PROXIMATE, VITAMIN AND ANTINUTRITIONAL CONTENT OF FRESH AND ROASTED *Tympanotonus fuscatus* HARVESTED FROM BUNDU CREEK, RIVERS STATE, NIGERIA

ABSTRACT

T. fuscatus (periwinkle) is an invertebrate of the gastropoda class, dominantly found in brackish waters of tropical and subtropical regions. This study compared the nutritional and anti-nutritional content of *T. fuscatus* from Bundu Creek, and the impact of processing on its nutritional and anti-nutritional parameters. Fresh and roasted *T.fuscatus* samples were purchased from fishermen at Bundu Creek Port-Harcourt, Rivers State. Fresh *T.fuscatus* were deshelled using a clean plier and fleshy portion was collected and washed with distilled water whereas, roasted samples were placed in an oven at 106°C for 2hours. Both samples were homogenized using a preheated mortar and pestle which further proceeded for analysis. Proximate composition, anti-nutrients, minerals and vitamin contents were determined using standard analytical procedures. The percentage proximate composition showed that roasted periwinkles were significantly ($p<0.05$) higher in protein (58.57±0.29% -13.90±0.03%), lipid (5.50±0.00%- 2.26±0.03%),carbohydrates (11.64±0.09%-5.10±0.03%), ash (10.80±0.06%-5.73±0.03%) and crude fibre content (5.54±0.16%-2.84±0.08%) when compared with fresh samples which had an increased moisture content (7.94±0.04%-70.19±0.05%). The anti-nutritional component saponins was significantly ($p<0.05$) increased in roasted samples (15.28±0.01%-3.80±0.00%) when compared with fresh samples. There was no measurable trace of Cyanogenic glycosides in both states. The roasting process significantly ($p<0.05$) reduced the presence of oxalate, phytate and flavonoids. For mineral content, Zinc, Iron, Magnesium and Phosphorus were significantly ($p<0.05$) higher in roasted samples than Calcium. No significant difference was observed in vitamin content for the fresh and roasted samples. This research has shown that processing generally, helped to amplify the nutritional properties of *T. fuscatus.*

Key words: *T. fuscatus*; Bundu creek; Proximate composition; Vitamins; Antinutrients.

1.0 INTRODUCTION

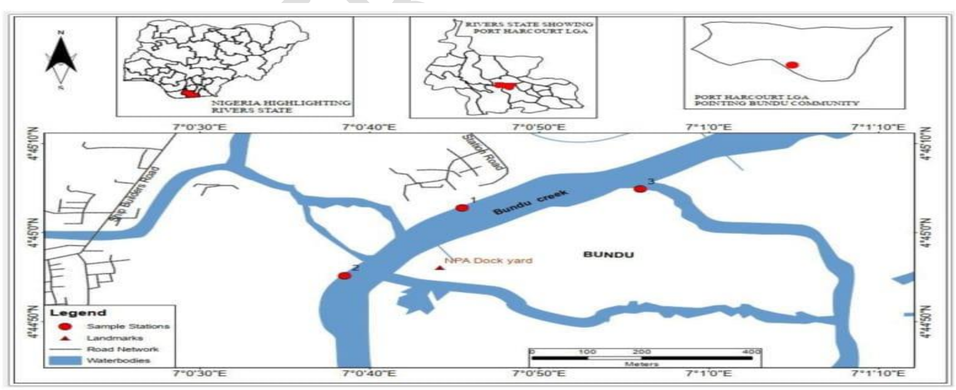
Seafoods are forms of marine lives comprising of sea animals and plants that are considered edible by Man (Ojiako *et al.*, 2018). They are known for their distinctive flavors, nutritional benefits, and culinary versatility (Tahergorabi *et al.*, 2011). Comprising of sea animals, seafoods includes but not limited to fishes (salmon, tuna, cod, haddock, tilapia, trout, sardines, mackerel), gastropods (periwinkle, sea snails and whelks), shellfishes which comprises of crustacean's shrimps, crabs, lobsters, crayfish and mollusks; not limited to bivalves, univalves, squids etc (Ojiako *et al*., 2018). Seafoods has played significant roles in human history; as valuable sources of nutrients in various dietary options, as trade commodities in driving economic growth for both local and international markets and also in cultural significance and lifestyle (Nwaka and Udoh 2022; Yaowu *et al*., 2009*)*. The consumption of seafoods has helped to alleviate food crises in many developing countries, providing valuable supplements to diverse lifestyle-related cases and providing nutritious diets for all ages (Durrazo *et al*., 2022; Hosomi *et al*., 2012; Reames, 2012). Presently, seafoods consumption has gradually increased throughout the world as consumers have become more informed on the numerous benefits it offers to a growing population (FAO, 2010).

