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SHORT COMMUNICATION

A PRELIMINARY INVESTIGATION ON THE RESPONSE OF SOME LOCALLY POPULAR VEGETABLES TO POSTHARVEST HOT WATER TREATMENT

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ABSTRACT

Each of the following commodities were dipped in hot water at different temperature-time combinations: tomato (*Lycopersicon esculentum)*, cucumber (*Cucumis sativus)* and bitter-gourd (*Momordica charantia)*-(55°C, 1 min), green chillies (*Capsicum annuum* 'Amu Miris') and carrot (*Daucus carota)*-(50°C, 1 min), bean (*Phaseolus vulgaris)*-(50°C, 30 sec) and okra (*Abelmoschus esculentus)*-(52°C, 30 sec). Some visual parameters that determine shelf-life of each commodity at room temperature (27±3°C) were observed and recorded. Decay initiation of tomato, cucumber, bitter-gourd, and carrot was delayed, but that of beans was advanced by the treatment. Green chillies and okra stored at ambient Relative Humidity (65±5%) conditions, irrespective of treatment, did not develop disease symptoms. Shrivelling and change in pigmentation of chillies and toughening of the pod of okra, were observed and these could not be corrected by treating with hot water. Treated tomatoes and chillies turned from green, yellow to red, and treated bitter-gourd turned from yellow to orange faster than the controls. The shelf life of all vegetables stored at 100 % Relative Humidity was reduced by about half compared to those at ambient Relative Humidity due to early decay initiation despite the hot water treatment.

INTRODUCTION

Postharvest hot water treatment of fruits and vegetables is practised as an alternative or to reduce usage of agrochemicals and is recorded to have several additional benefits (Wells and Cooley, 1973; Scriven *et al.*, 1988; Golan and Phillips, 1991; McCollum *et al.*, 1995; Lurie, 1998).

As no published data are available on the effect of hot water treatment on locally grown vegetables, this was a preliminary investigation to determine how their external appearance was affected by this treatment.

MATERIALS & METHODS

The vegetables used were, tomato (*Lycopersicon esculentum)*, green chillies (*Capsicum annuum;* 'Amu Miris'), cucumber (*Cucumis sativus)*, bitter-gourd (*Momordica charantia)*, carrot (*Daucus carota)*, bean (*Phaseolus vulgaris)* and okra (*Abelmoschus esculentus).*

Hot water treatment

A waterbath was prepared by filling a 50 l plastic basin with hot water. The temperature of the bath was monitored by an immersed thermometer. The temperature of the

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water had to be elevated every 3 min., by adding excess hot water. This was done carefully, away from the dipped fruits, and gently mixing up the water.

A treatment unit of each commodity of vegetables [tomato (4 fruits), green chillies (20 fruits), cucumber (1 or 4 fruits), bitter-gourd (1 or 4 fruits), carrot (1 or 4 roots), bean (10 pods) and okra (10 fruits)], was placed separately in a net-basket, and this basket was lowered into the water bath at a specified temperature. Immediately after the dip, the vegetables were taken out of the bath and exposed to flowing tap water at room temperature, while still in the net-basket, for *ca.* 1 min. The corresponding control set, composed of an equal number of vegetables as the treatment unit from each commodity, was dipped in water at room temperature. All vegetables thus treated, were allowed to drip dry at ambient conditions (i.e., temperature, 27±3°C ; Relative Humidity-RH, 65±5%).

The following temperature-time combinations were decided from literature, and/or by previous experiments (unpublished data of author): tomato 55°C, 1 min., green chillies, 50°C, 1 min., cucumber, 55°C, 1 min., bitter-gourd, 55°C, 1 min., carrot 50°C, 1 min., bean, 50°C, 30 sec., okra, 52°C, 30 sec..

Experimental design

The experiment with each commodity was replicated (R) 2 to 5 times as follows: tomato R=5, green chillies R=5, cucumber R=2, bitter-gourd R=4, carrot R=2, bean R=2, okra R=2. All vegetables of a commodity, treated on a single day (which composed of more than one treatment unit in some cases, and the corresponding controls), were considered as a single replication. The total number treated from each commodity is as follows: tomato 48 fruits, green chillies 480 fruits, cucumber 10 fruits, bitter-gourd 34 fruits, carrot 18 roots, bean 40 pods and okra 40 fruits. One treatment unit and the corresponding control set of vegetables, from each commodity in each replication, were stored at a higher RH (100%), as described below. All the other treated and control sets of each replication, were left on trays exposed to ambient conditions.

Daily observations were made on visual parameters which may lead to shelf-life reduction, such as microbial decay, change in pigmentation of skin and other visible changes such as desiccation and toughening. The moisture chambers (described below) were opened (maximum 5 min.) during daily observation times, but were kept closed at all other times. Mean values of the percentages of total pods/fruits/roots of a commodity that were diseased, and that had turned colour were calculated, for the day of termination of experiment for each commodity separately.

Preparation of moisture chambers

For storing at a higher RH, moisture chambers were prepared as follows. Plastic trays (40 cm x 30 cm x 7.5 cm) were lined with moist filter papers. Clean dry, glass petri dishes were arranged on the wet filter paper to rest the vegetables. They were placed on the petri dishes without touching the water, and each tray was covered with a heavy glass plate.

