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Elemental Analysis of Different Plant Parts of Grewia Mollis From Nhama, Hauwal Local Government Area of Borno State

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Abstract: *The safety and quantity of herbal medicine and foods have become increasingly important for health authorities, nutritionist, scientist and the general public. Natural products have provided important therapeutic and nutritional use in many areas of life. Grewia mollis is a plant used as a food and as a medicine and may contain different phytochemicals and elements which may be responsible for the therapeutic and nutritional activities it shows. This study looked at the concentrations of some of the elements present in different parts of Grewia mollis and compared them with the recommended values set by WHO and other countries for edible or medicinal plants. The elements arsenic, barium, iodine, sulphur, antimony, scandium, selenium, strontium, titanium and vanadium were analysis in the root bark, stem bark and leaves of Grewia mollis were determine using ICP-OES technique and wet digestion method. The elemental concentration in different parts of the plant and their biological effects on human and animals were discussed. The concentrations of most of the elements were within the recommended limit by WHO and other countries for edible plants and medicinal plants.*

Key words: Grewia mollis, plant parts, elemental composition, ICP-OES

1. Introduction

Historically, plants have provided a good source of anti –infective agents which are highly effective instruments in the fight against microbial infections, cancer and degenerative diseases. Seeking remedies for human ailment from the environment has formed the basis for therapeutics investigations of plant sources (Oluwole, *et al*, 2007).

Herbal medicine involves the use of plants for medicinal purposes. The term “herb” includes leaves, stems, flowers’ fruits, seeds, roots, rhizomes and barks (Gordon *et al*, 2001). The uses of plants for healing purposes have been the most ancient form of medicine known. The quest for plants with medicinal properties continues to receive attention as scientists are in need of plants, particularly of ethno botanical significance for a complete range of biological activities, which ranges from antibiotic to anti cancerous (Gandhiraja *et al*, 2009).

Natural products and their derivatives are obtained from the medicinal plants, which play a significant role in the discovery of modern drugs. The medicinal values of some plant species used in the homoeopathic system may be due to the presence of trace or macro elements (Vartika *et al.*, 2001). Mineral nutrients are usually present in plants in low concentrations and they fluctuate to a great extent, with respect to both space and time and also due to environmental factors such as weather, climate and physico-chemical properties, including soil type, soil pH and erosion (Chaves *et al*., 2013; Maathuis and Diatloff, 2013). Medicinal plants possess some important elements in small doses, which have both therapeutics and prophylactic properties. The elements are referred to as trace or macro elements (Hutchinson and Dalziel, 1963).

The ethno pharmacology provides an alternative approach for the discovery of therapeutic agent, namely the study of medicinal plants with a history of traditional use as a potential source of substances with significant pharmacological and biological activities (Ambasta, 1992).

Several plants and herbs species used traditionally have potential antibacterial, antifungal antitumor, antitoxic and antiviral properties (Mshelia *et al*, 2016a; Mshelia *et al*, 2016 b; Mshelia *et al*, 2008; Akinniyi *et al*, 2007; Zaria *et al*, 1995; Shelef, 1983; Zaika,1988) and this has raised the optimism of scientists about the future of bioactive agents (Das *et al*,1999). The major chemical substances of interest in plants were the secondary metabolites and the elements which are naturally occurring substances (Lozoya and Lozaya, 1989). There is currently a large and ever expanding global population base that prefers the use of natural products in treating and preventing medical problems because herbal plants have proved to have a rich resource of medicinal properties (Gandhiraja *et al*, 2009).

In recent years, several authors all across the world, reported many studies on the importance of elemental constituents of the herbal drug plants which enhanced the awareness about trace elements in these plants (Wong *et al*, 1993) in China; (Sharma *et al*., 2009) in India; (Sheded *et al*., 2006) in Egypt; (Koe and Sari, 2009; Basgel and Erdemoglu, 2006) in Turkey; (Ajasa *et al*., 2004) in Nigeria; (Kanias and Loukis, 1987) in Greece.

