Characteristics of postharvest quality in regional fruits treated with ionising radiation

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Abstract: Quality postharvest of three cultivated species of the Northeast Region of Brazil was evaluated after receiving ionising radiation. Cashew peduncles (*Anacardium occidentale* L. var. Nanum) stored for 14 days under 6.5°C had presented best results in the sensorial analyses for external appearance, flavour and aroma when irradiated with 1 kGy. Sapodillas (*Manilkara sapodilla* (L) Van Royen) irradiated with doses of 300, 600 and 900 Gy have not displayed harmed sensorial qualities when stored under 20°C during 12 days. Doses up to 800 Gy had not harmed the external and internal appearance of mangaba (*Hancornia speciosa* Gomes) after stored for fortnight under 13°C. Values of Total Soluble Solids, Total Titratable Acidity, pH and solid/acidity ratio have not been affected significantly by the different doses applied to the three studied species. Amount of ascorbic acid was lower in the irradiated fruits for the species *A. occidentale* L. var. Nanum and *H. speciosa* Gomes.
Keywords: radiation ionising; storage; conservation; postharvest; regional fruits; sensorial analyses.


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1 Introduction

Regional fruits are widely appreciated due to their nutritional value and organoleptic characteristics, and the interest for the consumption of so-called exotic species in natura has increased in recent years. This has social and economic importance, as fruit production is the sole source of income for many families.

Brazil’s Northeast has a great potential for the culture of cashew (A. occidentale L. to var. Nanum), sapodilla (Manilkara sapodilla L., Van Royen) and mangaba (Hancornia speciosa Gomes). These species have shown great adaptation to dry and hot weather and high luminosity prevalent in the region (Gomes et al., 2006). However, the culture of these species is still largely extractivist, with a few areas where rational planting is applied. One way or another, the production as a whole lacks more refined technology, with special regard to postharvest, which could dramatically improve fruit quality and increase the producers’ income (Bandeira et al., 2003; Silva et al., 2006; Ledo et al., 2007; Mendonça et al., 2007).
Application of new postharvest technologies will make possible the opening of new markets for these fruits, so far restricted almost exclusively to Brazil’s Northeast. The knowledge on postharvest quality will complement research that is being carried through with the objective of filling supermarket shelves with good quality fruits. Use of ionising radiation as method of conservation of foods is considered one emergent technique of the 21st century, and has been justified on the basis of constant losses of agricultural products such as cereals and fruits, besides the interest of health authorities in reducing the amount of chemicals used in postharvest for conservation during transport, storage and commercialisation (Moy, 2005).

In the present work, the main characteristics of postharvest quality of regional fruits after application of different doses of ionising radiation have been investigated.

2 Methodology

Dwarf-precocious cashew (*A. occidentale* L. to var. Nanum), sapodilla (*M. sapodilla* L., Van Royen) and mangaba (*H. speciosa* Gomes), cultivated in the Northeast Region of Brazil and harvested with complete physiological maturation, had received the following treatments: dwarf-precocious cashew: doses of 1.0, 2.0 and 3.0 kGy and stored during 14 days under 6.5°C and 50% of RH, total of 80 dwarf-precocious; sapodilla: doses of 0.3, 0.6 and 0.9 kGy and stored during 12 days under 20°C and 57% RH, total of 80 fruits; mangaba: doses of 0.4, 0.8 and 1.2 kGy and stored during 15 days under 13°C and 58% of RH, total of 168 fruits. They were afterwards analysed sensorially and chemically. All species had been conditioned in styrofoam trays and covered with a 12 µ thick PVC film.

1 *Sensory analyses*: A test of acceptability with use of a 9-point hedonic scale (9 = like very much) was performed. Small pieces of the fruits were randomly served in appropriate cabins. All fruits were individually analysed with external and internal appearance.

2 *Soluble Solids (SS)*: It was determined by refractometry. An Atago refractometer was employed, with the results expressed in percentage of °Brix, as recommended by Institute Adolfo Lutz (1985).

3 *Titratable Acidity (TA)*: Determined by electrometric procedure, as specified by Institute Adolfo Lutz (1985). Results are expressed in percentage of citric acid in the pulp.

