WIDENING THE MEALS VARIETY FOR IMMUNOCOMPROMISED PERSONS AND OTHER TARGET GROUPS BY IONIZING RADIATION

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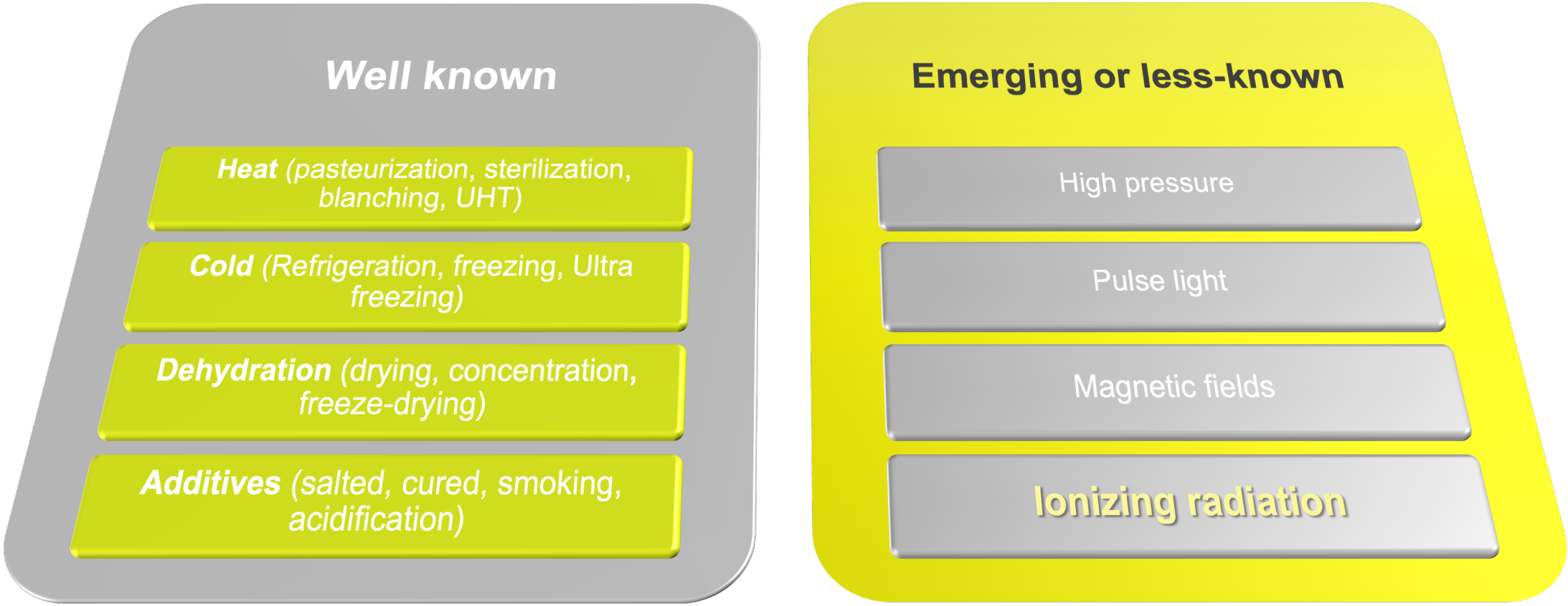
Outline

- Existing and promising methods for sterilization and conservation of foods
- Ionizing radiation for sterile or stable foods
- From design to commercialization using radiation
- Prototype validation - Examples
- Final Remarks

Existing and promising methods for sterilization and conservation of foods



Ionizing radiation for sterile or stable foods

- Provide the tools to achieve sterilization o decontamination levels depending on the intended target group (immunocompromised patients, general public, etc)
- In combination with other intervention/s, may generate shelf-stable products
- As a non-thermal treatment, maintain colors, aroma, freshness
- It can be applied at large scale, with affordable cost

Added Value we challenge to a new technology

Immunocompromised and other target groups

Increase the variety of foods available for specific targets (safer, more varied, nutritious and more attractive or tasteful for their diet)

https://es.quora.com/Cu%C3%A1l-es-la-mejor-dieta-para-pacientes-inmunodeprimidos

https://www.unicef.org/press-releases/acute-malnutrition-threatens-half-children-under-five-yemen-2021-un

Have highly nutritive and safe foods for emergency portion (earthquakes, floods, undernourishment)