Isolation and identification of fungal pathogens

Fungal pathogens were identified by microscopic observation of scrapings, taken from lesions as they appeared, without damaging the skin of vegetables. At the end of the study, pieces (2 x 2 mm) from the growing edges of lesions on vegetables were cut, surface sterilized with 1% NaOCl for 2 min. and plated on Potato Dextrose Agar. The plates were incubated at room temperature for 48 to 72 h, until colonies appeared. The cultural and morphological characteristics of these colonies were observed. The results obtained from the scrapings were compared and confirmed, with those colonies observed on agar plates.

RESULTS & DISCUSSION

The percent pods/fruits/roots that decayed, and the percent that underwent skin pigmentation at the end of the study for each commodity are given (Table 1). The shelf-life of each commodity in different replications varied heavily. Therefore, for compilation of information in Table 1, the following observations were made use of for each commodity, to determine the the day of termination of the experiment.

Table 1

Mean percentage vegetables diseased (% D) and changed in pigmentation (% P) in treated (T) or control (C) pods/fruits/roots stored at ambient conditions, at the end of the experiment. The temperature and time of treatment of each commodity, and the number of days each commodity was observed are given

Commodity treatment (number of days observed)		%D		%P	
		T	C	T	C
Tomato (30-60)	55°C 1 min.	0	50	100	87
Green chillies (10)	50°C 1 min.	0	0	21	11
Cucumber (7)	55°C 1 min.	10	50	0	0
Bitter gourd (7)	55°C 1 min.	0	30	83	17
Carrot (13)	50°C 1 min.	0	25	0	0
Bean (5)	50°C 30 sec.	55	15	0	0
Okra (70)	52°C 30 sec.	0	0	0	0

In tomato, by the 30th day, more than 50% of fruits in the control set in 4, of 5 replications were either diseased or showed skin shrivelling, or both. In the fourth replication of tomato, diseases did not develop up to 60 days, and the fruits did not look shrivelled. Hence taking observations on this replication was terminated on the 60th day. In green chillies, by the 10th day, fruits showed change in pigmentation of the skin and more than 50% of fruits in all replications showed skin shrivelling. In cucumber, by the 7th day, 50% of fruits in both replications were diseased. In bitter-gourd, by the 7th day, more than 50% of treated fruits in both replications showed change in skin pigmentation. In carrot, by the 13th day both replications showed disease development in the control groups. In beans, by the 5th day, more than 50% of treated pods were diseased in both replications. In okra, neither disease development nor pigmentation changes was observed. Therefore the experiment was terminated on the 70th day.

Treating tomato, cucumber, bitter-gourd and carrot delayed disease development. Cucumber, bitter-gourd and carrot for treatment, were carefully transported directly to the laboratory from a field soon after harvest. In previous experiments, when these three commodities obtained from retailers were treated, decaying occurred faster (unpublished observations of author). Fungal genera isolated from decaying vegetables are listed (Table 2). No fungal decay was seen on green chillies or okra irrespective of treatment.

Table 2
Fungal genera isolated from decaying vegetables

Vegetable	Fungal Pathogen
Carrot	*Geotrichum* sp.
	Fusarium sp.
Cucumber	*Curvularia* sp.
	Pythium sp.
	Colletotrichum sp.
	Aspergillus sp.
	Rhizopus sp.
Bean	*Colletotrichum* sp.
	Fusarium sp.
	Rhizopus sp.
Bitter-gourd	*Rhizopus* sp.
	Aspergillus sp.
Tomato	*Colletotrichum* sp.
	Geotrichum sp.
	Alternaria sp.

The treated beans were highly susceptible to attack by *Rhizopus* sp. However, it is recorded that beans (i.e. *Phaseolus* spp.) could be hot water (Wells and Cooley, 1973) or vapour heat (Jones, 1940) treated to increase shelf-life. The fungal pathogens that appeared among replications of the same commodity varied heavily. Therefore, quantification of the damage caused by each pathogen in each commodity was not attempted. However, *Aspergillus niger* was frequently found on bruised or damaged areas of skin of cucumber and bitter-gourd. There was no consistant order in which pathogens appeared on each commodity.

Treated tomato and chillies turned from green, yellow to red, and treated bitter-gourd turned yellow to orange faster than the respective controls (Table 1). In previous experiments bitter-gourd was treated for 5 min. at 55°C and skin pigmentation was observed. Reducing treatment time of bitter-gourd to 1 min. in the present study, did not help in eliminating this pigment change.

In previous experiments green chillies were treated at 60°C, 1 min., but as skin shrivelling (i.e. desiccation) was observed, the treatment temperature was brought down to 55°C with no beneficial effect (unpublished observations of author). In the present experiment they were treated at 50°C for 1 min. Shrivelling was not reduced, even with exposure to this relatively lower temperature, when compared with earlier hot water treatment temperatures. In both treated and control groups of okra, desiccation of smaller pods and toughening of larger pods was observed with time. Black streaking along the ridges was noticed in both treated and control groups of okra.

The shelf life of all vegetables stored at 100% RH was reduced by about a half or more due to the growth of Zygomycetes fungi including *Rhizopus* spp. Bacterial infections (distinguished from typically watery lesions) were also common, developing particularly on stem ends of chillies and tomato, root top of carrot, stem and blossom ends of cucumber, and all over the surface at isolated spots on bitter-gourd.

In industrialized countries hot water treatment is done as an adjunct to refrigeration. This step may eliminate the negative effect caused by pigment changes observed in the present study. This may also explain why hot water treatment is becoming popular in the industrialized countries. Tomatoes showed a positive response to the treatment in spite of the ripening effect, except for one replication, where no fruits in either the control or treated sets showed disease. This method also could be recommended for carrot and cucumber provided they are free of any skin blemished at the time of treatment.

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