International Journal of
Life Sciences
International Peer Reviewed Open Access Refereed Journal

Int. J. of Life Sciences, 2021; 9 (3):301-309
ISSN:2320-7817(p) | 2320-964X(o)

Research Article
Open Access

Nutritional composition and antinutritional factors of canistel (*Pouteria Campechiana (Kunth) Baehni*) kernel

Michelle Carole Fowe **Djouhou**[1]*, Laure Fotso **Maptouom**[1], Viviane Ruth **Djuikwo**[1], Gilbert Manga **Mbassi**[1], Abdel Malick **Pevetmi**[1], Guy **Noah**[1], Joseph Noah **Eyili**[1] and Elie **Fokou**[1]

[1]Department of Biochemistry, Faculty of Science, University of Yaoundé I, Yaoundé, Cameroon
*Corresponding author: Michelle Carole Fowe Djouhou, Department of Biochemistry, Faculty of Science, University of Yaoundé I, PoBox 812 Yaoundé, Cameroon, tel.: 00237 679 18 92 37.
E-mail: caroledjouhou@yahoo.fr

Manuscript details:

Received: 23.08.2020
Accepted: 20.09.2021
Published: 30.09.2021

Cite this article as:
Michelle Carole Fowe Djouhou, Laure Fotso Maptouom, Viviane Ruth Djuikwo, Gilbert Manga Mbassi, Abdel Malick Pevetmi, Guy Noah, Joseph Noah Eyili and Elie Fokou (2021) Nutritional composition and antinutritional factors of canistel (*Pouteria Campechiana (Kunth) Baehni*) kernel, *Int. J. of Life Sciences*, 9 (3): 301-309.

Available online on http://www.ijlsci.in
ISSN: 2320-964X (Online)
ISSN: 2320-7817 (Print)

ABSTRACT

Background: Fruit seeds are part of the residues of fruit that can be used for their nutritional, functional and/or medicinal properties. This study was aimed at assessing the nutritional composition and anti-nutrient factors of canistel (Pouteria Campechiana (Kunth) Baehni) seeds collected in the central region of Cameroon. Methods: Canistel seeds were obtained from fresh fruits and dried. Dried seeds were reduced into powder and used to determined carotenoids, vitamin C, minerals, proximate composition as well as anti-nutrients through standard methods. Results: Chemical analyses on the canistel seed samples showed they contain ash (1.91 ± 0.08 mg/100g), protein (7.66 ± 0.28 g/100g), lipid (7.61 ± 0.04 mg/100g), carbohydrate (6.51 ± 0.45 mg/100g), minerals, vitamin C (17.60 ± 2.26 g/100g), carotenoid (56.76 ± 0.00 mg/100g), fewer anti-nutrients (oxalates, phytates, tannins and saponins) and are rich in fibers (13.26 ± 0.71 mg/100g). Conclusion: Pouteria Campechiana (Kunth) Baehni) seeds are a good source of fibers and contain proteins, fats and carbohydrates. The micronutrients, Ca, Mg, K, Na, Fe and vitamin detected in the flour sample revealed the nutritional benefits of the seeds for human consumption.

Keywords: Pouteria Campechiana, canistel, proximate, anti-nutrients, seeds, minerals.

INTRODUCTION

Pouteria Campechiana (Kunth) Baehni commonly known as canistel, eggfruit or yellow sapote is a plant belonging to Sapotaceae family. The plant is native to Central and South America but is distributed to tropical and subtropical areas (Silva *et al*., 2009; Mehraj *et al*., 2015). Dietary phytochemicals are found in different parts of the plant like fruits, leaves and seeds or grains. The ripe fruits of canistel are excellent when eaten raw and can also be used in cakes, pies, ice creams, puddings or commercialized as pulp and flour in several countries. It has a yellow to orange soft pulp and mealy in texture with a very rich sweet flavor that somewhat resembles reminiscent of baked sweet potato. These fruits contain fibers, carbohydrates, lipids starch, calcium, phosphorus, carotene, thiamine, riboflavin, niacin and vitamin C (Pertiwi *et al*., 2020).

In the middle of canistel fruits are found one to five glossy seeds. Each seed has a hard-colored brown shell and white epidermis, with a yellowish-white seed (Amalia *et al*., 2020). The latter can be used in the pharmaceuticals and food industries because of their composition (Sunila and Murugan, 2017; Pertiwi *et al*., 2020; Amalia *et al*., 2020). Elsayed *et al*. (2016) reported that the phytochemical content and biological activity of ethanol extracts of canistel leaves and seeds can be used in traditional medicine for inflammation and pain. Because of its biggest size and base on its resemblance with bitter cola (*Garcinia kola*) and African walnut (*Coula edulis*), canistel seeds can be consumed by many persons as snacks and can even be more appreciated. In Cameroon, they remain unknown and are not valorized when in others countries, canistel seeds are reduced into powder or extracted for food supplementation and medicine (Amalia *et al*., 2020). This study aimed to determine the physicochemical properties of canistel (*Pouteria Campechiana (Kunth) Baehni*) seeds from Cameroon. The data obtained from this study will be useful in finding the right way of valorization and application of these seeds.

