

Sampling and Analysis Protocol

for Suspected Mercury-Added Skin Lightening Products

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Biodiversity Research Institute (BRI) is a 501(c)3 nonprofit organization located in Portland, Maine, USA. Founded in 1998, BRI is dedicated toward supporting global health through collaborative ecological research, assessment of ecosystem health, improving environmental awareness, and informing science-based decision making. The following sampling protocol is based on over 1,000 skin lightening products analyzed since 2016 and work conducted under the GEF 10810 Project "Eliminating Mercury Skin Lightening Products (Jamaica, Gabon and Sri Lanka)" conducted from 2022 - 2026.

This Protocol is considered an updated version of the document: Evers DC, M. Taylor, and M. Burton. 2023. Protocol for sampling and analyzing skin lightening products for mercury. Report BRI 2023-03, Biodiversity Research Institute, Portland, Maine, USA.

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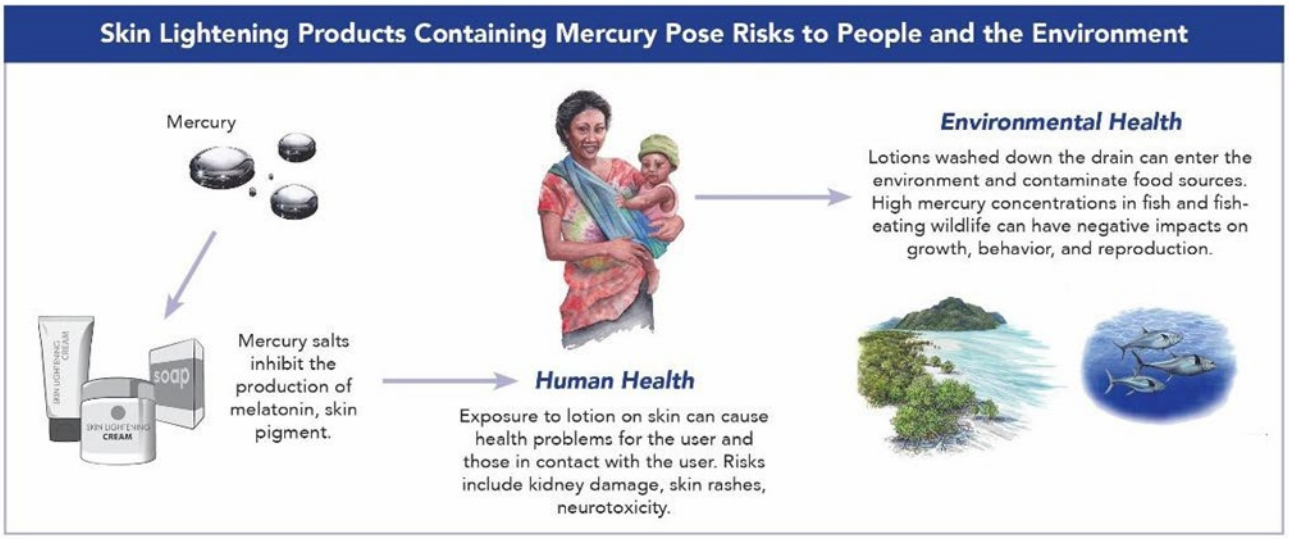
1.0 Introduction

The market for skin lightening products, also referred to as whitening or bleaching products, is widespread across various regions, often driven by deeply ingrained cultural and social ideals of beauty. Despite their toxicity, mercury compounds (among other potentially harmful substances) have been historically used in skin lightening products due to their ability to inhibit the production of **melanin**, the natural pigment that is responsible for color of skin as well as, hair and eyes.

Mercury in cosmetics can exist in two forms: inorganic and organic[1]. Organic mercury compounds such as phenyl mercuric salts may be used as a preservative. For mercury-added skin lightening products, more commonly inorganic mercury salts/compounds are intentionally added to inhibit melanin production. Common inorganic mercury salts used in this process include mercury(II) iodide, mercury(I) chloride (also referred to as calomel), mercury(II) oxide and most commonly, mercury (II) amidochloride or ammoniated mercury[2].

