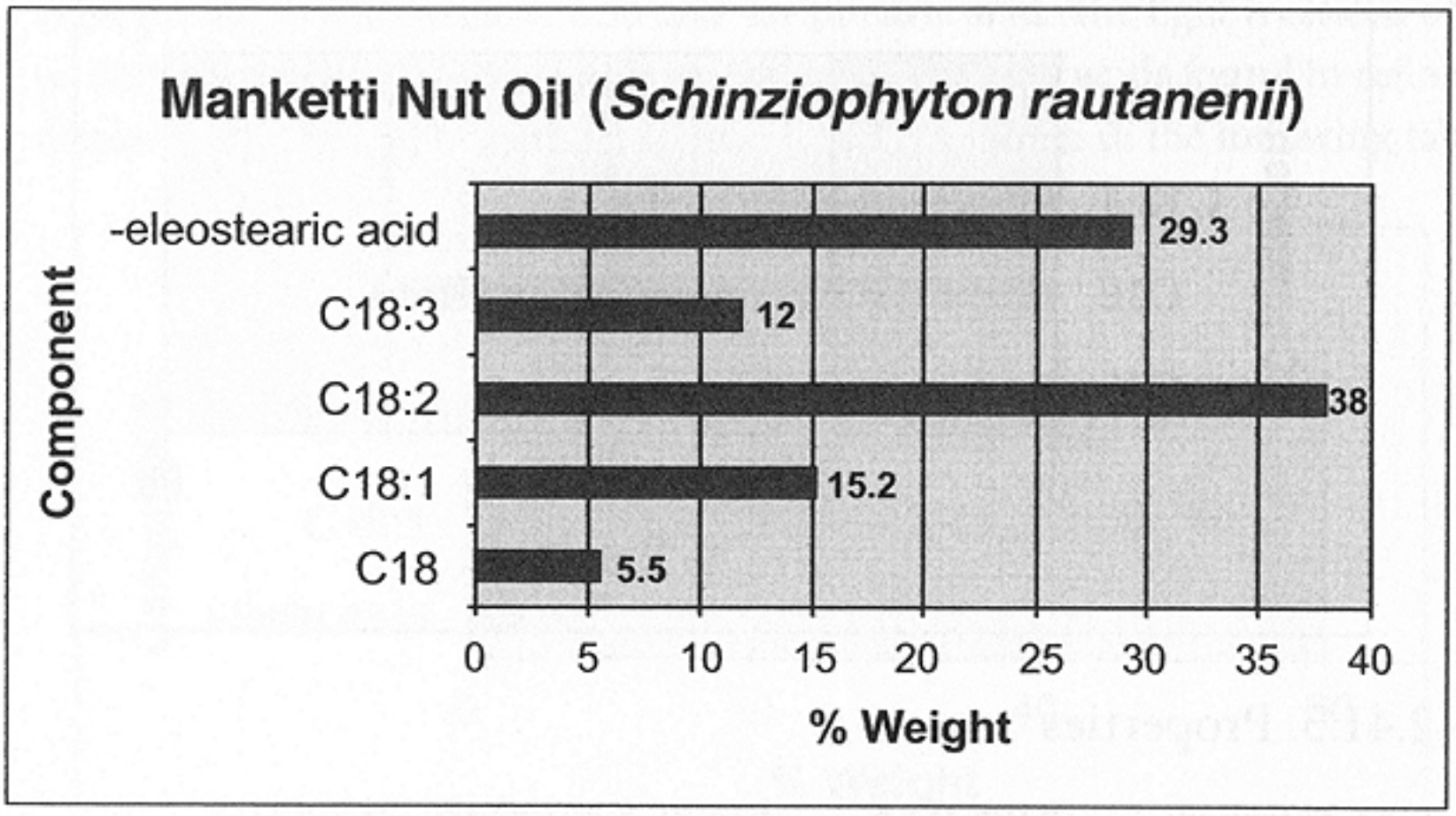
2.42 Manketti Nut Oil (*Schinziophyton rautanenii*)

Carbon Number 18.0

2.42.1. Source

Manketti Nut Oil is derived from the nut of *S. rautanennii*. The oil is light-yellow in color with a neutral odor. The source of Manketti Nut Oil is from Zambia. Manketti Nut Oil has hydrating, regenerating and restructuring properties, and provides natural UV protection for hair and skin.

2.42.2. Fatty Components



2.42.3. Properties

CAS Number: N/A
Iodine Value: 110 Titer Point: N/A
Carbon Number: 18.0

2.42.4. Commercial Availability

Manketti Nut Oil is an item of commerce.

2.42.5. INCI Status

Manketti Nut Oil is not yet listed in the CTFA dictionary.

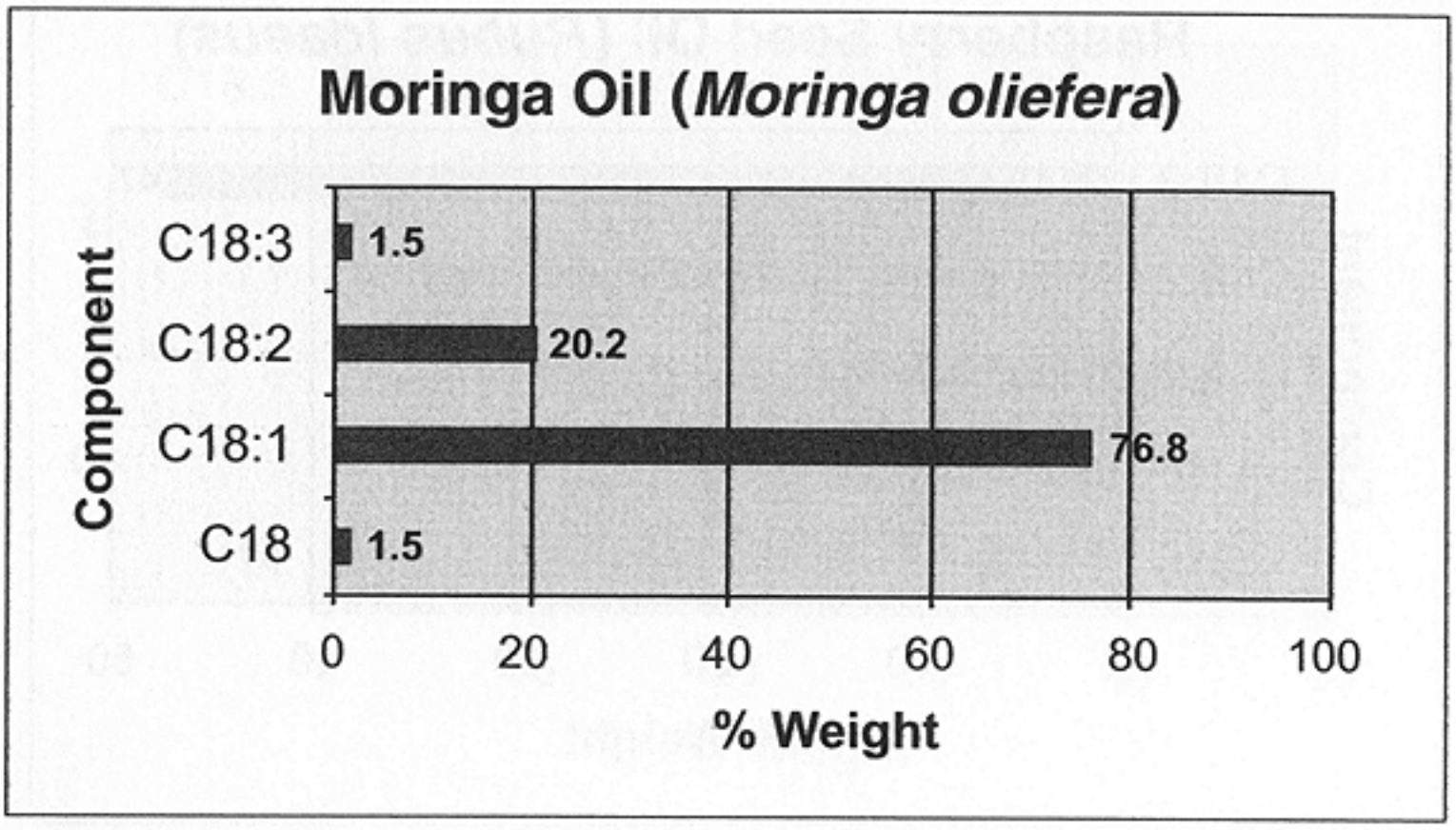
2.43 Moringa Oil (*Moringa oliefera*)

Carbon Number 18.0

2.43.1. Source

Moringa Oil is a pale yellow oil, with a mild, characteristic nutty flavor. Moringa Seed comes from the *M. oliefera* plant, which is from Urganda and Tanzania. Moringa Oil has a natural antioxidant that many consider to be the source of its remarkable oxidative stability. It also has nourishing and emollient properties, making it beneficial for use in skin and hair care products.

2.43.2. Fatty Components



2.43.3. Properties

CAS Number:	N/A		
Iodine Value:	75	Titer Point:	N/A
Carbon Number:	18.0		

2.43.4. Commercial Availability

Moringa Oil is an item of commerce.

2.43.5. INCI Status

Moringa Oil is not yet listed in the CTFA dictionary.

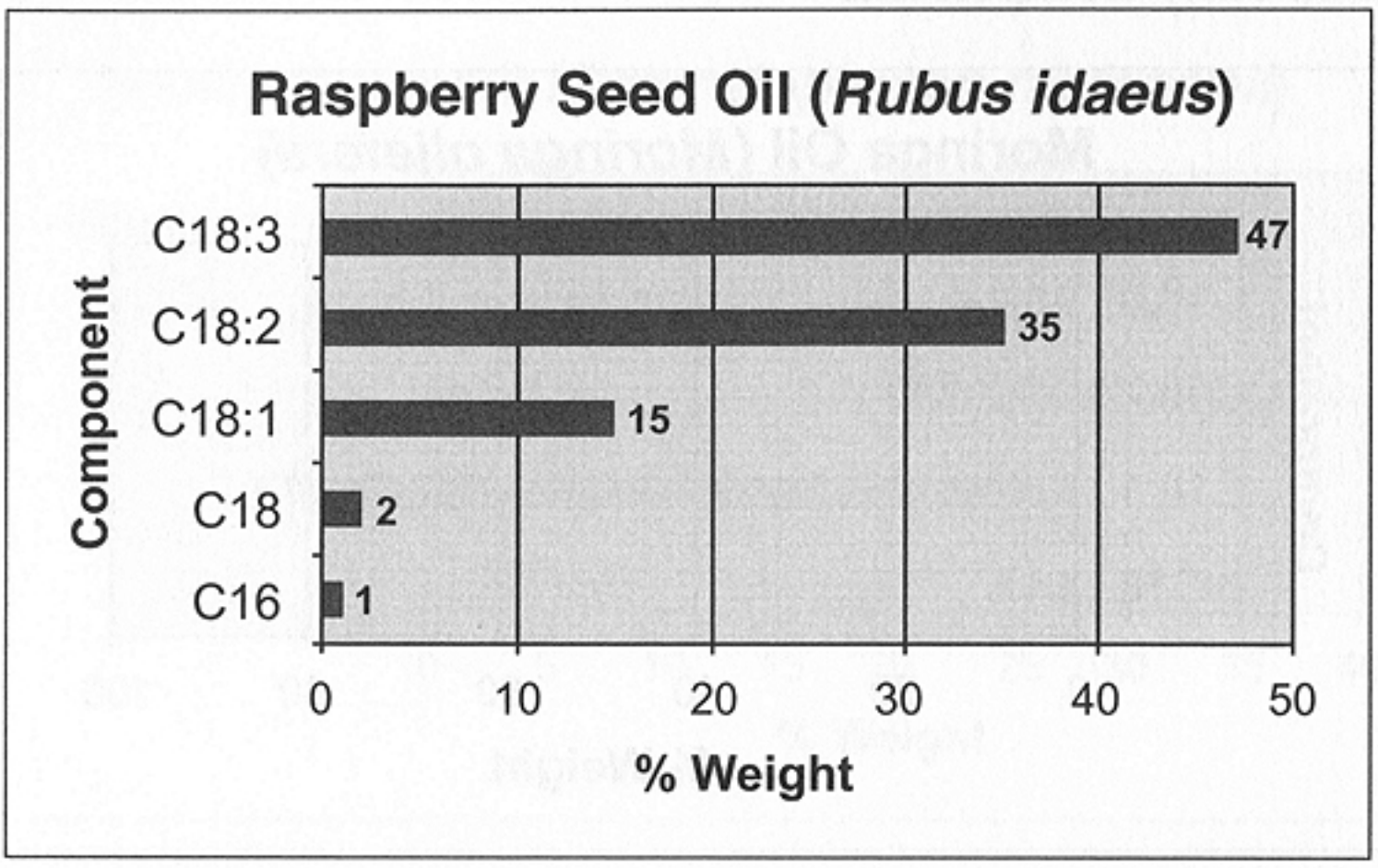
2.44 Raspberry Seed Oil (*Rubus idaeus*)

Carbon Number 18.0

2.44.1. Source

Raspberry Seed Oil contains exceptionally high levels of alpha and gamma tocopherols (Vitamin E), Vitamin A and omega-3 and omega-6 fatty acids. This provides the skin with significant broad-spectrum protection from damaging UV-A and UV-B rays.

