Safety Assessment of Sodium Sesquicarbonate, Sodium Bicarbonate, and Sodium Carbonate as Used in Cosmetics

Status:	Re-Review for Panel Consideration
Release Date:	November 9, 2023
Panel Meeting Date:	December 4-5, 2023

The Expert Panel for Cosmetic Ingredient Safety members are: Chair, Wilma F. Bergfeld, M.D., F.A.C.P.; Donald V. Belsito, M.D.; David E. Cohen, M.D.; Curtis D. Klaassen, Ph.D.; Allan E. Rettie, Ph.D.; David Ross, Ph.D.; Thomas J. Slaga, Ph.D.; Paul W. Snyder, D.V.M., Ph.D.; and Susan C. Tilton, Ph.D. The Cosmetic Ingredient Review (CIR) Executive Director is Bart Heldreth, Ph.D., and the Senior Director is Monice Fiume. This report was prepared by Regina Tucker, M.S., Scientific Analyst/Writer, CIR.

1620 L Street, NW, Suite 1200 ◇ Washington, DC 20036-4702 ◇ ph 202.331.0651 ◇
cirinfo@cir-safety.org

Commitment & Credibility since 1976

Memorandum

To: Expert Panel for Cosmetic Ingredient Safety Members and Liaisons
From: Regina Tucker, MS
Scientific Analyst/Writer, CIR
Date: November 9, 2023
Subject: Re-Review of the Safety Assessment of Sodium Sesquicarbonate, Sodium Bicarbonate, and Sodium Carbonate

The Expert Panel for Cosmetic Ingredient Safety (Panel) first published a review of the safety of Sodium Sesquicarbonate, Sodium Bicarbonate, and Sodium Carbonate in 1987 (identified as *originalreport_SodiumCarbonates_122023* in the pdf), with the conclusion that these ingredients are safe as presently used in cosmetic products, as described in that safety assessment. The Panel previously considered a re-review of this report and reaffirmed the 1987 conclusion, as published in 2006 *(rereview2006_SodiumCarbonates_122023)*.

Because it has been at least 15 years since the previous safety re-review was published, in accordance with Cosmetic Ingredient Review (CIR) Procedures, the Panel should consider whether the safety of Sodium Sesquicarbonate, Sodium Bicarbonate, and Sodium Carbonate should be re-opened. In October 2023, an extensive search of the world's literature was performed for studies dated 2000 forward. An historical overview, comparison of original and new use data, the search strategy used, and a synopsis of notable new data are enclosed herein (*newdata_SodiumCarbonates_122023*).

Current European Union regulations, toxicology, genotoxicity, carcinogenicity, anti-carcinogenicity, dermal irritation, ocular irritation, and clinical studies were located and are included for consideration by the Panel. No significant new findings were noted.

Also included for your review are current and historical use data (*usetable_SodiumCarbonates_122023*). The frequency of use of Sodium Sesquicarbonate has decreased, while the frequencies of use for both Sodium Bicarbonate and Sodium Carbonate have increased since the previous rereview was conducted. Specifically, the frequency of use of Sodium Bicarbonate increased from 66 uses in 2002 to 571 reported uses in 2023. The maximum reported concentration of use of all 3 ingredients has decreased since the previous re-review.

If upon review of the new studies and updated use data the Panel determines that a re-review is warranted, a Draft Amended Report will be presented at an upcoming meeting.

Re-Review – Sodium Sesquicarbonate, Sodium Bicarbonate & Sodium Carbonate - History and New Data

(Regina Tucker – December 2023 meeting)

Ingredients (3)	Citation	Conclusion	Use - New Data	Use - Historical Data	Notes
Sodium Sesquicarbonate **Sodium Bicarbonate** **Sodium Carbonate**	original: JACT 6(1): 121-138, 1987 re-review: IJT 25(2):1-89, 2006	Safe as used	Sodium Sesquicarbonate frequency of use (2023): 9 conc of use (2023): 0.5-69.1 Sodium Bicarbonate frequency of use (2023): 571 con of use (2023) 0.00001-67.6 Sodium Carbonate frequency of use (2023): 76 con of use (2023): 0.0002-48.7	Sodium Sesquicarbonate frequency of use (2002): 24 conc of use (2004): 2-90 Sodium Bicarbonate frequency of use (2002): 66 (excluding denture cleanser use) concentration of use (2004): 0.006-95 Sodium Carbonate frequency of use (2023): 21 con of use (2004) 0.000002-51	Sodium Sesquicarbonate Decrease in frequency and concentration of use. New use category in nails-other manicuring preparations Sodium Bicarbonate Significant increases in frequency of use. Decrease in concentration of use; notably, use concentration in oral hygiene products decreased from 95 to 66.4% in dentifrices. Sodium Carbonate Increase in frequency of use.; new use in baby products Slight decrease in concentration of use

NOTABLE NEW DATA			
Publication	**Study Type**	**Results – Brief Overview**	**Different from Existing Data?**
NON-COSMETIC USE			
Yamada M, Honma M. Summarized data of genotoxicity tests for designated food additives in Japan. Genes Environ. 2018 Dec 26; 40:27.	Food use	Sodium Bicarbonate and Sodium Carbonate are currently listed as two of 454 food additives allowed to be used in Japan.	Yes
The European Food Safety Authority (EFSA) Panel on Food Contact Materials, Enzymes, Flavourings and Processing Aids safety 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 Feb;16(2)	Food Additive	Sodium Carbonate and Sodium Bicarbonate have been evaluated and approved for use as additives in plastic food contact materials or as food additives. The EFSA Panel concluded that the use of Sodium Carbonate and Sodium Bicarbonate does not raise a safety concern when used in oxygen absorber/carbon dioxide emitter systems in sachets that prevent the physical release of their contents into the food.	This citation provides updated EU regulation information. Information on EU regulations is not provided in the previous rereview.
The European Food Safety Authority 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 1924/20061. *EFSA J*. 2010 Feb; 8 (2)	Food use	The EFSA Panel concluded that a cause-and-effect relationship has not been established between the consumption of Sodium Bicarbonate and a beneficial physiological effect for the general population related to reducing gastric acid levels.	This citation provides updated EU regulation information. Information on EU regulations is not provided in the previous rereview.
The European Food Safety Authority Panel on Additives and Products or Substances used in Animal Feed scientific opinion on the safety and efficacy of Sodium Carbonate (soda ash) for all species. *EFSA J*.2010; 8 (7)	Animal feed use	FEEDAP concluded that Sodium Carbonate is safe for all animal species, the consumers, and the users. At levels typically used in animal feed, sodium carbonate is not expected either to pose a risk for the environment.	This citation provides updated EU regulation information. Information on EU regulations is not provided in the previous rereview.

NOTABLE NEW DATA			
Publication	**Study Type**	**Results – Brief Overview**	**Different from Existing Data?**
TOXICOLOGICAL STUDIES			
Sodium Bicarbonate			
ECHA; Registration Dossier - ECHA (europa.eu) OECD; Sodium bicarbonate.doc (oecd.org)	Acute Oral Toxicity	Male/female Crl:CD BR rats (5 animals/group) were administered aq. Sodium Bicarbonate (females 3000, 3500, 4000 mg/kg bw, males: 3000, 3500, 4500 mg/kg bw) via gavage. No control animals were used. One female dosed with 4000 mg/kg died within 24 h of administration. All surviving animals gained weight during the post- exposure period. The surviving animals returned to a normal appearance by day 2. In females dosed with 3500 mg/kg, 4/5 had soft stool, 1/5 had a dark-stained urogenital area and 1/5 exhibited hypoactivity within the first day. Among the females dosed with 4000 mg/kg, 1/5 had soft stool and 1/5 was hypoactive during the first day. One female died on day 0 and a single erosion was found in the glandular mucosa of the stomach. In male rats, an enlarged pelvis was present in the right kidney of a male given 3000 mg/kg. Mandibular lymph nodes were enlarged in a male given 4000 mg/kg. Among the males dosed with 4500 mg/kg, 1/5 had soft stool and 1/5 was hypoactive during the first day. -Multiple opaque areas were on the parietal surface of the spleens of a male and female given 4000 mg/kg. The NOAEL was 4000 mg/kg in males and 3000 mg/kg in females.	Yes, a NOAEL is provided in this study.
Griffith JF. Interlaboratory variations in the determination of acute oral LD_{50}. *Toxicol Appl Pharmacol*. 1964 Nov, 6: 726-30. EHA; Registration Dossier - ECHA (europa.eu) OECD; Sodium bicarbonate.doc (oecd.org)	Acute Oral Toxicity	The oral LD_{50} of Sodium Bicarbonate was determined in male and female Sprague Dawley rats. Three laboratories administered 20% aq. Sodium Bicarbonate, another 3 laboratories administered 50% Sodium Bicarbonate in corn oil. The LD_{50} for Sodium Bicarbonate was 4220 - 8290 mg/kg bw.	Yes, The LD_{50} provided is different from the original report.
ECHA; Registration Dossier - ECHA (europa.eu)	Acute Inhalation Toxicity	Five male and female Sprague-Dawley rats were exposed to Sodium Bicarbonate (4.74 mg/l) for 4.5 h via whole body inhalation. No control group was included in the study design. There was no mortality. The LC_{50} was >4.74 mg/l. During the first hour of exposure, reduced movement and hunched posture was noted in most of the animals. Gross necropsy findings were unremarkable. One male and one female had moderately red lung tissue, while one male had slightly red lung tissue.	Yes, Inhalation data for Sodium Bicarbonate was not included in the original report.
Sodium Carbonate			
ECHA; Registration Dossier - ECHA (europa.eu)	Acute Dermal Toxicity	In a mouse study an LD_{50} of 2210 mg/kg bw is reported for Sodium Carbonate (additional details not provided)	Yes, acute dermal studies were not evaluated in the original report.
ECHA; Registration Dossier - ECHA (europa.eu) OECD; Naco.doc (oecd.org)	Acute Oral Toxicity	Groups of Wistar rats (5 male and 5 female) were dosed with 1300 - 5000 mg/kg bw 20% aq. Sodium Carbonate by gavage. Number of deaths at each dose: 1300 mg/kg: 0/10; 1800 mg/kg: 1/10; 2600 mg/kg: 4/10; 3600 mg/kg: 7/10; 5000 mg/kg: 10/10. Necropsy findings included molted or pale kidneys, nasal or oral discharge, red intestines, stomach with a red pyloric region or controlling red fluid, and molted or dark red lungs. The LD_{50} was 2800 mg/kg bw	Acute oral toxicity for Sodium Carbonate is not provided in the original report.
Sodium Carbonate Registration Dossier - ECHA (europa.eu)	Acute Oral Toxicity	In a study using rats, an LD_{50} of 4090 mg/kg bw was reported for Sodium Carbonate (additional details not specified)	Acute oral toxicity for Sodium Carbonate is not provided in the original report.

