

Analysis of Metallic Contamination and Toxicity Exposure by Different Branded Cigarettes in India

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Abstract: The project will study and analyse the metallic contamination found in few branded cigarettes in India. Simultaneously toxicity exposure will also be determined which may create serious health hazards. The metals selected for analysis are lead (Pb), cadmium (Cd), nickel (Ni), chromium (Cr) and mercury (Hg) which are highly toxic as well as carcinogenic in nature. The toxic metal concentration in different branded cigarettes ranges from Cd (0.045 ppm- 0.065 ppm), Pb (0.95 ppm – 1.25 ppm), Hg (2.5 ppm – 7.0 ppm), Cr (1.90 ppm – 2.50 ppm), Ni (0.29 ppm – 0.51 ppm). The concentration of above mentioned toxic metals are found to be slightly higher than the permissible limit proposed by Indian Journal of Pharmacology (IJP). This toxicity may cause various types of neurological disorders, nervous system damage and cancer. Therefore in conclusion part some sort of toxicological management and preventive measures will be emphasised for the betterment of environment point of view. Therefore different standard methodologies and instrumentations will be used to analyse the toxic metals found in cigarettes.

Keyword : Metallic contamination, toxic metals, Cigarettes, Blood samples.

1.0 Introduction

The consumption of tobacco through smoking cigarettes has become the burning issue for environment as well as human health point of view. "*Nicotianatobaccum*" is the main source of tobacco which is responsible for most of the death cases due to excessive inhalation of cigarettes directly or indirectly [1]. Tobacco is an annual or bi-annual plant growing 1-3 m tall with large sticky leaves that contain nicotine. Nicotine is highly toxic in nature and can cause different types of lung diseases and cancer. Cigarettes contain not only tobacco but it also consists of many carcinogenic substances such as benzene, toluene, phenol, nicotine, tar, carbon monoxide, formaldehyde and many heavy and toxic metals. The project will analyse the metallic contamination and toxicity exposure by few branded cigarettes available in India. The recent study found out that there is an increase in the no. of smokers to 110 million (2014) in India. Heavy metals are one of the lethal toxicants and are toxic when their concentrations are exceeded. As far as metallic contamination is concerned lead (Pb), cadmium (Cd), mercury (Hg), nickel (Ni) and chromium (Cr) are analysed by the Atomic Absorption Spectroscopy (AAS). The outcomes of the different toxic metals will also be compared with the permissible limit proposed by Indian Journal of Pharmacology (IJP) [2]. In the next part of the analysis, Pollution/Contamination Index (PI/CI) will also be calculated in order to analyse the exposure of toxicity for human health point of view. Finally in conclusion part some sort of threat level percentage will also be evaluated so that preventive measures and suggestions can also be given in order to deteriorate the no. of smokers in India.

2.0 Materials and Methodology

2.1 Sample Collection

The various five branded cigarettes samples were collected from the shop and kept in polythene bag without any contamination. The cigarettes which were taken for analysis are as follows: Scissor, Flake, Gold

Flake, Navy Cut and Classic. These above mentioned five branded cigarettes are the most popular and best selling cigarettes among smokers in India.

2.2 Sample Preparation

The cigarettes were cut into very small pieces by a stainless knife without taking the filter portion of the cigarette. Then these small pieces of cigarettes were kept in muffle furnace for half an hour maintaining the temperature of 550°C. Finally the ash were crushed by the mortar and made it to fine powder and collected in test tube.

2.3 Sample Treatment and Digestion

One gram of each cigarette sample powder was taken in volumetric flask which was digested with HNO₃ (5ml), HClO₄ (10ml). This mixture was placed on a hot plate for 1-2 hour maintaining the temperature about 80°C. Then the mixture was cooled and filtered in a 100 ml volumetric flask and made upto the mark [3].

2.4 Metal Analysis

Then different standard solutions of respective metals were prepared for calibration of AAS. As far as the toxic metal analysis is concerned Hg, Pb, Ni, Cd, Ni and Cr were analysed by Atomic Absorption Spectroscopy (VARIAN AA240 AAS) in Vellore Institute of Technology, Technology Business Incubator (TBI).

2.5 Quality Control

For quality control of the experimentation known samples were analysed before analysis and triplicate analysis were performed for accuracy [1]. Mean concentration were considered while analysis of toxic metal content.

3.0 Result

As previously mentioned, 5 different branded cigarette samples were taken from shops in India. Table 1 shows the concentration of heavy and toxic metals in branded cigarettes. As far as analysis is concerned Hg, Pb, Cd, Ni, Cr and Zn were determined. Table 2 shows the standard permissible level of toxic metals proposed by EPA and WHO. Now for the human welfare point of view Contamination Index (CI) will also be calculated for various branded cigarettes.

