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Assessment of toothpaste from local and imported origins for its heavy metals and minerals composition

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Abstract

The purpose of this study was to assess the concentration of heavy metals (Pb, Zn, Mn, Ni, Se, Cr, Cu & Fe) and minerals (Na, Ca, P& F) in different regular and herbal toothpaste collected from local markets and pharmacies of Lahore. They were divided into five groups each containing five toothpastes. Samples were digested in fume hood by using the diacid method. Mineral samples (Na, Ca & P) were analyzed by using Multi-channel Flame photometer. While Samples of heavy metals were measured using Atomic Absorption Spectrophotometer. Fluoride was determined by spectrophotometer. The result showed that Ca, Zn, Fe, Cr, Ni and Mn was above than permissible limit while K and Pb were within permissible limit. Cu was not detected at all. Fluoride was present within permissible limit in three groups while in remaining groups its concentration was slightly higher than permissible limit. Seand Na was above permissible limit in four group while in imported regular it was within permissible limit.

Keywords: Heavy metals, minerals, toothpaste, digestion, atomic absorption spectrophotometer, spectrophotometer, flame photometer, spectrophotometer.

Introduction

Toothpastes are used by everyone from children to old ones for personal hygiene. Toothpaste are in gel form which are utilize for oral care to get rid of bacteria[1]. FDA recognize all personal care product including toothpaste a cosmetic[2]. Toothpaste works as a multifunctional which protect us from bacteria and provide us with cool and fresh breath and fluoride protection. These also help us to whiten our teeth and protect us from bacterial infection in mouth[3]. Toothpaste have been in use from ancient times. Formulation of toothpaste started from 300-500 BC in China and India. In 19th century, modern toothpaste was developed. This was also the era when industrialization was started to peak. Many metals were being used in toothpaste manufacturing industry. The trend is being shifted towards better check and balance in toothpaste manufacturing to prevent oral illness[4].

There are many resources through which heavy metals can contaminate the toothpaste. Heavy metals can cross contaminate toothpaste in manufacturing by accident. These are also added deliberately to boost up the efficiency. The other major source for heavy metals to incorporate in toothpaste is plants. Herbal toothpastes take direct heavy metals intake from plant materials from which they are being made of. Plants like aloe Vera, peppermint sage and eucalyptus are being used for this purpose[5]. These metals are also being used in various kind of toothpastes and cosmetics for their different properties. In the past few decades, people have demanded to have check in on limits of these heavy metals in these cosmetic products including facial care and mouth care products like mouthwash and toothpaste[6].

The binding of arsenic with chemical groups, present in toothpaste, can disturb the many important human systems like nervous, cardiovascular, and gastrovascular system[7]. EPA's has studied lead's carcinogenic effects. If lead is being used in high level it can damage many body systems. It is also very harmful for pregnant women[8,9]. Higher level of chromium can also cause skin ulcer and can adversely affect the kidney and nervous system[10]. High level of cadmium can lead up to the damage of kidney, liver, lungs, and nervous system[11]. Mercury is very hazardous heavy metal. It damages many working systems of body by reacting with different kinds of chemicals that are present in our body[12]. Usage of nickel has increased in dental prostheses due its property of hardness. When toothpaste is used nickel can release from dental alloy and present serious health threats[13]. Zinc is added into toothpaste with its many salts for achieving different properties. Zinc continuing toothpaste has some effect on reducing the mouth odor[14]. Public has alerted from past many years due to the harmful effects of excess use of fluoride. Many salts of fluoride pose threats to human body if they are present in higher quantity. Fluoride can damage human skeleton bones as well as DNA[15]. Due to fluoride's reactive nature Calcium can combine with fluoride and form calcium fluoride which can disturb blood system[16]. Efforts are being made at larger scale to get rid of the issue of heavy metals in herbal product like toothpaste[17]. Limits have been introduced

for impurities to be present in toothpaste by many countries due to alarming issue of heavy metals in toothpaste. German federal government also has set limits for cosmetics and toothpaste and the limits for heavy metals set by German government are even much lower than other countries[18]. Heavy metals like lead and arsenic should not exceed than their set limit 20 and 2ppm accordingly[19,20].

