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EVALUATION OF MACRO AND MICRO ELEMENTS IN *DURIO ZIBETHINUS* MURR AND THEIR BIOLOGICAL ROLES ON HUMAN PHYSIOLOGY

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ABSTRACT

Durio zibethinus Murr. (Durian) is a medicinal plant that belongs to the family Bombacaceae. In tradition, the decoctions of the leaf and root have believed to show antipyretic effect and can also be used as a febrifuge and anti-malarial agent. In the present study, the concentrations of essential macro and micro elements were determined using Energy Dispersive X-ray Fluorescence techniques (EDXRF) being the most suitable instrument for the multi-element analysis in plant samples. Two macroelements- calcium (Ca) and potassium (K); and seven microelements- iron (Fe),manganese (Mn),zinc (Zn),copper (Cu), rubidium (Rb), strontium (Sr) and bromine (Br) were analyzed in different parts (leaves, stem-bark and roots) of Durio zibethinus Murr. The results revealed the levels of the two macroelements and seven microelements in Durio zibethinus leaves, stem-bark and roots. The levels of elements in different plant parts were found not to be significantly different ($p < 0.05$). This study is based on the elemental concentration in different parts of studied plant and their biological roles on human physiology. And the findings show that the plant contains important elements for human metabolism and prevention or healing of diseases.

Key words: *Durio zibethinus* Murr, macroelements, microelements, Energy Dispersive X-ray Fluorescence (EDXRF)

INTRODUCTION

1.0 HERBAL MEDICINE

Herbal medicine has become a topic of global importance during the last few years; resulted in impact on both world health and international trade. Since ancient times, herbal drugs are used in traditional systems of medicines which can be obtained from different parts of plants, like leaves, stem, bark, root, flower, seed or the whole plant (Joy et al., 2001). In developing countries the use of traditional herbal medicine is generally accepted and has been extended to the industrialized nations as a way to treat and prevent diseases according to a WHO report (WHO, 2003).

1.1 INORGANIC ELEMENTS IN MEDICINAL PLANTS

The inorganic elements in medicinal plants play significant roles in human physiology. They are the principal co-factors in enzymes production; also needed for the maintenance and regulation of cell, genes and membrane function (Babu et al., 2015). Hence, the deficiency of these elements in human body results in the reduced activity of the concerned enzymes (Wada, 2004).

2.0 *DURIO ZIBETHINUS*

Durio zibethinus Murr (Durian) is a medicinal plant that belongs to the family of *Bombacaceae* and cultivated in the tropical rain forest of Malaysia and the Southeast Asian countries (Bhore et al., 2012; Bautista et al., 2012). Durian is known as "King of Tropical Fruit" owing to its high nutritional status and its appearance that resembles the thorny thrones of Asian kings (Subhadrabandhu & Ketsa, 2001). Its fruit pulp is an excellent source of nutrients containing proteins, dietary fat, fibers, and carbohydrates (Bhore et al., 2012).

The durian leaf and root decoctions show antipyretic (Leontowicz, 2011), febrifugal effects (Brown, 1997) and anti-malarial agent (Bhore et al., 2012), relieve colds; treat phlegm, jaundice, swellings and skin diseases (Bautista et al., 2012). Its fruit is known to have potential medicinal and therapeutic (Chansiripornchai and Pongsamart, 2008), anti-oxidant (Ang et al., 2018), anti-cancer, anti-cardiovascular, anti-diabetic (Leontowicz et al., 2007; Siburian et al., 2019) and anti-obesity properties

(Leontowicz et al., 2008). It can also improve digestion, lower the blood pressure and relieve the symptoms of anxiety and stress disorders (Kumar et al., 2005; Haruenkit et al., 2007). (Ho and Bhat, 2015). According to Ansari (2016), the durian fruit pulp has potential fertility enhancing agent and effective to treat infertility in PCOS (polycystic ovarian syndrome). Durian fruits have also shown anti-proliferative activities as being reported by Jalil and Aziz (2019).

