

Sensorial analysis evaluation in cereal bars preserved by ionizing radiation processing

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Abstract

Gamma-rays utilized as a food-processing treatment to eliminate insect contamination is well established in food industries. Recent troubles in Brazilian cereal bars commercialization require a special consumer's attention because some products were contaminated by insects. To solve the problem, food-irradiation treatment was utilized as a safe and effective solution. The final product was free of insect contamination. The aim of this study was to determine the best radiation dose processing utilized to disinfestations and detect some change on sensorial characteristic by sensorial analysis in cereal bars. In this study, three different kinds of cereal bars were purchased in São Paulo (Brazil) in supermarkets and irradiated with 1.0, 2.0 and 3.0 kGy at "Instituto de Pesquisas Energéticas e Nucleares" (IPEN-CNEN/SP). The samples were treated with ionizing radiation using a ⁶⁰Co gamma-ray facility (Gammacell 220, A.E.C.L.). That radiation doses were used successfully as an anti-insect treatment in the cereal bars, since in some food industries doses up to 3.0 kGy are used to guarantee at least a dose of 1.0 kGy in internal cereal bars package. Sensorial analysis was necessary since cereal bars contain ingredients very sensitive to ionizing radiation process.

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1. Introduction

Ionizing radiation utilized as a food-processing treatment to eliminate insect contamination is well established in food industries. Recent troubles in the commercialization of Brazilian cereal bars require a special attention by consumers because some products were contaminated by insects during transport and storage. Food irradiation has been shown to be an effective tool to eliminate certain food borne-pathogens from food. Safety and efficiency of food irradiation has been approved by several authorities (FDA, USDA, WHO, FAO, etc.) and scientific societies based on extensive research (Tritsch, 2000; Morehouse, 2002).

Cereal bars were introduced in the last decade as a wholesome alternative of comfit when consumers show

more interest in health and diets (Bower and Whitten, 2000). The association between cereal bars and wholesomeness foodstuffs is a well-documented tendency in industrial food (Boustani and Mitchell, 1990).

Sensorial evaluation is based on fundamental psychological perception and physiological techniques (Dutcosky, 1996; Carpenter et al., 2000). Hedonic scales are used by experts and untrained consumers, which the best results are obtained using an untrained panelists (Amerine et al., 1965).

Radiation doses were used successfully as an anti-insect treatment in the cereal bars, since in the food industry doses up to 3.0 kGy are used to guarantee a dose at least 1.0 kGy in internal cereal bars package. The aim of this study was to determine the best dose of radiation processing of ⁶⁰Co utilized to disinfestations in processed cereal bars. Sensorial analysis was necessary since cereal bars contain ingredients very sensitive to ionizing radiation process.

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2. Experimental

2.1. Samples

Industrialized chocolate, banana and strawberry cereal bars (100 each one) were purchased from a supermarket in São Paulo, Brazil.

2.2. Irradiation

Cereal bars were irradiated at room temperature (nearly 28 °C), in original package, using a ^{60}Co gamma-ray facility (Gammacell 220) at Instituto de Pesquisas Energéticas e Nucleares—IPEN/CNEN (São Paulo, Brazil). The applied doses were 0 (control), 1.0, 2.0 and 3.0 kGy. The dose rate was 3.48 kGy/h. Harwell Amber 3042 dosimeters were used for the measurement of radiation dose.

2.3. Sensorial analysis

Tests took place in individual cabins illuminated by fluorescent lamps. Samples were served in individual plates, codified with a three-digit number, with a glass of water to 30 untrained volunteer panelists (15 men and 15 women). The samples were evaluated using a preference test based on a nine-point hedonic scale (9 = like extremely and 1 = dislike extremely). Odor, appearance and taste characteristics were measured.

2.4. Statistical analysis

Statistical analysis were performed by ANOVA, with a $p < 0.05$, in order to evaluate significant differences among irradiation doses analyzed.

