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Safety Assessment of Plant-Derived Fatty Acid Oils

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Abstract

The Cosmetic Ingredient Review Expert Panel (Panel) assessed the safety of 244 plant-derived fatty acid oils as used in cosmetics. Oils are used in a wide variety of cosmetic products for their skin conditioning, occlusive, emollient, and moisturizing properties. Since many of these oils are edible, and their systemic toxicity potential is low, the review focused on potential dermal effects. The Panel concluded that the 244 plant-derived fatty acid oils are safe as used in cosmetics.

Keywords

oils, safety, cosmetics

Introduction

Oils derived from edible vegetables, fruits, seeds, tree, and ground nuts have been safely consumed by, and applied to the skin of, humans for thousands of years. Although nuts, fruits, and vegetables themselves may cause allergic reactions in certain individuals, the refined oils derived from these plants generally pose no significant safety concern following oral exposure, and their general biology is well characterized due to extensive use in food materials. Initially used for anointing in religious ceremonies, oils and their components have also been used on the skin for their skin conditioning, occlusive, emollient, moisturizing, and other properties.

The full list of ingredients in this report, which includes oils, hydrogenated oils, unsaponifiables, oil fatty acids, and salts of the fatty acids, is found in Table 1. Although a large number of oils derived from plants are included in this safety assessment, there is a commonality in that they all are mixtures of triglycerides that contain fatty acids and fatty acid derivatives, the safety of which in cosmetics has been established. Thus, this safety assessment focused solely on the basic chemistry, manufacturing and production methods, uses, and irritation and sensitization potential of these oils as used in cosmetic ingredients.

In preparing this report, numerous inconsistencies were noted with both taxonomic and International Nomenclature Cosmetic Ingredient (INCI) naming conventions. For example, this report includes the macadamia nut ingredients, *Macadamia integrifolia* seed oil and *Macadamia ternifolia* seed oil, which are described in the *International Cosmetic Ingredient Dictionary and Handbook*.[1] The species *M integrifolia* is currently the only species of macadamia nut which is used for oil production. The name *M ternifolia* is an old naming convention for the edible nut that is currently used to describe a noncultivated, inedible species. Both *M integrifolia* seed oil and *M ternifolia* seed oil are the same ingredient. Similar naming conflicts have been discovered with *Triticum vulgare* (wheat) germ oil and *Triticum aestivum* (wheat) germ oil, *Orbignya oleifera* seed oil and *Orbignya speciosa* kernel oil, and *Moringa pterygosperma* seed oil and *Moringa oleifera* seed oil, with these pairs being synonyms for each other. The shea plant also has 2 species names, *Butyrospermum parkii* and *Vitellaria paradoxa*. Only *B parkii* (as *B parkii*

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Table 1. Plant-Derived Fatty Acid Oils.[a]

Actinidia chinensis (kiwi) seed oil
Adansonia digitata oil (baobab)
  Adansonia digitata seed oil
  Hydrogenated *Adansonia digitata* seed oil
Aleurites moluccanus seed oil (kukui [CAS no 8015-80-3])
  Hydrogenated kukui nut oil
  Aleurites moluccanus bakoly seed oil
Amaranthus hypochondriacus seed oil (amaranth)
Anacardium occidentale (cashew) seed oil (CAS no 8007-24-7)
Arachis hypogaea (peanut) oil (CAS no 8002-03-7)
  Hydrogenated peanut oil (CAS no 68425-36-5)
  Potassium peanutate
  Sodium peanutate
  Peanut acid (CAS no 91051-35-3)
Arctium lappa seed oil (burdock)
Argania spinosa kernel oil (argan)
  Hydrogenated *Argania spinosa* kernel oil
Astrocaryum murumuru seed butter (murumuru)
  Sodium *Astrocaryum murumuruate*
Avena sativa (oat) kernel oil
Bassia butyracea seed butter
Bassia latifolia seed butter (mahwa)
Bertholletia excelsa seed oil (Brazil)
Borago officinalis seed oil (borage [CAS no 225234-12-8])
Brassica campestris (rapeseed) seed oil
  Brassica campestris (rapeseed) oil unsaponifiables
  Hydrogenated rapeseed oil
  Rapeseed acid
  Potassium rapeseedate
  Sodium rapeseedate
Brassica napus seed oil (rapeseed)
Brassica oleracea Acephala seed oil (kale)
Brassica oleracea Italica (broccoli) seed oil
Butyrospermum parkii (shea) oil
  Butyrospermum parkii (shea) butter (CAS no 68920-03-6; 194043-92-0)
  Butyrospermum parkii (shea) butter unsaponifiables (CAS no 194043-92-0; 225234-14-0)
  Hydrogenated shea butter
Camelina sativa seed oil (false flax)
  Hydrogenated *Camelina sativa* seed oil
Camellia japonica seed oil
Camellia kissi seed oil (tea)
Camellia oleifera seed oil (tea seed)
  Hydrogenated *Camellia oleifera* seed oil
Camellia sinensis seed oil
Canarium indicum seed oil (galip)
Canola oil
  Canola oil unsaponifiables
  Hydrogenated canola oil
Carica papaya seed oil (papaya)
Carthamus tinctorius (safflower) seed oil
  Hydrogenated safflower seed oil
  Potassium safflowerate
  Sodium safflowerate
  Safflower acid
Carya illinoensis (pecan) seed oil
Caryocar brasiliense fruit oil (pequi)
Chenopodium quinoa seed oil (quinoa)
Citrullus lanatus (watermelon) seed oil

(continued)

Table 1. (continued)

Citrus aurantifolia (lime) seed oil
  Citrus aurantifolia (lime) seed oil unsaponifiables
  Hydrogenated lime seed oil
  Hydrogenated lime seed oil unsaponifiables
Citrus aurantium dulcis (orange) seed oil
  Citrus aurantium dulcis (orange) seed oil unsaponifiables
  Hydrogenated orange seed oil
  Hydrogenated orange seed oil unsaponifiables
Citrus grandis (grapefruit) seed oil
  Citrus grandis (grapefruit) seed oil unsaponifiables
  Hydrogenated grapefruit seed oil
  Hydrogenated grapefruit seed oil unsaponifiables
Citrus paradisi (grapefruit) seed oil
Citrus limon (lemon) seed oil (CAS no 85085-28-5)
Cocos nucifera (coconut) oil (CAS no 8001-31-8)
  Hydrogenated coconut oil (CAS no 84836-98-6)
  Cocos nucifera (coconut) seed butter
  Magnesium cocoate
  Potassium cocoate (CAS no. 61789-30-8)
  Potassium hydrogenated cocoate
  Sodium cocoate (CAS no 61789-31-9)
  Sodium hydrogenated cocoate
  Coconut acid (CAS no 61788-47-4)
  Hydrogenated coconut acid (CAS no 68938-15-8)
Coix lacryma-jobi (Job's tears) seed oil
Corylus americana (hazel) seed oil
  Hydrogenated hazelnut oil
Corylus avellana (Hazel) seed oil
Crambe abyssinica seed oil (Abyssinian mustard)
Cucumis sativus (cucumber) seed oil (CAS no 70955-25-8)
Cucurbita pepo (pumpkin) seed oil (CAS no 8016-49-7)
  Hydrogenated pumpkin seed oil
Cynara cardunculus seed oil (artichoke [CAS no 923029-60-1])
Elaeis guineensis (palm) oil (CAS no 8002-75-3)
  Elaeis guineensis (palm) kernel oil (CAS no 8023-79-8)
  Hydrogenated palm kernel oil (CAS no 68990-82-9; 84540-04-5)
  Elaeis (palm) fruit oil
  Hydrogenated palm oil (CAS no 8033-29-2; 68514-74-9)
  Elaeis guineensis (palm) butter (CAS no 8002-75-3)
  Palm kernel acid
  Potassium palm kernelate
  Potassium palmate
  Potassium hydrogenated palmate
  Sodium palm kernelate (CAS no 61789-89-7)
  Sodium palmate (CAS no 61790-79-2)
  Sodium hydrogenated palmate
  Palm acid
  Hydrogenated palm acid
Elaeis oleifera kernel oil
Euterpe oleracea fruit oil (acai)
Fragaria ananassa (strawberry) seed oil
Fragaria chiloensis (strawberry) seed oil
Fragaria vesca (strawberry) seed oil
Fragaria virginiana (strawberry) seed oil
Garcinia indica seed butter (kokum)
Gevuina avellana oil (Chilean hazel)
  Gevuina avellana seed oil
Glycine soja (soybean) oil (CAS no 8001-22-7)
  Glycine soja (soybean) oil unsaponifiables (CAS no 91770-67 -1)
  Hydrogenated soybean oil (CAS no 8016-70-4)

(continued)

Table 1. (continued)

Soy acid (CAS no 68308-53-2)
Potassium soyate
Sodium soyate
Gossypium herbaceum (cotton) seed oil (CAS no 8001-29-4)
Hydrogenated cottonseed oil (CAS no 68334-00-9)
Cottonseed acid (CAS no 68308-51-0)
Guizotia abyssinica seed oil (ramtil/niger)
Helianthus annuus (sunflower) seed oil (CAS no 8001-21-6)
Helianthus annuus (sunflower) seed oil unsaponifiables
Hydrogenated sunflower seed oil
Sunflower seed acid (CAS no 84625-38-7)
Hippophae rhamnoides oil (sea buckthorn)
Hippophae rhamnoides fruit oil (sea buckthorn)
Hippophae rhamnoides seed oil (sea buckthorn)
Irvingia gabonensis kernel butter (dika [CAS no 192230-28-7])
Juglans regia (walnut) seed oil (CAS no 8024-09-7)
Limnanthes alba (meadowfoam) seed oil (CAS no 153065-40-8)
Hydrogenated meadowfoam seed oil
Linum usitatissimum (linseed) seed oil (CAS no 8001-26-1)
Linseed acid (CAS no 68424-45-3)
Luffa cylindrica seed oil (luffa)
Lupinus albus seed oil (white lupine)
Lupinus albus oil unsaponifiables
Lycium barbarum seed oil (goji berry)
Macadamia integrifolia seed oil
Hydrogenated macadamia seed oil
Macadamia ternifolia seed oil (CAS no 128497-20-1 or 129811-19-4)
Sodium macadamiaseedate
Mangifera indica (mango) seed oil
Mangifera indica (mango) seed butter
Sodium mangoseedate
Morinda citrifolia seed oil (noni)
Moringa oleifera seed oil (ben/moringa)
Moringa pterygosperma seed oil
Oenothera biennis (evening primrose) oil
Hydrogenated evening primrose oil
Olea europaea (olive) fruit oil (CAS no 8001-25-0)
Olea europaea (olive) oil unsaponifiables (CAS no 156798-12-8)
Hydrogenated olive oil
Hydrogenated olive oil unsaponifiables
Potassium olivate (CAS no 68154-77-8)
Sodium olivate (CAS no 64789-88-6)
Olea europaea (olive) husk oil
Olive acid (CAS no 92044-96-7)
Orbignya cohune seed oil (cohune)
Orbignya oleifera seed oil (babassu [CAS no 91078-92-1])
Potassium babassuate
Sodium babassuate
Babassu acid
Orbignya speciosa kernel oil
Oryza sativa (rice) bran oil (CAS no 68553-81-1; 84696-37-7)
Hydrogenated rice bran oil
Oryza sativa (rice) germ oil
Oryza sativa (rice) seed oil
Rice bran acid (CAS no 93165-33-4)
Passiflora edulis seed oil (passion fruit [CAS no 87676-26-1])
Hydrogenated *Passiflora edulis* seed oil
Perilla ocymoides seed oil (perilla)
Persea gratissima (avocado) oil (CAS no 8024-32-6)
Persea gratissima (avocado) oil unsaponifiables (CAS no 91770-40-0)

(continued)

Table 1. (continued)

Hydrogenated avocado oil
Persea gratissima (avocado) butter
Sodium avocadoate
Pistacia vera seed oil (pistachio [CAS no 90082-81-8; 129871-01-8])
Hydrogenated pistachio seed oil
Plukenetia volubilis seed oil (sacha inchi)
Prunus amygdalus dulcis (sweet almond) oil (CAS no 8007-69-0; 90320-37-9)
Prunus amygdalus dulcis (sweet almond) oil unsaponifiables
Hydrogenated sweet almond oil
Hydrogenated sweet almond oil unsaponifiables
Sodium sweet almondate
Prunus armeniaca (apricot) kernel oil (CAS no 72869-69-3)
Prunus armeniaca (apricot) kernel oil unsaponifiables
Hydrogenated apricot kernel oil
Hydrogenated apricot kernel oil unsaponifiables
Prunus avium (sweet cherry) seed oil
Prunus domestica seed oil (prune/plum)
Prunus persica (peach) kernel oil (CAS no 8002-78-6; 8023-98-1)
Hydrogenated peach kernel oil
Punica granatum seed oil (pomegranate)
Hydrogenated *Punica granatum* seed oil
Pyrus malus (apple) seed oil
Ribes nigrum (blackcurrant) seed oil (CAS no 97676-19-2)
Hydrogenated blackcurrant seed oil
Ribes rubrum (currant) seed oil
Rosa canina fruit oil (dog rose)
Hydrogenated *Rosa canina* fruit oil
Rubus chamaemorus seed oil (cloudberry)
Rubus idaeus (raspberry) seed oil
Hydrogenated raspberry seed oil
Schinziophyton rautanenii kernel oil (mongongo)
Sclerocarya birrea seed oil (marula)
Sesamum indicum (sesame) seed oil (CAS no 8008-74-0)
Sesamum indicum (sesame) oil unsaponifiables
Hydrogenated Sesame seed oil
Sesamum indicum (sesame) seed butter
Sodium sesame seedate
Silybum marianum seed oil (thistle)
Solanum lycopersicum (tomato) fruit oil
Solanum lycopersicum (tomato) seed oil
Theobroma cacao (cocoa) seed butter (CAS no 8002-31-1)
Sodium cocoa butterate
Theobroma grandiflorum seed butter (cupuacu [CAS no 394236-97-6])
Sodium *Theobroma grandiflorum* seedate
Torreya nucifera seed oil (Kaya)
Triticum vulgare (wheat) germ oil (CAS no 8006-95-9; 68917-73-7)
Triticum aestivum (wheat) germ oil
Triticum vulgare (wheat) germ oil unsaponifiables
Hydrogenated wheat germ oil unsaponifiables
Hydrogenated wheat germ oil
Wheat germ acid (CAS no 68938-32-9)
Vaccinium corymbosum (blueberry) seed oil
Vaccinium macrocarpon (cranberry) seed oil
Hydrogenated cranberry seed oil
Vaccinium myrtillus seed oil (bilberry [CAS no 1161921-09-0])
Vaccinium vitis-idaea seed oil (ligonberry)
Vegetable (olus) oil
Hydrogenated vegetable oil

(continued)

Table 1. (continued)

Vitis vinifera (grape) seed oil (CAS no 8024-22-4)
Hydrogenated grapeseed oil
Sodium grapeseedate
***Zea mays* (corn) oil (CAS no 8001-30-7)**
***Zea mays* (corn) oil unsaponifiables**
***Zea mays* (corn) germ oil**
***Potassium cornate* (CAS no 61789-23-9)**
***Corn acid* (CAS no 68308-50-9)**

[a]Previously reviewed ingredients are in bold and italics.

[shea] oil or butter) is the current naming convention described by the cosmetics industry.

So that all plant-derived fatty acid oils that are cosmetic ingredients are included in 1 report, several ingredients that have been reviewed previously by the Cosmetic Ingredient Review (CIR) Expert Panel (Panel) are included in this report. The ingredients, their conclusions, and citations are found in Table 2. Previously reviewed fatty acids and glyceryl triesters are also found in Table 2.

Table 2. Previously Reviewed Oil and Fatty Acid Ingredients.

Ingredients	Publication date	Conclusion
Oil ingredients		
Arachis hypogaea (peanut) oil (CAS no 8002-03-7) Hydrogenated peanut oil (CAS no 68425-36-5) Peanut acid (CAS no 91051-35-3)	*IJT*. 20(S2):65-77, 2001	Safe
Carthamus tinctorius (safflower) seed oil (CAS no 8001-23-8)	*JACT*. 4(5):171-197, 1985; rereviewed, not reopened, *IJT*. 25(2):1-89, 2006	Safe
Cocos nucifera (coconut) oil (CAS no 8001-31-8) Coconut acid (CAS no 61788-47-4) Hydrogenated coconut acid (CAS no 68938-15-8) Hydrogenated coconut oil (CAS no 84836-98-6) Magnesium cocoate Potassium cocoate (CAS no 61789-30-8) Potassium hydrogenated cocoate Sodium cocoate (CAS no 61789-31-9) Sodium hydrogenated cocoate	*JACT*. 5(3):103-121, 1986; CIR final report, 2008	Safe
Corylus americana (hazel) seed oil *Corylus avellana* (hazel) seed oil	*IJT*. 20 (S1):15-20, 2001	Insufficient data
Elaeis guineensis (palm) oil (CAS no 8002-75-3) *Elaeis guineensis* (palm) kernel oil (CAS no 8023-79-8) Hydrogenated palm oil (CAS no 8033-29-2; 68514-74-9) Hydrogenated palm kernel oil (CAS no 68990-82-9; 84540-04-5)	*IJT*. 19(S2):7-28, 2000	Safe
Gossypium herbaceum (cotton) seed oil (CAS no 8001-29-4) Cottonseed acid (CAS no 68308-51-0) Hydrogenated cottonseed oil (CAS no 68334-00-9)	*IJT*. 20(S2):21-29, 2001	Safe
Oryza sativa (rice) bran oil (CAS no 68553-81-1; 84696-37-7) *Oryza sativa* (rice) germ oil Rice bran acid (CAS no 93165-33-4)	*IJT*. 25(S2):91-120, 2006	Safe
Prunus amygdalus dulcis (sweet almond) oil (CAS no 8007-69-0)	*JACT*. 2(5):85-99, 1983; rereviewed, not reopened, *IJT*. 24(S1):1-102, 2005	Safe
Sesamum indicum (sesame) seed oil (CAS no 8008-74-0) Hydrogenated sesame seed oil *Sesamum indicum* (sesame) oil unsaponifiables Sodium sesameseedate	*JACT*. 12(3):261-277, 1993; amended final report, 2009	Safe
Zea mays (corn) oil (CAS no 8001-30-7) *Zea mays* (corn) germ oil *Zea mays* (corn) oil unsaponifiables Corn acid (CAS no 68308-50-9) Potassium cornate (CAS no 61789-23-9)	Final report, 2008	Safe
Persea gratissima (avocado) oil (CAS no 8024-32-6)	*JEPT*. 4(4):93-103, 1980; rereviewed, not reopened, *IJT*. 22(1):1-35, 2003	Safe
Triticum vulgare (wheat) germ oil (CAS no 8006-95-9; 68917-73-7)	*JEPT*. 4(4):33-45, 1980; rereviewed, not reopened, *IJT*. 22(1):1-35, 2003	Safe

(continued)

Table 2. (continued)

Ingredients	Publication date	Conclusion
Fatty acids		
Arachidonic acid (CAS no 506-32 -1)	*JACT*. 12 (5):481-559, 1993	Insufficient data
Hydroxystearic acid (CAS no 106-14-9)	*IJT*. 18(S1):1-10, 1999	Safe
Lauric acid (CAS no 143-07-7) Myristic acid (CAS no 544-63-8) Oleic acid (CAS no 112-80-1) Palmitic acid (CAS no 57-10-3) Stearic acid (CAS no 57-11-4)	*JACT*. 6(3):321-401, 1987; rereviewed, not reopened, *IJT*. 25(2):1-89, 2006	Safe
Glyceryl triesters		
Trilaurin Triarachidin Tribehenin Tricaprin Tricaprylin Trierucin Triheptanoin Triheptylundecanoin Triisononanoin Triisopalmitin Triisostearin Trilinolein Trimyristin Trioctanoin Triolein Tripalmitin Tripalmitolein Triricinolein Tristearin Triundecanoin Glyceryl triacetyl hydroxystearate Glyceryl triacetyl ricinoleate Glyceryl stearate diacetate	*IJT*. 20(S4):61-94, 2001	Safe

Abbreviations: CIR, Cosmetic Ingredient Review; IJT, International Journal of Toxicology; JACT, Journal of the American College of Toxicology; JEPT, Journal of Environmental Pathology and Toxicology.

Chemistry

The group of ingredients characterized as fats and oils are the glyceryl esters of fatty acids (triglycerides) normally found in plants, including those that have been hydrogenated to reduce or eliminate unsaturation.[1] Figure 1 represents the general structure of fats and oils. The raw oil may include diglycerides, monoglycerides, free fatty acids, plant sterols, pigments, glucosides, proteins, natural antioxidants, vitamins, and impurities.[2,3] The extent to which these components are removed during processing varies. The available information on chemical properties of oils in this report, including Food Chemicals Codex specifications when provided, is found in Table 3.[4] The available fatty acid compositions for the oils in this report are found in Table 4.

The percentage of chemical constituents in individual oil types is dependent on the region where the oilseed plant is grown, individual cultivars, and plant genetics.[3] This is especially true with rapeseed, where the erucic acid content varies from 1% to 58.6%. Low erucic acid rapeseed oil is also known as canola oil.

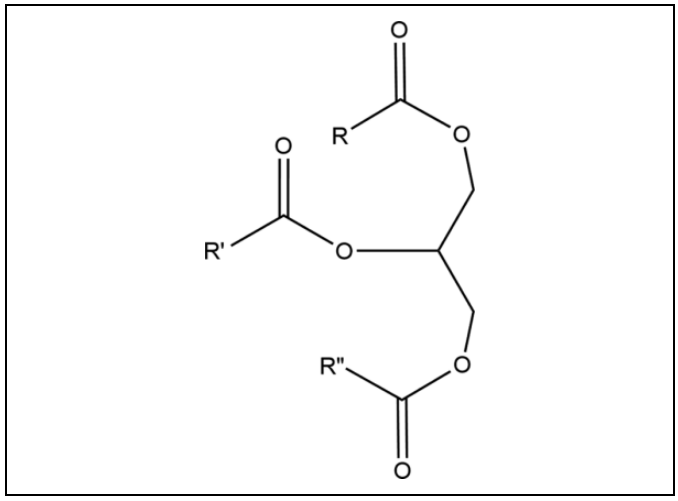

Figure 1. General structure of fats and oils, wherein RC(O)−, R′C(O)− and R″C(O)− may be the same or different fatty acid radicals.[1]

Table 3. Chemical Properties for Plant-Derived Fatty Acid Oils.

Properties and constituents	*Actinidia chinensis* (kiwi) seed oil[58]	*Adansonia digitata* oil [59,60]	Aleurites moluccana seed oil (kukui)[61–64]	*Anacardium occidentale* (cashew) seed oil[65]	*Arachis hypogaea* (peanut) oil[3,63,66–69]	*Argania spinosa* kernel oil[70,71]	*Astrocaryum murumuru* seed butter[3,72]
Appearance		Pale yellow	Clear yellow liquid		Light yellow	Yellow	Pale brown waxy solid at room temperature
Specific gravity			0.920-0.930 (20°C)		0.912-0.920 (20°C)	0.908-0.918 (20°C)	0.890-0.910 (25°C)
Refractive index			1.470-1.480 (20°C)		1.46-1.475 (20°C)		
Iodine value		65-95	130-175		74-107	95	15 max
Saponification value		190-210	185-210		180-208		270-350
Peroxide value, mEq/kg	44.37	5.0-10	5.0 max	0.22	0.39-5.0 max	10.0 max	20.0 max
Melting point (°C)							25-37
Unsaponifiable matter (%)			0.3-1		≤1.0		
Free fatty acids (%)	1.2	2.0 max as oleic acid	0.1-4		0.2-2.08		12.56 as oleic acid
Titer (°C)					26-32		
Acid value					0.5	3-4	

Properties and constituents	*Avena sativa* (oat) kernel oil[73]	*Bertholletia excelsa* seed oil[65,74]	*Borago officinalis* seed oil[75,76]	*Brassica campestris* (rapeseed) seed oil[3]	Hydrogenated rapeseed oil[4]	Rapeseed acid[77]	Canola oil[4]
Appearance	Yellow		Clear, pale yellow-golden		White waxy solid		Light yellow oil
Specific gravity	0.914-0.932 (25°C)	1.473	0.918-0.928 (20°C)				
Refractive index	1.469-1.471 (25°C)	0.914 (20°C)	1.474-1.479 (20°C)				1.465-1.467 (40°C)
Iodine value		74.2	130-155	81-112	4 max	119-120 g/100 g	110-126
Saponification value	176-186	192.4	184-194	168-192			
Peroxide value, mEq/kg	0.6-1.1	0.16	10.0 max		2.0 max		10 max
Melting point (°C)							
Unsaponifiable matter (%)	3.7-4.3			0.5-2			1.5 max
Free fatty acids (%)	0.1-0.3			1	2.0 max as oleic acid		0.1% max as oleic acid
Titer (°C)							
Acid value			1.0 max			197-200 mg KOH/g	

Properties and constituents	*Brassica oleracea* acephala seed oil[78]	*Brassica oleracea* Italica (broccoli) seed oil[79]	*Butyrospermum parkii* (shea) butter[3,63,80–83]	*Butyrospermum parkii* (shea) oil[4]	*Camellia oleifera* seed oil[84,85]	*Canarium indicum* oil[86,87]	Carica papaya seed oil[88,89]
Appearance	Yellow	Golden	Grey, tallow-like	Pale yellow	Clear, pale yellow or "water white"	Cream to golden	Pale yellow
Specific gravity	0.9010 (20°C)	0.910-0.918 (20°C)	0.918 (15°C)				
Refractive index	1.4741 (23°C)	1.465-1.475 (20°C)	1.468 (25°C)			1.45-1.47	
Iodine value	61.2	90-120	45-77	28-43	80-94		65-100
Saponification value	123.06		165-190	185-195	188-196		
Peroxide value (mEq/kg)			5.0 max	≤10	10.0 max	≤20	10.0 max
Melting point (°C)			32-46; 28-42 (slip)				
Unsaponifiable matter (%)	1.6		3-13	≤1.5	1.5 max	≤1	
Free fatty acids (%)			1.0 max as oleic acid	≤0.1 as oleic acid		0.2	0.8-3
Titer (°C)			49-54				
Acid value	2.1	1.5	1.5		1.0 max	≤10	

(continued)

Table 3. (continued)

Properties and constituents	*Carthamus tinctorius* (safflower) seed oil[4]	*Carya illinoensis* (pecan) seed oil[63,65,74]	*Caryocar brasiliense* fruit oil (pequi)[77,90]	*Citrullus lanatus* (watermelon) seed oil[3,91]	*Citrus aurantifolia* (lime) seed oil[92,93]	*Citrus aurantium* dulcis (orange) seed oil[94,95]	*Citrus paradisi* (grapefruit) seed oil[96,97]
Appearance	Light yellow oil		Yellow[90]	Pale to golden yellow liquid	Clear yellow	Clear, light yellow	Clear yellow
Specific gravity		0.924 (25°C)		0.8930-0.9166		0.910-0.920 (20°C)	
Refractive index		1.472		1.4668		1.466 -1.475 (20°C)	
Iodine value	135-150	100-105	48.65-74.80[90]; 50-70 g/100 g[77]	113-123		90-110	80-125
Saponification value		190	160.15-202[90]; 190-210 mg KOH/g	193-195		185-200	
Peroxide value (mEq/kg)	10 max	0.15	0.99-5.22[90]; ≤20[77]	≤5.0	5.0 max	5-10	5-10
Melting point (°C)							
Unsaponifiable matter (%)	1.5 max	0.35-40					
Free fatty acids (%)	0.1 max as oleic acid		0.98-2.85 (mg KOH/g)[90]	<5.0 as oleic acid		0.5 as oleic acid	
Titer (°C)							
Acid value			10 mg KOH/g max[77]		1.0 max	0.8 max	1.0 max

Properties and constituents	*Cocos nucifera* (coconut) oil[3,4,63]	*Cucurbita pepo* (pumpkin) seed oil[98,99]	*Elaeis guineensis* (palm) oil[3,4]	*Elaeis guineensis* (palm) kernel oil[3,4]	*Fragaria ananassa* (strawberry) seed oil[3,100,101]	*Fragaria chiloensis* (strawberry) seed oil[102,103]	*Garcinia indica* seed butter (kokum)[104–106]
Appearance	White to light yellow-tan	Dark green	Pale yellow to deep orange in color	Nearly colorless	Light golden/yellow to yellow	Light yellow with some green	
Specific gravity	0.917-0.919 (25°C/15.5°C)		0.921-0.925 (40°C)		0.93-0.95	0.912-0.930	
Refractive index	1.448-1.450 (40°C)		1.453-1.458 (40°C)			1.465-1.485	1.4565-1.4575 (40°C)
Iodine value	6-11	110-330	44-58	14-33		170-190	30-50
Saponification value	248-265	174-197	195-205	245-255		180-195	185-195
Peroxide value, mEq/kg	≤10	5.0 max	10 max	10 max	<15	10 max	
Melting point (°C)	22-26		25-50	25-30			37-43; 27 (slip)
Unsaponifiable matter (%)	≤0.5	1.5	0.2-0.8	1.5 max			1.5 max; 18-20; 32-40
Free fatty acids (%)	≤0.1% as oleic acid; ≤0.07% as lauric acid	1.5 as oleic acid	0.1 max as oleic acid; 0.09 as palmitic acid	0.1 max as oleic acid; 0.07 max as lauric acid		3	0.1-1
Titer (°C)	20-24						
Acid value					18 max		

