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SENSORIAL ANALYSIS OF IRRADIATED COFFEE (*Coffea arabica* L.) BY ELECTRON BEAM

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ABSTRACT

Coffee is an important commodity and it is one of the most widely consumed beverages in the world. The acceptance of coffee by consumers depends mainly on the sensory characteristics of the beverage, that is its flavor, body, color, acidity and aroma. Food irradiation is processing technology environmental friendly and safety which aimed at the improvement of food quality. Depending on the absorbed radiation dose various effects can be achieved resulting in increase the shelf life, disinfestation, microorganism load reduction, without causing sensory changes to the food. Sensory analysis is the examination of a food through the evaluation of the attributes sensorial of product. The objective this paper was to evaluate the sensory properties, acceptance and purchase intent by the consumer of coffee (*Coffea arabica* L.) after the irradiation process with doses 6.0, 12.0 and 18.0kGy by electron beam.

1. INTRODUCTION

Coffee is one of the major products in the global agribusiness, It is one of the most valuable primary products in world trade, in many years. In the consumer market for coffee, demand is growing for quality beverages with different preparation methods[1].

Coffee is susceptible to bacteria and fungi contamination at all plant stages, from production to consumption. The occurrence of fungi and bacteria causes modification in the color, and flavor, also loss of weight and the development of secondary metabolites that are toxic to humans [2].

Irradiation is a decontamination method use for a variety of foodstuffs, being very feasible, effective, environment friendly, extend the shelf life of fresh perishable foods, and has been shown to be an effective tool to eliminate certain food borne-pathogens from food [3]. Safety and efficiency of food irradiation has been approved by several authorities (FDA, USDA, WHO, FAO, etc.) and scientific societies based on extensive research [4, 5].

Sensory analysis is a very important tool in the characterization of different types of coffee, it is used to detect characteristics organolepticas, to characterize and to compare different coffee samples. The analysis is applied in the improvement of the quality and development of foods, besides to show the acceptance of the consumer to the product [6, 7].

2. MATERIALS AND METHODS

2.1. Materials - Food Samples

Coffee (*Coffea arabica* L.) was purchased in local supermarkets in São Paulo city (Brazil) from June to August 2010. A total of 500 g of samples were packed in plastic sachets, vacuum-sealed and labeled with their respective radiation doses. Coffee was maintained at ambient temperature (25ºC) during all experiment.

2.2. Methods

2.2.1. Irradiation

The samples were irradiated using an electron beam (EB) accelerator (Dynamitron II, Radiation Dynamics Inc.), at room temperature, in the presence of air, being 0, 6.0, 12.0 and 18.0 kGy the applied doses. Harwell Gammachrome YR dosimeters were used for radiation dose measurement. After irradiation, samples were kept in plastic bags and stored in a dry ambiance in the dark.

2.2.2. Beverage preparation

The sensory analysis, four coffee beverages were prepared adding 100 g of coffee to 1000 mL of hot water (approximately 75 °C). The coffee was filtered through white filter paper and and the temperature was kept constant inside of thermos bottle until the sensory evaluation [8]. The time between the samples preparation and sensory testing was very short, less than 20 minutes, to minimize aroma loss of coffee.

2.2.3. Sensorial test of acceptance

The tests were carried out the Dietetic Techniques Laboratory, College of Public Health of University of São Paulo.

The test was carried out with 30 non-expert panelists, the panel consisted of adults (from 18 to 50 years old) of both sexes.

Samples were inside a three-digit code plastic container, were given to the panelists with a cream cracker savory biscuit and so the palate could be cleaned tests took place in individual cabins illuminated by fluorescent lamps. Mineral water (glass of water 45 mL) was provided to wash the oral cavity after tasting each treatment

Test of acceptance the panelists evaluated each sample according a 9 point hedonic scale (1=dislike extremely and 9=like extremely); a score of 5 was considered the limit of acceptance [9]. Moreover, it was asked purchase intention of an irradiated coffee by consumers.

The project was approved by the Ethics Committee of the College of Public Health of University of São Paulo.

2. 3. Statistical Analysis

Statistical analysis were performed by Analysis of Variance (ANOVA) and Tukey's test ($p \leq 0.5$), in order to evaluate significant differences among irradiation doses evaluated.

3. RESULTS AND DISCUSSION

The analysis of variance performed with the results from each taster for the coffee (Table 1), it demonstrated that there was a significant difference at a level of $p \leq 0.05$ between the samples.