4 *(Soluble solids): (titrable acidity) ratio*: Calculated as the quotient between the two parameters above.

5 *Potential of hydrogen (pH)*: Determined by means of a digital pH meter with a glass electrode dipped in the solution containing the triturated pulp.

6 *Amount of vitamin C*: Determined with the methodology specified by Carvalho et al. (1990), having as reacting main the solution of 2,6-dichlorophenolindophenol. Results expressed as milligram of ascorbic acid per 100 g of pulp.

7 *Statistical delineation*: It used a fully casualised delineation, and the found values were submitted to the analysis of variance (*F* test) and comparison of the averages for the test of Tukey, in accordance with Gomes (2002).
3 Results and discussion

The best dose for the dwarf-precocious cashew was of 1.0 kGy (Table 1), whereas doses of 3.0 and 2.0 kGy have harmed the external appearance and reduced the firmness of the pulp, thus favouring the development of phytopathogens.

Significant differences were not found in the sensorial analyses of sapodilla, with marks equal to or higher than 6.6 for all variables studied in a scale of 1–9 (Table 1). However, at the end of the experiment control fruits showed a higher degree of maturation and lower firmness of the pulp to the touch. Besides, internal appearance of the pulp, in the majority of the fruits, was darker than that of the irradiated fruits. This, however, did not affect the general flavour of these fruits that were greatly appreciated by the appraisers. On the other hand, the succulence and the texture of the pulp have been favoured by doses of 0.60 and 0.90 kGy.

Table 1 Statistical results of the sensorial analyses of two regional species submitted to different doses of ionising radiation

<table>
<thead>
<tr>
<th>Dose (kGy)</th>
<th>Anacardium occidentale (L)*</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>External appearance</td>
<td>Internal appearance</td>
<td>Aroma</td>
<td>Flavour</td>
<td></td>
</tr>
<tr>
<td>0.00</td>
<td>7.30 a</td>
<td>7.20 a</td>
<td>6.20 a</td>
<td>5.40 ab</td>
<td></td>
</tr>
<tr>
<td>1.00</td>
<td>7.70 a</td>
<td>6.90 a</td>
<td>6.60 a</td>
<td>6.30 a</td>
<td></td>
</tr>
<tr>
<td>2.00</td>
<td>5.0 b</td>
<td>6.90 a</td>
<td>4.40 ab</td>
<td>4.10 ab</td>
<td></td>
</tr>
<tr>
<td>3.00</td>
<td>4.70 b</td>
<td>5.60 a</td>
<td>3.50 b</td>
<td>3.70 b</td>
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</tr>
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</table>

<table>
<thead>
<tr>
<th>Dose (kGy)</th>
<th>Manilkara sapodilla (L)*</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>External appearance</td>
<td>Internal appearance</td>
<td>Sweetness</td>
<td>General flavour</td>
<td>Texture</td>
</tr>
<tr>
<td>0.00</td>
<td>8.30 a</td>
<td>6.60 a</td>
<td>6.80 a</td>
<td>7.2 a</td>
<td>7.30 a</td>
</tr>
<tr>
<td>0.30</td>
<td>8.30 a</td>
<td>7.20 a</td>
<td>7.40 a</td>
<td>6.80 a</td>
<td>7.20 a</td>
</tr>
<tr>
<td>0.60</td>
<td>7.90 a</td>
<td>7.00 a</td>
<td>6.90 a</td>
<td>6.80 a</td>
<td>8.20 a</td>
</tr>
<tr>
<td>0.90</td>
<td>8.30 a</td>
<td>6.90 a</td>
<td>6.80 a</td>
<td>6.60 a</td>
<td>8.00 a</td>
</tr>
</tbody>
</table>

Notes: * Stored during 14 days under temperature of 6.5°C.
# Stored during 12 days under temperature of 20°C.

Averages followed by the same letter in the vertical line do not differ statistically for the test of Tukey (p < 5%); Scale: 1 = bad; 5 = good; 9 = very good.

