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Sensory evaluation by gamma radiation effect on protein allergen of laying hen eggs

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ABSTRACT

Although considered the most complete food and nutritionally shown to be part of a healthy diet, the egg is the source of many eating disorders, especially for infants. Irradiation has been used in studies not only as a means of microbiological control, but also on its structural action in the substances molecules and has been used to reduce the allergenic effects. The aim of this study was to evaluate the sensory effects of Co⁶⁰ gamma radiation on proteins, enabling the acceptability of allergy food for genetically intolerant people. Eggs commercial fresh and freeze-dried and subjected to gamma irradiation by Co⁶⁰ source at doses 0 (control), 10 kGy; 20 kGy and 30 kGy and rates of doses of 19.4 kGy/h and 31.8 kGy/h. Acceptability test was used by the hedonic scale, since it is necessary to know the “affective status” of consumers for the product, implying a preference, i.e. the most preferred samples are the most accepted and vice versa. The samples were presented as the habit of consumption (cooked) to a group of 41 adults panelists of both gender, aged from 21 to 40 years, and served under complete block design balanced with respect to the order of presentation. The evaluated attributes was flavor, appearance and overall acceptability. In general, for boiled eggs and freeze-dried, it was observed that the control sample was the most acceptable, followed by the sample irradiated with 10 kGy in both dose rates. In addition, panelists presented in testimony that they found interesting changes due to irradiation; also said they would not buy the product because of the marked change in appearance and smell, which at one point he ended up in disgust and detract from sales of the product, but they would buy irradiated with 10 kGy in both dose rate and dose of 20 kGy at a dose rate of 19.4 kGy/h.

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1. Introduction

Egg is a complete food with all the vitamins, minerals and amino acids that constitute a living being (Englert, 1998; Harder et al., 2007a, 2008).

Trade in poultry products grows every year in the world as the chicken meat and eggs are cheap sources of animal protein (Harder et al., 2007b, 2010).

According to a meta-analyses (Rona et al., 2007) the self-reported prevalence of food allergy was varied from 1.2% to 17% for milk, 0.2% to 7% for egg, 0% to 2% for peanuts and fish, 0% to 10% for shellfish, and 3% to 35% for any food.

When foods adverse reactions are caused by immunological mechanisms are said food allergies, whereas when caused by

toxic, pharmacological, metabolic and/or idiosyncratic, the chemicals are said food intolerances (Parker et al., 1993; Moreira, 2006).

The main foods that have been cited as causing food allergies are milk, eggs, peanuts, nuts, shrimp, fish and soy (Bock, 1986; Metcalfe, 1998; Moreira, 2006).

Irradiation is an excellent method of food conservation, as well as rein forces the action of other applied processes for the same purpose. Irradiation satisfies completely the objectives of giving food nutritional stability, sanitary conditions and along shelf life (EMBRARAD, 2010; Harder et al., 2009).

Investigations demonstrated that macronutrients, such as proteins and carbohydrates are relatively stable at doses of up to 10 kGy, and that, micronutrients, mainly vitamins can be sensitive to any method of food conservation. The sensitivity of various types of vitamins to irradiation and other methods for food conservation is variable; vitamins C and B1 (thiamin) are the most sensitive to irradiation. In general, the process of irradiation with acceptable dose cause little chemical changes in foods, whereas the

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food nutritional quality is no more affected than when it is treated with other conventional methods of preservation (Villavicencio et al., 1998; Harder et al., 2009).

The analysis of proteins, lipids, carbohydrates and nucleic acids, have been examined for the detection of physical and chemical changes, and methods to identify foods that have been irradiated, have been developed in several countries, the detection of free radicals, analysis microstructure studies of biological functions and analysis of microflora (Muñoz et al., 1985), however, given the same exposure, there may be sensory changes in the requirements, changing product acceptance, therefore, research involving taxes sensory are made as necessary as the characterization and analysis of product quality.

Combining the idea of a nutritionally complete food, but potentially allergenic, this study aimed to evaluate the sensorial effects of gamma radiation by source of Co⁶⁰ in eggs of laying hens in order to decrease the allergenicity of food, by submitting to the different doses and dose rates. Thus, the product, as fresh and dried, was submitted to the sensory analysis to determine product acceptance.

2. Material and methods

2.1. Sample preparation

Raw (*in natura*) chicken eggs with 5 day after laying, were obtained from Genetics Department, College of Agriculture “Luiz de Queiroz”—ESALQ, University of São Paulo - USP, Chicken Sector.

2.2. Treatments

Parts of fresh samples were freeze dried and, respectively, submitted the fresh with his own shell and the freeze dried packed in polypropylene bags.

All samples were irradiated with Co⁶⁰, source type multi-purpose, from Institute of Energetic and Nuclear Research (IPEN), under rates of 19.4 kGy/h and e 31.8 kGy/h, at doses of: 0 (control); 10 kGy; 20 kGy; 30 kGy.

Two rates of different doses were used to evaluate alterations and to be possible to compare cronic and agude rates.

2.3. Treatments evaluation

2.3.1. Sensorial analysis

Acceptability test used was the hedonic scale, since it is necessary to know the affective status” of consumers for the product, implying a preference, i.e. the most preferred samples are the most accepted and vice versa (Ferreira, 2000).

The scales were balanced, as it had an equal number of positive and negative categories, avoiding the induction of the panelist to the positive or negative. Hedonic scale was used in numbers, making it easier to understand the changing room.

A questionnaire was developed in the form of hedonic scale, which was presented one to each of the testers, so they could write their preferences.

The samples were submitted to a group of 41 adults panelists, according to Ferreira (2000), of both genders, aged 21–40 years old, and served under complete block design balanced with respect to the order of presentation of samples.

