E-BEAM PROCESSING FOR THE DECONTAMINATION OF RAW PEANUTS

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Countries in tropical climates, where the temperature and humidity of the environment are raised throughout the year, are susceptible to the deterioration of their agricultural products, mainly from microorganisms such as fungus and bacteria. Some of these substances can be carcinogenic as defined by the IARC (International Agency for Research on Cancer). The infestation of peanuts with toxigenic fungus can occur before the harvest or during drying and storage. Irradiation processing is commercially used with food products for the reduction of spores and the prevention of mycotoxins as toxigenic fungus, thus increasing the safety of foods and decreasing economic losses. The present study verifies the effect of ionizing radiation on the fungus contamination in peanuts by use of electron beam processing by surface treating peanuts collected in São Paulo city. Triplicates for each treatment were irradiated using an electron beam accelerator – a 1.5 MeV-25mA Radiation Dynamics Incorporated Dynamitron™, but set at a lower voltage, 0.55 MeV. The doses used were 1.0, 3.0, 5.0 and 7.0 kGy. The microbial counts follow the Berjak (1984) method. The results show that 7 kGy was the best dose to control the surface contamination of peanuts.

I. INTRODUCTION

Foods contaminated with pathogenic micro-organisms represent a threat to the public health, being able to cause great economic losses because of the expenses of medical treatment of ill consumers and because any microbial contamination will not meet quality demands, for example, of importing countries [1].

The United Nation's Food and Agricultural Organization (FAO) estimates that twenty five per cent of world-wide food production is lost by infestation caused by insects, bacteria, fungus and enzymes that degrade or contaminate foods as they are removed from the ground or during subsequent harvest, drying and stockage[2]. In Brazil, the state of São Paulo is the main producer of peanuts and the contamination with fungus is a serious problem affecting the quality of peanuts[3].

The diversity in the ways peanuts are consumed gives this product great economic value. Peanuts are consumed "in natura" or processed industrially, to produce some derivatives, such as oil and bran, or still in the manufacture of nourishing products as, conserves and confectioneries[4].

Since fungus is distributed in the ground and in the air, the infestation of the peanut with toxigenic fungus can occur before they are removed from the ground or during subsequent harvest, drying and storage. In many cases, the infestation of fungus inside the peanut is facilitated by nematode damage, cupins and other small insects[5,6].

The main mycotoxin that contaminates foods is aflatoxin, a toxic substance produced by one fungus when it finds ideal conditions of humidity and temperature. Its effect on human beings and animals has been intensely researched throughout the world. Aflatoxin attacks intermediary of foods, especially oleaginous seeds, as the peanut, the pistachio nut, the maize, chestnut-do-Brazil, seeds of cotton, bran of fish and sorgos'[7,8,9,10].

Food irradiation has been studied for many years as a means of conserving and disinfecting foods. Although mis-understood as having some restrictions, extremely this efficient process has been considered for specific applications by major agencies: the World Organization of Health (WHO); the United States Food and Drug Administration (US F&DA), the International Atomic Energy Agency (IAEA) and the Brazilian National Agency of Sanitary Monitoring. Food irradiation is a method capable of diminishing the economic losses due to food deterioration by eliminating pathogens, and thus increasing the level of food safety[9].

Irradiation processing destroys the microorganisms that cause illnesses, and also the worms, parasites and insects that spoil stored foods[4]. The objective of this work was to evaluate the effect of ionizing radiation from an electron beam on fungal contamination and the surface contamination of peanuts that were collected in the retail markets of São Paulo.

II. EXPERIMENTAL

II.A- Samples

5 kg samples of peanuts obtained in the markets of São Paulo city were used. Experimental controls (I and II) were (CI) which was surface disinfected and (CII) without any previous disinfection with sodium hypochlorite. The samples to be irradiated were placed in plastic bags holding approximately 300g each.

II.B- Irradiation

Samples were irradiated using an electron accelerator, a Radiation Dynamics, Incorporated Dynamitron™ with the voltage lowered to 0.55MeV, the beam scan width of 100 cm and the under-beam conveyance speed of 6.72m/min. Beam currents were adjusted to provide doses of 1, 3, 5 and 7 kGy. For the accomplishment of this experiment tests had been made to determine the doses of irradiation.

