Comparative Analysis of Antioxidant Properties and Fruit Quality Attributes of Organically and Conventionally Grown Melons (Cucumis melo L.)

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Abstract. Antioxidant properties and quality attributes were evaluated for 10 melon (Cucumis melo L.) cultivars grown under conventional and certified organic conditions in a 2-year field study. Differences among cultivars, produced either by conventional or organic methods, contributed the largest sources of variation in antioxidant properties. A 2.1- to 2.2-fold difference was seen between groups of cultivars with the highest and lowest levels of ascorbic acid when produced by organic and conventional methods, respectively. Choice of cultivar using conventional and organic production, respectively, enabled a 1.7- and 1.6-fold gain in total phenolics, a 2.6- and 4.2-fold gain in radical scavenging capacity determined by 2, 2’-azinobis (3-ethylbenzthiazoline-6-sulfonic acid) (ABTS), and 2.2-diphenyl-1-picyrylhydrazy1 (DPPH) as Trolox-equivalent antioxidant properties (TEAC), dry matter, and soluble solids content (SSC) in the same 10 cultivars grown in the same location, on the same soil texture and type, using organic and conventional practices for 2 consecutive years. This study had four primary objectives: 1) to evaluate antioxidant properties, including AA, TP, ABTS/TEAC, DPPH/TEAC, and quality attributes among 10 C. melo cultivars; 2) to examine 10 cultivars that may benefit small- and medium-scale growers seeking niche markets for melons with high antioxidant properties; and 3) to examine if organic production results in higher or lower antioxidant levels using research parameters that minimize experimental variables; and 4) to examine, to the extent possible, variation among antioxidant and quality attributes impacted by environmental conditions in 2 consecutive years.

Materials and Methods

Temperature and solar radiation. Data on temperature and solar radiation for two cropping seasons (2005–2006) were obtained from a Northern Colorado Water Conservancy...
Table 1. Classification and description of melon cultivars.

| Melon type                  | Cultivar           | Description                                                                 |
|-----------------------------|--------------------|-----------------------------------------------------------------------------|
| Galia                       | Arava              | Fragrant with soft green flesh; rind blushed when ripe, finely netted, nearly sutureless |
|                             | Haugen             | Green-fleshed (similar to a muskmelon); rind is smooth, has gold mottled lobes and green sutures when ripe |
| Muskmelon (cantaloupe)      | Burpee Hybrid      | Flesh is thick and deep orange in color; rind is gold with heavy netting when ripe and has deep sutures |
|                             | Early Queen        | Muskmelon hybrid with orange flesh; rind is full gold with medium lobes when ripe |
| Charentais                  | Edonis             | French melon with orange flesh and honey orange in color; rind has green sutures and golden lobes when ripe; fail to slip easily |
|                             | Savor              | Classic Charentais type, sweet and aromatic; rind has green sutures and golden lobes when ripe; fail to slip easily |
|                             | Swan Lake          | White flesh with some orange swirls; rind has golden lobes and whit sutures when ripe; fail to slip easily |
| Honeydew                    | Honey Orange       | Pale orange flesh honeydew; rind is light green with hint of gold when ripe |
|                             | Rayan              | Elongated shape with sweet, greengreen white flesh; rind is green turning a hint of dark gold when ripe, nearly sutureless |
| Butterscotch                | Sweetie #6         | Sweet and fragrant flavor; rind remains very green with a tinge of blue on ripening, and red exudates begin appearing at connection point of fruit and stem |

District weather station located within 100 m of the research plots. To examine possible effects of temperature, daily growing degree-day heat accumulation units were computed by subtracting the base temperature (10 °C) for warm season crops from the average temperature as daily GDD = [(Tmax + Tmin)/2] – base temperature in which Tmax and Tmin are maximum and minimum daily air temperatures. Each daily GDD was summed over the growing season. Solar radiation data were recorded with an “Epply” pyranometer and expressed as Langleys (1-calories/cm²).

Melon production and handling: The study was carried out with field plot trials in 2005 and 2006 at the Horticulture Field Research Center, Colorado State University, Fort Collins, CO. The research plots were certified organic by the Colorado Department of Agriculture in accordance with the National Organic Program standards. Conventional production plots were located within 50 m on identical soil texture (Nunn clay, pH 7.8) and were managed with inorganic fertilizers and insecticides.

