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^{60}Co IRRADIATION EFFECT ON COLOR IN MINIMALLY PROCESSED CAULIFLOWER (*Brassica* spp)

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ABSTRACT

Irradiation is a well-established process with clearly documented safety and efficacy. Consumers require a quality product that is convenient and has fresh-like characteristics and take product appearance, like color, into consideration as a primary criterion; it is considered a key role in food choice, food preference and acceptability. The objective of the present work was to investigate color degradation of cauliflower treated with gamma radiation during 14 days. Cauliflower irradiated samples with 0 and 1.5 kGy showed significant differences for value "L" on the 10th and 14th day, respectively for value "b" only the 0 kGy sample showed significant difference on day 10 of storage. On day 10 of shelf-life the irradiated cauliflower with doses of 1 and 1.5 kGy became more yellow compared to the control. The authors concluded that the treatment with low gamma radiation doses keeps the quality of fresh-cut vegetables.

1. INTRODUCTION

Irradiation is a well-established process with clearly documented safety and efficacy. Its efficacy stems from the fact that its activity is not limited to the surface, it can penetrate the product and eliminate microorganisms that are present in crevices and creases [1]. The consumption of fresh-cut vegetables, that are easy to prepare and ready-to-use (RTU), is one of the fastest-growing product categories due to a rising consumer demand for healthy convenience food [2].

Consumers use appearance as a primary criterion to judge the quality and freshness of fresh-cut vegetables at the time of purchase; color has been considered to have a key role in food choice, food preference and acceptability [3,4,5]. Cruciferous vegetables, including subspecies of *B. oleracea,* are relatively abundant sources of antioxidants with potential anticarcinogenic activity [6]. Subspecies of *Brassica oleracea*, including broccoli and cauliflower (var. *bortrytis*), belong to Cruciferous family [7]. The quality deterioration of broccoli is very fast after harvesting. Fresh broccoli is highly perishable with a storage life of 3-4 weeks in air at 0 ºC and 2-3 days at 20 ºC [8,9,10]. Yellowness occurs within 2-3 days at room temperature (about 15 ºC). The major limitation in storage at ambient temperature is the

quick yellowing of flowering buds due to chlorophyll breakdown [11,10]. The objective of the present work was to investigate color degradation of cauliflower treated with gamma radiation during 14 days.

2. MATERIAL AND METHODS

2.1 Samples

The samples of cauliflower (var. *bortrytis*) fresh-cut were supplied by Hydrofarm manufacture of São Paulo city.

2.2 Irradiation

Samples were irradiated using a Multipurpose ^{60}Co Irradiator at Instituto de Pesquisas Energéticas e Nucleares – IPEN/CNEN (São Paulo, Brazil). The applied doses were 1.5 kGy with dose rate of 3.79 kGy h^{-1}. Harwell Gamma Chrome YR Bath 64 dosimeters were used for the measurement of radiation dose. After irradiation, the samples were immediately stored at 5 ºC.

2.3 Measurement of color / color analyses

Using a Hunter colorimeter model Color Quest XE (Hunter lab) color was measured in terms of "L" (lightness; 0 = dark and 100 bright), "a" (negative = greenness and positive = redness) and "b" (negative = blueness and positive = yellowness). The measuring aperture diameter was 25.4 mm and $D_{65}/10^{o}$ was the illuminant / viewing geometry and calibrated with the standard black and white tiles. Color values for cauliflower were measured on days 0, 5, 7 and 14 and three readings were made on each sample from each package and the mean values were used to determine color "L", "a" and "b".

2.4 Statistical analysis

Statistical analysis of the results was done using analysis of variance One-way ANOVA and had been processed with *GraphPad Prism*, version 5.

3. RESULTS AND DISCUSSION

All values of "L", "a" and "b" are presented in table 1. In cauliflower samples irradiated with 0 kGy and 1.5 kGy showed significant differences for value "L" on the 10^{th} and 14^{th} day, respectively. On day 7, the samples of 0 kGy and 1.5 kGy showed significant differences. The control (0 kGy) and 1.5 kGy samples showed darkening on day 10 and 14, respectively. On day 7 of shelf-life the 1.5 kGy sample showed more brightness compared to the control sample. For value "b" only the 0 kGy sample showed significant difference on day 10 of storage. On the 10^{th} day, significant differences between the samples of 0 kGy and 1.5 kGy

were observed. On day 10 of shelf-life the cauliflower with dose of 1.5 kGy had become more yellow compared to the control.

Table 1. Values of "L", "a" and "b" of cauliflower.

Days	L		a		b	
	0 kGy	1.5 kGy	0 kGy	1.5 kGy	0 kGy	1.5 kGy
0	77.63	77.52	0.44	0.24	19.33	17.24
5	76.73	78.98	0.56	0.53	18.31	17.68
7	73.68	76.54	0.52	0.63	17.64	17.85
10	72.24	76.14	0.64	0.94	16.75	17.51
14	71.46	70.56	0.67	1.53	16.55	16.09

In cut Romaine lettuce, packaged under modified atmosphere, treated with gamma (doses of 0 kGy, 0.15 kGy and 0.35 kGy), after 21 days, no difference was observed in the color of the lettuce samples due the irradiation, and the samples exposed to low-dose of electron beam (0 kGy, 1.0 kGy and 1.5 kGy) didn't show any significant change between the control and irradiated samples throughout the entire storage period [12]. Kim (2005) didn't demonstrate significant difference in fresh-cut green onion samples irradiated with doses of 0 kGy, 0.5 kGy, 1.0 kGy and 1.5 kGy after 14 days of storage. Several studies show that irradiation can cause changes in pectin and cellulosic substances in plant tissues resulting in a discoloration of soft tissues [14]. The change of chlorophyll content is a main factor that affects the color of broccoli, which caused its yellowness during storage [15].

4. CONCLUSION

The authors concluded that the treatment with low doses of gamma irradiation keeps the quality of fresh-cut cauliflower.

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