NOTABLE NEW DATA			
Publication	**Study Type**	**Results – Brief Overview**	**Different from Existing Data?**
Genotoxicity			
Sodium Sesquicarbonate			
ECHA; Registration Dossier - ECHA (europa.eu)	in vitro QSAR) prediction model to determine mutagenicity	An assessment was conducted based on an examination of the composition of the substance and the potential of its constituents to induce gene mutations in mammalian cells. Data from a QSAR prediction was used to determine mutagenicity. The results of the study indicate Sodium Sesquicarbonate is not expected to induce gene mutations in mammalian cells or bacteria with and without metabolic activation.	no
Sodium Bicarbonate			
OECD; Sodium bicarbonate.doc (oecd.org)	Ames test	An Ames test was performed *using Salmonella typhimurium* (concentration not reported) TA98, 100,1535,1537, and 1538 with and without metabolic activation. Sodium Bicarbonate was not mutagenic.	no
OECD; Sodium bicarbonate.doc (oecd.org)	bacterial reverse mutation assay	Sodium Bicarbonate (0, 0.1, 0.5,1, 5, and 10 mg/plate) with *S. typhimurium* stains TA97 and TA102, with and without metabolic activation. The test was negative for mutagenicity.	no
Ishidate M Jr, Sofuni T, Yoshikawa K, Hayashi M, Nohmi T, Sawada M, Matsuoka A. Primary mutagenicity screening of food additives currently used in *Japan. Food Chem Toxicol*. 1984 Aug;22(8):623-36	bacterial reverse mutation assay	Sodium Bicarbonate (max. 10 mg/plate) in S. *typhimurium* strains TA92, TA94, TA98, TA100, TA1535, and TA1537 with an S9 mix. The test was negative for mutagenicity.	no
Yamada M, Honma M. Summarized data of genotoxicity tests for designated food additives in Japan. *Genes Environ*. 2018 Dec 26; 40:27.	in vitro mammalian chromosome aberration test	A chromosomal aberration test with Sodium Bicarbonate (max 1mg/ml) without metabolic activation was tested on a Chinese hamster fibroblast cell line. The test was negative without metabolic activation, however, 1 mg/ml caused 50% cell-growth inhibition.	Mammalian chromosome aberration test on Sodium Bicarbonate was not in the original report.
OECD; Sodium bicarbonate.doc (oecd.org)	in vitro-DNA-Repair Test in *Escherichia coli*	Sodium Bicarbonate (2500 µg without S9 and 5000 µg with metabolic activation) was evaluated in *E. coli* WP2, WP67, and CM871. The substance was tested up to the toxicity or solubility limits. Under the conditions of the study, Sodium Bicarbonate was not genotoxic	Sodium Bicarbonate in *E. coli* was not evaluated in the original report.
Sodium Carbonate			
Ishidate M Jr, Sofuni T, Yoshikawa K, Hayashi M, Nohmi T, Sawada M, Matsuoka A. Primary mutagenicity screening of food additives currently used in *Japan. Food Chem Toxicol*. 1984 Aug;22(8):623-36. Yamada M, Honma M. Summarized data of genotoxicity tests for designated food additives in Japan. *Genes Environ*. 2018 Dec 26; 40:27.	bacterial reverse mutation assay	A bacterial reverse mutation assay was performed according to OECD TG 471. Sodium Carbonate tested in *S. typhimurium* strains TA97 and TA102 was negative for genotoxicity.	Genotoxicity data for Sodium Carbonate was not included in the original report.
ECHA; Registration Dossier - ECHA (europa.eu) OECD; Naco.doc (oecd.org)	*E. coli* chromotest	Sodium Carbonate (0.11 – 11,000 mg/ml) were incubated with samples of *E. coli* PQ37 for 2 h without metabolic activation. Toxicity was observed at 1100 mg/ml. It was concluded that sodium carbonate did not induce primary DNA damage without metabolic activation.	Genotoxicity data for Sodium Carbonate was not included in the original report.

NOTABLE NEW DATA			
Publication	**Study Type**	**Results – Brief Overview**	**Different from Existing Data?**
CARCINOGENICITY			
Sodium Bicarbonate			
Fukushima S, Inoue T, Uwagawa S, Shibata MA, Ito N. Co-carcinogenic effects of NaHCO3 on o-phenylphenol-induced rat bladder carcinogenesis. *Carcinogenesis*. 1989 Sep;10(9):1635-40.	oral	Male Fisher 344 rats (31 animals/test group and 30 c0ntrols) were administered Sodium Bicarbonate (powdered diet supplemented with 0.64%), sodium *o*–phenyphenol 2%, 1.25) or Sodium Bicarbonate (0.16, 0.32, or 0.64%) and sodium *o*-phenylphenol combined 1.25%). Animals were fed continuously for 104 wk. Sodium Bicarbonate alone did not have a carcinogenic effect on the urinary bladder of rats. Papillary or nodular hyperplasia and papilloma incidence did not differ from the control group. The survival of the group receiving Sodium Bicarbonate was 84%. The survival rate of the control group was 73%. Animals exposed to Sodium Bicarbonate did not have significant increases in the number of tumors. The first bladder tumor was found in a rat that died in week 49. One rat in the group had a moderate-sized tumor of the bladder, but this was not significantly different from the control group. The NOAEL was 6400 mg/kg diet. Overall, Sodium Bicarbonate was not carcinogenic.	yes
Fukushima, S. et al., Co-carcinogenic effects of NaHCO3 on *o*-phenylphenol-induced rat bladder carcinogenesis. *Carcinogenesis* vol.10, no.9: 1635-1640, 1989.	oral	Male Fischer 344 rats (5/group) were administered 0.64% Sodium Bicarbonate (0.64%) or 0.16, 0.32, or 0.64% Sodium Bicarbonate with 1.25% sodium *o*-phenyl-phenol in feed for 8 wk. Sodium Bicarbonate was not carcinogenic. The pH, sodium concentration, and urine volume were increased in the Sodium Bicarbonate-exposed group as compared to the controls. The surface of the superficial epithelial cells of the urinary bladder was normal.	yes
OECD; Sodium bicarbonate.doc (oecd.org)	oral	Male Fischer 344 rats (10/group) were administered 0 or ~2240 mg/kg bw/d (2.9% of diet)) in feed for 70 d. The LOAEL for Sodium Bicarbonate was ~2240 mg/kg bw/d. No animals died; 3/10 rats had hyperplasia, while the kidneys and forestomach were normal. Scanning electron microscopy revealed 9/10 animals with severe and 1/10 with less severe changes in the bladder epithelium. The increase in bladder weight was assumed to be a secondary effect of the increased concentration of salt in the diet. The increase in pH was assumed to be a secondary effect of the increase of Sodium Bicarbonate in the urine.	yes
ANTI-CARCINOGENICITY			
Sodium Bicarbonate			
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 Jan-Dec;19	oral	In a review of findings from studies in which Sodium Bicarbonate is administered alone or in combination with other anticancer therapies as cancer treatments, several in vivo experiments revealed there could be possible anticancer effects of Sodium Bicarbonate in monotherapy and in conjunction with other anticancer therapies.	Yes
Mori D, Tsujikawa T, Sugiyama Y, Kotani SI, Fuse S, Ohmura G, Arai A, Kawaguchi T, Hirano S, Mazda O, Kishida T. 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 Dec 15;149(12):2116-2124.	oral	Mice (n = 6 per group) received 200 mmol/l Sodium Bicarbonate solution or regular tap water (control) orally. SCC7 tumor cells were inoculated in the mice at a dose of 5 x 10^5 cells/mouse on day 0, and mice were sacrificed on day 14. Tumor-bearing mice that ingested Sodium Bicarbonate had a neutralization of acidity in the tumor tissue, a decrease in PD-L1 expression in tumor cells, and suppression of tumor growth in vivo.	Yes
OTHER RELEVANT STUDIES			
Sodium Bicarbonate			
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, Intrapatient, Controlled Study. *Dermatol Ther (Heidelb)*. 2019 Sep;9(3):497-503.	effect of on psoriasis	A randomized, double blind, intrapatient, controlled study enrolled 30 adult male and female test subjects. Patients enrolled had a Psoriasis Area and Severity Index score of 10.8 Treatment was performed randomly on the left and right side of the body. Sodium Bicarbonate (30%) in a cetearyl alcohol, sodium cetearyl sulfate formulation was applied 2x/d for 28 d. Sodium Bicarbonate did not improve psoriatic lesions.	Yes, Othe relevant studies were not included at the time of the original report.

NOTABLE NEW DATA			
Publication	**Study Type**	**Results – Brief Overview**	**Different from Existing Data?**
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 Feb;175(1-2):153-8.	anti-fungal activity	The in vitro activity of Sodium Bicarbonate on yeasts, dermatophytes and molds responsible for human skin and nail fungal infections was evaluated. In vitro testing was performed on 70 clinical strains from patients with suspected onychomycosis or cutaneous fungal infection. Sodium Bicarbonate showed a dose-dependent antifungal activity, with the best antifungal activity on yeasts.	Yes, Othe relevant studies were not included at the time of the original report.
DERMAL IRRITATION AND SENSITIZATION STUDIES			
Sodium Bicarbonate			
ECHA; Registration Dossier - ECHA (europa.eu)	dermal irritation - animal	New Zealand White rabbits (3 males and 3 females); 4 h semi-occlusive patch; 0.5 g aq. Sodium Bicarbonate. PII of 0.3; the mean erythema score was 0.07/2 (erythema was not fully reversible within 48 h); the mean edema score was 0/2. Sodium Bicarbonate was considered slightly irritating.	Yes, this study produced slightly irritating results. In the original report Sodium Bicarbonate did not cause irritation.
ECHA; Registration Dossier - ECHA (europa.eu)	dermal irritation - animal	Kleinrussen, Chbb: HM rabbits (n=3); 4 h semi-occlusive patch (OECD TG 404); 0.3 g Sodium Bicarbonate. One rabbit had slight erythema 1 h after patch removal that resolved by 24 h. Another animal had slight erythema t 24 h after the patch removal that was resolved at 48 h	
ECHA; Registration Dossier - ECHA (europa.eu) OECD; Naco.doc (oecd.org)	dermal irritation - animal	New Zealand White rabbits (n=6); 4 h occlusive patch; 0.5 g Sodium Bicarbonate applied to the intact and abraded skin; test site was washed after patching. o signs of erythema or edema observed by 72 h. Sodium Carbonate was considered non-irritating.	
Sodium Carbonate			
OECD; Naco.doc (oecd.org)	dermal irritation - human	clinical patch test; 26 subjects; 15 min – 4 h occlusive patch with 0,.2 g Sodium Carbonate (98%); test sites were assessed 24, 48 and 72 h after patch removal. There was no reactivity among the volunteers; Sodium Carbonate were not classified as irritant.	
OCULAR IRRITATION STUDIES			
Sodium Sesquicarbonate			
ECHA; Registration Dossier - ECHA (europa.eu)	ocular irritation – animal	Isolated Chicken Eye (ICE) test performed according to OECD TG 438. Ross spring chickens; Sodium Sesquicarbonate (30 mg) applied neat for 10 sec in 3 animals and 30 sec in one. Ccorneal thickness, corneal opacity, and fluorescein retention of damaged epithelial cells were measured. After 4 h, very slight swelling, slight opacity, and slight or slight to moderate fluorescein retention. Sodium Sesquicarbonate was considered non-irritating for the eyes.	Yes, the animal species used in this report is different from the test animal in the original report. The original report involves studies with rabbits.
Sodium Carbonate			
ECHA; Registration Dossier - ECHA (europa.eu)	ocular irritation - animal	New Zealand white rabbits (n=6); ocular irritation study performed according to OECD TG 405; undiluted Sodium Carbonate (0.1 g) was instilled into the left eye for 72 h, and the right eye served as the untreated control. One animal showed conjunctival redness and chemosis after 72 h. Sodium Carbonate was considered not irritating to rabbit eyes.	no
ECHA; Registration Dossier – ECHA (europa.eu)	ocular irritation - animal	New Zealand White rabbits (n=6); 0.1 g Sodium Carbonate (0.1 g) instilled into the left eye for 72 h, and the right eye served as the untreated control. The mean Draize score was for conjunctival redness, chemosis, and for the iris were 1.67, 1.38 and 0.25, respectively. Sodium Carbonate was considered non-irritating for the eyes.	no
ECHA; Registration Dossier - ECHA (europa.eu) OECD; Naco.doc (oecd.org)	ocular irritation - animal	New Zealand white rabbits (n=9) Sodium Carbonate (0.1 ml) instilled in one of each animal; treated eyes of 3 rabbits were then rinsed with 30 ml distilled water, while the remaining eyes were unrinsed; 14-d observation period. Two animals with unwashed eyes had ruptured eyes and the remaining 4 had signs of irritation at the termination of the study; 6/6 animals with unwashed eyes had a positive cornea score, iris score, and conjunctivitis (redness and chemosis) score. In the rinsed eyes, one rabbit had signs of irritation at the termination of the study, and the others showed no signs of irritation from days 2 – 14; 1/3 rabbits with rinsed eyes had a positive cornea score, iris score and conjunctivitis (redness and chemosis) score. Sodium Carbonate was considered irritating for the eyes.	Yes, Sodium Carbonate is considered irritating in this study.