Materials and methods

The purpose of the study was to assess the concentration of heavy metals and minerals in different regular and herbal brands of toothpaste collected from local markets and pharmacies of Lahore. The selected brands were divided into five groups each containing five toothpastes. The five groups were Local Regular, Local Herbal, Imported Regular, Imported Herbal and Medicated. Samples were digested in fume hood by using the diacid method. One-gram sample was taken in Kjeldhal's digestion tube followed by the addition of 7mL of HNO_3 and after 30minutes 3mL of $HClO_4$ was added. This solution was heated at 150°C for 30minutes on digestion block and then at 250°C till the completion of digestion with the end point of vine green or clear watercolor. Samples were analyzed for Sodium (Na), Calcium (Ca) and Potassium (K) by using Multi-channel Flame photometer (AFP 100).

Heavy metals including Pb, Zn, Mn, Ni, Se, Cr, Cu and Fe in the digested samples were measured using Atomic Absorption Spectrophotometer (Polarized Zeeman Z-8230 Atomic Absorption Spectrophotometer). Fluoride was determined by spectrophotometer (V-1100 Spectrophotometer).

Quality Assurance: The quality assurance of heavy metals and mineral detection procedure through ASS was assessed by calibrating the instrument for each metal by feeding respective standards.

Statistical Analysis: The results were analyzed by applying one-way ANOVA test of SPSS software.

Results and discussion

Outcome of this study provides the concentration of sodium (Na), potassium (k), calcium (Ca), fluoride, zinc (Zn), iron (Fe), selenium (Se), lead (Pb), chromium (Cr), copper (Cu), nickel (Ni) and manganese (Mn) in groups of toothpaste; local regular, local herbal, imported regular, imported herbal and medicated are shown in Figure-1 to 12.

Discussions: Heavy metals and minerals are present in natural resources which can be incorporated into manufacturing process. Many countries have introduced many regulations to set permissible limits for the heavy metals and minerals contents in toothpaste. The purpose of the study was to assess the concentration of heavy metals and minerals in different regular and herbal brands of toothpaste collected from local markets and pharmacies of Lahore. i. Concentration of Na was detected at above than permissible limit by US patentin four groups while imported herabl was present under the permitted limit. The medicated group has the highest concentration. ii. Concentration of K was detected at less than permissible limit by US patent in all groups although imported regular group has the highest concentration but it was still less than permissible limit. iii. Concentration of Ca was present above than permissible limit by East African Stnadard in all groups. Imoprted regular has the highest concentration. iv. Concentration of Fluoride was present less than permissible limit by Pakistani Standard in three groups; local herbal, imported regular, imported herbal. While in two groups (local regular and medicated) it has surpassed slightly the permissible limit. v. Concentration of Zn was present very much above than permissible limit by US patent. Medicated group has the highest concentration. vi. Concentration of Fe has surpassed the permissible limit by many times. Medicated group has the highest concentration. vii. Concentration of Se was detected at less than permissble limit by Chinese standard in only imported herbal group while in all other four groups it has surpassed its limit. viii. Concentration of Pb was detected at less than permissible limit by Pakistani Standard in all five groups. ix. Concentration of Cr was detected at above than permissible limit by European Standard in all groups. Medicated group has the highest concentration. x. Concentratio of Cu was not detected in any group. xi. Concentration of Ni was detected at above than permissible limit by Nigerian Standard in all five groups. Imported herbal has the highest concentration. xii. Concentration of Mn was detected above than permissible limit by Nigerian Standard in all five groups. Imported regular has the highest concentration.

The result showed that Ca, Zn, Fe, Cr, Ni and Mn was present above than permissible limit while K and Pb was present under the permissible limit. Cu was not detected at all. Fluoride was present under the permissble limit in three groups while in two groups it was present slightly above than permissible limit. Se was present above than permissble limit in four group while in imported herbal it was under the permissible limit. Soudium was present above than permitted limit in four groups while in imported herbal it was present under the permitted limit.

Conculsion

Toothpaste is very essential for our daily hygienic routine. Heavy metals and minerals can be found in toothpastes by different means like usage of raw materials for manufacturing in which they are present due to their persistence nature, plant and water source and deliberate addition. Their long-time exposure can cause serious issues in humans. Above than permitted level of heavy metals and minerals cause many health problems. They can disrupt living systems that can lead up to cancer and death threat. High levels of concentration of heavy metals are not acceptable in toothpastes and many countries including Pakistan have proposed their limits that should not be surpassed.

