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Towards Sustainable Nutrition: Proximate Compositionand Mineral Analysis of Edible part of Periwinkle (Turritellacommunis)

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Abstract:*A study was conducted to know the nutritive value of Edible part of Periwinkle(Turritelacommunis). The proximate composition of periwinkle in both raw and boiled samples wasinvestigated. The proximate analysis was evaluated using standard analytical procedures. The proximate analysis revealed in raw sample that the moisture content is 15.5, ash content is 16.0%, crude fat is 18.8%, crude Fibre is 0, crude protein is 36.94% , and carbohydrate is 12.76% ; and in boiled sample moisture content is 12.0%, ash content is 12.0%, crude fat 4.74%, crude fibre is 3.0%, crude protein is 63.88% and carbohydrate is 4.38%. The minerals present in the raw sample are manganese, magnesium, calcium, lead, iron and zinc. There values in (ppm) are 0.43, 9.64, 2.62, 9.71, 14.7 and 0.11 respectively while minerals present in boiled sample are manganese, magnesium, calcium, iron and zinc with their values in (ppm) 1.29, 13.07, 1.54, 5.7 and 0.06respectively.It was revealed that the periwinkle is very rich in protein and there is no presence of lead after cooking, which would otherwise make it hazardous to human health. The results of the research have potentials for advancing sustainable nutrition. Further work can be done to further verify how safe the periwinkle is for nutrition.*

Keywords*:Proximate composition, Edible part, Periwinkle, Turritellacommunis, Mineral analysis*

I. Introduction

Shellfish is a fisheries and culinary term for exoskeleton-bearing aquatic invertebrates used as food. They can be divided into two groups namely molluscs and crustaceans. Familiar marine molluscs enjoyed as a food source by humans include many species of clams, mussels, oysters, winkles and scallops. Some crustaceans commonly eaten are shrimps, prawns, lobsters, crayfish and crabs. Finfish, shellfish and other aquatic organisms suitable for food and feed are of worldwide importance. They are excellent sources of high quality proteins which are superior to those in meat and poultry[1].

Periwinkle is a relatively cheap source of animal protein and is mostly consumed in some riverine areas of West Africa. Molluscs are generally soft-bodied animals that contain external skeleton called shell [2]. 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[3]. Periwinkle is commercially valuable, and the value compares favourably with those of domestic livestock and fish. A lot of publications are available on the nutritional qualities of Nigerian snails which are in the same class with the Nigerian periwinkle. However, there is scanty information on the nutritional qualities of periwinkles.

With the current rate of population increase, there would be a need for snail meat substitution so as to prevent their extinction due to consumption. Considering the enormous commercial, nutritional and industrial importance of periwinkle, the fish industry cannot continue to remain neglected. Hence, it is expedient to create awareness to the people about high proportion of nutritional indices of periwinkle.

Periwinkle meat is domestically used as human food, livestock feed and the shell can be painted with various colours and used as ornament for decoration[4].The conventional source of the anima~ protein for the West African populace come largely from livestock in form of poultry, beef, mutton and pork [5].The rapid growth of human population, together with the ever increasing standard of living have also placed great pressure on the existing sources of animal protein, thereby making it expensive. It is therefore necessary to explore non - conventional protein sources such as snails in order to increase the animal protein supply[6].

The knowledge of the biochemical composition of any edible organism is extremely important since the nutritive value is reflected in biochemical contents [7]. Generally, fish and shellfish meat are considered to be highly nutritious, owing to their content of essential amino acids and proteins; for example, shrimp meat is an excellent source of protein [8] and shrimp is one of the most popular species as it is a part of almost every nation's traditional meal rich in protein and minerals.Periwinkles are invertebrates and belong to the phylum Mollusca and class Gastropoda. They are widely distributed shore snails, chiefly herbivorous and they have a dark and sometimes spiral banded shell that readily withstands the buffeting waves characterized by turreted, granular and spiny shells with tapering ends [9].

In view of the many potentials of periwinkle for sustainable nutrition, this paper reports theproximate composition and mineral composition of periwinkle in raw and boiled samples with particular focus on Nigeria. It has six parts namely the introduction which lays out the background, the literature review which revisits relevant publications, the methodology setting out the approaches employed for the research, the results giving a summary of the findings, the discussion providing reflections on the research, and the conclusion.

II. Literature Review

There is little literature on periwinkle, especially Turritellacommunis. The substantial amount of relevant literatureis on other species of periwinkle and the snail family at large.

Initially, Adebayo-Tayo et al studied bacteriological and proximate analysis of periwinkles from two different creeks in Nigeria in 2006 andOgunbgenle and Omowole in 2012 worked on chemical functional and amino acid composition of periwinkle(Tympanotonusfuscatusvarradula)meat.Later, Adebayo-Tayo et al reported in 2011 on microbiological, proximate mineral and heavy metal composition of freshwater Snails from Niger Delta Creek in Nigeria.But then, metals are found in all living organisms where they play a variety of roles.

Metals such as Fe, Cu, Mg, Co, Zn are essential for human body but chronic metabolic disturbances may occur due to the deficiency or excess of these metals [12]. It is important to keep the level of these metals in their proper ranges for maintaining proper metabolic functions in human body. It can be done by taking selected foods in daily diets from a list which can give information about the metal contents of different foods [13]. Non-essential elements such as Pb, Cd, Cr, Ni and As are considered to be toxic and their presence in the body could cause profound biochemical and neurological changes [14].

The sources of toxic metals in the environment are the fossil fuels, mining industries, waste disposals and municipal sewage. Farming and forestry also contribute to the metal content in the environment due to the uses of fertilizer, pesticide and herbicides. As a consequence of environmental pollution, the contaminants may enter the food chain. Since humans ingest food for survival, the major route of entry of most metals into the body is through the diet.