Tympanotonus fuscatus (periwinkle) is an aquatic specie used as food in the coastal areas of Nigeria, most especially Rivers State. They are found at the inter-tidal zone of brackish water, creeks, estuaries and lagoons in the Niger Delta area (Akinrotimi *et al*., 2009; Jamabo, 2008; Akpang and Oscar, 2018; Moruf, 2021). This marine species is of two genera in Nigeria; *Tympanotonus* of brackish water origin and *Pachymelania* of fresh water origin (Ojiako *et al*., 2018). *T. fuscatus*, the common periwinkle also known as "The African mudcreeper" is the only non-extinct species of the genera *Tympanotonus* and even more, the most dominant species among aquatic mollusc (Elegbede et al., 2023; Ojiako et al., 2018; Reid et al., 2008). Periwinkles crawl under water but remain passive when exposed by the tide (Ideriah *et al*., 2005). Some mollusks are found mostly in shallow waters and sometimes in inter-tidal zone where they burrow into beds of the river serving as their habitat, feeding majorly on algae and diatoms (Egonmwan, (2008); Toyin, 2015). The periwinkle is an edible shell snail with a calcareous shell ranging in size from 10 to 30 mm. The shell is coiled in a series of whorls, which increase in diameter around the central region known as the columella. It has a large oval opening where the body whorl terminates having a black or dark brown appearance (Elegbede *et al*., 2023; Nwankwo & Nlemanya, 2019; Ojiako *et al*., 2018). *T. fuscatus* is readily available across many States in Nigeria, serving as a subsistent source of nutrients for human consumption or livestock feed (Aimikhe & Lekia, 2021). According to a study carried out by Nwaka and Udoh (2022), it was statistically proven that periwinkle contained a significant amount of protein, carbohydrate, ash, fiber, manganese, magnesium, calcium, iron and zinc with low fat content. Their study thus concluded that an increased consumption of periwinkle together with a balanced diet may help address deficiencies associated with macro and micro nutrients. The preparation of these natural nutrient reserves depend on cultural and regional preferences. Various preservation techniques utilizes various cooking methods like grilling, frying, steaming, roasting, poaching, sugaring, smoking, canning, sun drying solely to obtain a more stable form and reduced wastage of perishable seafood (Grumezescu and Holban, 2018). When prepared it can be incorporated into a variety of dishes (soups, stews, pottage, salad dressing etc) or as a side dish. According to Oguntona and Akinyele (1990), roasting is one of the traditional methods used in processing periwinkle in Nigeria. The process involves placing the periwinkle on a flat surface over hot coals and allowing it to roast over a period of time (Aminigo and Okoro, 2002). Biochemically, macronutrients (proteins, carbohydrates, lipids), micro nutrients (vitamins and mineral) and organoleptic qualities (color, texture, flavour and appearance) are important components of seafoods that can be altered during processing (Okwakpam *et al*., 2023).

This study was thus aimed at determining the nutritional and antinutritional composition of fresh and roasted *Tympanonus fuscatus* purchased from Bundu creek and the effects of roasting on the overall nutritional and antinutritional profile.

2.0 Material and Methods

2.1 Study area



Map 1 : Study area

Bundu creek was selected for this study. Bundu creek is a water body located in Port Harcourt, the capital of Rivers State in southern Nigeria. The creek is a tributary that flows into the Bonny River which is a major waterway in the Niger Delta region. It serves as a vital source of water for the local community and plays a crucial role in the ecosystem of the region. It is located at latitude 4.8156° N and longitude 7.0498° E.

