HIGHLY NUTRITIVE AND SAFE BREAD FOR PEOPLE SUFFERING ALIMENTARY EMERGENCIES

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Widening the meals variety for immunocompromised persons and other target groups by ionizing radiation
Our Challenge

Develope a food easy to produce, easy to eat, safe during storage time and if possible, also cheap.
TARGET GROUPS

People suffering alimentary emergencies such as:

- earthquakes and floods
- geographical isolation
- chronic malnutrition due to poverty
TARGET GROUPS

Hospitalized immuno-compromised patients, where many meals are forbidden for its microbiological contamination.

In general, Eliminate or reduce addition of microbial-controlling additives.
WHY BREAD?

- Feasibility to include ingredients in the composition for nutritional purposes
- Non expensive, easy to pack and transport.
- Good acceptability and high consumption in Argentina
- We can use irradiation to reduce or eliminate microorganisms and regulate the storage time
GUIDES TO FORMULATE THE HIGHLY NUTRITIVE BREAD:


Recommended dietary intakes (RDI) required by the Argentine Food Code (2011) for an adult population.
HIGHLY NUTRITIVE BREAD DESIGN

↑ Amount of calories
↑ High protein content

Standard recipe Wheat bread

21 recipes

Wheat and soy flour / milk whey / milk / egg / oil

+ Additives: texture, humidity

Preliminary Sensory evaluation

FINAL RECIPE
## NUTRITIONAL CONTRIBUTION

<table>
<thead>
<tr>
<th></th>
<th>HIGHLY NUTRITIVE BREAD</th>
<th>STANDARD WHEAT BREAD</th>
<th>2002UNHCR, UNICEF, WFP and WHO Guideline</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL KCAL/944 G OF BREAD (DAILY RATION) 2 units</td>
<td>2,283</td>
<td>2,067</td>
<td>2,200</td>
</tr>
<tr>
<td>CARBOHYDRATES (%)</td>
<td>68.0</td>
<td>86.5</td>
<td>&gt; 60</td>
</tr>
<tr>
<td>PROTEINS (%)</td>
<td>13.8</td>
<td>10.8</td>
<td>~15</td>
</tr>
<tr>
<td>LIPIDS (%)</td>
<td>18.2</td>
<td>2.7</td>
<td>~17</td>
</tr>
</tbody>
</table>

Comparision of the nutritional contribution of this highly nutritive bread, as compared to that of a common Argentine wheat bread, (according Theoretical calculations from "Food Composition and Nutrition Tables “ (1994), 5th. Ed., Souci-Fachman-Kraut, Ed. Medpharm, Germany.
Theoretical calculations from "Food Composition and Nutrition Tables" (1994), 5th Ed., Souci-Fachman-Kraut, Ed. Medpharm, Germany.)
MINERAL CONTENT IN RAW
RECOMMENDED DIETARY INTAKE

Theoretical calculations from "Food Composition and Nutrition Tables" (1994), 5th. Ed., Souci-Fachman-Kraut, Ed. Medpharm, Germany.)
2 units (daily ration)

VITAMIN CONTENT IN RAW
RECOMMENDED DIETARY INTAKE

- Highly nutritive bread
- Wheat bread

P.A: Panthotenic acid; F.A.: Folic acid

Theoretical calculations from "Nutrition Tables" (1992), 5th Ed., Souci-Fachman-Kraut, Ed. Medpharm, Germany.)
HIGH NUTRITIVE BREAD PRODUCTION

- Bread manufacturing at the food Laboratory
- Cooking: oven, 220ºC, 20 minutes.
- Packaging: polyethylene 100 µm thickness, heat sealed.
- Final weight: 450 g
- Storage conditions were:
  - temperature: 20 ± 1 ºC,
  - relative humidity, 59 ± 6 %,
  - in the darkness.
IRRADIATION DOSE SELECTION

D min

- Microbiological security (reducing total bacteria)
- Shelf life extension (eliminating spoilage microorganisms)

D max

- Product tolerance from a sensory point of view
- Theoretical evaluation of the loss of vitamins, and according to previous experience
Dose measurement was performed with silver and potassium dichromate dosimeters (traceable to NPL).

Irradiation was carried out at the Semi Industrial Cobalt-60 facility at the Ezeiza Atomic Center, Activity ~ 600 k Ci.
The most resistant microorganism was considered:

sporulated bacteria: $D_{10}$ value: 1.00 to 1.15 kGy (*)

## MICROBIOLOGICAL RESULTS

Samples were taken from three breads, for each irradiation dose. Total aerobic mesophilic bacteria, moulds and yeasts, and sporulated aerobic bacteria were performed according to ICMSF.
MICROBIOLOGICAL RESULTS

- 0 kGy: < 5 days
- 3 kGy: 5 - 7 days
- 6 kGy: 270 days
- 10 kGy: 390 days
Consumer panels, composed of 50 people, on five dates along storage time. A 9 point hedonic scale, ranging from “like extremely” to “dislike extremely” was employed to evaluate: aroma, aspect, flavour, texture and general acceptability of codified control and irradiated bread slices.

The bread was sliced and packed the day before the sensory evaluation took place.

Results were statistically analyzed by Dunnett test, p< 0.05 ("Manual on sensory testing methods", ASTM, 1977).
Days 270 and 390 were preliminary tested with a small panel.
270 STORAGE DAYS AT ROOM TEMPERATURE

HIGHLY NUTRITIVE BREAD
The bread formulation studied in this work, suitable to fulfill with nutritional requirements of a population suffering an alimentary emergency, can attain at least a 10 times shelf life extension at room temperature, maintaining its sensory characteristics and improving sanitary quality.

The experimental results showed the availability of a food product which is safe, shelf-stable, nutritious, cheap, easily handled, stored and distributed.

The stability of certain vulnerable nutrients in this bread, such as vitamins and fatty acids, to irradiation should be studied in the future, taking into account the storage time.

CONCLUSIONS
"THANK YOU FOR YOUR ATTENTION!"