



Level of Selected Elements in *Hibiscus sabdariffa* Calyces and *Lippia asperifolia* Leaves and Their Possible Effects on Human Blood Pressure

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To cite this article:

Abdul Ali Juma Mohamed, Ibrahim Ahmed Abass, Mayassa Salum Ally. Level of Selected Elements in *Hibiscus sabdariffa* Calyces and *Lippia asperifolia* Leaves and Their Possible Effects on Human Blood Pressure. *Modern Chemistry*. Vol. 7, No. 4, 2019, pp. 95-102.

doi: 10.11648/j.mc.20190704.12

Received: December 19, 2018; **Accepted:** January 15, 2019; **Published:** October 10, 2019

Abstract: The levels of selected elements in *Hibiscus sabdariffa* calyces and *Lippia asperifolia* leaves were determined for possible effects on human blood pressure. The aim was to determine the level of selected elements in each species and comparing the iron level, while investigation of their possible effects on human blood pressure was also highlighted. Ten samples each from *Hibiscus sabdariffa* calyces and *Lippia asperifolia* leaves were collected from four areas of Zanzibar Island (Bububu and Mtoni for *Hibiscus sabdariffa*, and Kombeni and Fuoni for *Lippia asperifolia*). The X-ray fluorescence method of analysis was used using EDXRF equipment at TAEC, Arusha, Tanzania. The summary of the analyzed elements is; Ca in *L. asperifolia* > Ca in *H. sabdariffa*; Fe in *L. asperifolia* > Fe in *H. sabdariffa*; P in *L. asperifolia* > P in *H. sabdariffa*; K in *L. asperifolia* < K in *H. sabdariffa*. Human blood pressures (fifty participants) were investigated before and after providing each participant with 300 mL of the extracted juice. The participants' blood pressures were recorded at 30-minute intervals after oral intake of the juice, which was done using clinically validated blood pressure arm monitor. The results obtained show that, the provision of juices caused participants' Systolic blood pressures (SBPs) as well their Diastolic Blood Pressures (DBPs) to drop remarkably. Following data analysis, the use of juices made from *H. sabdariffa* calyces and *L. asperifolia* leaves could be a good source of raising the level human hemoglobin (high iron content present in these plant species). Comparatively, *L. asperifolia* (due to high iron content present) could be a good and preferred source for increasing human blood level than *H. sabdariffa*. However, both plant species have negative relationship with SBPs and DBPs. Nevertheless, people are obliged to seek medical advice before their frequent and long consumption of these plant materials, this due to their significant impact on human blood pressure.

Keywords: *Hibiscus sabdariffa* Calyces, *Lippia asperifolia* Leaves, Calcium, Potassium, Systolic Blood Pressure, Diastolic Blood Pressure

1. Introduction

Traditional medicine remains an important source of health care, particularly in the developing countries such as Zanzibar. In Zanzibar, the traditional medicine has been used in the treatment of different kind of diseases including iron deficiency - anaemia. The Department of Forestry, Traditional, and Alternative Medicine Unit of Zanzibar has conducted an informal interview with community members,

healers, and villagers who are using the traditional medicine that revealed the wide acceptance of this type of healing or medicine [1]. In this study, the beverages of two plant species *Hibiscus sabdariffa* calyces and *Lippia asperifolia* leaves, which are used to cure iron deficiency, anaemia was examined.

Hibiscus sabdariffa (Roselle)

Dried Roselle calyces (RC) are commercially available and appreciated to obtain concentrated extracts which might

be used in the food and pharmaceutical industries for color and health benefits. Ingestion of infusions of RC may help to reduce chronic diseases such as diabetes mellitus and dyslipidemia. This is suggested to be due to the presence and the activity of some compounds, mainly flavonoids and anthocyanins, found as natural antioxidants in Roselle calyces extract (RCE) [2]. Anthocyanins present in RC might be used as a natural food colorant [3], and this is even safer than most synthetic dyes. Synthetic dyes containing azo functional groups and aromatic rings may have negative effects on human health including allergic and asthmatic reactions (Dipalma and Tartrazine [4], DNA damage [5], and hyperactivity [6]. Some synthetic dyes are considered to have potential carcinogenic and mutagenic effect to humans [7].

