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Heavy Metals Concentrations in Mobile Phone Recharge Cards in Port Harcourt Nigeria

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A B S T R A C T

The concentrations of heavy metals Cu, Ag, Cr, Ni, Cd and Pb in mobile phone recharge scratch cards were determined using Atomic Absorption Spectrophotometer by GBC Avatar 2.02. The results showed metal concentrations in the range of 11.05 – 17.45mg/kg Cu, 0.5 – 1.71mg/kg Ag, 3.04 – 4.7mg/kg Cr, 2.01 - 6.11mg/kg Ni, 1.12 – 1.82mg/kg Cd and 4.98 – 12.04mg/kg Pb. The concentrations of metals were found to be in the order Cu > Pb > Ni > Cr > Cd > Ag. The concentrations of Cr, Cu, Ag and Cd exceeded recommended limits. The results showed that the group of cards labeled ESC and EUC had higher metal content than GSC and GUC cards and is attributed to the thickness in size, coulour and materials used in the cards. The use of silver coated recharge cards pose serious concern to humans and the environment. Public awareness on proper handling and disposal of recharge scratch cards as well as further study to evaluate the contribution of recharge cards to heavy metal levels in soils were recommended.

Introduction

In recent times, the occurrence of metal contamination resulting from rapid growth or population increase, urbanization, exploitation of natural resources, extension of immigration and other modern agricultural practice as well as environmental regulation have become problem of increasing concern (Biney *et al*, 1994).

The use of mobile phone recharge scratch cards began via the introduction of Global system for mobile communication (G.S.M) in Nigeria, with ECONET 2001. This new development in communication technology replaced the older means of communication that was championed by Nigeria Postal Services (NIPOST) and Nigeria Telecommunication Limited (NITEL) in the country. The new innovation also brought about progressive changes and series of transformations into the communication industry. This increase in awareness led to the introduction of other service providers

such as GLO, Etisalat, Visafone, Starcomms, Multinet, etc.

The production, distribution, sales and especially, the use of mobile phone scratch cards in Nigeria is one thing that has not received the needed safety watch and attention, due partly to little or no awareness of the danger it likely pose and partly due to the negligence of the government and the people to implement and heed to safety notices, rules and regulations concerning the use of scratch cards in the world over.

The same is true of the activities of many Nigerians including government agencies who engage in the act and practice of discharging of wastes (e.g mining wastes, agricultural wastes, municipal wastes, medical wastes, industrial wastes, etc) into open dumpsites to create a scenario where our lands and ground water get contaminated with heavy metals and toxic substances/chemicals that are of great threat to human health and the environment.

It becomes important therefore to have thorough assessment of the sources (e.g scratch cards) of heavy metal contamination, their (the heavy metals) relative abundance and the sources of entry to human body from contamination. Some of the metals like Cd and Pb are capable of injuring the kidney and cause symptoms of chronic toxicity, including impaired organ function, poor reproductive capacity, hypertension, tumors and hepatic dysfunction (Abou – Arab *et al*, 1996).

The recharge scratch cards are usually provided in specific and peculiar colours by the service providers (MTN, GLO, ETISALAT, etc) or by their authorized card printing companies. The users are expected to scrap off the silver coating with scraper, but regrettably, many users always scratch the coatings with their finger nails so as to reveal the PIN.

Informed by this development and the health challenge faced by the world today, especially from the use of industrial products, researchers and environmental practitioners have taken keen interest in carrying out investigations on the levels of heavy metals in food and other industrial products commonly used by man as well as predict their health implications on humans since users of these products are most likely to be exposed to risk and health hazards in course of using them (Ubong and Gobo, 2001).

It is also revealed that the major routes of heavy metal uptake by man are food, water and air. Although some metals such as Cu, Zn and Mn are essential for growth and well being of living organisms including man, they are toxic at higher concentrations Ideriah *et al*, (2012). Infact, epidemiological evidence revealed that pollutants such as metals at even normal concentrations have adverse effects on human health (stern, 1973). Other metals such as Pb, Cd and Hg are non-essential for metabolic activities and are toxic (Biney *et al*, 1994).

