

Castor Oil Chemicals and Derivatives

Introduction – 3.1

Properties & Chemical Composition of Castor Oil – 3.2

Chemical, Physical Properties & Specifications of Castor Oil Grades & Derivatives – 3.3

Highlights

- ❖ While castor oil is popular in itself, its various derivatives and their unique properties and the consequent applications make castor oil even more important in the plant and vegetable oils hierarchy.
- ❖ The castor seed contains about 5.0% moisture, 12.0–16.0% protein, 45.0–50% oil. The seeds are high in phosphorus, 90% in the phytic form. In addition, the seed contains 60 mg/kg uric acid and 7 ppm HCN.
- ❖ Some of the key derivatives of castor oil include: sebacic acid, ricinoleic acid, 2-heptanol, undecylenic aldehyde, heptanoic acid, methyl undecylenate, 2-octanol, glycerine, undecanoic acid, undecylenic acid, calcium undecylenate, zinc undecylenate.
- ❖ Castor oil is unique among all fats and oils. It is the only source of 18-carbon hydroxylated fatty acid with a double bond between the ninth and tenth carbons, and is hence also known as dodecahydroxyoleic acid. No other vegetable oil contains such a diverse and high proportion of fatty hydroxyl acids.
- ❖ Ricinoleic acid, one of the key derivatives of castor oil, comprises approximately 87% of the fatty acid composition. It is used in coatings, plastics, inks and cosmetics.
- ❖ Apart from ricinoleic acid, the other fatty acids present are linoleic acid (4.2%), oleic acid (3.0%), stearic acid(1%), palmitic acid (1%), di-hydroxystearic acid (0.7%), linolenic acid (0.3%), and eicosanoic acid (0.3%).
- ❖ The oil is characterized by high viscosity which is unusual for a natural vegetable oil. Castor oil is hence used in blending lubricants.
- ❖ Regardless of where the castor beans are grown, the chemical composition remains constant. It is this consistency that has allowed castor oil to be used as the absolute standard for viscosity by the Bureau of Standards.
- ❖ Castor oil also has excellent emollient and lubricating properties as well as a marked ability to wet and disperse dyes, pigments and fillers.
- ❖ Due to its higher polar hydroxyl groups, castor oil will plasticize a wide variety of natural and synthetic resins, waxes, polymers and elastomers.

3.1 Introduction

While castor oil is popular in itself, its various derivatives and their unique properties and consequent applications make castor oil even more important in the plant and vegetable oils hierarchy.

Castor Plant Chemistry

Leaves: Per 100 g, the leaves are reported to contain on a zero-moisture basis, 24.8 g protein, 5.4 g fat, 57.4 g total carbohydrate, 10.3 g fiber, 12.4 g ash, 2,670 mg Ca, and 460 mg P.

Seeds: The seed contains about 5% moisture, 12.0–16.0% protein, 45.0–50% oil, 3.0–7.0 NFE, 23–27% CF, and 2.0–2.2% ash. Seeds are high in phosphorus, 90% in the phytic form. The seeds, in addition, contain 60 mg/kg uric acid and 7 ppm HCN. The seeds contain a powerful lipase, employed for commercial hydrolysis of fats, and amylase, invertase, maltase, endotrypsin, glycolic acid, oxidase, ribonuclease, and a fat-soluble zymogen. Sprouting seeds contain catalase, peroxidase and reductase.

Summary List of Key Derivatives of Castor Oil

Commercial Castor Oil	First Pressed Degummed Grade Castor Oil
Refined Castor Oil – F.S.G./B.S.S.	Refined Castor Oil – Extra Pale Grade
Refined Castor Oil – Pale Pressed Grade	Castor Oil Pharmaceutical (I.P/B.P./U.S.P.)
Sulfonated Castor Oil – Turkey Red Oil	Blown Castor Oil
Ricinoleic Acid	Hydrogenated Castor Oil
12-Hydroxy Stearic Acid (12-H.S.A.)	Methyl-12-Hydroxy Stearate
Methyl Ricinoleate	Urethane Modified Castor Oil
Dehydrated Castor Oil (DCO)	Glycerine
Urethane Grade	Ethoxylated Castor Oil
Sebacic Acid	Heptaldehyde
2-Heptanol	Undecylenic Aldehyde
Methyl Undecylenate	2-Octanol
Undecanoic Acid	Undecylenic Acid
Calcium Undecylenate	Zinc Undecylenate
Zinc Ricinoleate	Heptanoic Acid

3.2 Properties & Chemical Composition of Castor Oil

Castor oil's chemical formula is: $\text{CH}_3-(\text{CH}_2)_5-\text{CH}(\text{OH})-\text{CH}_2-\text{CH}=\text{CH}-(\text{CH}_2)_7-\text{COOH}$

