Evaluating Turatti's Malver New Peeling-Cutting Equipment Technology to Improve Fresh-Cut Mango Consumer Quality–Final Report (June 10, 2019)

Carlos H. Crisosto, Andrea Velázquez and Gayle M. Crisosto
Department of Plant Sciences
University of California, Davis
chcrisosto@ucdavis.edu

Summary: The performance of Turatti's Malver peeling and cutting machine (https://turatti-pacific.com/Turatti's Malver/) was evaluated using soft and hard, size six count, 'Tommy Atkins' mangos. In order to test its performance, four hundred mangos were sorted into four categories according to firmness: ≤ 4 pounds; 5-8 pounds; 9-12 pounds; and ≥12 pounds. During this work, we determined that 10 pounds firmness was the maximum threshold for Turatti's Malver peeler to perform well. Soft mangos with firmness ranging from 2 to 10 pounds were peeled and cut without harm. Contrary, hard mangos (>10 pounds) interfered with Turatti's machine performance at the peeling step and very soft mangos (≤1 pound) did not peel well, ending mushy after going through the machine. Fresh-cut mango evaluations included instrumental measurements, visual observations and sensory quality (expert panel). Fresh-cut mango slices obtained using Turatti's Malver peeling and cutting machine had a clean appearance, uniform yellow-orange color, and sharper cut edges compared to the other commercial sources of fresh-cut mango available. The other sources included commercial hand peeled and cut, and other mechanically processed. In all fresh-cut evaluations across all sources, including Turatti's Malver machine, flesh browning was not detected. We specifically followed flesh browning and other negative sensory attributes development on the fresh-cut mangos for at least a 10-day period while stored at 5°C. The expert sensory panel evaluations resulted in consistently higher sensory scores (positive sensory attributes) for fresh-cut slices processed with Turatti's Malver machine at firmness less than 10 pounds and having yellow to orange color (~40) than the other commercial sources (~33). The main negative sensory attributes that reduced the total sensory score on the other commercial sources were pale yellow color, hard firmness, lack of juiciness, low sweetness, sourness, green-unripe flavor, and lack of flavor. The total sensory score results were validated by the panelists' opinion on would you buy? Approximately 56 to 89% of the panelists would buy fresh-cut 'Tommy Atkins' mangos processed with a firmness ≤ 10 pounds with yellow to orange color. Unfortunately, for the four commercial samples available to use in this study (Memorial Day Weekend), none to 11% of the panelists would buy them. We believe that the use of mangos processed for fresh-cut that are undergoing ripening with a firmness between 4-10 pounds that are near the "ready-to-transfer" and/or "ready-to-eat" stages have the potential to increase fresh-cut mango consumption.

The availability of this type of peeling and cutting equipment in conjunction with the use of soft mangos combined with high quality (≥ 14% dry matter) are the building blocks to develop this produce category and to increase USA mango consumption. To the best of our knowledge, this is the first work to report the ability to commercially process (peel and slice) soft mangos and its potential impact on mango consumption.

Mangos are among the most widely consumed fruits in tropical and subtropical regions of the world, and mango consumption in temperate-zone countries has increased dramatically in recent years. USA imports comprise 43% of the total world imports and it has increased annually at an average of 12% in volume and 8% in value since 1994. In general, different cultivars are exported to USA starting in January-March with 'Kent' from Peru, and in March-May 'Tommy Atkins' come from Central America, primarily Guatemala and Nicaragua. February-September is the Mexican season (about 60% of total USA volume) with 'Ataulfo' followed by 'Haden', 'Tommy Atkins', 'Kent' and 'Keitt' mangos. From August to December, 'Tommy Atkins' mangos come from Brazil and Ecuador. Approximately 30% of USA households consume mangos. Consumers in the USA have a wide variety of fruits and vegetables available to purchase and are willing to pay premium prices for those with good flavor quality. As the objective of the National Mango Board (NMB) is to increase the consumption of mangos in the USA, one of their approaches is to identify current barriers to consumer satisfaction. In previous research conducted at UC Davis and funded by the NMB, "in store" consumer tests have revealed that consumers view the difficultly to peel and cut mangos as a barrier to increase consumption. It is predicted that consistent delivery of flavorful (high quality) "Ready-to-Eat" fresh-cut mangos (prepared for consumers) will increase their consumption. In fact, first time consumers of mangos, such as Caucasian Americans and other ethnic groups liked mangos intensively, but they did not know how and/or like to peel and cut them. Thus, mango has an ideal potential as a fresh-cut product due to its appealing flavor and texture; and the added convenience that a "Ready-to-Eat" fresh-cut product possesses compared to whole fruit, which require peeling and cutting before eating. Therefore, interest in fresh-cut as a new approach to increase consumption and deliver mangos "Ready-to-Eat" and convenient for consumption was followed. Currently, the fresh-cut mango segment represents less than one percent of mango category sales, but fresh-cut mango interest is growing.

