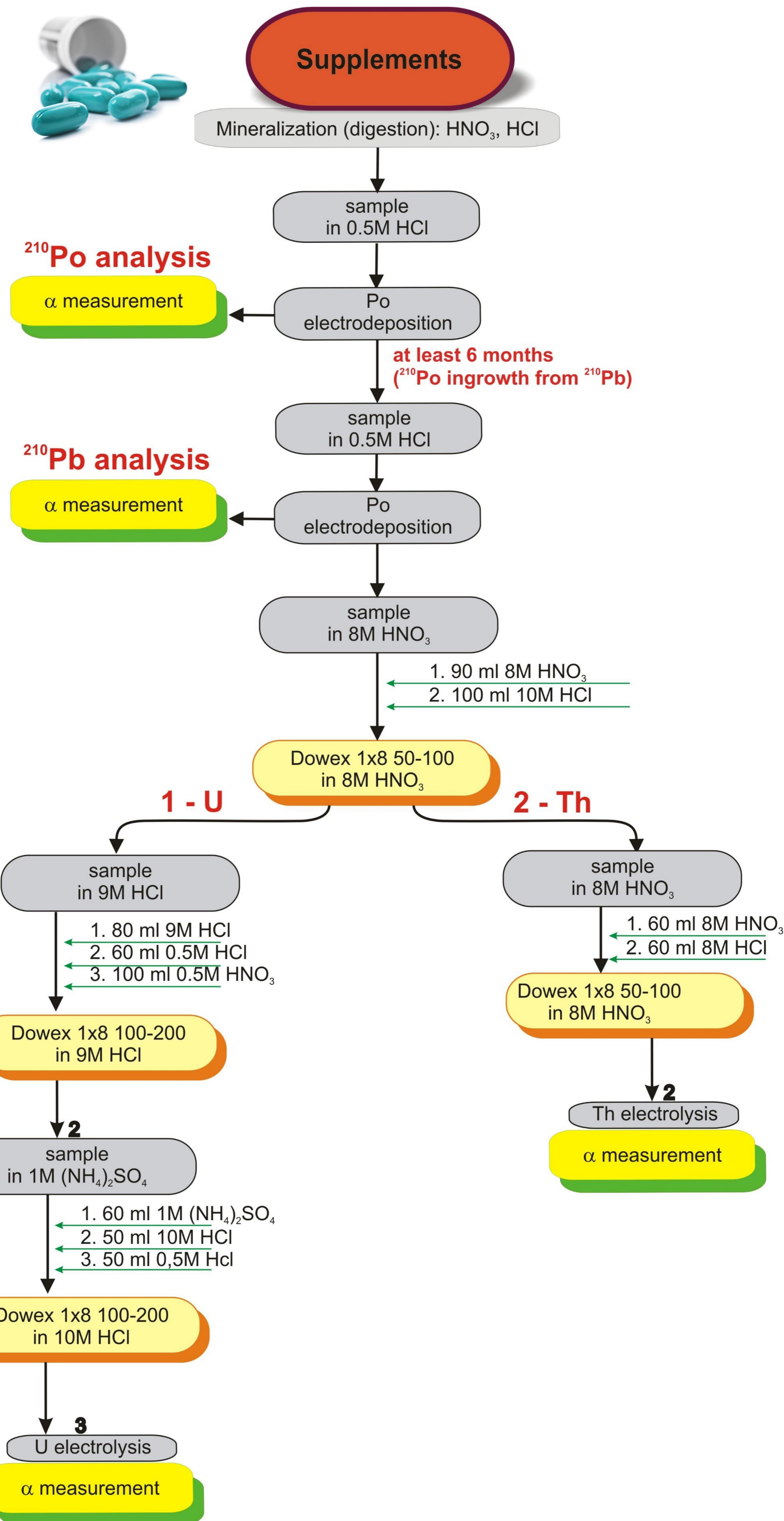# Simultaneous sequential analysis of U (^{234}U, ^{238}U) and Th (^{230}Th, ^{232}Th) isotopes in calcium and magnesium supplements

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Uranium and **thorium** are widely spread in nature, in the Earth's crust, occurs in over 200 minerals, locally at high concentrations. Isotopes of ^{234}U (0.0057%; $T_{1/2}$=2.455×10^5 years) and ^{238}U (99.2745%; $T_{1/2}$=4.468×10^9 y), as well as ^{228}Th (trace abundance; $T_{1/2}$ =1.91 y), ^{230}Th (0.02%; $T_{1/2}$=7.54×10^4 y) and ^{232}Th (99.98%; $T_{1/2}$ =1.4x 10^{10} y), occur naturally in decay chains; all are long-living alpha emitters of low radioactivity and radiotoxicity.

