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ASSESSMENT OF LEAD, CADMIUM, CHROMIUM, AND NICKEL IN SELECTED LIPSTICKS BRANDS SOLD IN THE KENYAN MARKET

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ABSTRACT

The desire to improve physical appearance has led to increased use of lipstick by millions of women. This is despite research showing that some brands of lipsticks are contaminated with higher levels of the heavy metals above the permissible level tolerable by the body. This study was conducted to determine the presence and concentration of lead, cadmium, chromium, and nickel in 27 brands of lipsticks of high, middle and low class sampled from Nairobi, Kenya. They were analyzed using atomic absorption spectroscopy technique. Data obtained was analyzed by one-way ANOVA using SPSS. Lead levels in lipstick ranged from 0.0060 to 0.0082 ppm with low class lipsticks having the highest concentration followed by the high class and the least concentration was in middle class lipsticks. Significance differences in lead levels were found between different brands of lipsticks. The concentration of cadmium in 9 brands of lipsticks was below the detectable limit. Chromium concentration in all brands of lipsticks analyzed was below the detectable level. The concentration of nickel in lipsticks ranged from 0.0006 to 0.0017 with middle class lipsticks having the highest concentration followed by high class lipsticks and the low class lipsticks had the lowest concentration. There was significance difference between mean of concentration of nickel in the brand of lipsticks. There is need to monitor concentration of heavy metal in lipstick and sensitize the public on usage of lipsticks especially those with detectable levels of heavy metals because long term exposure can cause health complication to the users.

Keywords: *Lead, Nickel, Chromium, Cadmium, Lipsticks*

Background to the Study

Throughout history, human has been willing to try almost any method or product to improve their physical appearance[1]. This has led to the invention of a variety of cosmetics products such as lipsticks, perfumes, lotions and powders being manufactured to cater to the increased demand. Cosmetics are usually applied to the body to beautify, cleanse or improving the appearance and enhancing attractive features[2]. Lipsticks are among the first facial cosmetics used by women as a powerful symbol of beauty and sexuality[3]. The ancient Sumerian women are credited as the first to use lipsticks; however, Egyptians were the real lovers of different variety of lipsticks. Egyptian used harmful substances such as lead, bromine, and iodine to make lipstick[4]. This led to the condemnation of the use of lipsticks, but there has been an evolution of ingredients used to make lipstick throughout history. What has remained constant is that women have been willing to apply anything on their lips to look attractive despite any toxic ingredient used to make the lipsticks[5].

The demand for lipsticks has increased tremendously over the last few decades around the world due to the growing awareness of the need to beautify the human body[6]. This has partly been contributed by an increase in advertisements in the media[7]. Today use of lipstick has become routine body care for millions of women around the world not only by the upper strata of society but also by middle and low-class people[8]. The high global demand for lipsticks has attracted the attention of researchers, toxicologists and regulators, who intend to ensure the safety levels of ingredients in the cosmetics products, are maintained. This is because lipstick is directly applied to the human skin and some of the ingredients in them can penetrate the skin and reach vital internal organs via the systemic circulation[9].

One of the health concern regarding cosmetics is their contamination with heavy metals that have potential health risks and environmental risks[10]. Heavy metals like lead, arsenic, nickel, cadmium, and chromium have been found in some cosmetics[11]. The bioaccumulation of these metals in the body over time has been associated with cancer, reproductive and developmental disorders, contact dermatitis, hair loss, lung damage, aging, skin disease and reaction, allergies, and damage of nails[12]. The deleterious chemicals and metals can enter into the body by inhalation of perfumes, deodorant, nail polish, scented powder, by absorption through penetration of harmful chemicals from body creams, moisturizers, cleanser, and eye shadow among other pathways[13]. It can also be by ingestion of chemicals and metals in the cosmetics. Women also ingest lipsticks through either licking during eating, drinking or kissing without their intention[10].

Trace amounts of heavy metals are common in the environment and diet and are necessary for good health, but large amounts of any of them may cause acute or chronic toxicity (poisoning)[14]. Eltegani et al[15] contend that in small quantities, certain heavy metals are nutritionally essential for a healthy life as the building blocks of our bodies. They are required for body structure, fluid balance, protein structures and to produce hormones[16]. They act as co-factors, catalysts or inhibitors of all enzymes in the body. Copper and iron, for example, along with other minerals are required for the electron transport system and thus needed for all cellular energy. In support of this Faruruwa and Bartholomew[17] add that metals like copper, nickel, chromium, and iron are essential in very low concentration for the survival of all forms of life, but, when present in higher concentration can cause metabolic anomalies.

