# Effect of mild irradiation doses on quality attributes of meat trimmings for production of patties

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## Introduction

Physicochemical parameters such as pH, color and lipid oxidation are gross indicators of meat quality, as well as sensory attributes (Shahidi, 1994).
Bovine trimmings are the main ingredient of patties produced worldwide. Since this meat results from mechanical disruption of several muscles, assessing microbiological markers (total *mesophilic* counts, *Escherichia coli* counts) and absence of pathogenic strains become mandatory and are used as trade standards.

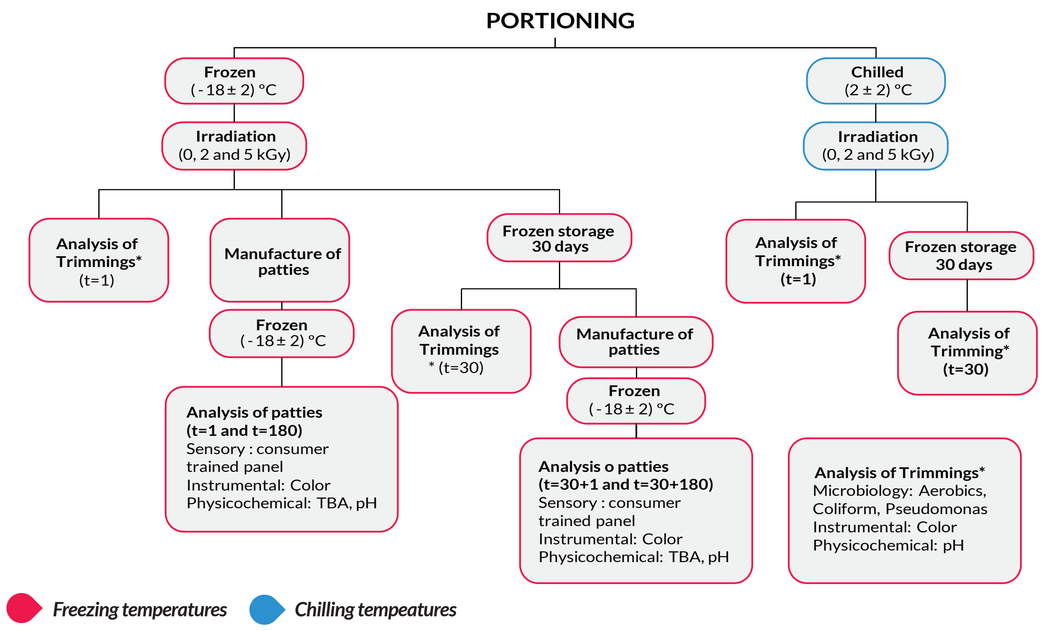
Irradiation may be applied to packaged products extending their shelf-life and improving their microbiological safety with minimal effects on their chemical composition, nutritional and sensory properties. Food spoilage microorganisms are generally very susceptible to irradiation. Even at low dose, irradiation can initiate or promote lipid oxidation resulting in undesirable off-odors and flavors (Lescano et al. 1991) and can produce a variety of color changes.

**The objectives of the present work were to assess the use of moderate doses of irradiation (2 and 5 kGy) as a tool to reduce the microbial load without altering the quality attributes of bovine trimmings and of patties made of irradiated trimmings. The study included microbiological indicators during 30 days of storage (*coliforms*, *pseudomonas* and *mesophilic* aerobics counts); physicochemical indicators (pH and color) and sensory changes during a 180 day storage period at freezing temperatures.**

## Materials and methods

Quality attributes of trimmings, irradiated at freezing (– 18 ± 2 °C) or chilling (2 ± 2 °C) temperatures, and patties made of irradiated trimmings were assessed on microbiological, physicochemical and sensory analyses **(Fig. 1)**

### *Meat Quality Attributes*




**Obtaining beef trimmings**
Beef trimmings (20% fat) were obtained from a local slaughter house.
Fresh trimmings (0 days age) from grass-fed animals were divided at deboning room in 2,5 Kg and 200 g portions for patty manufacture and trimming analysis, respectively.

**Irradiation method**
Trimmings were irradiated at target dose of 2 kGy (D1) and 5 kGy (D2).
Non-irradiated (NI, 0 kGy) samples were used as control.
Irradiation process was carried out at room temperature under a Cobalt-60 radiation source (Modular Equipment EMI-9, dry shield, Buenos Aires, Argentina).