Mercury is highly toxic and exposure may cause serious health problems, especially amongst pregnant women and children.



[1] Ladizinski B, Mistry N, Kundu RV (2011). Widespread use of toxic skin-lightening compounds: medical and psychological aspects. Dermatologic Clinics, 29:111-123.
[2] Secretariat of the Minamata Convention on Mercury (2025) Study of the Global Supply, Production, Trade and Use of Mercury Compounds. UNEP/MC/COP.6/INF/5. https://minamataconvention.org/sites/default/files/documents/information_document/UNEP-MC-COP6-INF05-Compounds_Trade_Study_English.pdf

Under the Minamata Convention on Mercury[3], Parties are obligated to phase out the manufacture, import and export of mercury-added skin lightening products. However, the presence of mercury in skin lightening products is often difficult to identify and monitor due to factors such as, a lack of proper labelling standards and inconsistent manufacturing practices. Through sampling and analysis conducted previously, data indicates that over 90% of mercury-added skin lightening products on the global market do not have any indication of mercury or its compounds as an ingredient on their product labeling.

To better understand the presence of mercury in skin lightening products, regular market surveillance activities are recommended.

PURPOSE OF SAMPLING AND ANALYSIS PROTOCOL:

This protocol was developed by Biodiversity Research Institute (BRI) to share recommended guidelines for market surveillance activities related to the sampling of suspected mercury-added skin lightening products available on the market. Best practices and recommendations for the analysis of samples are also provided.

Further information on the use and trade and monitoring of mercury-added skin lightening products is available on the United Nations Environment Programme's Global Mercury Partnership (UNEP GMP) website at the link provided: https://www.unep.org/globalmercurypartnership/our-work/mercury-products/eliminating-mercury-skin-lightening-products

[3] https://minamataconvention.org/en

2.0 Sampling Protocol for Skin Lightening Products and Other Cosmetics Suspected of Containing Mercury

2.1 Determining Sampling Parameters

2.1.1 Types of Products Recommended for Sampling

Previous assessments on Mercury-added Skin Lightening Products (Hg SLPs) indicate that it is very difficult to identify if a product has mercury or to determine mercury concentrations from labeling/packaging information alone since many Hg SLPs on the global market are often mislabeled or may be counterfeit.

To increase likelihood of identifying Hg SLPs in sampling activities, a **purposive sampling approach** is recommended whereby priority for sample collection can be given to products that fit *one or more* of these general categories:

Ingredients/Components Listing:

- Look for these harmful or prohibited substances:
- Mercury or mercury compounds (often labeled as): “Ammoniated Mercury” “Mercury,” “Mercurous chloride,” “Calomel,” “Mercurio,” “Hg” or other mercury salts.
- Hydroquinone (especially if over 2%)
- Corticosteroids (e.g., betamethasone, clobetasol propionate, hydrocortisone)
- Unknown chemical names or vague terms like “natural whitening agent” with no clear explanation
- Missing or extremely short ingredient lists can be a sign of concealment.
- Vague terms like "botanicals" or "herbal blend" with no further breakdown.

Labeling or marketing with key words such as:

- Skin Lightening
- Skin Whitening
- Skin Bleaching
- Skin Brightening
- Fairness
- Anti-pigmentation

Or advertised to achieve “fast results” with phrases similar to:

- “Whitens skin in 3-10 days”
- “Instant fairness”
- “Guaranteed lightening overnight”
- “Erases melanin”

No Manufacturer Information

No clear manufacturer name, address, or country of origin.

Lack of Regulatory Approval

No regulatory certification like: Fake approval logos or stamps.

Suspicious Packaging or Label Design

Labels may look unprofessional, with poor grammar or spelling, blurry printing, no expiration date or batch number.

Imported Product Not in Local Language

Imported items without a translated label may elude standard safety checks.

