# Stability of vitamin E content of γ- irradiated biscuits

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# INTRODUCTION

•Vitamin E => eight natural structurally tocopherols and tocotrienols compound expressed as:

✓ α-tocopherol).

• α-tocopherol represents an essential component in human nutrition required for the :

✓ => preservation of lipids in stable form in biological systems and in foods [WAGNER et al, 2004].

- Vitamin E : the main antioxidant, together with:

  ✓ Vitamins A and C

  ✓Copper, zinc and selenium

- Antioxidants in the diet: [WU et al., 2004]

✓ neutralize free radicals formed in the human body =>( process of oxidation)

✓ reduce serum lipid peroxides

- A diet rich in antioxidants has an important role in the prevention of diseases related to oxidative stress.

- A diet rich in foods containing vitamin E may help to protect against: [NATIONAL INSTITUTES OF HEALTH, 2002;FERREIRA, 2004; MAGUIRE, 2004].

✓Alzheimer´s disease

✓cancer

✓coronary heart  disease

# Table 1. Sources of vit. E in the diet (US or Europe):

| Products | Tocopherols,mg/100g | | | |
|---|---|---|---|---|
| | α | β | γ | δ |
| ***Oils*** | | | | |
| Soybean | 8 | 1.5 | 80 | 27 |
| Corn(1) | 11 | 5 | 60 | 1,8 |
| Linseed | 8 | - | 58 | 2 |
| Cottonseed | 39 | - | 39 | - |
| Rapeseed(2) | 32 | - | 38 | 2 |
| Palm | 26 | - | 32 | 7 |
| Sesame | 14 | - | 29 | - |
| Wheat-germ | 123 | 71 | 26 | 27 |
| Peanut | 13 | - | 21 | 2 |
| Sunflower(2) | 49 | - | 5 | 0,8 |
| Olive(2) | 12 | - | 0,7 | - |
| ***Margarines*** | | | | |
| Corn(1) | 5 | - | 46 | - |
| Soybean(1) | 5 | - | 34 | 10 |
| Sunflower(2) | 6 | - | 10 | 3 |
| ***Seeds*** | | | | |
| Sesame | - | - | 23 | - |
| Sunflower | 50 | 3 | - | - |
| ***Nuts*** | | | | |
| Almonds | 45 | 19 | - | |
| Pecan | - | - | 16 | - |
| Peanuts | 11 | - | 8 | - |
| Brazil | 11 | - | 5 | 3 |
| ***Cereal grains*** | | | | |
| Corn | 0,2 | - | 4,5 | - |
| Rice, white | 0,3 | - | 0,3 | - |

1 Preferred intake in the USA.
2 Preferred intake in Europe.

WAGNER et al, 2004

- The possibility of using gamma irradiation doses (different foods and read-to-eat foods ) to improve: [FAN, 2003]

✓ the microbiological quality of different foods

✓ to be balanced with the maintenance of product quality

✓ to preserve nutritional value and organoleptic quality

- Naturally occurring antioxidants are considered able to behave as radioprotectors [WIESS & LANDAUER, 2000].

- Radiation protecting properties of vitamin E has been described [KAMMERER et al, 2001;MANZI et al, 2003].

- The effects of vitamin E on the formation of final products of radiation-induced free-radicals transformation has been shown [SHADYRO et al, 2005].

- The vitamin E is able to oxidize:

✓ $\alpha$-hydroxyl-(containing radicals) => carbonyl

# MATERIAL AND METHODS

## Material

- Biscuits - commercially found in the market in 200g pouches, containing the following ingredients:

✓ whole grain wheat flour

✓raw sugar

✓sunflower

✓maize oil

✓soy lecithin

✓flavoring

✓citric acid

✓ wheat flour enriched:

➢ => iron and folic acid, maize starch, honey, barley malt, cinnamon, carnation powder, salt, chemical baking substances (sodium bicarbonate, ammonium bicarbonate and sodium acid pyrophosphate)

• Three different lots of biscuits were used, kept at a freezer overnight before irradiation.

# IRRADIATION

- Irradiation was performed in a $^{60}Co$ Gammacell 220(AECL) source, dose rate about 3.5kGy/h at doses of 1kGy and 3kGy.

- Dosimetric mappping was previously performed by Fricke dosimetry.

# VITAMIN E AND MEASUREMENTS

- The method employed [IAL, 2005] consists of:

✓saponification applied to 2-g samples:ethanol; pyrogalic acid($C_6H_6O_3$);potassium hydroxide(KOH).

