Bacteriological and Nutritional Qualities of Street – Vended Seafoods in Parts of Rivers State, Nigeria

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Abstract— It is noted in this study that one of the core principles of prevention of consumption of seafoods contaminated with microorganisms which may be pathogenic to consumers or that may cause food poisoning, is prevention of contamination by food handlers at wholesale and retail levels. However, the barriers of old practices and perhaps the most important of all, the yet unfulfilled need for continuing education of food handlers and street vendors at all levels of processing and retail make implementation of the acknowledged principles difficult. Consumers can protect themselves from potential problems that could arise from contamination, by refrigerating street-vended shucked shellfish as soon as possible after purchase and consuming them, adequately cooked, within two to three days.

I. INTRODUCTION

One of the great attractions of the Niger Delta region of Nigeria is the availability of seafood delicacies. Among the favourites are fresh fish, crustaceans and shellfish. There are numerous molluscan shellfish in the vast mangrove of the Niger Delta region of Nigeria but only a few reports on their ecology and distribution have been made (Deekae & Idoniboye-Obu, 1995).

These molluscs occur in several habitats in the mangrove and are found within salinities ranging from 2 to 4 ppt in the Nigeria and other estuaries in West Africa (Deekae & Idoniboye-Obu, 1995). They constitute a major source of protein in the diet of the people of the Niger Delta and other coastal states of Nigeria. Studies by Umoh and Basir (1977) and Mba (1980) showed that the protein contents and chemical composition of the molluscs are comparable to those of eggs.

Seafoods of economic importance popularly consumed by indigenes of the Niger Delta, especially the residents of the coastal areas of Nigeria include Thais callifera locally called ‘ngolo’, Tympanotonus fuscatus locally called ‘isam’ or ‘mi’ and Arca senilis locally called ‘ofingo or clam’. These sea foods are highly proteinous and tasty (Edmund, 1978).

In addition to the nutritional qualities of the flesh, the shells have found widespread use as high calcium sources in animal feed supplementation, and in decoration and road construction. Effective utilization of these protein rich aquatic resources is recommended to improve the protein intake of rural peasant populations usually affected by protein deficiency syndrome.

Risks Associated with Bare-Hand Contact with Food

In the food industry, contamination from microorganisms can be responsible for infectious disease outbreaks passed from food handlers to consumers via food (Paulson, 1996). Microflora of skin is categorized into resident and transient types. Resident bacteria are those that normally reside on the skin, in this case, the skin of the hands. Ninety percent of the resident flora of the hands are coryneform and coagulase negative staphylococci (Miller, 1994).

Among the resident microflora, Staphylococcus aureus is the only true pathogenic organism of food safety concern (Lowbury et al., 1964; Miller, 1994).

Resident flora are not easily removed by mechanical friction (Larson, 1995) since they are buried deep within the pores where they are protected by sebaceous gland secretions (Miller, 1994; Restaino & Wind, 1990). Transient organisms are of concern because they are readily transmitted by hands unless removed by mechanical friction of washing with soap and water or destroyed by the use of an antiseptic solution (Larson, 1995). Transient organisms can be considered skin contaminants that are acquired from environmental sources and become attached to the outer epidermal skin layer (FDA, 1999; Restaino & Wind, 1990). Hands as well as contaminated gloves, serve as vectors for transmission of transient microorganisms (Fendler et al., 1998).

II. MATERIALS AND METHODS

Source of Samples

Samples were collected from 6 popular sea food vendors at the Creek Road market and seafood harvesters at the waterside. The sea foods were all harvested from the Primroz Channel of Bonny River (Fig. 1).

Preparation of Samples for Analysis

Samples of street-vended seafoods which included Thais callifera, Tympanotonus fuscatus and Arca senilis (fig. 2) were purchased from street vendors at the Creek Road market over several weeks. The fresh, processed (i.e. shucked) samples, processed by the street vendors themselves, were collected and placed in labeled sterile sampling containers and kept in an ice box with temperature maintained at 4°C to minimize changes in population and concentration of bacteria.

