EAN-NORM Round Table Workshop Dresden

Production of Dicalcium Phosphate and its use as a food supplement for domestic animals in the NORM context

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Dicalcium Phosphate is a calcium and phosphorus feed supplement for domestic animals such as poultry, cattle and pigs. As an end-product of the phosphate industry it is enhanced in naturally occurring radionuclides (i.e. ^{238}U and its decay chain daughter). However, the digestion of the phosphate rock leads to different accumulation of radionuclides in DCP depending on the acid used for the rock digestion; whereas H_2SO_4 leads to high activity concentrations of ^{230}Th (1000 Bq·kg^{-1}) in the final product, the HCl based-process enhances ^{210}Pb in the DCP (up to 2000 Bq·kg^{-1}) .Fluxes of the ^{238}U series radionuclides (U and Th isotopes, ^{226}Ra, ^{210}Pb and ^{210}Po) during the DCP production process when the rock is digested with HCl are discussed herein.

The relatively high activity concentrations of ^{210}Pb and, to certain extent, ^{210}Po in DCP could pose a potential radiological risk to humans through chicken meat ingestion. Therefore, an experimental setup and a mathematical biokinetic model have been performed in order to understand how ^{210}Pb and ^{210}Po behave once incorporated into the chicken body through ingestion. The experimental set up consisted on the feeding of 42 chickens with three diets containing different concentrations of DCP. Animals were fed during six weeks and ^{210}Pb and ^{210}Po were analyzed in tissues as well as feces after radiochemical separation. About 95% of the ingested ^{210}Pb and ^{210}Po was immediately excreted. From the amount absorbed to tissues it was observed that whereas ^{210}Pb is mostly found in bones, ^{210}Po accumulates in liver and kidneys. A one-block-kinetic model has been developed in order to determine the variation of the total activity of ^{210}Pb and ^{210}Po accumulated in the chicken body throughout the 42 days life. The model correctly reproduces experimental results and also allows calculating the transfer rates for ^{210}Pb and ^{210}Po, useful for first-order models, i.e. under stationary metabolic conditions.