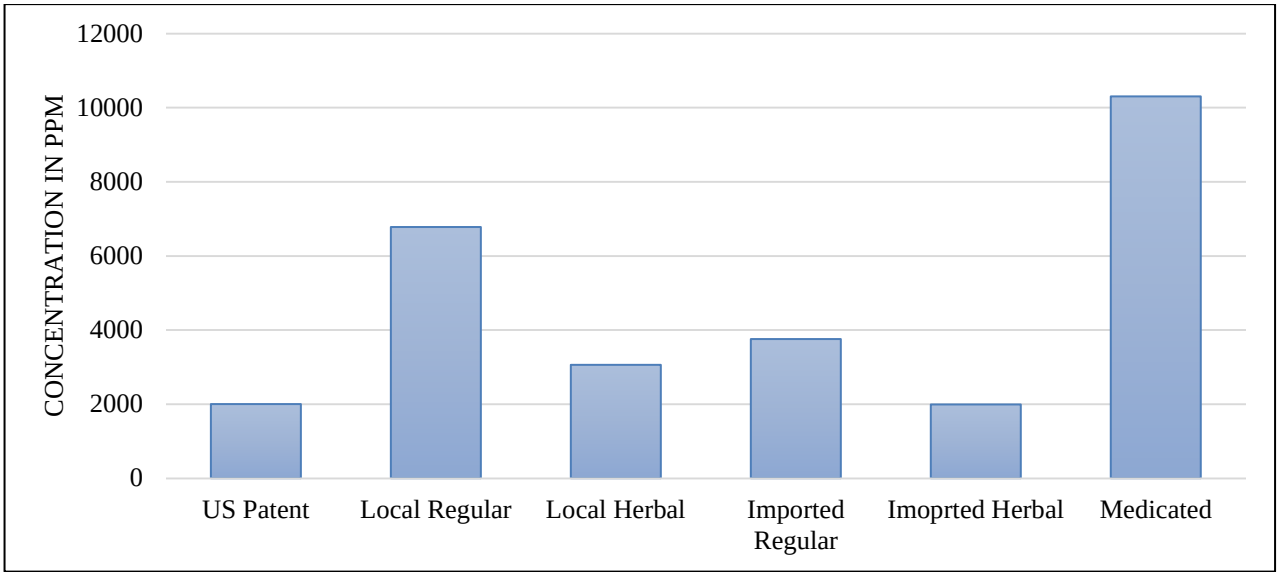

Figure-1: Concentration of Na.

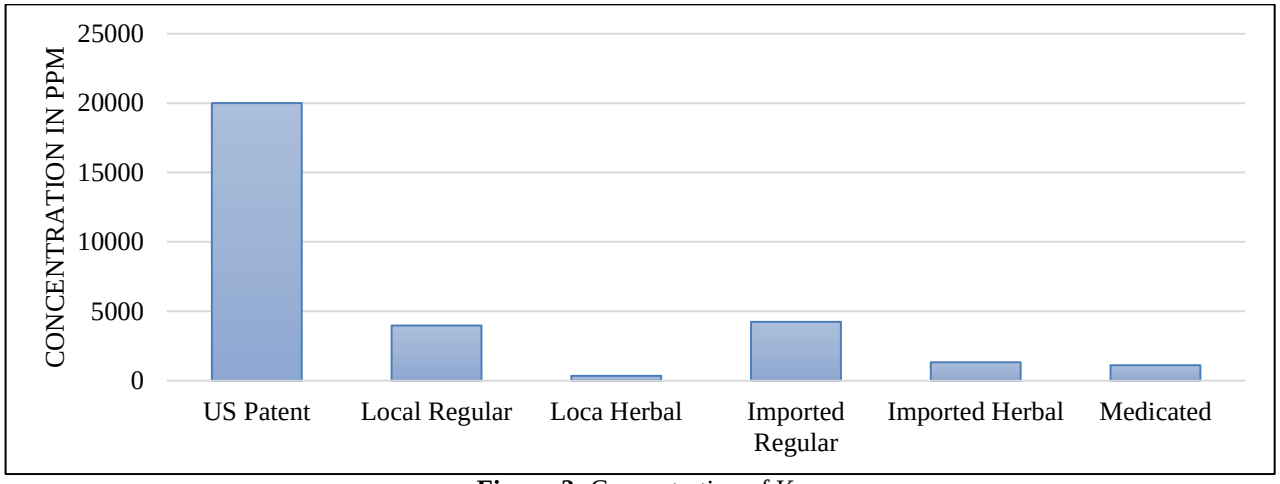

Figure-2: Concentration of K.

