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LEVELS OF PROXIMATE COMPOSITIONS AND MINERALS (Na, K, Ca, Mg, Cu, and Zn) PRESENT IN EUCALYPTUS (Eucalyptus globulus) AND GINGERBREAD PLUM (Noecarya macrophylla) LEAVES COLLECTED FROM SOKOTO TOWN

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Abstract

Sokoto state is been challenged with diverse array of problems such as food insecurity, malnutrition, poor healthcare. Thus, the need to search for locally available plant materials is intensified. The objective of this work was to conduct a phytochemical, proximate and Na, K, Ca, Mg, Cu, Zn (minerals) analysis of eucalyptus (Eucalyptus globulus) and gingerbread plum (Noecarya macrophylla) leaves using standard methods and materials of analytical grade. The proximate results revealed moisture of (7.10 ± 09), (7.73 ±0.3) ash (14.76 ± 0.2) (12.85 ± 0.11), crude lipid (1.38± 0.007) (1.46 ±0.02), crude fibre (2.42 ± 0.03) (2.54 ± 0.03), crude protein (5.66 ± 0.04) (7.3 ± 0.006), carbohydrates (68. 68 ± 0.31) (68.12 ± 0.23) for gingerbread plum and eucalyptus respectively. The minerals in gingerbread plum and eucalyptus respectively are as follows; zinc (0.59± 0.06 ppm).4 ± (0.005 ppm), calcium (11.38 ± 0.6 ppm) (19.48 ± 0.53 ppm), potassium (7.21 ± 1.2 ppm) (5.10 ± 0.93 ppm), copper (0.51 ± 0.007 ppm) (0.19 ± 0.04 ppm), magnesium (3.74 ± 0.41 ppm), (10.9 ± 93 ppm), sodium (7.65 ± 0.63 ppm) (12.21 ± 0.32 ppm). Phytochemicals determined include, alkaloids, saponins, tannins, phenols, and phytate. The results have revealed that, the two plants are rich in proximate, phytochemicals and minerals and can be useful for consumption.

Keywords: Magnesium, Calcium, Plants, Gingerbread Plum, Eucalyptus

INTRODUCTION

Plants are indispensable in the ecosystem. Man has continued to rely on plants for several immeasurable purposes and applications. Plants are natural gifts utilized by humans in the uncountable fields of such as in the area of food, clothing, fertilizers, cosmetics, transport, shelters, fragrances, and medicine, in the various part of the world such as China, India, Japan, Srilanka, Pakistan, Thailand, Nigeria, etc the practice of using plants for diverse array of medicinal or therapeutic purpose is wide in fact, medicinal plants refer to the group of plants that are applied in the therapeutic purpose for the sale of medicinal activities. They are rich sources of ingredients effective in the traditional letter native/ herbal medicinal purpose and for the development of synthetic molecules effective in modern medicine as well (Agrawal, 2014). About 20,000 medicinal plants were listed, more would come to the stage, and many were still undiscovered. Even the discovered ones are still not fully understood (Agrawal, 2014; Musa et al., 2021).

Parable, plums is native plants that are applied in various aspects of human life. The plum is reported to be applied in the treatment of several problems such as stomach pain, tooth pain, eye pain, etc. The fruit of plum is eatable and used in orange crushes, lemonades, dishes, snacks, and cooking among others. This happened because the plants contain various important components such as Proteins, Minerals, Oils and Phytochemicals. These give the potential plants to be applied in therapeutic and other applications (Yudharaj et al., 2016; Dar et al., 2017; Mohammed et al., 2019; Umar et al., 2023) likewise, eucalyptus is a plant of important in various purpose. It has been historically applied as repellant, flavoring agent, fragrance agent, antiseptic, and in several pharmaceutical needs. This could be attributed to its essential oils, phytochemicals, and physicochemical properties (Savic & Gajic, 2022).

