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EFFECTS OF GAMMA RADIATION ON MELON READ-TO-EAT

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ABSTRACT

This work comes from the irradiation of Cantaloupe melons (Cucumis melo L.), with the aid of gamma irradiation (Co60) to physical and chemical changes to assess their conservation. The research aimed to evaluate the effects of irradiation on melons, including the possibility of conservation, through pH, acidity, soluble solids and fresh squash. The samples were minimally processed and submitted to gamma radiation Co^{60} at doses of 0 (control); 1kGy and 2kGy. Physicochemical analyzes were made in periods of 1, 7 and 14 days after irradiation treatment. On day 1 and day 7, pH levels in irradiated samples had increased compared to control. Since the 14th day, the dose decreased 1kGy equaling the control. Soluble solids showed a statistical gradual decrease according to the increase of dose. The 14th had no significant difference while the 7th the dose was increased. The 1kGy sample decreased in another dose compared to the control. In fresh squash, absent statistics were observed for all samples in the three periods. And for the analysis of titratable acidity, there was observed no significant difference at day 1. There was observed a decrease in the 2kGy and 1kGy dose to 7 days compared to the control. On 14th day, a reduction in the dose of 2kGy and deterioration of 1kGy dose of the sample. Therefore, it demonstrates the irradiation doses of 2kGy, 1kGy physic-chemically alters the Cantaloupe melon pH, soluble solids content and acidity. And the dose of 2kGy is the one that longer preserves samples based on acidity values, greater and smaller values of soluble solids.

1. INTRODUCTION

Melon (*Cucumis melo L.*) belongs to the Cucurbitaceae Family, and is very popular not only for taste, but for the therapeutic properties that the fruit offers its consumers. Due to its large offered energy potential, productivity and demand have increased in countries around the world [1].

Currently the minimal processing of fruits, is due to the search and social demands for fresh, ready for consumption, safe and nutritious food. It ensures convenience to the consumer, living longer and healthier, since the minimal processing of fruits and vegetables should ensure the conservation of these nutritious foods [2].

According to Moretti (1999) [3], the minimal processing of fruits consists in selecting, preparing, washing, sanitizing, cutting, storaging, packaging and marketing of products, while maintaining their quality and freshness without requiring a prior preparation for consumption.

Like all alternative processes and have both positive and negative sides, minimal processing of fruits also has drawbacks, such as increasing the spoilage of food, increased respiratory rate, loss of water and vitamins, oxidative browning, change in color, flavor texture action of enzymes and microorganisms. Thus, it is necessary to search for new alternatives designed to solve these processes, harmful to the product and the consumer [4].

One method used to resolve such damage is the use of irradiation. It can be used directly in food preservation or as a complement to enhance the action of other processes for the same purpose [5].

2. MELON

Melon (*Cucumis melo L.*) belongs to the Cucurbitaceae Family, and is very popular not only for taste, but for the therapeutic properties that the fruit offers its consumers. Due to its large offered energy potential, productivity and demand have increased in countries around the world [1]

Melons originated in Africa and southwest Asia, but they gradually began to appear in Europe toward the end of the Roman Empire. Melons were among the earliest plants to be domesticated in both the Old and New Worlds [6].

2.1 Fruits ready-to-eat

Minimal processing has been defined as handling; preparation; packaging and distribution of agricultural commodities in the fresh state and may include processes such as cleaning; washing; sorting; peeling; cutting and use of low-dose irradiation. Two positive attributes of a commodity are minimally processed convenience and quality fresh food. Minimal processing may increase microbial damage in fruits due to the transfer of the microflora of the shell to the fruit flesh where microorganisms can grow rapidly [7], [8].

2.2 Food irradiation

The irradiation studies are currently focused in the food industry, especially for foods in which the use of heat is impossible for conservation purposes. Irradiation is, among all processes of conservation, the one further investigated [9]. The use of methods is also recommended for the improvement of technological properties of products intended for humam consumption.

This process is also used as a method of preservation, prolonging storage by delaying the ripening and sprouting some products. In certain fruit and vegetable irradiation doses can cause softening and increased permeability of the fabric. On the other hand, if the irradiation dose is applied in the correct will cause a delay in ripening thereof [8].

