SENSORY EVALUATION OF STONE FRUIT FOLLOWING HEAT/CONTROLLED ATMOSPHERE TREATMENT

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Introduction

Treatment of peaches and nectarines with high temperature forced air combined with a controlled atmosphere consisting of 1% oxygen and 15% carbon dioxide (also known as CATTS treatment) has been demonstrated to provide quarantine control of both Oriental fruit moth and codling moth. In addition to ensuring that the treatment is efficacious against the target pests, work has been ongoing over the past four seasons to determine the effect of CATTS on fruit quality. In general it has been found that standard quality parameters, such as surface quality, color, acidity and soluble solids are changed relatively little by CATTS treatment. The major goal of the 2004 season was to obtain greater detail on the effect of CATTS on fruit quality by evaluating both treated and untreated peaches and nectarines using a commercial sensory panel to examine the impact of treatment on both visual and taste attributes of quality.

Methods

Five varieties of peaches and nectarines were CATTS-treated using either a 12 ºC/h (slow) or 24 ºC/h (fast) heating rate, a 46 ºC final treatment chamber temperature and an atmosphere of 1% oxygen and 15% carbon dioxide. The peach varieties were: 1) 'Diamond Princess' (yellow flesh), 'Elegant Lady' (yellow flesh) and 'Summer Sweet' (white flesh). The nectarine varieties were: 1) 'Fire Pearl' (white flesh) and 2) 'Summer Bright' (yellow flesh). The treatment was terminated when the fruit seed surface temperature had been at 45 ºC or greater for 30 minutes (12 ºC/h) or 15 minutes (24 ºC/h), giving total treatment times ranging from 2.5 to 3.5 hours. Control fruit were held in the treatment room but not treated. Following treatment the fruit were stored for 2 weeks at 1 ºC and then ripened at 23 ºC until fruit firmness was determined to be 3 pounds or less. Sensory evaluations were performed on the ripe fruit at TreeTop, Inc. (Selah, WA) using a trained panel consisting of 24 to 30 TreeTop employees. Both visual and taste evaluations were performed.

Results

Visual Comparison Tests

Panelists gave average visual ratings for comparisons of untreated controls to each of the two treatments and with each of the treatments to each other ranging from 1.83 to 3.15 based upon a scale of 1 to 9 with 1 being no visual difference and 9 being very different (Table 1). In this test a separate comparison of control fruit to other control fruit of the same variety (untreated vs. untreated) was also run to act as a negative control. The size of the respective values for the negative controls (fruit were all the same) relative to the treatment comparisons indicate that there was little or no actual difference that could be detected between untreated fruit and either the fast- or slow-

treated fruit. There was also little or no difference between the two heat treatments in terms of appearance.

Taste

A triangle difference test where a panelist tries to select the different sample from a grouping of three samples was used as an initial test to determine if CATTS treatment had any noticeable effect on flavor. For all of the varieties tested a statistically significant number of panelists could differentiate some difference between the untreated and both the fast and slow treatments (Table 2). In only one case, the comparison of fast vs. slow heat treatments for the variety 'Fire Pearl', was there no significant difference.

In an attempt to determine why panelists could differentiate between untreated and CATTS-treated fruit, tests were run to determine which sensory attributes had been altered by heat treatment (Table 3). For 'Diamond Princess' only the untreated vs. slow treatment comparison could be made due to a lack of fruit. Panelists felt that CATTS-treatment caused a loss of flavor and a less acidic taste in this variety. In 'Elegant Lady', there was also noted a tendency for CATTS-treated fruit to be less flavorful and slightly mealier. Flavor was not affected in 'Summer Sweet' but treated fruit were softer. 'Fire Pearl' nectarines treated using the slow CATTS treatment had less flavor and sweetness than the control fruit, while fast CATTS-treated fruit differed from the control fruit mainly due to textural differences. A lack of fruit also prevented some of the tests being run for 'Summer Bright' nectarines but it was noted that the slow CATTS treatment slightly increased the acidity of the fruit.