In the last decade, mango tissue physiology and biology for fresh-cut have been studied by different groups in the USA (U Florida, USDA, and UC Davis) and all over the world (UCO and others). These studies include factors such as maturity, quality, cultivar, sanitation process, sensory attributes, nutritional components, organic fruit coatings, ideal modified atmosphere packaging (MAP), and packaging types. As a result of these research efforts, a satisfactory mango fresh-cut protocol is available for public use. Currently, private fresh-cut processors continue to improve their fresh-cut protocols based on these findings and their internal research and development. Most of the large-scale fresh-cut equipment development has been carried out by private equipment manufacturing groups. Three years ago, in a joint work between U Florida and UC Davis to gain information that would enable future investigations to improve the quality of fresh-cut mangos, it was reported that fresh-cut mango quality was variable, but mostly mediocre. Most of the fresh-cut mango had total sensory scores averaging about 30 on a scale with 20 as the lowest possible total score and 49 the highest. The product was mostly pale yellow with variable soluble solids concentration (SSC: 10% to 15%), titratable acidity (TA: 0.5% to 1.5%) and SSC/TA ratio (10 to 30). In packages using MAP, zero oxygen and 30% to 50% carbon dioxide were detected at the retail level. Fresh-cut operators agreed and complained that incoming mango quality is low and highly variable for quality attributes defined as lack of yellow color, low soluble solids concentration with a large firmness variability. Our evaluations last year and observations of mango fresh-cut products in the stores support that low maturity and unripe mangos are being used for fresh-cut. Processors argued that they must use unripe fruit because they are easier to peel and cut. We believe that the use of hard (unripe) mangos is a main barrier to consumption and it is creating the lack of fresh-cut sales. This is the reason why

peeling and/or cutting equipment that performs well on medium-soft (6-10 pounds) mangos will overcome this main barrier. The availability of this kind of peeling and/or cutting equipment in conjunction with the use of high-quality mangos ripened to approximately 8 pounds with more than 14% dry matter are building blocks to develop this sector and to increase USA mango consumption. Based on our discussions with fresh-cut operators and fresh-cut evaluations in retail stores, we have been searching for peeling and/or cutting equipment that can perform well on medium-soft mangos (6-10 pounds). Currently, there are several options in the market that should be inspected and evaluated. Among them, the Turatti Malver peeler looks very promising for peeling soft mangos as it won an innovation award at Fruit Logistica (Berlin) (https://www.youtube.com/watch?v=QeMnLUgNFLs). A Turatti branch is being opened in Salinas, CA and the new equipment is available for testing on ripe mangos. We proposed to evaluate Turatti's Malver peeler (Photo 1) and keep searching for other equipment options, therefore, we are contacting and collecting information on other companies. The goal of this proposal was to evaluate the relationship between fresh-cut damage and firmness for Tommy Atkins and Kent mango cultivars.

Identify a location and move peeling equipment to carry out the work: We discussed five potential locations in California to run the test: UC Davis, UC KARE (Parlier), Renaissance Food Group (Sacramento), Summeripe (Reedley) and Turatti North America (Salinas). After evaluating logistics such as electrical requirements and technician support availability to assist the test, we selected Turatti North America. The date of the test was set suddenly because of the highly qualified technicians' availability, who came from Italy and was available for us on Memorial Day (Monday and Tuesday) to support performance of this test.

