Compositional and Sensory Analyses of Sweetpotatoes after X-ray Irradiation Quarantine Treatment

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Abstract. Sweetpotato [*Ipomoea batatas* (L.) Lam.] roots of two Hawaii-grown clones were treated with 100 to 600 Gy X-ray irradiation and evaluated for quality before and after cooking. Root moisture content, surface color, and glucose and fructose concentrations were not affected by irradiation treatment for either the red-skin, yellow-flesh (RY) or the white-skin, purple-flesh (WP) clones. Firmness decreased at higher doses for RY roots, but not for WP roots. The alcohol insoluble solids and the starch concentrations of raw roots decreased linearly in response to increasing dose for both clones. Maltose decreased at higher doses in cooked RY roots only. Irradiation had the greatest effect on sucrose concentrations, which increased linearly in response to dose as starch concentrations decreased. A sensory panel perceived sweetpotato roots treated with 600 Gy irradiation as sweeter than control roots. Panelists found the overall acceptability to be the same for control and 600 Gy treated roots for both clones.

The diversification of Hawaii's agricultural industry depends on exporting new, high value crops from the islands. Hawaii's vegetable growers produce several unique varieties of sweetpotatoes [*Ipomoea batatas* (L.) Lam.], including purple-fleshed cultivars. Sweetpotatoes are subject to quarantine restrictions and are treated with methyl bromide before shipment to mainland U.S. and international markets. However, methyl bromide production, importation and use are being phased out, because it is an ozone-depleting substance (United Nations Environmental Programme, 2000). A market window exists for Hawaii's sweetpotatoes (Valenzuela et al., 1994), and shipments could increase if alternatives to methyl bromide fumigation are available.

The island of Hawaii has a commercial electron-beam facility that is used for quarantine treatment of tropical fruit. Irradiation doses up to 1000 Gray (Gy) have been approved by the U.S. Food and Drug Administration for the preservation and disinfestation of fruits and vegetables (Federal Register, 1986). Entomologists have developed irradiation treatments for quarantine security against the sweetpotato weevil [*Cylas formicarius elegantulus* (Summers)], the most important insect pest of sweetpotato in the field and during storage (Dawes et al., 1987; Hallman, 2001). An irradiation dose of 165 Gy was approved by the California Department of Agriculture in 2000 for quarantine security against sweetpotato weevils (Hallman, 2001).

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However, Hawaii also has infestations of the West Indian sweetpotato weevil [*Euscepes postfasciatus* (Fairmaire)] and the sweetpotato vine borer [*Omphisa anastomosalis* (Guenee)] (U.S. Dept. Agriculture, APHIS-PPQ, 2002). Recently, the U.S. Dept. of Agriculture, Animal and Plant Health Inspection Service (USDA-APHIS) issued a final rule that allows for the movement of sweetpotatoes from Hawaii following irradiation with a minimum dose of 400 Gy (Federal Register, 2004).

Previous studies using gamma (γ)-irradiation on sweetpotato roots were conducted with orange or white fleshed cultivars and did not quantify carbohydrate profiles after irradiation (Hallman, 2001; McGuire and Sharp, 1995), or measure maltose (Ajlouni and Hamdy, 1988; Lu et al., 1986), the major sugar produced in cooked roots. Sensory tests on baked roots showed that acceptability was severely reduced (Lu et al., 1986), and roots developed dark mottling at γ -irradiation doses of 500 Gy or above (Hallman, 2001; McGuire and Sharp, 1995). In one study, irradiated roots (200 to 1000 Gy) tasted sweeter than nonirradiated roots, but were not preferred by a sensory panel due to darker internal color (McGuire and Sharp, 1995). However, Hallman (2001) reported that roots treated with a 300 Gy dose did not differ from control roots in color, and there were no differences in organoleptic ratings. No information is available regarding the compositional quality of Hawaii's sweetpotato cultivars after irradiation treatment.

Picha (1985) developed a high pressure liquid chromatography (HPLC) method for the separation of sugars in raw and baked sweetpotatoes. Sucrose is the predominant sugar in raw roots, whereas maltose is absent in raw roots and highest in cooked roots. Sweetness of cooked roots is largely due to hydrolysis of starch to maltose and short-chain oligosaccharides by α -amylase and β -amylase (Morrison

et al., 1993). Heat activates the amylases upon cooking. The primary β -amylase product, maltose, confers sweetness to cooked roots, although maltose is less sweet than sucrose, glucose, or fructose (Biester et al., 1925).