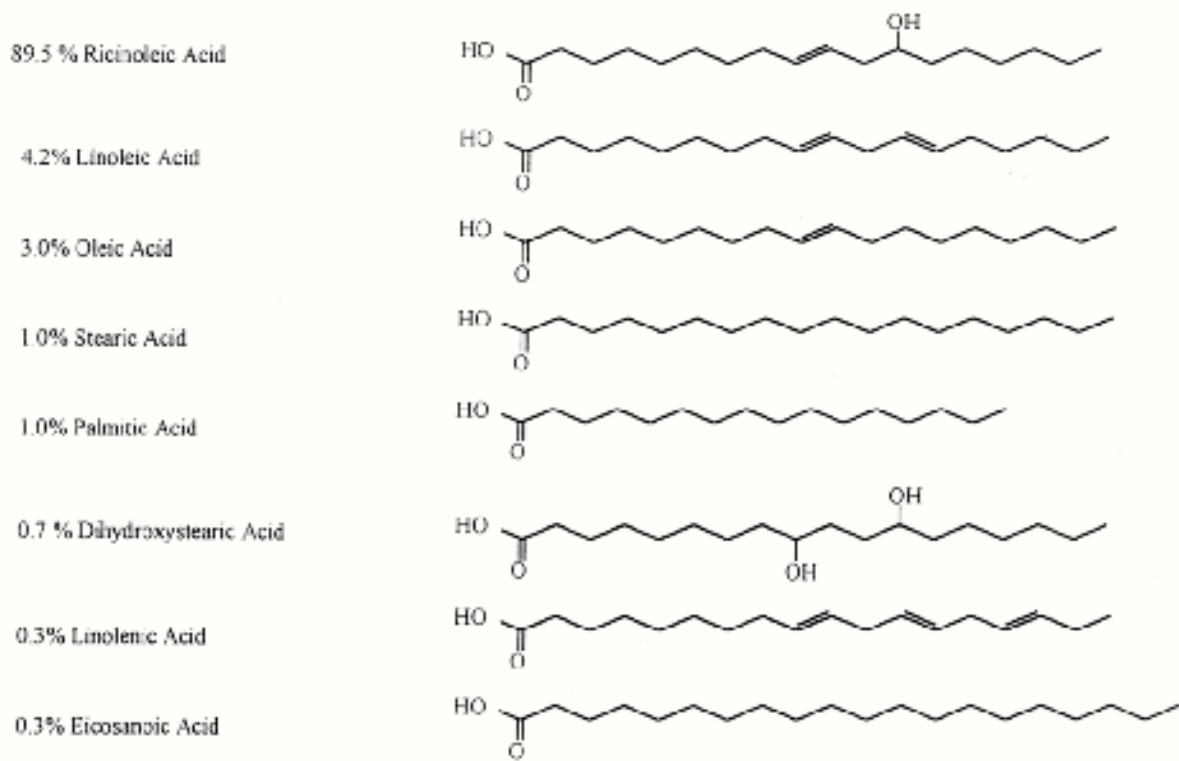
It is a fatty acid with 18 carbon atoms, a double bond between the ninth and tenth carbons, and is hence also known as dodecahydroxyoleic Acid. No other vegetable oil contains such a diverse and high proportion of fatty hydroxyacids.

Uniqueness of castor oil is that regardless of where the beans are grown, the chemical composition remains constant. It is this consistency that has allowed castor oil to be used as the absolute standard for viscosity by the Bureau of Standards.

Castor oil has a molecular weight of 298, a low melting point (5°C) and a low solidification point (12°C to -18°C). It is a monounsaturated fatty acid, soluble in pure alcohol, insoluble in water and has some miscibility in petroleum aliphatic solvents. It resists heat and leaves virtually no residue.

Castor Oil Chemistry and Composition

- ❖ Castor oil is unique among all fats and oils in that:
- ❖ It is the only source of an 18-carbon hydroxylated fatty acid with one double bond
- ❖ Ricinoleic acid (12-Hydroxyoleic Acid) comprises approximately 87% of the fatty acid composition
- ❖ Product uniformity and consistency are relatively high for a naturally occurring material
- ❖ It is a toxic, biodegradable, renewable resource



Castor Oil Composition vs. Composition of Other Vegetable Oils

Crop	% A vg. Oil Content	Oleic Acid	Linoleic Acid	Linolenic Acid	Ricinoleic Acid
Castor	45%	3%	4.2%	0.3%	90%
Rape Seed	42%	32%	19%	7%	-0-
Linseed	38%	20%	16%	50%	-0-
Sunflower	48%	26%	62%	-0-	-0-
Soybean	18%	27%	53%	7%	-0-
Palm	52%	40%	8%	-0-	-0-

Like other vegetable oils and animal fats, castor oil is a triglyceride, which chemically is a glycerol molecule with each of its three hydroxyl group esterified with a long chain fatty acid.