MATERIAL AND METHODS

Canistel seeds collection

Canistel fruits (Figure 1a) harvested from a farm located in the central region of Cameroon were transported to the Laboratory of Food Science and Metabolism.

Canistel seeds were removed manually from fruits, washed with tap water to remove the residue pulp. The excess water was drained out from seeds.

Water content and moisture analysis

Moisture and dry matter contents were carried out using a hot air oven. About 5 g of sample were stored at 105°C for 24 hours, and the difference in weight between the dry condition and wet (initial weight) condition was reported as water and moisture content (AOAC, 1980; Ranganna, 1986).

Determination of ash content

Ash content of material represents inorganic residue remaining after the destruction of organic matter present in the sample. The silica dish was kept in a muffle furnace at not more than 525°C for 4-6 hours. The ash weight was taken and the % ash was determined by formula, as given in the standard method (AOAC, 1980).

Determination of crude fibers

Crude fibers are organic residues that remain after the food sample has been treated under standardized conditions with standard boiled acid and alkali solutions. The crude fibers were determined by the standard method (AOAC, 1990).

Figure 2: (a) fresh canistel fruit; (b) canistel seeds; (c) peeled canistel seeds

The wholesome seeds (Figure 1b) were peeled manually to remove the brown seed coat. The peeled seeds (Figure1c) were adequately dried in an oven at 50 °C and milled. The milled samples were packaged in sterile plastics and stored at ambient temperature for analysis.

Determination of crude protein

The crude protein content was measured by the Kjeldahl method based on the conversion of organic nitrogen to ammonium sulfate. The nitrogen content (N) was converted into protein using 6.25 as the converting factor (AOAC, 1980).

Determination of total fats

Hexane soluble material in seeds was extracted from dried sample using a Soxhlet Extraction apparatus. The hexane was evaporated and residue was weighed (Bourely, 1982).

Total carbohydrate content

The total carbohydrates of the samples were determined by subtraction of total content of water, protein, lipid, fiber and ash to 100.

Carbohydrate (%) = 100 – (Water + Protein + Lipid + Fiber + Ash) (1)

Energy value

The kilocalorie (Kcal/100 g) value estimation was done by summing up the multiplied values for crude protein, crude lipid and carbohydrate, using the factors (4 kcal, 9 kcal, and 4 kcal), respectively. Energy value was thus calculated as follow:

Energy value (Kcal/100g) = (crude protein x 4) + (crude fat x 9) + (total carbohydrate x 4) (2)

Mineral composition

The minerals were extracted with 0.2 N nitric acid using the method described by Pauwels *et al*. (1992). Iron and phosphorus levels were determined spectrophotometrically (Jasco V-630 molecular absorption spectrophotometer) at respective wavelengths of 510 and 430 nm. The levels of sodium, potassium, magnesium and copper were determined by atomic absorption spectrophotometry (Agilent Technologies 55 AA Atomic Absorption Spectrometer) at 589.0; 766.5; 285.2 and 327.4 nm, respectively. Calcium contents were determined by complexometry as described by Pauwels *et al*. (1992): titration was performed with the Na_2-EDTA 0.002 M complex and the equivalence point was reached when the solution turned from purple to blue.

Ascorbic acid (Vitamin C)

Ascorbic acid was measured by titration using DCPIP (2,6-dichlorophenol-indophenol) (Negi & Roy, 2004). Extraction was done in acetic acid as extraction solvent. 5ml of the extract was pipetted into a boiling tube and 1ml of glacial acetic acid was added and titrated with the dye solution to a faint permanent pink color. The title (T) was recorded. The titration was repeated with 5ml of acetic acid for the blank (B1) and 5ml of ascorbic acid standard solution (st) and vitamin C content of the test sample was calculated using the relationship:

Vitamin C (mg/100 ml) = [(T - B1) / (st - B1)] x Dilution factor (3)

Total carotenoid and β-carotene

The carotenoids were extracted in hexane, at room temperature and the level was determined by spectrophotometry using the equation proposed by Wellburn (1994). The level of β-carotene was determined from that of carotenoid using 2592 (β-carotene Extinction Coefficient in petroleum ether).

Antinutritional factors

The total tannin and phytic acid content of canistel seeds were determined by the spectrophotometric procedure described by Brainbridge *et al*. (1996) and Gao *et al*. (2007) respectively. The oxalate content was quantified by titration with $KMnO_4$, 0.05mol/L according to the method of Aina *et al*. (2012) and the saponin content was determined with the Kozol (1990) method.

Statistical analysis

Statistical values that were calculated using MS Excel 2019 include mean and standard deviation. All data were presented as means of triplicates.

RESULTS AND DISCUSSION

Proximate composition

Table 1 presents the results of proximate analysis of canistel (Pouteria Campechiana) seeds. From these results, it is evident that canistel seeds contained crude protein (7.66 ± 0.28 g/100g), crude fat (7.61 ± 0.04 mg/100g), carbohydrate (6.51 ± 0.45 mg/100g), ash (1.91 ± 0.08 mg/100g) and fibre (13.26 ± 0.71 mg/100g).