A high total sugar content in raw sweetpotato roots does not necessarily result in higher sugar content in cooked roots (LaBonte et al., 2000). A cultivar could have a low amount of available starch for hydrolysis to maltose. Morrison et al. (1993) proposed four classifications for sweetpotatoes according to sugar concentrations in raw roots and starch hydrolysis during baking: 1) low initial sugar concentration and low starch hydrolysis, 2) low initial sugar concentration and high starch hydrolysis, 3) high initial sugar concentration and low starch hydrolysis, and 4) high initial sugar concentration and high starch hydrolysis. Traditional U.S. cultivars (such as the moist, orange-fleshed 'Jewel') are in class four. It was unknown which categories describe Hawaii's sweetpotato cultivars and how irradiation affects the quality of these cultivars. Our objectives were to determine the compositional and sensory attributes of Hawaii-grown sweetpotatoes following X-ray irradiation treatments at target absorbed doses up to 600 Gy.

Materials and Methods

Plant material. Sweetpotato roots of two local dry-fleshed clones were obtained from a grower on the Hamakua coast on the island of Hawaii on 29 May 2002. The roots had been harvested on 26 May 2002 and held at ambient conditions in a packing shed. The first clone was a white-skinned, purple-fleshed (WP) type similar to 'Okinawan' and 'Rapoza'. The second clone was a red-skinned, yellow-fleshed (RY) type similar to '71-5' (Valenzuela et al., 1994). Both of these sweetpotato clones are commonly grown on the island and consumed by the local population. Roots were culled before curing for 9 d at 30 °C and 90% relative humidity at the U.S. Pacific Basin Agricultural Research Center in Hilo, Hawaii, before treatments were applied. Root size ranged from 100 to 150 g for the WP clone and from 150 to 200 g for the RY clone.

Irradiation treatment. Sweetpotato roots (6.75 kg) were placed into fiberboard boxes for treatment at a commercial irradiation facility on the island of Hawaii (Hawaii Pride, Kea'au, Hawaii). WP and RY roots were mixed together inside each box. The facility uses an electron linear accelerator (5 MeV, model TB-5/15; SureBeam Corp., San Diego, Calif.) and converts the e-beam into X-rays for treatment of produce. Dosimeters (Opti-chromic detectors, FWT-70-83M, Far West Technology, Goleta, Calif.) were placed at six locations inside and two locations outside each box. The dosimeters were read at 600 nm with a FWT-200 reader (Far West Technology) to determine the dose variation within each box. Roots were treated with target absorbed doses of 0, 100, 200, 400, or 600 Gy irradiation at ambient temperature. Each irradiation dose was replicated four times. The average minimum and maximum absorbed doses inside the boxes were 107–117, 193–207, 386–407, and 573–602 Gy, with corresponding

dose uniformity ratios of 1.09, 1.07, 1.05, and 1.05, for the 100, 200, 400, and 600 Gy target dose treatments, respectively. Following treatment, roots were stored at 14.5 °C and 85% relative humidity for 2 weeks before quality analyses were performed. Control roots (0 Gy) were not subjected to irradiation, but were stored for 2 weeks.

Quality analyses. Quality and compositional analyses were performed on raw and cooked roots. Four roots of WP and RY clones were randomly sampled from each box for analyses. The external and internal surface colors of roots were quantified using a chromameter (Minolta Corp., Ramsey, N.J.) calibrated to a standard white reflective plate. Data were recorded as lightness (L*), chroma (C*), and hue angle (h°). Color values of four roots per sample were measured at three locations externally for each root. Firmness was measured on these same four roots using a force gauge mounted on a motorized test stand (Ametek, Largo, Fla.) having a 6-mm-wide chisel probe. The peak force (kg) was measured at a penetration depth of 7 mm. Roots were then cut longitudinally, and divided into halves. One half of each root was immediately measured for internal color, boiled for 25 min, and measured again for internal color after cooking.

A 10-g sample was removed from each raw and cooked root sample and dried in an oven at 70 °C for dry weight determinations. The remainder of the raw and cooked root halves were used for sugar and starch extractions. Grated root tissue (10 g) from four roots was combined in a glass test tube and homogenized with a tissumizer in 80% ethanol for 1 min at high speed. The slurry was immediately boiled for 15 min, cooled, and filtered through Whatman #4 paper. The filter cake was rinsed with additional ethanol, and dried for 48 h at 70 °C to obtain the alcohol insoluble solids (AIS) for starch analysis. The sugar extract was brought to a final volume of 100 mL. A 5-mL aliquot was filtered through a 0.22-µm membrane filter into vials for high-pressure liquid chromatography (HPLC).