Calcium is the most important metal for living organisms, vertebrates especially. In adult person body it constitutes about 1.4-1.66% of total body mass, and 99% of its amount is in bones and teeth.

Magnesium, called „king of life", is necessary for proper cells functioning and about 300 enzymes need magnesium presence. Magnesium in adult person body constitutes about 0.05% of total body mass and 60% is in bones while 29% in skeletal muscles.

Calcium Recommended Daily Intake (RDI) is estimated at: 800-1200 mg for children and 1000 mg for adults.

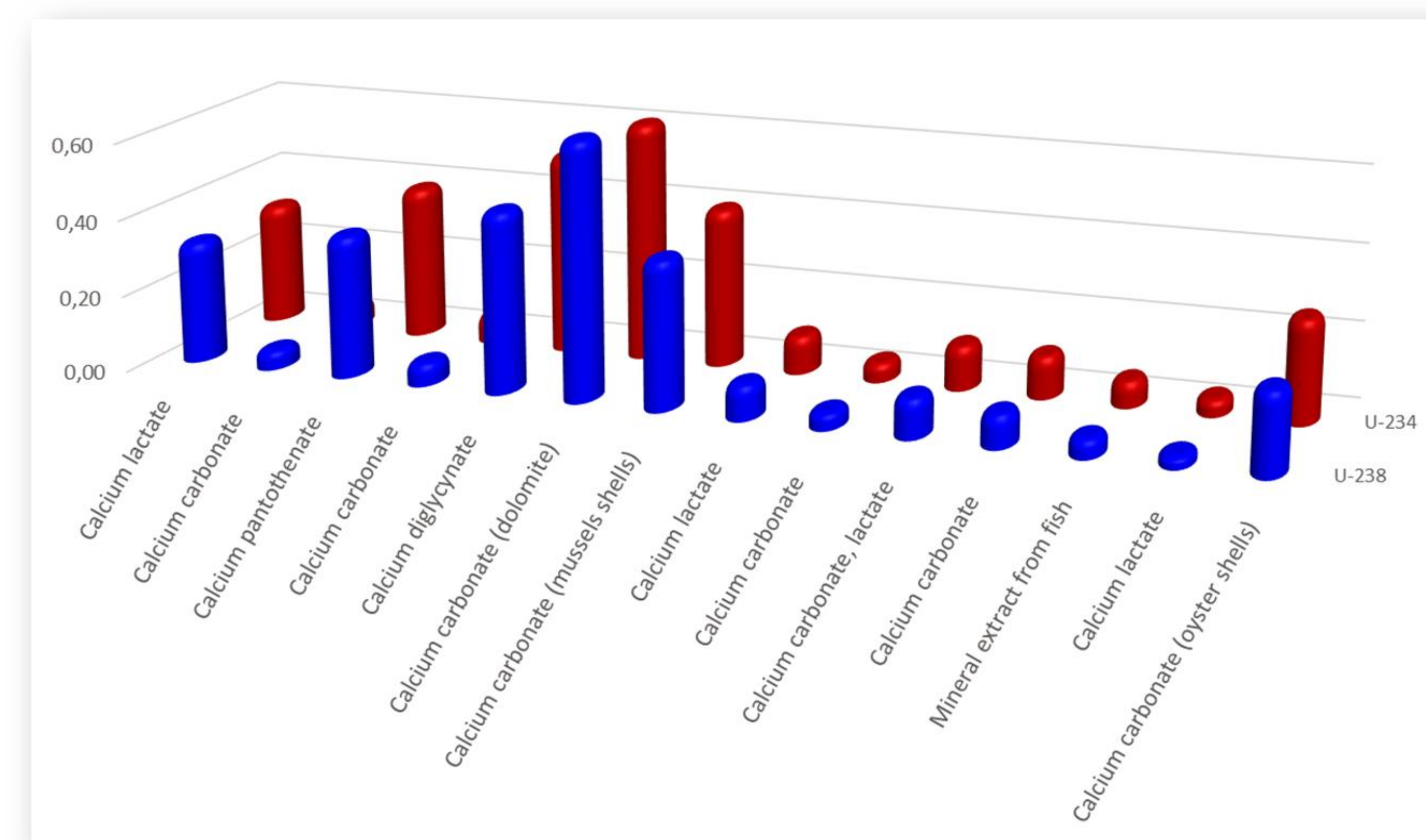**Magnesium RDI** is estimated at: 100-600 mg for children and 350-400 mg for adults.

