Potentially Toxic Metals Exposure From Body Creams Sold In Lagos, Nigeria

Onwordi C. Theresa[1*], Orizu C. Onebunne[1], Wusu A. Dorcas[2], Ogunwande I. Ajani[1]

1. Department of Chemistry, Lagos State University, P.M.B. 001, LASU Post Office, Ojo, Lagos, Nigeria
2. Department of Biochemistry, Lagos State University, P.M.B. 001, LASU Post Office, Ojo, Lagos, Nigeria

[*] Address for Correspondence: teresachinedu@yahoo.co.uk; chiedu.onwordi@lasunigeria.org

ABSTRACT: The present study analysed various level of cadmium, cobalt, copper, nickel and lead in 15 samples of commercial body cream classified into moisturizer and skin-lightening in Nigeria. The selected body cream were digested with Nitric /Perchloric acid (5:1) and the level of the metals were determined using atomic absorption spectrophotometry (AAS). Pb, Cr, and Co was not detected in the body creams. The level of Ni was found to be higher in the skin-lightening with value 5.09 ± 2.02 µg/g and lower in moisturizer at 3.61±1.74 µg/g level. Copper ranged from 2.27-17.85 µg/g with moisturizer having the higher value 17.85 ± 3.46 µg/g and skin-lightening with lowest mean value of 2.27 ± 0.06 µg/g. It is generally observed that the skin-lightening creams have the lower value of Cu compared to the moisturizer. The level of Cu in the various body cream analysed is lower when compared with results earlier obtained from personal care products' manufactured in Nigeria whereas the content of Ni is higher. It is worthy to note that the levels of the metals are higher compared with reports from other parts of the world.. Statically at 95% confidence level there is a significant difference between the Cu metal in the moisturizers and skin-lightening creams while there is no significant difference between Ni in classes of cream studied. This study has revealed that continuous use of these body creams could result in an increase in the Potentially toxic metal levels in human body beyond acceptable limits.

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1 Introduction

Metals are well-recognized causes of allergic contact dermatitis (ACD) both at occupational and environmental level. Various research aimed at exploring occupational, clinical, toxicological and environmental exposure of trace metals along with their impact on human health (Ashraf et al, 1995a; Hoffmann et aI. 2000; MacPherson and Bacso 2000; Seifert et al. 2000; Iyengar and Rapp 2001;Vishwanathan et al.2002) have been carried out. The key metals involved in this pathology are, in order of incidence, Ni, Co, and Cr, either taken alone or in their association (Fowler 1998; Kanerva et al. 2000; Liden et al. 2006). Basically, Ni is considered the primary source of causing ACD with a prevalence of 20% in females and 1% in males (Josefson et al. 2006). This is mainly due to the free Ni ions released from objects containing Ni – which daily came in contact with the skin (i.e., piercing, jewels, buttons, clasps, coins, etc.) – corroded by the human sweat. In order to reduce the Ni ACD, the release of this metal from various objects has been regulated by the European Council Directive communities (1994). Differently from Ni, Co and Cr ACD were mainly caused by occupational exposures. Human exposures to these xenobiotics from diverse sources have been widely studied. These usually involve industrial and medical wastes (Dorigo et al. 2004), pesticide, petroleum by-products (Mowat and Bundy 2001), beverages (Maduabuchi et al. 2008), snacks and confectioneries (Narin et al. 2005; Gopalani et al. 2007) and foods (Mahaffey et al. 1975). Allergy to cobalt chloride was associated to workers employed

in construction, electronic and electroplating industries or exposed to glass, ceramics, and paints (Fowler 1998; Kanerva et al. 2000; Liden et al. 2006). In addition, the presence of Co in Ni-alloys can cause skin sensitization when this material is used to produce jewels (Hindsen et al. 2005).As regards Cr, people working as photograph developer or with ceramics, constructions and tannery industry, or those dressing tanned leather might all develop ACD to this metal (Motolese et al. 1993; Barr'e Hansen et al . 2006) Another important way of skin exposure to metals is the use of cosmetic products such as moisturizing creams, lipsticks, eye cosmetics, shampoos, cleansing milk, henna dye, etc. In these make-up products, metals are present as impurities due to the particular sample formulation or the release from metallic devices used during their manufacture. In fact, the European Council Directive (1976) and further revisions banned the use of Cd, Co, Cr, Ni, and Pb as metallic ions or salts in the preparation of cosmetic formulations (European Council Directive , 1976)