HPLC analysis. HPLC was used to separate and quantify glucose, fructose, sucrose, and maltose in raw and cooked roots using a modified method of Picha (1985). Carbohydrates were analyzed by injecting 20 µL of sample into a liquid chromatograph (1100 series; Agilent Technologies, Wilmington, Del.) with premixed HPLC-grade water (25%) and acetonitrile (75%) as the mobile phase, and an aminopropylsilane column as the stationary phase (Agilent ZORBAX carbohydrate analysis column, 4.6 mm ID × 150 mm, 5µm), followed by an Agilent refractive index detector. A flow rate of 1.4 mL·min⁻¹ was used, and the column and detector temperatures were set at 30 °C. The mobile phase was vacuum filtered through a 0.45 µm membrane filter before use.

Sucrose, glucose, fructose, and maltose standards were prepared at five concentrations ranging from 250 to 2000 µg·mL⁻¹ to calibrate the HPLC. Carbohydrate peaks of the samples were identified according to HPLC retention times in comparison with authentic standards. For recovery tests, samples were spiked with

standard solutions before extraction. The detection limit for each sugar was 1 µg, and the recovery was 95%.

Starch analysis. Starch was determined by combining 30 mg of AIS with 10 mL distilled water, and heating at 100 °C in a water bath for 90 min (Hagenimana et al., 1994). A soluble starch standard was included also. After cooling, 5 mL of 0.01 M sodium acetate (pH 4.5) containing 10 units/mL of amyloglucosidase was added to each sample and the standard. The test tubes were incubated at 55 °C for 30 min. Following enzymatic hydrolysis, the total reducing sugars were measured using the method of Blakeney and Mutton (1980).

Sensory analysis. A sensory panel of eight co-workers was used to assess the sweetness, moistness, color, and overall acceptability of cooked sweetpotato roots. Training was provided at the beginning of the study using high quality, cooked roots of each clone. Five roots of each clone were randomly selected from individual boxes for sensory analysis. Panelists were presented roots treated with 0, 200 or 600 Gy X-ray irradiation and asked to rate each sample. The WP and RY roots of one replication were subjected to sensory analysis on the same day, but were presented separately to panelists. There were four replications. Panelists used a scale of 1 to 5 to rate each attribute, where a rating of 5 = the highest, or most acceptable, rating for each variable.

Statistics. The experimental design was a completely randomized design with four replications. Data for each clone were subjected to analysis of variance using the GLM procedure in SAS (SAS Institute, 1999). Dose response was tested by regression analysis or orthogonal polynomial analysis in SAS. Where applicable, means were separated using the Waller-Duncan *k* ratio *t* test.

Results and Discussion

Quality analyses. The average moisture contents of raw WP and RY roots were 66.4% and 59.7%, with corresponding dry matter

contents of 33.6% and 40.3%, respectively. Root moisture content was not affected by X-ray irradiation treatment at any dose for either clone (Table 1).

Lu et al. (1986) reported that γ-irradiation doses between 100 and 2000 Gy did not affect the moisture content of 'Jewel' and 'Georgia Jet' cultivars. The dry matter content of WP and RY roots exceeded the 32% reported for the staple-type cultivars, 'Rojo Blanco' and 'Whitestar' (LaBonte et al., 2000).

The percent AIS decreased linearly in response to increasing irradiation dose for raw WP ($P = 0.0155$) and RY ($P = 0.0037$) roots, and for cooked WP ($P = 0.0088$) and RY ($P = 0.0045$) roots (Table 1). Percent AIS is an indicator of crude starch content and is positively correlated with root dry weight (LaBonte et al., 2000). AIS ranged from 30.2% (0 Gy) to 25.8% (600 Gy) for raw WP roots, and from 37.8 to 33.0% for RY roots (Table 1). The percent AIS of 400 or 600 Gy treated roots was lower than that for nonirradiated roots of both clones ($P \leq 0.05$). The percent AIS of RY roots was higher than that reported for six cultivars (Picha, 1986). WP roots had similar percent AIS to that reported for 'Whitestar' (Picha, 1986).

