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Towards Total Conservation and Utilization of Aquatic Resources from Lower Qua Iboe River Estuary. I. Microbiology, Nutritional Quality and Heavy Metals Content of *Thais callifera* from Itak Abasi Creek, Akwa Ibom State, Nigeria

by

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ABSTRACT

The determination of Microbiological and nutritional quality and heavy metals content of Thais callifera from Itak Abasi Creek of the lower Qua Iboe River Estuary was carried out with a view to encouraging its conservation and consumption. The total aerobic bacterial and fungal counts were 3.3 x 10^7 and 2.1 x 10^4 cfu g^{-1}, respectively while the brackish water from where they were harvested had a total aerobic bacterial and fungal counts of 4.3 x 10^7 and 5.1 x 10^4 cfu g^{-1}, respectively. Bacillus megaterium, Staphylococcus aureus, Micrococcus varians, Salmonella typhi, Escherichia coli, Aspergillus sp. and Candida albicans were isolated from the aquatic resource while in addition Penicillium chrysogenum and Rhizopus sp were isolated from the water. Consumption of T. callifera with the microbial isolates will pose serious public health hazards. The nutrient composition (%) was found to be 67.6, 20.6, 2.8, 4.3 and 4.7 for crude proteins, fat, fibre, ash content and carbohydrate, respectively. The heavy metals content of T. callifera from Itak Abasi (in mg g^{-1}) were 2.75, 2.28, 1.04, 0.53, and 0.19 for Iron, copper, lead, nickel and vanadium, respectively. Although the heavy metals content may seem to be low, continuous consumption may lead to bioaccumulation and subsequent heavy metal poisoning. Application of an integrated coastal zone management (ICZM) framework will conserve this important resource of the lower Qua Iboe River Estuary.

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INTRODUCTION:

In Nigeria and in most developing countries, there is a serious threat of malnutrition and mal-nourishment (Metcalf and Strile, 1980). Protein is in short supply and the protein intake of the people is far below the recommended average (Newman *et al*, 1972). Protein deficiency diseases are therefore very rampant. Efforts made towards improving protein intake has led to a near total dependence on conventional meat protein sources like beef, poultry, fish and their products at the expense of non-conventional meat delicacies like shellfish (Jackqort, 1978). The consequence of such attitude is that the conventional meat sources are grossly in short supply and is beyond the reach of the low income group who incidentally constitute more than 80% of our population (Hackney et al, 1980).

Widespread poverty due to global economic recession has also led to the consumption of some seafood by residents in coastal states of the country. Much work have been done on *Egaria radiata* (Bryan, 1980) and Periwinkle (Hunter and Lunden, 1983, Umoh and Bassir, 1977).

Important seafood that has been grossly under-utilized is *Thais callifera.*
T. callifera is an abundant seafood along the lower Qua Iboe River Estuary. According to Edmund (1978) it is highly proteinous and tasty. Apart from its nutritional qualities, the shell has found widespread use as a high calcium source in animal feed supplementation and decorations (Edmund, 1978).

However, some of the major problems reported to be associated with the consumption of seafood include amongst others, the high heavy metals concentration and prevalence of pathogenic bacteria due to pollution of the shoreline by faecal materials. There is paucity of information on the microbiological and nutritional quality and heavy metals content of *T. callifera* from the lower Qua Iboe River Estuary. Moreover, Itak Abasi, a major creek by the Atlantic Ocean / Qua Iboe River mouth receives petroleum production effluent (PPE) from Mobil Producing Nigeria Unlimited, the second largest crude oil producer in Nigeria and the largest condensate producer in Africa (Mobil News, 1997). The quality of *T. callifera* from Itak Abasi creek of the lower Qua Iboe River Estuary (Fig. 1.0) will be used to predict the quality of the environment. This is because it is an important food resource available to the residents.

This paper describes the microbiology, nutritional quality and heavy metals content of *T. callifera* from Itak Abasi creek along the lower Qua Iboe River Estuary with a view to recommending its conservation and consumption.

MATERIALS AND METHODS

Collection and Treatment of Samples:

Samples of *T. callifera* were harvested from the mangrove roots along Itak Abasi Creek and the water sample from where the seafood were fished was collected in separately labelled sterile containers. The samples were transported to the laboratory for analysis.

