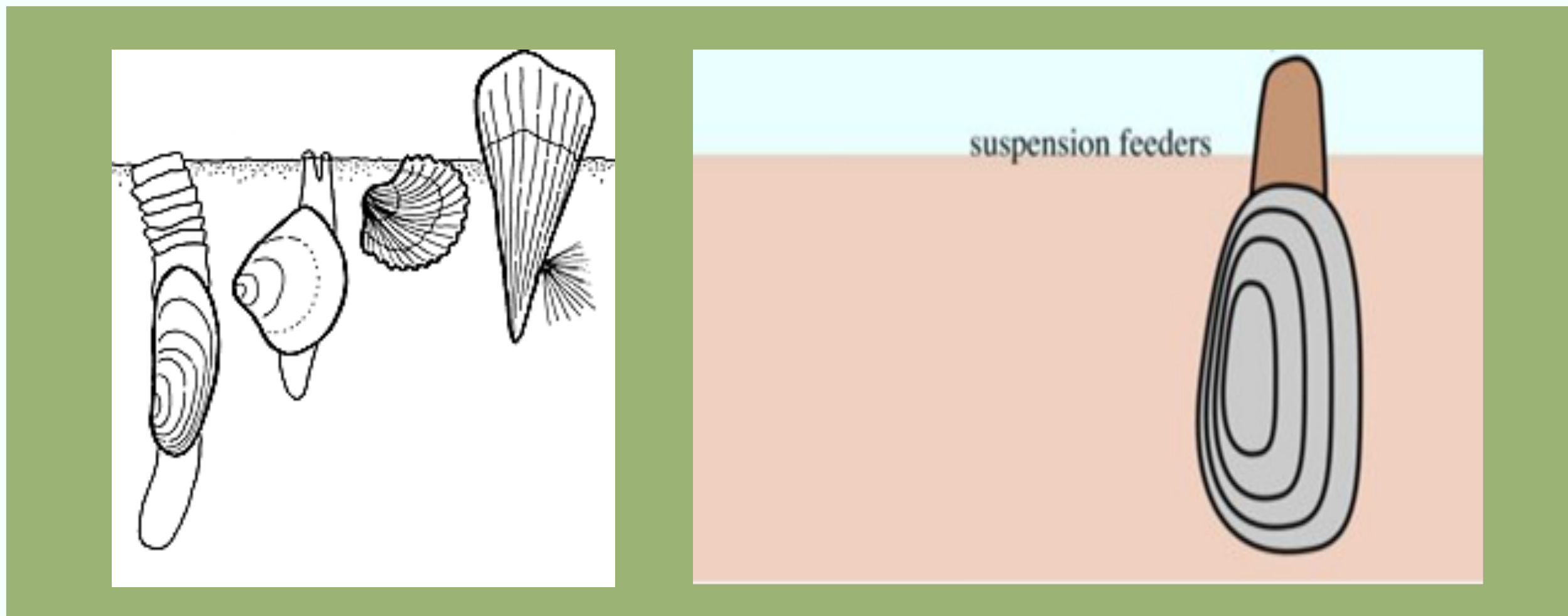


Introduction

Bivalve mollusks occupy a wide variety of environments, and they exhibit a wide variety of preferences for different bottom conditions; many live in clean sand, others are mud dwellers, still others prefer to attach themselves to rocks exposed at low tide. It is an organism that takes phytoplankton and suspended particles in the bottom of the sea as a food source. A wide variety of bivalves bury themselves in mud or sand



The variations levels of ^{210}Po in the edible tissue of bivalve is always different based on the digestive technique either using filtration or suspension method. Bivalves that do food intake filtration techniques have concentrations of ^{210}Po higher than the suspension food intake.

^{210}Po is one of the most radiotoxic natural radioactive isotopes known to humans due to its relatively long half-life (138 days) and alpha emitter. The highest activity concentrations of ^{210}Po in humans are found in the liver (30%), kidney (10%), spleen (7%) and the bone marrow (10%). Activity concentrations generally increase with age

Aims of this study (i) determine the ^{210}Po concentrations in green mussel, oyster, enamel Venus clam, radiated scallop and cockle collected from the upper Gulf of Thailand during 2017-2018 (ii) calculate the age dependent dose due to ^{210}Po consumption of these organisms and (iii) assess the lifetime cancer risk for the population.