Determine how soft mangos (stage of ripening) can be processed (peeled and cut) using Turatti's Malver machine: Approximately four hundred, hard, size six count, 'Tommy Atkins' mangos were collected at arrival to Costco from Freska to be used for the Turatti Malver peeler-cutter evaluation test (Photo 1). The Turatti Malver peeler-cutter dimensions are 54"Lx79"W x63"H with a weight of 950 lbs and electrical requirements of 60 Hertz, three Phases and 480 volts (https://www.youtube.com/watch?v=QeMnLUgNFLs. At arrival, we did a full mango quality evaluation on a subset of twenty whole fruit from each firmness category that includes firmness; color (Minolta and NMB color score, soluble solids concentration (SSC), titratable acidity (TA) and dry matter (DM). In addition to the NMB color score, we used the Minolta colorimeter because it removes human bias and error by expressing color as objective numerical values such as L* (lightness), Chroma (purity or saturation of color) and hue^{o} (color shade). L* represents changes from 0 (black) to 100 (white). Hue ranges from 0 to 360 degrees, with 0 being red, 90 being yellow, 180 being green, and 270 being blue. Chroma is the distance from the origin of the color sphere (gray), with greater numbers indicating progressively more pure or intense hue. Flesh firmness was measured on the two opposite flat sides of each of the 400 mangos parallel to the seed (skin removed) using a Fruit Texture Analyzer equipped with an 8 mm tip and labelled on the corresponding sides for sorting. SSC was measured on juice samples from longitudinal slices of each fruit (extracted with a hand press through two layers of cheesecloth, collected in screwcap plastic tubes and stored at -20 °C for later analysis. SSC was measured by placing a few drops of juice on the prism of a temperature-compensated digital refractometer (model PR 32α, Atago Co., Tokyo, Japan). Thus, based on fruit firmness, we labeled and sorted the mangos into four categories: ≤ 4 pounds, 5-8 pounds, 9-12 pounds and ≥ 12 pounds (Photo 2). After sorting, we placed the mangos back in labeled six count mango boxes and immediately transferred them to Turatti North America (Salinas) for peeling evaluations.

During handling, we kept the mangos approximately at 5°C. In general, there were no differences in quality among mangos ≤ 12 pounds. However, mangos from the high firmness category had lower flesh color, SSC, and DM than mangos from the other categories (Table 1).

Table. 1. 'Tommy Atkins' whole mango arrival quality attributes according to firmness categories.

Firmness Categories		NMB Color	Minolta Color			SSC (%)	DM (%)
			Hue	L*	Chroma		
Very Low	≤ 4 lbs	3.6	85.1	70.2	64.1	14.5	17.3
Low	5-8 lbs	3.0	89.4	73.7	57.4	13.9	16.4
Medium	9-12 lbs	3.6	91.1	74.2	54.4	14.2	16.6
High	≥ 12 lbs	2.4	93.0	76.6	52.0	13.0	15.7

We ran Turatti's peeling machine (Photo 1) with our mangos according to firmness categories, one category at a time. Within each category, mangos were run in groups, one group at the time (~10-12 halves per minute). Technicians modified Turatti's peeler, thus after peeling (Photo 1) mangos were cut in slices (Photo 3). The evaluations during our work included peeling and cutting. We retrieved peeled and cut fresh-cut mango slices in small plastic containers (like the ones being used commercially) and stored them overnight at low temperature (5°C) prior to transportation to UC Davis for further visual evaluations. Only fresh-cut product from two of the four firmness categories (≤ 4 pounds and 5-8 pounds) were collected as Turatti's machine was designed for soft mangos and therefore did not perform well with hard, unripe and immature mangos (> 10 pounds). We set Turatti's machine based on mango size, this size adjustment operation required to make a new piece to fit size six count. However, changing the part only took ~10 min. In additional runs, we also determined when Turatti's machine developed problems during peeling based on the current "soft" settings (Photo 4). From examination of labelled fruit (firmness measurements were on the stem end of each mango), we determined that 10 pounds firmness was the maximum threshold for Turatti's machine to perform well. Hard mangos interfered with machine performance during peeling, stopping machine operation. Very soft mangos (≤ 1 pound) did not peel well, ending mushy after going through the machine. We measured by weight, fresh-cut product yield of ~57% of the total mango weight after the skin and stone were removed from the two halves.

Firmness and visual color were measured on the Turatti fresh-cut samples and compared to other fresh-cut mangos available in the retail market on that date (Source 1, 2, 3, and 4, Photo 5). After 4 days at 5°C, firmness varied from 1.8 to 5.0 pounds in fresh-cut mangos prepared using Turatti's Malver machine (Table 2). At 4 days, fresh-cut mangos prepared from the 5-8 pounds category and ≤ 10 pounds category had soften approximately 0.5 to 0.75 pounds per day, ending with firmness of ~4 to 5 pounds. Fresh-cut mangos prepared from soft mangos (≤ 4 pounds) had significantly lower firmness (≤ 1.8 pounds) than the other sources. Even some mushy fruit was observed in these samples. The other commercial sources had significantly higher firmness (7-9 pounds) than fresh-cut mangos prepared using Turatti's Malver machine. Differences in fresh-cut flesh color were detected with L*; in general, mangos < 10 pounds had significantly lower L* (~65%) than mangos ≥10 pounds, indicating that their flesh color was closer to yellow to orange

(Table 2). The rest of the samples (commercial sources) presented flesh color higher than L* of ~70%, which indicates that fresh-cut flesh color was in the pale-yellow to yellow range. Color of fresh-cut mangos processed at firmness ≤ 10 pounds was uniform among slices in contrast to the commercial samples.

