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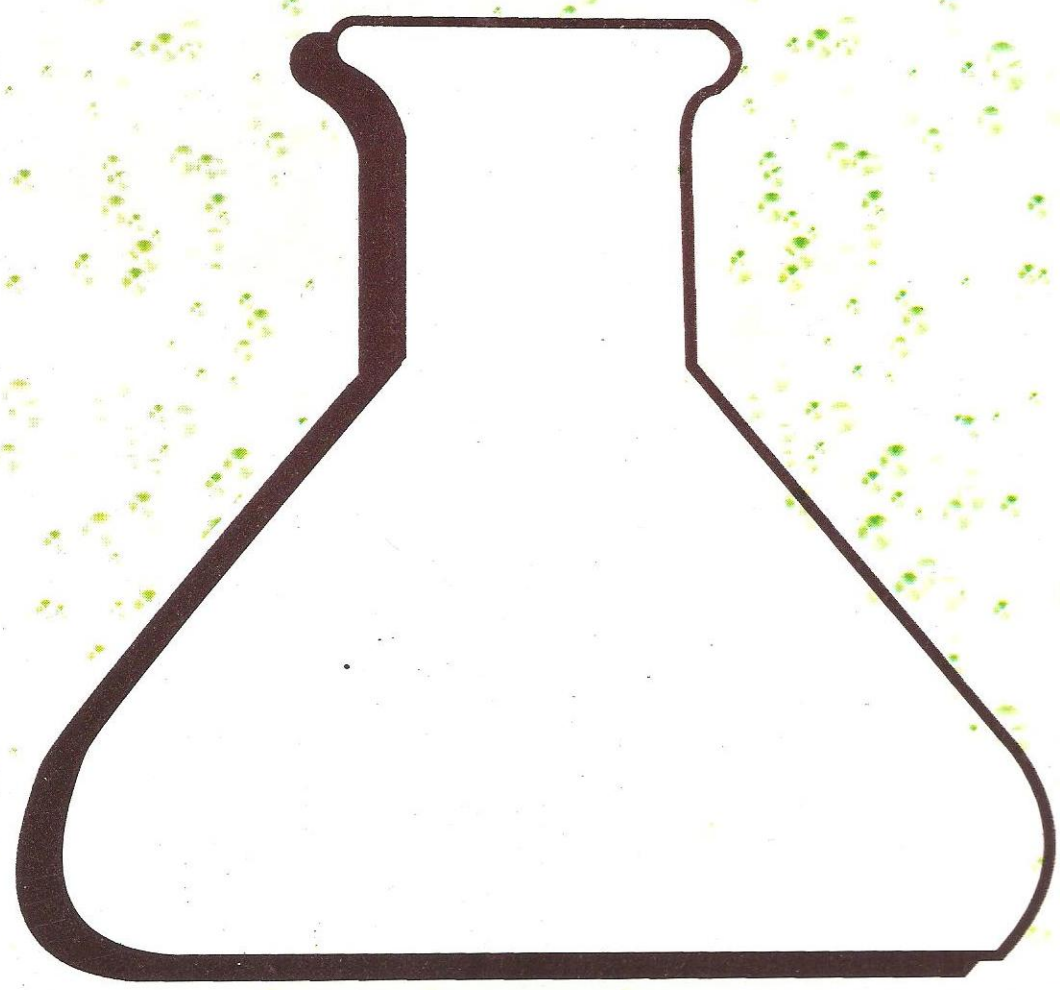

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Determination of Some Heavy Metals in Selected Beauty and African Black Soaps Commonly Used in Kano – Nigeria