The *T. callifera* samples for microbiological analyses were thoroughly washed with distilled water. They were cracked with a sterile hammer on a sterile surface (sterilized with alcohol and allowed to dry). The fleshy edible (meat) portion were picked with the aid of a sterile needle and rinsed with distilled water. They were then homogenized using a sterile crucible mortar and pestle.

Microbiological Analysis:

(a) **Serial Dilution:** A ten-fold Serial dilution of the sample was carried out according to the methods of Harrigan and McCance (1976).

(b) **Inoculation and Incubation:** One milliliter (1.0 ml) of appropriate 10-fold serial dilutions of the sample was inoculated on to nutrient agar (Oxoid CM 3), McConkay agar (Oxoid CM 7), Sabouraud dextrose agar (Oxoid CM 8), and TCBS (Oxoid CM 11) agar plates, in duplicates using pour plate technique of Harrigan and McCance (1976). One set of the inoculated plates were incubated at 37^0 C for 18-24h while another set were incubated at ambient (room) temperature (28 ± 2^0 C), for 48-72h. Visible discrete colonies in incubated plates were counted and expressed as colony forming units per gram (cfu g^{-1}).

(c) **Maintenance of Pure Culture:** Discrete colonies were purified by repeated subculture onto appropriate nutrient media. Pure cultures were preserved on nutrient

media slants and stored in the refrigerator (4^0C - 8^0C) until needed for further tests.

d) **Characterization and Identification of Microbial Isolates:** Pure cultures of microbial isolates were characterized based on cultural parameters, microscopic techniques and biochemical tests including carbohydrate utilization as described by Cruickshank *et al* (1975). Identification of the bacterial isolates was accomplished by comparing the characteristics of the cultures with that of known taxa using Bergey's Manual of Determinative Bacteriology of Buchanan and Gibbons (1974). Additional characterization criteria for the mould isolates included microscopic appearance of hyphae, shape and kind of asexual spore, presence of special structures such as footcell, sporangiophore or conidiophore and the characteristics of spore head. The probable identities of the moulds were determined according to the methods of Domsch and Gams (1970). The yeast isolates were identified using the schemes described by Barnett and Pankhurst (1974).

Nutritional Quality Determinations:

Moisture, crude protein, fat, fibre and ash contents of *T. callifera* were determined according to AOAC Methods (AOAC, 1975). Carbohydrate content was calculated by difference. The energy content was obtained by multiplying the protein, fat and carbohydrate content by factors 4, 9, and 4, respectively and summing them together (AOAC, 1975).

Heavy Metals Analysis:

The fleshy edible (meat) portion of *T. callifera* from Itak Abasi Creek was digested using the mixed acid digestion method of the Association of Official Analytical Chemist (AOAC, 1975). The digest was aspirated directly into Atomic Absorption Spectrophotometer, AAS (Pye Unicam 919 Model) with appropriate cathode lamps and wavelengths for each metal. The results of the analysis were recorded as R in the readout column of the instrument and later converted to mg l^{-1} (ppm) using the formular.

$$Mg\ l^{-1}\ (ppm) = (R \times D \times V) / Wt$$

where D is the dilution factor; V is the volume of digest prepared, and Wt is the weight of *T. callifera* originally taken for the digestion.

RESULT

Microbial Counts:
Microbial counts of *T. callifera* and the water sample from where they were harvested are presented on Table 1.0. The microbial counts of the aquatic resources are higher than that of the water from where they were harvested. While the total aerobic bacterial count of the *T. callifera* was 3.3×10^8 cfu g^{-1}, the corresponding count for the water where they were harvested was 4.3×10^7 cfu l^{-1}.

Characteristics of the Microbial Isolates:

The characteristics and identification schemes of the microbial isolates from *T. callifera* and its environment show that the isolates belonged to 5 genera of bacteria, 3 of fungi and 1 of yeast. Two species of *Bacillus* were identified.

Nutritional Quality of *T. callifera*:

Table 2.0 shows the nutritional properties of *T. callifera* from Itak Abasi Creek. The crude protein content was found to be quite high (67.6%) with the energy content of 474.6Kcal.

