Analysis of Heavy Metals in Selected Cigarettes and Syrupy Tobacco (Mu`assel) Brands Smoking in Baghdad Market Iraq

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Abstract
Smoking related diseases can be attributed to the inhalation of many different toxins including heavy metals which have a host of detrimental health effects. The current study reports the levels of cadmium (Cd), Nickel (Ni), copper (Cu), Iron (Fe), Zinc (Zn) and lead (Pb) in cigarettes and syrupy tobacco (Mu`assel) obtained from Baghdad – Iraq Markets. The mean concentrations of Cd, Ni, Cu, Fe, Zn and Pb were (26), (0.29), (0.42), (1000), (45.3) and (0.26) ppm respectively. There were some differences in metal concentrations of cigarette brands produced by different manufacturers suggesting differences in the source of tobaccos used by different companies. For (Ni), there were significant pairwise differences between Aspin and Al AMASE (Bountry) Mu`assel brands. For (Fe) Al Amase (Bountry) Brands had higher levels than Pine brands. Levels of (Cd) and (Pb) did not differ significantly across manufacturer group. Because of the variety of toxic heavy metals in different brands of cigarette tobacco and their numerous negative health effects metal content in cigarette tobacco should be reduced.

Keywords: Metal, Toxicity, Tobacco, smoking, Mu`assel

1. Introduction
The consumption of tobacco products and number of smokers have been increasing steadily all over the world. The use of cigarettes constitutes one of the major causes of morbidity and mortality in the world. In the tobacco plantation herbicides, insecticides, and fungicides are used to control the various parasite and plant diseases. Tobacco smoke has toxic, genotoxic, and carcinogetic properties. As a result of containing both 4000 identified organic and inorganic human carcinogenic compounds [1].

The exposure level to metals such as Cd, Cr, Pb and Ni in the smoke drawn from a single cigarette is small and likely not acutely toxic but their accumulation in tissues and fluids body over months, years and decades of exposure is depending on clearance rates and a health concern [2,3,4,5]. This is a particular issue for cadmium (Cd) and lead (Pb), which have long (10-12 year) half-lives in the human body.

Biomonitoring studies showed substantially higher Cd and Pb levels (6,7,8). Human toxicity of Pb is made complex by its multiple valence states with non-satisfactorily characterized in tobacco smoke [9,10].

The objective of the present study were many fold:
First, to investigate the heavy metal concentrations in different brands of tobacco cigarettes sold and/or produced in Iraq; second to find out if there are significant differences between different cigarette brands in their heavy metal contents; thirds: to compare our data with the other published articles of others parts of the world.

2. Experimental
2.1. Materials and Instruments
Sample collection: Seventeen different brands of cigarettes and syrupy Tobacco (Mu`assel) were purchased from different market fig (1,2), composite samples of each brand were made by removing the papers and filters of five cigarettes taken randomly from a pack of 20 cigarettes and five cigarettes from each pack of the same brand with different batch numbers were mixed together.

2.2. Digestion procedures:
Two oxidation procedures were considered to bring the solid sample to liquid from which can be measured by atomic absorption spectrometry (AAS) techniques.
First procedure: The mean weight of each cigarette brand was determined by weighing 5g sticks of each brand before and after removing the paper wrappers. The same weight of each Mu`assel sample was taken.
The samples were dried in an oven at 90°C for 1hr and allowed to cool in desicatiters five grams of each cigarette sample were ached at 500 °C in amuffle furnace. One gram of each of ash and row cigarettes were differently treated with a mixture of concentration HNO3 and HCL acid in a ratio of 1:3 and heated to near
dryness. The digest was filtered through whatman filter paper into a volumetric flask and made up to volume with distilled water. The later was analyzed for heavy metals (Pb, Cd, Ni, Cu, Zn and Fe) using an atomic absorption flame emission spectrophotometer phonex company. A standard reference material was prepared to validate method.

Second procedures
The samples were dried in an oven at 105 °C. The dried cigarette were pound using mortar and pestle and sieve with mesh sieve. About 1 g of ground tobacco cigarette was weighed into a clean 125ml flask. Amixture of 4ml of HCl, 25ml Conc. HNO$_3$ and 2ml Conc. H$_2$SO$_4$ was added.

The resulted mixture was heated gently on a hot plate under a fume-hood for 30 min .The flask was allowed to cool and 2ml of Conc. HNO$_3$ was further added. The mixture was finally heated strongly to a medium heat for 3 minutes and allowed to cool .The solution was completely filtered (using whatman no. 42 filter 9cm)into 100 ml volumetric flask and make up to the mark with distilled water.The filtrate solution was stored in the refrigerator waiting for heavy metal analysis using AAS.

Results and discussion
Heavy Metal Content in Cigarettes and syrupy Tobacco ( Mu âššel)
Figure (1): shows the averaged element concentration in duplicated wet digested samples in ppm for each of the seventeen cigarettes and syrupy tobacco brands sampled. Iron (Fe) was observed to higher in the brand AL-AMALE (bountry flavor) and the lowest level was observed in pin cigarette at 0.06 ppm.