Product Type

Hg SLPs can be found in a variety of forms: creams, soaps, lotions, gels, oils, serums, pills, powders etc. While mercury may be present in any form, previous research[4] suggests that creams have a higher likelihood of containing mercury than other forms, followed by soaps.

2.1.2 Factors Affecting Sample Size

Determining your sample size is largely dependent on available budget and resources. Costs of skin lightening products can range anywhere between $3.00 USD[5] to upwards $200 USD.

Location versus Sample Size

In addition to budget, sample collection should specify whether they are representative of the types of retail locations where they may be sold. These can include:

- Formal retail stores
- Informal markets (street markets, small businesses/beauty salons or convenience shops)
- Via online traders (this may be via formal platforms available such as Amazon.com etc. or via local vendors that advertise on social media platforms)

In terms of geographical location, it may be difficult to collect samples from across all locations within a country. If the specific location for sampling has to be limited, it is recommended that priority be given to capital cities and/or main port cities/areas and/or locations that researchers have confirmed as having a high presence of skin lightening practices.

Depending on available resources, sample sizes should consider various types of retail locations and geographical locations to have samples collected from all accessible areas.

[4] https://www.unep.org/globalmercurypartnership/our-work/mercury-products/eliminating-mercury-skin-lightening-products
[5] United States Dollars

2.1.3 Personnel Assigned for Sample Collection

Through sampling activities conducted by BRI in coordination with national stakeholders under the GEF 10810 Eliminating Mercury Skin Lightening Products Project, it was recommended that, especially for informal markets, the sampling team assigned purchase samples as "customers" to avoid bias from sellers who may hide counterfeit or harmful products if approached by surveyors in an official capacity.

Depending on the purpose of sampling efforts, recommended protocols may vary. For example, national governments may have protocols where designated officials are regulated to carry out market surveillance activities.

2.2 Equipment for Sampling

2.2.1 Standard Materials for Sample Collection

Item	Purpose
Phone/camera	To take a picture of the packaging of the sample collected. Be sure to take multiple photos of relevant information on all packaging, including brand and product names, country of manufacture, and ingredient lists.
Adhesive labels	For assigning a sample code to the product
Permanent marker or ball point pen	For labeling sample log and data sheets
Sample log	To ensure that all relevant information for the sample is well documented and can later be compared to other global datasets, a standard sample log is available and recommended for use. Details are provided in Section 2.3 of this protocol.

2.2.2 Duplicate Sampling Equipment and Methodology

In the event that each of the skin lightening products collected is to be analyzed by more than one laboratory (for example, an identified national laboratory and BRI's laboratory), aliquots or splits for each product should be done.

Additional materials for splitting samples are listed below.

Item	Purpose
0.5 – 1 ounce plastic containers (preferably with a secure screw top)	To contain each split sample
Rubbing alcohol	To sterilize containers and sampling area/equipment after each sample is prepared.
Plastic spatulas/ spoons/ droppers	For transferring products to sample containers.
Paper towels and cotton pads	For sanitizing sampling area
Labels and permanent marker or ball point pen	For labelling samples according to sample log
Gloves	To prevent cross-contamination amongst samples.

For each product that is to be split:

1. Obtain a sample container and sanitize by wiping with rubbing alcohol on a clean paper towel or cotton pad.
2. Label the sample container(s) according to the labeling format described in Section 1.3.
3. Prior to splitting the sample, ensure that the skin lightening product is homogenous by securely shaking or stirring with a sanitized stirrer/spoon.
4. Wearing gloves, use a clean spatula/spoon/dropper to place product in its labelled sample container. Secure cap/cover.
5. To prevent cross-contamination of samples during this process, ensure that sampling area and equipment are sanitized with rubbing alcohol after each sample is split. Change gloves as needed.

2.3 Logging of Samples

For sample collection, it is essential that each sample collected is properly labeled, key information documented and that a sample log is submitted for the analysis process to ensure

that no errors occur in sample identification. It is also important to ensure documentation is recorded legibly.

