Radiation processing of minimally processed vegetables and aromatic plants

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Vegetables and aromatic plants

• Vegetables are part of diet in world

• Microbial load cause food borne outbreaks

• Irradiation efficient way to
  – Helping a safe global trade
  – Reduce microorganism’s level and inhibit parasites
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• Aim of the work study
  – effect of gamma radiation on quality and safety of ready-to-eat vegetables
  – inactivation of bacteria responsible for several outbreaks around the world
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- Lettuce (*Lactuca sativa* L., cv Frisada)
- Watercress (*Nasturium officinale* L.)
- Parsley [*Petroselinum crispum* Mill. (A.W.Hill)]
- Coriander (*Coriandrum sativum* L.)
- Mint (*Mentha spicata* L.)
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• Irradiation and storage
  – Source - cobalt-60 plant
  – Dose rate of 0.7 and 4 kGy h\(^{-1}\)
  – Absorbed dose 0.5 up to 1 kGy
    – lettuce 0.5 up to 3.0 kGy
  – Stored at 4ºC
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• Performed analysis
  – Microbial count
    » Total aerobic mesophilic
    » Psychrotrophic
    » Total coliforms
    » Enterobacteriaceae
  – Atmosphere composition
  – Texture
  – Sensorial
  – Statistical
The radiation caused an overall reduction of 2 up to 4 log cycles in mesophilic and psychrotrophic counts.
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Results: Microbial

Enterobacteriaceae counts

To coliforms and Enterobacteriaceae, doses of 0.5 and 1 kGy, in overall substrates, resulted in reductions of 1.5 up to 7 log cycles.
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**Results: Atmosphere composition**

Lettuce irradiated at 1.5-2 kGy showed an increase in CO$_2$ and a decrease in O$_2$ levels (1$^{st}$ day).

The irradiation stimulated the respiration rate.
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Results: Atmosphere composition

Mint irradiated at 0.5 and 1 kGy showed different behaviour on O₂ level when compared with the others vegetables.
Irradiated lettuce (0.5 and 1 kGy) showed a significant decrease in texture, when comparing with non-irradiated.
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Results: Colour

- Results point out no detectable differences surface colour after irradiation in overall products.

- However after 7 days of shelf life the mint irradiated with 1 kGy presented lost greenness and became darker.
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Results: Vegetables shelf-life

- **Lettuce** irradiated at:
  - 0.5 and 1 kGy - 12 days
  - 0 and 2 kGy - 8 days

- **Watercress** irradiated at:
  - 0.5 kGy - 7 days
  - 0 and 1 kGy - 6 days
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Results: Aromatic plants shelf-life

- Parsley irradiated at:
  - 0, 0.5 and 1 kGy - 24 days

- Coriander irradiated at:
  - 0.5 kGy - 9 days
  - 0 and 1 kGy - 7 days

- Mint irradiated at:
  - 0 and 0.5 kGy - 7 days
  - 1 kGy - 4 days
<table>
<thead>
<tr>
<th>Product</th>
<th>$D_{10}$ $E. coli$ O157:H7</th>
<th>$D_{10}$ $L. innocua$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lettuce</td>
<td>0.14 kGy</td>
<td>0.19 kGy</td>
</tr>
<tr>
<td>Watercress</td>
<td>0.15 kGy</td>
<td>0.27 kGy</td>
</tr>
<tr>
<td>Coriander</td>
<td>0.15 kGy</td>
<td>0.27 kGy</td>
</tr>
<tr>
<td>Mint</td>
<td>0.15 kGy</td>
<td>0.31 kGy</td>
</tr>
<tr>
<td>Parsley</td>
<td>0.16 kGy</td>
<td>0.23 kGy</td>
</tr>
</tbody>
</table>
CONCLUSIONS

• The microbial reduction population was 1.5 up to 6 log accord the product.

• The optimum doses to be applied would be 1 kGy for lettuce, parsley and watercress and 0.5 kGy for mint and coriander minimally processed.
CONCLUSIONS

• The radiation dose necessary to kill $10^5$ studied microorganisms was:
  – *E. coli* 0.6 up to 0.8 kGy
  – *L. innocua* 1.0 up to 1.6 kGy.

• Since such populations are considerably greater than those occasionally found in these vegetables, the application of 0.5-1 kGy would result in high inactivation of these pathogens.
Traditional Portuguese kitchen
Sea food rice

Ingredients
“caroline” rice;
cockle;
shrimp;
garlic; olive oil;
black pepper;
piripiri; salt;

After cooking sprinkle with cut irradiated coriander and parsley.