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Annals of Biological Research, 2012, 3 (11):5151-5156
(http://scholarsresearchlibrary.com/archive.html)

Annals of Biological Research
Scholars Research Library
ISSN 0976-1233
CODEN (USA): ABRNBW

Comparative anti-nutrients assessment of pulp, seed and rind of rambutan (*Nephelium Lappaceum)*

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ABSTRACT

The anti-nutrient contents of the pulp, seeds and rind of rambutanNepheliumlappaceumwere evaluated. The study was carried out on both fresh and dried samples. Results of the investigation revealled that the anti-nutritional components such as saponin, alkaloid, hydrocyanic acid, phenols, oxalate, tannins, phytates were detected in all the samples but at a varying tolerable concentrations. However, other anti-nutrient constituents were in small insignificant amount in all the parts of the fruits. Although there was a significant difference at ($p< 0.05$) in the anti-nutrient compounds in the different parts of the fruits, seeds and rind which are the parts always discarded on the basis of acclaim toxicity, their consumption can contribute immensely to recommended daily allowance and maintenance of good nutritional status and hence good health for both man and animals.

Keywords: Comparative, anti-nutrients assessment, pulp, seed, rind rambutan (*nepheliumlappaceum).*

INTRODUCTION

Humanspossess great capacity to adapt physiologically to different types of foods. In spite of this, nutrition science has demonstrated that there are certain foods that cannot be eliminated, such as fruits and fresh vegetables [1]. As reported by [2].Fruits offer the most rapid methods of providing adequate supplies of vitamins, minerals and fibres to people living in the tropics. Most fruits and vegetables have low energy density and are recommended for weight management [3]. The optimal diet for everyone as recommended by the world health and food and agriculture organization is a low-fat, and fibre diet rich in complex carbohydrate characterized by a frequent consumption of fruits and vegetables at least 400g daily as well as whole-grains, cereals and legumes at least 30g daily [4]. A variety of fruits and vegetables are however consumed in Nigeria on a daily basis, and they form an integral part of our diet but most times only the fleshy pulp of these fruits are consumed leaving the seed and the rind. Fruits contain a high percentage of water averaging 85%, fats and protein in very small varying amounts, a fair proportion of carbohydrate present as cellulose, starch in small quantity and sugar. Beside their low energy value, they are known for their high micronutrients concentrations including carotene or provitamin A, vitamin k, ascorbic acid, riboflavin, iron, iodine and other mineral elements [5]. The main contribution of fruits in nutrition is vitamins

