INFLUENCE OF DIFFERENT WOUND-HEALING TEMPERATURES ON BACTERIAL SOFT ROT AND WEIGHT LOSS IN STORAGE

by
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Introduction

Tubers must be properly wound-healed during the initial stage of storage to minimize weight loss and bacterial infection. The curing interval allows for optimal skin set and suberization of cut surfaces thereby providing an adequate barrier against weight loss due to desiccation and/or infection. Currently, many harvested tubers are held between 55 and 60°F, at high relative humidity, for 2 to 4 weeks following harvest (4). The storage temperature is then lowered to various holding levels dictated by final tuber utilization. This study was initiated to determine if adequate wound-healing can be accomplished at lower temperatures.

High temperatures of 55 to 60°F during the wound-healing period may be detrimental in terms of:

1) Later sugar development
2) The spread of pathogenic organisms
3) Increasing the physiological age
4) Promoting weight loss

Tubers subjected to elevated curing temperatures will develop higher amounts of reducing sugars later in the storage season (1). For example, tubers exposed to a 2-week wound-healing interval at 60°F had approximately 24% more sugars measured 5 months after the storage temperature had been lowered to the holding level of 42°F than those initially cured for 2 weeks at 48°F. Higher wound-healing temperatures therefore result in higher basal levels of sugars after temperatures have been lowered to holding levels and this may be detrimental to processing quality.

Elevated curing temperatures will also promote the proliferation of pathogenic organisms. Figure 1 shows the progress of tissue loss due to the soft rot organism, Erwinia carotovora subsp. carotovora as a function of incubation temperature and interval. Approximately twice as much tissue loss occurred at 60 compared with 48°F over a short, 3-day incubation period. As the interval of incubation increased, the amount of tuber loss due to rot increased rapidly at the higher temperatures. Obviously the higher temperature of 60 is more conducive to rot and, if possible, should be avoided during the wound-healing interval. The relatively rapid loss of tissue due to rot emphasizes the importance of cooling tubers going into storage as rapidly as possible. Cooling tubers as quickly as possible coupled with the utilization of lower healing temperatures will inhibit rot in situations where a high inoculum is present.

Curing temperatures of 55 to 60°F favor increased rates of respiration which may be detrimental in terms of promoting weight loss and speeding up the aging process. Physiological age of seed tubers has been shown to markedly effect yield (2, 3) and therefore lower wound-healing temperatures are most important in seed storages.

This study was initiated to investigate the influence of time and temperature on the wound-healing process.

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Materials and Methods

Cylindrical cores from Russet Burbank tubers were distributed equally among 3 controlled temperature rooms maintained at 42, 48 and 60°F at high relative humidity. The cores wound-healed under these conditions for 6, 16 and 21 days after which they were weighed and subjected to desiccation or rot treatments to evaluate their resistance to weight loss.

The desiccation treatment involved placing the differentially healed cores in a forced-air drying oven at 149°F for 4 hours. The cores were then reweighed and the degree of healing was expressed as percent fresh weight loss over the desiccation interval.

Cores were also inoculated with the bacterial soft-rot organism, Erwinia carotovora, to evaluate rot progression as a function of temperature and time. Following incubation of the inoculated cores, the rotted tissue was rinsed away and the percent weight loss due to rot was recorded.

These methods allowed evaluation of the amount of resistance to rot and weight loss which had built up in the cores during wound-healing for various intervals at 42, 48 and 60°F.

Results

Potato tissue healed for 6 and 16 day intervals lost weight linearly when subjected to the elevated temperature treatment (Figure 2). Clearly, 60°F was the optimal wound-healing temperature for deterring weight loss after a 16-day healing interval. In other words, a more efficient weight loss barrier had formed at 60°F than at any other healing temperature after 16 days of curing. However, after 21 days of healing the difference between the 48 and 60°F healing temperatures, in terms of the amount of weight lost from the tissue during desiccation, was not that great. Therefore, the 20% increase in wound-healing temperature did not result in an equivalent increase in the barrier formed against desiccation after 3 weeks of curing.

Previously healed tissue was also inoculated with Erwinia carotovora to evaluate the amount of resistance to rot as a function of curing temperature. The same trend in weight loss was evident for tissue subjected to the rot organism as for tissue subjected to the desiccation treatment following 3 weeks of curing (Figure 3). This is evidence that rot and water loss are being restricted by the same barrier. The difference between the tissue healed at 48 and 60°F was not significant in terms of weight loss across the wound barrier. Therefore, the same amount of wound barrier is formed in tissue healed at 48 and 60°F after a 3-week interval.

Conclusions

The major benefit of wound-healing is considered to be the formation of an adequate wound barrier which will effectively retard weight loss and bacterial infection. Raising the curing temperature from 48 to 60°F did not result in an equivalent increase in the barrier formed against rot and desiccation. Any benefits derived from wound-healing at temperatures as high as 60°F are more than offset by the detrimental effects previously listed. A compromise temperature of 48 to 50°F for approximately 25 days will retard initial rot development while simultaneously permitting the development of an adequate wound barrier effective against desiccation and infection.

