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Studies of Polycyclic Aromatic Hydrocarbons in Wood Smoke and Smoked Fish

by
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Declaration

The work describe in this thesis was carried out by me under the supervision of Professor Arthur Bamunuarracchi and Dr.Yasmina Sulthanbawa and a report on this thesis has not been submitted in whole or in part of any University or any other institute for another degree.

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We Prof. Arthur Bamunuarracchi and Dr.Yasmina Sulthanbawa certify that the above statement made by the candidate is true and that this thesis is suitable for submission to the university for the purpose of evaluation.

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Abbreviations

PAH Poly Aromatic Hydrocarbons

HPLC High Performance Liquid Chromatography

GC Gas Chromatography

UV Ultra Violet

FlD Fluorescence Detector

PDA Photo Diode Array Detector

B(a)P Benzo(α)pyrene

EU European Union

LOD Limit of Detrection

SMF Smoked Fish

Napt Napthalene

Acy Aceynapthalene

Ace Acenapthene

Flu Fluranthene

Disposition: the way sth is placed or arranged

Phe Phenanthrene

Anth Anthracene

Fluor Fluoranthene

Pyr Pyrene

B(a)A Benzo(a)anthracene

Chry Chrycene

B(b)F B(b)Fluoranthene

B(k)F Benzo(k)fluoranthene

Di(a)A Dibenzo(a)Anthracene

B(g,h,i)P Benzo(ghi)pyrelene

In (123-cd)P *In (123-cd)Pyrene*

MS Mass spectroscopy

FT-IR Fourier transformation Infrared Spectroscopy

DAD Diode Array Detector

Abstract

Smoked fish has wide range of popularity among people in all over the world irrespective of their cultural differences. However the smoked food has gained concerns among scientific communities because the wood smoke contains toxic Poly Aromatic Hydrocarbons (PAHs). There are sufficient evidences to prove that PAHs are mutagenic and carcinogenic. Among those carcinogenic PAHs Benzo(a)pyrene,[B(a)P] has identifies as the most potent carcinogenic compound and hence it is considered as the marker compound for toxic PAHs. Most western countries have imposed strict regulatory measures to avoid risk of PAHs to the consumers.

Even though Fish and other food smoking has been practiced in Sri Lanka for a long time, no sufficient studies have carried out to determine the PAH emission of the existing smoking methods. This study was therefore focused on to find whether the existing smoking methods in Sri Lanka and wood species used for smoking are safe in the sense of PAHs present.

PAH emission from five woods (Mango. Jackfruit, Coconut Shell, Cinnamon and Madan) and three smoked fish products using three different wood species (Cinnamon, Jack and Lunumidella) were analyzed using HPLC consisted of UV and FlD detectors and a C18 reverse phase column. The smoking performed using a locally built smoker under optimized conditions to simulate the smoking of fish in rural areas in Sri Lanka. Smoke samples collected using a personal sampling pump. Wood smoke and smoked fish using same smoker analyzed for 16 PAHs (US EPA priority pollutants).

Smoke generated by all five woods contained light PAHs in large quantities, especially Naphthelene, Acenaphthene, Phenatherene and Fluoranthene. Cinnamon wood contained very high naphthalene content.(3117.6ug/litre) The heavy PAHs also detected on all wood species but Madan (*Zyzigium cumini*) and Jack wood contained higher quantities compared to other three wood species. B(a)p detected in Jack (1.35 µg/liter), Madan (11.77 µg/liter) and Coconut Shells(0.48 µg/liter).PAH content in smoked fish were very high compared to the wood smoke. Smoked fish from wood species jack, Cinnamon and Lunumidella contained B(a)p 38.77 µg, 2033.87 µg, 968.38 µg respectively per 100g of smoked fish. In this research all the obtained information showed that the local fish smoking methodologies (direct exposure to flue gas) extremely unsafe and therefore it has to be re-evaluated in the sense of PAH toxicity.

Chapter 1

Introduction