The Transfer of Artificial Radionuclides in Milk and Meat after Fukushima Releases

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1 Introduction:

The major releases of radioactive materials into the atmosphere from the reactors accident occurring at the Fukushima Dai-ichi nuclear power station (Japan) lasted nearly 10 days, from 12 to 22 March 2011. The radioactive plume was expected after 23 March in France. This was an opportunity to measure the artificial radionuclides in the food chain.

2 Objectives:

Evaluate *in situ* transfer of artificial radionuclides from the accidental releases of Fukushima in milk and meat produced in the south of France, acquire field data to strengthen the generic parameters used in models.

3 Methods:

Sampling and radioactive measurements were carried out on milk (goat and cow) and meat (beef and sheep) at different sites (figure 1) where the herds were outside at three main stages:

a/ before the Fukushima fallout;
b/during the time the radioactive air contamination was observed;
c/after the return to the initial level in the atmosphere.

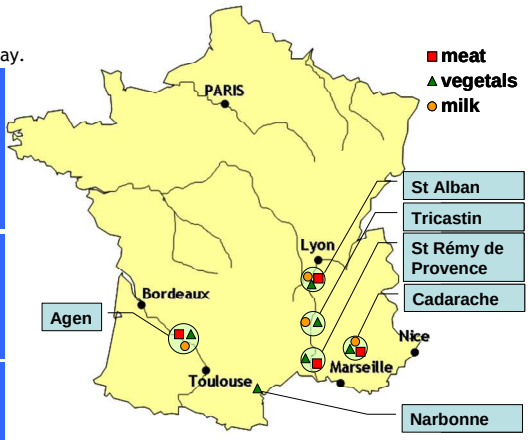

Figure 1: location of vegetation, milk and meat sampling sites.

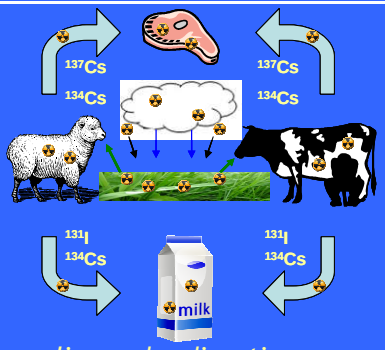

Figure 2: sampling and radioactive measurements.

In addition grass was also sampled to evaluate the transfer factor of iodine and caesium in milk and meat respectively. (figure 2)

4 Results:

Three radionuclides were considered as tracers to investigate the consequences of the Fukushima radioactive deposits to the food chain: ^{131}I, ^{134}Cs and ^{137}Cs. However ^{134}Cs will be the only one useful to study the relation between the 3 types of samples (figure 3).

The first detectable levels of ^{131}I and ^{134}Cs in grass were measured on 26/03 and 28/03 respectively. 2 to 3 days after they had been measured in milk and after only three weeks in meat for ^{134}Cs (figure 3).

[^{134}Cs] in meat was as follow : sheep > veal > beef > bull.

The environmental monitoring had further allowed evaluating the grass to milk transfer factors of iodine at several sites : 2.8 10^{-2} and 3.6 10^{-3} d L^{-1} for goat's and cow's milk respectively (Parache et al., 2011).

The grass to meat transfer factor of caesium are 1.22 10^{-2} and 6.65 10^{-1} d kg^{-1} for cow and sheep meat respectively.

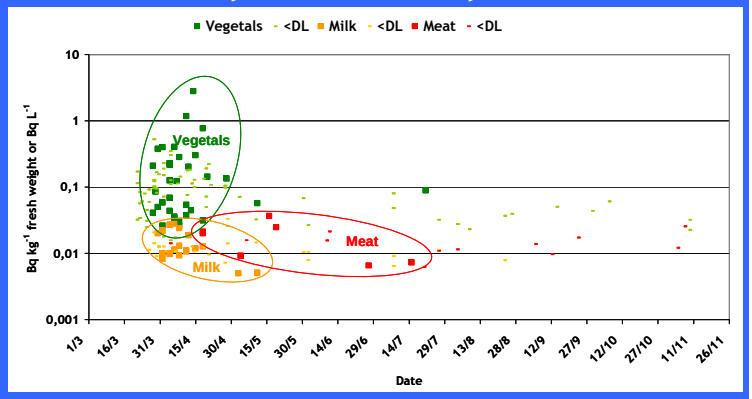

Figure 3: ^{134}Cs activities measured (all sites).

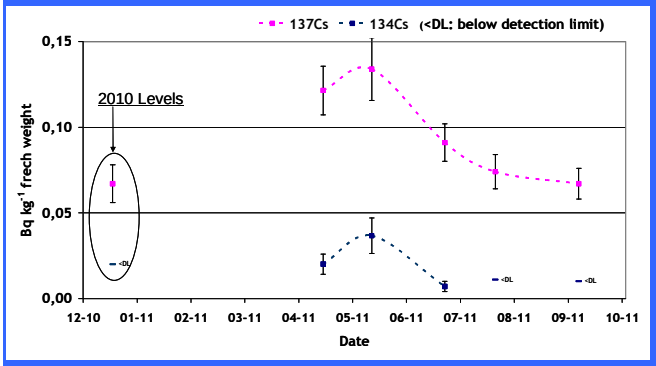

Figure 4: ^{137}Cs and ^{134}Cs in sheep meat (Cadarache).

In Cadarache, an increase of both caesium isotopes activity is observed in sheep meat in April 2011. Then ^{134}Cs decreases and reaches less than the detection limit in summer (figure 4). The time trends of iodine in goat's milk and vegetation is reported, with an increase followed by a decrease of activity along time (figure 5).

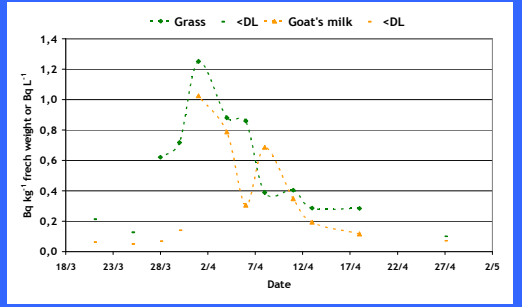

Figure 5: ^{131}I in grass and milk (Cadarache).

5 Conclusions:

^{131}I, ^{134}Cs had allowed to monitor the consequences of Fukushima releases in the food chains. The determined transfer factors in meat and milk were in good agreement with values reported before (Howard et al.,2009). Although ^{137}Cs has always been measured during monitoring, it has several sources in addition to Fukushima (Chernobyl deposits, nuclear weapons tests fallout).

References:
Parache V. et al. Transfer of ^{131}I from Fukushima to the vegetation and milk in France, *Environ. Sci. Technol.* 2011, 45: 9998-10003
Howard B.J. et al. Radionuclide transfer to animal products: revised recommended transfer coefficient values, *J. Environ. Radioactiv.* 2009, 100: 263-273.