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Re-Review Summary of Cholesterol as Used in Cosmetics

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Abstract

This is a safety assessment of Cholesterol as used in cosmetics. This ingredient is reported to function primarily as an emulsifier. The Expert Panel for Cosmetic Ingredient Safety (Panel) reviewed relevant animal and human data related to this ingredient. The Panel concluded that Cholesterol is safe as a cosmetic ingredient in the practices of use and concentrations as described in the safety assessment.

Keywords

Cosmetic Ingredient Review, Expert Panel for Cosmetic Ingredient Safety, Safety, Cosmetics, Cholesterol

Introduction

The Expert Panel for Cosmetic Ingredient Safety (Panel) first published the Final Report on the Safety Assessment of Cholesterol in 1986.[1] On the basis of the available information, the Panel concluded that Cholesterol is safe as presently used in cosmetic products, as described in the safety assessment. Upon re-review in December 2004, the Panel reaffirmed the original conclusion, as published in 2006.[2]

Because it has been at least 15 years since the prior re-review was published, in accordance with Cosmetic Ingredient Review (CIR) Procedures, the Panel again determined whether the safety assessment should be reopened. At the June 2024 meeting, the Panel considered updated 2023 information regarding product types and ingredient use frequencies as reported in the US Food and Drug Administration (FDA) Voluntary Cosmetic Registration Program (VCRP) database[3] and maximum use concentrations provided in response to a 2022 survey conducted by the Personal Care Products Council.[4] Overall, the reported frequency of use increased significantly and the reported concentration of use decreased for Cholesterol. In 2023, 494 uses were reported, while 258 uses were reported in 2002. Also, there were 5 newly reported uses in baby products in 2023. The maximum reported concentration of use was 0.25% in non-spray face and neck preparations and in non-spray and non-powder moisturizing products in 2022, compared to a maximum reported concentration of use of 3% in foundations reported in 2004. The cumulative frequency and concentration of use data are presented in Table 1.

In April 2024, an extensive search of the world's literature was performed for studies dated 2001 forward, and limited new relevant data were found.[5-7] New data included a plant-based method of manufacture, general absorption information, and a few studies on acute dermal and oral toxicity, in vitro dermal irritation, and sensitization and ocular irritation in animals.

The Panel expressed concern regarding heavy metals, pesticide residues, and other plant species that may be present in plant-derived Cholesterol. They stressed that the cosmetics industry should continue to minimize impurities in cosmetic formulations according to limits set by the US FDA and the US Environmental Protection Agency (EPA). Because Cholesterol is primarily sourced from animals, the Panel considered the risks inherent in using animal-derived ingredients, including the potential transmission of infectious agents and biologically-derived impurities (e.g., nucleic acids, proteins, endotoxins). The Panel stressed that Cholesterol derived from

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Table 1. Frequency (2023/2002) and Concentration (2022/2004) of Use of Cholesterol According to Likely Duration and Exposure and By Product Category.

	# of Uses		Max Conc of Use (%)	
	2023[3]	2002[2]	2022[4]	2004[2]
Totals*	**494**	**258**	**0.00001 – 0.25**	**0.002 - 3**
Summarized by likely duration and exposure**				
Duration of use				
Leave-on	*454*	*194*	*0.00001 – 0.25*	*0.005 – 3*
Rinse-off	*40*	*64*	*0.00005 – 0.03*	*0.002 – 1*
Diluted for (bath) use	*NR*	*NR*	*NR*	*NR*
Exposure type**				
Eye area	39	8	0.00001 – 0.05	0.002 – 0.3
Incidental ingestion	27	5	0.05	0.1
Incidental inhalation-spray	1; 198[a]; 120[b]	2; 94[a]; 44[b]	0.0001 – 0.0011; 0.00051 – 0.1[a]	0.005 – 2[a]; 0.01 – 2[b]
Incidental inhalation-powder	1; 120[b]; 3[c]	3; 44[b]	0.25[c]	0.01 – 2[b]
Dermal contact	422	196	0.0025 – 0.25	0.002 - 3
Deodorant (underarm)	NR	NR	NR	NR
Hair - non-coloring	28	26	0.00005 – 0.1	0.003-2
Hair-coloring	1	27	NR	NR
Nail	1	2	NR	0.1
Mucous membrane	27	7	0.05	0.1
Baby products	5	NR	NR	NR
As reported by product category				
Baby products				
Baby lotions/Oils/Powders/Creams	3	NR	NR	NR
Other baby products	2	NR	NR	NR
Eye makeup preparations				
Eyebrow pencil	1	NR	NR	NR
Eyeliner	NR	1	NR	NR
Eye shadow	NR	NR	NR	0.01
Eye lotion	12	1	0.0058 – 0.05	0.04 – 0.3
Eye makeup remover	NR	NR	NR	0.002
Mascara	15	2	0.00001	NR
Other eye makeup preparations	11	4	NR	NR
Fragrance preparations				
Perfumes	1	NR	NR	NR
Other fragrance preparation	NR	2	NR	NR
Hair preparations (non-coloring)				
Hair conditioner	8	13	0.00005 – 0.03	0.3
Hair spray (aerosol fixatives)	NR	NR	Aerosol: 0.0001 – 0.0011 Pump spray: 0.0002	NR
Hair straighteners	NR	NR	NR	0.003
Rinses (non-coloring)	2	1	NR	NR
Shampoos (non-coloring)	6	5	0.0001 – 0.002	NR
Tonics, dressings, and other hair grooming aids	4	3	0.00051 – 0.1	2
Other hair preparations	8	4	NR	0.2
Hair coloring preparations				
Hair dyes and colors (all types requiring caution statements and patch tests)	NR	27	NR	NR
Hair shampoos (coloring)	1	NR	NR	NR
Makeup preparations				
Face powders	1	3	NR	NR
Foundations	5	7	NR	3
Lipstick	27	5	0.05	0.1

