Research Journal of

Botany

ISSN 1816-4919

Academic
Journals Inc.

www.academicjournals.com

OPEN ACCESS

Research Journal of Botany

ISSN 1816-4919
DOI: 10.3923/rjb.2017.23.31

Research Article
Proximate Composition and Mineral Analysis of *Phragmanthera capitata* (Sprengel) Balle, a Mistletoe Growing on Rubber Tree

Franklin Uangbaoje Ohikhena, Olubunmi Abosede Wintola and Anthony Jide Afolayan

Medicinal Plants and Economic Development (MPED) Research Center, Department of Botany, University of Fort Hare, Alice, Eastern Cape, South Africa

Abstract
Background: Leaves of *Phragmanthera capitata* (Sprengel) Balle growing on rubber trees were evaluated in order to determine its nutritional, anti-nutritional and mineral compositions. **Materials and Methods:** Proximate and anti-nutrient analyses were performed using standard analytical methods while mineral contents were determined using Inductively Coupled Plasma-Optical Emission Spectrometer (ICP-OES). **Result:** The result of the proximate analysis showed that carbohydrate was more with a composition of 57.73±0.33 g/100 g. Protein, fat and fibre compositions were 12.50±0.50, 3.34±0.18 and 11.66±0.54 g/100 g. The total energy composition was 310.97±2.30 kcal/100 g. The mineral composition revealed that the leaves of the plant were very rich in basic minerals with high potassium level of 1047.83±34 mg/100 g. Calcium (6.22.58±0.01 mg/100 g), magnesium (361.15±0.01 mg/100 g) and phosphorous (115.40±0.01 mg/100 g) were also present in appreciable amount. The anti-nutrients evaluated had appreciable amounts in phytate (0.15±0.23%), oxalate (2.99±0.61%), saponin (3.46±0.01%) and alkaloid (4.20±0.11%). **Conclusion:** The study revealed that *Phragmanthera capitata* could serve as a source of essential nutrients which can go a long way in ameliorating most nutritional challenges and may contribute remarkably to the amount of nutrients in human.

Key words: Proximate, anti-nutrients, mineral, mistletoe, *Phragmanthera capitata*

Received: September 17, 2016 Accepted: November 15, 2016 Published: December 15, 2016

Citatio n: Franklin Uangbaoje Ohikhena, Olubunmi Abosede Wintola and Anthony Jide Afolayan, 2017. Proximate composition and mineral analysis of *Phragmanthera capitata* (Sprengel) Balle, a mistletoe growing on rubber tree. Res. J. Bot., 12: 23-31.

Corresponding Author: Anthony Jide Afolayan, Medicinal Plants and Economic Development (MPED) Research Center, Department of Botany, University of Fort Hare, Alice, Eastern Cape, South Africa

Competing Interest: The authors have declared that no competing interest exists.

Data Availability: All relevant data are within the paper and its supporting information files.

INTRODUCTION

Phragmanthera capitata (Sprengel) Balle is a mistletoe in the Loranthaceae family. It is a woody parasitic shrub with pendent branches of about 2 m long and has a yellow corolla with a pink-red tip often associated with ants' nests. It grows on trees in secondary jungles, plantations and bush Savannah areas, from Sierra Leone to Western Cameroons, Fernando Po and extending across the Congo basin to Zaïre, Nigeria, Gabon, Ivory Coast and Angola[1]. As with most mistletoe, *P. capitata* is an obligate hemi-parasitic plant which attaches to and penetrates the stems and branches of its host tree or shrub by a structure called the haustorium, through which it absorbs water and mineral nutrients, even though it can produce its own food through photosynthesis[2,3]. They are found parasitizing many economic important tree crops which include shear butter, neem, cocoa, avocado, kola and rubber to mention but a few[4].

Mistletoes have been widely used in various cultures in almost every continent to treat various ailments or as a diuretic agent[5]. It is commonly consumed in parts of West Africa for the treatment of hypertension, ulcers, epilepsy, diabetes, weakness of vision and for promoting muscular relaxation before delivery[6]. Some rural farmers use the leaves as feed for their goats and other livestock that have newly given birth to young ones[7,8]. In the ecosystem, mistletoe attracts avian frugivores and other broad array of animals depend on it for food, consuming the leaves and young shoots therefore, providing high quality food for a wide range of animals in forests and woodlands worldwide[9].

It is worthwhile to note that consumption of numerous types of edible plants as sources of food could be beneficial to nutritionally marginal population especially in developing countries where poverty and climate is causing havoc to the rural populace. In many countries, the supply of minerals is inadequate to meet the mineral requirements of farm animals and the growing human population. Minerals cannot be synthesized by animals/humans and must be provided from plants or mineral-rich water[10] and hence, research is looking inward to the use of non-conventional leafy plants as possible sources of cheap nutritional supplement[11].

The use of mistletoe in pharmaceuticals as drugs and other therapeutic agents for the treatment of divers' kinds of ailments are well known. Their phyto-composition and biological activities which are chiefly dependent on host species[4] are well reported and documented, hence it is widely known as "cure all"[12]. Despite its vast medicinal usage, little or no report is known about its nutritional values hence the aim of this study was to determine the nutritional and mineral compositions of *P. capitata* that is growing on rubber trees and also to providing scientific data based on our findings in relation to its dietary/nutritional and medicinal application(s).

