International Journal of Health Research, December 2010; 3(4): 217-221

Available at http://www.ijhr.org

Original Research Article

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Online Journal

Phytochemical, Proximate and Metal Content Analysis of the Leaves of *Psidium guajava* Linn (Myrtaceae)

Abstract

Purpose: To investigate the phytochemicals and some other constituents of the powdered leaves of Psidium guajava Linn and to evaluate the tolerability profile of the leaves because of their profound medicinal and non-medicinal uses.
Methods: The phytochemical analysis of Psidium guajava was carried out by using a standard procedure. Ash, fat, protein, carbohydrate and fibre contents were determined using proximate analysis while the metal contents were determined using Pearson's method.
Results: The phytochemical analysis revealed the presence of saponins, glycosides, terpenoids, anthraquinones, tannins, flavonoids and alkaloids, the proximate analysis showed a low ash value of 2.80%, protein content 2.80%, fibre 2.70% and fat 1.80% but a relatively high content of carbohydrate 88.90%. The metal content analysis revealed the presence of seven metals Calcium 1.34 mg/kg, Magnesium 0.64 mg/kg, Potassium 0.76 mg/kg, Sodium 0.05 mg/kg, Iron 16.18 mg/kg, at concentrations below the tolerable upper intake level except for Manganese 29.23 mg/kg and Zinc 56.49 mg/kg
Conclusion: The powdered leaves of Psidium guajava contain more of organic components and levels of manganese and zinc is above the tolerable upper intake established by the overseeing body.

Keywords: Psidium guajava, Toxicity, Screening, Tolerability, Leaves

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Introduction

Psidium guajava (common name is guava) has been employed in many parts of the world for a lot of its scientifically confirmed uses. These include antidiarrhoea[1], hypoglycaemic in alloxan induced diabetes mellitus in rats[2,3], anti-nociceptive[4-7], antimutagenic[8,9], antispasmodic[8], and antimicrobial[10-13]. In forklore, it has been used in the treatment of different conditions including fever, typhoid fever, and malaria. In many villages in Nigeria, it is used often in children and infants for the treatment of diarrhoea.

Psidium guajava is a large dicotyledonous shrub, or small evergreen tree, generally 3-10 m high with many branche. The stems are crooked and the bark is light to reddish brown, thin, smooth, and continuously flaking. Root system is generally superficial and very extensive, frequently extending well beyond the canopy. Each has some deep roots but no distinct taproot[14]. The leaves are opposite and simple; stipules are absent, petiole short, 3-10 mm long; blade oblong to elliptic, 5-15 x 4-6 cm, apex obtuse to bluntly acuminate, base rounded to subcuneate, margins entire, somewhat thick and leathery, dull grey to yellow-green above, slightly downy below, veins prominent, gland dotted. Inflorescence, axillary, 1- to 3-flowered, pedicles about 2 cm long, bracts 2, linear. Calyx splitting irregularly into 2-4 lobes, whitish and sparsely hairy within; petals 4-5, white, linear-ovate c. 2 cm long, delicate; stamens numerous, filaments pale white, about 12 mm long, erect or spreading, anther straw coloured; ovary inferior, ovules numerous, style about 10 cm long, stigma green, capitate[15]. Fruit is ovoid or pear-shaped berry, 4-12 cm long, weighing up to 500 g; skin yellow when ripe, sometimes flushed with red; pulp juicy, creamy-white or creamy-yellow to pink or red; mesocarp thick, edible, the soft pulp enveloping numerous, cream to brown, kidney-shaped or flattened seeds. The exterior of the fruit is fleshy, and the centre consists of a seedy pulp[16]. Young guava leaves are used to treat cough in India, and in China, the leaves are used as an anti-inflammatory and haemostatic agent[17,18]. The Food and Drug Administration (FDA) in United State of America noted that 2,621 adverse drug reactions and 184 deaths due to herbal products over a 5-year period. However, the report relied on voluntary physician reporting, which may substantially underestimate total incidence. Actual mortality and morbidity are difficult to assess due to underreporting[19].

Plant may produce multiple effects, and affect multiple organs, including the nervous, cardiovascular, gastro-intestinal, hepatic, renal, and hematologic systems. A lot of plants are toxic e.g. Apple *(Malus domestica),* Cassava *(Manihot esculenta),* Cherry *(Prunus cerasus),* Indian pea *(Lathyrus sativus),* Kidney bean or common bean *(Phaseolus vulgaris),* Nutmeg *(Myristica fragrans),* Lima bean or Butter Bean *(Phaseolus lunatus),* Potato *(Solanum tuberosum),* Rhubarb *(Rheum rhaponticum),* Tomato *(Solanum lycopersicum)* [20-23]. This study was carried out to evaluate the tolerability profile of the leaves of *Psidium guajava* using proximate screening and metal analysis.

Materials and Methods

Plant Materials

The leaves of the plant *Psidium guajava* was collected from Elele in Kelga Local Government Area of Rivers State, Nigeria, identified and authenticated by Pharm (Mrs) A. Ogah, Department of Pharmacognosy, Madonna University Elele. The mature leaves were gently plucked from the plant and dried at ambient temperature, the dried leaves were reduced to coarse powder in a ceramic mortar using a pestle and then milled to fine powder using Wiley Mill after which it was sieved through Sieve numbers 8 and 10 to obtain a fine powder

Phytochemical screening

Qualitative assay, for the presence of plant secondary metabolites such as carbohydrate, alkaloids, glycosides, flavonoids, tannins and saponins were carried out on the powdered leaves following standard procedure[23,24] .