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ABSTRACT

Several epidemiologic studies have investigated the potential carcinogenicity of human exposure to heavy metals from diverse sources but few or none was on African black and beauty soaps. Hence, this study examines the presence of some heavy metals in selected African black and beauty soaps commonly used in Kano- Nigeria, with a view to seeing whether solutions could be found in preventing or minimizing dermal infections/problems caused due to exposure to these metals. Different African black and beauty soap samples were purchased from retail outlets and open markets in Kano metropolis. The samples were oven-dried to constant weight at 80^{o}C for12hrs in the laboratory. 0.2g of the dried samples were digested with a mixture of H_2SO_4, HNO_3 and HCl (5:5:1 ratio) and analyzed for Ni, Cu, Fe, Co, Pb and Mn contents using air-acetylene flame atomic absorption spectrophotometer (Alpha 4) model by the standard calibration technique. From the study it has been noted that, the level of the metals are in the order Mn (0.532)> Fe (0.467)>Ni (0.432µg/g)>Pb (0.403µg/g)> Co (0.272µg/g)>Cu (0.241µg/g) in the beauty soaps, while in the African black soaps, the order is;Cu (0.852µg/g)> Ni (0.578µg/g)>Pb (0.481µg/g)> Fe (0.316µg/g)> Co (0.310µg/g) >Mn (0.250µg/g).There were no limit values for heavy metals in soaps by the regulations relating to consumer care products with which the values from this study could be compared with; hence it is difficult to ascertain if the values are high or low. But when the values are compared with the exposure limits of the metals in air as set out by EPA (1.5µg/L Pb, 1mg/m^{3}Ni, 0.1mg/L Co and 0.05µg/m^{3}Mn), the mean values of the metals Pb and Ni in both the Beauty and African Black Soaps are below the EPA limits while Co and Mn are above the limits.

Keywords: African Black Soap, Beauty Soap, Hazardous Substances, *Heavy Metals*

Introduction

Soap is an anionic surfactant used in conjunction with water for washing and cleaning, it plays an important role in people's lives, and it is widely used in everyday life that, it is hard to imagine living without it. .Different types of soaps are technically manufactured from animal or plant oils reacting with Lyle (strong solution of NaOH/KOH) to form glycerine and sodium/potassium salt of the fatty acid, a process called *saponification*(Paula, 2007).Black soap, which is a native to Western Africa for generations is prepared from natural ingredients such as plantain skins, banana leaves, palm oil, coconut oil and water, where the burnt plantain skin and banana leaves serve as the ashes, pap, yam or cassava flours are added to the mixture after the saponification process, to serve as additives and builders (Beetsch and Anza, 2013). In the process of soap manufacturing, there is no stage where heavy metal is added, it only gets in as a contaminant except if a heavy metal hydroxide is used and in that case the soap might not be used on skin but for other purposes. In US, soaps are generally exempted from the cosmetic provisions of the Federal Food, Drug and Cosmetic Act (the Act) and are often classified as consumer care product regulated by the Consumer Product Commission (Robert and Linda, 2010).

Heavy or toxic metals are trace metals with a density of at least five times that of water.Some may be important in the nutrition of plants, animals or humans (e.g. Zn, Cu, Mn, Cr, Ni, V, Se and Fe), while others (e.g. As, Pb, Cd and Hg)are not known to have positive nutritional effects(Spiegel, 2002).Recently Samara *et al*., (2009) have described heavy metals as those metals and semimetals with human or environmental toxicity. The bioaccumulation of these metals via ingestion, inhalation or absorption through the skin disrupt the immune, neurological,blood cardiovascular and endocrine functions of the body.High concentration exposure is not necessary in order to produce a state of toxicity in the body, most cases of heavy metals poisoning result from chronic low level exposure.

Several epidemiologic studies have investigated the potential carcinogenicity of human exposure to heavy metals from diverse sources such as air, food, water, soil ceramics, gasoline,

rubber toys, personal care products (cosmetics, mouthwash. toothpaste, shampoo, and hair care products etc. For instance, studies on:-the use of skin lightening creams containing hydroquinone, corticosteroid and mercury in Nigeria, revealed a prevalence of dermatological side effects with exogenous ochronosis as the commonest, Adebajo (2002),the use of underarm cosmetic as a possible cause of breast cancer(Darbre, 2003) and Talcum powders found to contain asbestiform and substantial amount of Ni, Co and Cr(Langer*et al*.,1976). Funtua and Oyewale, 1997; Ajayi*et al*., 2002 reported high levels of heavy metals in locally sourced eye make-ups. Nnorom*et al*. (2005), revealed the presence of Fe, Ni, Pb, Zn, Cr and Cdin eye liners, eye pencils and lipstick commonly used in Nigeria etc. but little is known on the exposure of human to heavy metals from the use of consumer care products such as soaps. Schwartz *et al*. (2004) and Ayenimo*et al*. (2010) determined the concentrations of Cd, Cr, Cu, Ag and Zn in personal care products(medicated and non-medicated soaps and creams).According to U.S. Agency for Toxic Substances and Disease Registry, fourout of the more than 20 heavy metals known, are of particular concern to human health: lead (Pb), cadmium (Cd), mercury(Hg) and inorganic arsenic (As). They are highly toxic and can cause damaging effects even at very low concentrations(ATSDR, 2000).The effect of heavy metal toxicity impaired the cognitive, motor and language skills.

