Sample Pages from Antinuclear Nutrition's chapter on Radionuclides Of Concern

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Radionuclides of Concern

The radionuclides of greatest concern are those that:

1. Are most likely to be released in radiological emergencies, especially if large quantities are involved.

2. Have half-lives long enough to reach humans and result in significant exposures.

3. Are biologically mobile and may pass through food chains or otherwise enter the body.

These radionuclides are most likely to become internal emitters and so are the ones to be guarded against, if possible. Good protection can be obtained from some radionuclides, practically none from others (see Protection Principles).

Every elemental species will have a certain characteristic affinity for deposition within the body. For example, a radioactive atom of iodine will behave for all practical purposes exactly like a stable atom of iodine, physically and chemically, up to the time that it disintegrates. Then, it alters its nuclear structure and is transmuted into another kind of element with different physical and chemical properties. Until it disintegrates, however, it will follow the same biological pathways that already exist for stable iodine, with the result that most iodine in the body is found to be concentrated in the thyroid gland (see Radioiodines).

Some radionuclides enter biological pathways because they are so similar to other elements for which pathways exist. This is true for strontium-90, which follows calcium into the body because the two elements are chemically similar. The same effect occurs with cesium-137, which is similar chemically to potassium, and follows potassium into the body almost as well as strontium follows calcium. The reason for the chemical similarities is that the outermost electron configurations of each pair of elements is the same. The number of electrons in the outermost electron shells of atoms determines to a large extent how they will behave chemically. This is reflected in the organization of the periodic table of the elements which arranges the elements in order of increasing atomic number and groups them in columns of chemical similarity. Calcium (Ca, atomic number 20) is located directly above strontium (Sr, atomic number 38). Both elements have identical outermost electron shells and thus very similar chemical characteristics. The periodic table helps to explain much of chemistry, and provides clues as to how radionuclides may contaminate biological systems.

The radionuclides shown in Figure 3 represent the end product yields of 42 chains of fission product decays as a function of mass number. In this case the figure represents the products of the fission of uranium-235. The curve for plutonium-239 or uranium-233 would be only slightly different. The curve is presented to illustrate the percentage distribution of fission products, but it does not represent the actual proportions of all radionuclides formed in fission, because the neutrons released in fission reactions can be absorbed by stable elements and induce radioactivity in them.

The spectrum of radionuclides released in a contamination event may vary in kind and quantity even from similar sources. For example, a core meltdown at a freshly fueled nuclear reactor would be less serious than the same accident at the same reactor but at a later time, because the quantity of fission products in