MATERIALS AND METHODS

Leaves of the mistletoe, *P. capitata* (Fig. 1, 2) were collected from mature rubber plantations in Rubber Research Institute of Nigeria, Iyanomo, located on latitude 6°00'-6°15' N, longitude 5°30'-5°45' E and on altitude 27 m a.s.l. in Benin city, which lies on the wet lowland rainforest of Edo State, Nigeria. Leaves were removed from the twigs, properly rinsed and air-dried at room temperature (mean morning and night temperature of 24°C and mean noon temperature of 27°C) in a well aerated atmosphere and prevented from direct sunlight to avoid denaturation of vital phyto-constituents. Dried leaves were pulverized using an electric motor blender and kept in an air-tight glassware container and stored at 4°C until when needed. The pulverized sample was used for all the analyses and all the analyses were carried out in triplicate.

Nutritive composition analysis: The moisture content was determined by the drying method and ash content by

Fig. 1: *Phragmanthera capitata* (Sprengel) Balle growing on rubber tree (*Hevea brasiliensis* L.)

Fig. 2: Leaves of *Phragmanthera capitata* (Sprengel) Balle

incinerating in a muffle furnace at 550°C as described by AgriLASA[13]. Dietary fibre was determined by acid/base digestion as described by Aina *et al.*[14]. Crude fat was extracted with ether, the nitrogen content of the plant was determined using the method described by Bvenura and Afolayan[15] by means of the Inductively Coupled Plasma-Optical Emission Spectrometer (ICP-OES). The value of nitrogen obtained was multiplied by 6.25 to give the percentage of crude protein[16].

The carbohydrate content was determined by weight difference between 100 and the sum of the percentage of protein, fat, ash, moisture and dietary fibre.

Energy content: The kilocalorie (kcal/100 g) value estimation was done by summing the multiplied values for crude protein, crude lipid (excluding crude fibre) and carbohydrate respectively at Atwater factors (4, 9 and 4 kcal) as thus:

$$\text{Energy value (kcal/100 g)} = (\text{Crude protein}\times4)+(\text{Crude fat}\times9)+(\text{Total carbohydrate}\times4)$$

Anti-nutritive composition

Determination of oxalate content: The modified titration method of Day and Underwood[17] was used to determine the oxalate content of the plant. One gram of the pulverized sample was weighed into a conical flask. Seventy five milliliters of 3 M H_2SO_4 was added and stirred with a magnetic stirrer for an hour. This was filtered and 25 mL aliquot of the filtrate was collected and warm to 80-90°C and kept above 70°C at all times. The hot aliquot was titrated against 0.05 M of $KMnO_4$ until an extremely faint pale pink colour persisted for 15-30 sec. The oxalate content was calculated by taking 1 mL of 0.05 M of $KMnO_4$ as equivalent to 2.2 mg oxalate.

Determination of phytic acid: Phytic acid was determined as described by Damilola *et al.*[18]. Two grams of the sample was weighed into a 250 mL conical flask. Hundred milliliters of 2% HCl was used to soak the sample for 3 h and then filtered through What man No. 1 filter paper. Twenty five milliliters aliquot of the filtrate was placed in a separate 250 mL conical flask and 5 mL of 0.3% ammonium thiocyanate solution as indicator. About 53.5 mL of distilled water was added to give the desired acidity. This was then titrated with standard iron III chloride solution which contains 0.00195 g iron mL^{-1} until a brownish yellow colour persisted for 5 min phytic acid was calculated thus:

$$\text{Phytic acid (\%)} = \text{Titre value}\times0.00195\times1.19\times100$$

Determination of saponins: Saponin content was determined as described by Obadoni and Ochuko[19]. Briefly, 20 g of the pulverized plant sample was added to 200 mL of 20% ethanol and kept on a shaker for 30 min and was then heated in a water bath at 55°C for 4 h. The resulting mixture was filtered and the residue re-extracted with another 200 mL of 20% aqueous ethanol. The filtrate mixture was combined and reduced to 40 mL in a water bath at 90°C. The concentrate was transferred into a separatory funnel and 20 mL of diethyl ether was added, shook vigorously. The ether layer which was the upper layer was discarded and the aqueous (bottom) layer retained in a beaker. The retained layer was re-introduced into the saparatory funnel and 60 mL of n-butanol was added and shook vigorously. The butanol extract which is the upper layer was retained while the bottom layer was discarded. The butanol layer was washed twice with 10 mL of 5% aqueous sodium chloride. The remaining solution was collected and heated in a water bath and evaporated to dryness to constant weight at 40°C in an oven. The saponin content was calculated using the equation:

$$\text{Saponin content (\%)} = \frac{\text{Weight of residue}}{\text{Weight of original sample}}\times100$$