However, all the plants including eucalyptus (*Eucalyptus globulus*) and gingerbread plum (*Noecarya macrophylla*) that are able to exhibits useful properties or applications according to their similar or unique compositions, physical properties, chemical properties, and quality in the same vein, these, properties being it physicochemical or otherwise varies according to geographical areas, climate, and other properties specific to areas where the plant is grown. This is directly in consonant with the function and applications of the plants the physicochemical properties and uses could vary with varying environment of the plants. Therefore, it is important to study the proximate and mineral contents of eucalyptus

(*Eucalyptus globulus*) and gingerbread plum (*Noecarya macrophylla*) plants in Sokoto Nigeria (Kitzberger et al., 2017; Abdullahi et al., 2023; Tukur et al., 2023). Living organisms such as humans or animals need energy because it confers them the temerity to do works; and this energy usually obtained from the environment. All animals acquire their foods (carbohydrates, proteins, lipids, Zn, Mg, Na, Cu, K, Ca, etc) directly or indirectly through the plants. Plants such as eucalyptus and gingerbread plum utilized carbon dioxide, water, light energy in the presence of chlorophyll to make foods such as carbohydrates (glucose) and liberate oxygen (for animals' respiratory benefits). The preformed foods made by plants are then catabolized in the biological system to make carbon dioxide, water, energy. Thereafter, the water, and carbon dioxide are taken up by plants; and energy is channeled to metabolic processes (Yudharaj et al., 2016; Dar et al., 2017; Mohammed et al., 2019). Proteins are made by plants are assemblies of amino acids monomers that serve in synthesis and repair of tissues in animals and are useful for certain physiological functions. Lipids contain higher proportion of energy to be tapped by animals for nutritional and physiologic benefits. Additionally, the plants are commonest sources of mineral nutrients that are needed for various functions. Parable, Na and K make 1% of blood plasma, maintain right osmotic pressure, needed for muscles and nervous functions. Ca is a major parcel of teeth and bones, partake in blood clotting, normal muscular activity, and is needed by nervous system and heart. Mg activates an important step in glycolysis and is a major parcel of bones. Cu is used in hemoglobin synthesis, and Zn is needed for functioning of several physiologic enzymes of the human body (Shehu et al., 2019; Gada & Ismaila, 2021).

Sokoto state is a state among the 36 state of the country that are faced with challenges affecting grown, development literacy and public health (Farid & Neda, 2014). There is using prevalence of antibiotic resistance, especially in developing countries where self-medication is rampant, indicating the need for more exploration of medicinal plants. The state is faced with challenging issue of infections and non-infectious diseases; the two which require the use of therapeutics that are accessible, affordable, effective, and cheap plants sources (like plum and eucalyptus) for redress in the state (Farid & Neda, 2014; Gada & Ismaila, 2021; Garba et al., 2022). The aggravating factor of challenges in the state could be poverty, that in turn compelled people to seek for alternative or traditional medicine therapies for their healthcare needs. However, there is paucity of knowledge regarding medicinal plants composition in the state albeit the information is required for

rational use of the plants in either modern or alternative medicinal applications. Thus, this study is imperative to unveil the physicochemical properties of the two medicinal plants (Kari et al., 2022). The properties and application of plum, and eucalyptus plants or other medicinal plants are only attainable because of the inherent properties of the plants. Some of these properties are physical assessed with sensory organs and others are chemical in nature. The information about these properties are useful in resolving the scarcity of empirical information about the plants in the state baseline information is provided from his study for further works by students, and scholars likewise, the association between the various functions of the plants and properties components could be generated knowledge at the public domain could be enhance on how to collect, handle, process and used medicinal plants for better (Muhammad & Umar, 2015). This study aimed to mainly conduct an analysis of Na, K, Ca, Mg, Cu, Zn, phytochemicals, and proximate compositions of plum, and eucalyptus leaves collected from Sokoto, Nigeria

METHODS

Study area, Sample Collection and Preparation

The research was carried out in Sokoto, Nigeria. Nigeria is a country located in the West Coast of Africa; lying 5^{0} North Equator and between 3^{0} and 4^{0}East of the Greenwich Meridian. It has 36 states and the Abuja Capital. One of the zones where Sokoto lies is the Northwest zone. Sokoto state is a state that lies in the northwestern part of the country bordering Kebbi, Zamfara, states, and Niger Republic. The samples gingerbread plum (*Noecarya macrophylla*) (*Gawasa*) and eucalyptus (*Eucalyptus globulus*) (*Turare*) leaves were brought from Sokoto City market and later the leaves were identified by botanist at Biology Department, Sokoto State University, Sokoto. Then, washed, cleaned, and allowed to oven dry for 98 hours. Then milled, using mortar and pestle and stored in an air-tightened container for further analysis.