2.2 Sample collection

Fresh and Roasted *T. Fuscatus* was purchased from fishermen at Bundu Creek in Port-Harcourt, Rivers State. These were conveyed to the laboratory in clean sack bags for analysis. Fresh samples were deshelled using clean sets of pliers and fleshy part was collected and rinsed in distilled water. Roasted samples were placed in an oven at 106°C for 2 hours to achieve completely dried forms and ground to powdered form using a preheated mortar and pestle. Fresh samples were homogenized until a completely uniform mixture was obtained. Both samples were properly labeled for further analysis.

2.3 Determination of Proximate and Mineral compositions

Proximate compositions such as crude protein, crude fat, carbohydrate, moisture content, crude fiber and ash content were measured using the method of Association of Official Analytical Chemists (AOAC, 2000). Nitrogen was determined by the micro-kjeldahl method and the percentage nitrogen was converted to crude protein by multiplying with 6.25. Carbohydrate was determined by difference. Minerals were determined using PerkinElmer AAnalyst 400 Atomic Absorption Spectrometer (AAS).

2.4 Determination of Vitamin Content

Vitamin contents (A, B1, B6, B12 and E) were determined using High Performance Liquid Chromatography Shimadzu Prominence series (HPLC).

2.5 Determination of Anti nutrients

Phytates was determined using UV spectroscopy, Oxalates using permanganate oxidation method, Cyanogenic glycosides using alkaline titrimetric method, Saponins using sohxlet continuous extraction method and Flavonoids using gravimetric method.

2.6 Statistical Analysis

Data was expressed as mean ± standard deviation of triplicate determination. One Way analysis of variance with interaction was used to determine the effect of the roasting process. Where the effect of a factor was significant, the results were compared using multiple comparison by Tukeys test in order to determine the differences between two means.

3.0 Results

3.1 Proximate composition of Fresh and Roasted Periwinkle

The results of the proximate composition of fresh and roasted *T.fuscastus* purchased from Bundu Creek, Port Harcourt are presented in Table 1. The results showed the mean protein content in samples as 13.90±0.00% (fresh) and 58.57±0.29% (roasted). Lipid content was 2.26±0.03%(fresh) and 5.50±0.00%(roasted). Carbohydrates content in samples were 5.10±0.03% (fresh) and 11.64±0.09%(roasted). Ash content was 5.73± 0.03%(fresh) and 10.80± 0.06% (roasted). Crude fibre was 2.84± 0.08% (fresh) and 5.54± 0.16%(roasted). Moisture content was 70.19±0.05% and 7.94±0.04% in fresh and roasted samples respectively.

TABLE 1: SHOWING THE PROXIMATE COMPOSITION (%) OF FRESH AND ROASTED *T.fuscatus*

	SAMPLE	
PROXIMATE (%)	Fresh *T. fuscatus*	Roasted *T. fuscatus*
Protein	13.90 ±0.00^{a}	58.57 ±0.29^{b}
Lipids	2.26±0.03^{a}	5.50±0.00^{b}
Carbohydrates	5.10±0.03^{a}	11.64±0.09^{b}
Ash	5.73±0.03^{a}	10.80±0.06^{b}
Crude fibre	2.84±0.08^{a}	5.54±0.16^{b}

Moisture content	70.19±0.05[a]	7.94±0.04[b]

Data are represented as mean ± standard error of triplicate values, values in a row bearing different superscript letters differ significantly from each other at 95% confidence level ($p<0.05$).

3.2 Mineral content of Fresh and Roasted periwinkles

The result of some mineral content of fresh and roasted *T.fuscatus* as expressed in mg/kg is shown in Table 2. Here it revealed that fresh and roasted samples contained 11012.40±137.42 and 10940±148.09 of Calcium ions respectively. Zinc content was 41.82±0.76(fresh) and 87.48±0.59(roasted). Iron content was 286.33±12.19(fresh) and 1060.00±0.79(roasted). Magnesium content was 3945.04±52.11(fresh) and 5174.05±63.31(roasted).Phosphorus content was 4.22±0.05(fresh) and 20.27±0.00(roasted).

