Comparative Nutritional, and Biochemical Evaluation of Ergeria Radiate (Clams) and Pomecia Palludosa (Gastropods) Delicacies and Effects of Processing Methods

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6 authors, including:

Stella Oyom Bassey
University of Calabar

Mbeh Ubana Eteng
University of Calabar

Eyong Ubana Eyong
University of Calabar

Ofem Effiong Ofem
University of Calabar

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Comparative Nutritional, and Biochemical Evaluation of *Ergeria Radiate* (Clams) and *Pomecia Palludosa* (Gastropods) Delicacies and Effects of Processing Methods.

[1]Bassey, S.C.O., [1]Eteng, M.U., [1]Eyong, E.U., [1]Ofem, O.E., [2]Akanyoung, E.O and [2]Umoh, I.B

[1]Department of Biochemistry and Physiology, College of Medical Sciences, University of Calabar-Nigeria.
[2]Department of Biochemistry, University of Uyo, Nigeria.

ABSTRACT

This study was conducted to investigate the comparative nutritional and biochemical evaluation of *Ergeria radiata* (clam) and *Pomecia palludosa* (gastropod) and the effects of cooking on their nutritional qualities. Proximate composition, amino acid profile, and anti-nutrients were determined in fresh sun-dried and cooked oven dried samples of *E. radiate* and *P. palludosa* for biological studies. Forty eight (48) male albino Wistar rats, aged between 29-32 days (45-55g) were used for these studies. They were divided into 6 groups of eight and fed on different experimental diets of *Pomecia palludosa* or *Egeria radiata* for 21 days. Both water and diet were given *ad libitum*. Crude fat, fiber and ash contents were not significantly difference in *E. radiate* and *P. palludosa* whether in the fresh or sun-dried samples. Toxicant levels were higher in *E. radiate* than *P. palludosa* in both cases, while cooking reduced the amount of toxicants. For both *E. radiate* and *P. palludosa* tyrosine, phenylalanine and leucine were higher and comparable to those of whole hen egg while arginine and glutamine were present in higher amount than those found in whole hen egg; lysine and leucine compared well with FAO/WHO standard of 1973. All other amino acids determined were present in low quantities. Values of PER, NPU and TD were higher in *E. radiate* and *P. palludosa* indicating their nutritional value. Cooking appeared to have no consistent impact on nutritional indices. These present cooked samples of *E. radiate* and *P. palludosa* delicacies as cheap sources of food nutrients, which could be used to combat protein energy malnutrition problems.

Key words: *Ergeria radiate* and *Pomecia palludosa*, nutritional quality, protein energy malnutrition.

Introduction

One of the most pressing nutritional problems facing the Nigerian Government and several other third world countries is how to be self sufficient in food production. Studies on Nigerian foods (Umoh IB, Bassir, 1977; Eka, 1978; Benson, 2007) show inadequacy in terms of quality and quantity of the foods as exemplified by widespread malnutrition. Most affected are the pre-school age children, pregnant and lactating mothers (ICNND 1965; WHO/FAO, 2007) protein deficiency is a major nutritional problem leading to the syndromes of protein energy malnutrition. Suggestions to improve the nutritional status of Nigerians had been through the mechanized agriculture, increasing available protein foods, conventional animal and plant foods; conventional oil seed protein, single cell proteins and fish protein concentrates. Other approaches include use of green leaves and leave protein concentrates, use of lesser-known proteins, and fortification of local infant weaning foods (Oke, 1973; Umoh *et al.*, 1980; Akinrele IA, Edwards, 1971; Ifon, 1980; Onuoha, 2006). Malnutrition is now widespread in Nigeria affecting all age groups in varying degrees with clinical symptoms of tissue wasting, growth failure, body weakness and weakened immune competence. The use of lesser-known proteins by peasants in the face of economic downturn affecting developing countries needs to be encouraged. Studies have shown that chemical composition varies from one foodstuff to another; whereas some are rich in essential amino acids, some are not. Animal proteins have high biological values whereas plant proteins are considered second-class proteins as some lack sulphur-containing amino acids but are rich in lysine Eneobong, (2001). Among these lesser known proteins are sea food *Ergeria radiata* (clam) and *Pomecia Palludosa* (gastropod),

Corresponding Author: Dr. Ofem, O.E, Physiology Department, College of Medical Sciences, University of Calabar, Nigeria.
E-mail: ofemo2003@yahoo.com; phone: +2348055929850

which is consumed by peasant in riverine south south of Nigeria. It is the objective of this study to evaluate and compare the nutritional aspect of *E. radiata* and *P. palludosa* as to justify its consumption and its use to tackle protein energy malnutrition in part.