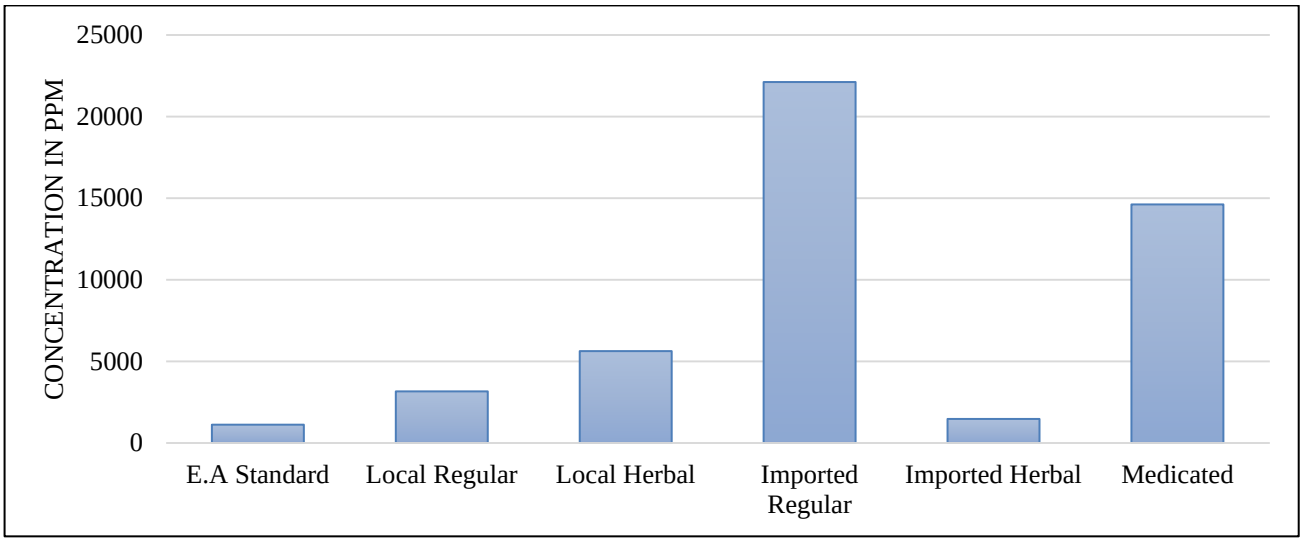

Figure-3: Concentration of Ca.

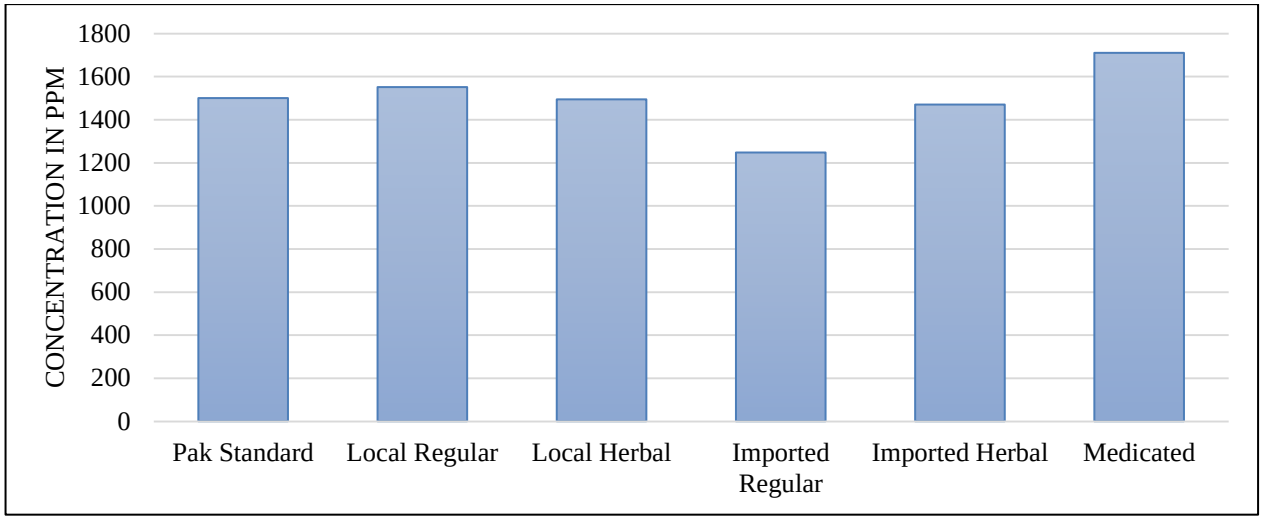

Figure-4: Concentration of Flouride.