3. MATERIALS E METHODS

The experiment was conducted at the Laboratory of Radiobiology and Environment (CENA-USP, Piracicaba / SP). The melons used for the experiment were provided by Varejão Dois Amigos, belonging to region of Piracicaba. The variety used was Cantaloupe melon. The samples were minimally processed and submitted to gamma radiation from a cobalt-60 source type Gammacell-220 installed at the Center for Nuclear Energy in Agriculture (CENA-USP).

The analyzes were performed on the 1st, 7th, 14th days after irradiation, at dosages of 0 (control), 1 and 2kGy. Each treatment consisted of five replicates containing 25 pieces of small melons per replication. After irradiation, the samples were stored in a climatic chamber at 6°C.

The effect of gamma radiation was evaluated by physical-chemical analyzes as: soluble solids, pH, titratable acidity and fresh squash loss.

To assess the soluble solids of the three varieties of melon, the sample was macerated. In sequence, three drops of juice were dropped to make a reading on a digital refractometer. The soluble solids content is expressed as brix [10][11].

To measure the hydrogen potential, melon samples were ground. In sequence, the pH value was measured with a digital pH meter [10].

The analysis of the titratable acidity was determined by titration with NaOH. The result was expressed as percentage of citric acid used [10].

The values of the loss of fresh squash analysis were obtained through the difference in percentage (%) between the initial and final squash amount at the end of each repetition, with the aid of an electronic precision scale.

4. RESULTS

The results obtained in the physical-chemical analyzes are shown in Tables 1 to 4.

It is observed in the pH values in Table 1: The first day of treatment, both doses increase compared to control pH and statistically do not differ from each other. The same happens on the 7th day of treatment. However, during this period the pH value found is the largest throughout the experiment. And at day 14 was observed a decrease of pH in dose 1kGy, which shall differ from the highest dose level and statistically to control.

Table 1: Obtained averages in hydrogen potential analysis of Cantaloupe melons irradiated with crescent doses of gamma radiation.

Samples	1st Day	7th day	14th day
0Gy(Control)	$5{,}81^{b*} \pm 0{,}04^{**}$	$4{,}47^{b} \pm 0{,}02$	$4{,}17^{b} \pm 0{,}01$
1kGy	$6{,}04^{a} \pm 0{,}01$	$6{,}15^{a} \pm 0{,}10$	--
2kGy	$5{,}98^{a} \pm 0{,}00$	$6{,}30^{a} \pm 0{,}04$	$6{,}09^{a} \pm 0{,}06$

* Sample of same letter in column does not differ significantly from the 5% level to the Tukey test.
** Samples values average in triplicate ± standard deviation.
-- The sample deteriorated, the analysis was not possible.

In the work of Siqueira (2007) [12] melons Cantaloupe irradiated with doses between 150Gy the 900Gy and evaluated for seven days, it was observed that the highest dose on the first day had the lowest pH. At the end of the experiment the lowest dose had the highest pH value. In the work Trigo et al. (2008) [13], with melon variety of Piel de Sapo irradiated with doses of 0.5 and 1kGy, it demonstrates that there was no variation in pH. Therefore, it can be said from the results of Siqueira (2007) [12], Trigo et al. (2008) [13] and this work, that due to variations in the pH, organic acids are present and interfere with the values.

In Table 2 which contains the values for the amount of soluble solids, it was observed at day 1 that soluble solids gradually decreased as the dose increased. At day 7, the picture changes, and it is noticed the dose of 1kGy increases relativelly to the control. And the dose of 2kGy remains, as before, less than control and 1kGy dose.

Table 2: Obtained averages in soluble solids analysis of Cantaloupe melons irradiated with crescent doses of gama radiation.