Materials and Methods

Collection and preparation of E. radiate and P. palludosa

Samples of *Pomecia palludosa* used for this study were harvested and bought from a riverine fresh water habitat at Idomi, Yakurr, Central Cross River State. Some were bought from a local market at Aningheje in Akampka Local Government Area of Cross River State. *Ergeria radiata* samples were freshly harvested from Calabar Itu bridge beach market in Akwa Ibom and Watt market in Calabar, Cross River State. Samples were collected between the months of January to March, 2009. The edible portions of the samples were randomly divided into tow portions. One portion was obtained fresh, sun-dried until it was crispy and powdered. The other portion was cooked and oven dried at 60oC until it was crispy.

Rat feeding experiment

Forty eight (48) male albino rats of the Wistar strain of initial weight between 45-55g were used for these studies. The animals were obtained from the animal house of the Biochemistry Department, College of Medical Sciences, University of Calabar-Nigeria. The animals were divided into 6 groups of 8 rats each. Group 1 received basal diet. Group 2 took reference diet. Group 3 had a test diet of fresh sun dried *Pomecia palludosa* (FSPP). Group 4 took a test diet of cooked oven-dried *Pomecia palludosa* (COPP). Group 5 had a test diet fresh sun-dried *Ergeria radiata* (FSER) and group 6 received test diet of cooked oven-dried *Ergeria radiata.* Both water and diet were given *ad libitum*. Approval was obtained from the Ethical Committee, University of Calabar Medical College.

Determination of proximate composition

The chemical evaluation of the samples for moisture, ash, crude protein, carbohydrate, and energy value were carried out as described by the methods of Association of Official Analytical Chemists (2006).

Moisture content

Two (2) grammes of each sample was accurately weighed and placed in a crucible with lid and placed in a hot air circulating oven (Astell Hearson) set at 100ºC. it was weighed intermittently for 12 hours until constant weight was obtained. The loss in weight was expressed as a percentage of the initial weight.

Ash content

A 2g portion of each sample was weighed accurately into a porcelain crucible and ignited in a muffle furnace at 550ºC until a light grey ash was obtained by subtracting the final weight of the crucible from its pressed as a percentage of the dry material.

Nitrogen and crude protein

Nitrogen and crude protein content of the samples were determined using the micro-kjedahl method Association of Official Analytical Chemists (2006). The crude protein content was obtained following the method of FAO, (1986).

Crude fat

The crude fat content of 2 grammes weight of each sample was determined by exhaustively extracting the sample with petroleum ether (BP 40º – 60ºC) using a soxhlet apparatus.

Crude fiber content

8-10 grammes of the fat-free samples were used for the fiber content determination. The method was based on the separate exhaustive extractions of substances soluble in the boiling 1.25% H_2SO_4 (w/v) followed by treatment with boiling 1.25 H_2SO_4 (w/v) solution. The remains after this exhaustive extraction were dried and ashed in a muffle furnace at 550ºC and the loss in weight after ashing was reported as fiber content.

Carbohydrate

The carbohydrate contents of the samples were determined by difference. The sum of the percentages of protein, fat, ash, fiber and moisture was determined and the value deducted from 100% to obtain the value for total carbohydrate content.

Energy value

Physical scoring was used in the estimation of the energy contents of the samples. The caloric (energy) value of each sample was obtained by multiplying the value of the crude protein, crude fat and total carbohydrate by the water factor of 4, 9 and 4 respectively and taking the sums of the products which were expressed in kilocalories per 100g (Kcal/100g).

Estimation of selected anti-nutritional substances

Hydrocyanate content was estimated using the standard method of A.O.A.C FAO, (1986). Oxalic acid was done by the method described by Dye, (1956), Phytic acid was carried out by the method of McCance Widdowson, (1953).

Biological value and protein quality in Pomecia palludosa and Ergeria radiata

For the evaluation of protein quality of the diets, the following parameters were used PER, NPU, NPR, BV and TD. They were calculated using the following standard procedures.

Determination of amino acid profile

The automated method based on Speckman *et al.,* (1958) which employs Technicon Sequencial amino acid analyser (TSM) was used.

Statistical analysis

All data were analyzed using the statistical analysis for statisticians (SAS) package. The data were analyzed by one way ANOVA and significant ones followed with a post-hoc (LSD) test between groups. All data were expressed as mean + SD and probability tested at 95% level of significant ($P<0.05$).

Results and Discussion

The results of nutritional evaluation of *Ergeria radiata* and *Pomecia palludosa* are summarized in tables 1 while the toxicant contents are shown in tables 2.

