Quantifying the Economic Impact of Marketing “Sensory Damaged” Tree Fruit

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Abstract

A trained panel was established as a sensory evaluation tool to evaluate pre and post-harvest technology on consumer perception. Important tree fruit sensory quality attributes such as soft, mealy, “off flavor”, and other changes during post-harvest cold storage handling are being evaluated. This panel is being used to validate new pre and post-harvest technology innovations to reduce post-harvest losses, and eventually will be used to measure consumer responses (acceptance) and contribute to the economic impact analysis of these new technologies at the market. The influence of rootstocks on the fruit soluble solids concentration, titratable acidity and size of peaches and nectarines is also being investigated. The role of 1-MCP as a post-harvest tool to reduce softening and decrease fruit losses at the retail end is being carefully evaluated in different peach, nectarine and plum cultivars. These two technologies are affecting important quality traits of tree fruit during their post-harvest life.

Introduction

Despite all of the information on the health benefits of eating fruits and vegetables, consumption of some commodities, such as peaches, nectarines and plums (tree fruit), are low or have even been decreasing in the last decade. A recent intensive consumer quality survey (1,552 consumers) indicated that fruit softening, spoilage, and lack of taste (“sensory damaged”) are the main barriers restricting California peach, nectarine and plum purchasing in the USA market (Sterling-Rice Group, 2006). Thus, prevention of these post-harvest quality losses (Table 1) during the cold chain could be an approach to improve tree fruit consumption, since major sensory quality problems (softening and unfavorable taste or lack of taste) occur during post-harvest handling.

Table 1. Top Reasons Purchases of California Peaches, Nectarines and Plums are Cut Back (2005)

Peaches	Nectarines	Plums
1. Too soft	1. Too expensive	1. Too expensive
2. Spoiled too quickly	2. Too soft	2. Too soft
3. Too expensive	3. Spoiled quickly	3. Not sweet
4. Overripe / threw away	4. Not sweet	4. Not enough flavor
5. Not sweet	5. Not enough flavor	5. Too tart
6. Not enough flavor	6. Inconsistent experience	6. Spoiled quickly
7. Not ready to eat	7. Overripe, threw away	7. Inconsistent experience
8. Inconsistent experience	8. Not ready to eat	8. Overripe, threw away
	9. Too tart	9. Not ready to eat
	10. Too stringy	

Sterling-Rice Group*, What Are Your Customers Thinking Project: Why Not?*
Prepared for the California Tree Fruit Agreement, October 26, 2006.

Our approach to handle these post-harvest losses is to establish a sensory evaluation system to understand fruit sensory losses during post-harvest handling and propose innovative treatments to reduce these barrier problems. This sensory evaluation system will consist of a trained panel (descriptive analysis) at KAC that will be validated by several 'in store' consumer panels (preference and acceptance).

At the same time, this trained panel tool will be used to validate new pre and post-harvest technology innovations to reduce post-harvest losses, and eventually used to measure consumer responses (acceptance) and contribute to the economic impact analysis of these new technologies at the market. Important tree fruit sensory quality attributes such as soft, mealy, "off flavor", and others change during post-harvest cold storage handling, so evaluation of these attributes during post-harvest life will be carried out using trained and consumer panels.

The sensory data will be analyzed using preference mapping (descriptive and consumer panels) to characterize the impact of these sensory attributes on consumer consumption (O'Mahony, M.A. 1986; Lawless and Heymann, 1998). In addition, to determine the impact of these sensory attributes on consumer perception, a relationship between the KAC trained panel and consumer acceptance will be tested. In this way, in the future our KAC trained panel can be used to screen out preliminary pre-post-harvest treatments prior to a full consumer evaluation and/or economic impact at the market place. As a final step, evaluation of the economic impact of these innovative post-harvest treatments on current "sensory damaged" commodities and fruit consumption during the cold chain will be carried out.