Amongst other effects, roselle is reported to possess antihypertensive, sedative, antiseptic, digestive as well as diuretic effect. The water extract from Roselle calyces are used to treat hypertension, heart ailments, and even leukemia. Roselle is also used as remedy for abscesses and pyrexia. Some parts of Roselle plant like flowers have been used in treating of respiratory related diseases such as cough and bronchitis [8].

Lippia asperifolia

The origin of *Lippia asperifolia* is from West Africa like Zimbabwe and Zambia, this species had been reported to be efficient in treating malarial symptoms in Mozambique [9].

Therefore, this study aimed at determining the level of iron and other selected elements from the juice extract of *Hibiscus sabdariffa* and *Lippia asperifolia* with a view to establish how people in Zanzibar can treat the iron deficiency, particularly as it affects human blood pressure.

General objectives

To determine the level of P, K, Ca, and Fe in the *Hibiscus sabdariffa* and *Lippia asperifolia* and to investigate their possible effects on human blood pressure.

Specific objectives

1. To determine the level of P, K, Ca, and Fe in *Hibiscus sabdariffa* (Roselle) and *Lippia asperifolia*.
2. To compare the level of iron present in *Hibiscus sabdariffa* and *Lippia asperifolia*.
3. To investigate the possible effects of the use of *Hibiscus sabdariffa* and *Lippia asperifolia* juices on human blood pressure in relation to P, K, Ca, and Fe contents.

Significance of the study

The findings are of great significance to the people suffering from blood pressures, pregnant women, and those with anaemia. The findings also provide baseline information about the respective potentiality and efficacy of *Hibiscus sabdariffa* and *Lippia asperifolia* as human body elemental supplement, blood supplement to the people suffering from blood deficiency and for blood pressure lowering.

2. Material and Methods

2.1. Description of the Study Area

The study was conducted in Unguja Island in Zanzibar. Zanzibar lies between latitude 6.16°S and longitude 39.2°E. Unguja is a hilly island, about 85 kilometres (53 mi) long (north-south) and 30 kilometres (19 mi) wide (east-west) at its widest, with an overall area of about 1,666 square kilometres (643 sq mi). Plants samples for *Lippia sp* were collected at four different areas of Unguja (Figure 1). Two areas of West B district (i.e kombeni lies latitude 06°14.650'S, and longitude 039°15.012'E and Fuoni lies latitude 06°11.612'S and longitude 039°17.087'E). While two areas of West A district, were chosen for collection of calyces of *Hibiscus sp*. (Mtoni lies latitude 06°08.122' S, and longitude 039°13.010'S and Bububu lies latitude 06°04.830'S and Longitude 039°13.815' E).

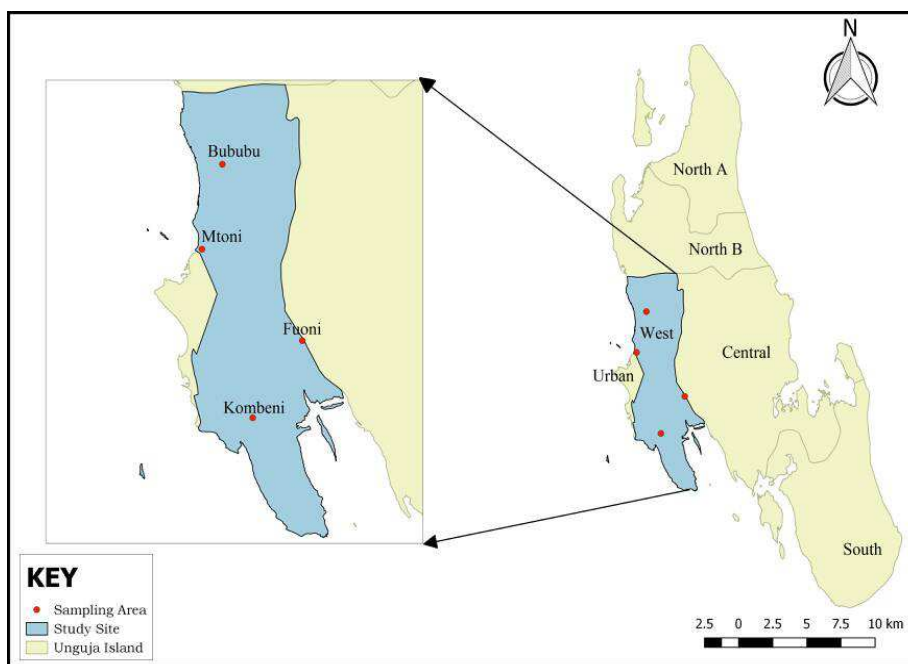


Figure 1. Location of Sampling Sites in Unguja Island.