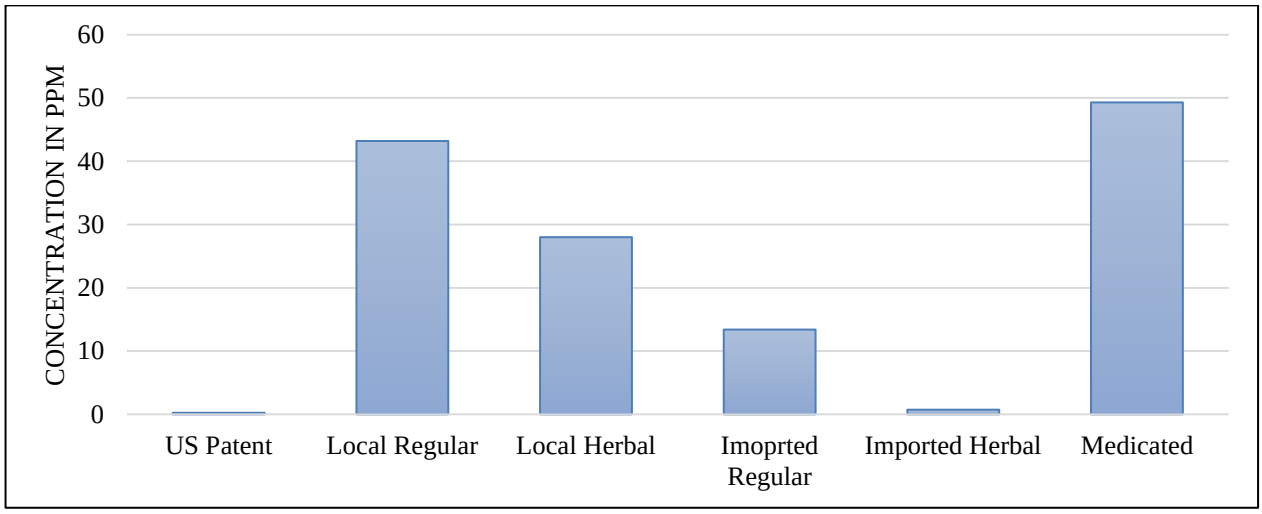

Figure-5: Concentration of Zn.