The sensorial acceptance test showed significant difference between control and irradiated samples (6.0, 12.0 and 18.0kGy). Nevertheless, the samples which received a dose of 12.0 kGy and 18 kGy did not significant differences from each other either. This test was carried out to evaluate a possible sensorial change observed by the consumers, in relation to the different radiation dose response using the hedonic scale.

The results (Table 2) of difference appearance demonstrated significant difference between control and irradiated samples in a level significance 95%.

In this survey 65% of respondents indicated who would buy irradiated coffee. The intention to purchase may be related to several factors such as the acceptability, price, knowledge and concerns towards the food irradiation.

Table 1. Analyses of variance for the coffee

Source of variation	Degrees of freedom	Sum of square	Mean square	F test
Sample	3	130,89	43,63	28,68
Taster	29	194,68	6,71	4,41
Residue	87	132,36	1,52	
Total	119	457,93		

Table 2: Average values obtained in the acceptance test using a hedonic scale for four samples of irradiated coffee

	Mean	Standard deviation
Control	$7,10^{A}$	1.18
Dose 6.0 kGy	$5,83^{B}$	1.60
Dose 12.0 kGy	$4,67^{C}$	1.73
Dose 18.0kGy	$4,50^{C}$	2.08

*Means with the same superscripts within column are not significantly different ($p \geq 0.05$)

Nemtanu et al (2005) analyzed the effects of irradiation with accelerated electrons up to 40.0 kGy on Beans and ground green coffee. The analyzes of Microbial load, rheological

behavior, electron paramagnetic resonance (EPR) and visible spectroscopy were performed and the results demonstraded that electron beam irradiation of green coffee is efficient to decontaminate green coffee even at low doses without severe changes in its properties [10].

Fanaro et al. (2012) evaluated the gamma radiation effects on odor volatiles in oolong tea at doses of 0, 5.0, 10.0, 15.0 and 20.0 kGy. The authors found Statistical difference between the 5.0 kGy and 15.0 kGy volatile profiles, in other hand the sensorial analysis showed that the irradiation at dose up 20.0 kGy did not interfere on consumer perception [11].

4. CONCLUSIONS

Therefore, the sensorial analysis of drink coffee showed significant difference in the acceptance test between irradiated and control samples. The Samples that received low doses of ionizing radiation showed higher acceptance than the other samples.

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REFERENCES

1. J. N. Wintgens, Coffee: Growing, Processing, Sustainable Production: A Guidebook for Growers, Processors, Traders, and Researchers. 2nd revised ed. Weinheim, wiley vch verlag GmbH & Co. KgaA; 2009.
2. C. F. Silva, R. F. Schwan, Ë. S. Dias, A. Wheals, Microbial diversity during maturation and natural processing of coffee cherries of *Coffea arabica* in Brazil, *International Journal of Food Microbiology*, **Volume 60** (2–3), pp. 251-260 (2000)..
3. FARKAS, J., MOHÁCSI-FARKAS, C. History and future of food irradiation. *Trends* in *Food Science & Technology* , **Volume 22**, pp. 121-126 (2011).
4. G.L. Tritsch, Food irradiation, *Nutrition*, **Volume 16** (7−8), pp. 698−718 (2000).
5. K. M. Morehouse, Food Irradiation—US regulatory considerations, *Radiation Physics Chemistry*, **Volume** 63, pp. 281−284 (2002).
6. R. P. Carpenter, D. H. Lyon, T. A. Hasdell, *Guidelines for sensory analysis in food product development and quality control*, second ed. Aspen (2000).
7. M.J. Schröder, Food Quality and Consumer Value, *Springer-Verlag*, pp.330 (2003).
8. Associação Brasileira da Indústria de Café (ABIC) http://www.abic.com.br/estatisticas.html (2013).
9. H.S. Stone, J.L. Sidel, *Sensory Evaluation Practies*, (3ed.) Academic Press, San Diego (2004).
10. M. R. Nemtanu, M. Brasoveanu, M. N. Grecub, R. Minea, Green coffee decontamination by electron beam irradiation, *Nuclear Instruments and Methods in*

Physics Research Section B: Beam Interactions with Materials and Atoms, **Volume 240** (1−2), pp.34-89 (2005).

11. G. B. Fanaro, R. C. Duarte, A.G. Santillo, M .E. M Pinto E Silva, E. Purgatto, A. L. C. H. Villavicencio, A.L.C.H. Evaluation of γ-radiation on oolong tea odor volatiles. *Radiation Physics Chemistry*, **Volume 81**, pp.1152-1156 (2012).