Trop. Anim. Prod. Invest. 25 (01):15-26 (2022)
ISSN: 1115-2540
http://tapi.animalsci.ui.edu.ng/index.php/journal/issue/archive

**ORIGINAL RESEARCH ARTICLE**

# Nutritional and Ethnomedicinal Potentials of *Parquetina nigrescens* Leaf Extracts in Livestock Production

**Olumide, M.D, Akintunde, A.O, Ndubuisi-Ogbonna, L.C, Shobo, B.A, Oreagba, T and Isiadinso,** I

Animal Science Unit, Department of Agriculture and Industrial Technology,
Babcock University, Ilishan-Remo, Ogun State, Nigeria.
Corresponding author: olumidem@babcock.edu.ng; +234 8067976334

## ABSTRACT

***The increasing clamour for organic animal production necessitated the investigation on the potential of Parquetina nigrescens leaf extract in livestock production. The extract of the leaves of Parquetina nigrescens was evaluated for the proximate, phytochemical, minerals and vitamins compositions. The fresh leaves of Parquetina nigrescens were harvested around 6:00hrs and 6:30hrs, thereafter, they were washed. 20g of the fresh leaves harvested were blended with 100ml of water using a blender. The blending was done for about 5 minutes after which the blended samples were well filtered using standard filter papers (Whatman paper No. 1). The filtrates were then used for chemical analysis. Proximate analysis indicated that the leaf extracts had high concentration of moisture (7.80%), crude fibre (9.38%), crude protein (8.40 %), ether extract (9.38%), and ash (6.90%). Mineral and vitamin analysis showed that Parquetina nigrescens leaf extract contained macro minerals (%) such as Na (0.36), Ca (29.96), P (6.88), K (23.21), Mg (4.05), micro minerals such as Si (23.71 ppm), Al (4.34%), Fe (3.59%), Ti (2.11ppm), Mn (1.46 ppm) and Cl (0.33%) and high content of vitamins A (2.27 mg/100g), B1 (270.25 mg/100g), B2 (850.26 mg/100g), B3 (325.20 mg/100g), C (16.20 mg/100g) and E (0.015 mg/100g) respectively. Phytochemical evaluation revealed that Parquetina nigrescens leaf extract have high contents of alkaloids (8.27 mg/100g), flavonoids (2.25 mg/100g), glycosides (0.06 mg/100g), saponin (5.20 mg/100g), steroids (0.20 mg/100g), phenols (0.86 mg/100g), terpenoids (0.52 mg/100g), tannin (6.30 mg/100g) and anthraquinones (1.55 mg/100g). The results showed that Parquetina nigrescens leaf extract are of high nutritional quality due to high crude protein, vitamins and mineral contents especially calcium and potassium with the resultant phytochemicals attributes that could serve as feed additives in monogastric animal production.***

***Keywords: minerals, phytochemicals, proximate composition, vitamins***

## INTRODUCTION

The therapeutic use of natural products from indigenous plants for ethnomedicinal and nutritional purposes for bioactive components that is beneficial to livestock and man (Oktay et al., 2003; Wangensteen et al., 2004). Recently, the interest in natural products from plants and their use has increased tremendously even in areas where conventional medicines are very much available.

Medicinal plants contain numerous biologically active compounds such as nutrients and phytochemicals which have physiological actions on the human body (Olowokudejo et al., 2008) and these inherent active ingredients are used to treat various ailments (Okigbo et al., 2008). Majority of the world's population in developing countries still relies on herbal medicines to meet their health needs (Uzoekwe and Mohammed, 2015).

*Parquetina nigrescens*, a perennial plant which grows in secondary forest and around villages in Nigeria as well as Senegal (Oluwafemi and Debiri, 2008; Ayoola et al., 2011) is used by traditional healers in Nigeria (Ayoola et al., 2011). In Nigeria, the leaves have been reported for treatment of helminthiasis (intestinal worm), while the roots are used for the management of rheumatism (Adeyemi, 1994). Over the years, *Parquetina nigrescens* has been used as an ingredient in the medications for insanity (Iwu, 1994), as well as an aphrodisiac in East Africa. Other uses include the decoction of the stem bark been given as cardiac tonic while the leaf and root decoction have been used for the treatment of gonorrhea and menstrual disorders (Iwu 1994).

*Parquetina nigrescens* is also a constituent of a commercial herbal preparation (Jubi formula) in Nigeria used in the treatment of anaemia in humans. *Parquetina nigrescens* has been shown to ameliorate hemorrhagic anemia (Agbor and Odetola, 2005). The analgesic, anti-inflammatory and antipyretic effects of *Parquetina nigrescens* leaf extract have been documented (Owoyele et al., 2009). The plants have been shown to have hematinic, antidiabetic, cardiotonic, anti-ulcerative and antioxidant properties (Ayoola et al., 2011; Datté and Ziegler, 2001; Ozaslan, 2011; Saba et al., 2010).

This study is aimed at evaluating the proximate composition, phytochemical constituents, vitamin and mineral composition present in *Parquetina nigrescens* leaf extract as there is dearth of information on the nutritive and phytochemicals values of the leaf extract of *Parquetina nigrescens*.

## MATERIALS AND METHODS

### Collection and Treatment of Samples

The fresh leaves of *Parquetina nigrescens* were obtained in Ibadan, Oyo State, Nigeria. The leaves were identified and authenticated by an agronomist in the Department of Agriculture and Industrial Technology, Babcock University, Ilishan-Remo, Ogun State, Nigeria. The study was carried out in Animal Science Laboratory of the Department of Agriculture and Industrial Technology, Babcock University, Ilishan-Remo, Ogun State, Nigeria. The leaves were harvested around 6:00hrs and 6:30hrs, thereafter, they were washed. 20g of the fresh leaves harvested were blended with 100ml of water using a blender. The blending was done for about 5 minutes after which the blended samples were well filtered using standard filter papers (Whatman paper No. 1). The filtrates were then used for further chemical analysis.

### Determination of Proximate Composition

The extract of *Parquetina nigrescens* leaves was analyzed for proximate composition (dry matter, ash, crude fat, crude fibre and crude protein contents) using the methods of Association of Official Analytical Chemists (AOAC, 2010). The dry matter content was determined by drying a known weight of the homogenized sample at 105$^{o}$C in an oven, until a constant weight was reached. For the total ash determination, the extract was converted to dry ash in a muffle furnace at 550$^{o}$C. The fat content was obtained by extraction with petroleum ether using a Soxhlet apparatus. Kjeldahl method was used for crude protein determination while the total carbohydrate content was obtained by difference. This was by deducting the total sum of the ash, crude fibre, crude protein and crude fat contents from 100% dry weight sample. The gross energy content (kcal/100 g) of the extract was calculated as described in FAO (2003) and Adinortey, (2012) which involved multiplying the percentages of the crude protein, crude fat and carbohydrate contents by 4.0, 9.0 and 4.0 respectively.

