

Research Article

Determination of iron contents in *Hibiscus sabdariffa* calyces and *Kigelia africana* fruit

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Abstract: Anaemia is one of the most common conditions encountered in primary care. Its consequences, although mild in most cases, are potentially very severe. Anaemia is caused by a number of factors including; dietary deficiency due to low intakes of dietary iron, vitamin B₁₂ and folic acid, inherited disorders or certain infections like malaria. This study aimed at determining the iron contents of the two plants used to treat iron deficiency anaemia in Tanzania namely; *Hibiscus sabdariffa* (calyces) and *Kigelia africana* (fruits). Iron content determination employed Atomic Absorption spectrophotometer. *Hibiscus sabdariffa* was found to contain a higher amount of iron content (164.78 mg/kg) than *Kigelia africana* (4.14 mg/kg). Presence of iron in both plants, justify their nutraceutical use as haemoglobin enhancer.

Keywords: Anaemia, *Hibiscus sabdariffa*, *Kigelia africana*, Iron

INTRODUCTION

Iron is essential to most life forms and normal human physiology. It is an integral part of many proteins and enzymes that maintain good health in humans and the regulation of cell growth and differentiation. Iron is an essential component of haemoglobin which is responsible for carrying oxygen in the body. Thus, iron deficiency limits oxygen delivery to cells, resulting in fatigue, poor work performance, and decreased immunity. On the other end, excess amounts of iron can cause toxicity and even death [1].

The plant *H. sabdariffa* is also known as roselle or rosella. It is reported to be antihypertensive, antiseptic, sedative, diuretic, digestive, purgative, emollient, demulcent and astringent [2,3]. The calyces are used to treat heart ailments, hypertension and leukemia. They are also reported to have diuretic, aphrodisiac, antiseptic, astringent, cholagogue, , sedative, laxative, and antimicrobial activity. They are also used as remedy for pyrexia and abscesses. [4,5]. The flowers and fruits are used for treatment of cough and bronchitis [6].

Phytochemical studies showed the presence of alkaloid, flavonoids, ascorbic acid, tannin, polyphenols, anthocyanin, oxalate and saponin [6]. Some of the confirmed biological activities employing animals and humans are lipid metabolism activity, antihypertensive effect and apoptosis [7,8].

In Tanzania, *H. sabdariffa* previously growing in the wild and regarded as farm weed except for the rural children who could eat the various parts especially the leaves and calyces as a snack. It is nowadays getting a special consideration due to its nutraceutical benefits as a

beverage particularly for treatment of iron deficiency anaemia. The plant is also used for the same purpose is in Uganda [9].

K. africana also called sausage tree is a native African plant belonging to the Bignoniaceae family. Various parts of plants are used traditionally for treatment of various diseases some of these are; skin ailments (fungal infection, boils, psoriasis and eczema), ulcers/wounds, haemorrhoids, rheumatism, venereal diseases, dysentery, pneumonia, antihelminthic, , malaria, diabetes, analgesic for toothache and backache, post-partum haemorrhage etc. [10,11]. Some of these ethnomedical claims have been confirmed in the *in vitro* biological testing e.g. antifungal and antibacterial activity provision of remedy for skin cancer [12].

K. africana fruits are large and very fibrous with numerous hard seeds generally not edible by humans as well as being poisonous when unripe. There are several food and beverage applications using fruit e.g. increase milk flow in lactating mothers, roasted seeds are eaten in Malawi during famine and the extract is used as an ingredient in beer fermentation,. Medicinally, its fruits are purgative and used as dressing for ulcers [13]. In Bunda district of Tanzania the fruit juice is used for treatment of anaemia particularly the pregnant women who cannot tolerate the taste of ferrous tablets [14]. Based on *Kigelia's* many potent health-promoting properties there is a parallel development of nutraceutical, cosmeceutical, and dietary supplement. [15].

Extracts of the fruits have been shown to exhibit various biological activities including; antibacterial and

antifungal [16,17], antioxidant [18], anti-inflammatory and antinociceptive activities, remarkable effect on solar hyperkeratosis and simple warts and moderate cytotoxic activity in the brine shrimp. Oral administration of the extract to mice showed significant reduction in tumor incidences by 67 % and tumor burden by 76% [15, 19]. In aquaculture studies, *K. africana* fruit meal was reported to enhance reproductive performance of cultured African catfish [20] and animal studies revealed the effect of fruit extracts on male infertility as a sperm booster to alleviate the oligo/azoospermia [21].