✓A petroleum ether extraction

✓ The extracts were washed with water

✓ Aliquots of the extracts were evaporated =>$N_2$

✓ The samples of vit. E were reconstitute: α- α `dipyridyl( $C_{10}H_8N_2$); ferric chloride; EDTA, ethanol

✓ Absorbance measurements were made at 520nm => a previously prepared calibration curve was used.

# RESULTS AND DISCUSSION

**Table2. Vitamin E content of irradiated biscuits, means (X) and standard deviations (sd), and % of retention**

1st lot

| Vitamin E (mg/100g) | | | |
|---|---|---|---|
| Sample | 1kGy | 0kGy | Retention (%) |
| 1 | 11,38 | 10,25 | |
| 2 | 12,33 | 11,48 | |
| 3 | 11,83 | 10,95 | |
| X | 11,84 | 10,89 | **108,72** |
| sd | 0,48 | 0,61 | |

1st lot

| Vitamin E (mg/100 g) | | | |
|---|---|---|---|
| Sample | 3kGy | 0kGy | Retention (%) |
| 1 | 10,45 | 10,25 | |
| 2 | 10,98 | 11,48 | |
| 3 | 11,35 | 10,95 | |
| X | 10,93 | 10,89 | **100,31** |
| sd | 0,45 | 0,61 | |

2nd

| lot | Vitamin E (mg/100 g) | | |
|---|---|---|---|
| Sample | 1kGy | 0kGy | Retention (%) |
| 1 | 8,88 | 8,80 | |
| 2 | 8,80 | 8,78 | |
| 3 | 9,65 | 9,43 | |
| X | 9,11 | 9,00 | **101,20** |
| sd | 0,47 | 0,37 | |

2nd lot

| Vitamin E (mg/100 g) | | | |
|---|---|---|---|
| Sample | 3kGy | 0kGy | Retention (%) |
| 1 | 8,80 | 8,80 | |
| 2 | 8,78 | 8,78 | |
| 3 | 9,45 | 9,43 | |
| X | 9,01 | 9,00 | **100,09** |
| sd | 0,38 | 0,37 | |

3rd lot

| Vitamin E (mg/100 g) | | | |
|---|---|---|---|
| Sample | 1kGy | 0kGy | Retention (%) |
| 1 | 7,40 | 7,40 | |
| 2 | 7,93 | 7,93 | |
| 3 | 9,13 | 9,15 | |
| X | 8,15 | 8.16 | **99,90** |
| sd | 0,88 | 0,90 | |

3rd lot

| Vitamin E (mg/100 g) | | | |
|---|---|---|---|
| Sample | 3kGy | 0kGy | Retention (%) |
| 1 | 7,38 | 7,40 | |
| 2 | 8,13 | 7,93 | |
| 3 | 9,15 | 9,15 | |
| X | 8,22 | 8,16 | **100,72** |
| sd | 0,89 | 0,90 | |

# DISCUSSION

- Diverse authors studied radiation effects on vitamin E containing foods. They found different results depending the system assayed, the water activity and the radiation conditions.
- Vitamin E is known as the most radiation-sensitive of the fat-soluble vitamins. [KILCAST, 1992]

- The main sources of this vitamin are: oils; dairy products, none of which suitable for irradiation
=>Because of their sensitivity to off-flavor

- Some radiation effects on foods could be of no nutritional relevance

• BAGOROGOZA, 2001, studied fresh skinless turkey breasts packaged in air or nitrogen gas irradiated at:

✓=> 2.4 to 2.9 kGy or not and stored at 2º C.

•Samples of raw and cooked turkey were evaluated by a descriptive panel:

✓Irradiation affected color, odor, flavor, and levels of vit.E levels by 33%

DIEHL, 1990, described that the treatment of minced pork:

- ✓=> a dose of 50kGy in the presence of air at ambient temperature destroyed vit. E completely

- ✓ When irradiation was carried out at 0ºC the loss was 75%, and at - 30ºC it was 55%

- SINGH, 1991 found

- no significant difference between vitamin E degradation in air and in nitrogen at dose rates between 1 kGy e 100kGy.

- No significant differences were observed in α–tocopherol loss from the irradiation of sunflower oil at total dose of 1kGy

- Irradiating vit.E in air at different doses produced a loss of vit E activity:

| kGy | % (vit E) loss |
|---|---|
| 10 | 51 |
| 50 | 78 |
| 100 | 95 |

- The loss of vit. E in oatmeal increased as the irradiation=> ⇑ TºC from:

✓ 7% => at 18ºC to

✓46% => 50ºC

- THAYER et al., 1991 found that the vitamin E content of:

- wheat decreased by irradiation at ambient temperature in the presence of air.