Flow diagram (left column)

Supplements

Mineralization (digestion): HNO$_3$, HCl

sample in 0.5M HCl

^{210}Po analysis — α measurement

Po electrodeposition

at least 6 months (^{210}Po ingrowth from ^{210}Pb)

sample in 0.5M HCl

^{210}Pb analysis — α measurement

Po electrodeposition

sample in 8M HNO$_3$

1. 90 ml 8M HNO$_3$
2. 100 ml 10M HCl

Dowex 1x8 50-100 in 8M HNO$_3$

1 - U

sample in 9M HCl

1. 80 ml 9M HCl
2. 60 ml 0.5M HCl
3. 100 ml 0.5M HNO$_3$

Dowex 1x8 100-200 in 9M HCl

2

sample in 1M (NH$_4$)$_2$SO$_4$

1. 60 ml 1M (NH$_4$)$_2$SO$_4$
2. 50 ml 10M HCl
3. 50 ml 0,5M Hcl

Dowex 1x8 100-200 in 10M HCl

3

U electrolysis — α measurement

2 - Th

sample in 8M HNO$_3$

1. 60 ml 8M HNO$_3$
2. 60 ml 8M HCl

Dowex 1x8 50-100 in 8M HNO$_3$

2

Th electrolysis — α measurement

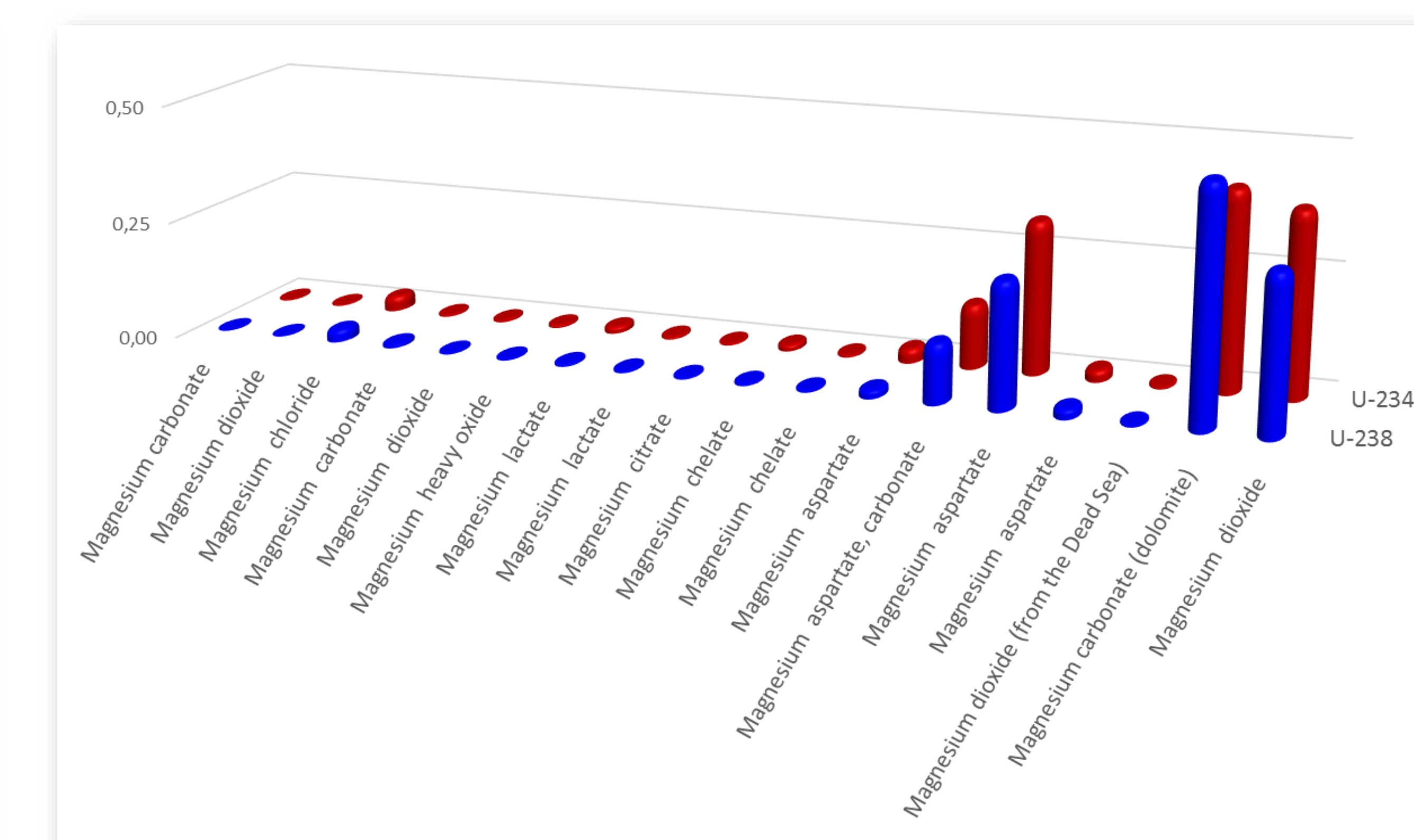Fig. 1. Annual effective dose from ^{234}U and ^{238}U from RDI 1 g of Ca intake