Apart from ricinoleic acid, the other fatty acids present are linoleic (4.2%), oleic (3.0%), stearic (1%), palmitic (1%), di-hydroxystearic acid (0.7%), linolenic acid (0.3%), and eicosanoic acid (0.3%).

The chemistry of castor oil is centered on its high content of ricinoleic acid and the three points of functionality existing in the molecule. These are:

- (1) The carboxyl group which can provide a wide range of esterifications;
- (2) The single point of unsaturation which can be altered by hydrogenation or epoxidation or vulcanization and the hydroxyl group which can be acetylated or alkoxyated, may be removed by dehydration to increase the unsaturation of the compound to give semi-drying oil.

The hydroxyl position is so reactive that the molecule can be split at that point by high-temperature pyrolysis and by caustic fusion to yield useful products of shorter chain length. The presence of hydroxyl group on castor oil adds extra stability to the oil and its derivatives by preventing the formation of hydroperoxides.

Properties

Density @ 20°C	0.956-0.963g/ml
Refractive Index	1.477 -1.479
Saponification Number	177-187
Iodine Value	82-88
Unsaponifiable Matter	0.3-0.5%
Hydroxyl Number	160mm
Viscosity @ 20°C	9.5-10.0 dPa.S

Crude castor oil is pale straw in colour but turns colourless or slightly yellowish after refining and bleaching.

Like all other vegetable oils, castor oil has different physical and chemical properties that vary with the method of extraction. Cold-pressed castor oil has low acid value, low iodine value and a slightly higher saponification value than solvent-extracted oil, and it is lighter in colour.

The oil is characterized by high viscosity, unusual for a natural vegetable oil. This behavior is due largely to hydrogen bonding of its hydroxyl groups. The high viscosity makes the oil useful as a component in blending lubricants. The hydroxyl groups in castor oil account for a unique combination of physical properties:

- Relatively high viscosity and specific gravity
- Solubility in alcohols in any proportion
- Limited solubility in aliphatic petroleum solvents

The uniformity and reliability of its physical properties are demonstrated by the long-term use of castor oil as an absolute standard for viscosity. Because of its higher polar hydroxyl groups, castor oil is not only compatible with but will plasticize a wide variety of natural and synthetic resins, waxes, polymers and elastomers. Castor oil also has excellent emollient and lubricating

properties as well as a marked ability to wet and disperse dyes, pigments and fillers. In the form of its chemical derivatives, castor oil's application versatility is further enhanced.

Although castor oil is a unique naturally-occurring polyhydroxy compound, a limitation of the oil is the slight reduction of its hydroxyl value and acid value on storage; both values may change by about 10% if stored for about 90 days. The reduction of these values is due to the reaction between hydroxyl and carboxyl groups in the oil molecule to form estolides.

3.3 Chemical, Physical Properties & Specifications of Castor Oil Grades & Derivatives

Commercial Grade Castor Oil

Appearance	Pale Dark Yellow
Colour in 1" Cell, Y+5R Lovibond	30 units max.
Iodine Value	82 – 90
Saponification Value	177 – 187
Hydroxyl Value	160 min.
Acid Value	2.0 max.
Moisture & Volatiles	0.50% max.
Specific Gravity @ 20° C	0.954 – 0.967

BP Grade Castor Oil

CAS Number	8001-79-4
EINECS	292-293-8
Colour	Nearly Colourless or Faintly Yellow
Relative Density at 20°C	0.952-0.965
Moisture	0.3% max.
Iodine Value	82-90
Saponification Value	176-187
Acid Value	2.0 max.
Unsaponifiables w/w	0.8% max.
Optical Rotation	between +3.5° and 6.0°
Hydroxyl Value	150 min.
Peroxide Value	5.0 max
Light Absorption	1.0 max

Pale Pressed Castor Oil

CAS Number	8001-79-4
Flash Point	>440°F,

	>227°C
HCC	V6
Boiling Point	>450°F, >232°C
Vapour Density	>Air
Colour Gardner	2 Max
Acid Value	1.5
% Moisture & Volatile	0.25 Max
Hydroxyl Value	160-168
Iodine Value	83-88
Saponification Value	175-185
Viscosity @ 25°C	6.3-8.9

Castor Oil U.S.P

CAS Number	8001-79-4
Flash Point	229°C (444°F) CC
Autoignition Temperature	449°C (840°F)
Appearance	Light yellow viscous liquid
Odor	Slight characteristic odor
Solubility	Negligible (< 0.1%)
Specific Gravity	0.961-0.963 @ 15.5°C
% Volatiles by volume @ 21°C (70°F)	100
Boiling Point	313°C (595°F)
Melting Point	-10°C (14°F)

Dehydrated Castor Oil

CAS Number	61789-45-5
Appearance	Viscous liquid
Colour Gardner	6 Max
Acid Value	5 Max
Iodine Value	123 Min
Hydroxyl Value	25 Max
Saponification Value	185 – 194
Viscosity at 30 °C	1.6 to 2.5 (poise 61 sec B4 cup)
Viscosity Gardner	G – J

Refined Castor Oil – FSG (First Special Grade)

Appearance	Pale Yellow, Viscous, Clear liquid
M.I.V.	0.25 % max.
F.F.A. (as oleic)	1.00 % max.

