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Research Article

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Levels of Selected Heavy Metals in Aloe Vera Branded Herbal Creams Sold in the Kenyan Markets

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ABSTRACT

Exposure of heavy metals is one of the major health concerns in both developing and developed countries. Preference of herbal cosmetics (lotions, soaps and creams) is on the rise and this necessitates determination of their heavy metal levels. Five brands of creams in the Kenyan market made from herbal cosmetic, Aloe vera, were analysed for the heavy metals, Hg, Pb, Cd, Zn, Mn and Cr. Atomic Absorption Spectroscopy and Cold Vapour Atomic Absorption Spectroscopy were the analytical methods employed. The mean level (ppm) reported ranged as follows: Hg (0.04 ± 0.01-0.11 ± 0.01), Pb (0.03 ± 0.01-0.68 ± 0.14), Cd (0.02 ± 0.01-0.06 ± 0.01), Zn (0.11 ± 0.01-1.99 ± 0.01), Mn (0.02 ± 0.01-0.10 ± 0.01), and Cr (0.03 ± 0.01-0.08 ± 0.01). Aloe vera creams therefore expose users to heavy metals whose effects would be detrimental especially to the long term users.

Keywords: Aloe vera; Cosmetics; Creams; Heavy metals

INTRODUCTION

Cosmetics are widely used for routine care of skin, hair, nails and teeth [1]. Lotions, creams gels, oils, emulsions, face masks, make up powders, tinted bases, perfumes, toilet soaps, shower and bath preparations, depilatories, deodorants and antiperspirants, hair care products and shaving products [2]. Cosmetics can either be herbal, those of natural origin and are made of ingredients that are gentler and less likely to be harmful, or synthetic, those which are conventional and made of ingredients likely to be harmful [3]. Ingredients such as formaldehyde and formaldehyde releasing compounds, hydroquinone, parabens and phthalates which could be harmful to human body are used in the production skin cosmetics which are among the most commonly used [4]. *Aloe vera*, olive oil and neem being herbal cosmetics are more preferred because they mild, biodegradable and have low toxicity profile [5].

Aloe vera (*Aloe barbadensis* Miller) is a widely used plant mainly because of its medicinal nature. It plays a key role in skin repair, wound healing and also prevention of UV- light penetration. *Aloe vera* lotions, creams, soaps and shampoos are all available in the markets [6,7]. It is of importance to note that *Aloe vera* plant absorbs toxic heavy metals from the soil which could be a cause of their presence in the cosmetics [8]. Heavy metal toxicity can result to damage or reduced mental and central nervous function, lower energy levels and damage to blood composition, lungs, liver, kidneys and other vital organs [9]. Repeated long term contact with some of the heavy metals of their compounds may cause cancere, contact dermatisis and skin irritations which are caused by Cr, Ni and Co [9,10]. Heavy metal exposure, however, is increasing especially in less developed countries, a concern that calls for attention [11].

Heavy metals can be absorbed into the organism through the skin and can be detected in sweat, blood and urine within periods of between six hours to 45 days of skin application [10,12]. Moist skin particularly promotes absorption of water soluble toxic elements and their compounds into the body [10]. Continuous use of cosmetics may therefore result in an increase in the heavy metal levels beyond acceptable limits as set by WHO [1,12]. There

is therefore a need to investigate the possibility of the presence of heavy metals in cosmetics due to their harmful effects [1]. We report the evaluation of heavy metals in lotions sold in the Kenyan market that are made from *Aloe vera*.

MATERIALS AND METHODS

Equipment and Chemicals

A buck scientific Absorption spectrophotometer (model VGP-210) was used to measure the analytes. All chemicals, reagents and solvents used were of analytical grade and included cadmium, lead, zinc and manganese and standards of mercury and chromium were purchased from Fluka Chemie GmbH Chemical Company, inc. USA. Concentrated hydrochloric acid, concentrated nitric acid, hydrogen peroxide, sulphuric acid, stannous chloride, silica gel, potassium permanganate and potassium chromate (K2CrO4) were sourced from Thomas Baker Chemicals Ltd Mumbai, India.