2.44.2. Fatty Components



2.44.3. Properties

CAS Number:	85681-87-4	EINECS Number:	288-225-2
Iodine Value:	161	Titer Point:	N/A
Carbon Number:	18		

2.44.4. Commercial Availability

Raspberry Seed Oil is an item of commerce.

2.44.5. INCI Status

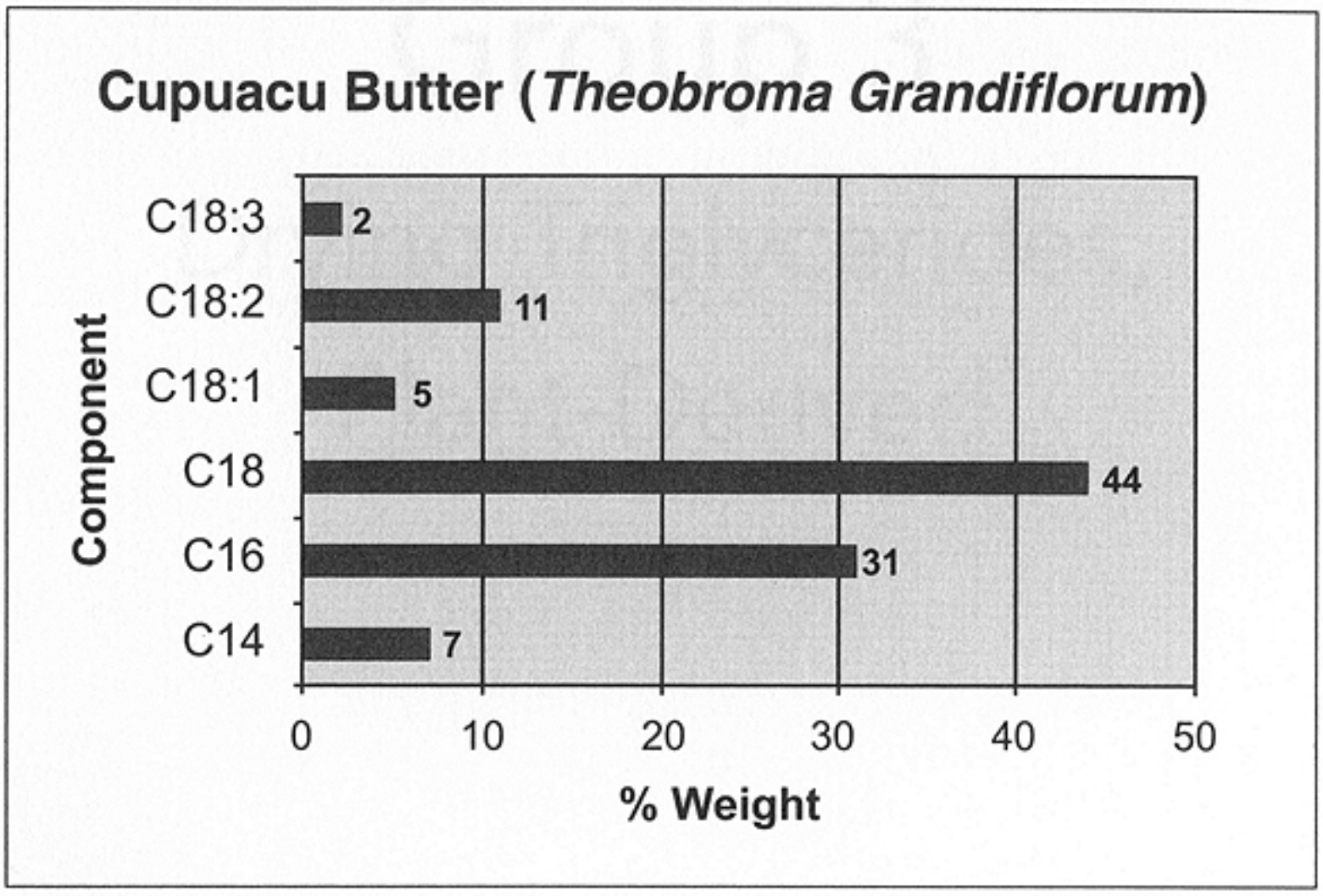
Raspberry Seed Oil is listed in the CTFA dictionary along with several derivatives.

2.45 Cupuacu Butter (*Theobroma Grandiflorum*)
Carbon Number 18.2

2.45.1. Source

Cupuacu Butter, derived from *T. grandiflorum*, comes from the Brazilian Rain Forest. It is said to be a natural emollient and moisturizer, and is considered a lanolin substitute in formulations.

2.45.2. Fatty Components



2.45.3. Properties

CAS Number:	394236-97-6	EINECS Number:	N/A
Iodine Value:	40	Titer Point:	25-30° C
Carbon Number:	18.2		

2.45.4. Commercial Availability

Cupuacu Butter is an item of commerce.

2.45.5. INCI Status

Cupuacu Butter is listed in the CTFA dictionary, as are several derivatives.

Group 3

Drying Triglycerides, Plant-Derived

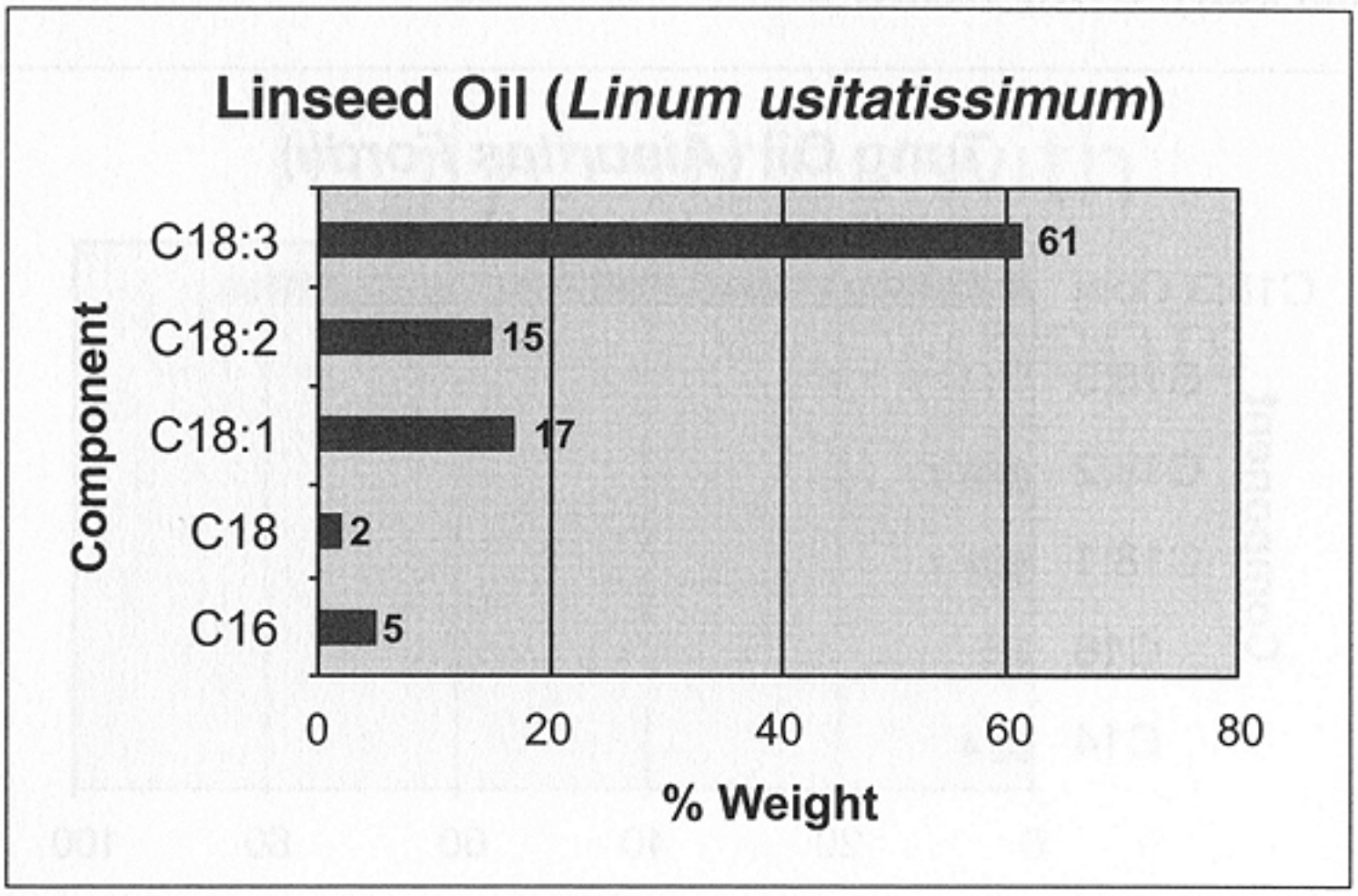
3.1 Linseed Oil (*Linum usitatissimum*)

Carbon Number 17.8

3.1.1. Source

Linseed Oil is a triglyceride derived from flax (*Linum usitatissimum*). It is cultivated in all the temperate areas of the world. Linseed Oil is a drying oil, meaning it dries into a solid. This is due to the high number of double-bonded and triple-bonded species present in the material.

3.1.2. Fatty Components



3.1.3. Properties

CAS Number:	8001-26-1	EINECS Number:	232-278-6
Iodine Value:	190	Titer Point:	20° C
Carbon Number:	17.9		

3.1.4. Commercial Availability

Linseed Oil is an item of commerce.