TABLE 2: SOME MINERAL COMPOSITION (mg/kg) OF FRESH AND ROASTED *T. fuscatus*

	SAMPLE	
MINERAL(mg/kg)	Fresh *T.fuscatus*	Roasted *T.fuscatus*
Calcium	11012.40±137.42[a]	10940±148.09[b]
Zinc	41.82±0.76[a]	87.48±0.59[b]
Iron	286.33±12.19[a]	1060.00±0.79[b]
Magnesium	3945.04±52.11[a]	5174.05±63.31[b]
Phosphorus	4.22±0.05[a]	20.27±0.00[b]

Data are represented as mean ± standard error of triplicate values, values in a row bearing different alphabetical superscript letter differ significantly from each other at 95% confidence level ($p<0.05$).

3.3 Antinutritional composition of Fresh and Roasted periwinkles

Antinutritient composition of fresh and roasted *T.fuscatus* is shown in Table 3. The results revealed no measurable traces of cyanogenic glycosides as indicated BDL in both fresh and roasted states. Oxalate content was 2.22±0.00% and 2.19±0.01% in fresh and roasted samples respectively. Phytate content in the fresh sample was 6.96±0.02% and was BDL in the roasted sample. Saponins content was 3.80±0.00% (fresh) and 15.28±0.01% (roasted). Flavonoids content was 3.15±0.03% and 1.56 ± 0.23 % in fresh and roasted states respectively.

TABLE 3: SHOWING THE ANTINUTRITIONAL COMPOSITION (%) OF FRESH AND ROASTED *T. fuscatus*

	SAMPLE	
ANTINUTRIENTS (%)	Fresh T. fuscatus	Roasted T. fuscatus
Cyanogenic glycosides	BDL	BDL
Oxalate	$2.22±0.00^{a}$	$2.19±0.01^{b}$
Phytate	$6.96±0.02^{a}$	BDL
Saponins	$3.80±0.00^{a}$	$15.28±0.01^{b}$
Flavonoids	$3.15±0.03^{a}$	$1.56±0.23^{b}$

Data are represented as mean ± standard error of triplicate values, values in a row bearing different superscript letters differ significantly from each other at 95% confidence level ($p<0.05$).

BDL - Below Detectable Limit

3.4. Vitamin Composition (ug/mg) of Fresh and Roasted periwinkles

The results of some fat and water soluble B vitamins present in *T.fuscatus* is as shown in Table 4. Vitamin A content was 0.456±0.010ug (fresh) and 0.507± 0.026ug (roasted).Vitamin E content was 1.487±0.045mg (fresh) and 1.546±0.001mg (roasted). Vitamin B1 content was 0.220±0.0002mg (fresh) and 0.279±0.0001mg (roasted). Vitamin B6 content was 0.242±0.0005mg (fresh) and 0.250±0.0003mg (roasted). Vitamin B12 content was 0.456±0.0003ug and 0.471±0.0007ug in fresh and roasted samples respectively.

TABLE 4: SHOWING SOME FAT AND WATER SOLUBLE B-VITAMINS (ug/mg) OF FRESH AND ROASTED *T. fuscatus*

	SAMPLE	
VITAMINS	FRESH *T. fuscatus*	ROASTED *T. fuscatus*

Vitamin A (Retinol)	0.456±0.010[a]	0.507± 0.026[a]
Vitamin E (Tocophenol)	1.487±0.045[b]	1.546±0.001[b]
Vitamin B1 (Thiamine)	0.220±0.0002[c]	0.279±0.0001[c]
VitaminB6 (pyridoxine)	0.242±0.0005[d]	0.250±0.0003[d]
VitaminB12 (Cobalamin)	0.456±0.0003[e]	0.471±0.0007[e]

Values are expressed as mean ± standard deviation. Values with the similar superscript letters are not significant at ($p \leq 0.05$) level.