(continued)

Table 1. (continued)

	# of Uses		Max Conc of Use (%)	
	2023[3]	2002[2]	2022[4]	2004[2]
Makeup bases	5	3	NR	0.02
Rouges	NR	1	NR	NR
Makeup fixatives	2	2	NR	NR
Other makeup preparations	11	4	NR	NR
Manicuring preparations (nail)				
Cuticle softeners	NR	1	NR	0.1
Nail creams and lotions	1	NR	NR	NR
Nail polish and enamel removers	NR	1	NR	NR
Personal cleanliness products				
Bath soaps and detergents	NR	2	NR	NR
Shaving preparations				
Aftershave lotion	1	3	0.012	0.1
Shaving cream	1	NR	NR	0.1
Other shaving preparations	1	NR	NR	NR
Skin care preparations				
Cleansing	14	11	0.005	1
Face and neck (exc shave)	80	22	Not spray: 0.25	0.3 – 2
Body and hand (exc shave)	40	19	NR	0.01 – 0.5
Foot powders and sprays	NR	3	NR	0.5
Moisturizing	171	61	Not spray or powder: 0.25	0.005 – 1
Night	19	24	NR	−0.1 – 1
Paste masks (mud packs)	7	4	0.0025	0.5
Skin fresheners	3	3	NR	NR
Other skin care preparations	30	13	NR	NR
Suntan preparations				
Suntan gels, creams, and liquids	NR	1	NR	0.02 – 0.4
Indoor tanning preparations	NR	NR	NR	0.005
Other suntan preparations	1	2	NR	NR

NR – not reported.
*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.
**Likely duration and exposure are derived based on product category (see Use Categorization https://www.cir-safety.org/cir-findings).
[a]It is possible these products are sprays, but it is not specified whether the reported uses are sprays.
[b]Not specified whether a spray or a powder, but it is possible the use can be as a spray or a powder, therefore the information is captured in both categories.
[c]It is possible these products are powders, but it is not specified whether the reported uses are powders.

these sources should be free of detectable pathogenic viruses, infectious agents, and biologically-derived impurities. In terms of endogenous physiology, the Panel noted the discovery of the transmembrane protein, Neimann-pick C1-like 1 (NPC1L1), which aids in Cholesterol transport across intestinal and hepatic cellular membranes and serves as a target for cholesterol absorption inhibitors used to manage hypercholesterolemia.[7]

In summary, the Panel reviewed frequency (2023) and concentration of use (2022) data, in addition to any new, available, and relevant safety data. Considering this information, as well as the information provided in the original safety assessment and the prior re-review document, the Panel reaffirmed the 1986 conclusion. The Panel discussed the possibility for this ingredient to be used in cosmetic products which may be incidentally inhaled. A detailed discussion and summary of the Panel's approach to evaluating incidental inhalation exposures to ingredients in cosmetic products is available at https://www.cir-safety.org/cir-findings.

Author's Note

Unpublished sources cited in this report are available from the Director, Cosmetic Ingredient Review, 555 13th St., NW, Suite 300W, Washington, DC 20004. cirinfo@cir-safety.org

Author Contributions

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References

1. Elder RL, ed. Final report on the safety assessment of cholesterol. *Int J Toxicol*. 1986;5(5):491-516.
2. Andersen FA, ed. Annual review of cosmetic ingredient safety assessments-2004/2005. *Int J Toxicol*. 2006;25(S2):21-22.
3. U.S. Food and Drug Administration Center for Food Safety & Applied Nutrition (CFSAN). Voluntary cosmetic registration Program - frequency of use of cosmetic ingredients. College Park, MD. [Obtained under the Freedom of Information Act from CFSAN; requested as "Frequency of Use Data" January 4, 2023; received February 2, 2023]; 2023.
4. Personal Care Products Council. Concentration of use by FDA product category: cholesterol. [Unpublished data submitted by the Personal Care Products Council on October 31, 2022]; 2022.
5. Munt M, Spieß O, Indolese A, Roux L, Giraud M, Schinzer D. Short and scalable synthesis of plant-based cholesterol in GMP grade. *Adv Synth Catal*. 2023;365(14):2406-2409.
6. European Chemical Agency. ECHA chem dossier: cholesterol (CAS 57-88-5). 2013. https://chem.echa.europa.eu/100.000.321/dossier-view/768a1ca6-0145-4f6f-b283-8f8b94b2c0d6/d51e9284-f5e5-4b74-9d52-8c8e8eddb7d2_d51e9284-f5e5-4b74-9d52-8c8e8eddb7d2?searchText=57-88-5. Last Updated: 2013. Date Accessed: April 14, 2024.
7. Jia L, Betters JL, Yu L. Niemann-pick C1-like 1 (NPC1L1) protein in intestinal and hepatic cholesterol transport. *Annu Rev Physiol*. 2011;73:239-259.