



# Screening of PAHS Concentrations in Traditionally Smoked Freshwater Fish Products from Tonle Sap in Cambodia

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## Introduction

- fish and fish products = major source of **protein income** for Cambodians
  - animal protein from fish meat is 18.3 kg per year and person, what is around 80% of total animal protein income (FAO, 2011; Hortle, 2007)
- lack of access to electricity
  - affecting 66 % of the population in Cambodia (The World Bank, 2014)
- very short peak period of fish being caught – necessity to process fish quickly and in a basic way (Eong & Hariono, 2003; FAO, 2011)
- smoking = one of the oldest preservation methods, still widely used (Stołyhwo & Sikorski, 2005)

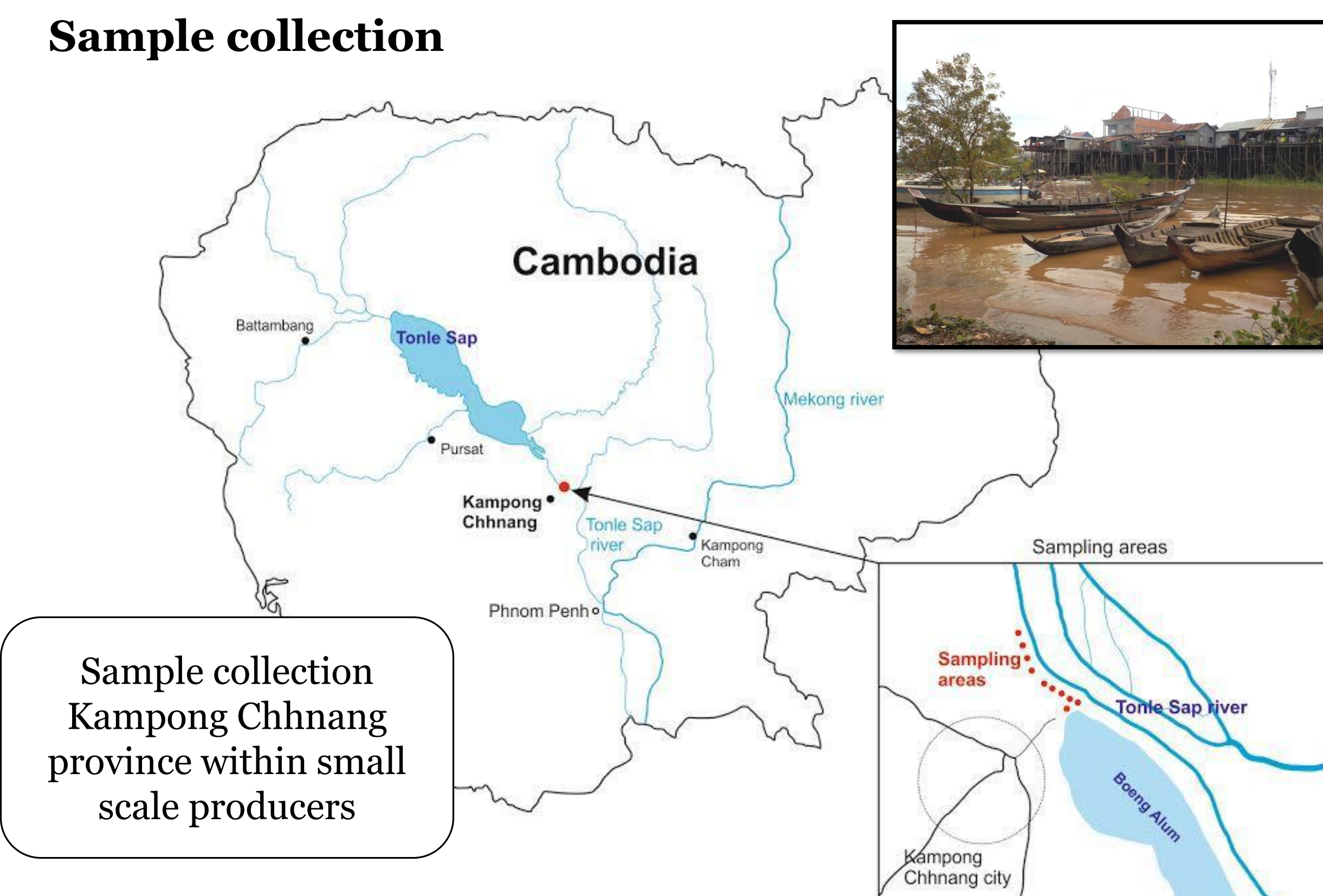
## Objectives

Traditional techniques of smoked fish production in Cambodia had not been fully investigated, thus aim of the work were:

- to monitor traditional technique of smoking fish in Cambodian rural areas
- to evaluate amounts of carcinogenic compounds in the smoked fish products in Cambodia



## Sample collection



- Collect 23 samples of 9 fish species from 10 producers
- Approximately 100g per sample placed in plastic bags and vacuum packed
- Stored frozen -20°C and transported to CULS in Prague, CZ