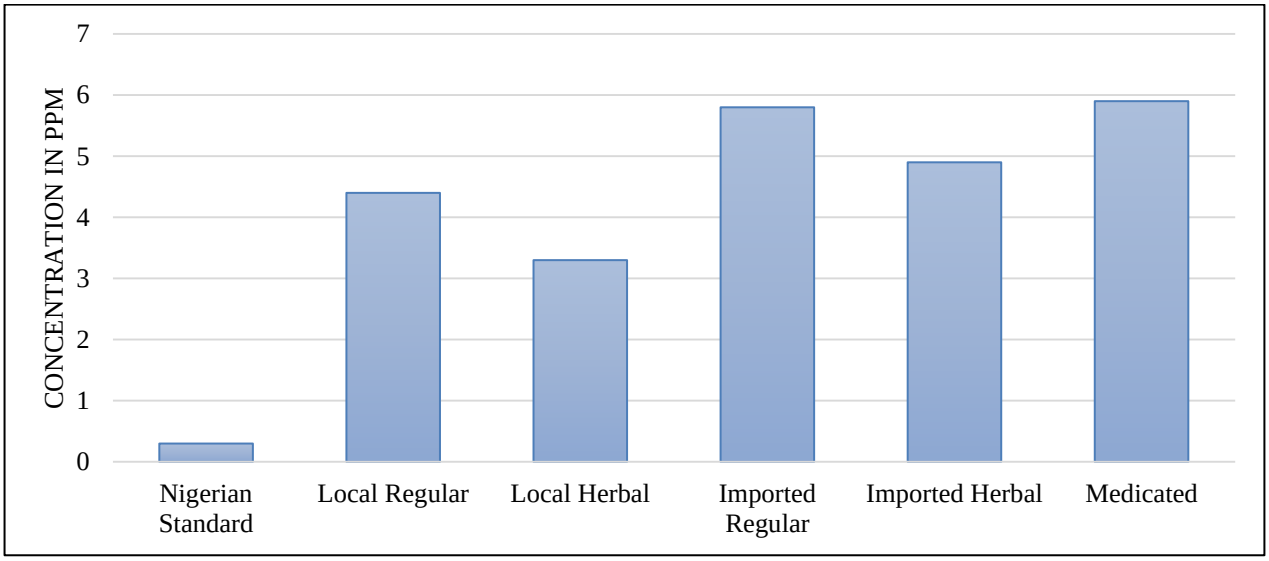

Figure-6: Concentration of Fe.

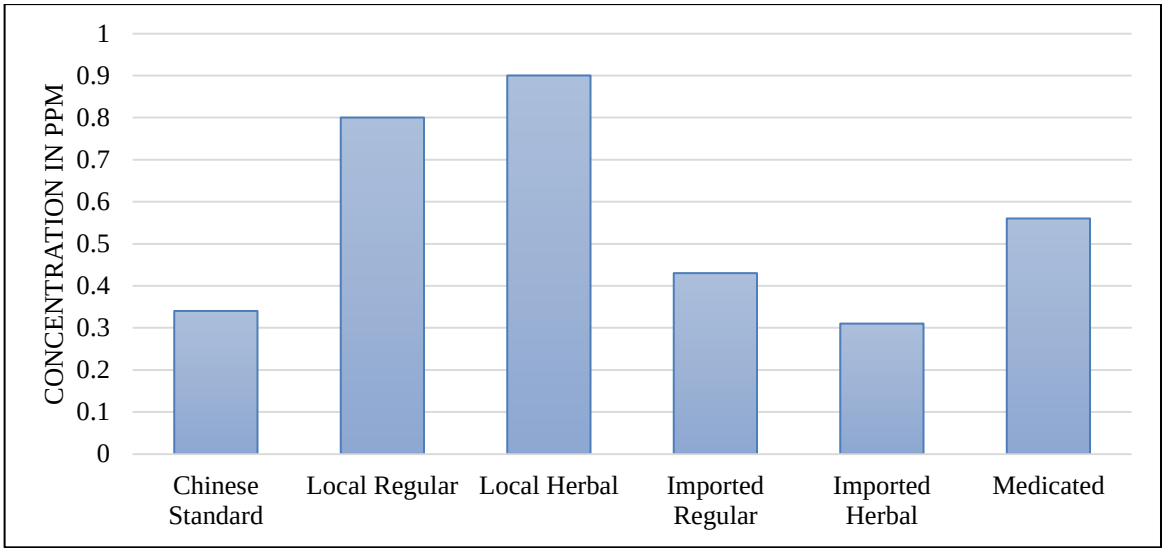

Figure-7: Concentration of Se.

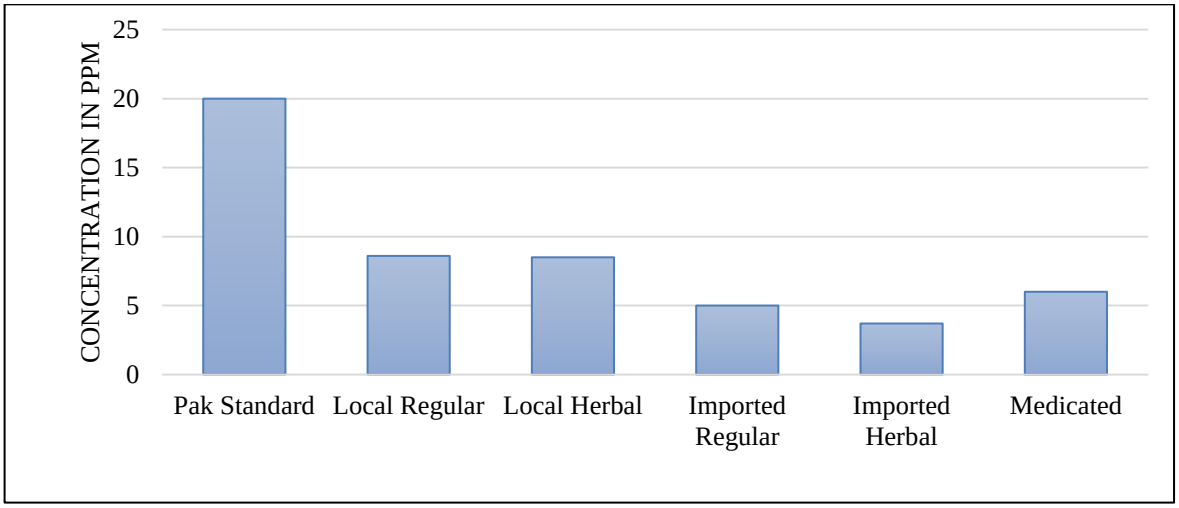

Figure-8: Concentration of Pb.

