

**HEALTH RISK ASSESSMENT OF RURAL AND URBAN
POPULATION DUE TO INDOOR AND AMBIENT AIR POLLUTION
(Sponsored by Ministry of Health and Family Welfare, Govt. of India)**

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Globally, almost 3 billion people rely on biomass fuel and coal as their source of domestic energy. In India 90% of the rural households use biomass solid fuels (wood, charcoal, dung and crop residue) as primary sources of domestic energy and pollutants released from these fuels in indoor air was reported as the contributor for effect on health. The combustion of biomass fuels produces a large number of air pollutants including nitrogen oxides (NO_x), Sulfur dioxide (SO₂), respirable particulate matter (RPM), formaldehyde and benzene. In India exposure assessment of index pollutants like SO₂, NO_x, Particulates matter (PM) and polycyclic aromatic hydrocarbon (PAH's) from Indoor air pollution (IAP) were reported, but exposure

assessment of benzene levels have not been reported. Therefore the present study is aimed for qualitative and quantitative estimation of benzene in indoor air samples produced due to combustion of solid biomass fuels in rural villages. In this study we quantified exposure to benzene from biomass fuels combustion in 55 rural homes. The personal sampler were used for air sampling in different type of kitchens using different type of fuels while GC-MS in MS-MS mode was developed for confirmation and estimation of benzene produced in indoor air due to incomplete combustion of different types of biomass fuels like wood, dung and mixed fuels in different type of kitchen. The spectrochromatogram of study sample of benzene in GC-MS in MS/MS mode has shown in figure-1. The geometrical mean (GM) of benzene exposure for cooks during cooking hours in indoor kitchen using mixed fuel was $69.5 \mu\text{g}/\text{m}^3$ while the exposure was $11.7 \mu\text{g}/\text{m}^3$ for open type kitchen. The benzene exposure was significantly higher ($p < 0.05$) in indoor kitchen with respect to open type using mixed fuels. Exposure of benzene ($114.1 \mu\text{g}/\text{m}^3$) for cooks in indoor kitchen using dung fuel was significantly higher in comparison to ($5.1 \mu\text{g}/\text{m}^3$) open type kitchen. Benzene exposure was $36.5 \mu\text{g}/\text{m}^3$ for cooks using wood fuel. The result showed benzene exposure of cooks in breathing zone differed significantly ($p < 0.0001$) across different type of fuels. The level of benzene exposure was high in dung fuel as compared to wood and intermediate level in mixed fuel. Benzene exposure depends upon determinant such as fuel types and fuel quantity/quality may perhaps allow an assessment of the most important determinants of indoor air pollution exposures in households of the rural villagers in India. The most important finding in this study is wood as a fuel produced less benzene and toluene levels than dung as a fuel.

Standardization of Method for Estimation of trans,trans Muconic Acid (t,t-MA) from Urine Samples

Solid Phase Extraction (SPE) and Reversed Phase Liquid Chromatography technique have been standardized for the estimation of trans,trans-Muconic acid, a benzene metabolite from urine samples. Blank urine samples spiked with various concentrations of t, t, MA (0.5,

1.0, 1.5, 2.0 $\mu\text{g/ml}$) were extracted by using QSAX SPE column, 100 mg/3cc (Analchem). QSAX SPE columns were connected to a Vac elute – a vacuum manifold (Varian, USA) conditioned with 6ml of methanol followed by 6 ml 0.1M Na phosphate buffer pH 7.4. A mixture of 1.8 ml urine sample and 2 ml of Na phosphate buffer spiked with 0.2 ml of t,t, MA standard was passed through the conditioned QSAX column at a slow flow rate (1 ml/minute) by applying vacuum. The column was rinsed with 6 ml of 1% acetic acid in HPLC water and dried under full vacuum for 3-5 minutes. The analytes were eluted slowly with 2x 0.5 ml of 10% acetic acid in methanol in labeled collection tubes kept in a rack in Vac elute. Eluted sample was concentrated under the slow stream of N₂ and reconstituted in 200 μl of mobile phase. Chromatographic analysis was performed on a Shimadzu, Japan LC-10AVP System, consisting of binary gradient pumps, a Rheodyne manual injector with 20 μl loop, thermostated column oven and PDA detector. The system was monitored by Class VP software (Version 6.12-SP4).

The Stationary Phase was LiChroCART 250-4, RP 18 endcapped stainless steel column (25 cm x 4.0 mm i.d., 5 μm particle size). Mobile phase consisted of glacial acetic acid HPLC grade (1%) and methanol HPLC grade (90:10 v/v). The mobile phase was degassed by filtration under reduced pressure with glass filter assembly using HAWP filter (0.22 μm) from Millipore followed by ultrasonication in transonic digital ultrasonic cleaning bath (ELMA, Germany) for 15 mins.