Sample Collection

Five different brands (coded CRM1, CRM2, CRM3, CRM4 and CRM5) of *Aloe vera* creams (two batches of each brand) were sampled from major supermarkets in Nairobi County. A total of thirty samples were obtained.

Determination of Heavy Metals

Sample and blank digestions were done under standard procedure as per [13]. 1.000 gram of cream was accurately measured into a conical flask. 15 ml concentrated nitric acid was added followed by 5 ml 30% hydrogen peroxide and then 5ml concentrated hydrochloric acid. The flask was closed and left for 15 minutes to ensure complete reaction. The mixture was heated at 150°C until no more brown fumes were produced. The sample solution was then cooled and 20 ml of deionised water added. The solution was filtered through Whatman paper number 1 into a 50ml volumetric flask and diluted to volume with deionised water before aspiration into the instrument.

Measurement of levels of heavy metals was done using Flame Atomic Absorption Spectroscopy, FAAS, for Pb, Cd, Zn, Mn and Cr while Cold Vapour Atomic Absorption Spectroscopy, CV-AAS, was employed for Hg with settings as provided by the manufacturer's manual. The digested samples were aspirated in triplicates with regular intercepts of standards to maintain a check on the instrument stability. The analysis proceeded only when the results were within 10% of earlier readings.

RESULTS AND DISCUSSION

The findings are reported in Table 1.

Table 1: Mean levels (ppm) of heavy metals in different *Aloe vera* creams

Mean levels (ppm) in different brands (Mean ± SE; n=9)							
Parameter	**Batch**	**CRM1**	**CRM2**	**CRM3**	**CRM4**	**CRM5**	**p-value**
Hg	1	0.04 ± 0.01^{a}	0.05 ± 0.01^{ab}	0.07 ± 0.00^{a}	0.10 ± 0.01^{c}	0.09 ± 0.01^{c}	<0.001
	2	0.04 ± 0.01^{a}	0.06 ± 0.00^{a}	0.05 ± 0.01^{a}	0.09 ± 0.00^{b}	0.11 ± 0.01^{b}	0.002
p-value		0.673	0.609	0.18	0.491	0.261	
Pb	1	0.01 ± 0.01^{c}	0.37 ± 0.13^{ab}	0.33 ± 0.06^{ab}	0.34 ± 0.09^{ab}	0.68 ± 0.14^{b}	0.01
	2	0.31 ± 0.15^{ab}	0.29 ± 0.10^{ab}	0.16 ± 0.05^{ab}	0.40 ± 0.02^{b}	BLD	-
p-value		0.069	0.646	0.042	0.511	-	
Cd	1	BLD	BLD	0.03 ± 0.01^{a}	0.06 ± 0.01^{b}	0.03 ± 0.01^{a}	<0.001
	2	BLD	BLD	0.03 ± 0.01^{a}	0.02 ± 0.01^{b}	0.02 ± 0.01^{b}	<0.001
p-value		-	-	1	<0.001	1	
Zn	1	0.37 ± 0.01^{b}	0.57 ± 0.02^{c}	1.99 ± 0.01^{d}	0.37 ± 0.01^{b}	0.16 ± 0.01^{a}	<0.001
	2	0.45 ± 0.01^{c}	0.49 ± 0.01^{c}	1.87 ± 0.01^{d}	0.38 ± 0.01^{b}	0.11 ± 0.01^{a}	<0.001
p-value		<0.001	<0.001	<0.001	<0.001	<0.001	
Mn	1	0.07 ± 0.01^{a}	0.04 ± 0.01^{a}	0.06 ± 0.01^{a}	0.07 ± 0.02^{a}	0.10 ± 0.01^{b}	0.01
	2	0.08 ± 0.01^{b}	0.02 ± 0.01^{a}	0.03 ± 0.01^{a}	0.02 ± 0.01^{a}	0.07 ± 0.01^{b}	<0.001
p-value		0.38	0.033	<0.001	0.014	0.002	
Cr	1	BLD	BLD	0.04 ± 0.01^{a}	0.03 ± 0.01^{a}	0.06 ± 0.01^{b}	<0.001
	2	BLD	BLD	0.04 ± 0.01^{a}	0.08 ± 0.01^{c}	0.06 ± 0.01^{b}	<0.001
p-value		-	-	1	<0.001	0.868	

