PHYSICALCHEMICAL, MICROBIOLOGICAL AND SENSORIAL EVALUATION IN CONSERVATION OF LEAN MINCED MEAT SUBMITTED TO GAMMA RADIATION BY COBALT 60

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Background

Minced meat stands out for composing several cooking dishes. However, it has short shelf life due to its their characteristics and contaminations. Irradiation reduces bacteria and parasites, this way helping to reduce health problems, and at the same time, it increases shelf life (SCHUTZ *et al.*, 1989). The use of doses of up to 10 kGy is safe and does not present toxicological risks or losses in term of nutritional characteristics (AIEA, 1991). Irradiation is important as a promising technique among the available current resources for the conservation of food disease. About 500 million tons of several nutritive products are irradiated all over the world annually, seeking to reduce the risk of alimentary infections and to increase the shelf life (ICGFI, 1995).

Objectives

To verify cobalt 60 gamma radiation doses effects on physicalchemical, microbiological and sensorial characteristics of lean minced meat samples through tests assays performed along the storage time.

Methods

The samples were constituted of minced meat (*Quadriceps femoral*) with low lipid level, wrapped to vacuous and irradiated with doses of 0.80, 1.54, and 2.28 kGy and submitted to physicalchemical analysis (BRASIL, 1981): sensorial characterization (color and smell), pH, filtration proof (time and aspect), cooking proof (smell and liquid characteristic), ammonia research (Nessler test), H_2S proof; microbiological analyses (BRASIL, 1981): aerobic psychrotophic bacteria and molds and yeast counts; sensorial analysis (DELLA MODESTA, 1994.): non structured category scale (color, smell, aspect, taste); statistical analysis: linear correlation and Kruskal Wallis test (pH and filtration time and microbiological and sensorial analyses), Fisher's test for the other physicalchemical analyses, Wallis and Wilcoxan Mann Whitney's test for paired analysis.

Results and Discussion

In sensorial characterization, the color of samples control was initially dark red turning into pinky red. In irradiated samples, it became brown from the 54th day on. For control samples, smell alteration was apparent on the 24th day while in irradiated samples, this alteration was noticed from the second day on, becoming strongly altered from the 54th day of analysis on. In relation to the physicalchemical analysis; the pH values oscillated within the normal range (Figure 01) in agreement with the Brazilian legislation (BRASIL, 1997). The results were similar to the ones found by FU *et al.* (1995) that described pH values of 5,53; 5,46 and 5,51 in control samples; 5,48; 5,25 and 5,63 in irradiated samples with 0,80 kGy; and 5,52; 5,29 and 5,52 in samples irradiated with 2,0 kGy on days 0, 7 and 9 shelf. In the filtration proof, an increase of time filtration values was observed with the storage time evolution and the samples were considered suspicions on the 11th day (Figure 02), but the filtrate aspect always remained clean. In the ammonia research, only the samples analyzed until the 4th day showed completely negative results. The color alteration (yellowish) in all day showed completely negative results. The color alteration (yellowish) in all samples increased in conformity with shelf life but typical positive result (full orange) was not verified until the 66th day. In the cooking proof; regarding the smell, the control samples remained unaffected until the 17th day; while the irradiated samples demonstrated alteration from the 4th storage day. In relation to the aspect of the cooking liquid; a slight cloudiness was observed in control and irradiated samples. In relation to the sulphidric gas analysis; the control and irradiated samples showed only slight spots on the acetate paper, not characterizing a positive result. In relation to shelf life, no changes were evident in physicalchemical analysis that could indicate quality degradation of the product until the 39th day for irradiated sample with 0.80 kGy; and until the 47th day to those irradiated with 1,54 and 2,28 kGy ($p<0.05$).

Figure 1- pH and shelf life

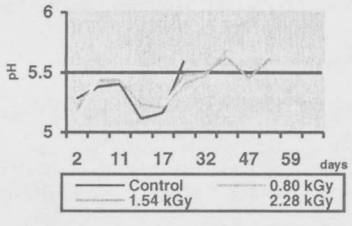
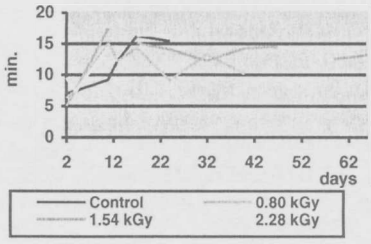


