# HIGHLY NUTRITIVE AND SAFE BREAD FOR PEOPLE SUFFERING ALIMENTARY EMERGENCIES

Comisión Nacional de Energía Atómica

UNER

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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

earthquakes and floods

People suffering alimentary emergencies such as:

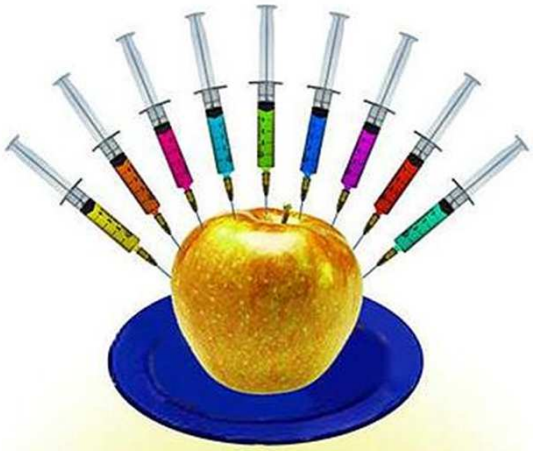
geographical isolation

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*:

- "Food and Nutrition Needs in Emergencies", 2002 UNHCR, UNICEF, WFP and WHO Guideline, Geneva.


