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A COMPARATIVE STUDY OF ELEMENTAL ANALYSIS IN MOSQUITO REPELLENT COIL AND CIGARETTE SMOKE

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Research Article

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ABSTRACT

Mosquito coil liberates smoke while burning. This smoke releases certain elements in the environment. However, very few studies have been carried out to ascertain the elemental contents of these mosquito coils. The present study was undertaken to determine the elements present in mosquito coil and its ash using instrumental analysis on Inductively Coupled Plasma-Optical Emission Spectrometer (ICP-OES) to find out the trace elements such as Lead, Cadmium, Arsenic, Mercury, Nickel, Chromium, Tin and Antimony. Based on this, the heavy element estimation in air was arrived at by deductive logic by subtracting the content of heavy metal in ash from that in the finished coil product. This study is compared with the cigarette powder, ash and the smoke which is released in the air, and finally both the products are compared for elements released in air within ½ hours. The overall content of Lead & Nickel released in air for coil (when burned for half an hour) was around 1.1 and 1.4 µg/coil, similarly for Chromium it was around 3.7 µg/coil and that of Tin was 7.75 µg/coil. On similar ground content of Lead released in air for cigarette (when burned for half an hour, which is the total burn time of a cigarette) were around 0.64 µg/cigarette, similarly for Nickel it was around 1.13 µg/cigarette, for Chromium it was around 3.25 µg/cigarette and that of Tin was 3.19 µg/cigarette. The results implied the content of heavy elements in the coil is at slightly higher level as compared to the cigarette. The findings published in the present communication are related to the levels of trace element contents in the mosquito coil, ash and its smoke. Similarly these results when compared with cigarette, cigarette ash and its smoke do not relate to toxicity of these elements at the level emitted to the non targets but only highlight the presence of heavy elements in coil as compared to cigarette.

KEYWORDS: *Cigarette, Mosquito Coil, Smoke, Toxic elements.*

INTRODUCTION

In tropical countries, mosquitoes are known to spread diseases like Malaria and Dengue fever. A common way of controlling mosquitoes in domestic households is to use insect repellants such as Mosquito repellent coils, Liquid Vaporizers, Mats and Aerosols sprays. These formulations have been developed and used successfully in many parts of the world to prevent indoor biting mosquitoes[1]. While using Mat and Liquid Vaporizers, the burning smell is not perceived, but when Mosquito Coil is burned, it will continuously emit smoke along with the active material used. This prevents the mosquitoes from biting. This mode of prevention has been in use for decades and has proven to be an effective mosquito repellant[6]. Earlier, natural source of repellent contains Pyrethrum as an active ingredient were used, but now a day's synthetic repellents mostly contain compounds like d-Allethrin, d-trans Allethrin, Prallethrin and Transfluthrin are used. The use of mosquito coils has been gaining popularity in communities with both high and low malaria transmission intensities as a supplement for protection for indoor, but outside its still bed net[4] The ash released after burning may contain trace elements, which when accidently inhaled into the body can cause damage to the living tissues[2,3].

The present study was undertaken to determine the heavy elemental contents of mosquito coil and their ash using Inductively Coupled Plasma (ICP) and to find out the heavy trace elements such as Lead (Pb), Cadmium (Cd), Arsenic (As), Mercury (Hg), Nickel (Ni), Chromium (Cr), Tin (Sn) and Antimony (Sb) present in mosquito coil, ash and in the smoke released in air. This data was further compared with the cigarette smoke and its ash.

MATERIALS AND METHODS

Trace element analysis of Mosquito Coil powder and Ash

Samples of mosquito coils present in Indian market were purchased from the local market. Ten single mosquito coils (12 hours, containing 0.1% d-trans Allethrin as an active ingredient) were selected for present study. The average weight of each single coil was 18.69 gm. Each coil has an outermost diameter of 14.5 cm. From these 10 coils, one double was selected, and was first separated into two single coils. One single coil was finely ground in a pre-cleaned porcelain dish. The homogenized samples were then placed inside polyethylene bag for analysis. The remaining single coil was lit up and left to burn overnight. It took about 9 - 10 hrs for coils to finish burning. In general, one single coil weighing 18.69 grams would give around 1.49 grams of ash after burning. The ash was then collected and placed in another polyethylene bag. Special care was taken to avoid any contamination from foreign partials. Thus, two sets of samples were ready for analysis. The net weight of the sample taken for analysis was approximately around 1 gram for both the coil powder and the coil ash powder[5].