NOTABLE NEW DATA			
Publication	**Study Type**	**Results – Brief Overview**	**Different from Existing Data?**
CLINICAL STUDIES			
Sodium Carbonate			
ECHA; Registration Dossier - ECHA (europa.eu)	Human exposure	Compilation and assessment of available published data for repeat dose toxicity. NOAEL of 10 mg/m^3 air for male and female human subjects is reported.	Yes, the effects of Sodium Carbonate in human subjects is not listed in the original report.

Abbreviations: BBN- N-butyl-N- (4-hydroxybutyl) nitrosamine;, ECHA – European Chemicals Agency; EFSA-European Food Safety Authority; FEEDAP - Panel on Additives and Products or Substances used in Animal Feed; LOAEL – lowest observed adverse effect level; NOAEL-no observed adverse effects level; OECD – Organisation for Economic Co-operation and Development; QSAR-Quantitative structure-activity relationship; TG – test guideline

Search (from 2000 to present)

PubMed

(((“Sodium Sesquicarbonate”) OR (533-96-0[CAS No.])) AND (("2000"[Date - Publication]: "3000"[Date – Publication]))) –28 hits; 0 useful

(((“Sodium Bicarbonate”) OR (144-55-8[CAS No.])) AND (("2000"[Date - Publication]: "3000"[Date – Publication]))) – 8000 hits; 9 useful

(((“Sodium Carbonate”) OR (497-19-8[CAS No.])) AND (("2000"[Date - Publication]: "3000"[Date – Publication]))) – 1505 hits; 3

The following qualifiers were used in the search of Sodium Bicarbonate and Sodium Carbonate: Absorption, Acute, Allergy, Allergic, Allergenic, Cancer, Carcinogen, Chronic, Development, Developmental, Excretion, Genotoxic, Irritation, Metabolism, Mutagen, Mutagenic, Penetration, Percutaneous, Pharmacokinetic, Repeated dose, Reproduction, Reproductive, Sensitization, Skin, Subchronic, Teratogen, Teratogenic, Toxic, Toxicity, Toxicokinetic, Toxicology, Tumor.

Table 1. Frequency (2023/2001)[1,2] and concentration (2023/2004)[2,3] of use according to likely duration and exposure and by product category

	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[1]	**2002[2]**	**2023[3]**	**2004[2]**	**2023[1]**	**2002[2]**	**2023[3]**	**2004[2]**	**2023[1]**	**2002[2]**	**2023[3]**	**2004[2]**
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**
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*	*0.0002-0.044*	*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*
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*
Exposure Type												
Eye Area	NR	NR	NR	NR	NR	8	0.012	0.04-0.2	4	NR	0.00068	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***
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], 0.01-56[b]	1; 6[a]; 11[b]	1[a]; 2[b]	0.0009-0.19[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]	20,0.01-56b,5[c]	6[a]	1[a]	0.0004[c]	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
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]
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
Hair-Coloring	NR	NR	NR	NR	NR	8	6	0.1-10	1	2	1-2	0.02-25
Nail	1	NR	NR	NR	2	NR	35.5	39	NR	NR	NR	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
Baby Products	NR	NR	NR	NR	1	1	0.001	5	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
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
Bubble Baths	NR	2	50	18	15	NR	NR	5-52	1	NR	NR	7-39
Bath Capsules					1	NR	NR	49				
Other Bath Preparations	4	2	NR	10-35	20	NR	63.3	1-64	1	NR	0.0012-42.3	0.009-39
Eye Makeup Preparations												
Eyebrow Pencil					NR	NR	NR	0.2	NR	NR	0.00068	0.2
Eyeliner					NR	1	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	2	NR	NR	NR
Fragrance Preparations												
Cologne and Toilet water Spray					NR	NR	0.001	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

Table 1. Frequency (2023/2001)[1,2] and concentration (2023/2004)[2,3] of use according to likely duration and exposure and by product category

	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[1]	**2002[2]**	**2023[3]**	**2004[2]**	**2023[1]**	**2002[2]**	**2023[3]**	**2004[2]**	**2023[1]**	**2002[2]**	**2023[3]**	**2004[2]**
Tonics, Dressings, and Other Hair Grooming Aids									NR	NR	NR	0.000002-0.01
Wave Sets												1
Other Hair Preparations					1	NR	NR	NR				
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
Makeup Preparations												
Blushers (all types)									NR	NR	NR	0.03
Foundations					NR	NR	NR	0.09	NR	1	NR	0.3
Lipstick					NR	NR	NR	0.03-1	NR	3	NR	NR
Other Makeup Preparations					1	NR	NR	NR				
Manicuring Preparations (Nail)												
Other Manicuring Preparations	1	NR	NR	NR	2	NR	35.5	39	NR	NR	NR	0.6
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[d]
Personal Cleanliness Products												
Bath Soaps and Detergents	NR	2	NR	NR	20	2	0.00001-43.5	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 (exc shave)					11	NR	NR	0.01-7	4	NR	NR	0.008
Body and Hand (exc 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				
Moisturizing					20	NR	11.8 (not spray)	0.4	7	2	0.0002 (not spray)	NR
Night (Spray)									1	NR	NR	NR
Paste Masks (mud packs)					2	1	0.02-4	61				
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[d]	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
[a] 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.
[b] It is possible these products are sprays, but it is not specified whether the reported uses are sprays.
[c] It is possible these products are powders, but it is not specified whether the reported uses are powders.

REFERENCES

1. U.S. Food and Drug Administration (FDA) Center for Food Safety and Applied Nutrition (CFSAN). 2023. 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

2. Andersen FA (ed.). Annual Review of Cosmetic Ingredient Safety Assessments 2004/2005-Sodium Sesquicarboante, Sodium Bicarbonate, and Sodium Cabonate,. *Int J Toxicol* 2006;25(S2):1-89.

3. Personal Care Products Council. 2023. Concentration of Use by FDA Product Category: Sodium Sesquicarbonate, Sodium Bicarbonate, and Sodium Carbonate. (Unpublished data submitted by Personal Care Products Council on October 31, 2022) Obtained under the Freedom of Information Act from CFSAN; requested as "Frequency of Use Data" January 4, 2023; received February 24, 2023

JOURNAL OF THE AMERICAN COLLEGE OF TOXICOLOGY
Volume 6, Number 1, 1987
Mary Ann Liebert, Inc., Publishers

5

Final Report on the Safety Assessment of Sodium Sesquicarbonate, Sodium Bicarbonate, and Sodium Carbonate

Sodium Sesquicarbonate, Sodium Carbonate, and Sodium Bicarbonate are used in cosmetic products at concentrations ranging up to 50%. The LD_{50} in rats for Sodium Bicarbonate ranged from 7.6 g/kg to 8.9 g/kg. Sodium Sesquicarbonate, Sodium Carbonate, and Sodium Bicarbonate caused conjunctivitis. Sodium Bicarbonate was not an ocular irritant to laboratory animals. Neither Sodium Bicarbonate nor Sodium Carbonate was a teratogen to laboratory animals. Sodium Sesquicarbonate and Sodium Bicarbonate were not mutagenic to two different cell cultures. Dermatitis, but not sensitization, was observed in employees of a Trona (Sodium Sesquicarbonate) mining facility. Sodium Carbonate, but not Sodium Bicarbonate, is a skin and eye irritant due to the alkaline nature of its solutions. The cosmetic use of Sodium Carbonate at high concentrations is mainly limited to products designed to be diluted before use and in products where pH is buffered to near neutrality. It is concluded that Sodium Sesquicarbonate, Sodium Bicarbonate, and Sodium Carbonate are safe as presently used in cosmetics.

CHEMISTRY

Sodium Sesquicarbonate is composed of Sodium Carbonate and Sodium Bicarbonate. Hence, the three sodium compounds are addressed in this report.* Physical properties of these compounds are listed in Table 1.

*This report updates studies of Sodium Sesquicarbonate, Sodium Bicarbonate, and Sodium Carbonate included in a 1975 GRAS report entitled *Evaluation of the Health Aspects of Carbonates and Bicarbonates as Food Ingredients.*

TABLE 1. Properties of Sodium Compounds[6]

	Sodium Sesquicarbonate	*Sodium Carbonate*	*Sodium Bicarbonate*
Formula	$Na_2CO_3 \cdot NaHCO_3 \cdot 2H_2O$	Na_2CO_3	$NaHCO_3$
Molecular weight	226.03	105.99	84.00
Crystalline form	Colorless, monoclinic	White, hygroscopic powder	White, monoclinic prisms
Boiling Point	– – –	Decomposes	– – –
Melting point	Decomposes	851°C	270°C
Density	2.112	2.532	2.159
Refractive index	1.5073	1.535	1.500
Solubility	Soluble in water	Soluble in water, slightly soluble in absolute alcohol, and insoluble in acetone	Soluble in water, slightly soluble in alcohol

Definition and Properties

Sodium Sesquicarbonate

Sodium Sesquicarbonate (CAS No. 533-96-0) is a white crystalline solid in either flake or powder form, known also as trona and urao.[1,2] It dissolves rapidly and completely in water, and its solutions are alkaline (0.1 M aqueous solution, pH 10.1).[1,3]

Sodium Carbonate

Sodium Carbonate (CAS Nos. 497-19-8 and 5968-11-6), known as soda ash and carbonic acid, disodium salt,[4] is a grayish white crystalline powder.[5] It is soluble in water and its aqueous solution is strongly alkaline (0.1 M, pH = 11.6).[2]

Sodium Bicarbonate

Sodium Bicarbonate (CAS No. 144-55-8) is a white crystalline solid in either powder or granule form.[2] Synonyms for this compound include baking soda, bicarbonate of soda, carbonic acid, monosodium salt.[4] The decomposition of Sodium Bicarbonate to Sodium Carbonate and carbon dioxide in aqueous solution is initiated at approximately 20°C; boiling completes the decomposition process.[2] A freshly prepared 0.1 M aqueous solution of Sodium Bicarbonate has a pH of 8.5.[2]

Methods of Production

Sodium Sesquicarbonate

Sodium Sesquicarbonate occurs naturally as trona ore and is produced via a double refining process; it is also prepared by partial carbonation of a soda ash solution, followed by crystallization, centrifugation, and drying.[7] The soda ash solution undergoing crystallization contains equimolar quantities of Sodium Car-

bonate and Sodium Bicarbonate.[5] Sodium Sesquicarbonate has been widely produced from Sodium Carbonate and a slight excess of Sodium Bicarbonate.[8]

Sodium Carbonate and Sodium Bicarbonate

Sodium Carbonate and Sodium Bicarbonate may be produced by the Solvay process.[9,10] In this process, carbon dioxide is bubbled through a solution of sodium chloride and ammonia to precipitate Sodium Bicarbonate; calcination of the Sodium Bicarbonate produces Sodium Carbonate.

Reactivity

X-ray diffraction patterns of Sodium Sesquicarbonate (trona), Sodium Bicarbonate, and Sodium Carbonate exposed to sulfur dioxide (SO_2) at 271°C indicate: the complete reaction of trona to sodium pyrosulfite and one form of sodium sulfate, the complete reaction of Sodium bicarbonate to sodium pyrosulfite, and no sulfur-bearing phases for the Sodium Carbonate sample.[11]

Analytical Methods

X-ray diffraction and scanning electron microscopy (in conjunction with energy dispersive x-ray analysis) are methods by which Sodium Sesquicarbonate, Sodium Carbonate, and Sodium Bicarbonate have been identified.[11]

Impurities

Sodium Sesquicarbonate

Results from assays of Sodium Sesquicarbonate indicate the presence of Sodium Bicarbonate (not less than 35.0% and not greater than 38.6%) and Sodium Carbonate (not less than 46.4% and not greater than 50.0%).[1] The following impurities have also been reported:

	FASEB[12]	*Food Chemicals Codex*[1]	*Estrin et al.*[13]
Arsenic	3 ppm[a]	3.000 ppm[a]	3 ppm maximum
Lead	10 ppm[a]	10.000 ppm[a]	20 ppm maximum
Iron	20 ppm[a]	0.002%	20 ppm maximum
Sodium chloride	5000 ppm[a]	0.500%	– – –
Water	– – –	13.8–16.7%	– – –

[a]Not greater than.

