EFFECT OF GAMMA IRRADIATION IN HEME AND NONHEME IRON OF POULTRY MEAT

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Introduction

Different treatments are utilized to increase the shelf life of meat and eliminate or decrease microorganisms in it. Some methods used are refrigeration, freezing and modification of atmosphere among other treatments. Irradiation treatment for food preservation was approved by the Food and Agriculture Organization/ World Health Organization (FAO/WHO, 2000) for doses of up to 10 kGy. This dosage does not have a negative effect on nutritional proprieties or toxic effect on food. Nowadays twenty-six countries utilize this process on a commercial scale.

Iron is present in food in two principal forms, heme and nonheme iron. The first is a constituent of hemoglobin (which carries oxygen from the lungs to the tissues) and myoglobin (which stores the oxygen utilized for muscular contraction and is also constituent of enzymes). The second is present in ferrosulfuric proteins and metalflavoproteins which are involved in oxidative metabolism (Carpenter & Mahoney, 1992; Martinez et al ,1999).

Giroux & Lacroix (1998) verified that irradiation promotes alterations of desamination, descarboxylation, breakage of peptide links, reduction of sulfuric links and oxidation of sulfuric groups. These alterations are catalyzed by free radicals formed by water hydrolysis. Since the heme iron is inserted in the hemoglobin molecule by sulfuric links, an alteration in this molecule conformation is possible, transforming the heme iron in nonheme iron. For this reason the research of irradiation effects on poultry meat is necessary.

Objectives

The change in the amount of heme and nonheme iron was compared in fresh raw and cooked poultry meat (cuts of breast and leg with thigh) without irradiation and with radiation at commercial doses (2, 4, 6 and 8 kGy).

Material and Methods

The poultry meat (breast and leg with thigh) was obtained at local markets in, Piracicaba, SP Brazil. The cuts were taken to the laboratory, separated into plastic bags of approximately 500g (two pieces of legs with thighs and one piece of breast) and then immediately irradiated at CENA (Center of Energy Nuclear in Agriculture).

Chemical analysis of dry matter was done in triplicate according to the AOAC method (1995).

The iron was determined according to the method described by Sarruge & Haag (1974) which utilized digestion with nitric and percloric acid and wavelengths of 248 nm for reading.

The determination of nonheme iron was done according to the Ferrozine method, which is based on reduction (with ascorbic acid) and subsequent protein precipitation. After adding Ferrozine and others substances, the mixture developed a color which was determined by absorbency.

The determination of heme iron was done according to the Hornsey (1956) method based on extraction with acidified acetone, with some alterations.

The means of the treatment results were calculated from three repetitions for all analyses. The Tukey test was used to verify significance at 5%.

Results and discussion

The results of heme iron (Table 1)obtained for the raw leg with thigh samples varied from 2.92 µg/g to 6.47 µg/g in doses of 2 kGy and 6 kGy respectively. For the raw breast samples, the variation was from 2.83 µg/g to 3.91 µg/g (without irradiation and 4 kGy respectively). The cooked samples presented a variation from 5.61 µg/g to 9.40 µg/g (without irradiation and 6 kGy) for leg with thigh samples and from 3.53 µg/g to 4.51 µg/g (without irradiation and 2 kGy respectively)for breast samples

The results of heme iron for leg with thigh samples is in accord with the literature, which has reported changes from 3.6 µg/g to 5.1 µg/g. However for the breast samples the results showed a higher value than found in the literature (from 1.4 µg/g to 1.8 µg/g) (Carpenter & Clark, 1995).

The nonheme iron (Table 2) presented values for raw leg with thigh samples which varied from 5.85 µg/g to 6.16 µg/g (2 kGy and 8 kGy respectively) and from 6.38 µg/g to 7.68 µg/g (8 kGy and 2 kGy respectively) for cooked samples. The breast samples when raw varied from 3.34 µg/g to 4.68 µg/g (without irradiation and 6 kGy respectively), and when cooked from 4.44 µg/g to 6.79 µg/g (without irradiation and 4 kGy respectively). These results were similar to Carpenter & Clark (1995) who presented 4.68 µg/g for leg with thigh samples and 4.1 µg/g for breast sample.

The heme iron quantities are different between the cuts analyzed. The breast samples presented the lowest quantity and the cooked leg with thigh the highest quantity of heme iron.

The nonheme iron was lower for the breast. Cooking increased the nonheme iron for breast and leg with thigh samples.

The irradiation dose did not show a correlation with the quantity of heme iron.

Conclusion

Treatment with irradiation does not interfere with heme or nonheme iron in poultry meat at the doses used, but the cooking of the meat alters the quantities of these different forms of iron.

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Tables

Table 1: Heme iron (µg/g) in fresh raw and cooked poultry meat (cuts of breast and leg with thigh) without irradiation and with radiation at doses 2, 4, 6 and 8 kGy.

Dose	Breast	Breast	Leg with thigh	Leg with thigh
KGy	Raw	Cooked	Raw	Cooked
0	2.83±0.1*^{b}	3.53±0.5^{a}	4.63±0.3^{b}	5.61±0.4^{b}
2	3.37±0.1^{a}	4.51±0.6^{a}	2.92±0.2^{c}	6.17±0.8^{b}
4	3.91±1.6^{a}	4.17±0.5^{a}	5.72±0.2^{a}	8.80±1.5^{ab}
6	3.53±0.2^{a}	3.57±1.2^{a}	6.47±1.2^{a}	9.40±1.2^{a}
8	3.13±0.3^{a}	4.35±1.2^{a}	6.26±0.6^{a}	8.22±0.8^{ab}

*Average ± standard deviation of 3 repetitions. Values in the same column, followed by different letters, show significant difference (p 0.05).

Table 2: Nonheme iron (µg/g) in fresh raw and cooked poultry meat (cuts of breast and leg with thigh) without irradiation and with radiation at doses 2, 4, 6 and 8 kGy.

Dose	Breast	Breast	Leg with thigh	Leg with thigh
kGy	Raw	Cooked	Raw	Cooked
0	3.34±0.2*^{b}	4.44±1^{b}	5.96±0.8^{a}	6.62±1.1^{a}
2	3.51±0.3^{b}	5.46±0.5^{ab}	5.85±0.6^{a}	7.68±0.8^{a}
4	4.68±0.2^{a}	6.79±0.5^{a}	5.72±0.8^{a}	6.99±0.7^{a}
6	4.64±0.2^{a}	6.59±1.2^{a}	6.05±1.7^{a}	6.66±0.2^{a}
8	3.82±0.2^{ab}	6.14±0.0^{a}	6.16±2.6^{a}	6.38±1.1^{a}

*Average ± standard deviation of 3 repetitions. Values in the same column, followed by different letters, show significant difference (p 0.05).

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