Minerals analysis

After the digestion has been completed, the AAS machine was used to determine the concentrations of Mg, Cu, Zn, Na, K and Ca in the gingerbread plum and eucalyptus samples (Garba et al., 2022).

Phytochemical analysis

The qualitative phytochemical compositions (tannins, saponins, phenols, alkaloids, flavonoids, steroids) present in the eucalyptus and gingerbread plum leaves were explored using the procedure and methods reported in Kaur et al., (2018).

Proximate content determination

Proximate content of samples collected in Sokoto, Nigeria was determined using methods and procedures related in Kaur et al., (2018). "The moisture, ash, crude fats, proteins and carbohydrates of all the samples were carried out using standard AOAC method (1990). The moisture and ash were determined using weight difference method. Crude fat was extracted by means of the Soxhlet apparatus with petroleum ether (40 to 60°C) for 6 hours. The nitrogen value, which is the precursor for protein of a substance, were determined by micro Kjeldahl method, involving digestions, distillation and finally titration of the sample. The nitrogen value was converted to protein by multiplying a factor of 6.25. Carbohydrate was determined by difference method. The carbohydrate was calculated by difference method and as the nitrogen free extract (NFE), calculated as % NFE = 100 - % (a + b + c + d + e) where a = protein, b = fat, c = fibre, d = ash, e = moisture. All the proximate values were reported in %. The proximate analyses were done in triplicates" as in Kaur et al., (2018).

Statistical analysis

The descriptive statistics and one-way analysis of variance (ANOVA) were carried out at ($p<0.05$) significance level using Microsoft excel version 7.

RESULTS AND DISCUSSION

The results for this work were presented in the tables 1, 2, 3. Table 1 shows the levels of proximate constituents in the two plants gingerbread plum and eucalyptus. Table 3 shows the results of phytochemicals present in the analyzed plants.

Table 1: Showing the proximate constituents of gingerbread plum (*Noecarya macrophylla*) and eucalyptus (*Eucalyptus globulus*) collected from Sokoto, Nigeria

Parameter	Gingerbread plum (%DW)	Eucalyptus (%DW)
Moisture	7.10 ± 0.9	7.73 ± 0.3
Ash	14.76 ± 0.2	12.85 ± 0.11
Crude lipid	1.38 ± 0.07	1.46 ± 0.02
Crude fibre	2.42 ± 0.03	2.54 ± 0.03
Crude protein	5.66 ± 0.04	7.30 ± 0.06
Carbohydrate	68.68 ± 0.31	68.12 ± 0.23

The values are mean ± standard deviation of triplicate determinations.

Table 2: Showing the mineral elements constituents of gingerbread plum (*Noecarya macrophylla*) and eucalyptus (*Eucalyptus globulus*) collected from Sokoto, Nigeria

Parameter	Gingerbread plum (ppm)	Eucalyptus (ppm)
Zinc	0.59 ± 0.06	0.40 ± 0.005
Calcium	11.38 ± 0.6	19.48 ± 0.53
Potassium	7.21 ± 1.2	5.10 ± 0.93
Copper	0.51 ± 0.07	0.19 ± 0.04
Magnesium	3.74 ± 0.41	10.93 ± 0.09
Sodium	7.65 ± 0.63	12.21 ± 0.32

The values are mean ± standard deviation of triplicate determinations.