Absorption of heavy metals through food has been shown to have serious consequences on health and thereby economic development, associated with a decline in labour productivity as well as increased direct costs of treating illness- such as kidney disease, damage to the nervous system, diminished intellectual capacity, heart disease, gastrointestinal diseases, bone fracture, cancer and death (Jarup, 2003). The excessive uptake of certain minerals by food crops from contaminated soils might have detrimental effects on food safety and quality, thus imparting detrimental impacts on human health.

Plants are used medicinally in different countries and are a source of many potent and powerful drugs (Srivastava *et al*, 1990). The beneficial medicinal effect of plant materials typically results from the combinations of secondary products present in the plant and the trace elements. The medicinal actions of plants are unique to a particular plant species or group and are consistent to the concept of the combination of secondary products, which are taxonomically distinct (Wink, 1999). The plant Grewia mollis has a history of use for the treatment of various ailments and the most commonly used part for this purpose is the root bark, seed, fruit, leaves and stem bark. The present study intends to determine the concentrations of some elements present in the leaves, stem bark and root bark of Grewia mollis.

Grewia mollis belong to the family Tiliceae and occurs widely in Tropical Africa, from Northern Nigeria, Senegal and Gambia Eastward to Somalia and Southward to Angola, Zambia and Zimbabwe (Burkill, 2000; Katanda *et al*, 1995; Kokwaro, 1993). Grewia mollis is a shrub or small tree that grows up to 10.5m tall (Sharma, 2002).

Various part of the pant were used in food and medicine, the fruit is used for the treatment of malaria fever (Fowller, 2006), while a medicinal salt is obtained from the ash of the stem and leaves which has been used for treatment of stomach ache (Persson, 1982). The powdered dried leaves and the stem bark have been used in soup preparation by the Bura and Tangele people.

The water extract of the stem bark is used as anti rat and ant termite by the local people. The mucilaginous bark and leaves are applied to ulcers, cuts, sores and snake bites while the bark and root preparation are taken to treat cough (Lockett *et al*, 2000; Brink, 2007). In East Africa, the leaves are pounded and mixed with water and taken against stomach problem and also given to constipated domestic animals (Ruffo *et al* 2002). Some findings showed that the mucilage obtained from the stem bark can be used as a good binder in paracetamol formulation (Martins *et al*, 2008 and Muazu *et al*, 2009).

The decoction of the leaves is used in baths and drinks against rickets in children and difficult birth (Lockett *et al*, 2000). Grawia mollis is frequently used in traditional ritual in Sudan and Ethiopia (Persson, 1982).

2. Material and Methods

Collection of Plant Material

The *Grewia mollis* plant parts were collected in Hawul local Government Area of Borno State. The collection was done in September when the leaves were green. The infected parts were removed and the healthy fresh part was air dried under a shade and pulverized using motorized miller.

Reagents: All the solvents and reagents used for this work were of Analar grade. Distilled water was used as solvent for solution preparation and all glass wares were washed, cleaned and dried in an oven at 105^{o}C.

Analytical Procedure

The Wet digestion method was used to digest the sample, 1gm of the sample was transferred into the digestion tube. 5ml of nitric acid-perchloric acid mixture (2:1 by volume) was added and the content mixed. The tube was placed into the digestion block inside a fume cardboard and the temperature controlled of the digestor set at 150^{o}C and digested for 1hour 30minutes. The temperature was then increased to 230^{o}C and digested for 30minutes. The digestor temperature was then reduced back to 150^{o}C for 30minutes. The digestor was then switched off and the tube removed and about 30ml of distilled water added to the tube within few minutes. The concentrated digest was not allowed to cool to room temperature to prevent the formation of in soluble precipitate. More water was then added to the tube to make up to mark on the tube and the content mixed thoroughly. The ICP-OES (Inductively Coupled Plasma-Optical Emission Spectrometry) method was used for the quantitative analysis of the elements in all samples. To determine the elemental levels, AOAC methods were used (AOAC 1996, 2003, 2012).