Cadmium, lead, mercury, arsenic, copper, zinc, and chromium are metals of considerable health environmental concern. They have been the subject of major studies as a result of toxicity associated with them in the environment (As Mohanna and Subromanyam 2001; Chou et al. 2002; Ayejuyo et al.2005).The toxic effects of heavy metals on human health and ecosystem are documented (Turkdogan et al. 2003; Gopalani et al. 2007; Kawata et al. 2007; Liu et al. 2009). At low concentration, some of these elements cause internal body organ damage in animals and humans. Various forms of mammalian cancers, respiratory diseases, organ failures and retardation of the intellect had been traced to metal poisoning (Brams et al. 1989; Davydova 1999; Hall 2002). Cadmium causes kidney damage and bone degradation because it affects calcium metabolism (Waalkes 1991). Nickel is a ubiquitous metal frequently responsible for allergic skin reactions and has been reported to be one of the most common causes of allergic contact dermatitis,as reflected by positive dermal patch tests (Clarkson,1988; Kitaurah et al. 2003; Cavani 2005;)

Zinc has been reported to cause the same signs of illness as does lead, and can easily be mistakenly diagnosed as lead poisoning (McCluggage 1991). Although individual metals exhibit specific signs of their toxicity, the following have been reported as general signs associated with cadmium, copper and zinc poisoning: gastrointestinal disorders, diarrhoea, stomatitis, tremor, ataxia, paralysis, vomiting and convulsion, depression, and pneumonia when vapours and fumes are inhaled (McCluggage 1991).

Information on the exposure to metal toxins through dermal contact is scanty, and few data exists on the personal care products' concentration of heavy metals in Nigeria. In view of this, the present study intended to determine the levels of Potentially toxic metals (cadmium, cobalt, copper, nickel and lead) from body cream basically moisturizers and skin-lightening (toning/bleaching) creams. The data generated can hence be used to evaluate and characterise sources of human and environmental exposure to Potentially toxic metals (PTM).

2 Materials and Method

Samples of commonly used body cream were purchased from some local stores in Lagos, Nigeria. The samples include moisturizers and skin-lightening(Toning/Bleaching) creams (Table 1). The items were transferred to the laboratory for analysis.1g of sample was wet digested in a porcelain/evaporating dish with a 5:1 mixture of Analar grade Nitric acid and Perchloric acid (Bocca et al. 2007). The digest was evaporated to almost dryness and then made up with distilled water to 50 mL. The sample solutions were subsequently analysed for Cd, Co, Cu, Ni and Pb using a flame atomic absorption spectrophotometer.

Each sample was analysed in triplicate, and reagent blank determination was performed to ascertain that no impurity was introduced during the digestion procedure.

3 Results and Discussion

Potentially toxic metal exposure from various types of body creams have been overlooked. The contents of PTM in the investigated samples as a mean of triplicate determination are described in Table 2-3.Figs 1-3 show the level of Ni/Cu in the samples.

All the body cream products in this study were found to contain substantial levels of copper, nickel and one of the moisturizer contained cobalt and cadmium. The nickel ranged from 1.82- 8.43 µg/g as shown in table 2&3 with TC in fig 2 having the highest mean value of 8.43 ± 0.14 µg/g and MA