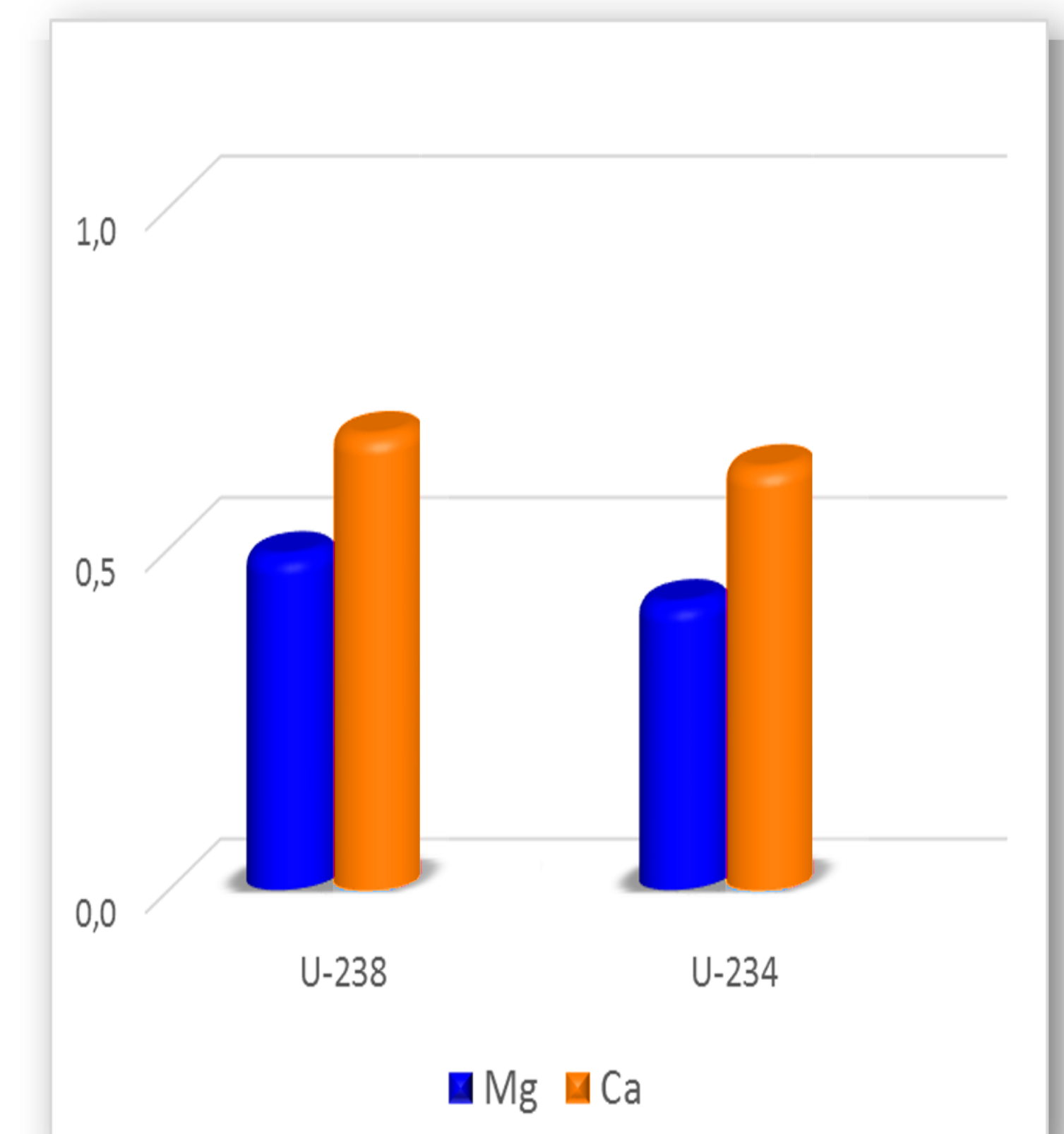Fig. 2. Annual effective dose from ^{234}U and ^{238}U from RDI 0.4 g of Mg intake

