

# Final Report of the Amended Safety Assessment of Myristic Acid and Its Salts and Esters as Used in Cosmetics

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## Abstract

This report addresses the safety of the inorganic salts and esters of various fatty alcohols of myristic acid. Most of the esters are used as skin conditioning agents in many types of cosmetics in a range of concentrations. Myristate esters are readily hydrolyzed to the corresponding alcohols and acids, which are then further metabolized. Myristate salts readily dissociate in any likely cosmetic formulation. The Cosmetic Ingredient Review (CIR) Panel recognized that much of the data supporting the ingredients in this group were previously reviewed in safety assessments for related ingredients. Where specific data did not exist, the Panel considered structure–activity relationships in determining the safety of these ingredients as used in cosmetics. The Panel determined that myristic acid and its salts and esters are safe as cosmetic ingredients in the current practices of use and concentration.

## Keywords

safety, cosmetics, myristic acid, salts, esters

## Introduction

In 1990, the Cosmetic Ingredient Review (CIR) Expert Panel concluded that butyl myristate is a safe cosmetic ingredient.<sup>1</sup> This safety assessment was re-reviewed in 2006 to consider new safety data and the Expert Panel reaffirmed that myristic acid ester is safe as used in cosmetics. The Expert Panel re-opened this safety assessment to include other esters that are chemically similar to butyl myristate, along with the salts of myristic acid. The Panel determined that the available data in the original safety assessment are sufficient to support the safety of these additional salts and ester of myristic acid.

The Expert Panel also combined this expanded report with other myristates that have already been reviewed. These and other related ingredients that were previously reviewed by the CIR Expert Panel are listed in Table 1.

This amended safety assessment, therefore includes:

- aluminum dimyristate,
- aluminum isostearates/myristates,
- aluminum myristate,
- aluminum myristates/palmitates,
- calcium myristate,
- cetyl myristate,

- decyl myristate,
- ethylhexyl myristate,
- ethyl myristate,
- glyceryl dimyristate,
- glyceryl isostearate/myristate,
- glyceryl myristate,
- isobutyl myristate,
- isocetyl myristate,
- isodecyl myristate,
- isopropyl myristate,
- isostearyl myristate,
- isotridecyl myristate,
- lauryl myristate,
- magnesium myristate,
- methyl myristate,

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- myristic acid,
- myristyl myristate,
- octyldodecyl myristate,
- oleyl myristate,
- potassium myristate,
- propylene glycol myristate,
- sodium myristate,
- tetradecyloctadecyl myristate,
- tridecyl myristate, and
- zinc myristate.

Data from previous safety assessments on butyl myristate, glycerol myristate, myristic acid, isopropyl myristate and myristyl myristate were reviewed and considered during this assessment. For these ingredients, the previous conclusions CIR Panel (as applicable to the ingredients noted) are summarized in the following sections.

### ***Butyl Myristate, JACT, 9(2) 1990***

Butyl myristate is the ester of butyl alcohol and myristic acid. It is a colorless, oily liquid, which is used in cosmetic formulations at concentrations up to 50%. Aliphatic esters such as butyl myristate may be readily hydrolyzed in vivo to the corresponding alcohol and acid, which are then further metabolized. The median lethal dose (LD<sub>50</sub>) of butyl myristate was greater than 8 g/kg in rats. In animal tests, undiluted butyl myristate was moderately irritating but was not a skin sensitizer. No evidence of eye irritation was noted. On the basis of the available data presented in this report on butyl myristate, as well as other related myristate compounds, the CIR Expert Panel found butyl myristate safe for cosmetic formulation usage.

### ***Glyceryl Myristate, IJT, 23(suppl 2:55-94)2004***

The safety of 43 glyceryl monoesters listed as cosmetic ingredients was reviewed in a safety assessment completed in 2000. Glyceryl myristate was included in this group. Glyceryl monoesters have little, acute or short-term toxicity in animals, and no toxicity was noted following chronic administration of a mixture consisting mostly of glyceryl di- and monoesters. Undiluted glyceryl monoesters may produce minor skin irritation, especially in abraded skin, but in general these ingredients are not irritating at concentrations used in cosmetics. These ingredients are not photosensitizers. Glyceryl monoesters tested failed to produce any significant positive reactions at concentrations used in cosmetics. Based on these data, the CIR Expert Panel found glyceryl myristic safe as a cosmetic ingredient in the current practices of its use and concentration.

### ***Myristic Acid, JACT, 6(3) 1987***

Oleic, lauric, palmitic, myristic, and stearic acids were reviewed as part of a group. These fatty acids are absorbed, digested, and transported in animals and humans. Little acute toxicity was observed when oleic, lauric, palmitic, myristic,

or stearic acid or cosmetic formulations containing these fatty acids were given to rats orally at doses of 15 to 19 g/kg body weight. Most of the data in this assessment was oleic, lauric, palmitic, and stearic acids; myristic acid was included in the safety assessment due to its structural similarity. In primary and cumulative irritation clinical studies, oleic, myristic, and stearic acids at high concentrations were nonirritating. Cosmetic product formulations containing oleic, lauric, palmitic, and stearic acids at concentrations ranging up to 13% were not primary or cumulative irritants, nor sensitizers. On the basis of available data from studies using animals and humans, it is concluded that oleic, lauric, palmitic, myristic, and stearic acids are safe in current practices of their use and concentration in cosmetics.

### ***Myristyl Myristate and Isopropyl Myristate, JACT, 1(4) 1982***

Acute oral and dermal toxicity tests indicated that myristyl myristate is nontoxic to rats. This cosmetic ingredient produced minimal-to-mild skin irritation, minimal eye irritation in rabbits, and no sensitization in guinea pigs. Studies with rabbits indicated that undiluted isopropyl myristate was a mild irritant after 24 hours and moderate to severe when applied for 3 consecutive days. Isopropyl myristate was minimally irritating to the rabbits' eyes and was not a skin sensitizer in studies with guinea pigs. In limited studies, isopropyl myristate was not carcinogenic on the skin of mice, but a mixture of isopropyl myristate and isopropyl alcohol significantly accelerated the carcinogenic activity of benzo(a)pyrene on the skin.

Human studies with isopropyl myristate indicated that it was not a human skin irritant or sensitizer when applied in a product formulation containing 15% to 58% of the ingredient. A product containing 43% of isopropyl myristate produced no phototoxicity and no photocontact allergenicity in human studies.

From the available information, it is concluded that myristyl myristate and isopropyl myristate are safe as cosmetic ingredients in the current practices of their use.

Summaries of the data from these reports are provided *in italics* where applicable throughout the report.

## **Chemistry**

### ***Definition and Structure***

The definitions, structures, and function in cosmetics of myristic acid and the related salt and esters are given in Table 2.

Also, included in Table 2 are the formulas/structures and functions in cosmetics as given in the *International Cosmetic Ingredient Dictionary and Handbook*.<sup>15</sup> The myristates are esters and salts of myristic acid that have the general formula shown in Figure 1.<sup>8</sup>

According to the *International Cosmetic Ingredient Dictionary and Handbook*,<sup>15</sup> myristic acid (CAS No 544-63-8) is an organic acid also known as tetradecanoic acid.

**Table I.** Related Ingredients Previously Reviewed by the CIR Expert Panel

Ingredient	Uses	Use Concentrations	Conclusion	Reference
n-Butyl alcohol	112; 29 (addendum)	≤0.1%-10%; 0.000007%-15%	Safe in nail preparations in the current practices of use.	2,3
Cetyl alcohol	2694; 2931 (re-review)	>0.1%-50%; 0.000002%-15%	Safe as cosmetic ingredients in the current practices of use.	4,5
Glyceryl dimyristate	None reported	None reported	Safe as cosmetic ingredients in the practices of use and concentration as described in this safety assessment.	6
Glyceryl isostearate/ myristate	None reported	None reported	Safe as cosmetic ingredients in the current practices of use and concentration.	7
Glyceryl myristate	19	1%-6%	Safe as cosmetic ingredients in the current practices of use and concentration.	7
Isopropyl myristate	2198; 881 (re-review)	≤0.1%->50%; 0.00008%-78%	Safe as cosmetic ingredients in the current practices of use.	6,8
Isostearyl alcohol	41; 16 (re-review)	>0.1%-50%; 0.001%-50%	Safe as cosmetic ingredients in the current practices of use.	5,9
Methyl alcohol	4	0.1%-5%	Safe as used to denature alcohol used in cosmetic products.	10
Myristic acid	36; 73 (re-review)	>0.1%-50%; 0.00001%-38%	Safe in the current practices of use and concentration in cosmetics.	2,11
Myristyl myristate	160; 244 (re-review)	0.1%-25%; 0.01%-20%	Safe as cosmetic ingredients in the current practices of use.	6,8
Oleyl alcohol	1018; 343 (re-review)	≤0.1%->50%; 0.002%-18%	Safe as currently used in cosmetics.	6,12
Propylene glycol myristate	11	None reported	Safe as cosmetic ingredients in the current practices of use.	13

Abbreviation: CIR, Cosmetic Ingredient Review.

Aluminum dimyristate (CAS No 56639-51-1) is also known as aluminum hydroxybis (tetradecanoate) and tetradecanoic acid, aluminum complex.

Aluminum Isostearates/Myristates (no CAS No) is also known as aluminum triisostearate/trimyristate.

Aluminum myristate (CAS No 4040-50-0) is also known as aluminum monomyristate; myristic acid, aluminum salt; and tetradecanoic acid, aluminum salt.

Aluminum myristates/palmitates (no CAS No) is also known as aluminum trimyristate/tripalmitate.

Butyl myristate (CAS No 110-36-1) is also known as butyl n-tetradecanoate; myristic acid, butyl ester, and tetradecanoic acid, butyl ester.

Calcium myristate (CAS No 15284-51-2) is also known as calcium tetradecanoate; myristic acid, calcium salt; and tetradecanoic acid, calcium salt.

Cetyl myristate (CAS No 2599-01-1) is also known as hexadecyl myristate; hexadecyl tetradecanoate; myristic acid, cetyl ester; myristic acid, hexadecyl ester; and palmityl myristate, and tetradecanoic acid, hexadecyl ester.

Decyl myristate (CAS No 41927-71-3) is also known as decyl tetradecanoate; myristic acid, decyl ester; and tetradecanoic acid, decyl ester.