Proximate composition

The moisture content of fresh and cooked *E. radiata* were significantly ($P<0.05$) higher than the respective values of fresh sun-dried and cooked *P. palludosa*.

The ash content of *P. palludosa* were not significant ($P>0.05$) different from those of *E. radiata* for both fresh and cooked samples.

Although, the values of the cooked oven-dried were lowered, the decrease was not significant ($P<0.05$).

There were no significant difference in the crude fat content of PP and ER whether fresh sun-dried or cooked oven-dried.

Crude fiber values were 15.00 + 0.01 obtained for both E. *radiata and P. palludosa* whether fresh or cooked.

The carbohydrate content of fresh sun-dried and cooked oven dried samples of both *Ergeria radiata* and *Pomecia palludosa* were not significantly different from each other.

Toxicants

The hydrogen cyanide contents were higher in *Ergeria radiata* than in *Pomecia palludosa*, but the levels were reduced on cooking by about 37%

The oxalate level of *Ergeria radiata* and *Pomecia palludosa* were not significantly different, and were also reduced following cooking.

Phytic acid concentrations in fresh sun-dried and cooked oven-dried *P. palludosa* were 0.35 ± 0.02 %, and 0.25 ± 0.13 respectively with percentage loss in cooking of 0.13. The values for *E. radiata* fresh sun-dried was 0.37 ± 0.03% and 0.25 ± 0.02 for cooked oven-dried with % loss 0.15 in cooking.

Biological value and protein quality

The body weight gain of the rats placed on *E. radiata* were significantly ($P<0.001$) higher than those placed on *P. palludosa*. Table 4

Their PER values were significantly ($P<0.001$) higher in *Ergeria radiata* than *Pomecia palludosa* and were both higher than the required standard value of 0.82 ± 0.001, Table 4

The NPR values obtained for *Ergeria radiata* and *Pomecia palludosa* were significantly different and higher than the NPR reference value (1.42 ± 0.001). The cooked oven dried samples had higher NPR values than fresh oven-dried, Table 3

The NPU values for the fresh sun-dried *E. radiata* and *P. palludosa* were significantly ($P<0.001$) lower compared with the reference. The fresh sun-dried samples of both *E. radiata* and *P. palludosa* compared marginally with that of casein, cooked samples had low NPU, Tables 3 and 4.

The TD value of cooked sun-dried *P. palludosa* and cooked oven-dried *E. radiata* were higher than that of casein. On the whole the samples appeared to have high digestibility and cooking improved digestibility, Table 4.

The BV of cooked oven dried *P. palludosa* and all other samples were comparable except cooked *E. radiate*, Table 4.

Amino acid composition

The amino acid composition of *E. radiata* and *P. palludosa* cooked oven-dried and fresh sun-dried samples are presented and compared with whole hen's egg and TAO (WHO, 1976) pattern in Table 5.

Glutamic acid occurred with highest amount in all the samples (cooked oven-dried and fresh sun-dried *E. radiata* and *P. palludosa* samples). Protein occurred in the least amounts, with exception of histidine, serine, alanine, tyronine and phenylalanine. The fresh samples had higher amino acid concentration than the cooked oven-dried, cooking as a processing method brought about changes on the amino acid profile pattern.

Discussion

Knowledge of the moisture content of food stuff, serves as a useful index of their keeping qualities and susceptibility to fungi infection. The fresh sun-dried samples of both *P. Paludosa* and *E. radiata* had lower moisture content than their corresponding cooked samples although the alterations were not significant ($P>0.05$). The findings here are in agreement with the report of Bender, (1966) who summarized that heat treatment significantly reduced moisture content. In general, moisture content in the fresh samples should normally be higher than the cooked ones but the fact that the fresh samples were sun-dried; this fact coupled with the length of time may have been responsible for the decrease in moisture content compared to the cooked oven dried. Going by these results, the *P. palludosa* samples may appear to have longer shelf life compared to *E. radiata* on account of their moisture content.

There were no significant changes in the ash value of *P. palludosa* fresh, sun-dried, and cooked oven dried. The same trend whether fresh sun-dried or cooked oven-dried were obtained for *E. radiata.* Similarly, the ash values for *E. radiata* and *P. palludosa* were not significantly different. The ash content represents the mineral content and is generally known that the mineral content varies with the type of soil or environment but the values reported here are within the range reported by Campbell-Platt, (1994).

Increase in carbohydrate content appears to be observed in cooked oven dried samples of *E. radiata* and *P. palludosa* compared with the corresponding fresh sundried sample. Heat processing appeared to increase the carbohydrate content of food (Akinrele IA, Edwards, 1971; Eastman, 1974).