2.3.1 Sample Code and Labeling

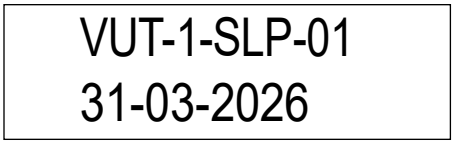
Each sample collected should have a unique sample label identification code (Sample ID). A recommended Sample IDs protocol is as follows:

Each country is assigned a unique three-letter code, following the country codes developed by the International Organization for Standardization (ISO). The full list of country codes is available online at: https://www.iso.org/obp/ui/#search/code/

When labeling each sample, the following convention is recommended:

- Record your 3-letter country code
- Assign a number corresponding to the sampling site (for example, label sample site 1, 2, or 3)
- Add the word SLP
- Include a two-digit, sequential number of the sample (e.g., from 01 to 35).
- Below the label, please record the date the sample was collected, using the format of DD-MM-YYYY.

As an example, the **first** cosmetic sample collected from **Vanuatu** (VUT) at **sample site 1** on **March 31st, 2026**, would be labeled as follows:



NOTE: The Sample Label will serve as the primary identification marker for both the sample collection and the analysis of the sample.

2.3.2 Documentation on Product Information

Each sample should be assigned a Sample ID as noted in the previous Section 2.3.1. This Sample ID should be entered into a written log table or MS Excel Spreadsheet referred to as a Sample Data Log.

The Sample Data Log should include all relevant information on the product for the corresponding Sample ID. The following information is recommended once available:

1. Sample ID
2. Name of Product
3. Product Description (key phrases, descriptions etc. stated on packaging)
4. Notable ingredients
5. Type of Product (cream, soap, lotion etc.)
6. Batch Number/Barcode Number
7. Date of Manufacture
8. Date of Expiration
9. Manufacturing Country
10. Manufacturing Company
11. Distributor
12. Location Type (formal, informal, online) and/or specific name of location/store that sample was collected from
13. Location in Country of Purchase (city, state etc.)
14. Country of Purchase
15. Sample Collection Date
16. Photo(s) of Product – photos of products labeled according to their corresponding Sample ID should be uploaded to a shareable Drive (Google Drive, OneDrive or other suitable platform) for reference.

An example of a Sample Data Log for 1 sample is provided in Attachment 1.

2.4 Handling and Storage of Samples

Care should be taken when handling samples to prevent leakage and potential harm to the environment or human health.

While brief exposure to Hg SLPs or other skin lightening products is not expected to be especially hazardous, care should be taken to minimize exposure to skin, inhalation or consumption.

It is recommended that samples be stored at ambient temperature. Samples collected should be inspected to ensure that they are sealed adequately to prevent leakage, loss of sample and cross-contamination. If there is a risk of leakage, it is recommended to place the sample in an additional sealed container or plastic bag.

2.5 Considerations for Sample Shipment (if exporting for analysis by external lab)

For the organizers of the sampling activity, your national government may have requirements for shipment of samples. The team coordinating the activity within the country of sampling is responsible for contacting all relevant authorities to ensure all export approvals are in place.

Prior to shipment, contact your local shipping service (FedEx or DHL or other agreed upon courier) to confirm whether any requirements are needed for shipping “cosmetic creams for laboratory analysis”. For example, in some cases, shipments must be sent via a shipping service location that is equipped with a working scanner.

*For samples that are to be shipped to BRI for analysis **(as part of a mutual agreement/ contract/project)**, the following protocol should be followed:*

- *Email a copy of your Sample Data Sheet to BRI (mark.burton@briwildlife.org) and/or other designated personnel and await further instructions about shipping. Once BRI receives and approves this information, arrangements can be made to ship samples.*
- *BRI will assist with the development of a “**Commercial Invoice**” to accompany the shipment.*
- *If shipping with DHL or FedEx, BRI may be able to assist with the shipping process.*

Ensure products are securely sealed but easily accessible for potential inspection by shipping agents or Customs.

Print a copy of the Sample Data Log and Commercial Invoice to place with the shipment.

