

# The Human Gut Transfer of Environmental Polonium-210

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## Introduction

This paper presents the results from the first year of a 3 year study to investigate the human gut transfer factor ( $f_{1a}$  value) for  $^{210}\text{Po}$  in foodstuffs. In this part of the study a total of 5 volunteers each ate approximately 300g of mussels (*Mytilus edulis* L.), providing 24h samples of their urine and faeces for 3 days before and for 7 days during and after eating. Subsamples of mussels were analysed to determine the intakes of  $^{210}\text{Po}$ , and the urine and faeces were analysed to determine the excretion.

Table I. Details of volunteers and intakes of  $^{210}\text{Po}$

Volunteer	Sex	Age	Weight of mussels eaten (g)	Concentration of $^{210}\text{Po}$ in subsample ( $\text{Bq kg}^{-1}$ (wet))*	Intake (Bq)*
LT201	M	55	319	$33.0 \pm 1.1$	$10.5 \pm 0.4$
LT202	F	42	217	$34.3 \pm 1.1$	$7.4 \pm 0.2$
LT203	M	39	418	$36.2 \pm 1.2$	$15.1 \pm 0.5$
LT204	M	49	270	$40.7 \pm 0.7$	$11.0 \pm 0.2$
LT205	M	38	308	$38.7 \pm 0.8$	$11.9 \pm 0.2$

\*errors represent  $\pm 1$  standard deviation based on counting statistics



Table II. Faecal excretion by LT201

Day(s)	Bq $^{210}\text{Po}$ excreted*
-3, -2, -1	$0.503 \pm 0.049$
0	$0.132 \pm 0.007$
1	NF
2	$1.761 \pm 0.043$
3	$0.941 \pm 0.021$
4	$3.583 \pm 0.102$
5	$0.84 \pm 0.02$
6	$0.99 \pm 0.03$
12, 13, 14	$0.556 \pm 0.021$
26, 27, 28	$0.752 \pm 0.027$

NF=No faecal excretion

Table III. Faecal excretion by LT 202

Day(s)	Bq $^{210}\text{Po}$ excreted*
-3, -2, -1	$0.238 \pm 0.013$
0	$0.099 \pm 0.005$
1	$1.18 \pm 0.03$
2	NF
3	$3.04 \pm 0.14$
4	NF
5	$1.23 \pm 0.07$
6	$0.170 \pm 0.006$
12, 13, 14	$0.688 \pm 0.019$
26, 27, 28	$0.238 \pm 0.008$

Table IV. Faecal excretion by LT 203

Day(s)	Bq $^{210}\text{Po}$ excreted*
-3, -2, -1	$0.703 \pm 0.030$
0	$0.987 \pm 0.041$
1	$5.34 \pm 0.36$
2	$0.642 \pm 0.015$
3	$0.824 \pm 0.021$
4	$0.726 \pm 0.032$
5	$0.436 \pm 0.013$
6	$0.444 \pm 0.029$
7	$0.365 \pm 0.015$
15, 16, 17	$0.804 \pm 0.029$
30, 31, 32	$1.14 \pm 0.05$

Table V. Faecal excretion by LT 204

Day(s)	Bq $^{210}\text{Po}$ excreted*
-3, -2, -1	$0.890 \pm 0.047$
0	NF
1	NF
2	$2.99 \pm 0.10$
3	$2.09 \pm 0.08$
4	NF
5	NF
6	$1.33 \pm 0.0$

Table VI. Faecal excretion by LT205

Day(s)	Bq $^{210}\text{Po}$ excreted*
-2, -1	$0.235 \pm 0.010$
0	$0.021 \pm 0.002$
1	$1.80 \pm 0.07$
2	$4.21 \pm 0.16$
3	$1.73 \pm 0.18$
4	$0.29 \pm 0.02$
5	$0.196 \pm 0.008$
6	$0.111 \pm 0.005$

**Results:** The apparent gut transfer factor ( $f_{1a}$ ), which includes any endogenous return to faeces, was calculated from the relation:

$$f_{1a} = \frac{\text{intake} - \text{faecal output}}{\text{intake}}$$

The results for  $f_{1a}$  are in the range 0.30 to 0.61 with a mean of 0.42. The degree of variability between individuals (around a factor of 2) is broadly in line with other studies. However the mean is lower than the result of around 0.8 observed for consumption of brown crab meat in our previous study, and more in line with the results recently observed for caribou meat. The present result is also more in conformity than our previous study with the value of 0.5 used by ICRP.

A further paper will report on urine data from this study and on studies using different foods. We are grateful to the UK Department of Health for funding this study. We also wish to thank the volunteers for their willing cooperation.

Table VII. Apparent gut transfer factors ( $f_{1a}$ ) for  $^{210}\text{Po}$  from faecal data

Volunteer	Intake (Bq)	Excess excretion	$f_{1a}$
LT201	$10.5 \pm 0.4$	$7.08 \pm 0.17$	$0.33 \pm 0.04$
LT202	$7.4 \pm 0.2$	$5.18 \pm 0.16$	$0.30 \pm 0.04$
LT203	$15.1 \pm 0.5$	$7.89 \pm 0.38$	$0.48 \pm 0.06$
LT204	$11.0 \pm 0.2$	$4.34 \pm 0.17$	$0.61 \pm 0.04$
LT205	$11.9 \pm 0.2$	$7.55 \pm 0.25$	$0.37 \pm 0.04$

Mean  $0.42 \pm 0.12^*$

\*standard deviation of the individual observations