Hydrogen cyanide content was significantly ($P<0.05$) higher in *E.* radiate compared with *P. palludosa*, cooking followed by oven drying reduced hydrogen cyanide contents. The reduction in hydrogen cyanide upon cooking and oven drying is an important observation since cyanide is known to be toxic to animals and it has been implicated in chronic degenerative neuropathy (Osuntokun). However, the concentrations of hydrogen cyanide obtained from our study are low compared with reported toxic concentration in human of 86mg-100mg/kg body weight.

The oxalic acid concentration was higher in both *E. radiata* and *P. palludosa* thus correlating with the carbohydrate content since oxalic acid arises from incomplete oxidation of carbohydrate, oxalic acid combines with calcium, iron and magnesium forming crystals of oxalate that may affect the gut and kidney Coe *et al.*, (2005). Calcium supplements taken along with foods containing oxalate can cause calcium oxalates to precipitate out in gut, thus reducing levels of the oxalate absorbed Morozumi, (2006).

In both *E. radiata* and *P. palludosa*, the phytic acid contents were low compared with toxic values of 90mg/kg in humans. Phytic acid, a principal storage form of phosphorus also chelates calcium, magnesium, iron and zinc Hurrell, (2003). Linder, (1992) reported that phytic acid prevents osteoporosis. Taking together, hydrogen cyanide and oxalate and phytic acid content of *E. radiata* were higher than the respective values of *Pomecia palludosa* in both cases and cooking reduced the amount of toxicants and these levels were low compared to toxic concentration in humans and being protein food the toxicant levels posed no adverse effects in consumers and were reduced upon processing.

The crude protein values obtained here are comparable with values (61.0 + 0.81) reported by Ifon and Umoh[24] for *E. radiata* and similarly compared well with those for periwinkle (*Littoring littorea*) (66.9%) and snail, *Vivapora quadrata,* 65.3% reported by Umoh and Bassir, (1977).

The values of crude protein obtained here in the study are higher than those reported for whole hen (40.7%) Umoh and Bassir, (1977). The USDA, (2007) have reported that protein content of apple snails are a good source of protein for humans for example protein value of *Pomecia haushu* is reported to be 72.9% for human, that is, it can provide 72.9g of human protein. Based on this consumption of *E. radiata* and *P. palludosa* can in part alleviate the problem of PEM although the foods are seasonal (Miller and Bender, 1955; Kikafunda and Bambona, 2055; FAO/WHO, 1991). Skeinke *et al.*, (1980) recommend the amino acid profile of a protein source is ideal for evaluation of dietary protein quality. The amino acid pattern of these lesser known protein sources presented and compared with that of whole hen's egg reported by Mba, (1980) and with FAO/WHO FAO, (1986) pattern showed that arginine and glutamine were present in higher amounts than those found in whole hen's egg. The three essential amino acids tyrosine, phenylalanine and leucine levels were comparable to those of whole hen's egg or even higher. All other amino acids determined were present but in lower quantities than the whole hen's egg. The essential amino acids leucine and lysine compared well with FAO/WHO FAO, (1986) pattern.

Both *E. radiata* and *P. palludosa* in either cooked oven dried or fresh sun-dried are deficient in phenylalanine, isoleucine, methionine but are sufficient in leucine, lysine with leucine even higher than FAO/WHO values in cooked *E. radiata* and *P. palludosa* samples.

Increase consumption of these lesser known protein sources over and above the present amount can meet the body needs of the essential acids which are deficient. Higher PER implies that the diet have high protein quality and the three essential amino acids tyrosine, phenylalanine and leucine levels were comparable to those in whole hen egg.

NPU values of the fresh sun-dried samples of *E. radiata* and *P. palludosa* were comparable with that of the standard, although those of the cooked samples were low, thus, it implies that nitrogen from *E. radiata* and *P. palludosa* is retained. TD values show that the *E. radiata* and *P. palludosa* have high digestibility. The BV of all samples were also comparable to those of the study.

Conclusion

The edible portions of *E. radiate* and *P. palludosa* delicacies consumed by riverine peasant Nigeria population are rich in crude protein, crude fat, fiber, ash, and carbohydrate contents. The carbohydrate contents were higher in *P. palludosa* than *E. radiate*.

Toxicant (hydrogen cyanide, oxalate and phytic acid) contents of *E. radiate* were higher than the respective values of *P. palludosa* in both cases and cooking reduced the amount of toxicants. These make *E. radiate* and *P. palludosa* delicacies cheap sources of food nutrients. Consumption of *E. radiata* and *P. palludosa* can in part alleviate the problem of PEM although the foods are seasonal.

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