Heavy metals are used in the manufacture of pigments and can be used in trace quantities into raw materials used in the manufacture of the various cosmetic products available to users[18]. Some of these metals are used in

cosmetics for one reason or the other, for example, cadmium's (a deep yellow to the orange element) color properties enable it to be used in some lipsticks and facial cosmetics. Chromium hydroxide [$Cr_2O(OH)_4$] and chromium oxide [Cr_2O_3] have uses as coloring agents in cosmetic products[19]. Additionally, apart from the regulated intentional uses of these heavy metals in cosmetics, they can be found as impurities also in various cosmetic products.

The above facts have led to regulatory organizations such as Health Canada and WHO to do investigation and recommend maximum permissible limits of heavy metals in cosmetics[20]. Table 1 shows the acceptable maximum limits of metals to be analyzed in this study.

Table 1: Permissible levels of heavy metals in cosmetics

Heavy metal	Permissible levels in cosmetics in part per million (ppm)
Lead	20
Cadmium	3
Chromium	50
Nickel	200

Source: [21]

Some cosmetics industries have been able to comply in keeping heavy metal contamination below the permissible levels. However, others have not been able to keep the concentration of heavy metals minimum than the permissible levels despite guidelines that have been provided. A good example of a cosmetic product found to contain a heavy metal (lead) at a higher concentration than the permissible level is lipsticks. Test conducted in the United States by the Campaign for Safe Cosmetics revealed that 61% of the 33 brands of lipsticks contained lead, with levels of up to 0.65 ppm[11]. The United States Food and Drug Administration also found lead in all the samples of lipsticks that it tested, with levels ranging from 0.09 to 3.06 ppm. A similar study conducted by Health Canada found that 81% of the samples of lipsticks that it tested for lead had levels ranging from 0.079 to 0.84 ppm, and in one unique case lipsticks contained 6.3 ppm[22]. This is an indication that some lipsticks in the market contain higher levels of lead than the permissible levels. Another study conducted in India by Sahu et al.[23] revealed that 15 out of 30 brands of lipsticks had chromium ranging from 0.45 ppm to 17.83 ppm, 13 out 30 had nickel ranging from 0.57 ppm to 9.18 ppm, while lead and cadmium were not detected in any of the 30 samples.

Faruruwa and Bartholomew[17] conducted a study to analyze the presence of heavy metals in facial cosmetic commonly used in Nigeria. The study revealed that in the 40 samples consisting of 10 different types of facial cosmetics (Powder, Lipstick, Eye pencil, Face Cleanser among others) had chromium, nickel, zinc, and iron found in varying concentrations in all the samples, 85% of the samples also contained Cd while 18 of the 40 samples had Pb above detection limit (0.20–31.70 $mgkg^{-1}$). The levels of Pb and Cd in superstores and open markets were lower in comparison to other metals under considerations. The result is in agreement with a study conducted by Barghash et al.[24] that revealed facial cosmetic commonly sold in Saudi Arabia had high levels of lead and cadmium.

El-Aziz et al[9] analyzed the concentration of nine heavy metals in 20 different facial cosmetics commonly used in Alexandria in Egypt. The finding found that the concentrations of Ni, Cr, Pb, and Cd were above the suggested safe limit for skin protection. Other heavy metals content investigated such as Mn, Hg, Cu, Zn, and Fe were within permissible levels. A similar study was conducted in Sudan by Eltegani et al[15] to analyze the content of arsenic, cadmium, lead, and mercury in face makeups. The result revealed that 50 percent of all the eyeliner

products analyzed contain Arsenic concentration above the allowed limit (3.0 ppm). While the percentages of the powder products analyzed contained As, Cd and Pb concentrations above the allowed limits at 8.1, 8 and 9.1 respectively.