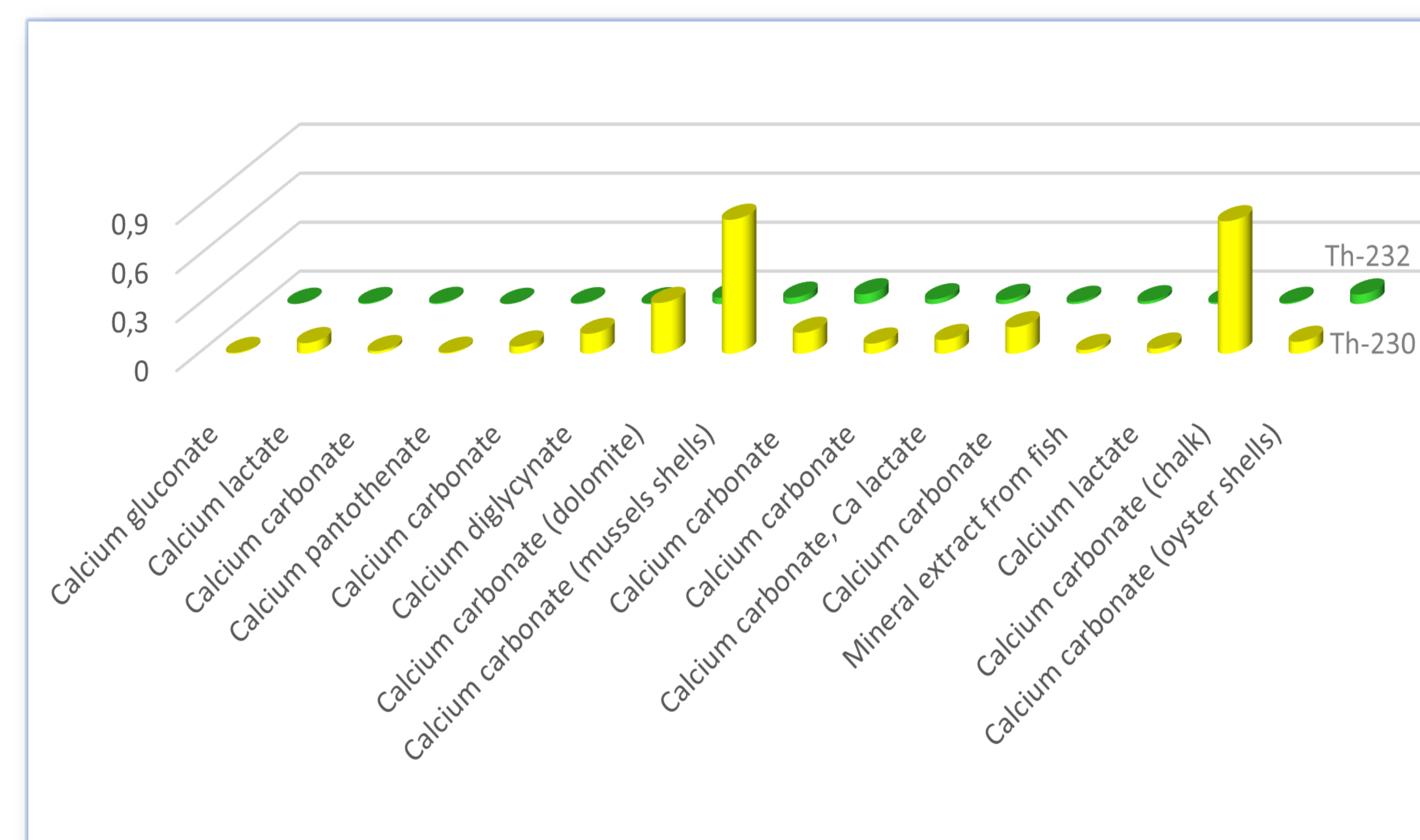Fig. 3. Ca and Mg supplements (Recommended Daily Intake) annual effective dose (µSv/year)