Table 2. 'Tommy Atkins' fresh-cut mango quality measured on slices from Turatti's Malver machine and commercial sources stored at 5°C after processing.

Sources	Days after Processing	Firmness Pounds	Minolta Color		
			Hue	L*	Chroma
1	14	7.2a	91.9a	76.9a	55.4a
2a	1	8.2a	91.8a	72.3a	57.9a
2b	2	8.6a	93.0a	69.7ab	56.0a
3	9	9.2a	89.4a	70.4ab	62.5a
Turatti ≤ 4 lbs	4	1.8c	88.2a	63.9b	58.7a
Turatti 5-8 lbs	4	3.8b	90.3a	67.5b	59.8a
Turatti ≤ 10 lbs	4	4.8b	89.6a	67.1b	58.9a
Significance		0.001	NS	0.001	NS

Sensory Evaluation

Sensory evaluations were conducted by an expert panel of three persons who were familiar with mango sensory quality attributes according to our last joint fresh-cut mango study protocol (Brecht et al., 2017). Each panelist evaluated three replications per source at room temperature on each date using ~10 slices per replication. Evaluations were performed on fresh-cut 'Tommy Atkins' mango slices processed using Turatti's Malver machine and on available commercial samples bought at retail stores and held overnight at 5 °C before evaluation by the panel. The samples were evaluated for appearance in terms of hue (1= pale yellow; 2= yellow; 3= orange); cut edge sharpness (1= damaged edge; 2= compressed/curvy; 3= sharp edge); cut edge fibrousness (1 = fibrous; 2 = some fibers; 3 = smooth); flesh browning (1= brown; 2= some browning; 3= no browning); moistness (1= dry; 2 = some water loss; 3 = moist); and translucency (1= translucent/ soggy; 2 = some water soaking; 3 = no translucency). Texture was evaluated in terms of firmness (1 = hard; 2 = firm; 3 = soft); juiciness (1= not juicy; 2= juicy); fibrousness (1= fibrous; 2 = not fibrous); and melting (1= not melting; 2 = melting). Taste was evaluated in terms of sweetness (1= not sweet; 2= sweet; 3 = very sweet); sourness (1= very sour; 2 = sour; 3 = not sour); bitterness (1= bitter; 2 = not bitter); and astringency (1= astringent; 2 = not astringent). Flavor and aroma were evaluated using the descriptors mango, tropical (1= no mango flavor; 2 = mango flavor); green, unripe (1= green flavor; 2 = no green flavor); piney, terpeney (1= piney flavor; 2 = no piney flavor);/fizzy (1= fermented; 2 = not fermented/fizzy); off flavor (1= off flavor; 2 = no off flavor); and no flavor (tasteless) (1= no flavor; 2 = has flavor). In addition, panelists were asked at the end of evaluating each sample if they would buy it yes or no. The sensory scoring was structured so that higher values corresponded to better quality/more ripeness with a minimum possible total of 20 points and a maximum possible total of 49 points.

Appearance sensory evaluation scores: 'Tommy Atkins' fresh-cut mango from fresh-cut samples processed using Turatti's Malver peeler-cutter machine and commercial samples bought at retail stores and held at 5 °C varied in appearance according to the source (Table 3). A total score adding all appearance sensory attributes including flesh color (hue), cut edge sharpness (Photo 6); cut edge fibrousness, flesh browning; moistness and translucency were high for mangos with firmness ≤ 10 pounds and yellow to orange color at the time of processing (15.4 to 16.0) compared to commercial sources (11.3 to 13.8). The high appearance scores on fresh-cut mangos processed with firmness ≤ 10 pounds were due to yellow to orange flesh color, sharp cut edges, and high moisture presence. Most of the sources presented absence of flesh browning and translucency, and mango slices across sources with very low firmness had a high incidence of translucency and mushy tissue. Mango slices cut using Turatti's Malver peeler-cutter machine had higher cut edge sharpness score and uniform slice color in the container than commercial sources that used other machines or hand peeling and/or cutting during fresh-cut processing.