Methods and Materials

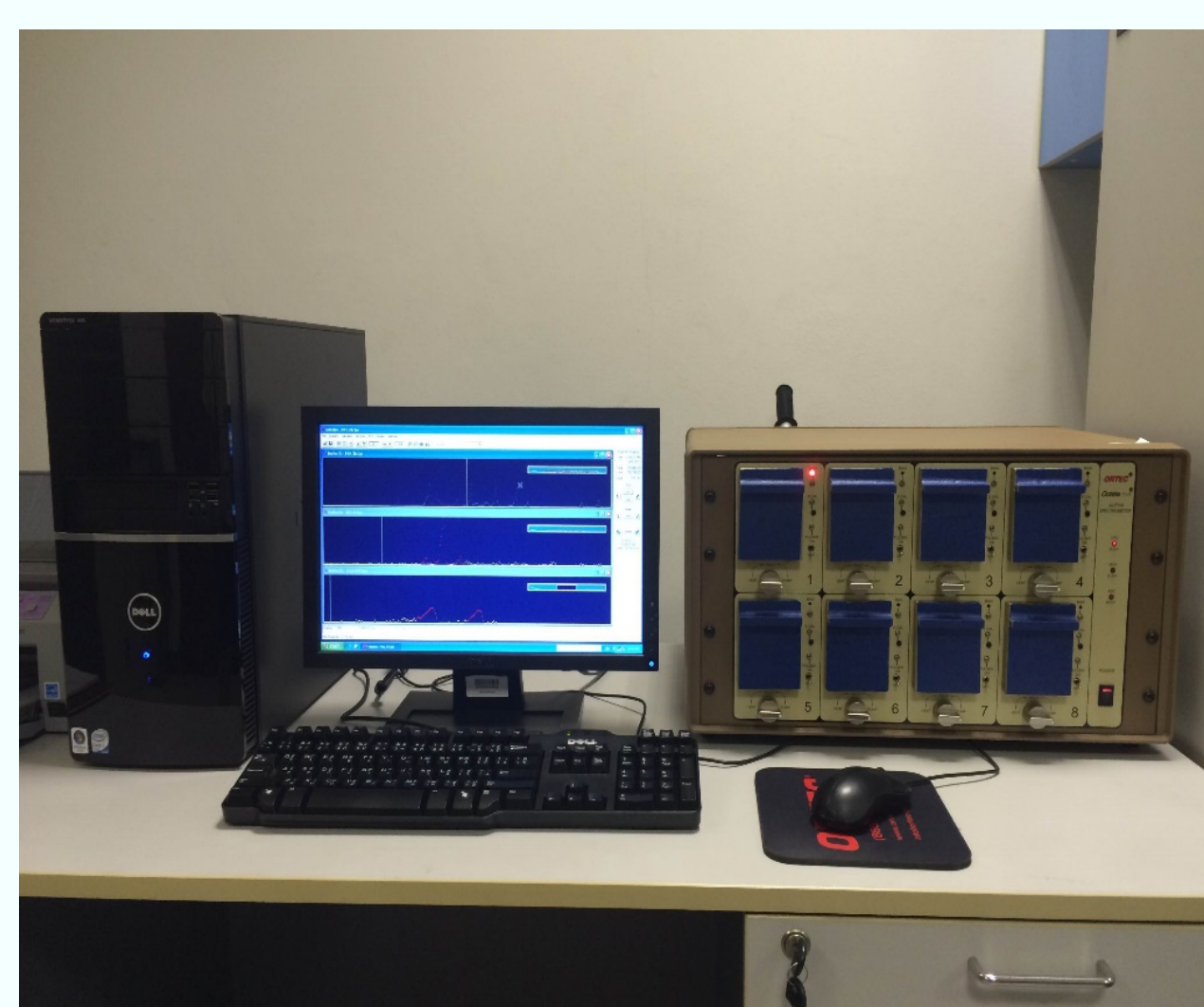