Sodium Carbonate

Sodium Carbonate consists of not less than 99.5% Sodium Carbonate, calculated on the anhydrous basis.[14] The Cosmetic, Toiletry and Fragrance Association (CTFA) specification for Sodium Carbonate lists arsenic (3 ppm maximum) and lead (20 ppm maximum) as impurities.[13] Other impurities include sodium chloride, sodium sulfate, calcium carbonate, magnesium carbonate, and Sodium Bicarbonate.[5]

Sodium Bicarbonate

Sodium Bicarbonate consists of not less than 99.0% Sodium Bicarbonate, calculated on the dried basis.[15] High purity commercial grades contain approximately 27.3% sodium.[16]

USE

Purpose in Cosmetics

Sodium Sesquicarbonate serves as a water softener in bath preparations.[17] Product formulation data[18] indicate that Sodium Sesquicarbonate occurs predominantly in bath preparations, whereas Sodium Bicarbonate and Sodium Carbonate (components of Sodium Sesquicarbonate) are used in bath, skin, and hair preparations.

The cosmetic formulation listing that is made available by the Food and Drug Administration (FDA) 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 prescribed 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 in such a case would be a fraction of that reported to the FDA. The fact that data are only submitted within the framework of preset concentration ranges also provides 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. The product formulation listings for Sodium Sesquicarbonate, Sodium Carbonate, and Sodium Bicarbonate are shown in Table 2. Sodium Sesquicarbonate occurs predominantly in bath preparations, ranging in concentration from >1–5% to >50%. Sodium Carbonate and Sodium Bicarbonate are found mostly in bath, skin, and hair preparations. Sodium Carbonate ranges in concentration from ≤0.1% to >10–25% and Sodium Bicarbonate from ≤0.1% to >50% in these preparations.

Surfaces to which Applied

Cosmetic products containing Sodium Sesquicarbonate, Sodium Carbonate, and Sodium Bicarbonate are applied to the skin and hair and may come in contact with the eyes, nasal mucosa, and other parts of the body.

Frequency and Duration of Application

Product formulations containing Sodium Sesquicarbonate, Sodium Carbonate, and Sodium Bicarbonate may be applied on a monthly basis or as often as several times daily. Many of the products may be expected to remain in contact with the skin for an hour at most and may be used repeatedly over a period of several years.

High concentrations of Sodium Carbonate and Sodium Bicarbonate occur mostly in bath formulations. In-use studies have indicated that approximately 17.0 g of any bubble bath formulation are diluted with approximately 15 gallons of water. Thus, the final concentration of bubble bath would be approximately 0.03%. For bath preparations in which Sodium Bicarbonate or Sodium Carbonate is present at concentrations of 25 or 50%, consumer exposure would amount to 0.0075 or 0.015%, respectively.[19]

Noncosmetic use

The Select Committee on Generally Recognized as Safe (GRAS) Substances (1975) concluded that there were no reasonable grounds for suspecting any hazards associated with using Sodium Sesquicarbonate, Sodium Carbonate, and Sodium Bicarbonate as food ingredients.[12] The conclusion was based on data from the following types of studies: acute studies,[20-23] subchronic and chronic feeding studies,[24] other feeding studies,[25-28] metabolic studies,[29-36] teratogenicity studies,[37,38] mutagenicity studies,[39] and clinical studies concerning digestion,[40] metabolism,[41,42] absorption and excretion,[43] urinary excretion,[44] renal function,[45] acid–base balance and renal function,[46-48] and exercise physiology.[49] Currently, Sodium Sesquicarbonate, Sodium Carbonate, and Sodium Bicarbonate are GRAS direct human food ingredients, with no limitations other than current good manufacturing practices.[7]

Sodium Sesquicarbonate is not included in the 1984 Over-The-Counter (OTC) Drug Review, but its major components, Sodium Carbonate and Sodium Bicarbonate, are listed as antacids that are GRAS.[50]

In addition to their use in food and pharmaceutical products, Sodium Sesquicarbonate, Sodium Carbonate, and Sodium Bicarbonate are used in aluminum production, textile processing, petroleum refining, and in the manufacture of soap, glass, and paper.[5,51]

BIOLOGICAL PROPERTIES

Absorption, Metabolism, and Excretion

The major extracellular buffer in the blood and interstitial fluid of vertebrates is the bicarbonate buffer system, described by the following equation:

$$H_2O + CO_2 \rightleftharpoons H_2CO_3 \leftrightharpoons H^+ + HCO_3^-$$

Carbon dioxide from the tissues diffuses rapidly into red blood cells, where it is hydrated with water to form carbonic acid. This reaction is accelerated by carbonic anhydrase, an enzyme present in high concentrations in red blood cells. The carbonic acid formed dissociates into bicarbonate and hydrogen ions. Most of the bicarbonate ions diffuse into the plasma. Since the ratio of H_2CO_3 to dissolved CO_2 is constant at equilibrium, pH may be expressed in terms of bicarbonate ion concentration and partial pressure of CO_2 by means of the Henderson-Hasselbach equation:

$$pH = pk' + \log [HCO_3^-]/\alpha P_{CO_2}$$

TABLE 2. Product Formulation Data[18]

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	>0.1–1	≤0.1
Sodium Sesquicarbonate									
Bath oils, tablets, and salts	237	24	5	7	6	4	2	–	–
Bubble baths	475	68	39	19	4	6	–	–	–
Bath capsules	3	2	–	–	2	–	–	–	–
Other bath preparations	132	11	–	2	6	3	–	–	–
Other fragrance preparations	191	1	–	–	–	1	–	–	–
Hair straighteners	64	1	1	–	–	–	–	–	–
Permanent waves	474	2	–	–	–	1	1	–	–
Other personal cleanliness products	227	2	–	–	–	2	–	–	–
1981 TOTALS		111	45	28	18	17	3	–	–
Sodium Carbonate									
Bubble baths	475	4	–	–	4	–	–	–	–
Hair conditioners	478	1	–	–	–	–	–	1	–
Hair straighteners	64	1	–	–	–	–	1	–	–
Permanent waves	474	1	–	–	–	–	1	–	–
Hair shampoos (noncoloring)	909	2	–	–	–	–	–	1	1
Hair dyes and colors (all types requiring caution statement and patch test)	811	1	–	–	–	–	1	–	–
Hair bleaches	111	2	–	–	–	1	–	1	–
Makeup foundations	740	1	–	–	–	–	–	–	1
Bath soaps and detergents	148	2	–	–	–	–	–	2	–
Douches	26	1	–	–	–	1	–	–	–
Other personal cleanliness products	227	3	–	–	–	–	2	–	1

Skin cleansing preparations (cold creams, lotions, liquids, and pads)	680	2	–	–	–	–	–	–	2
Hormone skin care preparations	10	1	–	–	–	–	–	–	1
Moisturizing skin care preparations	747	2	–	–	–	–	–	–	2
Skin fresheners	260	1	–	–	–	–	–	–	1
1981 TOTALS		25	–	–	4	2	5	5	9
Sodium Bicarbonate									
Bath oils, tablets, and salts	237	1	–	–	–	–	1	–	–
Bubble baths	475	4	–	–	4	–	–	–	–
Eyeliner	396	2	–	–	–	–	–	1	1
Fragrance powders (dusting and talcum, excluding aftershave talc)	483	5	–	–	4	–	–	1	–
Hair straighteners	64	1	–	–	–	–	–	1	–
Permanent waves	474	5	–	–	–	–	–	3	2
Other hair preparations (noncoloring)	177	1	–	–	–	–	1	–	–
Hair bleaches	111	1	–	1	–	–	–	–	–
Dentifrices (aerosol, liquid, pastes, and powders)	42	5	1	2	–	1	1	–	–
Deodorants (underarm)	239	2	–	–	–	–	2	–	–
Douches	26	4	–	–	1	–	1	1	1
Other personal cleanliness products	227	4	–	–	1	1	–	–	2
Other shaving preparation products	29	1	–	–	–	–	–	–	1
Paste masks (mud packs)	171	3	1	–	–	–	–	–	2
Skin fresheners	260	2	–	–	–	1	–	–	1
Other skin care preparations	349	4	–	–	4	–	–	–	–
1981 TOTALS		45	2	3	14	3	6	7	10

The blood plasma of man normally has a pH of 7.40. Should the pH fall below 7.0 or rise above 7.8, irreparable damage may occur. Compensatory mechanisms for acid–base disturbances function to alter the ratio of HCO_3^- to P_{CO_2}, returning the pH of the blood to normal. Thus, metabolic acidosis may be compensated for by hyperventilation and increased renal reabsorption of HCO_3^-. Metabolic alkalosis may be compensated for by hypoventilation and the excretion of excess HCO_3^- in the urine.[52–54]

^{14}C-Sodium Bicarbonate (18 μCi) was introduced via intraperitoneal injection into CFW mice.[35] Subsequently, assays of the blood and various organs of the body were performed (after 24 and 48 h and 1, 2, 4, and 12 weeks). After 1 h, more than 90% of the total radioactivity injected was lost through the lungs. Most of the radioactivity in the blood was in noncarbonate form after 24 h. In another study, five intraperitoneal injections of Sodium [^{11}C] Bicarbonate (made at 30-minute intervals) were administered to rats that had been fasted for 24 h.[33] The animals were killed 30 minutes after the last injection, and about 60% of the radioactivity was accounted for. The urine contained 1.3% of the radioactivity, and more than 50% of the radioactivity appeared as respiratory [^{11}C] carbon dioxide.

In humans, when plasma bicarbonate concentrations are below 24 mM, nearly all of the bicarbonate entering the renal tubules is reabsorbed; above this plasma level, excess bicarbonate is excreted.[47]

TOXICOLOGY

Inhalation Toxicity

Male rats were subjected to a Sodium Carbonate aerosol over a period of 3½ months.[55] The aerosol consisted of a 2% aqueous solution of Sodium Carbonate and the frequency of exposure was 4 h per day for 5 days per week. Pulmonary alterations included thickening of the intraalveolar walls, hyperemia, lymphoid infiltration, and pneumocyte desquamation (aerosol concentration = 70 ± 2.9 mg/m^3).

In another study, adult male rats (10, Sprague-Dawley and Wistar strains), mice (20, Swiss-Webster strain), and guinea pigs (10, Hartley-albino strain), were exposed to aerosols, consisting predominantly of Sodium Carbonate, for a period of 2 h.[56] Exposures occurred in a chamber described by Zwicker et al.[57] and at the following aerosol concentration ranges: 800–4600 mg/m^3 (rats), 600–3000 mg/m^3 (mice), and 500–3000 mg/m^3 (guinea pigs). For all aerosol concentration ranges, rats, mice, and guinea pigs had signs of respiratory impairment immediately after exposure. Clinical signs included dyspnea, wheezing, excessive salivation, and distention of the abdomen. Most of the deaths occurred during two periods: (1) during exposure and within 1–2 h afterward or (2) beginning at 1 day after exposure, peaking at 5–7 days, and continuing to 9–10 days after exposure. Some animals died less than 1 h after the beginning of exposure. The number of animals that died at various intervals during exposures was not given. Lesions in animals that died during or shortly after exposure were present in the posterior pharynx, larynx, anterior trachea, and, in approximately 3% of the animals, the lungs. For animals that survived for 1–14 days, lesions in the respiratory tract were limited to the laryngeal mucosa.

