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Understanding consumer acceptance of early harvested 'Hayward' kiwifruit

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Abstract

During two seasons, 'in-store' consumer acceptance tests were performed to determine the relationship between ripe soluble solids concentration (RSSC) and/or ripe titratable acidity (RTA) on 'Hayward' kiwifruit consumer acceptance. For this, 252 consumers were presented kiwifruit slice samples with RSSC of 11.0, 12.0, 13.0, and 14.0% with a RTA ranging from 0.8 to 1.2%. Kiwifruit with RSSC that ranged from 11.6 to $> 13.5\%$ were always liked by consumers but with different degrees of liking. A 12.5% RSSC is proposed as a minimum quality index for early-marketed kiwifruit. RTA played a significant role in consumer acceptance only on kiwifruit that had RSSC $< 11.6\%$ with RTA $\geq 1.17\%$ ('sour'). This kiwifruit quality survey indicated that some vineyards had kiwifruit with RSSC higher than 12.5% before they met the recommended minimum maturity standard of 6.5% HSSC. Kiwifruit picked with SSC $< 6.2\%$ developed flesh breakdown. This work demonstrated that some California vineyards could produce high taste quality (12.5% RSSC) kiwifruit before they reach 6.5% SSC measured when kiwifruit are hanging on the vines. © 2001 Elsevier Science B.V. All rights reserved.

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1. Introduction

During the last 5 years, use of the preconditioning protocol by shippers, packers, and buyers, and the ripening protocol by receivers and produce managers has allowed the California kiwifruit industry to safely deliver 'ready to buy' fruit to consumers during the early and late season (Crisosto et al., 1997). Because of the current kiwifruit market situation, it is economically advantageous to harvest early. However, repeat purchases are dependent upon good eating quality (taste) and it is essential that consumers are satisfied. Consumers consider high quality fruit to be those with nice appearance, high nutritional value, and good taste (Bruhn et al., 1991). According to current University of California recommendations, 'Hayward' kiwifruit harvest can start

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when kiwifruit reach a minimum of 6.5% SSC. In Chile and New Zealand, kiwifruit harvest is recommended to start when kiwifruit have at least 6.2% SSC. Earlier studies (Crisosto et al., 1984) demonstrated that late harvested kiwifruit have a long storage potential and are highly accepted by consumers. Consumer acceptance, rather than potential storage, is the most important factor to consider for kiwifruit that will be sold immediately.

There is limited information on the relationship between consumer preference or acceptance and chemical composition of ripe kiwifruit (Gorini and Lasorella, 1990; Mitchell et al., 1990; Crisosto, 1992). In other fruit, it has been reported that consumer preferences or acceptance are mainly based on SSC but other quality attributes may also be important (Sozzi et al., 1980; Ben-Arie et al., 1982; Matsumoto et al., 1983; Young and Paterson, 1985; Robertson and Meredith, 1989; MacRae et al., 1990). Among these other quality attributes, TA may play an important role in consumer preferences or acceptance (Lawes and Sawanobori, 1984; Pehrson and Ivans, 1988; Crisosto et al., 1997).

The purpose of this work was to determine consumer acceptance for early harvested California 'Hayward' kiwifruit in relation to RSSC, RTA and RSSC/RTA.

2. Materials and methods

2.1. Industry survey

During the 1998 season, 'Hayward' kiwifruit were collected at four different maturity stages (harvest dates) from eight vineyards in two production areas (San Joaquin Valley and Sacramento Valley). Ten vines (experimental unit) were labeled in each of five replicates per vineyard. In both seasons, 120 kiwifruit from each replicate were sampled at each maturity stage (harvest date). Sixty fruit were used for initial quality and 60 for quality evaluation on ripe kiwifruit. Kiwifruit samples from the four Sacramento Valley vineyards were harvested on 9/25/98, 10/7/98, 10/15/98, and 10/29/98, while those from the four

San Joaquin Valley vineyards were harvested on 9/22/98, 10/5/98, 10/15/98, and 10/22/98. During the 1999 season, kiwifruit were harvested on 9/30/99, 10/7/99, and 10/18/99 from three vineyards located in the San Joaquin Valley production area.

