RAP
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# ASSESSMENT OF EXCESS LIFETIME CANCER RISK DUE TO INGESTION OF RADIONUCLIDES IN SOME FOOD SPICES

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# Topics of this study

- Introduction
- The samples analyzed
- Sample collection and preparation
- Gamma-ray spectrometry laboratory
- Results and discussions
- Conclusions

# Introduction

- More than 100 varieties of spices are produced throughout the world.
- The spices have been used for rituals, cosmetics and perfumery. Also, their flavoring, coloring and, especially, preservative properties have founded wide applications both in the traditional food preparations and in the food industry..
- The spices are important in treating of diseases such as cancer, aging, metabolic, neurological, cardiovascular, and inflammatory diseases.
- In Albania, the type of spices in food has been increased in recent years. Some of spices are grown in Albania, while some others are imported from other countries.
- Radionuclides are found everywhere in the air, water, earth and therefore in the drinks and foods, therefore they can also be found in spices.

# Introduction

- **The aim of this study is:**

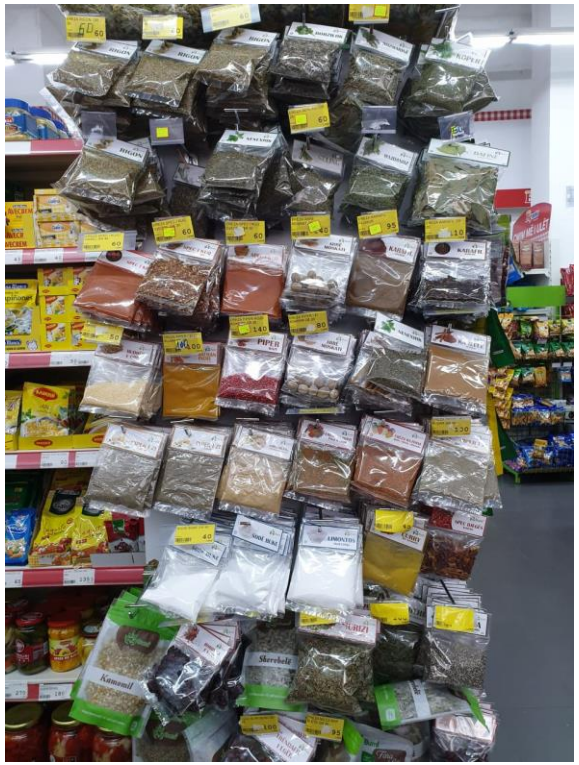
1. To assessment of the Excess Lifetime Cancer Risk (**ELCR**), due to the ingestion of radionuclides in food spices and the results obtained were compared with international reference values.

2. To assessment of the ELCR must detect radionuclides in spices, to calculate the activity concentration and Average Annual Committed Effective Dose **(AACED).**

3. The results from the study could be used to control the exposure of the public to natural and artificial radionuclides, due to the consumption of spices.

# The samples analyzed

**Table 1**. **Twenty Spice** Samples are collected randomly in some different markets in Tirana city, which may be produced in Albania or imported.

| No. | SAMPLE NAME |
|---|---|
| 1 | Black pepper |
| 2 | Curry |
| 3 | Ginger |
| 4 | Turmeric |
| 5 | Sri Lanka cinnamon |
| 6 | Cloves |
| 7 | Chia |
| 8 | cayenne pepper |
| 9 | Mix spices 1 |
| 10 | Mix spices 2 |
| 11 | Garlic |
| 12 | Celery |
| 13 | Parsley |
| 14 | Dill |
| 15 | Winter savory |
| 16 | Oregano |
| 17 | Rosemary |
| 18 | Peppermint |
| 19 | Bay laurel |
| 20 | Basil |