2.2. Sample Size

A total of 20 samples of plant materials were collected, 10 samples for *Hibiscus sp.* 5 samples were from Mtoni and another 5 samples were from Bububu. For *Lippia sp.* also 10 samples were collected, 5 samples from kombeni and another 5 samples were from Jumbi.

2.3. Sample Collection

Plants samples were taken from four different sites two sites for *Hibiscus sp.* (Bububu and Mtoni) and two sites for *Lippia sp.* (Kombeni and Fuoni) and kept in a clean plastic bag then transported to Veterinary Investigation laboratory in Maruhubi, Zanzibar for preparation.

2.4. Preparation of Plants Samples

At the Veterinary Investigation Centre Zanzibar, the plant samples were washed with distilled water and set dried in an oven of about 50°C temperature overnight, using electric grinder the samples were ground and subsequently sieved using the sieve mesh set (different sizes including 150µm) into fine particles like powder. The fine powder leaves samples were kept into a separate clean polythene bag with appropriate marking and transported to Arusha TAEC laboratory for chemical analysis.

2.5. Sample Preparation Prior to Analysis

At TAEC laboratory Arusha, plants samples were placed in the electric oven until the moisture in fine powder removed, 4.0 g of dry powder samples were weighed using the most accurate electric balance, 0.9 g of binder including starch powder was weighed and mixed well with the sample powder in a well labelled plastic holder. The mixture was then homogenized at a rate of 180 rev/min. The well homogenized samples were then pressed to a pressure of 15 bars. The circular discs (pellets) were then produced. The pellets were placed in the well-labelled holders and inserted into the XRF machine for elemental content analysis. The standard materials used were spinach reference standard.

2.6. Preparation of Roselle and *Lippia sp.* Beverages

Roselle and *Lippia asperifolia* beverages were prepared using the illustrated procedures (Figure 3). The ratios of calyces/leaves/hot ultrapure water used for the extraction were 35 g of dried calyces/leaves to 1.82 litres of hotwater (1:52, w/v), 35 g of dried calyces/leaves to 2.0 litres of hotwater (1:57, w/v) and 35 g of dried calyces/leaves to 2.17 litres of hot water (1:62, w/v) respectively. The extraction time was varied (i.e. 20, 25 and 30 min respectively) while the extraction temperature was kept constant (i.e. 100 ± 2°C). At the end of each hot extraction, the extract was filtered using a clean muslin cloth after which the extract was cooled to ambient temperature (30 ± 2°C).

2.7. Treatment of Juice Samples

The concentrated juices extracted from both *Hibiscus sabdariffa* and *Lippia asperifolia* were treated to twenty-five peoples for each, including males and females, in which each individual was provided with 300 millilitres of extracted juice. Thirty minutes later after the treatment, the blood pressure of each individual was monitored by using the clinically validated Blood Pressure arm monitor.

3. Results

3.1. Data Analysis

Statistical analysis of obtained data in this work was performed by using statistical software packages of SPSS version 20. These analyses include constructing tables obtained from descriptive statistics as well as making comparisons of mean elemental concentrations. Finally, correlations tests were conducted to test the degree of association between elements in *H. sabdariffa* and *L. asperifolia*. Data is presented by using table format data presentation.

3.2. Level of Selected Elements in *Hibiscus sabdariffa* and *Lippia asperifolia*

The levels of iron, calcium, phosphorus, and potassium in *Hibiscus sabdariffa* and *Lippia asperifolia* were determined and fully explained in the subsections below.

3.2.1. Iron (Fe)

The results revealed that *Lippia sp.* contained high amount of Fe (3274 – 1282 mg/Kg) compared to *Hibiscus sp.* (933.4 - 703.3 mg/Kg). According to data analysis, *Lippia sp.* at Kombeni area showed to contain high amount of Fe (3274 mg/Kg) than that of Fuoni. The level of Fe (933.4 mg/Kg) in *Hibiscus sp.* was higher at Mtoni area.

(Figure 2). FAO/WHO RNIs level for Fe is 19.6 mg/Kg [10].