**Production of patties**
Batches of frozen beef trimmings irradiated at NI, D1 and D2 were fine ground.
Ground beef was mixed with salt (0,75 %), citric acid (0,2 %) and ascorbic acid (0,7 %).
Packaging was carried out using polypropylene bags heat sealed .
Another series of patties manufacture were performed with irradiated trimmings aged 30 days.
The patties were stored up to 180 days from their elaboration.

**Analysis**
- ***Trimmings irradiated at NI, D1 or D2:*** Microbiological (Total Aerobic counts, *Coliform* enumerations, *Pseudomonas* spp.), pH, and instrumental color analyses were carried out on frozen and chilled trimmings samples stored 1 and 30 days.
- ***Patties manufactured from trimmings irradiated at NI, D1 or D2:*** Instrumental color and sensory analysis (trained panel and consumers evaluation) were carried out 1d after elaboration and after 180d of frozen storage.



## Results and discussion

### Microbiology

| | NI (0 kGy) | | | | D1 (2 kGy) | | | | D2 (5 kGy) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Chilled | | Frozen | | Chilled | | Frozen | | Chilled | | Frozen | |
| | 1d | 30d | 1d | 30d | 1d | 30d | 1d | 30d | 1d | 30d | 1d | 30d |
| **Total Aerobic log(cfu/g)** | 2,68[a] | 2,54[a] | 2,68[a] | 2,72[a] | 0,45 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| **Pseudomonas log ( cfu/g)** | 1,82[a] | 1,18[b] | 2,03[a] | 1,11[b] | <1 | <1 | <1 | <1 | <1 | <1 | <1 | <1 |
| **Coliforms (NMP/g)** | <3 | <3 | <3 | <3 | <3 | <3 | <3 | <3 | <3 | <3 | <3 | <3 |
| ***E. coli* (NMP/g)** | <3 | <3 | <3 | <3 | <3 | <3 | <3 | <3 | <3 | <3 | <3 | <3 |

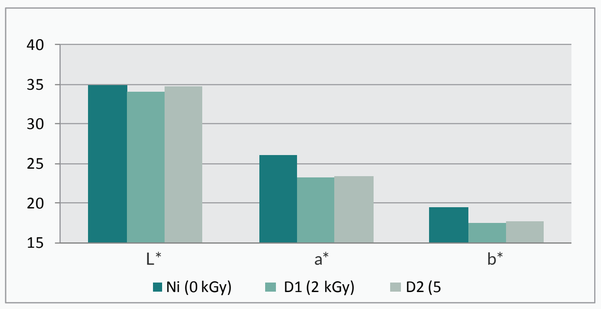
**Table 1**. Mean values of microbiological counts performed on beef trimmings irradiated at Ni (0 kGy), D1 (2 kGy) and D2 (5 kGy) under chilling (2 ± 2 °C) or freezing (−18 ± 2 °C) temperatures (n = 6). Within rows, means values with common letters (a, b) do not significantly differ (P N 0.05).

Table 1 shows that an irradiation dose of 2 kGy is able to produce a reduction of at least 1,5-log cycles from a total aerobic initial count of 3-log cfu/g and also provokes reduction of at least 1-log cycle in *Pseudomonas* spp., from an initial load of 2 log cfu/g.
- The temperature of the different irradiation treatments (chilling vs freezing) did not significantly affect the results.
- Overall, irradiation at D1 dose had a significant improvement on hygienic quality which was practically similar to that caused by an irradiation dose of 5 kGy.
- For both irradiation doses, reductions obtained on day 0 after treatment were preserved during a 30 day storage period at freezing temperatures.

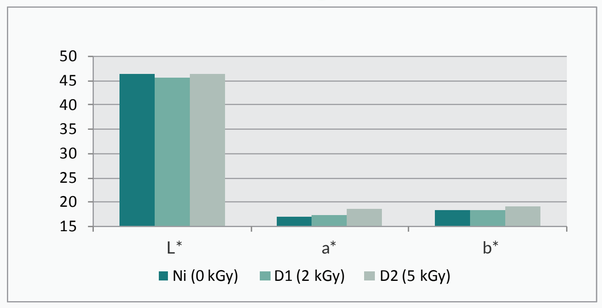
### Color

Non irradiated (Ni) samples presented higher **a* and b*** values than the irradiated ones.
Obtained values of a* and b* were affected by the temperature of irradiation process, and they were significantly lower in chilled samples.
Irradiation dose did not significantly affect **L*, a* and b*** values on beef patties (P > 0,05).