According to Martins et al[25], heavy metals can accumulate in the biological system over time and induce skin problems such as cancer. Heavy metals such as lead and cadmium are notable for their ability to accumulate in the body tissue faster than the body detoxification pathways can get rid of them; thus, a gradual build-up of toxic levels which can greatly be enhanced through the application of cosmetics and other personal care products on the skin. The skin, despite being a protective barrier, some components of cosmetics such as arsenic, cadmium, and lead penetrate and become available in our systems[26]. Sani et al[27] report that the possibility of exposure to cosmetic products may occur when applied via spray, while dermally applied products to the mucous membranes present the possibility of enhanced availability or in the case of lips products provide the opportunity for oral ingestion when these heavy metals impurities come into contact with the body[6]. When the heavy metal ions come in contact with the human body, they get absorbed and form complexes with carboxylic acid (–COOH), amine (–NH_2), and thiol (–SH) of proteins resulting in malfunctioning or death of the cells and consequently lead to a variety of diseases.

Some of the heavy metal poisoning such as lead have been recognized as a health hazard for more than 2,000 years[28]. Omenka and Adeyi[29] allude that lead can easily cross the placenta of mothers and damage the brain of fetuses. Exposure to lead for the first trimester of pregnancy has been found to cause alteration in the developing retina, thus resulting in defects in the visual system [30]. Children exposed to lead can result in learning difficulties, memory impairment, damage to the nervous system, and behavioral problems such as aggressiveness and hyperactivity[31]. The nervous systems of children are especially sensitive to lead. Lead has also been associated with kidney damage, cardiovascular disease and autoimmune disorder[32]. It also damages the liver, reproductive system, basic cellular processes, and brain functions. Lead enters the body mainly through inhalation of dust containing lead and through ingestion[33]. Pregnant women are the most vulnerable to lead poisoning because they absorb lead in the highest quantities. Some of the symptoms of lead poisoning include anemia, insomnia, headache, dizziness and irritability, weakness of muscles, hallucination and renal damages[34]. Lipstick is usually contaminated with lead mainly through use raw material containing lead or via the use of pigments that contain lead[35].

Cadmium color that is deep yellow to orange makes it suitable to be used as a pigment in manufacturing lipsticks[36]. Its absorption through the skin is very low (0.5%) because it binds to epidermal keratin and its absorption through ingestion is about 6 percent, however, it is toxic even when in low levels[37]. Long term exposure to cadmium leads to renal dysfunction and high exposure can lead to obstructive lung disease and cadmium pneumonitis[38]. Cadmium can cause serious effects on renal function, bones, and the pulmonary system[39]. It is classified by the International Agency for Research on Cancer (IARC) as a Group 1 known human carcinogen based on evidence from human and animal studies[40]. Cadmium has been implicated as a possible contributor to other cancers and identified as a mutagen and reproductive toxin[41]. Women might be more seriously affected than men by exposure to cadmium. In one Japanese study, the increase of cadmium in rice resulted in a significant increase in mortality for women, but not for men[42].

Chromium is used as a colorant in lipstick[43]. It exists in several intermediates some of which are essential to humans such as chromium (III) and other toxic like chromium (VI). Hexavalent Chromium (Cr^{+6}) is corrosive and allergic to the skin. It has been listed as carcinogens by the International Agency for Research on Cancer (IARC) [44]. Adverse effects of the Cr^{+6} on the skin may include ulcerations, dermatitis, and allergic skin reactions. Inhalation of Cr^{+6} compounds can result in ulceration and perforation of the mucous membranes of the nasal

septum, irritation of the pharynx and larynx, asthmatic bronchitis, bronchospasms and edema[45]. Respiratory symptoms may include coughing and wheezing, shortness of breath, and nasal itch.

Nickel is one of the contaminants found in Lipsticks. The body requires nickel in small quantities to produce red blood cell, however, excessive quantities of nickel are toxic[43]. Nickel has also been found to cause an allergic reaction when it comes in contact with the skin. It has also been showed that if consumed in high amounts, it affects kidneys, stomach, and liver[23]. Nickel is also connected with increased risk of lung cancer, cardiovascular disease, neurological deficits, and developmental deficits in childhood, and high blood pressure[46].

The studied reviewed reveals that facial cosmetics such as lipsticks may contain a high concentration of heavy metals than the permissible levels. There are millions of women in Kenya that use these cosmetic daily without knowing the safety of these cosmetic products. In the Kenyan market, production and supply of cosmetics undergo a quality control check by the Kenya Bureau of Standards (KEBS) [47]. Through this body KEBS; the government has limits of the levels of heavy metal in cosmetics. Despite the KEBS effort to check the safety of use of cosmetics in Kenya, some are not approved, they enter the market illegally. Very little research has been done in Kenya to investigate the content of heavy metals in Lipstick; therefore, it calls for research to determine levels of heavy metals of the lipstick to reduce adverse health effects associated with heavy metal contaminations.

