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Final Report on the Safety Assessment of Sodium Myreth Sulfate

Sodium Myreth Sulfate is the sodium salt of sulfated, ethoxylated myristyl alcohol which is used as a surfactant and cleansing agent in cosmetics at concentrations ranging from > 1.0–5.0% to > 50.0%. A formulation containing 7.0% Sodium Myreth Sulfate was shown to be an ocular irritant in experimental animals and in some human test subjects. These irritant effects were similar to those previously reported for the chemically similar compound Sodium Laureth Sulfate which was shown to be safe for use in cosmetics. The report summarizes the safety test data on Sodium Laureth Sulfate. Based upon the combined data cited in the report on both cosmetic ingredients, it is concluded that Sodium Myreth Sulfate is safe as a cosmetic ingredient in the present practices of use and concentration.

INTRODUCTION

The toxicity of Sodium Myreth Sulfate is reviewed in this report. A summary of the toxicity data on a structurally similar cosmetic ingredient, Sodium Laureth Sulfate, that has been reviewed by the CIR Expert Panel is also included.[1] With the exception that Sodium Myreth Sulfate contains 12 methene groups and Sodium Laureth Sulfate contains 10 methene groups, the chemical formulas for both ingredients are identical. The available toxicity data on Sodium Laureth Sulfate are considered to be supportive of the existing safety data on Sodium Myreth Sulfate.

CHEMISTRY

Chemical and Physical Properties

Sodium Myreth Sulfate (CAS No. 25446-80-4) is the sodium salt of sulfated, ethoxylated myristyl alcohol that conforms generally to the formula:[2]

$$CH_3(CH_2)_{12}CH_2(OCH_2CH_2)_nOSO_3Na$$

The average value of n is between 1 and 4. Other names for this chemical are: Sodium Myristyl Ether Sulfate, Sodium Polyoxyethylene (3.5) Myristyl Sulfate, 60%, and Sodium Polyoxyethylene (3) Myristyl Ether Sulfate, 60%. Sodium Polyoxyethylene

(3.5) Myristyl Sulfate, 60%, is a pale yellow, dilute alcoholic solution of Sodium Myreth Sulfate containing the following products: sodium sulfate (1.0% maximum), sodium chloride (1.5% maximum), free fatty alcohol (2.5% maximum), and ethanol (11.0 to 14.0%). Sodium Polyoxyethylene (3) Myristyl Ether Sulfate, 60%, is commercially available as a clear, pale yellow dilute alcoholic solution containing: sodium chloride (1.5% maximum), sodium sulfate (1.5% maximum), and ethanol (11.0 to 14.0%). The alcohol moiety of Sodium Myreth Sulfate is made up of approximately 12.0% C_{12}, 60.0% C_{14}, and 20.0% C_{16} alcohols.[3] Properties of Sodium Myreth Sulfate are summarized in Table 1.

Methods of Production

Sodium Myreth Sulfate may be produced via the following sequence of reactions: (1) addition of approximately 3 moles of ethylene oxide to myristyl alcohol, (2) sulfation of the alcohol ethoxylate, (3) neutralization of the acid ester with sodium hydroxide.[4]

Analytical Methods

Sodium Myreth Sulfate has been identified via infrared (IR) spectroscopy.[3]

Impurities

Sodium Polyoxyethylene (3) Myristyl Ether Sulfate, 60%, contains unsulfated material (2.5% maximum).[3] Data concerning the degree of unsaturation of Sodium Myreth Sulfate preparations and the possible presence of ethylene glycol and 1,4-dioxane were not available.

COSMETIC USE

Sodium Myreth Sulfate is used as a surfactant and cleansing agent in cosmetics.[5]

TABLE 1. PROPERTIES OF SODIUM MYRETH SULFATE[3]

	Sodium polyoxyethylene (3.5) myristyl sulfate, 60%	*Sodium polyoxyethylene (3) myristyl ether sulfate, 60%*
Color	Pale yellow liquid	Clear pale yellow liquid
Odor	Alcoholic	—
Solubility	Soluble in water and alcohol	—
pH of a 10.0% aqueous solution	8.0–9.0	—
pH of a 6.0% aqueous solution of the active ingredient	—	7.5–8.5
Cloud point	10°C maximum	Below 10°C
Assay (as Sodium Myreth Sulfate, MW 470)	58.0–60.0%	—
Assay (MW 435)	—	58.0% minimum
Identification	Positive: Close match to a standard IR spectrum with no indication of foreign materials	Positive: Close match to a standard IR spectrum with no indication of foreign materials

The FDA cosmetic product formulation computer printout[6] is compiled through voluntary filing of such data in accordance with Title 21 part 720.4 of the Code of Federal Regulations.[7] Ingredients are listed in preset concentration ranges under specific product type categories. Since certain cosmetic ingredients are supplied by the manufacturer at less than 100% concentration, the value reported by the cosmetic formulator may not necessarily reflect the actual concentration found in the finished product; the actual concentration would be a fraction of that reported to the FDA. Data submitted within the framework of preset concentration ranges provide the opportunity for overestimation of the actual concentration of an ingredient in a particular product. An entry at the lowest end of a concentration range is considered the same as one entered at the highest end of that range, thus introducing the possibility of a two- to ten-fold error in the assumed ingredient concentration. Sodium Myreth Sulfate is used in cosmetic products at concentrations ranging from > 1.0–5.0% to > 50.0% (Table 2).[6]