Determination of alkaloids: The alkaloid content was determined according to the method of Omoruyig *et al.*[20]. Briefly, 5 g of plant extract was mixed with 200 mL of 10% acetic acid in ethanol. The mixture was covered and allowed to stand for 4 h. This was filtered and the filtrate was concentrated on a water bath to one-fourth of its original volume. Concentrated ammonium hydroxide was added in drops to the extract until precipitation (cloudy fume) was completed. The whole solution was allowed to settle, the collected precipitates washed with dilute ammonium hydroxide and then filtered. The residue collected was dried and weighed. The alkaloid content was determined using this equation:

$$\text{Alkaloid (\%)} = \frac{\text{Weight of precipitate}}{\text{Weight of original sample}}\times100$$

Macro and micro-minerals analysis

Digestion and mineral analysis: The method described by Bvenura and Afolayan[15] was used for the digestion of plant material. Briefly, a digestion mixture comprising of selenium powder, sulphuric acid and salicylic acid were prepared. About 0.3 g of the ground plant material was placed in dry, clean digestion tubes. A volume of 2.5 mL of the digestion mixture was added to each tube and allowed to react at room temperature for 2 h. The tubes were heated in a block digester at 110°C for 60 min. The tubes were allowed to cool and three successive portions of 1 mL hydrogen peroxide added at 10 sec intervals due to the volatility of the reaction. The tubes were returned to the block digester at a temperature of 330°C and were removed from the block digester when the digest turned clear in colour. The tubes were allowed to cool to room temperature, contents transferred into 50 mL volumetric flasks and then deionized water was added to attain volumes of 50 mL. Standards were prepared for all the individual elements to be analyzed.

The macro-minerals (Calcium, magnesium, potassium, sodium and phosphorus) and micro-minerals (Iron, zinc, aluminum, manganese and copper) were determined using the Inductively Coupled Plasma-Optical Emission Spectrometer (ICP-OES, Varian 710–ES series, SMM Instruments, Cape Town, South Africa)[15]. All analyses were carried out in triplicates.

Statistical analysis of data: All experiments were done in triplicates and the results expressed as Mean±SD using the Microsoft excel 2010 spreadsheet.

RESULTS AND DISCUSSION

Proximate composition: Results of the proximate composition of *P. capitata* leaves were shown in Table 1. Parameters determined include; moisture content, total ash, fat, dietary fibre, crude protein and carbohydrate. There was relatively lower moisture content (7.36±0.70 g/100 g) in the sample which is comparable to values obtained in five cowpea verities (6.80±0.22 to 9.10±0.41 g/100 g) as reported by Owolabi *et al.*[21]. This low moisture level indicates a longer shelf life because moisture content determines the suitability of food products before consumption because it affects the physical and chemical aspects of food which relates to the freshness and stability for storage[22].

The ash content (7.41±0.07 g/100 g) evaluated from this sample was relatively higher than all five varieties of cowpea (3.38±0.93 to 4.46±0.41 g/100 g), Indian spinach (5.02 g/100 g), *Telfaira occidentale* (8.54 g/100 g) and all *Cissus populnea* stem (6.5±0.7-8.8±0.5 g/100 g) collected from three different locations as reported by Owolabi *et al.*[21], Asaolu *et al.*[10] and Adebowale *et al.*[23], respectively. The ash content of the sample (7.41±0.07 g/100 g) was relatively high indicating its richness in mineral nutrients. Ash content is a measure of the total amount of minerals present in the plant. These minerals act as inorganic co-factors in metabolic processes which means that without these inorganic co-factors, there could be impaired metabolism[24].

Table 1: Proximate composition of *Phragmanthera capitata* (Sprengel) Balle

Parameters	Composition (g/100 g dry weight)
Moisture content	7.36±0.07
Total ash	7.41±0.07
Crude fat	3.34±0.18
Crude fibre	11.66±0.54
Crude protein	12.50±0.50
Carbohydrates	57.73±0.33
Energy value (kcal/100 g)	310.97±2.30

Values are expressed as Mean±SD, n = 3

The dietary fibre content of the sample (11.66±0.54 g/100 g) is higher than Indian spinach (6.05 g/100 g), bush-buck (4.02 g/100 g), scent leaf (7.04 g/100 g), *Amaranthus hybidus* (8.05 g/100 g) and *Telfaria occidentale* (11.05 g/100 g) but slightly lower than *Vernonia amygdalina* (Bitter leaf) and *Hibiscus sabdariffa* with values of 12.08 and 12.04% respectively as reported by Asaolu *et al.*[10]. The dietary fibre recorded in the sample is lower than the Recommended Daily Intake (RDI) for men (31.00-38 g day^{-1}), females (25-26 g day^{-1}), pregnant women (28 g day^{-1}) and lactating mothers (29 g day^{-1})[25]. Nutritionally, relatively high dietary fibre evaluated in the sample is beneficial because it provides the buck necessary for proper peristaltic action and aids the absorption of trace elements in the gut and reduces cholesterol absorption[23,26].