TABLE1: ELEMENTAL COMPOSITION OF GREWIA MOLLIS PLANT PARTS

S.NO.	ELEMENTS	SYMBOL	PLANT PARTS (ppm)

			LEAF	STEM BARK	ROOT BARK
1	ARSENIC	As	7.595	53.430	62.060
2	BARIUM	Ba	96.600	117.500	685.200
3	IODINE	I	173.300	3017.000	1699.000
4	SULPHUR	S	0.000	3211.000	5320.000
6	ANTIMONY	Sb	0.000	3.582	0.000
7	SCANDIUM	Sc	0.183	0.000	0.052
8	SELENIUM	Se	0.000	20.310	1.936
9	STRONTIUM	Sr	0.000	451.900	0.000
10	TITANIUM	Ti	256.600	25.720	144.900
11	VANADIUM	V	0.000	0.000	0.000

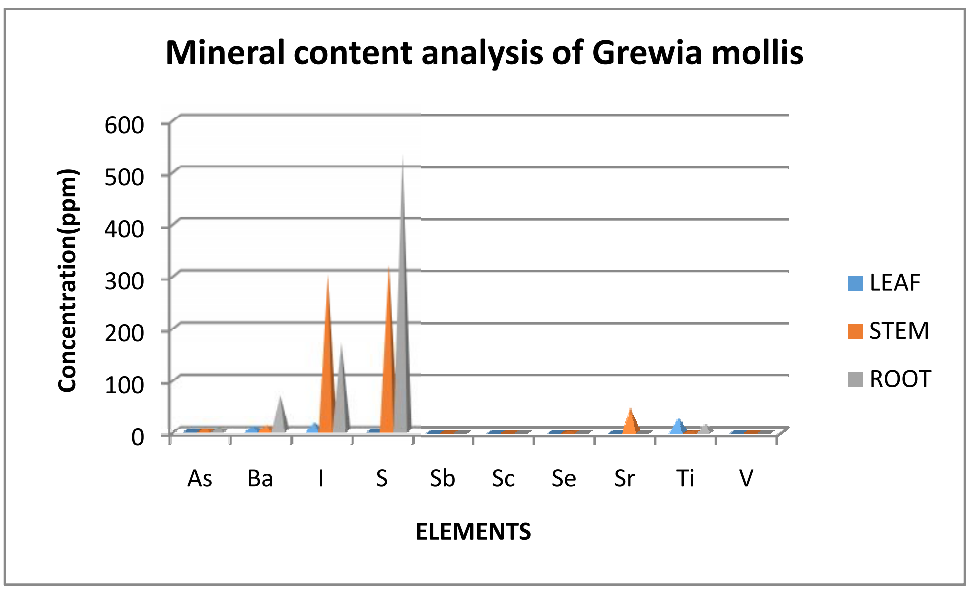

Fig. 1: Trace elements in various parts of Grewia mollis

Arsenic

The highest concentration of arsenic in the Grewia mollis was found in the root bark 62.06ppm followed by the stem bark 53.43ppm, while the least was found in the leaves 7.595ppm. The concentration of arsenic in the Grewia mollis is high above the one recommended for medicinal plants of 1.00ppm. The excessive use of the lead causes arsenic poisoning by the arsenic. Arsenic is required in ultra-trace amount. Arsenic poisoning may cause death through enzyme inhibition. The recommended concentration of arsenic in medicinal plants is less than 1.0 ppm. Excess of arsenic results in dermatitis, metabolic disorder, lung cancer, cardiovascular effects and neurological effects (Zhang *et al*, 2002). The arsenic content in the plants parts was found to be above recommended amount for medicinal plants therefore its consumptions should be done with care.

Barium

Barium is present as a trace element in both igneous and sedimentary rocks although it is not found free in nature (USEPA 1985). Most foods contains less than 0.002mg of barium per g (Gormican, 1970) some cereal product and nuts may contain high levels of barium (Mertz 1986). The concentration of barium in the Grewia mollis showed that the leaves concentration is 96.60 ppm, the stem bark is 117.50ppm and the root bark is 685.20 ppm. The recommended value of barium in drinking water is 2.00ppm (AFTSD, 2008) while the recommended daily intake is 140µg/g (CDER, 2015). The barium content of the Grewia mollis is very high when compared to the recommended concentration. The long term mean dietary barium intake for adult has been found to be 0.75mg/day including food and fluids (ICR, 1975) 0.6mg/day from total diet (IPC5,1990) and 1.24mg/day for food only (Schroeder et al 1972). Long term use of barium will cause hypertension, kidney damage (USNTP, 1994; IPCS 2001). Short term exposure can cause abdominal cramps, diarrhoea, vomiting, difficulties in breathing, increased or decreased blood pressure, numbness (NAS/NRC,1999; Lokeshappa *et al* ,2012).