Place the individually sealed samples and Sample Data Log in a shipping envelope or box obtained from the shipping provider. Please use a padded envelope to prevent breakage during shipment (Figure 1), or if using a box, ensure that products are secure with packing material.

Once shipment is processed, please notify BRI representative or other lab personnel as appropriate via email.

Figure 1: Example of a courier shipping service’s padded envelope used to ship samples.

2.6 Phased Approach to Sample Collection

To better understand the variability of mercury concentrations amongst batches of the same product or amongst different products of the same brand, a 2-phased approach to sampling can be considered:

- ***Phase 1: Baseline Development***

Sample collection focuses on collection of only one sample per product or brand according to the protocol in this document.

- ***Phase 2: Targeted Repeat Sampling***

Samples that were analyzed and confirmed to have mercury can be identified for a more targeted round of sampling to better understand the variation in mercury concentrations for each product type or brand. Variation of mercury within targeted Hg SLPs will be determined through multiple sampling of different containers/batches of the same product from different stores/sources or may be expanded to sample more products in the brand identified. This sampling strategy will strive to better understand the extent and variation of mercury concentrations in Hg SLPs.

From Phase 1 sampling, some products may be suspected of being counterfeit if their labeling information is inconsistent. For example, labels may look unprofessional, have poor grammar or spelling, blurry printing, no expiration date or batch number. Employing a Phase 2 sampling exercise may assist with confirming these theories.

The number of samples per product/brand is dependent on availability, budget and other resources and may range from a minimum of 2 to more than 10 samples per product/brand. It is imperative that the Sample Data Log be used to document any differences in product packaging information, specifically batch number/date of manufacture once available.

3.0 Sample Analysis Methods

Analysis of suspected Hg SLPs can be done through a variety of methods. Mercury concentrations in SLPs can vary widely from less than 0.001 parts per million (ppm) to concentrations exceeding 300,000 ppm in some cases. From product labeling alone, it is highly unlikely to be able to determine the range of mercury concentration that may be present in a sample. There are different analytical equipment capable of testing for mercury in samples, however most are highly sensitive and may be damaged if a high mercury sample is analyzed without first being diluted.

It is therefore recommended that analysis follows a two-step approach that first uses a screening method to determine whether the sample needs to be diluted prior to analysis on more advanced analytical equipment.

Details on lessons learned from analytical equipment use is provided in Section 3.3.

3.1 Step 1 (Screening):

A less sensitive analyzer such as Olympus x-ray fluorescence analyzer (XRF), Jerome® J405, or Lumex™ can be used as a screening tool to detect general mercury concentrations. The limit of detection (LOD) for many of these types of analyzers is higher than 1 ppm, usually at ~5 -40 ppm. Consequently, Hg SLP samples with less than 5 - 40 ppm of mercury will read as "< LOD," while the actual concentration could range between 0 - 40 ppm.

In the event that screening equipment is unavailable, it is highly recommended that desktop research be conducted to assess whether products sampled have been flagged previously as having mercury and their concentration ranges are known. A compilation of datasets and other references is available on the Global Database tab provided on the UNEP GMP website at the following link: https://www.unep.org/globalmercurypartnership/our-work/mercury-products/eliminating-mercury-skin-lightening-products

NOTE: From previous datasets assessed and provided in the above link, if mercury is intentionally added to skin lightening products, the concentrations of mercury typically exceed 50 ppm (over 50% Hg SLPs in assessment of global Hg SLPs datasets).

Depending on the purpose of analysis and resources available, screening via less sensitive analyzers may be sufficient for the analysis of samples, though it is recommended that Step 2 below be followed.

3.2 Step 2 (Laboratory Analysis):

Laboratory analysis equipment for mercury includes:

- Direct Mercury Analyzer (DMA) *which may refer to several brands of equipment where samples do not need to be digested prior to analysis*
- Inductively Coupled Plasma Mass Spectrometry (ICP-MS)
- Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES)
- Cold Vapor Atomic Absorption Spectroscopy (CVAAS)
- Cold Vapor Atomic Fluorescence Spectroscopy (CVAFS)
- Atomic Absorption Spectroscopy (AAS)

For all equipment listed above, protocols must be followed to prepare samples via digestion or other stipulated protocols.

