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Physico chemical and fatty acid composition of Nigerian periwinkle (*Tympanotonus fuscatus var radula*)

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$$Min \sum_{i=1}^{n} w_i . x_i$$

$$s.t \ A_{(n+w)\times n} X_{n\times 1} \geq b_{(n+w)\times 1}$$

$$Min \sum_{i=1}^{n} w_i . x_i$$

$$s.t \ y = A_{n\times n} X_{n\times 1} \geq b_{n\times 1}$$

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ABSTRACT

Mineral, physico-chemical, functional properties and fatty acid composition of Nigerian Periwinkle (*Tympanotonus fuscatus var radula*) were studied. The highest mineral in the sample was sodium with the value of 130mg per 100g while phosphorus had the lowest value of 2.18 mg per 100g. The refractive index was 1.46 and specific gravity was 0.89 g/cm^{3}while the viscosity was 40.8 mPa/sec. Oleic acid had the highest value of 30.1% followed by Linoleic acid (27.9%) while palmitoleic acid (0.14%) was the lowest fatty acid in the sample.

Introduction

Periwinkle is an affordable source of animal protein which contains the correct proportions of amino acids needed by the body for growth and cell development (Ogungbenle and Omowole, 2012). Periwinkle is also an aquatic animal which permeate successfully into a variety of habitats. They are mostly available and widely consumed in Niger Delta region of Nigeria. With the current global rate of population increase, there would be a need for periwinkle farming so as to prevent their extinction due to consumption, in addition there is need to create awareness to the public on the nutritional qualities of periwinkle. The objective of this work is to determine the minerals, physico chemical and fatty acid composition of Nigerian periwinkle.

Materials and methods

The periwinkle (*Tympanotonus fuscatus var radula)* samples were harvested in river Niger and bought at Onitsha market in south eastern of Nigeria. The fresh periwinkles were scrubbed, rinsed and meat extracted as described by (APHA, 1970). The meat which is the edible part was oven-dried at 95^0-105^{0}C, blended into flour and stored in freezer until used. The sample was then defatted using petroleum ether of analytical grade (British Drug House London) with boiling point range of 40 – 60^{o}C as described by AOAC (1990). The mineral composition of the flour was determined using method of Pearson(1976) while the physico chemical properties of the oil such as acid, peroxide, iodine and saponification values were determined using the methods described by Ogungbenle (2003) while specific gravity was determined conventional displacement method and refractive index was determined using Abbe's refractometer. The fatty acids profile was determined using a method described (Hall, 1982). The fatty esters analyzed using a PYE Unicam 304 gas chromatography fitted with a flame ionization detector and PYE Unicam computing integrator. Helium was used as carrier gas. The column initial temperature was 150^{o}C rising at 5^{o}C min^{-1} to a final temperature of 200^{o}C respectively. The peaks were identified by comparison with those of standard fatty acid methyl esters. A rheometer as described by Nzikou et al (2007) was used to measure the oil viscosities.

Results and discussion

Table 1 presents the mineral contents of periwinkle (*Tympanotonus fuscatus var radula)* in mg per 100g of sample. Sodium was the highest mineral with value of 130mg per 100g sample. The value was found to be higher than those of *Archachatina marginata*, *Achatina Achatina*, *Achatina fulica* and *Limicolaria specie* (four breeds of land snail in Nigeria) whose sodium values were 29.01, 30.95, 50.13 and 32.29mg/100g respectively reported by Babalola and Akinsoyinu (2009), female (113.0mg/100g), castrated (115.4mg/100g) and male (106.2 mg/100g) of broiled goat meat reported byJohnson et al.(1995).