3The protein content in the sample was 12.50±0.50 g/100 g and it was the second highest proximate composition of the sample. Though below the Recommended Dietary Allowance (RDA) for adult males and females (56 g day^{-1})[27], it is enough to provide 19.64% day^{-1} if 100 g (dry weight) of the sample were consumed. The protein content of the sample was quiet lower than reported results for different leafy vegetables consumed in Africa as reported by Asaolu *et al.*[10] and also lower than the five cowpea varieties (19.84±0.18-26.61±0.48 g/100 g) as reported by Owolabi *et al.*[21] but was higher than *Peperomia pellucida* (10.63±0.07 g/100 g) as reported by Ooi *et al.*[28]. Nutritionally, protein is the major component of all cells in the body and functions in growth, movement and body defense. It also serves the purpose of enzymatic catalyst and mediates metabolic and energy regulation[25,29].

The result showed that the fat (lipid) content of the sample was 3.34±0.18 g/100 g and it was the lowest nutritional composition evaluated in this study indicating the low level of fat in the sample which is far below the recommended percentage calorie requirement for fat per day which ranges from 20-35% calories (kcal/100 g). An active male requiring 3,000 cal per day[27] would need to consume 600-1050 cal or 67-117 g of fat day^{-1}. This sample could be a good choice for people requiring low fatty food source.

Carbohydrate had the highest nutritional composition of 57.73±0.33 g/100 g. This value is comparable to the five varieties of cowpea (56.24±0.51 to 63.30±0.33 g/100 g) recorded by Owolabi *et al.*[21] and higher than values obtained for *Peperomia pellucida* (46.58±2.74 g/100 g) and stem flour of *Cissus populnea* (43.7±2.5 to 48.1±3.5 g/100 g) as reported by Ooi *et al.*[28] and Adebowale *et al.*[23], respectively. The carbohydrate content of the sample (57.73±0.33 g/100 g) is lower than the DRI for carbohydrate (130 g day^{-1}) but can supplement 44.41% of the daily requirement for carbohydrate if 100 g were consumed (Dietary relative intakes)[25]. Nutritionally, this sample can provide readily accessible fuel, serve as source of energy for the body, for physical performance, breathing, maintaining body temperature and for contraction and relaxation of the heart muscles[29], it can also help in breaking down fatty acids and prevent ketosis, maintaining digestive health and gives food good flavourings.

The total energy derived from this plant as calculated was 310.97±2.30 kcal/100 g (Table 1) which is below the recommended daily energy intake of 1,000 kcal for sedentary children of ages 2-3 years and 1,000-1400 kcal day^{-1} for active children under the same age bracket, sedentary female adults (19-30 years) would need about 2,000 kcal day^{-1} and active female adults of the same ages would require 2,400 kcal day^{-1} to meet their daily intake. For sedentary men (19-30 years) and active men (14-18 years), their energy requirement per day is 2,800-3,200 kcal, respectively[25]. The higher the energy value of a food sample, the lesser the amount required to meet the required energy intake. This plant on the whole is a good energy source as all the required energy needed in human is supplemented from various food products.

Mineral composition of *P. capitata*: Table 2 shows the result of the mineral composition of the sample. The results showed that the sample is a good source of both macro and micro minerals. The minerals evaluated are in the other; K>Ca>Mg>P>Fe>Mn>Na>Zn>Cu.

The amount of K (1047.83±0.01 mg/100 g) in the sample is relatively lower than the Recommended Dietary Allowances (RDA, 4700 mg day^{-1}) for K and also lower than the values reported in *Peperomia pellucida* (6977±4.24 mg/100 g)[28] and *Cissus populnea* stem (2679±13 mg/100 g)[23] but higher than values recorded in *Cicer arietinum* (870 mg/100 g)[30], cowpea (15.67±1.17 to 18.69±0.29 mg/100 g)[21], Indian spinach (16.85 mg/100 g),

Table 2: Mineral composition of *Phragmanthera capitata* (Spreng.) Balle

Mineral elements	Composition (mg/100 g)
Calcium (Ca)	622.58±0.01
Magnesium (Mg)	361.15±0.01
Potassium (K)	1047.83±0.03
Phosphorous (P)	115.40±0.01
Sodium (Na)	19.23±3.71
Zinc (Zn)	2.49±0.14
Copper (Cu)	1.81±0.07
Manganese (Mn)	27.57±0.60
Iron (Fe)	105.15±8.11

Values are expressed as Mean±SD, n = 3

bitter leaf (73.25 mg/100 g), scent leaf (86.24 mg/100 g) and *Telfaria occidentalis* (130.24 mg/100 g)[10]. The Na content (19.23±3.71 mg/100 g) in the sample is far lower than the RDA (1500 g day^{-1}) and lower than almost all the traditional vegetables consumed in South Africa as reported by Odhav *et al.*[31]. The K and Na both function for proper fluid balance, nerve transmission and muscle contraction[32].

Calcium is the second highest mineral element in the sample with a value of 622.58±0.01 mg/100 g and plays a major role in building and maintaining strong bones and teeth, it also serves vital roles in nerve transmission, constriction and dilation of blood vessels, muscle contraction[27], normal functioning of blood coagulation, milk clotting[33], regulation of cell permeability, blood pressure regulation and immune system health[32]. Deficiency of calcium causes rickets, osteoporosis, back pain, indigestion, irritability, premenstrual tension and cramping of the uterus[34]. The daily Recommended Dietary Allowance (RDA) for Ca is 1000 mg day^{-1} for males and females aged 19-30 years which is a bite higher than the 622.58±0.01 mg/100 g obtained in the sample but it can conveniently supply 62.258% of the daily allowance hence it is a good supplement for people with Ca deficiency.