- Oats that were packaged, irradiated at 1 kGy, and stored for 8 months under nitrogen lost only 5% of their tocopherol content compared with a 56% loss in oats irradiated and stored in air.

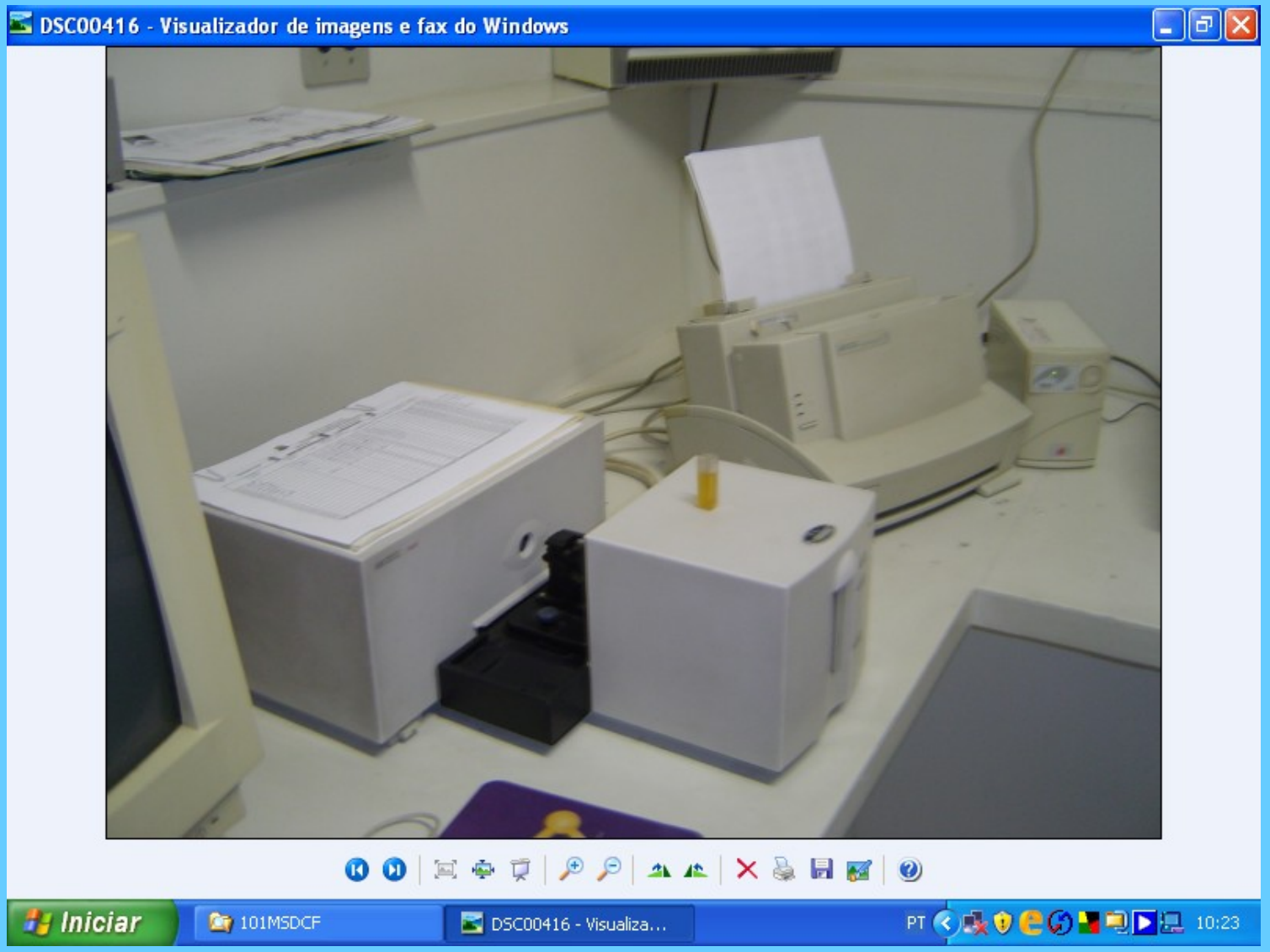
- hazel nuts at 1 kGy produced an 18% loss of α-tocopherol, while baking produced a 13% loss

