

Re-Review Summary of Sodium Sesquicarbonate, Sodium Carbonate, and Sodium Bicarbonate as Used in Cosmetics

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Monice M. Fiume[†], Wilma F. Bergfeld*, Donald V. Belsito*, David E. Cohen*, Curtis D. Klaassen*, Allan E. Rettie*, David Ross*, Thomas J. Slaga, Paul W. Snyder*, Susan C. Tilton*, and Bart Heldreth^{††}**

Abstract

This is a safety assessment of Sodium Sesquicarbonate, Sodium Bicarbonate, and Sodium Carbonate as used in cosmetics. These ingredients are used in bath, skin, and hair preparations. The Expert Panel for Cosmetic Ingredient Safety (Panel) reviewed relevant animal and human data related to these ingredients. The Panel concluded that Sodium Sesquicarbonate, Sodium Bicarbonate, and Sodium Carbonate are safe as cosmetic ingredients 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, Sodium Sesquicarbonate, Sodium Bicarbonate, Sodium Carbonate

Introduction

The Expert Panel for Cosmetic Ingredient Safety (Panel) first published the Final Report on the Safety Assessment of Sodium Sesquicarbonate, Sodium Bicarbonate, and Sodium Carbonate in 1987.¹ The Panel concluded that these 3 ingredients were “safe as presently used” in cosmetics. Upon re-review in March 2005, 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 December 2023 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) database³ and maximum use concentrations provided in response to the survey conducted by the Personal Care Products Council.⁴ The frequencies of use for both Sodium Bicarbonate and Sodium Carbonate have increased since the previous re-review was conducted; of note, the frequency of use of Sodium Bicarbonate increased from 66 uses in 2002 to 571 reported uses in 2023. The frequency of use of Sodium Sesquicarbonate has decreased. Additionally, the maximum reported concentrations of use of all three ingredients have decreased

since the previous re-review. The cumulative frequency and concentration of use data are presented in [Table 1](#).

In October 2023, an extensive search of the world’s literature was performed for studies dated 2000 forward, and new data were found.^{5–20} Toxicology, genotoxicity, carcinogenicity, anticarcinogenicity, dermal irritation, ocular irritation, and clinical studies were considered by the Panel. The Panel remarked that although a considerable amount of new data were available, no findings were noted that would change the existing conclusion.

In summary, the Panel reviewed 2023 frequency and concentration of use data, in addition to any new, available, 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 1987 conclusion. The Panel discussed the possibility for these ingredients to be used in cosmetic products which may be incidentally inhaled. A detailed discussion and summary of the Panel’s approach to

[†]Cosmetic Ingredient Review Senior Director

*Expert Panel for Cosmetic Ingredient Safety Member

**Expert Panel for Cosmetic Ingredient Safety Former Member

^{††}Cosmetic Ingredient Review Executive Director

Corresponding Author:

Bart Heldreth, Executive Director, Cosmetic Ingredient Review, 555 13th St., NW, Suite 300W, Washington, DC 20004, USA.

Email: cirinfo@cir-safety.org

Table 1. Frequency (2023³/2002²) and Concentration (2023⁴/2004²) of Use According to Likely Duration and Exposure and by Product Category.