Analysis of metals

The powdered sample (2g) was accurately weighed into a clean platinum crucible, ashed at 500°C, and cooled to room temperature in a desiccator, and this was dissolved in 10 ml 20% nitric acid and filtered into 100ml volumetric flask. Analysis of the sample for calcium, sodium, potassium, magnesium, zinc, iron and manganese content was carried out in triplicate on the AAS[26].

Proximate analysis

The proximate evaluation for the ash, moisture, fibre, protein, fat and carbohydrate content was done using the Association of Official Analytical Chemists method[27].

Results

Result of the phytochemical screening of powdered leaves of *Psidium guajava* revealed the presence of alkaloids, anthranquinone, cardiac glycosides, flavonoids, reducing sugars, tannins, saponins, and terpenoids.

Table 1: Result of proximate analysis of powdered leaves of *Psidium guajava*

Variable	Content (g)	Dietary Recommended Allowances in a male aged 40-50 years old[28]	Dietary Recommended Allowances in a female aged 40-50 years old[28]
Ash	2.80±0.80		
Protein	2.80±0.60	56g/day	46g/day
Fibre	2.70±0.40	38g/day	25g/day
Fat	1.80±0.30	20-35% of calories	20-35% of calories
Carbohydrate	88.90±0.70	130g/day	130g/day

Table 2: Metals in powdered leaves of *Psidium guajava*

Metals	Content (mg/kg)	Dietary Recommended Allowances in a healthy 25-year old male[28]	Tolerable Upper Intake level[28]
Calcium	1.34±0.30	1000mg	2500mg
Magnesium	0.64±0.01	400mg	350
Zinc	56.49±0.40	11mg	40mg
Manganese	29.23±0.60	2.3mg	11mg
Potassium	0.76±0.00	4700mg	–
Sodium	0.05±0.00	1500mg	2300mg
Iron	16.18±0.00	8mg	45mg

Discussion

The phytochemical analysis of the powdered leaves of *Psidium guajava* showed the presence of a lot of secondary plant metabolites which are responsible for its numerous medicinal effects and its nickname as the poor man's apple. The constituents include alkaloids, carbohydrates, reducing sugars, tannins, anthraquinones, terpenoids, flavonoids, glycosides and saponins. The prescence of these secondary metabolites supports the claims made by the tradition healers about *Psidium guajava.*

The proximate analysis of powdered sample of *Psidium guajava* leaves showed low moisture content of 1.0% and low ash value of 2.80%. The ash value indicates the quantity of inorganic components of the plant; hence a low value indicates that the powdered leaves of *Psidium guajava* contain more of organic components. There is also low quantity of protein and fat but an abundance of carbohydrate which makes it a source of energy.

The metal analysis of powdered sample of *Psidium guajava* showed the presence of all the metals screened for which include; magnesium, manganese, zinc, calcium, iron, sodium and potassium. The quantity of these metals in the powdered leaves of *Psidium guajava* revealed that they were well below tolerable upper intake level and within the recommended daily intake in healthy individuals established by the Dietary Reference Intakes (DRIs).

Manganese analysed is well above the tolerable upper intake level with 29.23 mg/kg and the tolerable upper intake level is 11 mg daily[28]. The villagers use a minimum of 500g leaves in treatment and the quantity of manganese in that is 14.62 mg/kg which is well above the tolerable upper intake level (Cholestatic liver disease, and possibly changes in the basal ganglia, have been reported to be associated with hypermanganesaemia in children[29,30]). Zinc at 500g minimum weight of leaves has a dose of 28.25mg/kg which is above the recommended daily intake of 11mg but below the tolerable upper intake of 40mg[28]. The Expert Group on Vitamins and Minerals have established a safe upper limit for zinc of 25mg daily[31] which is lower than 28.25mg/kg. Knowing that zinc can cause abdominal pain, dyspepsia, nausea, vomiting, diarrhoea, gastric irritation, and gastritis and much more complications on prolonged use[32], from the view of the Experts, extracts from *Psidium guajava* leaves should be administered with caution especially in infants.

Conclusion

It is established that the leaves of *Psidium guajava* are not completely safe for use by the people of Elele, Kelga Local Government area, Rivers State due to the result of this investigation that revealed the level of manganese and zinc to be above the tolerable upper intake level established by the U.S.A. Agency overseeing food safety; the F.D.A (Food and Drug Administration) and the Expert Group on Vitamins and Minerals. The phytochemical screening showed the presence of alkaloids, carbohydrates, reducing sugars, tannins, anthraquinones, terpenoids, flavonoids, glycosides and saponins which support the numerous claims about its activities.

Contribution of Authors

I declare that this work was done by the authors named in this article and all liabilities pertaining to claims relating to the content of this article will be borne by the authors. LOO conceived, designed and prepared the manuscript, KEI participated in some aspect of screening the plant (proximate analysis) while AAA collected and analysed the data.

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