Table 1: Mineral content of periwinkle

Minerals	mg/100g
Sodium	130
Potassium	103
Magnesium	104
Calcium	98.3
Phosphorus	2.18

Calcium content in periwinkle was 98.3mg/100g. This value was higher than *limicolaria specie* whose calcium content is 36.20mg/100g reported by (Babalola and Akinsoyinu, 2009) and 37.9mg/100g reported for male sex class of broiled goat meat (Johnson et al.,1995) but lower than that of *Archachatina marginata* with value of 212.38mg/100g reported by Adeyeye (1996). The presently reported value was also lower than male (536.11mg/100g) and female (694.87mg/100g) body parts with small thoracic appendages, cheliped muscle and exoskeleton for male (760.18mg/100g) and female (748.19mg/100g) of African fresh water crab (Adeyeye,2002). Calcium is involved in the calcification of bones and teeth. Its shortage therefore can affect the structure of bones which become weakened. Calcium ions are needed for blood clotting and infant development of bones and teeth (Ogungbenle, 2003). The high content of calcium in

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periwinkle suggests that its consumption can increase the calcium level in the body and contribute to blood clotting process. Magnesium is an activator of many enzyme systems and maintains the electrical potential in nerves (Shiles, 1973). Potassium is primarily an intracellular cation that can influence osmotic pressure and contribute to normal pH equilibrium of the body (Sandstead, 1967). Plant and animal tissues are rich sources of potassium. Therefore, the dietary containing periwinkle is capable of influencing osmotic pressure and maintain pH balance of the body fluid. But sodium is widely distributed in plants than animal sources (Fleck, 1976).

Table 2: Physico chemical properties of periwinkle

Physico chemical properties	
Peroxide value (MEq/kg)	43.0
Iodine value (MgI_2/100g)	59.0
Acid Value (MgK0H/g)	5.94
Saponification value (mgKOH/g)	256
Unsaponifiable matter	8.55
Viscosity (mPa/sec) @ 38^0C	40.8
Refractive index	1.46
Specific gravity g/cm^3	0.89
Free fatty acids (FFA)	0.17

The Table 2 shows some physiochemical properties obtained for periwinkle oil. The iodine value of periwinkle oil (59.0%) is higher than those of cereal grains and quinoa oil (54.0%) reported by Ogungbenle, 2003. Iodine value is a measure of degree of saturation of oil and it is an identity characteristic of native oil. It indicates the degree of unsaturation of the fatty acids (Nzikou et. al., 2010). Its high level reflects the susceptibility of the oil to oxidation. The iodine value obtained is high which suggest the presence of unsaturated fatty acid. The acid (5.94%) and peroxide value (43.0 MEq/kg) were higher than that of quinoa oil (0.50% and 2.44%) reported by Ogungbenle, 2003. But the acid value was lower than 5.92% calabash seed oil and 4.75% *Citrullus colocynthis* (Olaofe et. al.,2012). The saponification value of 256% was comparable with those of coconut 200-250%, butter fats (220-241%) (Ihekoronye and Ngoddy, 1985) but higher than cotton seed oil 190-200% and soy bean 190-194% (Paul and Southgate,1985). The specific gravity (0.89 g/cm^3) was lower than that of water as expected theoretically. This value was higher than kidney bean (0.68 g/cm^3) reported by Olaofe et.al., (2010). The refractive index was 1.46. This value was comparable with that of *Citrullus colocynthis* (1.460) but lower than lump –in-neck melon (1.490), *Citrullus lunatus* (1.470) and bottle gourd seed (1.490) reported by Olaofe et. al., (2012). Viscosity is a measure of resistance of a fluid to deform under shear stress. It is understood to be the thickness or pouring resistance. The viscosity of periwinkle oil was 40.8mPa/sec. This value was higher than 32.92mPa/sec.for *Terminalia catappa* (Nzikou et. al., 2010).