in fig 1 with lowest mean value of 1.82 ± 0.06 µg/g. The mean concentration of Ni as represented in fig 3 in the skin lightening cream is 5.09 ± 2.02 µg/g compared to that of moisturizer with mean value of 3.61 ± 1.74 µg/g . The nickel content of the body cream investigated are quite higher compared with the results reported by (Bocca et al. 2007) on levels of nickel and other potential allergenic metals in Ni-tested commercial body cream. It has been stated that Ni actually represents the main cause of contact dermatitis, minimal amounts of other toxic metals can also trigger a pre-existing allergy. Nickel dermatitis produces erythema, eczema and lichenification of the hands and other areas of the skin that contact nickel. Initial sensitisation to nickel is believed to result from dermal contact but recurring flares of eczema, particularly of the hands, may be triggered by ingestion. In fact, reactions to Ni were not isolated but associated to Cr, Co, and Pd sensitivity (Basketter et al. 1993; Santucci et al.2000; Basketter et al.2003; Hindsen et al. 2005). The abundance of nickel in these products is in this order: bleaching cream> toning cream > moisturizer. The study revealed that the maximum content (7.35 ± 0.03 µg/g) of nickel in the body cream products under study is lower than those obtained by Nnorom et al. (2005) for eyeliners (9.2 ± 4. lµg/g), eye pencils (13.4 ± 5.8µg/g) and lipsticks (14.6 ± 6.3 µg/g).

Copper ranged from 2.27-17.85 µg/g as shown in (Tables 2 & 3) with MB in (fig 1) having the highest mean value of 17.85 ± 0.09 µg/g and TA with lowest mean value of 2.27 ± 0.06 µg/g (fig 2). The ranged for toning/bleaching cream is 2.27-4.27. The mean concentration of Cu (fig 3) in moisturizers is 12.58 ± 3.46 µg/g compared to that of the skin lightening cream with mean value of 3.22 ± 0.73 µg/g . The level of copper in the cream analysed is in the order of moisturizer> bleaching cream> toning cream. The level of Cu in the cream analysed regardless of the type is greater than the work reported by (Ayenimo et al.,2009) in heavy metal exposure from personal care products for medicated cream (0.571–0.933 µg/g) , Non- medicated cream (1.829–6.847 µg/g). Cu compound can be used as biocides in medicated cream and this may be responsible for the high values obtained in this study. The effects of copper are manifesting at low concentrations (http://www.lenntech.com/periodicchart-elements/Cu-en.htm). The present study revealed that the investigated body creams could serve as significant sources of human exposure to Cu through dermal contact. Exposure to copper compound dusts can cause dermatitis, discolouring of the skin, and irritation of the nose and throat. Chronic exposure to copper can produce numerous physiological and behavioural disturbances, which include brain damage and progressive demyelination, psychiatric disturbances– depression, suicidal tendencies and aggressive behaviour– haemolytic anaemia, cirrhosis of the liver, motor dysfunction and corneal opacities (U.S. EPA 1987; ATSDR 1990a; Goyer 1991). Some patients may also experience poor coordination, tremors, disturbed gait, muscle rigidity, and myocardial infarction (ATSDR 1990a).Statically at 95% confidence level there is a significant difference between the Cu metal in the moisturizers and skin-lightening creams while there is no significant difference between Ni in classes of cream studied.

The present study has showed that the use of various classes of body creams can expose users to significant levels of Potentially toxic metals. Actually, exposure assessment involves three phases: sources of pollutants, concentrations of pollutants and doses of pollutants absorbed into the body using biomarkers like blood, skin and urine.

4 Conclusion

This study has shown that there is higher level of Cu in the moisturizer creams compared with the skin lightening creams. Moisturizer creams are the most commonly use body cream. Hence continuous use of these body creams could result in an increase in the trace metal levels in human body beyond acceptable limits. Efforts should be made at enlightening the users and the general public on the dangers involved.