The presence of Mg in the sample per 100 g was 361.15±0.01 mg which is sufficiently enough to supply the RDA of Mg per day for most of life stage groups which requires[25] 80-420 mg day^{-1}, hence the sample is a good source of Mg. Magnesium is important in the formation and function of bones, muscles and prevents high blood pressure and depression. It is also needed for making proteins, muscle contraction, nerve transmission and immune system health and plays important role in enzyme activity and prevents heart diseases[33]. The Mg is vital in strengthening cell membrane structure and modulates glucose transport across cell membranes[35]. Studies have shown that Mg supplementation improves insulin sensitivity in diabetic patients and it can improve insulin sensitivity in obese individuals who are at risk of type 2 diabetes mellitus[36].

The composition of phosphorous in the sample was 115.40±0.01 mg/100 g which is below the RDA of 700 mg day^{-1} for adults and also lower than chickpea seeds (226 mg/100 g) as reported by Alajaji and El-Adawy[30] and most vegetables consumed in South Africa as reported by Odhav *et al.*[31], phosphorous is important for healthy bones and teeth and it is found in every cell and maintains normal cell growth and repairs; it maintains blood sugar level, acid-base balance and normal heart beat level[32,33].

The body also needs micro (trace) minerals in very small amounts. Iron is considered to be a trace mineral, although the amount needed is somewhat more than for other micro minerals. The micro minerals assayed for are Zn, Cu, Mn and Fe. Iren (Fe) is the highest micro mineral produced by the sample with a composition of 105.15±8.11 mg/100 g which is far above the RDA of 8 mg day^{-1} for adult male and up to 28 mg day^{-1} for pregnant women. So, about 29.44 g of the sample is sufficiently enough to supply the RDA of Fe for pregnant women. The Fe is a major constituent of hemoglobin and a carrier of oxygen in the blood. The Fe is also important in tendon and ligament formation, certain chemicals in the brain are controlled by the presence and absence of iron and also needed for energy metabolism[32,37]. The Fe deficiency causes anaemia, weakness, depression, poor resistance to infection and in women may cause infertility[32] and hence this sample can be a good source for people with fertility challenges and other Fe deficiency crisis.

Zinc (Zn) content in the sample was 2.49±0.14 mg/100 g which is lower than the RDA of 8 mg for adult males, 18 mg for adult females and 27 mg for pregnant women[25]. The Zn is in part of many enzymes, needed for making protein and genetic material has a function in taste perception, wound healing, normal fetal development, production of sperm, normal growth and sexual maturation, immune system health[32]. This sample therefore can be a good Zn supplement for people with infertility challenges.

Copper is part of the enzymes such as cytochrome oxidase, lysyl oxidase and ceruloplasm, needed for iron metabolism in the blood[33]. The Cu deficiency can cause cardiac abnormalities in human and animals, anemia and neutropenia[38]. The amount of Cu in the sample (1.81±0.07 mg/100 g) is above the RDA of 0.9 mg day^{-1} for adult males and females, 1 mg day^{-1} for pregnant women and 1.3 mg day^{-1} for lactating mothers hence it's a good source of Cu and highly recommended for people with Cu deficiency.

Manganese acts as a cofactor and constituents of several enzymes involved in metabolic processes necessary for the skeletal development, reproductive function and growth. It is a cofactor of oxidative phosphorylation enzymes whose activity increases insulin secretion to improve glucose tolerance under diabetic condition[39]. This element is also involved in urea formation, metabolism of amino acids, cholesterol and carbohydrates[40]. The composition of Mn in the sample was 27.57 mg/100 g which is above the RDA of 2.3 mg for adult males, 1.8 mg for adult females, 2 mg for pregnant women and 2.6 mg for lactating mothers[25]. So, in providing the daily Mn requirement from the sample, adult males would need 8.34 g day^{-1}, adult females 6.53 g day^{-1}, pregnant women 7.25g day^{-1} and lactating mothers would need 9.43 g.

Table 3: Anti-nutrient composition of *Phragmanthera capitata* (Sprengel) Balle

Parameters	Values (%)
Phytic acid	0.15±0.23
Oxalate	2.99±0.61
Saponins	3.46±0.01
Alkaloids	4.20±0.11

Values are expressed as Mean±SD, n = 3

Anti-nutritional composition of *P. capitata*: The summary of the anti-nutritional composition of the sample is as shown in Table 3. Four anti-nutrients were studied, alkaloid was the most abundant with a percentage value of 4.20±0.11% which was closely followed by saponin (3.46±0.11%) and oxalate (2.99±0.61%). Phytic acid was the least with a percentage value of 0.15±0.23%.