Barium is not considered to be an essential element for human nutrition (Schroeder *et al* 1972). At high concentration barium causes vasoconstriction by its direct stimulation of arterial muscle, convulsion and paralysis (Stockinger, 1981). The acute toxic oral dose is between 3 and 4 g (Reeves, 1986; ICPCS 1990).

Iodine

Iodine is an essential microelement which plays an irreplaceable role in metabolism process (Gerber et al 1999; Weng *et al* 2013). Recommend daily requirement for iodine per day is 150µg in adolescent and adult WHO 1996; Bruno *et al* 2008). Iodine is a trace element that is essential for the synthesis of thyroid hormones in vertebrates, although iodoproteins are present in invertebrates (Frieden, 1984). Not less than 5% of the world’s population have goiters and many of these are associated with other disorders and constitute a major public health problem (Gaitan, 1990).

The highest concentration of iodine in the Grewia mollis were seen in the stem bark 3017.00ppm followed by the root bark 1699.00ppm and the leaves 173,30 ppm . When comparing the iodine content of Grewia mollis with the standard for fruits which is less than

30ng/g and vegetables less than10ng/g (Pennington *et al* 1995). Iodine is a basic component of the thyroid hormones, thyroxine and mono-, di-, and tri-iodothyronine and it is stored in thyroid as thyroglobulin (Hays and Swenson, 1985; Murray *et al*., 2000). Iodine deficient diet causes a wide spectrum of illness including goiter and mental retardation. The oral intake also includes iodine from water and beverages; however food provides by far the major contribution to the total iodine intake (Park *et al*, 1981). Presently the main additional iodine source beside the food is iodized kitchen salt (Burgi, 1998; Haldimann *et al* 2005. It is well known, however that iodine is characterised with bilaterial threshold; either overdose of iodine or deficiency of iodine can cause adverse effect (Wang and Zhang,1985).

Sulphur

The leaves of Grewia mollis showed total absence of sulphur while the stem bark showed a concentration of 3211.00ppm and the root bark 5320.00ppm. No data on the sulfate content of foodstuffs were found; however, sulfates are used as additives in the food industry (Codex Alimentarius Commission, 1992). The estimated average daily intake of sulfate in food in the USA is 453 mg, based on data on food consumption and reported usage of sulfates as additives (NAS, 1972; Informatics Inc., 1973). Sulfites and sulfides are also present in food. Sulphur is present in three amino acids which are cystine, cysteine and methionine. Connective tissue, skin, hair and nails are rich in sulphur. Also, thiamine and biotin member of vitamin B complex and coenzyme A contain sulphur in their molecules (Malhotra, 1998). Proteins vary widely in sulphur content, depending on their amino acid composition.

Scandium

Table1 showed that the concentration of scandium in the parts of Grewia mollis is 0.183ppm in the leaves, 0.052ppm in the root bark and zero in the stem bark. Scandium occurs in trace concentrations in the soil and plants, but widely distributed in nature. Literature concerning the bio chemistry of Scandium is limited and its biological role is rather unclear. Little is known about ecotoxicity of Scandium and it has been argued that Scandium is scarcely toxic (Bowen 1966) however (Luckey, 1977) indicated that Scandium may be carcinogenic. Wyttenbach *et al* (1994) reported that scandium cannot be taken up actively by plants making its absorption difficult.

Antimony

The concentration of antimony of Grewia mollis in showed 3.582ppm in the stem bark while the leaves and the stem showed total absence. Natural concentrations of antimony in the environment are low. Its abundance in the earth's crust is in the order of 0.2–0.3mgkg^{-1}. (Fowler and Goering, 1997). Background concentrations of antimony in the soil ranges between 0.3 and 8.6mgkg^{-1} (Kabata-Pendias and Pendias, 1984; Litschinger et al, 1998). Higher concentrations are usually related to anthropogenic sources. In general, inorganic Sb compounds were found to be more toxic than organic ones, and SbIII more than SbV (Filella et al, 2002).