The exposure time was 0,223 seconds per pass with two passes being used. Cellulose triacetate (CTA) film dosimeters were used for the inference of dose.

II.C- Technique of Berjak (1984)[11]

For the plating and fungus isolation in the peanut samples, a direct sowing technique was used, following the BERJAK (1984) method. Peanut samples of approximately 30g were disinfected in sodium hypochlorite solution (0.04%) for 3 minutes to eliminate external contaminants. After the disinfection the rind of the peanut was removed and the nuts were washed with distillated water. Some nuts were selected randomly and plated in Petri dishes that contained Agar Sabouraud Dextrose. For each sample, 3 such Petri dishes were prepared, each containing 11 nuts (samples in triplicate). All the samples were then incubated at 25º C for 3 days and the results expressed in percentage of the total of inoculated grains infected for fungus. In this experiment, two categories of samples were Treatment I which used samples of peanut with rind (shell) and Treatment II which used the peanut nut.

III. RESULTS AND DISCUSSION

As shown in Table 1, the presence of a fungus of the *Aspergillus* sort was found in all samples. This type of fungus (which produces species of mycotoxins) was found in the peanuts with rind (shell), in the controls groups (I and II) and in the irradiated samples, but to a lesser extent. In Table 1, the presence of fungus was frequent. However, the effective reduction was achieved with 7 kGy dose. For the samples irradiated at 7 kGy, the reduction of the fungi in comparison with controls I and II was 82.6 % and 81.9 %, respectively, demonstrating an effective reduction of the initial contamination.

For the peanuts without rind (shells), Table 2 shows that the appearance of fungus were less prevalent in the control groups I and II when compared to the control groups with rind (shells). The fungal contamination reduction by the radiation process was also effective at the 7 kGy dose (73.4% reduction and 54.9 % compared to the controls I and II, respectively), but considering the initial contamination, this dose was not sufficient for the complete disinfection of the nuts.
Amongst all the doses of irradiation and the controls, the more contaminated samples were the control without previous disinfestations (I) with the average of 76% of the nuts (grains) contaminated for the three repetitions of the experiment. In the irradiated nut (grain) samples, the dose of 7 kGy was effective for the fungus reduction leaving a minor 2.6% of contamination.

Table 1: Treatment I, percentage in the nuts (grains) of peanuts (with shell or rind) contaminated by fungus.

Doses (kGy)	***Repetition I***	***Repetition II***	***Repettion III***	Average
Control I	100	100	100	**100%**
Control II	100	100	98.1	**99.3%**
1 kGy	95.9	100	96.9	**97.6%**
3 kGy	38.4	43.6	56.5	**46.1%**
5 kGy	16.1	40.4	51.5	**36 %**
7 kGy	10.1	16.1	26.2	**17.4%**

Table 2: Treatment II, total percentage of contamination in nuts (grains) of peanuts (without shells or rind) contaminated by fungus.

Doses (kGy)	***Repetition I***	***Repetition II***	***Repettion III***	Average
Control I	62.6	65.6	100	**76.0 %**
Control II	42.4	38.4	91.9	**57.5 %**
1 kGy	43.4	40.4	51.5	**45.1 %**
3 kGy	7.1	26.2	7.0	**13.4 %**
5 kGy	5.0	11.1	5.0	**7.0 %**
7 kGy	2.0	3.0	3.0	**2.6 %**

Prado *et al*[12], when studying peanuts irradiated and disinfected, observed a reduction of fungi infection at 5 kGy and total fungi destruction at 10 kGy, after 180 days in storage at room temperature. Irradiated and non-disinfected nuts (grains) showed an increase of fungi population with 1 kGy dose, a reduction with 5 kGy dose and total destruction with 10 kGy dose. Gamma-irradiation in 10 kGy dose or higher, showed to be an efficient process to reduce the mycoflora of peanuts.

IV. CONCLUSION

The electron beam treatment shows more effect when applied to the nut (grain) of a peanut without a shell (rind) in controlling fungal contamination. Reductions in the amount of fungus can be attained at 7 kGy, with either treatment (T1) in the shell or as treatment (T2) of the nut (grain) itself. The use of higher beam voltages and higher doses, say 10 kGy, could lead to complete decontamination of peanuts, either in the shell (rind) or the nut (grain) itself.

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