Acute Oral Toxicity

Sodium Bicarbonate was given to Wistar SPF rats (weighing 100–150 g) via stomach tube.[23] The LD_{50} values reported were 8.9 g/kg (fed rats), 7.57 g/kg (fasted rats on wire floored cages), and 8.46 g/kg (fasted rats bedded on wood shavings).

Ten adult white rats (fasted for 24 h) were given 5 g/kg of Sodium Bicarbonate via gavage. One animal died 6 h after administration. The test substance did not induce toxic effects in the remaining nine rats.[58]

Ten CFE rats of the Carworth strain (weight range 200–300 g) were given 5 g/kg of Sodium Bicarbonate via gastric intubation. Each single administration was followed by a 14-day observation period. One death was reported. Sodium Bicarbonate was not classified as a toxic substance, since one half or more of the test animals did not die.[59]

Subchronic Oral Toxicity

Ten White Leghorn chicks (15 days old) were given 0.5% Sodium Bicarbonate in drinking water for 75 days.[60] The 10 control chicks received unsupplemented feed and water. Blood samples from both groups were drawn every 15 days, and pooled samples were used for biochemical analyses. A gradual rise in total protein (TP), uric aicd (UA), and nonprotein nitrogen (NPN) in the serum was reported for Sodium Bicarbonate-fed chicks. The increase in TP was statistically significant on the 45th day of feeding, whereas UA and NPN increased significantly on the 15th day. The authors noted excessive watery droppings following Sodium Bicarbonate administration as the possible cause of dehydration and the concentration of serum proteins. Significantly high UA values were attributed possibly to nephrotoxic effects of Sodium Bicarbonate, which led to decreased excretion of UA. Significantly high NPN values were attributed to hyperuric acidemia.

Ocular Irritation

A survey of ocular irritation studies indicated that alkalis generally were injurious to the corneal stroma, regardless of the type, as long as the pH was greater than 12.0.[61]

The potential for various alkalies to cause ocular irritation was evaluated in New Zealand albino rabbits (male and female) weighing 2.0–2.5 kg; two groups of at least six rabbits each were used for each material tested.[62] Sodium Carbonate, Sodium Sesquicarbonate, and Sodium Bicarbonate were administered in powder form (0.1 ml) to the central portion of the cornea of the right eye. The left eye served as the untreated control. The eyes of the first group of rabbits were rinsed for 2 minutes with 300 ml of tap water 30 seconds after exposure (rinsed eyes); the eyes tested in the second group were not rinsed after exposure (unrinsed eyes). Control and treated eyes were scored at 1 h and days 1, 2, 3, and 7 after exposure according to the scale of Draize et al.[63]: corneal opacity (0–4), iritis (0–10). Treated eyes of both groups were stained with fluorescein 1 h after the initial exposure and subsequently examined grossly for any damage to the cornea, iris, or conjunctiva. The concentrations and pH values of the alkalies tested and the number of rabbits with corneal opacities in the rinsed and un-

rinsed groups are shown in Table 3. Corneal opacities were produced in unrinsed eyes within 1 h after exposure to Sodium Carbonate, and the severest effect was noted by day 3 (mean Draize intensity score = 3.8 ± 0.2); the severity was maintained through day 7. In rinsed eyes, corneal opacities were observed on day 2 (mean Draize intensity score = 0.8 ± 0.5) and had disappeared by day 7. Iritis was observed in unrinsed eyes at 1 h after exposure to Sodium Carbonate, and a mean Draize score of 2.0 ± 0.0 was reported on days 1, 2, 3, and 7; in rinsed eyes, iritis was noted at 1 h after exposure and had disappeared by day 3. The incidence of iritis is as listed in Table 3 for corneal opacities. Sodium Carbonate also produced pannus in 3/6 unrinsed and 4/6 rinsed eyes, and keratoconus in 2/12 unrinsed eyes. Sodium Carbonate, Sodium Sesquicarbonate, and Sodium Bicarbonate produced conjunctivitis, which persisted through day 7 in all animals tested.

In another study, the ocular irritation potential of Sodium Bicarbonate was determined using six albino rabbits. The test substance (0.086 g) was instilled into the right eye of each animal; the left eye served as the untreated control. Treated and control eyes were examined every 24 h for a period of 3 days. Ocular irritation was scored according to the scale by Draize.[64] The results were as follows: one animal had slight conjunctival redness at 48 h postinstillation, three animals had slight conjunctival redness at 48 and 72 h, and two animals had slight conjunctival redness at 24, 48, and 72 h (one of the two animals also had slight conjunctival chemosis and discharge at 24 h). It was concluded that the test substance could not be classified as an ocular irritant.[65]

One-tenth milliliter of Sodium Bicarbonate was instilled into one eye (conjunctival sac) of each of six albino rabbits. Observations for signs of irritation were made during 1 week after instillation. The test substance did not induce ocular irritation in any of the rabbits.[58]

Skin Irritation

Contact of alkaline materials with the skin may cause irritation, corrosion, or erosion. Such materials react with tissue proteins to form albuminates and gelatinized tissues, resulting in deep injuries.[10]

TABLE 3. Corneal Opacities in Rinsed and Unrinsed Rabbit Eyes after Exposure to Alkalies at Different Concentration and pHs[62]

Alkali	*Concentration % w/v*	*No. of animals with corneal opacities*[a]		
		pH	*Rinsed*[b]	*Unrinsed*
Sodium Carbonate (anhydrous)	100.0	11.3[c]	2/6	12/12
Sodium Sesquicarbonate	100.0	9.9[c]	0/6	0/6
Sodium Bicarbonate	100.0	8.3[c]	0/6	0/6

[a]Number of animals out of number tested that exhibited the response.
[b]Tested eyes were irrigated with water for 2 minutes following a 30-second residence of the alkali.
[c]pH obtained from saturated solutions.

An aqueous solution of Sodium Carbonate (50% w/v) was placed on the skins (intact and abraded) of rabbits and guinea pigs.[66] The animals were examined at 4, 24, and 48 h after application of the solution for erythema, edema, and corrosion. The abraded skins of the rabbits had moderate erythema and edema, and those of the guinea pigs were negligibly affected. There were no signs of erythema, edema, or corrosion in the intact skins.

Sodium Bicarbonate (0.5 g) was applied to the abraded and nonabraded skin of six rabbits by means of patches made of surgical gauze. The patches remained in contact with the skin for 24 h. Examinations for signs of irritation were made immediately after patch removal and 48 and 72 h thereafter. None of the animals had signs of skin irritation.[58]

The skin irritation potential of Sodium Bicarbonate was determined using six albino rabbits. The test substance (0.5 g) was applied to both abraded and nonabraded clipped skin of the back of each animal via occlusive patches. Observations for signs of irritation were made at the end of the 24-h contact period and 48 h later. It was concluded that the test substance was not a primary irritant.[67]

Teratogenicity

Aqueous solutions of Sodium Carbonate were administered via oral intubation to pregnant mice at doses ranging from 3.4 to 340 mg/kg during days 6–15 of gestation. The test substance did not affect implantation or hinder the survival of dams or fetuses. Soft and skeletal tissue anomalies were noted in the experimental group, but the incidence of these findings did not differ from that of sham-treated controls. Similar negative results were reported for rats and rabbits at doses of 245 mg/kg and 179 mg/kg, respectively.[68]

Sodium Bicarbonate did not induce teratogenic effects when administered orally at the following doses: 580 mg/kg (mice), 340 mg/kg (rats), and 330 mg/kg (rabbits).[69]

Mutagenicity

The mutagenic potential of Sodium Sesquicarbonate was evaluated by means of the spot test and the plate incorporation test according to the methods of Ames et al.[70] The tests were conducted with mutant strains TA98, TA100, TA1535, TA1537, and TA1538 of *Salmonella typhimurium* LT2. In the spot test, Sodium Sesquicarbonate was mutagenic to strain TA100. Sodium Sesquicarbonate was not mutagenic to any of the strains examined in the plate incorporation test, having caused no statistically significant increases in the number of revertant colonies over that of solvent controls in either the presence or absence of metabolic activation.[71]

Sodium Bicarbonate was not mutagenic to *Saccharomyces cerevisiae* strain D4 and *Salmonella typhimurium* strains TA1535, TA1537, and TA1538 in suspension and plate tests, both in the presence and absence of metabolic activation.[39]

CLINICAL ASSESSMENT OF SAFETY

Skin and Mucous Membrane Irritation

Two hundred thirty employees (miners and surface workers) at a trona ore mining facility participated in a clinical study. Their mean age was 37.6, and the mean working period was 10.0 years. "Trona dermatitis" was detected in 115 of the employees and was characterized by pruritic, erythematous, raised, dry, and fissured lesions, commonly affecting the hands, arms, and legs. Dermatitis was uncommon among subjects before they began Trona mining. Fifty-eight (25%) of the 230 examined workers showed signs of mucous membrane inflammation, including 23 and 26 with conjunctivitis and pharyngeal inflammation, respectively. Ulcerations of the nasal or oral mucosa were noted in 4 workers. Employees showing signs of mucous membrane inflammation or ulceration were among the 115 with trona dermatitis. Sixty-seven of the 115 workers were selected for patch testing. Finn chambers were placed on the outer aspect of the arm and removed after 48 h. Test results were negative for 10% aqueous Sodium Carbonate and 10% aqueous raw trona. These results indicated that trona ore was an irritant but not a sensitizer.[72]

Skin Irritation and Sensitization

A bar soap product containing 0.25% Sodium Carbonate was evaluated for its skin irritation and sensitization potential at a concentration of 1% in water (effective Na_2CO_3 concentration = 0.0025%). The procedure was a modification of the Draize test for human sensitization.[64] Two-tenths milliliter of the test substance was applied to the back of each of 109 male and female subjects (>17 years old) via occlusive patches. During the induction phase, the first patch remained for 24 h and the site was then scored according to the scale by Draize.[64]: erythema (0–4). The next patch was applied 24 h after scoring. This procedure was repeated for a total of 10 induction exposures. The first challenge patch remained for 24 h and the site was then scored. Following a 24 h nontreatment period, a second challenge patch was applied and remained for 24 h. Grading occurred immediately after removal of the patch and 48 h later. Two subjects had very slight erythema and two had well-defined erythema during induction. At the end of the first challenge, four subjects had very slight erythema and one had well-defined erythema. Two subjects had well-defined erythema at the end of the second challenge. Very slight and well-defined erythema were observed in three subjects and one subject, respectively, 48 h after removal of the second challenge patch. The reactions observed were indicative of the weak, nonspecific irritation seen when occlusive patch testing of soap products is conducted. It was concluded that the soap product was neither a strong irritant nor a contact sensitizer.[73] In a similar study, Sodium Carbonate was tested at the same concentration (0.0025%) in another bar soap product. Occlusive patches were applied to 109 male and female subjects (>17 years old) according to the protocol previously mentioned. Four and three subjects had very slight and well-defined erythema, respectively, during induction. At the end of the first challenge, three and two subjects had very slight and well-defined erythema, respectively. Three subjects had well-defined erythema at the end of the second

challenge. Very slight and well-defined erythema were observed in one and two subjects, respectively, 48 h after removal of the second challenge patch. It was concluded that the soap product was neither a strong irritant nor a contact sensitizer.[74] In another study (same protocol) involving 107 male and female subjects (>17 years old), Sodium Carbonate was again tested at a concentration of 0.0025% in a different bar soap product. The grading scale for irritation ranged from 1 (mild erythema) to 4 (intense erythema with edema and vesicles). Three and two subjects had mild and intense erythema, respectively, during induction. At the end of the first challenge, mild erythema was observed in one subject and intense erythema in another. Mild and intense erythema were observed in two subjects and one subject, respectively, after the second challenge. It was concluded that the soap product was neither a strong irritant nor an allergen.[75]

The skin irritation and sensitization potential of a bar soap product containing 0.25% Sodium Carbonate was evaluated with 41 male and female subjects (>17 years old) according to a modified Draize test for human sensitization. Two-tenths milliliter of the product was applied via occlusive patches (24-h exposure) at a concentration of 1% in water (effective Na_2CO_3 concentration = 0.0025%). Induction applications, separated by a 24 h nontreatment period, were made to the arm three times per week for a period of 3 weeks. Irritation was scored immediately after the 24-h exposure according to the scale: 0–4 (intense erythema, edema, and vesicles). Challenge sites were graded immediately after the 24-h exposure and 72 h later. The number of subjects with mild erythema ranged from 15 (third insult) to 23 (ninth insult). One subject had mild erythema 24 h after application of the challenge patch. It was concluded that the product was neither a strong irritant nor a sensitizer.[76] In a similar study (same protocol), 0.2 ml of another bar soap product containing 0.25% Sodium Carbonate was tested at a concentration of 1% in water. Forty-one male and female subjects participated in the study. Observations of mild erythema ranged from 1 subject (second insult) to 18 subjects (ninth insult). The number of subjects with intense erythema ranged from 1 (third insult) to 12 (ninth insult). Four and three subjects had mild erythema at the original site 24 and 96 h after application of the challenge patch, respectively. Four subjects and one subject had mild erythema at an alternate site 24 and 96 h after application of the challenge patch, respectively. One subject had intense erythema at the original site 24 h after application of the challenge patch. It was concluded that the product was neither a strong irritant nor a sensitizer.[77] The same conclusion was stated in two other studies (same protocol) in which 53 subjects were patch tested (occlusive patches) with bar soap products containing 0.25% Sodium Carbonate at a concentration of 1% in water.[78,79]

Case Reports

Reports in which baking soda (Sodium Bicarbonate) was administered to children as a home remedy for various symptoms are available.[80–82] Symptoms consistent with alkalosis and impaired renal function were present. A diffuse erythematous rash with large areas of denuded skin was also observed when baking soda was applied directly to the skin.