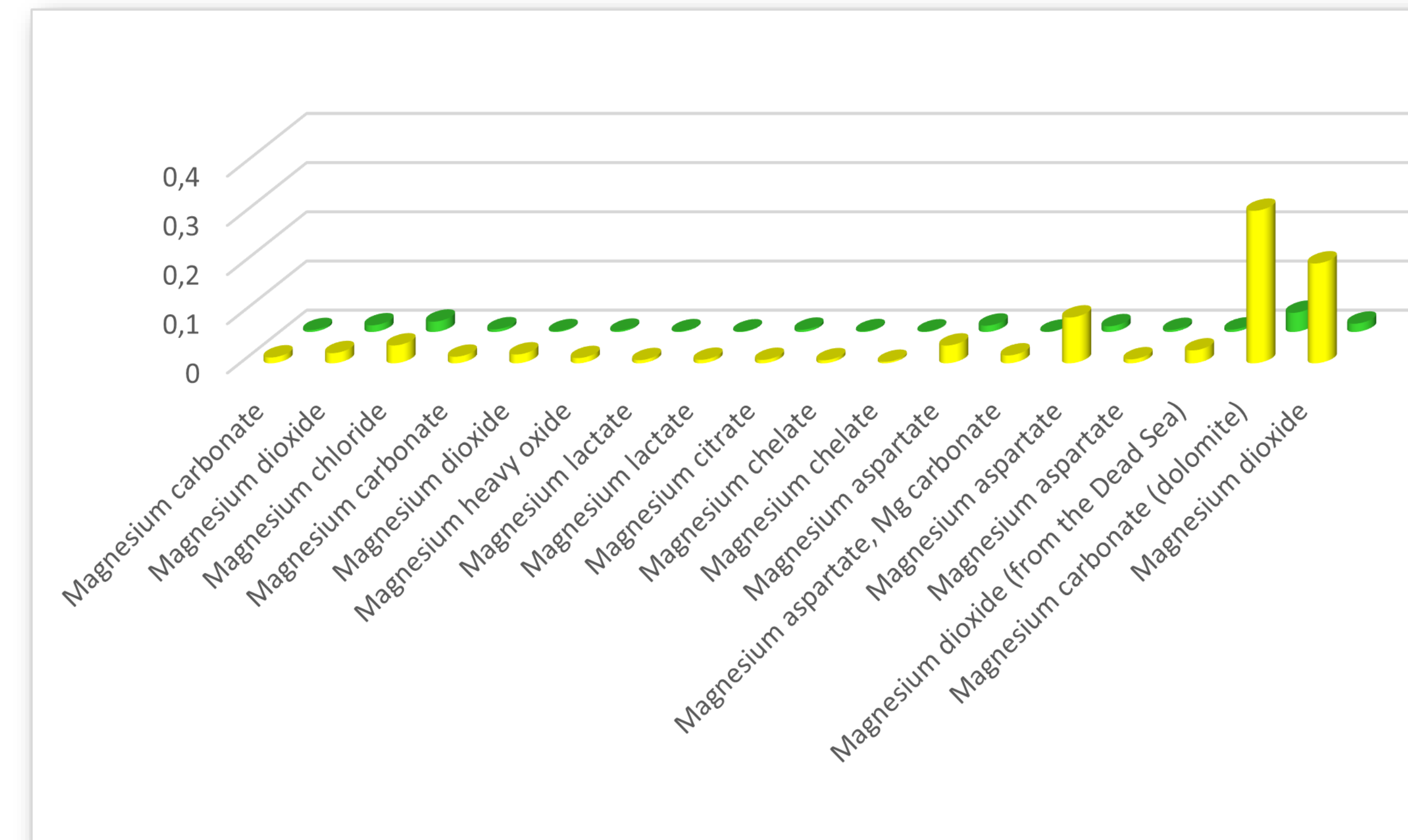Fig. 4. Annual effective dose from ^{230}Th and ^{232}Th from dose 1 pill daily