Acid Value	2.00 % max.
Iodine Value (Wijs)	82 – 90
Saponification Value	177 – 185
Hydroxyl Value	158 – 163
Colour on lovibond in 5.25"cell	Y- 20.0 Max. R – 2.0 Max.

First Special Grade Castor (FSG) Oil

Properties	Test Method	Magnitude
Free Fatty Acid(mg KOH/gm)	Aocs 13e.92	1.0% Max
Acid Value % (mgKOH / gm)	Aocs CaSa – 40	2.0% Max
Moisture & Volatiles %	Aocs Ca 2e – 25	0.25 % Max
Colour on Lovilond		
1" Cell (Y+5R)		2.2 Yellow, 0.3 Red Max
5 ¼" Cell (Y+5R)	Aocs Cc 13E – 92	20 Yellow, 2.0 Red Max
Colour Gardner		3 Max
Iodine Colour		4 Max
Iodine Value (By Wiss, gI 2 / 100g)	Aocs cd 1.25	82 – 90
Saponification Value (mgKOH / gm)	Aocs cd 3.25	177 – 185
Unsaponifiable Matter		1.0 % Max
Hydroxyl Value mgKOH / gm	Aocs cd 13-60	160 Min.
Density at 30°C	Aocs 10C – 95	
Specific gravity 15°C	Aocs Cc-10G-25	0.952 – 0.965
Viscosity at 20°C Pas		9.5 – 11.0
Viscosity at 25°C Pas		6.0 – 9.0
Viscosity Gardner		U – V
Refractive Index at 20°C	Aocs cc 7.25	1.477 – 1.481
Peroxide Value	Aocs cd 8.53	5 Max
Optical Rotation		+3.5° to +6.0°
Solubility		Complete soluble in Alcohol without turbidity
Ricinoleic Acid Content	GC	85% Min
Insoluble Impurities	Aocs Ca 3a – 36	0.02% Max

Castor Oil BSS Grade(British Standard Specifications)

Specific Gravity at 25° C	0.954-0.960
Acid Value	2.0 Max.
Saponification Value	175.0 Min.
Iodine Value	81-90

Hydroxyl Value	158 Min.
Colour Gardner	2.0 Max.

Blown Castor Oil

	Colour Gardner	Acid Value	Hydroxyl Value	Iodine Value	Saponification Value	Viscosity Gardner-Holdt/Strokes
Z-1	6 Max	12-16	151-158	69-73	200-220	Z-1/25-35
Z-6	12 Max	10-17	130-140	56-65	210-230	Z-5,6/100-150
Z-8	16 Max	11-16	125-135	58-66	220-245	Z-8/450-600

Urethane Grade

	Color Gardner	Acid Value	% Moisture & Volatile	Equivalent Weight	Hydroxyl Value	Iodine Value	Sapon Value	Viscosity @ 25° C
COLM	2 Plus Max	2.0 Max	0.02 Max	342	160-168	83-88	175-185	6.3-8.9

Ethoxylated Castor Oil

Synonyms –Castor oil polyoxyethylene ether

Typical properties of Ethoxylated Castor Oil (the properties given are for EO-36)

CAS Number	61791-12-6
Appearance	Clear or light yellow liquid
Density (g / cm-3) @ 25°C	1.05
pH (5% in water)	5–7
Cloud point, °C	68–75
Hydroxyl Value, mg KOH/g	37–45
Moisture, Percent	Max 0.5

12 HSA

12 HSA (12 Hydroxy Stearic Acid) is a wax-like, odourless and tasteless compound. The basic form of 12 HSA is a flake.

CAS Number	106-14-9
Formula	C ₁₈ H ₃₆ O ₃
Appearance	White Colour Flakes
Acid Value	175 Min.

Iodine Value	3.5 Max.
Melting Point	75°C Min.
Saponification Value	180-190
Hydroxyl Value	155 Min.
Colour Gardner (G)	5G Max.
Moisture	0.5 % Max.

