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Indoor Air Pollution: A Household Study in the Village Faridpur and Ranchi Colony, Durgapur, Burdwan District, West Bengal

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Abstract: Respiratory Diseases are public health concern worldwide. The diseases have been associated with air pollution mainly indoor air pollution from solid biomass fuel in developing country. A field study was undertaken to characterize the level of pollutant released from solid bio-fuel burring from the village of rural household and urban household in the area of Durgapur. Pollution was assesses by measuring SO_2, NO_x, SPM and API which are coming out from five different solid bio-fuels. Results showed that the NO_x and SO_2 level released from bio-fuels in the following order: wood>cow dung>dry leaf>coal>carbon cake and dry leaf>coal>cow dung>wood>carbon cake respectively. But, the highest SPM was obtained in case of cow dung and the lowest in carbon cake and air pollution index was ranges from 23.793 - 95.239. About 79 % people suffer from respiratory disease by using coal and only 24 % by cow dung. Results of this study suggested an association between respiratory disease and exposure to domestic biomass fuel smoke, but more extensive studies are needed to confirm the association between solid bio-fuel use and respiratory disease.

Key words: Respiratory disease % Solid biofuel % Indoor pollution % Sulphur dioxide

INTRODUCTION

Approximately 50% of the world's population and up to 90 % of rural household use biomass fuels as a domestic source of energy in the form of wood, crop residues and animal dung [1]. Cooking and heating with such solid fuels is the major source of indoor air pollution and pollution levels that exceed the allowable standard limits in developing countries [2]. Sulphur dioxide is a recognized pollutant because of its role in forming cold time smog [3]. It is acidic, irritant gas which in high concentrations can cause difficulties [4-6]. People with asthma are more susceptible to the adverse effects of the gas as high concentrations may result in the fail of lung function in asthmatics and may lead to tight chest, coughing, wheezing and phlegm at high levels [7]. Thus, we therefore conducted a study to measure pollution levels in kitchen using biomass fuel for cooking and find out the toxic pollutant released from solid bio-fuel and also established relationship between biomass fuel used and respiratory disease.

MATERIALS AND METHODS

Study Area: The study took place between March to May 2011 in Durgapur area of Burdwan district. Durgapur is located 23029'0" N and 87019'0" E. It has an average elevation of 65 metres (213 ft) and situated on the bank of the Damodar River. It had population 492,996 (Census 2001). Average temperature during summer session is 32°C while at the cold seasons is 20°C. The maximum temperature during summer rises up to 50°C while minimum temperature during winter comes down to 2°C. Average rain fall is 150 millimeters with the bulk of rainfall occurring around the July-September period. Various types of solid fuels like wood, dry leaf, coal, cow dung and carbon cake were used by the people of two target areas. Cooking is thus only source of biomass fuel pollutants exposure to the people.

Interview Scheduled: A self made questionnaire was made by considering the various dimensions like socioeconomical status, educational status, any special respiratory disease, duration and frequency of cooking in a day, kitchen room structure, ventilation mechanism, number of room, whether kitchen room separated from bedroom etc.

Air Pollution Sampling: We randomly select seventy five homes in Farid pur and Ranchi coloni for pollutants monitoring. In this study High Volume Sampler (Model: NPM-HVS/R, 02-HVS-1052) were used in the kitchen

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during day cooking time. Collection of samples for SPM from ambient air, GF/A whatman filter paper was used in high volume sampler at flow rate of 1.0 m^3/min. SPM was analysed as standard method. Filter paper was weighed before and after sampling. West and Geake method [8] and modified Jacob and Hochheiser [9] were used for analysis of SO_2 and NO_x respectively.

Air Pollution Index (API): The average of the sum of the ratios of three major pollutant concentrations to their respective air quality standard were obtained. The average was then multiplied by 100 to get the index [10].

$$API = 1/3 [SPM/S_{SPM} + SO_2/S_{SO2} + NO_x/S_{NOx}] \times 100$$

Where S_{SPM}, S_{SO2} and S_{NOx} represent the ambient air quality standards for SPM, SO_2 and Nox.

