Laboratory particle-phase emissions from sugarcane burning: chemical and mutagenicity characterization

E. R. Dias[1], K. F. Souza[1], D. A. Morales[2], F. Kummrow[3],
G. A. Umbuzeiro[2], L. R. F. Carvalho[1*]

[1] Institute of Chemistry, University of São Paulo, São Paulo, São Paulo, 05513-970, Brazil
[2] Faculty of Technology, State University of Campinas, Limeira, São Paulo, 13484-332, Brazil.
[3]Federal University of São Paulo, Diadema, São Paulo, 09972-270, Brazil.
Keywords: sugarcane burning, PAH, oxy-PAH, nitro-PAH.
*Presenting author email: lrfdcarv@iq.usp.br

Open burning of biomass is a common method for agricultural residue disposal and represents a considerable source of pollutants in the atmosphere. Although there are economic and practical benefits, the environmental and health risks of this activity need to be fairly recognized. Pollutants in smoke from agricultural burning include, among others, semi volatile organic compounds, present in solid and gas phases, such as polycyclic aromatic hydrocarbons (PAHs), which have carcinogenic and mutagenic properties to humans.

In Brazil, sugarcane is a predominant crop in the Southeastern region, especially in the state of São Paulo, whose currently production responds for 62% of the Brazilian entire production. Areas under the influence of sugarcane burning have presented higher mutagenic activity in comparison to urban areas (Umbuzeiro *et al*, 2008).

The objectives of this study were: (i) to assess PAHs, nitro-PAHs and oxy-PAHs emission levels from the burning of sugarcane straw; (ii) to determine the emission factors of the identified target compounds; (iii) to assess the mutagenic activity of fractionated organic extracts and (iv) to compare the identified compounds levels with the mutagenic responses in the *Salmonella*/microsome assay (White, 2002).

Smoke particulate matter from sugarcane subjected to laboratory burning was sampled by low volume air filtration on quartz fiber filters covered with Teflon. The polycyclic aromatic hydrocarbons (PAHs), nitro-PAHs and oxy-PAHs present were analyzed by GC-MS. PAH and nitro-PAH show to be only minor components and the target nitro-PAHs were undetected under the analytical conditions used. In contrast, the target oxy-PAH compounds (9-fluorenone = 9-Flu, 9,10-anthraquinone = 9,10-Ant and 1,9-benzo[10]anthrone = Bzo) were found at relatively high concentrations in each individual fraction.

This is the first report of emission factors for the PAHs and oxy-PAHs (Table 1) in the sugarcane burning. The emission factors ranged from 0.19 to 0.90 μg Kg^{-1} for PAH compounds (results of a single combined extract) and 6.1 to 10.5 μg Kg^{-1} for oxy-PAH compounds (average of ten results corresponding to the individual extracts).

Table 1. Emission factors (μg Kg^{-1}) of oxy-PAH compounds in particles from sugarcane burning.

Emission factor, ( ) = RSD in %		
9-Flu	9,10-Ant	Bzo
6.1(42.1)	10.5 (50.1)	10.1 (36.6)

The concentration of the target oxy-PAH compounds in smoke aerosols in the ten experiments performed were highly variable, as it depends on the combustion conditions.

The most mutagenic fractions in the *Salmonella*/microsome assay were the oxy ones (Figure 1). Unsubstituted PAHs are present at concentrations below of the sensitivity of the *Salmonella*/microsome microsuspension assay performed with the highly sensitive strain YG5161.

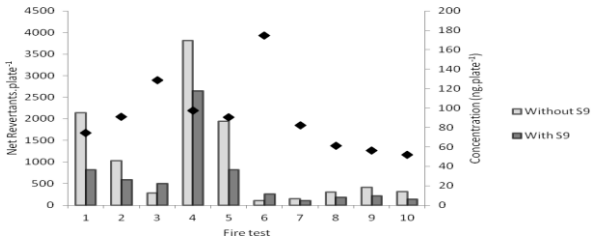

Figure 1. Mutagenicity of the oxy-PAH extracts in the Salmonella/microsome microsuspension assay with YG1041 with and without S9 expressed in net revertants per plate in comparison with the sum of the concentrations of the three oxy-PAH identified in the extracts (9-Flu, 9,10-Ant, Bzo) per plate.

This work has been supported in part by grants from FAPESP, Fundação de Amparo à Pesquisa de São Paulo (Project 08/58073-5).

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