The anti-nutrient activities of alkaloid are observed at high level intake/dosage to exert toxic and adverse effects to humans, especially in physiological and neurological activities. However, dosage differentiates between toxicity and pharmacological effects of alkaloids[41]. The percentage of alkaloid (4.2%) in the sample is higher than *Clerodendrum volubile* (0.79%)[11], *Cissus populnea* (0.23%)[23], red and white cocoyam leaves (1.44±0.08 and 1.50±0.05%, respectively)[18].

Oxalate composition of 2.99±0.61% in the sample was higher than 0.583±0.04 and 0.828±0.07% (converted values) of red and white cocoyam leaves respectively as reported by Damilola *et al.*[18]. The oxalate content of foods is of interest because consumption of high oxalate diet may result in hyperoxaluria thereby increasing the risk of kidney stones. Iron oxalate crystals cause significant oxidative damage and diminish iron stores needed for red blood cell formation while kidney stones are caused by calcium oxalate. Oxalate on the long run, can also act as a chelator and can chelate toxic metals such as mercury and lead[42] and can act as an antioxidant.

Phytic acid (phytate) though very low (0.15±0.23%) was also recorded in the sample (Table 2). This value is very small to cause any adverse anti-nutrient effect to phosphorus absorption in diet. Phytate chelates metal ions such as calcium, magnesium, zinc, copper, iron and molybdenum to form insoluble complexes that are not readily absorbed from the gastrointestinal tract[42,43]. The greatest effect of phytic acid on human nutrition is its reduction of zinc bioavailability[43]. Its antioxidant ability can be used in the food industry as a unique and versatile food preservative as it can increase nutritive value, prolong shelf life and prevent discoloration when added to fruits, vegetables, cheese, noodle, soy sauces, juices, bread, alcoholic beverages, meat fishmeal pastes and canned sea foods. Phytate can also act as an anti-cancer agent against colon, soft tissue, metastatic lung cancer, breast and prostate cancer[44]. It has been reported to reduce blood glucose and possess health benefits to diabetic patients and can also prevent kidney stone formation[45], hence this plant has the potential to serve as a remedy for people with the scare of high oxalate consumption which can lead to kidney stone formation.

The saponin content of the species was 3.46±0.01 5%. Saponin is a heterogeneous group of naturally occurring foam-producing triterpene or steroidal glycosides that occur in a wide range of plants[46]. Some biological effects of saponin in animals include erythrocyte haemolysis, reduction of blot (ruminant), inhibition of smooth muscles activity, enzyme inhibition and reduction in nutrient absorption, alteration of cell wall permeability and therefore produce some toxic effects when ingested, it also binds with the cell of the small intestine thereby affecting the absorption of nutrients across the intestinal wall[42,43]. Aside its anti-nutrient effects, saponin have been reported to have various biological benefits such as, anti-inflammatory, anti-diabetic, anti-HIV, anti-atherosclerotic and serve as protective functions like gastro-protective, hepatoprotective and hypolipidemic. Reports have also shown saponins to be effective in maintaining liver function, lowering blood cholesterol, preventing peptic ulcer, osteoporosis as well as platelet agglutination[42].

CONCLUSION

The study revealed that *Phragmanthera capitata*, a mistletoe growing on rubber tree has the potential of contributing useful amount of nutrients to human and animal diets. The anti-nutrients present were abite higher than most found in some conventional vegetables but preparation techniques like soaking, boiling and cooking reduce anti-nutrient thereby making their effect negligible. This plant can serve as a supplement to many mineral deficiencies and also as a source of medicine to a number of ailments, hence, mistletoe is known as a remedy for all kinds of diseases and sicknesses. Instead of been considered a pest, it should be seen as a plant with great potential in the food/nutritional and pharmaceutical industries. Further studies on its toxicity are ongoing to ascertain if any, its possible adverse effects.

SIGNIFICANT STATEMENTS

This study provides insights into the nutritional composition of *Phragmanthera capitata*, a mistletoe widely exploited in Africa. This study reveals important mineral compositions even higher than those found in some conventional vegetables. It is rich in carbohydrate which serves as a major source of energy and substantial amount of fibre, protein and fat. The findings of this study revealed that this species could be used to boast the immune system due to its rich mineral and nutrient compositions and hence could be the reason to its therapeutic application in folkloric medicine. This study also gives a baseline data on its nutritional composition as most research is on crop protection because of its parasitic mode of association.

ACKNOWLEDGMENT

The authors wish to acknowledge the financial support of Govan Mbeki Research Development Centre, University of Fort Hare, South Africa and Rubber Research Institute of Nigeria, Iyanomo.