3.1.5. INCI Status

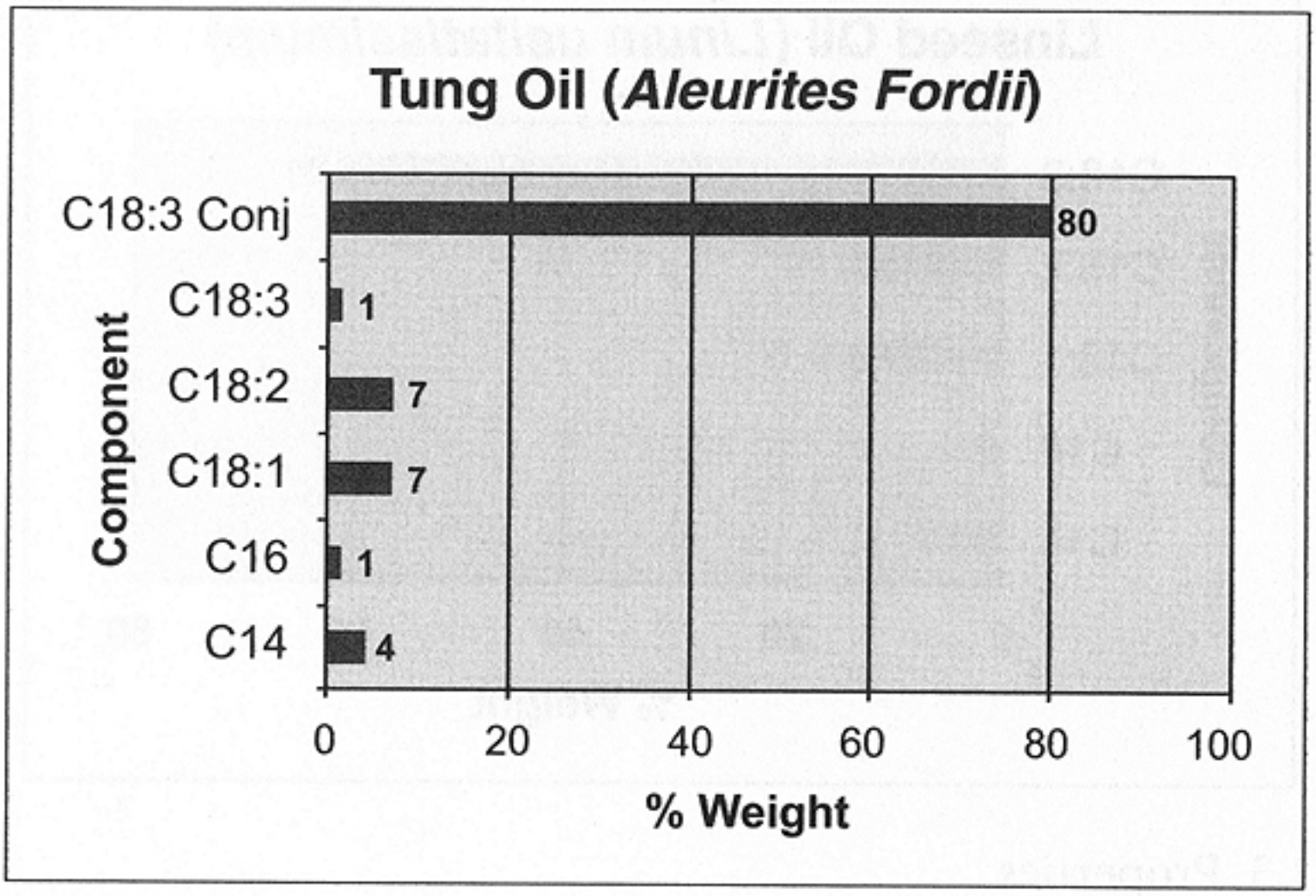
Linseed Oil is listed in the CTFA dictionary, both per se and in one derivative.

3.2 Tung Oil (*Aleurites fordii*)
Carbon Number 17.9

3.2.1. Source

Tung Oil is a triglyceride obtained from the seed of the Tung tree (*Aleurites fordii*), which is native to China and Indochina. Tung is described as a drying oil because of its abundance of double and triple bonds, particularly its high concentration of conjugated double bonds. These features make this oil react with itself in a homopolymerization reaction, which results in a film.

3.2.2. Fatty Components



3.2.3. Properties

CAS Number:	8001-20-5		
Iodine Value:	170	Titer Point:	40° C
Carbon Number:	17.9		

3.2.4. Commercial Availability

Tung Oil is an item of commerce.

3.2.5. INCI Status

Tung Oil is not yet listed in the CTFA dictionary.

Group 4

Triglycerides with Unusual Components

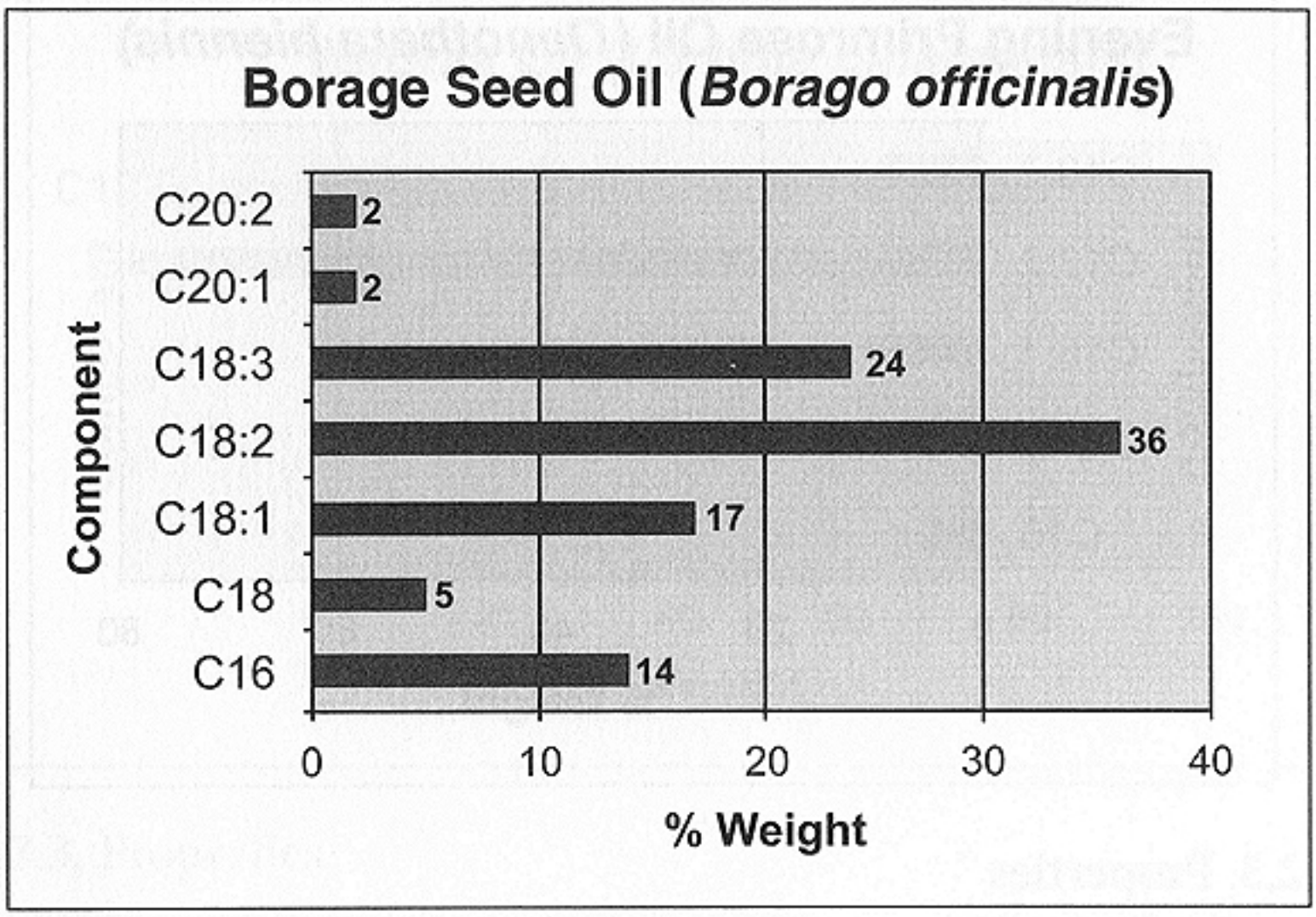
4.1 Borage Seed Oil (*Borago officinalis*)

Carbon Number 17.8

4.1.1. Source

Borage Seed Oil is a triglyceride derived from the herbaceous plant *B. officinalis*, which grows in the Mediterranean region. It is an unusual oil in that it has a high concentration of gamma linoleic acid.

4.1.2. Fatty Components



4.1.3. Properties

CAS Number:	84012-16-8	EINECS Number:	281-661-4
Iodine Value:	147	Titer Point:	0° C
Carbon Number:	17.8		

4.1.4. Commercial Availability

Borage Seed Oil is an item of commerce.

4.1.5. INCI Status

Borage Seed Oil is listed in the CTFA dictionary, both per se and in derivatives, including silicone derivatives.

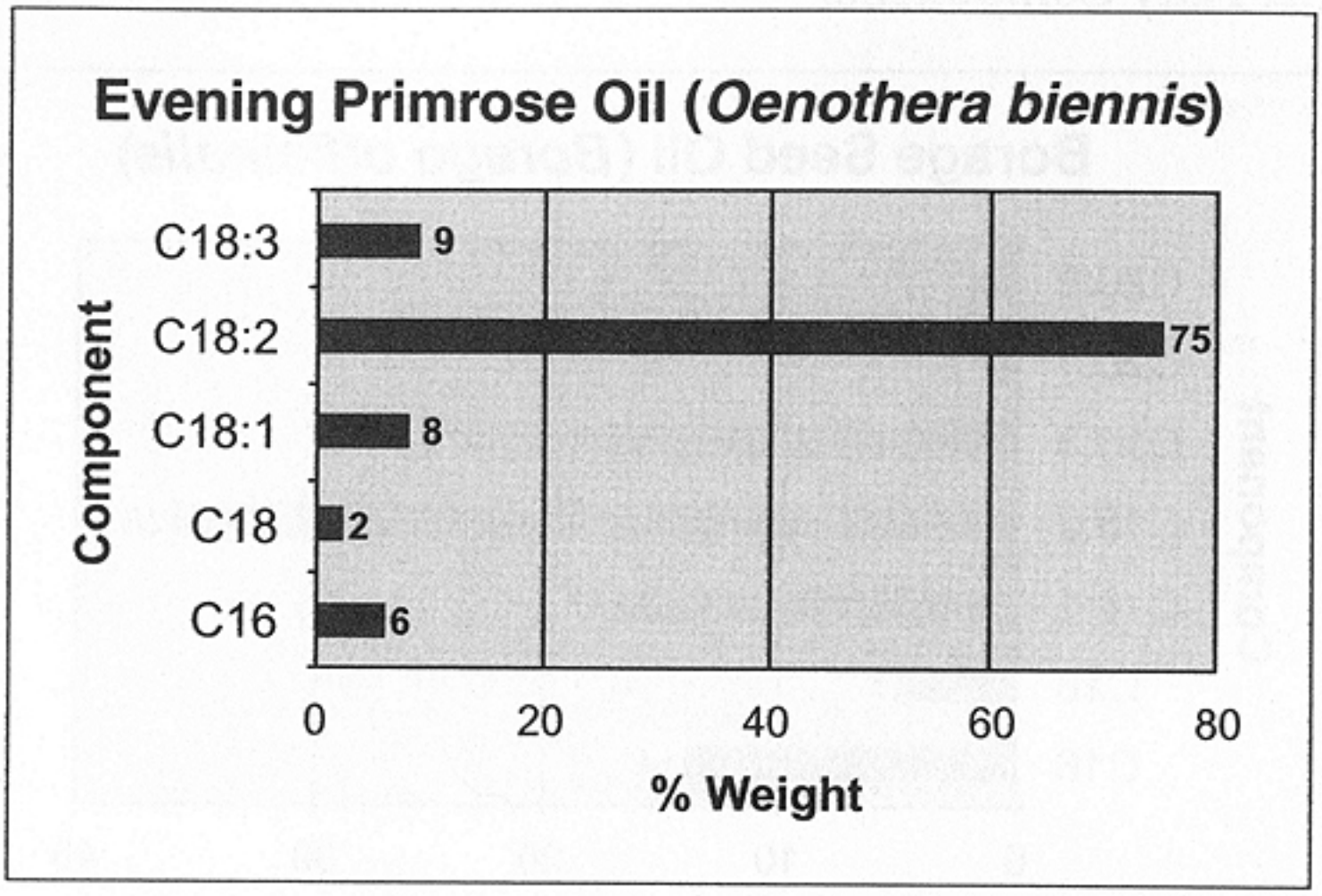
4.2 Evening Primrose Oil (*Oenothera biennis*)

Carbon Number 17.9

4.2.1. Source

Evening Primrose Oil is a triglyceride derived from the plant *Denothera biennis*. It has a high concentration of gamma linoleic acid.