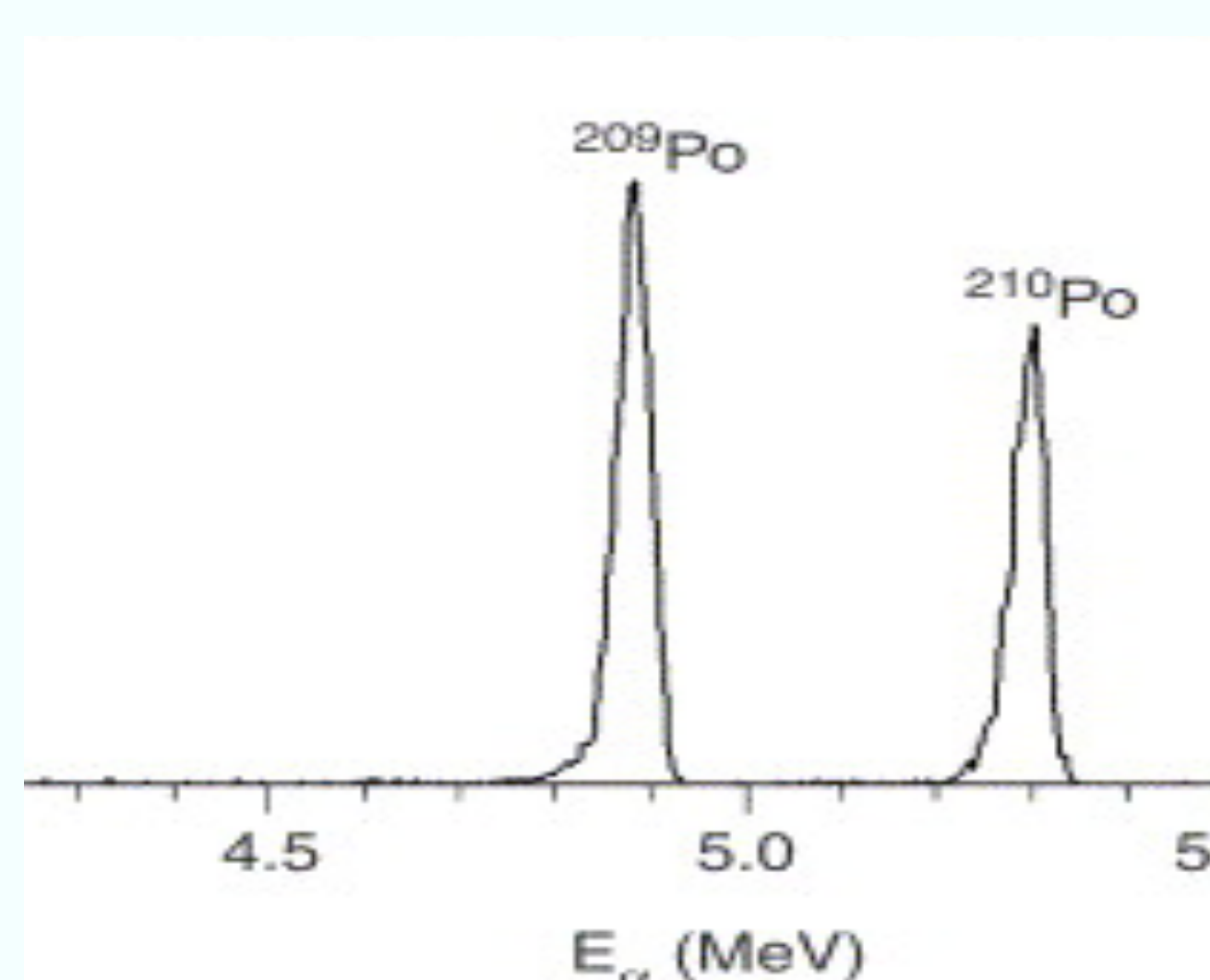
Sampling Site and preparation