The samples were boiled in hot water after boiling for 5 min and then were cut in half. Was added enough salt (2 mg) in each half to make them as close to the consumption habit. Were served at room temperature, packed in white plastic dishes for better visualization of the sample.

Although leave them as close to the habit of consumption, intake was not performed since it was not possible to determine its safety for ingestion through microbiological tests. Only the parameters being evaluated: flavor, appearance and overall acceptability.

Panelists were recruited after lunch, so that the feeling of hunger does not interfere with the result.

Panelists were placed in the dressing room, alone, that does not interfere with an outcome of another. White light was chosen for the analysis, since it was necessary to evaluate the product appearance.

All procedures were reviewed and approved by the Ethics Committee in Research of the College of Dentistry of Piracicaba–FOP/UNICAMP.

2.3.2. Statistical analysis

Results were submitted to a variance analysis, *F* test at 5%, and Tukey test, using SAS (Statistical Analysis System Institute, 1996).

3. Results and discussion

Shown in Table 1, the mean values obtained by the notes of the 41 panelists who participated in the sensory analysis for hard-boiled egg, hedonic scale.

Table 2 contains the mean values for scores of 41 panelists who participated in the sensory analysis, for freeze-dried egg, hedonic scale.

In general, for boiled eggs and freeze-dried (Tables 1 and 2), we can observe that the control sample was the most accepted, followed by the sample irradiated with 10 kGy in both rate of doses.

Table 1

Mean values of the notes to the tasters attributes: flavor, appearance and overall acceptance for boiled egg.

Treatment	Flavor	Appearance	Overall acceptability
Control	5.65 ± 1.98 ^{1a2}	6.75 ± 1.62 ^a	6.54 ± 1.96 ^a
<i>Rate of dose 19.4 kGy/h</i>			
10 kGy	4.50 ± 2.20 ^{ab}	5.20 ± 2.39 ^b	4.60 ± 2.50 ^b
20 kGy	2.93 ± 1.62 ^{cd}	3.10 ± 1.73 ^{cd}	3.48 ± 1.72 ^{bc}
30 kGy	2.70 ± 1.88 ^{cd}	2.03 ± 1.27 ^d	2.28 ± 1.66 ^c
<i>Rate of dose 31.8 kGy/h</i>			
10 kGy	3.85 ± 2.02 ^{bc}	4.10 ± 1.98 ^{bc}	4.23 ± 2.33 ^b
20 kGy	2.43 ± 1.63 ^d	2.23 ± 1.14 ^d	2.60 ± 1.56 ^c
30 kGy	2.98 ± 2.07 ^{cd}	1.93 ± 1.42 ^{cd}	2.53 ± 1.81 ^c

¹ Mean ± standard deviation.

² Médias followed by the same letter in column do not differ by Tukey test ($P < 0.05$).

Table 2

Mean values of the notes to the tasters attributes: flavor, appearance and overall acceptance for dried egg.

Treatment	Flavor	Appearance	Overall acceptability
Control	5.64 ± 1.61 ^a	6.28 ± 2.07 ^a	6.48 ± 1.81 ^a
<i>Rate of dose 19.4 kGy/h</i>			
10 kGy	4.84 ± 2.13 ^a	6.00 ± 1.71 ^{ab}	6.04 ± 1.43 ^{ab}
20 kGy	4.60 ± 2.33 ^a	4.48 ± 1.85 ^{ab}	5.00 ± 1.35 ^b
30 kGy	5.32 ± 1.79 ^a	4.98 ± 1.66 ^{ab}	5.15 ± 1.77 ^{ab}
<i>Rate of dose 31.8 kGy/h</i>			
10 kGy	4.84 ± 2.13 ^a	5.12 ± 1.69 ^{ab}	4.96 ± 2.01 ^b
20 kGy	5.16 ± 1.93 ^a	5.60 ± 1.73 ^{ab}	5.64 ± 1.15 ^{ab}
30 kGy	5.44 ± 1.80 ^a	4.77 ± 1.85 ^b	5.00 ± 1.38 ^b

¹Mean ± standard deviation.

²Médias followed by the same letter in column do not differ by Tukey test ($P < 0.05$).

In addition, panelists presented in their testimonies that they found interesting the changes due by the irradiation; also said they would not buy the product because of the changes of smell and appearance, which at one time comes to give disgust and detract from the sale of the product, but they would buy irradiated with 10 kGy in both rate of dose and dose of 20 kGy at a rate of dose 19.4 kGy/h.

The freeze dried samples were shown in Table 2, presented a quite different way form the raw egg. The approval did not differ from control, moreover, in the comments, several panelists pointed out that there was considerable reduction of the odor, what pleased.

Several researchers have studied the egg powder, which is a product widely used in food industry. According to Kushida et al. (2005) and Salm et al. (2002), emphasized the possibility of the use of egg powder formulations such as breads, pastas and other including being statistically accepted by tasters in sensory testing conducted by Nicola et al. (2004).

As can be seen from the results presented in Tables 1 and 2 the effect related to sensory changes promoted by gamma radiation is higher in boiled eggs than in freeze dried due to the higher water content of the cooked, according to Ferreira and Del Mastro (1998), which attributes this issue to the release of metabolites, due to the effects of irradiation, i.e., peroxidases.

4. Conclusions

The panelists agreed to buy eggs and irradiated with 10 kGy rates in both rate and doses and the 20 kGy irradiated with a rate of dose 19.4 kGy/h.

The irradiation causes significant changes in the color of boiled and raw egg yolk and acute rates doses looks likely to mitigate such behavior.

Freeze drying can be a most interesting way to present the samples to be irradiated, as presented apparent reduction of odor, appointed by the panelists.

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