Table 1 :Mean Concentration of Toxic Metals in Branded Cigarettes

Metals concentration/ Cigarettes	Pb (ppm)	Hg (ppm)	Cd (ppm)	Ni (ppm)	Cr (ppm)	Zn (ppm)
Scissor	0.93	3.6	0.056	0.519	2.477	1.4554
Flake	1.01	7.0	0.060	0.396	2.315	1.3958
Gold Flake	1.07	4.6	0.058	0.443	2.057	2.0878
Navy Cut	1.12	2.5	0.057	0.436	1.930	1.4707
Classic	1.21	2.6	0.047	0.294	2.322	1.3249

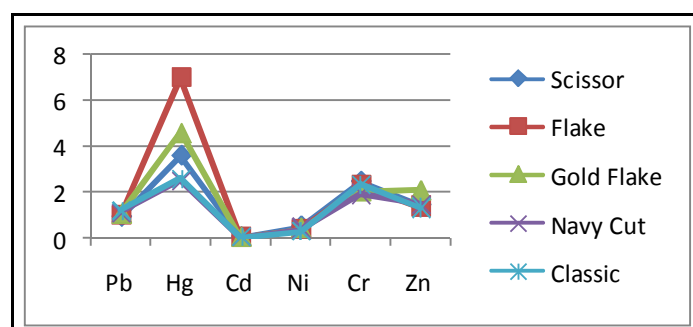


Fig 1: Statistical Analysis of Toxic Metal Concentration in Cigarettes

Table 2 :Permissible Limit of Toxic Metals

Metal	Concentration of Metal (ppm)
Lead (Pb)	0.1
Mercury (Hg)	0.01
Cadmium (Cd)	0.06
Nickel (Ni)	0.2
Chromium (Cr)	0.5
Zinc (Zn)	15

Contamination Index (CI) [1] : Contamination index can be calculated as follows,

$C.I = \text{Concentration of Metal} / \text{Standard or Permissible Value}$
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Contamination Index or Pollution Index shows the relative level of contamination by particular metal present in the given sample. Now according to the standard regulatory limit of Toxic metal given by Indian Journal of Pharmacology (IJP), Contamination Index can be calculated. Table 4 shows the summary of Contamination Index (C.I).

Table 3 : Contamination Index for Cigarettes Samples

Cigarette Sample	Pb	Hg	Cd	Ni	Cr	Zn
Scissor	9.3	360	0.93	2.59	4.95	0.097
Flake	10.1	700	1.00	1.98	4.63	0.092
Gold Flake	10.7	460	0.96	2.21	4.11	0.138
Navy Cut	11.2	250	0.95	2.18	3.86	0.098
Classic	12.1	260	0.78	1.47	4.64	0.088

The critical value for CI is 1.0 whereas value greater than 1.0 shows varying degree of contamination/pollution. Table 3 will show the standard regulatory limit of CI.

Table 4 : Standard interval for Contamination Index (C.I)

Contamination Index (C.I)	Significance
< 0.1	Very slight contamination
0.1 – 0.5	Slight contamination
0.51- 0.99	Moderate contamination
1.0 – 2.0	High Contamination
2.1 – 3.0	Very High Contamination
>3.1	Excessive contamination

4.0 Discussion

The analysis has generalised that the concentration of toxic metal in cigarettes is found to be in following order $Hg > Cr > Zn > Pb > Ni > Cd$. The concentration of cadmium is found to be very less as compared to other toxic metals. But there are many fatal effects and diseases have been identified due to bioaccumulation of toxic metals in human. So table 5 will show the effect of toxic metal on human health.

Table 5 : Effect of Toxic Metal on Human Health[2]

Toxic Metal	Effects
Lead (Pb)	Mental Retardation Gastrointestinal damage Chronic damage to nervous system
Mercury (Hg)	Psychological abnormalities Fatal effect on pregnant women
Cadmium (Cd)	Renal dysfunction Lung cancer Kidney damage
Nickel (Ni)	Lung cancer Larynx cancer Prostate cancer
Chromium (Cr)	Irritability Fatigue Damage to nervous system
Zinc (Zn)	Corrosive effect on skin Damage to nervous system

Moreover the Contamination Index (C.I) for Hg is found to be greatest among all toxic metal present in cigarette. The higher the value of Contamination Index indicates greater metallic contamination. The trend of contamination index (CI) of these toxic metals is found to be in the order of $Hg > Pb > Cr > Ni > Cd > Zn$.

As previously mentioned if the value of C.I is greater than 1.0 then there is greater risk of metallic contamination. So as far as the concentration of toxic metal is concerned Pb, Hg, Ni and Cr in the branded cigarettes are found to be beyond the permissible limit proposed by Indian Journal of Pharmacology (IJP) [2].

5.0 Conclusion

Analysis of toxic metals in different branded cigarettes is prominent parameter for assessing the risk of human health and environment. More or less as these toxic metals cause directly effect on the central nervous system so smoking should be avoided especially for chain smokers category. As the concentration level of lead, mercury and chromium exceeds the permissible limit so it may harm the human health by inducing cancer and other fatal diseases [4]. Such type of analysis is quiet helpful for both smokers and non-smokers category to adopt a healthy strategy. So in short, the analysis confirms that the cause of death and fatal diseases is not only for presence of tar and tobacco in cigarette but also due to toxic metallic contamination in it [5]. Finally, there is need for such research that analyze the content of toxic substances in tobacco products to help consumers, governmental associations and even manufacturers around the country to make positive and informed decisions.

6.0 References

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