	Sodium Sesquicarbonate					Sodium Bicarbonate					Sodium Carbonate				
	Max Conc of Use (%)					# of Uses					Max Conc of Use (%)				
	# of Uses	2023	2002	2023	2004	2023	2002	2023	2004	2023	2002	2023	2002	2023	2004
Totals*	9	24	0.5-69.1	2-90	571	66***	0.00001-67.6	0.006-95	76	21	0.0002-48.7	0.000002-0.6	0.000002-0.6	0.000002-0.6	0.000002-0.6
Summarized by likely duration and exposure**															
Duration of Use															
Leave-On	2	1	35	35-59	142	26	0.0003-55.1	0.01-56	22	7	0.0002-0.44	0.000002-0.6	0.0002-0.44	0.000002-0.6	0.000002-0.6
Rinse-Off	1	3	34.9	NR	132	33	0.00001-66.4	0.006-95	16	10	0.0002-2.3	0.01-32	0.0002-2.3	0.01-32	0.01-32
Diluted for (Bath) Use	6	20	0.5-69.1	2-90	297	7	63.2-67.6	1-64	38	4	0.0012-48.7	0.009-51	0.0012-48.7	0.009-51	0.009-51
Exposure Type															
Eye Area	NR	NR	NR	NR	NR	8	0.012	0.04-0.2	4	NR	0.00068	0.004-0.3	0.00068	0.004-0.3	0.004-0.3
Incidental Ingestion	NR	1	NR	NR	69	13***	0.35-66.4	0.03-95	6	3	0.0009-2	2***	0.0009-2	2***	2***
Incidental Inhalation-Spray	NR	1	35 ^a	35-59 ^a	34 ^a , 18 ^b	6 ^a , 4 ^b	0.001; 1-55.1 ^a	0.1, 0.2-0.4 ^a	1; 6 ^a	1 ^a , 2 ^b	0.0009-0.19 ^b	0.03; 0.008 ^a ; 0.000002-0.01 ^b	0.0009-0.19 ^b	0.03; 0.008 ^a ; 0.000002-0.01 ^b	0.03; 0.008 ^a ; 0.000002-0.01 ^b
Incidental Inhalation-Powder	NR	NR	35 ^a	35-59 ^a	18b, 1 ^c	9; 6 ^a ; 1 ^c	20; 1-55.1 ^a ; 0.0003-7 ^c	20.01-56b, 5 ^c	6 ^a	1 ^a	0.0004 ^c	0.008 ^a	0.0004 ^c	0.008 ^a	0.008 ^a
Dermal Contact	8	23	0.5-69.1	2-90	495	34	0.00001-67.6	0.006-64	69	12	0.0002-48.7	0.002-51	0.0002-48.7	0.002-51	0.002-51
Deodorant (underarm)	NR	NR	NR	NR	80 ^b	NR	0.05-15 (not spray)	0.01-15 ^b	NR	NR	0.012-0.016 (not spray)	0.002 ^b	0.012-0.016 (not spray)	0.002 ^b	0.002 ^b
Hair - Non-Coloring	NR	NR	NR	NR	5	3	0.05-3.4	0.09-10	NR	4	0.0002-2.3	0.000002-1	0.0002-2.3	0.000002-1	0.000002-1
Hair - Coloring	NR	NR	NR	NR	NR	8	6	0.1-10	1	2	1-2	0.02-25	1-2	0.02-25	0.02-25
Nail	1	NR	NR	NR	2	NR	35.5	39	NR	NR	NR	0.6	NR	0.6	0.6
Mucous Membrane	7	23	0.5-69.1	2-90	393	33	0.00001-67.6	0.03-95	52	10	0.0009-48.7	0.009-51	0.0009-48.7	0.009-51	0.009-51
Baby Products	NR	NR	NR	NR	1	1	0.001	5	NR	NR	0.044	NR	NR	0.044	NR
as reported by product category															
Baby Products															
Baby Lotions/Oils/Powders/Creams					1	1	NR	5							
Other Baby Products					NR	NR	0.001 (wipes, leave-on)	NR	NR	NR	0.044	NR	NR	0.044	NR
Bath Preparations (diluted for use)															
Bath Oils, Tablets, and Salts	2	16	0.5-69.1	2-90	261	7	63.2-67.6	30-64	36	4	13.5-48.7	40-51	13.5-48.7	40-51	40-51
Bubble Baths	NR	2	50	18	15	NR	NR	5-52	1	NR	NR	7-39	NR	NR	7-39

(continued)

Table 1. (continued)

	Sodium Sesquicarbonate					Sodium Bicarbonate					Sodium Carbonate				
	# of Uses		Max Conc of Use (%)			# of Uses		Max Conc of Use (%)			# of Uses		Max Conc of Use (%)		
	2023	2002	2023	2004		2023	2002	2023	2004		2023	2002	2023	2004	
Totals*	9	24	0.5-69.1	2-90	571	66***	0.00001-67.6	0.006-95	0.0002-51	48.7	76	21	0.0002-48.7	0.000002-51	
Bath Capsules															
Other Bath Preparations	4	2	NR	10-35	1	NR	NR	63.3	1-64	49	1	NR	0.0012-42.3	0.009-39	
Eye Makeup Preparations															
Eyebrow Pencil					NR	NR	NR	NR	0.2		NR	NR	0.00068	0.2	
Eyeliner					NR	1	NR	NR	0.04-0.1		1	NR	NR	NR	
Eye Shadow											NR	NR	NR	0.3	
Eye Lotion											NR	NR	NR	0.004	
Mascara					NR	6	0.012	0.2			1	NR	NR	0.2	
Other Eye Makeup Preparations					NR	1	NR	NR	NR		2	NR	NR	NR	
Fragrance Preparations															
Cologne and Toilet water Spray					NR	NR	0.001	NR	NR		1	NR	NR	0.03	
Powders (dusting/talcum, excl aftershave talc)					NR	9	20	20							
Other Fragrances	NR	1	NR	NR											
Hair Preparations (non-coloring)															
Hair Conditioner					NR	NR	0.05	5			NR	2	0.0002	0.01	
Hair Straighteners											NR	NR	2.3	NR	
Permanent Waves					NR	3	0.8	10			NR	1	NR	NR	
Rinses (non-coloring)															
Shampoos (non-coloring)					4	NR	3.4	0.09			NR	1	0.0053-0.41	0.08	
Tonics, Dressings, and Other Hair Grooming Aids											NR	NR	NR	0.000002-0.01	
Wave Sets															
Other Hair Preparations					1	NR	NR	NR						1	
Hair Coloring Preparations															
Hair Dyes and Colors					NR	8	6	NR			NR	2	1	0.1-0.6	
Hair Rinses (coloring)											NR	NR	NR	0.02	
Hair Color Sprays (aerosol)															
Hair Bleaches					NR	NR	NR	0.1-10			1	NR	NR	25	
Other Hair Coloring Preparation											NR	NR	2	1	

