Soaking foodstuff with lye as a counter measurement to reduce radioactivity.

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Sted, dd.mm.yyyy

Statens strålevern
Norwegian Radiation Protection Authority

Introduction

- Different possibilities
- -block uptake with stable analogue isotope or stable isotopes (ex Iodine)
- -fertilizing land
- -let contaminated animals feed the last time on not contaminated food
- -use contaminated food as food for eel, crayfish etc with short biolgical half life and let them eat uncontaminated food the last time before ”harvest”
- -liming lake and wetland
- -soaking with brine
- -salt stones with copperferrocyanate

Soaking with lye

- **Old scandinavian tradition**
- -special occupation as ”fiskblöteskor”
- -Mentioned by Carl Michael Bellman (1740-1795)
- *Se Dansmästaren Mollberg, Bröder,*
  I vår Krögar-stuga,
  Hur mot väggen han sig stöder,
  Med en röd Fiol.
  Konstigt har han lärt sig buga,
  Och med foten skrapa.
  Aldrig såg man större Apa
  I en Capriol.
  Hjelp Himmel nå!
  Nu sprang han öfver Disken,
  Bums i en Så,
  Där Krögarmor har Fisken.
  Himmel ach! Se på hur luten
  Dryper af Surtouten.
  Näsan tätt med blommor guten
  Skiner som en Sol.

- -Lutefisk was allowed to eat during the fast

Material

- Ling from (*Molva molva*) GLADA FISKEN, Malmö
- Ling matrial from Skärhamns frys AB (Lutefisk factory), 2 kg of lutefisk, 25 l of lye solution, 25 l of rinse solution
- Pike (*Esox lucius*), from Ryssby lake, 20 km East Ljungby, 1.2-1.6 kg
- Reindeer fillet (*Rangifer tarandus*), Östersund market hall, 2 fillets 0.35 kg each.
- Reindeer steak and liver, Viltspecialisten Malmö. 1 kg steak, 0.7 kg liver

Metods

- Soaking process

- -Using recipie from ”Princessornas kokbok, 1938”
- -Swelling the fisk for 1 week-changing water 4 times
- -0.1 kg of NaOH and 0.5 litre of $Ca(OH)_2$ + demieralized water. Sample/ water ration 1:5.
- -Potassium bicarbonate produced by boiling birch ash
- -One week soaking.
- -Rincing with water during one week, changing water every day
- -Temperature 10-15 ^{o}C
- -No swelling proces for pike and reindeer (fresh material)

Measurements

- -Gamma spectrometry for ^{137}Cs and ^{40}K after drying at 80 ^{o}C
- -For pike and ling skin and bone were removed
- -Solutions were evaporated to 180 ml or co-precipitated with copper ferrocyanate using ^{134}Cs as yield determinant
- ^{210}Po was measured by alpha spectrometry after wet ashing with nitric and perchloric acid and deposited on Ni-discs

Results

Ling	**^{137}Cs(Bq/kg)**	**^{40}K (Bq/kg)**	**^{210}Po (mBq/kg**
Before treatment	2.42	275	238
After treatment	0.04	-5	2030
Reduction level	98%	100%	increase

Ling from Skärhamns frys AB

Ling	**137Cs (Bq/kg)**	**40K (Bq/kg**	**210Po (mBq/kg)**
Before treatment (fillet)	2.96	426	316
After treatment	1.8	7.1	2101
Reduction level	40%	98%	increase