Canistel seeds contained 7.66 ± 0.04g/100g DM of protein. These seeds are richer in proteins than the pulp of the same fruit reported by Lim (2013); Marzuki *et al*. (2018) and Sethuraman *et al*. (2020). They also richer in protein that *Coula edulis* nuts (4.60

Table 1. Proximate composition (g/100g) and energetic value (Kcal/100g) of canistel (*Pouteria Campechiana*) seeds

	Water	Proteins	Lipids	Ash	Fibers	Carbohydrates	Energy
Mean	63.05	7.66	7.61	1.91	13.26	6.51	125.19
SD	1.12	0.28	0.04	0.08	0.71	0.45	1.27

Data are means + SD of triplicate determinations

g/100g DM) and *Garcinia kola* (1.86 ± 0.15 g/100g DM) obtained by Onuegbu and Iwu (2020) and Adesuyi *et al*. (2012) respectively. Canistel (*Pouteria Campechiana (Kunth) Baehni*) seeds cannot really contribute to the daily protein requirement (10-30g) of stipulated by USDA (2010).

The fat content of canistel (*Pouteria Campechiana (Kunth) Baehni*) seeds was 7.61 ± 0.04 g/100g DM. This value was greater than 5.73 g/100g DM and 6.73 g/100g DM obtained by Amalia *et al*. (2020) in blanched canistel flour. Canistel seeds are richer in fat than fruit pulp. Actually, canistel pulp fat content ranged from 0.10 to 4.97 g/100g DM (Lim, 2013; Sethuraman *et al*., 2020). Although the lipid content of canistel seeds is greater than that obtained by other authors in canistel pulp (0.10 to 4.97 g/100g DM) and *Garcinia kola* (0.19 ± 0.32 g/100g DM), its value does not make allow them to be considered as a fat source. The low-fat levels of these seeds could be beneficial for people with non-communicable diseases, such as heart disease, stroke and diabetes (Fashina *et al*., 2017). Fats are essential in diets for energy and they increase the palatability of foods by absorbing and retaining their flavors. Fats are also vital in the structural and biological functioning of the cells and help in the transport of nutritionally essential fat-soluble vitamins (Aiyesanmi and Oguntokun, 1996 cited by Onuegbu and Iwu, 2020).

The ash content of canistel seeds was 1.91 ± 0.08 g/100g DM. This value is similar to that obtained by Amalia *et al.* (2020) in blanched canistel flour. Ash content is a measure of the nutritional value of food which is regarded as the reflection of the mineral contents preserved in food materials. Usually, ash content does not exceed 5%; and this was confirmed in the present study.

The mean of crude fiber content was 13.26 ± 0.71 g/100g DM which is greater than the total fiber content reported for *Coula edulis* (4.72 g/100g DM), *Garcinia kola* (1.23 ± 0.15 g/100g DM) and *Pouteria Campechiana* pulp (2.12 ± 0.5 g/100g DM). This crude fiber content is also higher than the values reported from most other nuts (1.64 - 4.3%) (Onuegbu and Iwu, 2020). An adequate intake of fiber is important to facilitate and regulate intestinal transit, thus preventing constipation (Plessi *et al*., 1999). The soluble fiber helps lower blood sugar (for diabetics) and blood cholesterol by dissolving in water and forming a gummy substance that binds cholesterol and carbohydrates in the intestine (NHWC, 2002).

The amount of carbohydrate obtained by difference (6.51 ± 0.45) was lower than the value obtained for *Coula edulis* (45.67 g/100g DM), *Garcinia kola* (88.30 ± 0.08 g/100g DM) and *Pouteria Campechiana* (40.19 ± 2.70 g/100g DM) by Onuegbu and Iwu (2020); Adesuyi *et al*. (2012) and Sethuraman *et al*. (2020) respectively. Carbohydrates play a significant role in the organism; they provide energy for metabolism. The fact that canistel seeds are fairly low in carbohydrates makes them an excellent for diabetes and those following a low-carb diet.

Except for carbohydrates, canistel seeds are quite to be nutritionally richer than fruit pulp. They contain more proteins, lipids, ash and fibers. Actually, Sethuraman *et al*. (2020) reported that the pulp of canistel has 1.16, 4.97, 2.12, and 0.71 g/100g DM of crude proteins, crude fats, crude fibers and ash respectively.

Canistel seeds are fairly high in energy as 100 g provide 125,19 ± 1,27 Kcal of energy and thus supply only a very small percentage of the recommended dietary allowance (1300 - 3000 Kcal) of different age groups (FNB, 2004 cited by Onuegbu and Iwu, 2020).

