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BARD

FINAL REPORT

PROJECT NO. US-1015-85

**Heat Treatment to Retard Decay Development and
Physiological Changes in Film-Wrapped Horticultural
Crops**

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Standard BARD Cover Page for Scientific Reports

Date: July 10, 1990

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Bet Dagan, ISRAEL

BARD project No. US-1015-85

Title

Heat treatment to retard decay development and physiological
changes in film-wrapped horticultural crops

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Project's starting date: October 1, 1986

Type of Report: 1st Annual ☐ 2nd Annual ☐ Final ☒

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הספריה המרכזית
למדעי החקלאות
ב"ח - 771

630.72 , 633.15 ; 635.61 ; 634.25 ;

BAR / PHM ' 634.26 ; 631.34 ; 581.191,6 ; 631.56

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ABSTRACT

Sweet corn, melons, peaches and nectarines were wrapped with plastic film and heat treated with dry air, moisture air or hot-water. Wrapped produce was found improved when produce heated with hot-dry-air or hot-water for corn and melons and with moisture heat for nectarines and peaches. In addition to contamination control, the plastic wrap reduced water loss in treated produce and reduced injury associated with vapor heat treatment in nectarines and peaches. Sucrose added to hot water also reduced injury to non-wrapped fruit and supports the contention that hydration is an injurious factor that occurs during hot-water or moist heat treatment. Heat treatments that controlled decay were: hot-air exposure to 46C, or a 20 second 52C hot water dip of corn, 1-2 min in 55C hot water dip of 'Galia' melon, and 15 min exposure in a 52C moist-air oven (surface temperature 46C) of nectarines and peaches. These treatments had little physiological effect on respiration such as ethylene production and little or no phytotoxicity except for damage on the husk of heat treated sweet corn. Treatment of nectarine for 30 or 45 min slowed fruit softening and reduced ethylene production. Heating the fruit pathogen, *Monilinia fructicola* for 0.5 to 2 min altered the ultrastructure of mitochondria in non-germinated conidia.

Objectives of the original research proposal

- (1) To evaluate the efficiency and usefulness of hot dry air, moist air, and hot water to heat film-wrapped peaches, melons and sweet corn.
- (2) To establish a heat treatment for produce wrapped in polyvinylchloride films and to examine the possibility of heat treating individually wrapped fruits while packed in cartons.
- (3) To evaluate the pectolytic and cellulolytic enzyme activity in heated and non-heated peaches inoculated with Monilinia sp. or Rhizopus stolonifer, or in similarly treated melons inoculated with pathogenic Alternaria sp. or Fusarium sp.
- (4) To measure the rates of CO₂ and ethylene production, and the concentrations of sugars and total acid content in heated and unheated peaches, melons, and sweet corn, with special emphasis on the conversion of sugar to starch in sweet corn.
- (5) To develop a technique to determine the form of inoculum (conidia, mycelium, sclerotia, etc.) present on the commodity being heat-treated and to determine its potential for surviving a heat treatment.

Scientific Hypothesis

A non-phytotoxic heat-treatment of individually film-wrapped fruits or vegetables will control decay during usual marketing periods by the proven direct effect of heat combined with the protection against recontamination by plant pathogens that the film provides after treatment and without excessive water loss.

E. Copies of articles that have been published and reports make up the body of this report. Each stands alone introduced by a cover page with the following in titles:

1. Heat Treatment as a method of extending the shelf-life of Sweet Corn.....
2. The use of heat treatments to extend the shelf life of 'Galia' melons.....
3. Toward a practical, postharvest heat treatment for 'Galia' melons.....
4. Decay control and quality maintenance after moist air heat treatment of individually plastic wrapped Nectarines....
5. Evaluation of a moist air heat-treatment of individually plastic wrapped Nectarines and Peaches.....
6. Ultrastructural changes in dormant *Monilinia fructicola* conidia with heat treatment.....
7. Decreased injury to stone fruit heat treated in water containing sucrose.....

**1. Heat Treatment as a method of extending the
shelf-life of Sweet Corn.....**

ABSTRACT

Teitel, D.C., Barkai-Golan, R., Aharoni, Y., Copel, Z. and Davidson, H.,
Heat treatment as a method of extending the shelf-life of sweet corn.