Table 1: Classes of studied Body Cream

Class	Sample name	Legend	NAFDAC Reg. No
Moisturizer (n=5)	Moisture plus Tura	MA	02-0726
	Cocoa Butter	MB	02-1895
	Venus moisturising	MC	02-0898
	Pear moisturising	MD	02-1185
	Lux body cream	ME	02-3689
Toning Cream (n=5)	Fade cream	TA	NS
	Beautiful Skin tone	TB	NS
	Venus Skin toning	TC	02-1201
	Body Treat	TD	02-4560
	New Active plus Tura	TE	02-1993
Bleaching Cream (n=5)	Bio claire	BA	02-1770
	Body white	BB	NS
	Peau Claire	BC	02-1445/N
	Neutrotone white moon	BD	04-7403
	Diva Maxima (maxitone)	BE	NS

NAFDAC- National Agency for Food Drugs, Administration and Control, Nigeria

NS-not stated

Table 2: Heavy metal concentration and standard deviation (µg/g) in moisturing cream

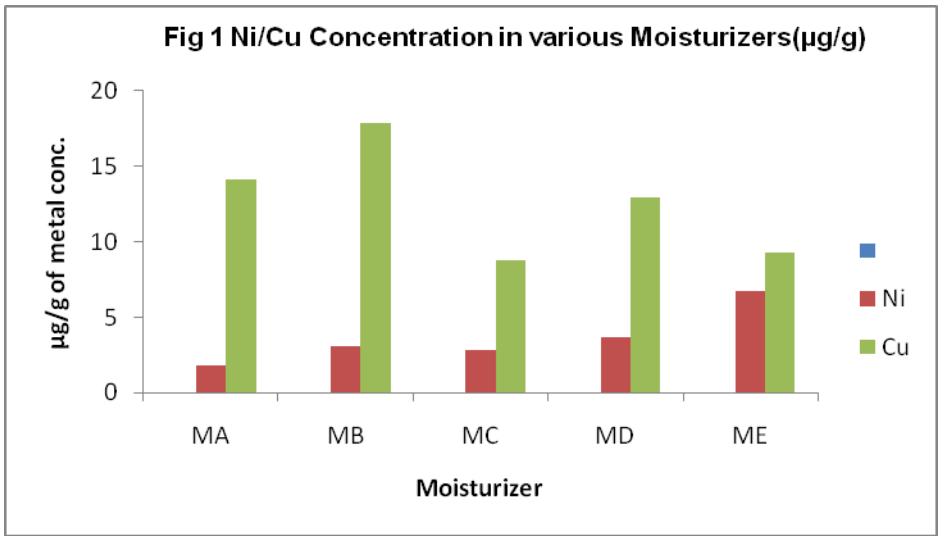
Sample code	Ni	Cu	Co	Cd	Pb
MA	1.82 ± 0.06	14.10 ± 0.39	ND	1.33 ± 0.31	ND
MB	3.10 ± 0.05	17.85± 0.09	ND	ND	ND
MC	2.78 ±0.60	8.80 ± 0.10	1.00 ± 0.0	ND	ND
MD	3.62 ± 0.10	12.92 ± 0.06	ND	ND	ND
ME	6.72 ± 0.10	9.25 ± 0.10	ND	0.18 ± 0.03	ND

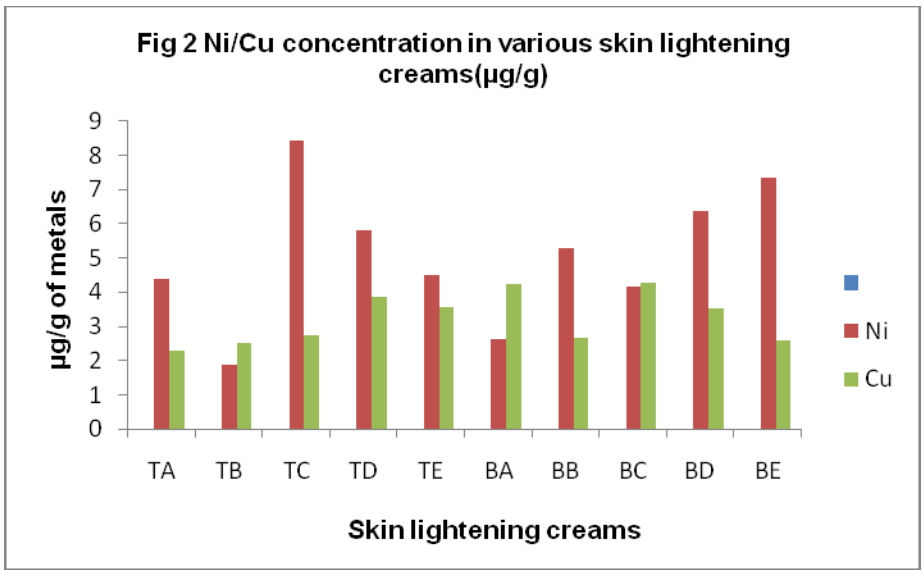
Table3: Heavy metal concentration and standard deviation (µg/g) in Toning /bleaching cream