Statement of the Problem

Majority of women in Kenya use lipsticks to improve their physical appearance on a daily basis. There is a possibility that some brands of lipstick may contain higher concentration than allowable level of the heavy metals that may lead to harmful health effect when used. A study conducted in Kenya by Abere[47] revealed that facial creams and soap contained some active skin lightening compounds above the maximum permissible limits. This is indication that some cosmetic products in the Kenyan market have harmful chemicals that affect users' health adversely.

In the Kenyan market production and supply of cosmetics undergo a quality control check by the Kenya Bureau of Standards (KEBS). Through this body KEBS; the government has limits of the levels of heavy metal in cosmetics. Despite the KEBS effort to check safety of use of cosmetics in Kenya, some are not approved, they enter the market illegally. Therefore, there is need to assess levels of heavy metal in the lipstick used by Kenyan women in order to know whether they are safe or not for use.

Objectives of the Study

This study was guided by the following objective:

i. To determine the levels of chromium, lead, nickel and cadmium in selected lipsticks brands in Nairobi County, Kenya.
ii. To compare levels of chromium, lead, nickel and cadmium between the selected brands of lipsticks and with the maximum permissible levels set by KEBS and WHO.

Research Hypothesis

The levels of chromium, lead, nickel and cadmium in the brands of lipsticks tested are below the maximum permissible limits set by KEBS and WHO.

Materials and Method

Design of the Study

This study adopted an experimental research design which involved sampling different brands of lipsticks in various beauty outlets in Nairobi County. The design enabled the researcher to plan in advance and execute scientifically proven procedures in order to get results that are both objective and valid. In this study the experiment involved use of atomic absorption spectrometry technique to determine levels of cadmium, lead, chromium, and nickel in selected brands of lipsticks in the Kenyan market.

Sample and Sampling technique

Sampling involved selecting a sample of a population to be studied as a representative of the whole population. The samples taken were appropriate representative of the whole population in order to ensure findings from the research sample can be generalized. This study adopted purposive sampling technique. Different brands of lipsticks common in the Nairobi market were selected. Nine different brands of lipsticks of low class middle class and high class were bought in different market levels in Nairobi County in Kenya. In each class of lipsticks, 9 brands were analyzed making a total of 27 brands for all the lipsticks to determine the concentration of lead, cadmium, chromium, and nickel. The classification is based on the prices of each lipstick such that high class is the most expensive and low class is the cheapest lipsticks in the Nairobi County market. Each sample was analyzed three times by AAS before taking the average result.

Chemicals reagents and solvents Chemicals

Reagents and solvents used in this study include cadmium, lead, chromium, and nickel metals that were purchased from a reputable chemical company. Concentrated nitric acid, hydrogen peroxide, concentrated hydrochloric acid sulphuric acid, stannous chloride, silica gel, and potassium permanganate were too sourced from a reputable company.

Cleaning of Apparatus

Plastic containers and glassware apparatus were washed with liquid detergent and warm water and rinsed with tap water. They were afterward soaked overnight in 10% analytical grade nitric acid and then rinsed with distilled water. The glassware was then dried in an oven at 105^0C for 24 hours.

Standard stock solutions and working standards

Stock solutions were purchased from a reputable company from which working standards were prepared by serial dilution. Five serial standards of each element were prepared for calibration. The final acid concentration was maintained at approximately 1% during serial dilution and subsequent dilution of stock solutions to keep the metal in free ion state. Appropriate weighing of metals was done before dissolving them in acids to make 1000 ppm of stock solutions. For Pb, 1.000 gram of lead metal, was dissolved in 250 ml of 1% v/v HNO_3 and diluted to 1 litre with 1% v/v HNO_3. For Cd, 1.000 gram of the metal, was dissolved in 250 mL HCl and then diluted to 1 litre with 1% v/v HCl. For Cr, 1.000 gram of Cr metal was dissolved in 250 ml of HCl and diluted to 1 litre with 1% v/v HCl. For Ni 1.000 gram of the metals, was dissolved in 250 mL HNO_3 and diluted to 1 litre with 1% v/v HCl. Following appropriate dilutions, the serial standard was prepared following ranges in ppm. The serial standards were then aspirated into the instruments. The absorbance of each element was plotted against their concentrations to obtain calibration curves. The correlation coefficients were calculated and used to express the performance of the instruments.