(continued)

Table 1. (continued)

	Sodium Sesquicarbonate				Sodium Bicarbonate				Sodium Carbonate			
	# of Uses		Max Conc of Use (%)		# of Uses		Max Conc of Use (%)		# of Uses		Max Conc of Use (%)	
	2023	2002	2023	2004	2023	2002	2023	2004	2023	2002	2023	2004
Totals*	9	24	0.5-69.1	2-90	571	66***	0.00001-67.6	0.006-95	76	21	0.0002-48.7	0.000002-51
Makeup Preparations												
Blushers (all types)												
Foundations												
Lipstick												
Other Makeup Preparations												
Manicuring Preparations (Nail)												
Other Manicuring Preparations	1	NR	NR	NR	2	NR	35.5	39	NR	NR	NR	0.03
Oral Hygiene Products												
Dentifrices					42	10	0.35-66.4	3-95	2	NR	0.65-2	2
Mouthwashes and Breath Fresheners					9	2	NR	0.1	1	NR	0.0009	NR
Other Oral Hygiene Products					18	1	NR	0.5	2	NR	NR	22
Personal Cleanliness Products												
Bath Soaps and Detergents	NR	2	NR	NR	20	2	0.0001-43.5	25-54	3	1	0.0074-0.4	3-32
Deodorants (underarm)					80	NR	0.05-15 (not spray)	0.01-15	NR	NR	0.012-0.016 (not spray)	0.002
Douches					NR	2	NR	NR				
Feminine Deodorants					2	2	1	NR				
Other Personal Cleanliness Products	1	1	34.9 (rinse-off)	NR	5	3	1	0.07-56	6	2	NR	NR
Shaving Preparations												
Preshave Lotions (all types)					1	NR	NR	NR				
Shaving Cream					1	NR	NR	0.006	NR	NR	0.0051	NR
Other Shaving Preparations					1	1	1.3	NR	NR	NR	0.0053	NR
Skin Care Preparations												
Cleansing					29	NR	0.01-43.5	0.04-26	1	1	0.003-0.93	0.02-0.2
Face and Neck (excl shave)					11	NR	NR	0.01-7	4	NR	NR	0.008
Body and Hand (excl shave)					5	NR	0.0003-7 (not spray)	10	2	1	0.0004 (not spray)	NR
Foot Powders and Sprays	NR	NR	35	35-59	NR	4	55.1	25-56				

(continued)

Table 1. (continued)

	Sodium Sesquicarbonate				Sodium Bicarbonate				Sodium Carbonate			
	# of Uses		Max Conc of Use (%)		# of Uses		Max Conc of Use (%)		# of Uses		Max Conc of Use (%)	
	2023	2002	2023	2004	2023	2002	2023	2004	2023	2002	2023	2004
Totals*	9	24	0.5-69.1	2-90	571	66***	0.00001-67.6	0.006-95	76	21	0.0002-48.7	0.000002-51
Moisturizing					20	NR	11.8 (not spray)	0.4	7	2	0.0002 (not spray)	NR
Night (Spray)												
Paste Masks (mud packs)					2	1	0.02-4	61	1	NR	NR	NR
Skin Fresheners					4	2	NR	NR	2	NR	0.019	NR
Other Skin Care Preparations	1	NR	NR	NR	14	4	0.005-30.8	2-5	1	NR	NR	NR
Suntan Preparations												
Suntan Gels, Creams, and Liquids					NR	NR	NR	0.2				
Other Suntan Preparations					1	NR	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>).

***Frequency and concentration of use of a denture cleaner were reported in 2002/2004; because this is not currently a product category, these data were omitted from the table.

^aNot 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.^bIt is possible these products are sprays, but it is not specified whether the reported uses are sprays.^cIt is possible these products are powders, but it is not specified whether the reported uses are powders.

evaluating incidental inhalation exposures to ingredients in cosmetic products is available at <https://www.cir-safety.org/cir-findings>.

