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COMPARISON OF TREATMENT IN SOYBEAN GRAINS BETWEEN ^{60}CO AND E-BEAMS APPLICATIONS

Gustavo B. Fanaro[1], Michel M. Araújo[1], Fernanda S. Thomaz[1], Renato C. Duarte[1] and Anna Lucia C. H. Villavicencio[1]

[1] Instituto de Pesquisas Energéticas e Nucleares (IPEN / CNEN - SP)
Av. Professor Lineu Prestes 2242
05508-910 São Paulo, SP – Brazil.
gbfanaro@ipen.br
villavic@ipen.br

ABSTRACT

Soybean is the most important oleaginous cultivated in Brazil, who is the second larguest exported in the world, and generates high incomes, direct and indirectly, its oils could be used since to cook even to machine´s fuel and the 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 on harvet of billions of dollar every year. An alternative to minimize the losses is preserving the grains through the irradiation that can come today from two diferents main sourses: e-beam and ^{60}Co. Beyond power to be off when it will not be in use, the source of e-beams machines does not need to be recharged, is easily available, possesss high tax of dose and low energy. However the ^{60}Co have low dose rate, high energy and the fotons emission is continuous. 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, 1.0, 3.0 and 5.0kGy irradiated in ambient temperature at ^{60}Co source Gammacell 220 (A.E.C. Ltda) and in e-beam accelerator - Radiation Dynamics (Radiation Dinamics Co. model JOB, New York, USA), 1.5 MeV-25mA with the lower dose.

1. INTRODUCTION

Soybean is one of the oleaginous more cultivated in the whole world, totalizing about 70% of all the oleaginosas seeds produced [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].

The soybean is the most important culture of grains in Brazil, that is the second largest world-wide exporter of this product and generate income of billions of dollar, directly and indirectly [7]. 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].

The foods are irradiated with the most diverse purposes such as: disinfection of agents who causing illnesses, to stretch the product shelf-life, to inhibit the germination and microorganisms inativation that degrade the food [9].

In accordance with the CODEX GENERAL STANDARD FOR IRRADIATED FOODS of CODEX ALIMENTARIUS (1984), for food irradiation, is only allowed to the gamma rays, proceeding from radionuclide (^{60}Co), with energy being able to arrive until 1,33MeV; X-rays, with maximum energy of 5MeV and electrons beam (e-beam), that are generated by machines that can reach maximum energy until 10MeV [11]. These types of radiation are allowed, because besides producing the effect desired in foods, they do not induce the radioactivity in these or on materials that follow them, for example, the packings [12]. 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, 1.0, 3.0 and 5.0kGy irradiated in two differents sources: ^{60}Co and e-beam.

2. EXPERIMENTAL

2.1 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.

2.2 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 power, 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, 1.0, 3.0 and 5.0kGy. CTA dosimeters for e-beam and Harwell Amber 3042 dosimeters to ^{60}Co were used for the measurement of radiation dose.

2.3 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.

2.4 DNA Comet assay

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

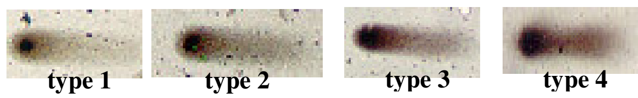

Fig. 1 DNA Comets classification

2.5 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.

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 with that the grain cooks faster, as shown in fig. 2. The use of 5.0kGy in this source decrease the cooking time for the half when it compares with the control time.

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 3.0kGy irradiated in e-beam is equivalent to a dose of 1.0kGy in ^{60}Co (174 min).

On the comet assay results, a slight DNA damage appeared after radiation treatment with doses over 1.0kGy in both of irradiation sources. It was also observed that this degradation increased with the radiation dose applied, based on higher DNA migration found (fig. 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.