- 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

Preliminar Sensory evaluation

↓

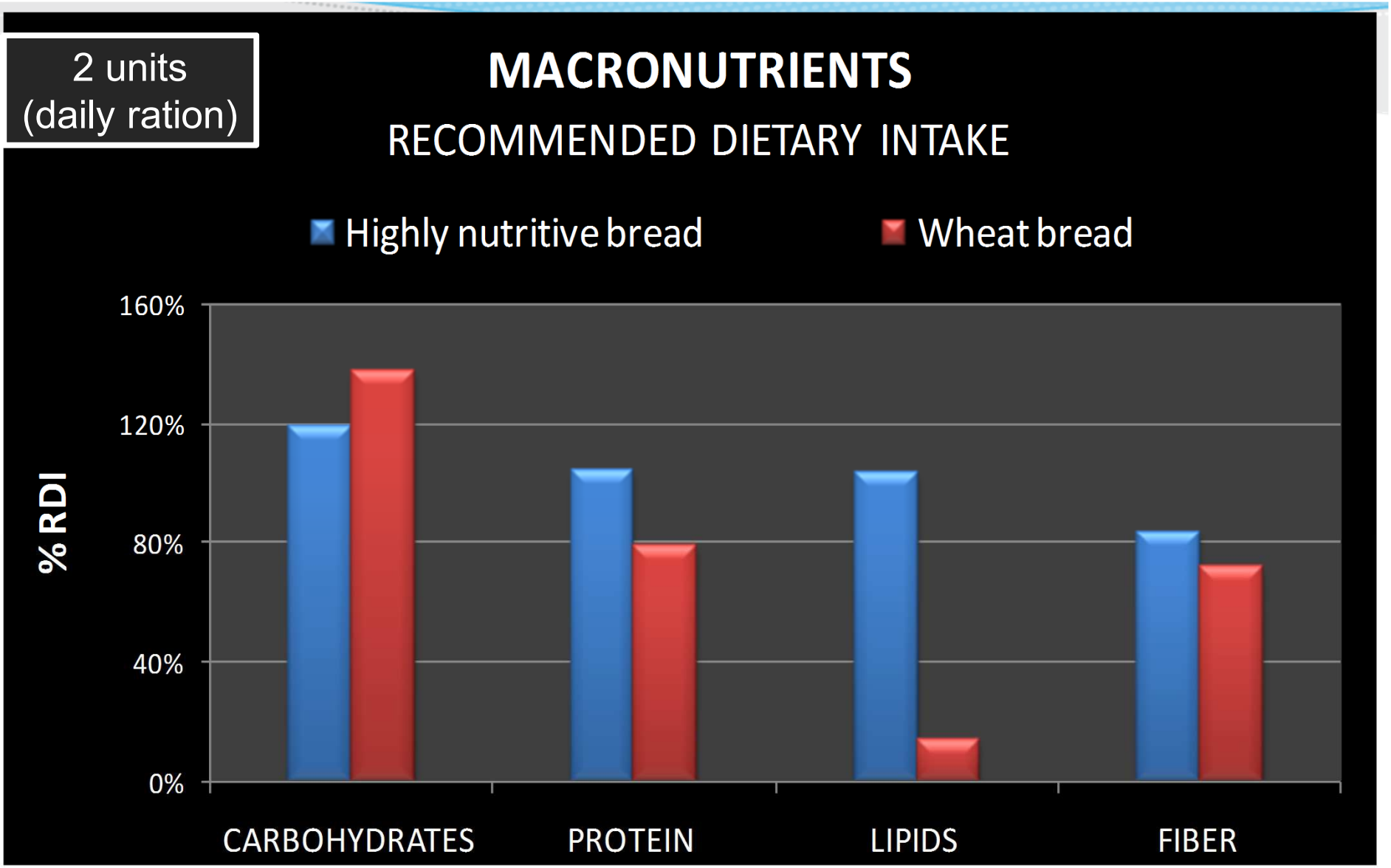
**FINAL RECIPE**

# NUTRITIONAL CONTRIBUTION

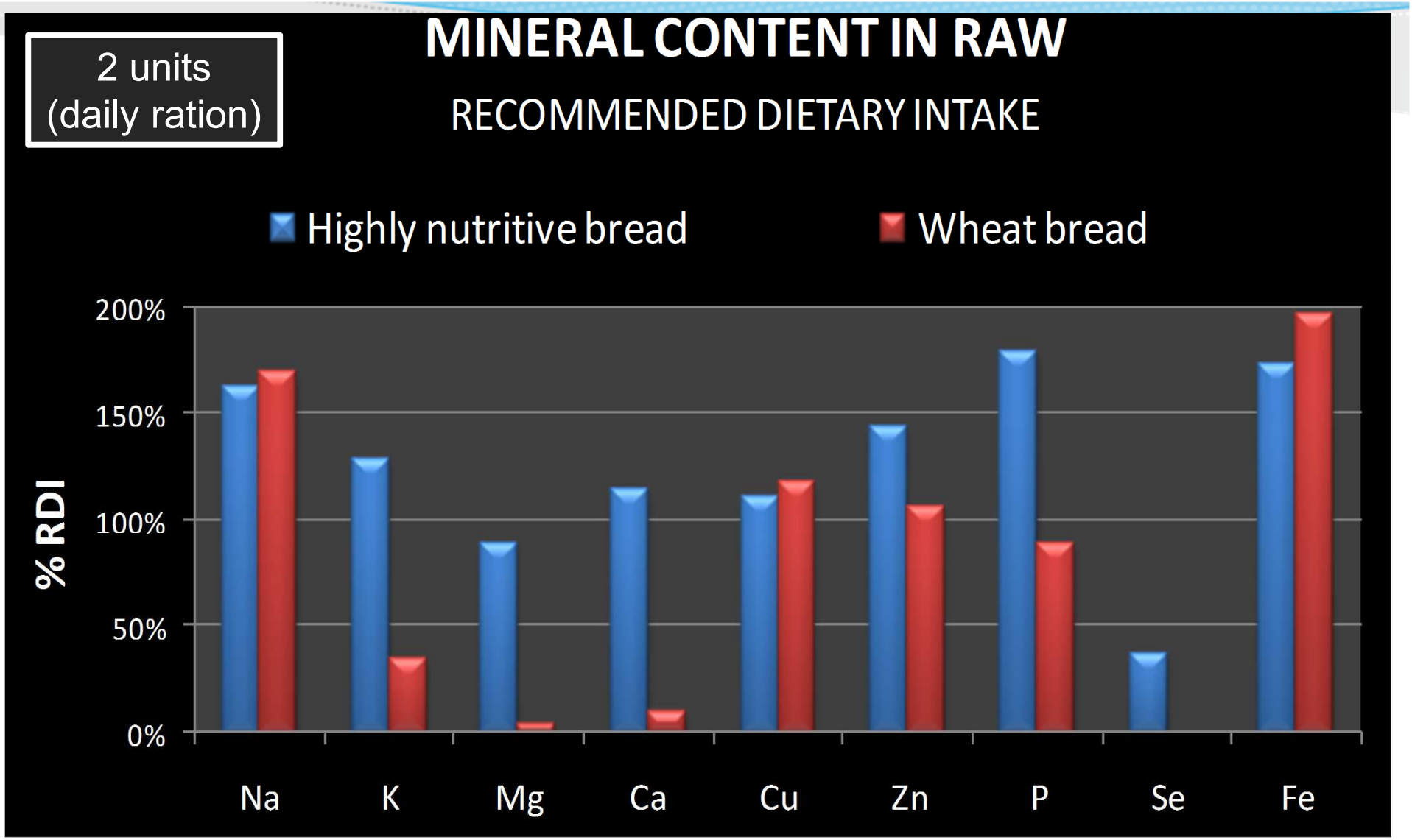
| | HIGHLY NUTRITIVE BREAD | STANDARD WHEAT BREAD | 2002UNHCR, UNICEF, WFP and WHO Guideline |
|---|---|---|---|
| TOTAL KCAL/944 G OF BREAD (DAILY RATION) 2 units | 2,283 | 2,067 | 2,200 |
| CARBOHYDRATES (%) | 68.0 | 86.5 | > 60 |
| PROTEINS (%) | 13.8 | 10.8 | ~15 |
| LIPIDS (%) | 18.2 | 2.7 | ~17 |

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.