4.2.2. Fatty Components



4.2.3. Properties

CAS Number:	90028-66-3	EINECS Number:	289-859-2
Iodine Value:	152		
Carbon Number:	17.9		

4.2.4. Commercial Availability

Evening Primrose Oil is commercially available per se and in two derivatives.

4.2.5. INCI Status

Evening Primrose Oil is listed in the CTFA dictionary.

4.2.6. Status in Japan

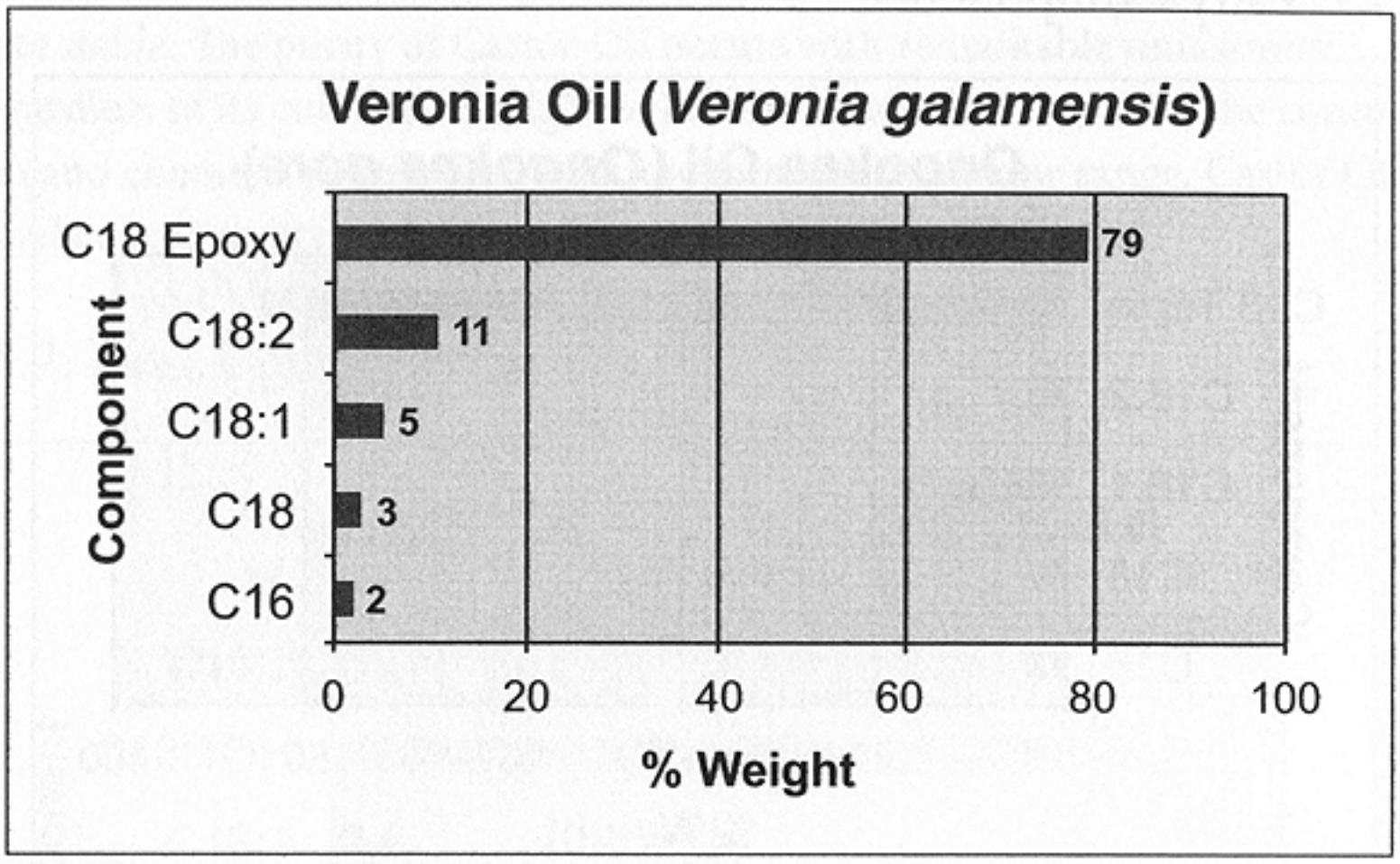
Name:	Evening Primrose Oil
Ingredient Code:	520772
Categories:	All categories with no limits

4.3 Veronia Oil (*Veronia galamensis*)
Carbon Number 17.9

4.3.1. Source

Veronia Oil is a triglyceride, which is obtained from the seed of *V. galamensis*. It contains a uniquely high concentration of epoxy.

4.3.2. Fatty Components



4.3.3. Properties

CAS Number:	169360-96-7	EINECS Number:	Not Applicable
Iodine Value:	106		
Carbon Number:	17.9		

4.3.4. Commercial Availability

Veronia Oil is currently being developed for the commercial market.

4.3.5. INCI Status

Veronia Oil is not listed in the CTFA dictionary.

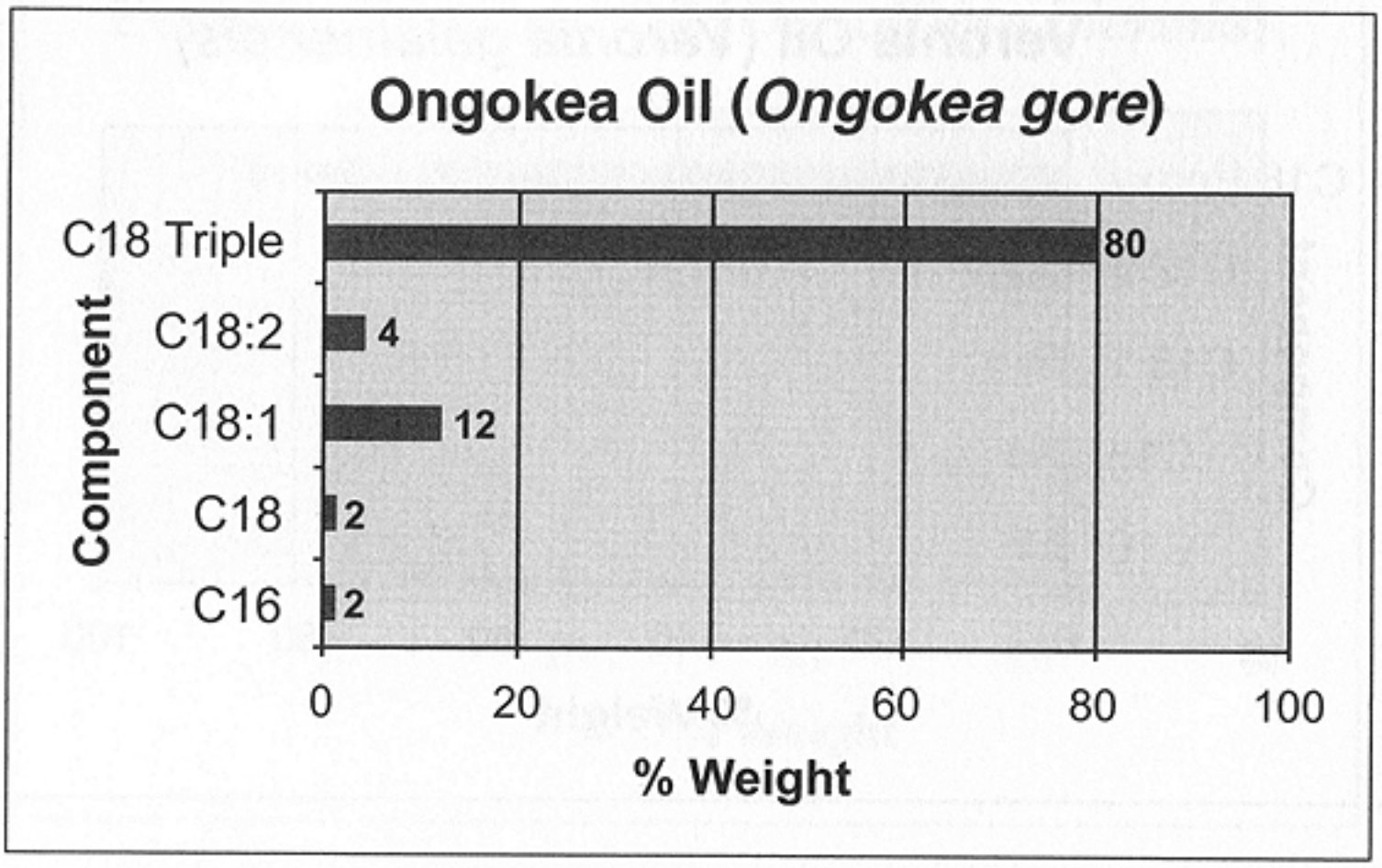
4.4 Ongokea Oil (*Ongokea gore*)

Carbon Number 18.0

4.4.1. Source

Ongokea Oil is a triglyceride derived from the species *O. gore*. It originates in Africa. This material is somewhat unique because of its high concentration of an acetylenic bond. Ongokea Oil is a drying oil.

4.4.2. Fatty Components



4.4.3. Properties

CAS Number:	16714-85-5		
Iodine Value:	190	Titer Point:	5° C
Carbon Number:	18.0		

4.4.4. Commercial Availability

Ongekea Oil currently is being developed as an item of commerce.

4.4.5. INCI Status

Ongekea Oil is not yet listed in the CTFA dictionary.

