NATIONAL SUMMARY REPORT ON HEAVY METAL ASSESSMENT IN SELECTED FOODS AND COSMETICS PRODUCTS

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EXECUTIVE SUMMARY

This report summarizes the findings of a nationwide surveillance exercise conducted by the Food and Drugs Authority (FDA), Ghana, in collaboration with UNICEF. The primary objective was to assess levels of heavy metal contaminants—namely Lead (Pb), Cadmium (Cd), and Mercury (Hg)—in selected food and cosmetic products available on the Ghanaian market. The targeted product categories were turmeric, cereal mix, bentonite clay (ayilor), kohl, and skin-lightening creams/lotions.

Samples were collected from sixteen administrative regions of Ghana and analyzed using validated analytical methods aligned with Codex Alimentarius, EU Regulation 1881/2006, Ghana Standard GS 1206:2019, and WHO/FDA tolerable limits. Atomic Absorption Spectroscopy (AAS) was employed for quantification, and rigorous quality control measures ensured accuracy and reliability.

The analytical results revealed high levels of heavy metal contamination in some of the selected food and cosmetic products. Kohl products had a 77.97% failure rate for lead, with regions such as Upper East and Eastern recording failure 100% rates. Significant cadmium contamination was observed in Cereal mixes with a 29.0% failure rate. Regional disparities were noted, particularly in the North East, Western North and Oti regions, where all samples failed the cadmium safety threshold. Turmeric samples presented a 42.09% failure rate for lead, with the Greater Accra and Central regions most affected. Bentonite clay (Ayilor) exhibited a 24.62% failure rate for lead, with high levels of contamination observed in the North East and Greater Accra regions. Skin lightening creams showed full compliance, with 100% of samples passing the test for mercury content.

The findings also highlighted that unbranded and locally sourced product (s) contributed significantly to the high levels of contamination. Most failures were traced to products sampled from open markets and retail shops, revealing notable regulatory gaps at the informal market level. These trends underscore the need for urgent regulatory interventions, especially in the local retail sectors. Recommended actions include the immediate recall of contaminated products from the market, intensification of routine market surveillance, heightened public education on the health risks associated with heavy metal contamination, and the harmonization of national safety standards with global benchmarks to ensure more robust protection of public health.

1.0 INTRODUCTION

This report presents the findings of a comprehensive nationwide surveillance initiative conducted by the Food and Drugs Authority (FDA) in partnership with UNICEF, Ghana. The primary objective of this initiative was to evaluate the levels of heavy metal contamination in selected food and cosmetic products. The metals analyzed included Lead (Pb), Cadmium (Cd), and Mercury (Hg) across various products, specifically turmeric, cereal mixtures, bentonite clay, kohl, and skin lightening creams. Sampling and analysis were performed in accordance with established standards, including Codex Alimentarius guidelines, EU Regulation 1881/2006, Ghana Standard GS 1206:2019, and WHO/FDA tolerable limits.

2.0 OBJECTIVES

The specific objectives of the surveillance exercise were as follows:

- To assess the safety status of selected food and cosmetic products with respect to contamination by heavy metals, specifically Lead, Cadmium, and Mercury.
- To identify specific products and regions with potential regulatory noncompliance.
- To inform evidence-based enforcement actions, consumer protection measures, and risk communication strategies.
- To generate baseline data for long-term monitoring and the development of targeted national policies on chemical safety in consumer products.

3. METHODOLOGY

3.1 Research Design

The study employed a cross-sectional research design to evaluate the concentration of selected heavy metals in widely consumed food and cosmetic products in Ghana. This design provides a snapshot of the current levels of contamination and associated risks to public health. Five product categories were targeted: kohl eyeliner, skin-lightening creams and lotions, cereal mixes, turmeric, and bentonite clay. These products were chosen based on market penetration, suspected or reported contamination, and health impact potential.

Sample collection was done nationwide, encompassing all sixteen administrative regions of Ghana. Retail sources included open markets, cosmetic and food shops, supermarkets, and postnatal weighing centers, to ensure adequate representation across different consumer environments.

3.2 Sampling Framework

A stratified random sampling approach was employed across all sixteen administrative regions of Ghana, with each region serving as a distinct stratum. Sample allocation within each stratum was proportionally determined using the most recent population census data, ensuring equitable representation across urban, peri-urban, and rural contexts. This method enhanced both the geographic coverage and population representativeness of the study. Samples were systematically collected from diverse sources, including open markets, supermarkets, and specialty shops, then securely sealed and transported for laboratory analysis. In total, one thousand six hundred and ninety-one (1,691) samples were gathered to support robust, generalizable conclusions.

3.3 Sample Size Determination

Sample sizes were calculated using Raosoft® sample size calculator at a 95% confidence level, 5% margin of error, and an assumed prevalence rate of 50%—a standard approach when the actual prevalence is unknown. The following parameters informed the sample size determination:

The estimated minimum sample sizes for skin-lightening creams, cereal mixes, and branded turmeric were 209, 278, and 12, respectively, derived from their registered population sizes of 460, 1,000, and 12 with the Food and Drugs Authority (FDA), Ghana. For Kohl, unbranded Turmeric, and Bentonite Clay, where the population size is unknown or infinite, the assumed population size of 1,000,000 was used, yielding a baseline sample size of 384 to ensure statistical validity.

To enhance the robustness and generalizability of the study findings, a total of 220, 300, and 12 samples were collected for skin-lightening creams, cereal mixes, and branded turmeric, respectively. Additionally, 390 minimum samples were obtained for Kohl, unbranded turmeric, and bentonite clay

3.4 Sampling Strategy

Sampling took place at three key distribution points in each region—open markets, supermarkets, and specialty retail shops. Products were randomly selected based on availability and brand diversity at each location. Where available, both imported and locally manufactured items were included. All products were sealed and coded before laboratory analysis to avoid bias.

3.5 Laboratory Analysis

Samples were subjected to either wet acid digestion or dry ashing, depending on the matrix composition of the product. Post digestion, the heavy metal content was analyzed using Atomic Absorption Spectroscopy (AAS), employing three specific techniques: flame AAS for general metal detection, cold vapor AAS for mercury quantification, and hydride generation AAS for metals requiring higher sensitivity. Calibration was performed

using certified standard solutions, with daily calibration curves developed to ensure data reliability. The accepted correlation coefficient threshold of ≥0.995 was maintained.
Stringent quality assurance and control protocols were enforced to uphold ISO/IEC 17025 standards. These included the use of reagent blanks, duplicate analyses, spike recovery assessments, certified reference materials (CRMs), and calibration verifications. Metal concentrations—including Lead (Pb), Cadmium (Cd), Mercury (Hg), and Arsenic (As)—were determined and expressed in parts per million (ppm) or parts per billion (ppb), depending on the detection threshold. Each sample result was then evaluated as either 'Pass' or 'Fail' based on its compliance with maximum permissible levels outlined by the Ghana Standards Authority, Codex Alimentarius, and other international regulatory benchmarks.

4.0 FINDINGS FROM THE ASSESSMENT

The following tables and charts present a comprehensive analysis of the failure rates, both in number and percentage, of samples for each contaminant categorized by product and geographic region. This data provides a detailed overview of contamination risks associated with various product types across distinct locations. Notably, Skin Light cream achieved a 100% passing rate, leading to its exclusion from the visual representations of the sample outcomes.

Table 1: Regional Percentage Failure Rates of Lead and Cadmium in Kohl

Region of Sampling	Total number of samples analysed	Lead (Pb)		Cadmium (Cd)	
		No. Failed	% Failed	No. Failed	% Failed
Ashanti	69	64	92.75%	4	5.80%
Bono	30	16	53.33%	10	34.62%
Central	7	3	42.86%	0	0%
Eastern	37	37	100%	15	40.54%
Greater Accra	69	50	72.46%	29	42.03%
North East	9	7	77.78%	3	33.33%
Northern	30	27	90%	6	20%
Oti	9	3	33.33%	5	55.56%
Savannah	7	6	85.71%	0	0%
Upper East	17	17	100%	3	17.65%
Upper west	11	10	90.91%	4	36.36%
Volta	22	8	36.36%	16	72.73%
Western	26	25	96.15%	24	92.31%
Western North	11	3	27.27%	9	81.2%

TOTAL	354	276	77.97%	128	36.16%

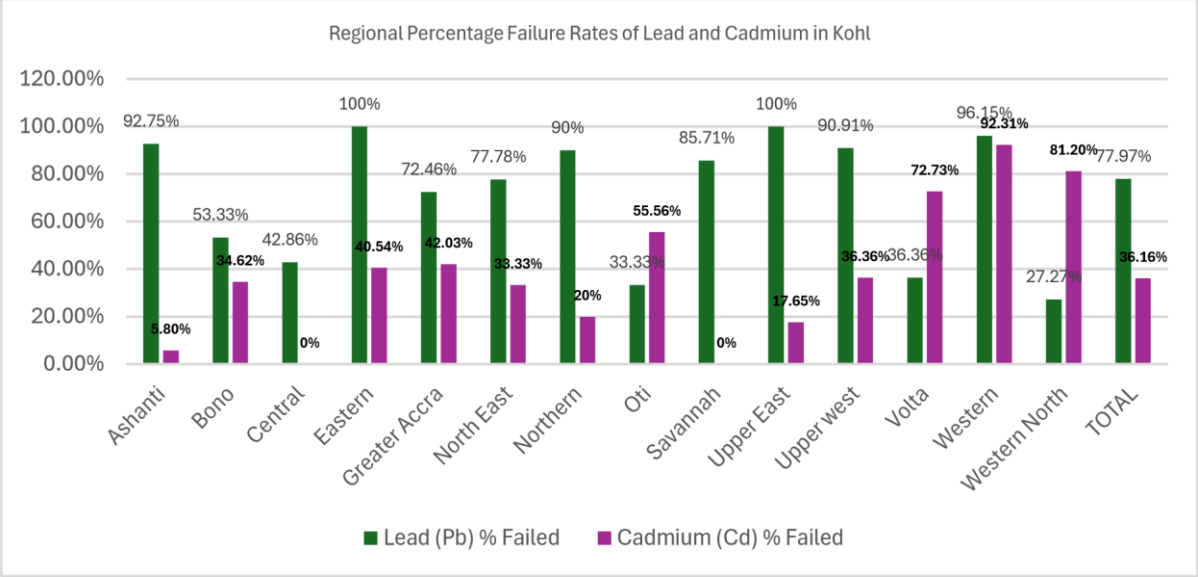

Figure 1: Regional Percentage Failure Rates of Lead and Cadmium in Kohl.

Table 2: Regional Percentage Failure Rates of Lead in Kohl base on Prepackage Status.

prepackage status	**Total number of samples analysed**	**Lead (Pb)**		**Cadmium (Cd)**	
		No. Failed	% Failed	No. Failed	% Failed
Branded	138	70	50.72%	71	51.45%
Unbranded	216	206	95.35%	57	26.39%
TOTAL	354	276	77.97%	128	36.16%

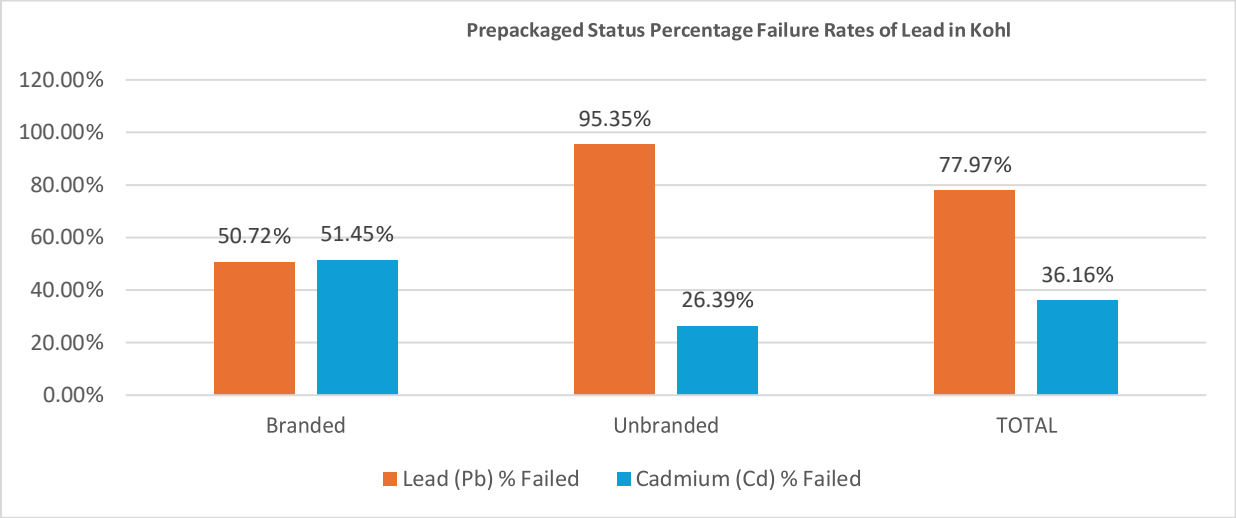

Figure 2: Prepackaged Status Percentage Failure Rates of Lead in Kohl.

Table 3: Origin Percentage Failure Rates of Lead in Kohl.

Origin	**Total number of samples analysed**	**Cadmium (Cd)**		**Lead (Pb)**	
		No. Failed	% Failed	No. Failed	% Failed
Imported	216	79	36.57%	148	68.52%
local	138	49	35.51%	128	92.75%
Total	354	128	36.16%	276	77.97%

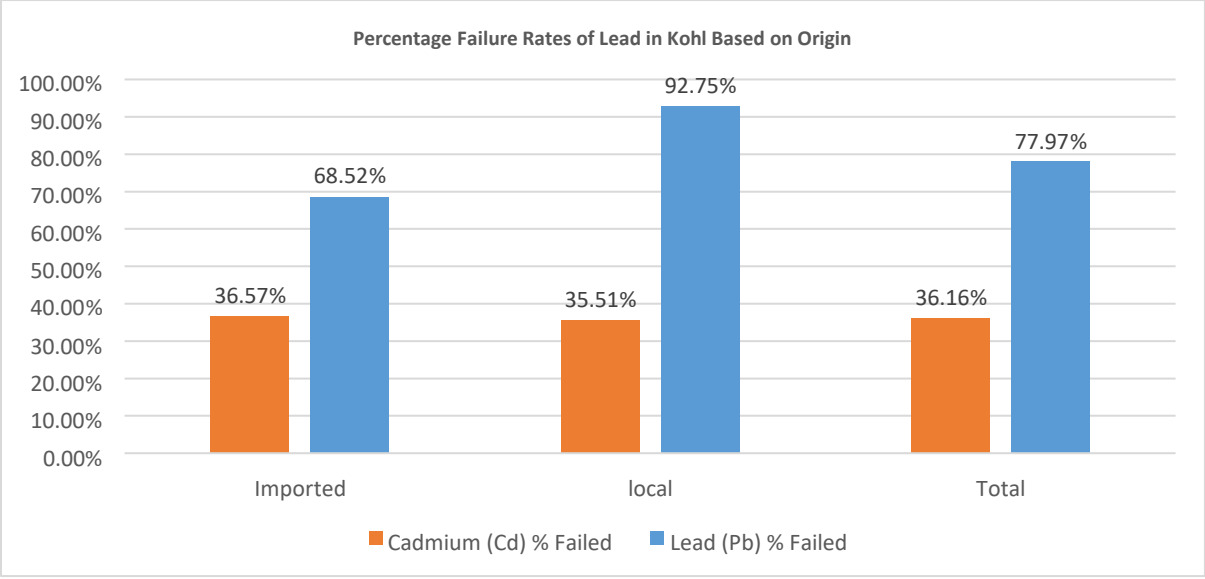

Figure 3: Percentage Failure Rates of Lead in Kohl Based on Origin.

Table 4. Percentage Failure Rates of Lead in Kohl Based on Place of Purchase

		Cadmium		Lead	
Place of Purchase	**Total number of samples analysed**	No. Failed	% Failed	No. Failed	% Failed
Open Market (Tabletop Vendors, Umbrellas)	271	79	29.15%	209	77.12%
Retail Shops (Stores, Containers)	83	49	59.04%	67	80.72%
Total	354	128	36.16%	276	77.97%

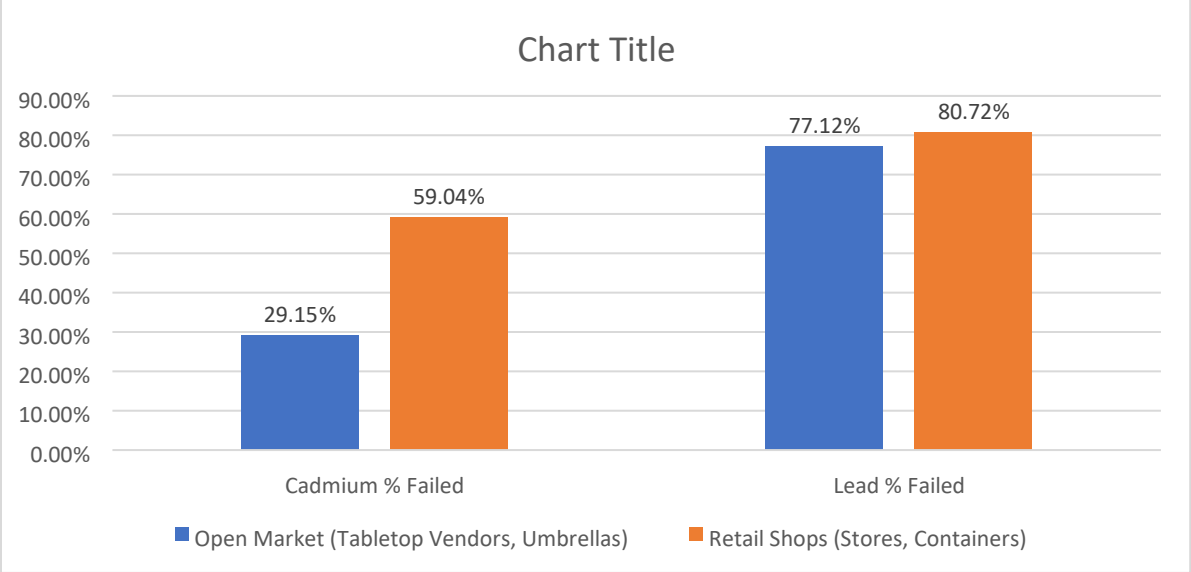

Figure 4: Percentage Failure Rates of Lead in Kohl Based on Place of Purchase

Table 5: Regional Percentage Failure Rates of Lead, Cadmium, and Mercury for Cereal Mix

Region of Sampling	**Total number of samples analysed**	**Lead (Pb)**		**Cadmium (Cd)**		**Mercury (Hg)**	
		No. Failed	% Failed	No. Failed	% Failed	No. Failed	% Failed
Ashanti	48	0	0.00%	28	58.33%	0	0.00%

Bono	32	0	0.00%	5	15.63%	0	0.00%
Central	27	2	7.41%	0	0%	0	0.00%
Eastern	33	3	9.09%	32	96.97%	0	0.00%
Greater Accra	60	5	8.20%	0	0%	0	0.00%
North East	4	0	0%	4	100%	0	0.00%
Northern	26	0	0%	0	0%	0	0.00%
Oti	15	1	6.67%	15	100%	0	0.00%
Savannah	5	0	0%	0	0%	0	0.00%
Upper East	13	0	0%	1	7.69%	0	0.00%
Upper west	9	0	0%	0	0%	0	0.00%
Volta	18	1	5.67%	0	0%	0	0.00%
Western	20	0	0%	0	0%	0	0.00%
Western North	7	0	0.0%	7	100%	0	0.00%
TOTAL	326	14	4.06%	92	29.02%	0	0.00%

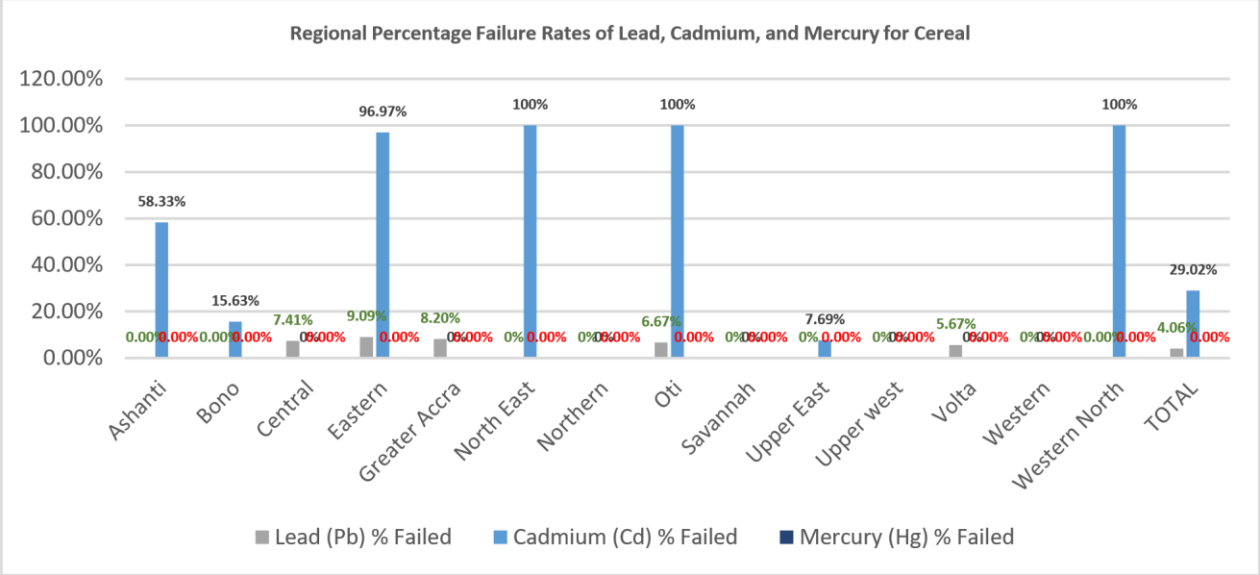

Figure 5: Regional Percentage Failure Rates of Lead, Cadmium, and Mercury for Cereal Mix

Table 6: Prepackage status Percentage Failure Rates of Lead and Cadmium Cereal Mix

prepackage status	**Total number of samples analysed**	**Lead (Pb)**		**Cadmium (Cd)**	
		No. Failed	% Failed	No. Failed	% Failed

Branded	226	10	4.42	56	24.78%
Unbranded	91	4	4.04%	36	39.56%
Total	**317**	**14**	**4.42%**	**92**	**29.02**

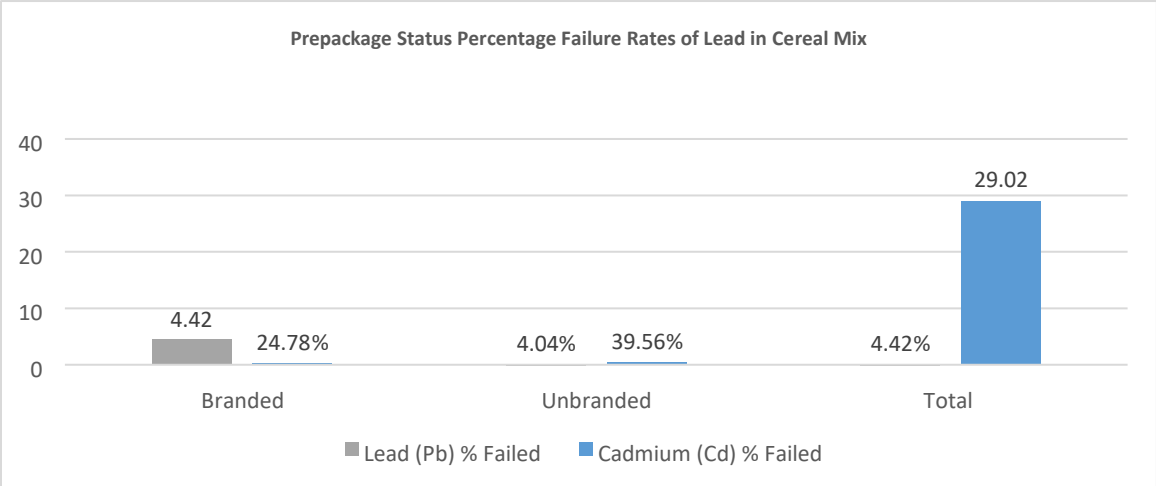

Figure 6: Prepackage Status Percentage Failure Rates of Lead in Cereal Mix

Table 7: Origin Percentage Failure Rates of Lead and Cadmium Cereal Mix

Origin	**Total number of samples analysed**	**Lead (Pb)**		**Cadmium (Cd)**	
		No. Failed	% Failed	No. Failed	% Failed
Imported	0	0	0%	0	0%
local	317	14	4.42%	98	30.15%
Total	317	13	4.08%	98	30.06%

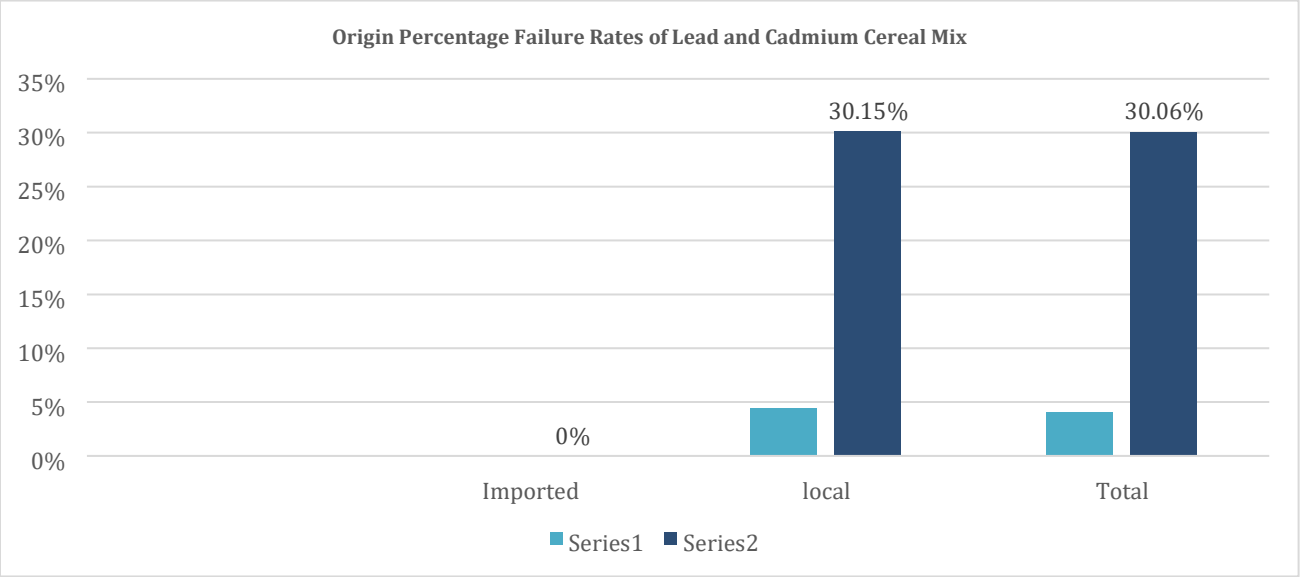

Figure 7: Origin Percentage Failure Rates of Lead and Cadmium Cereal Mix

Table 8: Percentage Failure Rates of Lead and Cadmium Cereal Mix

		Cadmium		Lead	
Place of Purchase	**Total of number samples analysed**	No. Failed	% Failed	No. Failed	% Failed
Hospital (Weighing Centers)	17	0	0.00%	1	5.88%
Open Market (Tabletop Vendors, Umbrellas)	132	49	37.40%	6	4.58%
Retail Shops (Stores, Containers)	79	9	11.39%	1	1.27%
Supermarket/Mall	89	34	38.20%	6	6.74%
TOTAL	**317**	92	29.02%	14	4.42%

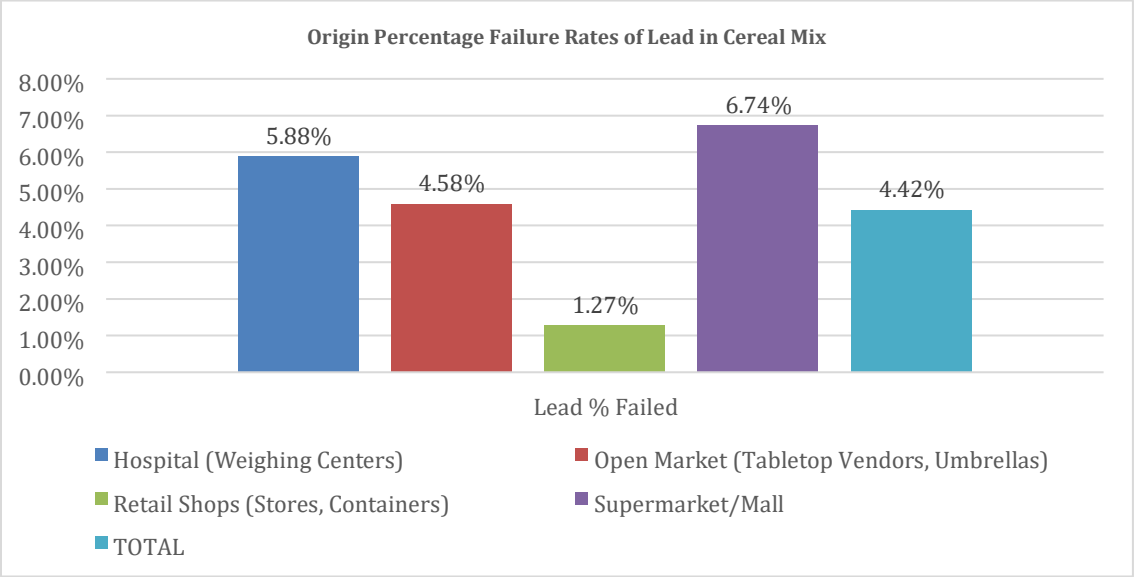

Figure 8: Percentage Failure Rates of Lead in Cereal Mix based on Origin

Table 9: Regional Percentage Failure Rates of Lead in Turmeric

Region of Sampling	Total number of samples analysed	Lead (Pb)	
		No. Failed	% Failed
Ashanti	68	3	4.41%
Bono	38	23	60.53%
Central	36	27	75%
Eastern	37	0	0%
Greater Accra	84	71	84.52%
North East	6	2	33.33%
Northern	22	2	9.09%
Oti	9	2	22.22%
Savannah	9	0	0%
Upper East	17	10	58.82%
Upper west	11	7	63.64%
Volta	44	20	45.45%
Western	26	8	30.77%
Western North	11	1	8.33%

TOTAL	392	165	42.09%

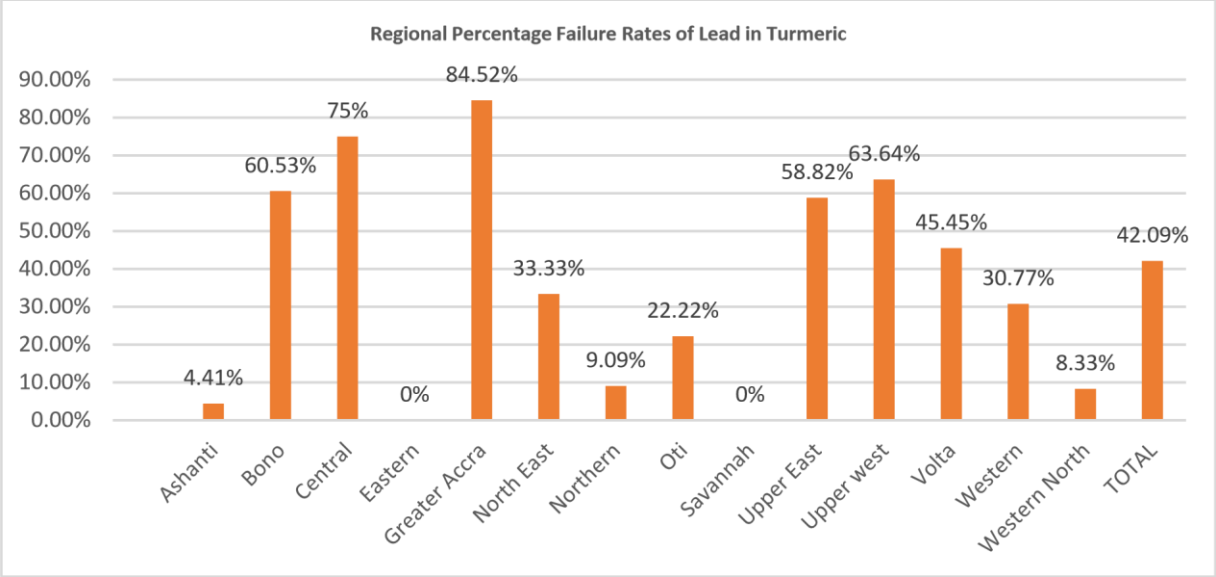

Figure 9: Regional Percentage Failure Rates of Lead in Turmeric

Table 10: Prepackaged Status Percentage Failure Rates of Lead in Turmeric

Prepackage status	**Total number of samples analysed**	**Lead (Pb)**	
		No. Failed	% Failed
Branded	42	35	83.33%
Unbranded	350	130	33.61

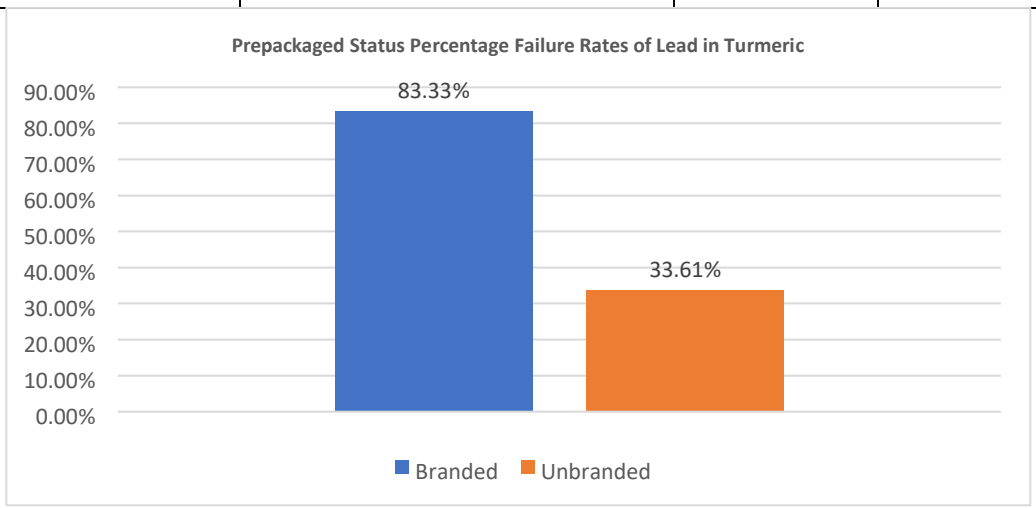

Figure 10: Prepackaged Status Percentage Failure Rates of Lead in Turmeric **Table 11:** Origin Percentage Failure Rates of Lead in Turmeric

Origin	Total number of samples analysed	Lead (Pb)	
		No. Failed	% Failed
Imported	9	5	55.56%
local	383	160	41.78%
Total	392	165	42.09%

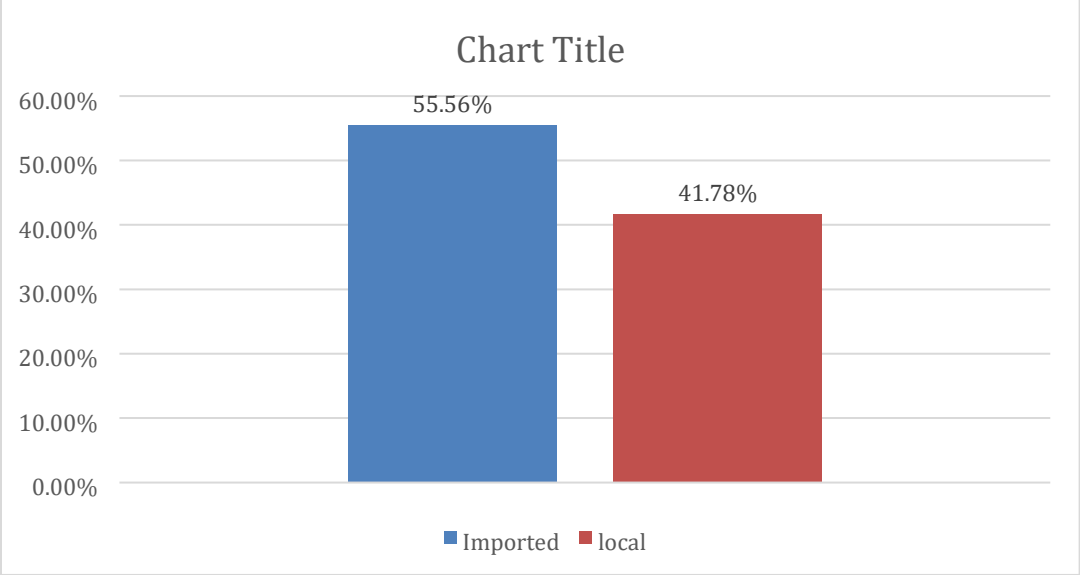

Figure 11: Origin Percentage Failure Rates of Lead in Turmeric

Table 12: Sampling Points Percentage Failure Rates of Lead for Turmeric

place of purchase	Total number of samples analysed	Lead (Pb)	
		No. Failed	% Failed
Open Market (Tabletop Vendors, Umbrellas)	267	100	37.45%
Retail Shops (Stores, Containers)	113	54	47.79%
Supermarket/Mall	12	11	91.67%
TOTAL	392	165	42.09%

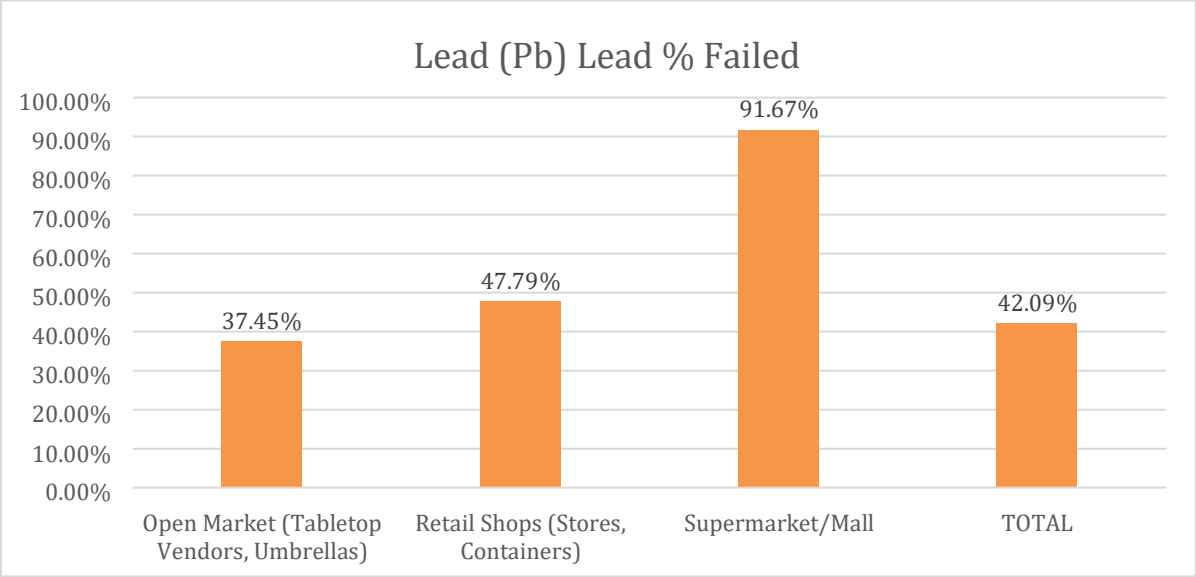

Figure 12: Sampling Points Percentage Failure Rates of Lead in Turmeric

Table 13: Regional Percentage Failure Rates of Lead and Cadmium for Bentonite Clay

Region of Sampling	Total number of samples analysed	Lead (Pb)		Cadmium (Cd)	
		No. Failed	% Failed	No. Failed	% Failed
Ashanti	68	2	2.94%	1	1.47%
Bono	38	6	15.79%	0	0%
Central	36	2	5.56%	0	0%
Eastern	37	9	24.32%	0	0%
Greater Accra	69	54	78.26%	0	0%
North East	9	8	88.89%	0	0%
Northern	30	0	0%	0	0%
Oti	9	0	0%	0	0%
Savannah	9	0	0%	0	0%
Upper East	18	2	11.11%	0	0%
Upper west	11	4	36.36%	0	0%
Volta	22	5	22.73%	2	9.09%
Western	26	1	3.85%	0	0%
Western North	12	4	33.33%	2	16.67%
TOTAL	394	97	24.62%	5	1.29%

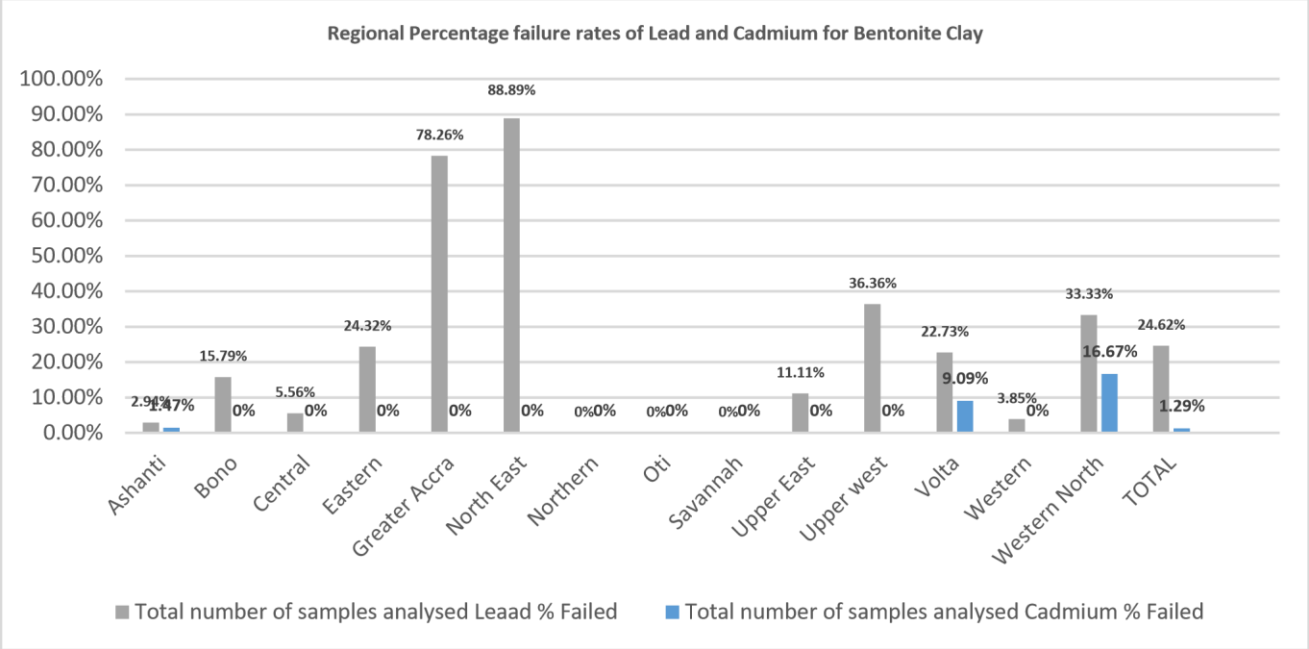

Figure 13: Regional Percentage failure rates of Lead and Cadmium for Bentonite Clay

Table 14: Percentage failure rate based on Place of purchase

Place of purchase	**Total number of samples analysed**	**Lead**		**Cadmium**	
		No. Failed	% Failed	No. Failed	% Failed
Open Market (Tabletop Vendors, Umbrellas)	278	77	27.70%	3	1.08%
Retail Shops (Stores, Containers)	116	20	17.24%	2	1.72%
TOTAL	394	97	24.62%	5	1.27%

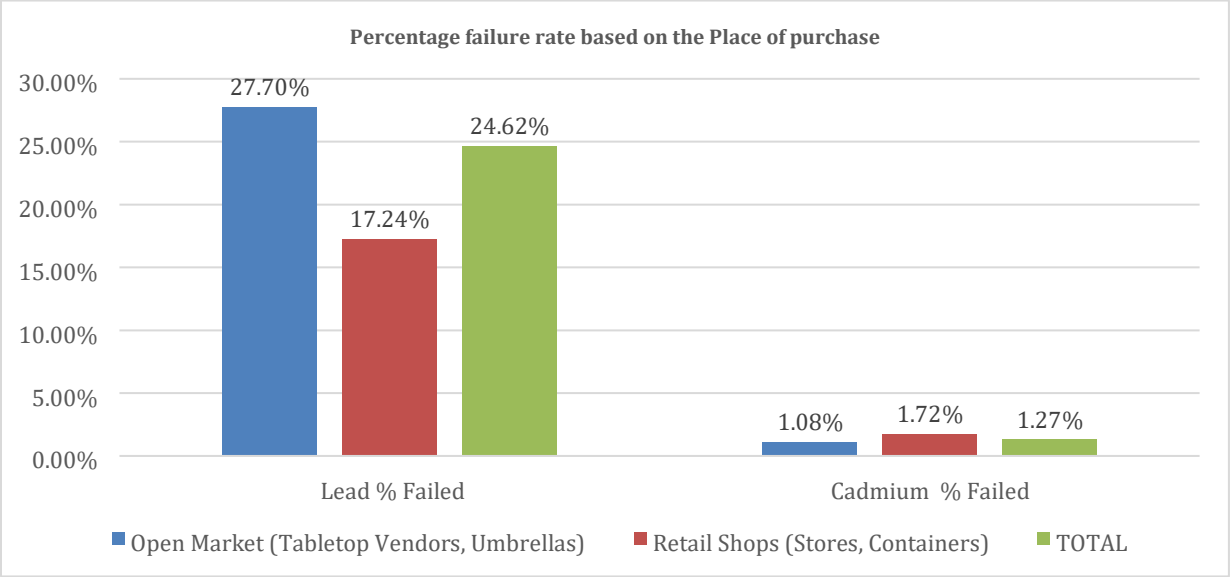

Figure 14: Percentage failure rate based on Place of purchase

Table 15: Percentage failure rate based on the Prepackaged Status

Prepackage status	**Total number of samples analysed**	**Lead (Pb)**		**Cadmium (Cd)**	
		No. Failed	% Failed	No. Failed	% Failed
Branded	0	0	0	0	0%
Unbranded	394	97	24.62%	5	1.27 %
TOTAL	394	97	24.62%	5	1.27 %

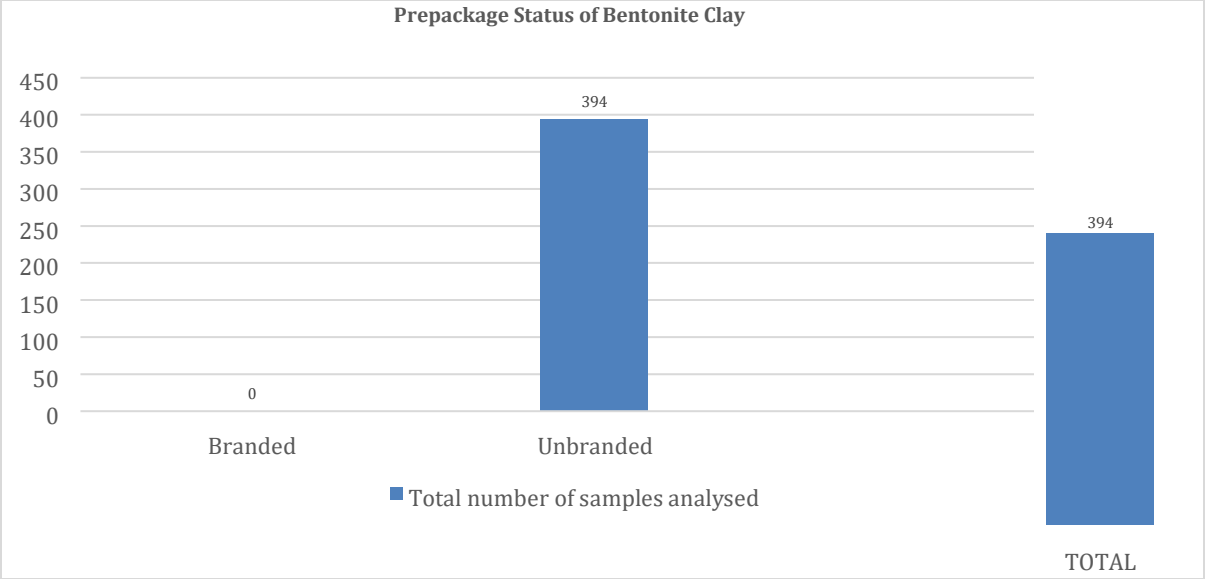

Figure 15: Percentage failure rate based on the Prepackaged Status

4.1 **Regulatory Benchmark References**

Product	Parameter	Threshold (Max Limit)	Source
Bentonite (clay)	Lead (Pb)	10 ppm	US FDA & WHO limits for clay/personal care products
	Cadmium (Cd)	3 ppm(3000ppb)	WHO Guidelines (no Codex level for clay)
Turmeric (spice)	Lead (Pb)	0.2 ppm (200 ppb)	Codex (CXS 193-1995), EU 1881/2006 Annex I
Kohl (cosmetic)	Lead (Pb)	< 20 ppm (FDA guideline; many countries ban kohl with Pb)	US FDA (cosmetics), EU bans Pb in cosmetics
	Cadmium (Cd)	< 0.5 ppm (500 ppb)	EU Cosmetic Regulation (EC) No 1223/2009
Cereal Products	Lead (Pb)	0.1 ppm	Ghana Standard GS 1206:2019; Codex CXS 193-1995
	Cadmium (Cd)	0.1 ppm (100 ppb)	EU 1881/2006 (as amended)
Skin Lightening Creams	Mercury (Hg)	1 ppm (max)	Ghana Standard GS 1206:2019

4.2 Risk Assessment

Regions with extremely high failure rates, especially in kohl and turmeric, pose a significant public health threat. Lead levels as high as 11,000 ppm were recorded in some kohl samples. Over 50% cadmium failure was also noted in cereal mix samples from some regions. While some products like skin lightening creams showed consistent compliance, others revealed the urgent need for regulatory intervention and product recall.

6. RECOMMENDATIONS

- Immediate product recall for high-risk items (especially kohl and turmeric).
- Strengthen border and market surveillance for high-risk products.
- Public sensitization on the health risks of unregulated product use.
- Capacity building for regional labs in rapid contaminant detection.
- Harmonization of national standards with updated international benchmark
- Initiation of a National Residue/Contaminant Monitoring control Plan to facilitate a well-structured food safety risk assessment and enhance management of food safety risks or hazards. It will also facilitate the identification of emerging food safety risks and fast-track regulatory measures to be put in place to reduce or eliminate their occurrence.
- The Food and Drugs Authority should engage with the Ghana Standards Authority to conduct a thorough review of current standards concerning heavy metals. It is essential to incorporate specific requirements for cadmium into these standards to ensure comprehensive safety and regulatory compliance.

7.0 CONCLUSION

The findings from this nationwide heavy metal surveillance reveal critical gaps in food and cosmetic product safety across Ghana. The high failure rates observed, particularly in kohl, turmeric, and cereal mix, highlight the urgent need for targeted regulatory enforcement and public health interventions. The presence of lead in kohl and turmeric at levels thousands of times above the permissible limit poses serious neurodevelopmental risks, especially for children and pregnant women. Likewise, cadmium contamination in cereal mixes threatens renal health upon chronic exposure.

These results underscore the necessity of continuous monitoring, rapid detection infrastructure, and stronger enforcement of safety standards. The harmonization of local guidelines with international standards must be expedited to close regulatory loopholes. Furthermore, public awareness campaigns should be intensified to inform consumers about the dangers associated with heavy metal contamination in everyday products.

By acting decisively on the evidence presented, the FDA and allied stakeholders can safeguard public health and restore consumer confidence in the safety of food and cosmetic products distributed across Ghana.