Properties and constituents	*Glycine soja* (soybean) oil[3,4]	*Gossypium herbaceum* (cotton) seed oil[3,4]	*Guizotia abyssinica* seed oil[3]	Hazel seed oil[a,66,107–109]	*Helianthus annuus* (sunflower) seed oil[3,4]	Sunflower seed acid[77]	*Hippophae rhamnoides* fruit oil[110]
Appearance	Light amber oil	Dark red-brown oil	Pale yellow with a bluish tint		Light amber oil		Orange-red
Specific gravity			0.910-0.928	0.912-0.917 (15.5°C); 0.905-0.925 (20°C)	0.894-0.899 (60°C)		0.90
Refractive index			1.467-1.471	1.467-1.474 (20°C)			

(continued)

Table 3. (continued)

Properties and constituents	*Glycine soja* (soybean) oil[3,4]	*Gossypium herbaceum* (cotton) seed oil[3,4]	*Guizotia abyssinica* seed oil[3]	Hazel seed oil[a,66,107–109]	*Helianthus annuus* (sunflower) seed oil[3,4]	Sunflower seed acid[77]	*Hippophae rhamnoides* fruit oil[110]
					1.4597-1.4745 (25°C)		
Iodine value	120.9-151.4	90-113	126-139	83-100	128-144	125-140 g/100 g	
Saponification value		180-198	180-195	180-200	188-194		
Peroxide value, mEq/kg	10 max	10 max		0.43; 10.0 max	10 max		10 max
Melting point (°C)					0		
Unsaponifiable matter (%)	0.3-0.6	1.5 max	0.5-1	≤1.0	0.3-0.5		
Free fatty acids (%)	0.05-0.7	0.1 max as oleic acid	0.4-3	0.2 max as oleic acid	0.1 max as oleic acid		
Titer (°C)							
Acid value				≤0.5		125-140 mg KOH/g	18 max

Properties and constituents	*Hippophae rhamnoides* seed oil[111–113]	*Irvingia gabonenesis* kernel butter[114]	*Juglans regia* (walnut) seed oil[63,66,74]	*Linum usitatissimum* (linseed) seed oil[3]	Macadamia nut oil[66,74,115–117]	*Mangifera indica* (mango) seed oil[3]	*Moringa oleifera* seed oil[118–120]
Appearance	Orange				Pale to golden yellow	Pale yellow to ivory cream color	
Specific gravity	0.890-0.955 (20°C)		0.917 (25°C)	0.927-0.931 (20°C)	0.911-0.918 (20°C)	0.91	0.908 (20°C); 0.8933 (24°C)
Refractive index	1.4650-1.4825 (20°C)		1.475 (25°C)	1.4786-1.4815	1.466 -1.470 (20°C)	1.456	1.4566 (40°C)
Iodine value	130-200		150-162	170-204	62-82	32-93	66.47
Saponification value	184-210		190-197	189-196	190-200	190-195	164.27; 192
Peroxide value, mEq/kg	5-10 max		0.37		0.36; 10.0 max		0.45; 10.0
Melting point (°C)				0		34-43	18.93
Unsaponifiable matter (%)	1.0	0.13	0.5	0.5-1.5	1.5	0.8-2.9	0.58
Free fatty acids (%)	2.0 max; 18 max	0.30	0.2-2.5	5	0.5 max; 1.0 max as oleic acid		2.55 as oleic acid
Titer (°C)							
Acid value	15				1		

Properties and constituents	*Oenothera biennis* (evening primrose) oil[121,122]	*Olea europaea* (olive) fruit oil[3]	*Olea europaea* (olive) husk oil[123]	Olive acid[77]	*Oryza sativa* (rice) bran oil[124,125]	*Oryza sativa* (rice) bran oil[124,125]	*Passiflora edulis* seed oil (passion fruit)
Appearance	Light yellow	Almost colorless to yellow, greenish, or brown in color			Light golden yellow	Light golden yellow	Golden-orange
Specific gravity	0.920-0.930 (20°C)	0.914-0.918			0.916-0.922 (15.5°C)	0.916-0.922 (15.5°C)	0.917 (20°C)
Refractive index	1.475-1.480 (20°C)	1.469-1.484			1.470-1.473 (20°C)	1.470-1.473 (20°C)	1.468-1.473 (20°C)
Iodine value	145-165	64-88; refined 75-94		85-91 g/100 g	92-115	92-115	119.9-129.29[126]
Saponification value	180-195	185-212; refined 184-186			180-195	180-195	176-187.4
Peroxide value, mEq/kg	10.0 max	20 max (refined)	14.33		10.0 max	10.0 max	1.37-2.23
Melting point (°C)							
Unsaponifiable matter (%)		0.6-1.2; 1.5 max refined					0.9-2.86

(continued)

Table 3. (continued)

Properties and constituents	*Oenothera biennis* (evening primrose) oil[121,122]	*Olea europaea* (olive) fruit oil[3]	*Olea europaea* (olive) husk oil[123]	Olive acid[77]	*Oryza sativa* (rice) bran oil[124,125]	*Oryza sativa* (rice) bran oil[124,125]	*Passiflora edulis* seed oil (passion fruit)
Free fatty acids (%)		0.6-1.4; 0.3 max refined			1.0 as oleic acid	1.0 as oleic acid	
Titer (°C)							
Acid value	1-2			190-201 mg KOH/g			2.11-2.36

Properties and constituents	*Persea gratissima* (avocado) oil[3]	*Pistacia vera* seed oil[65]	*Plukenetia volubilis* seed oil[127]	*Prunus amygdalus* (sweet almond) oil[3,57,63,66,128–130]	*Prunus armeniaca* (apricot) kernel oil	*Prunus avium* (sweet cherry) seed oil[131,132]
Appearance			Yellow-amber	Colorless to pale yellow liquid		Clear light yellow
Specific gravity	0.910-0.916		0.90-0.93 (20°C)	0.911-0.920 (20°C)	0.923[3]	0.905-0.925 (20°C)
Refractive index	1.461-1.465		1.478-1.481 (20°C)	1.467-1.473 (20°C)	1.4672-1.4722[3]	1.463 -1.480 (20°C)
Iodine value	71-95		180-200	93-106	81-123[3]	90-115
Saponification value	177-198		180-210	183-197	191[3]	105-135
Peroxide value, mEq/kg		0.22	0-15	0.19		10.0 max
Melting point (°C)						
Unsaponifiable matter (%)				0.4-1.0	0.4-1.4	
Free fatty acids (%)				1.0 max		0.5% max
Titer (°C)					0-6[133]	
Acid value			0-2	0.5		1.0 max

Properties and constituents	*Prunus domestica* seed oil[134,135]	*Prunus persica* (peach) kernel oil[3,136]	*Punica granatum* seed oil[137,138]	*Pyrus malus* (apple) seed oil[139]	*Ribes nigrum* (blackcurrant) seed oil[140–142]	*Ribes rubrum* (currant) seed oil[143]
Appearance		Pale yellow (refined)	Golden to dark yellow		Pale yellow or slightly greenish	Pale yellow or slightly greenish
Specific gravity		0.910-0.920 (20°C) refined	0.935 (15.5°C)	0.902-0.903 (25°C)	0.92	0.92
Refractive index				1.465-1.466 (40°C)		
Iodine value	90-108	90-115 (refined)	190-230	94.14-101.15	145-185	
Saponification value				179.01-197.25		
Peroxide value, mEq/kg	10.0 max	5.0 max (refined)	10.0 max	2.43-2.52	1-10	10 max
Melting point (°C)						
Unsaponifiable matter (%)						
Free fatty acids (%)	2.0 max as oleic acid		1.4; 5.0 max as oleic acid		0.2	
Titer (°C)						
Acid value				4.036-4.323	3; 18 max	18 max

(continued)

Table 3. (continued)

Properties and constituents	*Rubus chamaemorus* seed oil[144]	*Rubus idaeus* (raspberry) seed oil[145–147]	*Schinziophyton rautanenii* kernel oil[148]	*Sclerocarya birrea* seed oil (marula)[149]	*Solanum lycopersicum* (tomato) seed oil[150]	*Theobroma cacao* (cocoa) seed butter[3]
Appearance	Yellow-red	Yellow or yellow-red	Light yellow		Clear golden yellow to darker red	
Specific gravity	0.92	0.92			0.9135-0.9357	0.950-0.998
Refractive index			1.4830	1.46	1.4577-1.4771	1.453-1.458
Iodine value		175-195		100.25	105-130.5	35-40
Saponification value		180-200		162.70	156-194.9	190-200
Peroxide value, mEq/kg	10 max	5.0 max; 10 max	10 mg/kg	4.58		
Melting point (°C)				26-28		33.5
Unsaponifiable matter (%)				3.06		
Free fatty acids (%)		1.5 max as oleic acid				
Titer (°C)						
Acid value	18 max	18 max		33.70		

Properties and constituents	*Vaccinium corymbosum* (blueberry) seed oil[58,151,152]	*Vaccinium macrocarpon* (cranberry) seed oil[3,58,153–156]	*Vaccinium myrtillus* seed oil[157]	*Vaccinium vitis-idaea* seed oil[158]	*Vitis vinifera* (grape) seed oil[3]	*Zea mays* (corn) oil[159,160]
Appearance	Green with yellow tint or dark green/ brown	Pale yellow to greenish; light green	Pale yellow to greenish	Pale yellow		Clear, bright golden yellow
Specific gravity		0.923	0.93	0.92	0.91-0.93	0.920-0.928 (15.5°C)
Refractive index					1.470-1.476	1.472-1.476 (20°C)
Iodine value	155-175	140-180			125-143	103-128
Saponification value		170-200			176-206	185-195
Peroxide value, mEq/kg	20-24.62	<15; 10 max	10 max	10 max		10.0 max
Melting point (°C)						
Unsaponifiable matter (%)						
Free fatty acids (%)	0.67; 2.0 as oleic acid	0.7; 1.0 as oleic acid				
Titer (°C)						
Acid value		2.0 max; 18 max	18 max	18 max		0.2 max

Abbreviation: max, maximum.
[a]Information mainly on *Corylus avellana*.

Table 4. Total Fatty Acid Composition of Plant-derived Fatty Acid Oils (%).

Fatty acids	*Actinidia chinensis* (kiwi) seed oil[58]	*Adansonia digitata* oil (baobab) [59,60]	*Aleurites moluccana* seed oil (kukui)[61–63]	*Amaranthus hypochondriacus* seed oil (amaranth)[161]	*Anacardium occidentale* (cashew) seed oil[65]	*Arachis hypogaea* (peanut) oil[3,67,68]	*Arctium lappa* seed oil[162]	*Argania spinosa* kernel oil (argan)[70,71]	*Astrocaryum murumuru* seed butter (murumuru)[72]	*Avena sativa* (oat) kernel oil[73,163]
Caproic (C6)										
Caprylic (C8)									1.85	
Capric (C10)									1.85	
Lauric (C12)	0.02								47.46	
Myristic (C14)	0.03				0.07		0.01		26	0.2-0.3
Myristoleic (C14:1)										
Palmitic (C16)	5.96	18-30	5-8	19-20	9.9	5-16	7.27	10-15	6.28	13.9-18.82
Palmitoleic (C16:1)		1	0.5		0.4		0.01			0.1-0.4
Heptadecanoic (C17:0)					0.1					
Stearic (C18)	3.09	2-8	0.1-6.7	3	8.7	1-6.5	32.56	5-6.5	2.65	0.8-2.79
Oleic (C18:1)	14.6	30-40	10-35	22-26	57.2	33.3-76	50.21	45-55	12.56	31.4-51.26
Linoleic (C18:2)	17.55	24-34	35-50	46-50	20.8	8-47.5	3.18	28-36	2.87	22.8-43.1
Linolenic (C18:3)	57.4	1-3	24-40		0.2	0-0.6				0.64-2.1
Arachidic (C20)	0.34		1.5		1	0.17-3	0.22			
Eicosenoic (C20:1)			1		0.3	0.33-3	0.33			0.5-1
Eicosadienoic (C20:2)										
Arachidonic (C20:4)										
Behenic (C22)					0.4	1-5				
Erucic (C22:1)					0.3	0.5				
Docosadienoic (C22:2)										
Docosahexaenoic (C22:6)										
Lignoceric (C24)						0.2-3	0.49			
Others						<C16:0-0.4	heptadecenoic = 0.02; nonadecadienoic acid = 2.99; heneicosanoic acid = 1.07; dicosanoic acid = 0.43			arachidic (C20) + eicosadienoic (C20:2) = 0.1-0.3; C18:1, n-11 = 0.9-1.3

(continued)

Table 4. (continued)

Fatty acids	*Bassia butyracea* seed butter[a,104]	*Bassia latifolia* seed butter (Mahwa)[b,104]	*Bertholletia excelsa* seed oil (Brazil)[65]	*Borago officinalis* seed oil (borage)[75,76]	*Brassica campestris* (rapeseed) seed oil[3]	Rape seed acid[77]	*Brassica napus* seed oil (rapeseed)[164]	Hydrogenated rapeseed oil[4]	Canola oil[4]
Caproic (C6)									
Caprylic (C8)									
Capric (C10)									
Lauric (C12)									
Myristic (C14)			0.06			≤0.5		<1.0	<0.2
Myristoleic (C14:1)									
Palmitic (C16)	60.8	23.7-24.7	13.5	9-13	1.5-3	≤8	2	3-5.0	<6.0
Palmitoleic (C16:1)			0.3			≤2			<1.0
Heptadecanoic (C17:0)			0.2						
Stearic (C18)	3.2	19.3-29.9	11.8	3-5	0.7-1.3	≤3	1	38-42	<2.5
Oleic (C18:1)	30.9	36.3-43.3	29.1	10-22	12.1-57.4	54-70	21	1	>50
Linoleic (C18:2)	4.9	11.6-15.8	42.8	33-46	11.4-22.1	18-24	20	< 1.0	<40.0
Linolenic (C18:3)			0.2	18-25	8.3-12.5	5-10	2		<14
Arachidic (C20)			0.5			≤6	1	8-10.0	<1.0
Eicosenoic (C20:1)			0.2	2-6	5.6-3.1			< 1.0	<2.0
Eicosadienoic (C20:2)									
Arachidonic (C20:4)									
Behenic (C22)			0.1					42-50	<0.5
Erucic (C22:1)			0.3	1-3.5	1-58.6		53	< 1.0	<2.0
Docosadienoic (C22:2)									
Docosahexaenoic (C22:6)									
Lignoceric (C24)							2	1-2.0	<0.2
Others				α-linolenic (C18:3) = 0.4%; γ-linolenic = 1%-3.5%		<C14 = ≤0.5; >C18:3 = ≤5; >C20 = ≤6			<C14 = <0.1; C24:1 = <0.2

(continued)

Table 4. (continued)

Fatty acids	*Brassica oleracea* Acephala seed oil (kale)[78]	*Brassica oleracea* Italica (broccoli) seed oil[79]	*Butyrospermum parkii* (shea) oil[4]	*Butyrospermum parkii* (shea) butter[3,80–82]	*Camelina sativa* seed oil (false flax)[165]	*Camellia japonica* seed oil[166]	*Camellia kissi* seed oil[166]	*Camellia oleifera* seed oil (tea seed)[84,85]	*Camellia sinensis* seed oil[166]
Caproic (C6)									
Caprylic (C8)									
Capric (C10)									
Lauric (C12)									
Myristic (C14)				0.5					
Myristoleic (C14:1)									
Palmitic (C16)	4.4	0-5	3.8-4.1	3-9	7.8	7.9		6.1-15	8-10
Palmitoleic (C16:1)						0.16			
Heptadecanoic (C17:0)									
Stearic (C18)	0.7	0-5	41.2-56.8	30-50	2.96	2.46		0.8-2	1.5-3.5
Oleic (C18:1)	11.3	10-20	34.0-46.9	38-50	16.77	84.99	80	72-87	78-86
Linoleic (C18:2)	12.6	10-20	3.7-6.5	3-8	23.08	3.76		5.3-14.3	7-10
Linolenic (C18:3)	10.2	5-10		0.5 max	31.2				0.2-0.8
Arachidic (C20)	8.2		1-2	2.5-3		0.49			
Eicosenoic (C20:1)	0.4	5-10			11.99				
Eicosadienoic (C20:2)									
Arachidonic (C20:4)									
Behenic (C22)									
Erucic (C22:1)	51.8	40-50			2.8				
Docosadienoic (C22:2)									
Docosahexaenoic (C22:6)									
Lignoceric (C24)									
Others					3.4				

(continued)

Table 4. (continued)

Fatty acids	*Canarium indicum* oil (galip)[86,87]	*Carica papaya* seed oil (papaya)[88,89]	*Carthamus tinctorius* (safflower) seed oil[28,167]	*Carya illinoensis* (pecan) seed oil[63,65]	*Caryocar brasiliense* fruit oil (pequi)[c,77,90]	*Chenopodium quinoa* seed oil (quinoa)[168]	*Citrullus lanatus* (watermelon) seed oil[91]	*Citrus aurantifolia* (lime) seed oil[92,93]	*Citrus aurantium dulcis* (orange) seed oil[94,95]
Caproic (C6)									
Caprylic (C8)									
Capric (C10)									
Lauric (C12)	≤ 2								
Myristic (C14)	≤ 2			Trace	0.5	0.2		1	
Myristoleic (C14:1)									
Palmitic (C16)	28-38	8-18	2	3-4.3	34.4-44.3	9.9-11	8.0-13.0	20-30	14-22
Palmitoleic (C16:1)	≤2	2		0.1	1.3	0.1	<1.0		
Heptadecanoic (C17:0)	≤2			0.1					
Stearic (C18)	10-20	2-6		1.8-2	0.66-1.8	0.7-0.8	8.0-12.0	3-8	2-6
Oleic (C18:1)	30-40	60-77	26	40.6-79	54.55-57.4	22-50.2	15.0-30.0	20-38	26-35
Linoleic (C18:2)	12-22	3-25	68	16-50.3	0.84-2.8	1.2-56	55.0-65.0	30-45	35-45
Linolenic (C18:3)		0.8	Trace	0.7	0.18 -1.0	0.7-7	<1.0	5-15	2-6
Arachidic (C20)			Trace	Trace		0.7	<1.0	2	0.5
Eicosenoic (C20:1)		2		1.2			<1.0		
Eicosadienoic (C20:2)									
Arachidonic (C20:4)									
Behenic (C22)				0.2			<1.0		
Erucic (C22:1)				0.3					
Docosadienoic (C22:2)									
Docosahexaenoic (C22:6)							<2.0		
Lignoceric (C24)									
Others	Others ≤ 2	α-linolenic (C18:3) 2%					<1.0		

(continued)

Table 4. (continued)

Fatty acids	*Citrus grandis* (grapefruit) seed oil[96,97]	*Citrus limon* (lemon) seed oil[169]	*Citrus paradisi* (seed) oil[170]	*Cocos nucifera* (coconut) oil[29]	*Coix lacryma-jobi* (job's tears) seed oil[171]	*Corylus americana* (hazel) seed oil[164]	*Corylus avellana* (hazel) seed oil[9,107–109]	*Crambe abyssinica* seed oil (Abyssinian mustard)[164,172]	*Cucumis sativus* (cucumber) seed oil[173]	*Cucurbita pepo* (pumpkin) seed oil[98,99]
Caproic (C6)				0-1						
Caprylic (C8)				5-9						
Capric (C10)				6-10				<0.01-0.11		
Lauric (C12)	1.5		2.95	44-52				<0.01-0.14		
Myristic (C14)	1		1.01	13-19			≤0.2	<0.01-0.43		
Myristoleic (C14:1)								<0.01-0.09		
Palmitic (C16)	18-30	18.8	36.25	8-11	16.0	6	4-9	0.81-5.55	9-13	10-16
Palmitoleic (C16:1)				0-1			0.2-1	<0.01-0.77		
Heptadecanoic (C17:0)		0.08					≤0.1			
Stearic (C18)	2-8	3.5	5.95	1-3	trace	3	1-6	0.6-10.42	6-9	3-7
Oleic (C18:1)	20-38	30.1	18.34	5-8	53	76	66-85	12.8-23.13	14-20	18-38
Linoleic (C18:2)	30-48	33.4	29.26	Trace-2.5	30.5	15	7-25	9.08-15.86	60-68	40-62
Linolenic (C18:3)	2-6	13.5	3.58		trace		≤0.6	3.27-9.43	<1	1
Arachidic (C20)		0.3	0.38				≤0.5	<0.01 -1.19		
Eicosenoic (C20:1)		0.03	0.84				≤0.5	<0.01-6		
Eicosadienoic (C20:2)								<0.01-0.21		
Arachidonic (C20:4)								<0.01		
Behenic (C22)		0.08					≤0.3	<0.01-2.59		
Erucic (C22:1)							Trace-0.01	48.86-60		
Docosadienoic (C22:2)										
Docosahexaenoic (C22:6)								<0.01-1.34		
Lignoceric (C24)		0.2					0.01	<0.01-1.85		
Others		C23:0 = <0.01; C26:0 = 0.01	C12:1=1.44				C17:1 = ≤0.1	C20:3 = <0.01-0.19; C20:5 = <0.01-1.91		

(continued)

Table 4. (continued)

Fatty acids	*Cynara cardunculus* seed oil (artichoke)[174]	*Elaeis guineensis* (palm) oil[23]	*Elaeis guineensis* (palm) kernel oil[23]	*Elaeis oleifera* kernel oil[175]	*Euterpe oleracea* fruit oil (acai)[176]	*Fragaria ananassa* (strawberry) seed oil[58,100,101]	*Fragaria chiloensis* (strawberry) seed oil[103]	*Garcinia indica* seed butter (kokum)[d,114,177]	*Gevuina avellana* oil (Chilean hazel)[178]
Caproic (C6)			0.3	0.1					
Caprylic (C8)			4.4	0.9					
Capric (C10)			3.7	0.8					
Lauric (C12)		0.2	48.3	29.3					
Myristic (C14)		1.1	15.6	25.7		0.05			
Myristoleic (C14:1)									
Palmitic (C16)	12	44	7.8	10.1	22	4.32	3-5	2-8	1.9
Palmitoleic (C16:1)		0.1			2		0-0.2		22.7
Heptadecanoic (C17:0)									
Stearic (C18)	3	4.5	2	1.8	2	1.68	1-2	50-67.4	0.5
Oleic (C18:1)	25	39.2	15.1	26.4	60	10-20	15-18	27-42	39.4
Linoleic (C18:2)	60	10.1	2.7	4.5	12	28.5-50	40-46	0.5-2	5.6
Linolenic (C18:3)		0.4			Trace	25-40	30-36		0.1
Arachidic (C20)		0.4			2.5	0.71	0-0.2	0.7	1.4
Eicosenoic (C20:1)							0-0.2		3.1
Eicosadienoic (C20:2)									
Arachidonic (C20:4)									
Behenic (C22)									2.2
Erucic (C22:1)									
Docosadienoic (C22:2)									
Docosahexaenoic (C22:6)									
Lignoceric (C24)									0.5
Others			0.2	0.4		5.5-8.5	C18:3 w6 = 0-0.1		C18:1Δ12 = 6.2; C20:1Δ15 = 6.6; C22:1Δ17 = 7.9; C22:1Δ19 = 1.6

(continued)

Table 4. (continued)

Fatty acids	*Glycine soja* (soybean) oil[3]	*Gossypium herbaceum* (cotton) seed oil[24]	*Guizotia abyssinica* seed oil (Ramtil/Niger)[3]	*Helianthus annuus* (sunflower) seed oil[3]	Sunflower seed acid[77]	*Hippophae rhamnoides* fruit oil[f,110,179]	*Hippophae rhamnoides* seed oil[112,113,179]	*Irvingia gabonenesis* kernel butter[114,114]	*Juglans regia* (walnut) seed oil[180]
Caproic (C6)									
Caprylic (C8)									
Capric (C10)									
Lauric (C12)								35-51.1	
Myristic (C14)		2			≤2	0.4-0.6		36.8-58	
Myristoleic (C14:1)						0.2			
Palmitic (C16)		21	5.0-13	5.0-7.2	6-11	24-42	5-11.3	3.9-5	3-7
Palmitoleic (C16:1)						24-42	4.4		
Heptadecanoic (C17:0)									
Stearic (C18)		Trace	2.0-11	2.0-6.5	3-7	0.9-2.1	2-5	0.4-0.7	0.5-3
Oleic (C18:1)	11.5-60.0	30	6.0-40	14.7-37.2	19-31	3-30	11-30	0.6-2.7	9-30
Linoleic (C18:2)	0000	45	45-77	51.5-73.5	57-66		28-45	0.60	57-76
Linolenic (C18:3)	2.9 - 12.1			Trace-0.3	≤1	1.7-6.8	24.9-38	1.3	2-16
Arachidic (C20)		Trace		0.3-1	≤3				
Eicosenoic (C20:1)									
Eicosadienoic (C20:2)									
Arachidonic (C20:4)									
Behenic (C22)									
Erucic (C22:1)									
Docosadienoic (C22:2)									
Docosahexaenoic (C22:6)									
Lignoceric (C24)			2 max						
Others					>C20 = ≤3	vakccenic C18:1 (n-7) = 7.3-7.5; α-linoleic C18:2 = 4.1-5.5	vakccenic C18:1 (n-7) = 3.2; α-linoleic C18:2 = 34.1; others = 3 max		

(continued)

Table 4. (continued)

Fatty acids	*Limnanthes alba* (meadowfoam) seed oil[3]	*Linum usitatissimum* (linseed) seed oil[3]	*Luffa cylindrica* seed oil[181]	*Lupinus albus* seed oil[182]	*Lycium barbarum* seed oil[183]	*Macadamia integrifolia* seed oil[f,115–117,184]	*Mangifera indica* (mango) seed oil[g,3]	*Morinda citrifolia* seed oil[185]	*Moringa oleifera* seed oil (Ben/ Moringa)[118,119,186]	*Oenothera biennis* (evening primrose) oil[121,122]
Caproic (C6)										
Caprylic (C8)								1.44		
Capric (C10)										
Lauric (C12)						0.1-1.4				
Myristic (C14)			0.1			0.7-1.5			Trace	
Myristoleic (C14:1)										
Palmitic (C16)		5.5	12.2	14.44-21.57		6-12	5-8	9.0	5-9.3	4-10
Palmitoleic (C16:1)			0.1	0.36-1.03		12-25		0.12	1.5-3	
Heptadecanoic (C17:0)								0.13		
Stearic (C18)		3.5	0.1	1.37-3.91	3	0.5-8	33-48	4.07	3-8	2-4
Oleic (C18:1)		19.1	19.6	42.78-52.87	19.1	50-67	35-50	17.45	65-80	5-12
Linoleic (C18:2)		15.3	59.7	9.20-17.23	68.3	1.5-5	4.0-8	59.45	1.5-5	60-85
Linolenic (C18:3)		57		4.81-9.02	2.8	0.5 -1.9		0.27	1 -1.5	
Arachidic (C20)				1.61-2.30		1.5-5	1-7	0.51	2-5	
Eicosenoic (C20:1)	52 - 77			3.86-5.30		1.5-3.1		0.2	2.5-4	
Eicosadienoic (C20:2)										
Arachidonic (C20:4)					0.68					
Behenic (C22)				4.75-5.99		0.3-1			8-8.6	
Erucic (C22:1)	8.0-29			0.51-1.47		1			3	
Docosadienoic (C22:2)	7.0-20									
Docosahexaenoic (C22:6)										
Lignoceric (C24)									Trace	
Others										α-linolenic (C18:3) = 1%; γ-linolenic = 7%-12%

(continued)

Table 4. (continued)

