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Proximate, Chemical and Amino Acid Composition of Oven Dried Clam (*Merceneria m.*), Whelk (*Thias c.*), Oyster (*Crassostrea g.*) and Periwinkle (*Tympanotonus f.*) Meat

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Abstract: The proximate, chemical and amino acid composition of four oven dried shell fish meat samples were analysed, Clam, (*Mercenaria mercenaria*), Whelk, (*Thias coronata*), Oyster (*Crassostrea gasar*), and Periwinkle (*Tympanotonus fuscatus*). Results shows that whelk has the highest moisture content of 13.96±0.01, followed by oyster 8.99±0.00, clam, 8.98±0.01 and periwinkle 6.50±0.04. The protein content of periwinkle was the highest with a protein content of 70.42±0.03, followed by oyster 64.70±0.00, whelk 47.3±0.03, and clam 46.90±0.00 was the least. Ash content was highest in whelk 5.62±0.00, followed by clam 5.07±0.03, oyster 4.23±0.00 and the least periwinkle 3.38±0.01. The fat content of oyster was the highest with 10.60±0.00, followed by clam 10.07±0.03, whelk 9.20±0.00, and periwinkle 4.76±0.01, the least. Whelk contains the highest crude fiber content 10.45±0.01, followed by clam 10.10±0.00, oyster 5.33±0.04 and periwinkle 3.56±0.01. The calcium content was highest in oyster 580±0.000mg/100g sample and the least clam 101±0.000mg, selenium was highest in clam 40±0.000mg, and lowest in oyster 0.50±0.014mg. Oyster contains the highest levels of phosphorus 200±0.000mg, and the least whelk 110±0.000mg. Periwinkle contains the highest levels of Magnesium 150±0.000mg and the least clam 40±0.000mg. Oyster contains the highest levels of Zinc 100±0.000mg, the least clam 70±0.000mg. Clam contains the highest levels of iron 330±0.000mg and the least periwinkle 183.10±0.071mg. The highest level of Sodium was found in oyster 590±0.000mg and lowest clam 150±1.414mg. The mineral content of the four shell fish however differ significantly from each other at the ($P<0.05$). All the four shell fish contains all the essential and non-essential amino acids, they however differ significantly from each other at ($P<0.05$). The total amino acid values was highest in oyster with total amino acid values of 86.05±0.071, followed by whelk with total amino acid values of 83.02±0.000, clam with total amino acid values of 82.22±0.014 and the least is periwinkle with total amino acid values of 78.45±0.000. Oyster contains the highest total essential amino acid values 42.06±0.000, followed by whelk with total essential amino acid values of 40.65±0.014, clam 39.90±0.014 and the least is periwinkle with total essential amino acid values of 35.16±0.014.

Keywords: Shell Fish, Proximate, Chemical, Amino Acid, Clam, Whelk, Oyster and Periwinkle

1. Introduction

Shell fish are relatively cheap sources of protein and other nutrients such as minerals and vitamins that are in abundance in the Niger Delta region of South-South Nigeria [1]. They are excellent sources of protein, minerals and contribute greatly to the diets of the people of the Niger Delta region South- South Nigeria. [2]. They belong to the Mollusc family and are mostly found in shallow waters of the inter tidal zones where they burrow into the beds of the river which serves as their habitat and feed mostly on algae and diatoms, majority are also found in the oceans floors and seashores, While others are found in the fresh water fauna and the terrestrial ecosystem [3]. Mollusc is a very large family that

include gastropods; such as snails, slugs, periwinkles, whelk and others. Bivalves which include clams, oysters and others, cephalopods such as squids and others [4]. They are known good sources of protein and minerals [2]. These shell fish if properly harness could serve as alternative to conventional sources of protein in Nigeria. Conventional sources of protein such meat, chicken, egg, milk and fish are quite expensive and out of the reach of many poor families. Since many families cannot afford the recommended daily intake of protein due to poverty. As a result many families feed on high carbohydrate diets with little or no protein content which has led to protein malnutrition in many families and its consequences. Which include high infant mortality, low productivity among the work force, low resistance to disease conditions and poor growth and retardation [5]. This study therefore examines the proximate, chemical and amino acid content of four selected oven dried shell fish meat with the aim of using such as alternative sources of protein in Nigeria. Since these shell fish are found in abundance in the Niger Delta regions, they are also cheap and affordable. Findings from the work can assist Nigeria to find a lasting solution in addressing its protein malnutrition challenges. Nigeria at present stands as the nation with the poorest people in the world overtaking India [5].