SUMMARY

Sodium Sesquicarbonate, Sodium Carbonate, and Sodium Bicarbonate are inorganic crystalline compounds. In cosmetic products, they are used predominantly in bath, hair, and skin preparations. Noncosmetic uses include aluminum production, textile processing, petroleum refining, and the manufacture of soap, glass, and paper.

The inhalation of aerosols containing Sodium Carbonate has resulted in pathological changes within the lungs and respiratory passages of mice, rats, and guinea pigs.

In an acute oral toxicity study of Sodium Bicarbonate, LD_{50} values were 7.57 g/kg and 8.9 g/kg in fasted and fed rats, respectively. Sodium Bicarbonate was classified as a nontoxic substance in another acute oral study. Nephrotoxic effects were associated with the subchronic oral administration of Sodium Bicarbonate to white Leghorn chicks.

In an ocular irritation study involving rabbits, applications of Sodium Sesquicarbonate, Sodium Carbonate, and Sodium Bicarbonate caused conjunctivitis. Results from other ocular iritation studies indicated that Sodium Bicarbonate was not an ocular irritant in albino rabbits.

The application of an aqueous solution of Sodium Carbonate to intact and abraded skins of rabbits and guinea pigs produced irritation only in abraded skin. Sodium Bicarbonate did not cause irritation when applied to abraded and nonabraded skins of rabbits.

No teratogenic effects were noted when Sodium Bicarbonate and Sodium Carbonate were administered to pregnasnt rats, mice, and rabbits.

Sodium Sesquicarbonate was not mutagenic in *Salmonella typhimurium* LT2 mutant strains in the plate incorporation test but was mutagenic to strain TA100 in the spot test. Sodium Bicarbonate was not mutagenic to *Saccharomyces cerevisiae* and *Salmonella typhimurium* mutant strains in both suspension and plate tests.

Dermatitis, but not sensitization, was observed in employees of a trona (Sodium Sesquicarbonate) mining facility. The dermal application of Sodium Bicarbonate has been associated with the development of a rash and metabolic alkalosis in infants. Results from human skin irritation and sensitization studies indicated that a soap product containing 0.25% Sodium Carbonate was neither a strong irritant nor a sensitizer.

DISCUSSION

Sodium Carbonate, but not Sodium Bicarbonate, is a skin and eye irritant due to the alkaline nature of its solutions. Highly concentrated solutions of Sodium Carbonate have a pH of greater than 11. The cosmetic use of Sodium Carbonate at high concentrations is mainly limited to products designed to be diluted before use and in products where pH is buffered to near neutrality.

The available data on human skin sensitization are limited to the occupational testing of workers exposed to high levels of Sodium Sesquicarbonate and the testing of formulations containing low concentrations of Sodium Carbonate. A review of the combined data from sensitization studies indicates that neither

Sodium Carbonate nor Sodium Sesquicarbonate is a human sensitizer. Phototoxicity data are not available. However, the Panel notes the lack of a chromophore in these cosmetic ingredients and does not consider that testing for phototoxicity is warranted.

CONCLUSION

Based on the available data, Sodium Sesquicarbonate, Sodium Bicarbonate, and Sodium Carbonate are safe as presently used in cosmetics.

ACKNOWLEDGMENT

The Scientific Literature Review and Technical Analysis were prepared by Wilbur Johnson, Jr., Scientific Analyst and writer. Word processing for the report was performed by Karen Swanson.

REFERENCES

1. FOOD CHEMICALS CODEX. (1981). Washington, D.C.: National Academic Press, p. 299.
2. WINDHOLZ, M. (1983). *The Merck Index*, 10th ed. Rahway, NJ: Merck and Co., pp. 1230, 1232, 1241.
3. WILKINSON, J.B., and MOORE, R.J. (1982). *Harry's Cosmeticology*, 7th ed. Chemical Publishing, p. 101.
4. ESTRIN, N.F., CROSLEY, P.A., and HAYNES, C.R. (1982). *CTFA Cosmetic Ingredient Dictionary*. Washington, D.C.: Cosmetic, Toiletry and Fragrance Association, Inc., pp. 279, 280.
5. HAWLEY, G.G. (1971). *The Condensed Chemical Dictionary*, 8th ed. New York: Van Nostrand Reinhold Company, pp. 792, 810.
6. WEAST, R.C. (1982). *CRC Handbook of Chemistry and Physics*. Boca Raton, FL: CRC Press, p. B-147.
7. CODE OF FEDERAL REGULATIONS (CFR). (1984). Title 21, Food and Drugs, Parts 184.1736, 184.1742, 184.1792, and 720.4. Washington, D.C.: U.S. Government Printing Office.
8. SCHENK (1950). *Winnacker-Weingaertner, Chemische Technologie*. Volume I, p. 427. As cited in the *Merck Index* (1983), p. 1241.
9. OSOL, A. (1980). *Remington's Pharmaceutical Sciences*. Mack Publishing Company, p. 1264.
10. CLAYTON, G.D., and CLAYTON, F.E. (1981). *Patty's Industrial Hygiene and Toxicology*, 3rd rev. ed. New York: John Wiley and Sons, Vol. 2B, p. 3045.
11. DELACRUZ, O., and GREER, R.T. (1983). Relationship of the microstructure of nahcolite and trona to effective sorption of sulfur dioxide at elevated temperatures. Scanning Electron Microsc. **2,** 603–21.
12. FEDERATION OF AMERICAN SOCIETIES FOR EXPERIMENTAL BIOLOGY (FASEB). (1975). Evaluation of the health aspects of carbonates and bicarbonates as food ingredients. Prepared for Food and Drug Administration, Washington, D.C.
13. ESTRIN, N.F., HAYNES, C.R., and WHELAN, J.M. (1982). Cosmetic Ingredient Specifications. CTFA Compendium of Cosmetic Ingredient Composition. The Cosmetic, Toiletry and Fragrance Association, Inc.
14. NATIONAL FORMULARY. (1980). United States Pharmacopeial Convention, Inc., p. 1256.
15. UNITED STATES PHARMACOPEIA. (1980). United States Pharmacopeial Convention, Inc., p. 726.
16. ROSOFF, I.S. (1974). *Handbook of Veterinary Drugs. A Compendium for Research and Clinical Use*. New York: Springer Publishing Company, p. 532.
17. BALSAM, M.S., GERSHON, S.D., RIEGER, M.M., SAGARIN, E., and STRIANSE, S.J. (1972). *Cosmetics: Science and Technology*. New York: Wiley-Interscience, Vol. 2, p. 517.
18. FOOD AND DRUG ADMINISTRATION (FDA). (1982). Cosmetic product formulation data. FDA computer printout.
19. McEWEN, G. (1986). Personal communication. Cosmetic, Toiletry and Fragrance Association.
20. HOAG, L.A., WEIGELE, C.E., TALAMO, H., MARPLES, E., and WOODWARD, K. (1933). Effect of therapeutic doses of sodium bicarbonate on the kidneys. J. Pharmacol. Exp. Ther. **47,** 233–5.

21. VOSS, J.G. (1959). Effect of concentration on acute oral toxicity of NaCl and $NaHCO_3$ (unpublished). As cited in Informatics, Inc. (1972). Monograph on the carbonates. Submitted under DHEW Contract No. FDA 72-104. Rockville, MD.
22. HAGEGE, J., GABE, M., and RICHET, G. (1968). Augmentation du nombre des cellules intercalaires renales du rat soumis a une surcharge en bicarbonate alcalin. C.R. Acad. Sci. Ser. D. **267,** 1611–3.
23. SCHUTZ, E. (1968). [On the acute oral toxicity test]. Arzneim. Forsch **18,** 466–9. As cited in FASEB Contract Number: 223-75-2004.
24. KIRSNER, J.B. (1941). Effect of prolonged administration of large quantities of sodium bicarbonate on the kidney of the dog. Arch. Pathol. **32,** 76–84.
25. DELAPLANE, G.F. (1934). Some of the tissue changes in poultry resulting from the ingestion of sodium bicarbonate. Ohio State Univ. Vet. Alumni Quart. **21,** 146–66.
26. WITTER, J.F. (1936). A preliminary report on the injurious effect of sodium bicarbonate in chicks. Poultry Sci. **15,** 256–9.
27. KIRSNER, J.B. (1942). The serum electrolytes in the dog before and during acute alkalosis induced by sodium bicarbonate. J. Biol. Chem. **145,** 219–21.
28. ADAMS, W.L., WELCH, C.S., and CLARK, B.B. (1943). The effect of sodium bicarbonate on gastric secretion. Am. J. Physiol. **139,** 356–63.
29. WIGGLESWORTH, V.B. (1924). Studies on ketosis: I. The relation between alkalosis and ketosis. Biochem. J. **18,** 1203–16.
30. KERTI, F., and STENGEL, F. (1929). Uber die Wirkung von Gallensubstanzen sowie Alkali und Sauren auf das Blutbild der Wiessen Maus. Klin. Wochenschr. **8,** 2337–9. (Translation supplied with: Informatics Inc. (1972). Monograph on the carbonates. Submitted under DHEW Contract No. FDA 72-104. Rockville, MD.)
31. STOHR, R. (1933). [On glycogen mobilization with Na-bicarbonate.] Hoppe-Seyler's Z. F. Physiol. Chem. **217,** 156–9. (Translation supplied with: Informatics, Inc. (1972). Monograph on the carbonates. Submitted under DHEW Contract No. FDA 72-104. Rockville, MD.)
32. HAWLEY, E.E., DAGGS, R.G., and STEPHENS, D.J. (1937). The effect of the administration of acid and alkaline salts upon the ascorbic acid content of guinea pig tissues. J. Nutr. **14,** 1–8.
33. SOLOMON, A.K., VENNESLAND, B., KLEMPERER, F.W., BUCHANAN, J.M., and HASTINGS, A.B. (1941). The participation of carbon dioxide in the carbohydrate cycle. J. Biol. Chem. **140,** 171–82. As cited in FASEB Contract Number: FDA 223-75-2004.
34. GOULD, R.G., ROSENBERG, I.M., SINEX, M., and HASTINGS, A.B. (1948). Rate of $^{14}CO_2$ excretion following intraperitoneal administration of isotopic bicarbonate and acetate. Fed. Proc. Fed. Am. Soc. Exp. Biol. **7,** 157 (abstract).
35. SKIPPER, H.E., WHITE, L., and BRYAN, C.E. (1949). Studies on the hazard involved in the use of ^{14}C. I. Retention of carbon from labeled sodium bicarbonate. J. Biol. Chem. **180,** 1187–95.
36. SIMPSON, D.P. (1963). Tissue citrate levels and citrate utilization after sodium bicarbonate administration. Proc. Soc. Exp. Biol. Med. **114,** 263–5.
37. FOOD AND DRUG RESEARCH LABORATORIES, INC. (1973). Teratologic evaluation of FDA 71-84 (sodium carbonate) and FDA 71-79 (sodium bicarbonate) in mice and rats. Four final reports prepared under DHEW Contract No. FDA 71-260. Waverly, NY.
38. VERRETT, M.J. (1974). Investigations of the toxic and teratogenic effects of GRAS substances in the developing chick embryo: Sodium Carbonate. Food and Drug Administration, Department of Health, Education, and Welfare, Washington, D.C.
39. LITTON BIONETICS INC. (1974). Mutagenic evaluation of sodium bicarbonate (compound FDA 71-79). Prepared for Food and Drug Administration under Contract No. 223-74-2104. Kensington, MD.
40. McGEE, L.C., and EMERY, E.S. (1940). Factors influencing digestion in the jejunum. Am. J. Dig. Dis. **7,** 462–7.
41. WILEY, F.H., WILEY, L.L., and WALLER, D.S. (1933). The effect of the ingestion of sodium, potassium, and ammonium chlorides and sodium bicarbonate on the metabolism of inorganic salts and water. J. Biol. Chem. **101,** 73–82.
42. HAWTHORNE, B.E., and STORVICK, C.A. (1948). Effect of sodium bicarbonate and ammonium chloride on ascorbic acid metabolism of adults. Proc. Soc. Exp. Biol. Med. **67,** 447–9.
43. PETERSON, O.L., and FINLAND, M. (1942). The effect of food and alkali on the absorption and excretion of sulfonamide drugs after oral and duodenal administration. Am. J. Med. Sci. **204,** 581–8.
44. MARTIN, H.E., and JONES, R. (1961). The effect of ammonium chloride and sodium bicarbonate on the urinary excretion of magnesium, calcium, and phosphate. Am. Heart J. **62,** 206–10.
45. GAMBLE, J.L., WALLACE, W.M., ELIEL, L., HOLLIDAY, M.A., CUSHMAN, M., APPLETON, J., SHENBERG, A., and PIOTTI, J. (1951). Effects of large loads of electrolytes. J. Pediatr. **7,** 305–20.