### Determination of Phytochemicals

Standard spectrophotometric and titrimetric methods were used in the determination of phytochemical contents of the extracts. Flavonoids were determined using the methods of Boham and Kocipai, (1994), saponins, phenols and glycosides were done using the procedures of Obadoni and Ochuko (2001), alkaloids was carried out using the method of Harbone (1973) while oxalates and tannins were determined by titrimetric methods of Onwuka (2005).

### Determination of Minerals

Sodium and potassium contents were determined via flame photometry using the using X-ray fluorescence spectrophotometry, diffractometer type was Philip PW 1210. The diluents of sample was aspirated into the JENWAY Flame photometer (PFP7 Model) using the filter corresponding to each mineral element. All of these were carried out using the method described by (Oshodi, 1992). Phosphorus was determined by vanadomolybdate method (AOAC, 1995) while the other minerals were determined after wet digestion using Atomic Absorption Spectrophotometer (BUCK 210 VGP model).

### Determination of Vitamins Contents

Standard spectrophotometric methods of AOAC (2000) and Okwu (2004) were used in the determination of all the vitamin contents of the extracts except vitamin C that was determined using titrimetric method (Okwu, 2004).

### Statistical Analysis

Statistical Analysis Data was analyzed using SPSS Version 20.0. Results were expressed as Mean ± SD of three replicates determinations.

## RESULTS AND DISCUSSION

The proximate composition of *Parquetina nigrescens* leaf extract is shown in Table 1. The average result of the proximate composition of *Parquetina nigrescens* leaf extracts shows that the moisture content was 7.8%. Moisture content in a sample is used to determine its shelf life, thus sample with low moisture tend to last longer when stored compared to those with high moisture content (Alagbe, 2020). Low moisture content would therefore hinder the growth of spoilage microorganisms and enhance shelf life (Ruberto and Baratta, 2000). However, a relatively higher value of moisture is expected considering the fact that leaf extract is used in the present study.

The crude protein content of the extract was 8.40±0.02% which is relatively low compared to that reported for stone breaker (17.58 ±0.254%) reported by Adebisi et al. (2021) and *Ocinum gratissimum* (14.35%), *Vernonia amygdalina* (21.00%) and *Moringa oleifera* (25.90%) leaves reported by Olumide et al (2019). The crude protein content is also lower compared to 21.67%% of *Moringa oleifera* leaf seed reported by Akintunde and Toye (2014), 14.74% for *Phyllanthus niruri* leaf (Olufayo et al., 2021) and 19.61% for *Chromolaena odorata* (Akintunde et al., 2021a). The values are however in similar to the values reported for *Citrus sinensis* fruits (7.66%) (Ndubuisi-Ogbonna et al., 2021), unripe *Carica papaya* seed (8.90%) (Akintunde et al., 2021b) and 8.63% for sun-dried *Carica papaya* seed (Kolu et al., 2021). Crude protein in *Parquetina nigrescens* leaf extracts is higher compared to the values reported for clove (5.87 %) and turmeric (7.04%) by Adebisi et al. (2021). This result is an indication that *Parquetina nigrescens* leaf extracts may not be able to supply adequate amount of dietary protein to animals, thus it cannot be used as a sole protein source (Alagbe et al., 2019; Oluwafemi et al., 2020; NRC, 1994). According to Ojewuyi et al. (2014) protein is capable of supporting growth, transport of molecules such as oxygen and strengthening the immune system of animals. Food proteins are building block units and it is needed to produce vital hormones, important brain chemicals, antibodies, digestive enzymes, and necessary elements for the manufacture of DNA (Bailey, 2008; Usunobun et al., 2015).

Dietary ether extract (fat) is necessary to provide energy especially when carbohydrate is low or deficient in a diet to ensure that animals satisfy their energy requirement (Alagbe, 2019; Oluwafemi et al., 2020). Fats also aids the transport of fat-soluble vitamins in the body, enhance the structural and biological functioning of the cells in animals (Onuegbu and Iwu, 2020; Pamela et al., 2005). The lipids content of 9.38±0.3% of the extract is low compared to those of unripe seed of *Carica papaya* (29.50%) (Akintunde et al., 2021b) and sun-dried and oven-dried ripe seed of *Carica papaya* (27.00% and 29.50% respectively) (Kolu et al., 20211) but higher than the values reported for *Ocinum gratissimum* (4.20%), *Vernonia amygdalina* (3.60%) and *Moringa oleifera* (4.60%) leaves reported by Olumide et al (2019) and that reported for clove (2.90%) and turmeric (1.50%) (Adebisi et al., 2021). The results however suggest that *Parquetina nigrescens* leaf extract cannot be used as the sole source of fat. Thus, *Parquetina nigrescens* leaf extract can just be used as a supplement/additive.

**Table 1: Proximate composition *of Parquetina nigrescens* leaf extract**

| Parameter (%) | Composition |
|---|---|
| Moisture Content | 7.80±0.40 |
| Crude Protein | 8.40±0.02 |
| Lipids | 9.38±0.30 |
| Ash Content | 6.90±0.30 |
| Crude Fibre | 9.38±0.30 |

*Parquetina nigrescens* leaf extract has a crude fibre percentage of 9.38±0.3% which is higher compared to the leaves of *Ocinum gratissimum* (7.60%), *Vernonia amygdalina* (8.90%) and *Moringa oleifera* (8.00%) reported by Olumide et al (2019) but lower than 10.78% reported for *Chromolaena odorata* leaf (Akintunde et al., 2021a) and 13.02% reported for *Citrus sinensis* fruits (Ndubuisi-Ogbonna et al., 2021). High dietary fibre is advantageous because it reduces the risk of serum cholesterol level, coronary disease and promotes digestion in animals (Fasola et al., 2011). It suggests that the leaves of *Parquetina nigrescens* would provide high dietary

fibre in a diet. This indicates that the fiber (roughage) content of these plants are high and will promote digestion and prevent constipation when consumed.