Objectives

Establishing a Sensory Evaluation Tool for Testing Post-Harvest Handling Innovations (*this activity will be conducted in year one and two of the project and will address objectives one and two).*

Trained Panel - A trained panel consisting of twelve judges who eat tree fruit and screened for their taste acuity was developed at the Kearney Agricultural Center (KAC) as a tool for testing post-harvest technology changes of tree fruit. Panel training consisted of group and individual training.

1. **Group Training**

   In the group training, a panel overview, including schedules and purpose were covered, texture and flavor terms defined, samples presented and discussed for agreement on terms with judges. The purpose stated to the panel was to evaluate changes in tree fruit quality during post-harvest handling. First the texture and flavor terms were orally defined then; each judge was presented a sample of juicy, mealy and hard fruit one at a time to taste and discuss with the group. The fruit samples for reference and discussion to align terms agreement were nectarines commercially grown, packed, held at 32°F and then ripened at 68°F until they reached a flesh firmness of 2-4 lbf (juicy and normal peach flavor), nectarines commercially grown, packed, held at 32°F, but not ripened, only warmed to room temperature the day of training (Hard), and peaches commercially grown, packed, held at 41°F and then ripened at 68°F until they reached a flesh firmness of 2-4 lbf (Mealy). DS Waters's drinking water was used as the reference for No Flavor. No example was available by manipulations for Off Flavor at the time of training, only a definition could be used but the group was in agreement as to what constituted off flavor according to the definition. In addition, scorecard use, tasting procedures (how to cut the fruit and taste it) and perceptions were discussed**.**

2. **Individual Training**

   For the individual training each judge was presented 3 slices (reps) from the same fruit of one nectarine commercially grown, packed, held at 32°F and then ripened at 68°F until ripe to touch (juicy) and one peach commercially grown, packed, held at 41°F and then ripened at 68°F until ripe to touch (mealy) in random order to verify the consistency of their responses. Flesh firmness was measured on all samples immediately after tasting.

Testing Performance at the Retail Level of New Post-Harvest Technologies and their Impact on Consumer Preference (year 1 of 3).

1. **Evaluating the Role of 1-MCP in the Tree Fruit Industry**

   The role of 1-MCP (1-methylcyclopropene) was tested on reducing the softening rate during post-harvest handling of tree fruit. 1-MCP is a friendly plant growth regulator (PGR) that has been shown to be a potent inhibitor of softening, ripening and senescence with its commercial use in many fruits and vegetables. Thus, this PGR could provide an excellent opportunity for delayed harvest and development of high quality prior to harvest. At the same time, 1-MCP could reduce the rate of softening on fruit harvested at high maturity.

2. **1-MCP-Field Formulation**

   Our preliminary results indicate that current formulation of one MCP field application did not reduce softening during peach, nectarine and plum ripening "on the tree". Therefore treated fruit did not gain any quality attributes compared to untreated. We recommend modifications of the current field formulation for further evaluations. Also, 1-MCP applied immediately after harvest, did not reduce rate of softening on peach harvested from 8 to 2 lb. flesh firmness (tree ripe).

3. **1-MCP- Gas Formulation**

1-MCP post-harvest application (gas) to reduce softening during current post-harvest handling conditions (marketing riper but firmer fruit). 1-MCP treatment was very effective to reduce softening and extend shelf life on plum and some peach and nectarine cultivars. The 1-MCP treatment performance was related to fruit maturity and genotype. 1-MCP effect seems to be very promising in maintaining fruit firmness of most of the tested cultivars of plums and pluots, whereas it only works in a few of the tested peach and nectarine cultivars.

4. **1-MCP Post-Harvest Performance at Warm Transportation Temperature Conditions**

Softening of several 1-MCP post-harvest treated cultivars was evaluated under simulated temperature conditions above the killing temperature zone (fruit transport at 50-55°F in a refrigerated truck) to reduce chilling injury during post-harvest handling. 1-MCP treated plums held their flesh firmness above their bruising thresholds under this temperature regime. Most of the peach and nectarine cultivars evaluated softened below their bruising thresholds within the simulated test period.