Fresh live samples of each of the seafoods, to be processed aseptically in the laboratory, were also collected from harvesters at the waterside and placed in labeled sampling
containers. The samples were taken immediately to the laboratory and processed aseptically for analysis.

A portion of samples of each of the street-vended seafoods were subjected to further treatment in the laboratory by rinsing with sterile distilled water before bacteriological analysis.

Another portion of samples of each of the street-vended seafoods were also subjected to further treatment in the laboratory by precooking at 80°C for 3 minutes before bacteriological analysis.

**Analysis for Proximate Composition**

Analysis of proximate composition of each type of sea food was carried out to determine the moisture, carbohydrate, lipid, protein and ash contents as well as mineral composition.

### III. PRESENTATION OF RESULTS

**Proximate values of some street-vended sea foods in Port Harcourt.**

The proximate compositions of the selected molluscan shellfish sold in port Harcourt are presented and discussed. Values for mineral content of the selected molluscan shellfish are presented are also presented and discussed. They include calcium and phosphorus in significant amounts. Values for iron, magnesium, manganese, sodium and zinc are also shown. Heavy metals were not detected (Table 1).

**TABLE 1.** Mineral and heavy metal contents of some street-vended seafoods in Port Harcourt.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value (%)</th>
<th>Thais callifera</th>
<th>Tympanotonus fuscatus</th>
<th>Arca senilis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calcium (Ca)</td>
<td>0.402</td>
<td>0.582</td>
<td>0.610</td>
<td></td>
</tr>
<tr>
<td>Iron (Fe)</td>
<td>0.392</td>
<td>0.401</td>
<td>0.552</td>
<td></td>
</tr>
<tr>
<td>Magnesium (Mg)</td>
<td>0.028</td>
<td>0.024</td>
<td>0.032</td>
<td></td>
</tr>
<tr>
<td>Manganese (Mn)</td>
<td>0.108</td>
<td>0.113</td>
<td>0.168</td>
<td></td>
</tr>
<tr>
<td>Potassium (K)</td>
<td>0.128</td>
<td>0.182</td>
<td>0.180</td>
<td></td>
</tr>
<tr>
<td>Sodium (Na)</td>
<td>0.178</td>
<td>0.088</td>
<td>0.250</td>
<td></td>
</tr>
</tbody>
</table>

*ND: Not Detected

**Bacteriological analysis of samples of some street-vended seafoods in Port Harcourt**

Total viable bacterial counts of processed street-vended seafoods are presented and discussed. Values for processed street-vended seafoods purchased from street vendors and rinsed in the lab using sterile distilled water processed street-vended sea foods purchased from street vendors and precooked at 80°C for 3 minutes, and seafoods processed in the laboratory hygienically are also discussed.

Plate count values of street-vended seafoods were $4.06 \times 10^7$ cfu/g for *Thais callifera*, $3.85 \times 10^7$ cfu/g for *Tympanotonus fuscatus* and $1.21 \times 10^8$ cfu/g for *Arca senilis*.

The mean pH value of the seafoods, 8.62 for *Thais callifera*, 8.72 for *Tympanotonus fuscatus*, 6.62 for *Arca senilis*, is optimum for microbial growth. Most bacteria have pH minimums ranging from 4.0 to 5.0. The mean holding temperature of the sea foods by the street vendors was 29°C.

**Staphylococcal counts**

Staphylococcus counts on selective medium counts were $5.30 \times 10^5$ cfu/g, $4.45 \times 10^5$ and $7.0 \times 10^5$ cfu/g in street-vended samples of *Thais callifera*, *Tympanotonus fuscatus* and *Arca senilis* respectively.

Plate counts were $5.36 \times 10^4$ cfu/g, $4.45 \times 10^5$ cfu/g and $7.09 \times 10^5$ cfu/g in street-vended samples of *Thais callifera*, *Tympanotonus fuscatus* and *Arca senilis* respectively.