Fig. 5. Annual effective dose from ^{230}Th and ^{232}Th from dose 1 pill daily
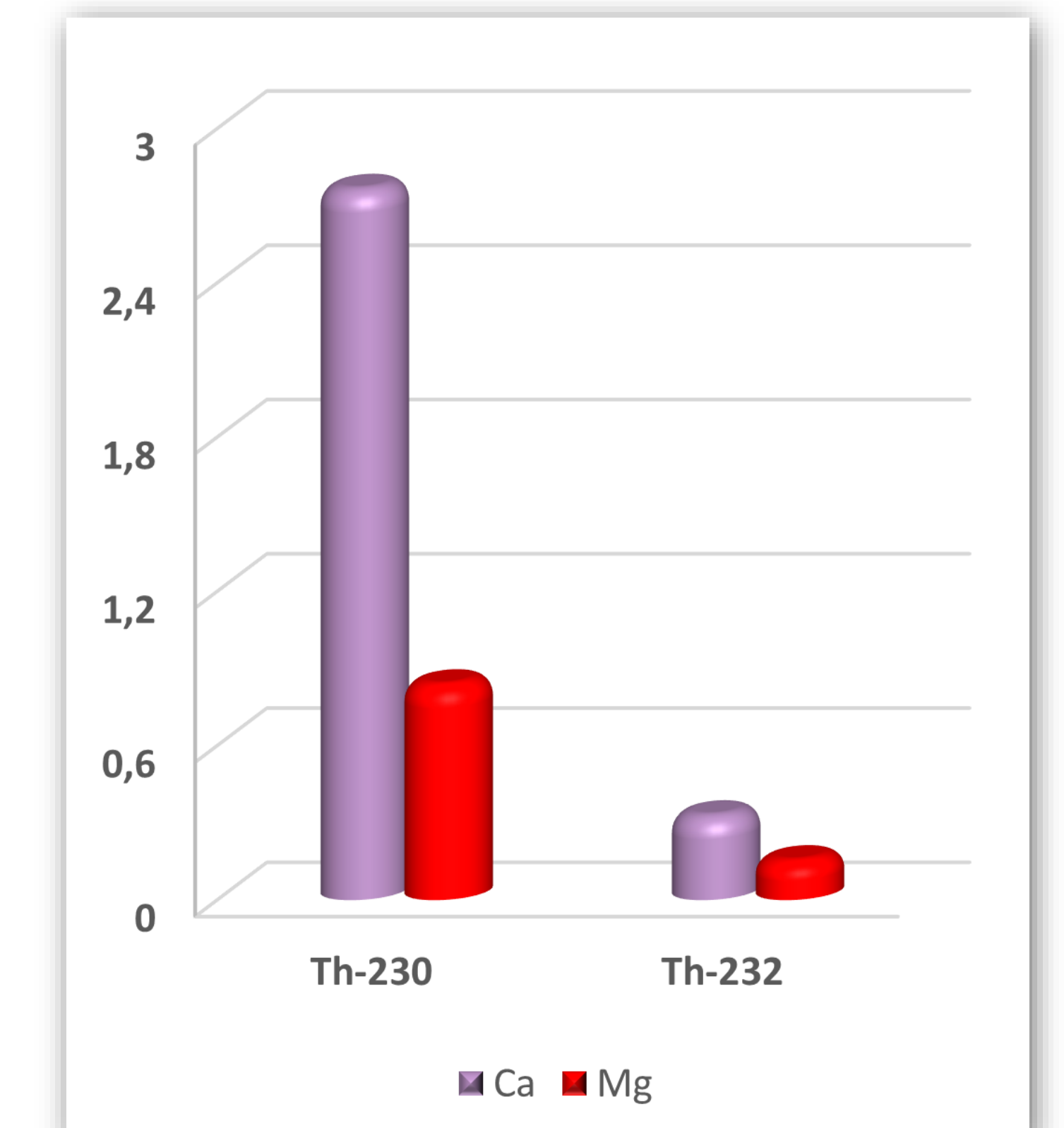
Fig. 6. Ca and Mg supplements (Recommended Daily Intake) – annual effective dose (µSv/year)

UNIWERSYTET GDAŃSKI

CHEMIA UG

IN MARI VIA TUA