5. **1-MCP Post-Harvest Applied During Conditioning**

1-MCP treatment appears to be a potential tool to control softening and extend shelf life on preconditioned plums, and some peach and nectarine cultivars. However, the treatment performance was controlled by the cultivar and time of application interaction. 1-MCP usually works more efficiently on maintaining tree fruit firmness when applied before the preconditioning than when applied after it.

6. **Sensory Evaluation of 1-MCP Treated Tree Fruit**

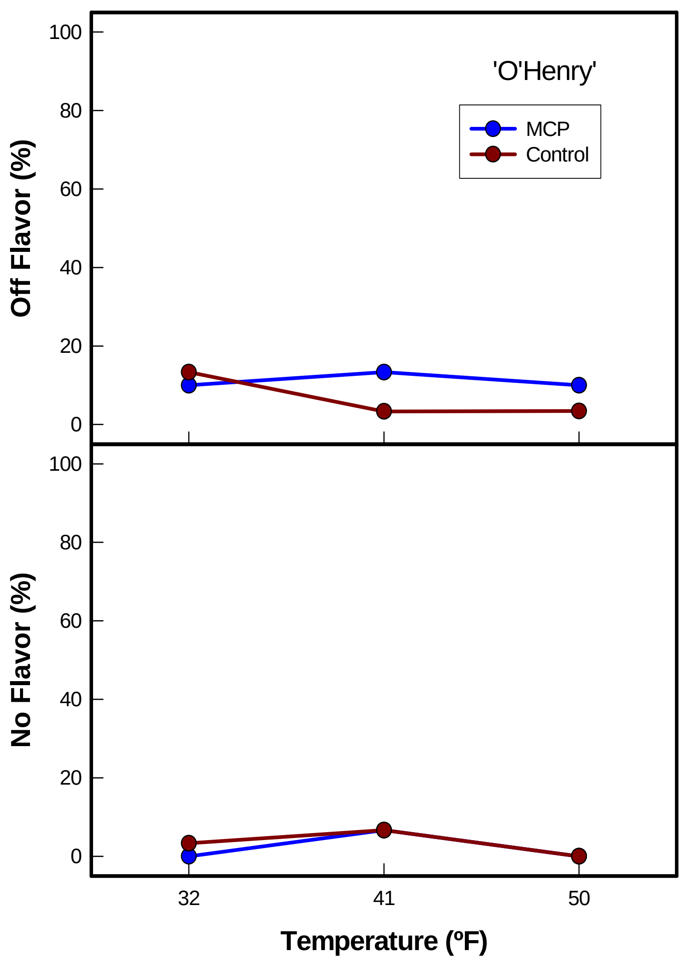
A preliminary screening test was conducted to determine if 1-MCP treatment had an effect on the sensory quality of the tree fruit during a simulated short shipment under three sets of temperature conditions (32, 41, or 50^{o}F) with 3 replications per treatment-temperature. Commercially grown 'O'Henry' peaches were harvested, packed and immediately transported to the F. Gordon Mitchell Post-harvest Laboratory, KAC where half of the fruit were placed untreated at each of the three test temperatures and the other half of the fruit were placed in controlled atmosphere (CA) Tanks for 1-MCP treatment at each of the three temperatures, treated for 12 hours in the CA Tanks and then held at the treatment temperatures. The KAC trained panel did not perceive any differences in the sensory damaged parameters between treated and untreated ripe fruit after being held for five days at their respective test temperatures, and then ripened at 68°F in a temperature-controlled room for one to five days until a subsample was ripe to touch for sensory evaluation (Fig. 1).

PRELIMINARY CONCLUSIONS

The benefits of using a trained panel in pre-harvest and post-harvest research programs are being demonstrated. Adding sensory evaluation of new pre- and post-harvest technology will help our industry to adopt beneficial new technology.

The benefits of 1-MCP on reducing softening and extending shelf life can be improved with the use of correct post-harvest temperature management; maintaining the fruit at 32°F during all of the storage and shipping process (instead of shipping the fruit at 41° F) as was done in our test.

Figure 1. Influence of storage temperature and MCP treatment on flavor quality of 'O'Henry' Peach (2009)



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