Heavy Metals Content of *T. callifera*:

Heavy metals content of *T. callifera* from Itak Abasi creek is as presented on Table 3.0. It was observed that the heavy metals content of *T. callifera* decreased with increase in body weight.

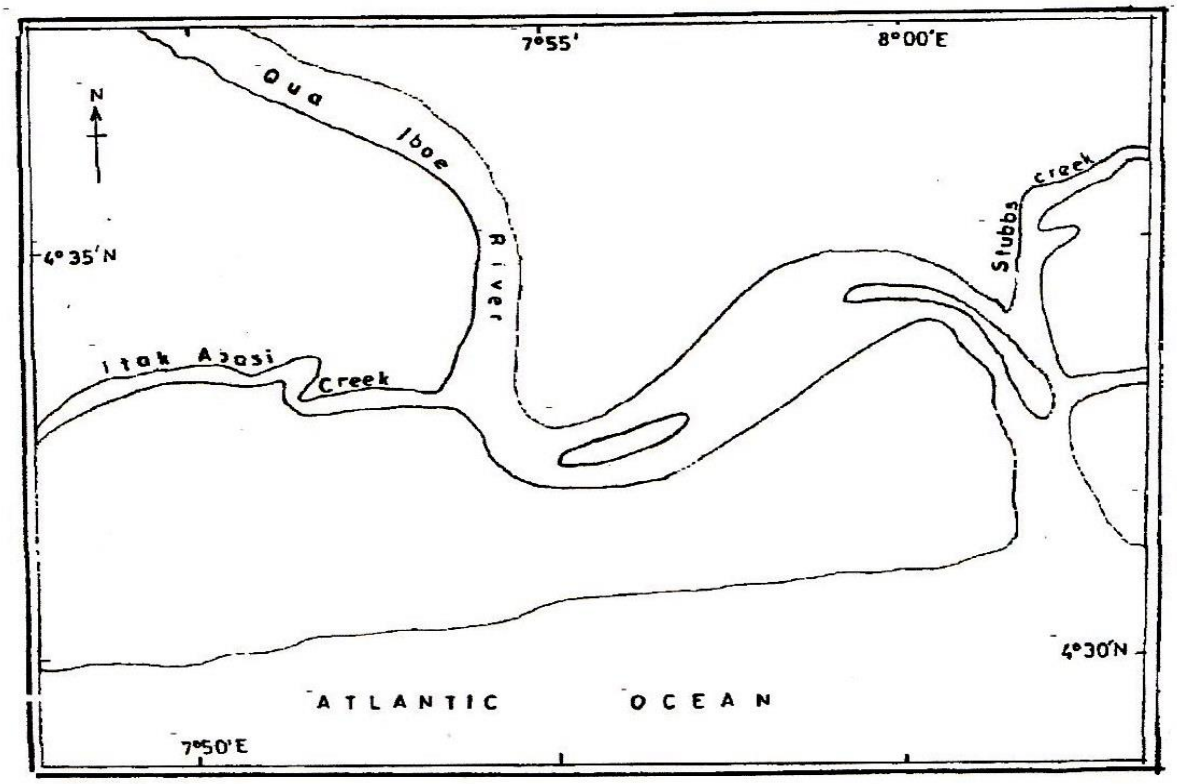

Fig. 1.0: Lower Qua Iboe River Estuary showing Itak Abasi Creek

Table 1.0: Microbial Count of *T. callifera* and Brackish Water:

Sample	Microbial count		
	Total Bacteria	**Total Fungi**	**Total coliform**
T. califera	$3.3\pm0.2 \times 10^{8}$ cfu g^{-1}	$2.1\pm0.2 \times 10^{5}$ cfu g^{-1}	$3.1\pm0.1 \times 10^{4}$ cfu g^{-1}
Water	$4.3\pm0.1 \times 10^{7}$ cfu L^{-1}	$5.1\pm0.3 \times 10^{4}$ cfu L^{-1}	$2.3 \pm0.2 \times 10^{3}$ cfu L^{-1}

Table 2.0: Nutritional Properties of *T. callifera* from Itak Abasi Creek

Parameters	Values
Crude Protein (%)	67.6
Crude fat (%)	20.6
Crude fibre (%)	2.9
Ash content (%)	4.2
Carbohydrate (%)	4.7
Energy content (cal)	474.6

