# Natural and anthropogenic radionuclides in Brazilian commercial dog food: preliminary results

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## INTRODUCTION

In recent decades, exposure assessments of non-human species to ionizing radiation, as well as their effects, have been incorporated into the radioprotection scenario. The anthropocentric standpoint of the International Commission on Radiological Protection (ICRP) has evolved from its publication 26 (ICRP, 1977) – which considered that other species were adequately protected within human protection framework; to its latest 124 publication (ICRP, 2014), in which the Commission presents the immersion of radiological protection of the environment in the already existing Commission's system of protection.

To estimate the effects of ionizing radiation over animals and plants, several key points must be considered, such as radionuclides concentrations, transfer parameters, dosimetry models and reference biota. The last parameter is specially considered, once it would be impossible to represent individually every animal and plant. Therefore, the vast number of non-human individuals can be represented by reference organisms to facilitate the assessment of exposure, absorbed dose and radiation effect for individuals from alike environments. There is, however, no specific representative for domestic animals, such as dog and cats.

Brazil holds the second largest dog and cat population in the world that consumes over 2 million tons of feed every year. According to the Brazilian Association of the Industry of Products for Pets (ABINPET), the national market has grown 7.3% in 2013 and represents, along with Japan, the second largest market in the global pet industry. Pet food segment leads the brazilian industry, with 65.7% of the market share in 2013, representing over 2.3 million tons of feed. All pet food must conform to required levels of proteins, fat and mineral content, including calcium and phosphorus. These minerals are often derived from phosphate rocks, already well known by their concentrations of uranium and thorium (Zapata and Roy, 2004).

Dog food content has been investigated by Elias (Elias *et al.*, 2012) using neutron activation analysis. Although the authors published a series of chemical concentration for several elements, no radiological study or the consequences from the ingestion of radionuclides have ever been conducted in Brazil.

The possible effects observed in dogs from the incorporation of radionuclides depend, among others, on their actual concentration in the food that was ingested. Hence, the present study will evaluate the activity concentrations of natural and anthropogenic radionuclides in several brands of dry dog food by high resolution gamma-ray spectrometry. This research is part of a wide study on internal absorbed doses for dogs and cats that will be estimated in the future, using adequate transfer parameters for these animals.

## MATERIALS AND METHODS

Initially, 32 different brands of dry dog food, from 13 producers, most commonly available in local markets, were selected, that differ in quality (standard, premium and super premium) and nutritional needs (adult, puppy, senior and weight control).

### Sample preparation and counting procedures

All brands were crushed into powder; kiln dried and individually tightly sealed in a 100 mL high density polyethylene (HDPE) flasks, with a plan screw cap and bubble spigot. The mean apparent density of the samples is 0.69 g/cm$^3$. To ensure secular equilibrium of natural uranium and thorium series, every sample rested for 30 days before placed in a low background extended range High Purity Germanium Detector (HPGe) Canberra/GX4020, for an acquisition time of 150,000 seconds. Activity concentration values were calculated with InterWinner 6.0 software (InterWinner, 2004).

The efficiency and background radiation curves were obtained using, respectively, a multi-element standard aqueous radioactive solution sample and an ultra-pure water sample, in the same geometry as the dog food samples.

### Assessed Radionuclides

The natural radionuclides considered were: $^{40}$K, $^{232}$Th and $^{226}$Ra from the $^{238}$U series. The activity of $^{40}$K was calculated using its single 1460 keV gamma transition, $^{226}$Ra activity was inferred from the strongest gamma transitions of $^{214}$Pb and $^{214}$Bi and $^{232}$Th activity from the strongest gamma transitions of $^{212}$Pb, $^{212}$Bi and $^{228}$Ac. The anthropogenic radionuclide content

in dog food investigated were: $^{60}Co$, $^{131}I$, $^{137}Cs$ and $^{134}Cs$, which are usually considered by the International Atomic Energy Agency (IAEA, 1996), for human consumption after a potentially contamination following a nuclear or radiological emergency.

## RESULTS AND CONCLUSIONS

Activity concentration values for all natural radionuclides considered are shown in Fig. 1 for each dog sample.