Digestion of samples and blanks

A 1.000 gram portion of sample lipstick was measured accurately into a conical flask. A 15 ml aliquot of concentrated nitric acid was added followed by 5ml 30% hydrogen peroxide and then 5 ml concentrated hydrochloric acid. The flask was then closed and left for 15 minutes to ensure complete reaction. The mixture was heated at 150^{o}C until no more brown fumes were produced. The sample solution was then cooled and 20 ml of deionized water added. The solution was then filtered through Whatman paper number 1 into a 50 ml volumetric flask and diluted to volume with deionized water before aspiration into the instrument. Aspirations were performed in triplicates in each case.

Measurements of levels of heavy metals

The digested samples were aspirated in triplicates with regular intercepts of standards to maintain a check on the instrument stability. Air/Acetylene flame and oxidant flow of 4.5L/min was used for Pb, Cd, Cr, and Ni.

Data analysis

The replicate values for levels of the heavy metals in the lipsticks and face powder were compared using One-Way ANOVA at 95% confidence level using SPSS 23 for windows. Significant differences used was taken at $p<0.05$.

Results and Discussion

The results of the three categories of lipsticks (for high, middle and low class) were analyzed using analysis of variance (ANOVA) to find out whether they were significantly different between their means.

Table 2: Mean Levels (ppm) of Heavy metals in lipsticks

Parameter	**Lipsticks**				
Lead	Categories	N	Mean	Std. Deviation	p-value
	High class	9	0.0068	0.0005	
	Middle class	9	0.0060	0.0005	0.003
	Low Class	9	0.0082	0.0004	
Cadmium					
	High class	9	BLD		
	Middle class	9	BLD		
	Low class	9	BLD		
Chromium					
	High class	9	BLD		
	Middle class	9	BLD		
	Low class	9	BLD		
Nickel					
	High class	9	0.0017	0.0003	
	Middle class	9	0.0031	0.0004	0.000
	Low class	9	0.0006	0.0001	

BLD = Below Limit of Detection

Concentration of lead in lipsticks

The finding in table 2 shows that the mean of the three brands of lipsticks; high, middle and low class are different. The mean for the concentration of lead in the low class lipsticks is highest (0.0082), followed by high-class lipstick (0.0068) and finally middle class (0.0060). Further analysis on table 1 shows that the differences between the mean are statistically significant since the P-value (0.003) is less than 0.05 the minimum threshold for values to be significant. This means that the differences observed in the mean of the concentration of lead between low, middle and high-class lipstick are not by chance. However, the concentration of lead in all the three categories of lipstick was below the KEBS and WHO permissible levels of lead that is acceptable in cosmetics. The maximum permissible level for lead by KEBS is 2.0 while for WHO is 10.0 part per million [[48]]. The result of this study correlates with a study conducted by Health Canada, which revealed that 81% of the samples of lipsticks that it tested for lead had levels ranging from 0.079 to 0.84 ppm, and in one unique case lipstick contained 6.3 ppm[22]. This is an indication that even though the brands of lipsticks tested is safe for use in terms of their concentration of lead, there is a possibility of finding a brand of lipsticks that contains high levels of lead more than the permissible level when a large sample size is used. There is thus a need to monitor different brands of lipsticks in the market because chronic low dose exposure to lead can result to several health complications such as high blood pressure, joint and muscle pain, difficulties with memory or concentration, headache, abdominal pain, mood disorders, reduced sperm count and abnormal sperm, miscarriage, stillbirth or premature birth in pregnant women[49].

Concentration of cadmium in lipsticks

The concentration of cadmium in the 27 brands of lipsticks brands investigated in this study was tested using AAS. The result revealed that in all the 27 brands of lipsticks, concentration of cadmium was below the minimum level that is detectable by the AAS. This result is in agreement with a study conducted by Moraa[48] in Kenya where all the cosmetics tested had cadmium con-centration that was below the limit of detection. Similar result by a study conducted by Faruruwa and Bartholomew[17] revealed that two brands of lipstick sample bought from superstore had cadmium concentration that was below the detectable limit; however, still on the same study sample of lipsticks bought in the open market had cadmium level ranging from 0.4 to 0.9 ppm. This is an indication that even though the brand of lipsticks investigated had a level of cadmium below the detectable limit, more sample of a different brand needs to be tested.