and the main source from which humans and animals derive their vitamin is from fruits and vegetables. Fruits such as pawpaw, oil palm, carrots and pumpkins provide large quantities of carotene. [2]reported a value of 200 IU each for avocado pear and passion fruit. Fruits and vegetables provide vitamin and minerals in quantities high enough to provide the body with its needs [6]. They have been linked to the management of anaemia because of their vitamin C content. When consumed with meals, they enhance iron status of the individual their high content of vitamin C improves absorption of iron [7]. Seeds and peels of grapes and pomegranates are also rich sources of natural antioxidant [8]. Research studies have recently shown that a diet rich in the vitamin antioxidants (Vitamin C and E) and the carotenoids is associated with improved health and a lower risk of coronary heart disease and cancer [1]. Food of vegetable origin rich in fibre, minerals and vitamins, also bring substances to the diet that although,not well understood nor classified as nutrients, display potent anti-carcinogenic and curative effects on a variety of diseases and illnesses, these substances are known as phytochemcials[1]. The fibre content of fruits and vegetables have been reported to have beneficial effects on blood cholesterol and they aid in the prevention of large bowel diseases [9]. It has also been reported that populations that consume diet rich in fruits and vegetables have significantly lower rates of many types of cancers [11]. Fruits have high vitamin, mineral, fibre, phytochemcial and antioxidant in their pulps, seeds and rinds but they have not been given much importance in the diets of many Nigerians especially the seed and rind which most times are discarded. Due to ignorance of the nutritive value and their curative advantages, lack of proper storage facilities, poor distribution, rising cost of fruits, poor accessibility and affordability [12], most low income groups have not given fruit consumption much importance in their daily diet. *NepheliumLappaceum* is a medium sized tropical tree. It is an evergreen tree growing to a height of 12-20m [13]. The leaves are alternate 10-30cm long, pinnate with 3-11 leaflets, each leaflet 5-15cm wide and 30-10cm broad. The fruit is round or oval drupe, 3-6cm long and 3-4cm broad. The leathery skin is reddish (rarely orange or yellow and covered with fleshy pliable spines. The seed is glossy brown 2-3cm with a white basal scar. *Nepheliumlappaceum* is adapted to warm tropical climates around 22-30^{o}c and is sensitive to temperature below 10^{o}c [13]. It is grown within 12-15^{o}c of the equator. The tree grows well on heights up to 500m (1600ft) above sea level and does best in soil rich in organic matter and thrive only on hilly terrain as they require good drainage. *Nepheliumlappaceum* tree bears twice annually, once in late fall and early winter. The fragile nutritious fruits must be ripened on the tree. Then they are harvested over a four to seven week period. The fresh fruits are easily bruised and have a limited shelf life. The best quality *Nepheliumlappaceum* is generally that which is harvested still attached to the branch. It is less susceptible to rot, damage and pests and remains fresh for a much longer time than the ones harvested from the branch. *Nepheliumlappaceum* can be kept for three to five days in the refrigerator and covered with plastic wrap to reduce moisture loss or leave them out in a humid environment. *Nepheliumlappaceum* fruit is usually sold fresh, used in making Jam and Jellies. Its single brown seeds is high in certain fats and oil (Oleic and arachidic acid) valuable to industry and used in cooking and manufacturing of soap. Its roots, back and leaves have various medicinal uses and are used in production of dyes. A second specie of *Nepheliumlappaceum* known as "wild" Rambutan is smaller in size than the usual red variety and is coloured yellow. Studies have shown that fruits and vegetables contain among other vital nutrients, an appreciable quantity of vitamin, fibre, antioxidants, phytochemicals and a daily consumption of at least 5 to 10 servings of a wide variety of fruits and vegetable is an appropriate strategy for significantly reducing the risk of chronic diseases and to meet nutrient requirement for optimum health [14]. These fruits are consumed, fresh, canned or processed and its consumption results in the production of vast amount of agricultural waste from their seeds and rind, disposal of these Agricultural wastes can have a serious environmental impact which is becoming harder to solve. Much effort will therefore be needed to develop the nutritional and industrial potential of by-products waste and these under- utilized agricultural products. Despite the numerous nutritional benefits from fruits only a small portion of plant material is utilized directly for human consumption [15], the remainder part may be converted into nutrient for either food or feed or into fertilizer. Although several research work have been done on the nutritional evaluation of some locally available fruits, not much have been done on the nutritional and anti-nutrient contents of many locally available fruits their pulp, seeds and rind which is most times discarded [16, 17, 18, 19, 20]. The knowledge of the nutritive and the anti-nutrient content of various parts of these fruits will encourage their consumption in diverse ways and re-utilization of the vast amount of seeds and peels discarded as waste for human food, animal feed and fertilizer. Much have been reported on the nutritional value of fruits and how it can be used to effectively prevent nutritional deficiency in man as well as treat nutritional diseases. The nutritional value and anti-nutrient content of many fruits, seeds and their rind has not be given much attention, such that most times these parts of fruit are discarded even with their hidden nutrient. The seeds and rind which are often the waste part of the fruits have not generally received much attention with a view to being used or recycled rather than discarded. Interestingly the seed and rind of some fruits have higher vitamins, fibres, minerals and other essential nutrients activity than the pulp fractions [8]. It is therefore necessary to evaluate the nutritional and anti-

nutrients content of these fruits and their waste materials so that the knowledge derived can be used to encourage adequate consumption of fruits and re- utilization of the seeds and rind in possible value added applications.

