INFLUENCE OF ELECTRON BEAM IRRADIATION ON SWEET CHERRY QUALITY

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The current treatment for the disinfestation of cherries involves fumigation with methyl bromide. Methyl bromide has been identified by the EPA as an ozone depletor. It is most likely the production and use of this chemical will be banned by the year 2000. The potential of the loss of methyl bromide is of great concern for the cherry export market. In 1994, over 1.7 million boxes of cherries from the U.S. were shipped to Japan for an estimated value of $42 million dollars. This level of trade will be jeopardized if a suitable alternative quarantine treatment is not found.

Gamma irradiation has been used to sterilize insects and is a proposed alternative for methyl bromide quarantine treatments. The major problem in the use of gamma radiation as a treatment is consumer acceptance. However, medical technology has developed non-source irradiators, which generate gamma radiation from an electrical source. Therefore, there is no radioactive waste to be disposed of or continuing contaminating source on site. Most phytotoxicity and insect sterility data have been obtained from irradiation with source irradiators. It is necessary to find if electron-beam irradiators can deliver an effective dose for insect sterility while maintaining fruit quality.

Bing and Rainier sweet cherries (55kg each) were obtained from commercial sources after handling and packing, the day of harvest in 1994 and 1995. Cherries were divided immediately into groups of 2.5kg and packed into boxes (46 x 25 x 5 cm) with liners. The boxed cherries were packed in Coleman coolers containing 2.5kg of gel refrigerant and a temperature recorder. Boxed cherries were shipped overnight express to the Florida Dept. of Agriculture and Consumer Services, Div. of Plant Industry, Irradiation Research Facility, Gainesville, FL (1994) or the Iowa State University, Irradiation Research Facility, Ames, IA. (1995) for treatment. Irradiation treatments (0.00, 0.15, 0.30, 0.60 and 0.90 KGy) were performed using the linear accelerator at each of these facilities. After treatment the cherries were returned overnight express to the USDA-ARS, Tree Fruit Research Laboratory, Wenatchee, WA and stored at 1C. Quality evaluations on the cherries were determined before shipment, immediately after return, after 7 days and 14 days of storage. The time required for shipment and treatment did not exceed 3 days and temperatures in the Coleman coolers did not exceed 10C.

Quality evaluations consisted of objective and subjective color, firmness, soluble solids content titratable acidity and evaluations for defects. Objective color of fruit and stems were determined with The Color Machine using the Hunter L, a, b system and calculated hue values (Hunter and Harold, 1987). Subjective color was determined using 2 laboratory personnel familiar with cherry color grades. Fruit and stems were rated individually on a scale of 1 to 3 (1=best, 3=poorest) and the mean values reported. Firmness was determined using the Universal TA-XT2 Texture analyzer equipped with a

3-mm probe set at 10 mm/sec and a penetration distance, after contact, of 7 mm. Soluble solids content of the fruit was determined by an Abbe-type refractometer with a sucrose scale calibrated at 20C. Acids were titrated to pH 8.2 with 0.1 N NaOH and expressed as the percentage of malic acid. Defects were graded by laboratory personnel as present or absent.

Eakin (1985) reported that control of codling moth on Bing cherries can be achieved with a radiation dose of only 0.25KGy and cherry fruit fly can be controlled with a dose of only 0.15KGy. In this study quality losses were not evident in Bing or Rainier sweet cherries with radiation doses up to 0.30KGy. At a dose rate above 0.60KGy there was a definite loss (14%) in firmness and a change in fruit color (higher Hunter L values) of Bing cherries, but no changes in hue or visual fruit color values were evident. Rainier cherries also displayed a similar loss in firmness, but firmness loss was initiated at a lower dose rate (above 0.30KGy). A color difference was also evident for Rainier cherries at or above 0.60KGy with increased hue values. This change in hue was also visible to the human eye at a radiation dose level of 0.90KGy. No change in Bing cherry stem color was present due to radiation dose level, but Rainier cherry stems displayed increased Hunter L values above 0.30KGy. Visual color of Rainier cherry stems improved as radiation dose rates increased. As irradiation dose increased there was an obvious loss in titratable acidity, for Rainer cherries, particularly at the 0.90KGy rate. No fruit defects (pitting or bruising) were present for Bing cherries at the radiation dose levels considered, but increased defects (pitting) at the highest radiation dose (0.90KGy) were present in Rainier cherries.

Considering radiation levels necessary for quarantine control (<0.50KGy) and the lack of quality loss in Bing and Rainier cherries at 0.50KGy and less, these two cherry cultivars are good candidates for quarantine treatment using the linear accelerator as the source of radiation. Jessup (1990) and Drake, et at (1994) also found that sweet cherries could be treated with gamma radiation sufficient for disinfestation with little or no quality loss. Quality loss in irradiated sweet cherries is small particularly when one considers that the more conventional means of disinfestation (MeBr) can result in considerable quality loss (Drake et al , 1991).

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