**Table 2: Phytochemical composition of *Parquetina nigrescens* leaf extract**

| Parameters | Observation | Conc. (mg/l00g) |
|---|---|---|
| Alkaloids | +++ | 8.27±0.05 |
| Flavonoids | + | 2.25±0.02 |
| Glycosides | + | 0.06±0.01 |
| Saponin | ++ | 5.20±0.02 |
| Steroids | + | 0.20±0.00 |
| Phenols | + | 0.86±0.01 |
| Terpenoids | + | 0.52±0.02 |
| Tannin | ++ | 6.30±0.03 |
| Anthraquinones | + | 1.55±0.02 |

+++ Present in high amount, ++ Present in moderate amount, + Present in low amount

It is also observed that *Parquetina nigrescens* leaf extract has 6.90±0.3% ash. The ash content values obtained is lower than those reported for *Ocinum gratissimum*, *Vernonia amygdalina* and *Moringa oleifera* leaves (10.50, 7.10 and 15.60% respectively) reported by Olumide et al (2019). Ash content is an index used to evaluate mineral availability in a sample, the result suggests that *Parquetina nigrescens* leaf extract is abundant in minerals, this is in agreement with the report of Umeaku et al. (2018) and Omokore and Alagbe (2019).

**Table 3: Vitamin concentration in *Parquetina nigrescens* leaf extract**

| Vitamins | Conc. (mg/l00g) |
|---|---|
| Vitamin A | 2.27± 0.05 |
| Vitamin $B_1$ | 270.25± 0.12 |
| Vitamin $B_2$ | 850.26 ±0.05 |
| Vitamin $B_3$ | 325.20± 0.12 |
| Vitamin C | 16.20± 2.20 |
| Vitamin E | 0.015±0.01 |

The phytochemical screening conducted on the leaf extract of *Parquetina nigrescens* revealed the presence of alkaloids, flavonoids, glycosides, saponins, steroids, phenols, terpenoids, tannin and anthraquinones as shown in Table 2. The sample contained alkaloids (8.27 mg/100g), flavonoids (2.25 mg/100g), glycosides (0.06 mg/100g), saponins (5.20 mg/100g), steroids (0.20 mg/100g), phenols (0.86 mg/100g), terpenoids (0.52 mg/100g), tannins (6.30 mg/100g) and anthraquinones (1.55 mg/100g).

**Table 4: Mineral concentration of *Parquetina nigrescens* leaf extract**

| Parameters | Composition |
|---|---|
| Si (ppm) | 23.71 |
| AI (%) | 4.34 |
| Fe (%) | 3.59 |
| Ti (ppm) | 2.11 |
| Ca (%) | 29.96 |
| P (%) | 6.88 |
| K (%) | 23.21 |
| Mn (ppm) | 1.46 |
| Na (%) | 0.36 |
| Mg (%) | 4.05 |
| Cl (%) | 0.33 |

The alkaloids were present in high amount in the quantitative analysis result suggesting the fact that too much of the extract will cause problems in the animals. Alkaloids has been found to have microbicidal effect and the major anti-diarrheal effect is probably due to their effects on small intestine and antihypertensive antifungal, anti-inflammatory, antifibrogenic effect (Ghosal et al., 1996). Flavonoids and glycoside were also present. Flavonoids have been found useful in drug preparation, in food, feed and beverages. Flavonoids from bitter leaf including phenolic acids had inhibitory activity against bacteria (Farombi and Owoeye, 2011). Saponin was present in moderate amount in the leaf extract. Tannins were also present in moderate amount. Phytochemical constituents of *Parquetina nigrescens* leaf extract indicated that it contained alkaloid, saponin, tannin, glycosides and flavonoids and this is in agreement with previously reported studies (NRC, 1994; Oloruntola et al., 2018). Also, the results of the phytochemical screenings were in line with the reports of Banjoko et al. (2020) who observed the presence of tannin, phenol, saponin, alkaloids, flavonoids, terpenes, steroids, glycosides and phytate for *Carica papaya* leaf meal.

The results were also in agreement with the observations of Airaodion et al. (2019) that *Parquetina nigrescens* leaf contained alkaloid,

saponin, tannin, flavonoid and phenols but contrary as Airaodion et al. (2019) observed the
Alkaloids have been suggested to perform antimicrobial, analgesic and antiplasmodic effects (Edeoga et al., 2005; Kasolo et al., 2010). The presence of high levels of alkaloids in *Parquetina nigrescens* leaf extract suggests that the plant may have good blood glucose lowering properties by reducing dietary glucose absorption in the gastrointestinal tract, as well as marked effects on immune system modulation and oxidative stress prevention (Adelowotan et al., 2008). The value observed for alkaloid was at variance with the value of 0.0363% reported for *Parquetina nigrescens* leaf by Airaodion et al. (2019). The variation might be due to variation in the method of extraction as Airaodion et al. (2019) soaked the leaves in water for 72 hours before cold extraction as against the method used in the present study.
In this study, it was also observed that the concentration of flavonoids obtained in this study was significantly higher when compared with the value of 0.03% reported by Airaodion et al. (2019) and 1.40 g/100g reported for *Phyllanthus niruri* leaf by Olufayo et al. (2021). As natural antioxidants, flavonoids play an important role in scavenging free radicals and preventing degenerative diseases such as cardiovascular diseases (Bisio et al., 2017; Cragg and Newman, 2013; Milella et al., 2016). However, they are also involved in the antiproliferation of carcinogenic cells, in cell cycle regulation and in the induction of apoptosis (Ugartondo et al., 2007; Russo et al., 2015; Rue et al., 2017). They can act to inhibit free-radical mediated cytotoxicity and lipid peroxidation, as anti-proliferative agents to inhibit tumor growth or as weak estrogen agonists or antagonists to modulate endogenous hormone activity (Jain et al., 2007). The result obtained for flavonoids thus suggests that *Parquetina nigrescens* leaf extract could perform multiple biological activities as anti-inflammatory, antioxidant, anti-allergic, antiplasmodic and anti-thrombotic (Alagbe, 2020; Musa et al., 2020; Olafadehan et al., 2020; Oluwafemi et al., 2020; Stafford, 1997). The results showed that the value obtained for glycosides (0.06 mg/100g) was lower than the value of 0.366 mg/100g reported by Banjoko et al. (2020) for *Carica papaya* leaf meal. The variation in results could be as a result of different test ingredient used for the study.

Saponin exhibits various important pharmacological activities i.e., antibacterial and antifungal activities (Odebiyi, 1978; Cheeke, 2000; Soetan et al., 2006). In this study, it was observed that the concentration of saponins in *Parquetina nigrescens* leaf extract was significantly lower when compared with 0.0093% reported by Airaodion et al. (2019), 1.82% for *Prosopis aficana* powder reported by Alagbe (2020) and higher than 0.424 mg/100g for *Carica papaya* reported by Banjoko et al. (2020). Saponins are naturally occurring surface-active glycosides with a distinctive foaming characteristic. Saponin has been reported by Surana et al. (2008) to have effect in hemolysis. Saponin has also been reported to have effect in cholesterol metabolism as it lowers serum cholesterol levels. Large mixed micelles formed by the interaction of saponins with bile acids account for their increased excretion. The resulting accelerated metabolism of cholesterol in the liver causes its serum levels to go down (Oakenfull, 1986). This might make *Parquetina nigrescens* leaf extract a potential remedy for disease conditions such as obesity, cardiovascular diseases and other cholesterol related diseases. The presence of saponin in *Parquetina nigrescens* leaf extract supports the facts that it has cytotoxic effect and can permeate the intestinal wall (Ayoola and Adeyeye, 2010).