Thus, it is essential to know the toxic metal contents in the foodstuffs humans consume everyday[15]. As such, an investigation into the proximate composition of periwinkle estimating the levels of its toxic metals such as Pb and Mn as well as essential metals such as Ca, Fe, Cu, Mg, Co and Zn in both raw and boiled samples is timely.

III. Methodology

The research employs relevant laboratory scientific methods. These steps were in phases, and the phases determined the effectiveness of one another. I describe and outline these methods and phases and the instruments involved.

Sample collection and preparation

The periwinkle was gotten from a market in Nigeria. The raw sample was prepared by breaking the shell to extract the edible part, and was thenair-dried.The boiled sample was prepared by heating the periwinkle in water without cracking its shell. After boiling, a pin was used to remove the edible part from the shell.The edible part was boiled a bit after which it was air dried and the dried samples of both the raw and the boiled samples were blended into finely grounded powder to facilitate easy extraction.

Biochemical and mineral analysis

Biochemical compositions such as crudeprotein,crude fat, carbohydrate, moisture content, crude fibre and ash content were measured using the method of Association of Official Analytical Chemists (AOAC)(1998). Nitrogen was determined by the micro-Kjeldahl method and the percentage nitrogen was converted to crude protein by multiplying by 6.25: carbohydrate was determined by difference and all determinations were performed in triplicates. Minerals (Ca, Mg, Mn, Pb, Fe and Zn) were determined using the atomic absorption spectroscopy technique International Institute of Tropical Agriculture (IITA).

IV. Results

Table 1: Proximate composition of edible part of Turittelacommunis

Proximate Composition	Content in percentage(%) in Raw Sample	Content in percentage(%) in Boiled Sample
Moisture content	15.50	12.00
Crude Fat	18.80	4.74
Crude Fibre	0.00	3.00
Crude Protein	36.94	63.88
Ash content	16.00	12.00
Carbohydrate	12.76	4.38

Table 2:Mineral Composition of edible part of Turittelacommunis

Minerals	Content in ppm for Raw Sample	Content in ppm for Boiled Sample
Manganese	0.43	1.29
Magnesium	9.64	13.07
Calcium	2.62	1.54
Lead	9.71	0.00
Iron	14.70	5.70
Zinc	0.11	0.06

V. Discussion

The percentage proximate and mineral composition of the samples is shown in Table 1 and 2 respectively.Proximate analysis has shown that the raw sample of the periwinkle is nutritionally rich with moisture content-15.5,crude fat-18.8%, crude fibre -0, crude protein-36.94%, ash Content-16.0% and carbohydrate-12.76%, but not as rich as the boiled sample with moisture content-12.0%, crude fat-4.74%, crude fibre-3.0%, crude protein-63.88%, ash content-12.0% and carbohydrate-4.58% constituents which provide an energy source to the consumers.

The mineral composition in the samples is shown in Table 2. The moisture content is found to be higher in theraw sample, perhaps as a result of fresh water trends that could absorb water from the external environment into their cells having higher concentration in order to balance the osmotic pressure between the cell and the surrounding water. The mineral elements analyzed in this work are essential minerals required by humans but the excess of which is hazardous. The concentration of different metals detected in the edible portion of the periwinkleis shown in Table 2.

Iron content in the samples is14.7ppm in the raw sample and 5.7ppm in the boiled sample while magnesium content in the raw sample is 9.64ppm and 13.07ppm in the boiled sample. Iron and Magnesium are essential trace elements: they play a major role in the metabolic processes that take place in human system and regulation of blood. Magnesium may function as co-factor to some enzymatic activities, and Iron is a major component of the haemoglobin found in human blood. Calcium is detected in both raw and boiled samples,mesuring 0.43ppm and 1.29ppm respectively.

The zinc content in the raw sample is 0.11ppm and in the boiled sample 0.06ppm.Since zinc is an essential element for both animals and humans, therecommended daily allowance is 10 mg/day ingrowing children and 15mg/day for adults(FNB/CDA/CIRDA/NRC 1974). It has a protective effect against the toxication of both cadmium and lead. A deficiency of zinc is marked by retarded growth, loss of taste and hypogonadism, leading to decreased fertility. Zinc toxicity is rare, but, at concentrations in water up to 40 mg/kg, may induce toxicity, characterized by symptoms of irritability,muscular stiffness and pain, loss of appetite, and nausea (FNB/CDA/CIRDA/NRC 1974).

There are other findings. Lead is detected at a high value of 9.71ppm in the raw sample compared to its absence intheboiled sample. Lead causes renal failure and liver damage in humans (Emmerson 1973).Manganese is detected in the samples,with the concentration of 0.43 in the raw sample and 1.29ppm in the boiled sample. Manganese deficienciescould lead to severe skeletal and reproductive abnormalities in mammals, and it widely distributesthroughout the body with little variation and inability to accumulate with age. Total daily intake might vary from 2.5 to 7.0 mg (SDWC/ACT/ALS/NRC 1977; SDWC/ BTEHH/ALS/NRC 1982).

VI. Conclusion

The study revealsthat periwinkle is nutritionally richand serve as a dependable, although underexplored, source of protein. The heavy metals that this study has analysed provide information about the concentration of the metals, remaining within their permissible safe levels for human consumption as laid down recently by the Commission of the European Communities (2001) . The study on the whole evidences the nutritional and metal status of periwinkle when cooked, revealing the absence of lead, known to be harmful for human consumption.Further investigation should be carried out on other metals that might be present in periwinkle in ascertaining how safe it might be for nutrition.

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