I-131 Tracer Studies

Field Studies: Deborah Oughton[1], Hans-Christian Teien[1], Marit Nandrup Petersen[1], Ali Hosseni[2], Till Seerhusen[3], Merete Myromslein[3], Brit Salbu[1]
Cow-Milk Studies: Brit Salbu[1], Anicke Brandt-Kjeldsen[1], Marit Nandrup Petersen[1], Knut Hove[1], Egil Prestløkken[1], Jordi Vives i Batlle[4], Juan Carlos Mora Canadas[5]
1- CERAD/NMBU, Aas; 2- DSA, Østerås, 3 - NIBIO, Apelsvoll and Fureneset; 4 – SCK-CEN, Belgium ; 5- CIEMAT Spain

Deborah.Oughton@nmbu.no

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Key Messages

In the early phase of an emergency situation, ^{131}I is one of the most important radionuclides for which information on transfer is needed to assess human food chain doses. However, because of the short half-life, models are often lacking in data on short-term processes.

- **Field tracer experiments** demonstrated little wash-off from grass and barley and that changes in ^{131}I concentration were dominated by biomass changes. There was a low but measurable transfer from foliage to potato, and from flower to strawberries.
- **Cow milk tracer experiments** showed that rapeseed diet reduced blood-milk transfer of ^{131}I by 50-90%. Data is being used to improve biokinetic models with new compartments and short-term kinetic parameters.

Field Tracer Experiments: Impact of stable I and climate on I transfer to crops

Because of its short half-life, foliar uptake and translocation within plants are major factors influencing the content of ^{131}I in foodstuffs. Both translocation and soil-to-plant transfer could also be dependent on stable iodine content.

Methods

- I-131 tracer (in artificial rainwater, KI) sprayed on various crops (grass, barley, potatoes, strawberries) at two field sites: Apelsvoll (inland, low I) and Fureneset (coastal, high I)
- Spraying and Sampling: 2017 - Grass and barley (three times during the growing season, June-August); 2018 - Grass and potatoes (one spray); 2019 - Grass, potatoes and strawberries (one spray). Samples were collected for three weeks after each spraying.

Field site Fureneset, Norway

Autoradiograph barley, 3 hrs post spray

Cow Milk Tracer Experiments: Impact of feed on blood to milk I transfer in cows

Iodine deficiency is re-emerging in some developed countries, including Norway. Since dairy is supposed to cover 60% of children's stable iodine needs, low stable iodine levels in milk could be an important risk factor for human health following exposure to radioactive iodine. Milk screening in Norway showed I-deficiency in winter compared to summer. Hypothesis is that the change in protein source (rapeseed) during winter caused a decrease in transfer of I from blood to milk.

Methods

- One week's acclimatization to feed (I concentration 4 mg/kg DM). A single $^{131}I^-$ dose administered to the vein of 4 cows; while $^{131}IO_3^-$ administerd o the rumen fistulated cows.
- Two cows were fed rapeseed cake and two soybean meal (2x2 Latin square where cows were their own control).
- Samples of milk, blood, urine, faeces, thyroid, etc collected for 3 weeks

Results Field Tracer Experiments

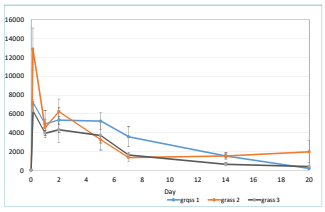

Fig 1: I-131 Bq/m^2 Grass - Apelsvoll June -July

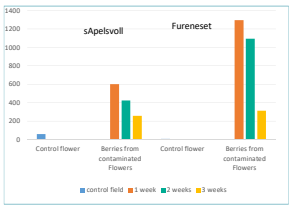

Fig 2: I-131 Bq Strawberries

- I-131 interception potentials, as well as changes in concentration in grass and barley, at both sites were dominated by changes in biomass. No evidence of a soil to plant uptake, thus no difference in transfer between sites.
- A relatively rapid decrease in total Bq/m^2 over the first 24 hrs, combined with low washoff, suggested a possible loss from evaporation.
- A low but measurable transfer from leaf to potato (ca. 50:50 peel:flesh) and from flower to strawberries was seen during 3 weeks
- Results are being further assessed together with field site climate data (precipitation, temperature, etc.)

Results Cow Milk Studies

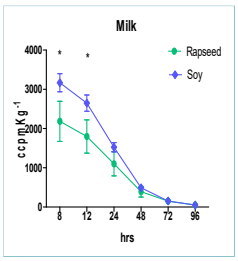

Fig 3: I-131 excretion in milk

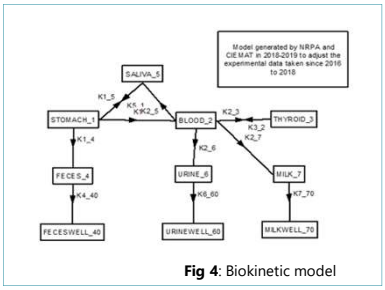

Fig 4: Biokinetic model

- Transfer of ^{131}I to milk was significantly reduced (50%) by rapeseed in feed, while extraction to urine increased.
- The reduced transfer of ^{131}I from blood to milk (due to glucosinolate and metabolites such as goitrin, indole acetonitrile, thiocyanate in rapeseed) could compete with iodine blood/milk transfer.
- Increasing rapeseed in diet could be used as countermeasure in an emergency situation (up to 90% reduction could be attained).
- The results are being used to improve the feed-cow-milk biokinetic models for ^{131}I.

Final Comments

Results should be valuable for assessing the potential economic and societal consequences of crop contamination, particularly those with a short harvest to market window, such as milk, soft fruits and new potatoes.
For both studies, data is being used to improve models in the short-term phase, including mass balance and total budget assessments, to gain further insight in processes underlying variations in iodine concentrations in foodstuffs.