ANALYTICAL DETERMINATION OF THIAMINE (VITAMIN B_1) IN IRRADIATED AND STORED BRAZILIAN BEANS

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ABSTRACT

Thiamine (vitamin B_1) content in two varieties of Brazilian beans, *Phaseolus vulgaris L.*, var. carioca and *Vigna unguiculata (L.) Walp*, var. macaçar, irradiated with doses ranging from 0, 0.5, 1.0, 2.5, 5.0 and 10.0 kGy was investigated. After a 6 months storage period, the optimum cooking time was established for each dose and variety. Sensorial evaluation tests were carried out by a panel of six people trained to this specific task. Our purpose to work with these beans is because conflicting results have appeared in studies about vitamin loss after low-dose irradiation. In our case, after a 6-month storage period of this two kinds of beans, in addition to the analysis of cooking time and sensory properties the vitamin B_1 content was evaluated. No significant vitamin losses were observed in Macaçar beans until 10.0 kGy. Carioca beans showed small losses after 2.5 kGy .

I. INTRODUCTION

Beans are an important source of nutrients and energy for Latin-American people (Pinn et al, 1993). Substantial quantities of these beans, produced in Brazil, are affected by insect infestation and efforts to improve the storage time quality for dry beans have included various pre-treatments and treatments, as well as processing by irradiation. For insect disinfestation in beans, irradiation offers an attractive alternative to chemicals. Radiation processing of beans for the purpose of insect disinfestation with dosages up to 1 kGy is a promising tecnique for reducing loss during storage of the nutritious foodstufs (Delincée. and Bognár, 1993). Gamma-rays and electrons can be used for the treatment of foods (Hayashi, 1991). Among existing technologies for food preservation, food irradiation is recognized as a safe and an effective method for a range of specific applications (Loaharanu, 1994; WHO, 1994). The results of over 30 years of research on the toxicological, biological and nutritional quality of irradiated foods have led the World Health Organization to recommend food irradiation as a technique for preserving and improving the safety of food (Diehl, 1993, 1995). Thiamine is a water-soluble vitamin which is highly sensitive to heat treatment. It occurs in considerable quantities in yeast, grain husks, whole-wheat products, peas, soya beans, peanuts, pork and liver. There are many factors which contribute to the destruction of this vitamin. Grains contain a lot of thiamine but this is often lost in the process of the refinement of grains, while the remaining can disappear through baking, cooking or frying. Thiamine is also destroyed by the oxygen in the air and by water (Tolonen, 1990). Bognár et al, 1993 show that thiamine was not affected even by high pressure meat tenderization. Thiamine is also an antioxidant (Tolonen, 1990). Considerable efforts have been made by researchers in order to develop studies in nutritional quality of irradiated foods. In the present work the effect of household cooking method and storage period were investigated by using an optimized analytical method.

II. MATERIAL AND METHODS

Brazilian beans, ***Phaseolus vulgaris L.***, var. carioca and ***Vigna unguiculata (L.) Walp***, var. macaçar, bought in a local market, were utilized. The samples were packed in plastic bags and the irradiation was carried out in a Gammacell (AECL) ^{60}Co source (IPEN, São Paulo, dose-rate ~ 1.2 kGy/h) with doses of 0, 0.5, 1.0, 2.5, 5.0 and 10.0 kGy. Following irradiation, the beans were stored at room temperature for 2 months in Brazil and then shipped to Germany. There they were stored at 24°C for more 4 months when the tests were made. Cooked and lyophilized samples were used. The optimal cooking time was determined for each dose. The beans were soaked overnight in distilled water at room temperature, and cooked at 100°C on the following day. Cooking parameters are listed in Table 1.

TABLE 1. Cooking time parameters

Food (irrad/ unirrad)	weight (g)	distilled water (g)	cooking temp. (°C)	Heating up time (min.)
Macaçar variety	250	950	100	8
Carioca variety	250	950	100	8

The sensorial evaluation was carried out by a trained taste panel of six people. "Official Collection of Testing Methods according to paragraph 35 LMBG 1990", using the following sequence as show in Table 2.

TABLE 2. Sensorial evaluation of cooking time

9	perfect, optimal
8	typical, no changes
7	typical, with slight changes
6	noticeable changes
5	mild defects
4	pronounced defects
3	strong defects
2	very strong defects
1	completely changed

Dry matter content was determined gravimetrically by drying at 103°C. The vitamin B_1 was determined in duplicate fluorometrically by high - performance chromatography (HPLC), Bognár, 1989.
Vitamin retention in the irradiated samples was calculed in the following way:

$$\text{Vitamin retention in \%} = \mathbf{B / A \,.\, 100}$$

Where:
A = Vitamin content in 100g dry matter of unirradiated sample after cooking (include cooking medium).
B = Vitamin content in 100g dry matter of irradiated sample after cooking (include cooking medium).

Imediately after processing the samples, mean values and standard deviations were calculated. A statistical test (t test) was performed on the results.