DISCUSSION

Proteins are the major structural component of cells. These biomolecules are utilized as a precursor for the building and repair of body tissues (Nwaka & Udoh 2022). The result of this study emphasized the fact that periwinkles are a significant source of proteins which on high consumption may help mitigate protein energy malnutrition (Klin-Kabari et al., 2017; Nwaka and Udoh 2022; Ogunbenle & Omowole 2012). The increase in protein content in the roasted sample observed in his study is attributed to the aggregation effect after the removal of water (Kumuolu-Johnson *et al*., 2010). The process of roasting decreases the moisture content leading to a reduction in overall weight (Devi, 2015). Since protein content is measured on a weight basis, the reduction in moisture content may have increased the protein concentration in the roasted periwinkle. The protein content of the fresh *T. fuscatus* obtained from this study (13.90%) was less than values reported by Inyang et al. (2018), Ivon and Eyo (2018), Ogunbenle and Omowole (2012) and Paul et al. (2022), whose mean values were; 22.52%, 46.51% and 74.74% and 34.14% respectively. However, regarding processing, the increase in protein content (58.57%) due to the roasting treatment was in line with a study by Okwakpam et al (2023) and Paul et al.(2022). In the study by Paul et al. (2022), *T. fuscatus* was subjected to oven-dried and cabinet dried processing method and obtained crude protein values of 70.53% and 61.97% respectively compared to fresh values 34.14% in reported study. Protein content may vary depending on factors such as the species, location of harvest and method of preservation (Abraha et al., 2018).

Lipid content of roasted *T. fuscatus* in this study was significantly higher compared to fresh samples (5.50% and 2.26%). The result of the lipid content in fresh *T.fuscatus* obtained from this study was higher than values reported by Davies and Jamabo (2016) and Elegbede et al.(2023) whose mean values were 1.16% and 1.02% respectively. The significant increase due to the roasting process observed in this study was not in line with values reported by Paul et al. (2022) which significantly decreased (2.20%, 1.25% and 1.13%) when fresh *T. fuscatus* was subjected to oven dried and cabinet dried processing method. Studies have shown that the standard lipid content in periwinkle may vary depending on the species and the method of preparation (Devi, 2015).

In this study, the carbohydrates content in roasted samples was more significant compared to fresh samples (11.64% and 5.10%). However, several studies have reported periwinkles to be relatively low in carbohydrates when compared to other seafoods (Ogungbenle & Omowole 2012; Paul et al., 2022; Yenugopal & Gopakumar 2017). The increase in carbohydrates observed due to roasting process corresponds to a study by Paul et al (2022) whose values (7.79%, 8.89% and 13.23%) significantly increased upon various drying techniques.

The ash content of the roasted *T.fuscatus* in this study was significantly higher than the fresh sample (10.80% and 5.73%). This indicates that roasted periwinkles are twice as much rich in minerals compared to fresh periwinkle. The result obtained from this study was higher than values reported in the proximate studies carried out by Davies and Jamabo (2016), Nwaka and Udoh (2022) & Ogunbenle and Omowole (2012) but less than values reported by Elegbede et al. (2023) who obtained a total ash content of 93.60%.

Expectedly, a significant increase in moisture content was observed in fresh sample compared to the roasted sample (70.19% and 7.94%). High moisture content facilitates osmosis which promotes cellular communication and maintains osmotic equilibrium (Davies et al., 2017). The result is in line with previously reported work by Nwaka and Udoh (2022). An increased moisture content in an organism is considered advantageous because of its contribution in the stabilization of the organism during locomotion (Davies, et al., 2017).

This study recorded a significant increase of crude fibre in roasted samples compared to fresh samples (5.54% and 2.84%). The result obtained were higher in values than previously reported work by Elegbede et al. (2023), Ogungbenle & Omowole (2012) & Paul et al. (2022) who stated that the low crude fibre in periwinkle makes it suitable for processing complementary foods. Crude fiber significantly impacts bowel health, weight management, blood sugar regulation, and heart health (Anderson et al.,2009).