Sodium Myreth Sulfate has been approved for use as a cosmetic ingredient in Japan.[8] It is not included in the list of substances that may not be used in cosmetic products marketed in countries of the European Economic Community.[9]

TOXICOLOGY

Ocular Irritation

The ocular irritation potential of a shampoo containing 7% Sodium Myreth Sulfate, 8% TEA-lauryl sulfate, and 4% cocamide MEA was evaluated at five different laboratories. In each laboratory, 100 μl of undiluted shampoo were instilled onto the corneal surface (one eye) of each of 24 albino rabbits (four groups of 6). Ocular reactions usually were scored at 1 h and 1, 2, 3, and 7 days post-instillation according to the method of Draize.[10] Scores for the cornea, iris, and conjunctiva at each time point were used to calculate the total score (Draize scale: 0–110). In order to estimate the course of irritation, the total scores for all animals per group were averaged at each point, and the summation of the means for the entire study was expressed as an estimate of area under the curve. The peak mean response that occurred during the course of a study was used to estimate the intensity of the response. Results from all experiments collectively indicated that the shampoo (Sodium Myreth Sulfate concentration = 7%) was a mild to moderate ocular irritant. When the shampoo was tested at a concentration of 20.0%

Table 2. Product Formulation Data for Sodium Myreth Sulfate[6]

Product category	*Total no. of formulations in category*	*Total no. containing ingredient*	*No. of Product Formulations Within Each Concentration Range (%)*				
			>50	*>25–50*	*>10–25*	*>5–10*	*>1–5*
Bubble bath products and bath soaps	624	5	—	2	2	1	—
Other bath or skin care products	1033	8	1	2	2	2	1
Hair shampoos	859	19	—	—	12	6	1
1989 TOTALS		32	1	4	16	9	2

(Sodium Myreth Sulfate effective concentration = 1.4%), minimal to practically no ocular irritation was observed.[11]

SUMMARY OF DATA ON SODIUM LAURETH SULFATE[1]

Absorption and Excretion

There was no detectable radioactivity in blood samples from guinea pigs that received a single dermal application of ^{14}C-Sodium Laureth Sulfate (in 0.6 ml of water). Treated areas were washed with water and covered with nonocclusive patches for 24 h. Most of the radioactivity was found in the skin rinsings, on the patches, or bound to the site of application. In another study, the quantity of Sodium Laureth Sulfate that was absorbed through guinea pig skin was calculated by dividing the amount that was excreted from an animal that received a 24-h cutaneous application by the amount that was excreted from an animal that had received the material by intraperitoneal injection. It was concluded that 2.4% of the radioactive Sodium Laureth Sulfate that had been cutaneously applied penetrated the skin. When Sodium Laureth Sulfate was administered orally and via intraperitoneal or subcutaneous injection, a large proportion of the administered dose was excreted in the urine, while the feces and expired air contained small quantities of radioactivity. At 2 days post-injection, the carcass retained less than 1.0% of the dose.

Oral Toxicity

In acute oral toxicity studies, Sodium Laureth Sulfate, at concentrations of 5.6 to 58.0%, was slightly toxic to rats.

In a subchronic oral toxicity study, male rats fed 5000 ppm Sodium Laureth Sulfate had increased kidney weight; female rats had increased heart, liver, and kidney weights. Increases in relative organ weights were not statistically significant. The "no effect" dietary concentration for Sodium Laureth was 1000 ppm. In a chronic oral toxicity study, rats were fed 0.1 and 0.5% Sodium Laureth Sulfate in the diet for a period of 105 weeks. Gross and microscopic lesions and the incidence of neoplasms were similar in experimental and control groups.

Ocular Irritation

In ocular irritation studies, Sodium Laureth Sulfate was tested at concentrations of 1.3 to 58.0%. Reactions ranged from no to moderate irritation in the 1.3 to 15.0% concentration range, with mild ocular reactions predominating. At concentrations of 17.5 to 30.0%, minimal to severe ocular irritation was observed; moderate to severe reactions predominated.

Skin Irritation

When Sodium Laureth Sulfate, at concentrations of 30.0 and 60.0%, was applied to the skin of rats, severe epidermal irritation resulted. Sodium Laureth Sulfate applied to abraded and intact dorsal skin (clipped free of hair) of albino rabbits induced no irritation at concentrations of 5.0 to 5.6%, minimal irritation at 6.0 to 10.0%

concentrations, and severe irritation at a concentration of 25.0%. Mild skin irritation was observed in guinea pigs that were immersed in 0.07 and 0.15% solutions of Sodium Laureth Sulfate.