Turkey Red Oil

CAS Number	8002-33-3
Appearance	Brownish yellow oil
Sp.Gravity	0.98
Melting Point	< 0°C
Boiling Point	> 150°C
Chemical Character	Anionic
pH	7 ~ 8
Sulfonation Degree	Minimum 4.0
Solubility	Miscible in water giving milky emulsion

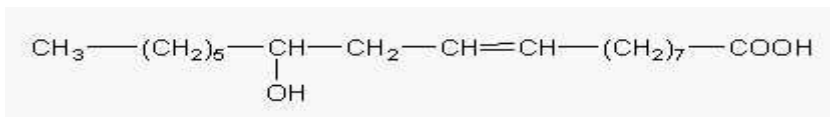
HCO – Hydrogenated Castor Oil

CAS Number	61788-85-0
Hydroxyl Value	158
Iodine Value	3
Saponification Value	180
Acid Value	2
Melting Point °C	86
Specific Gravity 25°C	1.02
Color	White to pale yellowish
Appearance @ 20°C:	Solid (mobile liquid @ 30°C)
Odor	Almost none
Flash Point °C	242 C DIN ISO 2592
Solubility in Water @ 20°C	100G/L
pH @ 100G/L H ₂ O	6 – 7

Ricinoleic Acid

Ricinoleic Acid (12-hydroxy-9-octadecenoic acid) is obtained by the hydrolysis of Castor Oil. It is a light coloured liquid with a ricinoleic content of approximately 90%. Primary uses include, coatings, plastics, inks and cosmetics

Biochemical studies have revealed that ricinoleic acid is produced in castor by the direct hydroxylation of the common fatty acid, oleic acid (18:1). The hydroxylation reaction is catalysed by a single, highly efficient enzyme, the fatty acid hydroxylase.



IUPAC Name– (E)-12-hydroxyoctadec-9-enoic acid

Synonyms– 12-hydroxy-(cis)-9-octadecenoic acid

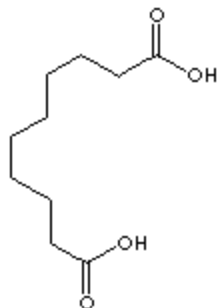
CAS Number	5323-95-5
Chemical Formula	C ₁₈ H ₃₄ O ₃
Mol Wt.	298.46
Physical State	Viscous yellow liquid
Melting Point	5.5°C
Boiling Point	245°C
Specific Gravity	0.94
Solubility in Water	Insoluble
Vapour Density	10.3
Flash Point	224°C
Stability	Stable under ordinary conditions
Appearance	Viscous yellow liquid
Acid Value	175 min
Hydroxyl Value	150 min
Iodine Value	80-91
Saponification Value	180 min
Colour, Gardner	8 max

Methyl 12 HSA –Methyl 12 Hydroxy Stearate

Hydroxyl Value	160+
Iodine Value	3
Saponification Value	175+
Acid Value	1.2
Melting Point °C	52
Specific Gravity 25 °C	1.02

Sebacic Acid

Sebacic acid is a dicarboxylic acid.



Chemical, Physical Properties & Specifications of Sebacic Acid

Chemical Names	Decanedioic acid 1,8-Octanedicarboxylic Acid Dicarboxylic acid C ₁₀
Chemical Formula	C ₁₀ H ₁₈ O ₄
CAS Number	111-20-6
Physical State and Appearance	White flake or powdered crystal in its pure state
Molecular Weight	202.24 g/mole
Color	Colorless to light yellow
Odour	Mild odor of fatty acid.
Boiling Point	Decomposes
Melting Point	132°C (269.6°F)
Specific Gravity	1.207 (Water = 1)
Density at 25°C	1.209 g per cubic centimeter
Dispersion Properties	See solubility in water, methanol, diethyl ether, acetone

A Sample Producer Specification for Sebacic Acid-

Form: Powder

Parameter	Values		
	Special High-grade	High-grade I	High-grade II
Sebacic Acid Content (%)	99.5min	99.5min	99.5min
Ash Content (%)	0.02max	0.03max	0.05max
Moisture Content (%)	0.3max	0.3max	0.3max
Alkaifusion Specific Color (Platinum-Cobalt No.)	5max	15max	25max

Melting Point Range °C	131 to 134.5	131 to 134.5	131 to 134.5
------------------------	--------------	--------------	--------------

Form: Grain

Parameter	Value
Sebacic Acid Content (%)	99.5min
Ash Content (%)	0.03max
Moisture Content (%)	0.1max
Alkali Fusion Chromaticity(Platinum-Cobalt Color No.)	25max
Melting Point Range, °C	131 to 134.5
Granularity(%)	95 and higher