Mineral composition

Table 2 showed that canistel seeds contained essential minerals, Ca (0.71 ± 0.01 mg/100g), K (20.25 ± 0.00 mg/100g), Na (0.46 ± 0.00 mg/100g), P (2.80 ± 0.02 mg/100g), Mg (60.13 ± 1.74 mg/100g) and Fe (16.21 ±

Table 2. Mineral composition in mg/100g (Mg, Ca, Na, P and K) and µg/100g (Fe and Cu) of canistel seeds

	Mg	Ca	Na	P	K	Fe	Cu
Mean	60.13	0.71	0.46	2.80	20.25	16.21	NA
SD	1.74	0.01	0.00	0.02	0.00	0.00	NA

Data are means + SD of triplicate determinations; NA: Not applicable

0.00 µg/100g). These seeds do not contain copper. The presence of these essential compounds implies that canistel seeds could be used as a nutritionally valuable and healthy ingredient for humans and animals. These nutrients may not be strictly medicinal but could be valuable in preventing diseases that are related to malnutrition.

Mineral nutrients are indispensable due to their major roles in human diet. They are involved in the maintenance of certain physicochemical processes which are essential to life (Eric *et al*., 2014). Some of them (iron, copper …) help in the prevention of some malnutrition incidences (Soetan *et al*., 2010). Essential minerals are of two groups: major minerals which are needed in amounts greater than 100 mg per day and constitute about 1% of the body weight and trace minerals required in less than 100 mg per day and constituting less than 0.01% of body weight (Lyimo *et al*., 2003). Calcium, a major mineral (up to 1200 mg is needed in daily diets) is responsible for bone and muscle formation, maintenance and prevention of osteopenia and osteoporosis (Ozcan and Akbulut, 2008); it also helps in clotting of blood, muscle contraction, and synaptic transmission of nerve impulses (Naga *et al*., 2012). Taking into consideration the recommendations of NRC (1989), the lowest calcium content (0.71 ± 0.01 mg) reported in the present study suggested that canistel seeds do not have the potential to supply Ca in humans.

Phosphorus content was 2.80 ± 0.02 mg/100g DM. This low content suggests that the consumption of canistel seeds couldn't help in the process of tooth and bone formation in children and their healthy development. The very low value of Ca/P ratio (0.25) indicates that Ca will be rapidly absorbed in the gastrointestinal tract. A ratio of 1/2 for children and 1/1 for adults presents a maximum absorption for this mineral in the respective individuals **(**O'dell, 1989; FAO/WHO, 2001).

The Na/K ratio in the body is linked with the prevention of hypertension and values greater than one are thought to increase chances of hypertension (Akinyeye *et al*., 2010). The value of this ratio in the present study is very low (0.023) indicating the high potential of these seeds in providing a healthy and balanced diet. Magnesium is reported to be efficient in the metabolism of carbohydrates and lipids, involved in cellular respiration, and also useful in general cellular biochemistry and functions (Tanase *et al*., 2011). FAO/WHO (2001) recommends a reduction in sodium intake to < 2g of salt/day to regulate blood pressure and reduce the risk of stroke and coronary heart disease in adults.

Magnesium is the most abundant mineral in canistel seeds (60.13 ± 1.74 mg/100g DM). This mineral is a cofactor for over 350 enzyme reactions, many of which involve energy metabolism. It is also involved in protein and nucleic acid synthesis and is needed for normal vascular tone and insulin sensitivity. The Dietary Reference Intake (DRI) values for magnesium are 30 mg/day for infants aged 0 to 6 months, 75 mg/day for 7 to 12 months, 80 mg for children 1 to 3 years and 130 mg for 4 to 8 years (IOM, 1997). These seeds can then be considered as a magnesium source for infants.

The sample contained a very low level of iron (16.21 ± 0.00 µg/100g DM). The obtained value is far behind that of *Coula edulis* (6.6108 mg/100g). Iron is blood building element and is very essential in human and animal consumption.

Iron plays an important role in women of childbearing age, pregnant women and during child development (Kordas and Stoolzfus, 2004). The recent FAO/WHO Expert Committee on vitamins and minerals provided recommended intakes considering diets of 5, 10, 12 and 15% of iron bioavailability (FAO/WHO, 2002). The recommended amounts for children, male and female adolescents are respectively 10, 12 and 15 mg per day (Herbert, 1987). Given the low iron content of these seeds, they cannot be considered as good sources of iron and have to be consumed with iron-rich foods or soups, for a good nutritional balance.

Mineral elements aid biochemical functions necessary for growth, development and overall health and they help in enzyme function (NHWC, 2002).

Total carotenoid and vitamin C content
The results of the total carotenoid, b-carotene and vitamin C content of canistel seeds are presented in Table 3. These seeds contain 56.76 ± 0.00 mg/100g (total carotenoid) considered as provitamin A and 17.60 ± 2.26 g/100g (vitamin C).

The presence of vitamins has been reported to improve the quality and dietary composition of vegetables. Vitamin A functions in the body apart from helping in growth also promote disease resistance, delay aging, and preside over the health of the eyes, nails, and hairs (Sobukola *et al*., 2007). Vitamin C helps in the health of the lungs and bronchia, teeth and gums, and bones and joints and purifies the blood. It also prevents the scavenging activities of toxicants that trigger the inflammatory cascade and is associated with reduced severity of inflammatory conditions such as asthma, osteoarthritis, and rheumatoid arthritis. It could also be used in herbal medicine for the treatment of common cold and prostate cancer (Traber *et al*., 2008; Picciano, 2012; Adeolu and Tenesi, 2013). Vitamin C (ascorbic) is a common antioxidant present in both plant and animal cells. It helps in blocking the damage caused by free radicals that are associated with the aging process, cancer and heart disease; it also plays a role in tissue regeneration and growth (MedlinePlus, 2020).