# Sample collection and preparation

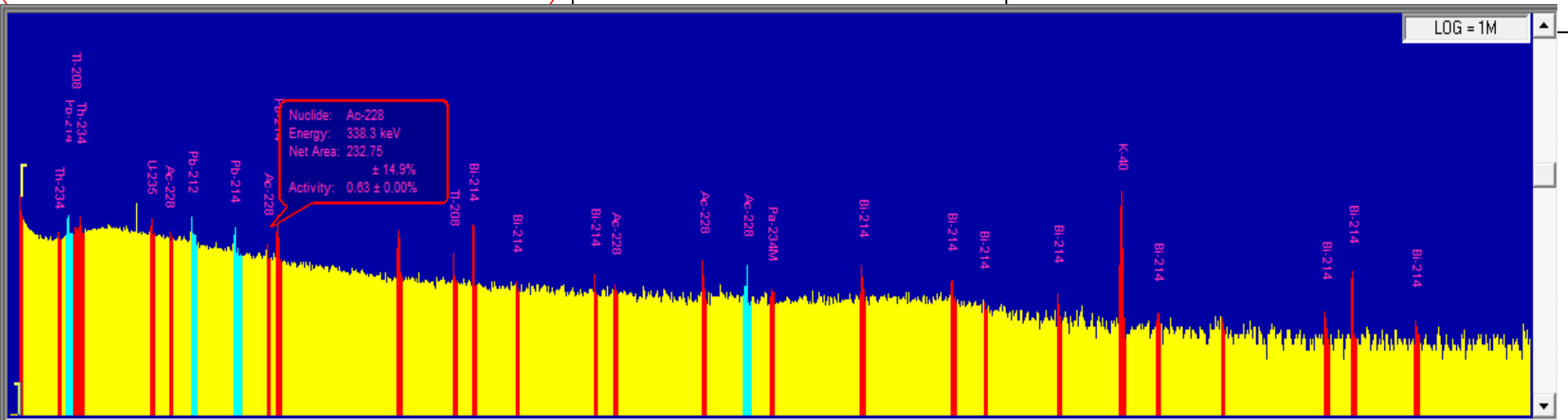
- Samples were open in air for drying on trays for a period of one week and then in oven were dried at a temperature of about $100^0$C for 2 to 4 hours until constant mass was obtained and to remove as much as possible moisture.


- Each of them is placed in Marinelli beaker and isolated, they are kept about 30 days until the secular equilibrium is reached.

# Gamma-ray spectrometry laboratory

| | |
|---|---|
| HPGe detector | Coaxial p-type, 40% of rel. eff. |
| Energetic resolution | 1.8 keV at 1332 keV ($^{60}$Co) |
| Cooling technology | $LN_2$ (-196°C) |
| Shielding | 10 cm Pb and Cu-Cd foils |
| Acquisition time | 24 hours (250 cc sample volume) |

## Spectrum of Sample 1



# Results and discussions I

Table 2. **Activity concentrations** of $^{40}K$, $^{226}Ra$, $^{232}Th$ and $^{137}Cs$. (E. Spahiu et al., DOI: 10.37392/RapProc.2022.03)

| No. | Sample Name | Activity Concentration (Bq kg$^{-1}$ ± 1$\sigma$) | | |
|---|---|---|---|---|
| | English name | $^{40}K$ | $^{226}Ra$ | $^{232}Th$ |
| 1 | Black pepper | 457.97±20.31 | 12.75±1.34 | 6.32±0.95 |
| 2 | Curry | 158.93±8.65 | 7.66±0.79 | 6.01±0.90 |
| 3 | Ginger | 612.83±26.51 | 7.63±0.80 | 6.56±0.98 |
| 4 | Turmeric | 849.27±36.94 | 15.90±1.67 | 5.20±0.78 |
| 5 | S. L. cinnamon | 173.72±9.34 | 12.28±1.30 | 21.90±1.78 |
| 6 | Cloves | 518.17±23.54 | 15.32±1.60 | 7.89±1.18 |
| 7 | Chia | 231.94±10.64 | 11.92±1.26 | 3.62±0.54 |
| 8 | Cayenne pepper | 720.82±31.27 | 17.07±1.80 | 4.00±0.60 |
| 9 | Mix spices 1 | 411.84±18.55 | 13.73±1.43 | 2.79±0.42 |
| 10 | Mix spices 2 | 429.51±19.24 | 11.81±1.22 | 2.04±0.31 |
| 11 | Garlic | 337.15±15.36 | 14.74±1.50 | 3.52±0.53 |
| 12 | Celery | 674.02±29.32 | 11.70±1.21 | 4.46±0.67 |
| 13 | Parsley | 674.94±29.45 | 15.08±1.60 | 5.46±0.82 |
| 14 | Dill | 812.75±34.57 | 5.15±0.52 | 4.46±0.67 |
| 15 | Winter savory | 420.44±18.89 | 9.87±1.05 | 5.48±0.82 |
| 16 | Oregano | 564.68±24.76 | 9.22±0.73 | 4.21±0.63 |
| 17 | Rosemary | 516.19±22.63 | 14.54±0.85 | 3.89±0.58 |
| 18 | Peppermint | 587.05±25.60 | 18.30±1.32 | 5.60±0.84 |
| 19 | Bay laurel | 247.41±12.41 | 21.01±0.95 | 5.65±0.85 |
| 20 | Basil | 742.85±31.77 | 11.20±0.52 | 5.78±0.87 |

$^{40}K$ has the highest values, possibly due to use of fertilizers, also transfer factor of $^{40}K$ is higher than some natural radioisotopes.