Ethyl myristate (CAS No 124-06-1) is also known as ethyl tetradecanoate and tetradecanoic acid, ethyl ester.

Ethylhexyl myristate (CAS No 29806-75-5) is also known as 2-ethylhexyl myristate; octyl myristate; and tetradecanoic acid, 2-ethylhexyl ester.

Glyceryl dimyristate (CAS No 53563-63-6) is also known as dimyristin; glycerol dimyristate; and tetradecanoic acid, diester with 1,2,3-propanetriol.

Glyceryl isostearate/myristate (no CAS No) is also known as glyceryl monoisostearate monomyristate.

Glyceryl myristate (CAS Nos 589-68-4 and 27214-38-6) is also known as glycerin monomyristate; glycerol monomyristate; glyceryl monomyristate, monomyristin; myristic acid monoglyceride; and tetradecanoic acid, monoester with 1,2,3-propanetriol.

Isobutyl myristate (CAS No 25263-97-2) is also known as 2-methylpropyl tetradecanoate; myristic acid, isobutyl ester; and tetradecanoic acid, 2-methylpropyl ester.

Isocetyl myristate (CAS No 83708-66-1) is also known as myristic acid, isocetyl ester; tetradecanoic acid, isocetyl ester; and tetradecanoic acid, isohexadecyl ester.

Isodecyl myristate (CAS Nos 17670-91-6 and 51473-24-6) is also known as 3,7-dimethyloctyl myristate; isodecyl tetradecanoate; myristic acid, isodecyl ester; tetradecanoic acid, 3,7-dimethyloctyl ester; tetradecanoic acid, isodecyl ester; and tetrahydrogeranyl myristate.

Isopropyl myristate (CAS No 110-27-0) is also known as IPM; isoproylis myristas; isopropyl tetradecanoate; 1-methylethyl tetradecanoate; myristic acid, isopropyl ester; and tetradecanoic acid, 1-methylethyl ester.

Isostearyl myristate (CAS No 72576-81-9) is also known as tetradecanoic acid, isooctadecyl ester.

**Table 2.** Definition, Structure, and Function of Myristic Acid and Its Salts and Esters Included in This Report as Given in the International Cosmetic Ingredient Dictionary and Handbook<sup>14</sup>

Ingredient	Definition	Formula/Structure	Function
Myristic acid	Organic acid that conforms generally to the formula:	$\text{CH}_3(\text{CH}_2)_{12}\text{COOH}$	Fragrance ingredient, opacifying agent, surfactant—cleansing agent
<b>Salts</b>			
Aluminum dimyristate	Aluminum salt of myristic acid	$[\text{CH}_3(\text{CH}_2)_{12}\text{COO}]_2\text{AlOH}$	Anticaking agent; emulsion stabilizer; viscosity increasing agent—nonaqueous
Aluminum isostearates/myristates	Aluminum salt of a mixture of isostearic acid and myristic acid	None provided	Anticaking agent; emulsion stabilizer; viscosity increasing agent—nonaqueous
Aluminum myristate	Aluminum salt of myristic acid	$[\text{CH}_3(\text{CH}_2)_{12}\text{COO}]_3\text{Al}$	Anticaking agent; emulsion stabilizer; viscosity increasing agent—nonaqueous
Aluminum myristates/palmitates	Aluminum salt of a mixture of palmitic acid and myristic acid	None provided.	Anticaking agent; emulsion stabilizer; viscosity increasing agent—nonaqueous
Calcium myristate	Calcium salt of myristic acid	$\text{C}_{14}\text{H}_{28}\text{O}_2 \cdot \frac{1}{2}\text{Ca}$	Anticaking agent; emulsion stabilizer; viscosity increasing agent—nonaqueous
Magnesium myristate	Magnesium salt of myristic acid	$[\text{CH}_3(\text{CH}_2)_{12}\text{COO}^-]_2 \text{Mg}^{+2}$	Anticaking agent; slip modifier; viscosity increasing agent—nonaqueous
Potassium myristate	Potassium salt of myristic acid	$\text{C}_3(\text{C}_2)_{12} \text{COOK}$	Surfactant—cleansing agent; surfactant—emulsifying agent
Sodium myristate	Sodium salt of myristic acid	$\text{CH}_3(\text{CH}_2)_{12}\text{COONa}$	Surfactant—cleansing agent; surfactant—emulsifying agent
Zinc myristate	Zinc salt of myristic acid	$[\text{CH}_3(\text{CH}_2)_{12}\text{COO}^-]_2 \text{Zn}^{2+}$	Anticaking agent; slip modifier; viscosity increasing agent—nonaqueous
<b>Esters</b>			
Butyl myristate	Ester of butyl alcohol and myristic acid	$\begin{array}{c} \text{O} \\ \parallel \\ \text{CH}_3(\text{CH}_2)_{12}\text{C} - \text{OC}_{10}\text{H}_{21} \end{array}$	skin-conditioning agent—emollient
Cetyl myristate	Ester of cetyl alcohol and myristic acid	$\begin{array}{c} \text{O} \\ \parallel \\ \text{CH}_3(\text{CH}_2)_{12}\text{C} - \text{OC}_{18}\text{H}_{37} \end{array}$	Skin-conditioning agent—occlusive
Decyl myristate	Ester of decyl alcohol and myristic acid.	$\begin{array}{c} \text{O} \\ \parallel \\ \text{CH}_3(\text{CH}_2)_{12}\text{C} - \text{OCH}_2(\text{CH}_2)_8\text{CH}_3 \end{array}$	Skin-conditioning agent—occlusive
Ethylhexyl myristate	Ester of 2-ethylhexyl alcohol and myristic acid	$\begin{array}{c} \text{O} \\ \parallel \\ \text{CH}_3(\text{CH}_2)_{12}\text{C} - \text{OCH}_2\text{CH}(\text{CH}_2)_3\text{CH}_3 \\ \quad \quad \quad   \\ \quad \quad \quad \text{CH}_2\text{CH}_3 \end{array}$	Skin-conditioning agent—emollient
Ethyl myristate	Ester of ethyl alcohol and myristic acid	$\begin{array}{c} \text{O} \\ \parallel \\ \text{CH}_3(\text{CH}_2)_{12}\text{C} - \text{OCH}_2\text{CH}_3 \end{array}$	Fragrance ingredient; hair conditioning agent; skin-conditioning agent—emollient
Glyceryl dimyristate	Diester of glycerin and myristic acid	$\begin{array}{c} \text{O} \qquad \qquad \text{OH} \\ \parallel \qquad \quad   \\ \text{CH}_3(\text{CH}_2)_{12}\text{C} - \text{OCH}_2\text{CHCH}_2\text{O} - \text{C}(\text{CH}_2)_{12}\text{CH}_3 \\ \qquad \qquad \qquad \parallel \\ \qquad \qquad \qquad \text{O} \end{array}$	Skin-conditioning agent—emollient

(continued)

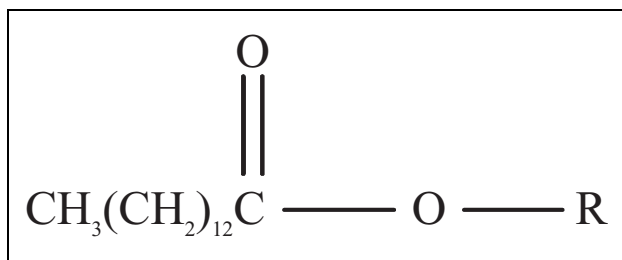
Table 2 (continued)

Ingredient	Definition	Formula/Structure	Function
Myristic acid	Organic acid that conforms generally to the formula:	$\text{CH}_3(\text{CH}_2)_{12}\text{COOH}$	Fragrance ingredient, opacifying agent, surfactant—cleansing agent
Glyceryl isostearate/myristate	Monoester of glycerin esterified with a blend of isostearic and myristic acids	None provided.	Skin-conditioning Agent—emollient; surfactant—emulsifying agent
Glyceryl myristate	Monoester of glycerin and myristic acid	$\begin{array}{c} \text{O} \\ \parallel \\ \text{CH}_3(\text{CH}_2)_{12}\text{C} - \text{OCH}_2\text{CH}(\text{OH})\text{CH}_2\text{OH} \end{array}$	Skin-conditioning agent—emollient; surfactant—emulsifying agent
isobutyl myristate	Ester of isobutyl alcohol and myristic acid	$\begin{array}{c} \text{O} \\ \parallel \\ \text{CH}_3(\text{CH}_2)_{12}\text{C} - \text{OCH}_2\text{CH}(\text{CH}_3)\text{CH}_3 \end{array}$	Skin-conditioning agent—emollient
Isocetyl myristate	Ester of isocetyl alcohol and myristic acid	$\begin{array}{c} \text{O} \\ \parallel \\ \text{CH}_3(\text{CH}_2)_{12}\text{C} - \text{OC}_{16}\text{H}_{33} \end{array}$	Skin-conditioning agent—occlusive
Isodecyl myristate	Ester of branched chain decyl alcohols and myristic acid	$\begin{array}{c} \text{O} \\ \parallel \\ \text{CH}_3(\text{CH}_2)_{12}\text{C} - \text{OC}_{10}\text{H}_{21} \end{array}$	Skin-conditioning agent—emollient
Isopropyl myristate	Ester of isopropyl alcohol and myristic acid	$\begin{array}{c} \text{O} \\ \parallel \\ \text{CH}_3(\text{CH}_2)_{12}\text{C} - \text{OCH}_2\text{CH}_3 \end{array}$	Binder; fragrance ingredient; skin-conditioning agent—emollient
Isostearyl myristate	Ester of Isostearyl Alcohol and myristic acid	$\begin{array}{c} \text{O} \\ \parallel \\ \text{CH}_3(\text{CH}_2)_{12}\text{C} - \text{OC}_{18}\text{H}_{37} \end{array}$	Binder; Skin-Conditioning Agent - Emollient
Isotridecyl myristate	Ester of myristic acid and isotridecyl alcohol	$\begin{array}{c} \text{O} \\ \parallel \\ \text{CH}_3(\text{CH}_2)_{12}\text{C} - \text{OC}_{13}\text{H}_{27} \end{array}$	Hair conditioning agent; skin-conditioning agent—occlusive
Lauryl myristate	Ester of lauryl alcohol and myristic acid	$\begin{array}{c} \text{O} \\ \parallel \\ \text{CH}_3(\text{CH}_2)_{12}\text{C} - \text{O}(\text{CH}_2)_{11}\text{CH}_3 \end{array}$	Hair conditioning agent; skin-conditioning agent—occlusive
Methyl myristate	Ester of methyl alcohol and myristic acid	$\begin{array}{c} \text{O} \\ \parallel \\ \text{CH}_3(\text{CH}_2)_{12}\text{C} - \text{OCH}_3 \end{array}$	Fragrance ingredient; skin-conditioning agent—emollient
Myristyl myristate	Ester of myristyl alcohol and myristic acid	$\begin{array}{c} \text{O} \\ \parallel \\ \text{CH}_3(\text{CH}_2)_{12}\text{C} - \text{O}(\text{CH}_2)_{13}\text{CH}_3 \end{array}$	Skin-conditioning agent—occlusive
Octyldodecyl Myristate	Ester of octyldodecanol and myristic acid.	$\begin{array}{c} \text{O} \\ \parallel \\ \text{CH}_3(\text{CH}_2)_{12}\text{C} - \text{OCH}_2\text{CH}(\text{CH}_2)_9\text{CH}_3 \\   \\ (\text{CH}_2)_7\text{CH}_3 \end{array}$	Skin-conditioning agent—occlusive

