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Screening Methods for Monitoring the Radionuclides Contamination in Biological Materials and Live Animals

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Communication

The presence of areas contaminated by anthropogenic radionuclides, such as ^{137}Cs, requires the prompt analysis of a large number of samples. A sanitary intervention, together with traditional surveillance systems, are fundamental to detect and interrupt the transmission of radionuclides into the food chain throughout either the direct human consumption of contaminated vegetables or the indirect human intake through the animal feeding. Moreover, an increase in the radioisotopes bioavailability is likely to be observed over one or two links in the food chain.

To prompt and simplify the analysis process, the authors propose an initial preliminary radioactivity measurement by using either screening methods on the cow milk, such as the Liquid Scintilation (LSC), or radio-chemical gamma counters on muscles, blood cells or other animal tissues. The choice of cow milk as main indicator is justified by its simplicity in being sampled and analized, as well as by the widespread distribution of dairy herds (i.e. sheep, goats and cattle) over the territory in light of a better veterinary supervision on food of animal origin. Additionally, LSC methods applied to the milk reveal to be particularly efficient in reading gamma-emitting radioisotopes, such as ^{137}Cs, unlike other high energy beta-emitting, such as ^{90}Sr, whose secondary Cherenkov radiation make the reading particularly sensitive.

Experimental results showed that LSC methods are particularly able to quickly and efficiently identify the contaminated milk samples, being thus suitable for immediate territorial screening campaigns aimed at preserving the food chain.

Although not new for radio-chemistry applications, this method results particularly suited to milk screening thanks to its ability to easily highlight the simultaneous presence of the two major contaminants, despite one of them be only a beta-emitter (^{90}Sr).

The reliability of LSC results has been quantitatively confirmed by gamma spectrometry analysis performed on the milk samples priorly found contaminated.

The authors have also studied the possibility of using automated radioimmunoassay equipments Perkin Elmer COBRA to identify the food contaminated by gamma-emitters. Despite showing a lower sensitivity with respect to the gamma spectrometry, this method permits the analysis of more than 40 tests per day by detecting contamination levels greater than 50 Bq.kg^{-1}.

By comparing the COBRA and gamma spectrometry results from samples of boar muscle at different contamination levels, data revealed a value of the Pearson Correlation very close to 1 to further demonstrate the validity of the two methods and the reliability of the monitoring system from 50 Bq.kg^{-1} ^{137}Cs onwards.

In conclusion, the method here proposed allows for a reduced reading time and highly automated radio-contamination analysis, which translate into the possibility of a larger number of tests performed. It proves to be valuable on two sides:

- Allow for a capillary control of ^{137}Cs in tissues and, by extension, in the majority of biological matrices
- The use of a commonly employed instrumentation, mostly in chemical-clinical analysis, allows for low cost control campaigns.

Furthermore, this method has been successfully applied to the radionuclide detection in blood clots with a concentration proportional to that present in the muscle.

Finally, the possibility of detecting contamination from small quantities of blood samples and perform daily numerous tests leads to the possibility of important screening in live animals and humans, as well as the monitoring of the biological ^{137}Cs elimination from contaminated organisms through diets and medical treatments.

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