The collected sample above is weighed, acid digested, diluted in De-mineralized water as per the standard operating procedure and aspirated on the instrument ICP-OES for analysis. First the sample blank is prepared (process remains same without sample) to eliminate the contamination from the reagents used in analysis, and secondly the sample is aspirated. The data was recorded on the integrator in ppm.

Trace elemental analysis of cigarette powder and Ash

Samples of cigarette present in Indian market were purchased from the local market. Thirty cigarettes were picked from three boxes and were then weighed. The average weight of each single cigarette was 0.75 gm. fifteen cigarettes were finely ground in a pre-cleaned porcelain dish (without the filters). The homogenized samples were then placed inside polyethylene bag for analysis. The remaining fifteen cigarettes were lit up and left to burn completely (passive burning). One single cigarette weighing 0.75 grams would give around 0.11 grams of ash. The ashes were then collected and placed in another polyethylene bag. Special care was taken to avoid any contamination from foreign particles. Thus, two sets of samples were ready for analysis. The net weight of the sample taken for analysis was approximately around 1 gram for both the cigarette powder and the cigarette ash powder. The analysis was carried out as per the method described in above.

RESULTS AND DISCUSSION

RESULTS:

1. Trace elemental analysis of Mosquito Coil powder and its Ash

The trace elemental contents in the mosquito coil and its ash were determined by inductively coupled plasma instrumental analysis. We have selected mosquito coils available in India.

Please refer Table No. 1 below.

The percentage content evaporated in air are calculated by multiplying content evaporated in air by 100 and dividing it by content in entire coil. They approximately depict the quantity of elements which are exposed to the users.

The content evaporated in air was arrived at by deductive logic by subtracting the content of elements in ash from that in the finished coil product.

Concentration of lead present in coil powder used for analysis is 2.13 (µg/g) ppm. Thus, in the entire coil of 18.69 grams, the lead content is 39.45 µg per coil. Similar calculation is done for coil ash and finally the difference (elements evaporated in air) is calculated by subtracting the content of elements in entire coil with the content of elements present in the ash.

2. Trace elemental analysis of Cigarette powder and its ash

The trace elemental contents of the cigarette and its ash were determined by inductively coupled plasma instrumental analysis. We have selected cigarettes available in India.

The content evaporated in air was arrived at by deductive logic by subtracting the content of elements in ash from that in the finished coil product.

The percentage content evaporated in air are calculated by multiplying content evaporated in air by 100 and dividing it by content in entire coil. They approximately depict the quantity of elements which are exposed to the users.

Please refer Table No. 2 below

DISCUSSION

The results of our analysis have shown that the method of inductively coupled plasma instrumental analysis is accurate in determining the concentration levels of various elements. In addition, by using this method of analysis many elements can be determined simultaneously. We had restricted our analysis for heavy elements like Lead, Cadmium, Arsenic, Mercury, Chromium, Nickel, Tin and Antimony. A total of eight elements have been detected in both the coils and their ash. Out of these eight elements, Arsenic, Mercury, Antimony were all detected in less than 0.01 ppm and Cadmium was detected in less than 0.05 ppm.

Table No. 1. The element analysis of mosquito coil and its ash

Elements	Concentration in coil powder	Content In entire coil	Concentration in coil ash	Content in entire coil ash	Content evaporated in air	Content evaporated in air#
	(µg/g) ppm	µg / coil	(µg/g) ppm	µg / coil Ash	µg / coil	%
Arsenic (As)	< 0.01	*	< 0.01	*	*	*
Mercury (Hg)	< 0.01	*	< 0.01	*	*	*
Cadmium (Cd)	< 0.05	*	< 0.05	*	*	*
Antimony (Sb)	< 0.01	*	< 0.01	*	*	*
Lead (Pb)	2.13	39.451	11.75	17.313	22.14	56.11
Nickel (Ni)	3.07	56.861	18.66	27.495	29.37	51.64
Chromium (Cr)	7.30	135.207	40.94	60.325	74.88	55.38
Tin (Sn)	14.29	264.672	74.39	109.613	155.06	58.59

the Concentration of these elements into smoke is tabulated in percentage.

* Below detection level

The results depicted in **Table No. 1** indicate that the highest concentration of Tin was present in both the coil and its ash where as lowest concentration was of Lead in both coil and ash. The overall percentage of Lead, Nickel, Chromium and Tin present in air was in the range of 50% – 60 %.