Author's Note

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References

1. Elder RL, ed. The final report on the safety assessment of sodium sesquicarbonate, sodium bicarbonate, and sodium carbonate. *J Am Coll Toxicol*. 1987;6(1):121-138.
2. Andersen FA, ed. Annual review of cosmetic ingredient safety assessments 2004/2005. Sodium sesquicarbonate, sodium bicarbonate, and sodium carbonate. *Int J Toxicol*. 2006;25(S2):68-70.
3. U.S. Food and Drug Administration (FDA), Center for Food Safety and Applied Nutrition (CFSAN). Voluntary cosmetic registration Program- frequency of use of cosmetic ingredients. 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: sodium sesquicarbonate, sodium bicarbonate, and sodium carbonate. Unpublished data submitted by Personal Care Products Council on February 24, 2023. 2023.
5. European Chemical Agency. Sodium carbonate (CAS No. 497-19-8). <https://echa.europa.eu/registration-dossier/-/registered-dossier/15432>. Last Updated March 13, 2023. Accessed October 22, 2023.
6. European Chemical Agency. Sodium hydrogencarbonate (CAS No. 144-55-8; sodium bicarbonate). <https://echa.europa.eu/registration-dossier/-/registered-dossier/16157>. Last Updated March 9, 2023. Accessed 23 October 2023.
7. European Chemical Agency. Trisodium hydrogencarbonate, (CAS no. 533-96-0; sodium sesquicarbonate). <https://echa.europa.eu/registration-dossier/-/registered-dossier/2170>. Last Updated December 17, 2015. Accessed October 20, 2023.
8. Organisation for Economic Co-Operation and Development (OECD). SIDS initial assessment report for SIAM 15: sodium carbonate. CAS No. 497-19-8. 2002. <https://hpvchemicals.oecd.org/ui/handler.axd?id=5a6538be-aa30-4a72-ad1c-906d9b5413bd>
9. Organisation for Economic Co-Operation and Development (OECD). SIDS initial assessment report for SIAM 15: sodium bicarbonate. CAS No. 144-55-8. 2002. <https://hpvchemicals.oecd.org/UI/handler.axd?id=e1859b4e-f6a4-4da8-8945-6294354cdf45>
10. EFSA Panel on Additives and Products or Substances used in Animal Feed FEEDAP. Scientific Opinion on the safety and efficacy of sodium carbonate (soda ash) for all species. *EFSA J*. 2010;8(7):1695.
11. EFSA Panel on Dietetic Products Nutrition and Allergies NDA. Scientific Opinion on the substantiation of health claims related to sodium bicarbonate and reducing gastric acid levels (ID 1653) pursuant to Article 13(1) of Regulation (EC) No 1924/2006. *EFSA J*. 2010;8(2):1472.
12. EFSA CEF Panel (EFSA Panel on Food Contact Materials, Enzyme, Flavourings and Processing Aids). Scientific Opinion on the safety assessment of the active substances, sodium erythorbate, sodium carbonate, sodium bicarbonate, iron sulphate, activated carbon, cellulose, calcium hydroxide, calcium chloride and water, for use as active system in food contact materials. *EFSA J*. 2014;12(2):3571.
13. Fukushima S, Inoue T, Uwagawa S, Shibata MA, Ito N. Co-carcinogenic effects of NaHCO₃ on *o*-phenylphenol-induced rat bladder carcinogenesis. *Carcinogenesis*. 1989;10(9):1635-1640.
14. Griffith JF. Interlaboratory variations in the determination of acute oral LD₅₀. *Toxicol Appl Pharmacol*. 1964;6:726-730.
15. Ishidate M Jr., Sofuni T, Yoshikawa K, et al. Primary mutagenicity screening of food additives currently used in Japan. *Food Chem Toxicol*. 1984;22(8):623-636.
16. Letscher-Bru V, Obszynski CM, Samsoen M, Sabou M, Waller J, Candolfi E. Antifungal activity of sodium bicarbonate against fungal agents causing superficial infections. *Mycopathologia*. 2013;175(1-2):153-158.
17. Mazzarello V, Piu G, Ferrari M, Piga G. Efficacy of a topical formulation of sodium bicarbonate in mild to moderate stable plaque psoriasis: a randomized, blinded, inpatient, controlled study. *Dermatol Ther*. 2019;9(3):497-503.
18. Mori D, Tsujikawa T, Sugiyama Y, et al. Extracellular acidity in tumor tissue upregulates programmed cell death protein 1 expression on tumor cells via proton-sensing G protein-coupled receptors. *Int J Cancer*. 2021;149(12):2116-2124.
19. Yamada M, Honma M. Summarized data of genotoxicity tests for designated food additives in Japan. *Gene Environ*. 2018;40: 27-28.
20. Yang M, Zhong X, Yuan Y. Does baking soda function as a magic bullet for patients with cancer? A mini review. *Integr Cancer Ther*. 2020;19:1534735420922579.