Although it had been found that in many cases differences existed in the taste of the fruit due to CATTS treatment the tests did not answer the overall question of whether a consumer would find the treated fruit good to eat. To attempt to answer this question preference tests for each variety were run (Table 4). These tests indicated that in four of the five varieties tested slow CATTS treatment caused a small but significant decrease in the preference score, although the score was still within the range of liking. For the four varieties tested using the fast CATTS treatment two were judged to have a worse flavor by the panelists with scores in the "dislike" range.

Conclusion

Overall the panelists indicated that appearance was not significantly altered by CATTS treatment. Taste, on the other hand, was sometimes negatively altered by treatment with decreases in flavor and changes in texture being potential causes. In the case of the slow CATTS treatment fruit were still determined to be acceptable by preference testing and given the relatively close scores it is uncertain whether or not the average consumer could discern the changes.

Table 1. Visual comparison tests. Scale of 1 (no difference) to 9 (very different) with the untreated control set to 1.0.

Variety	Untreated vs. untreated	Untreated vs slow CATTS	Untreated vs fast CATTS	Slow vs fast CATTS
Diamond Princess	3.22	2.91	No Test	No Test
Elegant Lady	1.69	3.05	3.15	2.55
Summer Sweet	2.51	2.54	1.83	2.21
Fire Pearl	1.53	2.01	1.88	2.34
Summer Bright	1.60	2.38	2.37	2.85

Table 2. Triangle tests for differences in taste. The number of panelists out of the total number tasting who were able to determine a taste difference is indicated. An asterisk indicates a significant difference (at 95% level).

Variety	Untreated vs slow CATTS	Untreated vs fast CATTS	Slow vs fast CATTS
Diamond Princess	9 of 29*	No Test	No Test
Elegant Lady	17 of 30*	17 of 30*	17 of 30*
Summer Sweet	15 of 29*	15 of 29*	15 of 29*
Fire Pearl	14 of 25*	15 of 25*	10 of 25
Summer Bright	13 of 24*	23 of 24*	18 of 24*

Table 3. Flavor and texture attribute comparisons. Average flavor and texture scores used a scale of 1 to 9 with the control (untreated) value set at 5. Numbers with asterisks are significantly different from the control (at 95% level). O. flavor=overall flavor and P/N flavor=peach/nectarine flavor.

Variety	Treatment Comparison	Flavor Attributes				Texture Attributes		
		O. Flavor	P/N Flavor	Sweetness	Acidity	Juiciness	Mealiness	Hard/Firm
Diamond Princess	Untr. vs slow	3.81*	4.01*	4.51	4.23*	4.78	5.22	4.96
	Untr. vs fast	Not performed						
	Fast vs slow	Not performed						
Elegant Lady	Untr. vs slow	4.33*	4.21*	4.71	4.62	4.52	5.52*	4.84
	Untr. vs fast	4.34	4.29*	5.02	4.72	4.56	5.80*	4.59
	Fast vs slow	5.20	5.21	6.51	4.71	5.23	5.23	4.73
Summer Sweet	Untr. vs slow	5.25	5.47	5.12	5.05	5.09	5.28	4.30*
	Untr. vs fast	4.81	4.71	5.07	4.98	4.45*	5.30	4.40*
	Fast vs slow	4.84	4.78	5.15	4.84	4.84	5.21	4.88
Fire Pearl	Untr. vs slow	3.88*	3.55*	3.46*	4.87	4.42	5.48	4.85
	Untr. vs fast	4.52	4.45	4.60	4.77	4.75	5.73*	4.25*
	Fast vs slow	No significant difference in triangle test						
Summer Bright	Untr. vs slow	4.61	4.71	4.47	5.69*	4.72	5.03	5.11
	Untr. vs slow	Not performed						
	Fast vs slow	Not performed						

Table 4. Preference tests using a 9-point hedonic rating scale. A rating of 5 indicates that the sample was neither liked nor disliked while numbers higher than 5 indicate increased liking and less than 5 increasing dislike. Numbers followed by different letters within a variety are significantly different from each other (95% level).

Variety	Untreated	Slow CATTS	Fast CATTS
Diamond Princess	6.87[a]	6.03[b]	No Test
Elegant Lady	6.59[a]	5.17[b]	4.86[b]
Summer Sweet	6.04[a]	5.86[a]	5.39[a]
Fire Pearl	6.85[a]	5.20[b]	5.70[ab]
Summer Bright	7.52[a]	5.91[b]	3.52[c]