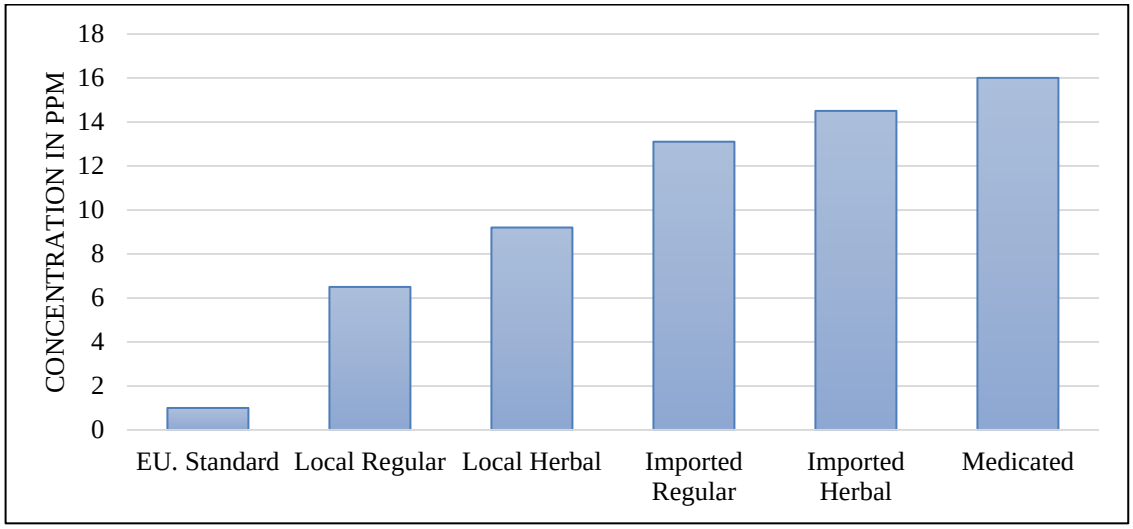

Figure-9: Concentration of Cr.

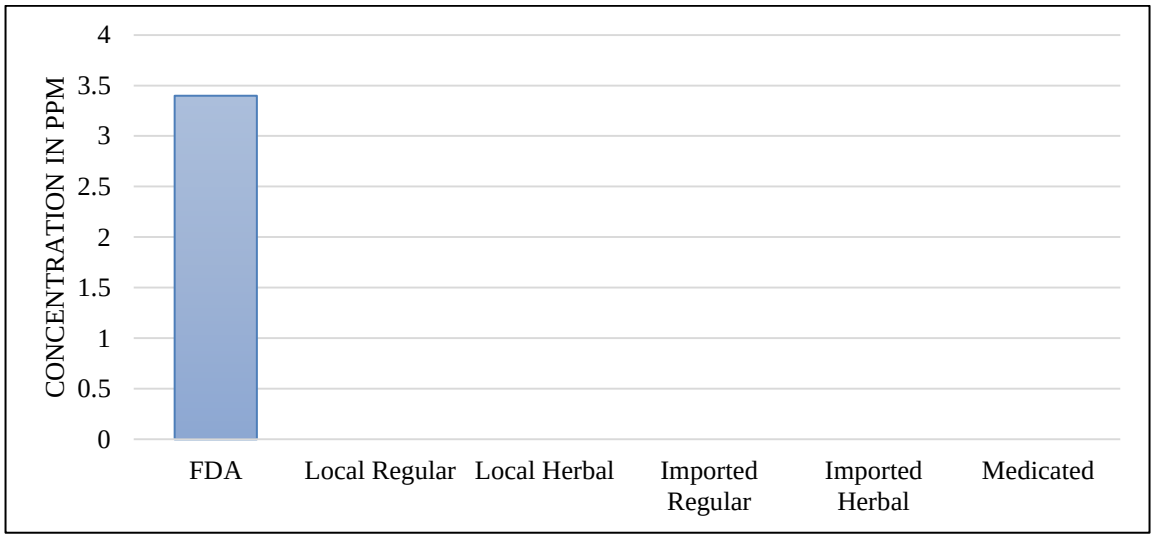

Figure-10: Concentration of Cu.