Pike

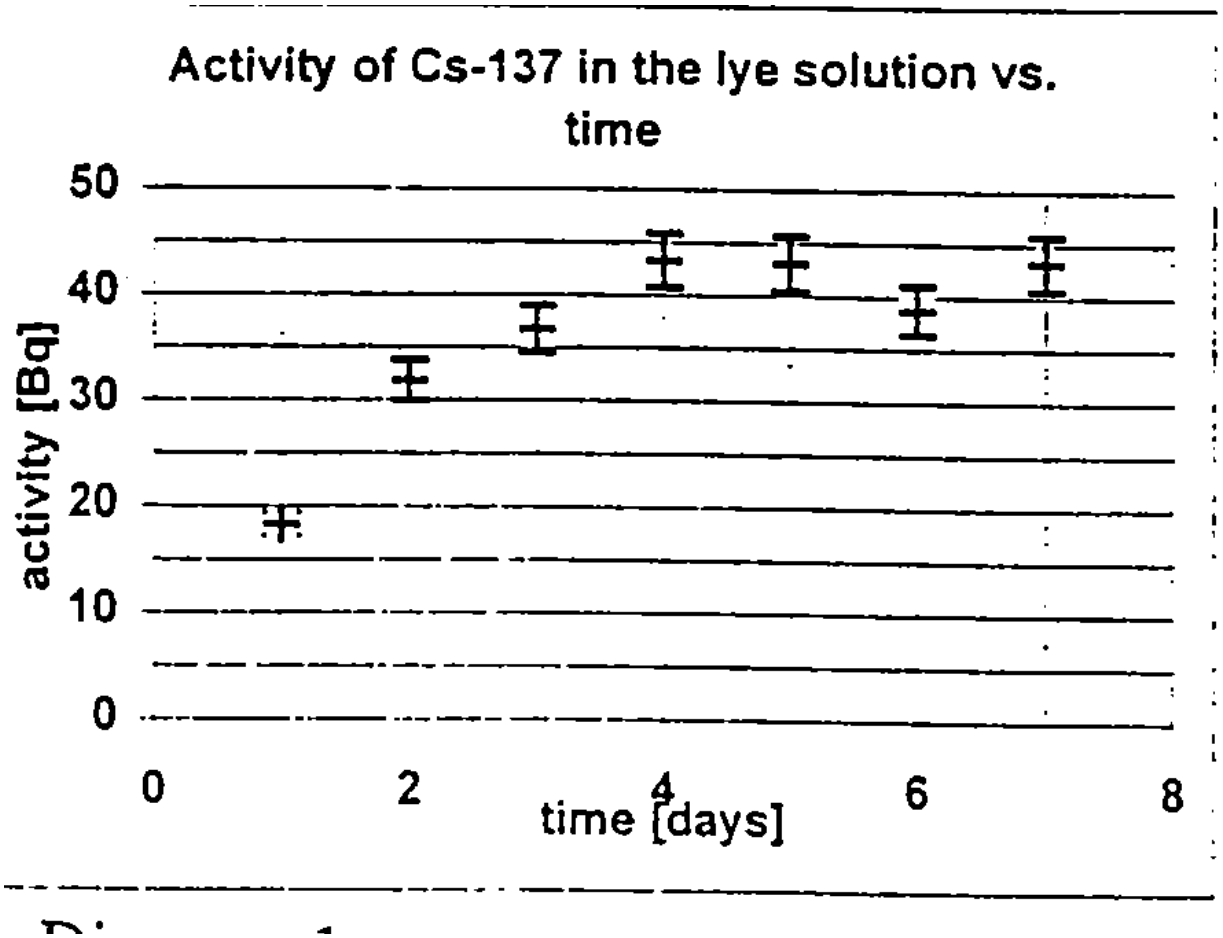
Pike	**^{137}Cs (Bq/kg)**	**^{40}K (Bq/kg)**	**^{210}Po (mBq/kg)**
Before treatment	96	524	739
After treatment	19	47	465
Reduction	80%	91%	41%

