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FUNGAL EVALUATION ON GREEN TEA IRRADIATED WITH DIFFERENT WATER ACTIVITIES

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ABSTRACT

The aim of this study was evaluate the fungal contamination in green tea irradiated with different radiation doses and water activities. Samples were irradiated in ^{60}Co irradiator at doses of 0, 2.5, 5.0, 7.5 and 10.0kGy with three different water activities. In the sample with decreased water activity, the count of fungi was lower than others samples followed by original Aw and the samples with the higher water activity, however there is no difference between the increased and decreased water activities samples after the irradiation on fungi contamination at dose of 2.5kGy.

1. INTRODUCTION

Tea is a widely popular beverage consumed in the world for over several thousand years after water [1] and its great popularity range from cultural traditions to purported health benefits. Results from epidemiological studies as well as laboratory experiments suggest that consumption of tea confers protection against the development of chronic diseases, such as cardiovascular and cancer [2].

Tea is processed from tender shoots of *Camellia sinensis* (L.) O. Kuntze and is mainly classified into green tea (unfermented), oolong tea (partially fermented) and black tea (fully fermented) [3]. Green tea, consumed mainly in Japan, China and Korea, is produced when freshly harvested leaves of *C. sinensis* are subjected to withering, panfried/steamed, prior to rolling/shaping, and drying [2].

Tea consumption in the world has increased because of its healthy benefits [4] evidence from animal studies indicates that green tea and its catechins retard the development or progression of atherosclerosis in apoE-deficient mice and hypercholesterolemic hamsters. Epidemiological studies have shown an inverse correlation between coronary heart disease risk and green tea consumption in humans [5].

Plant materials are highly susceptible to microbial contaminate due to the medium (water and soil) in which they grow. The current practices of harvesting, handling, storage and processing may cause additional contamination and microbial growth [6].

Irradiation with ionizing radiation is one of the most effective means to disinfecting dry food ingredients. The treatment by irradiation can inhibit cellular life division, like microorganisms and promoting a molecular structural modification [7]. The potential application of ionizing radiation in food processing is based that ionizing radiations inactivated microorganisms, insect gametes and plant meristems, prevented than from reproducing, resulting in various preservative effects as a function of the absorbed radiation dose [8]. Safety and efficiency of food irradiation has been approved by several authorities (FDA, USDA, WHO and FAO) and scientific societies based on extensive research [9].

Once absorbed by a biological material, ionizing radiation may have direct or indirect action. The indirect effect is caused by the interaction of radiation with a molecule of water (radiolysis), generating several kinds of free radicals that will interact with cells components, including DNA, and the largest damage in irradiated cell occurs by this action [10].

The radiolysis is the most important effect to be studied, once all food, even the dry foodstuffs, has water in its composition, then, the greater the amount of water (water activity) on food, greater should be the gamma radiation effect. The aim of this study was evaluate the fungal contamination in green tea irradiated with different radiation doses and water activities.

2. MATERIAL AND METHODS

2.1 Samples

The green tea was donated by Herbarium Laboratório Botânico Ltda. (Paraná, Brazil).

2.2 Water Activity (Aw)

The water activities were measured in Aqualab (3TE model) equipment.

To increase the water activity, in a desiccator, distilled water was added until the perforated mesh level for 48h. To decrease the water activity the samples were placed in an oven at 37°C/48h. In both case, the samples were placed in uncovered *petri* dish.

2.3 Irradiation

The samples were packed in plastic (polyethylene) bags, sealed and identified with their respective radiation doses. They were irradiated at room temperature in a ^{60}Co source Gammacell 220 (Nordion Ltd., Canada) with a dose rate of 1.67kGy/h, at doses of 0, 2.5, 5.0, 7.5 and 10.0kGy. Harwell Amber 3042 dosimeters were used to measure the radiation dose.

The samples were irradiated less than 12h of Aw measurement.

2.4 Fungal Evaluation

10g of sample were stirred with 90mL of 0.1% peptone buffered water for 20min/25°C in stomacher bags. Each suspension was diluted (10^{-1} to 10^{-4}) with the same diluent and then 0.1mL aliquot was spread on the surface of agar plate (dichloran glycerol agar - DG 18) and incubated at 25°C for 7 days. Counts were recorded in colony-forming units per gram (cfu/g) [11]. It was perform in triplicate.

2.5 Statistical Analysis

The data were analyzed using one-way ANOVA and Tukey test with significance level of 5%.

3. RESULTS AND DISCUSSION

The fungal profile and the water activities values are shown in table 1.

Table 1. Water activity and effects of γ-radiation on fungal contamination (cfu/g) in green tea.

Water activity		Doses (kGy)				
		0	2.5	5.0	7.5	10.0
Increased	0.882	$10.33x10^{3a}$	ND	ND	ND	ND
Original	0.563	$33.00x10^{2b}$	ND	ND	ND	ND
Decreased	0.232	$8.33x10^{2b}$	ND	ND	ND	ND

Different lowercase letters in the same column means a statistical difference ($p<0.05$).
ND: Not detected

In the sample with decreased water activity, the count of fungi was lower, which is explained by the value of Aw itself, once low Aw values limits the development of microorganisms [11]. The count of fungi in the higher Aw was much higher than the others samples which is explain again by the Aw value.

Despite has an initial contamination higher than the other samples, the level of fungi contamination in green tea with increased Aw was “not detected” when the dose of 2.5kGy was applied, being the same contamination level of the others samples. This shows that the radiolysis is an important phenomenon to be considered when the food irradiation process will be applied, manly when the sample has a contamination higher than recommended by sanitary agencies or health organizations, on the other hand, samples with lower Aw has lower contamination. It is important emphasize that the use of gamma radiation never can be used as a substitute of good manufacture practices and good agricultural practices.

Thomas et al. [12] showed that irradiation dose of 7kGy can be effective to control microbial growth in black tea (*Camellia sinensis*) and in extending their shelf life without any significant deterioration of quality constituents. Kumar et al. [13] demonstrated that the radiation at dose up to 10kGy was sufficient to ensure microbiological safety of several herbals and formulations products without affecting their biochemical characteristics. Those doses were from 3 to 4 times higher than our work.

Fanaro et al. [14] showed that there is no difference on volatile organic compounds with odors in green tea irradiated at doses up 20kGy. Furgeri et al. [15] demonstrated that the irradiation at doses up to 10kGy had no effect on phenolic compounds in maté (*Ilex paraguariensis*).

4. CONCLUSIONS

There is no difference between the increased and decreased water activities samples after the irradiation on fungi contamination at dose of 2.5kGy, however to irradiate the green tea. Other experiments will be performed to evaluate if the radiolysis and the lower Aw has the same effect in lower radiation doses.

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