Different levels of iron content for *H. sabdariffa* calyces have been reported from several studies, such as that of [8] (164.78 mg/Kg), [11] (177 mg/Kg), [12] (32 mg/Kg), and [13] (8,330 mg/Kg). These differences in iron content can be associated with geographical sources where the calyces had been collected; furthermore, it could be linked to the difference soil contents and climatic factor. This study also revealed that *L. asperifolia* contained iron levels at a range of 3274 – 1282 mg/Kg., which is higher than that obtained from *H. sabdariffa* (Figure 2), which is also higher than the recommended daily allowable amount of iron present in the leaves (161 mg/Kg) as noted by Maregesi *et al.*, [8].

Following data analysis, it is clear that *L. asperifolia* contained high content of iron as compared to *H. sabdariffa*. The statistical analysis showed that the difference is significant with p value of 0.001. Therefore, *L. asperifolia* can be considered as a good source of iron over the *H. sabdariffa*.

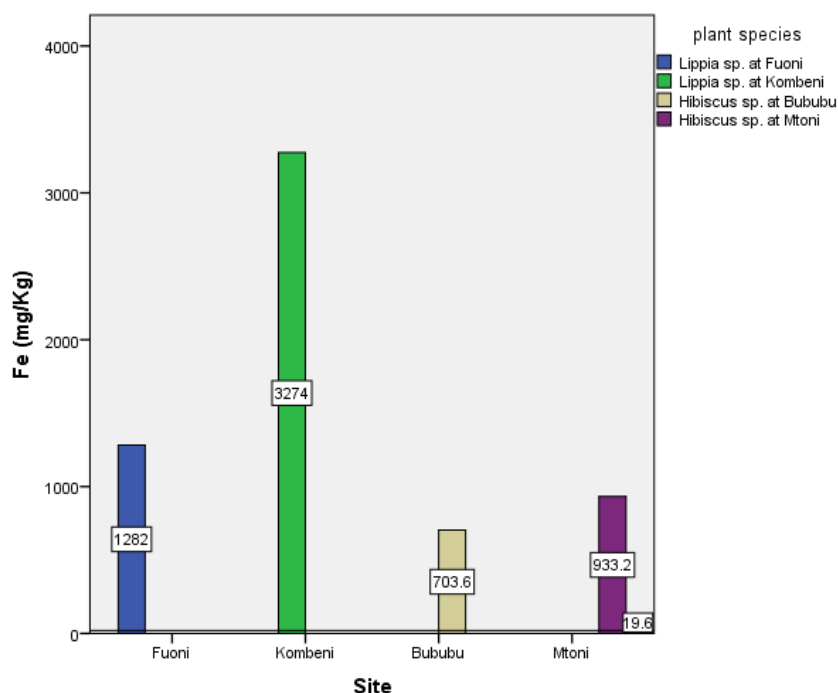


Figure 2. Level of Fe in *Lippia sp.* and *Hibiscus sp.*

3.2.2. Calcium (Ca)

Generally, the level of Ca in *Lippia sp.* ranged between 42869 – 35465 mg/Kg, compared with *Hibiscus sp.*; level of Ca was in the range of 16222 – 9215 mg/Kg. In the case of *Lippia sp.* the level of Ca (42869 mg/Kg) was higher at

Kombeni area than at Fuoni area. Whereby, the level of Ca (16221 mg/Kg) in *Hibiscus sp.* was highest at Mtoni area (Figure 3). This clearly shows that the level of Ca in present study is well above the RNIs of FAO/WHO, for Ca is 1300 mg/Kg [10].

