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GAMMA RADIATION IN THE CONTROL OF INSECTS IN ANIMAL FEED

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ABSTRACT

The pests as beetles, acarids, moths and mushrooms among other, usually infest products stored as: grains, crumbs, flours, coffee, tobacco, dried fruits, animal feeds, spices and dehydrated plants, causing the visual depreciation and promoting the deterioration of the products. The objective of this study was to use gamma radiation of Cobalt-60 in the disinfestation of some types of commercial feeds used for animals of small size. In the experiment, packages measuring 10 cm x 15 cm, with capacity of 30 grams of substrate with 4 types of trademarks were irradiated with doses of: 0 (control) 0.5; 1.0 and 2.0 kGy. Each treatment had 10 repetitions, infested with 10 insects for each package with the following species: *Lasioderma serricorne*, *Plodia interpuctella*, *Sitophilus zeamais* and *S. oryzae*. After the irradiation, all the packages were maintained at acclimatized room with 27 ± 2ºC and relative humidity of 70 ± 5%. The number of insects and holes in all packages were assessed after 60 days. The results showed that the dose of 0.5 kGy was sufficient to control all the species of insects in the tested feeds.
Key words: Gamma radiation, animal feed, insect, control.

1. INTRODUCTION

Dry foods the basis of cereals and grain products are valuable because they present appearance and taste characteristics. However, they are often contaminated with high levels of bacteria, fungi and insects, which, if not controlled, can cause rapid deterioration of foods and serious problems to consumers health [1]. Pests like beetles, mites, moths and fungi usually infest stored products such as grains, bran, flour, coffee, tobacco, dried fruit, animal feed, spices, dried plants, causing visual depreciation and promoting deterioration of the products [2,3,4].

Some control measures are adopted to solve the caused damage and losses due to pests such as good storage practices, monitoring of pests and chemical treatment, what in turn end up causing some damage, plus the resistance of insects to the active ingredients of the pesticide. Due to these problems, a need exists for more efficient methods of control at lower cost. Food irradiation by numerous factors has been presented as the best solution to control pests of grain and stored products [5,4,6,7].

The first use of ionizing radiation on insects was performed by [8] who irradiated with x-ray *Sitophilus oryzae*, but the results were not satisfactory. The promising results were only obtained by [9] who used X-rays to control *Lasioderma serricorne*, a pest stored of tobacco. Since 1950, has been a breakthroughs in this type of radiation research. The discovery of resistance of certain pests to chemicals, biological imbalance and toxicological problems caused by these products, contributed to this advance. The irradiation of stored products can solve these types of problems, since it does not allow the emergence of resistance [10] and leaves no residues in products [4,6,7,11,12,13,14,15]. Therefore the objective of this study was to use gamma radiation from Cobalt-60 for disinfestation of some types of products used for feeding small animals

2. MATERIAL AND METHODS

In the experiment, packaging was performed according to the methodology described by [16, 17]. Each package was made with a plastic sealer with the size of 10cm x 15cm, with a capacity of 30 grams of substrate (feed) per bag for all trademarks tested (1),(2),(3) and (4). Each treatment consisted of 10 replications and in each replication were inoculated 10 insects of each species, *L. serricorne*, *P. interpuctella* and *S. zeamais* and *S. oryzae*, a total of 400 insects in the experiment. The packaging with substrate and insect were sealed in a commercial sealing, and then irradiated in a source of Cobalt-60, type Gammacell-220, dose rate of 0.456 kGy/h., with doses of 0 (control) 0.5; 1.0 and 2.0 kGy. After irradiation, all packaging and control group were kept in a room with 27 ± 2 ° C and relative humidity of 70 ± 5%. After 60 days of the irradiation evaluations of insects were made inside in each package and then determining the sterilizing or lethal dose for each species of insect. The treatments were assigned completely at random in a 4x1 design (4 treatments and 1 sampling time) with 10 repetitions. The results of the evaluations were submitted to analysis of variance by F test, and the comparison of averages by the Tukey test at 5% using the statistical software SAS (Statistical Analysis System, 1989)

3. RESULTS AND DISCUSSION

Listed in Tables 1, 2, 3, and 4, the results with the feed types 1, 2, 3 and 4, with four types of packages that have been artificially infested with all species of insects and sealed according to [16,17] methodology. Subsequently, they were irradiated with increasing doses of gamma radiation from Cobalt-60, and evaluated 60 days after irradiation. The period was closen so that each insect species to complete the life cycle (egg to adult).

