PERGAMON

Radiation Physics and Chemistry 63 (2002) 341–343

Radiation Physics and Chemistry

www.elsevier.com/locate/radphyschem

Gamma radiation, cold and four different wrappings to preserve ginger rhizomes, *Zingiber officinallis* Roscoe

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Abstract

After irradiating with a single dose of 50 Gy, ginger rhizomes were dipped into paraffin for coating, wrapped in a plastic film of low-density polyethylene, on perforated or non-perforated polivinyl chloride film, and compared with non-wrapping and non-irradiation as the controls. After treatments the rhizomes were maintained refrigerated at 13°C and 80% relative humidity. As a main result it could be observed that dipping into paraffin and wrapping with plastics resulted in smaller weight loss of the rhizomes. © 2002 Published by Elsevier Science Ltd.

Keywords: Food irradiation; Food preservation; Ginger

1. Introduction

In some countries like Thailand, Japan, France, The Netherlands and many others the technology of food irradiation is used commercially. Losses due to sprouting of potatoes, onions, yams, garlic and ginger were reduced significantly without the addition of chemical substances, and many authors like Loaharanu (1972, 1974); Ikeda (1975); IAEA (1977, 1979, 1990, 1993); Nair et al. (1973); Thomas (1975, 1984, 1986, 1991); Thomas et al. (1975); Mukerjee (1995); Nketsia-Tabiri, (1998); and Pauli et al. (1988) published detailed studies on the effects of radiations on many different agricultural products, including rhizomes. In 1993 Käferstein and Moy confirmed that food irradiation is no longer a simple scientific curiosity but a technology ready for use in food supply programmes of developed and developing countries. They pointed out that irradiation is perhaps the only method capable of reducing food losses without affecting public health or the environment and not even increasing the prices of the products treated in this manner. In Brazil Wiendl (1986), showed in a meeting with South American scientists that food irradiation could be the answer to prevent the heavy losses occurring in the agriculture of the continent. Also, Wiendl and Arthur (1999) concluded that the best dose for prolonging the shelf life of onions, whose losses due to sprouting could reach more than 60% of the yield, was 40 Gy.

Thus, the main objective of the present research was to determine whether, beyond the single dose of 50 Gy of gamma radiations, if an even greater increase of effectiveness could be achieved using protection against loss of water due to transpiration and evaporation like dipping of the rhizomes into paraffin or wrapping into plastic films.

2. Materials and methods

The experiments were carried out in the Laboratory of Horticulture of the Department of Vegetable Production of the "Escola Superior de Agricultura Luiz de Queiroz", (Esalq), University of São Paulo (Usp), in Piracicaba, State of São Paulo, Brazil.

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0969-806X/02/$ - see front matter © 2002 Published by Elsevier Science Ltd.
PII: S0969-806X(01)00673-9

Table 1
Mean number of sproutings on ginger rhizomes irradiated with a single dose of 50 Gy of gamma radiations of ^{60}Co

Treatments	17–25°C, non-irradiated	13°C, non-irradiated	17–25°C, irradiated	13°C, irradiated
Control	11.22[a]	0.25[a]	0.00[a]	0.25[a]
Paraffin dipped	9.00[a]	0.00[a]	0.00[a]	0.00[a]
Plastic wrap	11.75[a]	0.00[a]	0.75[a]	0.25[a]
Perforated plastic	12.75[a]	0.00[a]	0.15[a]	0.25[a]
Styrofoam tray	9.00[a]	0.00[a]	0.25[a]	0.25[a]

All values are similar at the 95% confidence level—Tukey test (columns).

The rhizomes of ginger were harvested at the end of May 1998, than washed and dried in the shadow during 4 days. After drying they were separated into parcels of ~150 g, also taking into account the shape of the rhizomes. These parcels were combined into 20 treatments, and for statistical purposes separated into five blocks, holding four replicates or parcels each, totalling the 80 replicates of the whole experiment.

Forty of the replicates were irradiated with a single dose of gamma radiation of 50 Gy, at a dose rate of 1.05 kGy/h. The treatment includedthe following: controls packed into net bags to hold them together, rhizomes dipped individually into paraffin at 50°C and then also packed into nets, rhizomes packed into low-density polyethylene bags, intact or 25% perforated, and rhizome held on styrofoam trays covered with a thin PVC film. The experiment was carried out under two environmental conditions: in a chamber regulated at 13°C and 80% relative humidity and in the ambient conditions of the laboratory, varying from 17°C to 25°C and relative humidity from 60% to 80%.

The rhizomes were checked at 2 week intervals, during 4 months. The parameters checked were loss of weight and visual quality, estimated by a criteria of notes including measurements of sproutings, and the presence of rotting microorganisms.

The results were submitted to a statistical analysis of variability and the means compared by the Tukey test.

3. Results and discussion

It could be observed that the protection of the rhizomes through irradiation showed to be the most promising treatment, mainly if cold could also be provided. If a tight plastic packaging or dipping into paraffin was done, the conservation was almost perfect (Table 1).

It could be observed that, under both environmental conditions used, dipping into paraffin followed by the non-perforated plastic bagging was the most indicated method to preserve the ginger rhizomes. The weight losses were, respectively, 96.8% and 94.4% smaller, under refrigerated and ambient conditions. Statistically, the use of packaging was more important than refrigeration; thus the weight loss with plastic wrapping diminished by 56.3% in relation to the non-wrapped rhizomes. (Table 2).

Table 2
Mean values of weight loss (in grams) of ginger rhizomes comparing the use of cold (13°C) and ambient temperature (17–25°C) in irradiated samples

Treatments	17–25°C	13°C
Control	0.205[a]	0.116[a]
Paraffin dipped	0.154[b]	0.059[b]
Plastic wrap	0.094[c]	0.050[b]
Perforated plastic	0.009[d]	0.004[c]
Styrofoam tray	0.143[b]	0.035[d]

Values followed by the same letter are similar at the 95% confidence level—Tukey test (colums).

Table 3
Mean values of notes (from 1.000, best, to 3.000, worst) of ginger rhizomes comparing the use of cold (13°C) and laboratory conditions (17–25°C) on irradiated samples

Treatments	17–25°C	13°C
Control	3.000	2.000
Paraffin dipped	1.125	1.125
Plastic wrap	2.250	1.000
Perforated plastic	1.125	1.000
Styrofoam tray	2.250	1.000

From the viewpoint of appearance, paraffin dipping and plastic bagging showed to be more suitable, but the use of cold conditions would also enhance the quality of the rhizomes treated in this manner. (Table 3).

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