Table 3. Total carotenoid, b-carotene and vitamin C content of canistel seeds

	Total carotenoids (mg/100g)	b-carotene (mg/100g)	Vitamin C (g/100g)
Mean	56.76	0.02	17.60
SD	0.00	0.00	2.26

Data are means + SD of triplicate determinations

Table 4. Antinutrient composition (g/100g) of canistel seeds

	Oxalates	Phytates	Tannins	Saponins
Mean	0.15	0.07	0.07	1.08
SD	0.00	0.01	0.01	0.00

Data are means + SD of triplicate determinations

Anti-nutrient composition
From the results presented in table 4, it can be concluded that canistel seeds have low levels of oxalates (0.15 ± 0.00 g/100g), phytates (0.07 ± 0.01 g/100g), tannins (0.07 ± 0.01 g/100g) and saponins (1.08 ± 0.00 g/100g).

Most tropical and sub-tropical plants contain anti-nutrients factors. Depending on their level in food, they can limit nutrient digestibility. These anti-nutrients are also called phytochemicals and are defined as chemical compounds that occur naturally in plants and may have biological significance in a certain amount. The values obtained in the present study for all anti-nutritional factors revealed low levels of oxalates, phytates, tannins and saponins (0.15 ± 0.00; 0.07 ± 0.01; 0.07 ± 0.01; 1.08 ± 0.00). This anti-nutrient content was lower than that of *Garcinia kola* with 0.423 ± 0.00; 0.570 ± 0.05; 0.342 ± 0.00 and 2.471 ± 0.00 mg/100g DM respectively for oxalates, phytates, tannins and saponins obtained by Adesuyi *et al*. (2012). The tannin and phytate content of canistel seeds are also lower than that of *Coula edulis* nuts with 0.72 ± 0.071 and 0.28 ± 0.04 respectively (Onuegbu and Iwu, 2020).

Oxalates in food cause irritation in the mouth and interfere with the absorption of divalent minerals, particularly calcium, by combining with them to form insoluble salts. However, the level of oxalate in these seeds is not a major health concern, as the daily intake is 2 to 5 g of oxalate per day, which is thought to be the toxic level for humans (Hassan and Umar, 2004).

Phytates are an organically bound form of phosphorus in plants. Phytates in foods are known to bind with essential minerals (such as calcium, iron, magnesium and zinc) in the digestive tract, limiting their bioavailability and resulting in mineral deficiencies (Bello *et al*., 2008). They bind minerals to form insoluble salts, thereby decreasing their bioavailability or absorption (Muhammad *et al*., 2011). The mean daily intake of phytates is estimated to be 2000-2600 mg for vegetarian diets as well as diets of inhabitants of rural areas in developing countries, and 150-1400 mg for mixed diets (Grases *et al*., 1999). The phytate content of canistel seeds is lower than the acceptable level for vegetarian and mixed diets meaning that there will be no binding effect on Ca, Mg, Fe and Zn.

Tannins are plant polyphenols, which can form complexes with metal ions and with macro-molecules such as proteins and polysaccharides (De-Bruyne *et al*., 1999). Dietary tannins are said to reduce feed efficiency and weight gain in chicks. Tannins can bind to protein and form tannin-protein complexes. The latter are insoluble in water resulting in a decrease of protein digestibility by inhibiting the activities of digestive enzymes (Carnovale *et al*., 1991). The consumption of tannin-rich foods (≥ 5000 mg/100g DM) can cause esophageal cancer (Shils *et al*., 2006). The tannin content of canistel seeds is far under the total acceptable tannin daily intake for men, 560 mg (Ikpeme, 2012). The results showed that the concentrations of tannin in the tubers were below toxic levels.

Saponins are glycosides, which include steroid saponins and triterpenoid saponins. High levels of saponins reduce feed intake and growth due to the irritating taste and protein digestibility reduction. Saponins (in excess), causes hypocholestrolaemia because it binds cholesterol making it unavailable for absorption (Soetan and Oyewole, 2009); they also have haemolytic activity against red blood cells (Khalil and Eladawy, 1994). On the other hand, saponins are known to have a natural tendency to ward off germs, resulting in treating infections caused by fungi and yeasts. These compounds then serve as natural antibiotics, which help the body fight infections and microbial invasions (Sopido *et al*., 2000). Canistel seeds contain a moderate level of saponins; it is then recommended to treat (cooking, fermentation) before consumption to provide some beneficial effects on health.

Osagie (1998) reported that simple boiling, cooking and soaking can reduce the concentration of anti-nutrients in foodstuffs. However, many of the anti-nutrients in foods are under study for their potential health benefits (Dinkova and Kostov, 2012).