Fatty acids	*Olea europaea* (olive) oil[3]	*Olea europaea* (olive) husk oil[123]	Olive acid[77]	*Orbignya cohune* seed oil (Cohune)[3]	*Orbignya oleifera* seed oil (babassu)[3]	*Orbignya speciosa* kernel oil[187]	*Oryza sativa* (rice) bran oil[125]	*Oryza sativa* (rice) germ oil[25]	*Passiflora edulis* seed oil (passion fruit)[126]
Caproic (C6)									
Caprylic (C8)				7.5	4-8	2-10			
Capric (C10)				6.5	4-8	2-12			
Lauric (C12)				46.5	44-47	35-50			
Myristic (C14)	Trace		≤1.0	16	15-20	12-25		6.92[25]	0.03
Myristoleic (C14:1)									
Palmitic (C16)	7.5-20	14.96	9-15	9.5	6-9	4-15	14	9.28	8.57
Palmitoleic (C16:1)	0.3-3.5	2.18	≤2					4.41[25]	0.23
Heptadecanoic (C17:0)			≤0.5						
Stearic (C18)	0.5-3.5	1	2-5	3	3-5	1-7	2	7.91[25]	1.66
Oleic (C18:1)	53-86	64.08	69-78	10	10-12	5-20	45	17.81[25]	16.25
Linoleic (C18:2)	3.5-20	16.09	8-14	1	1 to 3	<3	34	16.22[25]	72.69
Linolenic (C18:3)	0-1.5	0.71	≤3.5				1	15.56[25]	0.26
Arachidic (C20)	Trace							3.08[25]	
Eicosenoic (C20:1)									
Eicosadienoic (C20:2)									
Arachidonic (C20:4)								5.48[25]	
Behenic (C22)	Trace								
Erucic (C22:1)									
Docosadienoic (C22:2)									
Docosahexaenoic (C22:6)									
Lignoceric (C24)	Trace								
Others								arachidontrienoic = 5.21[25]	Unspecified other fatty acids = 0.31

(continued)

Table 4. (continued)

Fatty acids	*Perilla ocymoides* seed oil (perilla)[3]	*Persea gratissima* (avocado) oil[3]	*Pistacia vera* seed oil (pistachio)[65]	*Plukenetia volubilis* seed oil (sacha inchi)[188]	*Prunus amygdalus* (sweet almond) oil[3,63,128–130,189]	*Prunus armeniaca* (apricot) kernel oil[33]	*Prunus avium* (sweet) cherry seed oil[h,131,132]	*Prunus domestica* seed oil (prune/ plum)[134,135]
Caproic (C6)								
Caprylic (C8)								
Capric (C10)								
Lauric (C12)								
Myristic (C14)			0.09	0.02	1			
Myristoleic (C14:1)								
Palmitic (C16)		13-17	7.4	4.72	4-9	4.6-6	4-10	4-9
Palmitoleic (C16:1)		3-5.1	0.7	0.04	0.8	1-2		1
Heptadecanoic (C17:0)				0.12	0.2			
Stearic (C18)			0.9	3.33	2-3	0.5-1.2	1-4	3
Oleic (C18:1)	14-23	67-72	58.2	10.46	62-86	58-65.7 (total 18:1)	23-55	60-80
Linoleic (C18:2)	16	10 to 12	30.3	37.64	20-30	29-33; 28.5 (undef 18:2)	30-55	15-25
Linolenic (C18:3)	63-70		0.4	48.96	0.4	05-1.0 (undef 18:3)	13	1
Arachidic (C20)			0.6	0.09	0.2	0.2	2	
Eicosenoic (C20:1)			0.6	0.3	0.3			
Eicosadienoic (C20:2)								
Arachidonic (C20:4)								
Behenic (C22)			0.3		0.2			
Erucic (C22:1)			0.6		0.1			
Docosadienoic (C22:2)								
Docosahexaenoic (C22:6)								
Lignoceric (C24)								
Others				C17:1 = 0.06; gamma C18:3 = 0.24; others = 0.02	<C16:0 = 0.1	Oleic/Linoleic = 90%-93%	Eleostearic (C18:3 conj) = 10%	

(continued)

Table 4. (continued)

Fatty acids	*Prunus persica* (peach) kernel oil[136]	*Punica granatum* seed oil (pome granate)[137,138]	*Pyrus malus* (apple) seed oil[139]	*Ribes nigrum* (black currant) seed oil[140–142]	*Ribes rubrum* (currant) seed oil[143,190]	*Rosa canina* seed oil (dog rose)[169,191]	*Rubus chamaemorus* seed oil[144]	*Rubus idaeus* (raspberry) seed oil[58,145–147]
Caproic (C6)								
Caprylic (C8)								
Capric (C10)								
Lauric (C12)								
Myristic (C14)						0.11-0.21		0.07
Myristoleic (C14:1)								
Palmitic (C16)	2.0-7	1-10	6.51-6.60	6-10	4.6-4.8	1.71-4.6		2-2.43
Palmitoleic (C16:1)			0-0.05			0.24-1.01		
Heptadecanoic (C17:0)						0.04		
Stearic (C18)	0.5-3.5	1-5	1.75-1.96	1-4	2-3	1.69-2.47		0.9-1
Oleic (C18:1)	55-70	3-12	37.49-38.55	9-16	17.1-17.8	14.71-21.7	13-19	8-13
Linoleic (C18:2)	22-33	2-12	50.70-51.40	40-54	36-48	47.9-54.41	40-52	47-63
Linolenic (C18:3)	$\leq$1		0.19-0.30	11-18	15-30	16.42-21.8	27-38	25-40
Arachidic (C20)			1.49-1.54	1		1.0-2.61		0.37
Eicosenoic (C20:1)			0.51-0.56	3		0.3		
Eicosadienoic (C20:2)						0.07		
Arachidonic (C20:4)								
Behenic (C22)			0-0.40	1		0.1-0.64		
Erucic (C22:1)				1				
Docosadienoic (C22:2)								
Docosahexaenoic (C22:6)								
Lignoceric (C24)						0.04		
Others		punicic (C18:3 conj) = 60-80; other C18:3 conj = 18%		C18:3 (n-6) = 11-18; C18:4 (n-3) = 2-5	C18:1n-7 = 0.5-0.6; C18:3n-6 = 5.6-12; C18:4n-3 = 2-5; others = 0-0.3	C17:1 = 0.01; C21:0 = 0.01; C23:0 = 0.03		

(continued)

Table 4. (continued)

Fatty acids	*Schinziophyton rautanenii* kernel oil[148]	*Sclerocarya birrea* seed oil (marula)[149,192]	*Sesamum indicum* (sesame) seed oil[22,48]	*Silybum marianum* seed oil (thistle)[193]	*Solanum lycopersicum* (tomato) seed oil[50]	*Solanum lycopersicum* (tomato) fruit oil[i,194]	*Theobroma cacao* (cocoa) seed butter[3]	*Theobroma grandiflorum* seed butter (cupuacu)[195]
Caproic (C6)		1.41						
Caprylic (C8)								
Capric (C10)								
Lauric (C12)					Trace-0.3			
Myristic (C14)		2.12	<0.5		1.5-2.3			Trace
Myristoleic (C14:1)					Trace			
Palmitic (C16)	8	9-12; 22.56	7.0-12.0	9.4	16.9-23.4	47	24-29	7.2
Palmitoleic (C16:1)		0.05-0.15	<0.5		3.3-6.8			0.1
Heptadecanoic (C17:0)								0.2
Stearic (C18)	9	5-8; 50.76	3.5-6.0	6.6	4.0-9.5	3	34-36	30.8
Oleic (C18:1)	15	4.13; 70 - 78	35-50	21.3	18.3-29.7	30	30-40	43.9
Linoleic (C18:2)	37	4.0-7.0	35-50	53.3	37.6-42.8	12	2.4	4.6
Linolenic (C18:3)	25	0.1-0.6	<1.0	trace	Trace-0.7			Trace
Arachidic (C20)		0.3-0.7	<1.0	3.8	0.8-1.3			11
Eicosenoic (C20:1)		0.1-0.5	<0.5	0.5				
Eicosadienoic (C20:2)								
Arachidonic (C20:4)		8.46						
Behenic (C22)		5.14	<0.5	2.4	Trace-0.7			
Erucic (C22:1)		0.1-0.5						
Docosadienoic (C22:2)								
Docosahexaenoic (C22:6)								
Lignoceric (C24)		4.13		0.7				
Others		butyric = 0.35%	Trace C14			Other (C14 + C20) = 8		

(continued)

Table 4. (continued)

Fatty acids	*Torreya nucifera* seed oil (kaya)[196]	*Triticum vulgare* (wheat) germ oil[26,46]	*Vaccinium corymbosum* (blueberry) seed oil[58,151,152]	*Vaccinium macrocarpon* (cranberry) seed oil[58,153–156]	*Vaccinium myrtillus* seed oil (bilberry)[157,197]	*Vaccinium vitis-idaea* seed oil (lingonberry)[158,197]	*Vitis vinifera* (grape) seed oil[3]	*Zea mays* (corn) oil[47,159,160]	*Zea mays* (corn) oil[47,159,160]
Caproic (C6)									
Caprylic (C8)									
Capric (C10)									
Lauric (C12)			0.02	0.14					
Myristic (C14)	Trace		0.09	0.08	2.2-2.5	1.6-2.6		0.1-1.7	0.1-1.7
Myristoleic (C14:1)									
Palmitic (C16)	6.03	11.0-16	3-8	4-6	4.8-7.4	4.4-6.7	7-9.5	8-16.5	8-16.5
Palmitoleic (C16:1)	Trace							0.2-1.6	0.2-1.6
Heptadecanoic (C17:0)	Trace								
Stearic (C18)	2.51	1.0-6	0.5-3.5	1-1.25	2.2-2.5	1.2-1.9	3.5-5.5	0-4.5	0-4.5
Oleic (C18:1)	30.35	8.0-30	15-25	15-25.3	17.4-23	10-25	14-44	19-49	19-49
Linoleic (C18:2)	51.26	44-65	35-45	32-42	35-47.5	30-46.8	46-74	34-66	34-66
Linolenic (C18:3)	0.23	4.0-10	22-38	30-40	23.1-40	25.2-55		0-2	0-2
Arachidic (C20)			0.25	0.07				1	1
Eicosenoic (C20:1)	0.28							1	1
Eicosadienoic (C20:2)	0.98								
Arachidonic (C20:4)									
Behenic (C22)									
Erucic (C22:1)									
Docosadienoic (C22:2)									
Docosahexaenoic (C22:6)									
Lignoceric (C24)									
Others	C18:1 Δ11 = 0.57; C18:3 Δ5,9,12 = 0.08; C20:2 Δ5,11 = 0.79; C20:3 Δ5,11, 14 = 6.68; others = 0.24	0-1.2 C20-22 saturated acids		α-linolenic (C18:3) = 34%-35%					

Abbreviations: max, maximum; undef, undefined; conj, conjugated alkene.
[a]As Bassia butyracea seed fat.
[b]As Bassia latifolia seed fat or Madhuca indica seed fat.
[c]As Caryocar brasiliense pulp oil.
[d]As *Garcinia indica* seed fat.
[e]As Hippophae pulp oil.
[f]*Macadamia integrifolia* and *Macadamia ternifolia* are synonyms; information is being reported under the more common name.
[g]As mango kernel fat.
[h]As cherry kernel oil.
[i]With palm oil.

The nutritional content of these oils varies with oil type. For example, sunflower oil contains high levels of vitamins A, D, and K, whereas palm oil is a rich source of vitamins A and E. Crude sunflower oil also has the highest content of vitamin E in the form of α-tocopherol among vegetable oils.[3]

Vegetable oil and hydrogenated vegetable oil are cosmetic labeling names for blends of plant-derived oils.[5] The composition of a blend is determined by the desired physical properties. Vegetable oil and hydrogenated vegetable oil may include, but are not limited to, canola oil, *Brassica campestris* (rapeseed) oil, *Carthamus tinctorius* (safflower) seed oil, *Helianthus annuus* (sunflower) seed oil, *Sesamum indicum* (sesame) seed oil, *Elaeis guineensis* (palm) oil, *E guineensis* (palm kernel) oil, *Cocos nucifera* (coconut) oil, *Gossypium herbaceum* (cottonseed) oil, *Glycine soja* (soybean) oil, *Zea mays* (corn) oil, *Olea europaea* (olive) oil, *Prunus amygdalus dulcis* (sweet almond) oil, and hydrogenated products of these oils.

Method of Manufacturing

The oil may be directly expressed from the source (seed or pulp) followed by solvent extraction. *Bailey Industrial Oil and Fat Products* states that the removal of pigments and polar materials is mandatory for most cosmetic applications.[6] The process used for oil refining for foods may be adequate for this purpose, or additional steps may be required. Special refining methods to yield colorless and odorless oils are used by the cosmetic industry and include proprietary adsorption chromatography and supercritical fluid extractions.

The majority of the oils presented in this report are produced either from mechanical extraction or solvent extraction or a hybrid of both methods, known as prepress solvent extraction.[3] In solvent extraction, hexane is the most commonly used solvent, as it is economical and easily removed from the extracted oil. Seeds that are rich in oil can be cold pressed to extract oil without the use of solvents.[7]

After the initial extraction by methods such as solvent extraction, the crude (degummed) oil is often refined.[3] The first step is treating the oil with caustic soda to neutralize free fatty acids, hydrolyze phosphatides, and remove some colored pigments and unsaponifiable materials. Soap stock is usually a byproduct of this step. The next step involves treating the neutralized oil with activated earth to further adsorb pigments. The last major step in refining oil is deodorizing, usually by a type of steam distillation, which is intended to remove all oxidative cleavage products that impart odor or flavor to the oil. Deodorization also removes tocopherols, sterols, and other minor constituents of free fatty acids and undesirable foreign materials. Figure 2 is a flowchart of the basic refinement process.

After deodorization, oils can be further processed by hydrogenation, which makes oil more resistant to oxidative and thermal damage, and by winterization, where oil is slowly cooled to promote formation of crystals that cause cloudiness, and then filtered to remove the crystals.

Cosmetic grade fatty acid plant oils may include a physical refining step that involves heating crude oil under vacuum.[7] This step allows for the removal of volatile components such as color compounds, odor compounds, and free fatty acids, which gives the refined oil a lighter color, less odor, and lower acid values.

Analytical Methods

Near-infrared spectroscopy and gas chromatography have been used, respectively, to phenotype and analyze fatty acid profiles in shea fat (described as *V paradoxa*, not *B parkii*).[8] The fatty acid composition of hazel seed oil (*Corylus avellana*, in crude form) has also been analyzed by gas chromatography.[9] The triacylglycerol and diacylglycerol composition oils from hazelnut, pistachio, almond, Brazil nut, and macadamia nuts have been characterized using high-performance liquid chromatography with atmospheric pressure chemical ionization and UV detection.[10] The triacylglycerol profile of Brazil nut oil has also been quantified using dry matrix-assisted laser desorption/ionization time-of-flight mass spectrometry.[11]

Impurities

Proteins. Many edible fatty acid oils are derived from foods that are recognized as potent food allergens. It has been shown that an individual who is allergic to a food will generally not react to the refined oil, especially if the oil has been "hot pressed" or has undergone more processing.[12,13] A prime example is *Arachis hypogaea* (peanut) oil. Peanuts are extremely allergenic to a large population, but reaction to the oil is rare. In its safety assessment on *A hypogaea* (peanut) oil, the Panel noted that the major concern associated with allergic reactions to peanuts is the protein.[14] The protein does not partition into the refined oil, and therefore, the oil is safe for use in cosmetics. However, researchers have reported protein levels in processed oils. Halsey et al reported that Lowry protein determinations of cold-pressed and refined sunflower oil were found to be 2 to 8 μg/mL protein,[15] whereas Zitouni et al reported trace amounts of protein in the refined oil.[16] Olszewski et al found 0.1 to 0.2 μg protein per gram of peanut oil,[17] whereas Ramazzotti et al reported finding immunoglobulin E (IgE)-responsive residual proteins in peanut oil extracts.[18] Porras et al found soy protein in some samples of soy oil, but not others.[19] Awazuhara et al reported 1.4 to 4.0 μg protein per 100 g of soy oil.[20] Although Paschke et al found approximately 35 μg/L protein content in refined soybean oil, no IgE-binding activity was detectable.[21]

Although the Panel has found a general lack of clinical effects for fatty acid oils already reviewed,[14,22–30] other groups have raised concerns. The European Medicines Agency (EMEA) Working Party on Herbal Medicinal Products concluded that soy and peanut products "should be treated as allergenic unless they have an analytically monitored non-allergenic specification and a safe maximum daily dose."[31] The EMEA found that threshold concentrations for induction of a protein contact dermatitis were not available and recommended, "all medications for topical use containing soya or peanut products should be treated as allergenic."

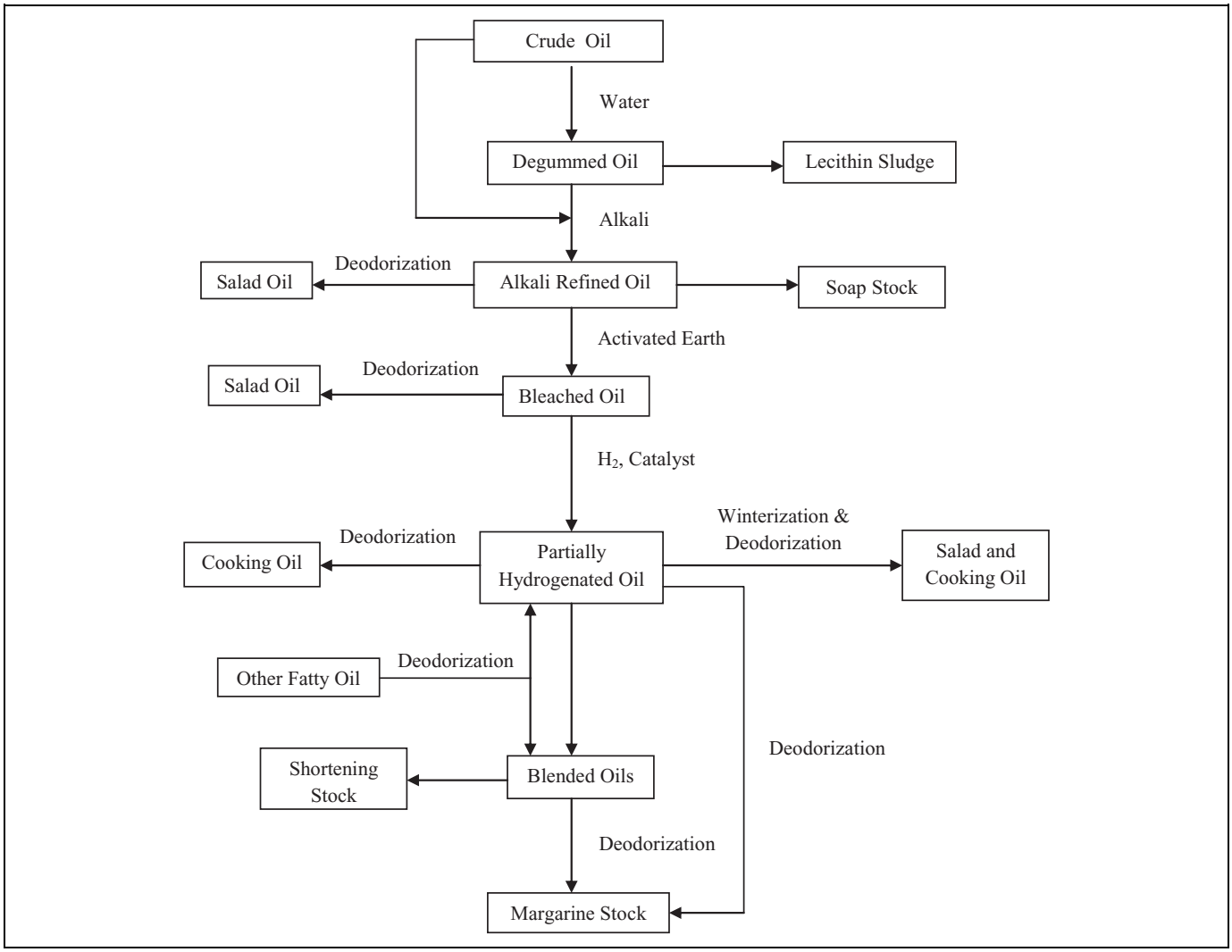

Figure 2. Basic oil refinement flowchart.[3]

Aflatoxin. Aflatoxins are metabolic products of the molds *Aspergillus flavus* and *Aspergillus parasiticus*. They are most often produced in stored agricultural crops (such as peanuts and other nut crops) when growth conditions and genetic requirements are favorable.[32–34] The International Agency for Research on Cancer (IARC) categorized aflatoxins as group 1 agents, "carcinogenic to humans."[35,36]

The US government places the following limitations on peanuts to be considered "negative" for aflatoxin: $\leq$15 ppb for "peanuts which have been certified as meeting edible quality grade requirements" and $\leq$25 ppb for "nonedible quality categories" (7 Code of Federal Regulations (CFR) sections 997.30 and 998.200).[37] Aflatoxin contamination was not a concern in the previous CIR safety assessments of peanut oil,[17] hazelnut oil,[41] or coconut oil.[29]

Glycidol. Glycidol and glycidol fatty acid esters have been detected in refined fatty acid oils.[38–41]

Gossypol. Gossypol reportedly is present in refined cottonseed oil at a concentration of $\leq$0.01%.[24] The concentration of gossypol in modified cottonseed products intended for human consumption is limited by federal regulation (21CFR 112.894).

Use

Cosmetic

The safety of the cosmetic ingredients addressed in this safety assessment is evaluated based on data received from the US Food and Drug Administration (FDA) and the cosmetics industry on the expected use of these ingredients in cosmetics. Use frequencies of individual ingredients in cosmetics are collected from manufacturers and reported by cosmetic product category in the FDA Voluntary Cosmetic Registration Program (VCRP) database. Use concentration data are submitted by the cosmetic industry in response to a survey, conducted by the Personal Care Products Council, of maximum reported use concentrations by product category.

There are 244 oil ingredients included in this safety assessment, 146 of which are reported to be used; 118 of the in-use ingredients have never been reviewed by CIR, while 28 have

been reviewed previously. For the ingredients being reviewed for the first time, the frequency of use[42] and/or concentration of use[43–45] can be found in Table 5. (Also included in Table 5 are 3 ingredients, *Citrullus vulgaris* (watermelon) seed oil, macadamia nut oil, and *Vaccinium oxycoccos* (cranberry) seed oil, that do not have identifiable INCI names; these ingredients are not part of this assessment, but they are very similar to the oils that are part of this assessment, and information on them is included in this report for completeness.) For the ingredients that have been reviewed previously, the current and historical[23–26,28,46–48] frequency and concentration of use is given in Table 6. The 97 ingredients not currently reported to be used are listed in Table 7.[42–45,49,50]

Of the oils included in this report, *B parkii* (shea) butter has the most reported uses in cosmetic and personal care products, with a total of 1,950; 1,680 of those uses are in leave-on formulations. A recent survey of use concentrations for *B parkii* (shea) butter reports a maximum use concentration of 60% in leave-on products as a cuticle softener, a manicuring application.[51] *Helianthus annuus* (sunflower) seed oil has the second greatest number of overall uses reported, with a total of 1,414; 1,054 of those uses are in leave-on formulations, having use concentrations up to 96%. Many other ingredients are used in an extensive number of formulations. For example, prunus amygdalus dulcis (sweet almond) oil, *O europaea* (olive) fruit oil, and *G soja* (soybean) oil have 1,127, 915, and 912 uses, respectively. Most of the in-use ingredients have uses in both leave-on and rinse-off product types, many are used in products that are applied around the eye and some are used in a way they can possibly be ingested. Some are used in products that involve mucous membrane exposure, and a few are used in underarm deodorant formulations. Many of the products are used in formulations at relatively high concentrations. *Olea europaea* (olive) fruit oil is used at up to 100%, *Persea gratissima* (avocado) oil is used at up to 98%, *H annuus* (sunflower) seed oil at up to 96%, and *G soja* (soybean) oil at 95%.

Oils are used in a wide variety of cosmetic products for their skin conditioning, occlusive, emollient, moisturizing, and other properties. Some of the oils included in this report are used in products that can be inhaled, and effects on the lungs that may be induced by aerosolized products containing these ingredients are of concern. The particle size of aerosol hair sprays and of pump hair sprays is 38 and >80 μm, respectively, and is relatively large compared to respirable particle sizes (≤10 μm). Therefore, because of their size, most aerosol particles are deposited in the nasopharyngeal region and are not respirable.

None of the oils, hydrogenated oils, unsaponifiables, oil fatty acids, and salts of the fatty acids described in this report were restricted from use in any way under the rules governing cosmetic products in the European Union.[52]

Noncosmetic

The primary use of plant-derived fatty acid oils is for cooking. Palm oil is the world's most widely consumed edible oil (41.7 million metric tons), followed by soybean oil, rapeseed oil, sunflower seed oil, cottonseed oil, peanut oil, palm kernel oil, coconut oil, and olive oil.[3,53] Nonfood, noncosmetic uses for edible fatty acid oils are found in Table 8.

Toxicological Studies

Many of the fatty acid oils in this assessment are edible, and exposure to the oils from food use would result in a much larger systemic dose than that resulting from use in cosmetic products. Consequently, their systemic toxicity potential, except as discussed below relating to carcinogenicity, is not addressed in this report. The safety focus of use of these oils as cosmetic ingredients is the potential for irritation and sensitization.

Carcinogenicity

The safety of glycidol fatty acid esters in refined vegetable oils was assessed by IARC. Glycidol was determined to be a group 2A (probably carcinogenic to humans) chemical, while glycidol fatty acid esters were determined to be a group 3 (not classifiable as to carcinogenicity to humans) chemical.[40,41]

The Federal Institute for Risk Assessment in Germany released a summary of their initial evaluation of the assessment of levels of glycidol fatty acid esters detected in refined vegetable fats.[39] Although acknowledging that the levels of glycidol that may be released from glycidol fatty acid esters are not known, the evaluation noted that glycidol is classified as probably carcinogenic to humans. The evaluation was based on findings of the German Chemical and Veterinary Test Agency that noted that glycidol is converted to 3-chloropropanediol and it appeared to be the 3-chloropropanediol that was detected in the vegetable fat.[38] The levels of 3-chloropropanediol were negligible at the crude oil, degummed, neutralized, and bleached stages, but levels were significant at the deodorized stage.

Anacardium occidentale *(Cashew) Seed Oil*

The modulatory effect of *A occidentale* (cashew) seed oil on antioxidant potential was investigated in female Swiss albino mice in a 120-day skin papillomagenesis study.[54] The mice were divided into 4 groups of 15 and 1 group of 10 (vehicle control). Test groups were as follows: group I was the vehicle control, receiving 0.1 mL acetone; group II was the positive control, receiving a single dose of 7,12-dimethylbenz(*a*)anthracene (DMBA; 0.005 mg/0.05 mL acetone) followed by applications of 2% croton oil 3 times a week until study termination; group III received a single dose of DMBA followed by applications of 2.5% cashew nut kernel oil 3 times a week until study termination; group IV received a single dose of DMBA followed by applications of 5% cashew nut kernel oil 3 times a week until study termination; and group V received 5% cashew nut kernel oil applied until study termination. The oil was applied to the clipped dorsal scapular region that was 2 cm in diameter. Body weights were recorded at regular intervals.

