ADVANCES BETWEEN E-BEAMS AND ^{60}CO APPLICATIONS IN SOYBEAN GRAINS

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Abstract

Soybean is the most important oleaginous cultivated in the whole world and generates income of billions of dollar, direct and indirectly and its nutrients become basic for the feeding human being, beyond its by-products, that offer great diversities of products for the nourishing industry. Between the main factors that limit the attainment of high incomes, are the illnesses caused by microrganism like fungi, bacteria, and viruses that, in general, are difficult to control and cause damages of billions of dollar every year. An alternative to minimize the losses is preserving the grains through the irradiation and then, the use of electron accelerator is indicated, therefore its advantage for exporting industria of grains in relation to the irradiators for ^{60}Co is basic. This work aims to compare the effects of the radiation through viscosimetry, DNA Comet Assay and Cooking time techniques in soybean grains at doses 0, 2.0, 4.0, 6.0kGy irradiated at e-beam accelerator - Radiation Dynamics (Radiation Dinamics Co. model JOB, New York, USA), 1.5 MeV-25mA with the lower energy and in a ^{60}Co source, Gammacell 220 (A.E.C. Ltda) in ambient temperature.

1. INTRODUCTION

Soybean is one of the oleaginous more cultivated in the whole world, totalizing about 70% of all the oleaginous seeds produced and generating income of billions of dollar, directly and indirectly[1,2]. Its nutrients become it basic for the feeding human being, beyond its by-products, that offer great diversities of products for the nourishing industry[2].

This grain has many benefits, through its protein, emulsion capacity, its hidrossoluvel part (soy milk) serves as substitute for people who have a lactose intolerance, could be considered a functional food, possesss the fitoestrogene that is used in the hormonal replacement substituting the estrogene and its oil after being used in frying process, can be used as machine fuel source (biodisel)[3,4,5,6].

Between the main factors that limit the attainment of high incomes, are the illnesses caused by microrganism like fungi, bacteria, and viruses that, in general, are difficult to control and cause damages on harvet of billions of dollar every year[7,8].

As an alternative process to minimize these losses and as a preserving process of the grains by radiation, the use of e-beam was indicated, since its advantage for the grains exportation industry is fundamental. Besides the possibility of being disconected when not in use, is easy handling and low degradation effect to the irradiated product, it can be building on ports and the soybean or any kind of grains can be irradiated few minutes before to get on board, this source does not need recharged, has high dose rate, streamlining the process and reducing logistics cost[9,10]. This work aims to compare the effects of the radiation through viscosimetry, DNA Comet Assay and cooking time techniques in soybean grains at doses 0, 2.0, 4.0 and 6.0kGy irradiated in two differents sources: 60Co and e-beam.

2. EXPERIMENTAL

2.A. Samples

The soybean grains were purchased from a supermarket in São Paulo, Brazil, packed in polyethylene bags, labeled and identified with its respective irradiation source and doses.

2.B. Irradiation

Samples were irradiated in ambient temperature at IPEN-CNEN Electron Accelerator, a Dynamitron Machine (Radiation Dynamics Co. model JOB, New York, USA), with 0.550MeV energy, scan 100 cm and support speed 6.72m/min, applied dose rate was between 2.23 to 11.22kGy/s and at ^{60}Co source Gammacell 220 (A.E.C. Ltda) with dose rate of 2.85kGy/h at doses of 0, 2.0, 4.0 and 6.0kGy. CTA dosimeters for e-beam and Harwell Amber 3042 dosimeters to ^{60}Co were used for the measurement of radiation dose.

2.C. Cooking time

The cooking time was carried out as discribed by BURR *et al.* (1968) and was used a Mattson cooker machine with 25 vertical plungers rest (89.96g ± 0.02 of

weigh). The cooking time of sample is taken as the time required for 13 plungers to be penetrated.

2.D. DNA Comet assay

The DNA Comet Assay was carried out as described by Cerda *et al.* (1997). Comets were classified as showed in figure 1.

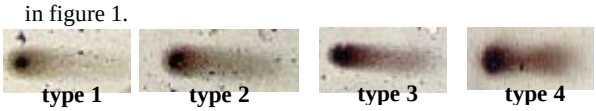

Figure 1. DNA Comets classification

2.E. Viscosimetry

The viscosimetry techniques were carried out as an adaptation of BERNARDES (1996) and SOUZA & ANDRADE (2000).

The samples had been triturated until being in pownder form. A concentration of 2% in distilled water was carried through and taken to the water bath at 70°C for 60 min. with agitation and left to cool for 180min. at 25°C. The measure of viscosity was made in a rotational viscometer Brookfield DV-III with an adapter of small samples and spindle SC4-18 and a speed of 250rpm at 25°C. Five measurements with an interval of 30 seconds had been taken between a measure and another one.

3. RESULTS AND DISCUSSION

The cooking test showed that according the soybean had the increase of dose, independently of the irradiation source, had a reduction of cooking time, but the use of ^{60}Co makes that the grain cooks faster, as shown in figure 2. The use of 6.0kGy in this source decrease the cooking time for the less to the half when it compares with the control time.