(continued)

Table 2 (continued)

Ingredient	Definition	Formula/Structure	Function
Myristic acid	Organic acid that conforms generally to the formula:	$\text{CH}_3(\text{CH}_2)_{12}\text{COOH}$	Fragrance ingredient, opacifying agent, surfactant—cleansing agent
Oleyl myristate	Ester of oleyl alcohol and myristic acid	$\begin{array}{c} \text{O} \\ \parallel \\ \text{CH}_3(\text{CH}_2)_{12}\text{C} - \text{O}(\text{CH}_2)_8\text{CH}=\text{CH}(\text{CH}_2)_7\text{CH}_3 \end{array}$	Hair conditioning agent; skin-conditioning agent—occlusive
Propylene glycol myristate	Ester of propylene glycol and myristic acid	$\begin{array}{c} \text{O} \qquad \text{OH} \\ \parallel \qquad   \\ \text{CH}_3(\text{CH}_2)_{12}\text{C} - \text{OCH}_2\text{CHCH}_3 \end{array}$	Skin-conditioning agent—emollient; surfactant—emulsifying agent
Tetradecyloctadecyl myristate	Ester of tetradecyloctadecanol and myristic acid	$\begin{array}{c} \text{O} \\ \parallel \\ \text{CH}_3(\text{CH}_2)_{12}\text{C} - \text{OCH}_2\text{CH}(\text{CH}_2)_{15}\text{CH}_3 \\   \\ (\text{CH}_2)_{13}\text{CH}_3 \end{array}$	Binder; emulsion stabilizer; film former; opacifying agent; skin-conditioning agent—occlusive
Tridecyl myristate	Ester of tridecyl alcohol and myristic acid	$\begin{array}{c} \text{O} \\ \parallel \\ \text{CH}_3(\text{CH}_2)_{12}\text{C} - \text{OCH}_2(\text{CH}_2)_{12}\text{CH}_3 \end{array}$	skin-conditioning agent—occlusive



**Figure 1.** General myristate formula,<sup>1</sup> in which R may be as small as a methyl group for methyl myristate or a potassium ion for potassium myristate.

Isotridecyl myristate (CAS No 96518-24-0) is also known as tetradecanoic acid, isotridecyl ester.

Lauryl myristate (CAS No 2040-64-4) is also known as dodecyl tetradecanoate; myristic acid, dodecyl ester, and tetradecanoic acid, dodecyl ester.

Magnesium myristate (CAS No 4086-70-8) is also known as tetradecanoic acid, magnesium salt.

Methyl myristate (CAS No 124-10-7) is also known as methyl tetradecanoate; myristic acid, methyl ester; and tetradecanoic acid, methyl ester.

Myristyl myristate (CAS No 3234-85-3) is also known as tetradecanoic acid, tetradecyl ester, and tetradecyl tetradecanoate.

Octyldodecyl myristate (CAS Nos 22766-83-2 and 83826-43-1) is also known as myristic acid, 2-octyldodecyl ester; 2-octyldodecyl myristate; tetradecanoic acid, octyldodecyl ester; and tetradecanoic acid, 2-octyldodecyl ester.

Oleyl myristate (CAS No 22393-93-7) is also known as 9-octadecenyl tetradecanoate and tetradecanoic acid, 9-octadecenyl ester.

Potassium myristate (CAS No 13429-27-1) is also known as potassium tetradecanoate and tetradecanoic acid, potassium salt.

Propylene glycol myristate (CAS No 29059-24-3) is also known as propylene glycol monomyristate; propylene glycol monotetradecanoate; and tetradecanoic acid, monoester with 1,2-propanediol.

Sodium myristate (CAS No 822-12-8) is also known as sodium tetradecanoate and tetradecanoic acid, sodium salt.

Tetradecyloctadecyl myristate (no CAS No) is also known as myristic acid, tetradecyloctadecyl ester.

Tridecyl myristate (CAS No 36617-27-3) is also known as tetradecanoic acid, tridecyl ester.

Zinc myristate (CAS No 16260-27-8) is also known as tetradecanoic acid, zinc salt.

### Physical and Chemical Properties

**Myristic acid.** Myristic acid occurs as a hard, white, or faintly yellow, glossy crystalline solid, as a white or yellow-white powder,<sup>16</sup> or as colorless leaflets.<sup>17</sup> Table 3 presents the physical and chemical properties of myristic acid and octyldodecyl myristate.

Myristic acid is made of tetradecanoic acid (95% minimum), hexadecanoic acid (4% maximum), and dodecanoic acid (3% maximum). Cosmetic, Toiletries and Fragrance Association ([CTFA] Table 4).<sup>25</sup>

**Table 3.** Physical Properties of Myristic Acid and Octyldodecyl Myristate

Physical Property	Value	Reference
Myristic acid		
Molecular weight	228.36	18
	228.38	19
Density (g/mL) at 70°C	0.8528	18
Melting point (°C)	58.5	18
	58	19
	54.4	20
Boiling point (°C)	250.5	18
Solubility		
Water	Insoluble	16,18,19
Ethanol	Soluble	
Methanol	Very soluble	
Chloroform	Soluble	
Benzene	Very soluble	
Ether	Very soluble	
Viscosity (cp, at 75 °C)	5.06	20
Acid value	245.7	20
Octyldodecyl Myristate		
Appearance	Oily liquid	21
Test at +8°C	Limpid	21
Odor	Faint	21
Color (Gardner Scale)	<1.5	21
Specific gravity at 20°C	1.435-1.457	21
Viscosity at 20°C	15-45 m.Pa.s	21
Acid value	< 7.00 mg KOH/g	21
Saponification value	90-110 mg KOH/g	21
Iodine value	<7.0 g I <sub>2</sub> /100 g	21
Peroxide value	<6.0 meq O <sub>2</sub> /kg	21
Alkaline impurities	<30 ppm NaOH	21
Water content	<0.50%	21
Sulphated ashes content	<0.1%	21
Heavy metals content	<10 ppm	21

**Table 4.** Comparison of Specifications<sup>a</sup>: Cosmetic and Food Grades of Myristic Acid<sup>22</sup>

Myristic acid	Cosmetics <sup>22,23</sup>	Foods <sup>16</sup>
Iodine value	0.5 maximum	1.0 maximum
Acid value	243-249	242-249
Saponification value	243-249	242-251
Unsaponifiable matter	0.2% maximum	1% maximum
Arsenic		3 ppm maximum
Heavy metals (eg, lead)		10 ppm maximum
Residue on ignition		0.1%
Titer (solidification point)	52-54°C	48-55°C
Water content		0.2%

<sup>a</sup> Cosmetic-grade myristic acid specifications for fatty acid composition is as follows: 12:0, 3% maximum; 14:0, 95% minimum; and 16:0, 4% maximum.<sup>25</sup>

**Butyl myristate.** Butyl myristate is a light, colorless, oily liquid. It is soluble in acetone, castor oil, chloroform, methanol, mineral oil, and toluene and insoluble in water. Other properties of butyl myristate include a freezing point range of 1°C to 7°C, a boiling point range of 167°C to 197°C (at 5 mm Hg), and a specific gravity between 0.850 and 0.858 at 25°C.<sup>26</sup>

**Isocetyl myristate.** Isocetyl myristate is an oily liquid with practically no odor. It has a density of 0.862, a freezing point of -39°C, and viscosity of 29.0 at 25°C. It is insoluble in water and soluble in most organic solvents. It is combustible.<sup>27</sup>

Nikko Chemicals Co, Ltd, reported that isocetyl myristate is a colorless liquid with a faint characteristic odor.<sup>28</sup> It has a

**Table 5.** Frequency of Use and Concentration of Myristic Acid and Its Salts and Esters in Cosmetics

Product Category (Total Number of Products in Each Category (FDA 2008)) <sup>69</sup>	Frequency of Use <sup>68</sup>	Concentration of Use (%) <sup>70,71</sup>
<b>Myristic Acid</b>		
<b>Bath products</b>		
Soaps and detergents (1329)	9	0.1-19
Other (138)	—	2
Eye makeup		
Eye shadow (1196)	1	0.5
Mascara (463)	2	—
<b>Noncoloring hair care products</b>		
Conditioners (1249)	9	0.00003-0.0002
Shampoos (1403)	10	0.00002-5
Tonics, dressings, etc (1097)	6	0.00002-1
Other (716)	4	—
<b>Hair-coloring products</b>		
Color sprays/aerosol (8)	—	0.00002
<b>Makeup</b>		
Blushers (539)	—	0.3
Face powders (613)	1	0.5
Foundations (635)	15	0.04-0.8
Leg and body paints (29)	2	—
Lipsticks (1912)	5	—
<b>Personal hygiene products</b>		
Underarm deodorants (540)	1	2
Douches (12)	—	4
Other (514)	2	6-9 <sup>a</sup>
<b>Shaving products</b>		
Aftershave lotions (395)	3	0.5
Shaving cream (162)	13	0.5-14
Other (107)	2	—
<b>Skin care products</b>		
Skin cleansing creams, lotions, liquids, and pads (1368)	101	0.08-15
Depilatories (62)	—	12
Face and neck creams, lotions, powder and sprays (1195)	1	39497
Body and hand creams, lotions, powder and sprays (1513)	13	0.8-10
Moisturizers (2039)	5	0.8
Night creams, lotions, powder and sprays (343)	—	0.005
Paste masks/mud packs (418)	—	4
Other (1244)	2	8
<b>Suntan products</b>		
Suntan gels, creams, liquids and sprays (156)	—	0.3
Indoor tanning preparations (200)	—	2
<b>Total uses/ranges for myristic acid</b>	<b>207</b>	<b>0.00002-20</b>
<b>Aluminum dimyristate</b>		
<b>Eye makeup</b>		
Eyeliners (684)	1	—
Eye shadow (1196)	133	0.2-3
Eye lotions (177)	—	0.09
Other (288)	1	0.3-2 <sup>b</sup>
<b>Makeup</b>		
Blushers (539)	6	0.5-2
Face powders (613)	12	0.5-2
Foundations (635)	1	0.01-2
Makeup bases (164)	1	—
Rouges (99)	13	0.4
Other (406)	4	—