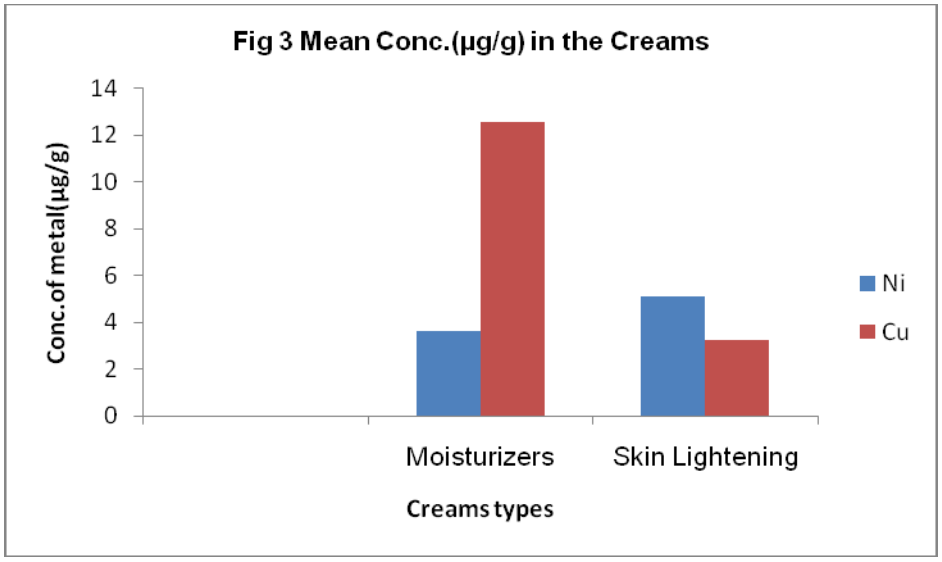
Sample code	Ni	Cu
TA	4.38 ±0.08	2.27 ±0.06
TB	1.88 ± 0.29	2.53 ± 0.23
TC	8.43± 0.14	2.73 ± 0.10
TD	5.82 ± 0.19	3.87 ± 0.14
TE	4.50 ± 0.10	3.55 ± 0.05
BA	2.63 ± 0.28	4.22 ±0.16
BB	5.30 ± 0.05	2.68 ± 0.16
BC	4.17 ± 2.02	4.27 ± 0.12
BD	6.38 ± 0.58	3.53 ± 0.10
BE	7.35 ± 0.03	2.58 ± 0.13

Note : Co, Cd and Pb were not dectected

ND- not dectected







References

[1] Ashraf W, Jaffar M, Mohammad, DComparison of trace metal levels in the hair of Pakistan urban and rural adult male population. Int. J. Environ. Studies.1995a; 47:63–68.

[2] Hoffmann K, Becker K, Friedrich C, Helm D, Krause C, Seifert B. (The German Environmental Survey 1990/1992 (GerES II): cadmium in blood, urine and hair of adults and children. J. Expo. Anal. Environ. Epidemiol. 2000; 10(2):126–135.

[3] MacPherson A Bacso J Relationship of hair calcium concentration to incidence of coronary heart disease. Sci. Total. Environ. 2000;255(1–3):11–19.