46. KIRSNER, J.B., and PALMER, W.L. (1943). Studies on the effect of massive quantities of sodium bicarbonate on the acid-base equilibrium and on renal function; Report of a case with remarkable tolerance. Ann. Intern. Med. **18,** 100-4.
47. PITTS, R.F., AYER, J.L., and SCHIESS, W.A. (1949). The renal regulation of acid-base balance in man. III. The reabsorption and excretion of biocarbonate. J. Clin. Invest. **28,** 35-44. As cited in FASEB Contract Number: FDA 223-75-2004.
48. van GOIDSENHOVEN, G.M.-T., GRAY, O.V., PRICE, A.V., and SANDERSON, P.H. (1954). The effect of prolonged administration of large doses of sodium bicarbonate in man. Clin. Sci. **13,** 383-401.
49. FICHERA, G. (1933). [Pulse, respiration, and urinary pH during muscular exercise under the influence of sodium bicarbonate] Morgunghi 75:1427-1430. (In Italian, translation supplied with: Informatics, Inc. (1972). Monograph on the carbonates. Submitted under DHEW Contract Number FDA 72-104. Rockville, MD.)
50. FDA. (1984). The division of Over-The-Counter Drug Evaluation Ingredient Status Report. National Center for Drugs and Biologics. (HFN-510). Washington, D.C.: Food and Drug Administration.
51. GRANT, J. (1972). *Hackh's Chemical Dictionary*, 4th ed. New York: McGraw-Hill Book Company, p. 621.
52. BROBECK, J.R. (1979). *Best and Taylor's Physiological Basis of Medical Practice*, 10th ed. Baltimore, MD: Williams & Wilkins, pp. 5-12-5-22.
53. MOUNTCASTLE, V.B. (1980). *Medical Physiology*, 14th ed. St. Louis: C.V. Mosby Co., Vol. II, pp. 1197-8.
54. GUYTON, A.C. (1981). *Textbook of Medical Physiology*, 6th ed. Philadelphia: W.B. Saunders Co., pp. 449-56.
55. RESHETYUK, A.L., and SHEVCHENKO, L.S. (1968). Hyg. Sanit. **33**(1-3), 129. As cited in *Patty's Industrial Hygiene and Toxicology*, 3rd rev. ed., p. 3060.
56. BUSCH, R.H., McDONALD, K.E., and BRIANT, J.K. (1983). Pathologic effects in rodents exposed to sodium combustion products. Environ. Res. **31**(1), 138-47.
57. ZWICKER, G.M., ALLEN, M.D., and STEVENS, D.L. (1979). Toxicity of aerosols of sodium reaction products. J. Environ. Pathol. Toxicol. **2,** 1139-50.
58. HUDSON LABORATORIES, INC. (1972). Eye irritation, skin irritation, and oral toxicity studies of Sodium Bicarbonate. Submitted to Church and Dwight Co., Inc. No CTFA Code No.*
59. LEBERCO LABORATORIES (1972). Acute oral toxicity study of Sodium Bicarbonate. Submitted to Church and Dwight Co., Inc. No CTFA Code No.*
60. MISHRA, S.K., SHARMA, U.K., and SINGH, N.P. (1981). Biochemical observations in poultry fed diets containing sodium bicarbonate. Indian J. Poult. Sci. **16**(3), 201-5.
61. MARZULLI, F., and MAIBACH, H. (1977). *Dermatotoxicology and Pharmacology*. Hemisphere Publishing Company, p. 152.
62. MURPHY, J.C., OSTERBERG, R.E., SEABAUGH, V.M., and BIERBOWER, G.W. (1982). Ocular irritancy responses to various pHs of acids and bases with and without irrigation. Toxicology **23**(4), 281-91.
63. DRAIZE, J.H., WOODARD, G., and CALVERY, H.N. (1944). J. Pharmacol. Exp. Ther. **82,** 377, 389.
64. DRAIZE, J.J. (1959). Scale for scoring ocular lesions. In: Appraisal of the safety of chemicals in foods, drugs, and cosmetics. Association of Food and Drug Officials of the United States. Texas State Department of Health, Austin 1, Texas, p. 51.
65. LEBERCO LABORATORIES (1972). Ocular irritation study of Sodium Bicarbonate. Submitted to Church and Dwight Co., Inc. No CTFA Code No.*
66. NIXON, G.A., TYSON, C.A., and WERTZ, W.C. (1975). Toxicol. Appl. Pharmacol. **31,** 481. As cited in *Patty's Industrial Hygiene and Toxicology*, 3rd rev. ed., p. 3060.
67. LEBERCO LABORATORIES (1972). Dermal irritation study of Sodium Bicarbonate. Submitted to Church and Dwight Co., Inc. No CTFA Code No.*
68. MORGAREIDGE, K. (1974). Teratologic evaluation of sodium carbonate in mice, rats, and rabbits. PB-234 868. National Technical Information Service. Springfield, VA. As cited in *Patty's Industrial Hygiene and Toxicology*, 3rd rev. ed., pp. 3060-1.
69. MORGAREIDGE, K. (1976). Teratologic evaluation of sodium bicarbonate in mice, rats, and rabbits. PB-234 871. National Technical Information Service. Springfield, VA. As cited in *Patty's Industrial Hygiene and Toxicology*, 3rd rev. ed., p. 3061.

*Available upon request: Director, Cosmetic Ingredient Review, Suite 810, 1110 Vermont Ave., N.W., Washington, D.C. 20005.

70. AMES, B.N., McCANN, J., and YAMASAKI, E. (1975). Mutat. Res. **31,** 347–64.
71. BLEVINS, R.D., and TAYLOR, D.E. (1982). Mutagenicity screening of twenty-five cosmetic ingredients with the *Salmonella*/microsome test. J. Environ. Sci. Health Part A **17,** 217–39.
72. ROM, W.N., MOSHELL, A., GREAVES, W., BANG, K.M., HOLTHOUSER, M., CAMPBELL, D., and BERNSTEIN, R. (1983). A study of dermatitis in trona miners and millers. J. Occup. Med. **25**(4), 295–9.
73. COSMETIC, TOILETRY AND FRAGRANCE ASSOCIATION. (CTFA). (1980). Human skin irritation and sensitization study of a bar soap product containing 0.25 percent Sodium Carbonate. CTFA Code No. 3-2-2.
74. CTFA. (1980). Human skin irritation and sensitization study of a bar soap product containing 0.25 percent Sodium Carbonate. CTFA Code No. 3-2-3.*
75. CTFA. (1981). Human skin irritation and sensitization study of a bar soap product containing 0.25 percent Sodium Carbonate. CTFA Code No. 3-2-4.*
76. CTFA. (1980). Human skin irritation and sensitization study of a bar soap product containing 0.25 percent Sodium Carbonate. CTFA Code No. 3-2-7.*
77. CTFA. (1980). Human skin irritation and sensitization study of a bar soap product containing 0.25 percent Sodium Carbonate. CTFA Code No. 3-2-8.*
78. CTFA. (1980). Human skin irritation and sensitization study of a bar soap product containing 0.25 percent Sodium Carbonate. CTFA Code No. 3-2-5.*
79. CTFA. (1980). Human skin irritation and sensitization study of a bar soap product containing 0.25 percent Sodium Carbonate. CTFA Code No. 3-2-6.*
80. BROWN, A.L., WHALEY, S., and ARNOLD, W.C. (October 1981). Acute bicarbonate intoxication from a folk remedy. Am. J. Dis. Child. **135,** 965.
81. GONZALEZ, J., and HOGG, R.J. (1981). Metabolic alkalosis secondary to baking soda treatment of a diaper rash. Pediatrics **67,** 820–2.
82. PUCZYNSKI, M.S., CUNNINGHAM, D.G., and MORTIMER, J.C. (1983). Sodium intoxication caused by use of baking soda as a home remedy. Can. Med. Assoc. J. **128,** 821–2.

TABLE 22

Historical and current uses and use concentrations for Sodium Dehydroacetate and Dehydroacetic Acid *(Continued)*

Product category	1981 uses (Elder 1985)	2002 uses (FDA 2002)	1981 concentrations (Elder 1985) %	2003 concentrations (CTFA 2003) %
Skin care				
Cleansing creams, lotions, etc.	15	8	≤0.1–1	0.007–0.02
Face and neck skin care	16*	11	≤0.1–1*	0.01–0.08
Body and hand skin care		9		0.03–0.05
Moisturizers	10	10	≤0.1–1	—
Night skin care	5	2	≤0.1–1	0.03
Paste masks/mud packs	3	6	≤0.1–1	—
Skin fresheners	2	—	≤0.1	—
Other skin care	9	16	≤0.1–1	0.03
Wrinkle smoothers**	2	—**	≤0.1	—**
Suntan				
Suntan gels, creams, and liquids	3	—	>0.1–1	0.2
Indoor tanning preparation	—	5	—	—
Other suntan preparations	1	—	>0.1–1	—
Total Uses/Ranges for Dehydroacetic Acid Totals	**139**	**88**	**≤0.1–1**	**0.007–0.7**

*These categories were combined in 1981 but are now separate.

**No longer considered as cosmetic product categories.

which suggest that the reproductive and developmental toxicity potential of Sodium Lauryl Sulfoacetate is an issue, it was agreed that the results of the proposed reproductive and developmental toxicity study would be considered when available.