Members of sebacic acid molecules

Product	CAS RN
1,1'-Isesebacoylbis(2-ethylaziridine)	25853-47-8
1,1'-Sebacoylbisaziridine	2798-06-3
1,4-Dioxatetradecane-5,14-dione	5578-82-5
1,6-Dioxacyclohexadecane-7,16-dione	58296-43-8
2,2,9,9-Tetramethylsebacic acid	22092-62-2
2-Ethylhexyl 2,2,5-trimethylhexyl sebacate	71607-40-4
2-Ethylhexyl nonyl sebacate	5137-28-0
2-Hydroxysebacic acid	103963-71-9
3,3'-(Sebacoyldiimino)bis(5-(acetamidomethyl)-2,4,6-triiodobenzoic acid)	25901-36-4
3,3'-(Sebacoyldiimino)bis(5-(propionamidomethyl)-2,4,6-triiodobenc acid)	25901-42-2
5,5'-Sebacoyldi(oxytryptamine) diacetate	52671-00-8
Ammonium hydrogen 9,10-dihydroxysebacate	84753-04-8
Ammonium octyl sebacate	4913-33-1
Barium sebacate	19856-32-7
Bis(2,2,6,6-tetramethyl-4-piperidiny) sebacate	52829-07-9
Bis(2-ethoxyethyl) sebacate	624-10-2
Bis(2-methylbutyl) sebacate	93805-24-

	4
Bis(3,5-dibromosalicyl)sebacate	74134-05-7
Bis(3-methylbutyl) sebacate	10340-42-8
Bis(cholest-5-en-3beta-yl) sebacate	23394-16-3
Bis(tetrahydrofurfuryl) sebacate	4650-79-7
Butyl 2,3-dihydroxypropyl sebacate	94109-50-9
Cadmium sebacate	4476-04-4
Cerium(3+) sebacate	25418-94-4
Cerium(4+) sebacate	94232-56-1
Choline, chloride sebacate	28492-70-8
Cupric sebacate	58783-12-3
Decanedioic acid bis(1,2,2,6,6-pentamethyl-4-piperidinyl)ester	41556-26-7
Di-2-ethylhexyl sebacate	122-62-3
Di-2-ethylhexyl isosebacate	29590-28-1
Diallyl sebacate	3137-00-6
Dicyclohexyl sebacate	4121-15-7
Didocosyl sebacate	42233-75-0
Diethyl Sebacate	110-40-7
Diisodecyl sebacate	28473-19-0
Diisopropyl sebacate	7491-02-3
Dilithium sebacate	19370-86-6
Dimethyl hexadecafluorosebacate	4590-24-3
Di-n-butyl Sebacate	109-43-3
Di-n-decyl sebacate	2432-89-5
Di-n-dodecyl sebacate	2432-88-4
Di-n-hexadecyl sebacate	26719-48-2
Di-n-hexyl sebacate	2449-10-7
Di-n-octadecyl sebacate	3072-03-5
Di-n-octyl sebacate	2432-87-3

Di-n-tetradecyl sebacate	26719-47-1
Dipentyl sebacate	6819-09-6
Dipotassium sebacate	52457-55-3
Dipropyl sebacate	15419-91-7
Di-tert-butyl bisperoxysebacate	22537-96-8
Divinyl sebacate	10355-50-7
Docosyl hydrogen sebacate	93819-99-9
Dodecyl hydrogen sebacate	92739-54-3
Iosefamic acid	5591-33-3
Lanthanum(3+) sebacate	25418-93-3
Lithium hydrogen sebacate	94042-76-9
Lithium, 12-hydroxyoctadecanoate sebacate complex	68815-49-6
Lithium, dimethyl sebacate, 12-hydroxyoctadecanoate naphthenate complex	68919-36-8
Methyl hydrogen sebacate	818-88-2
Neodymium(3+) sebacate	25418-96-6
Perfluorosebacic acid	307-78-8
Polifeprosan 20	90409-78-2
Poly(ethylenesebacate)	25037-32-5
Poly(hexamethylene sebacate)	26745-88-0
Praseodymium(3+) sebacate	25418-95-5
Sebacic acid	111-20-6
Sebacic acid 1,3,5-triazine-2,4,6-triamine salt	31970-90-8
Sebacic acid 1,3,5-triazine-2,4,6-triamine salt	94159-18-9
Sebacic acid 2,2',2''-nitrilotriethanol complex	94202-16-1