Explore how to contribute to improving the safety of existing products

Food Product Development

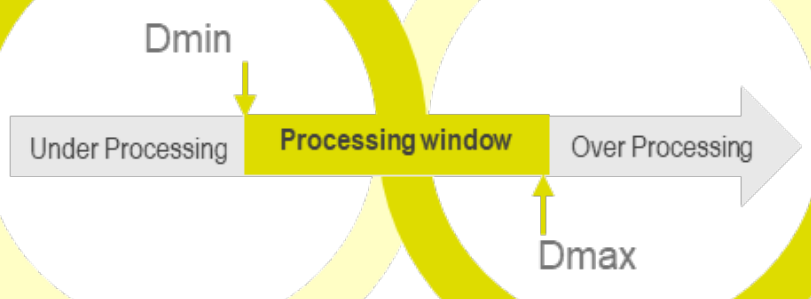
From design to commercialization using radiation

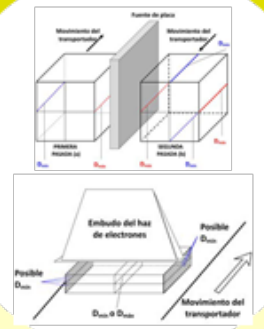
Irradiation Dmin

Minimum dose approach to achieve the purpose

Validation Process

To guarantee the processing window in the facility





Food Product Development

Composition, conditions, aw, packaging, additives, etc.

Irradiation Dmax

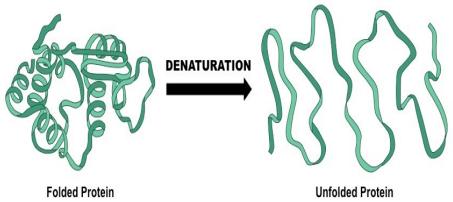
Maximum tolerance to maintain properties

Prototype validation and Commercial Application

Routine process

Food Product Development

Product design, composition, additives, scavengers, packaging, modified atmosphere, physical conditions, synergic treatment and other interventions

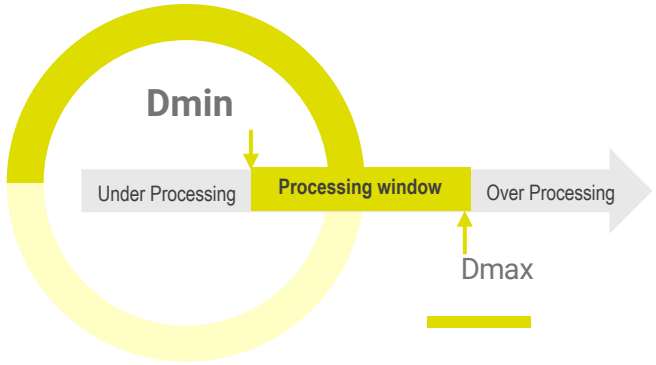


Enzyme inactivation or stabilisation

Packaging and Modified atmosphere

Physical condition

Frozen, dehydrated, refrigerated, etc.



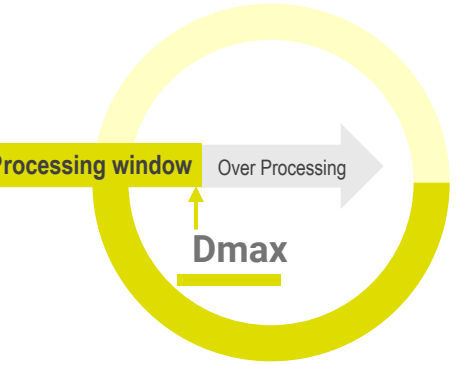
Determination of the irradiation Dmin

- Dose determination for the control of spoilage micro-organisms (shelf-life extension)

- Dose determination for the control of pathogenic micro-organisms and reduction of TBC

Shelf-stable products

“Cold pasteurization”



Determination of the tolerance irradiation dose

- Verify nutritional, functional and quality attributes throughout the shelf life of the product

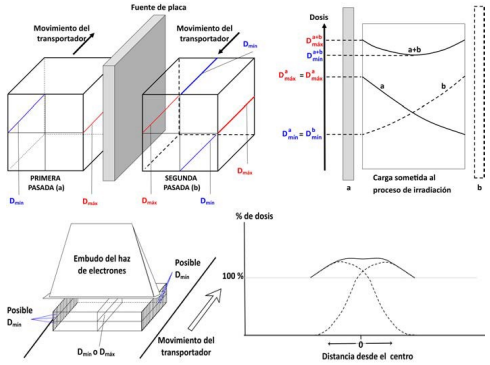
- Investigate and Identify optimum dose rate, Uniformity