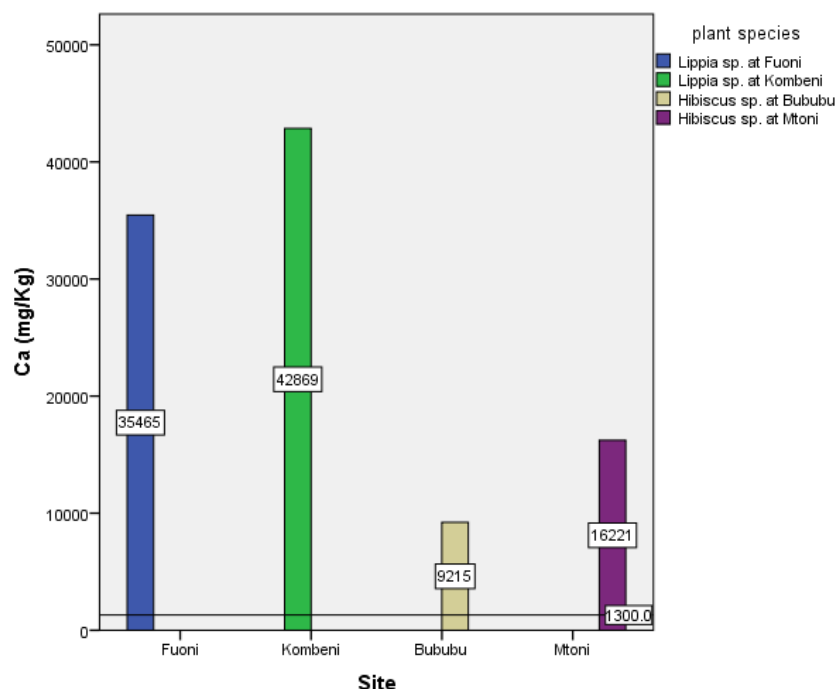


Figure 3. Levels of Ca in *Lippia sp.* and *Hibiscus sp.*

3.2.3. Phosphorous

In *Lippia sp.*, the levels of P contained were in the range of

3050 – 1549 mg/Kg compared to *Hibiscus sp.* (1986 to 993.5 mg/Kg). Remarkably, *Lippia sp.* at Kombeni area had higher amount of P (3050 mg/Kg) than *Lippia sp.* collected from

Fuoni areas. The level of P (1986 mg/Kg) in *Hibiscus sp.* was higher at Bububu area (Figure 4).

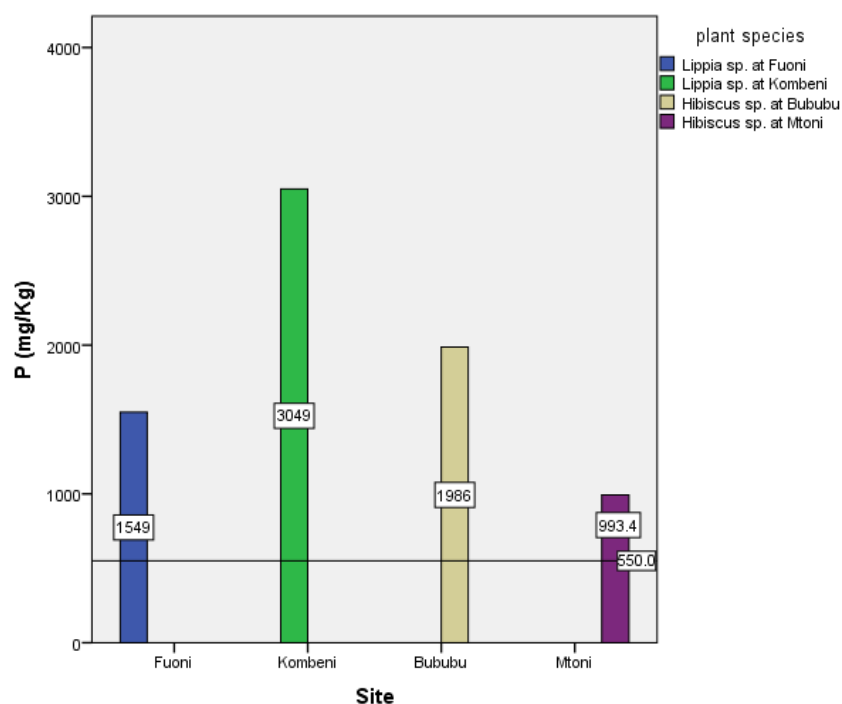


Figure 4. Levels of P in *Lippia sp.* and *Hibiscus sp.*

The RNIs level for P according to FAO/WHO, 2016 is 550 mg/Kg [10], revealing that the level of P reported in this study is above the RNIs (Figure 4).

3.2.4. Potassium (K)

In general, *Hibiscus sp.* contained high amount of K (22439 – 19354 mg/Kg) compared to *Lippia sp.*

(15635 – 11871 mg/Kg). Also according to the results, *Hibiscus sp.* at Mtoni area showed to contain high amount of K (22439 mg/Kg) than that of Bububu, and the level of K (15635 mg/Kg) in *Lippia sp.* was found to be high at Kombeni area.