Skin irritation was not observed 24 h after Sodium Laureth Sulfate (0.28% active) was applied to the vaginal mucosa of three beagle dogs. The undiluted ingredient (28.0% active) induced slight irritation in 2 of 3 animals, and mild irritation in the third animal. A formulation containing 0.07% Sodium Laureth Sulfate did not induce irritation of the vaginal mucosa in beagle dogs when applied over a period of three weeks.

Sodium Laureth Sulfate (18.0%) induced minimal irritation in human subjects receiving 24-h occlusive patches. In the first study, reactions were observed in three of 20 subjects. Reactions were observed in 11 of 20 subjects in the second study. Sodium Laureth Sulfate (1.25%) was classified as highly irritating in a 21-day cumulative skin irritation test involving 13 subjects. In a similar test involving 10 subjects, 0.7% Sodium Laureth Sulfate produced mild cumulative irritation. This determination was based on the four subjects who completed the study.

Skin Irritation and Sensitization

A shampoo containing 0.5% Sodium Laureth Sulfate induced minimal primary irritation, but no sensitization, in a repeated insult patch test involving 196 human subjects. In the maximization test, there was no evidence of skin sensitization in any of the 25 human subjects tested with a bubble bath formulation containing 14.3% Sodium Laureth Sulfate.

Skin Sensitization

The skin sensitization potential of a 0.1% aqueous solution of Sodium Laureth Sulfate was evaluated using guinea pigs. Positive reactions were not observed after the first challenge (topical application). Blistering was observed in animals challenged with intradermal injections of the test substance 1 h after the first challenge. Reactions classified as very strongly positive and positive were observed in 3 and 7 animals, respectively, 24 h later. Positive reactions were also observed in 6 animals 48 h after the second challenge; slight reactions were observed in the remaining 4 animals.

Reproductive Effects

No adverse effects on fertility, litter size, lactation, or survival of offspring were observed in dams fed 0.1% Sodium Laureth Sulfate for 14 weeks.

Tumorigenicity

No skin tumors were observed in mice after 0.1 ml of a 5.0% aqueous solution of Sodium Laureth Sulfate was applied twice weekly to the skin (interscapular area) for a period of 105 weeks.

Phototoxicity

In a phototoxicity study, weak nonvesicular reactions were observed in four of 103 human subjects treated with 0.07% Sodium Laureth Sulfate. In a second test, mild reactions were observed in two of 56 subjects.

SUMMARY

Sodium Myreth Sulfate (CAS No. 25446-80-4) is the sodium salt of sulfated, ethoxylated myristyl alcohol. It is produced via the addition of approximately 3 moles of ethylene oxide to myristyl alcohol, followed by sulfation of the alcohol ethoxylate and neutralization of the acid ester with sodium hydroxide.

Sodium Myreth Sulfate is used as a surfactant and cleansing agent in cosmetics at concentrations ranging from > 1.0–5.0% to > 50.0%.

A shampoo containing 7.0% Sodium Myreth Sulfate was a mild to moderate irritant when instilled into the eyes of albino rabbits. When the shampoo was diluted to a concentration of 1.4% Sodium Myreth Sulfate prior to instillation, minimal to practically no ocular irritation was observed.

DISCUSSION

Data indicating that a shampoo containing 7.0% Sodium Myreth Sulfate and a 20.0% dilution of this product induced mild to moderate ocular irritation and minimal to practically no ocular irritation, respectively, in albino rabbits are the only toxicological data available for the CIR Expert Panel's review of Sodium Myreth Sulfate. The Expert Panel has previously reviewed the safety of a chemically similar cosmetic ingredient, Sodium Laureth Sulfate [CH_3-$(CH_2)_{10}$-CH_2-$(OCH_2CH_2)_nOSO_3Na$; n = 1–4]. Sodium Laureth Sulfate was an ocular and/or skin irritant in experimental animals and in some human test subjects. The Expert Panel noted these irritant effects were similar to other detergents, and that the severity of the irritation increased with concentration. The Expert Panel concluded that Sodium Laureth Sulfate is safe for use in cosmetics products at current use concentrations. With the exception that Sodium Myreth Sulfate contains 12 methene groups and Sodium Laureth Sulfate contains 10 methene groups, the chemical formulas for both ingredients are identical. Additionally, Sodium Myreth Sulfate and Sodium Laureth Sulfate are sodium salts of sulfated ethoxylated myristyl alcohol (C-14) and sulfated ethoxylated lauryl alcohol (C-12), respectively. Because Sodium Laureth Sulfate and Sodium Myreth Sulfate are chemically similar cosmetic ingredients and have similar cosmetic use concentrations, the Expert Panel concluded that the data used in its safety assessment of Sodium Laureth Sulfate can also be used in the safety assessment of Sodium Myreth Sulfate.

CONCLUSION

On the basis of the animal and clinical data on Sodium Myreth Sulfate and Sodium Laureth Sulfate presented in this report, the CIR Expert Panel concludes that Sodium Myreth Sulfate is safe as a cosmetic ingredient in the present practices of use and concentration.

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