For DMA, no digestion is necessary and minimal preparation is required.

Following the results of the screening equipment, samples that indicate that they are below the LOD, can be prepared for laboratory analysis according to the relevant established protocols for the selected equipment.

Samples that indicated mercury concentrations above the LOD should then be evaluated to determine the concentration range against the sensitivity of the laboratory equipment selected. If mercury concentrations are expected to be exceedingly high (above 1,000 ppm for example), it is recommended that a dilution protocol be developed to dilute samples before analysis.

3.3 Analysis Considerations – Lessons Learned from BRI Analysis

Under the GEF 10810 Eliminating Mercury Skin Lightening Products project, BRI conducted a two-step analysis protocol that involved the use of an x-ray fluorescence (XRF) analyzer for screening and a Direct Mercury Analyzer (DMA) for laboratory analysis.

XRF was used as the first step to rapidly screen samples for the possible presence of mercury. Its non-destructive nature allows for quick analysis of a large number of products, making it ideal for initial surveys or baseline assessments. While XRF can reliably indicate whether mercury is present and provide approximate concentrations, it does not provide precise measurements as it has a higher LOD. The XRF used by BRI has a LOD of 9.99 ppm.

To confirm and precisely quantify specific mercury levels more accurately, products were subsequently run in the DMA as it provides precise, quantitative results (>0.001 ppm of mercury for the analytical equipment used by BRI) and is considered a reference method for regulatory

assessments. Using the XRF for broad screening followed by DMA for confirmatory testing ensured efficiency, reliability, and evidence-based identification of mercury-added SLPs.

XRF analysis was performed three times for samples with detectable mercury, and the mean concentration was used to ensure accuracy. Samples with no detected mercury (<LOD) were analyzed once. After XRF screening, samples determined to be below the XRF LOD were directly run on the DMA. Samples with detectable mercury concentrations were diluted based on the XRF concentrations before being analyzed via DMA.

The dilution protocol that was applied involved using petroleum jelly. Dilutions were performed with single use supplies to prevent carryover contamination between samples. The measured XRF concentration was used to calculate the dilution factor required to target a final dilution concentration of <25 ppm before running the samples on the DMA.

The DMA equipment was evaluated following calibration. Subsequently, the equipment performance was checked at the beginning and end of each run and after every 10 samples using two certified reference materials and check blanks. Recovery of reference materials was confirmed to be within 10% of certified values. In addition, duplicate analyses were performed every 20 samples on the DMA to verify proper instrument calibration.

4.0 Information Dissemination and Follow-up Actions

As part of ongoing global efforts to eliminate mercury-added skin lightening products, it is encouraged that stakeholders who engage in sampling and analysis of skin lightening products voluntarily share information with BRI and/or UNEP GMP for possible inclusion in the global database available at: https://www.unep.org/globalmercurypartnership/our-work/mercury-products/eliminating-mercury-skin-lightening-products

To find out more information, please email: bri@briwildlife.org

Attachment 1: Example of Sample Data Log for One Product

Extract from a MS Excel Spreadsheet Sample Data Log below:

Sample ID	Name of Product	Product Description	Location in Country of Purchase	Country of Purchase	Collection Date	Type of seller	Type	Notable Ingredient	Manufacturing Company	Manufacturing Country	Distributor	Batch Number / Barcode/ Manufacture Date	Photo Provided?
SLP-LKA-0625-198	Ujooba Gold Advanced Beauty Cream	Anti oxidents & multivitamin, 5-days beauty plan	Batticaloa, Kattankudy	Sri Lanka	Jun-25	Retail	Cream	not available	New Trend International	Pakistan	Barakath Fancy, No. 277, Main Street, Kattankudy	B.#.SP-2024 (09/2024)	Y

Photo Provided via a shared Google Drive.

NOTE: The Photo was labeled according to the Sample ID as "SLP-LKA-0625-198" to match the Sample Data Log: