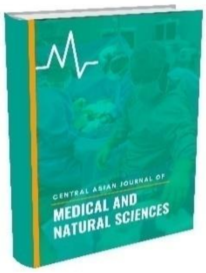
CENTRAL ASIAN JOURNAL OF MEDICAL AND NATURAL SCIENCES



Volume: 04 Issue: 02 | Mar-Apr 2023 ISSN: 2660-4159

http://cajmns.centralasianstudies.org

Determination of Lead and Aluminum in Selected Antiperspirant using Atomic Absorption Spectrometry in Baghdad City / Iraq

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Received 2nd Jan 2023,
Accepted 3rd Feb 2023,
Online 20th Mar 2023

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Abstract: The concentrations of metals (Al, Pb) were determined in Seven antiperspirant brands promoted in the City of Baghdad were purchased. The study was aimed at providing information on the concentration of metals in some antiperspirant products. The concentrations of metals in the samples were measured by atomic absorption spectrometry after digestion with a mixture of nitric acid, hydrochloric acid. The concentrations of Al and Pb in selected antiperspirant cosmetics ranged between (201.2 – 355.4 mg / L) and (2.688–5.311 mg / L) respectively for all the antiperspirant samples analyzed. (The concentrations of Al and pb were above the suggested safe limits for skin protection. The margin of safety values obtained were greater than 100 which indicated that the concentrations of the metals investigated in these facial cosmetics do not present considerable is to the users except in the case of face powders.

Key words: Antiperspirants, heavy metals, Cosmetics.

Introduction

Cosmetics are also known as makeup, which are products that are placed on specific places in the body, especially the face, in order to change its appearance. These different types of products usually consist of a mixture of chemicals of natural or industrial origin [1].The US Food and Drug Administration (FDA) defines cosmetic products as substances that are placed on the human body for the purpose of cosmetic or altering its appearance without affecting its functions [2]. There are types of cosmetics, including those targeted in this research, which are personal detergents and include an odor remover (underarm deodorants) [3].

The presence of many heavy metals in cosmetics is not permitted, due to its negative effects on the health of the person using them, and this is according to the US Food and Drug Administration law [4]. One of the sources of heavy metals in cosmetics is the water used in the manufacture of these preparations, as well as the raw materials used in their manufacture, such as oils and other materials, where a specific amount of heavy metals is allowed in the raw materials according to FDA [4]. Also, some heavy metals can be introduced into cosmetics through the dyes used in their manufacture, for example mercury, arsenic, and lead, but within limits [5]. Consequently, it is proposed that metal-induced oxidative stress in cells be partially responsible for the heavy metal toxic effects.

Various analytical techniques have been used to evaluate metals in cosmetics, such as laser induced breakdown spectroscopy (LIBS) [6], flame atomic absorption spectrometry (FAAS) [7] inductively coupled plasma mass spectrometry (ICP – MS) [8], inductively coupled plasma- emission spectrometry (ICP – OES) [9] and graphite furnace atomic absorption spectrometry (GFAAS) [10].

Heavy metals such as lead, mercury, cadmium, nickel, chromium and other toxic organic chemicals or phenolic compounds generated from pharmaceutical factories are known to affect surface and ground waters, which inevitably present a health hazard and because of the mutagenic and carcinogenic properties of heavy metals, they havegained significant attention because they are directly exposed to humans and other organisms [12]. Determining the lack of heavy metals in all human products is no misnomer then. The aim of this study is to quantify the amount of metals that are present in some of the antiperspirant prep arations on the Baghdad market.

Samples:

Seven various antiperspirants samples ware brands purchased from the local Baghdad city market in Iraq in April 2022, the information shown in Table 1.

Table 1: Details of the Antiperspirant samples obtained.

Samples	Country of manufacture And trade name	Date of manufacture	Date of Expiration
A	UAE / ULTRA MAX	02/10/2018	01/10/2022
B	Vietnam / BRANDS	10/02/2019	15/02/2023
C	Russia / REXONA	01/05/2017	05/05/2020
D	USA / REXONA	05/08/2018	10/08/2023
E	UK / REXONA	20/02/2018	25/02/2022
F	Turkey / VICHY	13/04/2017	15/05/2021
G	Germany / NIVEA	01/01/2019	10/01/2023

All the chemicals and reagents used in the research were of industrial quality and were collected from BDH Chemicals Ltd, UK. Concentrated Aqua (mixture conc. HNO3 and conc. HCL in ratio 1:3) was used to digest the samples while the corresponding metal salts were used as standards [namely:, $Pb(NO_3)_2$, $ALCl_3.6H_2O$.

Instrumentation

Microwave Digestion Device, AAS instrument (PERKIN ELMER A. Analyst 200; Germany) consisti ng of a hollow cathode lamp, a slit width of 0.7 nm and an air-acetylene flame were used for this work.

Sample Preparation

Digested 2ml of each brand using 10ml of conc.Aqua (in ratio 1:3, mixture of nitric acid and hydrochloric acid). The mixture was evaporated in a fume cupboard on a hot plate until the brown fumes vanished and left white fumes.

The digest was allowed to cool down and transferred to a 25ml volumetric flask, and the volume was balanced with deionized water to label.

The mixture was filtered into a sample bottle using filter paper. In the clear solutions obtained, the abs orption of aluminum and lead in each sample was measured using the Atomic Absorption Spectrophot ometer and the concentration extrapolated from the standard plot Figure 3 and 4) for each metal [12].

Standard Preparation

Calibration plots were obtained using a series of different standard concentrations for both Al and Pb metals, and were linear with a correlation coefficient of about one Figure 3and 4 respectively. The standard aluminum and lead solutions used in the calibration plot were prepared through a graded dilution of stock standards.

The dilute standards and blanks of a reagent were prepared and measured from the spectrophotometer for atomic absorption.

RESULTS

The heavy metals, lead, and aluminum were measured with varying concentration in all 7 Antiperspira nt samples. The aluminum and lead concentration levels were respectively 0.523 -3.214, and 2.729-5.813 mg / L.

The maximum lead concentration (5,813 mg / L) was found in sample (F) and aluminum (3,214 mg / L) in sample (A), as shown in table 2

Table 2: Metals (mg / l) levels in Antiperspirant Samples.

Sample	Al	Pb
A	276.6	5.311
B	287.3	4.683
C	268.5	4.782
D	228.4	3.57
E	201.2	4.468
F	214.2	3.458
G	355.4	2.688

Table 3: Mean, Standard deviation for heavy metals concentrations in Antiperspirant samples.

Concentration (mg/L)	Mean ± Std. Deviation	95% Confidence Interval for Mean	
		Lower Bound	Upper Bound
Lead	4.13± 0.92	3.31	4.96
Aluminum	261.67 ± 52.78	214.4	308.94

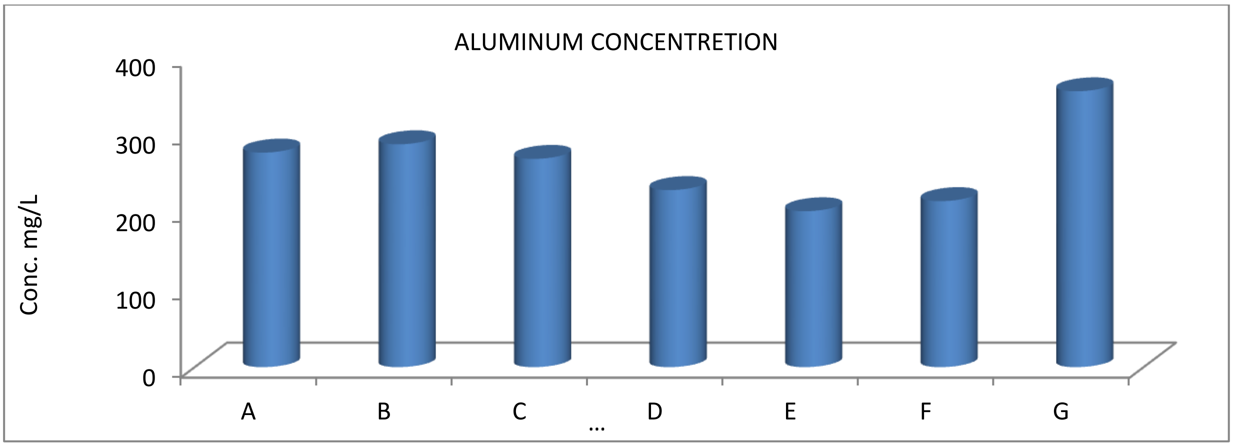

Figure 1: Aluminum content Sample A to G Studied in Antiperspirant

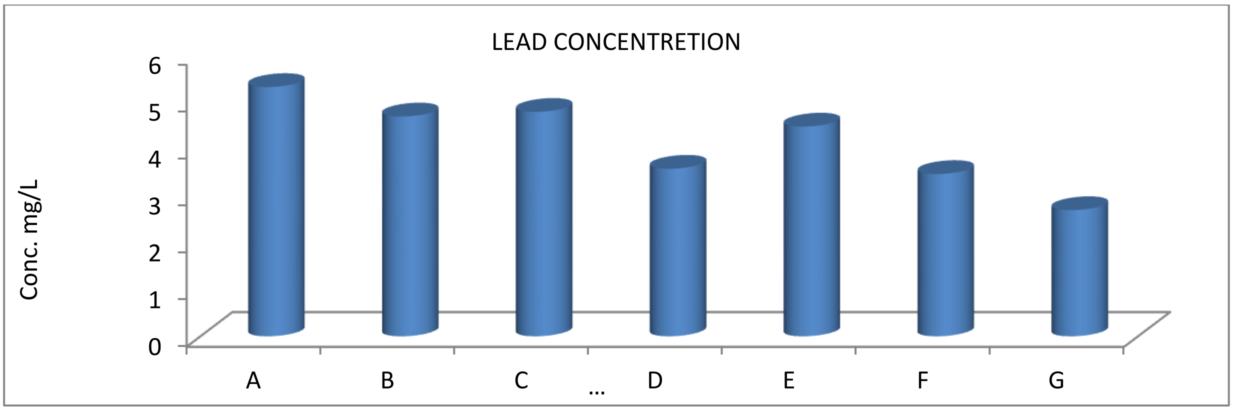

Figure 2: Lead content Sample A to G Studied in Antiperspirant

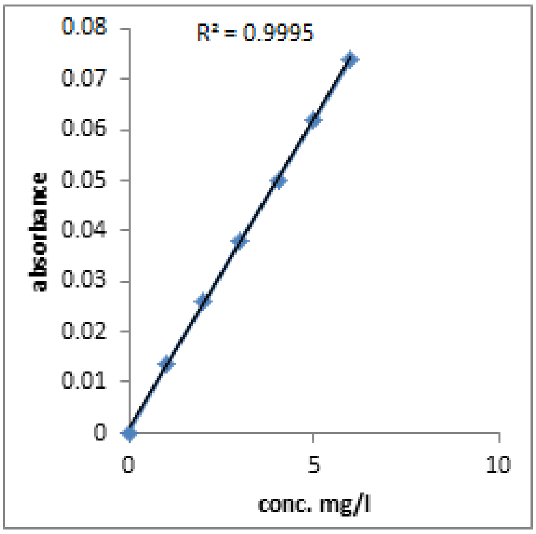

Figure 3: Calibration curve of Lead

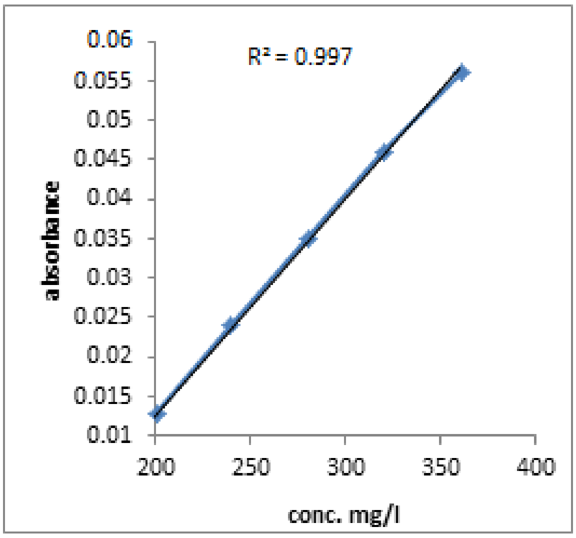

Figure4: Calibration curve of aluminum

DISCUSSION

The quantitative analysis of heavy metal content (Al, Pb) using the Atomic Absorption Spectrophotometer was performed on seven brands of Baghdad - city marketed antiperspirants. The concentrations of aluminum (Al) and lead (Pb) in the analyzed antiperspirant samples ranged from (201.2 – 355.4 mg / L) to (2.688 – 5.311 mg / L), as shown in Table 2 respectively.

The concentration of Lead (Pb) in the analyzed antiperspirant samples ranged from 2.688 to 5.311 mg / L. Lead is a dangerous metal and according to the US Food and Drug Administration (FDA) should not be used in antiperspirants. Lead is one of the four most responsible Heavy Metals for human health [13].

Aluminum concentrations ranged from 201.2-355.4 mg / L. High concentrations of Al in these products are due to the fact that the antiperspirant formulation uses a wide variety of aluminum salts. Such as, activated aluminum chloralhydrate (ACH) and activated aluminum zirconium chloralhydrate (AZCH) are essential ingredients in antiperspirants today. For some of the antiperspirant cosmetics tested, aluminum salt compounds were not reported as part of the ingredients, and these products were clearly classified as ''aluminum salt free'.' [14]

Furthermore, most countries control no guideline value for Al for these products, but aluminum chloralhydrate is limited by the US Food and Drug Administration (FDA) to 25 % w / v and aluminum zirconium chloride hydroxide complexes are limited to 20 % in cosmetics[14].

These products should not be used to treat broken, damaged or irritated skin, but current cultural practices may include pre-antiperspirant shaving, a skin abrasion method, loss of stratum corners and hair removal irritation, thereby negating the FDA clear warning. [15]

In addition, more research to determine the concentration of heavy metals in other antiperspirants brands in Baghdad city need to be performed to determine their safety.

Conclusion

This study is one of the few that characterizes ingredients in certain cosmetic products. We report the differences between the measured trace element concentrations and the steady-state concentrations of the products. Knowing the pattern of accumulation of these elements is vital to better understanding and comprehending the dangers of these elements.

Acknowledgement

The authors express their thanks to the staff of the Sawa Science Research Center for their cooperation with us in completing the research.

Declaration of interests

The authors declare no conflict of interests.

Funding: none

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