Table 3: Showing phytochemicals determined from gingerbread plum (*Noecarya macrophylla*) and eucalyptus (*Eucalyptus globulus*) collected from Sokoto, Nigeria

Phytochemicals	Gingerbread plum (ppm)	Eucalyptus (ppm)
Saponins	+	++
Tannins	+	+
Flavonoids	++	+
Phenols	++	++
Alkaloids	+	++
Phytate	+	-

Key: += presence of phytochemical, ++= abundant presence of phytochemical

Noteworthy, the behaviour of taking diet that is vast in fruits and vegetables is a renown act that promotes healthy life because of their vast nutrients therein. That is why most countries across various parts of the world had documented dietary recommendations involving fruits. Fruits have possessed elevated contents of nutrients such as fibre, vitamins, minerals, that help animals to checkmate cardiovascular diseases, high blood pressure, several types of cancers, and other chronic ailments. Likewise, it is needful to redirect further attention to the consumption of fruits that are domesticated or wild, accessible, and cheap, in the region of Sokoto; where there are ravaging issues such as malnutrition, double burden of diseases, food insecurity, and other challenges. However, it is worthy to note that, there is little or insufficient information divulging the nutrients present in gingerbread plum fruit in Sokoto, and West Africa region. Certainly, it is a good thing to have an elevated fibre level because it is useful in the maintenance of health through reducing cholesterol values, aiding food digestion, neutralization of constipation, and deferring of stomach emptiness; therewith lipids are utilized by cells and tissues during consumption for provision of energy in two-fold fashion better than carbohydrates, and also plays roles in making secretions by the cells and tissues. Table 1 presents the results for proximate analysis study of gingerbread plum and eucalyptus. From Table 1 the moisture, ash and carbohydrates are more abundantly observed than in the eucalyptus. While, the crude lipid, crude fibre, and crude protein are more abundantly observed in eucalyptus than the gingerbread plum. Carbohydrates are important macromolecules that provide source of energy for metabolism and partake in structural makings such as in the making of DNA and RNA for proper physiological activities of the body. Proteins are used to make new tissues, make enzymes, hormones, and antibodies required for homeostasis. Likewise, the lipid macromolecules provide energy and many other useful compounds such as vitamins, cholesterol, and hormones (Garba et al., 2022; Umar et al., 2023).

From this work, the levels of moisture, crude protein, are nearly identical to the findings reported in gingerbread plum seeds by Amza et al., (2010). While, the lipid and fibre are lower than contents found by Amza etal (2010); but carbohydrates in Table 1 in gingerbread plum are higher than the levels shown by Amza et al., (2010). In another similar work by Umar et al., (2023) in gingerbread plum fruits in Sokoto higher amounts of moisture, lipid, fibre were reported more than the ones found in Table 1. In the same vein, the moisture, ash, found in eucalyptus (in Table 1) were higher than the values reported from an Indian study of the same plant Diaby et al., (2022). A similar work from Sokoto

reported proximate values of ash, protein, and moisture that are higher than the values found in the eucalyptus in Table 1.

Table 4.2 shows the levels of mineral elements zinc, calcium, potassium, copper, magnesium, and sodium present in the two observed plants gingerbread plum and eucalyptus. In the Table 4.2, it was showing that zinc, potassium, copper, are abundant in gingerbread plum more than in the eucalyptus; while calcium, magnesium, and sodium are more abundantly observed in eucalyptus *Eucalyptus globulus* than the gingerbread plum ((*Noecarya macrophylla*)).

In Table 2, calcium (11.38 + 0.006 ppm), magnesium (3.74 + 0.42 ppm) are similar to the results of the work done in gingerbread plum reported in Sokoto by Umar et al., (2023); while sodium and potassium are comparatively lower. However, in earlier work reported by Garba et al., (2022) from Sokoto, lower levels (compared to those of gingerbread plum in Table 2) were reported.

Meanwhile, the levels of zinc, sodium, copper, and potassium are lower than the ones reported in *Z. Spina* fruit from Sokoto Okolo et al., (2023); but calcium, in Table 2 in eucalyptus is higher than the one reported by Amzat et al., (2010).