However, limited studies exist regarding the essential macro and micro elements present in different parts of *Durio zibethinus*, and taking into account the importance of these elements in various human metabolic processes and their curative properties, the required safety measures must be taken. The present study aimed at estimating the quantity of macro and micro elements in different parts of *Durio zibethinus*, as well as, their biological roles on human physiology.

MATERIALS AND METHODS

3.0 PLANT COLLECTION AND PREPARATION

Fresh plant materials of *Durio zibethinus* Murr., were collected from the premises of Igbinedion University, Okada, Edo State, Nigeria. Plant materials were identified by the herbarium curator of Department of Plant Biology, University of Ilorin and authenticated by comparing it with authentic specimen at the Botanical Survey of India, Coimbatore with Voucher No. UILH/001/1371. The plant materials were thoroughly washed, chopped into smaller pieces and air-dried at room temperature (26°C) for 12 weeks. The dried plant materials were ground into fine powders using an electrical grinder, stored in air-tight glass containers and kept away from sunlight to avoid photo-oxidation reactions.

3.1 EXPERIMENTAL SETUP

Energy Dispersive X-ray Fluorescence (EDXRF) spectrometry (Model: ECLIPSE III, AMTEK INC. MA; USA) was used to analyze the plant parts (leaves, stem-bark and root) using standard method of Buhrke et al. (1998). Powder pellet was prepared by mixing 2 g of plant powder with 0.2 g of pure wax (Hoechst Cridust wax) and homogenising the mixture by using an agate mortar. The prepared sample was pressed at 20 ton for 120 sec. to obtain a cylindrical pellet 40 mm in diameter. The standard solution with known content of elements was deposited onto a pellet of pressed plants using micropipette. After drying at room temperature, this pellet was homogenized and again pelletized under the same conditions as for the

analyzed sample. The quantitative analysis of the sample was carried out using the XRF-FP Quantitative Analysis Software package which converts elemental peak intensities to elemental concentrations.

3.2 STATISTICAL ANALYSIS

The statistical analysis was carried out with IBM SPSS version 25. All data were expressed as mean ± SD (n =3). Statistical differences between the plant parts were identified by using one-way ANOVA and the degree of freedom was $p < 0.05$.

RESULTS AND DISCUSSION

4.0 RESULTS OF CONCENTRATION OF MACRO AND MICRO ELEMENTS

The results of the concentration of essential macro and micro elements in medicinal plants are shown in Table 1. Quantitative analysis of two macroelements (Ca and K) and seven microelements (Fe, Mn, Zn, Cu, Rb, Sr and Br) was done. These results revealed the levels of the two macroelements in *Durio zibethinus* leaves, stem-bark and roots as 3.58 ± 0.04 wt.%, 6.13 ± 0.06 wt.% and 3.42 ± 0.05 wt.% respectively for Ca while K levels were 4.53 ± 0.07 wt.%, 3.48 ± 0.07 wt.% and 5.06 ± 0.10 wt.% respectively. The levels of the microelements in the leaves, stem-bark and roots of the plant were 219 ± 8.0 ppm, 69 ± 3.0 ppm and 622 ± 14.0 ppm respectively for Fe; Mn levels were 92 ± 2.0 ppm, 58 ± 1.0 ppm and 108 ± 3.0 ppm respectively; Cu levels were 26 ± 1.0 ppm, 21 ± 1.0 ppm and 30 ± 1.0 ppm respectively; Zn levels were 75 ± 3.0 ppm, 40 ± 3.0 ppm and 96 ± 4.0 ppm respectively; Rb levels were 9 ± 1.0 ppm, 7 ± 1.0 ppm and 10 ± 1.0 ppm respectively; Sr levels were 16 ± 1.0 ppm, 7 ± 1.0 ppm and 34 ± 2.0 ppm respectively and Br levels were 7 ± 1.0 ppm, 1 ± 1.0 ppm and 6 ± 1.0 ppm respectively. The levels of elements in different parts of the plant were found not to be significantly different ($P< 0.05$). These elements are vital in human metabolism and essential for the growth of living organisms.

Table 1: Metal content in leaves, stem-bark and root of *Durio zibethinus*.