Quality attributes measured at harvest included soluble solids concentration (HSSC), firmness (HF), and titratable acidity (HTA). Ripe soluble solids concentration (RSSC) and ripe titratable acidity (RTA) were measured on kiwifruit ripened at 20°C with 100 ppm ethylene until flesh firmness reached 9–13.5 Newtons (N).

2.2. Storage quality

In both the 1998 and 1999 seasons, 100 'Hayward' kiwifruit from each vineyard/maturity stage/replicate were packaged and stored at 0°C. In 1998, all fruit were evaluated after 4 months storage. In 1999, 15 fruit/vineyard per maturity stage from each of three replicates were removed from storage monthly, and ripened at 20°C until flesh firmness reached 9–13.5 N. Kiwifruit were then cut in half longitudinally from sepal end to stem end and evaluated for the presence or absence of flesh breakdown (FB). Flesh breakdown (Harman, 1981), also called internal breakdown (Lallu, 1997), was observed as a ring or zone of granular, water soaked tissue in the outer pericarp beginning at the stylar end of the fruit.

2.3. In store consumer test

Groups of 110 and 142 consumers at a major supermarket, located in Fresno County, were tested during the 1998 and 1999 seasons, respectively. Based on an industry-wide survey in 1998 and previous records, each consumer was presented with four ripe kiwifruit samples at four targeted RSSC levels (11.0, 12.0, 13.0, and 14.0%) to begin to define a minimum quality index for early harvested 'Hayward' kiwifruit. Target RTA levels were 1.00 and 0.60%. In 1998, there was a wide range of RTA at the targeted RSSC levels. To ripen previously cold stored kiwifruit samples, cold kiwifruit (0°C) were exposed to 100 ppm ethylene for 12 h following the preconditioning

protocol (Crisosto et al., 1997; Ritenour et al., 1999). This process was carried out 2–3 days prior to the consumer test and kiwifruit were allowed to ripen at 20°C until they reached 9–13.5 N firmness. Firmness was measured on each piece of ripe fruit before the consumer test. Any kiwifruit with firmness outside the 9–13.5 N range were not used in these tests.

In both seasons, each consumer that said he/she ate kiwifruit was asked to taste four ripe kiwifruit wedges presented in random order in coded $5\frac{1}{2}$ ounce soufflé cups at room temperature. The consumer was asked if he/she 'liked,' 'disliked,' or 'neither liked nor disliked' the sample. Then the consumer was asked his/her degree of liking/disliking: slightly, moderately, very much, or extremely. The response was recorded using a nine-point hedonic scale (1, dislike extremely to 9, like extremely). The consumer was instructed to sip bottled water in between samples to cleanse his/her palate. The RSSC and RTA were measured on each sample tasted. Consumer acceptance was measured as both a degree of liking and a percentage. The percentage of consumers liking the kiwifruit sample was calculated as number of consumers liking the kiwifruit sample (score > 5.0) divided by the total number of consumers within the sample (Lawless and Heymann, 1998). The percentage of consumers disliking the kiwifruit sample (score < 5.0) was calculated as the number of consumers disliking the kiwifruit sample divided by the total number of consumers within the sample. The percentage of consumers that neither liked nor disliked the kiwifruit sample was calculated as the number of consumers that neither liked nor disliked the kiwifruit sample (score = 5.0) divided by the total number of consumers within the sample.

Degree of liking data was subjected to analysis of variance (ANOVA) prior to Least Significant Differences (LSD) mean separation using the SAS program. In addition to the previous analysis, the Friedman multiple means comparison (Newell and MacFarlane, 1987; Basker, 1988) procedure for ranked data for the two combined seasons was used to compare degree of liking. Percentage consumer acceptance was also calculated in all of the cases.

3. Results and discussion

3.1. Harvest quality

3.1.1. 1998 Growing season

In both growing areas, kiwifruit HF decreased as HSSC increased but HTA did not change during the sampling period (Tables 1–3).

Average HF of kiwifruit growing in Sacramento Valley vineyards (Table 1) decreased from 94.5 to 70.7 N and HSSC increased from 4.9 to 6.9% between September 25 and October 29, 1998. During this sampling period, HTA remained between 1.87 and 2.00%. HF and HSSC values were similar among vineyards. After ripening fruit to a flesh firmness of 9–13.5 N average, vineyard kiwifruit RTA decreased to 0.63–1.01% while RSSC increased to 11.1–13.1%. In this growing season, three out of the four vineyards in the Sacramento Valley reached minimum maturity (6.5% HSSC) between October 15 and October 29, 1998. Vineyard #4 did not reach 6.5% HSSC or have a RSSC ≥ 12.5% by October 29. When the three vineyards met the minimum maturity of 6.5% HSSC (measured at harvest time), RSSC was approximately 13%, and kiwifruit HF was below 7.7 N. Kiwifruit from two of the four vineyards had a RSSC ≥ 12.5% by October 15 when HSSC was still below 6.5%.

