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GAMMA RADIATION IN THE CONSERVATION *Cucurbita moschata* PROCESSED MINIMALLY

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ABSTRACT

The objective of the work was to evaluate the effect of gamma radiation on (Cucurbita moschata) processed minimally. The zucchinis were acquired in of Horticulture Department of the ESALQ/ USP, Piracicaba, SP. Brazil, and taken to the laboratory of Food Irradiation of CENA/USP, where they were washed in running water, peeled and cut in cubes. The squash cubes were dipped in a solution of sodium hypochlorite 15ml/L for 4 minutes and kept in plastic box (polypropylene). They were irradiated with doses of: 0 (control), 1.0 and 2.0 kGy, in a source of Cobalt-60, type Gammacell-220 with a dose rate of 0.666 kGy/h, and stored in temperature of 5ºC. After 1, 3 and 7 days of irradiation were realized analyses of: color (factors L, a, b), pH, Brix and acidity. By obtained results conclude that there is not statistics difference between the treatments processed by irradiation and the control. Therefore the dose of 2.0 kGy can be used to reduce the level of microbial load without affects the physical chemical characteristics of minimally processed zucchini.

Keywords: gamma radiation, zucchini, minimum processed

1. INTRODUCTION

The zucchini is a fruit harvested still green, belonging to the Cucurbitaceae family, as well as watermelon, melon, cucumber and squash. When left on the plant, the fruit develops to form the mature pumpkin. It originated in mainland Latin American from Peru to South America. It is a fruit easy to digest, rich in niacin, besides being a source of B vitamins, has few calories.

Perishables, minimally processed products are marketed, in general, from a maximum of 5 days. Increased post-harvest life of these products for 10 to 15 days would bring great benefits to the market, enabling further expansion and marketing flexibility, and reduced losses. For this to be achieved, extensive research work should be carried out, seeking to develop storage technologies for increasing the preservation of products, minimizing the loss of quality.

When already processed and packed in plastic film shall be refrigerated merchandiser. One should pay attention to the expiration date and do not buy if yellowish liquid formation in the package bottom, which indicates that the product is beginning to deteriorate.

To increase the shelf life of minimally processed products, it is necessary studies on the physiological, qualitative and microbiological effects caused by minimal processing. These studies aim to get important basic knowledge for selection and development of products storage technology.

This study aimed to evaluate the effect of application of the irradiation process in different doses, on the physico-chemical characteristics of zucchini (*Curcubita moschata*) minimally processed

2. LITERATURE REVIEW

The definition of minimally processed refers to any fruit, vegetable or combination of them that was altered from its original form, that is, passed by processes such as selection, washing, sanitizing, peeling, cutting and packaging. The minimally processed product becomes usable in its entirety [1].

In Brazil, the minimum processing of fruits and vegetables is recent, having started in the 90 decade. The acceptance of these products is related primarily because of the ease, with no need to wash or prepare these foods for consumption. Along with the introduction of minimally processed foods in Brazil, there was a concern with the microbiological contamination of these products. The main sources of food contamination are Man (skin, mucosa, hair, eyes, etc.); animals (insects, rodents, domestic animals, etc.); using contaminated water (irrigation water and washing water); use of animal manures (eg soil); contaminated soil; use of contaminated equipment and utensils; preparation; packaging and inadequate storage [2].

Fruits and whole vegetables are less susceptible to invasion of microorganisms due to the presence of the shell which acts as a physical barrier. The minimally processed foods, to suffer mechanical damage (peeled and sliced) undergo rupture their cells causing exudation of nutrients, creating a more favorable environment for growth of microorganisms, which can cause faster deterioration of the food [2, 3].

To avoid problems related to contamination of minimally processed foods by microorganisms it is necessary strict control of processes including production of raw materials, processing and marketing of the final product. Processing can highlight the use of equipment and properly sanitized utensils and use of alternative techniques for microbial control in food, such as irradiation [1].

In studied physical-chemical, microbiological and nutritional changes in minimally processed carrots. It found that in any treatment performed with minimally processed carrots were found fecal coliforms, total, mesophilic anaerobic microorganisms and Salmonella. psicotrophic the presence of bacteria, which thrive at low temperatures was observed. It found also that vitamin C did not change significantly and β-carotene, phosphorus and copper have been reduced during the storage period [4].

Minimally processed radishes studied and found that the choice of plant quality and hygienic conditions during processing lead to: obtaining a product accepted by law regarding microbiological standard. He stressed that the minimally processed radishes should receive two sanitization with active chlorine 200 mg L-1 (before and after the preparation of the material) to a more effective treatment with microorganisms [5].

Some factors influence the quality of minimally processed vegetables such as quality of the plant, relative humidity of the storage environment, respiration, ethylene production, packaging and modified atmosphere, enzymatic browning and inhibitors, pathogenic microorganisms, sanitization [5, 6].

2.1. Irradiation

Food irradiation is "a physical process consisting submit food, already packaged or in bulk, the controlled doses of ionizing radiation, sanitary, phytosanitary and / or technological purposes" (Brazil, 2001). It is a technique considered "cold" not cause significant temperature increases during the process [7].

