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ANALYSIS OF PHYSICAL PROPERTIES OF COLOR AND TEXTURE IN GOJI-BERRY PROCESSED BY IONIZING RADIATION

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ABSTRACT

Goji-berry is fruit native from China, found on a red berry form and keeps an excellent source of antioxidants, such as carotenoids. The consumption of goji-berry is growing on the Brazilian commerce. To allow the commercialization of this foods its necessary of these foods are free of contaminants agents which may cause damages to the consumers health. For this warranty it's required of this method does not harm the food properties and quality. For this check was made the study using goji-berry. Irradiation is one of the methods that improves the safety and extends the shelf life of some foods. Food irradiation is a technology process of exposing a particular food to a controlled dose of ionizing radiation. This study aimed compares the effects of ionizing radiation processing on physical properties of color and texture in goji-berries at different irradiation doses. Samples were bought on the retail market in the city of São Paulo and processed by ionizing radiation on Nuclear and Energy Research Institute (IPEN/CNEN-SP) at doses of 2.5; 5.0; 7.5; 10.0 kGy and the control group. Then the samples were followed by color and texture analyses. The color assay's results showed that the irradiation process decreased red and yellow pigments. On the other hand, the sample's luminosity increased after being processed by ionizing radiation. On the texture assay was verified a decrease of the fruit compressive force, turning the fruit more softened.

1. INTRODUCTION

The ease of obtaining health information and increasing purchasing power lead people to eat healthier foods [1]. For these reasons, the imported fruit market has grown in Brazil. Data from the Foreign Trade Secretariat indicate an increase in the import of fresh and dried fruits. In the case of dried fruit, between 2010 and 2009 there is a variation of 28.94% in the total amount spent on imports. In 2009, US$ 307,868 million were spent and in 2010 this value increased to US $ 396,972 million [2].

Lycium barbarum, popularly known as goji-berry, is an oval-shaped red fruit from Tibet, a region of China [3]. Its consumption is linked to several health benefits, such as decreased oxidative stress [4], increased libido [5], protection against cancer [6], increased longevity [7] and vision protection [8]. According to information from merchants in the city of São Paulo, the fruit is sold in a dehydrated form because the useful life is short and in the natural form the fruit is easily contaminated by fungi.

One of the alternatives used to prolong the shelf life of the food is the irradiation process [9]. This process consists in exposing the food to controlled doses of ionizing radiation (gamma rays, x-ray or electron beam). Irradiation is capable of disrupting food enzymatic reactions and eliminating contaminating microorganisms [10]. However, the process is only satisfactory as long as the nutritional and sensory properties of the food are not impaired [9].

Depending on the dose and the sort of food, radiation can alter the texture of some by breaking sugars, making them softer [11] and may also cause radiolysis. Since water is the main constituent of foods and is processed by ionizing radiation, free radicals of the type H_3O^+, H_2O^+ are formed, which can later form H and OH radicals, and may interfere with the metabolism of other components such as lipids, carbohydrates and proteins [12]. Even though in extremely low concentrations, foods have components responsible for taste, color and odor and can be sensitive to radiation and can be degraded at high doses [13].

Based on the fact that color and texture are important parameters for food quality [14], this study aimed to analyze whether different doses of irradiation interferes with the characteristics of goji-berry.

2. MATERIAL AND METHODS

2.1. Purchase and Irradiation of Samples

The fruit was purchased at Zona Cerealista, a wholesaler located in the central region of the city of São Paulo. After the purchase the fruit was taken to the Nuclear and Energy Research Institute (IPEN/CNEN-SP) and irradiated in the doses of 2.5; 5.0; 7.5; 10.0 kGy and the control group non irradiated (0 kGy). The samples were processed using the same dose rate

(2.5 kGy / sec) by the Dynamitron electron accelerator accelerator model JOB188 brand IBA Industrial Inc., Edgewood. NY, USA.