*Vibrio* spp. were neither detected in samples processed in the laboratory nor in samples preheated at 80°C for 3 minutes (Fig. 3).
Counts of salmonellae

Salmonella plate counts were 1.07 x 10^2 cfu/g, 2.00 x 10^2 cfu/g and 3.50 x10^2 cfu/g in street-vended samples of Thais callifera, Tympanotonus fuscatus and Arca senilis respectively, and Shigella plate counts were 1.07 x 10^2 cfu/g, 2.00 x 10^2 cfu/g and 3.50 x 10^2 cfu/g in the same order.

Coliform counts

Total coliform counts and faecal coliform counts are presented in Table 2. Generally, counts were lower in samples of Tympanotonus fuscatus than in samples of Thais callifera.

** TABLE 2. Total Coliform counts in samples of street- vended seafoods in port Harcourt.**

<table>
<thead>
<tr>
<th>Sample code</th>
<th>Holding temperature(oC)</th>
<th>Thais callifera</th>
<th>Tympanotonus fuscatus</th>
<th>Arca senilis</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lab1*</td>
<td>30.0</td>
<td>8.72</td>
<td>&gt;1100</td>
<td>8.78</td>
</tr>
<tr>
<td>Str1*</td>
<td>30.0</td>
<td>8.48</td>
<td>&gt;1100</td>
<td>8.77</td>
</tr>
<tr>
<td>Str2</td>
<td>30.0</td>
<td>8.60</td>
<td>&gt;1100</td>
<td>8.72</td>
</tr>
<tr>
<td>Str3</td>
<td>28.5</td>
<td>8.62</td>
<td>&gt;1100</td>
<td>8.72</td>
</tr>
<tr>
<td>Lab2</td>
<td>28.5</td>
<td>8.69</td>
<td>93</td>
<td>8.65</td>
</tr>
<tr>
<td>Str4</td>
<td>28.5</td>
<td>8.48</td>
<td>&gt;1100</td>
<td>8.77</td>
</tr>
<tr>
<td>Str5</td>
<td>28.5</td>
<td>8.62</td>
<td>&gt;1100</td>
<td>8.73</td>
</tr>
<tr>
<td>Str6</td>
<td>28.5</td>
<td>8.62</td>
<td>&gt;1100</td>
<td>8.73</td>
</tr>
<tr>
<td>Lab</td>
<td>29.0</td>
<td>8.69</td>
<td>&gt;1100</td>
<td>8.72</td>
</tr>
<tr>
<td>Str</td>
<td>29.0</td>
<td>8.63</td>
<td>&gt;1100</td>
<td>8.65</td>
</tr>
<tr>
<td>Rin*</td>
<td>29.0</td>
<td>7.55</td>
<td>&gt;1100</td>
<td>8.72</td>
</tr>
<tr>
<td>Pre*</td>
<td>29.0</td>
<td>7.54</td>
<td>&gt;1100</td>
<td>8.62</td>
</tr>
</tbody>
</table>

* - rods, gram negative rods; +, ++, +++ indicate density of metallic sheen colour of colonies--; colonies exhibiting green metallic sheen not seen; lab, laboratory processed sample; Str, street vended sample; Rin, rinsed street-vended sample; pre, pre-cooked street-vended samples

IV. DISCUSSION OF RESULT

The nutritional and bacteriological qualities of the popular street-vended molluscan shellfish Thais callifera, Tympanotonus fuscatus and Arca senilis were determined. The proximate composition of the sea foods show the sea foods to contain an appreciable percentage crude protein. Thais callifera has a substantial content of carbohydrate material. Molluscan shellfish differ in chemical composition from both fish and crustacean shellfish in having significant carbohydrate material, largely in form of glycogen (Watt & Merrill, 1950). Seafoods provide high quality protein which ensures proper functions of the body.