Average HF for kiwifruit growing in San Joaquin Valley vineyards (Table 2), decreased from 93.6 to 81.0 N and HSSC increased from 5.4 to 6.9% between September 22 and October 22, 1998. During this sampling period, HTA remained near 2.00%. With the exception of vineyard #5 on the last harvest date, there were no important differences in HF, HSSC, HTA, RTA and RSSC among locations. Kiwifruit in vineyard #5 appear to have ripened faster than fruit from the other locations. After ripening to a flesh firmness of 9–13.5 N, kiwifruit RTA decreased to 0.62–1.00% while RSSC increased to 12.2–14.2%. In this growing season, vineyard #5 in the San Joaquin Valley reached minimum maturity (6.5% HSSC) by October 15. Vineyards #6 and #7 reached minimum maturity by October 22, and vineyard #8 did not meet the minimum maturity standard during the sampling period. When the

three vineyards met the minimum maturity standard of 6.5% HSSC, HF was below 80.6 N. Vineyard #6 was 6 years old and had an average HF of 87.3 N when it reached minimum maturity.

Kiwifruit from all vineyards sampled in the San Joaquin Valley had a RSSC ≥ 12.5% by October 5 when HSSC were still ≤ 6.0%. Kiwifruit from vineyards #5, #6 and #7 had a RSSC ≥ 14.2% when they reached 6.5% HSSC. Kiwifruit from vineyard #8 only had 13.5% RSSC on the last sampling date of October 22.

3.1.2. 1999 Growing season

In this short crop season, we only evaluated kiwifruit growing in the San Joaquin Valley. Kiwifruit HF decreased, HSSC increased, and HTA remained the same during the sampling period (Table 3). Average HF among vineyards decreased from 77.0 to 73.8 N, while HSSC increased from 5.8 to 7.1% from September 30 to October 18, 1999. During this sampling period, HTA remained between 1.97 and 2.08%. There were no important differences in HF and HSSC values among vineyards. After ripening fruit to a flesh firmness of 9–13.5 N, kiwifruit RTA decreased to 0.79–1.04%, while RSSC ranged from 12.9 to 15.0%. In this growing season, two of the three vineyards reached minimum maturity (6.5% HSSC) between October 7 and October 18, 1999. Vineyard #6 had a HSSC of 6.4% on the last sampling date. At the time the two vineyards met the minimum maturity standard, kiwifruit HF

Table 1

'Hayward' kiwifruit quality attributes from four vineyards in the Sacramento Valley at harvest and after ripening, 1998 growing season

Vineyard	Initial			Ripe (9–13.5 N)	
	Firmness (N)	HSSC (%)	HTA (%)	RSSC (%)	RTA (%)
Harvest 1 (9/25/98)					
1	86.9 a[a]	5.0 b	1.88 a	10.9 a	0.65 a
2	90.5 a	4.9 b	1.89 a	11.5 a	0.89 b
3	102.6 b	5.0 b	1.91 a	11.0 a	0.79 b
4	97.2 b	4.6 a	1.78 a	10.8 a	0.78 b
Mean	94.5	4.9	1.87	11.1	0.78
Harvest 2 (10/7/98)					
1	84.6 a	5.2 a	1.81 a	11.8 a	0.99 a
2	84.2 a	5.3 a	1.96 b	12.3 a	0.92 a
3	86.4 a	5.3 a	1.90 ab	12.3 a	1.06 a
4	95.9 b	5.0 a	1.80 a	11.6 a	1.05 a
Mean	87.8	5.2	1.87	12.0	1.01
Harvest 3 (10/15/98)					
1	81.0 a	5.8 b	1.93 a	12.6 a	0.64 a
2	79.7 a	5.7 b	2.03 b	12.5 a	0.57 a
3	80.1 a	5.7 b	1.91 a	12.1 a	0.64 a
4	87.3 b	5.1 a	1.98 ab	11.7 a	0.66 a
Mean	81.9	5.6	1.96	12.2	0.63
Harvest 4 (10/29/98)					
1	64.4 a	7.2 a	1.97 a	13.1 b	0.80 a
2	76.1 a	6.6 a	2.07 a	13.0 b	0.76 a
3	67.1 a	7.5 a	1.98 a	13.8 c	0.81 a
4	74.7 a	6.3 a	1.97 a	12.3 a	0.65 a
Mean	70.7	6.9	2.00	13.1	0.76

