

# APPLICATION OF RADIOMETRIC METHOD FOR THE DETERMINATION OF ELEMENT MIGRATION FROM PLASTIC PACKAGINGS INTO FOOD

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Plastics are one of the most used materials in food packaging industries. As the plastic manufacturing process involves the use of catalysts and different types of additives, these materials may contain toxic elements. And, when the foods are in direct contact with these packaging materials their components may migrate into the food<sup>1</sup>. Consequently the evaluation of toxic element migration from food packaging is of great interest to preserve human health.

In Brazil, the National Surveillance Agency (ANVISA) established boundary-values of migrants and recommended procedures to evaluate migration of elements and substances from plastic packaging into food<sup>2</sup>.

In this study a radiometric method was applied for element migration determination from plastic food packagings into food simulating solutions.

Plastic packaging of water, juice, soft drink and dairy products were tested. First, the packagings were washed with water then cut in sheets that were washed again with deionized water, dried and next cleaned with hexane. A total area of 0.405 dm<sup>2</sup> of each packaging with regular surfaces and without risks was selected for test.

The radiometric method consisted in irradiating plastics with neutrons, followed by exposition for migration and measurement the radioactivity in food-simulating solution. After irradiation, the sample was immersed in 30 mL of simulating solution for 10 days at 40°C. The choice of the simulating solution was based on the ANVISA recommendation<sup>2</sup>.

Certified standard solutions of Cd, Co, Cr and Sb were used to prepare diluted multielemental standard solutions that were pipetted on filter paper sheets and dried at room temperature.

The plastic samples and element standards placed in polyethylene involucres were irradiated for 16 h under a thermal neutron flux of 10<sup>12</sup> n cm<sup>-2</sup> s<sup>-1</sup> of the IEA-R1 nuclear reactor.

After the migration exposure time, the plastic sample was removed from the simulant and discarded. The simulating solution was transferred into a bottle for gamma-ray activities measurements using a hyperpure Ge detector coupled to a gamma ray spectrometer. The irradiated element standards were dissolved using nitric acid together with a carrier solution of elements. These standard solutions were measured in the same geometry of the simulants. The gamma-spectra were obtained using S100 Canberra software and in house software was use for data processing. Radioisotopes were identified according to their gamma ray energies and half-lives. The mass of the element that migrated from plastic into the simulant was calculated by comparative method. The migration detection limit was evaluated according to Currie<sup>3</sup> for the elements not detected in the simulating solutions.

Table 1 shows the ranges of element migration results obtained for food plastic packagings. These data are given in terms of element mass that migrated per simulant mass and area of plastic material exposed to migration (µg dm<sup>-2</sup> kg<sup>-1</sup>). Samples of water packaging presented only Sb migration. Packaging of juices and soft drinks presented Co and Sb migration and, of dairy products showed Co and Cr migration. The Cd migration was not detected in all food packaging materials analyzed.

Table 1. Range of element migration values (µg dm<sup>-2</sup> kg<sup>-1</sup>) from food plastic packagings into simulating solutions.

Content of Packaging (N*)	Simulant	Elements			
		Cd	Co	Cr	Sb
Water (8)	Water	< 22.3	< 0.1	< 0.8	0.3-0.8
Juice (2)	3% acetic acid	< 24.1	0.1-0.2	< 0.5	0.5-0.8
Soft drink (10)	3% acetic acid	< 29.5	0.04-0.6	< 0.6	0.2-1.6
Dairy products (5)	3% acetic acid	< 57.0	0.08-0.1	2.2-3.1	< 0.3

\*N= Number of samples analyzed

From the migration results, the total mass of each element that migrated into food were calculated. These values for Cr and Sb were lower than the maximum limit values established in the legislation<sup>4</sup>. These limit values are 100 µg kg<sup>-1</sup> for Cr and 2000 µg kg<sup>-1</sup> for Sb.

The advantages of the radiometric method are no necessity of blank analysis and the use of high purity simulants. Moreover, it is possible to evaluate the migration to the food content, instead of simulant. Migration detection limits also indicate the high sensitivity of the method.

## References

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