Table 1. Average number of holes and average emergency of *Sitophilus zeamais* adults from the artificially infested feed samples irradiated with increasing doses of gamma radiation from Cobalt-60.

Doses/kGy	Ration 1		Ration 2		Ration 3		Ration 4	
	Insects	Holes	Insects	Holes	Insects	Holes	Insects	Holes
0 (control)	13.0b*	6.0b	11.0b	7.0b	23.0b	12.0b	45.0b	13.0b
0.5	0.0a	0.0a	0.0a	0.0a	0.0a	0.0a	0.0a	0.0a
1.0	0.0a	0.0a	0.0a	0.0a	0.0a	0.0a	0.0a	0.0a
2.0	0.0a	0.0a	0.0a	0.0a	0.0a	0.0a	0.0a	0.0a

*Means followed by the same letters do not differ 5% probability at Tukey test.

Table 2. Average number of holes and average emergency of *Sitophilus oryzae* adults from the artificially infested feed samples irradiated with increasing doses of gamma radiation from Cobalt-60.

Doses/kGy	Ration 1		Ration 2		Ration 3		Ration 4	
	Insects	Holes	Insects	Holes	Insects	Holes	Insects	Holes
0 (control)	12.0b*	7.0b	10.0b	9.0b	16.0b	6.0b	27.0b	11.0b
0.5	0.0a	0.0a	0.0a	0.0a	0.0a	0.0a	0.0a	0.0a
1.0	0.0a	0.0a	0.0a	0.0a	0.0a	0.0a	0.0a	0.0a
2.0	0.0a	0.0a	0.0a	0.0a	0.0a	0.0a	0.0a	0.0a

*Means followed by the same letters do not differ 5% probability at Tukey test.

Table 3. Average number of holes and average emergency of *Lasioderma serricorne* adults from the artificially infested feed samples irradiated with increasing doses of gamma radiation from Cobalt-60.

Doses/kGy	Ration 1		Ration 2		Ration 3		Ration 4	
	Insects	Holes	Insects	Holes	Insects	Holes	Insects	Holes
0 (control)	18.0b*	9.0b	13.0b	11.0b	13.0b	8.0b	49.0b	17.0b
0.5	0.0a	0.0a	0.0a	0.0a	0.0a	0.0a	0.0a	0.0a
1.0	0.0a	0.0a	0.0a	0.0a	0.0a	0.0a	0.0a	0.0a
2.0	0.0a	0.0a	0.0a	0.0a	0.0a	0.0a	0.0a	0.0a

*Means followed by the same letters do not differ 5% probability at Tukey test.

Table 4. Average number of holes and average emergency of *Plodia interpunctella* adults from the artificially infested feed samples irradiated with increasing doses of gamma radiation from Cobalt-60.

Doses/kGy	Ration 1		Ration 2		Ration 3		Ration 4	
	Insects	Holes	Insects	Holes	Insects	Holes	Insects	Holess
0 (control)	15.0b*	9.0b	20.0b	11.0b	17.0b	7.0b	22.0b	13.0b
0.5	0.0a	0.0a	0.0a	0.0a	0.0a	0.0a	0.0a	0.0a
1.0	0.0a	0.0a	0.0a	0.0a	0.0a	0.0a	0.0a	0.0a
2.0	0.0a	0.0a	0.0a	0.0a	0.0a	0.0a	0.0a	0.0a

*Means followed by the same letters do not differ 5% probability at Tukey test.

The results in these tables showed that for *Sitophilus zeamais*, *Sitophilus oryzae*, *Lasioderma serricorne* and *Plodia interpuctella* the minimum dose of gamma radiation required to induce sterilization and hence the disinfection of all feed samples was 0.5 kGy. According to Arthur [12] a sterile population is an extinct population.

With respect to control groups as can be seen they reached a relatively large number of insects, thereby decreasing proportion of insect-food. Because of this, they were forced to leave the packaging looking for new foods. The numbers of openings observed in the packages in most cases are made by mandibles of insects mainly where the packages were sealed folds because in this local the packages have lower resistance to insect attack. These results are in line with those found by [15,18,3,19,20,21] and next to those from the

International Atomic Energy Agency (IAEA) which [7] promotes a generic sterilization dose of 0.4 kGy for most insect pests of agricultural importance.

4. CONCLUSION

The lowest dose of 0.5 kGy gamma radiation used was sufficient to induce sterility and consequently disinfest all insect pests in the studied animal feeds.

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