The results showed that the value obtained for steroids (0.20 mg/100g) in this study was higher than the value of 0.173 mg/100g reported for steroids in *Carica papaya* leaf meal by Banjoko et al. (2020). The observation from this study also agrees with the report of Aravind et al. (2013) that the extracts from an unripe *C. papaya* fruit may contain a little of terpenoids, alkaloids, flavonoids, glycosides, saponins and steroids. It could however be suggestive on the basis of this study that *Parquetina nigrescens* leaf extract can facilitate growth and help in improving the immunity of livestock as reported by Kurva and Dash (2013) that natural plant products promote various activities such as antistress, growth promotion, immuno-stimulation due to the presence of active principles such as flavonoids, essential oil, steroids etc.
The role of phenol is similar to that of vitamin C; they possess the ability to act as an antioxidant,

thus preventing diseases by scavenging free radicals (Bose et al., 1998: Hollman, 2001; Alagbe and Omokore, 2018; Olafadehan et al., 2020). The results showed that the value obtained for phenols (0.86 mg/100g) was lower than the value of 7.71 mg/g reported for *Parquetina nigrescens* leaf by Airaodion et al. (2019).

Terpenoids are known to possess antimalarial, anti-inflammatory, antimicrobial, antiviral and inhibition of cholesterol synthesis (Alagbe, 2020b: Mahato and Sen, 1997; Omokore and Alagbe, 2019). The observation for this study was in agreement with the submission of Aravind et al. (2013) that the extracts from an unripe *Carica papaya* fruit may contain a little of terpenoids. Kolu et al. (2021) and Saranraj et al. (2012) also reported the presence of terpenoids for ripe *Carica papaya* seed and *Phyllanthus amarus*. The results showed that the value obtained for terpenoids (0.52 mg/100g) was higher than the value of 0.217mg/100g reported for *Carica papaya* leaf by Banjoko et al. (2020) and lower than 2.10% reported for *Prosopis Africana* powder by Alagbe (2020a).

The presence of tannin obtained in this result (6.30 mg/100g) was contrary to the report of Ndubuisi-Ogbonna (2021) 0.04 mg/100g for *Citrus sinensis* fruits this could be as a result of a variation in plant used. The levels of tannins above 5% in the diet are often lethal (Reed, 1995) and the tannin content found in this study is lower thus confirming the safety in the consumption *Parquetina nigrescens* leaf extract by livestock especially monogastric animals. Tannins prevented the growth of several fungi, yeasts, bacteria, and viruses (Prohp and Onoagbe, 2012).

Phytic acid and/or phytate compete with essential dietary minerals such as calcium, zinc, iron and magnesium to make them biologically unavailable for absorption once they exceed their recommended ranges (Alagbe et al., 2018; Musa et al., 2020). Oxalate is a concern because of its negative effect on mineral availability. High oxalate diet can increase the risk of renal calcium absorption and has been implicated as a source of kidney stones (Chai and Liebman, 2004).

The average result of the vitamins composition in *Parquetina nigrescens* leaf extract (Table 3) reveals that vitamin A composition was 2.27mg, vitamin B content which are Vitamin $B_1$ (270.25mg), Vitamin $B_2$ (850.26mg), Vitamin $B_3$ (325.20mg), vitamin C (16.20mg), and vitamin E (0.015mg). Vitamins are required in trace amounts (micrograms to milligrams per day) in the diet for health, growth, and reproduction. Omission of a single vitamin from the diet of a species that requires it will produce deficiency signs and symptoms. Many of the vitamins function as coenzymes (metabolic catalysts); others have no such role, but perform certain essential functions (McDowell, 2000). Classically, vitamins have been divided into two groups based on their solubility in fat solvents or in water. Thus, fat-soluble vitamins include A, D, E, and K, while vitamins of the B-complex and C are classified water soluble. Fat-soluble vitamins are found in feedstuffs in association with lipids. The fat-soluble vitamins are absorbed along with dietary fats, apparently by mechanisms similar to those involved in fat absorption. Conditions favorable to fat absorption, such as adequate bile flow and good micelle formation, also favor absorption of the fat soluble vitamins (Wardlaw et al., 2004). Water-soluble vitamins are not well stored, and excesses are rapidly excreted in the urine (Loosli, 1991). Vitamin A plays a vital role in good sight (vision), support to immune system and inflammatory systems, cell growth and development, antioxidant activity, promoting proper cell communication (Tang, 2010). Vitamin $B_1$ involves in the energy production from carbohydrates and fats, its deficiency in the body could negatively affect the heart as well as the nervous system. Vitamin $B_2$ promotes iron metabolism and its deficiency also increase the risk of anemia or blood shortage (Asensi-Fabado and Munne, 2010). Vitamin $B_3$ is essential in production of energy from dietary proteins, carbohydrates and fats (McDowell, 2000). Functionally $B_6$ is very important vitamin as it is involved in red blood cell production, carbohydrate metabolism, liver detoxification, brain and nervous system health (Combs, 2007; Wardlaw et al., 2004). Folates (vitamin $B_9$) support the cardiovascular system, nervous system and also prevents cardio vascular disease in human (Hayden and Tyagi, 2004; Youdim et al., 2000). Vitamin $B_{12}$ is involved in production of red blood cells and also prevents the increase in level of homocysteine (Crider et al., 2011; Lanska, 2010). Vitamin C helps to boost the

immune system by scavenging free radicals; its deficiency induces the disease called scurvy. In case of scurvy, loss of bone strength, lose teeth and bleeding (Wardlaw et al., 2004). Vitamin D deficiency is associated with many disorders like, osteoporosis, rickets, osteomalacia, loss of balance, diabetes, rheumatoid arthritis, asthma, depression etc. (Jolliffe et al., 2013; Wagner and Greer, 2008). Vitamin K is important for bone health and blood clotting; its deficiency increases the risk of bone fracture (Hirota et al., 2013; Shearer and Newman, 2014). The results obtained for Vitamin C (16.20 mg/100g) in this study is close to the value of 17.61 mg/g reported by Airaodion et al. (2019).