The mineral composition of fresh and roasted *T.fuscatus* in this study revealed no significant difference in calcium content. However, high values of calcium were observed in both states (11,012.40mg/kg and 10,940mg/kg) which was greater than values reported by Elegbede et al.(2023), Nwaka &Udoh (2022) and Ogunbenle & Omowole(2012) who obtained values at 52.20%,1.55% and 41.98% respectively. High temperatures during roasting can degrade the calcium carbonate structure in the shells of mudcreepers, reducing their calcium content. Additionally, fresh mudcreeper might have more bioavailable calcium due to the intact natural matrix of the shell and tissues, which can be altered by heat (Bastías et al., 2017). Calcium is important for the build up and maintenance of strong bones, as well as regulate muscle contraction, nerve transmission, and blood clotting. Its implication is dose related as higher intake of calcium(>1400mg/day) may cause health problems such as cardiovascular disease and ischemic heart disease but not stroke (Kuehn, 2013).

In this study, values obtained for zinc, iron, magnesium and phosphorus reveals a significant increase in roasted samples (87.48mg/kg, 1060mg/kg, 5174.05mg/kg and 20.27mg/kg) compared to its fresh form (41.82mg/kg, 286.33mg/kg, 3945.04mg/kg and 4.22mg/kg). The results obtained in this study was greater than values reported by Elegbede et al.(2023) and Ogunbenle and Omowole (2016). Zinc is crucial for various catalytic, structural and regulatory functions in humans (Roohani et al.,2013). Zinc deficiency can cause a variety of health problems, including impaired growth, hair loss, and skin problems. While higher intake can cause nausea, diarrhea, and other gastrointestinal problems (Mojisola, 2014). Iron is important for the transportation of oxygen in the blood to various cells. It is required for energy production and metabolism. High intake and deficiency may lead to cases of hemochromatosis and anemia (Valverde et al., 2000). Magnesium regulate nerve and muscle function, as well as blood pressure and blood sugar levels. Magnesium deficiency can cause a variety of health problems, including muscle weakness, heart rhythm disturbances, and osteoporosis (Popović et al., 2010) whereas high intake could cause nausea, vomiting, and other gastrointestinal problems. Phosphorus plays an essential role in bone health, energy production, and nerve and muscle function, according to Valverde et al., (2000). A deficiency of phosphorus is seen in rare cases, with observed symptoms of muscle weakness, anemia, and bone loss.

The percent antinutritional components in fresh and roasted *Tympanonus fuscatus* revealed that there was no measurable value of Cyanogenic glycosides in fresh and roasted samples of the specie of interest. In comparison to Ademolu et al. (2017), their study revealed that *A. marginata*, a giant snail contained higher estimates of hydrocyanic acid actualized when the values of hydrocyanic acid in the albumen gland and hermaphroditic duct was sumed up. The results of this study has revealed that the consumption of periwinkle either in fresh or roasted state has no potential to produce highly toxic hydrogen cyanide when degraded by hydrolytic enzymes. Islamiyat et al. (2016) recorded that the intentional or unintentional exposure to cyanide containing foods can lead to acute in toxification characterized by growth retardation and neurological symptoms resulting from tissue damage in the central nervous system. Processing methods have proven to be very effective on reducing the risk of cyanide poisoning these methods includes soaking, roasting, fermenting as stated in those reviews (Ademolu et al., 2017; Kumbakani, 2020).

Oxalate significantly decreased in roasted samples compared to fresh samples (2.19% and 2.22%). In comparison to Ademolu et al. (2017), the percent oxalate levels obtained from the albumen gland were less than that of *T.fuscatus* irrespective of the treatment used. However in comparison to the percent antinutrients in hermaphroditic duct of these giants snails, *A. achatina* and *A. fulica* had values higher than *T.fuscatus*. Oxalates possess the ability to form soluble and insoluble salts with divalent and trivalent ions with its ability to form strong complexation reaction with essential mineral oxalates limits their bioavailability. According to Salgado et al. (2023), oxalates plays significant roles in nephrotoxicity upon severe cases like systemic oxalosis.

The presence of phytic acid in fresh samples (6.96%) was totally eliminated in roasted samples through thermal degradation. According to Kumar et al. (2010), phytate with its abundance of negatively charged phosphate group chelates Zn^{2+}, Mg^{2+}, Mn^{2+}, Cu^{2+}, Fe^{2+}, Fe^{3+}, Ca^{2+}, Na^{+}, K^{+} minerals in the gastrointestinal tract of humans and animals making them less available for various biochemical processes.