Table 5. Frequency and Concentration of Use According to Duration and Exposure.[a]

	No. of uses	Conc. of use (%)	No. of uses	Conc. of use (%)	No. of uses	Conc. of use (%)	No. of uses[42]	Conc. of use (%)	No. of uses[42]	Conc. of use (%)	No. of uses[42]	Conc. of use (%)
	Actinidia chinensis (kiwi) seed oil		*Adansonia digitata* oil		*Aleurites moluccanus* seed oil		*Anacardium occidentale* (cashew) seed oil		*Argania spinosa* kernel oil		*Astrocaryum murumuru* seed butter	
Totals[b]	7	0.1	6	0.01	141	0.00001-5	10	0.002-1	100	0.001-10	192	0.001-7
Duration of use												
Leave-on	5	NR	4	0.01	87	0.00002-5	9	0.04-1	87	0.001-10	171	0.001-7
Rinse-off	2	0.1	2	NR	54	0.00001-3	1	0.002	13	0.001-2	21	0.001-0.2
Exposure type												
Eye area	NR	NR	NR	NR	6	0.0001-0.005	NR	NR	11	0.1-1	21	0.06-0.5
Possible ingestion	1	NR	NR	0.01	1	0.01	NR	NR	9	0.1-1	22	1-7
Inhalation	1	NR	NR	NR	15	0.1	NR	NR	NR	0.01	NR	NR
Dermal contact	5	NR	5	0.01	76	0.00001-5	9	0.002-1	88	0.001-10	178	0.001-7
Deodorant (underarm)	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.001	NR	NR
Hair—noncoloring	2	0.1	1	NR	58	0.00002-0.1	1	NR	8	0.01-1	11	0.001-0.2
Hair—coloring	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.07-0.1	3	NR
Nail	NR	NR	NR	NR	4	NR	NR	NR	2	0.001-0.1	NR	NR
Mucous membrane	NR	NR	NR	NR	5	0.00001-0.4	NR	NR	2	0.001-2	3	NR
Bath products	NR	NR	NR	NR	6	0.01-0.3	NR	NR	1	0.05	NR	NR
Baby products	NR	NR	1	NR	NR	NR	NR	NR	NR	NR	NR	NR
	Sodium *Astrocaryum murumuruate*		*Avena sativa* (oat) kernel oil		*Bassia latifolia* seed butter		*Bertholletia excelsa* seed oil		*Borago officinalis* seed oil		*Brassica campestris* (rapeseed) seed oil	
Totals	NR	0.002-0.005	43	0.01-3	22	0.001-2	55	0.0003-0.5	180	0.001-1	27	0.007-17
Duration of use												
Leave-on	NR	0.002	37	0.1-3	17	0.001-0.05	18	0.0003-0.5	160	0.001-1	23	0.007-17
Rinse-off	NR	0.002-0.005	6	0.001-0.1	5	0.001-2	37	0.01-0.2	20	0.001-0.01	4	0.1-1
Exposure type												
Eye area	NR	NR	NR	0.2	4	0.01	1	NR	7	0.001-0.5	2	NR
Possible ingestion	NR	NR	NR	2	NR	NR	NR	NR	NR	0.01	1	9
Inhalation	NR	NR	NR	NR	NR	NR	1	NR	3	0.1	NR	NR
Dermal contact	NR	0.002-0.005	41	0.001-3	22	00.01-2	29	0.0003-0.5	168	0.001-1	27	0.007-17
Deodorant (underarm)	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Hair—noncoloring	NR	NR	2	0.1	NR	0.001-0.5	12	0.03-0.2	10	NR	NR	0.1
Hair—coloring	NR	NR	NR	NR	NR	NR	14	NR	NR	NR	NR	NR
Nail	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Mucous membrane	NR	0.002	2	0.01-0.1	5	NR	7	0.01	4	0.001-0.01	1	NR
Bath products	NR	NR	1	NR	NR	NR	3	NR	1	NR	NR	NR
Baby products	NR	NR	6	0.1	NR	NR	NR	NR	3	NR	NR	NR

(continued)

Table 5. (continued)

	No. of uses	Conc. of use (%)	No. of uses	Conc. of use (%)	No. of uses	Conc. of use (%)	No. of uses[42]	Conc. of use (%)	No. of uses[42]	Conc. of use (%)	No. of uses[42]	Conc. of use (%)
	Hydrogenated rapeseed oil		*Brassica oleracea* Italica (broccoli) seed oil		*Butyrospermum parkii* (shea) oil		*Butyrospermum parkii* (shea) butter		*Butyrospermum parkii* (shea) butter unsaponifiables		Hydrogenated shea butter	
Totals	1	0.3-4	NR	0.001-3	22	0.01-15	1950	0.0005-60	38	0.06-3	4	1
Duration of use												1
Leave-on	NR	0.3-4	NR	3	16	0.01-15	1680	0.001-60	35	0.06-3	2	1
Rinse-off	1	NR	NR	0.001-0.5	22	0.6-1	270	0.0005-30	3	NR	2	1
Exposure type												
Eye area	NR	2	NR	NR	1	NR	108	0.1-8	7	0.2-0.7	NR	NR
Possible ingestion	NR	NR	NR	NR	NR	15	128	0.5-26	2	3-Jan	NR	NR
Inhalation	NR	NR	NR	NR	NR	NR	17	0.001-3	NR	NR	NR	NR
Dermal contact	1	0.3-4	NR	NR	22	0.6-15	1724	0.001-45	33	0.06-3	4	1
Deodorant (underarm)	NR	NR	NR	NR	NR	NR	2	1	NR	NR	NR	NR
Hair—noncoloring	NR	NR	NR	NR	NR	NR	210	0.0005-3	5	2	NR	NR
Hair—coloring	NR	NR	NR	0.001-3	NR	NR	4	NR	NR	NR	NR	NR
Nail	NR	NR	NR	NR	NR	0.01-1	7	0.01-60	NR	NR	NR	NR
Mucous membrane	NR	NR	NR	NR	3	0.6	101	0.003-5	NR	NR	NR	NR
Bath products	NR	NR	NR	NR	3	1	13	1	NR	NR	2	NR
Baby products	NR	NR	NR	NR	NR	NR	24	0.01-5	NR	NR	NR	NR
	Camelina sativa seed oil		*Camellia japonica* seed oil		*Camellia kissi* seed oil		*Camellia oleifera* seed oil		Hydrogenated *Camellia oleifera* seed oil		*Camellia sinensis* seed oil	
Totals	76	0.002-1	NR	0.01-0.2	47	0.1-10	25	0.003-3	1	NR	12	0.1
Duration of use												
Leave-on	61	0.002-1	NR	0.01-0.2	34	0.1-10	23	0.003-3	1	NR	8	0.1
Rinse-off	15	1	NR	0.1	13	0.1-3	2	0.01-0.1	NR	NR	4	0.1
Exposure type												
Eye area	NR	0.05	NR	0.01	4	0.1	NR	2	NR	NR	NR	NR
Possible ingestion	34	0.05-0.5	NR	0.1	1	0.1	3	3	NR	NR	1	0.1
Inhalation	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Dermal contact	47	0.002-1	NR	0.01-0.2	36	0.1-10	23	0.003-3	1	NR	10	0.1
Deodorant (underarm)	NR	NR	NR	0.01	NR	NR	NR	NR	NR	NR	NR	0.1
Hair—noncoloring	29	1	NR	0.1	11	0.1-1	2	2	NR	NR	2	0.1
Hair—coloring	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Nail	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Mucous membrane	NR	NR	NR	0.1	1	0.1	NR	0.01-0.1	NR	NR	2	0.1
Bath products	NR	NR	NR	NR	1	0.3	NR	0.05	NR	NR	NR	NR
Baby products	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR

(continued)

Table 5. (continued)

	No. of uses	Conc. of use (%)	No. of uses	Conc. of use (%)	No. of uses	Conc. of use (%)	No. of uses[42]	Conc. of use (%)	No. of uses[42]	Conc. of use (%)	No. of uses[42]	Conc. of use (%)
	Canola oil		Canola oil unsaponifiables		Hydrogenated canola oil		*Carica papaya* seed oil		*Caryocar brasiliense* fruit oil		*Chenopodium quinoa* seed oil	
Totals	132	0.0002-73	NR	0.001	3	NR	NR	0.1	31	0.0005-0.2	1	0.3
Duration of use												
Leave-on	112	0.002-73	NR	NR	2	NR	NR	0.1	29	0.0005-2	1	NR
Rinse-off	20	0.02-33	NR	0.0001	1	NR	NR	NR	2	NR	NR	0.3
Exposure type												
Eye area	3	0.002-0.03	NR	NR	NR	NR	NR	NR	12	NR	NR	NR
Possible ingestion	62	0.3-70	NR	NR	NR	NR	NR	NR	12	0.2	NR	NR
Inhalation	1	0.0002-17	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Dermal contact	113	0.0002-73	NR	NR	3	NR	NR	0.1	30	0.0005-0.2	NR	NR
Deodorant (underarm)	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Hair—noncoloring	19	0.006-24	NR	0.001	NR	NR	NR	NR	1	NR	1	NR
Hair—coloring	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.3
Nail	NR	5	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Mucous membrane	2	0.02-1	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Bath products	1	1-33	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Baby products	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
	Citrullus lanatus (watermelon) seed oil		*Citrullus vulgaris* (watermelon) seed oil[c]		*Citrus limon* (lemon) seed oil		*Citrus paradisi* (grapefruit) seed oil		*Crambe abyssinica* seed oil		*Cucumis sativus* (cucumber) seed oil	
Totals	1	2	5	NR	6	6	NR	0.01-20	6	NR	6	NR
Duration of use												
Leave-on	1	2	3	NR	5	5	NR	0.08-20	5	NR	5	NR
Rinse-off	NR	NR	2	NR	1	1	NR	0.01-1	1	NR	1	NR
Exposure type												
Eye area	NR	NR	NR	NR	NR	1	NR	NR	NR	NR	1	NR
Possible ingestion	NR	NR	NR	NR	NR	NR	NR	5	NR	NR	NR	NR
Inhalation	NR	NR	NR	NR	NR	NR	NR	2	NR	NR	NR	NR
Dermal contact	1	2	5	NR	6	5	NR	2-5	6	NR	5	NR
Deodorant (underarm)	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Hair—noncoloring	NR	NR	NR	NR	NR	1	NR	0.01-20	NR	NR	1	NR
Hair—coloring	NR	NR	NR	NR	NR	NR	NR	9	NR	NR	NR	NR
Nail	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Mucous membrane	NR	NR	1	NR	1	NR	NR	NR	1	NR	NR	NR
Bath products	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Baby products	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR

(continued)

Table 5. (continued)

	No. of uses	Conc. of use (%)	No. of uses	Conc. of use (%)	No. of uses	Conc. of use (%)	No. of uses[42]	Conc. of use (%)	No. of uses[42]	Conc. of use (%)	No. of uses[42]	Conc. of use (%)
	Cucurbita pepo (pumpkin) seed oil		Palm kernel acid		Potassium palm kernelate		Potassium palmate		Sodium palm kernelate		Sodium palmate	
Totals	18	0.003-0.1	72	0.2-12	7	0.3-30	5	0.3-3	194	12-44	212	3-68
Duration of use												
Leave-on	17	0.003-0.1	3	NR	NR	NR	NR	NR	10	NR	7	NR
Rinse-off	1	NR	69	0.2-12	7	0.3-30	5	0.3-3	184	12-44	205	3-68
Exposure type												
Eye area	1	0.003	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Possible ingestion	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Inhalation	1	NR	NR	NR	NR	NR	NR	NR	1	NR	1	NR
Dermal contact	18	0.003-0.1	71	0.2-12	7	0.3-30	5	0.3-3	194	12-44	212	3-68
Deodorant (underarm)	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Hair—noncoloring	1	NR	1	NR	NR	NR	NR	NR	NR	NR	NR	NR
Hair—coloring	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Nail	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Mucous membrane	NR	NR	64	0.2-3	1	0.3-30	2	0.3-3	173	16-44	189	3-68
Bath products	NR	NR	NR	NR	NR	NR	NR	NR	3	NR	1	NR
Baby products	NR	NR	NR	NR	NR	NR	NR	NR	4	NR	3	NR
	Palm acid		*Elaeis oleifera* kernel oil		*Euterpe oleracea* fruit oil		*Garcinia indica* seed butter		*Gevuina avellana* oil		*Glycine soja* (soybean) oil	
Totals	33	1-17	5	NR	29	0.00001-0.5	30	0.1-2	5	0.002-0.2	912	0.0002-95
Duration of use												
Leave-on	1	NR	NR	NR	19	0.00001-0.5	27	0.1-2	5	0.04-0.2	718	0.0005-95
Rinse-off	32	1-17	5	NR	10	0.05	3	NR	NR	0.002-0.01	194	0.0002-95
Exposure type												
Eye area	NR	NR	NR	NR	2	0.5	1	NR	NR	NR	53	0.04-2
Possible ingestion	NR	NR	NR	NR	1	0.002	3	0.1-2	NR	NR	103	0.6-4
Inhalation	1	NR	NR	NR	1	NR	NR	NR	NR	NR	6	0.03-0.5
Dermal contact	33	1-17	NR	NR	14	0.00001-0.5	30	0.1-2	4	0.002-0.2	800	0.0005-93
Deodorant (underarm)	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.01-0.5
Hair—noncoloring	NR	NR	2	NR	15	NR	NR	NR	NR	NR	97	0.0002-95
Hair—coloring	NR	NR	3	NR	NR	NR	NR	NR	NR	NR	5	NR
Nail	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	6	0.02-95
Mucous membrane	31	1-4	NR	NR	3	NR	1	NR	NR	NR	70	0.01-52
Bath products	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	19	0.1-78
Baby products	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	21	2

(continued)

Table 5. (continued)

	No. of uses	Conc. of use (%)	No. of uses	Conc. of use (%)	No. of uses	Conc. of use (%)	No. of uses[42]	Conc. of use (%)	No. of uses[42]	Conc. of use (%)	No. of uses[42]	Conc. of use (%)
	Glycine soja (soybean) oil unsaponifiables		Hydrogenated soybean oil		*Helianthus annuus* (sunflower) seed oil		*Helianthus annuus* (sunflower) seed oil unsaponifiables		Hydrogenated sunflower oil		*Hippophae rhamnoides* oil	
Totals	12	0.0001-0.2	36	0.001-42	1414	0.000007-96	10	0.005-2	NR	6-35	15	0.2-0.7
Duration of use												
Leave-on	12	0.0001-0.2	33	0.001-39	1054	0.0002-96	10	0.005-2	NR	6-35	10	0.2-0.7
Rinse-off	NR	NR	3	0.05-42	360	0.000007-92	NR	0.002	NR	15-35	5	0.2
Exposure type												
Eye area	NR	NR	4	0.03-7	64	0.0005-19	2	0.02	NR	7	NR	NR
Possible ingestion	NR	NR	3	0.1-39	260	0.08-41	NR	NR	NR	6	NR	NR
Inhalation	NR	NR	NR	NR	3	0.0002-85	NR	NR	NR	NR	NR	NR
Dermal contact	12	0.0001-0.2	34	0.01-39	707	0.0002-96	10	0.005-2	NR	6-35	1	0.2-0.7
Deodorant (underarm)	NR	NR	NR	NR	1	0.0003-4	NR	NR	NR	NR	NR	NR
Hair—noncoloring	NR	NR	1	0.1	179	0.000007-92	NR	NR	NR	NR	6	NR
Hair—coloring	NR	NR	NR	NR	85	0.03-35	NR	NR	NR	15-35	NR	NR
Nail	NR	NR	NR	0.001-25	8	0.05-30	NR	NR	NR	NR	8	NR
Mucous membrane	NR	NR	NR	0.05-6	52	0.0003-4	NR	0.002	NR	NR	1	0.2
Bath products	NR	NR	NR	5-42	11	0.005-75	NR	NR	NR	NR	NR	NR
Baby products	NR	NR	NR	NR	18	0.2	NR	NR	NR	NR	NR	NR
	Hippophae rhamnoides fruit oil		*Irvingia gabonensis* kernel butter		*Juglans regia* (walnut) seed oil		*Limnanthes alba* (meadowfoam) seed oil		*Linum usitatissimum* (linseed) seed oil		Linseed acid	
Totals	7	0.004-2	109	0.003-0.4	15	0.00003-0.2	316	0.002-74	102	0.001-10	3	NR
Duration of use												
Leave-on	7	0.004-2	109	0.003-0.4	12	0.01-0.2	225	0.002-74	52	0.002-10	3	NR
Rinse-off	NR	NR	NR	NR	3	0.00003-0.1	91	0.01-2	50	0.001-0.4	NR	NR
Exposure type												
Eye area	1	NR	2	NR	1	NR	30	0.1-20	3	0.01	NR	NR
Possible ingestion	NR	NR	64	0.003-0.3	NR	NR	67	0.6-26	NR	0.01	NR	NR
Inhalation	NR	NR	NR	NR	NR	NR	1	0.1-3	3	NR	NR	NR
Dermal contact	6	2	108	0.003-0.4	15	0.003-0.2	211	0.002-74	58	0.003-4	3	NR
Deodorant (underarm)	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.05-0.1	NR	NR
Hair—noncoloring	NR	NR	1	NR	NR	0.00003-0.1	47	0.1-1	42	0.001-0.1	NR	NR
Hair—coloring	NR	NR	NR	NR	NR	NR	46	0.2-2	NR	NR	NR	NR
Nail	1	0.004	NR	NR	NR	NR	NR	0.5	2	0.002-0.05	NR	NR
Mucous membrane	NR	NR	NR	NR	NR	NR	4	0.001-0.6	5	0.003-0.4	NR	NR
Bath products	NR	NR	NR	NR	2	NR	2	0.5-0.9	1	0.02-0.2	NR	NR
Baby products	NR	NR	NR	NR	NR	NR	1	NR	2	NR	1	NR

(continued)

Table 5. (continued)

	No. of uses	Conc. of use (%)	No. of uses	Conc. of use (%)	No. of uses	Conc. of use (%)	No. of uses[42]	Conc. of use (%)	No. of uses[42]	Conc. of use (%)	No. of uses[42]	Conc. of use (%)
	Luffa cylindrica seed sil		*Lupinus albus* seed oil		*Lycium barbarum* seed oil		*Macadamia integrifolia* seed oil		*Macadamia ternifolia* seed oil		Macadamia nut oil[c]	
Totals	21	0.01	1	NR	2	NR	41	0.00006-5	533	0.0003-30	208	NS
Duration of use												
Leave-on	21	NR	1	NR	2	NR	25	0.00006-5	482	0.001-30	191	NS
Rinse-off	NR	0.01	NR	NR	NR	NR	16	0.006-3	51	0.0003-10	17	NS
Exposure type												
Eye area	1	NR	NR	NR	1	NR	3	0.1	16	0.1-15	22	NS
Possible ingestion	9	NR	NR	NR	1	NR	4	1	33	0.1-30	11	NS
Inhalation	NR	NR	NR	NR	NR	NR	NR	0.5	12	0.007-16	2	NS
Dermal contact	21	0.01	1	NR	2	NR	36	0.00006-5	493	0.001-30	170	NS
Deodorant (underarm)	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NS
Hair—noncoloring	NR	NR	NR	NR	NR	NR	12	0.01-0.03	33	0.0003-16	9	NS
Hair—coloring	NR	NR	NR	NR	NR	NR	NR	NR	3	0.02	NR	NS
Nail	NR	NR	NR	NR	NR	NR	NR	3	1	0.001-0.5	NR	NS
Mucous membrane	NR	0.01	NR	NR	NR	NR	10	2	12	0.02-10	NR	NS
Bath products	NR	NR	NR	NR	NR	NR	1	0.5	2	1-10	1	NS
Baby products	NR	NR	NR	RN	NR	NR	NR	NR	4	NR	NR	NS
	Mangifera indica (Mango) seed oil		*Mangifera indica* (mango) seed butter		Sodium mango seedate		*Moringa oleifera* seed oil		*Moringa pterygosperma* seed oil		*Oenothera biennis* (evening primrose) oil	
Totals	72	0.003-6	175	0.0005-3	1	NR	NR	0.001	15	0.003-3	150	0.00002-58
Duration of use												
Leave-on	64	0.003-6	134	0.01-5	NR	NR	NR	0.001	13	0.004-3	113	0.00002-58
Rinse-off	8	0.05-0.2	41	0.0005-0.5	1	NR	NR	NR	2	0.003	37	0.002-0.2
Exposure type												
Eye area	13	5	6	0.02	NR	NR	NR	NR	4	3	4	0.00002-0.5
Possible ingestion	7	0.03-6	25	1-5	NR	NR	NR	NR	1	NR	14	0.1-15
Inhalation	1	NR	2	0.02	NR	NR	NR	NR	NR	NR	2	NR
Dermal contact	60	0.003-6	147	0.0005-5	1	NR	NR	0.001	11	0.003-3	109	0.00002-58
Deodorant (underarm)	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.2
Hair—noncoloring	12	0.05-0.2	12	0.02-0.5	NR	NR	NR	NR	1	0.02	37	0.05-0.1
Hair—coloring	NR	0.05	16	NR	NR	NR	NR	NR	NR	NR	NR	NR
Nail	NR	NR	NR	0.5	NR	NR	NR	NR	NR	NR	4	0.001-3
Mucous membrane	2	0.1	10	0.0005-0.5	1	NR	NR	NR	NR	0.003	4	0.1-0.2
Bath products	NR	NR	1	NR	NR	NR	NR	NR	NR	NR	2	0.2
Baby products	NR	NR	3	NR	NR	NR	NR	NR	NR	NR	3	NR

(continued)

Table 5. (continued)

	No. of uses	Conc. of use (%)	No. of uses	Conc. of use (%)	No. of uses	Conc. of use (%)	No. of uses[42]	Conc. of use (%)	No. of uses[42]	Conc. of use (%)	No. of uses[42]	Conc. of use (%)
	Hydrogenated evening primrose oil		*Olea europaea* (olive) fruit oil		*Olea europaea* (olive) oil unsaponifiables		Hydrogenated olive oil		Hydrogenated olive oil unsaponifiables		Potassium olivate	
Totals	14	NR	915	0.0005-100	77	0.0001-3	50	0.0005-12	2	0.05-5	3	NR
Duration of use												
Leave-on	14	NR	617	0.001-100	68	0.0001-3	36	0.1-12	2	0.05-5	NR	NR
Rinse-off	NR	NR	298	0.0005-94	9	0.04-0.3	14	0.0005-0.1	NR	NR	3	NR
Exposure type												
Eye area	1	NR	26	0.004-17	12	0.02-0.4	13	0.1-3	NR	0.3-2	NR	NR
Possible ingestion	NR	NR	26	0.7-26	1	0.08	7	0.1-12	NR	NR	NR	NR
Inhalation	NR	NR	6	0.2-5	NR	3	NR	NR	NR	NR	NR	NR
Dermal contact	14	NR	711	0.0005-100	67	0.0001-3	34	0.0005-12	2	0.05-5	3	NR
Deodorant (underarm)	NR	NR	3	0.02-0.1	NR	NR	NR	NR	NR	NR	NR	NR
Hair—noncoloring	NR	NR	190	0.006-94	6	0.02-0.3	11	0.01-0.1	NR	NR	NR	NR
Hair—coloring	NR	NR	NR	0.2-0.5	NR	NR	NR	NR	NR	NR	NR	NR
Nail	NR	NR	5	1-40	NR	NR	NR	NR	NR	NR	NR	NR
Mucous membrane	NR	NR	121	0.0005-3	4	NR	1	0.0005	NR	NR	1	NR
Bath products	NR	NR	14	0.9-17	NR	NR	NR	NR	NR	NR	NR	NR
Baby products	NR	NR	9	0.2	NR	0.04	NR	0.4	NR	NR	NR	NR
	Sodium olivate		*Orbignya cohune* seed oil		*Orbignya oleifera* seed oil		Sodium babassuate		*Orbignya speciosa* kernel oil		*Passiflora edulis* seed oil	
Totals	16	4-18	1	NR	161	0.0009-27	NR	8	8	0.5-0.9	62	0.0007-3
Duration of use												
Leave-on	5	NR	NR	NR	118	0.0009-4	NR	NR	1	0.9	53	0.003-5
Rinse-off	11	4-18	1	NR	43	0.01-27	NR	8	7	0.5	9	0.0007-0.005
Exposure type												
Eye area	NR	NR	NR	NR	7	0.5-0.6	NR	NR	NR	NR	3	0.8
Possible ingestion	NR	NR	NR	NR	57	0.001-2	NR	NR	NR	NR	14	0.6-3
Inhalation	NR	NR	NR	NR	5	0.02-2	NR	NR	NR	NR	3	NR
Dermal contact	16	4-18	NR	NR	110	0.0009-27	NR	8	NR	NR	49	0.003-3
Deodorant (underarm)	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.003
Hair—noncoloring	NR	NR	1	NR	43	0.02-2	NR	NR	5	0.5-0.9	10	0.007-0.5
Hair—coloring	NR	NR	NR	NR	8	NR	NR	NR	3	NR	3	NR
Nail	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Mucous membrane	9	4-18	NR	NR	5	27	NR	8	NR	NR	1	NR
Bath products	NR	NR	NR	NR	2	0.01-0.1	NR	NR	NR	NR	NR	0.01-0.05
Baby products	1	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR

(continued)

Table 5. (continued)

	No. of uses	Conc. of use (%)	No. of uses	Conc. of use (%)	No. of uses	Conc. of use (%)	No. of uses[42]	Conc. of use (%)	No. of uses[42]	Conc. of use (%)	No. of uses[42]	Conc. of use (%)
	Perilla ocymoides seed oil		*Persea gratissima* (avocado) oil unsaponifiables		Hydrogenated avocado oil		*Persea gratissima* (avocado) butter		Sodium avocadoate		*Pistacia vera* seed oil	
Totals	7	NR	63	0.2-6	11	0.5	15	NR	1	NR	158	0.003-1
Duration of use												
Leave-on	5	NR	57	0.5-6	9	NR	15	NR	NR	NR	107	0.08-0.2
Rinse-off	2	NR	6	0.2	2	0.5	NR	NR	1	NR	51	0.003-1
Exposure type												
Eye area	2	NR	9	0.5	NR	NR	NR	NR	NR	NR	7	NR
Possible ingestion	NR	NR	2	3	2	NR	11	NR	NR	NR	6	NR
Inhalation	NR	NR	4	NR	NR	NR	NR	NR	NR	NR	NR	NR
Dermal contact	5	NR	56	0.2-3	8	NR	15	NR	1	NR	133	0.003-0.2
Deodorant (underarm)	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Hair—noncoloring	2	NR	2	6	3	0.5	NR	NR	NR	NR	16	0.05-1
Hair—coloring	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Nail	NR	NR	3	NR	NR	NR	NR	NR	NR	NR	NR	NR
Mucous membrane	NR	NR	NR	NR	NR	NR	NR	NR	1	NR	19	NR
Bath products	NR	NR	4	NR	NR	NR	NR	NR	NR	NR	8	NR
Baby products	NR	NR	1	NR	NR	NR	NR	NR	NR	NR	3	NR
	Plukenetia volubilis seed oil		Hydrogenated sweet almond oil		Sodium sweet almondate		*Prunus armeniaca* (apricot) kernel oil		Hydrogenated apricot kernel oil		*Prunus avium* (sweet cherry) seed oil	
Totals	13	0.05-0.6	21	0.5	4	15	588	0.00001-89	2	NR	2	0.01-0.02
Duration of use												
Leave-on	12	0.05-0.6	13	0.5	4	NR	449	0.0001-40	2	NR	NR	NR
Rinse-off	1	NR	8	0.5	NR	15	139	0.00001-89	NR	NR	2	0.01-0.02
Exposure type												
Eye area	1	NR	NR	NR	NR	NR	25	0.002-18	NR	NR	NR	NR
Possible ingestion	3	0.6	1	NR	NR	NR	38	0.001-5	NR	NR	NR	NR
Inhalation	NR	NR	NR	NR	NR	NR	5	0.0009-1	NR	NR	NR	NR
Dermal contact	13	0.6	15	0.5	4	15	486	0.00001-18	2	NR	2	0.01-0.02
Deodorant (underarm)	NR	NR	NR	NR	NR	NR	1	0.003-0.1	NR	NR	NR	NR
Hair—noncoloring	NR	NR	6	0.5	NR	NR	78	0.0001-89	NR	NR	NR	NR
Hair—coloring	NR	NR	NR	NR	NR	NR	10	0.1	NR	NR	NR	NR
Nail	NR	0.05	NR	NR	NR	NR	10	0.002-40	NR	NR	NR	NR
Mucous membrane	NR	NR	1	NR	NR	15	24	0.01-9	NR	NR	2	0.01-0.02
Bath products	NR	NR	1	NR	NR	NR	8	4	NR	NR	NR	NR
Baby products	NR	NR	NR	NR	NR	NR	7	NR	NR	NR	NR	NR

(continued)

Table 5. (continued)

	No. of uses	Conc. of use (%)	No. of uses	Conc. of use (%)	No. of uses	Conc. of use (%)	No. of uses[42]	Conc. of use (%)	No. of uses[42]	Conc. of use (%)	No. of uses[42]	Conc. of use (%)
	Prunus domestica seed oil		*Prunus persica* (peach) kernel oil		*Punica granatum* seed oil		*Pyrus malus* (apple) seed oil		*Ribes nigrum* (black currant) seed oil		*Rosa canina* fruit oil	
Totals	NR	0.04	22	0.003-22	46	0.001-1	8	NR	53	0.000001-0.3	121	0.001-19
Duration of use												
Leave-on	NR	NR	16	0.05-22	44	0.001-1	8	NR	45	0.000001-0.3	106	0.001-19
Rinse-off	NR	0.04	6	0.003-6	2	0.001-0.1	NR	NR	8	0.05	15	0.001-0.5
Exposure type												
Eye area	NR	NR	NR	NR	2	NR	NR	NR	2	0.08	17	0.1-0.5
Possible ingestion	NR	NR	NR	0.04-22	30	1	1	NR	7	0.03-0.1	7	0.001-2
Inhalation	NR	NR	NR	2	NR	NR	NR	NR	NR	NR	1	NR
Dermal contact	NR	0.04	18	0.003-22	46	0.001-1	8	NR	43	0.000001-0.3	109	0.008-19
Deodorant (underarm)	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Hair—noncoloring	NR	NR	4	NR	NR	NR	NR	NR	5	NR	9	0.001-0.5
Hair—coloring	NR	NR	NR	0.1	NR	0.1	NR	NR	NR	NR	NR	NR
Nail	NR	NR	NR	NR	NR	0.001	NR	NR	5	0.2	1	0.1-2
Mucous membrane	NR	NR	1	NR	2	0.001	NR	NR	2	NR	3	0.001
Bath products	NR	NR	1	0.1-1	NR	NR	NR	NR	NR	NR	1	0.5
Baby products	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
	Rubus chamaemorus seed oil		*Rubus idaeus* (raspberry) seed oil		*Schinziophyton rautanenii* kernel oil		*Sclerocarya birrea* seed oil		*Silybum marianum* seed oil		*Solanum lycopersicum* (tomato) fruit oil	
Totals	3	0.1	10	0.1-5	6	NR	29	1	NR	0.5	NR	0.01-1
Duration of use												
Leave-on	*3*	*0.1*	*8*	*0.1-5*	*4*	*NR*	*23*	*1*	*NR*	*0.5*	*NR*	*0.001-1*
Rinse-off	*NR*	*NR*	*2*	*NR*	*2*	*NR*	*6*	*1*	*NR*	*NR*	*NR*	*NR*
Exposure type												
Eye area	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	0.01
Possible ingestion	NR	NR	1	NR	NR	NR	6	NR	NR	NR	NR	0.001
Inhalation	NR	NR	NR	NR	NR	NR	2	NR	NR	NR	NR	NR
Dermal contact	3	0.1	8	0.1-5	3	NR	23	1	NR	0.5	NR	0.001-1
Deodorant (underarm)	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Hair—noncoloring	NR	NR	NR	NR	3	NR	6	1	NR	NR	NR	NR
Hair—coloring	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Nail	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR
Mucous membrane	NR	NR	2	NR	NR	NR	2	NR	NR	NR	NR	NR
Bath products	NR	NR	1	NR	NR	NR	NR	NR	NR	NR	NR	NR
Baby products	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR	NR