Table No. 2: The elements and their average level of concentration (in ppm) in cigarette and its ash

Elements	Concentration in cigarette powder	Content in entire cigarette	Concentration in cigarette Ash	Content in Entire cigarette Ash	Content evaporated in Air	Content evaporated in air*
	(µg/g) ppm	**µg / cigarette**	**(µg/g) ppm**	**µg / cigarette ash**	**µg / cigarette**	**%**
Lead (Pb)	0.97	0.715	0.71	0.077	0.64	89.23
Nickel (Ni)	2.30	1.696	5.23	0.567	1.13	66.54
Chromium (Cr)	5.13	3.783	4.92	0.534	3.25	85.89
Tin (Sn)	4.32	3.185	< 0.01	0.00	3.19	100

*the conversation of these elements into smoke is tabulated in percentage.

Similarly, the results from **Table No. 2** revel that the percentage of heavy elements like Lead and Chromium in air was around 80 – 90%, for Nickel it was 67% and for Tin it was almost 100%.

Further, we have studied the parameters of burning of coil and cigarette smoke and compared on the basis of time taken for burning of one cigarette. It takes approximately 10 hours to burn the entire coil. Therefore, we assume that the elements present in air are distributed over the period of 10 hours. This was compared with the burn time of cigarette, which burns (passively) for around ½ hour; the content emitted in air for coil in ½ hours is calculated proportionally.

As shown in **Table No. 3**.

Table-3: Burning of coil and cigarette smoke parameters comparison

Elements	Content evaporated in air for coil in 1/2 hours	Content evaporated in air for cigarette in 1/2 hour
	µg / Coil	**µg / cigarette**
Lead (Pb)	1.11	0.64
Nickel (Ni)	1.47	1.13
Chromium (Cr)	3.74	3.25
Tin (Sn)	7.75	3.19

From the above results, we can conclude that the quantity of certain elements released in air for ½ hour of coil burning is more as compared to the Cigarette burning.

As per the CENTRAL POLLUTION CONTROL BOARD the standard limits for "National Ambient Air Quality Standards" are 1 µg/m^3 for Lead for 24 hours [6].

CONCLUSIONS

Based on the present study, a conclusion can be derived that the content of heavy elements in mosquito repellent coil is slightly more as compared to the cigarette present in Indian market. This increased elemental concentration in coils could be attributed to the raw materials used for manufacturing of coils, i.e. saw dust and coconut shell powder. Further study needs to be conducted to find the content of heavy elements in base raw material powder and replace it fully or partly to reduce the contamination of heavy element in the coil. Also to bring a "green concept" coil, it is possible to use by-products of other plant sources as raw materials.

The findings published in the present communication are related to the level of trace element content in the mosquito coil, ash and smoke. Similarly results compared with cigarette, cigarette ash and its smoke does not relate to toxicity of these elements at the level emitted to the non targets. This only highlights the presence of heavy elements in coil as compared to cigarette.

The element content evaporated (emitted) in air found out for Mosquito coil and Cigarette are within the Occupational Safety and Health Administration (OSHA) limits [7]

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REFERENCES

1. Birley, M. H., Mutero, C. M., Turner, I. F. and Chadwick, P.R. 1987. The effectiveness of mosquito coils containing esbiothrin under laboratory and field conditions. *Ann. Trop. Med. Parasitol., 81:163-171*.
2. Bridford K, Stein H(1979)Health implication of trace elements in the environment. In : Risby TH (ed) ultra trace metal analysis in biological science and environment,chap,3 Adv chem. Ser, no.172.Washington Dc, *American chem. Bull. Environ. Contam. Heavyol. (1992) 49:663-669, 1992 Springer-Verlag New York Inc.*
3. Byers Rk (1965) Heavyity of lead. *Pediat 18:943-947*
4. Charlwood JD, Jolley D. The coil works (against mosquitoes) in Papua New Guinea. *Trans R Soc Trop Med Hyg 1984;78:678*.
5. Noorddin Ibrahim, Mosquito Coil: A source of Elimental pollution. *The bulletin of Environmental Contamination and Heavyology, Bull. Environ. Contam. Heavyol. (1992) 49:663-669 Springer-Verlag New York Inc.*
6. REGN No. D.L. 33004/99 - *The Notifications on National Ambient Air Quality Standards were published by the Central Pollution Control Board in the Gazette of India, Extraordinary vide notification No(s).S.O. 384(E), dated 11th April,1994 and S.O. 935 (E), dated 14th October 1998*.
7. http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=standards&p_id=9992

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