Table 3. Appearance sensory evaluation scores for 'Tommy Atkins' fresh-cut mango slices processed using Turatti's Malver peeler-cutter machine and commercial samples bought at retail stores and held overnight at 5 °C before evaluation by an expert panel.

Source	Hue Color[z]	Cut Edge Sharpness	Cut Edge Fibrousness	Flesh Browning	Moistness	Translucency	Total Score
1	1.3	1.4	2.2	2.0	1.6	2.8	11.3
2a	1.8	1.8	2.0	3.0	2.8	2.4	13.8
2b	1.9	2.4	2.2	2.8	1.9	2.6	13.8
3	1.6	1.1	2.2	2.4	1.6	2.8	11.7
Tur ≤ 4 lbs	3.0	2.0	2.2	3.0	3.0	2.2	15.4
Tur 5-8 lbs	2.4	2.7	2.2	3.0	2.7	2.7	15.7
Tur ≤ 10 lbs	2.3	3.0	2.4	3.0	2.7	2.6	16.0

[z]The samples were evaluated for appearance in terms of hue flesh color (1= pale yellow; 2= yellow; 3= orange); cut edge sharpness (1= damaged edge; 2= compressed/curvy; 3= sharp edge); cut edge fibrousness (1= fibrous; 2= some fibers; 3= smooth); flesh browning (1= brown; 2= some browning; 3= no browning); moistness (1= dry; 2 = some water loss; 3 = moist); and translucency (1= translucent/ soggy; 2= some water soaking; 3= no translucency).

Texture sensory evaluation scores: The expert panel detected high fibrousness and lack of melting texture across most of 'Tommy Atkins' samples with no significant differences between sources (Table 4). 'Tommy Atkins' fresh-cut mango processed using Turatti's Malver peeler-cutter machine had higher total texture scores (4.0 to 4.5) than the commercial fresh-cut samples available (2.5 to 3.0). The main positive texture attributes with the greatest impact on final sensory scores for samples processed at firmness ≤ 10 pounds with yellow to orange color were soft firmness and juicy texture. Most of commercial samples were hard and lacked juiciness.

Table 4. Texture sensory evaluation scores for 'Tommy Atkins' fresh-cut mango processed using Turatti's Malver peeler-cutter machine and on available commercial samples bought at retail stores and held overnight at 5 °C prior to evaluation by an expert panel.

Source	Firmness[z]	Juiciness	Fibrousness	Melting	Total Score
1	2.0	1.3	1.0	1.0	5.3
2a	1.7	1.3	1.0	1.0	5.0
2b	1.7	1.8	1.2	1.0	5.7
3	1.7	1.6	1.3	1.0	5.6
Turatti ≤ 4 lbs	2.8	2.0	1.0	1.3	7.1
Turatti 5-8 lbs	2.4	2.0	1.3	1..0	6.7
Turatti ≤ 10lbs	2.7	2.0	1.3	1.0	7.0

[z]Texture was evaluated in terms of firmness (1= hard; 2 = firm; 3 = soft); juiciness (1= not juicy; 2 = juicy); fibrousness (1 = fibrous; 2 = not fibrous); and melting (1= not melting; 2 = melting).

Taste sensory evaluation scores: All sample sources lacked bitterness and astringency without any important sensory differences between sources (Table 5). 'Tommy Atkins' fresh-cut mango processed using Turatti's Malver peeler-cutter machine had higher total taste sensory scores (8.0 to 8.2) than the commercial fresh-cut samples (6.5 to 6.9). Higher sweetness and lower sourness were the main positive taste attributes with an important impact on the final taste score for samples processed at firmness ≤ 10 pounds with yellow to orange color compared to commercial samples (close to "not sweet" and "sour").

Table 5. Taste sensory evaluation scores for 'Tommy Atkins' fresh-cut mango processed using Turatti's Malver peeler-cutter machine and on commercial available samples bought at retail stores and held overnight at 5 °C before evaluation by an expert panel.

Source	Sweet[z]	Sour	Bitter	Astringent	Total Score
1	1.3	1.8	1.8	2.0	6.9
2a	1.1	1.9	1.9	2.0	6.9
2b	1.4	1.7	1.5	1.9	6.5
3	1.1	1.9	1.9	2.0	6.9
Turatti ≤ 4 lbs	1.8	2.6	1.8	2	8.2
Turatti 5-8 lbs	1.8	2.4	1.9	2.0	8.1
Turatti ≤ 10lbs	1.8	2.3	1.9	2.0	8.0

[z]Taste was evaluated in terms of sweetness (1= not sweet; 2 =sweet; 3 =very sweet); sourness (1= very sour; 2= sour; 3= not sour); bitterness (1= bitter; 2= not bitter); and astringency (1= astringent; 2= not astringent).