Generally, minerals from plant sources are less bio-available than those from animal sources. As presented in Table 4, *Parquetina nigrescens* leaf extract contained silicon, aluminum, iron, calcium, phosphorous, potassium, manganese, sodium, magnesium and chlorine. Silicon, calcium and potassium are in relatively high amounts (23.71 ppm, 29.96 mg/kg and 23.21 mg/kg respectively). The value obtained for silicon (23.71 ppm) and aluminum (4.34%) in this study was in contrast with the report of Nwaokobia et al. (2018) who reported absence of silicon and aluminum in date's seed.

Iron is stated to be a crucial nutrient that pregnant woman, nursing mothers, newborns, convulsing patients, and the elderly need in their diets to avoid anemia and other disorders (Oluyemi et al., 2006). Presence of minerals such as zinc, iron and magnesium in *Parquetina nigrescens* leaf extract may possibly contribute to immunomodulatory action, since these substances have been implicated in immune modulation (Ravalglia et al., 2000) and may also enhance the activities of antioxidant enzymes (Prasaid, 2000), since these elements serve as cofactors for such enzymes and ultimately modulate the immune system (De et al., 2005), thus be an important activity that could be attributed to its neuroprotective property. The mineral profile showed that *Parquetina nigrescens* leaf extract has high values of iron, phosphorus, potassium and calcium. This results further suggests that that constant utilization of *Parquetina nigrescens* leaf extract by livestock could be needed in maintaining strong bone, muscle contraction and relaxation, blood clothing, reduce blood pressure, and helps in the haemoglobin formation because of its high potassium and iron. This further justifies the use of the plants for hematinic, antidiabetic, cardiotonic, anti-ulcerative and antioxidant properties as claimed by Datté and Ziegler (2001), Saba et al. (2010), Ozaslan (2011) and Ayoola et al. (2011).

*Parquetina nigrescens* leaf extract would be a good source of calcium supplements for livestock especially poultry as observed in this study and calcium plays a vital role in structural and physiological functions, are needed in a certain ratio for bone growth and repair and for other body functions of livestock animals. It functions partly in muscle contraction and relaxation, blood clotting, membrane permeability, nerve function, cardiac regulation and enzyme activation. Vitamin D, which is a precursor for calcium, is however needed for active absorption (Ikpeama et al., 2014). Potassium (K) is identified to reduce blood pressure and it functions in controlling skeletal muscle contraction and nerve impulse transmission. It is vital for the maintenance of osmotic and fluid balance in the body. It is required for chemical reactions in muscles and for skeletal growth. High calcium and potassium meals are usually recommended for animals with soft bone problems (Kubinarawa, 2007). The potassium and calcium contents of the extract are necessary for livestock with soft bone problems to improve bone mineralization. The findings on the minerals and vitamins of *Parquetina nigrescens* leaf extract further validate its antimicrobial, antioxidant and hermetic properties.

The findings on the minerals and vitamins of *Parquetina nigrescens* leaf extract further validate its antimicrobial, antioxidant and hermetic properties.

## CONCLUSION

In this study, it was observed that *Parquetina nigrescens* leaf extract is rich in key nutrients (as validated by its proximate, vitamins, mineral and phytochemicals analyses) and possesses antioxidant potential. Hence, they might act as prophylactics and remedy to different diseases such as cardiovascular diseases, anaemia and immune booster. *Parquetina nigrescens* leaf extract also have the potential of being a possible replacement for antibiotics especially for monogastric animals.

**Conflict of interest**

The authors declare no conflict of interest

**References**


Adebisi, A. A, Olumide, M. D. and Akintunde, A. O. 2021. Nutritive value and phytochemical screening of turmeric and clove as a potential phyto-additive in livestock production. *Nigerian Journal of Animal Science*, 23 (2): 142-152.

Adelowotan, O, Aibinu, I., Adenipekun, E. and Odugbemi, T. 2008. The invitro antimicrobial activity of *Abrus precatorius* (L) fabaceae extract on some clinical isolates. *Nigerian Postgraduate Medical Journal*. 15: 32- 37.

Adeyemi, S. O. 1994. Ethnobotanical study of the antirheumatic plants in parts of Oyo, Ogun and Lagos States. Project Report in the Department of Microbiology and Botany, University of Ibadan.

Adinortey, M. B. 2012. Phytochemical screening, proximate and mineral composition of *Launaea taraxacifolia* leaves. *Research Journal of Medicinal Plant*. 3: 1-9.

Agbo, G. A. and Odetola, A. A. 2005. Effect of *Parquetina nigrescens* on Erythrocyte indices and serum electrolytes of Rats following acute blood loss. *Pakistan Journal of Biological Sciences*. 8(4):527-531.

Airaodion, A. I, Olatoyinbo, P. O, Ogbuagu, U, Ogbuagu, E. O, Akinmolayan, J. D, Adekale, O. A, Awosanya, O. O, Agunbiade, A. P, Oloruntoba, A. P, Obajimi, O. O, Adeniji, A. R. and Airaodion, E. O. 2019. Comparative Assessment of Phytochemical Content and Antioxidant Potential of *Azadirachta indica* and *Parquetina nigrescens* Leaves. *Asian Plant Research Journal*. 2(3): 1-14.

Akintunde, A. O. and Toye, A. A. 2014. Nutrigenetic effect of graded levels of *Moringa oleifera* seed meal on performance characteristics and nutrient retention in local and exotic chickens. *International Journal of Moringa and Nutraceutical Research (IJMNR).* 1:*56-73*.

Akintunde, A. O, Ndubuisi-Ogbona, L. C, Ajayi, O. A, Chioma, C, Jimoh, W. A. and Afodu, O. J. 2021a. Utilization of *Chromolaena odorata* leaf meal as a supplement in broiler chickens' diet. *Nigerian Journal of Animal Science*, 23 (1): 189-198.

Akintunde, A. O, Kolu, P, Ndubuisi-Ogbonna, L. C, Akinboye, O. E, Akintunde, I. A. and Adewole, S. A. 2021b. Nutritive and Phytochemical Values of Unripe Seeds of *Carica papaya* and Prospects in Animal Nutrition. *Nigerian Research Journal of Chemical Sciences*, 9(2):278-287.

Alagbe, J. O. 2019. Proximate, Mineral and Phytochemical Analysis of *Piliostigma thonningii* Stem Bark and Roots. I*nternational Journal of Biological, Physical and Chemical Studies.* 1(1):1-7.

Alagbe, J. O, Shittu, M. D, Bamigboye, S. O and Oluwatobi, A. O. 2019. Proximate and mineral composition of *Pentadiplandra brazzeana* stems bark. *Research Journal of Engineering, Computer and Applied Sciences*. 1: 91-99.