(continued)



**Table 5 (continued)**

Product Category (Total Number of Products in Each Category (FDA 2008)) <sup>69</sup>	Frequency of Use <sup>68</sup>	Concentration of Use (%) <sup>70,71</sup>
Suntan products		
Other (62)	2	—
Total uses/ranges for aluminum dimyristate	174	0.01-3
Aluminum myristate		
Eye makeup		
Eye shadow (1196)	6	0.01-1
Makeup		
Blushers (539)	14	—
Face powders (613)	3	—
Total uses/ranges for aluminum myristate	23	0.01-1
Aluminum myristates/palmitates		
Makeup		
Face powders (613)	2	6
Total uses/ranges for aluminum myristates/ palmitates	2	6
Butyl myristate		
Makeup		
Lipsticks (1912)	16	—
Makeup bases (164)	6	—
Rouges (99)	1	—
Other (406)	2	—
Skin care products		
Moisturizers (2039)	1	—
Total uses/ranges for butyl myristate	26	—
Cetyl myristate		
Eye makeup		
Eye shadow (1196)	1	—
Skin care products		
Face and neck creams, lotions, powder and sprays (1195)	2	—
Body and hand creams, lotions, powder and sprays (1513)	1	6
Moisturizers (2039)	1	—
Other (1244)	2	—
Total uses/ranges for cetyl myristate	7	6
Glyceryl myristate		
Fragrance products		
Other (399)	1	—
Makeup		
Makeup bases (164)	1	—
Personal hygiene products		
Underarm deodorants (540)	1	—
Skin care products		
Face and neck creams, lotions, powder and sprays (1195)	3	—
Body and hand creams, lotions, powder and sprays (1513)	5	—
Moisturizers (2039)	5	—
Night creams, lotions, powder and sprays (343)	2	—
Paste masks/mud packs (418)	3	—
Other (1244)	2	—
Suntan products		
Suntan gels, creams, liquids and sprays (156)	1	—
Other (62)	1	—
Total uses/ranges for glyceryl myristate	25	—
Isobutyl Myristate		
Skin care products		

(continued)

**Table 5 (continued)**

Product Category (Total Number of Products in Each Category (FDA 2008)) <sup>69</sup>	Frequency of Use <sup>68</sup>	Concentration of Use (%) <sup>70,71</sup>
Body and hand creams, lotions, powder and sprays (1513)	—	30
Paste masks/mud packs (418)	—	10
Suntan products		
Suntan gels, creams, liquids and sprays (156)	—	3
Total uses/ranges for isobutyl myristate	—	3-30
Isocetyl myristate		
Makeup		
Foundations (635)	5	—
Skin care products		
Other (1244)	1	—
Total uses/ranges for isocetyl myristate	6	—
Isodecyl myristate		
Makeup		
Foundations (635)	1	—
Total uses/ranges for isodecyl myristate	1	—
Isopropyl myristate		
Baby products		
Lotions, oils, powders, and creams (132)	4	3
Bath products		
Oils, tablets, and salts (257)	21	39494
Soaps and detergents (1329)	1	0.006-1
Other (239)	2	23
Eye makeup		
Eyebrow pencils (147)	12	0.04-20
Eyeliners (684)	49	39495
Eye shadow (1196)	31	39450
Eye lotions (177)	4	—
Eye makeup remover (131)	3	—
Other (288)	4	—
Fragrance products		
Colognes and toilet waters (1288)	9	39461
Perfumes (569)	3	11
Powders (278)	3	—
Sachets (28)	10	—
Other (399)	39	58
Noncoloring hair care products		
Conditioners (1249)	45	0.5-48
Sprays/aerosol fixatives (371)	1	0.02-10
Straighteners (144)	4	—
Permanent waves (141)	1	—
Shampoos (1403)	4	0.4-1
Tonics, dressings, etc (1097)	39	0.4-23
Other (716)	13	1-10 <sup>c</sup>
Hair-coloring products		
Dyes and colors (2481)	1	30 <sup>d</sup>
Shampoos (48)	1	—
Color sprays (8)	1	—
Bleaches (152)	2	22
Makeup		
Blushers (539)	36	0.07-2
Face powders (613)	16	0.3-4
Foundations (635)	39	0.001-14
Leg and body paints (29)	1	—
Lipsticks (1912)	49	39472
Makeup bases (164)	8	—
Makeup fixatives (38)	1	—

(continued)

**Table 5 (continued)**

Product Category (Total Number of Products in Each Category (FDA 2008)) <sup>69</sup>	Frequency of Use <sup>68</sup>	Concentration of Use (%) <sup>70,71</sup>
Other (406)	14	2-3 <sup>f</sup>
Nail care products		
Basecoats and undercoats (62)	1	—
Cuticle softeners (18)	2	39537
Creams and lotions (17)	1	38
Nail polish and enamel removers (41)	1	—
Other (124)	2	—
Personal hygiene products		
Underarm deodorants (540)	10	0.08-51
Feminine deodorants (21)	5	39579
Other (514)	13	3-60 <sup>g</sup>
Shaving products		
Aftershave lotions (395)	11	—
Preshave lotions (27)	8	17
Shaving cream (162)	5	1
Other (107)	6	—
Skin care products		
Skin cleansing creams, lotions, liquids, and pads (1368)	52	39468
Depilatories (62)	2	—
Face and neck creams, lotions, powder and sprays (1195)	48	0.4-5
Body and hand creams, lotions, powder and sprays (1513)	157	2-39
Foot powders and sprays (48)	2	—
Moisturizers (2039)	129	0.2-17
Night creams, lotions, powder and sprays (343)	26	0.1-5
Paste masks/mud packs (418)	10	39521
Skin fresheners (285)	—	3
Other (1244)	61	3-82 <sup>h</sup>
Suntan products		
Suntan gels, creams, liquids and sprays (156)	22	39486
Indoor tanning preparations (200)	6	—
Other (62)	6	1-3 <sup>i</sup>
Total uses/ranges for isopropyl myristate	1057	0.001-82
Lauryl myristate		
Noncoloring hair care products		
Shampoos (1403)	3	—
Total uses/ranges for lauryl myristate	3	—
Magnesium myristate		
Eye makeup		
Eyeliners (684)	—	0.5
Eye shadow (1196)	76	0.6-7
Eye lotions (177)	1	—
Mascara (463)	1	—
Other (288)	1	6 <sup>k</sup>
Fragrance products		
Powders (278)	2	5
Other (399)	1	—
Makeup		
Blushers (539)	6	0.2-5
Face powders (613)	80	0.3-10
Foundations (635)	9	0.05-0.09
Lipsticks (1912)	—	3
Makeup bases (164)	—	0.0001
Rouges (99)	1	—
Makeup fixatives (38)	2	—

(continued)

**Table 5 (continued)**

Product Category (Total Number of Products in Each Category (FDA 2008)) <sup>69</sup>	Frequency of Use <sup>68</sup>	Concentration of Use (%) <sup>70,71</sup>
Other (406)	9	—
Nail care products		
Nail polishes and enamels (17)	1	—
Skin care products		
Body and hand creams, lotions, powder and sprays (1513)	—	5
Other (1244)	1	—
Suntan products		
Indoor tanning preparations (200)	1	—
Other (62)	2	—
Total uses/ranges for magnesium myristate	194	0.0001-10
Myristyl myristate		
Baby products		
Lotions, oils, powders, and creams (132)	14	39448
Other (138)	1	—
Bath products		
Oils, tablets, and salts (257)	5	—
Eye makeup		
Eyebrow pencils (147)	6	6
Eyeliners (684)	8	39611
Eye shadow (1196)	8	39575
Eye lotions (177)	5	0.4-4
Other (288)	7	4-6 <sup>i</sup>
Fragrance products		
Perfumes (569)	—	39494
Other (399)	6	—
Noncoloring hair care products		
Conditioners (1249)	8	—
Rinses (47)	1	—
Shampoos (1403)	3	—
Tonics, dressings, etc (1097)	1	—
Other (716)	—	2 <sup>l</sup>
Makeup		
Blushers (539)	1	1
Face powders (613)	—	0.5
Foundations (635)	7	0.8-5
Leg and body paints (29)	2	39605
Lipsticks (1912)	18	39607
Makeup bases (164)	3	—
Other (406)	5	3-7 <sup>m</sup>
Nail care products		
Cuticle softeners (18)	1	3
Creams and lotions (17)	1	2
Other (124)	2	—
Personal hygiene products		
Underarm deodorants (540)	6	2
Other (514)	—	3
Shaving products		
Aftershave lotions (395)	9	2
Shaving cream (162)	7	0.3
Skin care products		
Skin cleansing creams, lotions, liquids, and pads (1368)	4	2
Face and neck creams, lotions, powder and sprays (1195)	26	0.5-8
Body and hand creams, lotions, powder and sprays (1513)	51	39449
Foot powders and sprays (48)	1	—

(continued)