2. Materials and Methods

The shell fish used in this study were bought from the popular Ogbia market capital of Ogbia Local Government Area of Bayelsa state South -South Nigeria. The shell fish bought are then properly washed and parboiled for few minutes and then the meat removed with sterilized needles and knives. The meat then parked into plastic containers and transported in iced cooled containers to the Department of Food Science and Technology River State university Port Harcourt laboratory. The meat were then oven dried with an electric oven model BHG-9140A at 60°C for 24 hours. The proximate analysis was done using the [7] to determine the moisture, ash, crude fibre, fat and carbohydrate content. The nitrogen content was determined by the micro Kjedahl method and the nitrogen is converted to protein by multiplying by the conversion factor of 6.25. While the carbohydrate content was determined by difference. The mineral analysis was done by dry ashing according to [8]. One gram of sample ashed at 550°C for 3 hours and the ash dissolved in 100ml volumetric flask using distilled water and 5ml concentrated HCL acid. The filtrate is then used to determined mineral element. All the mineral elements except phosphorus were determined by spectrophotometer using bunch scientific Atomic Absorption spectrophotometer. The equipment was calibrated to zero with de-ionized water before analysis.

$$\% \text{ element} = \frac{(\text{PPM}) \times \text{vol. of solute}}{10^4 \times \text{wt of sample}}$$

Metal (mg/100g)=% metal X 1000

Phosphorus was determined using Molybdate method.

Amino acid profile was determined using the [9] method. Twenty grams of each sample are dried with an electric oven model BHG-9140A at 130oc until it attains constant weight.

2.1. DE Fattening of Sample

Five grams of the sample is placed into an extraction thimble and extraction done for 15 hours in soxhlet extraction apparatus using chloroform/ methanol mixture at a ratio of 2: 1.

2.2. Sample Hydrolysis

Five grams of the defatted sample is weighed into a glass ampoule. 7mls of 6NHCL is then added. Oxygen is expelled by passing nitrogen into the ampoule. This is done to prevent oxidizing amino acids, such as methionine and cysteine from been oxidized. The ampoule is then sealed with Bunsen burner flame and inserted in an oven that has been set at 105°C and left to hydrolysed for 24hrs.

After which the ampoule is allowed to cool and the content filtered. The filtrate is then evaporated until it is dry using a rotary evaporator. The residue is then dissolved in 5mls acetate buffer PH 2.0 and stored in plastic bottles in a freezer.

2.3. Loading of the Hydrolysate into the Analyzer

Sixty Micro Litters of Sample (60ul) Is Then Loaded Into the Cartage of the Analyzer, Model 20A. An integrator attached to the analyzer then calculates the peak area proportional to the concentration of each amino acid.

2.4. Statistical Analysis

All statistical analysis are done in duplicates. Data obtained were then analyzed with Analysis of variance (ANOVA) and pair wise comparison test and significant levels accepted at ($P<0.05$).

3. Results and Discussion

The proximate composition of the oven dried clam, whelk, oyster and periwinkle meat are presented on table 1. The moisture content of whelk is the highest 13.96±0.01 above 10%. All the other samples have moisture content below 10% with values of, 8.98±0.01 for clam, 8.99±0.01 for oyster and 6.50±0.04 for periwinkle. The protein content of periwinkle was highest with 70.42±0.03, followed by oyster 64.70±0.00, whelk 47.34±0.03 and clam 46.90±0.00. The fat content of the shell fish meat samples indicates that oyster has the highest fat content 10.60±0.00, followed by clam 10.07±0.03, whelk 9.20±0.00 and periwinkle 4.76±0.01. Whelk has the highest ash content 5.62±0.00, clam 5.07±0.03, oyster 4.23±0.00, and periwinkle 3.38±0.01. The crude fibre content was highest in whelk 10.45±0.01, clam 10.10±0.00, oyster 5.33±0.04, and periwinkle 3.55±0.01. The protein content of periwinkle in this study was 70.42±0.03, this results agree with the findings of [1] who reported protein content of periwinkle as 74.74 on dried weight basis. The protein content of oyster in this studies was 64.70±0.00 on dried weight basis, this result agrees with the results of [10-12] who report protein content of oyster as 63.03, ranging between 52 to 64 depending on the season, and

between 55 to 68%. The protein content of clam in this study was 47.34±0.03, this findings also agree with the findings of [13], who reported protein content of clam as 47.38. From the above analysis the oven dried shell fish meat contain reasonable levels of protein that can be compared to other conventional proteins consumed in Nigeria. For example mutton contains 16.9 percent protein, duck 18.6%, and chicken 20.5%.