The PDA detector was monitored at 259 nm wavelength and column was kept at 40°C in column oven. The flow rate was 1.00 ml/min.

Fig. 2 shows the chromatogram of extract of blank urine spiked with t,t MA. The total run time was 12 minutes with t,t MA eluting at 8.7 minutes. Calibration curve was prepared with various concentrations of t,t MA in the range of 0.5-2.0 $\mu\text{g/ml}$. The correlation coefficient (r) was 0.997. The recovery of t,t MA was in the range of 80 – 98%.

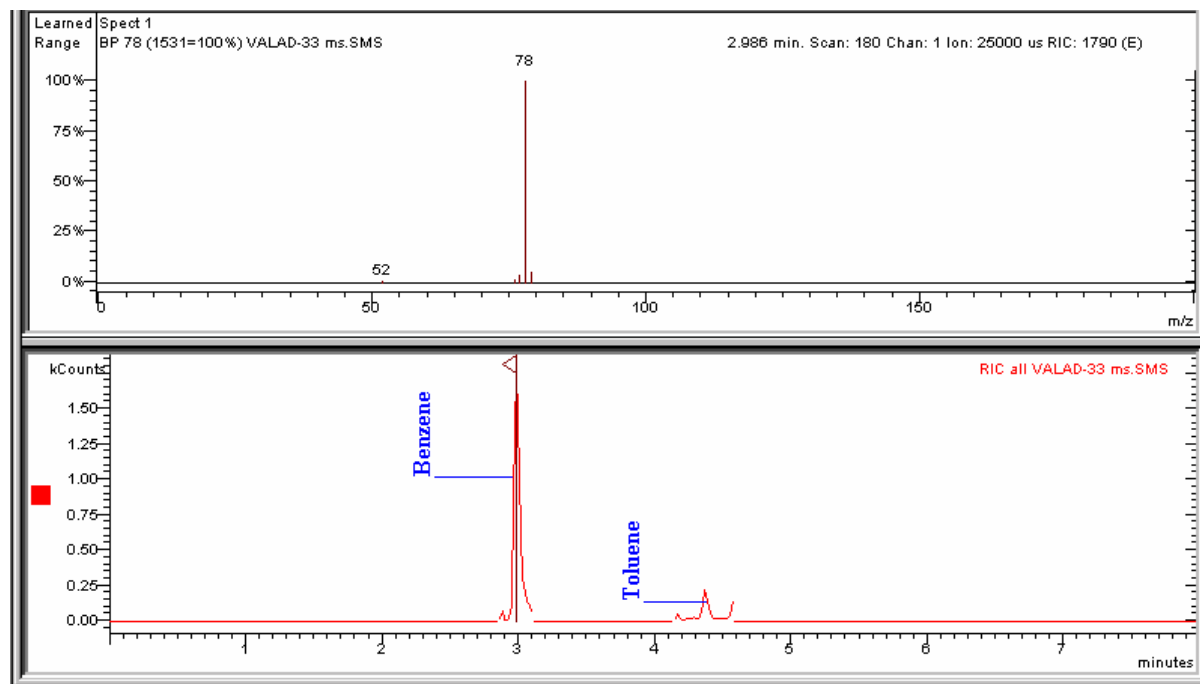


Figure:1. GC-MS Spectrochromatogram of benzene in MS/MS mode

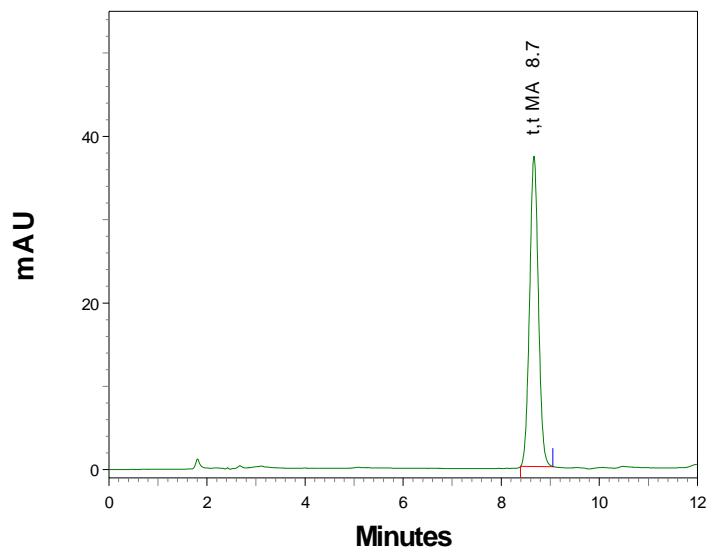


Figure:2 Chromatogram of trans, trans Muconic acid (t,t MA)