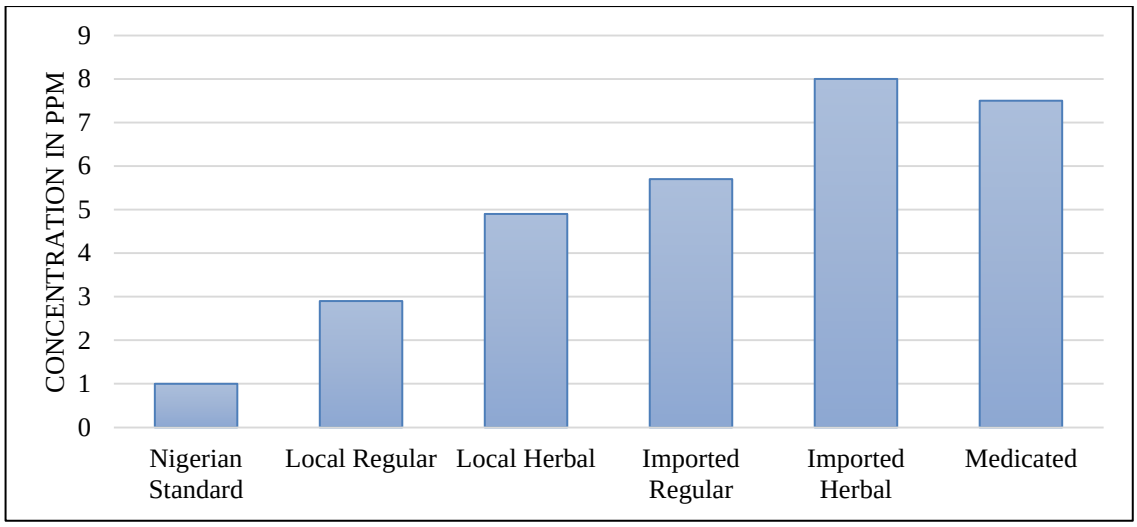

Figure-11: Concentration of Ni.

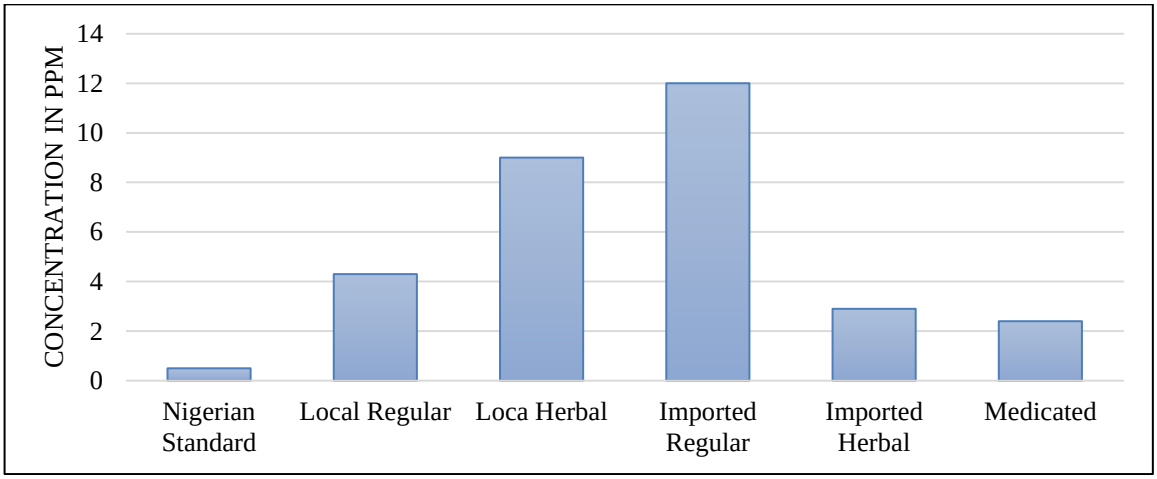

Figure-12: Concentration of Mn.

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