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Effects of Post Harvest Treatments and Processing on Ethylene Bisdithiocarbamate (EBDC) Fungicide Residues from Apples & Apple Products and Elucidation of Possible Degradation By-products & Pathways

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Pesticides are used worldwide to protect crops by controlling insects, diseases, fungi and other pests. Protecting crops from pests gives higher yields, resulting in greater variety and availability of food at a low cost. Ethylene bisdithiocarbamates (EBDCs), because of their low cost and broad disease control, are among the best crop protection tools available to the horticultural industry. However, the consumer groups have become concerned with food safety especially, pesticide residues on (or in) the fruit at harvest. As a results, there is a need to develop methods for removing or reducing the levels of pesticide residues on fresh and processed fruits after harvest. Ozone, chlorine, chlorine dioxide and a mixture of acetic acid, hydrogen peroxide and peroxyacetic acid were investigated to reduce or remove mancozeb and ETU residues on apples.

The objective of this study was to determine the effectiveness of different post harvest treatments and processing on the reduction of mancozeb and ETU residues on apples and processed apple products.

Mancozeb (Dithane 75DF® was applied on Golden Delicious apples throughout the growing season at the recommended rate. The apples were hand-picked randomly at optimum maturity and stored at 4℃ until processed. Five washing treatments (at 15 min dipping time) were used, based on results of a model system study: (1) No wash, (2) Water wash, (3) Calcium hypochlorite wash @ 50 and 500ppm (4) Chlorine dioxide wash @ 10ppm (5) Peroxyacetic acid wash @ 50ppm (6) Ozone wash @ 3ppm. Treated apples were processed as whole fruits, slices, sauce (peeled and unpeeled), juice and pomace and frozen at -20℃ until residue analysis. All samples were analyzed by GLC and HPLC for mancozeb and ETU residues.

Results indicate that post harvest and processing treatments were effective in reducing residues on the apples. Chlorine dioxide and peroxyacetate treatment reduced mancozeb levels by 82% and 90%, respectively in the whole fruits. Processing reduced mancozeb and ETU residues 82-92% and 96-100%, respectively, with peeling and blanching the most effective processing treatment. When these treatments were combined with processing into apple sauce, mancozeb and ETU were reduced by 100% (i.e., below detectable limits). These results suggest that ozone, chlorine dioxide and peroxyacetate were effective in the degradation of mancozeb and ETU on/in apples and apple products and that processing also significantly play an important role in reducing mancozeb and ETU levels on the whole fruit and in processed products.

The degradation products and possible pathways during chemical oxidation reaction were investigated. Samples were detected by Time-of-Flight Mass Spectrometry (TOFMS) with an electron ionization source. Several degradation by-products were detected and identified as a result of chemical oxidation.