

## EFFECTS OF GAMMA RADIATION IN CAULIFLOWER (*Brassica spp*) MINIMALLY PROCESSED

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### ABSTRACT

Consumers demand for health interests and the latest diet trends. The consumption of vegetables worldwide has increased every year over the past decade, consequently, less extreme treatments or additives are being required. Minimally processed foods have fresh-like characteristics and satisfy the new consumer demand. Food irradiation is an exposure process of the product to controlled sources of gamma radiation with the intention to destroy pathogens and to extend the shelf life. Minimally processed cauliflower (*Brassica oleraceae*) exposed to low dose of gamma radiation does not show any change in sensory attributes. The aim of this study was to analyze the effects of the low doses of gamma radiation on sensorial aspects like appearance, texture and flavor of minimally processed cauliflower.

### 1. INTRODUCTION

The demand for minimally processed fruits and vegetables has increased worldwide in the last decade [1]. Consumer attitudes towards foods have changed in the last two decades increasing the requirements for fresh-like products. Consequently, less extreme treatments or additives are being required. Minimally processed foodstuffs (MPF) have fresh-like characteristics and satisfy this new consumer demand. Besides freshness, the MPF also provide the convenience demanded by consumers [2].

These products are subjected to a minimum process in order to provide a ready-to-use product and subjected to one or several steps such as selection, washing, peeling and/or cutting, sanitization or treatment and packaging. These foods are frequently consumed as salads component, and a risk of public health can be associated to them [3]. Food irradiation is an exposure process of the product to controlled sources of ionizing radiation with the intention to destroy pathogens [4]. The combination of irradiation with minimum processing could improve the safety and quality of minimally processed vegetables and extend the self-life on the product [3].

The aim of this research was to study the effect of irradiation on minimally processed cauliflower (*Brassica oleraceae*) on sensory attributes submitted to ionizing radiation of <sup>60</sup>Co.

## 2. MATERIAL AND METHODS

### 2.1. Samples

Cauliflower samples (n=30) (*Brassica oleraceae* L.) were purchased at a local market of São Paulo city.

### 2.2 Minimum Process

Cauliflower samples were rinsed thoroughly in distilled water in order to remove impurities. A sterile stainless steel knife was used to cut main stalk into small parts. After cutting, samples were washed again in cold distilled water (4°C) and then submerged in cold water with 200 ppm sodium hypochlorite solution (4°C) for 10 minutes. Following, they were submerged in cold water with 3 ppm sodium hypochlorite solution (4°C) for 5 minutes and rinsed in distilled water. Samples were packed in polyethylene bags (16.5cm x 14.9cm) and stored at 5°C.

### 2.3 Irradiation

Samples were irradiated into isothermal box with Ice Foam<sup>®</sup> (4°C) using a Multipurpose <sup>60</sup>Co Irradiator installed at Instituto de Pesquisas Energéticas e Nucleares – IPEN/CNEN (São Paulo, Brazil). The applied doses were 0 (control), 0.5 kGy and 1.0 kGy with dose rate of 3.0 kGy/h. Harwell Gamma Chrome YR Bath 64 dosimeters were used for the measurement of radiation dose. After irradiation, the samples were immediately stored at 5°C.

### 2.4 Sensorial analysis

Before sensorial analysis, cauliflower samples were cooked in boiling water (100°C) for 4 minutes. Tests took place in individual cabins illuminated by fluorescent lamps. Samples were served in individual plastic glass, codified with a three-digit number, with a glass of water to 30 untrained volunteer panelists (15 men and 15 women). The samples were evaluated using a preference test based on a nine-point hedonic scale (9 = like extremely, 1 = dislike extremely). Appearance, texture and flavor characteristics were measured.

### 2.5 Statistical analysis

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

## 3. RESULTS AND DISCUSSION

The observed results for the sensorial acceptability of the minimally processed cauliflower samples (*Brassica oleraceae* L.) refer to the following features: appearance, texture and flavor. The attributed scores to the sensorial analysis are showed in Table 1.

**Table 1. Hedonic scale scores.**

<b>Hedonic Scale</b>	<b>Score</b>
I liked extremely	9
I liked very much	8
I liked moderately	7
I liked a bit	6
Neither liked nor disliked	5
I disliked a bit	4
I disliked moderately	3
I disliked very much	2
I disliked extremely	1

Cauliflower flavor maintained similar after radiation processing. No significant differences were observed between non-irradiated and irradiated samples ( $p>0.05$ ). In respect to the texture, no differences were observed in all the samples analyzed. After irradiation, samples did not differ significantly to control ( $p>0.05$ ). Texture is one of the most important features for the product acceptance by the consumer. Refrigeration and other treatments, such as minimum processing and irradiation can accelerate these alterations. Results related to appearance, indicated that no significant difference between the samples were found ( $p>0.05$ ). Score averages attributed to the appearance, texture and flavor are showed in Table 2.

**Table 2. Score averages related to appearance, texture and flavor.**

<b>Doses</b>	<b>Score Average</b>		
	<b>Appearance</b>	<b>Texture</b>	<b>Flavor</b>
0 kGy	7.5	7.7	7.7
0.5 kGy	7.7	7.7	7.8
1.0 kGy	7.7	7.8	7.8

According to RDC 21 of January 2001 (ANVISA/MS), foods can be exposed to any radiation dose since that does not cause any changes in its sensorial characteristics [5]. Depending on vegetable, a dose of 1.0 kGy improves its sensorial characteristics, such as color and flavor; on the other hand, some products can not stand any radiation dose, reducing its quality, becoming the product unacceptable to the consumer. Irradiated carrots with 0.5 kGy, 0.75 kGy and 1.0 kGy doses, showed an improvement in color and flavor features [6], however texture was promised.

The sensorial attributes of the minimally processed American lettuce, sliced in anaerobiosis, were not affected by gamma radiation with doses of 0.7 kGy and 0.9 kGy when compared with the same lettuce not irradiated. With a dose of 1.1 kGy, it was observed that the texture

presented a statistically significant reduction, indicating that this dose should not be used for this product [7].

#### 4. CONCLUSION

We concluded that the minimally processed cauliflower irradiated with 0.5 kGy and 1.0 kGy doses, maintained its sensorial attributes. It showed that minimum processing joined to irradiation processing, could result in a product with better acceptance for the consumer market.

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