Mean values within the same row followed by the same letters are not significantly different (SNK, α=0.05); BLD- Below Limit of Detection

Mercury was detected in all Aloe vera branded cream samples. The mean levels ranged from 0.04 ± 0.01 to 0.11 ± 0.01 ppm. The levels were found to differ significantly ($p<0.05$) between the brands. The presence of Hg in the cosmetics can be explained as it is a common ingredient in cosmetics with its role being to lighten the skin [12,14]. The levels of Hg in the lotions, creams and soaps were all below the maximum WHO recommended limit of 1ppm [15]. In comparison to Hg levels found in Indian herbal cosmetic preparations (0.041 to 2.183 ppm), the present findings show lower levels but agree to the risks that could result to the use of these products since Hg has adverse effects if absorbed through the skin or otherwise [12].

In creams, lead was detected in all except CRM5 batch 2. The mean levels ranged from 0.03 ± 0.01 to 0.68 ± 0.14 ppm. The levels however were found to differ significantly between the brands ($p<0.05$). Lead has been found to be a common contaminant in various cosmetics [1]. The levels of lead in the lotions, creams and soaps, however, were below the WHO maximum recommended limits of 10 ppm [15]. While some of the values found in this study were lower than those reported in literature, some were higher [14,16]. Levels ranging from 0.40-1.40 ppm were reported in herbs[1] while much higher ranging from 1.470 to 33.1 ppm has also been recorded [14].

Zinc was found to be contained in all the *Aloe vera* branded creams analyzed. The mean levels ranged from 0.11 ± 0.01 to 1.99 ± 0.01 ppm. The levels differed significantly between the brands and also between batches ($p<0.05$) level of significance. To play a role as a sunscreen and also to whiten the skin, zinc oxide is used as an ingredient in cosmetics [17]. The levels of zinc as found in this study were lower than those reported in literature where zinc has been detected to levels as high as 56.57 ppm [14,16]. Manganese was also detected in all the creams with mean levels ranging from 0.02 ± 0.01 to 0.10 ± 0.01 ppm. The levels differed significantly between the brands and also between batches ($p<0.05$) level of significance. The presence of manganese in these cosmetics may be attributed to the Aloe vera plant which absorbs metal ions from the soil among them manganese [8]. The levels obtained were low compared to those recorded by which ranged from 65 to 717 ppm [16]. This may be due to compositional differences of products [14].

Cadmium was found to be contained in all the creams except in CRM1 and CRM2 which were both below the limit of detection. The mean levels of cadmium ranged from 0.02 ± 0.01 to 0.06 ± 0.01 ppm. The levels differed significantly between the brands and also between batches for CRM4 ($p<0.05$) level of significance. In cosmetics cadmium find usefulness due to its deep yellow to orange pigmentation. The levels were however below the maximum recommended limits of 10 ppm by WHO [15]. Low levels ranging from 0.10 to 0.46 ppm were also recorded by [16]. Chromium was detected in all the creams except in CRM1 and CRM2 whose concentration levels were below the limit of detection. The mean levels ranged from 0.03 ± 0.01 to 0.08 ± 0.01 ppm. The levels differed significantly between the brands and between batches in CRM4 ($p<0.05$) level of significance. The low levels recorded in this study are comparable to the levels recorded which ranged from 0.50 ppm to 2.70 ppm [18].

CONCLUSION

The presence of heavy metals in Aloe vera creams is evident from the results though the levels were below the maximum recommended limits by the WHO and KEBS. The findings however show need of concern for users of these cosmetic products since continuous use would be harmful to their health.

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