MATERIALS AND METHODS

SOURCES OF MATERIALS

5kgs of *Nepheliumlappaceum*(Rambutan) were bought from the local markets in Calabar, Obudu and Obubra Local Government Area in Cross River State, Nigeria. The samples were bought when available in their fresh state and in sufficient quantity for the analysis.

COLLECTION AND TREATMENT OF SAMPLES

Eight *Nepheliumlappaceum*weighing 2.5kg each were used for the phytochemical screening. The fruit were bought at different times for the anti-nutrient analysis.The samples for drying were washed and cut open with a knife into small pieces. The seeds were removed from the pulp before separating the red pulp from the rind. The seeds were washed, allowed to drain and placed on a foil. The pulp was chopped into shreds, allowed to drain and placed in another tray lined with foil, the rind was chopped into tiny cubes and placed in a separate tray line with foil.They were transferred into the oven. The dried samples were removed and grounded separately in a steel-blade grinding mill to pass through a 30-mesh sieve [22]. The samples were stored in airtight containers and labelled accordingly from which required quantities were scoped out for phytochemical screening. The fresh samples were prepared using the same methods of preparation as in the dry samples but were used in their fresh state.

PHYTOCHEMICAL ESTIMATION

Qualitative and quantitative analysis were carried out on each of the test samples using diverse methods viz:
Tannins were estimated using the method of [23], Oxalate was done using the method of [24]. Hydrocyanic acidwas estimated using the method by [25].Alkaloid determination was done using the alkaloid precipitation gravimetric method described by [23]. Flavonoids estimation was done using ethyl acetate precipitation graviemetric method [23]. Phenols content was evaluated according to the folin-cioccitean colorimetric method [26]. However, Phytate was estimated by spectrophotometer method as described by [27]. Saponin determination was done using forth and emulsion test by [23].

ANALYSIS OF DATA

The results of the proximate analysis and anti-nutrient screening were analysed for statistical significance by one way ANOVA (F- ratio) [28] and student ‘t’ test were applicable values at ($p<0.05$) were regarded as significant in comparison with appropriate control. All data were expressed as means of ± SEM.

RESULTS

The results of assessment of Anti-nutrient contents of *Nepheliumlappaceum*is presented in (table 1) based on mg/100g fresh and dried matter.

Statistical evaluation shows that Saponin content of fresh *Nepheliumlappaceum* rind (0.52 ± 0.01) was significantly lower than the pulp (1.50 ± 0.00) at ($P<0.05$). There was however no significant difference between the rind and the seed at ($P<0.05$). The dry rind (2.24 ± 0.57) and seed (2.10 ± 0.05) were significantly lower than the pulp (3.18 ± 0.21) but there was no significant difference between the seed and the rind at ($P<0.05$) as shown in the table. Beside, alkaloid was not detected in both fresh and dry pulp of *Nepheliumlappaceum*. Fresh *Nepheliumlappaceum* rind (2.17 ± 0.07) was significantly higher in alkaloid than the pulp (0.82 ± 0.01) at ($P<0.05$). The alkaloid content of the dry rind (4.41 ± 0.01) was also significantly higher than the seed (1.95 ± 0.02) at ($P<0.05$).

More so, HCN was not detected in both fresh and dry sample of *Nepheliumlappaceum* and *pepo’L* pulp, seed and rind.Statistical assessment also reveal that tannin content of fresh *Nepheliumlappaceum* rind (1.35 ± 0.01) was significantly higher than the seed (0.15 ± 0.00) and pulp (0.12 ± 0.00) at ($P<0.05$). The seed was however not significantly different with the pulp. The dry pulp (0.35 ± 0.01) was significantly higher than the seed (0.28 ± 0.01) but lower than the rind (1.72 ± 0.02) at ($P<0.05$) as presented in the table.