[a] Mean separation within each harvest date by LSD at $P \leq 0.05$. Different letters within columns in the same harvest date indicate significant differences.

Table 2
'Hayward' kiwifruit quality attributes from four vineyards in the San Joaquin Valley at harvest and after ripening, 1998 growing season

Vineyard	Initial			Ripe (9–13.5 N)	
	Firmness (N)	HSSC (%)	HTA (%)	RSSC (%)	RTA (%)
Harvest 1 (9/22/98)					
5	89.6 a[a]	5.5 a	1.91 a	12.3 ab	0.76 a
6	93.6 a	5.4 a	2.28 a	12.8 b	0.67 a
7	88.2 a	5.5 a	1.86 a	11.9 a	0.80 a
8	102.2 b	5.1 a	1.97 a	11.9 a	0.75 a
Mean	93.6	5.4	2.01	12.2	0.75
Harvest 2 (10/5/98)					
5	82.8 a	5.8 b	1.85 a	13.2 a	0.99 a
6	88.7 b	5.8 b	2.09 c	13.5 a	1.02 a
7	87.8 b	6.0 b	1.96 b	13.4 a	0.93 a
8	83.3 a	5.4 a	2.04 bc	13.2 a	1.06 a
Mean	85.5	5.8	1.99	13.3	1.00
Harvest 3 (10/15/98)					
5	81.0 a	6.8 c	1.87 a	14.3 b	0.76 bc
6	86.9 bc	6.0 ab	2.14 b	14.2 b	0.57 a
7	90.0 c	6.4 bc	2.08 b	13.8 b	0.69 ab
8	85.1 ab	5.9 a	2.12 b	12.9 a	0.86 c
Mean	86.0	6.3	2.05	13.8	0.72
Harvest 4 (10/22/98)					
5	71.6 a	8.0 c	2.08 ab	14.9 b	0.69 c
6	87.3 c	6.5 ab	2.18 bc	14.2 ab	0.54 a
7	80.6 b	7.0 b	2.08 ab	14.2 ab	0.57 ab
8	84.2 bc	6.2 a	2.26 c	13.5 a	0.68 bc
Mean	81.0	6.9	2.15	14.2	0.62

[a] Mean separation within each harvest date by LSD at $P \leq 0.05$. Different letters within columns in the same harvest date indicate significant differences.

was ≥ 71.6 N. Kiwifruit from the three vineyards had an average RSSC of 12.9% on the first sampling date (September 30) while HSSC was 5.8%. Kiwifruit from vineyards #5 and #7 had a RSSC $\geq 15.0\%$ when they reached minimum maturity (6.5% HSSC). This survey agrees with the one we conducted in 1991 (data not shown).

3.2. Storage quality

3.2.1. 1998 Growing season
Flesh breakdown (FB) symptoms were detected after 4 months at 0°C. Kiwifruit storage quality was not evaluated prior to 4 months cold storage. Incidence of FB was related to HSSC (Fig. 1). There was a high incidence of FB after storage in

kiwifruit picked before they reached 6.3% HSSC. During this growing season, kiwifruit reached approximately 6.3% HSSC after October 6 in vineyards in the San Joaquin Valley and after October 13 in vineyards in the Sacramento Valley.

