

Braiding Hair Test Methodology

STUDY OBJECTIVES

The objectives of this study were to:

- Determine the levels of arsenic, cadmium, lead, and 65 volatile organic compounds (VOCs) in samples of popular braiding hair.
- Estimate likely human exposures under realistic use conditions and compare those estimates to available health-based limits.
- Use this information to inform the public about the occurrence and potential risks of these contaminants in braiding hair.
- Urge regulatory agencies to act to reduce their contamination in braiding hair and the resulting human exposure.

TESTED PRODUCTS

We tested 30 braiding hair products and a total of 90 samples for VOCs and heavy metals. We tested two samples per product for microbiology testing (a total of 60 samples). We selected the products based on available marketplace data indicating the type of hair (human, artificial, plant-based), availability, and, when appropriate, their ranking among the top 10 products sold. We purchased at least three samples of each product online.

TEST APPROACH AND METHODOLOGY

Each sample was blind-coded and shipped to an independent, accredited laboratory for heavy metals and VOC analyses.

The samples were prepared and analyzed for VOCs and heavy metals in accordance with the following methods:

- VOCs by gas chromatograph-mass spectrometry (GC-MS) following Environmental Protection Agency method 8260C. Sample preparation included weighing out 0.5-1.0g of synthetic hair and placing it in a sealed VOA vial containing a stir bar and 5 milliliters of VOC-free water. The sealed sample vial was then placed in a 100° C water bath for 10 minutes, then removed and cooled to room temperature. Sample analysis was then completed by method 8260C.
- Arsenic, cadmium and lead by inductively coupled plasma-mass spectrometry (ICP-MS) following EPA Method 6020B. Sample preparation included digesting one-gram of sample with repeated additions of nitric acid (HNO₃) and hydrogen peroxide (H₂O₂). Sample is then refluxed in the presence of Hydrochloric acid (HCl) prior to dilution to a final volume of 100mL. Sample extract is then analyzed by ICP-MS.

Bacteria were analyzed by the following methods:

- Aerobic plate count and yeast and mold count USP<2021> Microbiological Examination of Non-Sterile Products: Microbial Enumeration Tests for Nutritional and Dietary Supplements
- E. coli = E. coli USP<2022> Microbiological Procedures for the Absence of Specified Microorganisms in Nutritional and Dietary Supplements
- P. aeruginosa = Pseudomonas aeruginosa USP<62> United States Pharmacopeia. General Chapter <62>. Microbiological Examination of Nonsterile Products: Tests for Specified Microorganisms. USP–NF. Rockville, MD: United States Pharmacopeial Convention
- Staph aureus = Staphylococcus aureus USP<2022> (same as above)

The testing conformed to the quality control criteria and performance requirements set in the cited official methods, as well as those in ISO 17025.

DATA ANALYSES

We reported the average of three samples tested of a product.

To estimate the average of a metal or VOC in a product, we assumed zero for a sample for which the metal or VOC was not detected, but we included all the samples tested for the product in the average.

We recorded the presence or absence of Staphylococcus aureus, Pseudomonas aeruginosa, and Escherichia coli as either positive or negative. For Aerobic plate count and yeast and mold count, we reported quantitative results.

RISK ASSESSMENT

For the exposure estimates, we assumed a wearer or handler of braiding hair can be exposed orally to a very small portion of the constituent heavy metals and/or VOCs from handling the hair and via hand-to-mouth activities, and a resulting transfer of the VOC or metal into the mouth. Since our test methodologies measured total contents of the heavy metals and VOCs (as opposed to emitted or skin-absorbed quantities, for example) in the products, we estimated a US adult's likely oral intake of lead and VOCs under realistic use conditions and exposure scenarios. In this exposure scenario, we assumed only 2.5% of the measured lead or VOCs would be released into the moist hands of the wearer or handler over a 24-hour period of hair braiding or daily handling that could then be transferred into the mouth via various, normal hand-to-mouth movements. We compared our estimated daily exposures or intakes from this exposure

scenario to the exposure limits in Table 1 below and those of other VOCs not listed, and used the following equation:

$$\% \text{ CR Level of Concern} = (\text{Estimated Adult Daily Exposure} / \text{Reference Dose or MADL}) \times 100$$

This equation derives from the public health concept of hazard quotient and the following equation: Hazard Quotient (HQ) = Estimated Daily Exposure/Reference Dose or MADL

A % CR Level of Concern greater than 100 or HQ greater than 1.0 indicates a comparatively higher health risk at this exposure level.

We used the California Office of Environmental Health Hazard Assessment (OEHHA) Maximum Allowable Dose Levels (MADL) as our benchmarks for CR's levels of concern for cadmium and lead. MADLs are levels established through California's Proposition (Prop) 65 law. CR uses

these values because the standards are the most protective of health. A measured level greater than 100% of CR's level of concern indicates that consumption of that serving amount per day would pose a comparatively higher health risk.

However, while we use the MADLs involved in Prop 65, we approach our exposure assessment differently from what's outlined in Prop 65. Prop 65 takes into consideration consumers' average exposure over time to calculate whether a product exceeds the MADL and requires a warning label. By contrast, Consumer Reports assumes a constant exposure over time in its risk assessment calculations. This difference in methodology means no Prop 65 judgments can be made from CR's findings. Our results are meant to provide guidance on which products have comparatively higher levels of lead, not to identify the point at which lead exposure will have measurable harmful health effects, or to assess compliance with California law.

Selected Health-Based Exposure Limits			
Heavy Metal	Source	Endpoint and Basis for Limit	Value (Unit)
Inorganic Arsenic	EPA (2025)	Non-cancer oral reference dose based on increased incidence of diabetes and ischemic heart disease	0.06 ug/kg-day
Cadmium	OEHHA (2017)	OEHHA Proposition 65 Maximum Allowable Dose Level (MADL) for Chemicals Causing Reproductive Toxicity (cadmium, oral exposure)	4.1 ug/day
Lead	OEHHA (2017)	OEHHA Proposition 65 Maximum Allowable Dose Level (MADL) for Chemicals Causing Reproductive Toxicity (total lead, oral exposure)	0.5 ug/day
Acetone	EPA RfD (2003)	Non-cancer oral reference dose based on kidney pathology Link	0.9 mg/kg-day
Benzene	EPA RfD	Non-cancer oral reference dose based on hematological effects	0.004 mg/kg-day
Methylene Chloride	EPA RfD	Non-cancer oral reference dose based on liver toxicity	0.06 mg/kg-day
Toluene	EPA RfD	Non-cancer oral reference dose based on increased kidney weight	0.08 mg/kg-day