Firmness of RY roots decreased linearly with increasing irradiation dose ($P = 0.0007$) (Table 1), and this response may adversely affect storability of irradiated RY roots. The firmness of WP roots treated with 200, 400 or 600 Gy irradiation was not significantly different from the firmness of control roots. However, the WP roots treated with 100 Gy irradiation were softer than the control roots ($P \leq 0.05$). Irradiation effects on root firmness appear to be dependent on variety and dose. Doses between 100 and 800 Gy had no effect on firmness for the moist, orange-fleshed varieties, 'Jewel' and 'Georgia Jet' (Lu et al., 1986), but roots softened after exposure to 1500 to 2000 Gy. McGuire and Sharp (1995) reported that 'Jewel' roots treated with 600 Gy were firmer than control roots after 1 month storage, but the trend reversed at doses above 600 Gy. For the staple-type cultivar, 'Picadito', irradiation

Table 1. Percent moisture, percent alcohol insoluble solids, and firmness of raw and cooked sweetpotato roots following treatment with x-ray irradiation and 2 weeks storage at 14.5 °C.

Irradiation dosage (Gy)	Moisture (%)		AIS ^z (%)		Firmness (kg)
	Raw	Cooked	Raw	Cooked	
RY clone ^z					
0	59.0 ^y	57.5 ^y	37.8 ^y	19.8	12.8 ^y
100	60.2	58.0	35.7	18.8	12.6
200	59.5	57.0	35.0	18.1	11.8
400	59.5	58.1	34.1	17.5	11.7
600	60.5	59.5	33.0	17.5	11.5
Significance	NS	NS	L**	L**	L***
WP clone ^z					
0	64.4	63.6	30.2	17.0	11.4
100	65.4	65.3	27.2	15.3	9.9
200	67.9	65.0	27.6	16.5	11.0
400	67.8	65.0	26.5	13.8	10.4
600	66.3	64.6	25.8	13.7	10.5
Significance	NS	NS	L*	L**	NS

^zAIS = alcohol insoluble solids; RY clone = red skin, yellow-flesh roots; WP clone = white skin, purple-flesh roots.

^yMoisture and AIS values are means of four replications. Firmness values are means of 16 observations. Firmness was measured on raw roots only.

NS, **, *** Nonsignificant or significant at $P \leq 0.05$, 0.01 or 0.001, respectively. Significant trends were linear (L).

Fig. 1. Relationship between X-ray irradiation dose and starch contents of sweetpotato roots for raw and cooked red-skin, yellow-flesh (RY) roots and white-skin, purple-flesh (WP) roots after 2 weeks storage at 14.5 °C.

did not affect root firmness.

The surface color of raw or cooked RY roots

was not affected by irradiation (data not shown). However, we observed some dark streaking in the internal tissue of RY control and treated roots upon cutting or cooking. This discoloration was a characteristic of the yellow-fleshed clone and was not caused by irradiation. RY roots developed a golden yellow color upon cooking. The peel color of WP roots increased in saturation (chroma) with increasing irradiation dose ($P \leq 0.001$), and peel color was slightly lighter for roots treated with 200 or 600 Gy than control roots ($P \leq 0.05$, data not shown). The internal color of raw WP roots tended to be slightly redder ($P \leq 0.05$) after treatment at 400 Gy (352 h°) when compared to control roots (344 h°). Irradiation treatment did not affect the internal color of cooked WP roots (data not shown). WP roots developed an attractive, deep-purple color after cooking when compared to uncooked roots.

Fig. 2. Relationship between X-ray irradiation dose and sugar contents of sweetpotato roots for raw (A) and cooked (C) red-skin, yellow-flesh (RY) roots and raw (B) and cooked (D) white-skin, purple-flesh (WP) roots after 2 weeks storage at 14.5 °C.

Table 2. Sensory ratings for sweetpotato roots following treatment with X-ray irradiation and 2 weeks storage at 14.5 °C.

Irradiation dosage (Gy)	Sweetness	Moisture	Color	Acceptability
RY clone ^a				
Control	2.96 b ^y	2.95 b	3.27 a	3.02 b
200 Gy	3.48 a	3.52 a	3.62 a	3.59 a
600 Gy	3.54 a	3.27 ab	3.50 a	3.43 ab
WP clone ^a				
Control	3.33 b	3.82 a	4.01 a	3.59 a
200 Gy	3.53 ab	3.44 ab	4.01 a	3.69 a
600 Gy	3.78 a	3.29 b	3.98 a	3.57 a

^aRY clone = red skin, yellow-flesh roots; WP clone = white skin, purple-flesh roots.