The first research use of irradiation in food were carried out by the Center for Nuclear Energy in Agriculture (CENA) in the 50 Brazilian law for the use of this technology is described today in Resolution RDC No. 21 of January 26, 2001[8].

Radiation sources authorized by the National Nuclear Energy Commission for use in food are: gamma radiation Cobalt 60 gamma radiation and Cesium 137; X-rays (generated by machines operating at energies up to 5 MeV) and electrons (generated by machines operating at energies up to 10 MeV). In processing food sources of accelerated electrons and Cobalt 60 are the most used. irradiation doses to be used in foods must meet minimum and maximum values, and minimum values those necessary to ensure the proposed objective and maximum values those below doses that affect the functional properties and / or sensory characteristics of the food (Brazil, 2001). The 60Co gamma radiation at high power tissue penetration and half-life of 5.3 years [9].

The irradiation dose is measured generally in Gray (Gy) or kiloGray (kGy), where 1kGy corresponds to 1000 Gy. with average dose applications are considered between the 1 to 10 kGy, which aim primarily to reduce microorganisms on the surface or inside the food, resulting in a higher quality of food preservation and prevention as food poisoning [10].

The use of irradiation technique has been extensively studied and has shown satisfactory results in relation to food preservation in most analyzed experiments. In studies in recent years have not been found substances that are produced exclusively in irradiated foods [11].

The irradiation process does not cause an increase food radioactivity exposed to this process, regardless of the dose and exposure time. It is noteworthy that international health authorities approved the irradiation doses up to 10 kGy, as a security measure for the food [9].

Analyzed the behavior of minimally processed carrots when exposed to gamma radiation doses of 0.5; 0.75 to 1 kGy. It was found that these were reduced by three to four log cycles of the mesophile count, microorganisms that develop in medians temperatures during storage. It was emphasized further that the dose of 0.75 kGy and use modified atmosphere of 5% O^2 and 10% CO^2 were the most suitable conditions, which conditions remained acceptable for consumption for 24 days [12].

Irradiation of minimally processed carrots with doses of 1 kGy showed a reduction of pathogens, pH change and kept other chemical properties (soluble solids, humidity), appearance and texture unchanged. Furthermore, there is a preference by the tasters compared the odor and taste of carrots irradiated against non-irradiated [13]. According with [12] ionizing gamma radiation with a maximum dose of 1 kGy kept quality post-harvest carrot, not significantly altering values related to the presence of Vitamin C and carotenoids, therefore, considered an effective technique for reducing post harvest losses.

Examined the effects of lower doses of gamma radiation to 2 kGy pre carrots and tomatoes cut cherries stored under refrigeration. The aspects analyzed (color, nutritional quality, soluble solids, sensory quality and permeability of the cell membrane) did not change significantly, enabling the irradiation process to guarantee the food safety of these foods [14].

The gamma radiation at doses up to 2 kGy did not significantly affect the organoleptic characteristics, the presence of vitamin C and carotenoid of minimally processed foods. For the carrot was product firmness loss, but this feature did not affect its acceptability [15].

The use of irradiation was observed in radish seeds and sprouts. Doses of 1 to 3 kGy were effective in significantly reducing the contamination by microorganisms in alfalfa and radish seeds. Already in alfalfa sprouts and radish were used doses of up to 2 kGy, which did not cause significant organoleptic changes in the analyzed products [16].

Analyzed the behavior of consumers in relation to the consumption of food treated by alternative methods, emphasizing the use of irradiation. The result was that consumers are increasingly demanding in terms of safety of food purchased and are likely to buy these products, but emphasize that lack the dissemination of information on methods such as irradiation of food [17].

3. MATERIAL AND METHODS

Zucchini were obtained in the horticultural trade in the city of Piracicaba after 2-3 days of harvest and taken to the laboratory Irradiation Foods CENA / USP. They were washed in running water and cut into cubes. The zucchini cubes were immersed in sodium hypochlorite solution 15ml / L and dried for four minutes in a plastic scoop. After drying the same were placed in plastic containers (polypropylene).

After mounting the trays were irradiated in a Cobalt-60 source, type Gammacell 220, under a dose rate of 0.666 kGy/hour at doses of 0 (control), 1.0, and 2.0 kGy and stored in a refrigerator with 5 ° C. Fresh weight loss were evaluated, the color (L factors A, B), pH, ° Brix, and titratable acidity. The first analysis was performed on the same day after irradiation, the second after 3 days and the third after 7 days. The experimental design was completely at random with five repetitions for each treatment.

Color Determination: The color of zucchini cubes were evaluated with the help of colorimeter Minolta Choma Meter CR-200, to measure possible changes in color and brightness. Measurements were made in two cubes contained in the packages, with three parameters for each reading. Since these parameters analyzed from the following aspects: a) values of a *: shades of colors ranging from blue-green (negative values) to the purplish red (positive values); b) b * values: shades ranging from yellow (positive values) to blue (negative values); c) L *: given the coordinates of a * and b *, a rectangular plane axes, highlighting the brightness of the color between white and black tones (in positive and negative respectively).

pH Determination: The pH values were measured with the aid of a pH meter Digimed DMPH.