Phytate content of fresh *Nepheliumlappaceum* seed (0.40 ± 0.00) was significantly higher than the pulp (0.15 ± 0.00) and rind (0.77 ± 0.00) at P<0.05. There was no significant difference with the pulp and rind. However, that of the dry pulp (0.71 ± 0.00) was significantly higher than the rind (0.40 ± 0.12) but lower than the seed (0.77 ± 0.03).

Phenol content of fresh *Nepheliumlappaceum* rind (0.31 ± 0.01) was significantly higher than the seed (0.20 ± 0.00) and rind (0.11 ± 0.00) at (P<0.05) but there was no significant difference with the seed and pulp at (P<0.05). The dry seed (0.41 ± 0.09) was significantly higher than the pulp (0.36 ± 0.07) but lower than the rind (0.68 ± 0.06) at (P<0.05). Furthermore, oxalate content of fresh *Nepheliumlappaceum* seed (0.26 ± 0.01) was significantly higher than the pulp (0.11 ± 0.00) and rind (0.12 ± 0.00) at (P<0.05). There was no significant difference with the pulp and rind at (P<0.05). The dry rind (0.10 ± 0.00) was however significantly higher than the pulp (0.07 ± 0.00) but lower than the seed (0.19 ± 0.01) at (P<0.05) as shown on the table.Flavonoid content of fresh *Nepheliumlappaceum* rind (88.84 ± 0.02) was significantly higher than the seed (16.00 ± 0.10) and pulp (7.64 ± 0.01) at (P<0.05), but the pulp was lower than the seed. Dry *Nepheliumlappaceum* rind (22.30 ± 0.30) was significantly higher than the pulp (3.27 ± 0.67) and seed (1.63 ± 0.32) at (P<0.05), the seed however was significantly (P<0.05) lower than the pulp.

TABLE 1 Anti-nutrient contents (mg/100g) of fresh and dried rambutan (*Nepheliumlappaceum*).

	Saponin	Alkaloid	HCN	Tannin	Phytate	Phenol	Oxalate	Flavonoids
FRP	1.50 ±0.00	0.00 ±0.00	0.00 ±0.00	0.12 ±0.00	0.15 ±0.01	0.11 ±0.00	0.11 ±0.00	7.64 ±0.01
FRS	0.98 ±0.01	0.82 ±0.01*	0.00 ±0.00	0.15 ±0.00	0.40 ±0.00*	0.20 ±0.00	0.26 ±0.01*	16.00 ±0.10*
FRR	0.53 ±0.01*	2.17 ±0.07*,a	0.00 ±0.00	1.35 ±0.01*,a	0.17 ±0.00a	0.31 ±0.01*	0.12 ±0.00*,a	88.84 ±0.02*,a
DRP	3.18 ±0.21	0.00 ±0.00	0.00 ±0.00	0.35 ±0.01	0.71 ±0.00	0.36 ±0.07	0.07 ±0.00	3.27 ±0.67
DRS	2.10 ±0.05*	1.95 0.02*	0.00 ±0.00	0.28 ±0.01*	0.77 ±0.03*	0.41 ±0.09*	0.19 ±0.01*	1.63 ±0.32*
DRR	2.24 ±0.57	4.41 ±0.01*,a	0.00 ±0.00	1.72 ±0.02*,a	0.40 ±0.12*,a	0.68 ±0.06*,a	0.10 ±0.00a	22.30 ±0.30*

FRP = fresh rambutan pulp; DRP = dry rambutan pulp;
FRS = fresh rambutan seed; DRS = dry rambutan seed;
FRR = fresh rambutan rind; DPR = dry rambutan rind.
Values are expressed as mean ± SEM, n = 3.
**p<0.05 vs pulp; a = p<0.05 vs seed.*