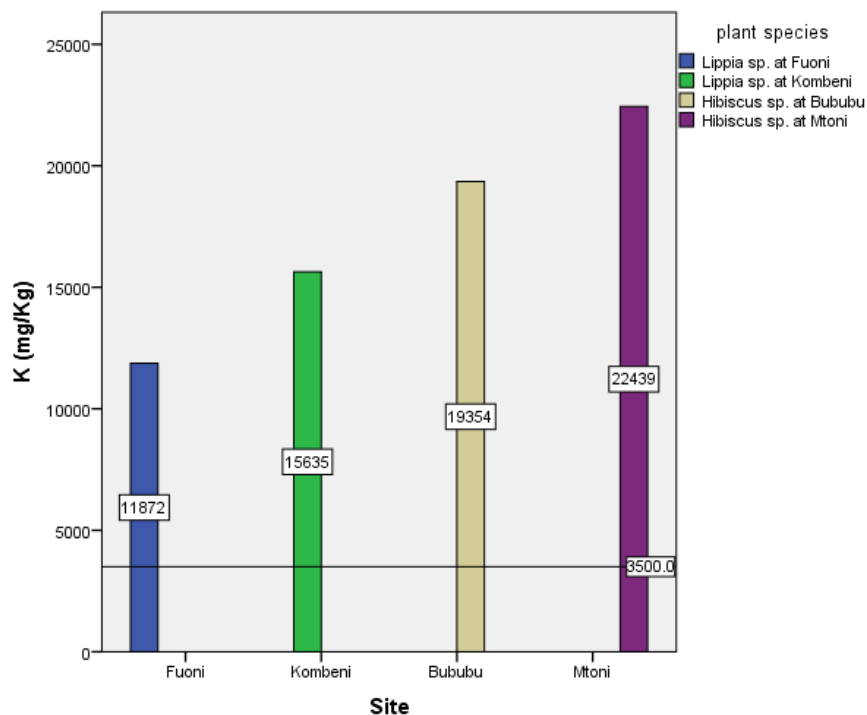


Figure 5. Levels of K in *Lippia sp.* and *Hibiscus sp.*

The FAO/WHO RNIs level for K is 3500 mg/Kg [10]. This shows that the level of K reported in this study is above the RNIs (Figure 5).

The possible effects of the use of *Hibiscus sabdariffa* and *Lippia asperifolia* juices on human blood pressure.

The juice extract from these two plant species have been found to lower both DBP and SBP and the lowering is

significant with $p = 0.001$ and $p = 0.002$ for both DBP and SBP respectively using the *L. asperifolia* juices extract.

Variation in SBP

The trends of SBP before and after the consumption of juices (made from *Hibiscus sp* and *Lippia sp.*) can be clearly seen from figure 6 and figure 7 respectively.