Zinc was observed to be highest in the brand AL-AMALE (bountry flavor) at 90.1 ppm and the brand Aspin have the lowest (Zn) concentration of 0.53 ppm Dw 

Cupper (Cu) maximum level of 1 ppm and minimum level of =0.037 , 0.060 ppm was observed in the brands muzay A French tabacco (AL FAHER two apples and ALFAKHER gum with mint ) respectively

The brand ASPIN and Miami have the lowest and highest level of Ni detected respectively.Pb concentration was observed to be higher in the brand ALFAHER (orange) at 0.429 ppm. while the lowest level was observed in the brand pin at 0.1ppm Cd detected in the brand ALAMASE(BAGHDAD NIGHT)with 0.49 ppm and in pin with 0.03 ppm . Level of Cd detected for all brands. The mean concentration of each of these trace metals studied was also determined Fe, Zn, Cu, Pb, Ni and Cd averaged 325.428, 13.234, 0.3046, 0.2414, 0.3779 and 0.115176 respectively (table 1).

Though the minimum levels of Cd and Pb were observed in one of the high priced cigarette brand PIN and ASPIN sold in Baghdad market. The claim by same smokers that only the cheap priced cigarettes brands increase their body burden has been disproved by the highest concentration of Cd found in brand ALAMASE(Baghdad night). From this fact no brand is considered to be safer than another.

However from literature the amount of trace metals in cigarettes and levels depends several factors including the variety and origin of the plants. Compared to the present study , Jung (1998) [11] reported higher concentration for metals except for lead (Pb) that was about ten times higher in the present study compared to 1.35ppm and 0.74 ppm obtained for Korean and United Kingdom cigarettes respectively .

The result obtained for Jordanian cigarettes does hot compare well with the present study etal (2005). Although Pb was reported lower .Also the work of Nnorom [12] and Nwankwo [13] etal (1977) who individually reported lower levels for Cd in developing countries companied to developed countries corroborate with the present study.

Variation among studies could be due to earlier observation that heavy metal content of cigarettes varied largely with region of production for all the elements of interest determined in this work. the levels obtained do not differ much between the brands except for Iron (Fe) and (Zn).Iron (Fe) concentration in mu âššel the brands ALFAKHER different type and ALMMASE difference type differs largely; about hundred times higher than in the cigarettes, in differs brands zinc concentration in the mu âššel brands (ALFAKHER and ALMASE) A is about ten times higher than cigarettes in deferent brands analyzed.

The trace metal content established in the smoke emanating from the burning cigarette (i.e. the total trace metal content obtained through wet digestion minus the trace metal content in the ash) is reported in (Fig1).

The amount of (Fe)2000 ppm , (Zn)90.1ppm , (Cu)0.815 ppm , (Pb)0.429 ppm, (Ni)0.925 ppm and (Cd) 0.489 ppm delivered into the total smoke was observed to be highest in brand ( ALAMASE Bounty Flavour ) , Royale ,ALFAKHER (orange), Miami and ALAMASE(Baghdad night ) respectively ( Fig 2).

The lowest concentrations of these metals were observed in the brand pine , aspin, capital, ( aspin and pine ), aspine and pine at ( Fe 0.06 ppm), ( Zn 0.53 ppm ) , ( Cu 0.02 ppm ) , (pb 0.1 ppm ) , ( Ni 0.06 ppm ) and ( Cd 0.03 ppm ) respectively . No substantial difference was observed for all element in the tested brands of cigarettes.

Of most importance in this work and for smokers is the amount of metals in the mainstream smoke (i.e.
Approximately 0.1 µg Cd was estimated to be passed into the mainstream smoke, with a daily intake of 2.0 µg for a smoker of 20 sticks of cigarettes, the estimated levels especially 2mg for a smoker of 20 sticks of Iraq cigarettes was higher than the less than 0.1 mg (Cd) and daily intake of 1mg for a smoker of 20 sticks of German filter cigarettes. Another study shows that this cigarettes is known to display higher Cd level and lower Pb level. this corroborates the works of oladipo et al (14) who showed high similarity of German cigarettes to Nigerian cigarettes, in most common elements except for Cd and Pb which exhibit higher and lower levels respectively. Lead estimated to range between 0.1 mg -0.429 mg passes into mainstream smoke. there is a relationship between the amount of lead inhaled in Nigerian cigarettes with those inhaled in Korean 0.4 mg-1.19 mg and United Kingdom 0.22mg-0.65 mg reported by Jung et al[11]. From the result of our work an average of 25% of Cu, Ni and Zn contained in the tested cigarettes was assumed to be passed into mainstream smokes. Thus base on this, a daily in take of 0.304 (0.02-0.815) mg of Cu and 0.45(0.53-90.10)mg Zn was estimated to be passed into mainstream smoke.