Sample	1st day	7th day	14th day
0Gy (Control)	$7{,}40^{a*} \pm 0{,}64^{**}$	$5{,}61^{b} \pm 0{,}06$	$5{,}77^{a} \pm 1{,}6$
1kGy	$6{,}00^{b} \pm 0{,}02$	$5{,}93^{a} \pm 0{,}02$	--
2kGy	$5{,}03^{c} \pm 0{,}00$	$4{,}96^{c} \pm 0{,}00$	$5{,}61^{a} \pm 0{,}27$

* Sample of same letter in column does not differ significantly from the 5% level to the Tukey test.
** Samples values average in triplicate ± standard deviation.
-- The sample deteriorated, the analysis was not possible.

It is desirable that the °Brix of melons are in a range of 9°Brix to 10°Brix, which means the fruit is still not ripe, enduring transportation to market centers [12]. It is observed that the results are lower than desirable, indicating lower level of soluble solids, and the dose of 2kGy presented the lowest values.

Still in the work of the same author, we obtain averages similar to those found in this work. However, there was no observation of decrease on day 1 as doses increased. However, studies of Pizarro; Castilho; Benedetti and Haj-Isa (2006) [14], it was observed that in minimally processed Canary melons, non-irradiated and analyzed within 10 days, there were no significant differences in variable soluble solids compared to treatments with control, nor between them, during the study period. It can be said that the radiation interferes soluble solids, decreasing the same, especially when the dosage is greater than 1kGy.

It is observed in Table 3 that there was no statistical difference between the controls and the doses used on any day during the analysis.

Table 3: Obtained averages in fresh squash analysis of Cantaloupe melons irradiated with crescent doses of gama radiation.

Sample	1st day	7th day	14th day
0Gy (Control)	145,048[a*] ± 9,35[**]	119,24[a] ± 3,75	89,85[a] ± 2,35
1kGy	137,109[a] ± 6,52	110,88[a] ± 6,61	--
2kGy	139,897[a] ± 4,99	111,99[a] ± 5,67	85,17[a] ± 5,00

* Sample of same letter in column does not differ significantly from the 5% level to the Tukey test.
** Samples values average in triplicate ± standard deviation.
-- The sample deteriorated, the analysis was not possible.

In the study by Siqueira et al. (2005) [15] also there was not mass change on the first day compared to doses used. However, the seventh day, doses of 600 and 750Gy demonstrate increased statistical value compared to other doses and control. However, it was observed that the values decreased from the first day to the seventh day, as is also observed in this study.

It is observed in Table 4 that there is no statistical difference in the first day after irradiation. However, there is a decrease on the 7th day, where the smallest dose has the lowest statistical value. On the 14th day there is a statistical difference between the control and dose 2kGy, and there was a deterioration of the sample 1kGy, making it not possible to perform the analysis of titratable acidity.

Table 4: Obtained averages in titratable acidity (%) analysis of Cantaloupe melons irradiated with crescent doses of gama radiation.

Sample	1st day	7th day	14th day
0Gy (Control)	3,78[a*] ± 0,10[**]	5,16[a] ± 0,00	10,18[a] ± 0,06
1kGy	3,64[a] ± 0,06	3,09[c] ± 0,00	--
2kGy	3,94[a] ± 0,11	3,64[b] ± 0,06	2,75[b] ± 0,06

* Sample of same letter in column does not differ significantly from the 5% level to the Tukey test.
** Samples values average in triplicate ± standard deviation.
-- The sample deteriorated, the analysis was not possible.

The loss of acidity is expected in the fruit during the ripening process. The concentration of organic acid tends to decline because they are used as substrates for respiration of the fruit [12]. In the same study above, it is also noted the increased acidity in Cantaloupe melons irradiated with doses between 150 to 900Gy as doses of radiation increases. As also noted in the work of Boas et al. (2004) [16], no statistical variation of the acidity range in minamally processed Flash Orange melons, stored in different atmospheres on days 0, 2, 4, 6 and 8.

Therefore, as the pH, the effect of gamma radiation is present in different organic acids, that interferes in the percentage values of acidity.

5. CONCLUSION

It is possible to conclude that gama radiation influences the physical-chemical characters, such as pH, amount of soluble solids and titratable acidity of Cantaloupe melons. It is also possible to affirm the 2kGy dose is the most adequate to the fruit conservation, because it presented the highest average in acidity and the lowest in soluble solids.

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