Isolated bioactives of *K. africana* fruit include; iridoids, naphthoquinones, phenylpropanoids and phenylethanoid derivatives [22, 23] and flavonoids [24]. Juices of both fruits are also taken by HIV-AIDS patients to raise the haemoglobin content and especially those taking antiretroviral drugs.

We are reporting the iron contents *H. sabdariffa* calyces and *K. africana* fruit as part of the on-going study of determining the nutritional value and metal analysis.

MATERIAL AND METHODS

Acquisition of plant material

The dry red calyces of *Hibiscus sabdariffa* (Malvaceae) was purchased from Institute of Traditional Medicine at Muhimbili University Health and Allied Sciences - Dar Es Salaam, Tanzania on 13/2/2012 and the fruits of *Kigelia africana* (Bignoniaceae) were collected from Kitonga village - Ruvu, Tanzania on 27/2/2012.

Determination of iron content

Method

Ashing by drying method for food analysis as described by Shimadzu [25] was employed in this work to free the iron atoms. Ferrous analysis was done by using atomic absorption spectrophotometer.

Equipment

Atomic absorption spectrophotometer – Model: AA-6300 Shimadzu Company AAS Graphite Furnace from Japan.

Chemicals

Analytical reagent Nitric acid, Hydrochloric acid and Standard Iron solution were purchased from Scharlau Company, South Africa.

Sample preparation

Powdered 5 g of the sample was air dried and placed in a quartz beaker then it was heated gently and continuously on a hot plate until enough water is driven off for partial carbonization to occur. The beaker was placed in an electrical furnace and the heat rate was increased at 100 °C per 1 hour up to 500° C where it was heated for three hours to conduct ashing. The

sample was wetted with 2-5 ml of nitric acid, dried and heating continued at 500°C to attain complete ashing. Two to four (2 - 4 ml) of water were added to the ash, then dried followed by addition of 5 ml of hydrochloric acid to dissolve the salts. Water was used to make fixed volumes of measurement solutions.

Preparation of standard iron solution

Four standard solutions containing 0.5, 1, 1.5, and 2 mg/L in 100 ml for each were prepared.

Measurement of iron content

Both standard iron solutions and ferrous content in the filtrate was determined by the Atomic Absorption Spectrophotometer. Ferrous content in plant tissue is expressed on oven dry weight basis, after determining moisture content in a sub-sample of fresh plant. Determination of iron for each plant sample was carried out in triplicate.

RESULTS AND DISCUSSION

The iron content

Our results showed that, *H. sabdariffa calyces* contain 164.78 mg/kg of iron. Different values of iron content for *H. sabdariffa* have been reported from the previous studies containing 32.2 mg/kg [26] and 177 mg/kg [27] while another study showed the calyces to contain 8,330 mg/kg [28] This can be associated with geographical sources from where the calyx had been obtained having different soil, climate among other factors. The iron content is also higher than that of the common green vegetable *Spinacia oleracea* (27.1 mg/kg) [29] which is a popular recommended vegetable for people suffering from iron deficient anaemia in Tanzania. The recommended daily allowance for iron is 8mg/day and 18mg/day for adult males and females respectively [1], implying the consumption of 50g or 109 g of calyces to obtain these amounts which are bearable.

This study also revealed that, *K. africana* fruit contain 4.14 mg/kg of iron which is lower than the recommended daily allowance and the amount reported in the in leaves i.e.161mg/kg in the previous study [30]. It should also be noted that this value was obtained from a single fruit collected far away from place where the plant is used i.e. Mara region of Tanzania. Soil composition and climate have their contribution to the metal composition of various plant parts. Since previous studies by acute toxicity tests indicated the fruits being non-toxic [31], we are encouraged to work on this plant. Our team is currently collecting several samples from various locations and different stages of development for analysis in order to determine not only the iron levels but macro and macronutrient contents and carry out the proximate analysis. This will show the nutritional and metal profiles as well as giving a better statistical analysis to give justifiable recommendation and help in the formulation and standardization of *K. africana* fruit as a nutraceutical.

CONCLUSION

In the plants iron occur as salts which have an astringent action resulting in irritation of the gastrointestinal mucosa leading to gastric discomfort, nausea, vomiting and diarrhea or constipation. Vegetable drugs with high iron contents may result into causing toxicity, the observed iron contents of *H. sabdariffa calyces* and *K. africana* fruit cannot subject the user to the toxic levels. From the results, the use of *H. sabdariffa calyces* and *K. africana* fruit juices to raise the haemoglobin level is justifiable. To best of our understanding this is the first report for *K. africana*. A more comprehensive study regarding the nutritional profile and metal content of this fruit is required.

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