Sensory evaluation

Quality and nutritional parameters

Texture analyses

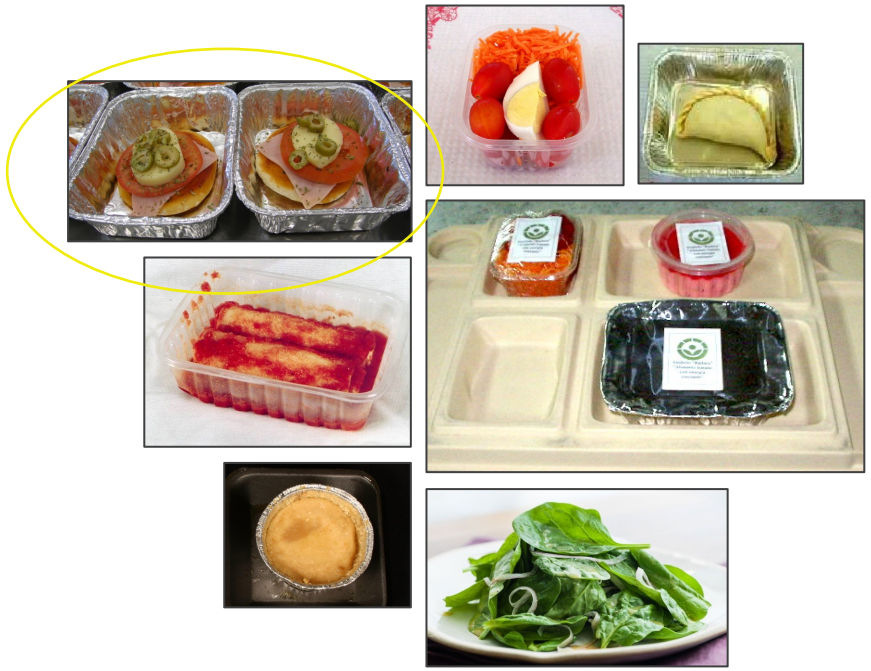
Radiosensitive vitamins.



Irradiation conditions

Prototype validation - Examples

- Review the collected data, evaluate the potential improvements in the product and processing developing specification



Immunocompromised patient group

Intermediate doses

Example: pizza

Approach: Pizza irradiated to control non sporulated pathogens like Listeria monocytogenes and others more radiosensitive.

Ingredients: 000 wheat flour, sunflower oil, yeast powder, canned tomato puree, fresh garlic, baked ham, fresh tomato, mozzarella cheese, green olives, dried basil and marjoram, sodium chloride, tap water

Conditions: precooked mass + ingredients, packed in an Aluminium trail and refrigerated.

D_{10} determination to calculate the disinfection dose to assure 6 log-reduction of the intended most radio resistance pathogen, *L. monocytogenes*

D_{min} to assure 6 log-reduction *L. monocytogenes*

3 kGy, D_{10} 0.53 kGy

Storage time

Up to 10 days, at 4ºC

The results showed that the product is nutritive and microbiologically safe, during the selected storage time.

Also, these results demonstrated that a weekly provision to hospital services would be possible.

Higher doses

Example: highly nutritive bread

Other groups

Approach: Highly Nutritive Bread- to extend Storage time at room, reducing spoilage microorganisms.

Formulation based on "*Food and Nutrition Needs in Emergencies*", 2002UNHCR, UNICEF, WFP and WHO Guideline, Geneva; and "Recommended dietary intakes (RDI) required by the Argentine Food Code" (2011) for an adult population.

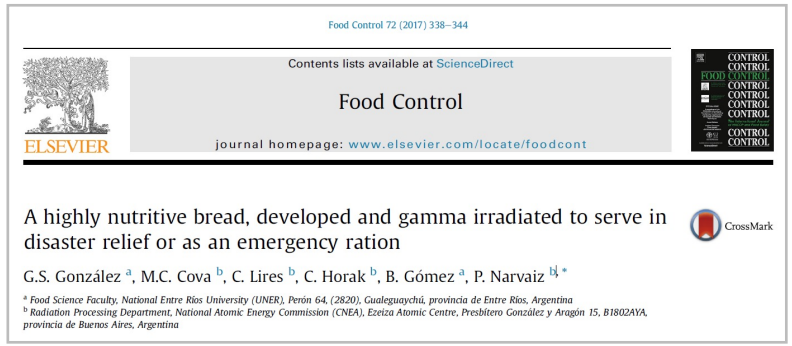
Ingredients: milk power, egg powder, whey milk, soy flour, wheat flour, water, vitamins, minerals.

