

REVIEWER'S REPORT

Manuscript No.: IJAR- 58569

Title: Toxicological Assessment and Strategic Risk Mitigation of Heavy Metal Contamination in Shampoos: A Case Study from Aden, Yemen.

Recommendation:

Accept as it is

Accept after minor revision.....

Accept after major revision

Do not accept (*Reasons below*)

Rating	Excel.	Good	Fair	Poor
Originality		✓		
Techn. Quality		✓		
Clarity			✓	
Significance			✓	

Reviewer Name: **ANAPANA GOPAL**

Reviewer's Comment for Publication.

General Comments

This manuscript investigates the concentrations of arsenic (As), nickel (Ni), cobalt (Co), and copper (Cu) in twelve commercially available shampoo brands marketed in Aden, Yemen, using ICP-OES. The topic is important because cosmetic safety and heavy metal contamination remain significant public health concerns, particularly in developing countries where regulatory surveillance may be limited. The analytical approach is appropriate, and the findings indicating elevated levels of arsenic, nickel, and cobalt are potentially valuable for public health authorities.

However, the manuscript requires substantial revision before it can be considered for publication. Although the analytical work is useful, the manuscript overstates several conclusions, lacks sufficient analytical validation, contains methodological weaknesses, and requires considerable improvement in scientific writing and data interpretation.

Minor Comments

1. Novelty is limited

Heavy metal analysis of shampoos using ICP-OES has been widely reported worldwide.

The authors should clearly explain:

- What is scientifically novel?
- Is this the first comprehensive investigation in Yemen?
- How does this study advance existing knowledge beyond previous regional reports?

Currently, the work appears primarily as a regional monitoring study rather than a novel scientific contribution.

2. Analytical method validation is incomplete

Although ICP-OES is an appropriate analytical technique, important validation parameters are missing, including:

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- Method detection limits (MDL)
- Limit of quantification (LOQ)
- Recovery percentage
- Certified reference material (CRM)
- Calibration coefficient (R^2)
- Precision (%RSD)

Only reagent blanks and triplicate analyses are described, which are insufficient for validating quantitative analytical results.

3. Sample size is relatively small

Only twelve shampoo brands were analyzed.

The authors should justify:

- sampling strategy,
- market representation,
- selection criteria,
- whether these brands represent the majority of products available in Aden.

The limited sample size restricts generalization of the conclusions.

4. Exposure assessment is lacking

The manuscript concludes that consumers face serious health risks.

However, no quantitative exposure assessment has been performed.

The study should estimate:

- daily dermal exposure,
- systemic exposure dose,
- hazard quotient (HQ),
- margin of safety (MoS),
- cancer risk (if applicable).

Without exposure assessment, statements regarding severe public health risks remain speculative.

5. Overinterpretation of toxicological risks

The manuscript repeatedly links shampoo use with:

- systemic toxicity,
- carcinogenicity,
- reproductive disorders,
- neurological damage.

These statements require caution because:

- shampoos are rinse-off cosmetic products,
- dermal absorption of metals varies considerably,
- actual absorbed doses were not measured.

The conclusions should distinguish between **hazard** and **actual exposure risk**.

6. Strategic mitigation framework is not experimentally validated

The proposed framework recommending:

- mandatory manufacturing control,
- port laboratories,
- herbal alternatives,

is largely conceptual.

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The framework is useful as a policy perspective but should not be presented as an experimentally validated outcome of the study.

7. Statistical analysis requires improvement

The manuscript uses One-way ANOVA and LSD tests.

However,

the following should also be reported:

- normality testing,
- homogeneity of variance,
- effect size,
- confidence intervals.

Furthermore, multiple comparisons using LSD are relatively liberal. More robust post-hoc procedures (e.g., Tukey's HSD) may be considered.

8. Discussion should better differentiate contamination sources

The discussion attributes contamination mainly to manufacturing quality.

Possible additional sources include:

- contaminated raw materials,
- packaging,
- storage,
- environmental contamination,
- intentional additives.

A broader discussion would strengthen the manuscript.

Specific Comments

Abstract

The abstract is informative.

However, it should avoid making strong toxicological claims that are not directly supported by exposure assessment.

The recommendation for herbal shampoos should be softened because herbal products may also contain heavy metals depending on raw material quality.

Introduction

The introduction is comprehensive but lengthy.

Several paragraphs discussing heavy metal toxicity are repetitive.

The literature review should focus more on:

- cosmetic contamination,
- previous shampoo studies,
- current regulatory challenges,
- existing gaps in Yemen.

Recent international studies (2023–2025) should be incorporated where appropriate.

Materials and Methods

Additional methodological details are required regarding:

- ICP-OES operating parameters,
- analytical wavelengths,
- calibration procedure,
- detection limits,

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- digestion recovery,
- quality control acceptance criteria.

These details are essential for reproducibility.

Results

The presentation of numerical results is generally clear.

However,

Table 2 could be simplified because:

- statistical superscripts reduce readability,
- regulatory limits could be presented separately.

The authors should also include:

- coefficient of variation,
- confidence intervals,
- graphical distribution (boxplots or violin plots).

Figures

Figures 2 and 3 are visually attractive.

However,

they resemble infographic-style illustrations rather than conventional scientific figures.

Several graphics appear promotional and should be simplified to improve scientific presentation.

Discussion

The discussion should compare findings with more international studies beyond India, Pakistan, Sudan, and Yemen.

More attention should be given to:

- possible contamination mechanisms,
- differences among countries,
- implications for cosmetic regulation,
- limitations of ICP-OES measurements.

Limitations

A dedicated limitations section should be included.

Important limitations include:

- small sample size,
- single-city sampling,
- absence of exposure assessment,
- lack of CRM validation,
- only four metals analyzed,
- no assessment of lead, cadmium, mercury, or chromium.

Conclusion

The conclusion should be moderated.

Instead of stating that shampoos cause severe toxicity, the authors should conclude that elevated concentrations **may represent a potential health concern warranting further investigation and regulatory monitoring.**

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Language and Presentation

The manuscript requires careful English editing.

Numerous issues include:

- repetitive wording,
- overly promotional language,
- inconsistent terminology,
- grammatical errors,
- excessive use of adjectives such as "alarming," "grave," "critical," and "comprehensive."

Scientific writing should remain objective and evidence-based.

Strengths

- Relevant public health topic.
- Appropriate use of ICP-OES for heavy metal determination.
- Inclusion of quality control measures and statistical analysis.
- Comparison with international regulatory limits.
- Useful baseline data for Yemen.
- Practical implications for cosmetic safety regulation.

Weaknesses

- Limited novelty.
- Small sample size.
- Incomplete analytical method validation.
- No exposure or human health risk assessment.
- Overinterpretation of toxicological consequences.
- Strategic framework is conceptual rather than experimentally supported.
- Discussion requires deeper scientific analysis.
- Language needs substantial editing.

Final Recommendation

The manuscript presents useful analytical data on heavy metal contamination in shampoos marketed in Aden, Yemen, and addresses an important public health issue. However, the current version has significant methodological, interpretative, and presentation-related shortcomings. In particular, the absence of comprehensive analytical validation, lack of quantitative health risk assessment, overstatement of toxicological implications, and need for improved scientific writing limit the manuscript's suitability for publication in its present form.

Recommendation: Minor Revision.