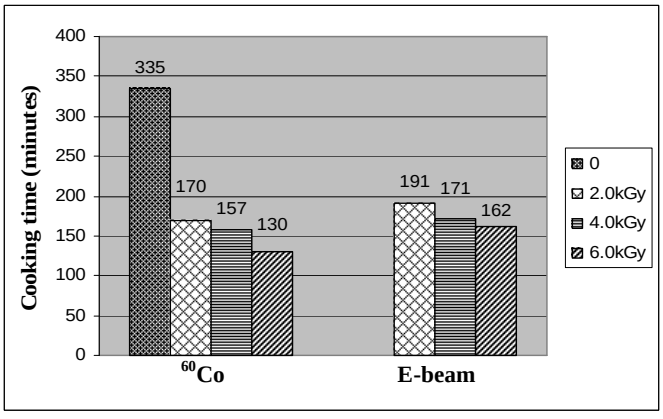

Figure 2. Cooking time of irradiated soybean

It was possible to evidence that for the cooking time, it has an equivalence of doses between the irradiation methods, in other words, the dose of 4.0kGy irradiated in e-beam is nearly to a dose of 2.0kGy in ^{60}Co.

On the comet assay results, a slight DNA damage appeared after radiation treatment with doses over 1.0kGy in both of irradiation sources. The unirradiated soybeans (Type 1) were in round form of DNA, and of nearly the same size and shape. Soybeans irradiated to different doses showed the comets of different shape and size.

It was also observed that this degradation increased with the radiation dose applied, based on higher DNA migration found (figure 3 and 4). Frequently non-irradiated soybeans exhibited comets type 1 and 2 only, with very slight amounts of type 3, while when the dose were increased the number of type 3 and 4 increase too. VILLAVICNCIO *et al.* (2004) show that samples treated with doses of 500Gy on ^{60}Co alredy has a significative damage in soybean DNA.

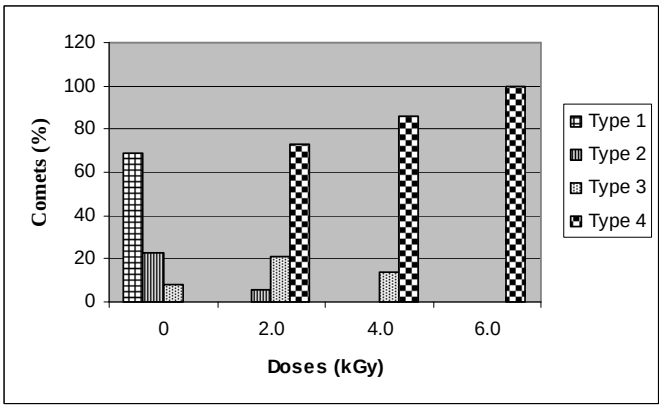

Figure 3. Percentage of different comets types after ^{60}Co treatment

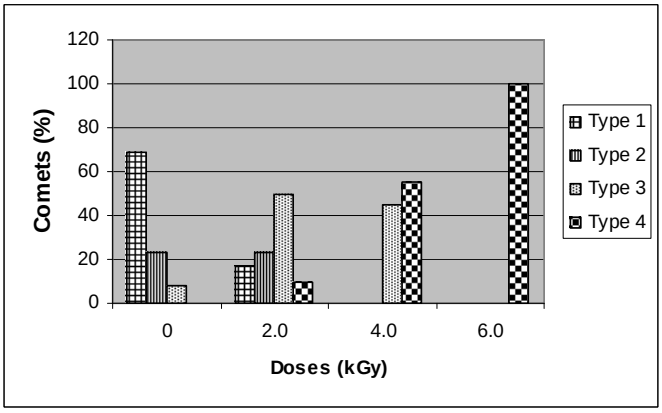

Figure 4. Percentage of different comets types after e-beam treatment.

Comparing comets formed in the different irradiation methods, the treatment for e-beam showed to be less deleterious for the soybean until the dose of 4.0kGy, therefore it does not have difference on treatment when compared the doses of 6.0kGy.

Analisying the viscosity, alike the dose are increased, has a small increase on the sample viscosity, independently of employed irradiation source (figure 5). These results are in accordance with the datas founded by SOUZA & ANDRADE (2006).

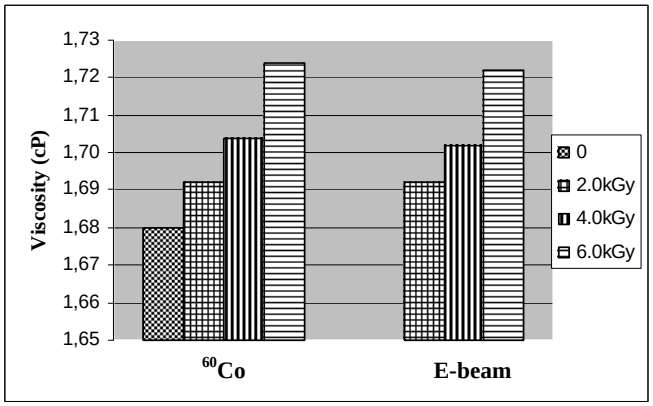

Fig. 5. Irradiated soybean viscosity

Due the biggest capacity of electrons penetration, the use of ^{60}Co intervenes more on the properties of the soybean[16,17], showing to be more aggressive to the grain than the e-beam treatment.

4. CONCLUSION

The results shows that the use of ^{60}Co intervenes more on the properties of the soybean than the e-beam, however the dose of 6.0kGy has the same deleterius effect on soybean DNA. Our data are in accordance with the literature, since doses until 2.0kGy with e-beam treatment do not promote nutritional losses and less formation of undesirables compounds. Nevertheless the choice of the better source and irradiation dose will change as the objective to be reached.

5. ACKNOWLEDGMENT

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