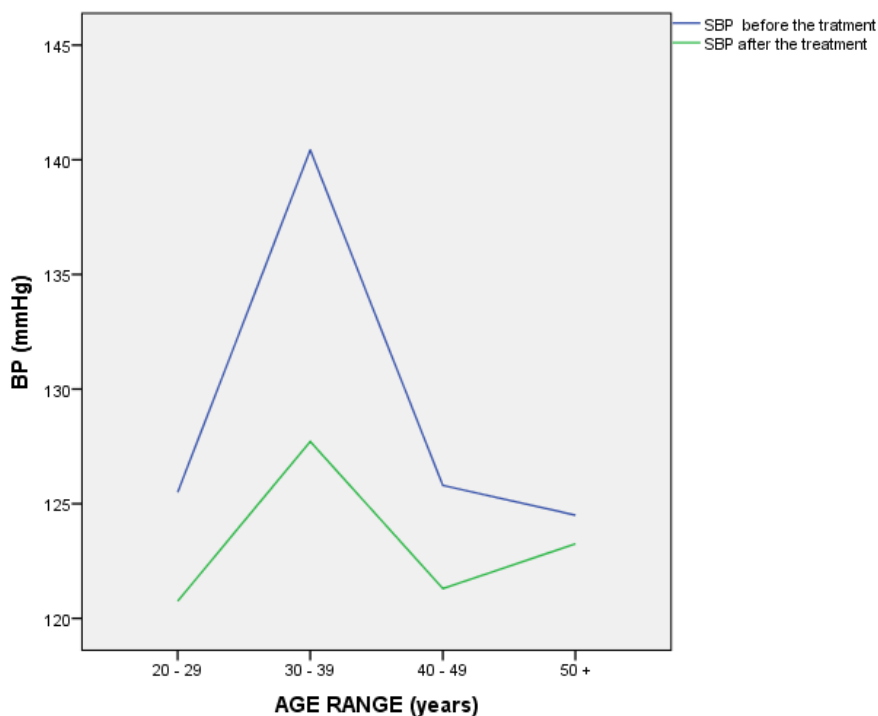


Figure 6. Effect of *Hibiscus sp.* juice on SBP.

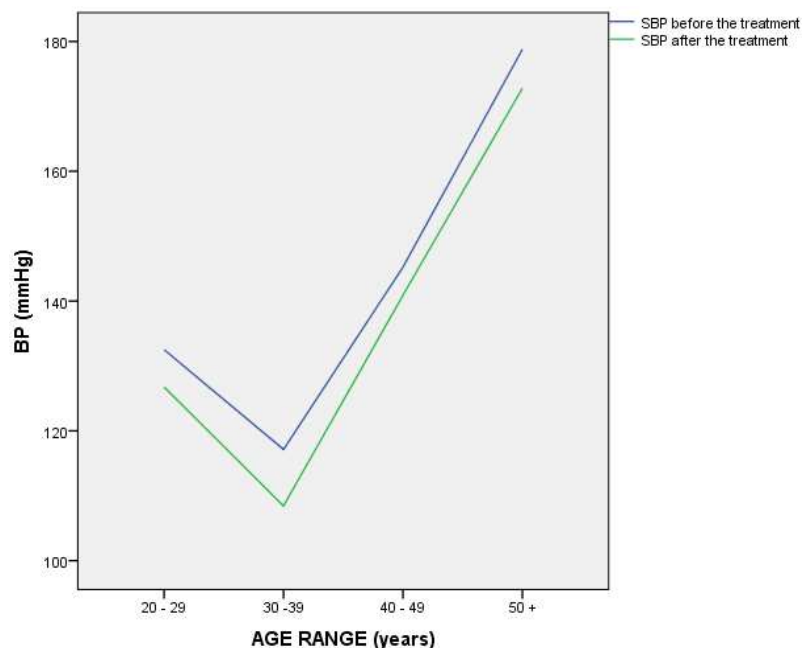


Figure 7. Effect of *Lippia sp.* juice on SBP.

The lines for SBP after treatment are lower than those of SBP before the treatment denoting a remarkable lowering in

SBP. The difference in SBP before and after the treatment of *Lippia sp.* juice was significant ($p = 0.002$). However,

variation in SBP was not significant when *Hibiscus sp.* was administered ($p = 0.609$).

Variation in DBP

The analysis showed the lowering in DBP in both *Hibiscus sp.* and *Lippia sp.* (Figures 8 and 9).