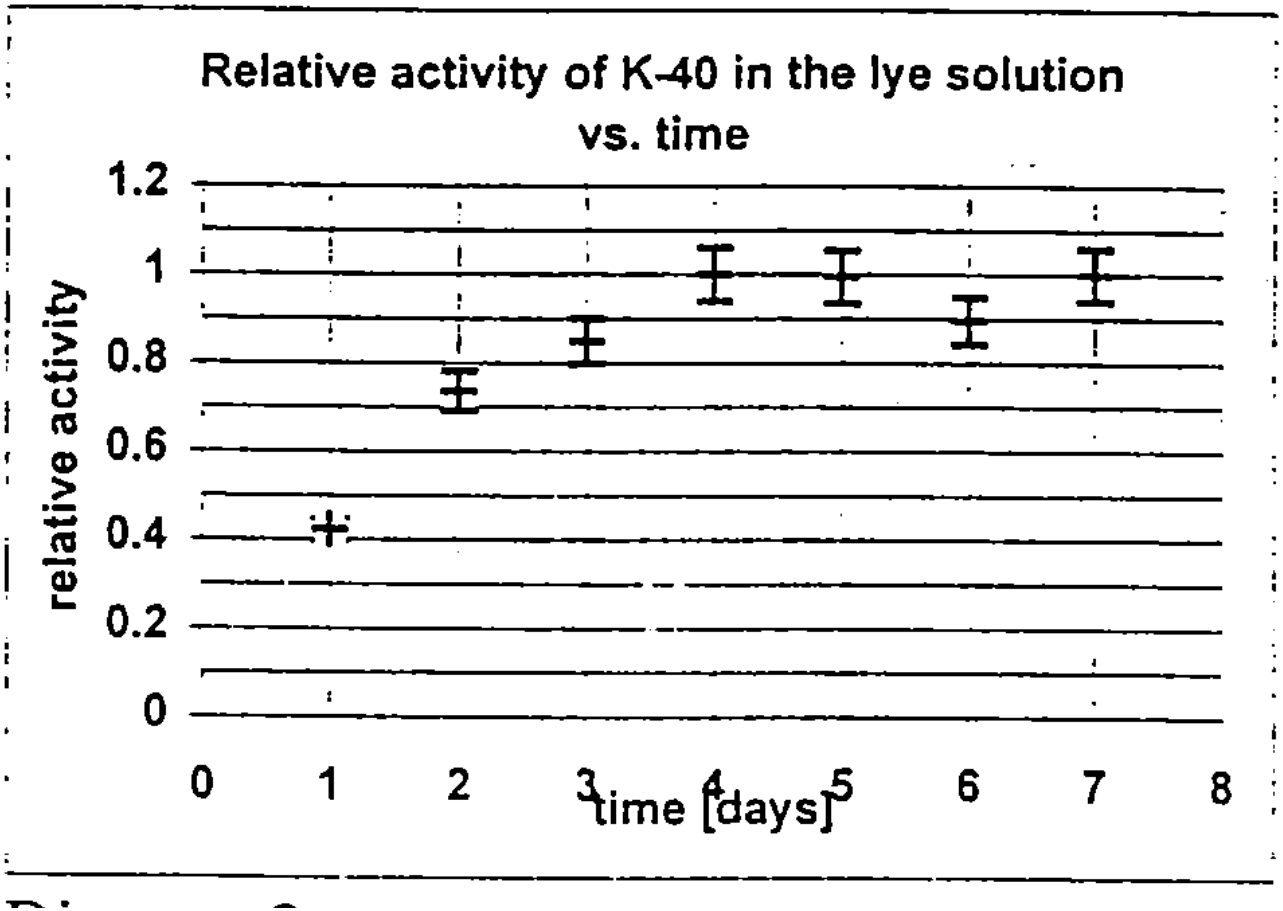
Reindeer fillet

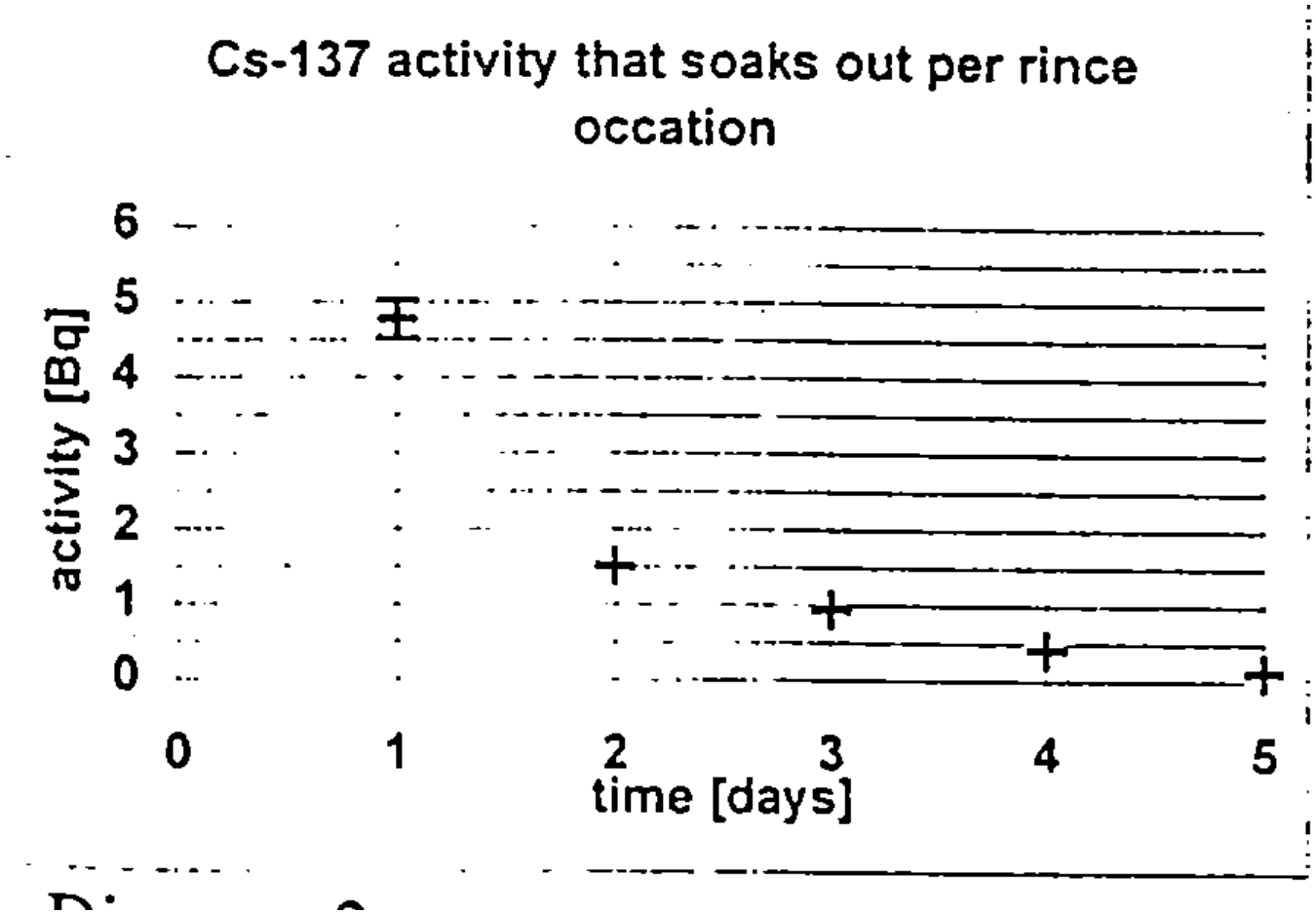
Reindeer fillet	**^{137}Cs (Bq/kg)**	**^{40}K (Bq/kg)**	**^{210}Po (mBq/kg)**
Before treatment	1825	386	8339
After treatment	349	1150	2495
Reduction	81%	increase	70%