[4] Seifert B, Becker K, Helm D, Krause C , Schulz C, Seiwert M. The German Environmental Survey 1990/1992 (GerES II): reference concentrations of selected environmental pollutants in blood, urine, hair, house dust, drinking water and indoor air. J. Expo. Anal. Environ. Epidemiol. 2000;10(6 Part 1): 552–565

[5] Iyengar, G.V. and Rapp, A, 'Human placenta as a 'dual' biomarker for monitoring fetal and maternal environment with special reference to potentially toxic trace elements Part 1: Physiology, function and sampling of placenta for elemental characterization. Sci. Total. Environ..2001 ;280(1–3): 195–206.

[6] Vishwanathan, H, Hema A , Deepa E, Usha Rani MV. Trace metal concentration in scalp hair of occupationally exposed autodrivers. Environ. Monit. Asses. 2002; 7: 149–154.

[7] Fowler JF. Occupational dermatology Curr. Probl. Derm. 1998);10 *:* 213–244.

[8] Kanerva L; Jolanki R; Estlander T; Alanko K; Savela A Incidence rates of occupational allergic contact dermatitis caused by metals**.** American Journal of Contact Dermatitis. 2000;11(3):155-160.

[9] Lidèn, *C*.; Bruze, M.; Menné, T. In: Frosch,. P.J.; Menné, *T*.; Lepoittevin, *J*.-*P* , Eds.; Textbook of Contact Dermatitis,*4th ed* Springer-Verlag*:* Berlin, 2006, *pp*. *537-568*.

[10] Josefson A, Farm G, Stymne B , Meding B). Nickel allergy and hand eczema a 20-year follow up. Contact Dermatitis .2006; 55:286–290.

[11] Directive 94/27/EC of the European Parliament and of the Council of 30 June 1994. Official Journal of the European Communities, L 188, 22 July 1994, 1–2.

[12] Dorigo U, Bourrain X, Berard A, Leboulanger C Seasonal changes in the sensitivity of river microalgae to atrazine and isoproturon along a contamination gradient. Sci Tot Environ 2004; 318:101–114.

[13] Maduabuchi JMU, Nzegwu CN, Adigba EO, Oragwu CI, Agbo FN, Agbata CA, Ani GC, Orisakwe OE Iron, manganese and nickel exposure from beverages in Nigeria: a public health concern? J Health Sci. 2008; 54(2):335–338.

[14] Narin I, Tuzen M, Sari H, Soylak M. Heavy metal content of potato and corn chips from Turkey. Bull Environ Contam Toxicol .2005;74:1072–1077

[15] Gopalani M, Shahare M, Ramteke DS, Wate SR Heavy metal content of potato chips and biscuits from Nagpur city, India. Bull Environ Contam Toxicol .2007;79:384–387.

[16] Mahaffey KR, Corneliussen PE, Jelinek CF, Fiorino JA Heavy metal exposure from foods. Environ Health Perspect 1975; 12:63–69.

[17] Hindsen, *M*., *Persson*, *L*. and *Gruvberger*, *B*. Allergic *contact dermatitis* from cobalt in jewellery Contact Dermatitis *2005*; 53 (*6*): *350–351*.

[18] Motolese A, Truzzi M, Giannini A, Seidenari S. Contact dermatitis and contact sensitization among enamellers and decorators in the ceramics industry. Contact Dermatitis 1993; 28(2):59-62.

[19] Barré Hansen M, Menné T, Duus Johansen J. Cr(III) reactivity and foot dermatitis in Cr(VI) positive patients, Contact Dermatitis 2006; 54:140-144.

[20] Directive 76/768/EEC of the Council of 27 July 1976. Official Journal of the European Communities, L 262, 27 September 1976, 169–200.

[21] As As Mohanna MV, Subromanyam SY Flux of heavy metal accumulation in various organs of crab.Environ Int 2001;27:321-326.

[22] Chou CL, Paon LA,Moftatt JD, Zwicker B. Copper contamination and chromium,silver and zinc concentrations in the digesrive glands of American lobster (Homarus americanus) from the Inner Bay of fundy atlantic canada. Bull environ Contam Toxicol 2002; 65: 470-477. Doi: 10.1007/s001280000148.

