Bacteriological Study of Grilled Fish Consumed in Yamoussoukro Commune, Political Capital of Côte d'Ivoire

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Abstract: The objective of this study is to evaluate hygienic quality of "grilled fish" sold in the streets of Yamoussoukro, political capital of Côte d'Ivoire. We have concentrated on the steps of fresh fish removal guts (scale/evisceration), grilled, condiments, mixed condiments and grilled fish ready for consumption. Microbiological analyses aimed at the counts Total Aerobic Mesophilic Flora (TAMF) on PCA agar, Staphylococci (STAPH) on Mannitol-Chapman agar, Total Coliforms (TC) and Thermotolerant (THC) BCP-D agar, (SAL) Salmonella DCLS agar. 144 samples were analyzed during three months (April to June 2009). It appeared that the preparation of the fish before cooking is not hygienic. However, cooked remains the best way to reduce the number of corrupt samples. The production of the final meal, with the addition of condiments leads to the food re-contamination.

Key words: Coliform, food hygiene, grilled fish, intoxication, Salmonella, Staphylococcus, street

INTRODUCTION

Food sold in the streets are very common in developing countries. Prepared, most often by women as commercial activities, they have the advantage to be varied. We found meat, fish, cereals, milk, etc. (Obayelu et al., 2009) and available at all time (FAO, 1996). As such, this consuming mode is the mode of quick and easy consumption affecting all social groups (Mensah et al., 2002).

However, the conditions of preparation and selling are sources of contamination especially by germs involved in poisoning food (Kunene et al., 1999). Diseases resulting are a major problem of food safety and a reason of mortality in developing countries (Bukar et al., 2010).

Faced with this issue of public health in developing countries (Elmahmood and Doughari, 2007), we have undertaken the study of cooked fish commonly called "grilled fish”, sold in the streets of the District of Yamoussoukro. We plan to assess the microbiological quality of this type of food and propose to identify the principal reasons of bad hygiene. During our study, we’ll also consider impact of preparation and selling mode to safety risks.

MATERIALS AND METHODS

Essential preparation steps: Fish used are carp (Cyprinus carpio). They have sins in the Kossou barrage (town located at 40 km of Yamoussoukro). Condiments contained mixture of slices of various vegetables, spices, industrial condiments (mayonnaise, tomato paste, canned, vinegar, refined palm oil, salt, Maggi cube). The diagram of preparation is summarized in Fig. 1.

Samples: The study was conducted in the streets of the District of Yamoussoukro over a period of three months: April to June 2009. A questionnaire, prepared by our care, has helped us identify provenance of raw materials, hygiene conditions, school level of cooks, knowledge on food safety and also consumer category.

They were concerned the steps of scales and eviscerated fish, fresh fish, grilled fish and condiments. We have divided Yamoussoukro in three areas to take account all category of consumer. It is the principal road (because of travelers), the "maquis-street" (for tourists), and 220 accommodations (for the local population).

The frequency of sampling is by week and by sector for a total of 144 samples (36 fresh fish scale-eviscerated, 36 grilled fish, 36 condiments, 36 fish ready for consumption).
Fish Condiments

Washing

Slice Washing

Covering (tomato, salt, oil, spice extract)

Mixture

Grilled*

Adding vinegar, mayonnaise, and other ingredients

Ready to eat grilled fish

Fig. 1: Essential steps of grilled fish preparation *. A phase of pre-heating followed the final cooking after the consumer choice

Table 1: Media Designations Roles

<table>
<thead>
<tr>
<th>Designations</th>
<th>Roles</th>
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<tbody>
<tr>
<td>Physiological water (9% NaCl)</td>
<td>Dilutions</td>
</tr>
<tr>
<td>Water buffered peptone (DIFCO)</td>
<td>Pre-enrichments for Salmonella counts</td>
</tr>
<tr>
<td>Sodium selenite + Cystine (AES)</td>
<td>Enrichment for Salmonella counts</td>
</tr>
<tr>
<td>PCA agar (BIOMEREUX)</td>
<td>Enumeration of TAMF</td>
</tr>
<tr>
<td>BCP-D agar (BIOMEREUX)</td>
<td>Total and thermotolerant Coliform count</td>
</tr>
<tr>
<td>Mannitol chapman agar (SHARLAUD)</td>
<td>Enumeration of Staphylococci</td>
</tr>
<tr>
<td>DCLS agar (Oxoid)</td>
<td>Count of salmonella</td>
</tr>
</tbody>
</table>

consumption). Transport to laboratory required hoarfrost with dry-ice.

For each samples, we counted Total Aerobic Mesophilic Flora (TAMF) for the estimation of general hygiene, Staphylococci (STAPH) because they contaminate orifices and skin of the manipulators, Total Coliforms (TC), Thermotolerant Coliforms (THC) as indicators of recent fecal contamination and Salmonella (SAL) because Yamoussoukro is an endemic area of typhoid fever.

Microbiological analyses: Ten g are taken for each analyze. Sample is mashed in sterile porcelain mortar. The end result is dissolved in 90 mL of physiological water (9% NaCl) and homogenized by rotation during three (03) min. With this first dilution (1/10), a series of dilution is performed by adding successively to 1 mL of the mixture 9 mL of physiological water. (0.1 (repeated twice) mL) of each dilutions is spread on the appropriate medium. The techniques used and the limits are listed in Table 1 and 2.

