R1.3 Determination of radionuclidic purity

For gamma emitters the most useful method of examination for radionuclide purity is gamma spectrometry. It does have limitations, however, because:

- -beta-emitting impurities are, in general, not detected;
- -when sodium iodide detectors are employed, the photoelectric peaks due to impurities may be obscured by those due to the major radionuclide, or, in other words, the degree of resolution of the instrument could be insufficient. This problem could be solved by the use of high resolution solid state semiconductor detectors, such as high purity germanium (HPGe) detector; and
- -unless the instrument has been calibrated with a standard source of known radionuclide purity under identical conditions of geometry, it is difficult to determine whether additional peaks are due to impurities or whether they result from such secondary effects as backscatter, coincidence summation, or fluorescent X-rays.

The range of gamma spectrometry may be extended in two ways first, by observing changes in the spectrum of a preparation with time (this is especially useful in detecting the presence of long-lived impurities in a preparation of a short-lived radionuclide); secondly, by the use of chemical separations, whereby the major radionuclide may be removed by chemical means and the residue examined for impurities, or whereby specific impurities may be separated chemically and then quantified. It is evident that chemical means will not separate an impurity that is isotopic with the major radionuclide.

Radionuclide impurities are directly related to the production process of a radionuclide. Based on technical limitations and safety requirements limits have been set for radionuclidic impurities in radiopharmaceutical preparations, expressed as a percentage of the total radioactivity.

For identification of gamma emitters the method of choice is gamma spectrometry. In order to interpret the energy spectrum of radionuclides it is necessary that the energy range be calibrated with appropriate reference preparations. Gamma spectrometry may be performed using high resolution germanium detectors. Beta emitting impurities are not detected by gamma spectrometry. Long lived impurities in a preparation of a short-lived radionuclide may be determined after the decay of the short-lived radionuclide.

Chemical separation of impurities is an effective method both during the production process and as an analytical procedure. The exact measurement of trace amounts of beta- and alpha-emitting radionuclides in preparations of generally applied gamma radionuclides requires special techniques. Chemical separation of the radioactive impurities is used prior to the measurement of non-penetrating radiation.