This study is part of a larger project from USDA/CSREES/NRI entitled “Differentiating Small Farm Produce Offerings through Nutritional Superior Cultivars, Marketing, and Extension Programs,” in which six crops, including melons, were planted on conventional and certified organic fields. The experimental units were laid out in a split plot with the whole plots arranged as a completely randomized design. Production systems were assigned to whole plots and cultivars were designated as subplots. Three blocks in each production system were replicated for each cultivar. Each 163-m² organic or conventional production system was planted to 450 plants in the three replicate blocks that included 10 cultivars described in Table 1. Cultivars were randomized within each replicate block. Three cultivars were designated as subplots. Three blocks in each production system were replicated for each cultivar. Each 163-m² organic or conventional production system was planted to 450 plants in the three replicate blocks that included 10 cultivars described in Table 1. Cultivars were randomized within each replicate block. Three cultivars were designated as subplots. Three blocks in each production system were replicated for each cultivar. Each 163-m² organic or conventional production system was planted to 450 plants in the three replicate blocks that included 10 cultivars described in Table 1. Cultivars were randomized within each replicate block. Three cultivars were designated as subplots. Three blocks in each production system were replicated for each cultivar. Each 163-m² organic or conventional production system was planted to 450 plants in the three replicate blocks that included 10 cultivars described in Table 1. Cultivars were randomized within each replicate block. Three cultivars were designated as subplots. Three blocks in each production system were replicated for each cultivar. Each 163-m² organic or conventional production system was planted to 450 plants in the three replicate blocks that included 10 cultivars described in Table 1. Cultivars were randomized within each replicate block.
removed and concentrated to dryness in a Vacufuge™ [Eppendorf North America (Westbury, NY), VWR, CO] for 2 h at 45 °C. The concentrated extracts were reconstituted and analyzed for TP, ABTS, and DPPH. Because the Vacufuge™ concentration step was shown in preliminary trials and in previous research (Esparaza-Rivera et al., 2006) to degrade essentially all vitamin C, data for TP, ABTS, and DPPH antioxidant capacity are considered not to reflect a contribution from vitamin C as an antioxidant.

Total phenolics. TP was standardized against gallic acid (Sigma Chemicals Co., St. Louis, MO) and expressed as milligrams per 100 g of melon fresh weight (mg GAE/100 g FW) using a microplate-based Folin-Ciocalteu assay adapted from Spanos and Wrolstad (1990). Vacufuge concentrated samples were reconstituted with 1.0 mL 80% acetone (Fisher Chemicals, Fair Lawn, NJ) and 100 μL of this extract was diluted with 900 μL of nanopure water. In triplicate, 35 μL diluted samples were pipetted into 96-well microplates. Using a multichannel pipette, 150 μL of 0.2 M Folin-Ciocalteu reagent (Sigma Chemicals Co.) and 115 μL 7.5% (w/v) Na₂CO₃ (Sigma Chemicals Co.) were added to all wells. The plate was incubated at 45 °C, cooled to room temperature for 1 h, and read at 765 nm using a Spectra Max Plus (Molecular Devices Corp., Sunnyvale, CA) spectrophotometer. Trolox-equivalent antioxidant capacity was assessed with two different assays.

ABTS⁺ scavenging assay. ABTS⁺ [2,2’-azinobis (3-ethylbenzthiazoline-6-sulfonic acid)] (Calbiochem, EMD Biosciences, La Jolla, CA)/TEAC was measured using a microplate ABTS⁺ radical cation assay based on the method developed by Miller and Rice-Evans (1997). ABTS⁺ solution was prepared by mixing 40 mg ABTS in 15 mL distilled water and 2.0 ± 0.5 g of MnO₂ (Sigma Chemicals Co.). After 20 min with occasional stirring, the MnO₂ was removed by vacuum filtration and a 0.2 μm Acrodisk (VWR, Denver, CO) syringe filter. Absorbance of the ABTS⁺ solution was read at 734 nm in a Spectra Max Plus spectrophotometer and adjusted to 0.70 absorbance units (AU) by adding 5.0 mM phosphate buffer solution. Twenty-five microliters of reconstituted samples and 250 μL of ABTS⁺ solution was mixed well on a platform shaker and read at 734 nm after exactly 60 s at 25 °C. The absorbance value was expressed as micromoles TEAC/mL in assay and compared with a set of Trolox standards. This was converted to micromoles TEAC/100 g sample (FW) with linear regression taking into account all dilution and concentration factors.

DPPH⁺ assay. Antioxidant activity was measured with a microplate-based 2,2-diphenyl-1-picrylhydrazyl DPPH⁺ scavenging assay based on the method of Lu and Foo (2000) with some modifications. A 0.1 mM DPPH⁺ solution was prepared by mixing 7.89 mg DPPH with 100% methanol and adjusting the absorbance value to 0.95 AU. Fifteen microliters of the reconstituted samples was
mixed with 285 μL of DPPH\textsuperscript{+} solution and read at 515 nm in the spectrophotometer after exactly 3 min at 25 °C. Results were expressed as microns DPPH/TEAC/100 g FW from linear regression of a Trolox standard curve taking into account all dilution and concentration factors.