RESULTS AND DISCUSSION

From the present study, it has been found that the maximum NO_2 was in the fuel wood and minimum in the carbon cake (Fig. 1). Similarly, the oxide of sulphur was released from the solid bio-fuel in the order dry leaf> coal> Cow dung> Wood> carbon cake (Fig. 2).

Disease status from the Table 1 indicate that the maximum percentages of people (79%) affected by burning of coal. This is probably due to the chemical

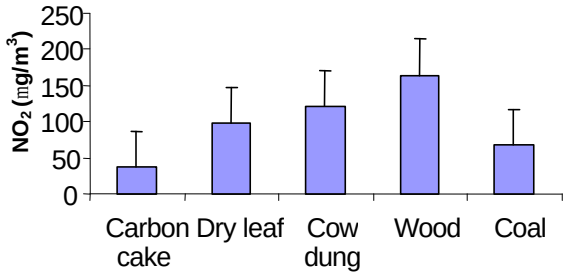

Fig. 1: NO_2 level of different solid bio-fuels released during cooking. Vertical bar with similar letters are not significantly different ($p<0.05$)

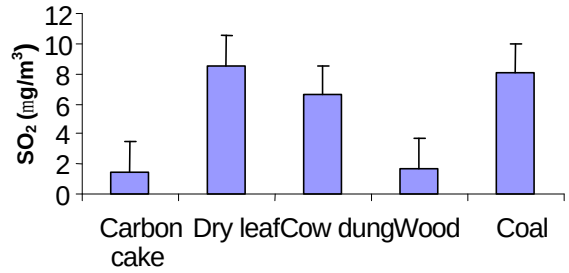

Fig. 2: SO_2 level of different solid bio-fuels released during cooking. Vertical bar with similar letters are not significantly different ($p<0.05$)

Table 1: Percentage of people affected in respiratory disease due to burning of solid bio-fuel burning

Fuel used	Respiratory Disease (%)
Wood	44
Cow dung	24
Dry leaf	65
Coal	79
Carbon cake	34

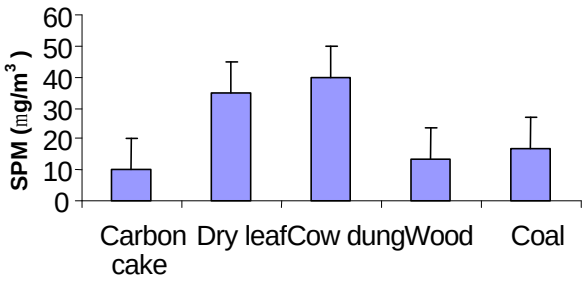

Fig. 3: SPM level of different solid bio-fuels released during cooking. Vertical bar with similar letters are not significantly different ($p<0.05$)

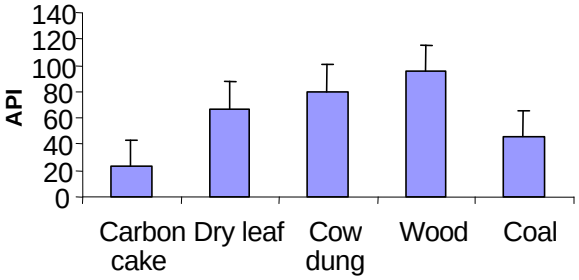

Fig. 4: API level of different solid bio-fuels released during cooking. Vertical bar with similar letters are not significantly different ($p<0.05$)

resulting from combustion of coal may form residues and household surfaces and food [11]. Although, all types of solid bio-fuels causes some problems like acute respiratory infections (ARI), Chronic Obstructive Pulmonary Disease (COPD), asthma, low birth weight, cataract and blindness [12].

Moreover, from the study area it was found that only 12 % family has single room which is used for both cooking and sleeping and there is no proper ventilation. Perhaps this is one of the major causes behind the disease. The same observation was noted by Kilabuk [13]. The health status of the people of the target areas showed that mostly sufferer from headaches, dizziness, sleep ness, irritated eyes, breathing problem along with respiratory problems. But, all the symptoms do not bearded by a single respondent. Actually people with allergies, asthma, or chronic respiratory or heart problems are particularly

susceptible to health effects from combustion pollutants [14]. The suspended particulate matter in the study area ranges from 9.999 µg/m^3 to 40.00 µg/m^3 (Fig. 3).