CONCLUSION

This work has revealed the nutritional composition of the nut which has provided information for nutritional orientation and counseling for the health sector as well as its potentials for both human consumption and raw material for the commercial food industry. *Pouteria Campechiana (Kunth) Baehni*) seeds are a low source of proteins, fats and carbohydrates but a good one for fibers. The micronutrients, Ca, Mg, K, Na, Fe and vitamin C detected in the flour sample revealed the nutritional benefits of the seeds for human consumption. Its physical proximity with *Garcinia kola* helps to predict its medicinal and pharmaceutical properties that have to be investigated. They can also be useful in various food industries as a raw material.

Acknowledgements:
We express our gratitute to Principal ESN, Sharadchandra Arts, Commerce & Science College, Naigaon (Bz) Dist. Nanded for facilities and encouragements.

Conflicts of Interest: The authors declare no conflict of interest.

REFERENCES

Adeolu A., Tenesi D.O. Assessment of proximate, mineral vitamin and phytochemical compositions of plantain (*Musa paradisiaca*) bract-an agricultural waste. *Journal of plant science*, 2013, *4*(7), 192-197.

Adesuyi A.O., Elumm I.K., Adaramola, F.B., Nwokocha, A.G.M. Nutritional and phytochemical screening of *Garcinia kola*. *Advance Journal of Food Science and Technology*, 2012, *4*(1), 9-14.

Ainan V.O., Sambo B., Zakari, A., Haruna, H.M.S., Umar, K., AKinboboye, R.M., Mohammed A Determination of nutritional and antinutritional content of *Vitis vinifera* (Grapes grown in Bomo (Area C) Zaira.Nigeria. *Advance Journal of Food Science and Technology*, 2012, *4*(6), 225-228.

Akinyeye R.O., Oluwadunsin A., Omoyeni A. Proximate, mineral, anti-nutrients, phyto-chemical screening and amino acid compositions of the leaves of *Pterocarpus mildbraedi harms*. *Electronic Journal of Environmental, Agricultural and Food Chemistry*, 2010, *9*(8), 1322-1333. https://doi.org/10.12691/jnh-3-1-3

Amalia L., Setiarto R.H.B., Fitrilia T., Masyrifah, S. Effect of blanching on the physicochemical. *African Journal of Food, Agriculture, Nutrition and Development,* 2020, *20*(7), 17063-80.

A.O.A.C. Official Methods of Analysis 13th edition. William Horwitz: Washington. D.C. 1980.

A.O.A.C.: Official Methods of Analysis. 16thEd.Association of Official Analytical Chemists. Washington. D.C. 1990.

Bainbridge Z., Tomlins K., Willings K., Westby, A. Methods for assessing quality characteristics of non-grain starch staple. Part 4 advanced methods. National resources institute. 1996, University of Greenwich, UK ISBN 0 – 85954 – 400 – 1: 43–79. http://gala.gre.ac.uk/id/eprint/11040/1/Doc-0171.pdf

Bello M.O., Falade O.S., Adewusi S.R., Olawore, N.O. Studies on the chemical compositions and anti-nutrients of some lesser-known Nigeria fruits. *African Journal of Biotechnology*, 2008, *7*(21), 3972-3979. https://doi.org/10.12691/ajfn-2-1-3

Bourely J. Observation sur le dosage de l'huile des graines de cotonnier. *Coton et Fibres Tropicales,* 1982, *27*(2), 183-196. https://agritrop.cirad.fr/455410/

Carnovale E., Lugaro, E., Marconi, E. Protein quality and anti-nutritional factors in wild & cultivated species of vigna spp. *Plant Foods for Human Nutrition*, 1991, 41, 11-20. https://doi.org/10.1007/bf02196377

De-Bruyne T., Pieters L., Deelstra H., Ulietinck A. Condensed vegetable tannins: Biodiversity in structure and biological activities. *Biochemical systematic and Ecology*, 1999, 27, 445-459. https://doi.org/10.12691/ajfn-2-1-3

Dinkova-kostova A.T., Kostov, R.V. Glucosinolates and isothiocyanates in health and disease. *Journal of Trends in Molecular Medicine*, 2012, *18*(16), 537-547. https://doi.org/10.1016/j.molmed.2012.04.003

Elsayed A.M., El-Tanbouly N.D., Moustafa S.F., Abdou R.M., Awdan S.A.W.E. Chemical composition and biological activities of *Pouteria campechiana (Kunth) Baehni*. *Journal of Medicinal Plants Research*, 2016, *10*(16), 209-215. https://doi.org/10.5897/JMPR2015.6031

Eric N.D., Yamell R.H., Katty, J.D. Dilemmas of traditional bacterical research. *Journal of ethnopharmacology*, 2014, 55, 46-54.

FAO/WHO. 2001. Human vitamin and mineral requirements. Report of a joint FAO/WHO expert consultation Bangkok, Thailand, 281p. FAO/WHO 2002. Human vitamin and mineral requirements. Report of a Joint FAO/WHO Expert Consultation, Bangkok, Thailand. Rome: World Health Organization and Food and Nutrition Organization of the United Nations.

