

POLONIUM-210 IN ITALIAN TOBACCO

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Abstract—It is known that ^{210}Po contained in tobacco is volatile at the temperature of a burning cigarette. Hence a radiation hazard from ^{210}Po may arise for a smoker's bronchial epithelium.

Hence measurements of ^{210}Po were started in most popular Italian cigarettes. A later stage of the work will consider the tobacco from some Italian regions. Polonium was extracted from tobacco samples by a wet ashing procedure and plated on nickel discs. The discs were mounted on ZnS phosphors and the alpha activity was counted. The polonium alpha spectrum was measured by an ionization chamber. The method can be simply carried out, but difficulty arises from the low-background alpha counting necessary for determining accurately the minute quantities of ^{210}Po (of the order of 10^{-2} pCi).

INTRODUCTION

Some authors^(6, 8, 9) have suggested that ^{210}Po is a factor in the genesis of bronchial cancer in smokers. This nuclide—decay product of ^{210}Pb , having a 19.4 year half-life—is an alpha emitter with a 138 day half-life. The principal modes of introduction into the human body are (1) through almost all foods (vegetables, fruits, water, etc.); (2) as natural fall-out due to radon disintegration products escaping into the atmosphere from the soil; (3) as contamination in smoke from tobacco.

Considering tobacco, it is well-known that polonium is volatile at the temperature of a burning cigarette and can therefore be absorbed with smoke. Neglecting, for the time being, any consideration of how natural radioactivity enters the lungs through smoke and therefore on the dose to the organ, the ^{210}Po concentration is being measured in tobacco grown in Italy. In order to analyse in more detail the absorption of this nuclide in the plant, we also intend to examine:

- (a) how it is distributed in leaves, roots and bark;
- (b) what is the degree of radioactive equilibrium between the ^{210}Po and its parent ^{210}Pb ;

- (c) whether it is absorbed by plants directly from the soil or through deposition on leaves of natural fall-out contained in the atmosphere or by a combination of both.

A number of tobacco plants were therefore chosen in various plantations of an Italian region. The leaves are treated in the laboratory, some of them being fresh and the others being cured. Later a determination will be performed of the radioactive content of the soil in which they have been growing. Finally to investigate the absorption mechanism from leaves and roots a series of plants has been grown with hydroponic culture in a glasshouse. Some of these will be exposed to an atmosphere rich in radon, others will be nourished with ^{210}Pb and ^{210}Po solutions. The oldest tobacco samples to be found in Italy will also be studied.

The first part of the work was concerned with the ^{210}Po content in the most popular Italian cigarettes, that is Alfa, Nazionali, Nazionali Esportazione and Nazionali Super. Preference was given to types that are cured with Italian tobacco blends.

ANALYTICAL METHODS

1–2 g of tobacco previously dried at 105°C are digested in 70 ml of cold concentrated

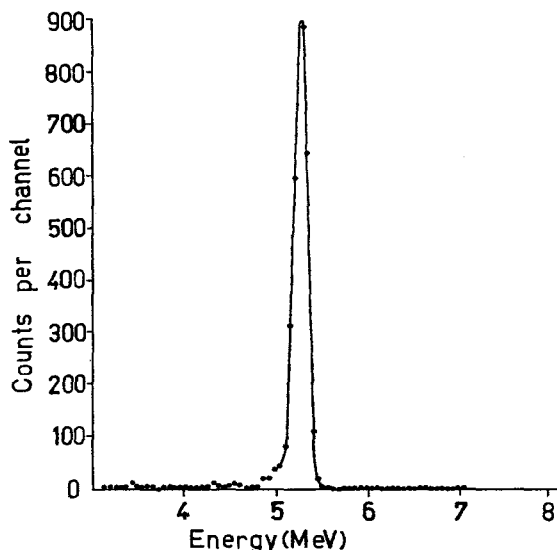


FIG. 1. α -spectrum of a sample of 2 g of tobacco, using an ionization chamber. Counting duration was 25 hr.

HNO_3 . This is then heated in a water bath for about 4 hr and subsequently in a sandbath until 10–20 ml remains. 20 ml of 70% HClO_4 are added and the solution is heated again in the sandbath until fuming. It is then cooled and cautiously diluted with distilled water until the solution is 20–30 ml. It is neutralized with 18 N NaOH and is re-acidified with 0.1 N HCl to dissolve possible metallic hydroxides. It is filtered and washed with 0.1 N HCl adjusting the volume to 200 ml. 200 mg of ascorbic acid are then added to eliminate possible interference due to trivalent cations present in the solution (i.e. Fe). The solution is then poured into the plating cell which is placed in a thermostatic bath at 90°C. ^{210}Po plating is carried out on Ni discs (previously pickled with heptane, acetone and then dried) by stirring the solution at 250 rpm. The deposition time was 4 hrs. Calibration tests showed that the deposition recovery is of the order of 90%.

The deposition cell consists of a commonly used commercial baby nursing bottle with the bottom removed. The Ni disc diameter is 36 mm.

The deposits were measured by means of ZnS(Ag) scintillation counters with an extremely low background equal to 0.36 ± 0.05 counts/hr. The ZnS(Ag) layers were 50 mm in diameter. The mean of several reagent blank determinations was 1.1 ± 0.1 counts/hr. The counting efficiency of 45% was determined with electrolytically plated ^{239}Pu calibrated sources.

Alpha particle spectroscopy was performed on several samples using an ionization chamber. This confirmed that only ^{210}Po was present.

The results obtained are reported in pCi/g of dry tobacco in Table 1 below. These results have been corrected for the yield of the chemical separation and counting efficiency, taking into account the activity due to the ^{210}Po collected on the filter during the chemical processing.

Table 1. ^{210}Po content of Popular Italian Cigarettes

Type of cigarette	^{210}Po pCi/g of tobacco (mean value)
Alfa	0.37 ± 0.03
Nazionali	0.48 ± 0.03
Nazionali Esportazione	0.53 ± 0.03
Nazionali Esport. Super	0.42 ± 0.04

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