^yAll values are means of 32 observations. Mean separation within columns for each clone by the Waller-Duncan k ratio *t* test. Sensory ratings were on a scale of 1 to 5, where a rating of 5 = highest, most acceptable rating for each variable.

Lu et al. (1986) reported that doses of gamma irradiation up to 2000 Gy had no effect on sweetpotato color. McGuire and Sharp (1995) found changes in peel color imperceptible for 'Jewel' and 'Picadito' roots following irradiation, but the flesh color of 'Picadito' became more yellow-gray. Also, cooked 'Picadito' roots developed dark mottling when treated with 500 Gy but not 300 Gy (Hallman, 2001). In another study, cooked 'Picadito' and 'Jewel' roots became darker than controls when treated at 400 Gy, but not 200 Gy γ -irradiation (McGuire and Sharp, 1995).

Starch and sugar analyses. The starch concentration of irradiated sweetpotatoes decreased linearly as irradiation dose increased for raw RY, cooked RY, and raw WP roots ($P = 0.003$, 0.0004, and 0.0008, respectively) (Fig. 1). The starch concentrations of raw and cooked RY roots treated with 400 or 600 Gy irradiation were significantly lower than for control roots. Nonirradiated raw WP roots had significantly more starch than irradiated roots, regardless of dose. However, for cooked WP roots, irradiation treatment did not significantly affect the starch content ($P > 0.05$). Starch has been shown to decrease in sweetpotato roots irradiated with 1000 Gy doses or higher and stored for 2 weeks (Ajlouni and Hamdy, 1988; Hayashi and Kawashima, 1982; Lu et al., 1986), but low doses (<1000 Gy) did not decrease starch content for cultivars, 'Jewel' and 'Georgia Jet' (Lu et al., 1986).

Irradiation had the greatest effect on sweetpotato sucrose concentrations ($P = 0.0001$), and this was reflected in the total sugar concentrations of raw RY and WP roots ($P = 0.001$), but not cooked roots ($P > 0.05$) (Fig. 2). Sucrose increased linearly in response to irradiation dose, as starch concentrations decreased. The regression equations for raw RY and WP roots were sucrose = $30.01 + 0.04$ (dose); $R^2 = 0.93$ and sucrose = $35.58 + 0.03$ (dose); $R^2 = 0.87$, respectively. The equations for cooked RY and WP roots were sucrose = $31.93 + 0.04$ (dose); $R^2 = 0.76$ and sucrose = $38.05 + 0.03$ (dose); $R^2 = 0.77$, respectively. In a study by Hayashi and Kawashima (1982), irradiation (1000 Gy) enhanced the sucrose content of raw sweetpotato roots from 2.5% to 4.6% in control roots to >8% in irradiated roots, regardless of storage period. Sucrose contents were 1.5 and 2 times higher than controls in 600 Gy-treated raw WP and RY roots, respectively. The increase in sucrose concentrations were similar for cooked roots. There are no previous reports on the sugar contents of cooked sweetpotato roots following irradiation.

Sucrose has been shown to increase, and starch to decrease, during curing and storage of nonirradiated sweetpotatoes (Picha, 1987). The enzyme degrading starch in raw roots was proposed to be a phosphorylase, because no maltose was detected (Picha, 1987). However, the enzymatic regulation of starch degradation and sucrose synthesis in raw sweetpotato roots remains unclear. The activities of sucrose synthase and sucrose phosphate synthase were enhanced by 2.5 and 10 times, respectively, in sweetpotato roots treated with 1000 Gy γ -irradiation (Hayashi et al., 1984). These enzyme

activities were at high levels during the time when sucrose was accumulating 1 to 2 weeks after irradiation. Also, Ajlouni and Hamdy (1988) reported increased enzyme activities for starch phosphorylase, β -amylase, phosphoglucose isomerase, phosphoglucomutase, sucrose synthase, and sucrose phosphate synthase within 5 d after treatment of roots with 1000 to 2000 Gy irradiation. At 3000 Gy, all enzyme activities were inhibited. There is no information on which sweetpotato enzymes are enhanced at lower doses (<600 Gy) of irradiation.