# Results and discussions II

Table 3. Average Annual Committed Effective Dose (AACED) in the Spice samples (Consume Rate 1 kg/year). (E. Spahiu et al., DOI: 10.37392/RapProc.2022.03)

The range of dose was found from 5.61 μSv $y^{-1}$ to 10.91 μSv $y^{-1}$ and the average value was found to be 8.12 μSv $y^{-1}$.

| No. | Sample Name | AACED (μSv $y^{-1}$) |
|---|---|---|
| 1 | Black pepper | 7.86 ± 0.45 |
| 2 | Curry | 5.75 ± 0.44 |
| 3 | Ginger | 7.44 ± 0.36 |
| 4 | Turmeric | 10.91 ± 0.56 |
| 5 | S. L. cinnamon | 9.55 ± 0.55 |
| 6 | Cloves | 9.32 ± 0.55 |
| 7 | Chia | 5.61 ± 0.38 |
| 8 | Cayenne pepper | 10.17 ± 0.56 |
| 9 | Mix spices 1 | 7.04 ± 0.43 |
| 10 | Mix spices 2 | 6.44 ± 0.37 |
| 11 | Garlic | 7.03 ± 0.45 |
| 12 | Celery | 8.48 ± 0.41 |
| 13 | Parsley | 9.66 ± 0.52 |
| 14 | Dill | 7.51 ± 0.30 |
| 15 | Winter savory | 6.63 ± 0.37 |
| 16 | Oregano | 7.06 ± 0.29 |
| 17 | Rosemary | 8.16 ± 0.31 |
| 18 | Peppermint | 10.05 ± 0.45 |
| 19 | Bay laurel | 8.72 ± 0.34 |
| 20 | Basil | 9.07 ± 0.32 |

# Results and discussions III

Table 4. The range of Excess Lifetime Cancer Risk (**ELCR**) due to ingestion of radionuclide in food spices was found to be from $2.0\times10^{-5}$ to $3.8\times10^{-5}$ with average value $2.8\times10^{-5}$.

| No. | Sample Name | ELCR ($\times10^{-5}$) |
|---|---|---|
| 1 | Black pepper | 2.8 |
| 2 | Curry | 2.0 |
| 3 | Ginger | 2.6 |
| 4 | Turmeric | 3.8 |
| 5 | S. L. cinnamon | 3.3 |
| 6 | Cloves | 3.3 |
| 7 | Chia | 2.0 |
| 8 | Cayenne pepper | 3.6 |
| 9 | Mix spices 1 | 2.5 |
| 10 | Mix spices 2 | 2.3 |
| 11 | Garlic | 2.5 |
| 12 | Celery | 3.0 |
| 13 | Parsley | 3.4 |
| 14 | Dill | 2.6 |
| 15 | Winter savory | 2.3 |
| 16 | Oregano | 2.5 |
| 17 | Rosemary | 2.9 |
| 18 | Peppermint | 3.5 |
| 19 | Bay laurel | 3.1 |
| 20 | Basil | 3.2 |

# Conclusion 1: Activity Concentration

Level of the natural and artificial radioactivity of 20 types spice samples produced in Albania and imported is presented.

- The range of the activity concentrations of natural radionuclides in food spices varies:

from 173.72 to 849.47 Bq $kg^{-1}$ for $^{40}K$, from 5.15 to 21.01 Bq $kg^{-1}$ for $^{226}Ra$ and

from 2.04 to 21.90 Bq $kg^{-1}$ for $^{232}Th$.

- The activity concentration of the artificial radionuclide of $^{137}Cs$ is found only in 2 spices, at low values (others are < MDA):

  0.41 Bq $kg^{-1}$ (Bay Laurel) and 0.53 Bq $kg^{-1}$ (Oregano).

# Conclusion 2: Average Annual Committed Effective Dose (AACED)

- The range of AACED values were found in spice samples to varies:

  from 5.61 μSv $y^{-1}$ to 10.91 μSv $y^{-1}$.

- The Average value of AACED was found: 8.12 μSv $y^{-1}$

- *The average annual effective dose, due to ingestion the food spices was lower compared to the average worldwide dose of 290 μSv$y^{-1}$ from UNSCEAR 2000, and even lower than the recommended limit of 1 mSv $y^{-1}$ for public exposure by WHO (World Health Organization) and ICRP (International Commission on Radiological Protection) for all age.*

# Conclusion 3: Excess Lifetime Cancer Risk (ELCR)

- The range of ELCR values were found in spice samples to varies:

  from $2.0\times10^{-5}$ to $3.8\times10^{-5}$ with average value $2.8\times10^{-5}$.

- The average value of ELCR is lower than the world average value of $29\times10^{-5}$ for the public.

- *Therefore, these food spices can be used as a human diet with an acceptable risk and do not have any serious radiological effect.*
- *They are safe for consumption with low radiological risks.*

# Thank You!