DISCUSSION

The fresh and dried pulp, seeds and rind of *Nepheliumlappaceum* was analysed and interpreted.Eight phytochemical components were found in the fresh and dried pulp seed and rind of *Nepheliumlappaceum*. There were saponin, alkaloids, tannins, phytates, oxalate, phenols and HCN, flavonoids a known phytochemical with antioxidant properties. The highest content of all the anti-nutritional factors detected was in the alkaloid and saponin content of fresh and dry pulp, seed and rind. The fresh rind of *Nepheliumlappaceum*, pulp recorded a high value of flavonoid more than the other parts of the fruit although the values were low compared to earlier work. The high values of flavonoids in the rind and seed of *Nepheliumlappaceum* is in agreement with the work of [28] who reported that the peels of *Nepheliumlappaceum* possesses antioxidant properties.High amount of phenolic compounds were found in the seeds and peels. With regards to levels observed, the prominent among them were flavonoids, alkaloids and saponins while oxalate, tannin, phytate, HCN and phenols were the least.Flavonoid was more in the rind. This result agrees with the findings of [18] who reported that natural colouring in plant based food with antioxidant, anti-inflammatory and diuretic effect is due to flavonoid as is observed in the rind of *Nephelium*.Alkaloid was high in the rind of the three fruit samples and the seeds of *Nepheliumlappaceum* within the range of 1.01mg - 4.41mg, Saponin range was within 1.01 -4.22mg in the different parts of the fruit samples. Alkaloids are known to cause depressed growth in animals and saponins possesses both beneficial cholesterol lowering anddeleterious properties. Although some can be highly toxic under experimental conditions, acute saponin poisoning is relatively rare both in animal and in man. The toxic levels of these anti-nutrients however have not been established as reported by [29]. He also

stressed that saponins have bitter taste and can reduce plant palatability, some of which are toxic to cold blooded animals at a particular concentration. There is therefore need for further research to define the role of these natural products in their host organism which have been described as poorly understood till date. Oxalate, phytate, tannin, HCN and phenols were the least in concentrations. In 1991 however, FAO/ WHO recommended that HCN levels in mammals is 10mg/kg dry weight (10ppm) which is higher than what was obtained in this study. [30]reported that phytic acid intake of 4-9mg/100g is said to decrease iron absorption by 4-5 folds in humans and the lethal level of oxalate in man is 3-5g as reported by [24]. Recently, [31] reported that a daily intake of 450mg of oxalic acid have been reported to interfere with various metabolic processes. The values obtained for phytate and oxalate are lower than the lethal dosage reported in other studies while the toxic effect of these anti-nutrients may not occur when these fruits are consumed because their levels are not enough to elicit toxicity.Tannins are known to affect the digestive tracts and their metabolites are toxic [32]. The precise toxic amount of tannin to cause depression in human is not known, but the values obtained for these phenolic substance is within the range of 0.03mg – 1.72mg/100g. From this study, it was observed that HCN and flavonoid content were more in the fresh than in the dry sample.

This result is similar to that of [33, 34, 35] who reported that numerous processing methods including some drying, roasting, heat treatment like frying, drying and boiling have been shown to reduce HCN content of protein containing foods such as legumes and a 45-50% reduction in HCN content in cassava at 50^{o}C and 53%-60% at 70^{0}C and toxic phytochemicalspresent in plants.[36]alsoreported that leaching in dry samples is due to heat treatments which results in a change in the solubility or the chemical reactivity of polyphenols causing an apparent decrease in assayable polyphenols.There is a significant difference in the phytochemical content in the pulp, seed and rind of each fruit. Flavonoid was significantly high in the rind of *Nepheliumlappaceum* compared with the other parts of the fruit. Alkaloid, Tannin, Phenol were significantly high in the rind of the fruit compared with the pulp and seed while Phytate and Oxalate were significantly high in the seeds compared with the pulp and rind of the fruit.The anti-nutrient compounds in the different parts of the fruits, the seeds and rind which are the parts always discarded where below FAO/ WHO recommended save levels. Thus the pulp and rind can contribute immensely to recommended daily allowance and maintenance of good nutritional status and hence good health for both man and animals.

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