Alagbe, J. O. 2020a. Chemical evaluation of proximate, vitamin and amino acid profile of leaf, stem bark and roots of *Indigofera tinctoria. International Journal on Integrated Education.* 3(10): 150-157.

Alagbe, J.O. 2020b. Proximate, phytochemical and vitamin compositions of *Prosopis aficana* stem bark. *European Journal of Agricultural and Rural Education* (EJARE), 1(4):1-7.

A. O. A. C. 2000. Association of Official Analytical Chemists. Official Methods of Analysis 19th Edition Washington, D.C pp 69-77.

A. O. A. C. 2010. Official Methods of Analysis of Association of Official Analytical Chemists. 18th Edition, Washington, DC.

Aravind, G, Debjit, B, Duraivel, S. and Harish, G. 2013. Traditional and Medicinal Uses of *Carica papaya*. *Journal of Medicinal Plants Studies*. 1(1):7-15.

Asensi-Fabado, M. A. and Munne-Bosch, S. 2010. Vitamins in plants: occurrence, biosynthesis and antioxidant function. *Trends in Plant Science*. 15(10): 582-592.

Ayoola, B. P. and Adeyeye, A. 2010. Phytochemical and nutrient evaluation of *Carica papaya* (Pawpaw) leaves. IJRRAS 5(3):325-328.

Ayoola, A. O, Akinloye, O, Oguntibeju, O. O., Oke, J. M. and Odetola, A. A. 2011. Antioxidant activities of *Parquetina nigrescens. African Journal of Biotechnology*.

10(24):4920-4925.DOI: 10.5897/AJB10.1622.

Bailey, R. 2008. The Role of Proteins in the body. About.com Guide to Biology.

Banjoko, O. J, Adebayo, I. A, Osho, I. B, Olumide, M. D, Fagbiye, O. O, Ajayi, O.A. and Akinboye, O. E. 2020. Evaluation of varying levels of *Carica papaya* leaf meal on growth, carcass, hematological parameters and its use as anticoccidial for broiler chicken. *Nigerian J. Anim. Sci*. 22(3): 229-241.

Bisio, A, De Mieri, M, Milella, L, Schito, A. M, Parricchi, A, Russo, D, Alfei, S, Lapillo, M, Tuccinardi, T. and Hamburger, M. 2017. Antibacterial and hypoglycemic diterpenoids from *Salvia chamaedryoides*. *J. Nat. Prod*. 80: 503–514.

Boham, B. A. and Kocipai-Abyazan, R. 1994. Flavonoids and Condensed Tannins from Leaves of Hawaiian *Vaccinium vaticulatum* and *V. calycynium*. *Pac. Sci*. 48: 458-463

Bose, T. K, Das, P. and Maiti, G. G. 1998. Trees of the World. Volume 1. Regional Plant Resource Centre, Bhubaneswar, India. 26-506.

Chai, W. and Liebman, M. 2004. Assessment of oxalate absorption from Almonds and Black beans with and without the use of an extrinsic label. *Journal of Urology*. 172: 953-957.

Cheeke, P. R. 2000. Actual and potential applications of *Yucca schidigera* and *Quillaja saponaria* saponins in human and animal nutrition. *Journal of Animal Science*. 77:1-10.

Cragg, G. M. and Newman, D. J. 2013. Natural products: A continuing source of novel drug leads. Biochim. Biophys. Acta. 1830:3670–3695.

Crider, K. S, Bailey, L. B. and Berry. R. J. 2011. Folic acid food fortification: its history, effect, concerns, and future directions. *Nutrients* 3: 370-84.

Datté, J. Y. and Ziegler, A. 2001. Pharmacological investigation on nigrescigenin-a cardenolide from *Parquetina nigrescens* (Afzel.) Bullock: comparative studies on cardiotonic effects of *Parquetina nigrescens*, gastrophanthin and noradrenaline in guinea-pig isolated atria. *J. Pharm. Pharmacol*. 53:859-866.

Edeoga, H. O, Okwu, D. E and Mbaebie, B. O. 2005. Phytochemical constituents of some Nigerian medicinal plants. *African Journal of Biotechnology*. 4(7):658-688.

FAO .2003. "Food energy-methods of analysis and conversion factors", Food and Nutrition Paper 77, Food and Agriculture Organization of the United Nations, Rome, Italy, 1–93.

Farombi, E. O. and Owoeye, O. 2011. Antioxidative and Chemo preventive Properties of *Vernonia amygdalina* and *Garcinia biflavonoid*. *International Journal of Environmental Research and Public Health*. 8: 2533–2555

Fasola, T. R, Adeyemo, F. O, Adeniji, J. A and Okonkwo, I. H. 2011. Antiviral potentials of *Enantia chlorantha* extracts on yellow fever virus. *Nature and Science* 9(9):99-105

Ghosal, S., Tripathi, V. K and Chauhan, S. 1996. Active constituents of *Emblica officinalis*: Part 1—the chemistry and antioxidant effects of two hydrolysable tannins, emblicanin A and B. *Indian Journal of Chemistry*. 35B, 941–948.

Harborne, J. B. 1973. Phytochemical Methods, London. Chapman and Hall, Ltd. pp 49-188.

Hirota, Y, Tsugawa, N. and Nakagawa, K. 2013. Menadione (vitamin K3) is a catabolic product of oral phylloquinone (vitamin K1) in the intestine and a circulating precursor of tissue menaquinone-4 (vitamin K2) in rats. *J. Biol. Chem*., 288(46): 33071-80.

Hollman, P. C. 2001. Evidence for health benefits of plant phenols: Local or systemic effects. *J. Sci. Food Agric*. 81: 842-852.

Ikpeama, A., Onwuka, G. I. and Nwankwo, C. 2014. Nutritional Composition of Turmeric (*Curcuma longa*) and its Antimicrobial Properties International. *Journal of Scientific & Engineering Research*. 5(10):1085 – 1089

Iwu, M. M. 1994. African Medicinal Plants in the search for new drugs based on ethnobotanical, Ciba foundation symposium 185: 116-125.

Jain, A. S., Surana, S. J., Gokhale, S. B., Tatiya, A. U. and Bothara, R. C. 2007. Antimicrobial properties of *Eranthemum roseum* (Vahl) R. Br. *Iranian Journal of Pharmaceutical Research*. 6(2):131-133.

Jolliffe, D. A., Griffiths, C. J. and Martineau, A. R. 2013. Vitamin D in the prevention of acute respiratory infection: systematic review of clinical studies. *J. Steroid Biochem*. 136: 321-9.