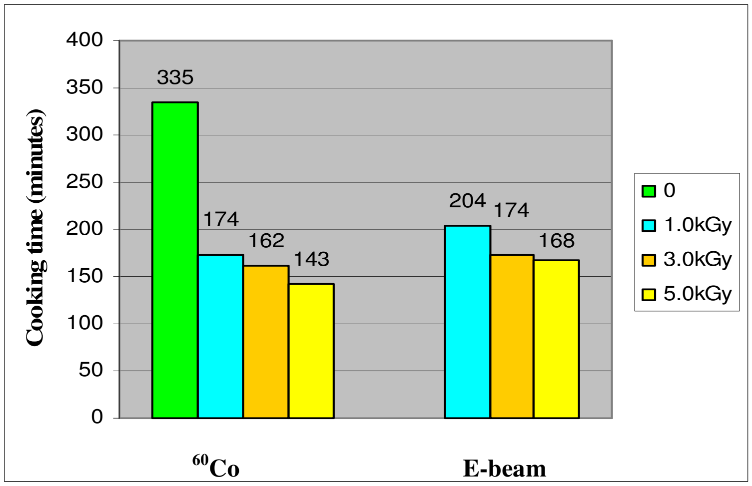

Fig. 2. Cooking time of irradiated soybean

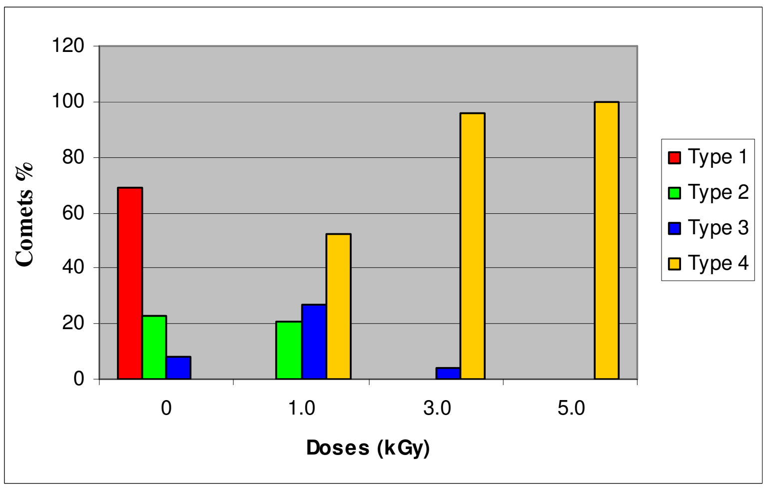

Fig. 3. Percentage of different comets types after ^{60}Co treatment.

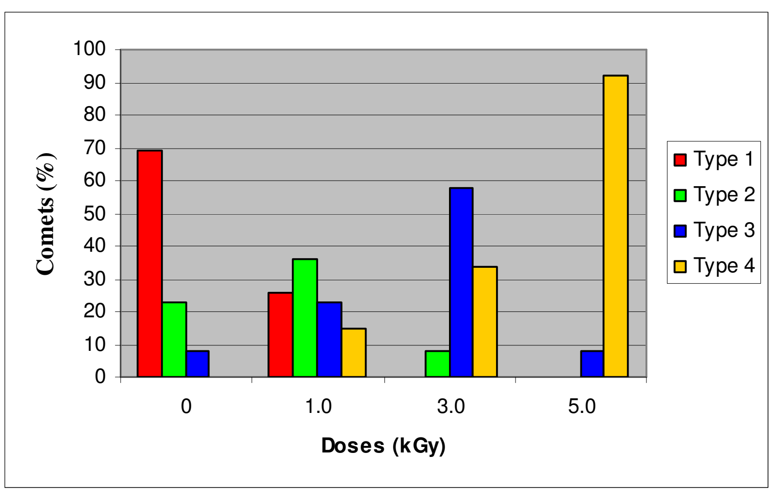

Fig. 4. Percentage of different comets types after e-beam treatment.

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 3.0kGy, therefore it does not have difference on treatment when compared the doses of 5.0kGy.

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

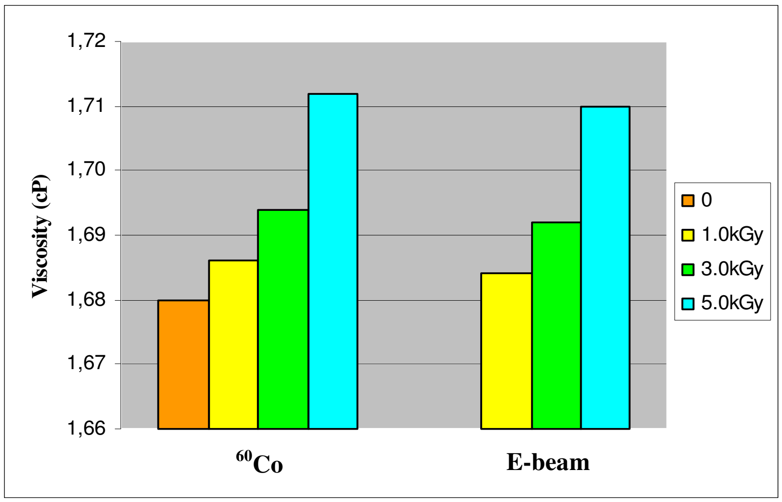

Fig. 5. Irradiated soybean viscosity

Due the biggest capacity of electrons penetration, the use of ^{60}Co intervenes more on the properties of the soybean than the e-beam [11,12]. This effect can be beneficial or not, depending on the effect that if it desires. If desire decrease the cooking time of this grain, the use of sources of ^{60}Co is indicated, but the pH of soybean oils irradiated in ^{60}Co is bigger than the irradiated with e-beam [18], however that does not have interference of the irradiation in the characteristics of soybean proteins [2].

4. CONCLUSION

The results show that the use of ^{60}Co intervenes more on the properties of the soybean than the e-beam, however the dose of 5.0kGy has the same deleterius effect on soybean DNA, but did not have difference of treatment in the viscosity of the studied samples.

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