## Fish name

## Number of samples per species

|                                      |   |
|--------------------------------------|---|
| <i>Henicorhynchus caudimaculatus</i> | 3 |
| <i>Phalacrotonus bleekeri</i>        | 5 |
| <i>Kryptopterus hexapterus</i>       | 3 |
| <i>Belodontichthys truncatus</i>     | 3 |
| <i>Thynnichthys thynnoides</i>       | 3 |
| <i>Osteochilus lini</i>              | 3 |
| <i>Ompok bimaculatus</i>             | 1 |
| <i>Paralaubuca typus</i>             | 2 |

## Sample evaluation



extraction of completely homogenized samples by Soxtec apparatus

pre-cleaning (from lipids) by gel permeable chromatography (GPC)

analytes were evaluated by high performance liquid chromatography with fluorescence detector (HPLC-FD) Waters PAH C18 (250 x 2.1 mm)

- Identification of PAHs was based on comparison of retention times with standards
- quantification was performed by the method of external standards

- Results → in  $\mu\text{g.kg}^{-1}$  of sample. Sum PAHs (PAHs4) was calculated as total of concentration of benzo[a]pyrene, chrysene, benzo[a]anthracene and benzo[b]fluoranthene according to the Appendix of Commission Regulation (EC) No 1881/2006

## Conclusions

- Results showed that smoked fish represents important source of nutrients for Cambodian population but can lead to excessive intake of PAHs which can lead to higher risk of carcinogenic disease development as well as other PAHs related diseases.
- To decrease this risk, local population should be educated in use of better smoking techniques and improvement smoking kilns or at least change of smoking parameters which could lead to safer fish products.

## References

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- Stołyhwo A, Sikorski ZE. 2005. Polycyclic aromatic hydrocarbons in smoked fish—a critical review. Food Chemistry 91(2): 303-311.
- The World Bank. 2014. Access to electricity (% of population). Available at <http://data.worldbank.org/>: Accessed 2016-11-16.

## Results

- In general, the amount of the four priority PAHs in all samples highly exceeded maximum limits (ML) given by EC 1881/2006.
- Maximum limits for a  $\Sigma 4$  PAHs and BaP were exceeded **2 times**
- Maximum limit for a  $\Sigma 4$  PAHs was exceeded **50 times** and BaP was exceeded **60 times**

Determined values ( $\mu\text{g.kg}^{-1}$ ) of four priority PAH.

| Sample No. | Producer | Fish scientific name             | benzo[a]anthracene* | chrysene           | benzo[b]fluoranthene | benzo[a]pyrene    | $\Sigma$ PAH 4      |
|------------|----------|----------------------------------|---------------------|--------------------|----------------------|-------------------|---------------------|
| 1          | 3        | Micronema bleekeri               | 13.65               | 23.85              | 3.84                 | 6.13              | 47.47               |
| 13         | 2        | <b>Belodontichthys truncatus</b> | <b>5.22</b>         | 21.57              | 6.64                 | 8.66              | <b>42.09</b>        |
| 14         | 3        | Belodontichthys truncatus        | 17.29               | 27.36              | 3.98                 | 8.01              | 56.64               |
| 23         | 5        | <b>Paralaubuca typus</b>         | <b>204.06</b>       | 242.62             | 31.62                | 119.45            | <b>597.75</b>       |
|            |          | median                           | 73.4                | 113.95             | 11.04                | 53.85             | 200.61              |
|            |          | average $\pm$ SD                 | 75.91 $\pm$ 60.59   | 108.84 $\pm$ 67.89 | 13.55 $\pm$ 9.09     | 54.69 $\pm$ 36.26 | 252.98 $\pm$ 167.67 |

- Highest mean concentration was measured at sample of *Paralaubuca typus* from producer number 5 who reported longest time of smoking which is considerable higher than usually reported times (2-12 hours in DC).

- The type of the wood used for the smoking can also significantly influence PAH content in fish. In general soft wood is not recommended due to its high resin and lignin content.

- Other factors affecting PAHs content in final fish product are fish fat content, temperature of fire and smoke and distance of the product from fire. However it is necessary to mention that during this field research the fat content and temperature wasn't measured and the proximity was mentioned before.

| Fish producer | Time of smoking | Fish rotation frequency | Fuel used for smoking   |
|---------------|-----------------|-------------------------|---|
| 1             | 5 - 10 hours    | N/A                     | Kreak (unspecified mixture of woods); fuelwood: Trosek (Peltophorum dasyrrhachis)           |
| 2             | 1 - 2 days      | every 1 hour            | Kreak (unspecified mixture of woods); fuelwood: Trosek (Peltophorum dasyrrhachis)           |
| 5             | 5 - 6 days      | every 1.5 hour          | <b>Kreak (unspecified mixture of woods); fuelwood: Deam reang (Barringtonia acutangula)</b> |
| 6             | 2 - 3 days      | every 1 hour            | Kreak (unspecified mixture of woods); fuelwood: Deam reang (Barringtonia acutangula)        |

- This maximum mean concentration of 597.75 $\mu\text{g.kg}^{-1}$  for  $\Sigma 4$  PAHs and 204.06 $\mu\text{g.kg}^{-1}$  for BaP was recorded for *Paralaubuca typus* sample smoked for 5 - 6 days on mixed fire wood and *Barringtonia acutangula*.