**Soluble solids content and percent dry matter.** Soluble solids concentration of fresh melon tissue samples was measured using a temperature-compensated, handheld refractometer (Reichert, Depew, NY). The dry matter percentage was obtained gravimetrically from dried and fresh weights.

**Ascorbic acid.** Standard solutions were prepared by mixing 100 mg dithiothreitol (Promega Corp., Madison, WI) and 10 mg ascorbic acid (Sigma Chemicals Co.) and by diluting to five concentrations to prepare the standard curve. Lyophilized melon tissue was extracted in 5% w/v aqueous solution of metaphosphoric acid (VWR) containing 1% w/v dithiothreitol (Sigma Chemicals Co.). The mixture was vortexed for 15 s and rotated for 15 min at 4 °C. To separate the liquid from the solid phase, the refrigerated mixture was centrifuged for 5 min at 4000 rpm at 4 °C. This procedure was repeated twice. The supernatant from the first and second extractions was filtered through a 0.45-mm nylon syringe filter (Acrodisk, VWR, Denver, CO) before injection onto an Inertsil 4C (Metachem; Thermo Fisher, St. Louis, MO) high-performance liquid chromatography (HPLC) column (Agilent Technologies, Santa Clara, CA) and run with a phosphoric acid/methanol gradient similar to Esparaza-Rivera et al. (2006). Samples prepared for ascorbic acid analysis by HPLC were not Vacuvufeg™ concentrated and were prepared shortly after freeze drying using actinic glassware at 0 to 4 °C until reacted with dithiothreitol before injection.

**Statistical analysis.** Analysis of variance was carried out using SAS Mixed Procedure (Version 9.1; SAS Inc., Cary, NC). Pearson correlation coefficients \((r)\) are from SAS. Differences between means use the Tukey-Kramer \((P \leq 0.05)\) method.

**Results**

**Temperature, solar radiation, and precipitation.** Melons accumulated more total heat units from field planting to harvest in 2006 than in 2005 (Fig. 1A), but in the last 30 d before harvest in 2005, melons were exposed to a larger number of greater than 30 °C days than in 2006 (Fig. 1B). Solar radiation received by crops from planting to harvest, including the 30 d before harvest, was almost the same for the 2 years (Fig. 1C).

Although natural precipitation in the 2006 growing season (74 mm) was only 35% of that received in 2005 (222 mm), irrigation was monitored and adjusted to avoid periods of drought stress in both years. The significant interaction between year and cultivar for all parameters indicates that environmental factors had a large effect on some cultivars but not on others. There was also a significant interaction between year and production system for TP, indicating that TP was influenced by yearly environmental effects and production system. Cultivar and production system interactions implied that some cultivars had different levels of ascorbic acid and ABTS radical scavenging capacity when grown organically or conventionally, whereas others were unaffected by production-system variables. Table 3, mean values for cultivars in the highest and lowest mean separation ranges for each parameter measured, are presented in Table 4 along with mean values for cultivars between the highest and lowest ranges classified as a midrange class. Cultivars within each of the high and low classes do not differ. Accordingly, average values of each class provide an indication of the gain or loss to be derived in selecting a cultivar and in choosing to produce by either conventional or by organic means for the antioxidant or quality parameters examined (Table 4).

| Source | Ascorbic acid (mg/100 g FW) | Total phenolics (mg GAE/100 g FW) | DPPH antioxidant capacity (μmol TEAC/100 g FW) | Dry matter | Soluble solids |
|--------|-----------------------------|----------------------------------|-----------------------------------------------|------------|---------------|
| Year (Y) | <0.05 | <0.05 | <0.01 | <0.01 | <0.05 | <0.0001 | <0.01 |
| Cultivar (C) | <0.0001 | <0.0001 | <0.0001 | -0.01 | <0.0001 | <0.0001 | <0.0001 |
| Production system (PS) | <0.05 | <0.01 | NS | NS | NS | NS | NS |
| Y × PS | NS | NS | NS | NS | NS | NS | NS |
| C × PS | <0.05 | NS | <0.0001 | NS | NS | NS | NS |
| Y × C | <0.01 | <0.001 | <0.0001 | NS | <0.01 | NS | NS |

*nS = nonsignificant or significant at P ≤ 0.05, 0.01, 0.001.