2.2. Color Analysis

Konica Minolta Chroma Meter CR-400 colorimeter was used for the color analysis. Calibration was done with standard plate CR-A43, the apparatus was positioned vertically on the sample and the parameters of L *, a * and b * were measured. The parameter L * (0 = black and 100 = white) represents the brightness of the sample, while the others are responsible for pointing out the chromaticity. The criterion a * indicates the green or red color (negative = green and positive = red) and criterion b * represents the blue or yellow color (negative = blue and positive = yellow). This assay was realized with 25 repetitions for each sample and at the end the mean and standard deviation were calculated. The methodology was used as established by the colorimeter manufacturer.

2.3. Texture Analysis

The texture analysis was performed using the Stable Micro Systems texturometer (model TA.XT plus®), using the software Exponent. The test was carried out by measuring the force of measurement (N) and compression for rupture of the goji-berry. For the samples analysis, the P / 2N model probe with stainless steel needle and 2 mm thickness was used, where it was applied in the center of the fruit. The depth of each penetration was 2 mm with a velocity of 1 mm / second. This assay was realized with 25 repetitions for each sample and at the end the mean and standard deviation were calculated.

3. RESULTS AND DISCUSSION

Table 1 below shows the results found in the colorimetric analysis of goji-berry.

Table 1: Average ± standard deviation of goji-berry colorimetric analysis.

	L*	a*	b*
Control	32.34 ± 0.23	37.39 ± 0.08	29.74 ± 0.06
2.5 kGy	33.07 ± 0.09	30.11 ± 0.05	23.17 ± 0.28
5.0 kGy	35.92 ± 0.11	33.75 ± 0.49	25.04 ± 0.36
7.5 kGy	33.12 ± 0.11	33.68 ± 0.14	24.64 ± 0.11
10.0 kGy	35.17 ± 0,11	33.76 ± 0.22	26.93 ± 0.11

L*: Brightness (0 = black and 100 = white);

a*: Green or red color (negative = green and positive = red);

b*: Blue or yellow color (negative = blue and positive = yellow).

Each value was expressed as mean ± standard deviation

The results found in the color analysis of goji-berry did not show differences between themselves with the increase of radiation dose received, indicating that the irradiation did not affect the chromaticity characteristics of the fruit. The 2.5 kGy dose presented lowest indexes of color, but it is not possible to conclude if this decrease occurred due to the radiation effect because the subsequent doses presented higher results. According to Santillo [15], the process of irradiation did not show differences between color and luminosity parameters in samples of Benitaka grapes variety.

Table 2 below shows the results found in the goji-berry texture analysis.

Table 2: Compression force and standard deviation of goji-berry texture analysis.

	Compression Force (N) ± Standard Deviation
Control	2.88 ± 1.23
2.5 kGy	1.27 ± 1.27
5.0 kGy	0.63 ± 0.26
7.5 kGy	0.35 ± 0.14
10.0 kGy	0.45 ± 0.19

The results found in the compression test showed that the irradiation caused the texture of the goji-berry to become more softened. Between the control group and the dose of 2.5 kGy the average compression force fell about 56%, and it was subsequently decreased as the dose increased, with the exception of the 10 kGy group. Meanwhile, between the control group and the 7.5 kGy dose the average fell even more, about 87%. Considering the result indicated in the Table 2, the dose with the lowest mean strength was 7.5 kGy. The 10 kGy dose showed a 84% decrease in mean strength compared to control group and an increase of 30% when compared to the 7.5 kGy group. This increase may have occurred due to some enzymatic reaction of the food. However, the decrease in the mean compressive strength of irradiated doses in relation to the control group can be justified by several previously mentioned factors, such as the radiolysis and / or breaking of sugars present in the food. It is important to state that for each type of food there may be a different result. According to Tomac et al. [16], the irradiation of anchovies resulted in the increase of the compression force necessary for the rupture of the food as the increase of the dose received.

4. CONCLUSIONS

By the results was concluded that the irradiation process decreased red and yellow pigments, despite of, the sample's luminosity has increased after being processed by ionizing radiation. The results of the texture assay showed a decrease of the fruit compression force, causing the fruit to become more softened, concluding that the irradiation would be viable for the conservations of the goji-berry that will be posteriorly commercialized in less solid forms, such as syrups, jellies, nectars, juices, among others.

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