References

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Figure 1. Percent weight loss from fresh-cut tissue inoculated with E. carotovora and incubated at 42, 48 and 60^{o}F for various intervals. Mean separation by Duncan's multiple range test, 1% level.

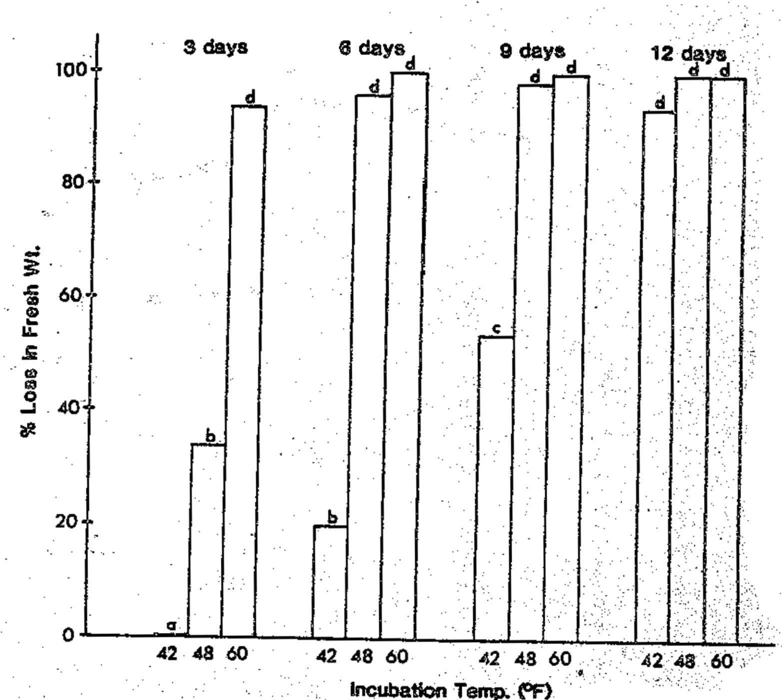

Figure 2. Percent weight loss from potato tissue healed for 6, 16 or 21 days at various temperatures. Mean separation by Duncan's multiple range test, 1% level.

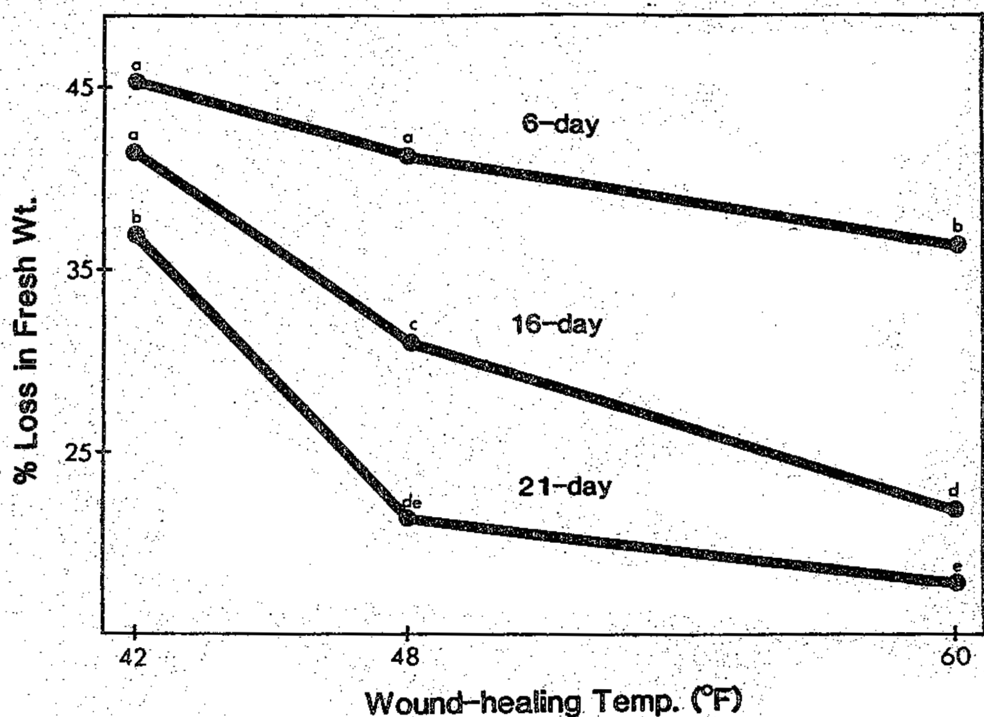

Figure 3. Percent weight loss stimulated from tissue healed at 42, 48 and 60°F by subsequently inoculating with E. carotovora or subjecting to elevated temperatures.