**Table 5 (continued)**

Product Category (Total Number of Products in Each Category (FDA 2008)) <sup>69</sup>	Frequency of Use <sup>68</sup>	Concentration of Use (%) <sup>70,71</sup>
Moisturizers (2039)	63	0.5-3
Night creams, lotions, powder and sprays (343)	10	2
Paste masks/mud packs (418)	5	0.5
Skin fresheners (285)	1	—
Other (1244)	6	39449
Suntan products		
Suntan gels, creams, liquids and sprays (156)	—	7
Indoor tanning preparations (200)	2	2
Total uses/ranges for myristyl myristate	??	0.3-17
Octyldodecyl Myristate		
Baby products		
Lotions, oils, powders, and creams (132)	2	—
Eye makeup		
Eyebrow pencils (147)	—	0.3
Eyeliners (684)	1	2
Eye shadow (1196)	3	0.3
Eye lotions (177)	1	2
Mascara (463)	1	—
Other (288)	1	—
Fragrance products		
Other (399)	2	—
Noncoloring hair care products		
Tonics, dressings, etc (1097)	1	—
Makeup		
Blushers (539)	2	0.007
Face powders (613)	2	—
Foundations (635)	8	39518
Lipsticks (1912)	10	0.07-21
Shaving products		
Aftershave lotions (395)	4	1
Preshave lotions (27)	2	—
Skin care products		
Skin cleansing creams, lotions, liquids, and pads (1368)	2	—
Face and neck creams, lotions, powder and sprays (1195)	9	39510
Body and hand creams, lotions, powder and sprays (1513)	8	0.9-4
Moisturizers (2039)	16	0.5-2
Paste masks/mud packs (418)	3	—
Skin fresheners (285)	—	0.3
Other (1244)	10	1
Suntan products		
Indoor tanning preparations (200)	7	—
Other (62)	—	1
Total uses/ranges for octyldodecyl myristate	95	0.007-21
Potassium Myristate		
Bath products		
Soaps and detergents (1329)	5	—
Eye makeup		
Eyeliners (684)	1	—
Other (288)	1	—
Makeup		
Foundations (635)	1	—
Skin care products		
Skin cleansing creams, lotions, liquids, and pads (1368)	18	39574

(continued)

**Table 5 (continued)**

Product Category (Total Number of Products in Each Category (FDA 2008)) <sup>69</sup>	Frequency of Use <sup>68</sup>	Concentration of Use (%) <sup>70,71</sup>
Other (1244)	1	—
Total uses/ranges for potassium myristate	27	5-7
Propylene glycol myristate		
Eye makeup		
Other (288)	1	—
Makeup		
Lipsticks (1912)	2	5
Other (406)	1	—
Skin care products		
Face and neck creams, lotions, powder and sprays (1195)	1	4
Body and hand creams, lotions, powder and sprays (1513)	3	—
Moisturizers (2039)	1	—
Other (1244)	4	—
Suntan products		
Suntan gels, creams, liquids and sprays (156)	2	6
Total uses/ranges for propylene glycol myristate	15	4-6
Sodium myristate		
Bath products		
Soaps and detergents (1329)	3	0.5-6
Noncoloring hair care products		
Conditioners (1249)	1	—
Shampoos (1403)	3	—
Personal hygiene products		
Underarm deodorants (540)	1	0.2
Skin care products		
Skin cleansing creams, lotions, liquids, and pads (1368)	6	—
Face and neck creams, lotions, powder and sprays (1195)	1	—
Total uses/ranges for sodium myristate	15	0.2-6
Zinc myristate		
Eye makeup		
Eyebrow pencils (147)	—	4
Eyeliners (684)	1	5
Eye shadow (1196)	50	0.5-6
Eye lotions (177)	—	0.05
Other (288)	9	—
Fragrance products		
Powders (278)	—	5
Makeup		
Blushers (539)	33	0.3-3
Face powders (613)	18	39526
Foundations (635)	5	0.001-6
Lipsticks (1912)	—	5
Makeup bases (164)	—	5
Other (406)	1	—
Nail care products		
Basecoats and undercoats (62)	—	0.00005
Nail polishes and enamels (419)	5	—
Skin care products		
Face and neck creams, lotions, powder and sprays (1195)	—	5
Suntan products		

(continued)

Table 5 (continued)

Product Category (Total Number of Products in Each Category (FDA 2008)) <sup>69</sup>	Frequency of Use <sup>68</sup>	Concentration of Use (%) <sup>70,71</sup>
Suntan gels, creams, liquids and sprays (156)	—	0.1
Total uses/ranges for zinc myristate	122	0.00005-20

<sup>a</sup> 6% in a shower gel; 9% in a body scrub.

<sup>b</sup> 0.3% in a lash powder; 2% in a brow powder wax.

<sup>c</sup> 1% in an aerosol hair shine; 10% in a hair oil treatment.

<sup>d</sup> 5% after dilution.

<sup>e</sup> 11% after dilution.

<sup>f</sup> 4% in a lip liner pencil.

<sup>g</sup> 4% in a body scrub.

<sup>h</sup> 4% in a foot lotion; 82% in a massage oil.

<sup>i</sup> 1% and 3% in tanning oils.

<sup>j</sup> 6% in a lash powder.

<sup>k</sup> 4% in an eye pencil.

<sup>l</sup> 2% in a hairdressing crème conditioner.

<sup>m</sup> 7% in a concealer.

<sup>n</sup> 0.7% in a moisturizing sprays.

maximum acid value of 1 and a saponification value range of 120 to 130.

**Isopropyl myristate.** Isopropyl myristate is a colorless, almost odorless, mobile liquid with a bland taste. It is soluble in acetone, castor oil, chloroform, cottonseed oil, ethanol, ethyl acetate, mineral oil, and toluene and insoluble in water, glycerol, sorbitan, and propylene glycol. It is miscible with liquid hydrocarbons and fixed oils, and it dissolves lanolin, cholesterol, and many waxes.<sup>29-31</sup>

**Octyldodecyl myristate.** 2-Octyldodecyl myristate is a colorless, odorless liquid with a maximum acid value of 0.5, saponification value range from 105 to 111, and a maximum hydroxyl value of 5.0. On ignition, the residue has a maximum of 0.5%.<sup>32</sup>

Gattefossé<sup>22</sup> stated that octyldodecyl myristate was slightly soluble in ethanol at 96°C, soluble in chloroform and methylene chloride, insoluble in water, and freely soluble in mineral oils.

**Potassium myristate.** Potassium myristate is a white-to-pale yellow solid with a faint characteristic odor.<sup>33</sup>

### Ultraviolet Absorption

**Glyceryl myristate.** Glyceryl myristate has UV absorption  $\lambda_{\text{max}}$  of 238 nm and  $\lambda_{\text{min}}$  of 270 nm.<sup>34</sup>

### Reactivity

The myristate esters can be expected to undergo chemical or enzymatic hydrolysis to myristic acid and the corresponding alcohol. Transesterification and other typical ester reactions may also occur. Butyl myristate, if synthesized from a pure, saturated fatty acid, would not significantly autoxidize, discolor, or develop an odor.<sup>35</sup>

### Methods of Manufacture

Aluminum dimyristate, aluminum myristate, butyl myristate, calcium myristate, decyl myristate, ethylhexyl myristate, ethyl myristate, glyceryl dimyristate, glyceryl myristate, isobutyl myristate, isocetyl myristate, isodecyl myristate, isopropyl myristate, isotridecyl myristate, lauryl myristate, magnesium myristate, methyl myristate, myristyl myristate, octyldodecyl myristate, potassium myristate, propylene glycol myristate, sodium myristate, tetradecyloctadecyl myristate, tridecyl myristate, and zinc myristate have plant and synthetic sources. Aluminum isostearates/myristates, aluminum myristates/palmitates, cetyl myristate, glyceryl isostearate/myristate, isostearyl myristate, and oleyl myristate have plant, animal, and synthetic sources.<sup>15</sup>

**Myristic acid.** According to the CTFA (now the Personal Care Products Council [the Council]), myristic acid is produced commercially by the saponification and fractionation of animal or vegetable fats and oils. The isolated acid fraction is hydrogenated to produce the saturated fatty acid.<sup>35</sup>

Myristic acid is a solid organic acid usually obtained from coconut oil, nutmeg butter (*Myristica fragrans* Houtt), palm seed oils, and milk fats.<sup>18,20</sup> Seed oils of the plant family, Myristaceae, contain the largest amounts of myristic acid (up to 80%), but small amounts have been measured in most animal fats and vegetable oils.

The following methods have been used in the preparation of myristic acid: isolation from tail-oil fatty acids, from 9-ketotetradecanoic acid; by electrolysis of a mixture of methyl hydrogen adipate and decanoic acid, by Maurer oxidation of myristanol; and from cetanol.<sup>18</sup> The most common means of preparation is by fractional distillation of hydrolyzed coconut oil, palm kernel oil,<sup>36</sup> or coconut acids.<sup>17</sup>

**Butyl myristate.** Butyl myristate is derived from the esterification of myristic acid and butyl alcohol in the presence of an

acid catalyst. The product is stripped to remove excess alcohol and alkali refined to neutralize the catalyst. Butyl myristate is obtained through fractional distillation.<sup>35</sup>

**Isocetyl myristate.** Nikko Chemicals Co, Ltd, reported that isocetyl myristate is produced by the esterification of isocetyl alcohol and myristic acid.<sup>37</sup>

**Isopropyl myristate.** Isopropyl myristate is commercially produced by distillation, which is preceded by the esterification of myristic acid and isopropanol, in the presence of an acid catalyst. The product is stripped to remove excess isopropanol, alkali refined to neutralize the catalyst, and then the product is distilled to obtain isopropyl myristate.<sup>38</sup>

**Methyl myristate.** Methyl myristate is derived by the esterification of myristic acid with methanol or alcoholysis of coconut oil with methanol.<sup>27</sup> It is purified by vacuum fractional distillation.

