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Effect of gamma-irradiation on the levels of total and *cis*/*trans* isomers of beta-carotene in dehydrated parsley

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Abstract

Ionizing radiation is a method for preservation of foods that use the high energy of gamma rays or accelerated electrons, thereby ionizing molecules. The most important precursor of vitamin A is β-carotene, a carotenoid with pro-vitamin A activity. The highly unsaturated chain confers the instability of β-carotene, and some reactions, as isomerisation, can reduce the characteristics of pro-vitamin A. The present study investigated whether increasing doses of 0, 10 and 20 kGy lower the total β-carotene level and if an enhancement of *cis*-isomers occurred on samples of dehydrated parsley. No differences were observed of either fractions analyzed at doses applied in this study, nor did it contribute to the decrease of vitamin A.

Keywords: Gamma-radiation; β-carotene; Isomers; Dehydrated parsley

1. Introduction

Vitamin A is an essential nutrient for humans. A healthy diet requires the intake of vitamin A or precursors (pro-vitamins) (Olson, 1986). Carotenoids are a class of vegetal pigments, and some of them can be converted to vitamin A in human body. The most important precursor of vitamin A is β-carotene, a carotenoid with the highest pro-vitamin A activity (Oliveira and Marchini, 1998).

The highly unsaturated chain confers the instability of β-carotene, and some reactions can reduce the characteristics of pro-vitamin A. The presence of light, acids, heat, oxygen, the methods of preservation and the storage time are destruction factors which lower the total β-carotene level and may cause isomerisation reactions (Gross, 1987). In nature, the most stable and common configuration is the *all-trans* isomer. The *cis* form exists in minor amount, and they are less convertible to vitamin A. Although isomerisation reactions can occur during food processing or storage, their formation is not desirable (Bertoli, 1998).

Ionizing radiation is a method for preservation of foods that use the high energy of gamma rays or accelerated electrons, thereby ionizing molecules. Radiation doses of 1–10 kGy are proposed for spices and dehydrated vegetables, eliminating or reducing pathogens and insects, increasing the storage time and replacing chemical fumigants (Delincée et al., 1998).

Parsley is a very common spice in Brazil. Gamma-irradiation is an alternative against usual contamination, due to precarious cultivation and process conditions (ICGFI, 1999). Studies using radiation doses up to 50 kGy did not cause qualitative and quantitative changes on dehydrated parsley (Farkas, 1988).

This paper intends to report whether increasing doses of radiation affects the amount of β-carotene isomers, as

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well as vitamin A nutritional value of irradiated dehydrated parsley.

2. Experimental

2.1. Samples

Samples of dehydrated parsley were bought in a local market in São Paulo, Brazil.

2.2. Irradiation

The samples were irradiated in their own plastic package in a ^{60}Co Gammacell 220 (AECL) installed in Instituto de Pesquisas Energéticas e Nucleares (IPEN), São Paulo, Brazil. The applied radiation doses were 0, 10 and 20 kGy, and the dose rate was 6.41 kGy.

2.3. Analysis of β-carotene

Three samples of each product were used for each dose of radiation. The open column chromatographic method of Almeida and Penteado, 1987 was performed to analyze and quantify total β-carotene and β-carotene isomers.

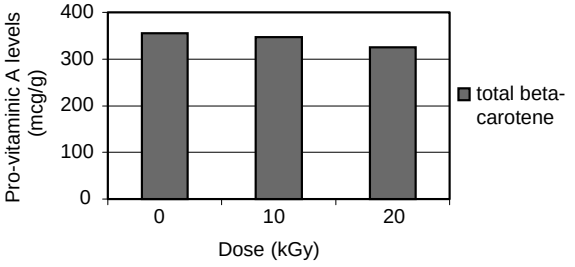

Fig. 1. Total β-carotene levels of dehydrated parsley samples irradiated at 0, 10 and 20 kGy.

3. Results and discussion

First, the analysis of total β-carotene was performed. Fig. 1 and Table 1 show that increasing doses of radiation did not affect significantly the levels of total β-carotene and pro-vitamin A.

Complete analysis quantified β-carotene isomers in dehydrated parsley. The presence of *all-trans* β-carotene and *9-cis* β-carotene was verified (Table 1). There is a slight tendency for decreasing of pro-vitaminic A levels with increasing dose, however the decrease is statistically significant. The contents of isomers were also not significantly different from irradiated and non-irradiated samples (Fig. 2).

Gamma-irradiation also did not seem to induce *all-trans* β-carotene destruction and/or 9-*cis* β-carotene

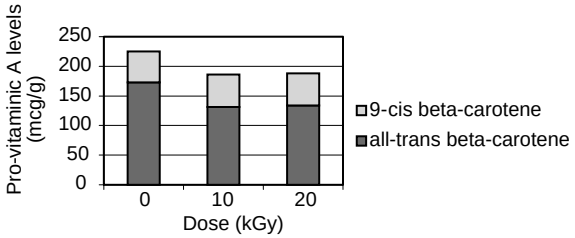

Fig. 2. *9-cis* β-carotene and β-carotene *all-trans* levels of dehydrated parsley samples irradiated at 0, 10 and 20 kGy.

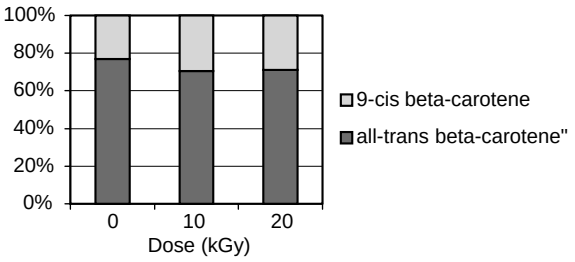

Fig. 3. Proportion between β-carotene isomers of dehydrated parsley irradiated at 0,10 and 20 kGy.

Table 1
Total and isomers β-carotene levels of dehydrated parsley samples treated with increasing doses of gamma-radiation

	Without isomers separation		With isomers separation		
Samples (kGy)	Total β-carotene (μg/g)	RE[a]/100 g of sample	9-*cis* β-carotene (μg/g)	β-carotene *all-trans* (μg/g)	RE[a]/100 g of sample
0	355.12±16.67	5918.66±277.83	51.93±9.22	173.03±16.68	3411.78±371.73
10	346.31±13.45	5771.83±224.16	54.55±3.44	131.16±15.37	2740.59±291.13
20	324.81±34.92	5413.50±582	54.35±4.13	133.96±4.09	2785.23±110.16

[a] RE means Retinol equivalent.

formation. Increasing doses did not modify β-carotene isomers proportion, as shown in Fig. 3.

According to the International Consultative Group on Food Irradiation (ICGFI), gamma-irradiation does not affect the content of β-carotene or other carotenoids with pro-vitaminic A activity (ICGFI, 1999).

Josimovic (1983) did not notice any significantly quantitative changes in some chemical compounds of dehydrated parsley irradiated with doses up to 20 kGy. Perhaps changes due to radiation would not have taken place since dehydration extracts only unstable compounds.

4. Conclusions

The presented data did not indicate that increasing doses of gamma-radiation affect significantly β-carotene content. The levels of total β-carotene and its isomers, *all-trans* β-carotene and *9-cis* β-carotene were not directly correlated to the doses of radiation applied. Therefore, radiation from 0 to 20 kGy of dehydrated parsley did not contribute to the decrease of its vitaminic A content.

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