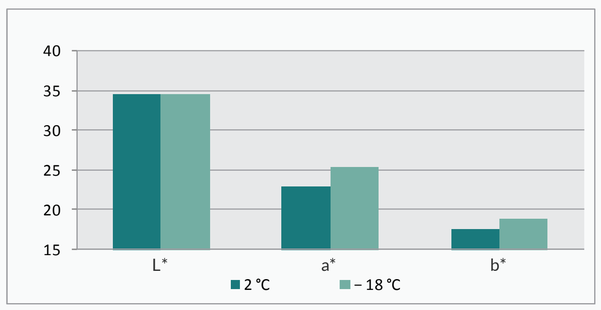
***Trimming - Color vs irradiation dose*** **A**




***Patties - Color vs irradiation dose*** **B**




***Trimming - Color vs irradiation temperature*** **C**




***Patties - Color vs storage time*** **D**

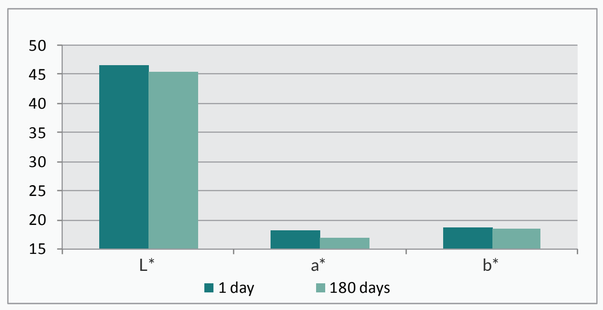
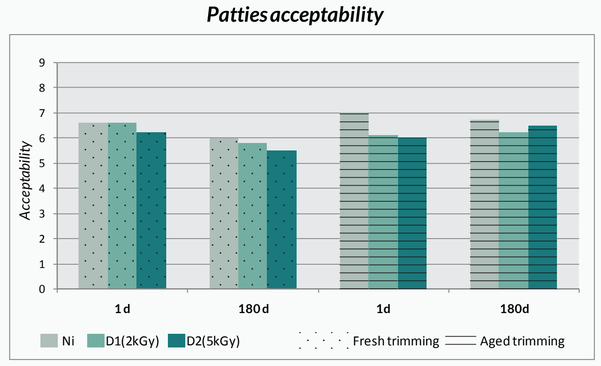



**Figure 2.** CIELAB color parameters of beef trimmings ( 2A and 2B) and of patties (2C and 2D)

### Sensory evaluation

***Patties acceptability***




***Off flavor intensity***

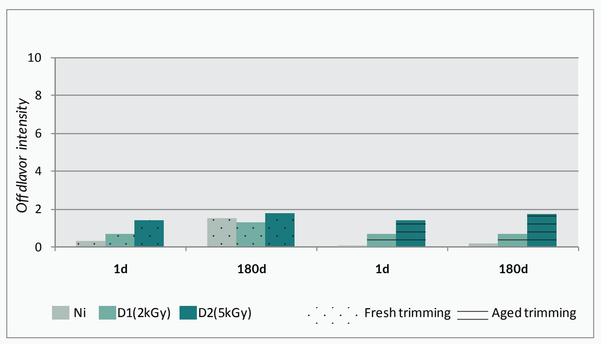



**Figure 3**. Odd flavor intensity mean rates for patties made of fresh (1d) and aged (30 d) trimmings. Treatment means with common letters (a-b) are not significantly different (P>0.05).

**Figure 4**. Acceptability mean values for patties made of fresh (1d) and aged (30d) trimmings. Treatment means with common letters (a,b) are not significantly different (P>0.05).

Off-flavor intensity of patties was the only parameter where judges detected differences. Nevertheless, values obtained for off flavor were all below 2 in a 0 to 10 scale.
Figure 3 and figure 4 show that patties made of aged trimmings irradiated at D2 on 1day of storage had a higher off-flavor intensity (P>0,05) and a significantly smaller acceptability (P>0,05) than patties made of non-irradiated aged trimmings, however the acceptability was higher than 6.
On 180 day of storage, patties made of 30d aged trimming had slightly higher (P>0,05) acceptability than patties made of fresh trimming (data non shown).

## CONCLUSIONS

**The results of meat quality attributes (pH, color, sensory analysis, *Pseudomonas* spp., coliforms and mesophilic counts) implies that irradiation may provide an alternative capable of decreasing the microbial load of meat products while slightly altering its physicochemical and sensory properties of trimmings and patties.**

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