Determination of soluble solids; soluble solids were measured in Brix, using a hand refractometer Model REF 113.

Titratable acidity: Determined by titration with NaOH solution (0.1N) and expressed as percentage citric acid [18] to titrate 10 g of crushed sample was diluted in 100 mL of distilled water.

The experimental design was completely at random with five repetitions for each treatment. The experimental plot consisted of a tray containing approximately 155g of zucchini. To analyze the results we used the Tukey test at 5% probability [19].

4. RESULTS AND DISCUSSIONS

The mean pH values treatments with doses of 0 (control), 1.0, and 2.0 kGy irradiated zucchini are shown in Table 1. The values found for pH between different treatments showed no significant difference at 5% probability, where the maximum irradiation dose 2kGy kept optimal pH conditions for the metabolism of vegetables.

Table 1. Average pH values of the samples of zucchini irradiated with gamma radiation from Cobalt-60 into three times of ratings (1, 3 and 7 days).

Doses kGy	1	3	7
0 (control)	6.38[a]	6.33[a]	6.53[b]
1.0 kGy	6.38[a]	6.28[a]	6.86[a]
2.0 kGy	6.43[a]	6.43[a]	6.50[b]

Same letter values in the column are not statistically different to us than 5%

The average results of total soluble solids were expressed in ° Brix and are in Table 2. After analysis of variance between the different treatments of zucchini there was no significant difference, with maintenance of total soluble solids, indicating that the process of irradiation did not accelerate maturity.

Table 2. Brix average values of samples zucchini irradiated with gamma radiation from Cobalt-60 into three times of ratings (1, 3 and 7 days).

Doses em kGy	1	3	7
0 (controle)	0.63[a]	0.66[b]	2.40[a]
1,0 kGy	0.63[a]	0.80[a]	2.55[a]
2,0 kGy	0.68[a]	0.64[b]	2.45[b]

Same letter values in the column are not statistically different to us than 5%

The average results obtained for acidity are in Table 3. It can be seen that the first, second and third day after irradiation was no significant difference, however the last day after irradiation this difference did not occur.

Table 3. Mean values titratable acidity of the samples zucchini irradiated with gamma radiation from Cobalt-60 into three times of ratings (1, 3 and 7 days).

Doses kGy	1	3	7
0 (control)	0.56[a]	0.66[b]	0.54[a]
1,0 kGy	0.56[a]	0.80[a]	0.47[a]
2,0 kGy	0.61[a]	0.64[b]	0.54[a]

Same letter values in the column are not statistically different to us than 5%

The average values of the results obtained by instrumental analysis of the color zucchini are shown in Table 4. It can be seen that there was no significant difference between them with respect to staining factors (L, a, b).

Table 4. Mean values of internal color (factors, L, a and b) samples of zucchini irradiated with gamma radiation from Cobalt-60 into three times of ratings (1, 3 and 7 days).

	1	**3**	**7**
Doses/ kGy	**L**	**a**	**b**
0 (control)	81.15[a]	-5.82[a]	16,68[a]
1,0 kGy	85,25[a]	-5,57[a]	16,59[a]
2,0 kGy	85,22[a]	-5,30[a]	16,68[a]
0 (control)	85,80[a]	-5,67[a]	16,70[ab]
1,0 kGy	85,93[a]	-5,36[a]	18,66[a]
2,0 kGy	85,82[a]	-5,00[a]	15,85[b]
0 (control)	85,71[a]	-5,30[a]	16.85[a]
1,0 kGy	86,06[a]	-4,80[ab]	16,64[a]
2,0 kGy	87,10[a]	-3,80[b]	14,68[a]

Same letter values in the column are not statistically different to us than 5%

Table 5. Mean values of external color (factors, L, a, b) samples of zucchini irradiated with gamma radiation from Cobalt-60 into three times of ratings (1, 3 and 7 days).

Days	**1**	**3**	**7**
Doses/kGy	**L**	**a**	**b**
0 (control)	57.50[a]	-12.62[a]	25.48[a]
1,0 kGy	58.19[a]	-12.02[a]	24.40[a]
2,0 kGy	59.24[a]	-11.79[a]	24.46[a]
0 (control)	58.52[a]	-11.81[a]	25.18[a]
1,0 kGy	55.05[a]	-11.96[a]	25.04[a]
2,0 kGy	57.65[a]	-11.22[a]	24.76[a]
0 (control)	57.61[a]	-11.83[a]	25.75[a]
1,0 kGy	59.62[a]	-11.59[ba]	25.07[a]
2,0 kGy	64.36[a]	-10.27[b]	26.47[a]

Same letter values in the column are not statistically different to us than 5%

5. CONCLUSION

The results obtained in the experiment, it can be concluded that the dose of 2.0 kGy can be used to reduce the level of microbial load without affects the physical chemical characteristics of minimally processed zucchini.

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