[23] Ayejuyo OO, Raimi OG, Moisili OR Determination of trace metals in Silver Cat Fish (Chryssichthys nigrodigitatus), associated water and soil sediment from Beach line Fish Ponds. Pak J Sci Ind Res 2005; 48(1): 39-41

[24] Turkdogan MK, Kilicel F, Kara K, Tuncer L, Uygan I. Heavy metals in soil, vegetables and fruits in the endemic upper gastrointestinal cancer region of Turkey. Environ Toxicol Pharmacol 2003;13(3):175–179

[25] Kawata K, Yokoo H, Shimazaki R, Okabe S. Classification of heavy metal toxicity by human DNA microarray analysis. Environ Sci Technol 2007; 41:3769–3774

[26] Liu H, Chen L P, Ai YW, Yang X, Yu YH, Zuo YB, Fu GY. Heavy metal contamination in soil alongside mountain railway in Sichuan, China. Environ Monit Assess 2009;152:25–33

[27] Brams E, Williams A, Weatherspoon L Biological monitoring of an agricultural food chain: soil cadmium and lead in ruminant tissue. J Environ Qual 1989;18:317–323

[28] Davydova SL Dangerous lead pollution in Russia. Russs J Org Chem 1999 ;35(1):160–163
[29] Hall AH Chronic arsenic poisoning. Toxicol Lett 2002;128(1– 3):69–72
[30] Waalkes MP Cadmium and human health. Health Environ Digest 1991;5(4):1–3
[31] Clarkso n TW. Biological Monitoring of Toxic Metals; Plenum Press: New York, 1988 pp 265-282,
[32] Kitaura H, Nakao N, Yos Hida N, Yamada T..Induced sensitization to nickel in guinea pigs immunized with mycobacteria by injection of purified protein derivative with nickel. New Microbiol. 2003;26(1): 101
[33] Cavani A. Breaking tolerance to nickel. Toxicology 2005;209 (2): 119,
[34] McCluggage D Heavy metal poisoning, NCS magazine, published by the bird hospital, CO, USA. 1991 (www.cockaties.org/ articles/diseases/metals.html)
[35] Bocca B , Forte G , Petrucci F, Cristaudo A Levels of nickel and other potentially allergenic metals in Ni-tested commercial body creams. Journal of Pharmaceutical and Biomedical Analysis 2007;44: 1197–1202
[36] Basketter DA, Briatico-Vangosa G, Kaesner W,. Lally C, Bontinck WJ..Nickel, cobalt and chromium in consumer products :a rolein allergic . Contact Dermat. 1993; 28: 15–25.
[37] Santucci B, Valenzano C, de Rocco M,Cristaudo APlatinum in the environment: frequency of reactions to platinum-group elements in patients with dermatitis and urticaria Contact Dermat. 2000; 43(6): 333–338.
[38] Basketter DA,. Angelini G, Ingber A,. Kern PS, Menn´e T, Nickel,chromium and cobalt in consumer products,revisiting safe levels in the new millennium. Contact Dermat. 2003;49 :1–7.
[39] Nnorom ,IC, Igwe JC, Oji-Nnorom CG. Trace metal contents of facial (make-up) cosmetics commonly used in Nigeria. Afr. J Biotechnol 2005; 4(10):1133-1138
[40] Ayenomo, JG, Yusuf, AM, Adekunle, AS, Makinde, OW Heavy metal Exposure from Personal care Products.Bull Environ Contam Toxicol 2009;84(1): 8-14
[41] U.S. EPA Drinking water criteria document for copper. Prepared by the office of health and environmental assessment, environmental criteria and assessment office, cincinnati, OH, for the office of drinking water, Washington, DC. ECAO-CIN-417. 1987
[42] ATSDR (Agency for Toxic Substances and Disease Registry. Toxicological profile for copper. Prepared by syracuse research corporation for ATSDR, U.S. public health service under Contract 88-0608-2. ATSDR/TP-90-08 1990a.
[43] Goyer RA Toxic effects of metals. In: Amdur MO, Doull J, Klaasen CD (eds) Casarett and Doull's toxicology, 4th edn. Pergamon Press, New York, NY, 1991;pp 653–655

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