Figure 2 - Time filtration and shelf life



According to figures 3 and 4, the use of irradiation technology was shown to be more efficient in the reduction of psychrotophic aerobic bacterium ($r = - 0.662$) in relation to mould and yeast counts ($r = -0.578$), with no significant differences between the treatments made by gamma radiation ($p> 0.05$). Species of *Salmonella, Escherichia coli, Yersinia enterocolitica, Campylobacter sp.* and *Listeria monocytogenes* may be eliminated by relatively low doses. Molds such as *Aspergillus, Penicillium, Fusarium sp* are frequently reduced in number with a dose of 5 kGy. The absorbed dose from 3 to 7 kGy is high enough to reduce the number of microorganisms at an acceptable level without causing significant physicalchemical alterations in the foods (ICGFI, 1995). The results of this research demonstrated that smaller doses can be used to achieve significant reduction of the microorganisms in food, and at the same time, without significant alterations and that larger doses should be used in products destined to immune-depressed people, in accordance with the ICGFI (1991) which recommended that the absorbed dose should be enough to allow the technological purpose and the maximum should not exceed the limit of tolerance of the product.

Figure 3- Yeasts and molds count and shelf life

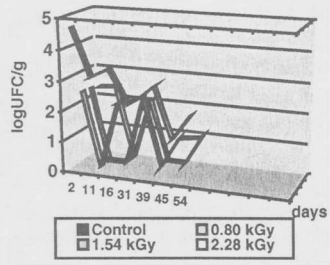
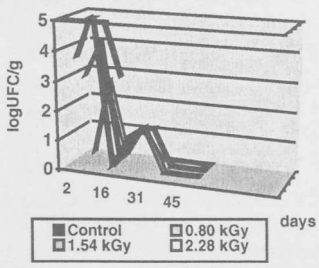


Figure 4- Aerobic psycrotrophic bacterium count and shelf life



Based on sensorial analysis it was observed (Table 01), that the irradiated samples results were stable, close to acceptance levels during the shelf life evolution. The samples irradiated with 0.80 kGy obtained better results, even when compared with control samples. For irradiated samples (1.54 and 2.28 kGy), however, there was a tendency of increase of the arithmetical averages with shelf life, but the results were always in the average acceptance range. There were no alterations in terms of color and aspect that could affect the quality of the samples. Nonetheless, significant differences were observed in flavor and smell ($p < 0.05$) among the irradiated samples. The results are in agreement with RHODES & SHEPHERD (1966) who stated that the maximum of radiation dose that can be applied in the bovine meat at 0ºC in the absence of atmospheric air, without causing sensorial alterations detected by panelists trained for sensorial analysis is 4 kGy. The sensorial analyses demonstrated that the panelists did not identify smell, taste, aspect and color that expressed disapproval of irradiated samples and the alterations were discreet and did not commit the final result. The results were similar to FU *et al.* (1995) where trained panelists did not notice color and smell alterations in samples of minced meat. The conclusions by NIEMAND *et al.* (1981) – in regard to samples of cow loin steaks wrapped to vacuous and irradiated with 2 kGy which could reach shelf life higher than 10 weeks - may be correlated to the ones in our research, which indicated a possible increase in shelf life as high as nine weeks. There is agreement with ICGFI (1991) that mentioned that the absorbed dose which produces increase of shelf life varies from 1 to 2,50 kGy and that usually, the minimum dose that it is effective under adequate local conditions should be used.

Table 1 – Sensorial analysis results (arithmetical averages)

Attribute	SAMPLES														
	Radiation Dose (kGy)/ Shelf life (days)														
	Control			0.80				1.54				2.28			
	04	11	24	04	11	24	39	04	11	24	39	04	11	24	39
Color	2.5	2.3	2.4	3.4	2.4	1.9	1.7	3.4	2.4	2.4	2.4	3.8	3.1	2.9	1.8
Smell	1.6	3.1	2.6	1.6	1.3	1.6	3.6	4.0	3.5	2.9	3.1	3.9	3.9	3.2	3.8
Aspect	3.2	3.9	3.2	3.1	3.3	2.3	2.2	3.9	3.1	3.3	2.3	3.3	2.9	3.8	3.0
Taste	2.4	3.2	4.8	3.8	2.4	2.4	2.5	5.7	3.9	3.4	4.1	5.6	5.5	4.1	4.6

Conclusions

The physicalchemical and sensorial analysis did not demonstrate any alterations which could commit the product quality until the 39th day for irradiated samples with 0.80 kGy and until the 47th day for the irradiated samples with 1.54 and 2.28 kGy and in cold temperature storage. The pH remained within normal values of consumption during the 59th and 66th days, respectively. The application of irradiation technology effectively reduced the microbial counts, being more effective in aerobic heterotrophic psycrotrophic bacteria counts. In the overall; irradiated samples with 0.80 kGy obtained the best results.

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