Formation of polycyclic aromatic hydrocarbons in traditionally smoked fish released for consumption in Côte d’Ivoire

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Overview

- Background
- Objectives
- Process of smoking fish in the area of Abidjan
- Materials and methods
- Results
- Conclusion - Recommendations
Background

- More than 80% of the country’s fresh fish is traditionally smoked for sale in the local market and for export.

- During the smoking process, Benzo(a)Pyrene, PAH of reference, can be released. It is potentially genotoxic and carcinogenic for humans and was found in products destined for export to the EU in 2007.

- In 2006, a European by-law (EC no. 1881/2006) determined maximum levels of specific contaminants in food produce (BaP in smoked fish) and thus required surveillance of all smoked products (ETP) to be exported to the EU.
Background

• The application of these regulations is a severe setback for this profitable market in Côte d’Ivoire.

• Smoked fish accounts for 0.73% of the total export volume which corresponds to 2.30% of foreign currency.

• The sector employs approximately 70,000 people who feed another 400,000.

• Our study aims to assess the risks of the formation of PAH in fish smoked for human consumption to help stimulating that market again in Côte d’Ivoire.
Objectives

✔ Assess risk factors associated with the processes of transformation of fresh fish into smoked fish

✔ Popularize strategies to reduce the risks of intake of PAHs in the flesh of smoked fish released for human consumption
MANUFACTURING PROCESS OF SMOKED FISH

Receipt → Unpacking

1. Frozen fresh fish
   - Defrosting
   - Scaling
   - Washing

2. Fresh fish without ice
   - Folding
   - Entire fish
   - Cut fish

3. Washing
   - Draining
   - Smoking under heat

4. Fishing

5. Draining
   - Smoking under heat

6. Fishing
   - Cooling

7. Fishing
   - Dry smoked fish

8. Fishing
   - Sale on the market
   - Dispatch to EU
   - Storage

Wrapping

CSRS Centre Suisse de Recherches Scientifiques en Côte d'Ivoire
Cooking - smoking

1 - Scaling–cleaning –setting up

2 - Draining

3 – Fire place in the smoking area

4- Covered fish
Two types of smoked fish

Dry smoked fish

Damp smoked fish
Materials and methods

- Area of production of smoked fish
- Participatory approach
- Samples of fish (fresh and smoked)
Methodology

Descriptive analysis of production systems of smoked fish and quantitative analysis by determining the level of PAH in fish samples

I – Descriptive analysis (15 months)
- Design of survey leaflets
- Constitution of equipment for research
- Three (3) sites of smoking
- Processes of smoking (wood, type of smoking, smoking materials, duration of smoking, type of fish used)
Methodology

II – Quantitative analysis

- Sampling, Extraction and measurement of fat content through Soxhlet method; Extraction and determination of PAHs by ISO 15 753 - 2004 (Validated method)

- Estimate of BaP intake = DJE
  DJE = daily cons. of fish x qty of BaP contained in fish

- Risk assessment using DJE et VR (RIVM, 2001) for comparison
## Results

### I-Descriptive analysis : There is a risk

- 423 respondents (88% are women), 59% are no scolarised
- 67% of operators use branches of rubber tree
- Fat fish is preferably used for smoking
- GPHs are very unknown as well as dangers encountered

### II-Quantitative analysis : The risk is high

- Level of fat content in fish used for smoking > 6%
- Concentration of PAHs varies according to the nature of constituents, smoking and compliance of GPHs (fluoranthene is higher in low-fat fish than in fat fish)
## Level of BaP in fresh and smoked fish

<table>
<thead>
<tr>
<th>Designation</th>
<th>Fresh fish</th>
<th>Smoked fish</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean concentr. BaP</td>
<td>8.53 µg/kg</td>
<td>28.64 µg/kg</td>
</tr>
<tr>
<td>Criterion (Reg. EU 1881/2006)</td>
<td>2 µg/kg</td>
<td>5 µg/kg</td>
</tr>
<tr>
<td>Conclusion</td>
<td>[BaP&lt;sub&gt;ff&lt;/sub&gt;]° &gt;level</td>
<td>[BaP&lt;sub&gt;sf&lt;/sub&gt;]° &gt;level</td>
</tr>
</tbody>
</table>
# Exposure assessment to BaP: Compound with non–threshold effects

<table>
<thead>
<tr>
<th></th>
<th>Value of reference</th>
<th>Source</th>
<th>Fresh fish</th>
<th>Smoked fish</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daily consumption of</td>
<td>0.0493</td>
<td>COMHAFAT, 2008</td>
<td>0.0493</td>
<td>0.0493</td>
</tr>
<tr>
<td>fish (kg/j/hbt)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DJE (mg/kg p.c./j)</td>
<td>-</td>
<td>-</td>
<td>7x 10⁻⁶</td>
<td>23x10⁻⁶</td>
</tr>
<tr>
<td>ERU₀ (mg/kg p.c./j)⁻¹</td>
<td>0.2 (mg/kg/j)⁻¹</td>
<td>RIVM, 2001</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ERI = ERU₀ x DJE</td>
<td>Excess risk for cancer by 10⁻⁶</td>
<td></td>
<td>1.7x10⁻⁶</td>
<td>4.6x10⁻⁶</td>
</tr>
</tbody>
</table>
Conclusion - Recommendations

- Smoked fish is a popular food, is a food for export
- Smoking fish is a means of subsistence for national economy
- With European by-law (EC no. 1881/2006) determined maximum levels of specific contaminants in food, it is impossible to export smoked fish, some productors lost there job (specially women)
- On local informal market we found HAP in smoked fish
- Risk factors are known
- The control of the factors will reduce the formation of PAHs
Acknowledgements