Heavy metals such as Ag, Cd, Pb, Zn, Mn, Cu, Fe and Cr are found to be the major cause of nephritis, anuria and extensive lesions in kidneys (Chukwujuidu *et al*, 2007). Since many people use their finger nails to scratch recharge cards, it becomes a route for entry of heavy metals into human body.

Ideriah *et al*., (2005) reported heavy metal pollution of soils around municipal solid wastes dump in Port Harcourt with concentrations of Cd and Cu exceeding permissible limits. Ideriah *et al*., (2006) reported that wastes dumps contributed to

the concentrations of nutrients, heavy metals and other soil parameters in Port Harcourt adding that road traffic is not the major source of lead around waste dumps.

Port Harcourt, Rivers State is one of the environmental sensitive areas of the world and in Nigeria in particular. Also high rate of sales and use of mobile phone recharge scratch cards is predominantly immeasurable in the city than could be observed in the rural areas.

For this reason therefore, it becomes necessary to investigate the presence and levels of heavy metals, Ag, Cd, Pb, Ni, Cu, and Cr in mobile phone scratch cards and compare the levels with permissible limits.

Materials and Methods

Sample collection and identification

Mobile phone recharge cards were purchased from retail shops in Port Harcourt, Rivers State. The card samples from networks E and G were divided into two groups, scratched cards and unscratched cards. The silver coatings of one group of the recharge cards of each network were carefully scratched off using a stainless steel scraper. Thus, the card samples were identified as ESC and GSC (scratched cards), EUC and GUC (unscratched cards). The samples were stored in plastic vial containers.

Sample digestion and analysis

Glass wares, crucibles and plastic containers were washed with liquid soaps, rinsed with distilled water and soaked in 10% HNO_3 for 24 hours cleansed with deionized water to prevent contamination (Adnan, 2003). Reagents used were of analytical grades. Five grams of each recharge card samples was weighed into a beaker and 2ml of nitric acid (HNO_3) was added, followed by 6ml of HCL. The beaker was placed on a hot plate and heated to near dryness. The digested samples were filtered through Whatman No. 1 filter paper and made up to 50ml with deionized water. The sample solutions were analyzed with Atomic Absorption spectrophotometer (AAS) by GBC Avatar 2.02. Metal determination was done singly for each recharge card.

Results and Discussion

The results of heavy metals obtained from the analysis of recharge cards are presented in Table 1 and Figs. 1-5.

The concentrations of copper were found to range from 11.05 – 17.45 mg/kg. The maximum concentration of Cu was found in GUC sample (17.45mg/kg), while the minimum concentration was 11.05mg/kg in GSC. The results also showed that the concentration of Silver (Ag) was highest (1.71mg/kg) in EUC and minimum in GUC (0.5mg/kg). The results of copper obtained are below their recommended level in soil (100mg/kg) by FAO/WHO (2001). The level of Silver proved satisfactory with the soil recommended value of 0.3mg/kg. The values of silver obtained exceeded recommended limit value 0.01mg/l by EPA and 0.10mg/l for drinking water. This implies that the unscratched recharge cards are sources of Silver in the environment and its level pose health and environmental concern.

Chromium had highest concentration of 4.75mg/kg in GSC and least in GUC (3.04mg/kg) showing that chromium is far above its recommended value in soil (1.0mg/kg) FAO/WHO, 2001) and pose serious environmental and health concern to health.