Flavor and Aroma sensory evaluation scores: Panelists detected no "fermented" or "off flavor" across all sources (Table 6). Turatti samples processed at firmness ≤ 10 pounds with yellow to orange color had mango flavor and lacked green/unripe flavor compared to the commercial sources. In general, the lower total flavor and aroma scores for the commercial sources (9.3-9.6) compared to the Turatti samples processed at firmness ≤ 10 pounds (11.3-11.5) were due to lack of mango flavor and having green flavor and piney flavor.

Fresh-cut processed using mangos at firmness ≤ 10 pounds and having yellow to orange color ("ready-to-transfer" and/or "ready-to-eat" stages) had a higher total sensory scores (~40) than other commercial available sources (~33).

Table 6. Flavor and aroma sensory evaluation scores for 'Tommy Atkins' fresh-cut mango processed using Turatti's Malver peeler-cutter machine and on commercial samples bought at retail stores and held overnight at 5 °C before evaluation by an expert panel.

Source	Mango/ tropical fruit/coconut[z]	Green/ unripe fruit	Piney/ Terpeney	Fermented/ fizzy	Off flavor	No Flavor	Total Score
1	1.1	1.1	1.7	2.0	2.0	1.7	9.6
2a	1.0	1.3	1.4	2.0	1.9	1.7	9.3
2b	1.3	1.3	1.4	1.9	2.0	1.7	9.6
3	1.0	1.4	1.4	1.9	2.0	1.7	9.4
Turatti ≤4 lbs	1.8	1.8	2.0	2.0	2.0	1.7	11.3
Turatti 5-8 lbs	1.9	1.9	2.0	2.0	2.0	1.7	11.5
Turatti ≤ 10 lbs	1.7	1.9	1.9	2.0	2.0	2.0	11.5

[z]Flavor and aroma were evaluated using the descriptors mango, tropical (1= no mango flavor; 2 = mango flavor); green, unripe (1 = green flavor; 2 = no green flavor); piney, terpeney (1 = piney flavor; 2 = no piney flavor);/fizzy (1 = fermented; 2 = not fermented/fizzy); off flavor (1= off flavor; 2 = no off flavor); and no flavor (tasteless) (1 = no flavor; 2 = has flavor).

Will Buy? A preliminary consumer purchase test question was asked for each sample that the panelists evaluated. Panelists were asked at the end of evaluating each sample if they will buy it, yes or no. On the date of evaluation, fresh-cut postharvest life on samples ranged from 1 to 18 days in the distribution channels after processing, thus, some sources had a very low will buy choice (Table 6). Based on these preliminary results, panelists will not buy the fresh-cut mangos (0%) from three sources and only 11% from the other two sources of ten fresh-cut mango sources. However, 56 to 89 % of the panelists will buy four of the ten sources. These four sources were fresh-cut mangos processed at firmness ≤ 10 pounds with yellow to orange color undergoing ripening. Comparison of will buy choice between fresh-cut mangos within 1 to 5 days of postharvest life, still demonstrated the higher choices for fresh-cut mangos processed with fruit undergoing ripening (72%) against other commercial fresh cut (2.8%.).

Table 6. Panelists' responses to "Will Buy?" for 'Tommy Atkins' fresh-cut mangos from different sources and evaluated after different numbers of days after processing (held at 5°C).

Source	Days after Processing	Will Buy (%)
1a	14	11
1b	18	11
2a	1	0
2b	2	0
2c	3	11
3	9	0
Turatti ≤ 4 lbs	4	56
Turatti 5-8 lbs	4	76
Turatti 5-8 lbs	7	89
Turatti 10 lbs	7	67

Conclusions

- The Turatti Malver new peeling-cutting machine performed well on mangos ≤ 10 pounds firmness. Hard mangos interfered with machine performance during peeling, stopping machine operation. In addition, very soft mangos (≤1 pound) did not peel well, ending mushy after going through the machine.

- By cutting mangos with a sharp knife (seed removal), then peeling and cutting into slices using the Turatti Malver machine, we measured a product yield of ~57% of the total mango weight in fresh-cut slices after we removed the stone and skin.