Sebacic acid 2,2',2''-nitrilotriethanol complex	85030-06-4
Sebacic acid 2,2',2''-nitrilotriethanol complex	70103-35-4
Sebacic acid 2,2'-iminodiethanol complex	81189-11-9
Sebacic acid 2,2'-iminodiethanol complex	84145-30-2
Sebacic acid 2,2'-iminodiethanol complex	94200-21-2
Sebacic acid 2-aminoethanol complex	82801-62-5
Sebacic acid 2-butoxyethyl ester	68186-66-3
Sebacic acid bis(2-(2-butoxyethoxy)ethyl) ester	70900-46-8
Sebacic acid bis(2-butoxyethyl) ester	141-19-5
Sebacic acid bis(2-mercaptoethyl) ester	60642-69-5
Sebacic acid bis(2-methoxyethyl) ester	71850-03-8
Sebacic acid bis(phenylmethyl) ester	140-24-9
Sebacic acid dihydrazide	925-83-7
Sebacic acid diisooctyl ester	27214-90-0
Sebacic acid ditridecyl ester	2741-62-0
Sebacic acid morpholine complex	84522-37-2
Sebacic acid N-(2-aminoethyl)-N'-(2-((2-aminoethyl)amino)ethyl)ethane-1,2-diamine salt	84501-59-7
Sebacic acid 1,3,5-triazine-2,4,6-triamine salt	94159-19-0
Sebacic acid 1,6-hexanediamine salt	6422-99-7
Sebacic acid aluminum salt	5505-62-4
Sebacic acid bis((17beta-hydroxy-17-methylandrosta-1,4-dien-3-ylidene)hydrazide)	15437-53-3
Sebacic acid dimethyl ester	106-79-6
Sebacic acid dinonyl ester	4121-16-8
Sebacic acid disodium salt	17265-14-4
Sebacic acid lead(2+) salt	29473-77-6
Sebacic acid methyl 1,2,2,6,6-pentamethyl-4-piperidinyl ester	82919-37-

	7
Sebacic acid monoethyl ester	693-55-0
Sebacyl-bis(1-methylpiperazine-4-methyl iodide)	61167-37-1
Sebacyldicholine	7095-43-4
Sebacoyl chloride	111-19-3
Sebacoyldioxybis(tributylstannane)	30099-72-0
Sodium hydrogen sebacate	14047-57-5
Tetradecyl hydrogen sebacate	93819-98-8
Tetrahydrofurfuryl hydrogen sebacate	4650-83-3

Heptaldehyde

Synonyms: Enanthal, enanthaldehyde, enanthole, heptyl aldehyde, enanthic aldehyde, n-heptaldehyde, heptanal, n-heptanal

CAS Number	111-71-7
Molecular Formula	C ₇ H ₁₄ O
Appearance	Colourless Liquid
Melting Point	-43°C
Boiling Point	40 – 42°C
Density (g cm ⁻³)	0.818
Flash Point	35°C
Explosion Limits	1.1 – 5.2%
Water Solubility	Slight

2-Heptanol

Synonyms: Amyl methyl carbinol, 5-heptyl alcohol, heptan-2-ol, methyl amyl carbinol, 1-methylhexanol

CAS Number	543-49-7
Molecular Formula	C ₇ H ₁₆ O
Appearance	Colourless Liquid
Boiling Point	160 – 162°C
Density (g/cm ³)	0.817
Flash Point	64°C

Undecylenic Aldehyde

Synonyms: 10-Undecenal; C-11 Aldehyde, undecylenic; 1-Undecen-10-al; 10-Undecylenaldehyde; Undecylenaldehyde

CAS Number	112-45-8
Molecular Formula	C ₁₁ H ₂₀ O
Molecular Weight	168.28
Appearance	Clear, colorless to pale yellow liquid.
Flash Point	76°C (168.80°F)
Physical State	Liquid
Appearance	Clear, colorless to pale yellow
Odor	Rose-like
Vapour Density	5.8
Boiling Point	235°C
Freezing/Melting Point	7°C
Solubility	Insoluble
Specific Gravity/Density	845 g/ml

Methyl Undecylenate

CAS Number	5760-50-9
Formula	C ₁₂ H ₂₂ O ₂
Molar Refractivity	59.47 ± 0.3 cm ³
Parachor	521.5 ± 4.0 cm ³
Index of Refraction	1.444 ± 0.02
Surface Tension	29.5 ± 3.0 dyne/cm
Density	0.886 ± 0.06 g/cm ³
Polarizability	23.57 ± 0.5 10 ⁻²⁴ cm ³
Molecular Weight	198.3018800
Odor Type	Earthy
Odor Strength	Medium
Odor Description at 100.00%	Earthy Fungal Rose Fatty Floral
Substantivity	24 Hour(s)
Appearance	Colorless to pale yellow clear liquid
Assay	98.00 – 100.00 %
Specific Gravity	0.87900 – 0.88900 @ 25.00 °C
Optical Rotation	-2.00 to +2.00
Melting Point	-28.00 - -27.00 °C. @ 760.00 mm Hg
Boiling Point	247.00 – 248.00 °C. @ 760.00 mm Hg
Boiling Point	159.00 – 160.00 °C. @ 50.00 mm Hg
Acid Value	1.00 max. KOH/g
Shelf Life	24.00 month(s) or longer if stored properly

Flash Point (°F.)	>200.00 °F. TCC (> 93.33 °C.)
---------------------	-------------------------------