4.5 Castor Oil (*Ricinus communis*)

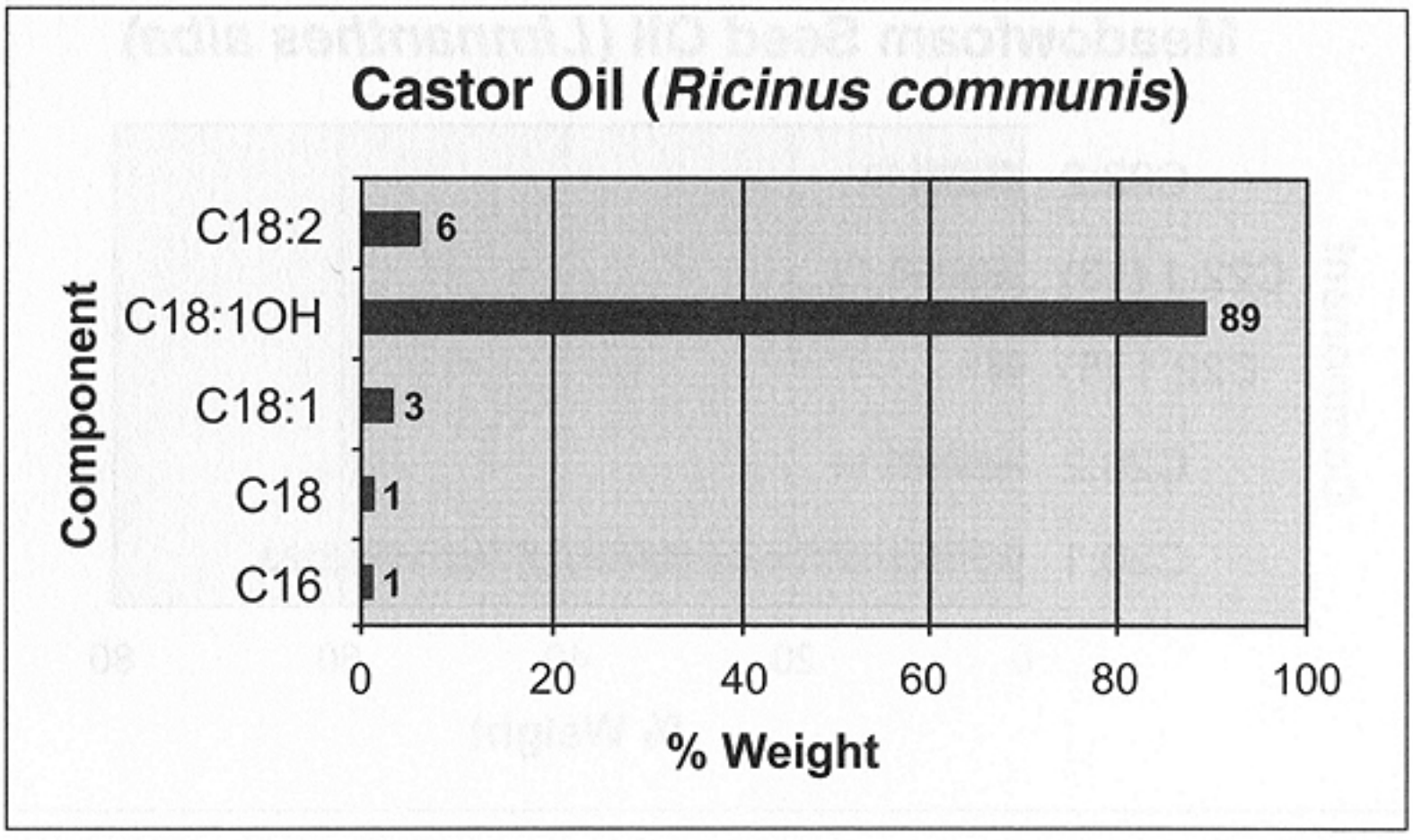
Carbon Number 18.0

4.5.1. Source

Castor Oil is a unique triglyceride derived from *R. communis L.* The castor plant grows wild in many subtropical and tropical areas. Today, 90% of world Castor Oil production occurs in Brazil, China and India. This oil contains a large number of hydroxy-containing, unsaturated compounds.

Castor Oil is a clear, viscous, light-colored fluid that is nondrying and quite stable. The purity of Castor Oil occurs with remarkable uniformity. Regardless of its country of origin or season in which it is grown, the composition and chemical properties remain within a very narrow range. Castor Oil has broad compatibility with oils, waxes, natural resins and gums.

4.5.2. Fatty Components



4.5.3. Properties

CAS Number:	8001-79-4	EINECS Number:	232-293-8
Iodine Value:	85	Titer Point:	2° C
Carbon Number:	18.0		

4.5.4. Commercial Availability

Castor Oil is an item of commerce, available in a variety of grades.

4.5.5. INCI Status

Castor Oil is listed in the CTFA dictionary, both per se and in 69 derivatives. Silicone derivatives as well as surfactant derivatives are available.

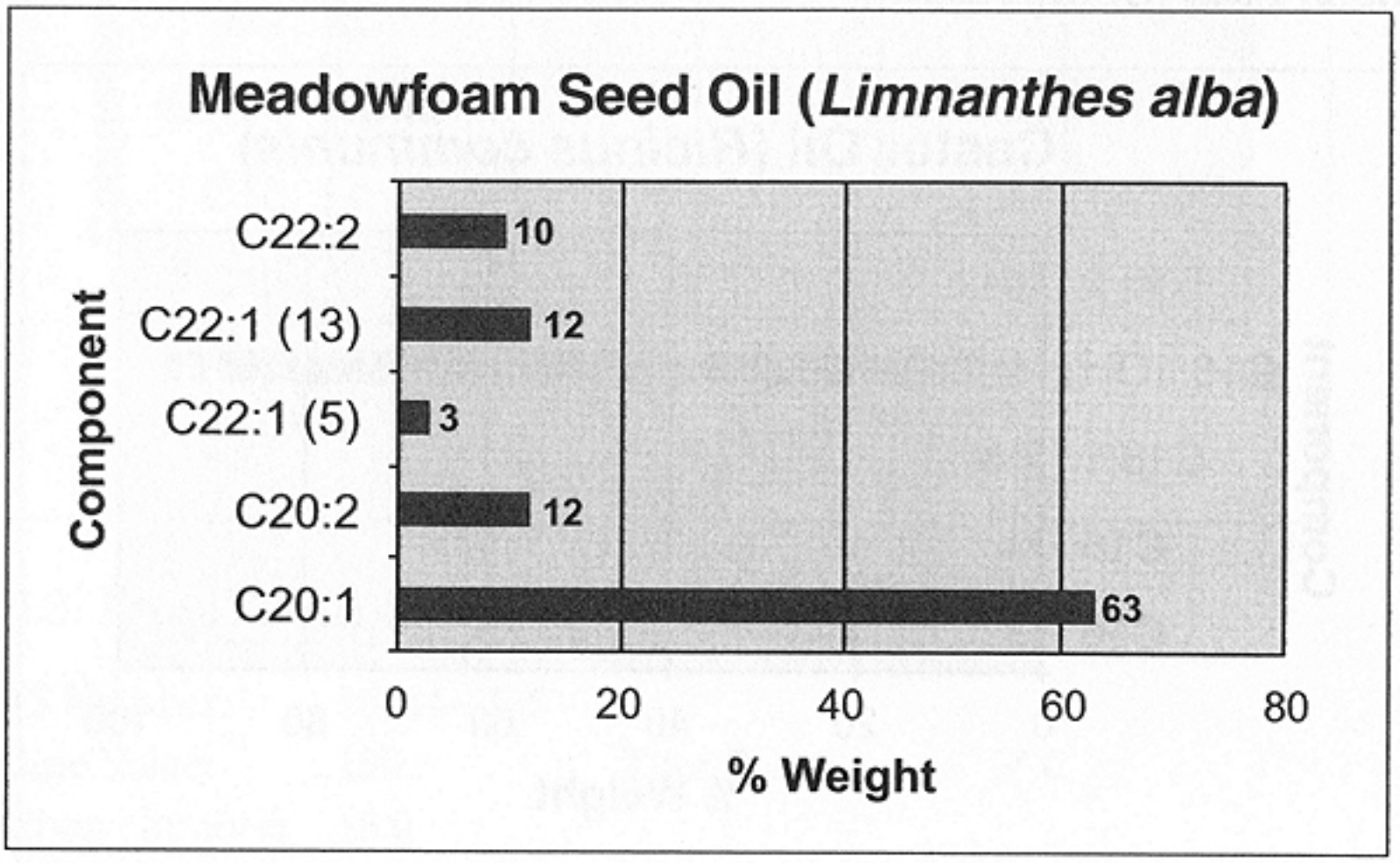
4.6 Meadowfoam Seed Oil (*Limnanthes alba*)

Carbon Number 20.5

4.6.1. Source

Meadowfoam Seed Oil is a triglyceride derived from the herbaceous winter plant *Limnanthes alba*, which is grown in the southern portion of the State of Oregon in the United States. The name meadowfoam comes from the plant's appearance as a canopy of white foam. This is a relatively new raw material, and is unique in that it has both a high concentration of fractions at or above 20 carbons and has a unique arrangement of double bonds. Furthermore, the double bonds in the doubly unsaturated product are not conjugated; as in linoleic acid, the oil is liquid to very low temperatures, and is stable to oxidation.

4.6.2. Fatty Components



4.6.3. Properties

CAS Number: 153065-40-8 EINECS Number: 293-165-5
Iodine Value: 95
Carbon Number: 20.5

4.6.4. Commercial Availability

Meadowfoam Seed Oil is commercially available.

4.6.5. INCI Status

Meadowfoam Seed Oil is listed in the CTFA dictionary, both per se and in 15 surfactant and five silicone derivatives.

4.6.6. Status in Japan

Name: Meadowfoam Seed Oil
Ingredient Code: 521124
Categories: In categories 1-7 with no limits

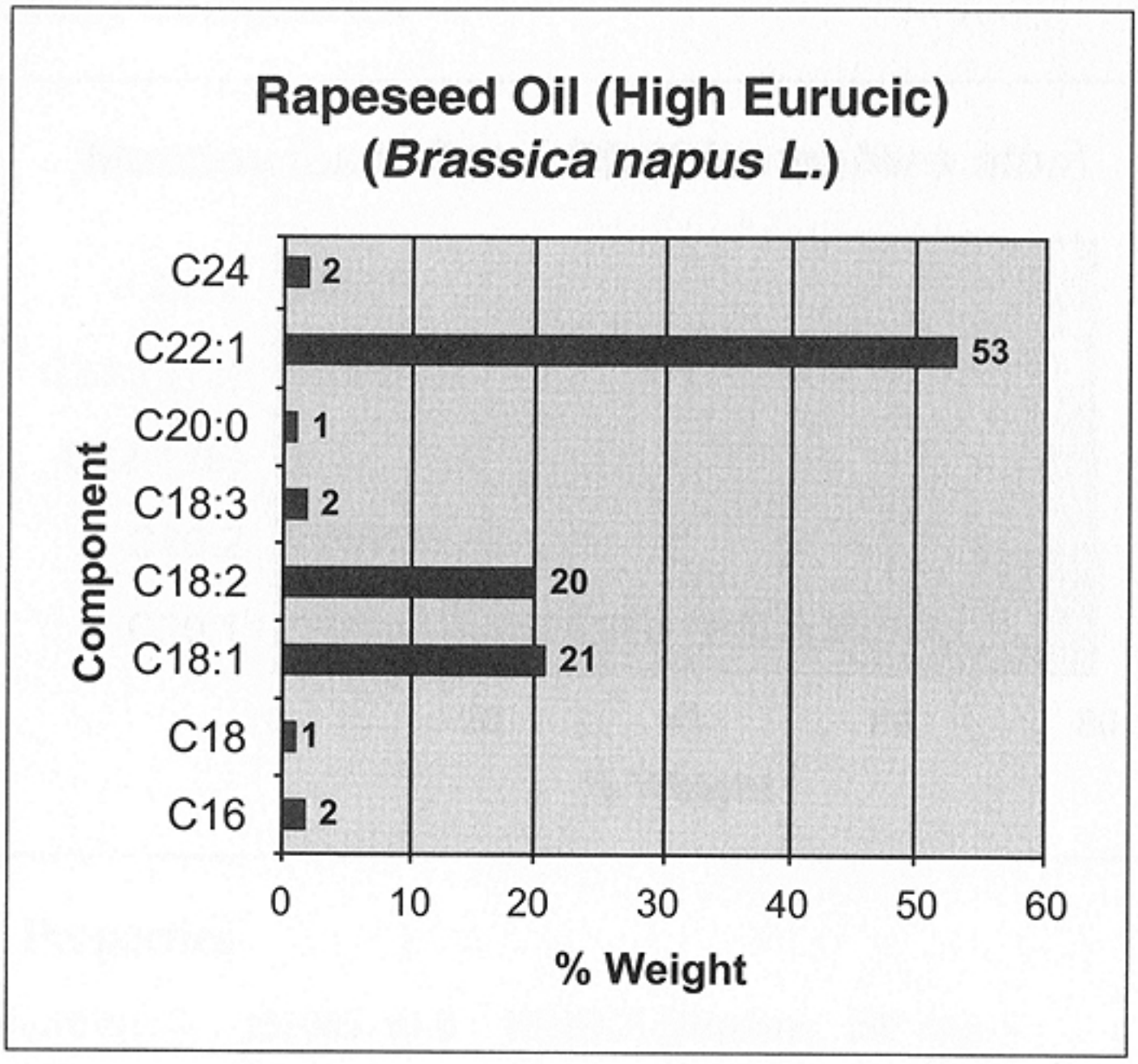
4.7 Rapeseed Oil (High Eurucic) (*Brassica napus L.*)

Carbon Number 20.6

4.7.1. Source

Rapeseed Oil is a triglyceride derived from the *Brassica napus L.* It is cultivated in North America, more specifically in Canada. Recently, there has been an effort to bioengineer this crop to produce a carbon more like the carbon distribution of Soybean Oil. This newly engineered oil has been called Canola. Cooking applications for Rapeseed Oil have provided the primary motivation for lowering its percentage of higher-molecular-weight fractions. In food applications, higher-molecular-weight fractions are considered less healthful.