2 units
(daily ration)




**Theoretical calculations from " Food Composition and Nutrition Tables “ (1994), 5th. Ed., Souci-Fachman-Kraut, Ed. Medpharm, Germany.)**

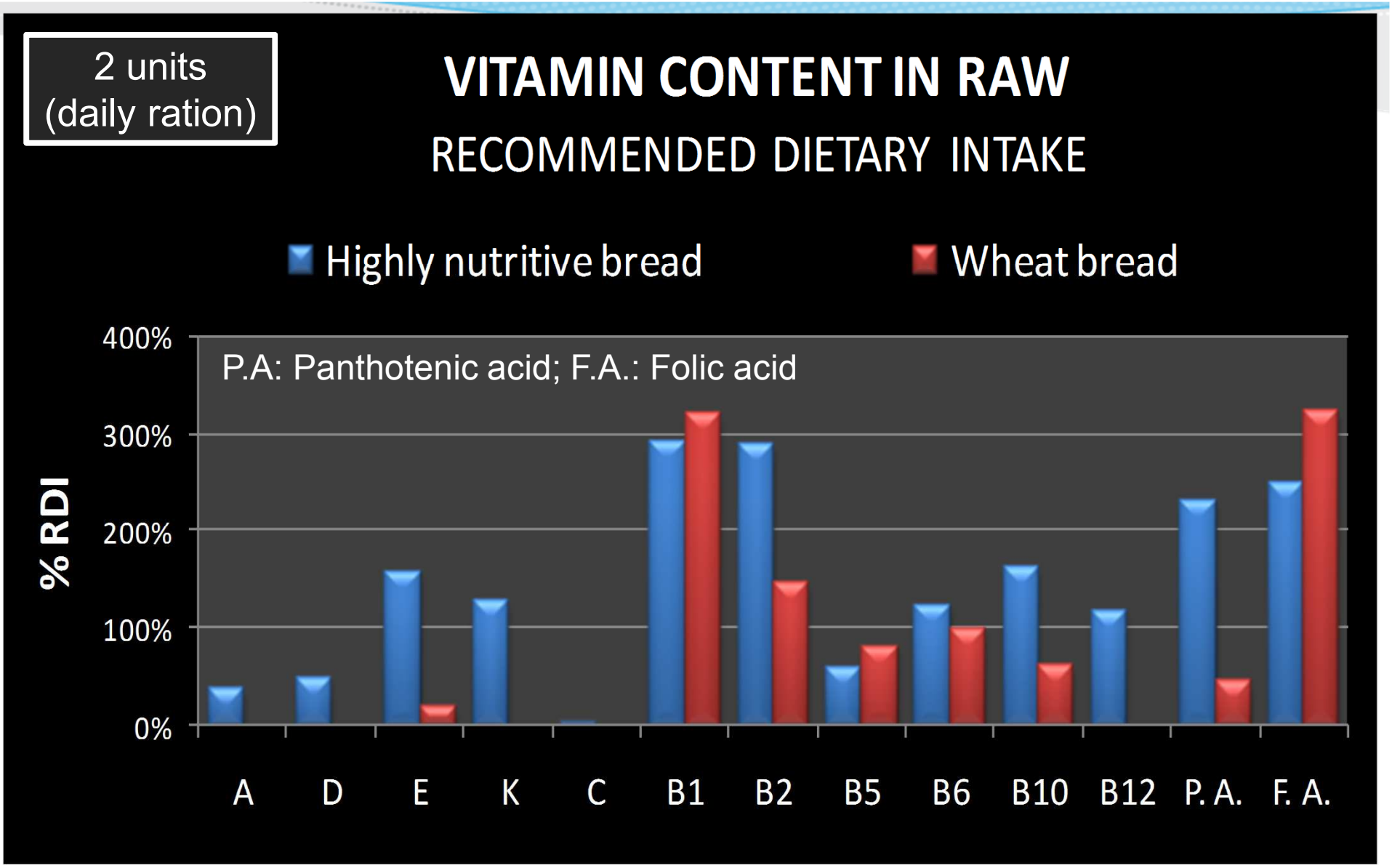



**Theoretical calculations from " Food Composition and Nutrition Tables “ (1994), 5th. Ed., Souci-Fachman-Kraut, Ed. Medpharm, Germany.)**