After incubation at 37°C for 24 h, we counted all colonies on PCA agar (TAMF). According to Mannitol-Chapman agar, incubated at 37°C/48 h only colonies mannitol+(yellow) were counted. Incubation of BCP-D agar is made at 37°C/24 h for total coliform and 44°C/48 h for thermotolerant coliforms. Suspected colonies are yellow (Lactose+). After a pre-enrichment of 25 g of sample in water buffered peptone (35°C/24 h), followed by enrichment in Sodium Selenite/Cystin broth (35°C/24 h), 1 mL is spread over DCLS agar and incubated at 37°C/24 h. The colonies (SAL) colorless, translucent or whitish are counted. The averages for each counts allowed us to assess the corrupt samples.

RESULTS AND DISCUSSION

The results are summarized in Table 3. They highlight percentage of samples corrupt in accord with the limits (Table 2). They take into account the steps of fresh fish, scale-eviscerated fish, grilled with or without condiments and condiments.

Fresh, scale/eviscerated, grilled fish: Fresh fish, scale/eviscerated fish analyzed on PCA agar (TAMF), BCP-D agar during 24 h at 37°C (TC), Mannitol-Chapman agar (STAPH) are all corrupt. Seventy five percent are outside of limit according THC (BCP - D agar during 48 h to 44°C) and 25% (DCLS agar) a presumption of presence of SAL. However grilled reduced these rates. TAMF is brought 100 to 14%, STAPH from 100 to 75 and 100 to 50% according to TC, THC from 75 to 25% and 25% to absence for SAL in 25 g for all samples according to the technique used.

The high rate of fresh fish outside could be explained by the practice of scale and evisceration (Mensah et al., 2001; Roberto et al., 2006) exclusively manual using contaminated equipment and work surfaces added to it a poor clean water (Oranusi et al., 2007). Our investigation was especially designated the equipment and utensils used, the absence of cold throughout the process, the work

Table 2: Microbiological criteria

<table>
<thead>
<tr>
<th>Bacteria</th>
<th>Limits</th>
<th>Standards concerned</th>
</tr>
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<tbody>
<tr>
<td>FAMT</td>
<td>10^7 UFC/g</td>
<td>V 08-011/ISO 4833 (1991): count the TAMF</td>
</tr>
<tr>
<td>Staphylococci</td>
<td>10^6 UFC/g</td>
<td>08-014/ISO v 6868 (1948): Enumeration of Staphylococcus</td>
</tr>
<tr>
<td>CT/CTH</td>
<td>10^7 UFC/g (CT); 10 UFC/g (CTH)</td>
<td>V 08-015/ISO 4832 (1991): Enumeration of coliforms</td>
</tr>
<tr>
<td>Salmonella</td>
<td>Absence in 25 g</td>
<td>V 08-013/ISO 6579 (1993): Research of Salmonella</td>
</tr>
</tbody>
</table>

Guiraud, 1998
It consists mainly of feces of farm animals (Mensah et al., 2007). Another factor of contamination of vegetables is compost. Waters constitute the majority of the irrigating system. Operation of purification centers. Unfortunately, these water from the city. However, we found a defect in interconnected. It is also the place of recovery of waste. The lake system of Yamoussoukro commune is principally produce around the lakes. Yamoussoukro are principally produce around the lakes. The beneficial effect of heat treatment on the reduction of the levels of contamination is recognized in the food process (Akaki et al., 2008). However, the manual manipulation during cooking, the poor maintenance of utensils, insalubrious working environment are sources of re-contamination of grilled fish (Barro et al., 2006; Kunene et al., 1999; Oranusi et al., 2007).

**Grilled fish and condiments:** The effect of heat treatment is allayed by the adding of condiments. Indeed, the analysis of condiments gives 75, 86.11, 100, 75, 36.11% corrupt samples respectively for TAMF, STAPH, TC, THC and SAL (Table 3). His addition will set to be the origin of the increase in the proportion corrupt food. Our investigations revealed that vegetables used in Yamoussoukro are principally produce around the lakes. The lake system of Yamoussoukro commune is interconnected. It is also the place of recovery of waste water from the city. However, we found a defect in operation of purification center. Unfortunately, these waters constitute the majority of the irrigating system. Another factor of contamination of vegetables is compost. It consists mainly of feces of farm animals (Mensah et al., 2001). The post-harvest treatments and poor storage conditions, the presence of insects, rodents or pests, the physical alterations (damages) are any possible contamination ways (Guiraud, 1998; Oranusi et al., 2007).

McKellar et al. (2002) have shown through a model of probability that mayonnaise associated to ingredients is a medium who share its composition (salt, pH, acetic acid, sucrose) may favor survival d’ *Escherichia coli* O157: H7. Could be added manipulators with gastroenteritis or back of contaminated sites (Mensah et al., 2002), condiments washing use contaminated water and/or frequent contact with unsuitable objects (Barro et al., 2006; Tendekayi et al., 2008). The persistence of salmonella in condiments would also explain by the the use of open and poorly preserved mayonnaise jars (Hadjichristodoulou et al., 1999).

**CONCLUSION**

Grilled fish is a food for common consumption in Côte d’Ivoire. Health evaluation of this food in Yamoussoukro commune (political capital of Côte d’Ivoire) was based on counts of Total Aerobic Mesophilic Flora (TAMF), *Staphylococci* (STAPH), Total Coliforms (TC), Thermotolerant Coliforms (THC), and *Salmonella* (SAL). The results obtained by our analyses have shown that the treatment of fresh fish in an insalubrious environment remains detrimental to general hygiene. However, the heat treatment of cooking substantially reduced the rate of corrupt samples. By contrast, after cooking condiments adding destabilize this beneficial aspect. The origin of condiments, the poor body hygiene or clothing, the use of contaminated utensils is also important source of contamination.

Based on these conclusions, it is an imperative to implement training programs of the preparers taking into account basic food hygiene guidelines.

**REFERENCES**


