Abstract

Insect pest infestation of commodities is a major problem in the production, storage and export marketing of agricultural produce. Codling moth (*Cydia pomonella* L.) is a key and a quarantined pest of pome and stone fruits, and nuts destined for export markets and requires unique postharvest treatments by many importing countries. The imminent loss of methyl bromide, an effective chemical fumigant against codling moth and many other insect pests, because of its ozone depletion potential, has created an urgent need and a fervent search for alternatives, preferably physical methods such as heat treatment. Presently, different heat treatment methods are being investigated for commodities disinfestation.

In this study, electromagnetic energies at the radio frequency (RF) and microwaves were investigated for cherries and apples against codling moth larvae. Treatment of fruits with 27 MHz RF or 915 MHz microwaves to selected lethal temperatures showed great potential as a replacement for methyl bromide. RF or microwave treatment of fruits in air had many drawbacks such as difficulty in treating eggs and larvae outside of fruit, core focussed heating and thus internal bruising for apples, skin burning, stem browning for cherries, and less than 100% kill of the insects.

A novel technique using ionized water immersion and RF energy overcame the above problems. Cherries or apples immersed in suitably matched saline water and treated with RF energy showed uniformity of temperature within and among fruits, 100% kill of infesting codling moth larvae, and quality that compared well with those fruits fumigated with methyl bromide.

Dielectric properties and ionic conductivity values of immersion saline water, cherries, apples, and infesting codling moth larva were determined as a function of temperature, with the dielectric loss factor of insects $\geq$2.0 times those of the host commodities, suggesting possible differential heating of the insect in these fruits, particularly at the RF region.

A computer-controlled heating block system was developed that enabled investigation of the thermal death time (TDT) kinetics of insects and the effect of heating rates on mortality. Insect mortality data were analyzed using thermal processing theories and concepts. Kinetics data namely, D, z and activation energy values determined for codling moth, suggested that a high-temperature-short-time process is suitable for insect control in fresh commodities. High heating rates gave less

accumulated lethality, thus a longer holding time at the end temperature was required to obtain similar mortality.

This immersion-RF technique should also be extended to other pests and hosts, e.g. mites on pears, to obtain desired targeted heating effect--surface, uniformly (whole fruit), or core heating.