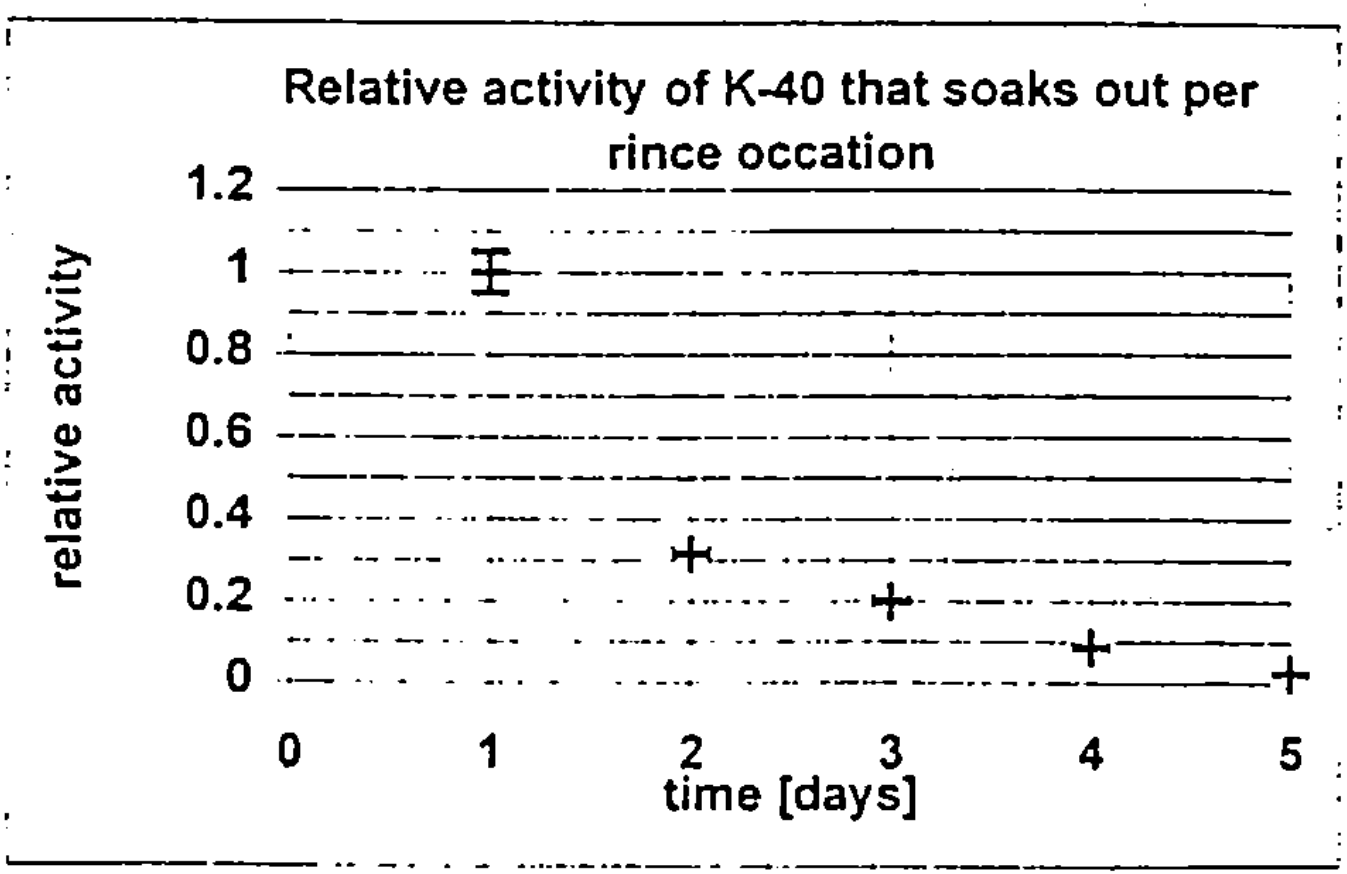
Reindeer steak

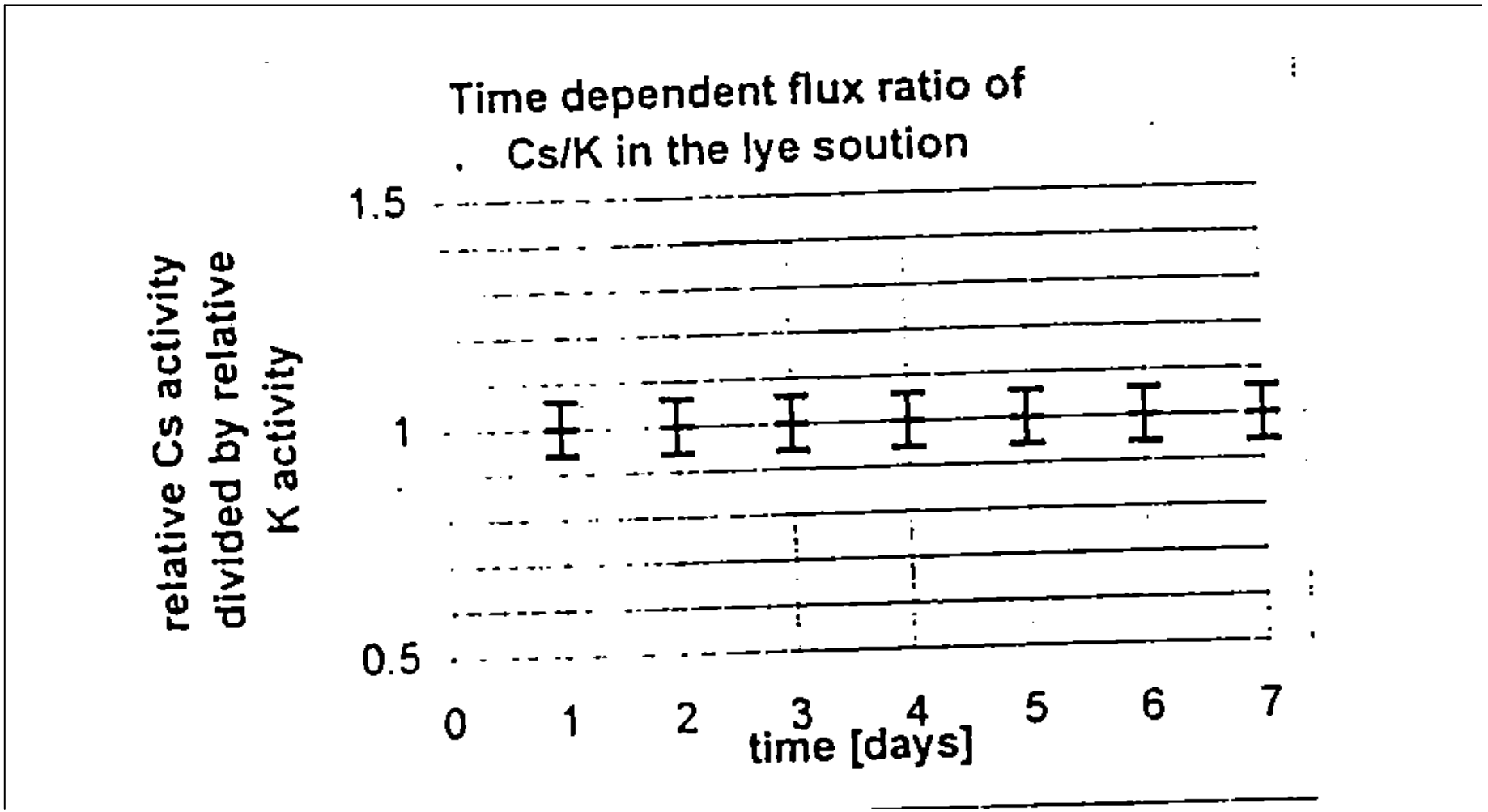
Reindeer steak	**^{137}Cs (Bq/kg)**	**^{40}K (Bq/kg)**	**^{210}Po (mBq/kg)**
1017	616		11140
19	NM		10286
98%			7.6%