An evaluation of the bacteriological quality of the selected street-vended seafoods showed that these sea foods contained various bacteria including Vibrio spp., Enterobacter spp., Micrococcus spp., Bacillus spp., Pseudomonas spp., Salmonella spp. and Shigella spp. and Staphylococcus spp.

The microbial quality of the river, estuaries and seashores from which seafoods are harvested influence the microflora of seafood samples (Pelczar et al., 1986).

The isolation of faecal coliforms, Shigella spp. and Bacillus spp. from samples processed in the laboratory would indicate that the sea foods were contaminated from where they were harvested.

It was also observed from processed (shucked) street-vended samples, that during processing, further contamination with bacterial pathogens occurred. The process of shucking with bare hands in an uncontrolled and filthy environment, with little or no regard for proper food handling practices, could result in further contamination of the seafood with bacteria and bacterial spores from the hands, nails, nasal passage and mouth of the workers during processing and from the environment where the processing was being carried. Also, poor handling practice during retailing and purchase results in further contamination of the seafood. The isolation of Staphylococcus spp., faecal coliforms, Vibrio spp. and Salmonella spp. as well as the dominance of Bacillus spp. in total viable bacterial plate counts may confirm this. Further studies showed most of the Staphylococcus species isolated to be non pathogenic Staphylococci.

Using the MPN technique, faecal coliforms were detected in street-vended samples of Thais callifera, Tympanotonus fuscatus and Arca senilis. Faecal coliforms were also detected in samples of the same seafoods processed in the laboratory. This indicates that faecal contamination of the street-vended samples of the seafoods is from where the seafood was harvested.

Ninety percent (90%) of the samples of Thais callifera and all samples of Arca senilis studied in the laboratory demonstrated faecal coliform counts of 1100 coliforms per
100g and more than (> ) 1100 coliforms per 100g. Lower coliform counts were observed in both street-vended samples and laboratory processed samples of *Tympanotonus fuscatus*. Further tests confirmed the presence of *Escherichia coli* in all street-vended samples. Such high counts indicating gross faecal contamination of these seafoods are most likely due to faecal pollution of the environment from where these seafoods were harvested.

However, when processed samples were precooked at 80°C for 3 minutes, faecal coliforms were no longer detected in samples of *Tympanotonus fuscatus* and *Arca senilis*; counts of up to 900 coliforms per 100gg of sample were still observed for *Thais californa*, indicating that *Thais californa* must be boiled properly to eliminate coliforms in the samples.

This may be because *Thais callifera* is larger in flesh size than *Tympanotonus fuscatus* and *Arca senilis*. Most strains of *Escherichia coli* are harmless commensals.

However some strains are pathogenic and can cause diarrhoeal disease. The infectious dose of E. coli is quite low, so as much as possible their mere presence must be avoided.

In summary, although species of bacteria which include pathogenic strains were isolated from the seafoods, the plate count values of *Staphylococcus* spp., *Vibrio* spp. and *Salmonella* spp. were below growth values required to cause disease, whereas the values for faecal coliforms and *Shigella* spp. were high. Although most of these bacteria may be non-pathogenic to humans, some strains cause various forms of gastroenteritis, while some are important human pathogens responsible for a variety of diseases (Prescott et al., 1996). However, the pH of the seafoods and the holding temperature of the seafoods by the street vendors may encourage bacterial proliferation.

Species of *Vibrio*, *Shigella* and faecal coliforms were found to be present due to faecal contamination of the seafoods from the water where they were harvested, and species of *Staphylococcus*, *Salmonella* and *Vibrio* were found to be present as a result of poor food handling practice by the street vendors during processing and retail operations.

Hygienic food handling involving the use of clean potable water and minimal contact with bare hands as well as mild heat processing of the seafoods, was observed to have improved the overall bacteriological quality of the seafoods by reducing the overall total viable counts and eliminating the presence of *Staphylococcus* spp., *Salmonella* spp. and *Vibrio* spp. in processed seafoods.

REFERENCES