3. Results

Odor parameter results are shown in Fig. 1. Chocolate cereal bars present itself odor in all samples. Among irradiated samples, panelist's preference for 2.0 kGy was higher; however, some detected a light off-odor of chocolate in 1.0 and 3.0 kGy irradiated samples. Differently, irradiated banana samples were preferred by most of panelist (highest score reached with a 2.0 kGy dose). Irradiated banana samples showed stronger banana odor than control samples. In the same figure, we can observe that strawberry odor did not change too much among doses applied. Control strawberry samples had the same preference as 3.0 kGy irradiated sample. There were no statistical significant difference ($p \leq 0.05$) between control and irradiated samples for all cereal bar studied to this parameter.

Appearance results are expressed in Fig. 2. There was a expressive difference between chocolate samples, therefore control samples had similar acceptance as 2.0 kGy. Although there was a loss of color in the irradiated

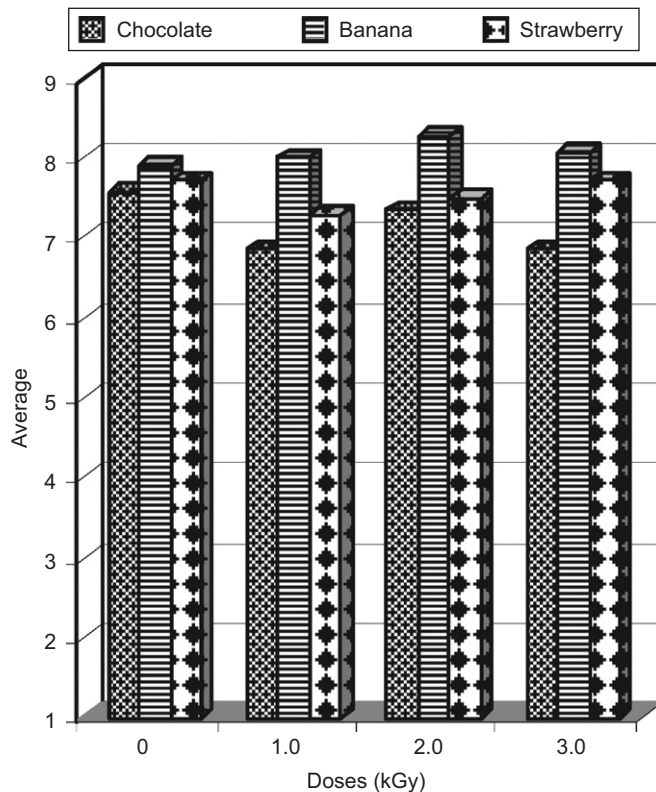


Fig. 1. Odor score averages of chocolate, banana and strawberry cereal bars.

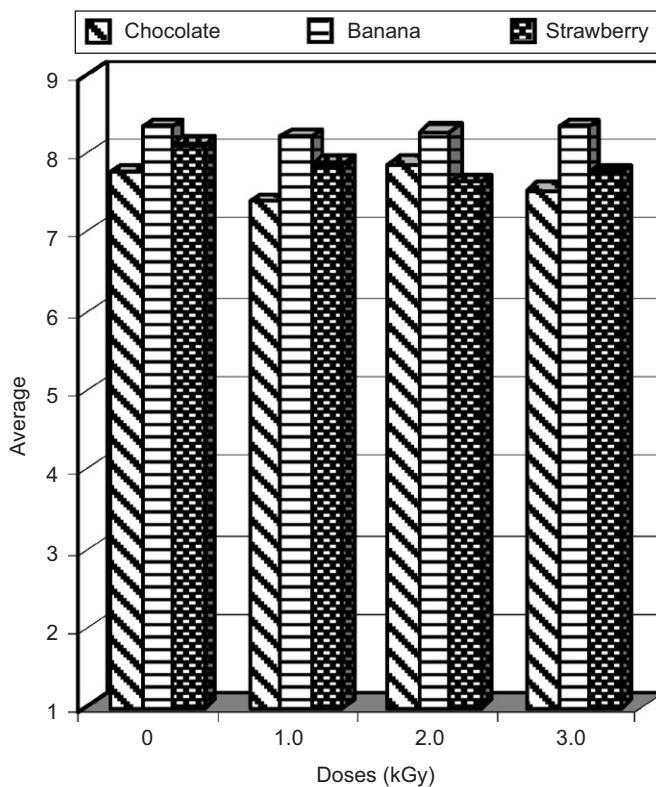


Fig. 2. Appearance score averages of chocolate, banana and strawberry cereal bars.