Toxicity risks posed by consumption of plants grown on antimony-contaminated soil if taken up by plants, it may enter the food chain and present a health risk for animals and humans, even if the plants themselves remain unaffected. Li and Thornton investigated soil and pasture herbage contaminated by antimony and found that very little of these element is usually absorbed by grazing animals from the soil or herbage and that health problems in grazing livestock therefore are not common (Li and Thornton,1998). As has been mentioned before, plants can take up high amounts of antimony while still being and looking healthy but humans and animals consuming such plants over longer periods of time may become poisoned. Gebel *et al* 1998,. Also, risk factors like consuming seafood or home-grown produce apparently did not affect antimony concentrations in urine, blood or scalp hair (Gebel *et al*, 1998). Owing to the limited knowledge about antimony toxicity, it is difficult to assess the health risks of exposure to elevated concentrations of antimony. Acute antimony poisoning of humans or animals via ingestion of antimony-contaminated soil or consumption of plants grown on antimony-contaminated soil is extremely unlikely. Also, chronic effects are to be expected only under rare circumstances.

Selenium

The elemental analysis of the Grewia mollis showed total absence selenium in the leaves while the stem bark showed a concentration of 20.31ppm and the root bark concentration of 1.936ppm table 1. Selenium is essential for human body playing an important role as an antioxidant in the body (Jezek *et al* 2012). It is considered as individual antioxidant that can co operate with other antioxidants such as vitamin C and E (Jarzynska and Falandys 2011) and in processes protecting the cells from free radicals. in such manner selenium protects the body from development of cancer, cardiovascular diseases and masculine sterility (Mach, 2008).

Selenium is a constituent of glutathione peroxidase (Murray *et al*., 2000). It is a constituent element of the entire defence system that protects the living organism from the harmful action of free radicals. Organic selenium is more thoroughly reabsorbed and more efficiently metabolized than its inorganic equivalent, which is poorly reabsorbed and acts more as a prooxidant provoking glutathione oxidation and oxidative damage to the DNA (Levander, 1983; Schrauzer, 2000; Wycherly *et al*., 2004). Selenium participated in thyroid hormones metabolism, immune system, inhibits virulence, slows down the development of AIDS through reducing the speed of HIV development, reduce risk of abortion.(Rayman, 2000) diabetes and asthma prevention (Jezek *et al* 2012) and moderate the effect of radiation (Surai 2006).

Deficiency of selenium is connected with acceleration of senility and development of Alzheimers diseases, selenium affect in a positive manner human mind and mental wellness (Jezek *et al*, 2012; Finley 2006).Recommended daily intake of selenium for adult is 5mg/day. (FNB,2000; Rayman, 2008). Selenium deficiency results in white muscle disease, an illness that cause high mortality in young calves and lambs. (Hays and Swenson, 1985).

In humans, toxic levels in some soils and megadose supplementation induces hair loss, dermatitis, and irritability (Murray *et al.,* 2000). Deficiency disease or symptoms are also secondary to parenteral nutrition, protein-energy malnutrition. There is a considerable variation in the availability of selenium in different feedstuffs. Even in the presence of adequate levels of vitamin E, poultry rations still require an adequate level of selenium in the feed but care should be taken to prevent selenium toxicity. Sources include fishmeal, sea foods, dried brewer's yeast, kidney, liver, eggs and grains.

Strontium

The concentration of strontium in the root bark and leaves of Grewia mollis is below detection whereas the concentration in the stem bark is 20.31ppm. The result showed there is a minimal risk of poisoning by strontium since it is below detection in the plant.

Strontium is found in nearly everywhere in small amount and can be exposed to low levels of strontium by breathing air, eating food, drinking water or accidentally eating soil or dust that contain strontium. There are no harmful effects of stable strontium in humans at the level typically found in the environment. The harmful effect of strontium includes problems with bone growth in children, distraction of bone marrow and blood cells (ASTSDR, 2004). Cancer as a result of damage to genetic material (DNA) in cells. The omission of strontium caused an impairment of the calcification of the bones and teeth and a higher incidence of carious teeth. Strontium is one of the most abundant and potentially hazardous radioactive by-products of nuclear fission. Strontium is preferentially excreted, especially in the urine, thereby providing some means of protection against it.