Saponins significantly increased in roasted samples(15.28%) compared to fresh samples(3.80%). Results from this study agrees with Savage (2003), that saponins are remarkably stable to heat processing, and their biological activity is not reduced by normal cooking processes. A recent review revealed wet processing methods as an effective technique in the reduction of saponins due to the leaching (Khadija et al., 2022). Saponins have a property of being able to interact with the cholesterol group of erythrocyte membranes, which leads to hemolysis (Fleck et al., 2019). The thermal stability property of saponins in this study may show promise in treating individuals with high cholesterol related cases (Desai et al., 2009).

In flavonoids a significant decrease was observed in roasted samples. The properties of flavonoids as antinutrients is reported to chelate metal ions like zinc and iron reducing their absorption and inhibiting digestive enzymes and possibly precipitating proteins (Adamczyk et al., 2017; Karamać, 2009). Other research focus mostly on their observed pharmaceutical effects in which it acts as an antioxidant and an antibiotic (Kumar & Pandey, 2013;Panche et al., 2016).

The concentration of fat soluble and water soluble B-vitamins A, E and B1,B6,B12 respectively reveals no significant difference between fresh and roasted forms of *T. fuscatus*. However, values obtained in this study were less than values reported by Ezomoh et al.(2022) who obtained values at 8.5%, 131.30% and 30.26%, 10.66%, 2.36% for fat soluble A,E and water soluble B1,B6,B12 vitamins respectively. Vitamin A plays a crucial role in maintaining human health, particularly in vision, immune function, and skin health (Ross, 2011). Fresh periwinkles, small marine snails, contain a notable amount of Vitamin A (Eruygba et al., 2021). However, the roasting process, has been shown to maintain the concentration of Vitamin A, suggesting a potential enhancement of its bioavailability (Ejiogu et al., 2022). Vitamin E is renowned for its antioxidant properties, contributing to the defense against oxidative stress in the body. Vitamin B1 plays a critical role in various bodily processes, particularly energy metabolism and nerve function. Its importance was first recognized in the early 1900s with the identification of beriberi, a severe vitamin B1 deficiency characterized by neurological and cardiovascular symptoms (National Institutes of Health., 2023). Vitamin B6 is associated with a range of potential health benefits. Research suggests that it plays a role in enhancing cognitive function, particularly in older adults with mild cognitive impairment (Miller, 2005). This improvement is attributed to the involvement of vitamin B6 in the synthesis of acetylcholine, a neurotransmitter crucial for memory and learning. Vitamin B6 has been linked to a reduced risk of heart disease by aiding in the lowering of homocysteine levels, a known risk factor for cardiovascular issues (Waldman et al., 2002). Elevated homocysteine levels can contribute to blood vessel damage and increase the likelihood of atherosclerosis. The stability of Vitamin B12 concentration in periwinkle after the roasting process holds significance, particularly in the context of human nutrition and potential dietary benefits. Vitamin B12, also known as cobalamin, plays a crucial role in red blood cell formation, DNA synthesis, and neurological function. The observed lack of significant change in Vitamin B12 levels post-roasting prompts a closer examination of its implications.While the current study sheds light on the stability of Vitamin B12 in roasted periwinkle, further research is warranted to delve into the specific compounds or reactions responsible for this preservation.

CONCLUSION

The findings of this study indicates that the nutritional and antinutritional factors of *T. fuscatus* subjected to roasting is valuable to health. The presence of high vital minerals in roasted forms present *T. fuscatus* as a good dietary supplement for micronutrient deficiencies. The antinutritional content phytate, oxalate and flavonoids were reduced due to the roasting process with an exception to saponins which was relatively increased and cyanogenic glycosides which was not present in both states. Fat and water soluble vitamin concentration showed no significant effect based on the roasting method of processing. The vitamin composition of *T. fuscatus* showed that it is a good source of vitamin A, E and B1, B6 & B12 and roasting had no effect on the vitamin composition of *T. fuscatus*. This research has proven that roasting process to be effective in amplifying the nutritional composition of *T. fuscatus*.

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