III. RESULTS AND DISCUSSION

The optimal cooking time of carioca beans, as illustrated in figure 1, decrease wich to increase of the dose,

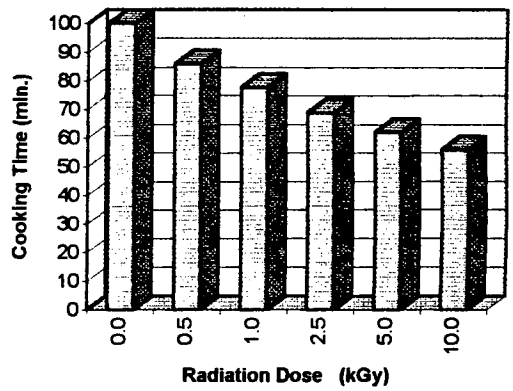

Figure 1. Effect of radiation dose on cooking time (var. Carioca)

Although the var. macaçar showed a small deviating response to dose of 5.0 kGy, as noted in figure 2, we could also observe a decrease of cooking time with the dose increase.

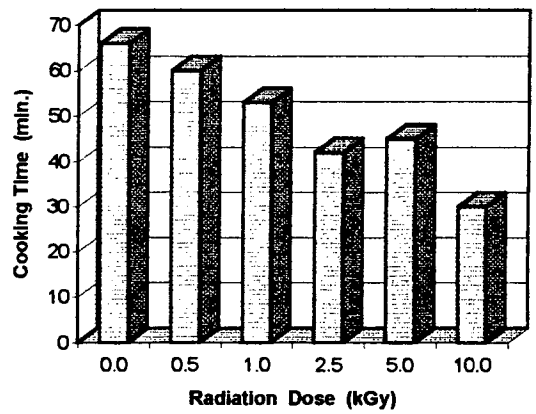

Figure 2. Effect of radiation dose on cooking time (var. Macaçar)

In both kind of sample, immediately after irradiation processing in raw beans, a small odour could be noted in doses more than 2.5 kGy. After cooking carioca and macaçar varieties, showed significant changes in sensory quality until doses permitted for insect disinfestation, up to 1.0 kGy. Sensory quality was evaluated by at least six

trained assessors using a nine-point scale for sensory analysis as described in table 2. Immediately after cooking, the samples were allowed to cool down to 60° C and analyzed immediately. At higher doses the sensory quality was impaired (table 3).

TABLE 3. Influence of irradiation on the sensory quality of var. carioca cooked beans

var. Carioca						
caracteristics	DOSE (kGy)					
	0	0.5	1.0	2.5	5.0	10.0
color	9	8	7 - 8	7	6	6
odour	9	7 - 8	7	6	5	5
taste	9	7 - 8	7	6	5	4
form	9	7 - 8	7 - 8	7	7	6
texture	9	7 - 8	7	6	6	6

var. Macaçar						
caracteristics	DOSE (kGy)					
	0	0.5	1.0	2.5	5.0	10.0
color	8	8	8	7	7	5
odour	7	7	7	6	4	3
taste	7	7	7	6	4	3
form	8	8	8	8	7	6
texture	7	7	7	7	6	6

Tables 4 and 5, shows loss of vitamin B_1 , the changes in the cooking time and dry matter. The cooking time was reduced upon irradiation. Reduction in cooking time after radiation processing has been reported for several legumes, such as chickpeas and mungbeans (Nene et al. 1975, Rao and Vakil 1985, Aurangzeb et al. 1990), lentils (Nene et al. 1975, Ismail et al. 1976, Rao and Vakil 1985, Naji et al. 1986), soybeans (Inayatullah et al. 1987).

TABLE 4. Vitamin B_1 and the effect of radiation dose and cooking time in Carioca variety.

Dose (kGy)	Thiamine content µg/100 g dry matter	Cooking time (min.)	Dry matter g/100g sample
0	560 ± 45*	100	92.8
0.5	569 ± 30	86	89.3
1.0	552 ± 26	78	92.7
2.5	520 ± 30	69	97.9
5.0	480 ± 15*	62	93.1
10.0	520 ± 20*	56	98.5

Results are means ± standard deviation and (*) n = 2-4 analysis.

There was only a small effect on the thiamine content in var. carioca in doses higher 2.5 kGy (table 4). Var. macaçar does not show significant losses in the samples (table 5).

Table 5. Vitamin B_1 and the effect of radiation dose and cooking time in Macaçar variety.

Dose kGy	Thiamine content µg/100 g dry matter	Cooking time (min.)	Dry matter g/100g sample
0	380 ± 30*	66	97.4
0.5	370 ± 25	60	93.6
1.0	395 ± 20	53	93.1
2.5	395 ± 25	42	95.1
5.0	393 ± 25*	45	91.4
10.0	370 ± 20*	30	93.3

Results are means ± standard deviation and (*) n = 2-4 analysis.

These results are in accordance with other studies on the vitamin B_1 content of irradiated foodstuffs, with a dose level of about 1 kGy and show only slight losses of the vitamin in leguminoses (Delincée & Bognár, 1993). A greater number of papers in the literature show that irradiation treatment can bring a higher quality preservation (Wiendl et al., 1995; Lacroix et al., 1995a,b; Shengfu, et al., 1993; Zhi cheng et al., 1993; Lacroix et al., 1993; Chosdu et al., 1993; Hau & Liew, 1993).

IV. CONCLUSION

The observed loss in carioca beans irradiated vitamin B_1 at an insecticidal dose of up to 1 kGy is small. No significant losses were found in the macaçar variety.
The cooking time is considerably reduced at doses up to 2.5 kGy, but a decrease in sensory quality in both varieties are found at higher doses.

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