Titanium

The daily recommended concentration of titanium in food is 0.8µg/g (CDER, 2015), while the concentration of titanium shown in table 1 Grewia mollis part indicate that the leave is 256.6ppm, stem bark 25.72ppm and the root bark is 144.90ppm. Titanium is generally accepted to be a relatively inert substance with minimal side effects (Albrektsson, 1985; Smith *et al*, 1997; Lugowske *et al*, 2000). Excess exposure may be toxic on cell may cause brain injury and development of degenerative brain disease (Marquez-Ramirez *et al*, 2012; Yu *et al*, 2008). However, evidence in the literature suggests that under some circumstances, the presence of titanium particles may be harmful, especially following frictional wear of medical prostheses or of screws such as those used in plate fixation during surgical procedures (Witt and Swann, 1991; Case *et al*, 1994).

Aggressive soft tissue reactions with black extracellular deposits and titanium particles within histiocytes and foreign body giant cells have been observed resulting from rough surface titanium alloy medical prostheses or those which have loosened (Witt and Swann, 1991; Scale, 1991). Titanium is generally accepted to be a relatively inert substance with minimal side effects. Titanium is important in protection of human skin against UV-induce aging and cancer

(Nohynek and Dufour, 2012).

Elevated serum levels have also been reported for loose devices (Jacob et al, 1991). Titanium particles have also been implicated in the development of histiocytotic lesions in regional lymph nodes (Albores-Saavedra et al, 1994). Some further side effects can include dark staining in the tissue around titanium (Scale, 1991; Urban *et al,* 2000). The element is carcinogenic to humans and causes adverse effects by producing oxidative stress, resulting in cell damage, redness and immune response (Skocaj *et al*, 2011).

This has led to concern about the long term metabolic, oncogenic and immunologic effects of titanium particles (Witt and Swann, 1991). Further reports in the medical literature suggest that metal debris may be a contributing factor in component loosening and failure. (Witt and Swann, 1991; Scale, 1991).

Lalor *et al*. 1991 have shown a macrophage reaction with a large T-lymphocyte response, with absence of plasma cells suggesting an immunological reaction such as type IV hypersensitivity may be involved in this process. They and others suggested that sensitization to titanium may have contributed to the failure of medical prostheses (Witt and Swann, 1991; Lalor, 1991).

Vanadium

Vanadium is considered nonessential for higher plants and most higher animals, although reported to be beneficial for some, it is an essential trace element for some algae and other microorganisms, and for chicks and rats. Some food plants may accumulate high levels of vanadium without exhibiting toxicity symptoms, (Connor and Shacklette, 1975).

Animals Under normal dietary conditions have no reports of toxicity attributed to vanadium in feedstuffs. The plant Grewia mollis showed total absence of vanadium therefore there are no dangers of vanadium poisoning from taking any part of the plant Grewia mollis while the set limit is 3.00ppm (EMA, 2007).

Vanadium compounds have been demonstrated to have effects on glucose metabolism in vitro (Frieden, 1984) and also in lipid metabolism (Hopkins and Mohr, 1974). Vanadium also has a wide range of other biological activities like effects on ribonuclease, alkaline phosphatase, adenyl cyclase, NADH oxidase and phosphofructokinase (Ramasarma and Crane, 1981). Vanadium has been shown to be nutritionally essential for both the chick and the rat (Hopkins and Mohr, 1971; Strasia, 1971; Nielsen and Ollerich, 1973; Hopkins and Mohr, 1974). The vanadium was below detection in the Grewia mollis parts.

CONCLUSION

From the present research results it can be concluded that most of the elemental concentration in the parts of Grewia mollis are within the recommended values set by WHO and some countries for edible plants and medicinal plants. The result showed that there were total absence of sulphur, antimony, selenium and strontium in the leaves, while the stem bark showed total absence of scandium and vanadium and the root bark showed total absence of antimony and strontium. It can be concluded from the result that the eating of the plant parts for food or medicine pose minimal danger from poisoning by the elements.

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