Table 1. *Proximate composition of oven dried sample of 4 selected shell fish meat.*

Samples	%moisture Content	% crude protein	%crude ash	% crude fat	% crude fiber	% carbohydrate
Clam	8.98±0.01^{b}	46.90±0.00^{e}	5.07±0.03^{b}	10.07±0.03^{b}	10.10±0.00^{b}	18.88±0.04^{a}
Whelk	13.96±0.01^{a}	47.34±0.03^{d}	5.62±0.00^{a}	9.20±0.00^{c}	10. 45±0.01^{a}	13.43±0.06 ^{b}
Oyster	8.99±0.00^{b}	64.70±0.00^{c}	4.23±0.00^{c}	10.60±0.00^{a}	5.33±0.04^{c}	6.15±0.04^{d}
Periwinkle	6.50±0.14^{c}	70.42±0.03^{b}	3.38±0.01^{d}	4.76±0.01^{d}	3.56±0.01^{d}	11.38±0.13^{c}

Values are mean±SD of duplicate samples.
Values bearing different subscript in the same column differ significantly $p < 0.05$.

The chemical composition of the four oven dried shell fish meat are presented on table 2. The table indicates high levels of mineral content. These include calcium which is required in our diets for proper bone and teeth formation and development, blood clothing and other numerous body functions. The calcium content of the oven dried shell fish meat ranges from 101±0.000mg in clam to 580±0.000mg in oyster. The results are consistent with the calcium content of periwinkle and whelk [4] who reported the calcium content of periwinkle as 103.70mg and whelk as 495mg. These high levels of calcium is of a dietary importance to those that uses shell fish as major source of protein. The Selenium content of the oven dried shell fish ranges from 40±0.000mg in clam to 0.50±0.014mg in oyster. Selenium is required in the body for proper body functions. As such the presence of selenium in the oven dried shell fish meat is good as it will provide those who consumed the shell fish additional health benefits apart from their protein content. All the four shell fish under consideration contains high levels of phosphorus ranging from 200±0.000mg in oyster to 110±0.000mg in whelk. These values when compared with that of beef 156mg, egg 218mg and milk 95mg indicates the shell fish meat are good sources of phosphorus. Phosphorus is needed in the body as co-enzymes, a major component of the nucleic acid, phospholipids and adenosine tri-phosphate (ATP). It also helps in bone and teeth formation. Magnesium found in the oven dried shell fish meat ranges from 150±0.000mg in periwinkle to 40±0.000 mg in oyster and clam. These values are reasonably high when compared with values found in cat fish 0.6mg and beef 25mg [14]. Magnesium is needed for proper bone formation, as co-factors and other biochemical functions in the body. Zinc content of the meat samples ranges from 100±0.000mg in oyster to 70±0.000mg in clam, These high levels are good for the body as zinc is one of the most important elements in the body as it plays a role in cell replication and gene expression, amino acid synthesis and tissue repairs and also boost the immune system. Iron levels in the meat sample ranges from 330±0.000mg in clam to 183.10±0.071mg in periwinkle. These values when compared to [15] indicates high levels of occurrence in the shell fish meat. These values when compared to that of snail with 27.61mg is quite high. The high levels of iron in the meat sample is good since iron is needed in the body in the form of haemoglobin and myoglobin which are involve in the transportation of oxygen in cellular respiration. It is also required in the formation of enzymes involved in electron transfer and oxidation in the body, in the brain and spinal cord. The sodium content of the meat samples ranges from 590±0.000mg in oyster to 150±1.414 mg in clam. This explains the fact that clam was obtained from the fresh water area which is generally low in sodium chloride (salt) while oyster is from the sea and contains high levels of sodium. Sodium is found in the sea as sodium chloride or common salt. Sodium is needed in the body for the maintenance of body fluid and sodium balance in the older people. Low sodium levels in the body can lead to kidney failure, heart failure and brain dysfunction [16].