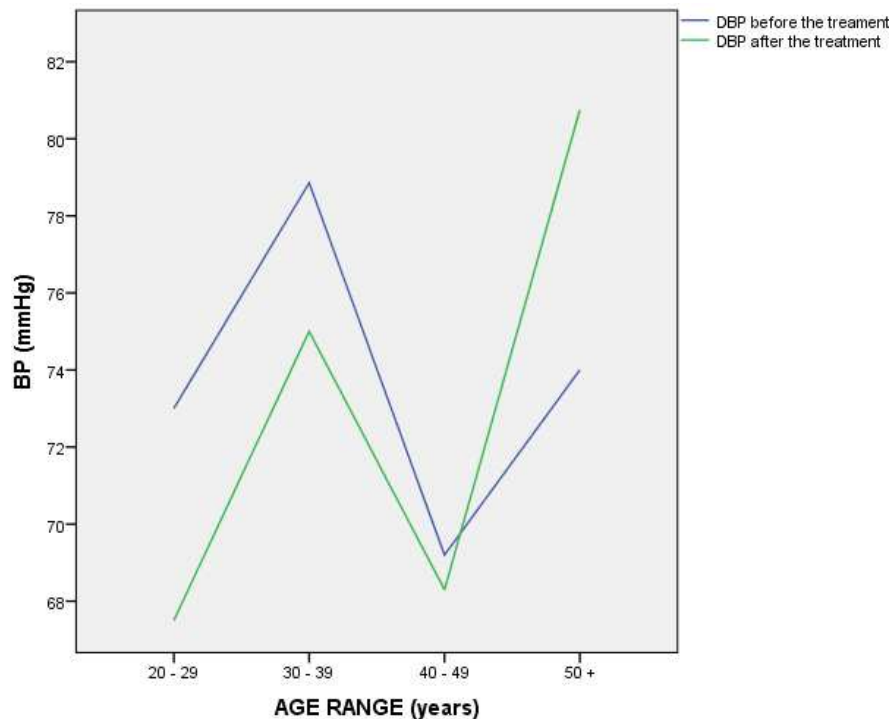


Figure 8. Variation of DBP using *Hibiscus sp.* Juice.

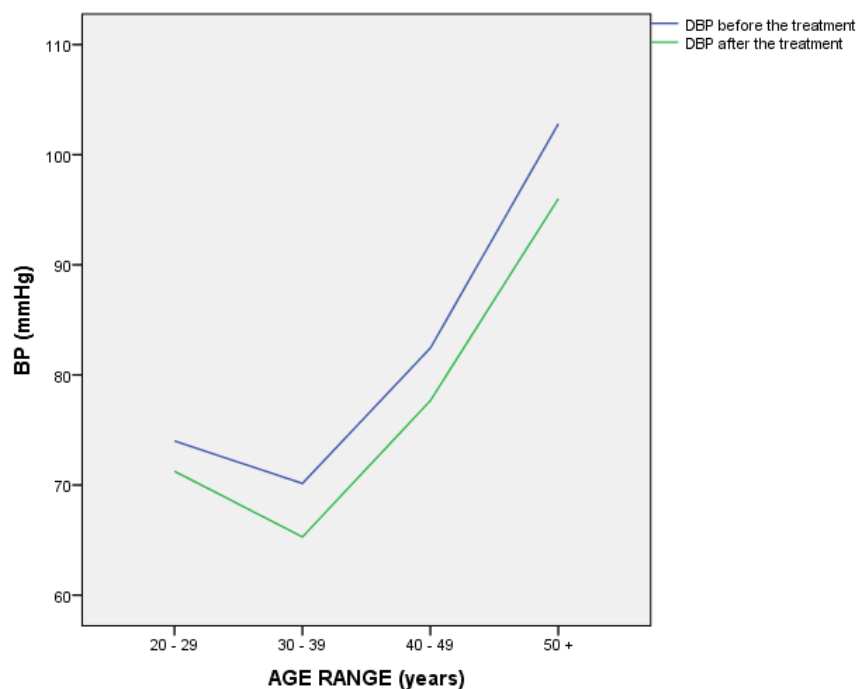


Figure 9. Variation of DBP using *Lippia sp.* Juice.

The value of $p = 0.001$ (significant difference) was noted for DBP after the treatment of *Lippia sp.* juice. The variation in DBP was not significant when juice of *Hibiscus sp.* was given to the participants ($p = 0.388$).

4. Discussion

From the analysis of K, Ca, Fe, and P in *Hibiscus sp.* and *H. sabdariffa* it has been observed that; Ca in *L. asperifolia* >

Ca in *H. sabdariffa*; Fe in *L. asperifolia* > Fe in *H. sabdariffa*; P in *L. asperifolia* > P in *H. sabdariffa*; K in *L. asperifolia* < K in *H. sabdariffa*, this shows that *L. asperifolia* is relatively an excellent source of Ca, Fe, and P as compared to *H. sabdariffa*. The findings from present study depict that, there is a significant decrease of SBP as well as DBP after the participants consumed the plants extracts, but the decrease of SBP and DBP was not significant when the juices (made from *H. sabdariffa*) were consumed by the participants.

5. Conclusion

Following data analysis, the use of juices made from *H. sabdariffa* calyces and *L. asperifolia* leaves could be a good source of raising the level human hemoglobin (high iron content present in these plant species). Comparatively, *L. asperifolia* (due to high iron content present) could be a good and preferred source for increasing human blood level. Nevertheless, people are obliged to seek medical advice before their frequent and long consumption of these plant materials, this due to their significant impact on human blood pressure.

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