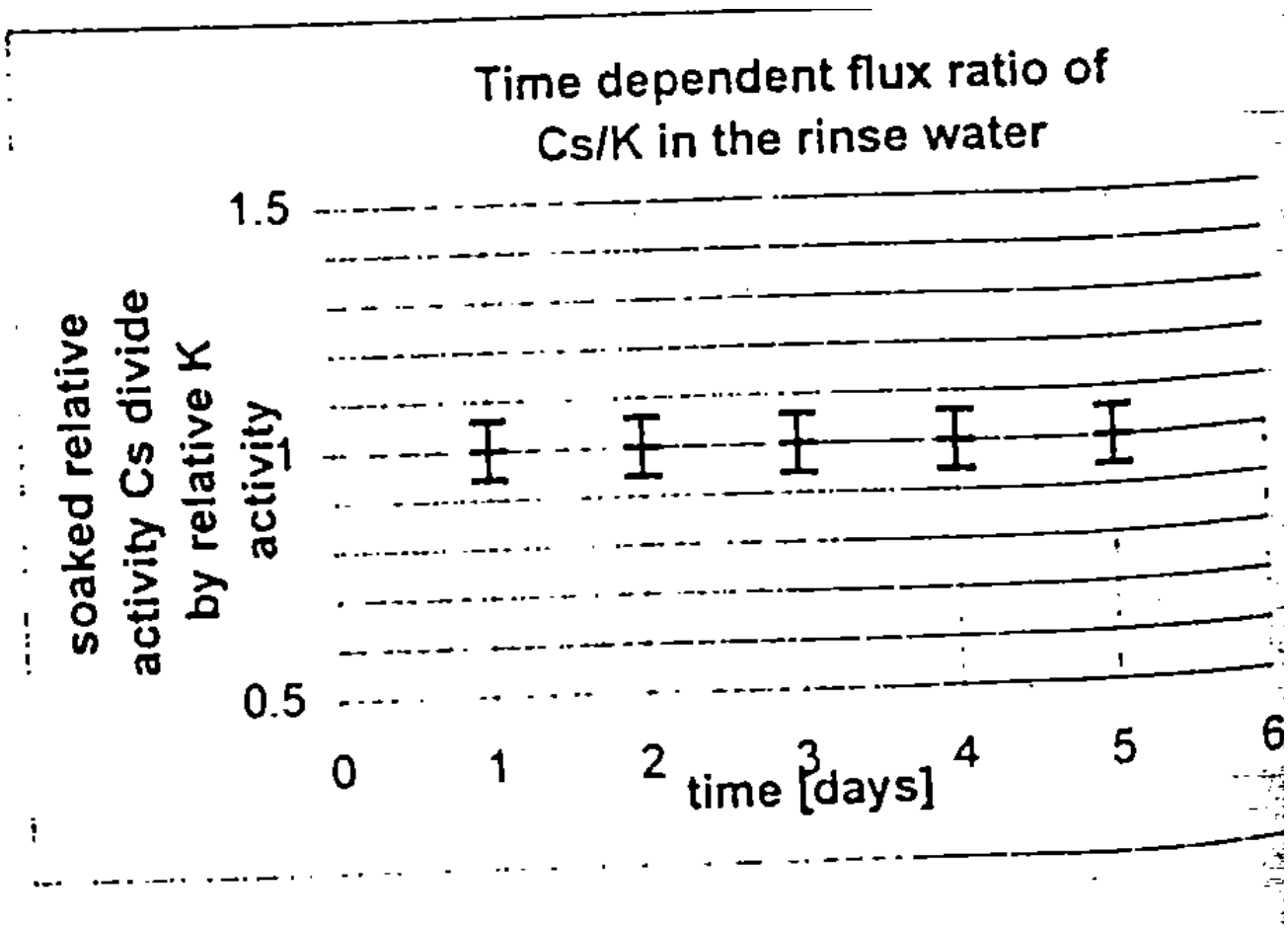

Activity of Cs-137 in the lye solution vs. time
activity [Bq]
50
40
30
20
10
0
0
2
4
6
8
time [days]


Relative activity of K-40 in the lye solution
vs. time
relative activity
1.2
1
0.8
0.6
0.4
0.2
0
0
1
2
3
4
5
6
7
8
time [days]


Cs-137 activity that soaks out per rince occation
activity [Bq]
6
5
4
3
2
1
0
0
1
2
3
4
5
time [days]


Relative activity of K-40 that soaks out per rince occation
relative activity
1.2
1
0.8
0.6
0.4
0.2
0
0
1
2
3
4
5
time [days]


Time dependent flux ratio of
Cs/K in the lye soution
relative Cs activity
divided by relative
K activity
1.5
1
0.5
0
1
2
3
4
5
6
7
time [days]


Time dependent flux ratio of
Cs/K in the rinse water
soaked relative
activity Cs divide
by relative K
activity
1.5
1
0.5
0
1
2
3
4
5
6
time [days]

Reindeer-potash

Reindeer steak	**^{137}Cs (Bq/kg)**	**^{40}K (Bq/kg)**	**^{210}Po (mBq/kg)**
Before treatment	1017	616	11140
After treatment	196	477	8148
Reduction	81%	23%	27%

Reindeer liver	**^{137}Cs (Bq/kg)**	**^{40}K (Bq/kg)**	**^{210}Po (mBq/kg)**
Before treatment	75	1763	8615
After treatment	13	388	10330
Reduction	82%	78%	increase

Conclusions

- It is an effective method to reduce ^{40}K and ^{137}Cs in foodstuff (80-100%)
- There is an high intracellular concentration of potassium copared to extracellular.
- There is a breakdown of the cell membrane by NaOH and the and the alkali ions can move freely.
- The brekdown of proteins is a slower process.
- Effective for alkali metals. The cell membranes are broken down and the ions can move into the lye solution
- Cs behaves as K
- From counter measurement point of view use thin pieces of meat and one day soaking so cell membranes are broken down.
- Less effective for Po. Po bound to proteins.
- NaOH more effectiv than Potash
- It is from radiological point of view safe to eat soaked food stuff with lye. But the food is terribel