

Health Risk Assessment from Natural Polonium-210 in the Canadian North

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This Bureau has carried out a number of studies over the past 10 years on radioactivity in traditional food items of aboriginal inhabitants in the Canadian Arctic. Information gained from these studies is presented here to demonstrate how to carry out a health assessment in a situation where radiation doses to humans may reach several times the normal background value and where the affected population has significant health concerns. The radionuclide selected for this assessment is naturally-occurring polonium-210 (Po-210). Po-210 is produced by decay of natural radon gas in the atmosphere and accumulates on slowly growing lichens. These in turn serve as the principal food source of caribou. Northern aboriginal peoples depend upon caribou for a large fraction of their protein requirement. The radiation dose to a human receptor from this pathway depends upon the following factors:

1. Po-210 concentrations in caribou meat and organs

Data are presented from various laboratory measurements to show the ranges and most likely values of these concentrations. Values can reach 25 Bq/kg in meat (muscle tissue), and more than 10 times that level in liver and kidney.

2. Amount of meat and other organs consumed by northern people

This information is obtained from a combination of dietary surveys and direct measurements using cesium-137 as a tracer. Typical adult consumptions in most northern communities range from 50 to 200 grams of meat per day on a year-round average.

3. Uptake of and retention of polonium by the human body

This factor was very poorly understood at the beginning of the study. An experiment was carried out with human volunteers who consumed caribou meat containing known amounts of Po-210. The uptake and retention were determined from measurements of Po-210 in excreta. It was confirmed that 40 to 80 % of ingested polonium is absorbed by the human gastrointestinal tract.

4. The Relative Biological Effectiveness (RBE) of Po-210 alpha radiation

An experiment is in progress to determine the effect of this radiation on human and animal cell cultures. Further details will be presented.

These factors are combined in order to estimate the equivalent doses to various human organs and to the human body as a whole. Doses to the whole body can be several mSv per year and can be an order of magnitude higher in certain organs. Standard risk coefficients from the International Commission on Radiological Protection and other agencies are used to predict cancer and other health effects from the radiation doses. Finally, health statistics from the Canadian north are examined to if there is a preponderance of the predicted health effects.