3.2.2. 1999 Growing season
During the 1999 growing season, kiwifruit from the San Joaquin Valley were removed from cold storage monthly and evaluated for incidence of FB. FB did not become commercially important until after 3 months at 0°C for these early harvested kiwifruit. Incidence of FB was also well related to HSSC (Fig. 1). During the first 3 months of cold storage, incidence of FB was very low. Kiwifruit from one vineyard had a higher

Table 3
'Hayward' kiwifruit quality attributes from three vineyards in the San Joaquin Valley at harvest and after ripening, 1999 growing season

Vineyard	Initial			Ripe (9–13.5 N)	
	Firmness (N)	HSSC (%)	HTA (%)	RSSC (%)	RTA (%)
Harvest 1 (9/30/99)					
5	73.4 b[a]	5.8 a	2.02 a	13.0 a	0.92 b
6	78.8 b	5.8 a	1.97 a	12.8 a	1.02 b
7	75.6 b	5.7 a	1.92 a	13.0 a	0.60 a
Mean	76.1	5.8	1.97	12.9	0.85
Harvest 2 (10/7/99)					
5	75.6 b	6.3 b	2.05 a	13.8 a	0.81 b
6	83.7 a	6.1 a	2.13 b	13.3 a	0.90 bc
7	72.0 b	6.4 b	2.05 a	14.9 b	0.66 a
Mean	77.0	6.3	2.08	14.0	0.79
Harvest 3 (10/18/99)					
5	75.2 b	7.8 c	2.10 b	15.9 a	1.08 b
6	75.2 b	6.4 a	2.19 b	14.2 a	1.20 c
7	71.6 a	7.0 b	1.80 a	15.0 a	0.85 a
Mean	73.8	7.1	2.03	15.0	1.04

[a] Mean separation within each harvest date by LSD at $P \leq 0.05$. Different letters within columns in the same harvest date indicate significant differences.

incidence of FB than kiwifruit from the others. Differences in FB incidence can be explained by seasonal influences (Lallu, 1997). The 1998 and 1999 growing seasons had differences in weather patterns and crop loads.

3.3. Consumer test

3.3.1. 1998 Season

Consumer acceptance, expressed as degree of liking, was significantly related to RSSC, RTA and RSSC: RTA (Fig. 2). Kiwifruit with RSSC that ranged from 11.6 to >13.5% were always liked by consumers but with different degrees of liking. Consumers liked these kiwifruit from 'slightly' (5.9) to 'moderately' (6.6), and acceptance varied from 70 to 84%.

The 'neither like nor dislike' option was selected by only a few consumers, varying from 6.9 to 1.0% depending on RSSC level (Table 4). The percentage of consumers that chose the 'neither like nor dislike' option decreased from 6.9 to 1.0% as RSSC increased. For kiwifruit with equal to or higher than 13.5% RSSC, the percentage of con-

sumers that chose the 'neither like nor dislike' option was approximately 1.0%.

There was a significant interaction between RSSC and RTA on the degree of liking. For this reason, data were further analyzed using three levels of RTA (Fig. 3). Degree of liking was the
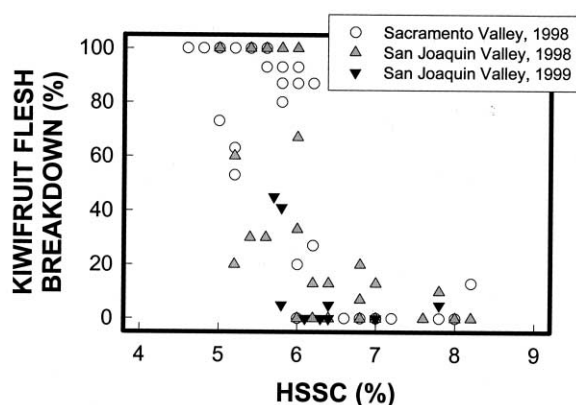