(continued)

Table 5. (continued)

	No. of uses	Conc. of use (%)	No. of uses	Conc. of use (%)	No. of uses	Conc. of use (%)	No. of uses[42]	Conc. of use (%)	No. of uses[42]	Conc. of use (%)	No. of uses[42]	Conc. of use (%)
	Solanum lycopersicum (tomato) seed oil		*Theobroma cacao* (cocoa) seed butter		*Theobroma grandiflorum* seed butter		*Triticum vulgare* (wheat) germ oil unsaponifiables		Wheat germ acid		*Vaccinium macrocarpon* (cranberry) seed oil	
Totals	1	NR	442	0.000002-37	153	0.00005-7	17	0.2	16	NR	21	0.002-2
Duration of use												
Leave-on	*1*	*NR*	*367*	*0.000002-37*	*119*	*0.00005-7*	*17*	*0.2*	*3*	*NR*	*18*	*0.002-2*
Rinse-off	*NR*	*NR*	*75*	*0.0001-2*	*34*	*0.001-1*	*NR*	*NR*	*13*	*NR*	*3*	*0.003-0.1*
Exposure type												
Eye area	NR	NR	11	0.0002-9	21	0.1-2	1	NR	NR	NR	2	NR
Possible ingestion	NR	NR	33	37	49	7	NR	NR	NR	NR	NR	0.3
Inhalation	NR	NR	2	0.4	NR	NR	NR	NR	NR	NR	NR	NR
Dermal contact	1	NR	417	0.000002-37	141	0.00005-7	17	0.2	NR	NR	17	0.002-2
Deodorant (underarm)	NR	NR	NR	0.001-1	NR	0.1	NR	NR	NR	NR	NR	NR
Hair—noncoloring	NR	NR	24	0.01-2	9	0.001-1	NR	NR	16	NR	4	0.01-0.1
Hair—coloring	NR	NR	NR	0.1	3	NR	NR	NR	NR	NR	NR	NR
Nail	NR	NR	NR	0.1-1	NR	NR	NR	NR	NR	NR	NR	NR
Mucous membrane	NR	NR	35	0.02-2	19	0.05-0.1	NR	NR	NR	NR	1	0.003-0.1
Bath products	NR	NR	4	0.1-1	4	NR	NR	NR	NR	NR	NR	NR
Baby products	NR	NR	8	0.01	NR	NR	NR	NR	NR	NR	NR	NR
	Vaccinium myrtillus seed oil		*Vaccinium oxycoccos* (cranberry) seed oil[c]		*Vaccinium vitis-idaea* seed oil		Vegetable (olus) oil		Hydrogenated vegetable oil		*Vitis vinifera* (grape) seed oil	
Totals	33	0.01-0.1	4	NS	9	NR	165	0.0005-31	457	0.0004-60	465	0.001-43
Duration of use												
Leave-on	*32*	*0.01-0.12*	*3*	*NS*	*9*	*NR*	*135*	*0.0005-11*	*439*	*0.0005-60*	*368*	*0.001-41*
Rinse-off	*1*	*NR*	*1*	*NS*	*NR*	*NR*	*30*	*0.002-31*	*18*	*0.0004-8*	*97*	*0.001-43*
Exposure type												
Eye area	NR	NR	NR	NS	NR	NR	11	0.01-11	102	0.008-49	14	0.01-5
Possible ingestion	29	0.01	NR	NS	NR	NR	74	0.03-11	216	0.8-60	34	0.03-7
Inhalation	NR	NR	NR	NS	NR	NR	1	0.0005-0.02	1	3	6	0.001-7
Dermal contact	33	0.01-0.1	4	NS	1	NR	143	0.0005-31	450	0.005-60	401	0.001-41
Deodorant (underarm)	NR	NR	NR	NS	NR	NR	NR	–	NR	NR	NR	0.001-0.2
Hair—noncoloring	NR	NR	NR	NS	NR	NR	2	0.02-2	2	0.0005-0.09	46	0.01-0.3
Hair—coloring	NR	NR	NR	NS	NR	NR	18	–	NR	0.0004-1	10	43
Nail	NR	NR	NR	NS	8	NR	1	2	1	0.2	8	0.001-35
Mucous membrane	NR	NR	NR	NS	NR	NR	1	0.03-2	2	2-4	21	0.001-7
Bath products	NR	NR	NR	NS	NR	NR	2	0.002-0.02	NR	0.5	8	0.01-2
Baby products	NR	NR	NR	NS	NR	NR	1	–	NR	NR	5	NR

(continued)

Table 5. (continued)

	No. of uses	Conc. of use (%)	No. of uses	Conc. of use (%)
	Hydrogenated grapeseed oil		Sodium grapeseedate	
Totals	7	0.3-0.5	4	NR
Duration of use				
Leave-on	4	0.3-0.5	4	NR
Rinse-off	3	0.5	NR	NR
Exposure type				
Eye area	NR	NR	NR	NR
Possible ingestion	1	0.5	NR	NR
Inhalation	NR	NR	NR	NR
Dermal contact	5	0.5	NR	NR
Deodorant (underarm)	NR	NR	NR	NR
Hair—noncoloring	1	NR	4	NR
Hair—coloring	NR	NR	NR	NR
Nail	1	0.3	NR	NR
Mucous membrane	1	NR	NR	NR
Bath products	NR	NR	NR	NR
Baby products	NR	NR	NR	NR

Abbreviations: NR, not reported to the Voluntary Cosmetic Registration Program (VCRP) or Personal Care Products Council; NS, not surveyed.
[a]Ingredients not previously reviewed by the Cosmetic Ingredient Review (CIR).
[b]Because each ingredient may be used in cosmetics with multiple exposure types, the sum of all exposure types may not equal the sum of total uses.
[c]Not listed as an International Nomenclature Cosmetic Ingredient (INCI) name; included because of similarity.

Table 6. Current and Historical Frequency and Concentration of Use According to Duration and Type of Exposure—Previously Reviewed Ingredients.[a]

	No. of uses		Conc. of use (%)		No. of uses		Conc. of use (%)		No. of uses		Conc. of use (%)		No. of uses		Conc. of use (%)	
	Arachis hypogaea (peanut) oil				Hydrogenated peanut oil				*Carthamus tinctorius* (safflower) seed oil				*Cocos nucifera* (coconut) oil			
Data year	1998	2010	1984	2010	1998	2010	1998	2010	2002	2010	2003	2010	2007	2010	2008	2010
Totals[b]	22	74	Mostly ≤25; >50 (1 use)	0.0001-30	19	12	[c]	2-5	142	508	0.00005-84	NS	626	798	0.0001-80	NS
Duration of use																
Leave-on	14	59	[c]	0.0001-1	19	12	[c]	2-5	114	402	0.00005-84	NS	243	409	0.005-80	NS
Rinse-off	8	15	[c]	0.0002-30	NR	NR	[c]	NR	28	106	0.001-72	NS	383	389	0.0001-16	NS
Exposure type																NS
Eye area	NR	4	[c]	NR	NR	NR	[c]	NR	5	15	1-6	NS	7	25	0.01-80	NS
Possible ingestion	3	NR	[c]	NR	NR	NR	[c]	2	18	83	0.1-60	NS	19	44	0.2-51	NS
Inhalation	NR	2	[c]	NR	NR	NR	[c]	NR	3	5	5	NS	7	10	0.01-26	NS
Dermal contact	19	53	[c]	0.0001-1	19	12	[c]	2-5	113	395	0.001-72	NS	380	548	0.005-80	NS
Deodorant (underarm)	NR	NR	[c]	NR	NR	NR	[c]	NR	NR	NR	NR	NS	NR	NR	0.1-16	NS
Hair—noncoloring	3	21	[c]	25-30	NR	NR	[c]	NR	28	79	0.00005-27	NS	97	176	0.0001-13	NS
Hair—coloring	NR	NR	[c]	NR	NR	NR	[c]	NR	NR	20	1	NS	145	69	NR	NS
Nail	NR	NR	[c]	NR	NR	NR	[c]	NR	1	32	84	NS	2	5	0.005-2	NS
Mucous membrane	4	2	[c]	NR	NR	NR	[c]	NR	NR	31	NR	NS	12	161	0.0005-16	NS
Bath products	NR	NR	[c]	NR	NR	NR	[c]	NR	NR	3	7	NS	141	15	0.004-23	NS
Baby products	NR	NR	[c]	NR	NR	NR	[c]	NR	NR	6	10	NS	12	15	0.010-0.3	NS
	Hydrogenated coconut oil				Magnesium cocoate				Potassium cocoate				Sodium cocoate			
Data year	2007	2010	2008	2010	2007	2010	2008	2010	2007	2010	2008	2010	2007	2010	2008	2010
Totals[b]	62	105	0.001-50	NS	11	9	NR	NS	24	40	0.003-40	NS	230	340	1-52	NS
Duration of use																
Leave-on	55	79	0.001-50	NS	NR	NR	NR	NS	4	NR	28	NS	12	16	NR	NS
Rinse-off	7	26	0.001-38	NS	11	9	NR	NS	20	40	0.03-40	NS	218	324	1-52	NS
Exposure type																
Eye area	9	7	0.2-22	NS	NR	NR	NR	NS	NR	NR	NR	NS	NR	NR	NR	NS
Possible ingestion	6	10	0.7-29	NS	NR	NR	NR	NS	NR	NR	NR	NS	NR	NR	NR	NS
Inhalation	NR	NR	0.3	NS	NR	NR	NR	NS	NR	NR	NR	NS	1	NR	NR	NS
Dermal contact	3	102	0.001-25	NS	11	9	NR	NS	22	38	0.3-40	NS	175	269	1-52	NS
Deodorant (underarm)	NR	NR	NR	NS	NR	NR	NR	NS	NR	NR	NR	NS	NR	NR	NR	NS
Hair—noncoloring	3	3	0.001-2	NS	NR	NR	NR	NS	2	2	15	NS	55	71	2	NS
Hair—coloring	NR	NR	0.5-0.6	NS	NR	NR	NR	NS	NR	NR	0.003	NS	NR	NR	NR	NS
Nail	NR	NR	0.8-25	NS	NR	NR	NR	NS	NR	NR	NR	NS	NR	NR	NR	NS
Mucous membrane	NR	18	1-17	NS	NR	NR	NR	NS	NR	8	0.3	NS	1	238	1-2	NS
Bath products	1	NR	0.5-39	NS	NR	NR	NR	NS	11	NR	0.3-40	NS	149	3	1-52	NS
Baby products	1	1	2-50	NS	NR	NR	NR	NS	NR	NR	NR	NS	2	5	NR	NS

(continued)

Table 6. (continued)

	No. of uses		Conc. of use (%)		No. of uses		Conc. of use (%)		No. of uses		Conc. of use (%)		No. of uses		Conc. of use (%)	
	Coconut acid				Hydrogenated coconut acid				*Corylus americana* (hazel) seed oil				*Corylus avellana* (hazel) seed oil			
Data year	2007	2010	2008	2010	2007	2010	2008	2010	1998[d]	2010	1998	2010	1998[d]	2010	1997	2010
Totals[b]	142	141	0.03-14	NS	NR	NR	6-10	NS	[d]	10	[c]	NR	85	150	≤100	0.005-98
Duration of use																
Leave-on	18	17	NR	NS	NR	NR	6	NS	[d]	9	[c]	NR	74	131	[c]	0.005-98
Rinse-off	124	124	0.03-14	NS	NR	NR	10	NS	[d]	1	[c]	NR	11	19	[c]	0.005-5
Exposure type				NS				NS								
Eye area	1	1	NR	NS	NR	NR	NR	NS	[d]	NR	[c]	NR	2	9	[c]	0.1
Possible ingestion	NR	NR	NR	NS	NR	NR	NR	NS	[d]	NR	[c]	NR	NR	NR	[c]	14
Inhalation	NR	NR	NR	NS	NR	NR	NR	NS	[d]	NR	[c]	NR	NR	2	[c]	NR
Dermal contact	140	140	0.04-14	NS	NR	NR	6-10	NS	[d]	10	[c]	NR	83	147	[c]	0.005-98
Deodorant (underarm)	NR	NR	NR	NS	NR	NR	NR	NS	[d]	NR	[c]	NR	NR	NR	[c]	NR
Hair—noncoloring	2	1	0.03-0.3	NS	NR	NR	NR	NS	[d]	NR	[c]	NR	1	2	[c]	NR
Hair—coloring	NR	NR	NR	NS	NR	NR	NR	NS	[d]	NR	[c]	NR	NR	NR	[c]	NR
Nail	NR	NR	NR	NS	NR	NR	NR	NS	[d]	NR	[c]	NR	1	1	[c]	NR
Mucous membrane	1	101	0.04-2	NS	NR	NR	NR	NS	[d]	1	[c]	NR	4	1	[c]	NR
Bath products	93	NR	0.04-14	NS	NR	NR	NR	NS	[d]	NR	[c]	NR	2	2	[c]	NR
Baby products	1	1	NR	NS	NR	NR	NR	NS	[d]	NR	[c]	NR	NR	1	[c]	NR
	Elaeis guineensis (palm) oil				*Elaeis guineensis* (palm) kernel oil				Hydrogenated palm kernel oil				Hydrogenated palm oil			
Data year	1997	2010	1997	2010	1997	2010	1997	2010	1997	2010	1997	2010	1997	2010	1997	2010
Totals[b]	36	272	[c]	0.002-48	11	77	[c]	0.05-23	29	47	[c]	0.4-13	13	152	[c]	0.2-30
Duration of use																
Leave-on	28	171	[c]	0.008-13	9	60	[c]	0.8-3	27	45	[c]	0.4-13	13	134	[c]	0.2-30
Rinse-off	8	101	[c]	0.002-48	2	17	[c]	0.05-23	2	2	[c]	0.6-2	NR	18	[c]	2
Exposure type																
Eye area	NR	12	[c]	0.04-2	NR	10	[c]	0.8	5	2	[c]	2-10	1	61	[c]	0.2-30
Possible ingestion	NR	11	[c]	2	NR	6	[c]	NR	2	5	[c]	3-13	3	12	[c]	2-30
Inhalation	1	3	[c]	NR	NR	NR	[c]	NR	NR	1	[c]	NR	NR	NR	[c]	1
Dermal contact	36	229	[c]	0.002-48	11	71	[c]	0.05-2	24	47	[c]	0.4-13	12	123	[c]	0.4-30
Deodorant (underarm)	NR	NR	[c]	NR	NR	NR	[c]	NR	NR	NR	[c]	NR	NR	NR	[c]	NR
Hair—noncoloring	NR	43	[c]	2-34	NR	6	[c]	0.9-23	NR	NR	[c]	NR	NR	NR	[c]	NR
Hair—coloring	NR	NR	[c]	NR	NR	NR	[c]	NR	NR	NR	[c]	NR	NR	NR	[c]	NR
Nail	NR	NR	[c]	NR	NR	NR	[c]	3	NR	NR	[c]	NR	NR	NR	[c]	NR
Mucous membrane	7	68	[c]	0.002-48	NR	10	[c]	0.05	2	2	[c]	0.9-2	NR	17	[c]	2
Bath products	NR	NR	[c]	NR	NR	1	[c]	NR	NR	NR	[c]	NR	NR	NR	[c]	NR
Baby products	1	2	[c]	NR	NR	NR	[c]	NR	NR	NR	[c]	NR	NR	NR	[c]	NR

(continued)

Table 6. (continued)

	No. of uses		Conc. of use (%)		No. of uses		Conc. of use (%)		No. of uses		Conc. of use (%)		No. of uses		Conc. of use (%)	
	Gossypium herbaceum (cotton) seed oil				Hydrogenated cottonseed oil				*Oryza sativa* (rice) bran oil				*Oryza sativa* (rice) germ oil			
Data year	1998	2010	1998	2010	1998	2010	1998	2010	2002	2010	2000-2003	2010	2002	2010	2000-2003	2010
Totals[b]	4	83		0.004-32	272	362	[c]	0.001-24	39	371	0.1-39	0.0003-78	6	34	0.1	0.003-3
Duration of use																
Leave-on	1	68		0.08-32	272	358	[c]	0.001-24	32	267	0.1-8	0.0003-78	5	29	0.1	0.003-3
Rinse-off	3	15	[c]	0.004-29	NR	4	[c]	0.01-0.1	7	104	0.2-39	0.005-6	1	5	NR	0.003-3
Exposure type																
Eye area	NR	4		0.1-11	116	155	[c]	0.5-24	NR	5	0.1-1	0.5-0.8	NR	2	NR	0.01-1
Possible ingestion	NR	9	[c]	0.2-1	151	NR	[c]	8-12	NR	17	0.1-1	0.1-8	NR	4	NR	0.1-3
Inhalation	NR	12	[c]	0.2	NR	NR	[c]	NR	NR	11	NR	0.1	NR	NR	NR	NR
Dermal contact	4	78	[b]	0.004-29	156	356	[c]	0.001-24	36	321	0.1-39	0.0003-27	6	32	0.1	0.003-3
Deodorant (underarm)	NR	1	[c]	0.2	NR	NR	[c]	NR	NR	NR	NR	0.5	NR	NR	NR	0.003
Hair—noncoloring	NR	2	[c]	NR	NR	4	[c]	0.01-0.1	3	42	0.3	0.005-0.5	NR	NR	NR	NR
Hair—coloring	NR	NR	[c]	NR	NR	NR	[c]	NR	NR	NR	NR	0.3	NR	NR	NR	NR
Nail	NR	1	[c]	0.5-32	NR	NR	[c]	NR	2	5	NR	0.02-78	NR	NR	NR	NR
Mucous membrane	NR	7	[c]	0.004-0.01	NR	NR	[c]	NR	NR	48	1	0.0006-6	NR	1	NR	0.003-0.005
Bath products	NR	NR	[c]	NR	NR	NR	[c]	NR	1	17	1-39	0.2	NR	1	NR	0.5
Baby products	NR	NR	[c]	NR	NR	8	[c]	NR	NR	1	NR	NR	NR	NR	NR	NR
	Persea gratissima (avocado) oil				Prunus amygdalus dulcis (sweet almond) oil				*Sesamum indicum* (sesame) seed oil				*Sesamum indicum* (sesame) oil unsaponifiables			
Data year	2001	2010	2001	2010	2002	2010	2002	2010	2009	2010	2008	2010	2009	2010	2008	2010
Totals[b]	188	883	0.001-23	0.0001-98	375	1127	0.004-76	0.0001-77	402	480	0.0001-73	NS	6	17	0.01-0.03	NS
Duration of use																
Leave-on	40	657	0.001-23	0.0005-98	302	791	0.004-76	0.001-77	313	374	0.0001-73	NS	NR	17	0.01-0.03	NS
Rinse-off	148	226	0.1-5	0.0001-15	73	336	0.01-2	0.0001-43	89	106	0.001-68	NS	NR	NR	NR	NS
Exposure type																
Eye area	8	24	0.1-3	0.05-2	6	28	0.4	0.1-22	11	14	0.0008-10	NS	NR	NR	0.01	NS
Possible ingestion	29	60	0.7-21	0.05-26	3	55	0.5	0.1-19	57	52	0.1-16	NS	NR	11	0.03	NS
Inhalation	2	11	0.02-3	0.01-8	3	18	1-3	0.5-39	5	5	2	NS	NR	NR	NR	NS
Dermal contact	165	685	0.001-23	0.0005-98	323	986	0.04-11	0.001-46	346	414	0.0008-73	NS	6	17	0.01-0.03	NS
Deodorant (underarm)	NR	NR	NR	0.1	NR	2	0.004	0.02-1	NR	NR	NR	NS	NR	NR	NR	NS
Hair—noncoloring	11	189	0.002-3	0.0001-41	46	116	0.3-3	0.001-19	50	59	0.0001-30[e]	NS	NR	NR	NR	NS
Hair—coloring	8	NR	NR	0.3	2	2	0.1	0.02	NR	NR	0.03-0.8[f]	NS	NR	NR	NR	NS
Nail	4	7	0.4-19	0.001-34	4	13	1-76	0.001-77	6	7	≤1-10	NS	NR	NR	NR	NS
Mucous membrane	NR	43	0.1-5	0.002-3	19	93	0.5	<0.1-23	4	28	NR	NS	NR	NR	NR	NS
Bath products	5	25	0.1-5	0.6-6	10	41	0.01-0.1	0.1-43	27	5	0.09-68	NS	NR	NR	NR	NS
Baby products	NR	9	NR	NR	7	14	NR	2-3	1	3	6	NS	NR	NR	NR	NS

(continued)

Table 6. (continued)

	No. of uses		Conc. of use (%)		No. of uses		Conc. of use (%)		No. of uses		Conc. of use (%)		No. of uses		Conc. of use (%)	
	Triticum vulgare (wheat) germ oil				*Zea mays* (corn) oil				*Zea mays* (corn) oil unsaponifiables				*Zea mays* (corn) germ oil			
Data year	2001	2010	2001	2010	2007	2010	2006	2010	2007	2010	2006	2010	2007	2010	2006	2010
Totals[b]	303	527	0.00002-18	0.0001-28	498	598	0.00003-14	NS	7	1	NR	NS	37	53	0.2-25	NS
Duration of use																
Leave-on	80	373	0.00002-18	0.0001-28	241	361	0.00003-14	NS	6	1	NR	NS	25	34	3-25	NS
Rinse-off	223	154	0.00002-5	0.001-2	257	237	0.001-0.07	NS	1	NR	NR	NS	12	19	0.2-3	NS
Exposure type																
Eye area	9	12	0.00004-3	0.0001-0.5	39	35	0.0008-0.2	NS	NR	NR	NR	NS	NR	NR	NR	NS
Possible ingestion	33	29	0.1-3	0.3-5	29	30	0.003-10	NS	NR	NR	NR	NS	NR	NR	NR	NS
Inhalation	2	7	0.0002-0.01	0.0001-0.0005	1	1	0.001-0.1	NS	NR	NR	NR	NS	NR	NR	NR	NS
Dermal contact	220	360	0.00002-18	0.0005-23	276	371	0.00003-14	NS	7	1	NR	NS	31	50	3-25	NS
Deodorant (underarm)	NR	NR	0.02	NR	1	4	NR	NS	NR	NR	NR	NS	NR	NR	NR	NS
Hair—noncoloring	63	142	0.0001-2	0.0001-<1	38	40	0.0001-0.02	NS	NR	NR	NR	NS	4	3	0.2	NS
Hair—coloring	12	20	0.1	0.01-0.2	182	183	0.004-0.007	NS	NR	NR	NR	NS	NR	NR	NR	NS
Nail	4	2	0.1-4	0.1-28	1	3	0.001-5	NS	NR	NR	NR	NS	NR	NR	NR	NS
Mucous membrane	3	22	0.02-1	0.01-0.5	2	2	0.004-0.01	NS	NR	NR	NR	NS	4	3	3	NS
Bath products	1	2	0.001-2	0.5	NR	NR	0.001-0.01	NS	NR	NR	NR	NS	3	4	NR	NS
Baby products	1	9	0.5	NR	8	8	0.004	NS	NR	NR	NR	NS	2	4	NR	NS

Abbreviations: NR, not reported to the Voluntary Cosmetic Registration Program (VCRP) or the Council; NS, not surveyed.
[a]Ingredients that were recently reviewed were not resurveyed for concentration of use.
[b]Because each ingredient may be used in cosmetics with multiple exposure types, the sum of all exposure types may not equal the sum of total uses.
[c]Concentration of use data were not given in the original report.
[d]Was not distinguished whether *C americana* or *C avellana* was reported; arbitrarily reported under *C Avellana* (hazel) seed oil for this table.
[e]15% after dilution.
[f]0.4 after dilution.

Table 7. Ingredients With No Reported Use Concentrations or Uses.

Adansonia digitata seed oil
Aleurites moluccanus bakoly seed oil
Amaranthus hypochondriacus seed oil
Arctium lappa seed oil
Babassu acid
Bassia butyracea seed butter
Brassica campestris (rapeseed) oil unsaponifiables
Brassica napus seed oil
Brassica oleracea acephala seed oil
Canarium indicum seed oil
Carya illinoensis (pecan) seed oil
Citrus aurantifolia (lime) seed oil
Citrus aurantifolia (lime) seed oil unsaponifiables
Citrus aurantium dulcis (orange) seed oil
Citrus aurantium dulcis (orange) seed oil insaponifiables
Citrus grandis (grapefruit) seed oil
Citrus grandis (grapefruit) seed oil unsaponifiables
Cocos nucifera (coconut) seed butter
Coix lacryma-jobi (Job's tears) seed oil
Corn acid
Cottonseed acid
Cynara cardunculus seed oil
Elaeis (palm) fruit oil
Elaeis guineensis (palm) butter
Fragaria ananassa (strawberry) seed oil
Fragaria chiloensis (strawberry) seed oil
Fragaria vesca (strawberry) seed oil
Fragaria virginiana (strawberry) seed oil
Guizotia abyssinica seed oil
Hippophae rhamnoides seed oil
Hydrogenated *Adansonia digitata* seed oil
Hydrogenated apricot kernel oil unsaponifiables
Hydrogenated *Argania spinosa* kernel oil
Hydrogenated blackcurrant seed oil
Hydrogenated *Camelina sativa* seed oil
Hydrogenated cranberry seed oil
Hydrogenated grapefruit seed oil
Hydrogenated grapefruit seed oil unsaponifiables
Hydrogenated hazelnut oil
Hydrogenated kukui nut oil
Hydrogenated lime seed oil
Hydrogenated lime seed oil unsaponifiables
Hydrogenated macadamia seed oil
Hydrogenated meadowfoam seed oil
Hydrogenated orange seed oil
Hydrogenated orange seed oil unsaponifiables
Hydrogenated palm acid
Hydrogenated *Passiflora edulis* seed oil
Hydrogenated peach kernel oil
Hydrogenated pistachio seed oil
Hydrogenated pumpkin seed oil
Hydrogenated *Punica granatum* seed oil
Hydrogenated raspberry seed oil
Hydrogenated rice bran oil
Hydrogenated *Rosa canina* fruit oil
Hydrogenated safflower seed oil
Hydrogenated sesame seed oil
Hydrogenated sweet almond oil unsaponifiables
Hydrogenated wheat germ oil
Hydrogenated wheat germ oil unsaponifiables
Lupinus albus oil unsaponifiables
Morinda citrifolia seed oil
Olea europaea (olive) husk oil
Olive acid
Oryza sativa (rice) seed oil
Peanut acid
Potassium babassuate
Potassium cornate
Potassium hydrogenated cocoate
Potassium hydrogenated palmate
Potassium peanutate
Potassium rapeseedate
Potassium safflowerate
Potassium soyate
Prunus amygdalus dulcis (sweet almond) oil unsaponifiables
Prunus armeniaca (apricot) kernel oil unsaponifiables
Rapeseed acid
Ribes rubrum (currant) seed oil
Rice bran acid
Safflower acid
Sesamum indicum (sesame) seed butter
Sodium cocoa butterate
Sodium hydrogenated cocoate
Sodium hydrogenated palmate
Sodium macadamiaseedate
Sodium peanutate
Sodium rapeseedate
Sodium safflowerate
Sodium sesameseedate
Sodium soyate
Sodium *Theobroma grandiflorum* seedate
Soy acid
Sunflower seed acid
Torreya nucifera seed oil
Triticum aestivum (wheat) germ oil
Triticum vulgare (wheat) germ oil unsaponifiables
Vaccinium corymbosum (blueberry) seed oil

Skin papillomas greater than 1 mm in diameter at the application sites were recorded weekly and included in the data analysis if they persisted for more than 2 weeks. The positive control group yielded expected results (86% tumor incidence). No tumors were observed in the vehicle control or the other test groups. The authors concluded that cashew nut kernel oil did not exhibit any solitary carcinogenic activity.

Dermal Irritation and Sensitization Studies

Nonhuman

Dermal irritation and sensitization nonhuman studies, including photosensitization and comedogenicity studies, are summarized in Tables 9 and 10. Undiluted, technical grade, *A hypogaea* (peanut) oil was moderately irritating to rabbits and

Table 8. Examples of Noncosmetic Uses of Oils.