The aim and objective of this study is to determine the presence of heavy metals in selected beauty and African black soaps commonly used in Kano metropolis, Nigeria to see whether solutions could be found in preventing or rather minimizing dermal infections/problems probably caused due to the use of these soaps contaminated by the metals.

Materials and Methods

Selected beauty and African black soap samples were purchased from retail outlets and open markets in Kano metropolis, Nigeria and coded A, B, C, A_1, B_2 and C_3. The samples were oven-dried to constant weight at 80^{o}C for12 hrs. 0.2g of the dried samples were digested with a mixture of 1.8M H_2SO_4, 0.8M HNO_3 and 0.6M HCl (5:5:1 ratio) and heated on a water bath until appearance of white fumes. After cooling,6cm^3 of 6M nitric acid was added, boiled for 10min. and filtered with Whatman No 4 filter paper into 100cm^3 volumetric flask and made up to mark with deionisedwater. These were subsequently analyzed for Co, Cu, Fe, Pb,Mnand Nicontents using air-acetylene flame atomic absorption spectrophotometer (Alpha 4) model by the standard calibration technique. The analytical accuracy was monitored with 10% insertion rate of sample triplicates, blanks and spikes. By the applied atomic spectroscopy method, an acceptable detection limit of the elements studied was achieved and the reliability of the results was statistically satisfactory.

Results and Discussion

Table 1 shows the concentrations of the metals determined in the selected soap samples. The mean level of the metals are in the order Mn> Fe>Ni>Pb> Co>Cu in the beauty soaps, while in the African black soaps, the order is;Cu > Ni >Pb> Fe > Co>Mn. Pairwise comparisons(Appendixes I & II) in both the Beauty and African black soaps shows that there is no significant difference in the concentration of the metals ($Fc > F\alpha,\mu_1\mu_2$ i.e. $28.195 > F_{0.05,1,77} = 4.00$) in both the samples. On comparing the mean concentrations of the two main samples, the Co, Cu, Pb and Ni contents in the African Black Soaps are higher than that in the Beauty soaps, while the Fe and Mn contents in the Beauty soaps are higher than that in the African black soaps. There is no report from the literature to our knowledge on the analysis of heavy metals in Beauty or African Black Soaps; hence data obtained from this study is only compared to similar studies elsewhere (like medicated soaps, detergents and cosmetics). The mean values of Cu in this study (0.241 and 0.852µg/g) for Beauty soap and African black soap respectively) when compared to that obtained by Ayenimo*et al*. (2009), in medicated and non medicated soaps (0.596 and 0.264 ppm) respectively, no much significant difference was found; butboth appear to be low, when compared with the Cu value (2.61µg/g) obtained in the Irish detergents byCaitrona and Nick (2002).Copper toxicity has been characterized in patients with Wilson's disease and at high levels it results in anemia, liver, kidney, intestinal irritation and copper poisoning (Samara *et al*., 2009).

Similarly, the Co content (3.03µg/g) from the detergents is also higher than the Co contents of this study. Acute toxicity of cobalt may be observed as effects on the lungs, including asthma, pneumonia and wheezing (Samara *et al*., 2009).