4.7.2. Fatty Components



4.7.3. Properties

CAS Number:	8002-13-9	EINECS Number:	232-299-0
Iodine Value:	100	Titer Point:	13° C
Carbon Number:	20.6		

4.7.4. Commercial Availability

Rapeseed Oil is commercially available per se and in ten derivatives.

4.7.5. INCI Status

Rapeseed Oil is listed in the CTFA dictionary, both per se and in derivatives.

4.7.6. Status in Japan

Name:	Rapeseed Oil
Ingredient Code:	002281
Categories:	Categories 1-7 with no limits

4.8 Crambe Oil (*Crambe abyssinica*)

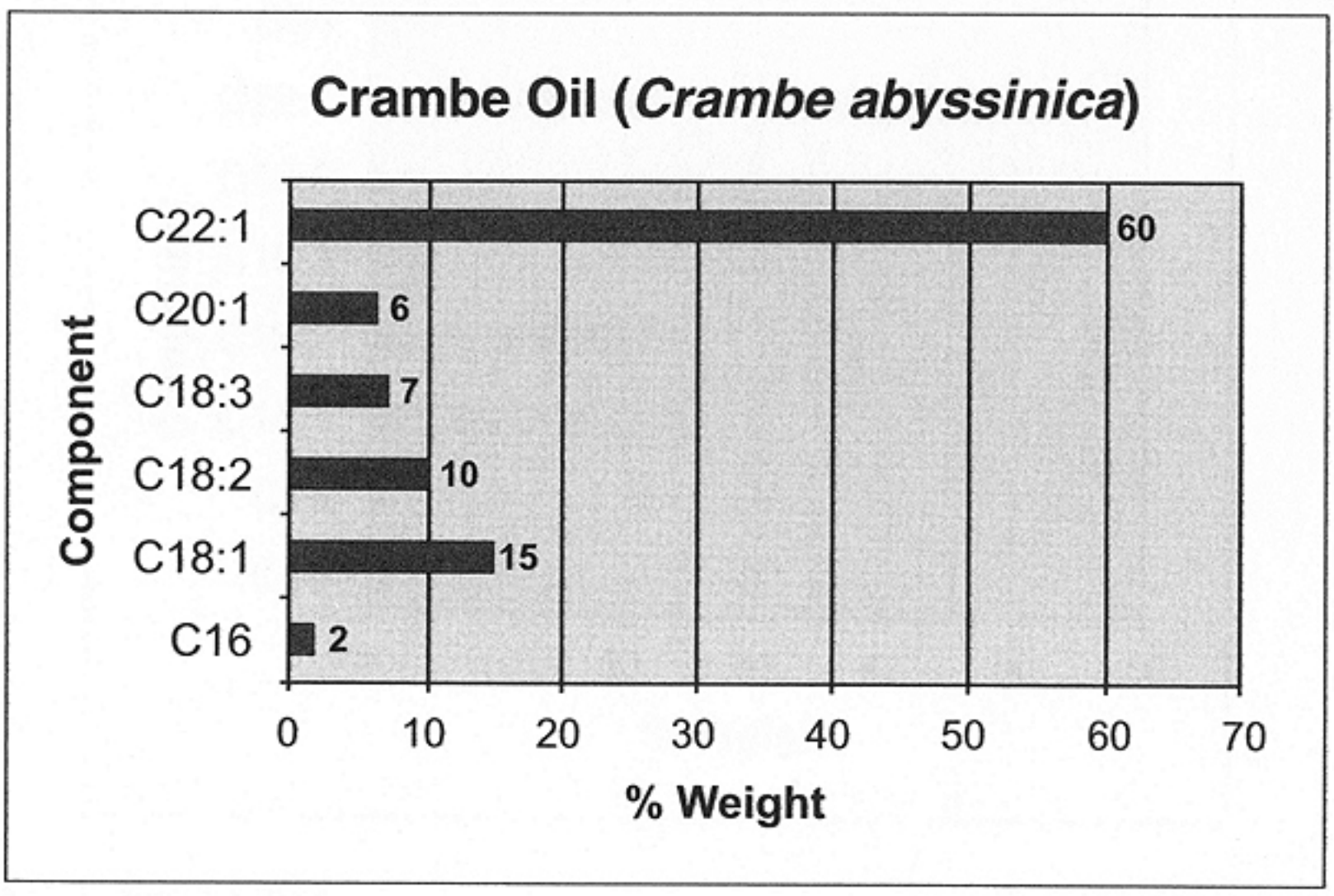
Carbon Number 20.6

4.8.1. Source

Crambe Oil is an oilseed crop from the mustard family, which includes crops such as Rapeseed (Canola and industrial Rapeseed Oil) and tame mustard. It started receiving consideration as an alternative crop in the late 1950s because of its unique oil properties. Recently it has been introduced into the personal care market both per se and in derivatives.

Crambe has been grown commercially in the Northern Plains area of the United States since the early 1990s. Commercial interest in crambe as an alternative crop developed in part because it can be grown with conventional small-grain equipment. It also requires less pest management inputs than some similar crops, and demonstrates good tolerance of variable growing conditions. Production peaked in the mid 1990s, and current data for domestic production is limited.

4.8.2. Fatty Components



4.8.3. Properties

CAS Number:	68956-68-3	EINECS Number:	273-313-5
Iodine Value:	88	Titer Point:	6° C
Carbon Number:	20.6		

4.8.4. Commercial Availability

Crambe Oil is commercially available per se and in derivatives.

4.8.5. INCI Status

Crambe Oil is listed in the CTFA dictionary, both per se and in derivatives.

4.8.6. Status in Japan

Name:	Crambe Oil
Ingredient Code:	004409
Categories:	Categories 1-7 with no limits

Group 5

Animal-Derived Esters

5.1 Beeswax (*Cara alba*)

5.1.1. Source

Beeswax, or white wax, is a complex ester produced by worker bees, *Apis mellifica*; it is cultured worldwide and found on all continents of the globe. The chemical composition of the wax depends on the species of the bee producing the wax. Beeswax is extracted by melting the honeycomb or by boiling it in water, and then skimming the crude wax off the top. The color of the crude material is dependent upon the type of flower producing the pollen and the age of the hive. Beeswax is a complex structure and, as such, possesses unique properties that make it an invaluable raw material for many of today's industries. Beeswax has been a very important wax used by mankind over the years. It consists of about 15% free fatty acids and 15% hydrocarbon resins, with the esters making up the balance. It is important to note that bees are not harmed during collection.

5.1.2. Fatty Components

Component	Fatty Acid Typical % Weight	Fatty Alcohol Typical % Weight	Component	Hydrocarbon Typical % weight
C14	7	n/a	C25	5
C16	2	n/a	C27	5
C18	3	n/a	C29	10
C24	15	5	C30	5
C26	50	70	C31	40
C28	15	25	C33	30
C30	5	5	C35	5

Principal Ester Composition

Alcohol	/	Acid	%
C30	/	C16	23
C30	/	C26	12
C30	/	C30	12
C26	/	C16*	10

* Hydroxy-palmitate

5.1.3. Properties

CAS Number:	8006-40-4 (white)	EINECS Number:	232-383-7
CAS Number:	8012-89-3 (Yellow)	Melting Point:	64° C
Iodine Value:	10		

5.1.4. Commercial Availability

Beeswax is an item of commerce.

5.1.5. INCI Status

Beeswax is listed in the CTFA dictionary, both per se and in 22 derivatives. Silicone derivatives as well as surfactant derivatives are available.

5.1.6. Status in Japan

Name:	Beeswax
Ingredient Code:	500495
Categories:	All categories with no limits

5.2 Shellac Wax (*Shellac cera*)

5.2.1. Source

Shellac Wax is a complex ester from the waxy fraction of the resin excreted by the cochineal insect *Tachardia lacca*, which is native to India. The material was originally a component of varnish. Shellac Wax contains about 5% hydrocarbon.

5.2.2. Fatty Components

Component	Fatty Acid Typical % Weight	Fatty Alcohol Typical % Weight	Component	Hydrocarbon Typical % weight
C14	3	n/a	n/a	n/a
C16	15	n/a	n/a	n/a
C18	3	n/a	C27	45
C28	n/a	65	C29	35
C30	29	25	C31	15
C32	30	10	C34	5
C34	25	n/a	n/a	n/a

5.2.3. Properties

CAS Number:	97766-50-2		
Iodine Value:	6	Melting Point:	79° C

5.2.4. Commercial Availability

As a by-product of shellac resin, Shellac Wax has limited availability.

5.2.5. INCI Status

Shellac Wax is listed in the CTFA dictionary.

Group 6

Plant-Derived Esters

6.1 Carnauba Wax (*Copernicia cerifera*)

6.1.1. Source

At present, the only place in the world where the carnauba palm tree can be found is northeastern Brazil. This palm tree (*C. cerifera*), often called the "tree of life," produces a wax on its leaves that protects them from the region's severe weather conditions.

Harvesting occurs around September, following traditional procedures. The leaves are cut and placed on the ground to dry in the sun. Modern technology then takes over to scrape this valued product from its leaf.

6.1.2. Fatty Components

Carnauba Wax is composed of monohydroxy and dihydroxy-containing fatty alcohols, having 28 to 34 carbon atoms; and hydroxy acids, their esters and polyesters. This polymeric nature of the wax accounts for its hardness and high melting point.

6.1.3. Properties

CAS Number:	8015-86-9	EINECS Number:	232-399-4
Iodine Value:	11	Titer Point:	84° C

6.1.4. Commercial Availability

Carnauba is an item of commerce.

6.1.5. INCI Status

Carnauba is listed in the CTFA dictionary, both per se and in derivatives. Silicone derivatives are available.

6.1.6. Status in Japan

Name:	Carnauba Wax
Ingredient Code:	002086
Categories:	All categories with no limits

6.2 Jojoba Oil (*Buxus chinensis*)

6.2.1. Source

Jojoba Oil is an ester derived from the woody evergreen shrub *Simmondsia chinensis* which grows in coarse, well-drained desert soil. It is found in the southern part of the State of Arizona in the United States and northwest Mexico.

6.2.2. Fatty Components

Component	Fatty Acid Typical % Weight	Fatty Alcohol Typical % Weight
C18:1	14	n/a
C20:1	70	42
C22:1	16	48
C24:1	n/a	10

6.2.3. Properties

CAS Number: 61789-91-1
Iodine Value: 86 Titer Point: 6° C

6.2.4. Commercial Availability

Jojoba Oil is an item of commerce.

6.2.5. INCI Status

Jojoba Oil is listed in the CTFA dictionary, both per se and in 16 derivatives. Silicone derivatives are available.