The relationship between total sugar concentration and irradiation dose could be described by the equations: total sugars = $31.51 + 0.04$ (dose); $R^2 = 0.92$ for raw RY roots (Fig. 2A), and total sugars = $46.39 + 0.03$ (dose); $R^2 = 0.84$ for raw WP roots (Fig. 2B). Others have reported that total sugar contents increased with doses up to 800 Gy for 'Jewel' and over 500 Gy for 'Georgia Jet' (Lu et al., 1986). Irradiation did not affect the fructose and glucose concentrations of raw and cooked roots of either clone ($P > 0.05$) (Fig. 2). Maltose was not detected in raw roots (Fig. 2A and B), but decreased linearly in response to irradiation dose ($P = 0.011$) in cooked RY roots only (Fig. 2C). The cooked RY roots had less starch available for hydrolysis to maltose in 400 and 600 Gy treated roots when compared to controls ($P \leq 0.05$) (Fig. 1).

Raw RY roots had less total sugar concentrations at each dose than WP roots (Fig. 2A and B), but a reverse pattern was observed for cooked roots (Fig. 2C and D), mostly resulting from higher maltose levels in RY roots. RY roots had higher starch concentrations than WP roots (Fig. 1), therefore more starch was available for hydrolysis upon cooking. Also RY roots may have had higher amylase activities than WP roots, although enzyme activities were not measured in this study. According to the classification suggested by Morrison et al. (1993), both RY and WP clones are class two types, having low initial sugar concentrations and high starch hydrolysis.

Sensory analysis. Sweetpotato roots treated with 600 Gy X-ray irradiation were perceived as sweeter than control roots for both clones (Table 2). McGuire and Sharp (1995) also found that γ -irradiated sweetpotatoes tasted sweeter than nonirradiated roots, but were not preferred by a panel because of root darkening at the 400 Gy treatment. The sensory results agree with the total sugar and sucrose concentrations determined by HPLC (Fig. 2C and D). The sucrose contents were 28.7, 39.1, and 53.9 mg·g⁻¹ fresh weight for cooked RY roots, and 40.2, 43.7, and 57.7 mg·g⁻¹ fresh weight for cooked WP roots for the 0, 200, and 600 Gy treatments, respectively. Although maltose concentrations were much higher than sucrose concentrations in cooked roots, maltose tended to decline with increasing irradiation doses (Fig. 2C and D). Also, three molecules of maltose are needed to equal the sweetness of one molecule of sucrose (Biester et al., 1925). Therefore, panelists likely perceived sweeter

roots at the 600 Gy treatment because of the higher sucrose concentrations when compared to the controls.

Panelists found no significant differences in color ratings among treatments for either clone (Table 2), and these results agree with the objective chromameter results for internal color of cooked roots. For the RY clone, roots treated with 200 Gy irradiation were sweeter, moister, and more acceptable overall than control roots. The RY roots exposed to the 600 Gy treatment did not differ from the control roots for moisture, color, and overall acceptability. Panelists rated the control WP roots as moister than roots treated with 600 Gy irradiation, but the overall acceptability was the same for all treatments. In contrast, Lu et al. (1986) found that the sensory quality of roots treated with γ -irradiation and stored for 2 months was severely affected by doses of 500 Gy or above (Lu et al., 1986).

Conclusions

X-ray irradiation at doses up to 600 Gy did not affect the root moisture content or glucose and fructose concentrations of two Hawaii-grown sweetpotato clones. Irradiation did not cause browning or perceptible discoloration of RY or WP roots. The firmness of RY roots decreased at doses >200 Gy, possibly reducing the storability of RY roots. Starch concentration decreased and sucrose concentration increased in response to irradiation dose, and the 600 Gy-treated roots were perceived as sweeter than nonirradiated roots by a sensory panel. Panelists found the overall acceptability of nonirradiated and 600 Gy-treated roots to be the same.

Lu et al. (1986) suggested that the optimum irradiation dose for treating sweetpotatoes without affecting quality may lie between 100 and 500 Gy. A dose of 165 Gy was approved by the California Department of Agriculture in 2000 for quarantine security against sweetpotato weevils based on the research by Hallman (2001), but higher doses may be required to sterilize or kill the sweetpotato vine borer present in Hawaii. USDA-APHIS recently issued a final rule that requires a minimum dose of 400 Gy for the movement of irradiated sweetpotatoes from Hawaii (Federal Register, 2004). In our study, the 400 Gy dose did not reduce the quality of purple-fleshed and yellow-fleshed sweetpotatoes, and commercial shipments from Hawaii have begun. However, we observed a slight decrease in firmness and starch concentrations in roots treated with 400 Gy, and these factors may shorten the storage life of irradiated roots.

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