All these mineral elements determined revealed (in Table 2) considerable values that can profoundly help the consumers in maintenance of health, growth, and development due to the diverse functions a combo of them or each one of them play (s) (Muhammad et al., 2015ab; Okonwu & Ariaga, 2016). For example, potassium (the elevated element determined) is unavoidable for protein synthesis, modulation of body fluids, nerve and muscle activities, regulation of blood pressure, and regulation of glucose and glycogen metabolism[25]. Calcium in particular term is required for nerve impulse transmission, cell permeability modulation, and blood clotting regulation. Potassium (the 2nd most elevated element assessed) and magnesium (the lowest element assessed); partake in the acid base, as well as electrolyte balance; that is why these levels are recommended for people to lower their hypertension risk because magnesium reduces pressure, and is unavoidable in DNA synthesis. The sodium/ potassium ratio is a good value that must be regulated for optimum blood pressure maintenance. Nerve signaling, and muscle functions, are also essential body activities that need sodium unavoidably (Muhammad et al., 2015ab; Okonwu & Ariaga, 2016; Oklo et al., 2023). In a nutshell, the availability of good nutritional indicators in terms of proximate contents, and elements at a significant level found in this fruit gives a good

source of food material that is cheap and accessible to the people especially in the region challenged by chronic, infectious diseases and malnutrition. The fruit can indeed act as a safe, nutritious food, that in turn help in growth and development of animals, and humans.

Table 3 shows the levels of some basic phytoconstituents analyzed in the leaves of gingerbread plum and eucalyptus collected from Sokoto. Therewith, the Methanolic exacts of the two analyzed plants encompass saponins, tannins, flavonoids, phenols, alkaloids, and phytate (which was only found in eucalyptus). The presence of phytochemicals similar to the one explored in eucalyptus and gingerbread (as revealed in Table 3) was similarly reported elsewhere. Parable, Garba etal., (2022) reported antimicrobial capacity of gingerbread on *S. aureus, S. faecalis, P. arruginosa, C. albicans, S. typhimurium,* and *C. kriusei*; this is an indication of the presence of useful phytochemicals that act against the examined microbes (Ayoade et al., 2022; Garba et al., 2022). Likewise, Bala etal., (2022) in their works reiterated the presence of phytochemicals (such as tannin, phytate, and relations) in components of gingerbread plum obtained from Niger and Guinea Republics; and a corroborated finding that revealed tannins, alkaloids, saponins, and steroids in seeds of gingerbread plum collected from Sokoto, Nigeria had already been published by Warra et al., (2010). Thus, the presence of the aforementioned compounds justified the utilization and effectiveness of the gingerbread plum components in the treatment of various ailments such as dysentery, toothache, skin infection, and wound healing (Garba et al., 2010). Meanwhile, pertaining eucalyptus leaves, this work shows that, the leaves contain phytoconstituents (Table 3) similar to the works related by Kaur et al., (2019); Adekoya & Akeem (2021). Kaur etal., (2021) showed that, the plant possesses the ability to act against certain microbes (an indication of phytochemistry effectiveness).

Consequently, considering the current world trend especially in the developing nations (where poor settings are dominant, where people depend on complimentary care, healthcare is scarce and costly, antimicrobial resistance is rising) the two plants studied would invariably provide a good source of phytochemicals that proffer several benefits (Ghareeb et al., 2018). Flavonoids have act some antioxidant agents, antifungal, anti-inflammatory, anticancer, and in many other useful ways. Alkaloids act to reduce blood pressure, kill tumor cells, and stimulate respiration. Phytate reduces blood glucose and therefore is important in amelioration of diabetes. Saponins protect gastric system, prevent ulcer, reduces body lipid, and ameliorates blood glucose. Tannins have the potential of acting as antibacterial, antiviral, and antiparasites (Chukwuebuka & Chinenye, 2015). Thus,

the two analyzed plants are good sources of nutrients (macromolecules such as carbohydrates, lipids, etc; and useful elements such as Zn, Cu, Mg, Na, Ca, and K) which could be useful in nutritional and medical interventions to safeguard public health.

CONCLUSION

Nowadays, in the Sokoto region, the semi-arid region there are issues such as food insecurity, climate problems, malnutrition, and double burden of diseases; therefore, it is utmost to utilize cheap, and accessible materials to curtail the worsening of these problems. That is why, proximate compositions (ash, moisture, and the likes), phytochemicals, and the elements (sodium, copper, magnesium, potassium, zinc, and calcium) were determined in the gingerbread plum (*Noecarya macrophylla*) and eucalyptus (*Eucalyptus globulus*). It was shown from the results of this work that, the two plants are rich in proximate and mineral elements in most of the occasions and therefore act as good sources to the people especially the rural people.

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