- Fresh-cut mango slices obtained using the Turatti Malver peeling and cutting machine had a clean appearance, lack of browning development, uniform yellow-orange color, and sharper cut edges compared to the other commercial sources of fresh-cut mango available.

- The expert sensory panel evaluations resulted in consistently higher sensory scores (positive sensory attributes) for fresh-cut slices processed with Turatti's Malver machine at firmness ≤ 10 pounds and having yellow to orange color ("ready-to-transfer" and/or "ready-to-eat" stages) than the other available commercial sources.

- The predominant positive traits for fresh-cut mangos prepared using a “ready-to-transfer” and/or “ready to eat” stage mangos, contrary to the other available sources were uniform yellow-orange color in all slices in the container, juicy, soft, sweet, mango flavor and lack of green flavor.

- Approximately 56 to 89% of the panelists would buy fresh-cut ‘Tommy Atkins’ mangos processed with a firmness ≤ 10 pounds with yellow to orange color.

- We believe that the use of mangos processed for fresh-cut when undergoing ripening (“ready-to-transfer” and/or “ready-to eat” stages) would have the potential to increase fresh-cut mango consumption.

PHOTOS

Photo 1. Turatti Malver Peeler and Cutter.

Photo 2. Fresh-cut mango preparation and processing.






Photo 3. Fresh-cut mangos from commercial sources and processed with Turatti Malver peeler and cut at different firmness levels.



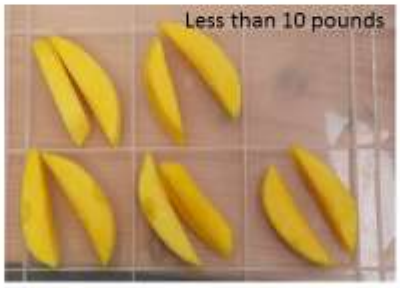



Photo 4. Fresh-cut mangos prepared at different firmness levels with the Turatti Malver Peeler and Cutter.

Photo 5. Commercial fresh-cut mango sources.

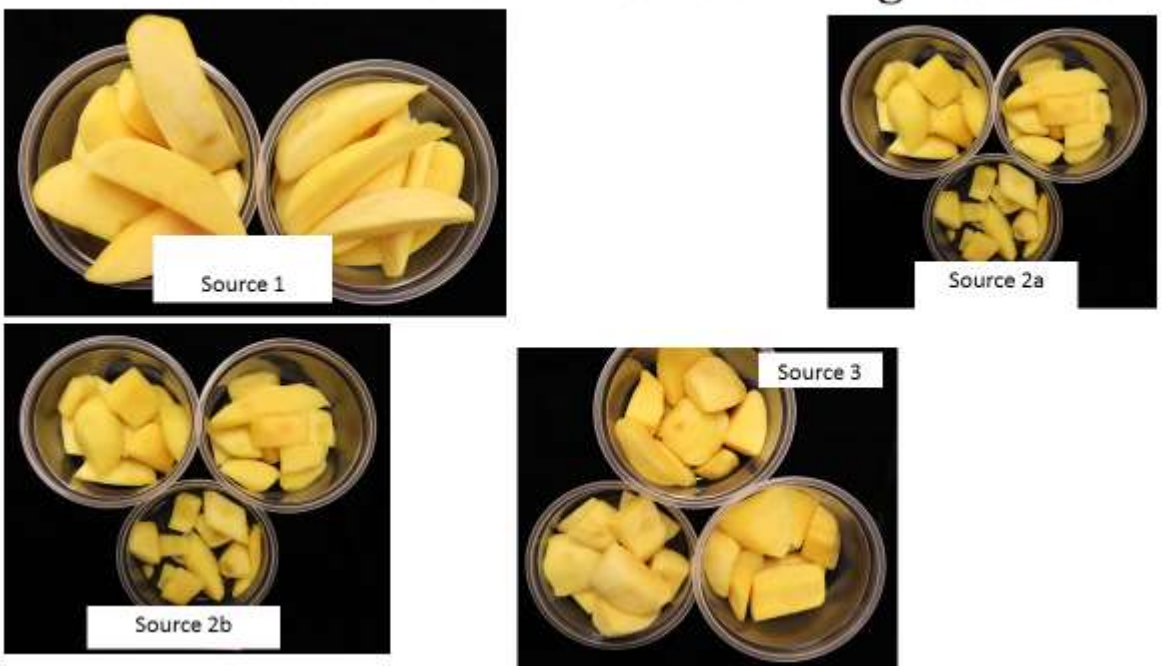
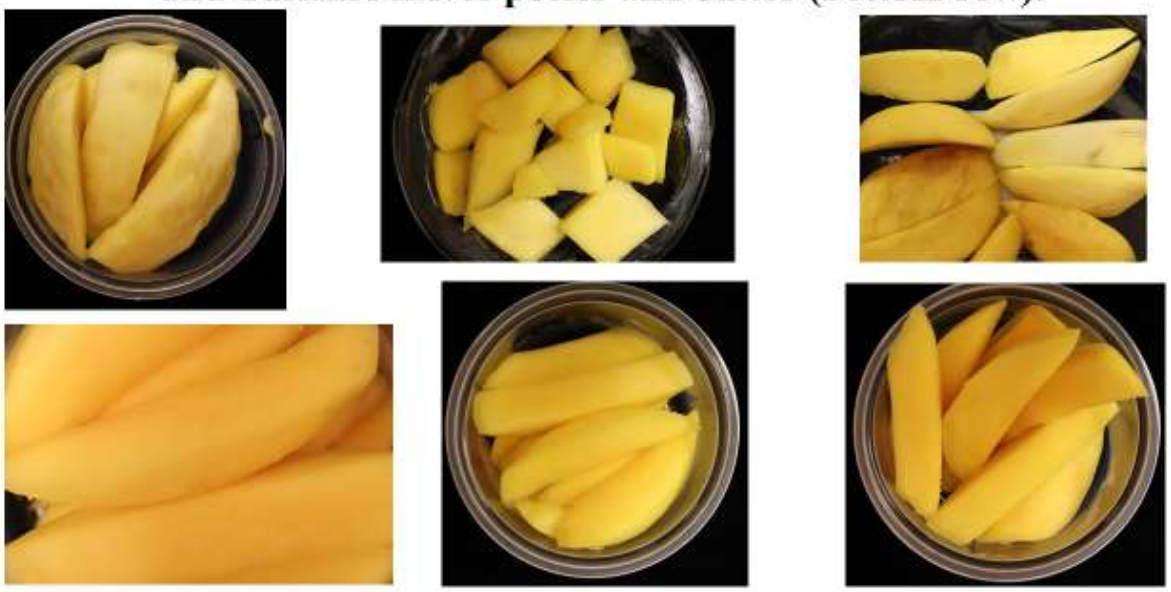