2 units
(daily ration)

# VITAMIN CONTENT IN RAW

## RECOMMENDED DIETARY INTAKE




**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

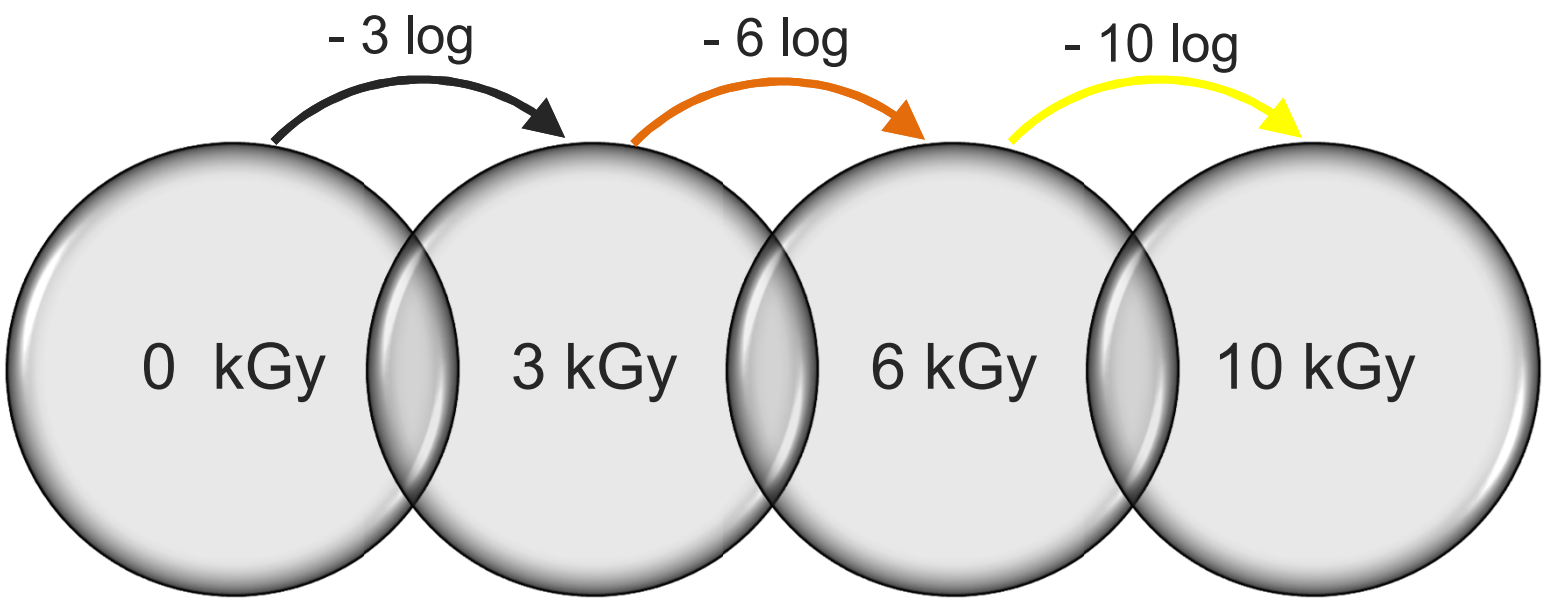
Irradiation was carried out at the Semi Industrial Cobalt-60 facility at the Ezeiza Atomic Center, Activity ~ 600 k Ci.

Dose measurement was performed with silver and potassium dichromate dosimeters (traceable to NPL)

# DOSE SELECTION

The most resistant microorganism was considered:

sporulated bacterias: $D_{10}$ value: 1 ,00 to 1,15 kGy (*)




(*) Grecz, N.; Brannon, R., et al, 1985; Padwal-Desai, S. R.; Ghanekar, et al, 1973 and previous own experiences with other bread formulations (non-published results)