Kasolo, J. N, Gabriel, S, Bimenya, L. O, Joseph, O. and Ogwal-Okeng, J. W. 2010. Phytochemicals and uses of *Moringa oleifera* leaf in Ugandan rural communities. *Journal of Medicinal Plants Research.* 4(9): 753-757

Kolu, P, Olumide, M. D. and Akintunde, A. O. 2021. Potentials of ripe *Carica papaya* seed meal using different processing methods as alternative feed ingredients in monogastric animal nutrition. *Nigerian Journal of Animal Science*, 23 (3): 177-184.

Kubinarawa, D, Ajoku, G. A. and Enwerem, N. M. 2007. Preliminary phytochemical and antimicrobial screening of 50 medicinal plants from Nigeria. *African Journal of Biotechnology*. 6(14): 1690- 1696

Kurva, R. R. and Dash, G. 2013. American Journal of Drug Discovery and Development ISSN 2150-427x

Lanska, D. J. 2010. Historical aspects of the major neurological vitamin deficiency disorders: the water-soluble B vitamins. Handbook Clin. Neurol. 95: 445-76.

Loosli, J. K. 1991. In Handbook of Animal Science (P.A. Putnam, ed.) Academic Press, San Diego.

McDowell, L. R. 2000. Vitamins in Animal and Human Nutrition. 2nd Edition. Iowa State University Press/Ames.

Milella, L, Milazzo, S, De Leo, M, Vera Saltos, M. B, Faraone, I, Tuccinardi, T, Lapillo, M, De Tommasi, N. and Braca, A. 2016. α-Glucosidase and α-Amylase Inhibitors from *Arcytophyllum thymi* folium. *J. Nat. Prod*. 79:2104–2112.

Musa, B, Alagbe, J. O, Adegbite, M. B. and Omokore, E. A. 2020. Growth performance, caeca microbial population and immune response of broiler chicks fed aqueous extract of *Balanites aegyptiaca* and *Alchornea cordifolia* stem bark mixture. *United Journal for Research and Technology*. 2(2):13-21.

National Research Council. 1994. Nutrient Requirements of Poultry: Ninth Revised Edition, 1994. Washington, DC: The National Academies Press. https://doi.org/10.17226/2114

Ndubuisi-Ogbonna, L. C, Akintunde, A. O, Ademola, A. A, Akintunde, I. A. and Afodu, O. J. 2021. Evaluation of the Nutritive and Phytochemical Properties of *Citrus sinensis* Fruits as a Feed Ingredient in Livestock Production. *Nigerian Research Journal of Chemical Sciences*. 9(2):288-295.

Nwaokobia, L. K, Ogboru, R. O. and Idibie, C. A. 2018. Investigating the Proximate, Ultimate and Chemical Composition of Four Cultivars of Date Seed, *Phoenix dactylifera*. World News of Natural Sciences. 18(2): 52-61.

Oakenfull, D. G. 1986. Aggregation of bile acids and saponins in aqueous solution. *Australian Journal of Chemistry*. 39: 1671-1683.

Obadoni, B. O. and Ochuko, P. O. 2001. Phytochemical studies and Comparative efficacy of the crude extracts of some homeostatic plants in Edo and Delta States of Nigeria. *Global Journal for Pure Applied Science*. 8: 203-208

Odebiyi, A. and Sofowora, A. E. 1978. Phytochemical Screening of Nigerian Medicinal Plant. Part III, Lloydia, 41, 234-246.

Ojewuyi, O. B, Ajiboye, T. O, Adebanjo, E. O, Balogun, A and Mohammed, A. O. 2014. Proximate composition, phytochemical and mineral contents of young and mature *Polyalthia longifolia Sonn*. Leaves. *Fountain Journal of Natural and Applied Sciences*. 3(1):10-19.

Okigbo, R. N, Eme, U.E. and Ogbogu, S. 2008. Biodiversity and conservation of medicinal and aromatic plants in Africa. Biotechnology. Mol. Biol. Rev., 3(6): 127-134

Oktay, M., İlhami Gülçin, I. and Küfrevioğlu, O. I. 2003. Determination of in vitro antioxidant activity of fennel (*Foeniculum vulgare*) seed extracts. LWT - *Food Science and Technology*. 36(2): 263-271. https://doi.org/10.1016/S0023-6438 (02)00226-8.

Okwu, D. E. and Morah, F. N. I. 2004. Mineral and nutritive value of *Dennettia tripetala* fruits. *Fruits.* 59:437–442. doi: 10.1051/fruits: 2005006.

Olafadehan, O. A, Oluwafemi, R. A and Alagbe, J. O. 2020. Performance, haemato-biochemical parameters of broiler chicks administered Rolfe (*Daniellia oliveri*) leaf extract as an antibiotic alternative. Advances in Research and Reviews, 1:4.

Oloruntola, O. D, Ayodele, S. O. and Oloruntola, D. A. 2018. Effect of pawpaw (*Carica*

*papaya)* leaf meal and dietary enzymes on broiler performance, digestibility, carcass and blood composition. Resources Alimentaires ET alimentation. 71(3):00

Olowokudejo, J. D., Kadiri, A. B. and Travih, V. A. 2008. An Ethnobotanical Survey of Herbal Markets and Medicinal Plants in Lagos State of Nigeria. Ethnobotanical Leaflets, 12: 851-65.

Olufayo, O. O, Tayo, G. O, Olumide, M. D. and Akintunde, A. O. 2021. Assessment of the nutritive value of *Phyllanthus niruri Linn*. (Stonebreaker) leaves. *Nigerian Journal of Animal Science*, 23 (3): 108-115.

Olumide, M. D, Ajayi, O. A, and Akinboye. O. E. 2019. Comparative study of proximate, mineral and phytochemical analysis of the leaves of *Ocimum gratissimum, Vernonia amygdalina and Moringa oleifera*. *Journal of Medicinal Plants Research*. 13(15): 351-356. DOI: 10.5897/JMPR2019.6775

Oluwafemi, F. and Debiri, F. 2008. Antimicrobial effect of *Phyllanthus amarus* and *Parquetina nigrescens* on *Salmonella typhi*. *African Journal of Biomedical Research*. 11, 215–219.

Oluwafemi, R.A., Egwuiyi. G.N and Alagbe, J.O. (2020a): Effect of feeding *Polylathia longifolia* leaf meal as partial replacement of wheat offal. *European Journal of Agricultural and Rural Education.* 1(1), 1-7.

Oluwafemi, R. A, Isiaka, O and Alagbe, J. O. 2020b. Recent trends in the utilization of medicinal plants as growth promoters in poultry nutrition- A review. Research in: Agricultural and Veterinary Sciences. 4(1): 5-11.