REFERENCES

1. Takem, L.P., G.A. Eshiet, O.G. Ogom and U.U. Mbang, 2014. Exploratory and anxiety potentials of aqueous extract of *Phragmanthera capitata*. J. Phytopharmacol., 3: 400-404.
2. Hassan, A.F., I.T. Numan, K.W. Al-Sammarrae and S.A. Hussain, 2005. Hematopoietic toxicity of *Loranthus europaeus* chloroform extract: *In vitro* study. Int. J. Comprehen. Pharm., 17: 345-352.
3. Agbo, M.O., C.S. Nworu, F.B.C. Okoye and P.O. Osadebe, 2014. Isolation and structure elucidaton of polyphenols from *Loranthus micranthus* Linn. parasitic on Hevea brasiliensis with antiinflammatory property. EXCLI J., 13: 859-868.
4. Adesina, S.K., H.C. Illoh, I.I. Johnny and I.E. Jacobs, 2013. African mistletoes (Loranthaceae); ethnopharmacology, chemistry and medicinal values: An update. Afr. J. Tradit. Complement. Altern. Med., 10: 161-170.
5. Jadhav, N., C.R. Patil, K.B. Chaudhari, J.P. Wagh, S.J. Surana and R.B. Jadhav, 2010. Diuretic and natriuretic activity of two mistletoe species in rats. Pharmacogn. Res., 2: 50-57.

6. Bassey, M.E., 2012. Phytochemical investigations of *Tapinanthus globiferus* (Loranthaceae) from two hosts and the taxonomic implications. Int. J. Chem. Environ. Pharm. Res., 3: 174-177.
7. Ishiwu, C.N., J.E. Obiegbuna and N.M. Aniagolu, 2013. Evaluation of chemical properties of mistletoe leaves from three different trees (Avocado, African oil bean and Kola). Nig. Food J., 31: 1-7.
8. Sher, H. and M.N. Alyemeni, 2011. Pharmaceutically important plants used in traditional system of Arab medicine for the treatment of livestock ailments in the kingdom of Saudi Arabia. Afr. J. Biotechnol., 10: 9153-9159.
9. Mathiasen, R.L., D.L. Nickrent, D.C. Shaw and D.M. Watson, 2008. Mistletoes: Pathology, systematics, ecology and management. Plant Dis., 92: 988-1006.
10. Asaolu, S.S., O.S. Adefemi, I.G. Oyakilome, K.E. Ajibulu and M.F. Asaolu, 2012. Proximate and mineral composition of Nigerian leafy vegetables. J. Food Res., 3: 214-218.
11. Erukainure, O.L., O.V. Oke, A.J. Ajiboye and O.Y. Okafor, 2011. Nutritional qualities and phytochemical constituents of *Clerodendrum volubile*, a tropical non-conventional vegetable. Int. Food Res. J., 18: 1393-1399.
12. Adodo, A., 2004. Nature Power: A Christian Approach to Herbal Medicine. 3rd Edn., Generation Press, Surulere, Lagos, ISBN-13: 9789780601874, Pages: 209.
13. AgriLASA., 2007. Method No. 6.1.1 for Feeds and Plants. In: Agrilasa Handbook of Feeds and Plant Analysis, Vol. 1, 2nd Edn., Palic, P., A.S. Claasens, J. Collier, A. Loock and D. Hattingh (Eds.)., Agri Laboratory Association of South Africa, Pretoria.
14. Aina, V.O., B. Sambo, A. Zakari, H.M.S. Haruna, K. Umar, R.M. Akinboboye and A. Mohammed, 2012. Determination of nutritional and anti-nutritional content of *Vitis vinifera* (Grapes) grown in Bomo (Area C) Zaira, Nigeria. Adv. J. Food Sci. Technol., 4: 445-448.
15. Bvenura, C. and A.J. Afolayan, 2012. Heavy metal contamination of vegetables cultivated in home gardens in the Eastern Cape. South Afr. J. Sci., 108: 1-6.
16. Magomya, A.M., D. Kubmarawa, J.A. Ndahi and G.G. Yebpella, 2014. Determination of plant proteins via the Kjeldahl method and amino acid analysis: A comparative study. Int. J. Sci. Technol. Res., 3: 68-72.
17. Day, Jr. R.A. and A.L. Underwood, 1986. Quantitative Analysis. 5th Edn., Prentice-Hall Publication, London, UK., Pages: 701.
18. Damilola, O.L., O.B. Joseph, A. Olufemi and I.A. Amoo, 2013. Chemical composition of red and white cocoyam (*Colocosiaesculenta*) leaves. Int. J. Sci. Res., 11: 121-125.
19. Obadoni, B.O. and P.O. Ochuko, 2002. Phytochemical studies and comparative efficacy of the crude extracts of some haemostatic plants in Edo and Delta states of Nigeria. Global J. Pure Applied Sci., 8: 203-208.
20. Omoruyig, B.E., G. Bradley and A.J. Afolayan, 2012. Antioxidant and phytochemical properties of *Carpobrotus edulis* (L.) bolus leaf used for the management of common infections in HIV/AIDS patients in Eastern Cape Province. BMC. Complement Altern. Med., Vol. 12. 10.1186/1472-6882-12-215.
21. Owolabi, A.O., U.S. Ndidi, B.D. James and F.A. Amune, 2012. Proximate, antinutrient and mineral composition of five varieties (improved and local) of Cowpea, *Vigna unguiculata*, commonly consumed in samaru community, Zaria-Nigeria. Asian J. Food Sci. Technol., 4: 70-72.
22. Igwe, O.U. and D.E. Okwu, 2013. Investigation of the chemical composition of *Brachystegia eurycoma* harms plant parts used in herbal medicine. Int. Res. J. Pharm. Applied Sci., 3: 51-55.
23. Adebowale, K.O., L.M. Nwokocha and W.B. Agbaje, 2013. Composition of *Cissus populnea* stem. J. Food Compos. Anal., 30: 41-46.
24. Jonathan, A.A. and A.S. Funmilola, 2014. Nutritional and anti-nutritional composition of *Bridelia ferruginea* Benth (Euphorbiaceae) stem bark sample. Int. J. Scient. Res. Knowl., 2: 92-104.
25. Institute of Medicine, 2006. Dietary Reference Intakes: The Essential Guide to Nutrient Requirements. National Academies Press, Washington DC, USA., ISBN: 978-0-309-15742-1, Page: 1344.
26. Dhingra, D., M. Michael, H. Rajput and R.T. Patil, 2012. Dietary fibre in foods: A review. J. Food Sci. Technol., 49: 255-266.
27. USDA. and DHHS., 2010. Dietary Guidelines for Americans. 7th Edn., U.S. Government Printing Office, Washington, DC., USA., Pages: 112.
28. Ooi, D.J., S. Iqbal and M. Ismail, 2012. Proximate composition, nutritional attributes and mineral composition of *Peperomia pellucida* L. (Ketumpangan Air) grown in Malaysia. Molecules, 17: 11139-11145.
29. Hussain, J., A.L. Khan, Najeeb ur Rehman, Zainullah, F. Khan, S.T. Hussain and Z.K. Shinwari, 2009. Proximate and nutrient investigations of selected medicinal plants species of Pakistan. Pak. J. Nutr., 8: 620-624.
30. Alajaji, S.A. and T.A. El-Adawy, 2006. Nutritional composition of chickpea (*Cicer arietinum* L.) as affected by microwave cooking and other traditional cooking methods. J. Food Compos. Anal., 19: 806-812.
31. Odhav, B., S. Beekrum, U.S. Akula and H. Baijnath, 2007. Preliminary assessment of nutritional value of traditional leafy vegetables in KwaZulu-Natal, South Africa. J. Food Compos. Anal., 20: 430-435.
32. WebMD, 2014. Vitamins and supplements minerals: Their functions and sources guide. WebMD Medical Reference, Healthwise.