Sweet corn (Zea mays L.) ears, cvs Jubilee and Sweetie, were wrapped in 18 um PVC film and heated in an oven to an internal temperature of 46 °C or dipped for 20 s in a 52 °C water bath prior to wrapping. Oven heating was the most effective antifungal treatment, providing protection for over 6-7 d at 18 °C, while the hot water dip inhibited pathogen development for over 4 d at 18 °C. Neither heat treatment affected fresh and dry weight loss, nor C₂H₄ and CO₂ evolution. However, oven heating was accompanied by heat injury to the wrapper leaves. There were no differences in the cultivar response to the heat treatments. The hot water dip is viewed as a potentially feasible anti-fungal, postharvest treatment for sweet corn.

NOTE: Further details unavailable for this report.

F. DESCRIPTION OF COOPERATION

The physiology of the film-wrapped product was studied in Israel and in the U.S. The major emphasis on the physiological aspects of this study was as follows:

- (1) Respiration and Ethylene production
- (2) Sugar, total acid content evaluation
- (3) Atmosphere under film
- (4) Sensory evaluations

The physical aspects of the heat treatment and general quality evaluation was carried out at both locations because of differences in products in Israel and in the U.S. and included:

- (1) Heat transfer to the film-wrapped product
- (2) General or visual quality evaluation
- (3) Treatment development and selection

The pathology of the film wrapped product was studied in Israel by R. Barkai-Golan and in the U.S. by D. Phillips. This work was carried out as follows:

- (1) Methods for evaluation of inoculum.
- (2) Evaluation of the inoculum on treated products
- (3) Evaluation of disease control

G. EVALUATION OF THE RESEARCH ACHIVEMENT.

The aims of the orriginal proposal have been meet. Several papers have been written and published and several others are partialy written and under reveiw. The specific areas of oaccomplishment are:

- (1) Heat treatment and plastic wrap proceedures developed for sweet corn, 'Galia' melons, nectarines and peaches.
- (2) New infromation on the effects of heat treatment on the physiology of melons, corn and nectarines.
- (3) New information on the nature of heat phytotoxicity on nectarines and peaches.
- (4) New information on the cytological effects of heat on ungerminated Monilinia fructicola conidia found on the fruit surface of stone fruit

We have found that a non-phytotoxic heat-treatment of individually film-wrapped corn, melons, nectarines, and peaches will control decay during usual marketing periods by the proven direct effect of heat combined with the protection against recontamination by plant pathogens that the film provides after treatment and without excessive water loss. In some cases non-phytotoxic heat teatment can alter the physiology of the treated product in such a way as to maintain high quality longer than an untreated product. The results could reduce pesticide use and may thereby increase our ability to export the fresh produce.

Additionally, the changes in carbon dioxide and ethylene production induced by the heat treatments and by the moisture modification resulting from film wrapping have shed light on physiological and phytotoxic changes associated with heat treatments. This new information will lead to greater accpetance of heat treatments by industry and more research on the use and effects of heat-treatment on fresh produce.

Publications

Anthony, B. R. 1988. Decay control and quality maintenance after moist air heat treatment of plastic-wrapped nectarines. M.S. thesis, School of Agricultural Sciences and Technology, California State University, Fresno.

Anthony, B. R., Phillips, D. J., Aharioni, Y. 1989. Decay control and quality maintenance after moist air heat treatment of plastic wrapped nectarines. *Phytopathology* 78: 1618. (abstract).

Anthony, B. A., Phillips, D. J., Badr, S., Aharoni, Y. 1989. Decay control and quality maintenance after moist air heat treatment of individually shrink-wrapped nectarines. *J. Amer. Soc. Hort. Sci.* 114: 946-949.

Phillips, D. J. 1990. Decreased injury to stone fruit heat treated in water containing sucrose. *Phytopathology* 80:in press. (abstract)

Margosan, D. A. and Phillips, D. J. 1990. Ultrastructural changes in dormant Monilinia fructicola conidia with heat treatment. *Phytopathology* 80:in press. (abstract)

Teitel, D. C., Aharoni, Y., and Barkai-Golan, R. 1989. The use of heat treatments to extend the shelf life of 'Galia' melons. *J. Hort. Sci.* 64:367-372.