EFFECTS OF IRRADIATION ON QUALITY OF FRESH FRUITS AND VEGETABLES

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In 1956, gama-radiation was proposed as a potential quarantine treatment for fruits. At that time, work was begun at the USDA Laboratory in Hawaii to determine the effects of gama-radiation on fruit flies infesting papayas and other tropical fruits. Much has been learned over the intervening years on this technology. Most of this work has dealt with insect mortality, yet some studies also have dealt with the effect on fruit quality and condition.

During any handling or treatment following harvest, horticultural commodities can be damaged. This is particularly true when commodities are subjected to some quarantine treatments required for disinfestation purposes. It is important that quarantine treatments such as irradiation are efficacious but do not adversely affect the commodity's quality, condition, and susceptibility to decay. If the quarantine treatment reduces the value of the commodity, then the treatment is not fully effective. In other words, any treatment that disinfests a commodity should have minimal deleterious effects on that commodity. Damage manifests itself as the loss of market quality attributes including shelf life, appearance, flavor, texture, aroma, and increased susceptibility to decay organisms.

Several factors influence the response of fresh fruits and vegetables to irradiation and include characteristics of individual commodities or irradiation procedures. Also, preharvest factors such as climatic conditions and cultural practices affect composition and quality of these commodities, which may influence their response to irradiation stress. Additionally, the manner in which radiation is administered can affect the response of commodities.

Most fresh fruits and vegetables will tolerate ionizing radiation at 0.25 kGy with minimal detrimental effects on quality. At doses between 0.25 and 1.0 kGy, some commodities can be damaged. Generally, non-fruit vegetables (e.g., lettuce) are much more sensitive to irradiation stress than are fruits (e.g., apples) and fruit-vegetables (e.g., tomatoes). Some fruits have a high relative tolerance to irradiation and only slight detrimental effects have been reported. Other fruits have a moderate relative tolerance to irradiation. There have been some inconsistencies among the research reports on these fruits and further evaluation is needed. A third group of fruits has a low relative tolerance to irradiation. Most published data on these fruits indicate significant detrimental effects, and further investigation is likely to be nonproductive.

Irradiation effects on the quality and condition of fruits and vegetables have been assessed differently depending upon the evaluator. Opinions among researchers have varied widely as to the point at which commodity injury is important. Horticulturists, postharvest physiologists, and other plant scientists are generally far more critical of injury effects than scientists not accustomed to studying living commodities. As a consequence, large differences are found in reports on quality and condition due to irradiation.

Several areas should be considered for future research on the effects of irradiation on

the quality and condition of horticultural commodities. Pre- or postharvest treatments which would reduce damage need to be developed. Improved horticultural practices such as irrigation, hormonal sprays, fertilization, and increasing calcium uptake may increase resistance to the stress of some treatments. Other factors include: maturity of the commodity at harvest, time between harvest and treatment, and post-treatment storage conditions.

Another endeavor would be to discover the physiological basis of the conditioning phenomenon, a pretreatment process which has been shown to reduce damage from heat and cold treatments. Conditioning treatments could alleviate some of the damage from irradiation exposure. There is also a need for determining the physiological and biochemical basis of damage resulting from irradiation treatments.

Another area is the development of objective methods for measuring damage from treatments in order to provide uniformity in assessing quality and damage and to also provide quantifiable information which can be related to biochemical indices. Lastly, there is need to relate biochemical indices to damage incurred as a result of radiation. These indices could be used to indicate the thresholds of damage or to predict the potential for damage. Development of this type information will permit greater flexibility in the development of quarantine irradiation treatments.

Some of the irradiation treatments have no deleterious effects on the condition and quality of some commodities and cultivars. However, injury can occur at times with approved treatments under commercial conditions. It is important that treatments developed under laboratory conditions be feasible in a commercial setting. The treatment protocol must tolerate not only the variability in commodity condition, but also treatment variations which occur under commercial conditions without leading to commodity damage or insect survival.