33. Shivraj, H.N. and C.N.N. Khobragade, 2009. Determination of nutritive value and mineral elements of some important medicinal plants from Western Part of India. J. Med. Plants, 8: 79-88.
34. Hasling, C., K. Sondergaard, P. Charles and L. Mosekilde, 1992. Calcium metabolism in postmenopausal osteoporotic women is determined by dietary calcium and coffee intake. J. Nutr., 122: 1119-1126.
35. Jahnen-Dechent, W. and M. Ketteler, 2012. Magnesium basics. Clin. Kidney J., 5: 3-14.
36. Volpe, S.L., 2013. Magnesium in disease prevention and overall health. Adv Nutr., 4: 378S-383S.
37. Gaeta, A. and R.C. Hider, 2005. The crucial role of metal ions in neurodegeneration: The basis for a promising therapeutic strategy. Br. J. Pharmacol., 146: 1041-1059.
38. Smith, J.C., 1987. Copper nutritive and cardiovascular integrity. Proceedings of the University of Missouri's 21st Annual Conference on Trace Substances in Environmental Health, May 24-28, 1987, St. Louis, Mo., USA., pp: 499-513.
39. Lee, S.H., H.A. Jouihan, R.C. Cooksey, D. Jones, H.J. Kim, D.R. Winge and D.A. McClain, 2013. Manganese supplementation protects against diet-induced diabetes in wild type mice by enhancing insulin secretion. Endocrinology, 154: 1029-1038.
40. Zablocka-Slowinska, K. and H. Grajeta, 2012. The role of manganese in etiopathogenesis and prevention of selected diseases. Postepy. Hig. Med. Dosw., 66: 549-553.
41. Makkar, H.P.S., S. Siddhuraju and K. Becker, 2007. Methods in Molecular Biology: Plant Secondary Metabolites. Humana Press, Totowa, New Jersey, USA.
42. Egbuna, C. and J.C. Ifemeje, 2015. Biological functions and anti-nutritional effects of phytochemicals in living system. IOSR J. Pharm. Biol. Sci., 10: 10-19.
43. Akande, K.E., U.D. Doma, H.O. Agu and H.M. Adamu, 2010. Major antinutrients found in plant protein sources: Their effect on nutrition. Pak. J. Nutr., 9: 827-832.
44. Liu, Z., F. Cheng and G. Zhang, 2005. Grain phytic acid content in japonica rice as affected by cultivar and environment and its relation to protein content. Food Chem., 89: 49-52.
45. Dost, K. and O. Tokul, 2006. Determination of phytic acid in wheat and wheat products by reverse phase high performance liquid chromatography. Anal. Chim. Acta, 558: 22-27.
46. Jenkins, K.J. and A.S. Atwal, 1994. Effects of dietary saponins on fecal bile acids and neutral sterols and availability of vitamins A and E in the chick. J. Nutr. Biochem., 5: 134-137.