Oil	Use[3,64,105,180,189,198–200]
Aleurites moluccanus seed oil (kukui)	Wood preservative, varnishes, paint oil, illumination, soap making, waterproofing paper, rubber substitute, insulating material
Arachis hypogaea (peanut) oil	Pharmaceutical, soap making, lubricants, emulsions for insect control, diesel engine fuel
Brassica napus seed oil (rapeseed)/canola oil	Rubber additive, lubricants, fat liquoring of leather, varnishes and lacquers, textile chemicals, detergent additives, plasticizers, weed control
Butyrospermum parkii (shea) oil	Illumination
Camelina sativa seed oil (false flax)	Drying oil, manufacturing of varnishes and paints
Citrullus lanatus (watermelon) seed oil	Illumination
Cocos nucifera (coconut) oil	Lubricants, hydraulic fluid, paints, synthetic rubber, plastics, illumination
Elaeis guineensis (palm) oil	Crayon and candle manufacturing, tin plate industry
Elaeis guineensis (palm) kernel oil	Detergent production, pharmaceutical, crayon and candle manufacturing, tin plate industry
Garcinia indica seed butter (kokum)	Candle and soap making, sizing of cotton yarn, pharmaceutical
Guizotia abyssinica seed oil (Niger/Ramtil)	Paint, lubricant, pharmaceutical
Helianthus annuus (sunflower) seed oil	Manufacturing of lacquers, copolymers, polyester films, modified resins, plasticizers, alkyl resins, other similar products
Juglans regia (walnut) seed oil	Paints, soap making
Linum usitatissimum (linseed) seed oil	Manufacturing of linoleum, cloth oil, printing and lithographic inks, core oils, linings, packings, oil-modified alkyd resins, caulking compounds, putties, leather-finishing compounds, lubricants, greases, polishes, pyrotechnic compositions, pigment binder in petrochemicals, concrete protector, stabilizer/plasticizer for vinyl plastics, industrial stains, jute textiles, drying oil in paints and varnishes
Mangifera indica (mango) seed butter	Substitute for cocoa butter
Olea europaea (olive) fruit oil	Textile industry, pharmaceutical
Orbignya cohune seed oil	Manufacturing of soaps, candles, nightlights, cotton dyeing, ointment base, substitute for cocoa butter in food
Perilla ocymoides seed oil (perilla)	Substitute for linseed oil in the manufacture of paints, varnishes, linoleum, oilclothes, and printing inks
Prunus amygdalus dulcis (sweet almond) oil	Pharmaceutical, energy source
Prunus armeniaca (apricot) kernel oil	Pharmaceutical
Theobroma cacao (cocoa) seed butter	Pharmaceutical
Vitis vinifera (grape) seed oil	Substitute for linseed oil in the manufacture of paints, and varnishes

Table 9. Dermal Effects—Nonhuman Studies.

Ingredient	Concentration	Animals	Procedure	Results	Reference
Dermal irritation and sensitization					
Adansonia digitata seed oil					
Adansonia digitata (baobab) oil	100%		MatTek EpiDerm MTT viability assay; 100 μL of test material for 1-24 hours	Classified as nonirritating	[201]
Arachis hypogaea (peanut) oil					
Arachis hypogaea (peanut) oil		Hartley and/or Himalayan guinea pigs	Single drops of a store-bought peanut oil were applied to clipped skin on the backs of 4 guinea pigs. Applications were made at 2- to 6-week intervals, for a total of 7 applications over a 5-month period. It appears that the test sites were not covered. The test sites were scored 24 hours after application. Well-defined erythema was considered a positive reaction	None of the animals had a positive reaction following the initial application. Two animals had positive reactions following application at weeks 6 and 12, while 1 animal had a positive reaction following dosing at week 12 only	[14]

(continued)

Table 9. (continued)

Ingredient	Concentration	Animals	Procedure	Results	Reference
			Butyrospermum parkii (shea) butter		
Butyrospermum parkii (shea) butter	Not specified	3 male New Zealand white (NZW) rabbits	0.5 mL applied to the shaved dorso-lumbar region under an occlusive patch for 4 hours	Very slight erythema with or without edema was observed in 2 rabbits; resolved by day 3 or 4	202
Butyrospermum parkii (shea) butter	Induction: 75%; challenge: 20% and 50%	10 female albino Hartley/Dunkin guinea pigs	Maximization study with Freund's complete adjuvant (FCA) during induction	No evidence of delayed hypersensitivity	203
			Crambe abyssinica seed oil		
Crambe abyssinica seed oil	Undiluted		Dermal irritation study; details not provided	Not a dermal irritant	204
			Hippophae rhamnoides seed oil		
Hippophae rhamnoides seed oil		Albino rabbits, number not specified	0.5 mL applied under an occlusive patch for 4 hours	No irritation	205
			Olea europaea (olive) fruit oil		
Olea europaea (olive) fruit oil		12 Harley and/or Himalayan guinea pigs	Single drops of a USP-grade olive oil that had been stored in its original metal container for 10 years were applied to a clipped area on the backs of 12 guinea pigs. (The composition of the oil was not determined.) Applications were made at 2- to 6-week intervals over a period of 5 months. Four guinea pigs were treated similarly using store-bought virgin olive oil	None of the animals had a positive reaction following the initial application of either oil. With 10-year-old olive oil, 11 of 12 of the animals had a positive reaction at some point. Some, but not all, of these guinea pigs reacted consistently following the first positive reaction; 2 animals had only 1 positive reaction; 2 guinea pigs in this group died by week 16. In the group dosed with virgin olive oil, 1 animal had a positive reaction at week 2 and 1 animal had a positive reaction at weeks 4 and 6	206
		22 guinea pigs sensitive to the 10-year-old USP olive oil	Cross-reactivity to store-bought olive oil, another store-bought olive oil (not specified as virgin olive oil), corn oil, and peanut oil was determined. The 5 oils were applied simultaneously to the backs of the guinea pigs	18 of the animals reacted to the virgin olive oil, and 18 reacted to the other store-bought olive oil. (Overlap of these animals was not complete.) Cross-reactivity to corn or peanut oil was not observed	
		8 sensitized and 4 nonsensitized guinea pigs	Single drops of the unsaponifiable fraction of the 10-year-old oil were applied	All of the sensitized animals reacted to the unsaponifiable fraction, while the nonsensitized animals did not	
			Zea mays (corn) oil		
Corn oil, store-bought		6 Hartley and/or Himalayan guinea pigs	Sensitization study, details not specified	0 of the animals had a positive reaction following the initial application; 2 animals had positive reactions following application at weeks 4 and 6, while 1 animal had a positive reaction following application at week 12	206
			Phototoxicity		
			Butyrospermum parkii (shea) butter		
Butyrospermum parkii (shea) butter	10% and 20% in acetone	10 Pirbright white guinea pigs	Animals were treated with test compound, then irradiated with UV-B light for 80 seconds followed by UV-A light for 80 minutes	Not phototoxic	207

Table 10. Dermal Effects—Nonhuman Studies—Summarized From Previous CIR reports.

Procedure and results	Reference
Dermal irritation and sensitization	
Arachis hypogaea (peanut) oil	
Undiluted technical grade *Arachis hypogaea* (peanut) oil was moderately irritating to rabbits and guinea pig skin and mildly irritating to rat skin following exposure; there was no indication that the test site was occluded. However, in a 48-hour occlusive patch test using miniature swine, technical grade *Arachis hypogaea* (peanut) oil was not irritating	14
Carthamus tinctorius (safflower) oil	
Undiluted *Carthamus tinctorius* (safflower) seed oil was minimally irritating in a repeat open patch test using rabbits and was not a primary irritant or sensitizer in a maximization study using guinea pigs	28
Cocos nucifera (coconut) oil	
Undiluted *Cocos nucifera* (coconut) oil was nonirritating to rabbit skin. In guinea pigs, undiluted *Cocos nucifera* (coconut) oil was not a sensitizer in a Magnusson-Kligman maximization study	29
Hydrogenated coconut oil	
Undiluted hydrogenated coconut oil was nonirritating to rabbit skin. In guinea pigs, undiluted hydrogenated coconut oil was not a sensitizer in a Buehler test	29
Coconut acid	
Undiluted coconut acid was minimally irritating to rabbit skin	29
Sodium cocoate	
In single-insult occlusive patch tests of a 5% aqueous solution of a bar soap containing 13% sodium cocoate, scores of 1.6 to 4.0/8.0 were reported	29
Elaeis guineensis (palm) oil	
Undiluted *Elaeis guineensis* (palm) oil was practically nonirritating to minimally irritating to rabbit skin. *Elaeis guineensis* (palm) oil, 5%, was nonallergenic in a maximization study	23
Gossypium herbaceum (cotton) seed oil	
Cosmetic formulations containing 3.4% to 8.97% hydrogenated cottonseed oil were not irritating to rabbit skin	24
Oryza sativa (rice) bran oil	
Undiluted *Oryza sativa* (rice) bran oil was not irritating to rabbits, and in a guinea pig maximization study, no reactions were observed when 5% was used at induction and 25% and 50% *Oryza sativa* (rice) bran oil were used at challenge. An *Oryza sativa* (rice) bran oil/ *Oryza sativa* (rice) germ oil mixture, concentrations not stated, did not cause a contact allergy response. Undiluted hydrolyzed rice protein was also not irritating or sensitizing	25
Oryza sativa (rice) germ oil	
Oryza sativa (rice) germ oil was not a primary dermal irritant	25
Prunus amygdalus dulcis (sweet almond) oil	
Undiluted prunus amygdalus dulcis (sweet almond) oil and 2 moisturizer formulations, each containing 25% prunus amygdalus dulcis (sweet almond) oil, were tested for skin irritancy in rabbits using occlusive patches. Undiluted prunus amygdalus dulcis (sweet almond) oil was nonirritating (primary irritation index, PII = 0/4). The formulations containing 25% prunus amygdalus dulcis (sweet almond) oil were minimally irritating (PIIs = 0.28 and 0.72, respectively). In a 60-day cumulative irritation test, 10% and 100% prunus amygdalus dulcis (sweet almond) oil was applied to rabbits. When tested in 7 separate trials, 100% prunus amygdalus dulcis (sweet almond) oil produced mean maximum irritation indices (MMIIs) ranging from 0.34 to 1.34 (maximum score = 8). At a concentration of 10%, MMIIs for this ingredient ranged from 0 to 0.66. Results indicated that, when applied to the skin over a long period of time, prunus amygdalus dulcis (sweet almond) oil is slightly irritating; whereas at 10%, it is practically nonirritating A maximization assay was used to determine the sensitizing potential of prunus amygdalus dulcis (sweet almond) oil using guinea pigs. Intradermal induction used concentrations of 5% amygdalus dulcis (sweet almond) oil, the dose-range phase of the experiment used a single dermal application of 5%, 10%, or 100% Prunus amygdalus dulcis (sweet almond) oil, a booster induction injection of 100% Prunus amygdalus dulcis (sweet almond) oil was applied occlusively for 48 hours 1 week later, challenge was with 5% prunus amygdalus dulcis (sweet almond) oil in petrolatum applied topically under occlusion for 24 hours. Prunus amygdalus dulcis (sweet almond) oil was nonsensitizing Undiluted prunus amygdalus dulcis (sweet almond) oil was tested for irritancy in groups of 6 male albino rabbits. The test material was applied under occlusion to the clipped intact and abraded dorsal skin of each animal. Twenty-three hours later, patches were removed; sites were scored at 24 and 48 hours. The primary irritation indices (PIIs) for 7 test samples of prunus amygdalus dulcis (sweet almond) oil ranged from 0 to 0.18 (maximum score = 8), indicating that this ingredient is practically nonirritating to skin	208

(continued)

Table 10. (continued)

Procedure and results	Reference
Dermal irritation and sensitization	
Sesamum indicum (sesame) seed oil	
Undiluted *Sesamum indicum* (sesame) seed oil was nonirritating or minimally irritating to rabbit skin	48
Triticum vulgare (wheat) germ oil	
Triticum vulgare (wheat) germ oil, undiluted and at 2% in formulation, was nonirritating to mildly irritating, and undiluted *Triticum vulgare* (wheat) germ oil was not sensitizing to guinea pigs	26
Phototoxicity	
Elaeis guineensis (palm) oil	
A facial lotion containing 1.5% *Elaeis guineensis* (palm) oil was not phototoxic in the phototoxicity yeast assay	23
Oryza sativa (rice) bran oil	
Oryza sativa (rice) bran oil, tested undiluted during induction at 10% at challenge, was not a photosensitizer in guinea pigs	25
Oryza sativa (rice) germ oil	
Oryza sativa (rice) germ oil, $\leq$75%, was not phototoxic or photosensitizing	25
Comedogenicity	
Corylus avellana (hazel) seed oil	
A comedogenicity study was conducted in which 0.1 mL of *Corylus avellana* (hazel) seed oil (pH 6) was applied to the pinna of the ear of albino rabbits. No local irritation was noted at the application site. A "slight difference in the number and size of the pilosebaceous follicles" was noted via magnifying glass. A "slight excess of sebum and a dilation of the follicles" was noted upon microscopic examination of the treated areas	30

Abbreviation: CIR, Cosmetic Ingredient Review.

guinea pig skin, and 5% aqueous solutions of a bar soap containing 13% sodium cocoate had irritation scores of 1.6 to 4.0 of 8 in animal studies. However, the majority of the remaining animal irritation and/or sensitization studies conducted on a large number of the oils included in this report, primarily in formulation, did not report any significant irritation or sensitization reactions, indicating that refined oils derived from plants are not dermal irritants or sensitizers. None of the tested oils, including *B parkii* (shea) butter (up to 20%) and *Oryza sativa* (rice) germ oil ($\leq$ 75%), were phototoxic in animal studies. The comedogenicity of *C avellana* (hazel) seed oil was evaluated using rabbits, and a slight difference in the number and size of the pilosebaceous follicles and a slight excess of sebum and a dilation of the follicles were observed.

Human

Plant-derived fatty acid oils are commonly believed to be safe for use on the skin.[6] de Groot notes that no documentation exists to show that high-quality edible lipids cause adverse reactions in normal individuals (except for potential comedogenicity).[55] Very few reports of adverse reactions to cosmetic use of edible fatty acid oils have been reported.

Many plant-derived fatty acid oils are derived from foods that are recognized as potent food allergens. The allergic reactions are thought to be caused by the proteins present in the food. It has been shown that an individual who is allergic to a food will generally not react to the refined oil, especially if the oil has been "hot pressed" or has undergone more processing.[12,13] In its safety assessment on *A hypogaea* (peanut) oil, the Panel noted that while peanuts are extremely allergenic to a large population, reaction to the oil is rare. The major concern associated with allergic reactions to peanuts is the protein,[14] which does not partition into the refined oil; therefore, the oil is safe for use in cosmetics. Crevel et al also concluded that chemically refined peanut oil is safe for the majority of peanut allergic individuals.[13] They stated that "as peanut is acknowledged to be one of the most potent food allergens, it is reasonable to extrapolate the conclusions drawn up for peanut oil to other edible oils." However, they concede that validated analytical methodology for establishing the protein content of oil is needed.

In support of the conclusions stated earlier, Crevel et al also examined the allergenicity of some other oils. Very few instances of allergic reactions to other major edible fatty acid oils have been reported. Even sesame oil, which differs from the other oils, is used as a flavorant and, therefore, is not refined, is expected to contain significantly more protein than the other edible fatty acid oils, and has had very few reports of allergic reaction. Additional studies demonstrating safety are summarized later in this section.[15,56]

A large number of clinical irritation and sensitization studies were made available on many of the oils, primarily in formulation, and these studies are summarized in Table 11. All of the data indicated that the oils were not irritants or sensitizers. Summary statements of human dermal studies, including

Table 11. Dermal Effects—Human Studies.

Ingredient and concentration	Participants completed	Method	Results	Reference
Dermal irritation and sensitization				
		Adansonia digitata seed oil		
0.01% *Adansonia digitata* seed oil in a lip product	106	Human repeat insult patch test (HRIPT) with 0.2 g test material, semi-occluded	Not a dermal irritant or sensitizer	209
100% *Adansonia digitata* seed oil	107	HRIPT with 0.02-0.05 ml test material, semi-occluded	Not a dermal irritant or sensitizer	210
		Aleurites moluccana seed oil		
0.005% aleurites moluccana seed oil in scalp conditioner/hair wax	104	HRIPT; occlusive; applied neat	Not a dermal irritant or sensitizer	211
~3% in a skin cleanser	110	Modified HRIPT; semi-occlusive; 10% dilution in distilled water	Not a dermal irritant or sensitizer	212
		Arachis hypogaea (peanut) oil		
Dermatologic product containing 0.01% fluocinolone and refined *Arachis hypogaea* (peanut) oil	Peanut-sensitive participants; 8 children, 6 adults	Skin prick test with peanut extracts, a solution of 50% glycerin (negative control), a solution of 1.8 mg/mL histamine phosphate in 50% glycerin (positive control), the complete test product, vehicle only (without fluocinolone), and refined *Arachis hypogaea* (peanut) oil	1 child had a trace positive reaction	213
		Patch test with product, vehicle only, and refined *Arachis hypogaea* (peanut) oil	No reactions	
		Argania spinosa kernel oil		
5% *Argania spinosa* kernel oil in a face serum	108	Primary cutaneous irritation	No primary irritation	214
5% *Argania spinosa* kernel oil in a face serum	108	HRIPT; occlusive; applied neat	Not an irritant or a sensitizer	214
10% *Argania spinosa* kernel oil in a skin salve	209	HRIPT; occlusive; applied neat	Not a sensitizer	215
10% *Argania spinosa* kernel oil in a skin salve	51	4-week use test; applied to lips, hands/nails, elbows, knees, feet/heels	Did not elicit significant dermal irritation or dryness; 2 participants had level 1(mild, very slight erythema) on the lips, and 5 had level 1 erythema on the elbows, lips, or knees; 15 participants reported subjective irritation	216
		Astrocaryum murumuru		
1% *Astrocaryum murumuru* seed butter in a lipstick	97	HRIPT with 150 mg test material, semi-occluded	Not a dermal irritant or sensitizer	217
4% *Astrocaryum murumuru* seed butter in a lipstick	108	HRIPT, occluded	Not a dermal irritant or sensitizer	218
4% *Astrocaryum murumuru* seed butter in a lipstick	108	HRIPT, occluded	Not a dermal irritant or sensitizer	219
4% *Astrocaryum murumuru* seed butter in a lipstick	108	HRIPT, occluded	Not a dermal irritant or sensitizer	220
4% *Astrocaryum murumuru* seed butter in a lipstick	106	HRIPT, occluded	Not a dermal irritant or sensitizer	221
4% *Astrocaryum murumuru* seed butter in a lipstick	106	HRIPT, occluded	Not a dermal irritant or sensitizer	222
4% *Astrocaryum murumuru* seed butter in a lipstick	108	HRIPT, occluded	Not a dermal irritant or sensitizer	223

(continued)

Table 11. (continued)

Ingredient and concentration	Participants completed	Method	Results	Reference
		Dermal irritation and sensitization		
		Avena sativa (oat) kernel oil		
3% *Avena sativa* (oat) kernel oil in a body and hand formulation	100	HRIPT with 0.2 mL, occluded	Not a dermal irritant or sensitizer	224
		Bassia latifolia seed butter		
2% *Bassia latifolia* seed butter in a body scrub	110	HRIPT with 1% aqueous solution of the formulation, semi-occluded	Not a dermal irritant or sensitizer	225
		Borago officinalis seed oil		
1% *Borago officinalis* seed oil in a body and hand formulation	213	HRIPT with 0.2 g, occluded	Not a dermal irritant or sensitizer	226
2% *Borago officinalis* seed oil in a face serum	108	primary cutaneous irritation	No primary irritation	214
2% *Borago officinalis* seed oil in a face serum	108	HRIPT; occlusive; applied neat	Not an irritant or a sensitizer	214
		Brassica campestris (rapeseed) oil		
5% Hydrogenated rapeseed oil in a baby oil	105	HRIPT with 0.2 mL, semi-occluded	Not a dermal irritant or sensitizer	227
		Brassica oleracea Italica (broccoli) seed oil		
0.5% *Brassica oleracea* Italica (broccoli) seed oil in a hair conditioner	102	HRIPT with 150 μL of test material, 10% dilution, semi-occluded	Not a dermal irritant or sensitizer	228
		Butyrospermum parkii (shea) butter		
Butyrospermum parkii (shea) butter and fractions of unsaponifiable lipids from *Butyrospermum parkii* (shea) butter; the "liquid" sample was obtained from a supplier; the unsaponifiable fraction was obtained through low temperature crystallization of the supplied sample	21	Single applications to normal skin and sodium lauryl sulfate (SLS)-irritated skin; right volar forearm was treated with 50 μL of each test material in 12-mm Finn chambers for 48 hours; the left volar forearm was treated with 50 μL of 14% aqueous SLS for 7 hours, rinsed, dried, and then treated with 50 μL of each test material for 17 hours; cutaneous blood flow (CBF) and transepidermal water loss (TEWL) were measured	Normal skin: barely perceptible erythema observed in a "small" number of participants at 24 hours after treatment with shea butter; no irritation to the shea unsaponifiable fraction; no significant difference in CBF or TEWL SLS-treated skin: 2 participants had a slight- and moderate reaction to the unsaponifiable fraction; no significant difference in CBF or TEWL	229
0.1% *Butyrospermum parkii* (shea) butter in a scalp conditioner	114	Primary cutaneous irritation; formulation diluted to 1%	No primary irritation	230
2% *Butyrospermum parkii* (shea) butter in a cream	119	Primary cutaneous irritation	No primary irritation	231
0.1% *Butyrospermum parkii* (shea) butter in a scalp conditioner	110	HRIPT; occlusive; formulation diluted to 1%	Not a dermal irritant or sensitizer	230
2% *Butyrospermum parkii* (shea) butter in a cream	118 (irritation)/ 116 (sensitization)	HRIPT; occlusive	Not a dermal irritant or sensitizer	231
4% *Butyrospermum parkii* (shea) butter in a face cream	51	HRIPT with 20 μL test material, occluded	Not a dermal irritant or sensitizer	232
4% *Butyrospermum parkii* (shea) butter in an eye cream	108	HRIPT with 20 μL test material, occluded	Not a dermal irritant or sensitizer	233
23.5% *Butyrospermum parkii* (shea) butter in a lip gloss	104	HRIPT	Not a dermal irritant or sensitizer	234

(continued)

Table 11. (continued)

Ingredient and concentration	Participants completed	Method	Results	Reference
		Dermal irritation and sensitization		
23.7% *Butyrospermum parkii* (shea) butter in a lip gloss	104	HRIPT	Irritation on induction days 5 to 9 in 1 participant; no sensitization	235
24.1% *Butyrospermum parkii* (shea) butter in a lip wax	113	HRIPT	Not a dermal irritant or sensitizer	236
24.1% *Butyrospermum parkii* (shea) butter in a lip wax	2 runs	Episkin	Average viability 67.3%—no irritation potential	237
24.7% *Butyrospermum parkii* (shea) butter in a lip gloss	40	28-day use study, 2-6 times/day	1 participant with desquamation	238
45% *Butyrospermum parkii* (shea) butter in a body/hand massage	109[a]	HRIPT	Not a dermal irritant or sensitizer	239
45% *Butyrospermum parkii* (shea) butter in a body/hand massage	109[a]	HRIPT	Not a dermal irritant or sensitizer	240
45% *Butyrospermum parkii* (shea) butter in a body/hand massage	109[a]	HRIPT	Not a dermal irritant or sensitizer	241
45% *Butyrospermum parkii* (shea) butter in a body/hand massage	109[a]	HRIPT	Not a dermal irritant or sensitizer	242
45% *Butyrospermum parkii* (shea) butter in a body/hand massage	31	2-week use study, 2 times per day	No erythema, edema, or dryness	243
60% *Butyrospermum parkii* (shea) butter in a cuticle cream	111	HRIPT	Not a dermal irritant or sensitizer	244
		Camelina sativa seed oil		
0.25% *Camelina sativa* seed oil in a body powder	204	HRIPT with 0.1 g, semi-occluded	Not a dermal sensitizer	245
7% *Camelina sativa* seed oil in an oil treatment	103	HRIPT with 200 μL test material, semi-occluded	Grade 1 (mild erythema) reactions in 4 participants for 1 or 2 patches in the induction phase, grade 1 (mild erythema) in different participants at the 48-hour challenge reading. Study concluded test material was not a dermal irritant or sensitizer	246
		Camellia sinensis seed oil		
0.0985% *Camellia sinensis* seed oil in a lipstick	108	HRIPT with 0.2 g, occluded	Not a dermal irritant or sensitizer	247
0.0985% *Camellia sinensis* seed oil in a lipstick	108	HRIPT with 0.2 g, occluded	Not a dermal irritant or sensitizer	248
		Canola oil		
74.7% canola oil in a body oil	101	HRIPT with 150 μL test material, semi-occluded	Not a dermal irritant or sensitizer	249
		Carthamus tinctorius (safflower) oil		
5% *Carthamus tinctorius* (safflower) seed oil in a cleansing oil rinse-off	214	HRIPT with 0.2 mL of a 10% vol/vol aqueous solution, semi-occluded	3 participants had a "?" reaction following a patch during the induction and 1 participant had definite erythema with no edema or damage to the epidermis (+D) following the seventh patch. No reactions were observed at a new test site. No other reactions were observed. Study concluded test material was not a dermal sensitizer	250

(continued)

Table 11. (continued)

Ingredient and concentration	Participants completed	Method	Results	Reference
		Dermal irritation and sensitization		
30% *Carthamus tinctorius* (safflower) seed oil in a massage oil	107	HRIPT with 0.2 mL test material, semi-occluded	1 participant had slight erythema following the seventh patch that did not reoccur, no other reactions observed. Not a dermal irritant or sensitizer	[251]
		Caryocar brasiliense fruit oil		
0.1% *Caryocar brasiliense* fruit oil in a lipstick	100	HRIPT with 200 mg test material, semi-occluded	Not a dermal irritant or sensitizer	[252]
		Chenopodium quinoa seed oil		
1% *Chenopodium quinoa* seed oil in a UV SPF cream	105	HRIPT with 0.02 mL test material, occluded	"An acceptable level of irritation" was observed in the induction phase consisting of grade 1 (mild erythema) in 39 participants, with 1 additional subject exhibiting a grade 2 (moderate erythema) reaction. No evidence of skin sensitization was observed	[253]
1% *Chenopodium quinoa* seed oil in a UV SPF cream	102	HRIPT with 0.02 mL test material, occluded	"An acceptable level of irritation" was observed in the induction phase, with 54% of the participants exhibiting a grade 1 (mild erythema) reaction and 3% of the participants exhibiting a grade 2 (moderate erythema) reaction. One participant had a strong reaction to the third induction patch and discontinued the induction phase after the sixth application. At challenge, the participant had only papules at 96 hours. Due to reactions to other materials tested at the same time, it could not be determined if the test material was the causative agent. No evidence of skin sensitization was observed in the remaining participants	[254]
		Citrullus lanatus (watermelon) seed oil		
2% *Citrullus lanatus* (watermelon) seed oil in a facial oil	105	HRIPT, semi-occluded	Not a dermal irritant or sensitizer	[255]
		Cocos nucifera (coconut) fruit oil		
0.15% *Cocos nucifera* (coconut) oil in a scalp conditioner/hair wax	104	HRIPT; occlusive; applied neat	Not a dermal irritant or sensitizer	[211]
31% *Cocos nucifera* (coconut) oil in a lip balm	222	HRIPT with 0.2 g test material, occluded	2 participants had low-level, transient (±) reactions during the induction, no other reactions were observed. Study concluded that test material was not a dermal sensitizer	[256]
		Corylus avellana (hazel seed) oil		
1% *Corylus avellana* (hazel) seed oil in a moisturizing cream	25	Amended Draize patch test, 10% standard concentration	Nonirritating	[257]
1% *Corylus avellana* (hazel) seed oil in a moisturizing cream	32	60 day clinical study	"Fairly good acceptability"	[258]

(continued)

Table 11. (continued)