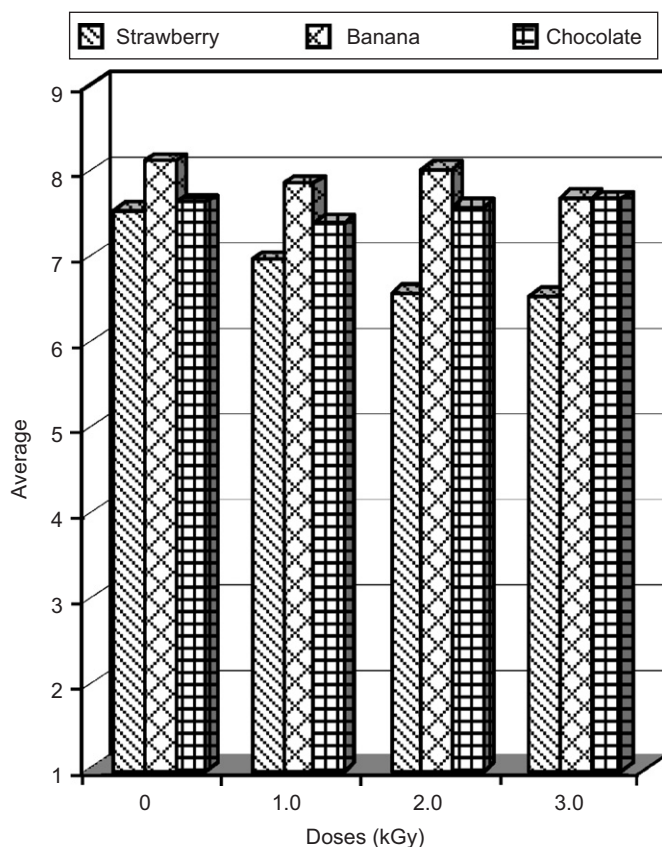


Fig. 3. Taste score averages of chocolate, banana and strawberry cereal bars.

samples, most panelists preferred this sample (obtained averages close to 8.0 in the test of sensorial acceptance). Cereal bars irradiated with 1.0 and 3.0 kGy obtained the lowest score from panelists. Strawberry cereal bar samples obtained negative results due to irradiation processing. How much bigger was the applied dose, lesser the acceptance. As well as odor analysis, irradiated banana cereal bars showed a minimal variation in appearance with the applied doses. Control and 3.0 kGy irradiated samples scored the same acceptance (8.32). No significant statistical differences were found ($p \leq 0.05$) between control and irradiated samples for all cereal bar studied to this parameter.

Taste results are showed in Fig. 3. Banana samples irradiated with 2.0 kGy had the higher acceptance, similar to control samples; 1.0 and 3.0 kGy irradiated samples received the lowest score to this feature. Both control and irradiated strawberry samples showed similar results referred to taste. Strawberry samples obtained averages

close to 7.5, proving irradiation treatment did not affect negatively this sample. Chocolate cereal bars taste decreased their acceptance with increasing radiation doses. Due to the high lipids percentage in the chocolate, irradiation could have started a lipid oxidation reaction, leading to a light rancid taste. Some authors justify that by adding artificial flavor, lipid oxidation could be dissembled. There were no statistically significant difference ($p \leq 0.05$) between control and irradiated samples for all cereal bar studied to this parameter.

As the purpose of this paper was evaluate changes on sensorial qualities in cereal bars using radiation processing as a phytosanitary treatment. Our results show that banana and chocolate cereal bars processed with 2.0 kGy was the most preferred radiation dose and for strawberries 3.0 kGy was the best choice.

4. Conclusion

It can be concluded from this study under our conditions analyses that a dose of 2.0 kGy is sufficient to maintain the sensorial quality to chocolate and banana and 3.0 kGy to strawberry in cereal bars. Food-radiation processing was utilized as a safe and effective solution. The final product can be free of insect contamination and sensorial test approved for the ionizing treatment with the doses applied. Irradiation did not have a significant negative impact on the appearance, odor and taste, according to statistical analyses.

Acknowledgments

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