# CONCLUSION

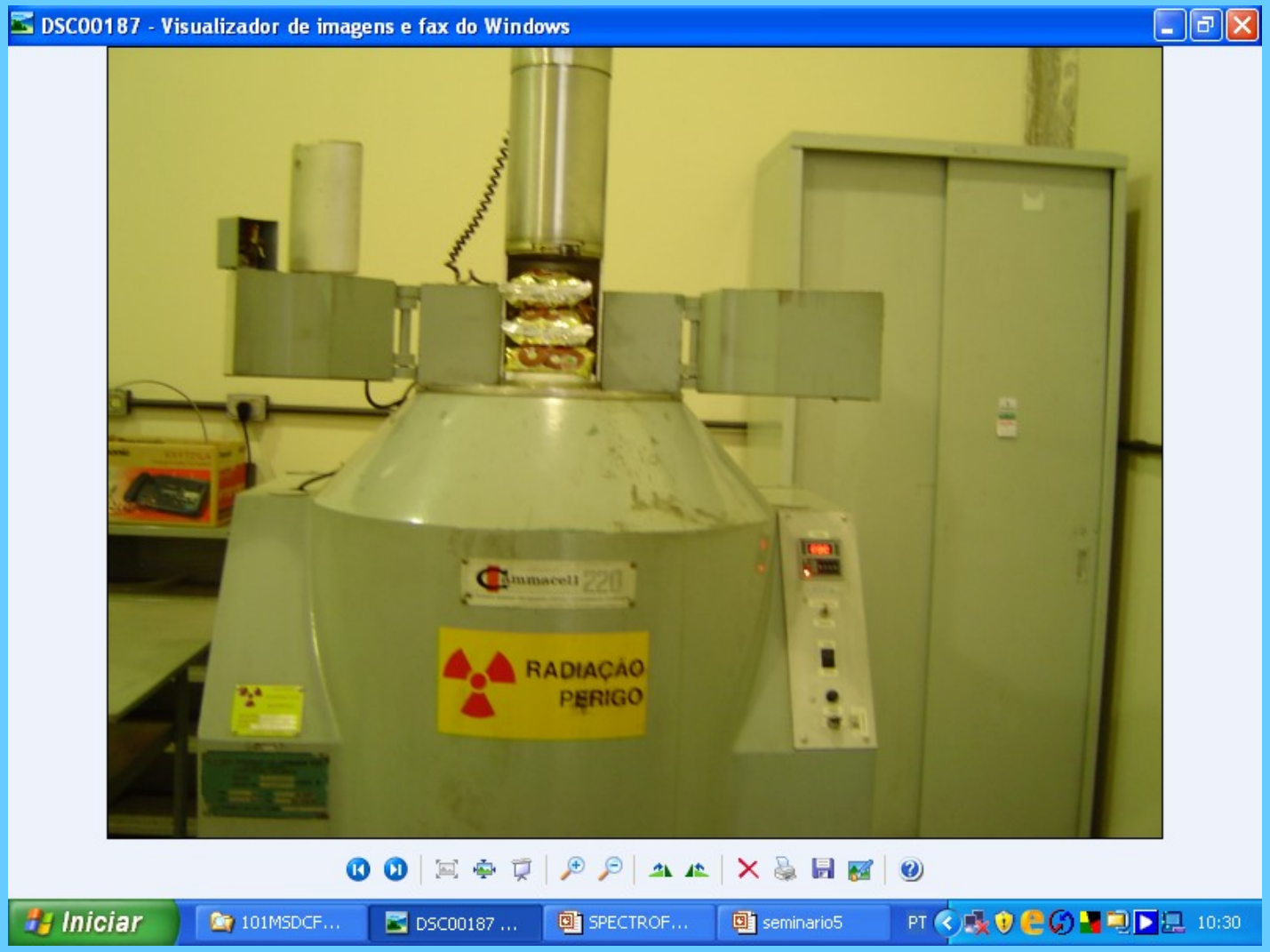
- From the obtained results it is possible to conclude that:

  ✓ there was a notorious stability of the vitamin content of the biscuits submitted to γ-irradiation at the assayed doses.

  ✓A sensory analysis will be required in order to recommend the application of the radiation technique for microbiological assurance to this kind of vit. E containing product.




**Spectrofophotometer u.v-visible (Hewlett Packard)**




**Samples of irradiated biscuits in the 60 Co (Gammacell 220-AECL)**

# thank you

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