Conditions: cooked, packed in laminate PS/PP, room temperature.

Dose calculation base on aerobic sporulated bacterias

Dmin to assure 6 log-reduction sporulated bacteria — 6 kGy, (D_{10} 1.00 to 1.15 kGy)

Storage time — Up to 43 days, at RT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A highly nutritive bread, developed and gamma irradiated to serve in disaster relief or as an emergency ration

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The results showed that the product is nutritive and microbiologically safe, during the selected storage time.

Higher doses

Example: honey (liquid and creamy)

Approach: Reduce the risk of presence of *Clostridium botulinum*.

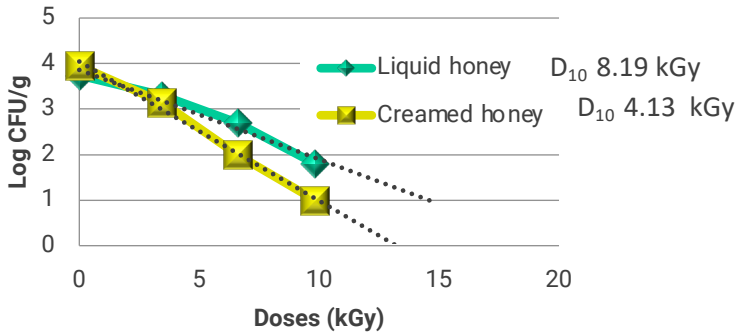
Ingredients: pure liquid and creamy honey

Conditions: Honey fractionated into commercial polycarbonate flasks

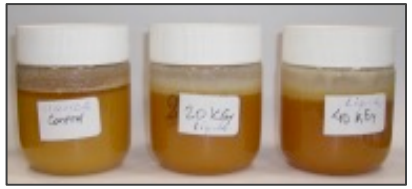
Sensory analysis

Chemical analysis: Hydroxymethylfurfural Content, Diastasic Activity, Free Acidity, Reducing Sugars

Dose calculation base on the D_{10} value of the surrogate *Cl. sporogenes* (ATC11437)



Liquid Honey
5 Months after Irradiation
RT Storage (25°C, dark)



Creamy Honey
5 Months after Irradiation
RT Storage (25°C, dark)

Honey fractionated into commercial polycarbonate flasks, and irradiated at a minimum dose of 20 kGy to inactivate Clostridium botulinum spores, attained: 2.4 fold log reduction in Liquid Honey, 4.8 fold log reduction in Creamy Honey.

The results showed that Chemical parameters established by national and international regulations were not modified by this treatment even at the 40 kGy dose.

Other groups

Higher doses

Example: Long life meat

Approach: Reduce the risk of presence of *Clostridium botulinum*.

Ingredients: bovine meat, cured and cooked

Conditions: Vacuum packaging, irradiated in frozen conditions

Dmin — Around 20 kGy,

Storage time — Up to 9 months, at RT

Commercially available: https://carnelargavida.com/index_en.html

Final Remarks

- It is feasible to apply ionizing radiation treatments not only to simple food systems but also to complex ones like some whole ready- to- eat meals
- It is a fact, ionizing radiation may increase the variety of foods available for target groups such as immunocompromised persons or others suffering alimentary emergencies.
- These more attractive, safer and fresh foods, improve their feeding quality (more diversification is allowed) with both nutritional and psychological benefits

The feasibility of obtaining clean or sterile meals, \nutritious and stable food, should motivate us to continue exploring how to scale up this technology and make it accessible to those groups whose diets are limited.

Teamwork

National Commission of Atomic Energy

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National Entre Rios University

Cossani E., G Gonzalez, B. Gomez

Other Institutions:

Pineiro Hospital, Clinics Hospital, Fernandez Hospital, Garrahan Hospital, University of Buenos Aires, CITECA, Private partners (Food and packaging industries, Private irradiation facility, food catering services, NGO, ONG)

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