Fig. 1. Relationship between harvest SSC and 'Hayward' kiwifruit flesh breakdown from eight vineyards measured after 4 months cold storage at 0°C, then ripened at 20°C until soft, 1998 and 1999 growing seasons.
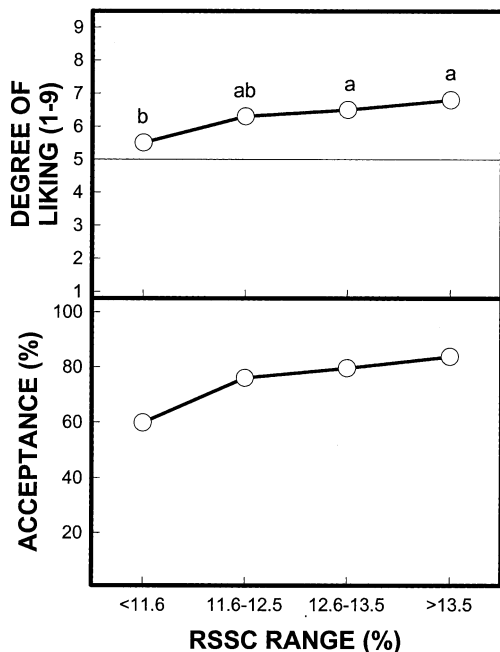
Fig. 2. Relationship between 'Hayward' kiwifruit ripe soluble solids concentration (RSSC), consumer degree of liking (1, dislike extremely; 2, dislike very much; 3, dislike moderately; 4, dislike slightly; 5, neither like nor dislike; 6, like slightly; 7, like moderately; 8, like very much; 9, like extremely), and percentage consumer acceptance, 1998 growing season.
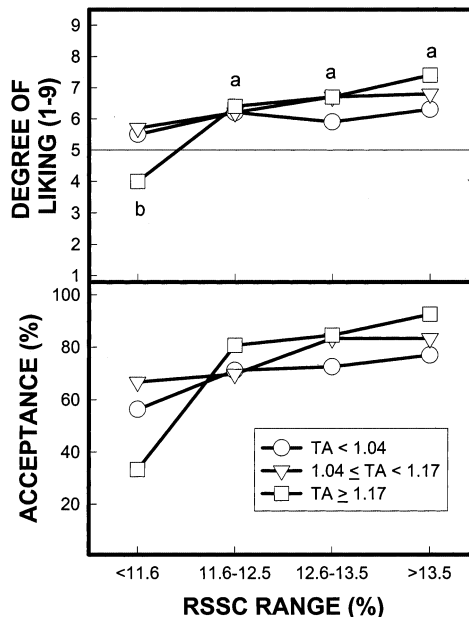
Fig. 3. Relationship between 'Hayward' kiwifruit ripe soluble solids concentration (RSSC), degree of liking (1, dislike extremely; 2, dislike very much; 3, dislike moderately; 4, dislike slightly; 5, neither like nor dislike; 6, like slightly; 7, like moderately; 8, like very much; 9, like extremely), and percentage consumer acceptance at three different levels of titratable acidity, 1998 growing season.

Table 4
Relationship between ripe soluble solids concentration (RSSC) and consumer acceptance of ripe 'Hayward' kiwifruit

RSSC range (%)	Degree of liking[a]	Like	Neither like nor dislike	Dislike
1998 growing season consumer acceptance (%)				
9.8–11.4	5.9 b	59.8	6.9	33.3
11.6–12.4	6.2 ab	75.4	5.8	18.8
12.6–13.4	6.6 a	79.6	4.6	15.7
13.6–15.0	6.6 a	83.8	1.0	15.2
P-value	0.020	–	–	–
LSD 0.05	0.6	–	–	–
1999 growing season consumer acceptance (%)				
9.4–11.4	6.2 c	71.6	7.4	21.0
11.6–12.4	6.8 b	85.6	4.0	10.4
12.6–13.0	7.0 ab	84.8	7.6	7.6
13.2–15.0	7.3 a	89.9	3.8	6.3
P-value	0.0001	–	–	–
LSD 0.05	0.4	–	–	–

[a] Degree of liking with 1, dislike extremely; 2, dislike very much; 3, dislike moderately; 4, dislike slightly; 5, neither like nor dislike; 6, like slightly; 7, like moderately; 8, like very much; 9, like extremely.
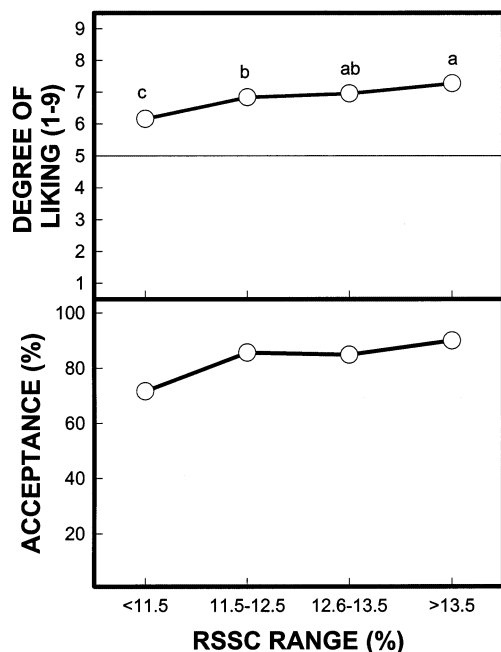
Fig. 4. Relationship between 'Hayward' kiwifruit ripe soluble solids concentration (RSSC), consumer degree of liking (1, dislike extremely; 2, dislike very much; 3, dislike moderately; 4, dislike slightly; 5, neither like nor dislike; 6, like slightly; 7, like moderately; 8, like very much; 9, like extremely), and percentage consumer acceptance, 1999 growing season.