6.2.6. Status in Japan

Name: Jojoba Oil
Ingredient Code: 520987
Categories: All categories with no limits

6.3 Candelilla Wax (*Candelilla cera*)

6.3.1. Source

Candelilla Wax is extracted from the outer surface of the *Euphorbia cerifera* plant, which is native to the arid regions of northern Mexico. The plants grow wild in the plains and in the foothills of Mexico's Northcentral Plateau. With a melting point ranging from 66 to 71° C, Candelilla is well-suited to the preparation of many wax products where heat resistance is an important consideration. Candelilla Wax is used in polish, dressings, coatings and finishes where a reasonably high melting point is desirable. In addition, this wax blends easily with fatty acids, paraffin and other waxes used in the manufacture of candles and tapers. Candelilla can be used for dyes in the printing of various materials, providing excellent lubricant properties and resistance to high pressure.

6.3.2. Fatty Components

Candelilla Wax is composed of 50% hydrocarbon. The remainder is fatty acids, aliphatic triterpenic alcohols and their esters, and some resin.

Component	% Weight	Chemical Nature
Acids	8	C30 – C34
Alcohols	10	C20-C32
Esters	30	C42-C64
Hydrocarbons	50	C31
Resin	2	n/a

6.3.3. Properties

CAS Number: 8006-44-8 EINECS Number: 232-347-0
Melting Point: 68-73° C

6.3.4. Commercial Availability

Candelilla Wax is an item of commerce.

6.3.5. INCI Status

Candelilla Wax is listed in the CTFA dictionary. Silicone derivatives are available.

6.3.6. Status in Japan

Name: Candelilla Wax
Ingredient Code: 500120
Categories: All categories with no limits

Conclusion

Nature has provided a plethora of materials that are potentially useful for synthesizing surfactants. For formulators, the type and source of natural raw materials are major variables to consider when making new cosmetic products. Formulators need to know some basic information on the sources and chemistries of these raw materials in order to make informed decisions on product formulation. The selection of oils and waxes, both per se and in surfactant molecules, affects not only product performance, but also cost and label copy.

The formulator has a variety of potential oils to use in formulation. Sometimes the specific oil is chosen for the marketing potential that is based upon a name, other times it is a skin feel, which comes from carbon distribution, and sometimes it is the natural antioxidant that is present in the oil that is of interest. The formulator must decide why a specific oil is of interest and use the appropriate oil in the formulation.

Appendix A

INCI Names for Oils

Vegetable Oil Name	Latin Name	INCI Designation
Andiroba Seed Oil	Carapa guianensis (aka guaianensis)	NR*
Apricot Kernel Oil	Prunus armeniaca	Prunus Armeniaca (Apricot) Kernel Oil
Argan Oil	Argania spinosa	Argania Spinosa Kernel Oil
Artemisia Oil	Artemisia sphaerocephala	NR*
Avocado Butter	Persea gratissima	Persea Gratissima (Avocado) Butter
Avocado Oil	Persea gratissima	Persea Gratissima (Avocado) Oil
Babassu Oil	Orbignya oleifera	Orbignya Oleifera Seed Oil
Baobab Oil	Adansonia digitata	Adansonia Digitata Oil
Beeswax	Cera alba	Beeswax (Cera Alba)
Bitter Cherry Kernel Oil	Prunus cerasus	Prunus Cerasus (Bitter Cherry) Seed Oil
Black Currant Seed Oil	Ribes nigrum	Ribes Nigrum (Black Currant) Seed Oil
Black Walnut Oil	Juglans nigra	Juglans Nigra (Walnut) Seed Oil
Blue Passion Flower Seed Oil	Passiflora caerulea	NR*
Borage Seed Oil	Borago officinalis	Borago Officinalis Seed Oil
Brazil Nut Oil	Bertholletia excelsa	Bertholletia Excelsa Seed Oil
Buriti Oil	Mauritia flexuosa	Mauritia Flexuosa Fruit Oil
Camellia Oil	Camellia oleifera or sinensis	Camellia Sinensis Leaf Oil
Candelilla Wax	Candelilla cera	Euphorbia Cerifera (Carnauba) Wax
Canola Oil	Canola	Canola

*NR means not registered

Vegetable Oil Name	Latin Name	INCI Designation
Cape Chestnut Oil	Calodendrum capense	Calodendrum Capense Nut Oil
Carnauba Wax	Copernicia cerifera	Copernicia Cerifera (Carnauba) Wax
Cashew Nut Oil	Anacardium occidentale	Anacardium Occidentale (Cashew) Seed Oil
Crambe Oil	Crambe abyssinica	Crambe Abyssinica Seed Oil
Castor Oil	Ricinus communis	Ricinus Communis (Castor) Seed Oil
Chaulmoogra Oil	Taraktogenos kurzii	Taraktogenos Kurzii Seed Oil
Chia Oil	Salvia hispanica	Salvia Hispanica Seed Oil
Chufa Oil (aka Rush nut oil)	Cyperus esculentus	Cyperus Esculentus Root Oil
Cocoa Butter	Theobroma cacao	Theobroma Cacao (Cocoa) Seed Butter
Coconut Oil	Cocos nucifera	Cocos Nucifera (Coconut) Oil
Coffee Bean Oil	Coffea arabica	Coffea Arabica (Coffee) Seed Oil
Corn Oil	Zea mays	Zea Mays (Corn) Oil
Cottonseed Oil	Gossypium herbaceum	Gossypium Herbaceum (Cotton) Seed Oil
Cranberry Seed Oil	Vaccinium macrocarpon	Vaccinium Macrocarpon (Cranberry) Seed Oil
Cupuacu Butter	Theobroma grandiflorum	Theobroma Grandiflorum Seed Butter
Echium Seed Oil	Echium plantagineum	Echium Plantagineum Seed Oil
Evening Primrose Oil	Oenothera biennis	Oenothera Biennis (Evening Primrose) Oil
Gold of Pleasure Oil	Camelina sativa	Camelina Sativa Seed Oil
Grape Seed Oil	Vitis vinifera	Vitis Vinifera (Grape) Seed Oil
Grapefruit Seed Oil	Citrus grandis	Citrus Grandis (Grapefruit) Seed Oil
Hazelnut Oil	Corylus americana	Corylus Americana (Hazel) Seed Oil

Vegetable Oil Name	Latin Name	INCI Designation
Hemp Oil	Cannabis sativa	Cannabis Sativa Seed Oil
Horseradish Tree (Moringa) Oil	Moringa pterygosperma (aka oleifera)	Moringa Pterygosperma Seed Oil
Hybrid Safflower Oil	Carthamus tinctorius	Carthamus Tinctorius (Safflower) Seed Oil
Illipe Butter	Shorea stenoptera	Shorea Stenoptera Seed Butter
Japan Wax	Rhus succedanea	Rhus Succedanea Fruit Wax
Jojoba Oil	Buxus chinensis	Simmondsia Chinensis (Jojoba) Seed Oil
Kiwi Seed Oil	Actinidia chinensis	Actinidia Chinensis (Kiwi) Seed Oil
Kokum Butter	Garcinia indica	Garcinia Indica Seed Butter
Kukui Nut Oil	Aleurites moluccana	Aleurites Moluccana Seed Oil
Lime Seed Oil	Citrus aurantifolia	Citrus Aurantifolia (Lime) Oil
Linseed Oil	Linum usitatissimum	Linum Usitatissimum (Linseed) Seed Oil
London Rocket Oil	Sisymbrium irio	Sisymbrium Irio Seed Oil
Macadamia Nut Oil	Macadamia integrifolia (aka ternifolia)	Macadamia Ternifolia Seed Oil
Mango Butter	Mangifera indica	Mangifera Indica (Mango) Seed Butter
Manketti Nut Oil	Schinziophyton rautanenii (Ricinodendron rautanenii)	Schinziophyton Rautanenii Kernel Oil
Marigold Seed Oil	Calendula officinalis	Calendula Officinalis Seed Oil
Marula Oil	Sclerocarya birrea	Sclerocarya Birrea Seed Oil
Meadowfoam Seed Oil	Limnanthes alba	Limnanthes Alba (Meadowfoam) Seed Oil
Mobola Plum Oil	Parinari curatellifolia	Parinari Curatellifolia Seed Oil
Murumuru Butter	Astrocaryum murumuru	Astrocaryum Murumuru Seed Butter
Neem Oil	Melia azadirachta	Melia Azadirachta Seed Oil

Vegetable Oil Name	Latin Name	INCI Designation
Ngali Nut Oil	Canarium indicum	Canarium Indicum Seed Oil
Olive Oil	Olea europaea	Olea Europaea (Olive) Fruit Oil
Ongokea Oil	Ongokea gore	NR*
Palm Kernel Oil	Elaeis guineensis	Elaeis Guineensis (Palm) Kernel Oil
Palm Oil	Elaeis guineensis	Elaeis Guineensis (Palm) Oil
Papaya Seed Oil	Carica papaya	Carica Papaya Seed Oil
Passion Fruit Seed Oil	Passiflora edulis	Passiflora Edulis Seed Oil
Peach Kernel Oil	Prunus persica	Prunus Persica (Peach) Kernel Oil
Peanut Oil	Arachis hypogaea	Arachis Hypogaea (Peanut) Oil
Pecan Oil	Carya illinoensis	Carya Illinoensis (Pecan) Seed Oil
Pequi Oil	Caryocar brasiliense	Caryocar Brasiliense Fruit Oil
Perilla Oil	Perilla ocymoides	Perilla Ocymoides Seed Oil
Pistachio Nut Oil	Pistacia vera	Pistacia Vera Seed Oil
Plum Kernel Oil	Prunus domestica	Prunus Domestica Seed Oil
Pomegranate Seed Oil	Punica granatum	Punica Granatum Seed Oil
Poppy Seed Oil	Papaver orientale	Papaver Orientale (Poppy) Seed Oil
Pumpkin Seed Oil	Cucurbita pepo	Cucurbita Pepo (Pumpkin) Seed Oil
Rapeseed Oil	Brassica campestris	Brassica Campestris (Rapeseed) Seed Oil
Raspberry Seed Oil	Rubus idaeus	Rubus Idaeus (Raspberry) Seed Oil
Rice Bran Oil	Oryza sativa	Oryza Sativa (Rice) Bran Oil
Rose Hip Oil (Dog Rose)	Rosa canina	Rosa Canina Fruit Oil
Rose Hip Oil (Sweet Brier)	Rosa rubiginosa	Rosa Rubiginosa Seed Oil

*NR means not registered

Vegetable Oil Name	Latin Name	INCI Designation
Safflower Oil	Carthamus tinctorius	Carthamus Tinctorius (Safflower) Seed Oil
Sea Buckthorn Oil	Hippophae rhamnoides	Hippophae Rhamnoides Fruit Oil
Seaside Plum Oil	Ximenia americana	Ximenia Americana Seed Oil
Sesame Oil	Sesamum indicum	Sesamum Indicum (Sesame) Seed Oil
Shea Butter	Butyrospermum parkii	Butyrospermum Parkii (Shea Butter)
Shellac Wax	Shellac cera	Shellac Wax
Shorea Robusta Butter	Shorea robusta	Shorea Robusta Seed Butter
Soybean Oil	Glycine soja	Glycine Soja (Soybean) Oil
Sunflower Seed Oil	Helianthus annuus	Helianthus Annuus (Sunflower) Seed Oil
Sweet Almond Oil	Prunus amygdalus dulcis	Prunus Amygdalus Dulcis (Sweet Almond) Oil
Sweet Cherry Kernel Oil	Prunus avium	Prunus Avium (Sweet Cherry) Seed Oil
Sweet Orange Seed Oil	Citrus aurantium dulcis	Citrus Aurantium Dulcis (Orange) Peel Oil
Tall Oil	Tallol	Tall Oil
Tallow	Adeps bovis	Tallow
Tamanu Oil	Calophyllum inophyllum	Calophyllum Tacamahaca Seed Oil
Tung Oil	Aleurites fordii	NR*
Veronia Oil	Vernonia galamensis	NR*
Walnut Oil	Juglans regia	Juglans Regia (Walnut) Seed Oil
Watermelon Seed Oil (Ootanga)	Citrullus vulgaris	Citrullus Vulgaris (Watermelon) Seed Oil
Wheat Germ Oil	Triticum vulgare	Triticum Vulgare (Wheat) Germ Oil

*NR means not registered

Appendix B

Oils (Listed Alphabetically)

Appendix C

Analytical Methods

The two methods that follow are typical of the methods used to determine distribution and iodine value of oils.