**Myristyl myristate.** Myristyl myristate is produced by the esterification of myristic acid and myristyl alcohol in the presence of an acid catalyst. The product is stripped to remove excess myristyl alcohol; alkali is used to neutralize the catalyst, and then purified to separate myristyl myristate.<sup>39</sup>

**Octyldodecyl myristate.** Octyldodecyl myristate is produced by the esterification of myristic acid with 2-octyl dodecanol, manufactured from vegetable sources.<sup>22,40,41</sup>

**Potassium myristate.** Potassium myristate is produced by the reaction of potassium hydroxide and myristic acid.<sup>42</sup>

Reacting lauric acid, myristic acid, and palmitic acid with water, glycerin, potassium hydroxide, and tetrasodium EDTA produces a product containing potassium myristate (15%) as well as potassium cocoate (23%), EDTA-4Na (0.2%), and water (61.8%).<sup>43</sup>

## Analytical Methods

The myristates can be analyzed by thin-layer chromatography (TLC),<sup>44</sup> gas-liquid chromatography,<sup>45</sup> and x-ray powder diffraction.<sup>46</sup>

Two basic methods for the analysis of the fatty acids have been reported by the cosmetic industry. Primarily, gas chromatography (GC) of fatty acid methyl esters, prepared by the boron trifluoride–methanol method, is used for the separation and relative identification of fatty acids in a mixture.<sup>47,48</sup> Infrared spectra of the fatty acids are used for fingerprinting, functional group identification, and impurity screening.<sup>23,49–53</sup> Determination of physicochemical properties also aids in positive identification of a specific fatty acid.<sup>20,47</sup>

Flame ionization detection (FID) is usually coupled with the GC of fatty acid methyl esters. Mass spectrometry (MS) has also been used with GC for compound identification.<sup>54</sup>

Thin-layer chromatography and high-performance liquid chromatography (HPLC) are also used in fatty acid identification and quantitation.<sup>54–57</sup> Methods of detection include UV, fluorescence spectroscopic, and refractive index detection.

Mass spectrometry with temperature profiling of the chemical ionization source has been reported as a method for initial compound separation. Its coupling with a second MS allows direct analysis of complex lipid sources.<sup>58</sup> Other separation methods include centrifugal liquid and adsorption chromatography.<sup>59</sup> Identification procedures range from methods such as gravimetry<sup>47</sup> and histochemical staining<sup>60</sup> to ultraviolet, infrared, and nuclear magnetic resonance spectroscopy.<sup>20,61,62</sup>

Cotte et al<sup>63</sup> used Fourier-transform infrared (FT-IR) microscopy to locate myristic acid in dermal layers.

## Impurities

**Myristic acid.** The myristates used as cosmetic ingredients are mixtures of fatty esters, as the myristic acid and alcohols used in the preparation of these ingredients are themselves mixtures of acids and alcohols, respectively. The CTFA Cosmetic Ingredient Chemical Description<sup>51</sup> for myristic acid lists the following as component acids:

- n-tetradecanoic acid,  $\text{CH}_3(\text{CH}_2)_{12}\text{COOH}$  (95% minimum),
- n-hexadecanoic acid,  $\text{CH}_3(\text{CH}_2)_{14}\text{COOH}$  (4% maximum),
- and n-dodecanoic acid,  $\text{CH}_3(\text{CH}_2)_{10}\text{COOH}$  (3% maximum).

Myristic acid may contain unsaponifiable material, mostly hydrocarbons, at a maximum concentration of 0.2%, and some grades may contain glyceryl monomyristate at a maximum concentration of 0.07%. Butylated hydroxytoluene (BHT) may be present as an added antioxidant.<sup>51</sup>

**Butyl myristate.** Minor impurities, which may be present, are fatty acids (such as myristic acid) at a maximum of 0.2%.<sup>35</sup>

**Glyceryl myristate.** Impurities in glyceryl myristate include glycerol (0.3%), diglycerol (0.57%), and free fatty acid (0.14%).<sup>64,65</sup> The ratio of 1,2-(mono)glycerol diester to total (mono)glycerol diester is 27.8. Specifications include monoester content (minimum 90%), free glycerol (maximum 1%), and free fatty acids (maximum 1.5%). The typical value for heavy metals (as lead) in glyceryl myristate is <10 mg/kg.

**Isocetyl myristate.** Isocetyl myristate is 95% pure with a maximum of heavy metals of 20 ppm and arsenic of 2 ppm.<sup>28</sup>

**Isopropyl myristate.** Isopropyl myristate may have myristic acid, other free fatty acids are present at a maximum concentration of 1.0%, and unsaponifiable material is present at a maximum concentration of 0.2%. There are no known diluents, solvents, or additives present.<sup>38</sup>

The ester composition is varied according to the specific usage requirement, provided that the specification limits conform to the following: isopropyl myristate, not less than



90.0% (limits,  $\pm 5.0\%$ ); isopropyl palmitate, not more than 10.0% (limits,  $\pm 3.0\%$ ); and isopropyl laurate, tridecanoate, pentadecanoate, heptadecanoate, and stearate, none more than 10.0% (limits, 2.0% each).<sup>66</sup>

**Methyl myristate.** Technical grade methyl myristate is 93% pure and can be purified to >99.8%.<sup>27</sup> Spectrum Chemicals and Laboratory Products<sup>67</sup> stated that a sample of methyl myristate was 99.4% pure. Impurities were not listed.

**Myristyl myristate.** Myristyl myristate may have free fatty acids, mainly myristic acid, at a maximum concentration of 1.5%. There are no known diluents, solvents, or additives present.<sup>39</sup>

**Octyldodecyl myristate.** Nikko Chemicals Co, Ltd<sup>32</sup> stated that 2-octyldodecyl myristate has a maximum of 20 ppm heavy metals and 2 ppm arsenic.

**Potassium myristate.** Nikko Chemicals Co, Ltd<sup>34</sup> stated that potassium myristate has a maximum of 40 ppm heavy metals and 2 ppm arsenic.

## Use

### Cosmetic

Use information is supplied to the US Food and Drug Administration (FDA) by industry as part of the Voluntary Cosmetic Ingredient Reporting Program (VCRP).<sup>68</sup> Use concentration information is gathered by the Personal Care Products Council (Council) unless noted otherwise. Table 5 presents the use and concentration of myristic acid and its salts and esters in cosmetics.

There were no uses or use concentrations reported for the following:

- aluminum isostearates/myristates,
- calcium myristate,
- decyl myristate,
- ethyl myristate,
- ethylhexyl myristate,
- glyceryl dimyristate,
- glyceryl isostearate/myristate,
- glyceryl myristate,
- isostearyl myristate,
- isotridecyl myristate,
- oleyl myristate,
- tetradecyloctadecyl myristate, or
- tridecyl myristate.

**Butyl myristate.** Butyl myristate was used in 26 cosmetic products in 2007. Concentration of use data were not reported, although in 1990, concentrations ranged from 1% to 50%.<sup>1</sup>

**Glyceryl myristate.** Glyceryl myristate was used in 25 cosmetic products in 2007; no use concentrations were reported, although in 1998, its concentrations ranged from 1% to 6%.

### Cosmetic Aerosols

Cetyl myristate is used in 2 face and neck creams, lotions, powders, and sprays.

The potential adverse effects of inhaled aerosols depend on the specific chemical species, the concentration, the duration of the exposure, and the site of deposition within the respiratory system.<sup>72</sup> In general the smaller the particle, the farther into the respiratory tree the particle will deposit and the greater the impact on the respiratory system.<sup>73</sup>

Anhydrous hair spray particle diameters of 60 to 80  $\mu\text{m}$  have been reported, and pump hair sprays have particle diameters of  $\geq 80 \mu\text{m}$ .<sup>74</sup> The mean particle diameter is around 38  $\mu\text{m}$  in a typical aerosol spray.<sup>75</sup> In practice, aerosols should have at least 99% of particle diameters in the 10 to 110  $\mu\text{m}$  range. This means that most aerosol particles are deposited in the nasopharyngeal region and are not respirable.

### Noncosmetic

Myristic acid is used in foods as a plasticizing, lubricating, binding, and defoaming agent and as a reagent in the manufacture of other food-grade additives.<sup>16,36,76</sup> Myristic acid is used as a flavoring agent in foods.<sup>17</sup>

Straight-chain monobasic carboxylic acids from fats and oils derived from edible sources, such as the fatty acid myristic acid, are accepted as safe for use in food and in the manufacture of food-grade additives, provided they meet particular conditions and specifications. The unsaponifiable matter in the fatty acid or fatty acid-derived food additive must not exceed 2%, the food additive must be free of chick-edema factor, and it must be produced and labeled in accordance with good manufacturing practice.<sup>77</sup>

Butyl myristate is also used as a plasticizer, as a lubricant for textiles, and in paper stencils.<sup>78</sup>

Both ethyl and methyl myristate are generally recognized as safe food additives by the FDA.<sup>79</sup>

## General Biology

### Metabolism and Absorption

**Myristic acid.** Like other higher molecular weight aliphatic esters, the myristates are readily hydrolyzed to the corresponding alcohols and acids, which are then further metabolized.<sup>76</sup> Myristic acid is a digestible constituent of most vegetable and animal fats and is nontoxic when ingested.<sup>80</sup>

Rioux et al<sup>81</sup> incubated cultured Sprague-Dawley rat hepatocytes in radiolabeled myristic acid for 3, 6, 12, and 2 hours. Electrophoresis of the products revealed that myristic acid (4 nmol/L) was metabolized into 18 well-resolved proteins in the 10 to 20 kd range.

Cotte et al<sup>63</sup> used FT-IR to measure the penetration of pre-deuterated myristic acid in pig ear skin using Franz diffusion cells. After 1 day, myristic acid penetrated to the epidermis. For comparison, palmitic acid was detected in the stratum corneum and did not penetrate any further.

**Ethyl myristate.** Savary and Constant<sup>82</sup> orally administered ethyl myristate mixed with olive oil in the feed (90% boiled rice, 10% lipid by wet weight) of rats with thoracic-duct fistula. Lymph was collected for 24 to 100 hours. The ester was recovered in small quantities in the thoracic-duct lymph. In the hydrolysis of lymph triglycerides, fatty acid yields from total dietary lipids were 55 mg/h coming from total dietary lipids and 22 mg/h coming from dietary monoalcohol fatty ester.

**Ethyl and methyl myristate.** Hydrolysis of ethyl myristate (emulsified in buffer) by rat pancreatic juice or pure porcine pancreatic lipase was at a lower relative rate (25% and 31%, respectively) than tetradecyl butyrate (100% and 110%), hexadecyl formate (55% and 80%), hexadecyl propionate (37% and 46%), hexadecyl butyrate (100% and 100%), and *n*-hexyl laurate (110% and 150%). The relative rates of hydrolysis for methyl myristate were 61% and 90%, respectively.<sup>83</sup>

**Isopropyl myristate.** Four monkeys were exposed for 5 seconds to the spray of an aerosol antiperspirant containing <sup>14</sup>C-labeled isopropyl myristate.<sup>84</sup> Two animals were killed immediately after exposure, and the other 2 were killed 24 hours later. The distribution of <sup>14</sup>C in the exhaled air and in several tissues indicated that only 0.25% of the dose sprayed at the animals was absorbed; about 10% of this reached the lower respiratory tract. Some 85% of the absorbed isopropyl myristate was eliminated in 24 hours, mainly as exhaled carbon dioxide; very little labeled material reached any tissues other than the lungs.