2-Octanol

Synonyms: capryl alcohol, caprylic alcohol, ethylpentylcarbinol

CAS Number	123-96-6
Molecular Formula	C ₈ H ₁₈ O [Structural CH ₃ (CH ₂) ₅ COHCH ₃]
Appearance	Colourless liquid with a pungent odour
Melting Point	-38°C
Boiling Point	174 – 181°C
Vapour Pressure	0.15 mm Hg at 25°C
Specific Gravity	0.819
Flash Point	71°C (closed cup)

Glycerine

Synonyms: Glycerol; 1,2,3-Propanetriol; Glyceritol; Glycic Alcohol; 1,2,3-Trihydroxypropane; 1,2,3-Propanetriol

CAS Number	56-81-5
Molecular Formula	C ₃ H ₈ O ₃
Molecular Weight	92.0542
Physical State	Liquid
Appearance	Clear
Odor	Faint odour
Vapour Pressure	.0025 mm Hg @ 5
Vapour Density	3.17 (H ₂ O=1)
Boiling Point	290°C
Freezing/Melting Point	20°F
Autoignition Temperature	400°C (752.00 deg F)
Flash Point	193°C (379.40 deg F)
Decomposition Temperature	290°C
Solubility	Miscible in water. Insoluble in chloroform
Specific Gravity/Density	1.4746

Undecanoic Acid

Synonyms: 1-decanecarboxylic acid, hendecanoic acid, undecoic acid, undecylic acid, N-undecoic acid, hendecanoic acid, N-undecylic acid, 1-decane carboxylic acid, N-undecanoic acid

CAS Number	112-37-8
Chemical Formula	C ₁₁ -H ₂₂ -O ₂

Appearance	Colourless to light yellow liquid or solid
Odour	Waxy, creamy, coconut odour
Physical State and Appearance	Solid. (Low Melting Point Solid. Above 28.5°C it is a colorless to slightly yellow liquid)
Flash Points	Closed Cup: >93.333°C (200°F)
Molecular Weight	186.3 g/mole
Boiling Point	228°C (442.4°F)
Melting Point	28.5°C (83.3°F)
Appearance	Colourless crystals

Undecylenic Acid

Synonyms: 10-Hendecenoic; 10-Henedecenoic acid; 10-Undecylenic acid; Undecyl-10-enic acid

CAS Number	112-38-9
Chemical Formula	$C_{11}H_{20}O_2$
Auto-Ignition Temperature	275°C (527°F)
Flash Points	Closed Cup: 148°C (298.4°F). Open Cup: 160°C (320°F)
Physical state and appearance	Solid (low melting point solid)
Odour	Fruity. Rosy
Molecular Weight	184.28 g/mole
Colour	Yellow. (Light.)
Boiling Point	232 -235°C.@ 182 mm Hg; 230 – 235°C.@ 130 mm Hg.
Melting Point	24.5°C (76.1°F)
Specific Gravity	0.9072 (Water = 1)
Decomposition Temperature	275°C (527°F) @ 760 mm Hg

Calcium Undecylenate

CAS Number	1322-14-1
Chemical Formula	$C_{22}H_{38}O_4Ca$
Physical state and appearance	Solid
Molecular Weight	406.62 g/mole
Melting Point	Decomposes

Zinc Undecylenate

Synonyms –Zinc diundec-10-enoate; Undecylenic acid zinc salt

CAS Number	557-08-4
Chemical Formula	$C_{22}H_{38}O_4Zn$

Physical state and appearance	Solid
Molecular Weight	431.92 g/mole

Zinc Ricinoleate

Zinc Ricinoleate	13040-19-2
Melting Point	160°F
pH	6.6
Specific Gravity	Approx. 600 kg/m ³
Solubility in Water	Insoluble
Appearance & Odour	Beige pellets with characteristic odor
Flash Point	>482°F
Auto Ignition Temperature	Approx. 824.00°F

Heptanoic Acid

Synonym: 1-Hexanecarboxylic acid; Enanthic acid; Enanthylic acid; Heptylic acid; n- Heptoic acid; n-Heptylic acid; Oenanthic acid; Oenanthylic acid

CAS Number	111-14-8
Chemical Formula	CH ₃ -(CH ₂) ₅ -COOH
Flammability of the Product	May be combustible at high temperature
Auto-Ignition Temperature	289°C (552.2°F)
Flash Points	Closed Cup: >112°C (233.6°F)
Flammable Limits	Lower: 1.1% Upper: 10%
Products of Combustion	Carbon oxides (CO, CO ₂)
Physical State and Appearance	Liquid (Oily liquid)
Odour	Disagreeable. Rancid. Faint Tallow-like
Molecular Weight	130.19 g/mole
Colour	Clear
pH (1% soln/water)	Acidic
Boiling Point	222.2°C (432°F)
Melting Point	-7.5°C (18.5°F)
Specific Gravity	0.92 (Water = 1)
Vapour Density	4.49 (Air = 1)
Water/Oil Dist. Coeff.	The product is more soluble in oil; log(oil/water) = 2.4