Table 2. *Mineral Content of 4 Selected Oven Dried Shell Fish Meat Samples.*

Minerals (Mg/100g)	Clam	Whelk	Oyster	Periwinkle
Calcium (Ca)	101.00^{d}±0.000	500.00^{b}±0.000	580.00^{a}±0.000	116.10^{c}±0.071
Selenium (Se)	40.00^{a}±0.000	7.00^{c}±0.000	0.50^{d}±0.014	27.60^{b}±0.028
Phosphorus (P)	180.00^{b}±0.000	110.00^{d}±0.000	200.00^{a}±0.000	160.00^{c}±1.414
Magnesium (Mg)	40.00^{c}±0.000	80.00^{b}±1.414	40.00^{c}±0.000	150.60^{a}±0.000
Zinc (Zn)	70.00^{d}±0.000	80.00^{c}±1.414	100.00^{a}±0.000	96.00^{b}±0.000
Iron (Fe)	330.00^{a}±0.000	250.00^{c}±0.000	270.00^{b}±0.000	183.10^{d}±0.071
Sodium (Na)	150.00^{d}±1.414	550.00^{c}±0.000	590.00^{a}±0.000	580.00^{b}±0.000

Values are mean±SD of duplicate samples.
Values bearing different subscript in the same row differ significantly $p < 0.05$.

The amino acid profile of the four oven dried shell fish meat are shown on table 3. The meat samples contain all the amino acid, and all the essential amino acids in different proportions. The meat sample contains high levels of

glutamic acid higher than the other amino acids with values ranging from 14.24±0.000g for oyster to 11.20±0.000g for clam. The amino acid that occur less in all the shell fish meat sample is cysteine with values ranging from 1.21±0.000g in periwinkle to 0.85±0.000g in clam. While Tryptophan is highest in periwinkle with values of 1.07±0.014g, and lowest in clam with 0.84±0.000g. Leucine content was highest in oyster with 7.64±0.014g and lowest in clam 7.06±0.014g, lysine highest in clam with 6.79±0.000g and lowest in periwinkle 5.30±0.000g. Isoleucine highest in oyster with 5.24±0.000g and lowest in periwinkle 3.25±0.14g. Valine highest in oyster with 3.51±0.000g and lowest in clam 2.98±0.000g. Other essential amino acids include methionine, highest in whelk 2.68±0.014g and lowest in periwinkle 0.96±0.000g, arginine highest in oyster 6.45±0.000g and lowest in periwinkle 5.50±0.000g, Threonine highest in oyster 4.11±0.000g and lowest in periwinkle 3.09±0.014g, aspartic acid occurs in abundance in the shell fish meat samples with periwinkle 9.61±0.014g and the least in oyster 9.18±0.000g. The results also indicates that glutamic acid, aspartic acid and leucine are the most abundant amino acids in the samples with values ranging from 11.20g to 13.09g for Glutamic acid, 9.16g to 9.55g for Aspartic acid and 7.06g to 7.6g in Leucine. This results agrees with the results of [1] that indicated in their analysis of chemical, functional and amino acid composition of Periwinkle. Which shows that Aspartic acid, Glutamic acid and Leucine are the major abundant amino acids in Periwinkle.

Table 3. *Amino Acid Profile of Samples of 4 Selected Shell fish oven dried meat.*