Table 3.0: Heavy metals content of T. *callifera* from Itak Abasi Creek

Mean Dry body	Metal (mg g^{-1}				
weight (g)	Fe	Cu	Pb	Ni	Ve
2.5 - 3.0	2.75±0.2	3.8±0.3	1.04±0.2	0.53±0.1	0.19±0.2
3.5 - 4.5	2.32±0.1	2.50±0.2	0.87±0.2	0.47±0.2	0.12±0.1
5.0 and above	2.07±0.1	2.0±0.2	0.73±0.2	0.39±0.1	0.10±0.1

DISCUSSION:

The role of protein in a diet cannot be over-emphasized. A diet is balanced when it has adequate protein and other essential nutritional factors as its constituent (Pellet and Young, 1980). Due to the prevalent malnutrition in major urban slums and rural areas, the need for cheap, protein - rich and readily available source is quite necessary (Ifon and Umoh, 1987; Egwelle, 1982). Seafoods in general and shellfishes in particular have been identified as a rich protein substitute to conventional animal protein sources (Umoh, *et al*, 1980; Umoh and Bassir, 1977).

Thais callifera is one of the seafoods found on West African Coast and Estuaries (Edmund, 1978). The samples used in this work were harvested from Itak Abasi Creek of the lower Qua Iboe River estuary. Since this creek does not only receive unregulated sewage from the residents of the fishing settlements along this creek, but also effluent from industries, they are bound to be contaminated. Adequate knowledge of the impact of the unregulated effluent on the survivability of the organism, and the microbiology, nutritional quality and heavy metals content of these organisms is necessary for its conservation and effective utilization.

Itak Abasi Creek of the lower Qua Iboe River Estuary from where the *T. callifera* for this study were harvested receives effluent from Mobil Producing Nigeria Unlimited, MPNU (the 2nd largest Oil Producing Company in Nigeria and the largest condensate producer in Africa). The pollution status of this environment (the lower Qua Iboe River Estuary) has been monitored and found to be quite high (Udotong, *et al*, 1997). *T. callifera* harvested from Itak Abasi Creek along the lower Qua Iboe River Estuary has been shown to be contaminated. This may have been the reason for its general rejection despite its high-protein and energy content.

The high microbial counts of the seafood in general and high total coliform counts in particular (Table 1.0) gives an indication of unwholesomeness (ICMSF, 1978; Powers, 1976). The microbial counts of *T. callifera* are higher than counts of the water from where they were harvested. This is not surprising, as this organism is a filter feeder. Moreover, the presence of enteric bacteria like *E. coli* and *Salmonella* sp., is a major cause for concern because of its public health implications: they are capable of causing food borne diseases. The detection of E. *coli* from both samples (*T. callifera* and water) is indicative of recent faecal contamination of the environment. The presence of *Staphylococcus aureus* and *Candida albicans* from both *T. callifera* and the water from where they were harvested suggests that the residents here bath in this water since *S. aureus* is normal flora of the skin. *T. califera* has been reported by Fiegier and Novak (1981) to be rich in protein and carbohydrate. *T. callifera* is said to be different in its chemical composition from other shellfishes by having a high carbohydrate and nitrogen

content. Effective utilization of this protein rich aquatic resource is therefore recommended to improve the protein intake of the rural peasant populations usually affected by the protein energy malnutrition (PEM) deficiency syndrome (Egwelle, 1982; Pellet and Young,1980; Umoh et al.,1980).

The pollution status of Itak Abasi Creek of the lower Qua Iboe River Estuary may endanger the survivability and existence of *T. callifera*; the whelk may become extinct with continuous exposure to these pollutants. An integrated resource management approach, such as integrated coastal zone management (ICZM), is required to address the broad range of social and environmental issues along the lower Qua Iboe River Estuary and adjoining creeks and to move of the region towards sustainable development. Conservation of *T. callifera* in particular and other coastal resources in general through this approach is necessary because according to Moffat and Linden (1995), ICZM has two fundamental objectives:

i) To promote sustainable utilization of coastal resources, and
ii) To restore and maintain the integrity of coastal ecosystems.

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