The range of Ni contents in this study (ND – 1.350µg/g) was also compared with those obtained from the analysis of liquid and powdered detergents (0.4 – 0.717mg/dm^3) by Ebner*et al*., (1978) and that from facial cosmetics (4.4 – 22.8µg/g) by Nnorom*et al*.,(2005) respectively, which appear to be in the moderate level. Symptoms of nickel toxicity include skin rash, when things containing it are in direct contact with the skin, it may contribute to asthma, chronic bronchitis, brain and liver swelling, thyroid malfunction and interference with enzymatic reactions. High level exposure to nickel, lead and cobalt by being absorbed through the skin can act as poisons affecting the skin, liver, kidney, brain, bone, heart (Moyer et al., 1999). The values for iron determined in this study (0.064 – 0.634µg/g) was found to be very low when compared with that

obtained from facial cosmetics (17.0 – 632.0 µg/g) analyzed by Nnorom*et al*., (2005). Iron is not of toxicological significance, but at high level, it has been found in association with heart disease and cancer. Iron compounds have an established role as colorants in many cosmetic products; it exhibits a functional importance as a trace metal in the normal growth and functional maturation of the skin (Lansdown, 2001). There is much significant difference between the Pb values obtained in this study (0.111-1.000µg/g) as compared to that obtained from Saudi Arabian henna (1.29-16.48µg/g) analyzed by Al-Saleh and Coate, (1995) and to that obtained by Nnorom*et al*., (2005) from facial cosmetics (105.5-131.0µg/g). Exposure to lead by dermal contact can contribute to significant toxicity (Ali *et al*., 1978). According to ASEAN Cosmetic Documents, (2003) As, Cd, Pb and Hg are prohibited in the composition of cosmetic products.

High dose exposure to manganese brings about clinical intoxication called "manganism", with extra pyramidal signs and psychiatric features (hallucination). Manganese can be accumulated in the CNS and cause long term effects (Lucchini*et al*.,2009). The Mn value in this study (ND – 1.250µg/g) was only compared with the value obtained by Bocca*et al*., (2007) from the analysis of body creams (Mn 59.9ng/g).

There were no limit values for heavy metals in soaps by the regulations relating to consumer care products with which the values from this study could be compared with; hence it is difficult to ascertain if the values are high or low. But when the values are compared with the exposure limits of the metals in air as set out by EPA (1.5µg/L Pb, 1mg/m^{3}Ni, 0.1mg/L Co and 0.05µg/m^{3}Mn), the mean values of the metals Pb and Ni in both the Beauty and African Black soaps are below the limits while Co and Mn are above the limits.

Table 1: Concentration of the metals (µg/g) analyzed in the soap samples

Metals	Beauty Soaps				African Black Soaps			
	A	B	C	Mean	A_1	B_1	C_1	Mean
Co	0.429	0.202	0.185	0.727	0.143	0.143	0.643	0.310
Cu	0.228	0.264	0.231	0.241	0.944	0.889	0.722	0.852
Fe	0.641	0.234	0.525	0.467	0.385	0.500	0.064	0.316
Pb	0.778	0.295	0.135	0.403	0.111	1.000	0.333	0.481
Mn	1.250	0.145	0.173	0.523	0.250	0.500	ND	0.250
Ni	0.769	0.345	0.182	0.432	ND	1.350	0.385	0.578

Key: ND – Not detected

Conclusion

The study revealed the presence of six heavy metals; Co, Cu, Fe, Mn, Ni andPb which is supposed to be absent totally. It is not indicated in the list of ingredients of the soaps that they contain these metals, but they may likely be present as contaminants during the manufacturing process. The greatest risk for harm of these metals, even with only minute exposure, is to infants, young children and pregnant women who make use of these soaps. It is suggested that the stake holders involved in the monitoring of consumer products in Nigeria such as the NAFDAC, SON e. t. c should scrutinize consumer products properly before releasing them to the market.

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Appendix I: The results were analyzed using pairwise comparisons and univariate analysis of variance (ANOVA).

Between Subject Factors

		Value Label	N
Soaps	1	Beauty soap	6
	2	African Black soap	6
Metals	1	Co	2
		Cu	2
	2	Fe	2
	3	Pb	2
	4	Mn	2
	5	Ni	2
	6		

Key: N – Number of observation

Appendix II: Test between Subject Effects

Dependent Variable Concentrations

Source	Type III Sum of Squares	Df	Mean Square	F	Sig
Corrected model	.090[a]	6	.015	.327	.897
Intercept	2.146	1	2.146	46.572	.001
SOAPS	.013	1	.013	.283	.615
Metal	.077	5	.015	.335	.872
Error	.230	5	.046		
Total	2.467	12			
Corrected total	.321	11			

Key: Df– degree of freedom
F - ANOVA
Sig - significance