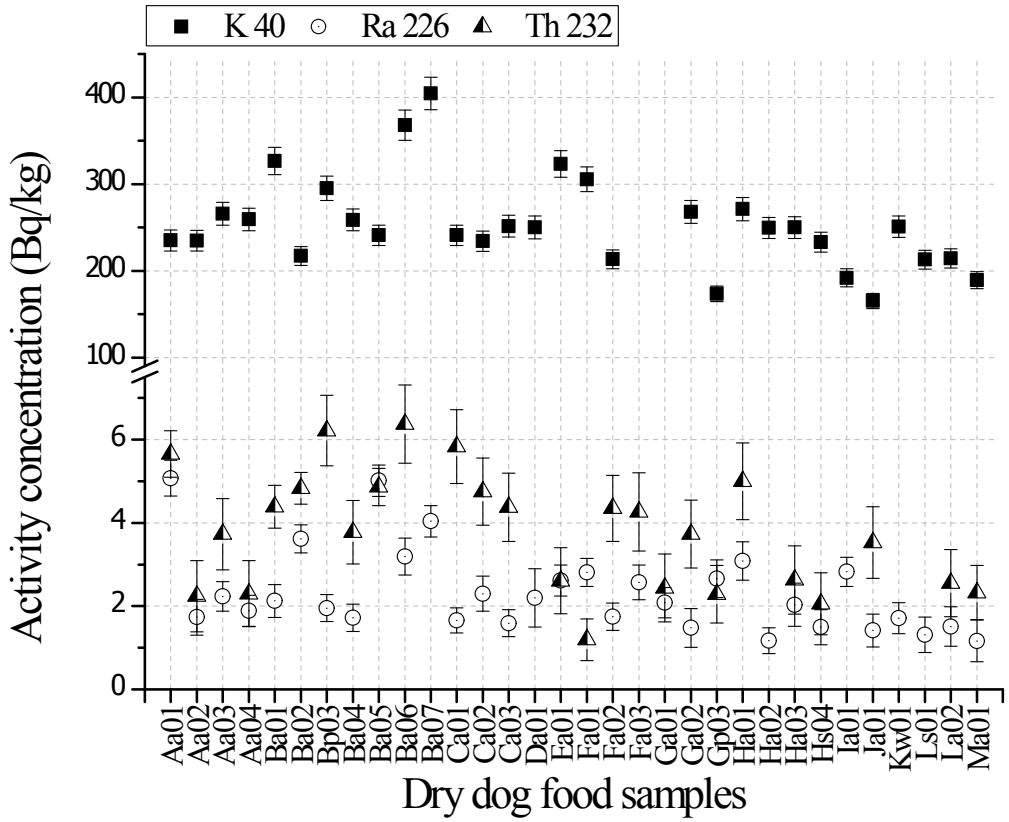


**Figure 1.** Natural radionuclides activity concentration values, assessed for 32 different samples of dry dog food. Producers are labelled from A to M, numbers indicating the samples from the same origin. Nutritional needs are labelled as following: “a” for adult, “p” for puppy, “s” for senior and “w” for weight control.

In general, for 66% of the samples, thorium activity concentrations are higher than the concentrations for radium. The activity concentration values for the artificial radionuclides

considered were below the detector Minimum Detectable Activity (MDA) levels, showed in Table 1.

**Table 1.** MDA range values for the artificial radionuclides considered.

| | Co – 60 | I – 131 | Cs – 134 | Cs – 137 |
|---|---|---|---|---|
| MDA (Bq/kg) | 0.8 – 1.8 | 0.7 – 1.0 | 0.7 – 1.1 | 0.8 – 1.1 |

The activity concentrations obtained from the samples will be used afterwards to estimate the whole body activity concentration for small domestic mammals, whose habits and exposure situations are distinct and not very often described in the literature. Another important consideration is that, in Brazil, pet products and services grow significantly every year, due to an increase number of dogs and cats owners that considers their animals as family members and demands quality in the products available. Therefore, this study is important not only to provide information on food content, but also to contribute on biota exposure database.

## ACKNOWLEDGEMENT

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