Fashina A.B., Adejori E.A., Akande, F.B. Effects of slice thickness and blanching time on the proximate properties of dried ground yam. *International Food Research Journal,* 2017, *24*(3), 1349-1352.

Gao Y., Shang C., Saghai-Maroof M., Biyashev R., Grabau E., Kwanyuen P., Burton J., Buss G. A modified colorimetric method for phytic acid analysis in soybean. *Crop Science*, 2007, *47*(5), 1797-1803. https://doi.org/10.2135/cropsci2007.03.0122

Grases F.J.G., March R.M., Prieto B.M., Simonet A., Costa-Bauza A. Urinary phytate in calcium oxalate stone formers and healthy people dietary effects on phytate excretion. *Scandinavian Journal of Urology and Nephrology*, 1999, 34, 162-164. https://doi.org/10.1080/003655900750016526

Hassan A.S., Umar K.J. Antinutritive factor in African locust beans (*Parkia biglobosa*). Proceedings of the 27th International Conference, of the Chemical Society of Nigeria, 2004, pp. 322-326.

Herbert V. Recommended dietary intakes (RDI) of iron in humans. *American Journal of Clinical Nutrition*, 1987, 45, 679-86. https://doi.org/10.1093/ajcn/45.4.679

Ikpeme C.E., Eneji C., Igile G. Nutritional and organoleptic properties of wheat (*Triticum aestivum*) and Beniseed (*Sesame indicum*) composite flour baked foods. *Journal of Food Research,* 2012, *1*(3), 84. https://doi.org/10.5539/jfr.v1n3p84

Institute of Medicine (IOM) 1997. Dietary Reference Intakes for Calcium, Phosphorus, Magnesium, Vitamin D, and Fluoride. Washington, DC: National Academy Press.

Khalil A.H., Eladawy T.A. Isolation, identification and toxicity of saponins from different legumes. *Food Chemistry*, 1994, *50*(2), 197-20. https://doi.org/10.1016/0308-8146(94)90120-1

Kordas K., Stoltzfus R.J. New evidence of Iron and Zinc interplay at the enterocyte and neural tissues*. Journal of Nutrition*, 2004, 134, 1295-1298. https://doi.org/10.1093/jn/134.6.1295

Kozol M.J. Afrosimetric estimation of threshold saponin concentration for bitterness in quinosa (*Chenopodium quinoa Wild*). *Journal of the Science of Food and Agriculture*, 1990, *54*(2), 211-249. https://doi.org/10.1002/jsfa.2740540206

Lim T.K. *Pouteria campechiana. Edible Medicinal and Non-Medicinal Plants*, 2013, 6, 133-137. Fruits New York, NY, USA: Springer. https://doi.org/10.1007/978-94-007-5628-1_23

Lyimo M., Temu R.P.C., Mugula J.K. Identification and nutrient composition of indigenous vegetables of Tanzania. *Plant Foods for Human Nutrition*, 2003, *58*(1), 85-92. https://doi.org/10.1023/a:10240448 31196

Marzuki N.H.C., Hamid M.A., Wahab R.A. Assessment of fatty acid composition and response surface optimization of ultrasonic-assisted extraction of phenolic compounds from *Pouteria campechiana* pulp. *Malaysian Journals of Fundamental and Applied Sciences*, 2018, *14*(2), 269-277. https://doi.org/10.11113/mjfas.v14n2.984

MedlinePlus Vitamin C.2021. Retrieved April 5, 2021. From:https://medlineplus.gov/ency/article/002404.htm#:~:text=Vitamin%20C%20is%20needed%20for, wounds%20and%20form%20scar%20tissue

Mehraj H.R.K., Sikder U., Mayda S., Taufique T. Plant physiology and fruit secondary metabolites of canistel (*Pouteria Campechiana*). 2015, *33*(12), 1908-14. https://doi.org/10.5829/idosi.wasj.2015.33.12.15625

Muhammad S., Hassan L.G., Dangoggo S.M., Hassan S.W., Umar K.J., Aliyu R.U. Nutritional and antinutritional composition of *Sclerocarya birrea* seed kernel. *Studia*

Universitatis "Vasile Goldiş". Life Sciences Series, 2011, *21*(4), 693-699.

Naga Raju G.J., Sarita P., Reddy S.B. Correlation of trace elemental content in selected anticancer medicinal plants with their curative ability using particle induced X-ray emission (PIXE). *Journal of Medicinal Plants*, 2012, *7*(16), 1081-1086.

National Health and Wellness Club N.H.W.C. 2002. Smart nutrition: The essential vitamin, mineral and supplement reference guide. NHWC, Minnetonka. Pp 13-76. www.healthandwellnessclub.com

National Research Council Collection N.R.C. (1989). Archives of American Mathematics. The University of Texas at Austin. http://www.national academies.org/

Negi P.S., Roy, S.K. Changes in beta-carotene and ascorbic acid content of fresh amaranth and fenugreek leaves during storage by the low-cost technique. *Plant Foods for Human Nutrition*, 2004, 58, 225-230. https://doi.org/10.1023/B:QUAL.00000 40361.85578.b5

O'dell B.L. Mineral interactions relevant to nutrient requirements. *Journal of Nutrition*, 1989, 119, 1832-1838.