Sampling sites locate at Trad Province where is in the upper Gulf of Thailand. The soft tissue portion of the bivalve was removed and separated from the shell. The weight of wet tissue was measured and record. All samples were freeze-dried, Aliquot of the dried, ground and homogenized samples was weighed and analyzed for ^{210}Po .

Analytical procedure

The radiochemical analysis using 0.12 Bq ^{209}Po as internal isotopic tracer with 10 g of dried homogenized marine biota sample was performed. Finally, the ^{209}Po and ^{210}Po were plated onto a silver disc and measured by low background 450 mm² ion implant detector from ORTEC EG&G (Octete Plus) alpha spectrometer.



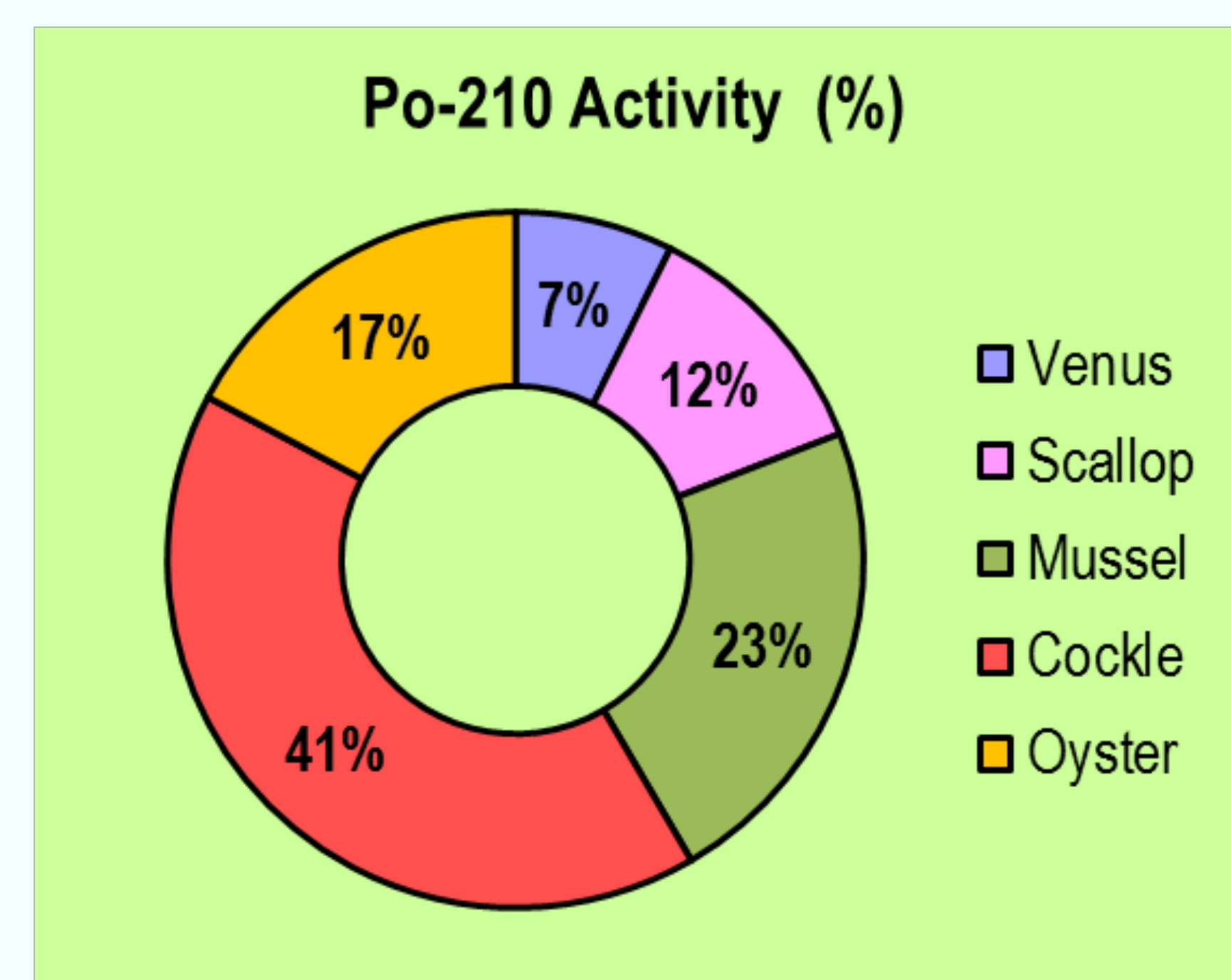
Results and Discussion

Activity concentration of ^{210}Po

The average values found for the activity concentration of ^{210}Po Bq.kg⁻¹ w.w. and their habitats were shown in Table

Cockle	Mussel	Oyster	Scallop	Venus Clam
6.05 ± 0.94	3.31 ± 0.20)	2.54 ± 0.36	1.73 ± 0.37	1.07 ± 0.24
Sediment	Mid depth	Mid depth	Shallow	Shallow

Bivalve is an organism that takes phytoplankton and suspended particles on the seabed as food sources. The activity of Po-210 in organic particles resembles the profile of nutrient elements where the concentration is low on the surface of the water and increases at mid-depth and decreases at maximum depth



Age Dependent Annual Effective Dose

Annual effective dose for each species as well as for four age groups (19-30 years, 31-50 years, 51-70 years, and >71 years) of 2.31 to 14.92 μSv.y⁻¹ were well below the WHO permissible limit of 100 μSv.y⁻¹.

The calculated cancer risk of mortality was found in the range of 0.32 x 10⁻⁵ to 1.80 x 10⁻⁵ and also the calculated cancer risk of morbidity was found in the range of 0.44 x 10⁻⁵ to 2.49 x 10⁻⁵.

As per the WHO and US.EPA, the carcinogenic risks in the study area were well below the recommended safe level for radiological risk. Therefore, the 5 species of shellfish in the upper Gulf of Thailand were safe from the radiological aspect for investigated radionuclide, and poses no significant radiological exposure and health risk to the public.

Conclusions

^{210}Po concentrations (Bq/kg wet weight), the annual effective dose and cancer risk of mortality/ morbidity due to ^{210}Po observed in green mussel, oyster, enamel Venus clam, radiated scallop and cockle from the upper Gulf of Thailand during 2 years studied (2017-2018) is presented.

- ❑ Concentrations of ^{210}Po ranged from high values of **Cockle > Mussel > Oyster > Scallop > Venus clam**
- ❑ The annual effective ^{210}Po doses due to seafood consumption were found to be in the range of 2.31 to 14.92 μSv.y⁻¹
- ❑ The calculated cancer risk of mortality was 0.32 x 10⁻⁵ to 1.80 x 10⁻⁵
- ❑ The calculated cancer risk of morbidity was 0.44 x 10⁻⁵ to 2.49 x 10⁻⁵

Based on the international maximum permissible limit, the obtained effective dose levels of seafood in the studied area are considered radiological safe for human intake.

Acknowledgement

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