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RESEARCH ARTICLE

A Short Review on Polonium as a carcinogen in tobacco

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Abstract

In tobacco, small amount of radioactive Polonium element is present which is one of the causative agent of cancer caused by tobacco. People are unaware of dangerous effects caused by polonium poisoning from heavy smoking tobacco. Certain Preventive methods can be used to remove polonium when harvesting tobacco plant.

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INTRODUCTION

Polonium is a rare and highly radioactive element which is chemically similar to bismuth and tellurium, in nature it is mainly found in Uranium ores and found in very small amount in soil. Isotope of Polonium (^{210}Po) is the one of the main causative agent of cancer caused by tobacco smoking due to its emission of alpha radiation. Alpha particles emitted from ^{210}Po are very high energy form of radiation (5.3 million eV) which has less traveling range hence, they can be blocked by a few sheet of paper. In human body, polonium can cause damage to liver, bone marrow & other soft tissue like alveoli and bronchi in lungs.

Absorbed doses of radiation can be measured using units called rads, and experiments have shown that as little as 15 rads of polonium can induce lung cancers in mice. That's only about a fifth of what a smoker would get if they averaged 2 packs a day for 25 years. Indeed, the lung tissues of smokers who have died of lung cancer have absorbed about 80-100 rads of radiation.

Properties of Polonium:

Symbol	Po
Atomic number	84
Electronic Configuration	$4f^{14} 5d^{10} 6s^2 6p^4$
Elemental Category	post-transition metal
Crystal Structure	cubic

	α -Po
Half Life	138 days
Ionizing energy	1st: 812.1 kJ/mol

Effect of Polonium on human body

Tobacco contains polonium in very low concentration but due to heavy tobacco smoking, over the period of time it's quantity increases which leads to be continuous exposure to radiation of polonium and it causes damage to tissue and leads to cancer or tumor.

when people inhale tobacco smoke, the tar from tobacco smoke builds up and traps lead-210 and polonium-210 on the sensitive tissue of bronchioles but polonium-210 (whose half life is about 138 days) quickly grows in as the lead-210 (half life = 22.3 years) decays and becomes the dominant radionuclide. Over time, the dose of polonium-210 directly on tissues of the bronchioles gets very high, and intense localized radiation doses can occur at the bronchioles.

Cancer is caused by abnormal growth of damaged cell/tissue. Abnormal or high Radiation dose can alter or damage DNA molecule and when that altered or damage DNA molecule replicates, it leads to cancerous Tissue.

How Polonium get into Tobacco

Leaf of tobacco contains minute amount of radioactive isotopes of polonium which came from decay of radium in soil. but tobacco plants can also absorb radioactive elements directly from the air around them. Tobacco leaves are covered in sticky hairs, making them easy to contaminated from harmful chemicals from atmosphere.

other than natural ways, there are some human causes which leads to polonium contamination like phosphate fertilizers, largely used by the tobacco industry, contain radium which decays to form products lead-210 and polonium-210. When phosphate fertilizer is spread on tobacco fields year after year, the concentration of lead-210 and polonium-210 in the soil rises. Hence Tobacco leaves get radioactive contamination.

Some methods for prevention of Polonium contamination:

- 1) Use of alternative polyphosphate sources, such as organic fertilizers from animals .
- 2) Use of ammonium phosphate as a fertilizer, instead of calcium phosphate.
- 3) Different storage methods. Po-210 radioactivity of tobacco rose over time while in storage. As a consequence, harvesting tobacco while it is still green and avoiding prolonged storage in silos in order to prevent an increase in Po-210 concentration due to Pb-210 slow decay could be recommended.
- 4) Genetic modifications of tobacco plants with significant reduction of Prichomes concentration on the leaves, on which Pb-210 and Po-210 accumulate .
- 5) Resin filters may decrease lung exposure to alpha radiation. On the contrary, common filters reduce Po-210 activity, on average, by 4.6%.
- 6) A biological way to remove Po-210 by treating polyphosphate rocks with bacteria capable of reducing sulphates .
- 7) The simplest and most applicable solutions would be the quantitative decrease in polyphosphates use in tobacco cultivations and the regulation of the maximum acceptable level of alpha radiation of cigarettes, which should also be clearly indicated on the packet.

Conclusion:

Radioactive Polonium(²¹⁰PO) is one of the most dangerous carcinogen found in Tobacco leaves. It can be removed from tobacco by various method but risk of cancer will not decrease because there are other carcinogen other than polonium present in tobacco which can cause cancer.