Suzuki et al<sup>85</sup> reported that <sup>14</sup>C-labeled isopropyl myristate penetrated into sebaceous glands, stratum spinosum, hair infundibula, and follicles.

Brinkmann and Müller-Goymann<sup>86</sup> used differential scanning calorimetry, wide-angle x-ray diffraction, and small-angle x-ray diffraction to examine human abdominal and breast skin soaked in isopropyl myristate. The authors reported a slight increase in the short distance of orthorhombically arranged lipids, while that of hexagonally packed lipids decreased. The long distance of the lamellar structure was unaffected. Isopropyl myristate insertion caused a more densely packed lipid order. The authors suggest that isopropyl myristate does a lateral insertion into lipophilic areas of the stratum corneum microstructure with an anchoring of the isopropyl group in the polar region of the layer.

### Dermal Penetration Enhancement

Myristic acid has been tested for its ability to enhance the dermal penetration of a number of chemicals. In most cases, skin treated with myristic acid increased dermal penetration.<sup>87-90</sup> Enhanced penetration was also observed by butyl myristate.

Testing of isopropyl myristate showed mixed results regarding dermal penetration enhancement.<sup>90-96</sup>

### Other Effects

#### Dermal

**Isopropyl myristate.** Suzuki et al<sup>85</sup> reported that isopropyl myristate induced acanthosis, edematous degeneration of collagen fibers, and changes in blood vessels when applied to Angora rabbits.

#### Enzyme

**Methyl myristate.** Osama et al<sup>97</sup> reported that the half maximal inhibitory concentration (IC<sub>50</sub>) of methyl myristate for the inhibition of rat brain prostaglandin D synthase and swine brain prostaglandin D<sub>2</sub> dehydrogenase was >200 µmol/L in both cases.

#### Cytotoxicity

**Methyl myristate.** Takeara et al<sup>98</sup> used the 3-(4,5-dimethylthiazole-2-yl)-2,5-diphenyl tetrazolium bromide (MTT) test to evaluate the cytotoxicity of methyl myristate on 4 strains of leukemia cells. For acute promyeloblastic leukemia (HL-60) cells, the IC<sub>50</sub> was 4.68 (1.52-14.44 confidence interval [CI]) µg/mL, >6.25 µg/mL for chronic myelogenic leukemia (K-526) cells, >6.25 µg/mL for lymphoblastic leukemia (CEM) cells, and 4.31 (3.66-5.09 DI) µg/mL for T-cell leukemia (Molt-4) cells.

### Animal Toxicology

#### Acute Oral Toxicity

Data from a previous assessment of myristic acid showed that little acute toxicity was observed at oral doses of 15 to 19 g/kg body weight of 2.2% to 13% myristic acid in rats.<sup>2</sup> In an acute oral toxicity study of butyl myristate in rats, the LD<sub>50</sub> was >8g/kg. The acute oral LD<sub>50</sub> for undiluted isopropyl myristate is >16 mL/kg in rats and 49.7 mL/kg in mice.<sup>1</sup>

**Butyl myristate.** An acute oral toxicity study of butyl myristate was conducted using 10 rats (strain/sex not provided). Daily observations were made over a period of 14 days. The LD<sub>50</sub> was >8 g/kg. No data on weights of animals tested, ranges of chemical concentration tested, or responses of individual rats were available.<sup>35</sup>

Laboratoire de Recherche et d'Experimentation<sup>99</sup> orally administered butyl myristate (2000 mg/kg) to male NMRI EOPS mice (n = 5). The mice were observed for 6 days. There was no mortality, and no clinical or behavioral signs were observed. Weight gain was satisfactory.

**Ethyl myristate.** Food and Drug Research Laboratories, Inc,<sup>100</sup> orally treated 10 rats (strain/sex not provided) with 5 g/kg ethyl myristate. Over a 14-day observation period, none of these animals died.

### Acute Dermal Toxicity

Butyl myristate (2g/kg) was nontoxic and nonirritating when applied to the skin of rabbits.<sup>101</sup>

**Ethyl myristate.** Food and Drug Research Laboratories, Inc.,<sup>100</sup> dermally treated 10 rabbits with 5 g/kg ethyl myristate. Over a 7-day observation period, 2 of 10 animals died.

**Isopropyl myristate.** The acute dermal toxicity of undiluted isopropyl myristate and 3 product formulations containing isopropyl myristate were evaluated. Isopropyl myristate was considered nontoxic to the animals tested (rabbits and guinea pigs).

### Acute Parenteral Toxicity

Previous safety assessments noted that the intraperitoneal and subcutaneous LD<sub>20</sub> for isopropyl myristate exceeded 79.5 mL/kg in rats and the intraperitoneal LD<sub>50</sub> exceeded 50.2 mL/kg in mice.<sup>1</sup>

### Sub-Chronic Dermal Toxicity

Previous safety assessments noted that myristic acid produced slight irritation after topical application to the skin of the external ear canal of 4 albino rabbits. No adverse effects were produced from subchronic topical application of myristic acid to rabbit skin.<sup>2</sup>

Subchronic dermal toxicity studies with product formulations containing 16% to 47% isopropyl myristate showed no toxicity over 4 weeks.<sup>1</sup> Butyl myristate and isopropyl myristate were nontoxic when applied to the skin of rabbits. Isopropyl myristate was moderately-to-severely irritating when applied for 3 consecutive days to the clipped skin of rabbits. Butyl myristate was considered moderately irritating in rabbits in one study and nonirritating in another.

### Inhalation Toxicity

Previous safety assessments cited acute inhalation toxicity studies in rats showing no adverse effects from 2 product formulations containing 16% to 20% isopropyl myristate.<sup>1</sup> No toxic effects were observed in subchronic inhalation toxicity studies in guinea pigs and in cynomolgus monkeys.

### Chronic Toxicity

No chronic toxicity data were found.

### Ocular Irritation

Previous safety assessments cited Draize testing of myristyl myristate and isopropyl myristate at concentrations up to 100% that produced minimum eye irritation in rabbits.<sup>1</sup> Butyl myristate (no concentration provided) was considered nonirritating to the rabbit eye. Undiluted isopropyl myristate produced

only minimal eye irritation in rabbits. Myristic acid (1.5%) was minimally irritating to the eyes of rabbits.<sup>2</sup>

### Dermal Sensitization

Previous safety assessments cited data showing that butyl myristate was a moderate skin irritant when intradermally administered to guinea pigs but was not a sensitizer.<sup>1</sup> Isopropyl myristate did not produce sensitization in guinea pigs. Myristyl myristate produced minimal skin irritation but no sensitization in guinea pigs administered myristyl myristate topically or intracutaneously.

### Comedogenicity

**Isopropyl and myristyl myristate.** Treatment with isopropyl myristate resulted in comedogenic activity in the rabbit ear assay.<sup>102-104</sup>

Nguyen et al<sup>105</sup> applied myristyl myristate (50% in petrolatum; 0.5 g) and isopropyl myristate (50% in various mediums; 0.5 g) to the glabrous inner portion of both ears of New Zealand white rabbits (n = 6; male and female; 6 weeks old) for 5 days per week (Monday to Friday) for 4 consecutive weeks. The ears were then biopsied and scored for comedones through clinical examination and slide biopsy. The control substance was crude coal tar (10%). Isopropyl myristate was found to be comedogenic in all media; myristyl myristate was less comedogenic.

### Genotoxicity

**Isopropyl myristate.** Blevins and Taylor<sup>106</sup> reported that isopropyl myristate tested negative in the *Salmonella*/microsome test in strains TA1538, TA1537, TA1535, TA100, and TA98, with and without activation.

### Carcinogenicity

Previous safety assessments noted that isopropyl myristate was not carcinogenic on the skin of mice, but a mixture of isopropyl myristate and isopropyl alcohol significantly accelerated the carcinogenic activity of benzo(a)pyrene on the skin.<sup>1</sup>

### Clinical Assessment of Safety

**Previous safety assessments on the following ingredients are summarized below:**

**Isopropyl myristate.** <sup>1</sup> Human primary skin irritation studies showed no reactions to isopropyl myristate alone and a mild irritation from product formulations containing 15% to 58% isopropyl myristate. Repeated application of undiluted isopropyl myristate for 21 days produced only slight irritation. Isopropyl myristate was not a human skin sensitizer when in petrolatur or in product formulations at 15% to 58%, although a case report of sensitization was found. A product containing 43% isopropyl myristate produced no phototoxicity and no photocontact allergenicity in human studies.

**Myristic acid.**<sup>2</sup> In clinical primary and cumulative irritation studies, myristic acid at concentrations of 100% or 40% to 50% in mineral oil were nonirritating. Mild-to-intense erythema in single insult occlusive patch tests, soap chamber tests, and 21-day cumulative irritation studies were produced by cosmetic product formulations containing 2% to 93% myristic acid, and were generally not related to the fatty acid concentrations in the formulations. The Expert Panel also considered data from other fatty acids (oleic, lauric, pamic, and stearic) due to the structural similarities among these ingredients.

### Dermal Sensitization

**Ethyl myristate.** Kligman<sup>107</sup> applied ethyl myristate for 5 alternate-day 48-hour periods on the volar side of the arm of 25 participants after pretreatment for 24 hours with 2.5% aqueous sodium lauryl sulfate under occlusion. Sodium lauryl sulfate (5%-15%) was applied to the test site for 1 hour before the application of the challenge. There were no signs of sensitization for either the 48- or 72-hour challenge. It was not stated in the text, but according to the Research Institute for Fragrance Materials (RIFM),<sup>108</sup> ethyl myristate was tested at 12%.

### Provocative Skin Testing

**Isopropyl myristate.** Uter et al<sup>109</sup> performed a retroactive study of dermatitis patients patch tested for sensitization to isopropyl myristate. Isopropyl myristate was tested in 20% petrolatum using 8117 patients and 10% petrolatum using 4554 patients between January 1992 and December 2001. The higher concentration had 43 doubtful reactions, 5 irritant reactions, 6 + reactions, and 2 ++/+++ reactions. The lower concentration had 9 doubtful reactions, 2 irritant reactions, 7 + reactions, and 1 ++/+++ reaction. The authors concluded that isopropyl myristate does not need to be tested for during routine patch tests.