This is quite possible because when wood, household garbage, dry leaves are burned, they produced smoke and release toxic gases. Again, the highest API was recorded in wood (95.239) and lowest in Carbon cake (23.793) and moderate API in case of coal (46.048) (Fig. 4).

It was concluded that different types of solid biofuel use in both rural and urban area significantly contributed to the atmospheric air pollutant load in the ambient atmosphere. Wood as solid fuel contributed maximally and carbon cake minimally contributed towards generation of air pollutants among the different solid fuels studied under the present investigation. Results of this present investigation also suggests an association between respiratory disease and exposure to domestic biomass fuel smoke, but more extensive studies are needed to confirm the association between solid bio-fuel use and respiratory disease.Apart from the gaseous pollutants, there are some biological contaminates like bacteria, molds, virus and yeasts are usually found in moist indoor environment. Therefore, adequate ventilation of the indoor environment can be recommended for optimum penetration of sunlight as well as proper dilution of air pollutants under indoor environment. Although, these results of the small study suggest a relationship between exposure to biomass fuel smoke and respiratory disease in children and cooks, further comprehensive study is needed to confirm the association.

REFERENCES

1. World Resources Institute, UNEP, UNDP, World Bank, 1998-99. World resources: a guid to the global environment, Oxford: Oxford University Press.
2. WHO/UNDP, 2004. Joint Statement. Indoor air pollution -the killer in the kitchen. Geneva.
3. Hermann, K., 1991. Handbook of Environmental Health and Safety: Principles and Practices. Lewis Publishers, Boca Raton, Florida, pp: 33431.
4. Arch, S.H., 1954. A micro analytical method for the determination of sulphur dioxide in the atmosphere. Micro. Chem. Acta, pp: 668-678.
5. Herman, K., 1961. Effects of air pollution on human health. WHO Air Pollution Monograph Series, 46: 159-220.
6. Purnaendu, K.D., 1991. Flourometric determination of atmospheric sulphur dioxide without tetrachloromercurate (II). Analytical Chemistry, 53: 2084-2087.
7. Ayodele, J.T. and F. Abubakar, 2010. Sulphur dioxide as indoor pollutant in Kano municipality Kano-Nigeria. J. Environmental Chemistry and Ecotoxicol., 2(1): 9-13.
8. West, P.W. and G.C. Gaeke, 1956. Fixation of sulpher dioxide as sulfitomercuate (II) and subsequent colorimetric determination, J. Analytical Chemistry, 28: 1816-1819.
9. Jacob, M.B. and J.B. Hochheiser, 1958. Continuous sampling and ultramicrodetermination of nitrogen dioxide in air, J. Analytical Chemistry, 30: 426-428.
10. Rao, M.N. and H.V.N. Rao, 1989. Air Pollution, Tata Mc Graw-Hill Publishing Company limited, New Delhi, pp: 271-272.
11. Ghosh, R., Amirian, M. Dostal, R.J. Sram and I.H. Piccioho, 2011. Indoor coal use and Early childhood Growth, Arch Pediatr Adolesc Med. Published online February, 7: http:// archpedi. Ama-assn.org/cgi/content/short/archpediatrics.2010.294.
12. Bruce, N., R. Perex-Padilla and R. Albalak, 2000. Indoor air pollution in developing countries: a major environmental and Public health challenge. Bull WHO, 78: 1080-1092.
13. Kilabuko, J.H., H. Matuki and S. Nakai, 2007. Air Quality and Acute Respiratory Illness in Biomass Fuel Using homes in Bagamoyo, Tanzania. International J. Respiratory Public Health, 4(1): 39-44.
14. Howks, L.K. and A.B. Hassen, 2002. Combustion pollutants, cooperative Extension, Utah Sate University.