Ingredient and concentration	Participants completed	Method	Results	Reference
		Dermal irritation and sensitization		
5% *Corylus avellana* (hazel) seed oil in a massage oil	107	HRIPT with 0.2 mL test material, semi-occluded	1 participant had slight erythema following the seventh patch that did not reoccur, no other reactions observed. Not a dermal irritant or sensitizer	251
		Crambe abyssinica seed oil		
5% *Crambe abyssinica* seed oil in a face and neck product	54	HRIPT; semi-occluded, undiluted	Not a dermal irritant or sensitizer	259
100% *Crambe abyssinica* seed oil in an unspecified product	107	HRIPT; undiluted	Not a dermal irritant or sensitizer	204
		Elaeis guineensis (palm) oil		
15.7% sodum palm kernelate in a soap	42	28-day use test	Good acceptability for use	260
61.6% sodium palmate in a soap	42	28-day use test	Good acceptability for use	260
		Euterpe oleracea fruit oil		
0.5% *Euterpe oleracea* fruit oil in an eye treatment	104	HRIPT with 150 μL test material, semi-occluded	Not a dermal irritant or sensitizer	261
		Glycine soja (soybean) oil		
0.19% *Glycine soja* (soybean) unsaponifiables in a face and neck product	50	HRIPT, occluded	Not a dermal irritant or sensitizer	262
39% Hydrogenated soybean oil in a lipstick	108	HRIPT, occluded	Not a dermal irritant or sensitizer	263
		Garcinia indica seed butter		
0.3869% *Garcinia indica* seed butter in a body and hand product	101	HRIPT, 0.2 g applied, occlusive	Not a sensitizer; irritation was observed in 1 subject	264
		Gossypium herbaceum (cotton) seed oil		
3.6% Hydrogenated cottonseed oil in a lip balm	222	HRIPT with 0.2 g test material, occluded	2 participants had low-level, transient (±) reactions during the induction, no other reactions were observed. Study concluded that test material was not a dermal sensitizer	256
		Helianthus annuus (sunflower) seed oil		
6% *Helianthus annuus* (sunflower) seed oil in a skin cream	108	Primary cutaneous irritation	No primary irritation	265
20% *Helianthus annuus* (sunflower) seed oil in a face serum	108	Primary cutaneous irritation	No primary irritation	214
0.264% *Helianthus annuus* (sunflower) seed oil in a cream	57	HRIPT; Finn chambers, applied neat	Not a dermal irritant or sensitizer	266
6% *Helianthus annuus* (sunflower) seed oil in a skin cream	106	HRIPT, occlusive	Not a dermal irritant or sensitizer	265
20% *Helianthus annuus* (sunflower) seed oil in a face serum	108	HRIPT; occlusive; applied neat	Not an irritant or a sensitizer	214
1% *Helianthus annuus* (sunflower) seed oil in a soap	42	28-day use test	Good acceptability for use	260
39.8% *Helianthus annuus* (sunflower) seed oil in a massage oil	107	HRIPT with 0.2 mL test material, semi-occluded	1 participant had slight erythema following the seventh patch that did not reoccur, no other reactions observed. Not a dermal irritant or sensitizer	251

(continued)

Table 11. (continued)

Ingredient and concentration	Participants completed	Method	Results	Reference
Dermal irritation and sensitization				
Helianthus annuus (sunflower) seed oil unsaponifiables				
2% *Helianthus annuus* (sunflower) seed oil unsaponifiables in a night product	100	HRIPT, semi-occluded	Not a dermal irritant or sensitizer	[262]
2% *Helianthus annuus* (sunflower) seed oil unsaponifiables in a face and neck product	100	HRIPT, semi-occluded	Not a dermal irritant or sensitizer	[262]
Hippophae rhamnoides seed oil				
5% *Hippophae rhamnoides* seed oil	10	Cutaneous local tolerance test, 0.02 mL single 48 hours occlusive application	Not an irritant; average irritation score of 0	[267]
Irvingia gabonensis kernel butter				
0.31% *Irvingia gabonensis* kernel butter in a face and neck product	52	HRIPT, occluded	Not a dermal irritant or sensitizer	[262]
Limnanthes alba (meadowfoam) seed oil				
71.3% *Limnanthes alba* (meadowfoam) seed oil in a facial repair product	109	HRIPT, semi-occluded	7 participants had $\pm$ on the first day of the induction only, no other reactions. Not a dermal irritant or sensitizer	[268]
Linum usitatissimum (linseed) seed oil				
9.4% *Linum usitatissimum* (linseed) seed oil in mascara	105	HRIPT with 0.2 g test material, semi-occluded	Not a dermal irritant or sensitizer	[269]
Luffa cylindrica seed oil				
0.01% *Luffa cylindrica* seed oil in a body wash	102	HRIPT; 0.2 mL of a 1% dilution using distilled water was applied to a $1'' \times 1''$ pad applied with a semi-occlusive patch	Not a dermal irritant or sensitizer	[270]
Macadamia ternifolia seed oil				
0.5% *Macadamia ternifolia* seed oil in a cleansing oil rinse-off	214	HRIPT with 0.2 mL of a 10% vol/vol aqueous solution, semi-occluded	3 participants had a "?" reaction following a patch during the induction and 1 participant had definite erythema with no edema or damage to the epidermis (+D) following the seventh patch. No reactions were observed at a new test site. No other reactions were observed. Study concluded test material was not a dermal sensitizer	[250]
30% *Macadamia ternifolia* seed oil in a body and hand product	55	HRIPT; semi-occluded, undiluted	Not a dermal irritant or sensitizer	[259]
Mangifera indica (mango) seed oil				
2% *Mangifera indica* (mango) seed oil in a lipstick	100	HRIPT with 150 μL test material, semi-occluded	Not a dermal irritant or sensitizer	[271]
3.87% *Mangifera indica* (mango) seed oil in an eyeliner	102	HRIPT with 0.2 g of test material, semi-occluded	Not a dermal irritant or sensitizer	[272]
Mangifera indica (mango) seed butter				
1% *Mangifera indica* (mango) seed butter in a facial lotion	100	HRIPT with 200 μL test material, semi-occluded	Not a dermal irritant or sensitizer	[273]
9% *Mangifera indica* (mango) seed butter in a body product	102	HRIPT with 0.2 g, semi-occluded	Not a sensitizer	[274]

(continued)

Table 11. (continued)

Ingredient and concentration	Participants completed	Method	Results	Reference
Dermal irritation and sensitization				
		Moringa oleifera seed oil		
0.01% *Moringa oleifera* seed oil in a cleansing oil rinse-off	214	HRIPT with 0.2 mL of a 10% vol/vol aqueous solution, semi-occluded	3 participants had a "?" reaction following a patch during the induction and 1 participant had definite erythema with no edema or damage to the epidermis (+D) following the seventh patch. No reactions were observed at a new test site. No other reactions were observed. Study concluded test material was not a dermal sensitizer	250
		Moringa pterygosperma seed oil		
3% *Moringa pterygosperma* seed oil in an eye treatment	104	HRIPT with 150 μL test material, semi-occluded	Not a dermal irritant or sensitizer	275
		Oenothera biennis (evening primrose) oil		
1.99% *Oenothera biennis* (evening primrose) oil in a foundation	600	HRIPT, occluded	Not a dermal irritant or sensitizer	276
		Olea europaea (olive) fruit oil		
0.7% *Olea europaea* (olive) fruit oil in a scalp conditioner	114	Primary cutaneous irritation; formulation diluted to 1%	No primary irritation	230
0.1595% *Olea europaea* (olive) fruit oil in a scalp conditioner/hair wax	104	HRIPT; occlusive; applied neat	Not a dermal irritant or sensitizer	211
0.7% *Olea europaea* (olive) fruit oil in a scalp conditioner	110	HRIPT; occlusive; formulation diluted to 1%	Not a dermal irritant or sensitizer	230
1.6% *Olea europaea* (olive) fruit oil in a body lotion	110	HRIPT with 0.02 mL test material, occluded	1 participant had slight erythema following the seventh patch that did not reoccur, no other reactions observed. Not a dermal irritant or sensitizer	277
10% *Olea europaea* (olive) fruit oil in a skin salve	209	HRIPT; occlusive applied neat	Not a sensitizer	215
22% *Olea europaea* (olive) fruit oil in a body moisturizer	105	HRIPT, semi-occluded	Not a dermal irritant or sensitizer	278
58.7% *Olea europaea* (olive) fruit oil in a conditioning hair oil	102	HRIPT with 0.2 mL, semi-occluded	Not a dermal irritant or sensitizer	279
69.6% *Olea europaea* (olive) fruit oil in a foundation	209	HRIPT with 200 μL test material, occluded	Not a dermal irritant or sensitizer	280
10% *Olea europaea* (olive) oil in a skin salve	51	4-week use test; applied to lips, hands/nails, elbows, knees, feet/heels	Did not elicit significant dermal irritation or dryness; 2 participants had level 1 (mild, very slight erythema on the lips) and 5 had level 1 erythema on the elbows, lips, or knees; 15 participants reported subjective irritation	216
		Olea europaea (olive) oil unsaponfiables		
2.5% *Olea europaea* (olive) oil unsaponfiables in a bath body mist	107	HRIPT with 150 μL test material, semi-occluded	Not a dermal irritant or sensitizer	281
		Hydrogenated olive oil		
12% hydrogenated olive oil in a lipstick	108	HRIPT, occluded	Not a dermal irritant or sensitizer	263

(continued)

Table 11. (continued)

Ingredient and concentration	Participants completed	Method	Results	Reference
Dermal irritation and sensitization				
		Hydrogenated olive oil unsaponifiables		
2% Hydrogenated olive oil unsaponifiables in a face and neck product	50	HRIPT, occluded	Not a dermal irritant or sensitizer	262
5% hydrogenated olive oil unsaponifiables in a skin cleansing product	57	HRIPT, semi-occluded, 10% dilution of product	Not a dermal irritant or sensitizer	262
		Sodium olivate		
17.64% sodium olivate in a body bar soap	107	HRIPT, semi-occluded	Not a dermal irritant or sensitizer	282
		Orbignya oleifera seed oil		
3.79% *Orbignya oleifera* seed oil in a cream cleanser	104	HRIPT with 0.2 mL of a 10% dilution of formulation, semi-occluded	Not a dermal irritant or sensitizer	283
		Orbignya speciosa kernel oil		
0.4125% *Orbignya speciosa* kernel oil in a hair conditioner	104	Modified HRIPT; semi-occlusive; 10% dilution in distilled water	Not a dermal irritant or sensitizer	284
		Persea gratissima (avocado) oil		
0.2% *Persea gratissima* (avocado) oil in a scalp conditioner	114	Primary cutaneous irritation; formulation diluted to 1%	No primary irritation	230
0.2% *Persea gratissima* (avocado) oil in a scalp conditioner	110	HRIPT; occlusive; formulation diluted to 1%	Not a dermal irritant or sensitizer	230
10% *Persea gratissima* (avocado) oil in a skin salve	51	4-week use test; applied to lips, hands/nails, elbows, knees, feet/heels	Did not elicit significant dermal irritation or dryness; 2 participants had level 1(mild, very slight erythema on the lips) and 5 had level 1 erythema on the elbows, lips, or knees; 15 participants reported subjective irritation	216
		Plukenetia volubilis seed oil		
0.51% *Plukenetia volubilis* seed oil in a lipstick	0.51% *Plukenetia volubilis* seed oil in a lipstick	0.51% *Plukenetia volubilis* seed oil in a lipstick	0.51% *Plukenetia volubilis* seed oil in a lipstick	0.51% *Plukenetia volubilis* seed oil in a lipstick
		Prunus amygdalus dulcis (sweet almond) oil		
7% *Prunus amygdalus dulcis* (sweet almond) oil in an oil treatment	103	HRIPT with 200 μL test material, semi-occluded	Grade 1 (mild erythema) reactions in 4 participants for 1 or 2 patches in the induction phase, grade 1 (mild erythema) in different participants at the 48-hour challenge reading. Study concluded test material was not a dermal irritant or sensitizer	246
10% *Prunus amygdalus dulcis* (sweet almond) oil in a face serum	108	Primary cutaneous irritation	No primary irritation	214
10% *Prunus amygdalus dulcis* (sweet almond) oil in a face serum	108	HRIPT; occlusive; applied neat	Not an irritant or a sensitizer	214
10% *Prunus amygdalus dulcis* (sweet almond) oil in a skin salve	209	HRIPT; occlusive applied neat	Not a sensitizer	215

(continued)

Table 11. (continued)

Ingredient and concentration	Participants completed	Method	Results	Reference
		Dermal irritation and sensitization		
10% *Prunus amygdalus dulcis* (sweet almond) oil in a skin salve	51	4-week use test; applied to lips, hands/nails, elbows, knees, feet/heels	Did not elicit significant dermal irritation or dryness; 2 participants had level 1 (mild, very slight erythema on the lips) and 5 had level 1 erythema on the elbows, lips, or knees; 15 participants reported subjective irritation	216
15% *Prunus amygdalus dulcis* (sweet almond) oil in a massage oil	107	HRIPT with 0.2 mL test material, semi-occluded	1 participant had slight erythema following the seventh patch that did not reoccur, no other reactions observed. Not a dermal irritant or sensitizer	251
25% *Prunus amygdalus dulcis* (sweet almond) oil in a lip balm	222	HRIPT with 0.2 g test material, occluded	2 participants had low-level, transient (±) reactions during the induction, no other reactions were observed. Study concluded that test material was not a dermal sensitizer	256
~31% *Prunus amygdalus dulcis* (sweet almond) oil in a facial oil	108	Modified HRIPT; semi-occlusive; applied neat	Not a dermal irritant or sensitizer	285
45.25% *Prunus amygdalus dulcis* (sweet almond) oil in a facial oil	109	HRIPT; semi-occlusive; applied neat	Not a dermal irritant or sensitizer	286
46% *Prunus amygdalus dulcis* (Sweet Almond) Oil in a cuticle softener	106	Modified Draize assay with an induction phase (3×/week for 10 applications) and a challenge phase, applied neat, occlusive	Not a dermal irritant or sensitizer	287
		Prunus armeniaca (apricot) kernel oil		
2% *Prunus armeniaca* (apricot) kernel oil in a face cream	51	HRIPT with 20 μL test material, occluded	Not a dermal irritant or sensitizer	232
2% *Prunus armeniaca* (apricot) kernel oil in an eye cream	108	HRIPT with 20 μL test material, occluded	Not a dermal irritant or sensitizer	233
2.5% *Prunus armeniaca* (apricot) kernel oil in a cream	119	Primary cutaneous irritation	No primary irritation	231
19.749% *Prunus armeniaca* (apricot) kernel oil in a face serum	108	Primary cutaneous irritation	No primary irritation	214
0.005% *Prunus armeniaca* (apricot) kernel oil in a scalp conditioner/hair wax	104	HRIPT; occlusive; applied neat	Not a dermal irritant or sensitizer	211
1% *Prunus armeniaca* (apricot) kernel oil in a cream	57	HRIPT; Finn chambers, applied neat	Not a dermal irritant or sensitizer	266
2.5% *Prunus armeniaca* (apricot) kernel oil in a cream	118 (irritation)/ 116 (sensitization)	HRIPT; occlusive	Not a dermal irritant or a sensitizer	231
19.749% *Prunus armeniaca* (apricot) kernel oil in a face serum	108	HRIPT; occlusive; applied neat	Not an irritant or a sensitizer	214
		Prunus domestica seed oil		
0.04% *Prunus domestica* seed oil in a preshave lotion	105	HRIPT with 0.2 mL, occluded	Not a sensitizer	288

(continued)

Table 11. (continued)

Ingredient and concentration	Participants completed	Method	Results	Reference
		Dermal irritation and sensitization		
		Prunus persica (peach) kernel oil		
24% *Prunus persica* (peach) kernel oil in a lip balm	222	HRIPT with 0.2 g test material, occluded	2 participants had low-level, transient (±) reactions during the induction, no other reactions were observed. Study concluded that test material was not a dermal sensitizer	256
		Ribes nigrum (blackcurrant) seed oil		
0.1% *Ribes nigrum* (blackcurrant) oil in a scalp conditioner	114	Primary cutaneous irritation; diluted to 1%	No primary irritation	230
0.25% *Ribes nigrum* (blackcurrant) oil in a cream	119	Primary cutaneous irritation	No primary irritation	231
0.1% *Ribes nigrum* (blackcurrant) Oil in a scalp conditioner	110	HRIPT; occlusive; diluted to 1%	Not a dermal irritant or sensitizer	230
0.2% *Ribes nigrum* (blackcurrant) seed oil is an eye mask	228	HRIPT, occluded	4 participants had "?" or "+" reaction during induction that were not considered clinically relevant, no other reactions observed. Not sensitizing	289
0.2% *Ribes nigrum* (blackcurrant) oil in a skin cream	106	HRIPT, occlusive	Not a dermal irritant or sensitizer	265
0.25% *Ribes nigrum* (blackcurrant) oil in a cream	118 (irritation)/ 116 (sensitization)	HRIPT; occlusive	Not a dermal irritant or a sensitizer	231
0.2% *Ribes nigrum* (blackcurrant) seed oil is an eye mask	195	4-week safety in-use study	No adverse reactions reported. Product considered suitable for sensitive skin	290
		Rosa canina fruit oil		
0.39% *Rosa canina* fruit oil in a skin cream	108	Primary cutaneous irritation	No primary irritation	265
0.39% *Rosa canina* fruit oil in a skin cream	106	HRIPT, occlusive	Not a dermal irritant or sensitizer	265
		Rubus chamaemorus seed oil		
2.5% *Rubus chamaemorus* seed oil in product	10	Single occlusive patch test for 48 hours with 25 μL	Not an irritant	291
		Rubus idaeus (raspberry) seed oil		
5% *Rubus idaeus* (raspberry) seed oil in a face and neck product	102	HRIPT, occluded	Not a dermal irritant or sensitizer	262
		Sesamum indicum (sesame) seed oil		
25% *Sesamum indicum* (sesame) seed oil in a face serum	108	Primary cutaneous irritation	No primary irritation	214
8% *Sesamum indicum* (sesame) seed oil in a skin salve	209	HRIPT; occlusive applied neat	Not a sensitizer	215
25% *Sesamum indicum* (sesame) seed oil in a face serum	108	HRIPT; occlusive; applied neat	Not an irritant or a sensitizer	214

(continued)

Table 11. (continued)

Ingredient and concentration	Participants completed	Method	Results	Reference
		Dermal irritation and sensitization		
8% *Sesamum indicum* (Sesame) seed oil in a skin salve	51	4-week use test; applied to lips, hands/nails, elbows, knees, feet/heels	Did not elicit significant dermal irritation or dryness; 2 participants had level 1 (mild, very slight erythema on the lips), and 5 had level 1 erythema on the elbows, lips, or knees; 15 participants reported subjective irritation	216
		Solanum lycopersicum (tomato) seed oil		
0.0023% *Solanum lycopersicum* (tomato) seed oil in a cream cleanser	104	HRIPT with 0.2 mL of a 10% dilution of the formulation, semi-occluded	Not a dermal irritant or sensitizer	292
		Theobroma cacao (cocoa) seed butter		
50.1% *Theobroma cacao* (cocoa) seed butter in a lip balm	106	HRIPT with 150 μL test material, semi-occluded	Not a dermal irritant or sensitizer	293
		Theobroma grandiflorum seed butter[294]		
5% *Theobroma grandiflorum* seed butter in a lip balm	106	HRIPT with 150 μL test material, semi-occluded	Not a dermal irritant or sensitizer	295
		Triticum vulgare (wheat) germ oil		
0.005% *Triticum vulgare* (wheat) germ oil in a scalp conditioner/hair wax	104	HRIPT; occlusive; applied neat	Not a dermal irritant or sensitizer	211
		Vaccinium macrocarpon (cranberry) seed oil		
0.04% *Vaccinium macrocarpon* (cranberry) seed oil in a face and neck product	53	HRIPT, occluded	Not a dermal irritant or sensitizer	262
		Vaccinium myrtillus seed oil		
~1% *Vaccinium myrtillus* seed oil in a facial oil	116	Modified HRIPT; semi-occlusive; volatilized	Not a dermal irritant or sensitizer	294
		Vaccinium vitis-idaea seed oil		
5% *Vaccinium vitis-idaea* seed oil in product	10	Single occlusive patch test of 48 hours with 0.02 mL	Not an irritant	296
		Vegetable oil		
4% vegetable oil in a foundation	115	HRIPT, semi-occluded	1 participant had ± on the first day of the induction only, no other reactions. Not a dermal irritant or sensitizer	297
4% vegetable oil in a lipstick	106	HRIPT with 0.2 g, occluded	Not a dermal irritant or sensitizer	298
11% vegetable oil in an eye shadow	106	HRIPT, semi-occluded	Not a dermal irritant or sensitizer	299
		Vitis vinifera (grape) seed oil		
39% *Vitis vinifera* (Grape) seed oil in a preshave lotion	105	HRIPT with 0.2 mL, occluded	Not a sensitizer	288
90% *Vitis vinifera* (grape) seed oil in a fragranced oil	105	HRIPT; semi-occluded; applied neat	Not a dermal irritant or sensitizer	300
0.5% Hydrogenated grapeseed oil in a lip product	53	HRIPT; semi-occluded	Not a dermal irritant or sensitizer	301

(continued)

Table 11. (continued)

Ingredient and concentration	Participants completed	Method	Results	Reference
Dermal irritation and sensitization				
		Zea mays (corn) germ oil		
20% *Zea mays* (Corn) germ oil in a cleansing oil rinse-off	214	HRIPT with 0.2 mL of a 10% vol/vol aqueous solution, semi-occluded	3 participants had a "?" reaction following a patch during the induction and 1 participant had definite erythema with no edema or damage to the epidermis (+D) following the seventh patch. No reactions were observed at a new test site. No other reactions were observed. Study concluded test material was not a dermal sensitizer.	250
Comedogenicity				
		Ribes nigrum (blackcurrant) seed oil		
0.2% *Ribes nigrum* (blackcurrant) seed oil in an eye mask formulation	6	Applied undiluted; occlusive	Average score of 0.00 comedones/cm^2; noncomedogenic	302

Abbreviations: HRIPT, human repeat insult patch test; SPF, sun protection factor; UV ultraviolet light. [a]The same 109 panelists tested these 4 formulations that differed only in color and fragrance.

phototoxicity/photosensitization data, from previous CIR reports on oils are provided in Table 12.

Ocular Irritation Studies

Nonhuman

Ocular irritation studies were performed using animals and alternative assays on a number of plant-derived fatty acid oils. Although the majority of the oils were nonirritating to mildly irritating, a few studies indicated some significant irritation. For example, a lotion containing 1.5% *E guineensis* (palm) oil was moderately irritating to rabbit eyes, and a mascara containing 9.4% *Linum usitatissimum* (linseed) seed oil was predicted to be moderately irritating in an alternative assay. Available ocular irritation studies are summarized in Table 13. Summary statements of ocular irritation studies from previous CIR reports on oils are provided in Table 14.

Human

In clinical ocular irritation studies, formulations containing 9.4% *L usitatissimum* (linseed) oil and 0.2% *Ribes nigrum* (blackcurrant) seed oil did not produce adverse reactions and were considered safe for contact lens wearers. These studies are also summarized in Table 13.

Clinical Studies

Clinical Trials/Case Studies

Plant-derived fatty acid oils have been used as vehicles for delivery of therapeutic agents or used alone in treating skin disorders. Adverse reactions to the oils were notably absent in such clinical tests. Case studies have reported isolated allergic reactions. The available data are summarized in Table 15.

Summary

The report addresses the safety of plant-derived fatty acid oils. These oils, which are derived from vegetable and fruit plants, are composed of monoglycerides, diglycerides, and primarily triglycerides, free fatty acids, and other minor components, including natural antioxidants and fat-soluble vitamins. The percentage of chemical constituents and nutritional content of individual oil types is dependent on region where the oil plant is grown, individual cultivars, and plant genetics. Oils used in cosmetics are likely produced in the same manner as those used in the food industry. Oils may be expressed through mechanical or solvent extraction. The oils may undergo further refining, such as neutralizing, bleaching, and deodorizing, to remove pigments, odors, unsaponifiable materials, and other undesirables.

So that all plant-derived fatty acid oils that are cosmetic ingredients are included in 1 report, several ingredients that have been reviewed previously by the Panel are included in this report. The ingredients, their conclusions, and citations are found in Table 2. Some study results utilized in those previous safety assessments were also utilized in this safety assessment and cited below where appropriate.

Individuals who have food allergies to a plant protein rarely exhibit allergic reactions when exposed to refined oils of the same plant. Data evaluation by the Panel regarding the method of manufacture indicates that protein constituents do not partition into the refined oils. The Panel has also found a general lack of clinical effects for fatty acid oils that they have already reviewed; however, other researchers have raised concerns about the presence of residual proteins in oils, such as peanut and soy.

Table 12. Dermal Effects—Human Studies—Summarized From Previous CIR Reports.

Procedure and results	Reference
Dermal irritation and sensitization	
Carthamus tinctorius (safflower) oil	
Cosmetic formulations containing 3% to 5% *Carthamus tinctorius* (safflower) seed oil were not irritating to humans in occlusive patch tests and were not primary irritants or sensitizers in repeated insult patch tests.	28
Cocos nucifera (coconut) fruit oil	
An HRIPT was performed using 103 participants with a tanning butter containing 2.5% *Cocos nucifera* (coconut) oil; no erythematous reactions were seen at challenge; A bar soap containing 13% *Cocos nucifera* (coconut) oil produced very mild irritation when tested as a 1% aqueous solution on 106 participants, and it was minimally to mildly irritating in a soap chamber test with a 8% aqueous solution; the soap produced no unusual irritation response in a 2-week normal use test; undiluted *Cocos nucifera* (coconut) oil was not an allergen in 12 participants.	29
Hydrogenated coconut oil	
Four lipstick formulations containing 10% hydrogenated coconut oil were tested with a single 48-hour application on 204 females; there was no evidence of primary irritation and no indication of sensitization on retests performed 14 days later.	29
Potassium cocoate	
In a test using 40 healthy participants and 480 patients with active skin disease, 5% aqueous potassium cocoate produced 5 positive responses.	29
Corylus avellana (hazel seed) oil	
A patch testing reference book by de Groot noted that the published literature does not contain recommended test concentrations concerning hazel seed oil. To serve as a guide to the reader, de Groot reported that an unpublished (and at the time, ongoing) study found no irritant reaction in 1 to 20 patients having or suspected to have cosmetic product contact allergy who had been patch tested with 30% hazel seed oil in petrolatum.	30
Elaeis guineensis (palm) oil	
Elaeis guineensis (palm) oil, 15% in petrolatum or cosmetic formulations containing 1.0% to 2.0%, was not an irritant or sensitizer in clinical studies. Bar soap flakes, tested at dilutions that contained $\leq$2.13% palm kernel oil, were not irritating or sensitizing.	23
Gossypium herbaceum (cotton) seed oil	
Patients who were hypersensitive to cottonseed proteins were not sensitive to cottonseed oil in a skin prick test	24
Hydrogenated cottonseed oil	
In a clinical patch test, the irritation potential of a cosmetic formulation containing 3.4% hydrogenated cottonseed oil was mildly low, and the severity of reaction to 10.4% hydrogenated cottonseed oil was acceptably low in a use study. Cosmetic formulations containing 10.6% to 20.86% hydrogenated cottonseed oil were not irritating or sensitizing.	24
Oryza sativa (rice) bran oil	
Rice is generally regarded as hypoallergenic, although some case studies of allergic reactions to raw rice have been reported. In clinical testing, formulations containing 1.04% to 8.0% *Oryza sativa* (rice) bran oil were not irritating or sensitizing. Hydrolyzed rice protein was not irritating to human participants.	25
Persea gratissima (avocado) oil	
Persea gratissima (avocado) oil was not an irritant or sensitizer when human participants were patch tested with cosmetic formulations containing up to 10.7% *Persea gratissima* (avocado) oil or in patch tests using 100% *Persea gratissima* (avocado) oil.	27
Prunus amygdalus dulcis (sweet almond) oil	
Undiluted *Prunus amygdalus dulcis* (sweet almond) oil was nonirritating in a single insult patch test with 101 participants, and it was nonirritating and nonsensitizing in an HRIPT using 52 participants. Cosmetic formulations containing 0.1% to -5% were practically nonirritating and nonsensitizing in HRIPTs performed with 6,906 participants. In the Lanman-Maibach 21-day cumulative irritancy assay, a moisturizer containing 25% *Prunus amygdalus dulcis* (sweet almond) oil had a total irritancy score of 14 of 630.	208
Sesamum indicum (sesame) seed oil	
In clinical testing, undiluted *Sesamum indicum* (sesame) seed oil was not irritating. Cosmetic formulations containing 8% to 14.3% *Sesamum indicum* (sesame) seed oil were nonirritating to essentially nonirritating. Prophetic patch testing with formulations containing 10% to 11% *Sesamum indicum* (sesame) seed oil were not irritating with or without UV light. Patients with contact allergy to *Sesamum indicum* (sesame) seed oil were patch tested, and most had positive reactions to sesamol, sesamin, and sesamolin.	48

(continued)

Table 12. (continued)

Procedure and results	Reference
Dermal irritation and sensitization	
Triticum vulgare (wheat) germ oil	
In clinical testing, *Triticum vulgare* (wheat) germ oil was not an irritant or a sensitizer.	26
Phototoxicity/photosensitization	
Cocos nucifera (coconut) oil	
Bar soaps made with 13% *Cocos nucifera* (coconut) oil, tested as a 3% aqueous solution, tested using 10 participants, and a similar soap, prepared as 1% or 3% aqueous solutions, tested on 52 panelists, did not produce any evidence of photosensitization.	29
Sodium cocoate	
Bar soaps 13% sodium cocoate, prepared as a 3% aqueous solution, tested using 10 participants did not produce any evidence of photosensitization.	29
Prunus amygdalus dulcis (sweet almond) oil	
Formulations containing 0.1% to 2.0% *Prunus amygdalus dulcis* (sweet almond) oil, tested for photosensitization in a total of 764 participants, did not manifest photosensitivity in any of the test participants.	208
Oryza sativa (rice) bran oil	
Formulations containing 1.04% *Oryza sativa* (rice) bran oil were not photosensitizing.	25

Abbreviation: CIR, Cosmetic Ingredient Review; HRIPT, human repeat insult patch test.