Fatty Acid Distribution

Scope: This method is applicable to all methyl esters, fatty acids and triglycerides.

Summary: The sample is converted to a methyl ester and analyzed by gas chromatograph with a SP-2340 packed column installed.

The methyl ester response factors are very similar to one another. Therefore, when performing calculations, the area of one methyl ester peak is divided by the sum of all of the methyl ester peaks to determine distribution.

Apparatus:

1. Gas chromatograph capable of temperature programming with a packed inlet and a flame ionization detector (FID).
2. Integrator.
3. SP-2340 packed column, 100/120 Supelcoport, 6' x 1/8".
4. 10 µL syringe.
5. Analytical balance capable of determining weights to two decimal places.
6. Pipettes, 2 mL and 10 mL.
7. Volumetric flask, 50 mL.
8. Steam bath.

Reagents:

1. Boron trifluoride-methanol (BF_3), 14% solution, reagent grade (see **Remark 1** on page 108).
2. Petroleum Ether, reagent grade.
3. Potassium hydroxide (KOH), 0.5N in methanol (Standardized using CCM-1).
4. Saturated sodium chloride (NaCl).

Procedure: *Instrument Setup:*

Install the SP-2340 packed column into a GC equipped with an FID and an integrator. Follow the instrument

manufacturer's recommendations when installing the column. Use the following conditions and settings to run this method.

Flows:

Carrier: 30-40 mL/minute
Air: 360-440 mL/minute
Hydrogen: 30-40 mL/minute

Instrument Conditions:

Column:	100° C; hold for one minute.
	100 – 250° C @ 8.5° C/minute
	Hold for two minutes.
	250 – 275° C @ 16° C/minute
	Hold for five minutes.
Injection Port:	280° C
Detector:	300° C

Integrator Parameters:

Peak Width (sec):	5
Slope (μV/min):	238
Min. Area (Count):	2000
Stop Time (min):	27.21
Atten (2^X mV):	7
Chart Speed:	5 mm/minute

Preparation of Methyl Esters from Fatty Acids:

1. Weigh 0.3 grams of sample into a 50 mL volumetric flask. Pipette 10 mL of BF_3 into the flask and heat for 30 minutes on a steam bath.
2. Remove the flask from the steam bath and fill flask with saturated NaCl until the volume reaches the neck of the flask. Seal the flask, shake thoroughly, and allow the oil to separate (see **Remark 2** on page 108).
3. Pipette 2 mL of petroleum ether into the flask and seal flask.

Preparation of Methyl Esters from Triglycerides and Other Lipids:

1. Weigh 0.2 grams of sample into a 50 mL volumetric flask. Pipette 4 mL of 0.5 N methanolic KOH into the flask and

heat for 5 minutes (or until the fat globules have gone into solution) on a steam bath.
2. Pipette 10 mL of BF_3 into the flask and heat for 30 minutes on a steam bath.
3. Remove the flask from the steam bath and fill flask with saturated NaCl until the volume reaches the neck of the flask. Seal the flask, shake thoroughly, and allow the oil to separate (see **Remark 2** on page 108).
4. Pipette 2 mL of petroleum ether into the flask and seal flask.

Sample Analysis:

1. Inject 1 µL of the pet ether layer into a GC setup with the conditions and parameters outlined in the Instrument Setup section of this method.
2. Compare the chromatogram to that of a standard chromatogram in order to assign the peaks to the correct carbon chain length methyl ester (see **Remark 3** on page 108).
3. Using Equation 1 in the Calculations section of this method, calculate the carbon chain distribution. The results should be reported in percent with the sum of all individual methyl esters equaling 100%.

Calculations:

Equation 1

$$\% \text{ Individual Methyl Ester} = \frac{ME_i \text{ area counts}}{\text{Sum of } ME_{all} \text{ area counts}} \times 100$$

Where: MEi = Individual methyl ester
MEall = All methyl ester peaks

Safety: Petroleum ether is extremely flammable. Use in a well-ventilated area and avoid getting in eyes, on skin or on clothing.

Potassium hydroxide is corrosive. Do not get dilute solutions in eyes, on skin or on clothing.

Boron trifluoride is highly flammable and toxic. Use in a well-ventilated area and avoid getting in eyes, on skin or on clothing.

Remarks:

1. Boron trifluoride is very volatile and hygroscopic. It should be stored in an explosion-proof refrigerator.
2. The oil layer is less dense than the saturated NaCl solution. Therefore, the oil layer will float on top of the saturated NaCl solution.
3. The standard chromatogram should be generated using a methyl ester solution in which the concentrations of the individual components is known.

Iodine Value (Wijs Method)

Scope:

This method is applicable to all normal fatty acids, oils and fatty amines that do not contain conjugated double bonds. It cannot be used for quaternary ammonium compounds.

When iodine value is determined on fatty acids containing conjugated double bonds, the result is not to be used as a value of total unsaturation, but rather a value to compare with similar systems' degree of unsaturation (see **Remark 1** on page 110).

Summary:

The iodine value is a measure of the unsaturation of fatty acids and is expressed in terms of the number of centigrams of iodine absorbed per gram of sample (percent iodine absorbed).

A sample is dissolved in chloroform and then reacted, in the dark, with Wijs solution for a set amount of time. KI and deionized water are added to the flask and the solution is titrated with 0.1N sodium thiosulfate.

Apparatus:

1. Erlenmeyer flasks, 250 mL iodine determination with ground glass stoppers.
2. Analytical balance, capable of determining weights to four decimal places.
3. Pipette, 10 & 25 mL class A volumetric.
4. Burette, 50 mL class A with 0.2 mL divisions.
5. Graduated cylinders, 50 mL.
6. Stir bars.
7. Stir plate.
8. Steam bath.

Reagents:

1. Chloroform, reagent grade.
2. Wijs solution, reagent grade (see **Remark 2** on page 110).

3. Potassium iodide (KI) solution, 15% in deionized water.
4. Mercuric acetate solution, 2.5% in acetic acid.
5. Sodium thiosulfate, 0.1N (Standardized using LTC-0050).
6. Starch indicator solution, 1% in deionized water (see **Remark 3** on page 110).

Procedure:

1. Using Table I as a guide, weigh an appropriate amount of sample into a tared Erlenmeyer flask (see **Remarks 4 & 5** on page 110). Record the weight. Label the flask accordingly.
2. Dissolve the sample by adding 25 mL of chloroform to the flask and swirling the flask. If needed, heat the flask on a steam bath to completely dissolve the sample.
3. After the sample solution has cooled to room temperature, pipette 25 mL of Wijs solution into the flask and swirl the contents till thoroughly mixed (see **Remarks 2 & 6** on page 110).
4. Prepare a blank sample by pipetting 25 mL of chloroform and 25 mL of Wijs solution into an empty Erlenmeyer flask (see **Remark 4** on page 110). Label the flask accordingly.
5. Stopper the flasks with a ground glass stopper. Pipette about 5 mL of the 15% KI solution into the stopper well.
6. Using a timer, store the flasks in a dark place for 30 minutes (60 minutes for expected iodine values greater than 150) to allow the reaction to take place completely (see **Remark 7** on page 110).
7. After the reaction is complete, remove all of the flasks from the dark at the same time. Add about 20 mL of the 15% KI solution and 75 mL of deionized water to each of the flasks. Add a stir bar to each flask and mix well.
8. Using 0.1N sodium thiosulfate, titrate the blank sample to a pale yellow endpoint (see **Remark 8** on page 110). Add about 2 mL of the starch indicator solution to the flask and continue titrating until the blue color just disappears (usually a white endpoint). Repeat this titration for each of the samples.
9. Using Equation 1 in the Calculations section of this method, calculate the iodine value. Report this value to 1 decimal place.

Calculations:

Equation 1

$$\text{Iodine Value (IV)} = \frac{(\text{mL Blank - mL Sample})(\text{N})(12.69)}{\text{sample wt.}}$$

Precision: The relative standard deviation for iodine value determinations was determined to be ±1.3% when one sample was analyzed 36 times by different chemists on different days within the same laboratory. This relative standard deviation was determined on a sample with an average iodine value of 134.7.

Safety: Chloroform is a known carcinogen. Do not breathe in vapors. Use in a well-ventilated area at all times. Do not get in eyes, on skin or on clothing.

Wijs solution can cause severe burns, and the vapors can cause lung and eye damage. Use in a well-ventilated area at all times. Do not get in eyes, on skin or on clothing.

Acetic acid is corrosive and toxic. Use caution when handling. Do not get in eyes, on skin or on clothing.

Mercuric acetate is corrosive and highly toxic. Use caution when handling. Do not get in eyes, on skin, or on clothing.

Remarks:

1. This is due to the fact that addition to one double bond of a conjugated diene and two double bonds of a conjugated triene goes rapidly but saturation of the remaining double bond is extremely slow.
2. Because the preparation of the Wijs solution is time consuming and involves the use of both hazardous and toxic chemicals, this solution may be purchased from a chemical supplier. Only use solutions that contain no carbon tetrachloride. Store in an explosion-proof refrigerator to keep the solution cool and out of the light. Never allow the temperature of the solution to rise above 25-30° C. All Wijs solutions are sensitive to temperature, moisture and light.
3. The 1% starch solution can be purchased from a chemical supplier. However, if it is to be made in the lab, Potato Starch for Iodometry is recommended because it produces a deep blue color in the presence of the iodonium ion. Soluble Starch is not recommended because a consistent deep blue color may not be developed when some soluble starches interact with the iodonium ion. The following are suitable starches: Soluble Starch for Iodometry, Fisher S516-100, Soluble Potato Starch, Sigma S-2630, Soluble Potato Starch for Iodometry, J.T. Baker 4006-04.

4. All glassware must be completely clean and completely dry!
5. When analyzing dehydrated castor oil fatty acids or their derivatives, weigh 0.11 - 0.13 grams of sample. Due to the amount of free hydroxyl groups in castor oil, it yields high iodine values.
6. When analyzing fatty amines, add 10 mL of 2.5% mercuric acetate solution along with the Wijs solution. Add 10 mL of this solution to the blank as well. The reaction time is only 3 minutes for fatty amines.
7. If the reaction is not terminated within 3 minutes of the designated reaction time (30 or 60 minutes), the sample must be discarded and reanalyzed.
8. The samples must be titrated within 30 minutes of the reaction completion (when they were removed from the dark). Otherwise, the samples must be discarded and reanalyzed.

References:

1. A.O.C.S. Official Method Cd 1-25.
2. A.O.C.S. Official Method Tg 1a-64.
3. A.O.C.S. Official Method Tg 2a-64.

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Oils of Nature

O'Lenick, Steinberg, Klein and LaVay

Written by some of the most respected names in the industry, *Oils of Nature* provides information on salient properties of certain naturally occurring oils, waxes and esters used in the formulation of personal care products. Information on chemical properties, CAS numbers, source, carbon distribution and availability of the raw materials and derivatives is included. The growing interest in natural, green renewable resources for inclusion in personal care products make this book of growing interest to the formulator.

A few topics include:

- Animal-derived triglycerides
- Plant-derived triglycerides
- Drying Triglycerides, plant-derived
- Triglycerides with unusual components
- Animal-Derived Esters
- Plant-Derived Esters

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