Amino Acid	Clam	Whelk	Oyster	Periwinkle
Leucine*	7.06^{c}±0.014	7.29^{b}±0.000	7.64^{a}±0.014	7.29^{b}±0.000
Lysine*	6.79^{a}±0.000	6.36^{b}±0.014	5.73^{c}±0.000	5.30^{d}±0.000
Isoleucine*	4.19^{c}±0.000	5.04^{b}±0.000	5.24^{a}±0.000	3.25^{d}±0.014
Phenylalanine*	4.19^{b}±0.000	3.90^{c}±0.000	4.43^{a}±0.014	3.81^{d}±0.000
Tryptophan	0.84^{d}±0.000	0.94^{b}±0.014	0.89^{c}±0.000	1.07^{a}±0.014
Valine*	2.98^{d}±0.000	3.21^{c}±0.014	3.51^{a}±0.000	3.45^{b}±0.000
Methionine*	2.30^{c}±0.000	2.62^{a}±0.014	2.45^{b}±0.000	0.96^{d}±0.000
Proline	3.86^{b}±0.000	3.25^{d}±0.000	3.45^{c}±0.014	3.96^{a}±0.000
Arginine *	6.02^{b}±0.014	5.93^{c}±0.000	6.45^{a}±0.000	5.50^{d}±0.000
Tyrosine	3.44^{b}±0.000	3.27^{c}±0.014	3.61^{a}±0.014	3.09^{d}±0.000
Histidine*	2.43^{c}±0.000	2.30^{d}±0.000	2.49^{b}±0.000	2.55^{a}±0.014
Cysteine	0.85^{c}±0.000	0.85^{c}±0.000	0.91^{b}±0.014	1.21^{a}±0.000
Alanine	5.61^{a}±0.000	4.75^{b}±0.000	4.00^{c}±0.000	3.30^{d}±0.014
Glutamic acid	11.20^{d}±0.000	12.56^{c}±0.014	14.24^{a}±0.000	13.85^{b}±0.014
Glycine	2.85^{c}±0.071	2.99^{c}±0.000	3.23^{b}±0.014	3.85^{a}±0.000
Threonine*	3.94^{b}±0.014	4.00^{ab}±0.000	4.11^{a}±0.000	3.05^{c}±0.070
Serine	4.38^{b}±0.000	4.21^{c}±0.000	4.48^{a}±0.000	3.35^{d}±0.014
Aspartic acid	9.23^{c}±0.014	9.55^{b}±0.000	9.18^{d}±0.000	9.61^{a}±0.014
Total Amino Acid	82.22^{d}±0.014	83.02^{b}±0.000	86.05^{a}±0.070	78.45^{c}±0.000

*Essential Amino Acid.
Values are mean±SD of duplicate samples.
Values bearing different subscript in the same row differ significantly $p < 0.05$.

Total essential amino acid of the four oven dried shell fish meat are presented on table 4. Oyster has the highest total essential amino acid of 42.06±0.000g, whelk 40.65±0.014g, clam 39.90±0.014g and periwinkle 35.16±0.014g. Oyster also has the highest total non- essential amino acid values of 43.99±0.000g, periwinkle 43.29±0.014g, whelk 42.38±0.000g and clam 42.32±0.014g. Oyster has the highest total amino acid score of 86.05±0.071g, whelk 83.03±0.000g, clam 82.22±0.014g and periwinkle 78.45±0.000g. This is an indication that all the shell fishes under consideration have a high percentage of essential amino acid content which is an indication of the content of good quality protein. This figures compares favorably with that of snails consumed in Nigeria which has essential amino acid content of 36.1mg – 45.0mg crude protein with histidine [17]. It is necessary to note that 40.93mg essential amino acids is within the range of the total requirements for infants which ranges from 40.8 – 58.8mg [18].

Table 4. *Showing Essential and Nonessential Amino Acid Content of Shell Fishes.*

Amino acid	clam	whelk	oyster	Periwinkle
Total essential amino acid	39.90^{c}±0.141	40.65^{b}±0.014	42.06^{a}±0.000	35.16^{d}±0.014
Total nonessential amino acid	42.32^{d}±0.014	42.38^{c}±0.000	43.99^{a}±0.000	43.29^{b}±0.014
Total amino acid	82.22^{d}±0.014	83.03^{b}±0.000	86.05^{a}±0.071	78.45^{c}±0.000

Values are mean±SD of duplicate samples.
Values bearing different subscript in the same row differ significantly $p < 0.05$.

4. Conclusion and Recommendations

These values clearly indicates that shell fish such as clam, whelk, oyster and periwinkle are good sources of high quality protein that can be integrated into our diets for healthy living. The protein content can also be utilized for the formulation of infant and weaning foods. Other protein sources in Nigeria include; meat, egg, chicken, fish, and dairy products, these protein are usually regarded as high quality proteins or conventional protein sources. The rising cost of these major protein sources due to the rapid increase in population growth in the country has given rise to concerns for alternative sources of protein. Since many poor rural house hold cannot afford these conventional proteins anymore. Hence the need for this study on alternative or none conventional protein sources called shell fishes which are abundant sea resources of the Niger Delta region of Nigeria that can be harness to address the protein malnutrition scourge that is presently plaguing the country. Base on the research findings we are recommending the consumption of oven dried shell fish meat which can easily be transported to areas of need and be used as protein sources since they contain good quality protein that is comparable with the conventional proteins but at the same time available in large quantities and are affordable in other to address the protein malnutrition in Nigeria.

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