Table 13. Ocular Irritation—Nonhuman and Human.

Ingredient	Concentration	Test group	Procedure	Results	Reference
Nonhuman studies					
Adansonia digitata seed oil					
Baobab oil	100%		MatTek EpiOcular MTT viability assay; 100 μL of test material for 16 to 256 minutes	Nonirritating	201
Aleurites moluccana seed oil					
Aleurites moluccana oil			Draize test	Not an ocular irritant	303
Aleurites moluccana oil			In vitro conjunctival cell assay	Not cytotoxic	303
Aleurites moluccana oil			Ocular burn treatment efficacy test	No adverse effects	304
Butyrospermum parkii (shea) butter					
Butyrospermum parkii (shea) butter	Undiluted	3 male Kleinrussen Chbb: HM rabbits	0.1 mL instilled into the conjunctival sac of 1 eye for 24 hour	Not irritating; mild conjunctival reactions	305
Crambe abyssinica seed oil					
Crambe abyssinica seed oil	Undiluted		Details not provided	An ocular irritant, but not corrosive	204
Fragaria ananassa (strawberry) seed oil					
Fragaria ananassa (strawberry) seed oil	5% to 50% in a lipophilic solvent		Neutral red release test	IC_{50} > 50%; negligible cytotoxicity	306
Hippophae rhamnoides seed oil					
Hippophae rhamnoides seed oil	5% to 50% in a lipophilic solvent		Neutral red release test	IC_{50} > 50%; negligible cytotoxicity	307

(continued)

Table 13. (continued)

Ingredient	Concentration	Test group	Procedure	Results	Reference
Nonhuman studies					
Linum usitatissimum (linseed) seed oil					
Mascara containing 9.4% *Linum usitatissimum* (linseed) oil	Diluted at 0% ot 50% in mineral oil		Neutral red release test	NR_{50} > 50%; slightly cytotoxic	308
Mascara containing 9.4% *Linum usitatissimum* (linseed) oil	67.1% solution in mineral oil		Hen egg test-chorioallantoic membrane assay (HET-CAM)	Moderately irritating	308
Mascara containing 9.4% *Linum usitatissimum* (linseed) oil	66.9% solution in mineral oil		Reconstituted epithelial culture assay	Slightly cytotoxic	308
Olea europaea (olive) fruit oil					
Olea europaea (olive) fruit oil, "high purity"	Undiluted	Rabbits; number not specified	Draize test	Not irritating	303
Olea europaea (olive) fruit oil, "high purity"			In vitro study using human conjunctival epithelial cells	Did not induce cellular necrosis or apoptosis	303
Ribes nigrum **(**blackcurrant**)** seed oil					
Eye mask containing 0.2% black Ribes (blackcurrant) seed oil	50% dilution		HET-CAM assay	Practically no irritation	309
Rubus chamaemorus seed oil					
Product containing 2.5% *Rubus chamaemorus* seed oil			Neutral red release assay	Negligible cytotoxicity; product was considered well tolerated	310
Vaccinium vitis-idaea seed oil					
Vaccinium vitis-idaea seed oil	5% to 50% in a lipophilic solvent		Neutral red release test	IC_{50} > 50%; negligible cytotoxicity	311
Zea mays (corn) oil					
Zea mays (corn) oil, "high purity"	Undiluted	Rabbits, number not specified	Draize test	Not irritating	303
Zea mays (corn) oil, "high purity"			In vitro study using human conjunctival epithelial cells	Did not induce necrosis or apoptosis	303
Human studies					
Linum usitatissimum (linseed) seed oil					
9.4% *Linum usitatissimum* (linseed) seed oil in a mascara		33 female participants	4 week study; 16 wore contact lenses, 17 had "sensitive" eyes	No subjective irritation and no adverse reports; clinically safe for use by contact lens-wearers	312
Ribes nigrum (blackcurrant) seed oil					
0.2% *Ribes nigrum* (blackcurrant) seed oil in an eye mask	Undiluted	52 participants	4 week in-use study	No adverse reactions; safe for contact-lens wearers	313

Abbreviations: IC_{50}, half maximal inhibitory concentration; NR_{50}, midpoint cytotoxicity

Glycidol fatty acid esters are possible impurities in refined vegetable oils. Although the amount of glycidol that may be present with glycidol fatty acid esters is not known, the IARC has noted that glycidol is probably carcinogenic to humans and that glycidol fatty acid esters are not classifiable as to carcinogenicity in humans. Peanuts and soy may contain aflatoxins, metabolic products of certain molds that are carcinogenic to humans.

Of the oils described in this report, *B parkii* (shea) butter has the most reported uses in cosmetic and personal care products with a total of 1,950 and is used at a maximum concentration of 60%. Oils are used in a wide variety of cosmetic products,

Table 14. Ocular Irritation—Nonhuman—Summarized From Previous CIR Reports.

Procedure and results	Reference
Cocos nucifera (coconut) oil	
Undiluted *Cocos nucifera* (coconut) oil, instilled into rabbit eyes without rinsing, produced minimal eye irritation.	29
Hydrogenated coconut oil	
Undiluted hydrogenated coconut oil produced mild irritation in 1 study, minimal irritation in another, negligible, or minimal irritation in 8 additional tests. Two lipstick formulations containing 10% hydrogenated coconut oil both produced slight conjunctivitis.	29
Coconut acid	
Undiluted coconut acid produced mild irritation in rabbit eyes in 2 studies and minimal irritation in a third.	29
Elaeis guineensis (palm) oil	
Undiluted *Elaeis guineensis* (palm) oil and cosmetic lotions and creams containing 1.5% to 2.0% *Elaeis guineensis* palm) oil were minimally irritating to the eyes of rabbits, whereas 1 lotion containing 1.5% *Elaeis guineensis* (palm) oil was moderately irritating.	23
Hydrogenated palm oil	
Hydrogenated palm oil suppositories were mildly irritating to rabbit eyes.	23
Hydrogenated cottonseed oil	
Cosmetic formulations containing 3.4% to 12.3% hydrogenated cottonseed oil were mildly irritating to the eyes of rabbits.	24
Oryza sativa (rice) bran oil	
A mixture of *Oryza sativa* (rice) bran oil and *Oryza sativa* (rice) germ oil, concentrations not stated, were not irritating to rabbit eyes. Undiluted *Oryza sativa* (rice) bran oil was considered minimally irritating.	25
Oryza sativa (rice) germ oil	
Oryza sativa (rice) germ oil, concentration not stated, was not a primary irritant.	25
Prunus amygdalus dulcis (sweet almond) oil	
The ocular irritation potential of undiluted *Prunus amygdalus dulcis* (sweet almond) oil and cosmetic formulations containing up to 25% *Prunus amygdalus dulcis* (sweet almond) oil were evaluated using rabbits. Undiluted *Prunus amygdalus dulcis* (sweet almond) oil was practically nonirritating or minimally irritating, and formulations containing up to 25% *Prunus amygdalus dulcis* (sweet almond) oil were nonirritating to minimally irritating. In most instances, reactions that occurred were limited to conjunctival irritation, which cleared by the third day of observation.	208
Sesamum indicum (sesame) seed oil	
Undiluted *Sesamum indicum* (sesame) seed oil was nonirritating to minimally irritating to rabbit eyes, and a lipstick containing 10% to 11% *Sesamum indicum* (sesame) seed oil was not an ocular irritant.	48
Triticum vulgare (wheat) germ oil	
Undiluted *Triticum vulgare* (wheat) germ oil was, at most, a minimal ocular irritant, and 2% in a water emulsion was not irritating.	26

Abbreviation: CIR, Cosmetic Ingredient Review.

including use in hair spray and other aerosolized products. None of the oils, or the related counterparts, described in this report is restricted from use in the European Union.

Anacardium occidentale (cashew) seed oil was not a tumor promoter in a DMBA skin test system. The safety focus of use of these oils as cosmetic ingredients is on the potential for irritation and sensitization. Undiluted, technical grade, *A hypogaea* (peanut) oil was moderately irritating to rabbits and guinea pig skin, and 5% aqueous solutions of a bar soap containing 13% sodium cocoate had irritation scores of 1.6 to 4.0 of 8 in animal studies. However, the majority of the remaining animal irritation and/or sensitization studies conducted on a large number of the oils included in this report, primarily in formulation, did not report any significant irritation or sensitization reactions, indicating that refined oils derived from plants are not dermal irritants or sensitizers. None of the tested oils, including *B parkii* (shea) butter (up to 20%) and *O sativa* (rice) germ oil ($\leq$ 75%), were phototoxic in animal studies. The comedogenicity of *C avellana* (hazel) seed oil was evaluated using rabbits, and a slight difference in the number and size of the pilosebaceous follicles and a slight excess of sebum and a dilation of the follicles were observed.

The results of a large number of clinical irritation, sensitization, and photoxicity/photosensitziation studies indicated that plant-derived fatt acid oils were not irritants or sensitizers in humans. In clinical testing with an eye mask containing 0.2% *Ribes nigrum* (blackcurrant) seed oil (undiluted), the formulation was noncomedogenic.

Table 15. Clinical Trials/Case Studies.

Ingredient	Patients/condition	Effect/observation	Reference
		Aleurites moluccana seed oil	
Aleurites moluccana oil	15; mild, stable plaque psoriasis	Efficacy study "just enough (oil) to moisten the plaque" was applied 3× daily for 12 weeks; no side effects or adverse events were reported.	314
		Anacardium occidentale (cashew) seed oil	
Anacardium occidentale (cashew) seed oil	37-year-old male resin researcher	Presentation of bullae on his right leg after dropping pure oil from a bottle on his right thigh; skin was thoroughly washed immediately; erythema developed 10 days after exposure.	315
		Patch testing was performed with cashew nut oil 3% alcohol, cashew nut oil 0.3% alcohol, cashew nut oil 0.03% alcohol, and urushiol 0.01% petrolatum; a "+" reaction was reported on day 2 and "++" reactions on days 3 and 4 to the 3% dilution; a "+" reactions to the 0.3% dilution and urushiol was reported on days 2 to 4; a "+" reaction was observed on days 2 and 3 and a "+" reaction was observed on day 4 to the 0.03% dilution.	
		Cocos nucifera (coconut) oil	
Cocos nucifera (coconut) oil		Did not produce adverse effects in several therapeutic studies.	29
		Glycine soja (soybean) oil	
Glycine soja (soybean) oil	7; history of immediate hypersensitivity reaction after the ingestion of soybeans	A double-blind crossover study; the patients were first skin tested by the puncture method with a crude whole soybean extract, a partially hydrogenated oil, a nonhydrogenated oil, and a cold-pressed soybean oil; olive oil from a retailer was used as a negative control.	56
		Since all 7 patients had negative skin tests to the oils and positive reactions to the crude soybean extract, they were challenged orally with capsules of each of the oils in random order on 4 separate days. None of the patients reacted to the oral challenges; the researchers remarked that although a reaction to the cold-pressed soybean oil did not occur in this study, cold-pressed oils may contain soybean protein and should be avoided.	
Soy oil proteins	4; known allergy to soybean	Sera was used to examine the allergenicity; neither the IgE nor the IgG_4 in the sera reacted to protein in the soy oil.	20
		Helianthus annuus (sunflower) oil	
Refined and cold-pressed sunflower oils	Patients had anaphylactic reactions following ingestion of sunflower seeds	No reactions were seen upon oral or open challenge with refined or cold-pressed sunflower oils, both of which were shown to contain detectable amounts of protein.	15
	1 woman; desensitized to mugwort (of the Compositae family) pollen for a year, and then had an anaphylactic reaction to sunflower (also of the Compositae family) seeds.	A delayed positive reaction to sunflower oil in a skin prick test was discovered; prick test results with 10 control participants were negative. In an oral challenge test, a delayed reaction was again observed, with symptoms occurring 2.25 to 8 hours after administration.	316
		Macadamia seed oil	
Macadamia seed oil in a lipstick	28-year-old woman; chelitis	Chelitis case reported after lipstick use; patient was patch tested with ingredients contained in the lipstick; positive reactions to diisostearyl malate and macadamia seed oil were reported; the condition improved after discontinuing the use of lipsticks containing these 2 ingredients.	317

(continued)

Table 15. (continued)

Ingredient	Patients/condition	Effect/observation	Reference
		Olea europaea (olive) fruit oil	
Olea europaea (olive) fruit oil		Throughout the literature, it is stated that sensitization to *Olea europaea* (olive) fruit oil is considered rare. Case reports have been described, however, and generally involved patients with venous eczema, some type of dermatitis or lesion, or an occupational exposure. Patch testing with *Olea europaea* (olive) fruit oil produced positive reactions in most of these cases, and these results were usually regarded as allergenic. The concentrations of *Olea europaea* (olive) fruit oil tested were not always given, but, when stated, test concentrations giving positive results, ranged from 30% to100%. When the constituents of olive oil were tested as well, the results of that testing were negative.	318–325
Olea europaea (olive) fruit oil		Whether the reactions to olive oil were contact sensitization or irritation were investigated using open and occlusive testing. It was concluded that olive oil presented as a weak irritant rather than a contact sensitizer in the few case studies was observed.	326
		Persea gratissima (avocado) oil	
Persea gratissima (avocado) oil	1 female; dermatitis around the eyes and earlobes	Patch testing with her sunscreen resulted in positive results. In subsequent patch testing of the individual ingredients, a positive reaction to undiluted oil, but not to the active ingredient, was observed; 20 control participants were involved, and reactions to *Persea gratissima* (avocado) oil were not seen.	327
		Sesamum indicum (sesame) seed oil	
Sesamum indicum (sesame) seed oil in an ointment	Female	Pruritic erythema, papules, and vesicles appeared after application of the ointment; patch testing was performed with the ointment and with the individual ingredients, including undiluted *Sesamum indicum* (sesame) seed oil. Both the ointment and *Sesamum indicum* (sesame) seed oil produced positive reactions on days 2, 3, 4, and 1; the other components did not cause a reaction. Results were negative in patch testing of *Sesamum indicum* (sesame) seed oil using 20 healthy participants.	328

Abbreviations: IgE, immunoglubulin E; IgG4, immunoglobulin G4.

The ocular irritation potential of a number of the oils, mostly in formulation, was evaluated by testing using animals or alternative assays. The majority of the test results did not report significant ocular irritation; however, a lotion containing 1.5% *E guineensis* (palm) oil was moderately irritating to rabbit eyes and a mascara containing 9.4% *L usitatissimum* (linseed) seed oil was moderately irritating in an alternative assay.

In human testing, a mascara containing 9.4% *L usitatissimum* (linseed) seed oil did not produce ocular irritation or adverse effects in contact lens wearers or participants with sensitive eyes. An eye mask containing 0.2% *R nigrum* (blackcurrant) seed oil (undiluted) was tested and considered safe for contact lens wearers.

Plant-derived fatty acid oils have been used as vehicles for delivery of therapeutic agents or used alone in treating skin disorders. Adverse reactions to the oils were notably absent in such clinical tests. Case studies have reported isolated allergic reactions.

Discussion

Plant-derived fatty acid oils, oils which have been hydrogenated to reduce or eliminate unsaturation, fatty acid salts, and oil unsaponifiables were reviewed by the Panel. Most of these ingredients in this report are mixtures of triglycerides containing fatty acids and fatty acid derivatives, the safety of which in cosmetics has been established. Upon review of these ingredients, the Panel expressed concern regarding gossypol (for cotton-derived ingredients), pesticide residues, and heavy metals that may be present in botanical ingredients. The Panel stressed that the cosmetics industry should continue to use the

necessary procedures to limit these impurities in the ingredient before blending into cosmetic formulations.

Additionally, the Panel considered the safety of glycidol and glycidol fatty acid esters in refined vegetable oils. Although the Panel recognizes that these impurities may be carcinogenic, absorption through the skin would be very low and likely does not pose a significant hazard. Nonetheless, suppliers should take steps to eliminate or reduce the presence of glycidol and glycidol fatty acid esters in plant-based fatty acid oils that are used in cosmetic products. Aflatoxins, which are potent carcinogens, may be present in moldy nuts and coconut copra but are not found in oils expressed from these nuts and copra. The Panel adopted the US Department of Agriculture designation of $\leq$15 ppb as corresponding to "negative" aflatoxin content.

Certain plant-derived oils are used in cosmetic products that may be inhaled during their use. In practice, however, the particle sizes produced by the cosmetic aerosols are not respirable.

The Panel discussed the relationship between food allergies and exposure to refined oils. Individuals who have food allergies to a plant protein rarely exhibit allergic reactions when exposed to refined oils of the same plant. The Panel has found a general lack of clinical effects for plant-derived fatty acid oils already reviewed.

Fatty acid composition data were available for the majority of the oils included in this review and the Panel agreed that the composition data, in combination with the available data on method of manufacture, impurities, safety test data, a long history of safe use in foods, and an absence of adverse reactions in clinical experience, were a sufficient basis for determining safety. The Panel did note that vegetable oil is a blend of a number of different oils and that a specific composition of vegetable oil was not available. The Panel determined that the safety of vegetable oil as used in cosmetic formulations has been established, providing that the blend contains oils for which the fatty acid composition is known.

Additionally, although data on the fatty acid composition of *Fragaria vesca* (strawberry) seed oil and *Fragaria virginiana* (strawberry) seed oil were not available, data were available for *Fragaria ananassa* (strawberry) seed oil and *Fragaria chiloensis* (strawberry) seed oil. In that the fatty acid compositions of *F ananassa* and *F chiloensis* (strawberry) seed oil were similar to each other and it was assumed that *F vesca* and *F virginiana* (strawberry) seed oils would also have similar fatty acid compositions.

The Panel also noted that arachidonic acid is a fatty acid constituent of *Lycium barbarum* seed oil, *O sativa* (rice) germ oil, and *Sclerocarya birrea* seed oil. Although a previously published CIR evaluation concluded that insufficient data exist to support the safety of arachidonic acid in cosmetic products, the Panel was of the opinion that the concentration of use of these ingredients was sufficiently low that the amount of free arachidonic acid from these oils would not warrant concern.

Finally, the conclusion reached by the Panel on the safety of the plant-derived fatty acid oils supersedes the 2001 conclusion of insufficient data for *Corylus americana* and *C avellana* (hazel) seed oil.

Conclusion

The Panel concluded that the 244 plant-derived fatty acid oils included in this review are safe in the present practices of use and concentration described in this safety assessment. Were ingredients not in current use (as indicated by *) to be used in the future, the expectation is that they would be used in product categories and concentrations comparable to others in this group. The ingredients found safe are:

Actinidia chinensis (kiwi) seed oil
Adansonia digitata oil
Adansonia digitata seed oil*
Aleurites moluccanus bakoly seed oil*
Aleurites moluccanus seed oil
Amaranthus hypochondriacus seed oil*
Anacardium occidentale (cashew) seed oil
Arachis hypogaea (peanut) oil
Arctium lappa seed oil*
Argania spinosa kernel oil
Astrocaryum murumuru seed butter
Avena sativa (oat) kernel oil
Babassu acid*
Bassia butyracea seed butter*
Bassia latifolia seed butter
Bertholletia excelsa seed oil
Borago officinalis seed oil
Brassica campestris (rapeseed) oil unsaponifiables*
Brassica campestris (rapeseed) seed oil
Brassica napus seed oil*
Brassica oleracea Acephala seed oil*
Brassica oleracea Italica (broccoli) seed oil
Butyrospermum parkii (shea) butter
Butyrospermum parkii (shea) butter unsaponifiables
Butyrospermum parkii (shea) oil
Camelina sativa seed oil
Camellia japonica seed oil
Camellia kissi seed oil
Camellia oleifera seed oil
Camellia sinensis seed oil
Canarium indicum seed oil*
Canola oil
Canola oil unsaponifiables
Carica papaya seed oil
Carthamus tinctorius (safflower) seed oil
Carya illinoensis (pecan) seed oil*
Caryocar brasiliense fruit oil
Chenopodium quinoa seed oil
Citrullus lanatus (watermelon) seed oil
Citrus aurantifolia (lime) seed oil*
Citrus aurantifolia (lime) seed oil unsaponifiables*
Citrus aurantium dulcis (orange) seed oil*
Citrus aurantium dulcis (range) seed oil unsaponifiables*
Citrus grandis (grapefruit) seed oil*
Citrus grandis (grapefruit) seed oil unsaponifiables*
Citrus limon (lemon) seed oil*

Citrus paradisi (grapefruit) seed oil
Coconut acid
Cocos nucifera (coconut) oil
Cocos nucifera (coconut) seed butter*
Coix lacryma-jobi (Job's tears) seed oil*
Corn acid*
Corylus americana (hazel) seed oil
Corylus avellana (hazel) seed oil
Cottonseed acid*
Crambe abyssinica seed oil
Cucumis sativus (cucumber) seed oil
Cucurbita pepo (pumpkin) seed oil
Cynara cardunculus seed oil*
Elaeis (palm) fruit oil*
Elaeis guineensis (palm) butter*
Elaeis guineensis (palm) kernel oil
Elaeis guineensis (palm) oil
Elaeis oleifera kernel oil
Euterpe oleracea fruit oil
Fragaria ananassa (strawberry) seed oil*
Fragaria chiloensis (strawberry) seed oil*
Fragaria vesca (strawberry) seed oil*
Fragaria virginiana (strawberry) seed oil*
Garcinia indica seed butter
Gevuina avellana seed oil
Gevuina avellana oil
Glycine soja (soybean) oil
Glycine soja (soybean) oil unsaponifiables
Gossypium herbaceum (cotton) seed oil
Guizotia abyssinica seed oil*
Helianthus annuus (sunflower) seed oil
Helianthus annuus (sunflower) seed oil unsaponifiables
Hippophae rhamnoides fruit oil
Hippophae rhamnoides oil
Hippophae rhamnoides seed oil*
Hydrogenated *Adansonia digitata* seed oil*
Hydrogenated apricot kernel oil
Hydrogenated apricot kernel oil unsaponifiables*
Hydrogenated *Argania spinosa* kernel oil*
Hydrogenated avocado oil
Hydrogenated blackcurrant seed oil*
Hydrogenated *Camelina sativa* seed oil*
Hydrogenated *Camellia oleifera* seed oil
Hydrogenated canola oil
Hydrogenated coconut acid
Hydrogenated coconut oil
Hydrogenated cotton seed oil
Hydrogenated cranberry seed oil*
Hydrogenated evening primrose oil
Hydrogenated grapefruit seed oil*
Hydrogenated grapefruit seed oil unsaponifiables*
Hydrogenated grape seed oil
Hydrogenated hazelnut oil*
Hydrogenated kukui nut oil*
Hydrogenated lime seed oil*
Hydrogenated lime seed oil unsaponifiables*
Hydrogenated macadamia seed oil*
Hydrogenated meadowfoam seed oil*
Hydrogenated olive oil
Hydrogenated olive oil unsaponifiables
Hydrogenated orange seed oil*
Hydrogenated orange seed oil unsaponifiables*
Hydrogenated palm acid*
Hydrogenated palm kernel oil
Hydrogenated palm oil
Hydrogenated *Passiflora edulis* seed oil*
Hydrogenated peach kernel oil*
Hydrogenated peanut oil
Hydrogenated pistachio seed oil*
Hydrogenated pumpkin seed oil*
Hydrogenated *Punica granatum* seed oil*
Hydrogenated rape seed oil*
Hydrogenated raspberry seed oil
Hydrogenated rice bran oil*
Hydrogenated *Rosa canina* fruit oil*
Hydrogenated safflower seed oil*
Hydrogenated sesame seed oil*
Hydrogenated shea butter
Hydrogenated soybean oil
Hydrogenated sunflower seed oil
Hydrogenated sweet almond oil
Hydrogenated sweet almond oil unsaponifiables*
Hydrogenated vegetable oil
Hydrogenated wheat germ oil*
Hydrogenated wheat germ oil Unsaponifiables*
Irvingia gabonensis kernel butter
Juglans regia (walnut) seed oil
Limnanthes alba (meadowfoam) seed oil
Linseed acid
Linum usitatissimum (linseed) seed oil
Luffa cylindrica seed oil
Lupinus albus oil unsaponifiables*
Lupinus albus seed oil
Lycium barbarum seed oil
Macadamia integrifolia seed oil
Macadamia ternifolia seed oil
Magnesium cocoate
Mangifera indica (mango) seed butter
Mangifera indica (mango) seed oil
Morinda citrifolia seed oil*
Moringa oleifera seed oil
Moringa pterygosperma seed oil
Oenothera biennis (evening primrose) oil
Olea europaea (olive) husk oil*
Olea europaea (olive) oil unsaponifiables
Olea europaea (olive) fruit oil
Olive acid*
Orbignya cohune seed oil
Orbignya oleifera seed oil
Orbignya speciosa kernel oil
Oryza sativa (rice) bran oil
Oryza sativa (rice) germ oil

Oryza sativa (rice) seed oil*
Palm acid
Palm kernel acid
Passiflora edulis seed oil
Peanut acid*
Perilla ocymoides seed oil
Persea gratissima (avocado) butter
Persea gratissima (avocado) oil
Persea gratissima (avocado) oil unsaponifiables
Pistacia vera seed oil
Plukenetia volubilis seed oil
Potassium babassuate*
Potassium cocoate
Potassium cornate*
Potassium hydrogenated cocoate*
Potassium hydrogenated palmate*
Potassium olivate
Potassium palm kernelate
Potassium palmate
Potassium peanutate
Potassium rapeseedate*
Potassium safflowerate*
Potassium soyate*
Prunus amygdalus dulcis (sweet almond) oil
Prunus amygdalus dulcis (sweet almond) oil unsaponifiables*
Prunus armeniaca (apricot) kernel oil
Prunus armeniaca (apricot) kernel oil unsaponifiables*
Prunus avium (sweet cherry) seed oil
Prunus domestica seed oil
Prunus persica (peach) kernel oil
Punica granatum seed oil
Pyrus malus (apple) seed oil
Rapeseed acid*
Ribes nigrum (blackcurrant) seed oil
Ribes rubrum (currant) seed oil*
Rice bran acid*
Rosa canina fruit oil
Rubus chamaemorus seed oil
Rubus idaeus (raspberry) seed oil
Safflower acid*
Schinziophyton rautanenii kernel oil
Sclerocarya birrea seed oil
Sesamum indicum (sesame) oil unsaponifiables
Sesamum indicum (sesame) seed butter*
Sesamum indicum (sesame) seed oil
Silybum marianum seed oil (thistle)
Sodium *Astrocaryum murumuruate*
Sodium avocadoate
Sodium babassuate
Sodium cocoa butterate*
Sodium cocoate
Sodium grapeseedate
Sodium hydrogenated cocoate*
Sodium hydrogenated palmate*
Sodium macadamiaseedate*
Sodium mangoseedate
Sodium olivate
Sodium palm kernelate
Sodium palmate
Sodium peanutate*
Sodium rapeseedate*
Sodium safflowerate*
Sodium sesameseedate
Sodium soyate*
Sodium sweet almondate
Sodium *Theobroma grandiflorum* seedate*
Solanum lycopersicum (tomato) fruit oil
Solanum lycopersicum (tomato) seed oil
Soy acid*
Sunflower seed acid*
Theobroma cacao (cocoa) seed butter
Theobroma grandiflorum seed butter
Torreya nucifera seed oil*
Triticum aestivum (wheat) germ oil*
Triticum vulgare (wheat) germ oil
Triticum vulgare (wheat) germ oil unsaponifiables*
Vaccinium corymbosum (blueberry) seed oil*
Vaccinium macrocarpon (cranberry) seed oil
Vaccinium myrtillus seed oil
Vaccinium vitis-idaea seed oil
Vegetable (olus) oil
Vitis vinifera (grape) seed oil
Wheat germ acid
Zea mays (corn) germ oil
Zea mays (corn) oil
Zea mays (corn) oil unsaponifiables

Authors' Note

Unpublished sources cited in this report are available from the Executive Director, Cosmetic Ingredient Review, 1620 L Street, NW, Suite 1200, Washington, DC 20036, USA.

Author Contributions

Christina L. Burnett contributed to conception and design; contributed to acquisition, analysis, and interpretation; and drafted the manuscript. Bart Heldreth contributed to conception and design; contributed to analysis and interpretation; and critically revised the manuscript. Monice M. Fiume contributed to conception and design; contributed to analysis and interpretation; drafted the manuscript; and critically revised the manuscript. Wilma F. Bergfeld, Donald V. Belsito, Ronald A. Hill, Curtis D. Klaassen, Daniel Liebler, James G. Marks, Ronald C. Shank, Thomas J. Slaga, and Paul W. Snyder contributed to conception and design; contributed to analysis and interpretation; and critically revised the manuscript. All authors gave final approval and agree to be accountable for all aspects of work ensuring integrity and accuracy.

Declaration of Conflicting Interest

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