Table 3 illustrates that palmitic acid C16:0 and stearic acid C18:0 are the major constituents of the saturated fatty acid component. The oleic acid was the major monounsaturated fatty acid present in oil of periwinkle while the polyunsaturated fatty acids present were Linolenic acid and Linoleic acid. Oleic acid had the highest value (30.1%) while linoleic acid was in the second position with value of 27.9% and then palmitic acid takes the third position with the value of 26.6%. This corroborates the results reported by Oshodi et al.(1995) for African yam bean. The value of myristic acid in periwinkle oil (2.64%) was higher than that of bottle gourd seed (0.16%) but lower than those of calabash seed oil (5.36%) reported by Olaofe et. al. (2010) and date palm fruit (5.36 %) reported by Ogungbenle (2011). While that of palmitic acid (26.6%) was lower than the value of 35.8% for *Terminalia catappa* (Nzikou et. al.,2010) but higher than 16.3% *m. longissimus dorsi* of hartebeest reported by Johnson et. al.(2010).

Table 3: Fatty acids composition of periwinkle

Fatty acids	%
Lauric acid	0.89
Myristic acid	2.64
Palmitic acid	26.6
Palmitoleic acid	0.14
Stearic acid	0.94
Oleic acid	30.1
Linoleic acid	27.9
Linolenic acid	7.40
Arachidic acid	1.42
Lignoceric acid	0.52
Behenic acid	1.35
O/L	1.06

The value of Linoleic acid (27.9%) was lower than that of pigeon pea oil (54.8%) reported by Oshodi et al.(1993) and soy beans (52.0%) (Paul and Southgate, 1985).. Oleic acid (30.1%) is found to be the most concentrated in periwinkle oil but lower than those of corn oil (55.7%) and safflower oil (72.6%) reported by Ihekoronye and Ngoddy (1985) and higher than those of *m. longissimus dorsi* of hartebeest (18.4 %) reported by Johnson et. al.(2010) and 44.81 % of date palm fruit (Ogungbenle, 2011).

Oleic acid, Linoleic acid and palmitic acids were the major fatty acids in periwinkle. A higher proportion of either linoleic or linolenic acid is associated with legumes containing insignificant amount of lipids (Salunkhe et al., 1985). The values of linoleic (27.9%) and oleic (30.1%) acids were also lower than that of *Terminalia catappa* seed oil reported by Nzikou et. al.(2010). Periwinkle oil can be classified in the oleic – linoleic group (Nzikou et. al.,2010). Linoleic acid which is one of the most important polysaturated fatty acid in human food because of its prevention of cardiovascular disorders/coronary heart diseases, linoleic acid also helps to reduce high blood pressure (Vles, 1989, Boelhouwer, 1983). Periwinkle would serve the purpose when consume in the body. The n-6 and n-3 fatty acids have critical roles in the membrane structure and as precursor of eicosanoids which are potent and highly reactive compound. Since they compete for the same enzymes and have different biological role, the balance between the n-6 and n-3 fatty acids in the diet can be of considerable importance (WHO/FAO 1994). Saturated and monounsaturated fatty acids can be synthesized from carbohydrates and proteins. A high fat, low carbohydrate diet increases the risk for onset of non-insulin dependent diabetes mellitus. It has been found that relative to carbohydrates, the saturated fatty acids elevate serum cholesterol, while the polyunsaturated fatty acids lower serum cholesterol. The saturated fatty acids (SFA) such as lauric (12:0), myristic (14:0) and palmitic (16:0) have been established as the most important of the dietary risk factors in CHD (Bender, 1992). There are three types of lipoproteins (protein-lipid-complexes) in the blood. These are low-density lipoproteins (LDL) in which 46% molecule is cholesterol, high density (HDL) which include 20% as cholesterol and very low density lipoprotein (VLDL) which have 8% cholesterol. High level of total blood cholesterol is associated with the incidence of CHD as well as high intake of saturated fatty acids (Bender, 1992). Polyunsaturated linoleic acid moderately reduced serum cholesterol and CDL, levels (WHO/FAO, 1994). Linoleic and α-linolenic acid are the most important essential fatty acids

required for growth physiological function and body maintenance (Salunkhe et.al,1985).

Conclusion

It can be concluded that periwinkle (*Tympanotonus fuscatus van radula)* is rich in protein, some essential minerals but low in fat and is nutritionally good for consumption and also formulations of baby foods.

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