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

Osagie A.U. Anti-nutrient factors in nutritional quality of plant foods. *Journal of Food Science*, 1998, 112, 25-27.

Ozcan M.M., Akbulut M. Estimation of minerals, nitrate and nitrite contents of medicinal and aromatic plants used as spices, condiments and herbal tea. *Food Chemistry*, 2008, *106*(2), 852-858. https://doi.org/10.1016/j.foodchem.2007.06.045

Pauwels J.E., Van Ranst M., Verloo, Mvondo A. Manuel d'analyses de sols et de plantes. Equipements, Gestion de stocks, de verrerie et produits chimiques. Publications agricoles-28, AGCD, Bruxelles, Belgique. 1992, 265 p. http://hdl.handle.net/1854/LU-223183

Pertiwi S.R., Nurhalimah S., Aminullah A. Optimization on process of ripe canistel (*Pouteria campechiana*) fruit flour based on several quality characteristics. *Brazilian Journal of Food Technology*. 2020, 23, e2019056. https://doi.org/10.1590/1981-6723.05619

Picciano M.F. Vitamins in milk. A Water- soluble vitamins in Human milk in. Handbook of Milk Composition, R. G. Jensen, Ed., 2012, pp. 90–99, Academic Press, San Diego.

Plessi M., Berteli D., Monzani A. Dietary fiber and some elements in nuts and wheat bran. *Journal of Food composition and Analysis*, 1999, 12, 91-96. https://doi.org/10.1006/jfca.1999.0812

Ranganna S. 1986. Handbook of Analysis and Quality Control for Fruit and Vegetable Products. Tata McGraw Hill Publishing Co. Ltd., New Delhi, 190-210. https://doi.org/10.12691/jfnr-2-4-8

Sethuraman G., Nizar N.M.M., Muhamad F.N., Tengku A.S.T., Suhairi M., Jahanshiri E., Gregory P.J., Azam-Ali S. Nutritional composition of canistel (*Pouteria Campechiana (Kunth) Baehni*). *International Journal of Food Science and Nutrition*, 2020, *5*(6), 53-57.

Shils M.E., Shike M., Ross A.C., Caballero B. & Cousings R.J. Modern nutrition in health and disease. 10th Edn., Lippincott Williams and Wilkins, A WoltersKlumer Company. 2006, 280-281.

Silva C.A.M., Simeoni L.A., Silveira D. Genus Pouteria: Chemistry and biological activity. *Brazilian Journal of Pharmacognosy*, 2009, 19, 501-509. https://doi.org/10.1590/S0102-695X20090003 00025

Sobukola O.P., Dairo O.U., Dairo O.U. Modeling drying kinetics of fever leaves (*Ocimum viride*) in a convective hot air dryer. *Nigerian Food Journal*, 2007, 25, 145-153. https://doi.org/10.4314/nifoj.v25i1.33663

Soetan K.O., Oyewole O.E. The need for adequate processing to reduce the anti-nutritional factors in animal feeds, A review. *African Journal of Food Science*, 2009, *3*(9), 223-232.

Soetan K.O., Olaiya C.O., Oyewol O.E. The importance of mineral elements for humans, domestic animals and plants: a review. *African Journal of Food Science*, 2010, *4*(5), 200-222. https://doi.org/10.5897/AJFS.9000287

Sopido O.A., Ahiniyi J.A., Ogunbanosu J.U. Studies on certain characteristics of extracts of barke of *Pansinystalia macruceras* (K. Schem.) Pierve Exbeille. *Global Journal of Pure and Applied Sciences*, 2000, 6, 83-87. https://doi.org/10.4314/gjpas.v6i1.16082

Sunila A.V., Murugan K. Nutritional composition of fruits from *Pouteria campechiana* (*Kunth) Baehni* at different stages of development. *Trends in Biosciences*. 2017, *10*(20), 4020-4026. http://trendsinbiosciencesjournal.com

Tanase C.M., Griffin P., Koski K.G., Cooper M.J., Cockell K.A. Sodium and potassium in composite food samples from the Canadian Total Diet Study. *Journal of Food Composition and Analysis*, 2011, *24*(2), 237-243.

Traber M., Shils M.E.G., Shike M., Ross A.C., Caballero B., Cousins R.J. Modern nutrition in health and disease, Philadelphia. *Lippincott Williams and Wilkiins*, 2008, 396-411.

United states Department of Agriculture USDA. (2010). National nutrient database for standard reference, Agricultural Research Service SR23. http://www.ars.usda.gov/services/docs.htm%29/08/ 2014

Wellburn A.R. The spectral determination of chlorophyll a and b, as well as total carotenoids, using various solvents with spectrophotometers of different resolution. *Journal of Plant Physiology*, 1994, 144, 307-313. https://doi.org/10.1016/S0176-1617(11)81192-2.