5. Conclusion
The concentration of heavy metal trace elements in brand cigarette commonly smoked in Iraq have been determined. the levels of metals especially those with lexicological effects estimated in smoke can cause adverse health effects among smokers .

People subjected to environmental tobacco smoke are at higher risk of contracting cigarette smoking health related disease

The synergistic action of trace metals on certain vital organs in the body is responsible for numbers of complications such as paralysis strokes, atherosclerosis, and peripheral arterial disease among others.

![Figure (1): Metals concentration in cigarette brands](image-url)
Table (1): Metals concentration in cigarette brands and Mu’assel.

<table>
<thead>
<tr>
<th>Brand</th>
<th>IRON</th>
<th>ZINC</th>
<th>COPPER</th>
<th>LEAD</th>
<th>NICKEL</th>
<th>CADMIUM</th>
<th>Aspin silver</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>4.350</td>
<td>1.765</td>
<td>0.680</td>
<td>0.260</td>
<td>0.280</td>
<td>0.115</td>
<td>Aspin silver</td>
</tr>
<tr>
<td>A2</td>
<td>14.410</td>
<td>1.910</td>
<td>0.780</td>
<td>0.160</td>
<td>0.395</td>
<td>0.040</td>
<td>gitanes</td>
</tr>
<tr>
<td>A3</td>
<td>4.385</td>
<td>1.680</td>
<td>0.655</td>
<td>0.185</td>
<td>0.925</td>
<td>0.042</td>
<td>miami</td>
</tr>
<tr>
<td>A4</td>
<td>13.050</td>
<td>1.760</td>
<td>0.580</td>
<td>0.200</td>
<td>0.410</td>
<td>0.040</td>
<td>gauloises</td>
</tr>
<tr>
<td>A5</td>
<td>9.500</td>
<td>1.770</td>
<td>0.815</td>
<td>0.145</td>
<td>0.315</td>
<td>0.037</td>
<td>royale</td>
</tr>
<tr>
<td>A6</td>
<td>2.860</td>
<td>0.530</td>
<td>0.150</td>
<td>0.100</td>
<td>0.060</td>
<td>0.045</td>
<td>Aspin blue</td>
</tr>
<tr>
<td>A7</td>
<td>0.520</td>
<td>5.800</td>
<td>1.000</td>
<td>0.170</td>
<td>0.350</td>
<td>0.046</td>
<td>kent</td>
</tr>
<tr>
<td>A8</td>
<td>0.060</td>
<td>1.440</td>
<td>0.100</td>
<td>0.100</td>
<td>0.150</td>
<td>0.030</td>
<td>Pine</td>
</tr>
<tr>
<td>A9</td>
<td>0.150</td>
<td>1.650</td>
<td>0.020</td>
<td>0.150</td>
<td>0.250</td>
<td>0.035</td>
<td>capital</td>
</tr>
<tr>
<td>A10</td>
<td>125.000</td>
<td>7.170</td>
<td>0.050</td>
<td>0.429</td>
<td>0.397</td>
<td>0.071</td>
<td>alFakher (orange)</td>
</tr>
<tr>
<td>A11</td>
<td>2000.000</td>
<td>90.100</td>
<td>0.061</td>
<td>0.329</td>
<td>0.528</td>
<td>0.085</td>
<td>alAmase (bounty flavour)</td>
</tr>
<tr>
<td>A12</td>
<td>7200.000</td>
<td>23.700</td>
<td>0.037</td>
<td>0.248</td>
<td>0.314</td>
<td>0.229</td>
<td>Mazaya(a French tobacco)</td>
</tr>
<tr>
<td>A13</td>
<td>143.000</td>
<td>15.200</td>
<td>0.061</td>
<td>0.252</td>
<td>0.460</td>
<td>0.167</td>
<td>alAmase (gum fusion flavour)</td>
</tr>
<tr>
<td>A14</td>
<td>358.000</td>
<td>9.120</td>
<td>0.060</td>
<td>0.352</td>
<td>0.361</td>
<td>0.198</td>
<td>alAmase (sultanni)</td>
</tr>
<tr>
<td>A15</td>
<td>624.000</td>
<td>23.800</td>
<td>0.043</td>
<td>0.279</td>
<td>0.339</td>
<td>0.112</td>
<td>alFakher (two apples)</td>
</tr>
<tr>
<td>A16</td>
<td>646.700</td>
<td>14.690</td>
<td>0.043</td>
<td>0.397</td>
<td>0.458</td>
<td>0.489</td>
<td>alAmase (Baghdad night)</td>
</tr>
<tr>
<td>A17</td>
<td>866.300</td>
<td>22.900</td>
<td>0.044</td>
<td>0.348</td>
<td>0.433</td>
<td>0.177</td>
<td>alFakher (gum with mint.)</td>
</tr>
</tbody>
</table>

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