Photo 6. Fresh-cut mango slide edges of commercial (top row) and Turatti Malver peeler and cutter (bottom row).



LITERATURE

Brecht, J. K. A. Plotto, E. A. Baldwin, J. BAI, S Jamir, C. H. Crisosto and G. M. Crisosto. 2017. Sensory Quality of Fresh-cut Mango at the Consumer Level Sampled through the Year. *Proc. Fla. State Hort. Soc.* 130:158–164.

Dea, S., J.K. Brecht, M.C.N. Nunes, and J.P. Emond. 2010c. Modified atmosphere packaging for fresh-cut 'Kent' mango. Proc. Fla. State. Hort. Soc. 123: 278-289.

Dea, S., J.K. Brecht, M.C.N. Nunes, and EA Baldwin. 2013. Optimal ripeness stage for processing mangoes into fresh-cut slices. HortTechnology 23:12-23.

Kader, A.A. 2008. Fresh-cut mangos as a value-added product (literature review and interviews). March 2018. National Mango Board (www.mango.org) National Mango Board. 2016. Mango handling and ripening protocol. March 2018.

Ngamchuachit, P., H.K. Sivertsen, E.J. Mitcham, and D.M. Barrett. 2015. Influence of cultivar and ripeness stage at the time of fresh-cut instrumental and sensory qualities of fresh-cut mangos. Postharvest Biol. Technol. 106:11–20.

Ngamchuachi, P., H.K. Sivertsen, E.J. Mitcham, and D.M. Barrett. 2014. Effectiveness of calcium chloride and calcium lactate on maintenance of textural and sensory qualities of fresh-cut mangos. J. Food Sci. 79:C786–C794.

Resende Nassur, Rita, Sara González-Moscoso, Gayle M. Crisosto Luiz Carlos de Oliveira Lima, Eduardo Valério de Barros Vilas Boas and Carlos H. Crisosto. 2015. Describing Quality and Sensory Attributes of 3 Mango (*Mangifera indica* L.) Cultivars at 3 Ripeness Stages Based on Firmness. 2015. Journal of Food Science, v. 80, issue 9.