Oluyemi, E. A., Akinlua, A. A, Adenuga, A. A. and Adebayo, M. B. 2006. Mineral contents of some commonly consumed Nigerian foods. Science Focus; 11(1):153 - 157.

Omokore, E. O and Alagbe, J. O. 2019. Efficacy of dried *Phyllanthus amarus* leaf meal as an herbal feed additive on the growth performance, haematology and serum biochemistry of growing rabbits. *International Journal of Academic Research and Development.* 4(3): 97-104.

Onuegbu N. C. and Iwu C. A. 2020. Physical and Nutritional Properties of *Coula edulis. International Journal of Life Sciences* 9(3): 46-55.

Onwuka, G. I. 2005. Food Analysis and Instrumentation: Theory and Practice. Lagos, Nigeria: Naphtali Prints.

Oshodi, A. A. 1992. Comparison of Proteins, minerals and Vitamin C content of some dried leafy vegetables. *Pakistan journal of science and industrial research*. 35:267-269.

Owoyele, B. V, Nafiu, A. B, Oyewole, I. A., Oyewole, L. A. and Soladoye, A. O. 2009. Studies on the analgesic, anti-inflammatory and antipyretic effects of *Parquetina nigrescens* leaf extract. *Journal of Ethnopharmacology* 122(1): 86-90. https://doi.org/10.1016/j.jep.2008.11.027.

Ozaslan, M. 2011. *Parquetina nigrescens* checks the ulceration and oxidation. *Pak. J. Biol. Sci.* 14:1124-1125.

Pamela, C. C, Richard, A. H. and Denise, R. F. 2005. Lippincotts illustrated Reviews Biochemistry 3rd ed., Lippincott Williams and Wilkins, Philadelphia. 335- 388.

Prasaid, A. S. 2000. Effects of zinc deficiency on Th1 and Th2 cytokines shift. *Journal of Infectious Diseases*. 182: 62-68.

Prohp, T. P. and Onoagbe, I. O. 2012. Determination of phytochemical composition of the stem bark of triplochiton scleroxylon k. schum. (sterculiaceae). *International Journal of Applied Biology and Pharmaceutical Technology*. 3(2), 68-76.

Ravalglia, G, Forti, P. and Maioli, F. 2000. Effects of micronutrient status on natural killer cell immune function in healthy free-living subjects age>90years. *American Journal of Clinical Oncology* 3(2): 871.

Reed, J. D. 1995. Nutritional toxicology of tannins and related polyphenols in forage legumes. *Journal of Animal Science*. 73: 1516–1528.

Ruberto, G. and Baratta, M. T. 2000. Antioxidant activity of selected essential oil components in two lipid model systems. Food Chemistry, 69: 167 - 174.

Rue, E. A, Rush, M. D. and Van Breemen, R. B. 2017. Procyanidins: A comprehensive review encompassing structure elucidation via mass spectrometry. Phytochem. Rev. 1–16

Russo, D, Valentão, P, Andrade. P. B, Fernandez, R. A and Milella L. 2015. Evaluation of

antioxidant, antidiabetic and anticholinesterase activities of *Smallanthus sonchifolius* landraces and correlation with their phytochemical profiles. *Int. J. Mol. Sci*. 16:17696–17718.

Saba, A. B, Oyagbemi, A. A. and Azeez, O. I. 2010. Antidiabetic and hematinic effects of *Parquetina nigrescens* on alloxan induced type-1 diabetes and normocytic normochromic anaemia in Wistar rats. *Afr. Health. Sci*.10:276-282

Saranraj, P. and Sivasakthivelan, P. 2012. Screening of antibacterial activity of the medicinal plant *Phyllanthus amarus* against urinary tract infection causing bacterial pathogens. *Applied Journal of Hygiene*. 1(3): 19-24, DOI: 10.5829/ idosi.ajh.2012.1.3.71111

Shearer, M. J. and Newman, P. 2014. Recent trends in the metabolism and cell biology of vitamin K with special reference to vitamin K cycling and MK-4 biosynthesis. *J. Lipid Res*. 55(3): 345-62.

Soetan, K. O, Oyekunle, M. A, Aiyelaagbe, O. O. and Fafunso, M. A. 2006. Evaluation of the antimicrobial activity of saponins extract of *Sorghum bicolor L*. Moench. *Afr. J. Biotech.* 5 (23), 2405-2407.

Surana, S. J, Tatiya, A. U, Jain, A. S, Desai, D. G, Shastri, K. V and Katariya, M. V. 2008. Pharmacognostical and physiochemical standardizetion of root of *Eranthemum roseum* (Vahl) R. Br. Phcognosy Magazine, 4:75-79.

Tang, G. 2010. Bioconversion of dietary provitamin A carotenoids to vitamin A in humans. *Am. J. Clin. Nutr.* 91(5): 1468S-1473S.

Ugartondo, V, Mitjans, M, Touriño, S, Torres, J. L and Vinardell. M. P. 2007. Comparative antioxidant and cytotoxic effect of procyanidin fractions from grape and pine. *Chem. Res. Toxicology*. 20:1543–1548.

Umeaku, C. N, Chris- Umeaku, C. I, Emmy-Egbe, I. O, Ukoha, C. C, Uzor, U. C, and Agbo, U. J. 2018. Proximate, Phytochemical and Antibacterial Analysis of *Persa americana* Obtained from Nigeria. *J. Dis. Med.* 4(3)89-95.

Usunobun, U, Okolie, N. P, Anyanwu, O. G, Adegbegi, A. J. and Egharevba, M. E. 2015. Phytochemical screening and proximate composition of *Annona muricata* leaves. *Eur. J. Bot. Plaint Sci. Phytol.* 2(1): 018-028.

Uzoekwe, N. M. and Mohammed, J. J. 2015. Phytochemical, proximate and mineral contents of leaves and bark of *Ficus capensis*. *Journal of Applied Science and Environmental Management*. 2015; 8(4): 125 – 129.

Wagner, C. L, and Greer, F. R. 2008. Prevention of rickets and vitamin D deficiency in infants, children, and adolescents. Pediatrics, 122: 1142-52.

Wangensteen, H, Samuelsen, A. B. and Malterud, K .E. 2004. Antioxidant activity in extracts from coriander. *Food Chemistry*. 88(2): 293-297. https://doi.org/10.1016/j.foodchem.2004.01.047.

Wardlaw, G. M, Hampl, J. S. and DiSilvestro, R. A. 2004. Perspective in Nutrition. Sixth ed.Mcgraw-Hill College. 1-1056.

Youdim, K. A., Shukitt-Hale, B, and MacKinnon, S. 2000. Polyphenolics enhance red blood cell resistance to oxidative stress: in vitro and in vivo. Biochim. Biophys. Acta. 1523(1): 117-22.