Concentration of chromium in lipsticks

The concentration of chromium metal in all the 27 brands of lipsticks was determined using AAS. The concentration in all the high class, middle class and low-class brands of lipsticks in this study had a concentration that was below the machine detectable limit. This result is in agreement with a study conducted by Sani et al[27] investigating the concentration of chromium in 10 brands of lipstick. The result revealed that 9 out of 10 lipstick analyzed had concentration below the detectable limit, while the one brand had a concentration of 0.0016 ppm. A similar study conducted by Sahu et al[23] analyzing 30 brands of lipstick revealed that 15 out of the 30 had chromium ranging from 0.0051 to 17.83 ppm. The maximum permissible level of chromium in cosmetics by KEBS is 50.0 ppm[50] and also for WHO it is 50.00 ppm[51]. The levels of chromium in this study are therefore below maximum permissible levels. However, there is a need to monitor the concentration of chromium because long term exposure to chromium has been shown to increase risk of lung cancer and may also damage the small capillaries in kidneys and intestines[23].

Concentration of nickel in lipsticks

The concentrations of nickel in 27 brands of the lipstick brands were determined using AAS. The result in table 2 shows that the middle class had the highest concentration of nickel (0.0031), followed by high class (0.0017) and the lowest was in low class (0.0006). This difference in the mean is statistically significant because p values are 0.000 less than 0.05 the minimum threshold for values to be significant. The low level of nickel in lipstick recorded in the current study is in line with a study conducted by Gonzalez [52], which revealed that the concentration of nickel in lipsticks was 0.0020 ppm. However, other studies have found a higher concentration. A good example is a study conducted by Sahu et al.[23], which recorded that 13 out of 30 different brands of lipsticks analyzed had a concentration of nickel ranging from 0.57 to 9.18 ppm. The maximum permissible level for nickel is 200 parts per million[21]. Therefore, the concentrations of nickel in lipsticks in this study were below the maximum limit. Despite the low levels, there is a need for continuous monitoring of nickel in lipsticks because exposure to nickel for a long duration has serious harmful health effects such as chronic bronchitis, reduced lung function, and cancer of the lung and nasal sinus[46, 52].

Conclusions

The finding of the study indicates that lead was detectable in all the 9 brands of lipsticks analyzed in this study. The mean of the high, middle and low class of lipsticks were all statistically significant. The recorded concentration of lead in lipsticks was below the maximum permissible levels as per KEBS and WHO standard. Cadmium was not detectable in all the 9 brands of lipsticks that were analyzed. The concentration of chromium in high, middle-class and low class brands of lipsticks were below detectable level. Nickel was detected in all the 9 brands of lipsticks that were analyzed. The comparison of the mean of nickel concentration of high, middle and low-class category of lipsticks was statistically significant. However, the recorded concentrations of nickel in all brands analyzed were below the maximum permissible level. These results do not warrant the safety use of lipsticks since it is evidenced by the literature that continuous use would be detrimental to health.

Recommendation

The study makes the following recommendation

i. Levels of heavy metals should be monitored by KEBS in all brands of lipstick because there was significant difference in terms of heavy metal detected between different brands.
ii. The public should be sensitized on usage of lipsticks especially those with detectable levels of heavy metals because long term exposure of some of these heavy metal even in small quantities can cause health complication to the users.
iii. Policies should be set to regulate distribution of all cosmetics in the Kenyan market
iv. KEBS should include levels of heavy metals on the labels of facial cosmetics in the market.

Significance of the Study

Heavy metals may find way into facial cosmetics products in the final market as impurities or trace amount of raw material of the cosmetics. However, labels on the packages of cosmetics sold in Kenya indicate neither the presence nor the levels of heavy metals. The finding of this study is therefore useful to users of these products because they are now informed of the status of the levels of heavy metals in brands of lipsticks investigated. The information will enable them to make informed decision when deciding which brand of facial make up to purchase. The finding of this research is useful to relevant authority that control standard of cosmetics in the

market. Information unraveled by this study will enable them to take necessary measures supported by evidence in regulating facial cosmetics that may not be to the required standard in controlling contaminants ingredients.

Limitations of the Study

There are many types and brands of facial cosmetics sold in Nairobi County, Kenya. This study only considered red lipsticks. Additionally, only lead, cadmium, chromium and nickel were analyzed. The different possible metal ions of each specific heavy metal such as Cr^{3+} or Cr^{4+}were not be analyzed.

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