REFERENCES

Cosmetic, Toiletry, and Fragrance Association (CTFA). 2004. Use concentration data on sodium lauryl sulfoacetate from industry survey. Unpublished data submitted by CTFA, 2004 (1 page.)[24]

Elder, R. L. 1987. Final report on the safety assessment of sodium lauryl sulfoacetate. *J. Am. Coll. Toxicol.* 6:261–277.

Environmental Protection Agency (EPA). 2004. High Production Volume (HPV) Challenge Program. Robust summaries & test plans: sodium lauryl sulfoacetate (acetic acid, sulfo-, 1-dodecyl ester sodium salt). Internet site accessed August, 2004. http://www.epa.gov/chemrtk/sdmlaurl/c14936tc.html.

Food and Drug Administration (FDA). 2002. Frequency of use of cosmetic ingredients. *FDA database*. Washington, DC: FDA.

Gottschalck, T. E., and G. N. McEwen, Jr., eds. 2004. *International Cosmetic Ingredient Dictionary and Handbook*, 10th ed., Washington, DC: CTFA. 1743.

Nikitakis, J. M., and G. N. McEwen, Jr., eds. 1990. *CTFA Compendium of Cosmetic Ingredient Composition—Descriptions I and II*. Washington, DC: CTFA.

NOTOX Safety and Environmental Research BV. 2003. HPV assessment report and test plan for sodium lauryl sulfoacetate (acetic acid, sulfo-, 1-dodecyl ester sodium salt) CAS 1847-58-1. Prepared for: Stepan Company, Northfield, IL. Appendix A. Hambakenwetering: NOTOX, 1–24.[24]

[24]Available for review: Director, Cosmetic Ingredient Review, 1101 17th Street, NW, Suite 412, Washington, DC 20036-4702, USA.

SODIUM SESQUICARBONATE, SODIUM BICARBONATE, AND SODIUM CARBONATE

A safety assessment of Sodium Sesquicarbonate, Sodium Bicarbonate, and Sodium Carbonate was published in 1987 with the conclusion that these ingredients are safe as presently used in cosmetic products (Elder 1987). Studies available since that safety assessment was completed, along with updated information regarding uses and use concentrations, were considered by the CIR Expert Panel. After reviewing the available data, the Panel determined to not reopen this safety assessment.

Sodium Sesquicarbonate was used in 111 products in 1981, based on voluntary reports provided to FDA by industry; use concentrations ranged from >1% to 50% (Elder 1985). In 2002 there were 24 uses (FDA 2002) and according to an industry survey in 2004 the current range of use concentrations is 2.0% to 90% (CTFA 2004).

Sodium Bicarbonate was used in 45 products in 1981, based on voluntary reports provided to FDA by industry; use concentrations ranged from less than 0.1% to 50% (Elder 1985). In 2002 there were 70 uses (FDA 2002) and according to an industry survey in 2004 the current range of use concentrations is 0.006% to 95% (CTFA 2004).

Sodium Carbonate was used in 25 products in 1981, based on voluntary reports provided to FDA by industry; use concentrations ranged from less than 0.1% to 25% (Elder 1985). In 2002 there were 21 uses (FDA 2002) and according to an industry survey in 2004 the current range of use concentrations is 0.000002% to 51% (CTFA 2004).

Table 24 presents the available use and concentration information. The most recent information now constitutes the present practices of use.

TABLE 24

Historical and current uses and use concentrations for Sodium Sesquicarbonate, Sodium Bicarbonate, and Sodium Carbonate

Product category	1981 uses (Elder 1987)	2002 uses (FDA 2002)	1981 concentrations (Elder 1987) (%)	2004 concentrations (CTFA 2004) (%)
	Sodium Sesquicarbonate			
Bath				
Oils, tablets, and salts	24	16	>1–50	2–90
Soaps and detergents	—	2	—	—
Bubble baths	68	2	>5–50	18
Capsules	2	—	>10–25	—
Other bath	11	2	>5–50	10–35
Fragrances				
Other fragrances	1	1	>5–10	—
Noncoloring hair care				
Straighteners	1	—	>50	—
Permanent waves	2	—	>1–10	—
Personal hygiene				
Other personal hygiene	2	1	>5–10	—
Skin care				
Foot powders and sprays	—	—	—	35–59
Total uses/ranges for Sodium Sesquicarbonate	**111**	**24**	**>1–50**	**2–90**
	Sodium Bicarbonate			
Baby care				
Lotions, oils, powders, and creams	—	1	—	5
Bath				
Oils, tablets, and salts	1	7	<5–10	30–64
Soaps and detergents	—	2	—	25–54
Bubble baths	4	—	>10–25	5–52
Capsules	—	—	—	49
Other bath	—	—	—	1–64
Eye makeup				
Eyebrow pencils	—	—	—	0.2
Eyeliners	2	1	≤0.1–1	0.04–0.1
Mascara	—	6	—	0.2
Other eye makeup		1		
Fragrance				
Powders	5	9	>0.1–10	20
Noncoloring hair care				
Conditioners	—	—	—	5
Straighteners	1	—	>0.1–1	—
Permanent waves	5	3	≤0.1–1	10
Shampoos	—	—	—	0.09
Other noncoloring hair care	1	—	>1–5	—
Hair-coloring products				
Dyes and colors	—	8	—	—
Bleaches	1	—	>25–50	0.1–10
Makeup				
Foundations	—	—	—	0.09
Lipsticks	—	—	—	0.03–1
Nail care				
Other	—	—	—	39

TABLE 24
Historical and current uses and use concentrations for Sodium Sesquicarbonate, Sodium Bicarbonate, and Sodium Carbonate *(Continued)*

Product category	1981 uses (Elder 1987)	2002 uses (FDA 2002)	1981 concentrations (Elder 1987) (%)	2004 concentrations (CTFA 2004) (%)
Oral hygiene				
Dentifrices	5	10	>1–50	3–95
Mouthwashes and breath fresheners	—	2	—	0.1
Other oral hygiene	—	1	—	0.5
Personal hygiene				
Underarm deodorants	2	—	>1–5	0.01–15
Douches	4	2	≤0.1–25	—
Feminine deodorants	—	2	—	—
Other personal hygiene	4	3	≤0.1–25	0.07–56
Shaving				
Shaving cream	—	—	—	0.006
Other shaving	1	1	≤0.1	—
Skin care				
Cleansing creams, lotions, etc.	—	—	—	0.04–26
Face and neck skin care	—*	—	—*	0.01–7
Body and hand skin care		—		10
Foot powders and sprays	—	4	—	25–56
Moisturizers	—	—	—	0.4
Paste masks/mud packs	3	1	≤0.1–50	61
Skin fresheners	2	2	≤0.1–10	—
Other skin care	4	4	>10–25	2–5***
Suntan products				
Suntan gels, creams, liquids, and sprays	—	—	—	0.2
Total uses/ranges for Sodium Bicarbonate	**45**	**70**	**≤0.1–50**	**0.006–95**
	Sodium Carbonate			
Bath				
Oils, tablets, and salts	—	4	—	40–51
Soaps and detergents	2	1	>0.1–1	3–32
Bubble baths	4	—	>10–25	7–39
Other	—	—	—	0.009–39
Eye makeup				
Eyebrow pencils	—	—	—	0.2
Eye shadow	—	—	—	0.3
Eye lotions	—	—	—	0.004
Mascara	—	—	—	0.2
Fragrances				
Colognes and toilet waters	—	—	—	0.03
Noncoloring hair care				
Conditioners	1	2	>0.1–1	0.01
Straighteners	1	—	>1–5	—
Permanent waves	1	1	>1–5	—
Shampoos	2	1	>0.1–1	0.08
Tonics, dressings, etc.	—	—	—	0.000002–0.01
Wave sets	—	—	—	1

(Continued on next page)

TABLE 24

Historical and current uses and use concentrations for Sodium Sesquicarbonate, Sodium Bicarbonate, and Sodium Carbonate *(Continued)*

Product category	1981 uses (Elder 1987)	2002 uses (FDA 2002)	1981 concentrations (Elder 1987) (%)	2004 concentrations (CTFA 2004) (%)
Hair coloring				
Dyes and colors	1	2	>1–5	0.1–0.6
Rinses	—	—	—	0.02
Bleaches	2	—	>0.1–10	25
Other hair coloring	—	—	—	1
Makeup				
Blushers	—	—	—	0.03
Foundations	1	1	≤0.1	0.3
Lipsticks	—	3	—	—
Nail care				
Other nail care	—	—	—	0.6
Oral hygiene				
Dentifrices	—	—	—	2
Other oral hygiene	—	—	—	22***
Personal hygiene				
Underarm deodorants	—	—	—	0.002
Douches	1		>5–10	—
Other	3	2	>1–5	—
Skin care				
Cleansing creams, lotions, etc.	2	1	≤0.1	0.02–0.2
Face and neck skin care	—*	—	—*	0.008
Body and hand skin care		1		—
Moisturizers	2	2	≤0.1	—
Skin fresheners	1	—	≤0.1	—
Hormone preparations**	1	N/A**	≤0.1	N/A**
Total uses/ranges for Sodium Carbonate	**25**	**21**	**≤0.1–25**	**0.000002–51**

*This category was combined when the original safety assessment was performed and is now two separate categories.

**No longer included as a cosmetic product category.

***Denture cleanser.

JEFO. 2004a. Sodium Bicarbonate Powder "Cow Brand". http://www.jefo.ca Accessed on 11/8/2004.

JEFO. 2004b. Sodium Sesquicarbonate (Arm & Hammer). http://www.jefo.ca. Accessed on 11/8/2004.

Kuu, W. Y., R. Chilamkurti, and C. Chen. 1998. Effect of relative humidity and temperature on moisture sorption and stability of sodium bicarbonate powder. *Int. J. Pharmacol*. 166:167–175.

Lewis, R. J. ed. 1996. *Sax's Dangerous Properties of Industrial Materials*, 9th ed., 2952. New York: John Wiley and Sons.

Mallinkrodt Baker, Inc. 2004. Sodium bicarbonate. http://www.chem.tamu.edu Access 11/8/2004.

Mallinkrodt Baker, Inc. 2004. Sodium carbonate anhydrous. http://www.jtbaker.com 11/8/2004.

Marvola, M., Nykanen, S., and M. Nokelainen. 1991. Bioavailability of erythromcin acistrate from hard gelatin capsules containing sodium bicarbonate. *Pharm. Res*. 8:1056–1058.

Miller, H. C. 1993. Cardiac arrest after intravenous pentamidine in an infant. *Pediatr. Infect. Dis. J*. 12:694–696.

National Institute for Occupational Safety and Health (NIOSH). 2004. Sodium sesquicarbonate dihydrate. http://www.cdc.gov. Accessed on 11/8/2004.

Orica. 2004. Chemical Fact Sheet–Sodium Carbonate. http://www.orica.com. Accessed on 11/8/2004.

Sander, J. E., S. I. Savage, and G. N. Rowland. 1998. Sodium sesquicarbonate toxicity in broiler chickens. *Avian Dis.* 42:215–218.

Sodipo, O. A. 1993. How safe is the consumption of Trona? *Am. J. Public Health* 83:1181.

Solvay Chemicals. 2004a. Dense Soda Ash—Properties. http://www.sodaash.com. Accessed on 11/8/2004.

Solvay Chemicals. 2004b. Trona—Sodium Sesquicarbonate. http://www.solvaychemicals.us. Accessed on 11/8/2004.

United States Department of Energy. 2004. Soda Ash. http://www.oit.doe.gov. 6 pages.

Uzogara, S. G., Morton, I. D., Daniel, J. W., and Emery, J. M. 1990. Use of kanwa-cooked cowpea (Vigna unguiculata) in infant food formulation: effect on protein utilization and digestibility. *J. Trop. Pediatr*. 36:207–208.

Walker, J. A., Sherman, R. A., and R. P. Cody. 1990. Effect of oral base on enteral aluminum absorption. *Arch. Intern. Med*. 150:2037–2039.