### Case Reports

**Isopropyl myristate.** Bharati and King<sup>110</sup> reported a 64-year-old woman who presented with an eczematous rash from a commercial sunscreen. Patch testing of the European standard series gave positive results for formaldehyde, quaternium-15, imidazolidinyl urea, and diazolidinyl urea. A further patch test of the ingredients in the sunscreen resulted in positive reactions for isohexadecane 10% alcohol and isopropyl myristate 10% alcohol.

### Summary

This report addressed the safety of the following inorganic salts and esters of various fatty alcohols of myristic acid, including:

- aluminum dimyristate,
- aluminum isostearates/myristates,
- aluminum myristate,
- aluminum myristates/palmitates,

- butyl myristate,
- calcium myristate,
- cetyl myristate,
- decyl myristate,
- ethylhexyl myristate,
- ethyl myristate,
- glyceryl dimyristate,
- glyceryl isostearate/myristate,
- glyceryl myristate,
- isobutyl myristate,
- isocetyl myristate,
- isodecyl myristate,
- isopropyl myristate,
- isostearyl myristate,
- isotridecyl myristate,
- lauryl myristate,
- magnesium myristate,
- methyl myristate,
- myristyl myristate,
- octyldodecyl myristate,
- oleyl myristate,
- potassium myristate,
- propylene glycol myristate,
- sodium myristate,
- tetradecyloctadecyl myristate,
- tridecyl myristate, and
- zinc myristate.

Most of the esters are used as skin conditioning agents in cosmetics, but other functions include the following: anticaking agents, emulsion stabilizers, viscosity increasing agents, surfactants—cleansing agents, surfactants—emulsifying agents, slip modifiers, fragrance ingredients, hair conditioning agents, binders, film formers, and opacifying agents.

Myristic acid is produced by the saponification and fractionation of animal or vegetable fats and oils followed by isolation of the acid fraction that is then hydrogenated.

Analytical methods include TLC, gas-liquid chromatography, x-ray powder diffraction, GC, infrared spectrometry, HPLC, MS, gravimetry, and histochemical staining.

Component fatty acids of myristic acid include *n*-tetradecanoic acid, *n*-hexadecanoic acid, and *n*-dodecanoic acid. Myristic acid and other myristates may contain unsaponifiable material, and some grades may contain glyceryl monomyristate. Impurities in glyceryl myristate include glycerol, diglycerol, and free fatty acid. Other impurities include heavy metals and arsenic.

Isopropyl myristate is the most commonly used ingredient in this assessment and is used in over 1000 products at concentrations of 0.001% to 82%.

Myristic acid, aluminum myristate, aluminum myristates/palmitates, butyl myristate, cetyl myristate, glyceryl myristate, isobutyl myristate, isocetyl myristate, isodecyl myristate, isodecyl myristate, isopropyl myristate, lauryl myristate, magnesium myristate, myristyl myristate, octyldodecyl myristate, potassium myristate, propylene glycol myristate, sodium

myristate, and zinc myristate are also reported as used and/or have reported concentration of use.

No uses or use concentrations were reported for aluminum isostearates/myristate, calcium myristate, decyl myristate, ethyl myristate, ethylhexyl myristate, glyceryl dimyristate, glyceryl isostearate/myristate, isobutyl myristate, isostearyl myristate, isotridecyl myristate, methyl myristate, oleyl myristate, tetradecyloctadecyl myristate, and tridecyl myristate.

Myristic acid is approved as a food reagent and additive. Butyl myristate is also used as a plasticizer, as a lubricant for textiles, and in paper stencils.

The myristates are readily hydrolyzed to the corresponding alcohols and acids, which are then further metabolized. Butyl myristate may be readily hydrolyzed *in vivo* to its corresponding acid and alcohol, which are then further metabolized.

When isopropyl myristate was aerosolized, 85% of the absorbed isopropyl myristate was eliminated in 24 hours, mainly as exhaled carbon dioxide; very little labeled material reached any tissues other than the lungs in monkeys.

Myristic acid, butyl myristate, and isopropyl myristate enhanced the dermal penetration of several drugs.

The  $IC_{50}$  of methyl myristate for the inhibition of rat brain prostaglandin D synthase and swine brain prostaglandin  $D_2$  dehydrogenase was  $>200 \mu\text{mol/L}$ .

The acute oral  $LD_{50}$  of butyl myristate was  $>8 \text{ g/kg}$  for rats. The acute oral  $LD_{50}$  for isopropyl myristate was  $>16 \text{ mL/kg}$  in rats and  $49.7 \text{ mL/kg}$  in mice.

Acute dermal application of butyl myristate ( $2 \text{ g/kg}$ ) was non-toxic and nonirritating to rabbits. When 10 rabbits were treated with a single dermal dose of ethyl myristate ( $5 \text{ g/kg}$ ) resulted in the death of 2 over 7 days. The intraperitoneal and subcutaneous  $LD_{50}$  for isopropyl myristate exceeded  $79.5 \text{ mL/kg}$  in rats and the intraperitoneal  $LD_{50}$  was  $>50.2 \text{ mL/kg}$  in mice.

No death occurred, and no evidence of systemic toxicity was found at necropsy when the rats were exposed to aerosolized isopropyl myristate.

Myristic acid, isopropyl myristate, and myristyl myristate were minimally irritating to the eyes of rabbits. Butyl myristate was nonirritating to the rabbit eye.

Myristic acid was nonirritating in a single insult occlusive patch test and slightly irritating in a repeat open patch test on rabbits. Butyl myristate was a moderate skin irritant in rabbits and guinea pigs. Isopropyl myristate and myristyl myristate were minimally irritating in several formulations in rabbits and mice.

Isopropyl myristate was nonirritating when injected parenterally in albino rabbits.

Butyl myristate and myristyl myristate were nonsensitizing to guinea pigs.

Isopropyl myristate and myristyl myristate were comedogenic to rabbit ears.

Isopropyl myristate tested negative in the Salmonella/Microsome test in strains TA1538, TA1537, TA1535, TA100, and TA98, with and without activation.

In clinical primary and cumulative irritation studies, myristic acid was nonirritating. Isopropyl myristate can produce slight irritation but is not a human sensitizer at 15% to 50%.

Isopropyl myristate up to 100% was nonirritating, nonirritating in cumulative skin irritation tests, nonphototoxic, and non-photoallergenic in humans.

## Discussion

The data on butyl myristate and the related salts and esters, coupled with the data on the related chemicals (myristic acid, myristyl myristate, and isopropyl myristate), are a sufficient basis for a safety assessment. The CIR Expert Panel believes that there is little toxicological and chemical difference between myristic acid and any of its inorganic salts included in this report. The salts are expected to dissociate in any product formulation, independent of whether the salt is aluminum, calcium, magnesium, potassium, sodium, or zinc. For the various esters of fatty alcohols and myristic acid, the CIR Expert Panel considers that these fatty acid esters are subject to hydrolysis to form myristic acid and the component fatty alcohols. It is the experience of the Panel in its review of fatty alcohols of varying length of carbon chains that there is little difference in toxicity. Accordingly, the available data were considered supportive of the safety of the entire group as used in cosmetics.

The Expert Panel recognized that use concentration data are not available for all ingredients in this group and that some ingredients in the group are not in current use. The Expert Panel considered that the use concentrations for the ingredients that are in use are not likely to be different from the use concentrations for other myristates. Were those ingredients not in current use to be used in the future? The Panel expects that they would be used in products and at concentrations similar to those reported.

The Expert Panel recognized that these ingredients can enhance the penetration of other ingredients through the skin. The Panel cautioned that care should be taken in formulating cosmetic products that may contain these ingredients in combination with any ingredients whose safety was based on their lack of dermal absorption data, or when dermal absorption was a concern.

A number of the ingredients in this report—cetyl myristate, octyldodecyl myristate, and sodium myristate—have uses that include sprays. There are no data available on inhalation toxicity for these ingredients or the other ingredients in this assessment. The Expert Panel determined that there is sufficient inhalation toxicity data on isopropyl myristate in its assessment demonstrating no inhalation toxicity. In addition to the inhalation toxicity data, the Panel determined that butyl myristate and the salts and esters can be used safely in hair sprays, because the ingredient particle size is not respirable. The Panel reasoned that the particle size of aerosol hair sprays ( $\sim 38 \mu\text{m}$ ) and pump hair sprays ( $>80 \mu\text{m}$ ) is large compared with respirable particulate sizes ( $\geq 10 \mu\text{m}$ ).

There are no data on the reproductive or developmental toxicity of myristic acid or its component parts for the derivatives. Based on structure–activity relationships, the Expert Panel considered that these chemicals had little potential for such toxicity when used as cosmetic ingredients.

Isopropyl myristate was not genotoxic in the Ames assay. The Expert Panel determined this to be sufficient carcinogenicity data for the related ingredients in this safety assessment.

## Conclusion

The CIR Expert Panel finds that myristic acid, aluminum dimyristate, aluminum isostearates/myristates, aluminum myristate, aluminum myristates/palmitates, butyl myristate, calcium myristate, cetyl myristate, decyl myristate, ethyl myristate, ethylhexyl myristate, glyceryl dimyristate, glyceryl isostearate/myristate, glyceryl myristate, isobutyl myristate, isocetyl myristate, isodecyl myristate, isopropyl myristate, isostearyl myristate, isotridecyl myristate, lauryl myristate, magnesium myristate, methyl myristate, myristyl myristate, octyldodecyl myristate, oleyl myristate, potassium myristate, propylene glycol myristate, sodium myristate, tetradecyloctadecyl myristate, tridecyl myristate, and zinc myristate are safe as cosmetic ingredients in the current practices of use and concentration. Were ingredients in this group not in current use to be used in the future? The expectation is that they would be used in product categories and at concentrations comparable to others in the group.

## Authors' Note

Unpublished sources cited in this report are available from the Director, Cosmetic Ingredient Review, 1101 17th Street, Suite 412, Washington, DC 20036, USA.

## Declaration of Conflicting Interest

No potential conflict of interest relevant to this article was reported. F Alan Andersen, PhD, and Lillian C. Becker are employed by the Cosmetic Ingredient Review.

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