For mangaba, control fruits also displayed greater firmness of the pulp to the touch, as tests with the penetrometer could not be carried out. For this species, some 50% of control fruits showed ‘wrinkling’, a condition that affected only 24% of those that received 0.40 kGy. It was observed that doses above 1.20 kGy harmed the external appearance of the fruits, causing darkening of the rind.

Chemical analyses of SS, TA, soluble solids/total acidity ratio and hydrogen potential (pH) did not result in significant differences between the different doses applied for the three studied species, which indicates little influence of the ionising radiation on quality characteristics of these fruits, as had been observed by other researchers (Camargo et al., 2006; Palou et al., 2007). However, the amount of vitamin C was affected by ionising radiation in the species Anacardium occidentale (L) and H. speciosa Gomes (Table 2), with lower figures in the fruits that had received the highest doses, when compared with control fruits.
Table 2  Statistical results of the chemical analyses of three regional species submitted the different doses of ionising radiation

<table>
<thead>
<tr>
<th>Dose (kGy)</th>
<th>SS (*Brix)</th>
<th>TA (% citric acid in juice)</th>
<th>Ratio SS/TA</th>
<th>pH</th>
<th>Vit. C (mg ascorbic acid/100 ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Anacardium occidentale (L)*</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>0.00</td>
<td>10.72 a</td>
<td>0.24 a</td>
<td>44.66 a</td>
<td>4.29 a</td>
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<td>1.00</td>
<td>10.49 a</td>
<td>0.25 a</td>
<td>42.52 a</td>
<td>4.26 a</td>
<td>192.38 ab</td>
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<tr>
<td>2.00</td>
<td>10.27 a</td>
<td>0.20 a</td>
<td>50.96 a</td>
<td>4.45 a</td>
<td>181.69 ab</td>
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<tr>
<td>3.00</td>
<td>10.41 a</td>
<td>0.22 a</td>
<td>48.69 a</td>
<td>4.48 a</td>
<td>133.00 b</td>
</tr>
<tr>
<td></td>
<td>Manilkara sapodilla (L)#</td>
<td></td>
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<tr>
<td>0.00</td>
<td>22.30 a</td>
<td>0.14 a</td>
<td>158.28 a</td>
<td>5.00 a</td>
<td>3.32 a</td>
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<td>21.67 a</td>
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<td>149.62 a</td>
<td>4.70 a</td>
<td>2.85 a</td>
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<td>0.60</td>
<td>20.49 a</td>
<td>0.13 a</td>
<td>155.22 a</td>
<td>5.01 a</td>
<td>3.33 a</td>
</tr>
<tr>
<td>0.90</td>
<td>22.32 a</td>
<td>0.17 a</td>
<td>133.48 a</td>
<td>4.97 a</td>
<td>3.80 a</td>
</tr>
<tr>
<td></td>
<td>Hancornia speciosa (Gomes)†</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.00</td>
<td>17.28 a</td>
<td>1.91 a</td>
<td>9.06 a</td>
<td>3.15 a</td>
<td>159.47 a</td>
</tr>
<tr>
<td>0.40</td>
<td>16.67 a</td>
<td>1.91 a</td>
<td>8.81a</td>
<td>3.20 a</td>
<td>127.27 ab</td>
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<tr>
<td>0.80</td>
<td>17.25 a</td>
<td>1.77 a</td>
<td>9.75 a</td>
<td>3.20 a</td>
<td>125.73 ab</td>
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<td>1.20</td>
<td>17.83 a</td>
<td>1.69 a</td>
<td>10.52 a</td>
<td>3.22 a</td>
<td>93.53 b</td>
</tr>
</tbody>
</table>

Notes: * Stored during 14 days under temperature of 6.5°C.  
# Stored during 12 days under temperature of 20°C.  
† Stored during 15 days under temperature of 13°C.  
Averages followed by the same letter in the vertical line do not differ statistically for the test of Tukey (p < 5%).

4 Conclusion

In this paper we presented what ionising radiation had more effect on the sensorial characteristics than that on the chemical characteristics of the studied species, with exception of the amount of vitamin C. As all species studied are not well known with respect to postharvest physiology, more research must be carried through with use of this technology so that its effects are fully understood.

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References