Table.1 Concentrations (mg/kg) of Heavy Metals in Recharge Cards

S/No.	Sample Code	Cu	Ag	Cr	Ni	Cd	Pb
1.	ESC	14.06	1.17	4.37	3.24	1.34	9.71
2.	EUC	16.76	1.71	4.00	4.98	1.82	12.04
	Total	30.82	2.88	8.37	8.22	3.16	21.75
	Average	15.41	1.44	4.185	4.11	1.82	10.88
3.	GSC	11.05	1.21	4.75	6.11	1.12	8.74
4.	GUC	17.45	0.50	3.04	2.01	0.98	4.98
	Total	28.5	1.71	7.79	8.12	2.10	13.72
	Average	14.25	0.855	3.89	4.06	1.05	6.86

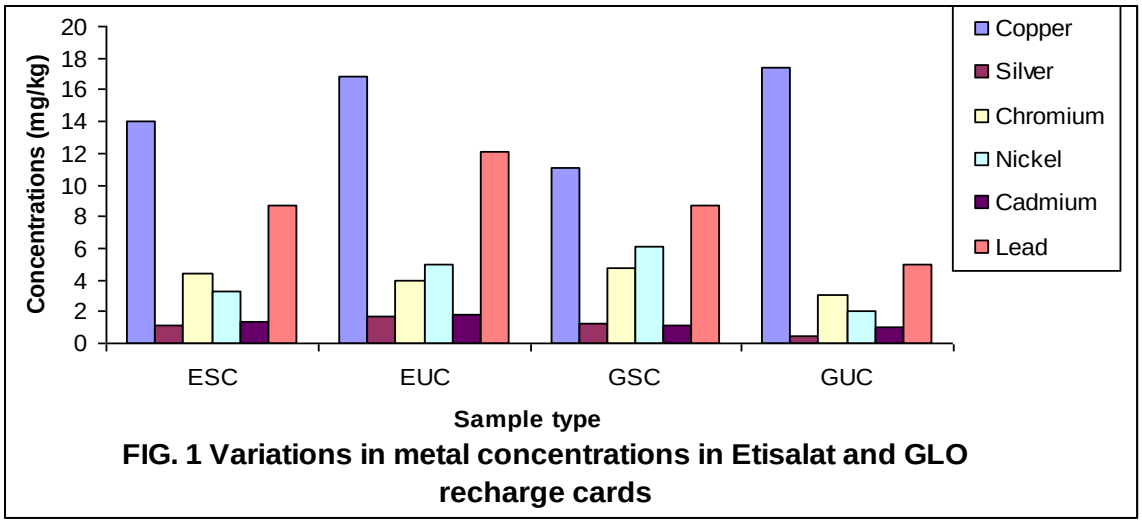

FIG. 1 Variations in metal concentrations in Etisalat and GLO recharge cards

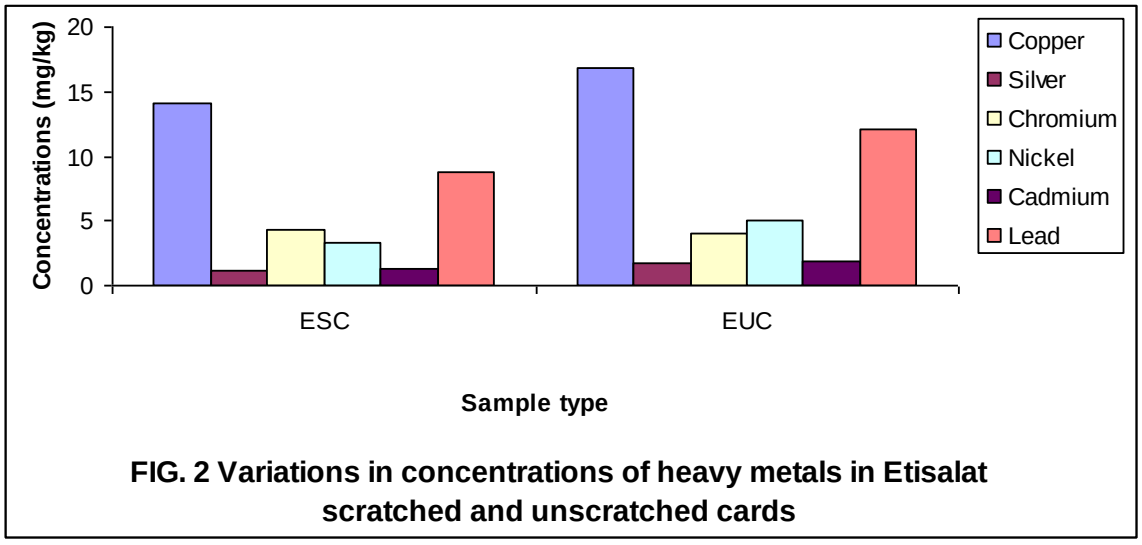

FIG. 2 Variations in concentrations of heavy metals in Etisalat scratched and unscratched cards

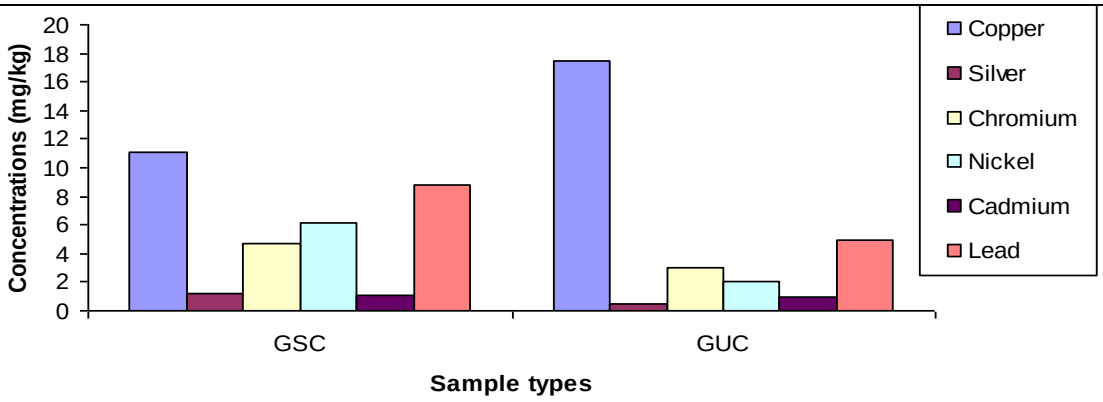

FIG. 3 Variations in concentrations of heavy metals in Glo scratched and unscratcd cards