# MICROBIOLOGICAL RESULTS

| | Storage time (days) | | | | |
|---|---|---|---|---|---|
| | 1 | 7 | 60 | 270 | 390 |
| **Unirradiated** | | | | | |
| Bacteria counts | < 50 | 1,20 x $10^6$ | NPD | NPD | NPD |
| Spores | < 50 | < 50 | NPD | NPD | NPD |
| Molds & yeasts | < 50 | 150 | NPD | NPD | NPD |
| **6 kGy** | | | | | |
| Bacteria counts | < 50 | < 50 | < 50 | < 50 | < 50 |
| Spores | < 50 | < 50 | < 50 | < 50 | < 50 |
| Molds & yeasts | < 50 | < 50 | < 50 | 85 | NPD |
| **10 kGy** | | | | | |
| Bacteria counts | < 50 | < 50 | < 50 | < 50 | < 50 |
| Spores | < 50 | < 50 | < 50 | < 50 | < 50 |
| Molds & yeasts | < 50 | < 50 | < 50 | < 50 | < 50 |

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

# *SENSORY ANALYSIS*

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:

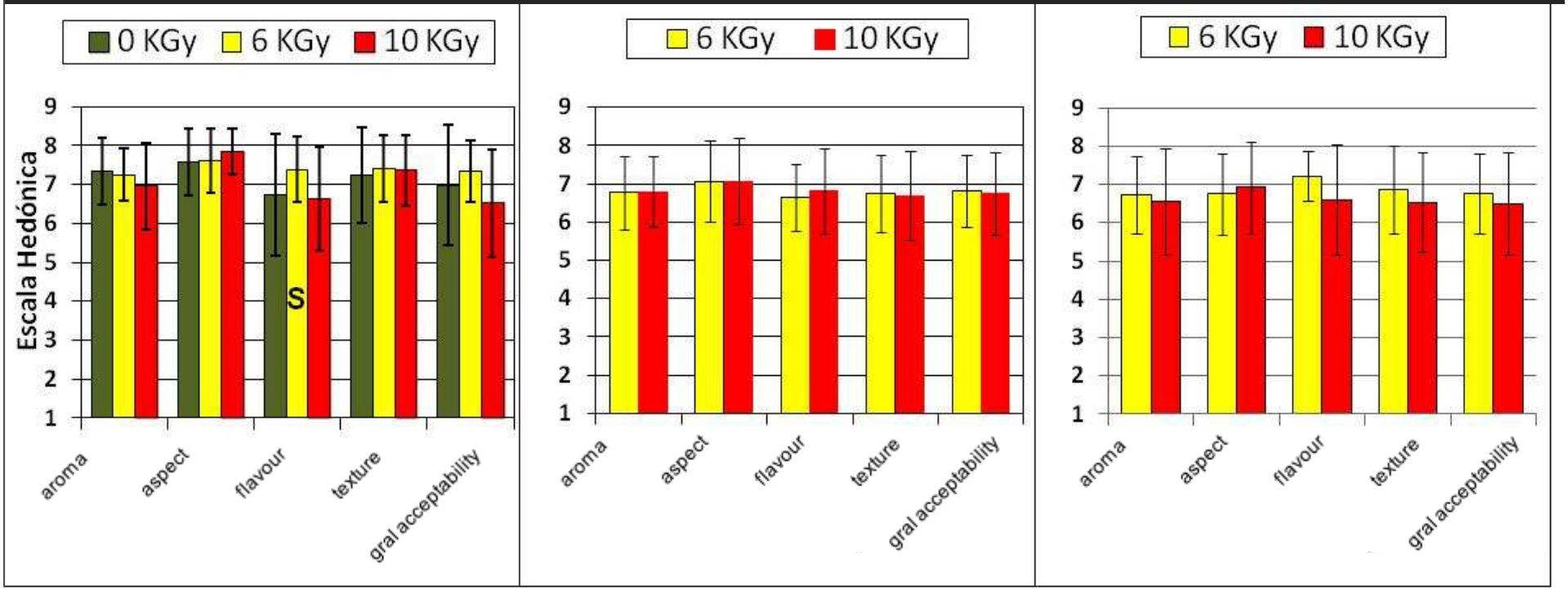
aroma, aspect, flavour, texture and general acceptability of codified control and irradiated bread slices.

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).

# SENSORY ANALYSIS RESULTS

| Sensory evaluation – Day 1st | Sensory evaluation – Day 29th | Sensory evaluation – Day 71st |
|---|---|---|




Days 270 and 390 were preliminary tested with a small panel.

# 270 STORAGE DAYS AT ROOM TEMPERATURE

# CONCLUSIONS

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 esperimental results showed the availability of a food product which is safe, shelf-stable, nutritious, cheap, easily handed, 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.


“THANK YOU FOR YOUR ATTENTION!