Elements	Conc. in Leaves ± SD	Conc. in Stem- bark ± SD	Conc. in Root ± SD
Ca (wt. %)	3.5775 ± 0.04	6.1283 ± 0.06	3.4240 ± 0.05
K (wt. %)	4.5343 ± 0.07	3.4796 ± 0.07	5.0641 ± 0.10
Fe (ppm)	219 ± 8.0	69 ± 3.0	622 ± 14.0
Mn (ppm)	92 ± 2.0	58 ± 1.0	108 ± 3.0
Cu (ppm)	26 ± 1.0	21 ± 1.0	30 ± 1.0
Zn (ppm)	75 ± 3.0	40 ± 3.0	96 ± 4.0
Rb (ppm)	9 ± 1.0	7 ± 1.0	10 ± 1.0
Sr (ppm)	16 ± 1.0	7 ± 1.0	34 ± 2.0
Br (ppm)	7 ± 1.0	1 ± 1.0	6 ± 1.0

All data were expressed as mean ± SD (n =3).

4.1 BIOLOGICAL ROLES OF MACRO AND MICRO ELEMENTS

The function of inorganic elements in human metabolism has long been established. In order to maintain good health, macro and microelements influence many biochemical processes. Major and trace elements as regards medicinal plants play significant roles in combatting diseases (Rajurkar and Damame, 1997; Pandey et al., 2006). Herbs usually accumulate both essential and non-essential metals from soil and environment during their growth. Thus, the practical understanding of metal content to evaluate the quality of herbal products is extremely important.

Calcium (Ca) is responsible for keeping bones strong and regulates cellular activities and cellular mortality. It also reduces the risk of osteoporosis and its deficiency produces skeletal muscle spasms and abnormality in heartbeat (Khan et al., 2011).

Potassium (K) is the predominant positively charged ion inside body cells. It plays a major role in maintaining fluid, electrolyte balance, cell integrity, heartbeat and reducing hypertension (Frances and

Elcanor, 1999). The shortage or excess of K can affect human health (Ekinci et al., 2004).

The function of iron (Fe) in the body is associated with hemoglobin and the transportation of oxygen from lungs to the tissue cells (Sigel, 1978). Its shortage causes nutritional deficiency in humans (Reddy et al., 1987).

Manganese (Mn) is important for several enzymatic processes; it helps in in metabolizing protein and carbohydrates in the body (Wang et al., 2008); eliminating fatigue and reduces nervous irritability (Hamilton et al., 1994; O'Dell and Sunde, 1997).

Copper (Cu), being a constituent of several enzymes, involved in metabolic reactions in the body and responsible for the maintenance of healthy heart and blood vessels; for the development of bones and nervous system (Fox, 2003). Low level of Cu causes iron deficiency in humans, that is, anti-anaemic (Barreau and Solomon, 1979).

The normal functioning of various enzymes is attributed to the presence Zn metal. Zn deficiency leads to the loss of appetite, growth retardation, weakness and stagnation of sexual growth (Saracoglu et al., 2009).

Rubidium is closely related with potassium in metabolism, and it shows interchangeability with potassium in a variety of biological systems with little evidence for any toxicity (Lombeck, et al., 1980). In biological systems, calcium can be interchanged with strontium in the human body; most of the absorbed strontium is deposited in the bones (Pors- Nielsen, 2004). The plant stem-bark containing a fairly good amount of Bromine (Br) is an indication that the plant can be used for the preparation of the drugs in curing natural diuretic, phlegm eliminating and stomach invigorating diseases (Chen et al., 1993). From EDXRF analysis results, it is obvious that *Durio zibethinus* accumulates essential elements in significant concentrations indicating that the plant is a good source of nutrient elements with potential therapeutic benefits.

CONCLUSION

The levels of Ca, K, Fe, Mn, Zn, Cu, Rb, Sr and Br in different parts of *Durio zibethinus* indicate that the plant is a good source of nutrient elements with potential therapeutic benefits. It is therefore recommended that the plant material may be useful in the formulation of nutritional and/or therapeutic products.

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