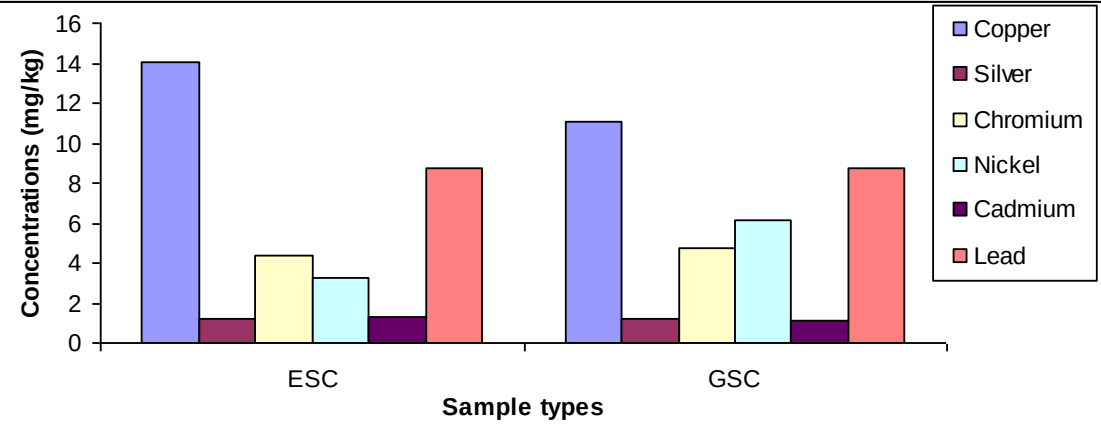

FIG.4 Variations im heavy metal concentrations Etisalat and Glo scratched cards

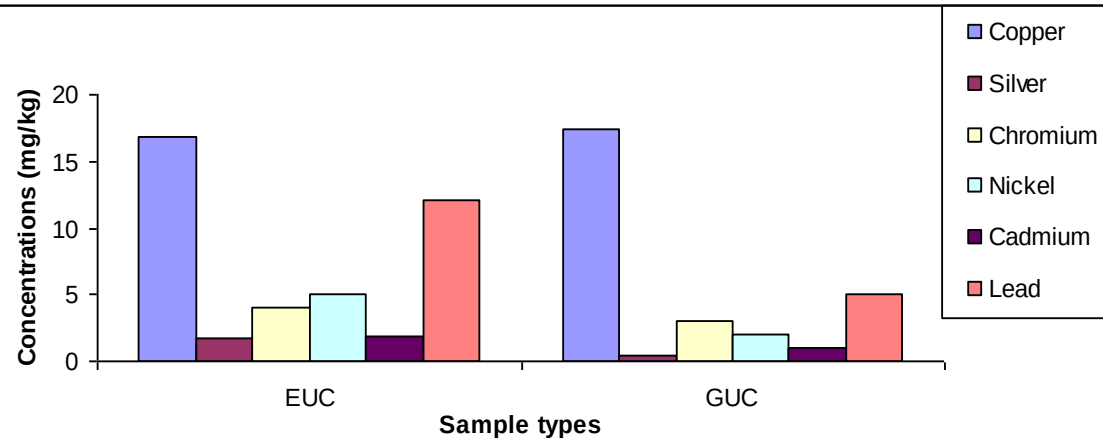

FIG. 5 Variations in metal concentrations in Etisalat and Glo unscratced cards

Nickel value obtained ranged between 2.01mg/kg and 6.11mg/kg and it is higher than the recommended value in soil (1.05mg/g) by FAO/WHO (2001) and is of great concern to health.

The concentrations of cadmium varied from 0.98mg/kg in GUC to 1.82mg/kg in EUC, showing that the concentration is above the recommended limits in soil (1.0µg/g) by FAO/WHO (2001) except for GUC. The concentrations of lead obtained from the analysis ranged between 4. 98mg/kg in GUC and 12.04mg/kg in EUC. This shows that the value of lead obtained is below the recommended value in soil (50mg/kg) by FAO/WHO (2001).

It is observed in Figs. 2 and 3 that the concentrations of the metals in unscratched cards were higher than those in scratch cards. This implies that the silver coating covering the PIN contributed to the difference in metal concentrations. Statistical analysis using t-tests on the mean concentrations of the metals showed significant difference ($P<0.05$) between EUC and GUC ($r = 0.9343$) as well as GSC and GUC ($r = 0.9171$) while there is no significant difference ($P>0.05$) between ESC and GSC ($r = 0.9210$) as well as ESC and EUC ($r = 0.9722$). Analysis of variance (ANOVA) showed no significant difference ($P>0.05$) between EUC and GUC as well as ESC and GSC while the difference between the metals showed significant difference ($P<0.05$). The results showed that the group of cards labeled ESC and EUC had higher metal content than GSC and GUC cards (Figs. 4 and 5). This could be attributed to the thickness in size, coulour and materials used in the cards.

Conclusion

The results obtained from the study indicated the presence of heavy metals, especially Cu, Pb, Cr and Ni in mobile phone recharge cards sold and used in Nigeria. The presence and concentrations of Ag, Cr, Ni and Cd are of great concern due to their high health risk, more so at levels exceeding permissible limits. This study has created awareness of the potential danger on the environment as well humans especially those who scratch cards with finger nails. The levels of the metals in the scratch cards imply that they contribute to the levels of heavy metals in the environment.

Based on the results of the study, it is recommended that the GSM companies and the Government should undertake public awareness campaign for proper handling and disposal of recharge scratch cards. Also further study should be carried out to evaluate the contribution of recharge cards to heavy metal levels in soils.

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