Table 5
Combined 1998 and 1999 seasons, degree of liking according to ripe soluble solids concentration (RSSC) means separation based on rank sums for multiple comparison for ripe 'Hayward' kiwifruit

Average 1998/1999 season RSSC level (%)	Degree of liking (score 1–9)[a]
11.0	5.6 α[b]
12.0	6.4 β
12.8	6.6 β
13.8	6.8 β

[a] Degree of liking with 1, dislike extremely; 2, dislike very much; 3, dislike moderately; 4, dislike slightly; 5, neither like nor dislike; 6, like slightly; 7, like moderately; 8, like very much; 9, like extremely.

[b] Same letters within the column indicate no significant differences ($P \leq 0.001$) between the means according to the critical values of differences among rank sums for multiple comparisons (Friedman multiple means comparison, Newell and MacFarlane, 1987).

same for kiwifruit with RSSC > 11.6% combined with high (> 1.17%), moderate (1.04–1.17%) and low (< 1.04%) RTA (Fig. 3). However, when kiwifruit had RSSC < 11.6%, RTA played a significant role in consumer acceptance (Fig. 3 and Table 5). Kiwifruit with RSSC < 11.6 and RTA > 1.17% ('sour') had a significantly lower degree of liking than kiwifruit with < 11.6 and RTA < 1.17%. Consumer degree of liking of kiwifruit with RSSC < 11.6 and RTA < 1.17% was not significantly different.

3.3.2. 1999 Season

Kiwifruit with RSSC that ranged from 11.5 to 13.5% were always accepted by consumers (Fig. 4), but with different degrees of liking. Consumers liked these kiwifruit from 'moderately' (6.2) to 'very much' (7.3) and acceptance ranged from 72 to 90% (Fig. 4). There was no significant interaction between RTA and RSSC with degree of liking. This agreed with the fact that during this season, kiwifruit RTA never reached values higher than 1.08%.

The 'neither like nor dislike' option was selected by only a few consumers (Table 4). The percentage of consumers that chose the 'neither like nor dislike' option decreased from 7.4 to 3.8% as RSSC increased. For kiwifruit which had equal to or higher than 13.2% RSSC, the percentage of consumers that chose the 'neither like nor dislike' option was approximately 3.8.

Two years of 'in store' consumer tests indicated that consumers liked 'very much' ripe kiwifruit with RSSC ≥ 12.5% (Table 5). However, consumers disliked kiwifruit with ≤ 11.6% RSSC and ≥ 1.17% RTA. Some vineyards had RSSC ≥ 12.5% before they reached the minimum maturity index of 6.5% HSSC. We propose 12.5% RSSC as a quality index for early harvested California 'Hayward' kiwifruit; thus, kiwifruit in vineyards that reach 12.5% RSSC could be harvested and consumed early in the season. Determination of RSSC can be accomplished by subjecting fruit to warm ethylene (100 ppm) treatments. By following this ripening protocol (Crisosto, 1999; Ritenour et al., 1999), kiwifruit should ripen within 7–10 days. Fast prediction of RSSC is being investigated by using the relationship between dry

weight (DW) and RSSC (Crisosto, 1992; Slaughter and Crisosto, 1998), although the correlation between DW and RSSC has not been acceptable under Californian conditions. Further work on consumer acceptance and kiwifruit dry weight is in progress. This work also showed that kiwifruit picked before they reach 6.2% HSSC do not store well because they develop commercially important flesh breakdown by 3 months at 0°C. These results agree with earlier work done in New Zealand (Harman, 1981) and California (Mitchell et al., 1990).

Based on this industry survey and others, it is clear that there is an opportunity for some specific growing areas to market high quality tasting 'Hayward' kiwifruit early in the season.

Acknowledgements

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