| Source | Ascorbic acid (mg/100 g FW) | Total phenolics (mg GAE/100 g FW) | ABTS antioxidant capacity (μmol TEAC/100 g FW) | DPPH antioxidant capacity (μmol TEAC/100 g FW) |
|--------|-----------------------------|----------------------------------|-----------------------------------------------|-----------------------------------------------|
| Production system | Cultivar | | | | |
| Conventional | Savor | 38.1 ± 1.9 a² | 71.7 ± 6.1 a | 220.5 ± 39.0 a | 301.5 ± 22.2 a |
| | Sweetie #6 | 34.2 ± 1.4 a | 64.0 ± 5.9 ab | 96.2 ± 21.7 bc | 243.3 ± 21.9 b |
| | Burpee Hybrid | 26.5 ± 2.8 b | 59.2 ± 3.3 abc | 112.8 ± 27.6 bc | 177.1 ± 19.7 c |
| | Edonis | 23.0 ± 4.0 bc | 64.5 ± 3.6 ab | 169.5 ± 21.5 ab | 172.7 ± 14.0 c |
| | Rayan | 22.2 ± 1.3 bcd | 53.9 ± 4.5 bcd | 100.1 ± 17.0 bc | 171.3 ± 21.5 c |
| | Haogen | 21.2 ± 2.3 bcd | 40.5 ± 4.7 d | 81.2 ± 11.3 c | 148.7 ± 27.1 c |
| | Swan Lake | 19.8 ± 0.9 cde | 45.8 ± 2.6 c | 86.5 ± 9.8 c | 152.8 ± 18.6 c |
| | Honey Orange | 19.2 ± 1.8 cde | 51.8 ± 3.1 bcd | 86.2 ± 7.6 c | 156.3 ± 17.8 c |
| | Early Queen | 17.5 ± 0.6 de | 61.0 ± 1.7 c | 190.7 ± 28.5 a | 185.5 ± 6.4 c |
| | Arava | 16.2 ± 1.0 e | 41.7 ± 1.7 d | 55.3 ± 11.6 c | 138.3 ± 10.0 c |
| Organic | Savor | 38.0 ± 3.4 a | 65.7 ± 2.8 abc | 119.0 ± 24.0 bcd | 231.7 ± 32.5 a |
| | Sweetie #6 | 37.8 ± 1.9 a | 68.7 ± 4.3 a | 220.7 ± 75.1 a | 194.8 ± 16.2 ab |
| | Burpee Hybrid | 33.8 ± 5.0 ab | 63.5 ± 8.4 abc | 83.7 ± 14.3 cd | 138.0 ± 20.0 bcd |
| | Edonis | 27.3 ± 3.0 bc | 74.8 ± 7.2 a | 92.2 ± 11.8 ab | 177.3 ± 11.0 abc |
| | Rayan | 24.2 ± 2.6 cd | 66.7 ± 6.3 ab | 163.7 ± 49.9 ab | 170.9 ± 23.6 abc |
| | Haogen | 17.7 ± 0.7 d | 52.3 ± 9.8 bcd | 52.7 ± 13.0 d | 93.7 ± 16.5 d |
| | Swan Lake | 22.2 ± 1.1 cd | 50.8 ± 5.4 cd | 54.8 ± 10.0 d | 127.8 ± 22.6 cd |
| | Honey Orange | 22.7 ± 0.4 cd | 69.7 ± 3.9 a | 136.7 ± 34.7 bc | 131.5 ± 5.8 cd |
| | Early Queen | 25.2 ± 1.2 cd | 69.5 ± 7.3 a | 116.2 ± 18.2 bcd | 178.2 ± 10.4 abc |
| | Arava | 18.2 ± 0.6 d | 44.7 ± 4.3 d | 49.0 ± 10.4 d | 96.3 ± 8.5 d |

²Treatment means within columns for each production system followed by the same letter are not significant at the α = 0.05 level according to the Tukey multiple comparison test.
Ascorbic acid. Cultivars varied widely (P < 0.0001) in mean ascorbic acid from 16.2 to 38.1 mg/100 g fresh weight. Cultivars Savor and Sweetie #6 had the highest ascorbic acid content averaged over both years regardless of production system (Table 5). Selecting cultivars for conventional or organic production from those with the highest ascorbic acid values (i.e., ‘Savor’ and ‘Sweetie #6’) over those with the lowest ascorbic acid values provided a potential 2.2- and 2.1-fold increase, respectively. Among cultivars with the highest ascorbic acid, production system made no difference, and midrange and low cultivars were only slightly higher in ascorbic acid when produced organically (Table 4).

Total phenolics. TP also varied (P < 0.0001) by cultivar, with ‘Savor’ having the highest TP under conventional production and ‘Sweetie #6’, ‘Edonis’, ‘Honey Orange’, and ‘Early Queen’ having the highest TP under organic production (Table 3). Some cultivars differed in TP from 1 year to the next under both production systems indicating that differences in weather events from 1 year to the next and the production system both influenced total phenolic content. TP was 1.6- to 1.7-fold higher for cultivars in the highest versus lowest class (Table 4).

Radical scavenging ABTS and DPPH capacity. Trolox-equivalent antioxidant capacity of cultivars measured with ABTS and DPPH revealed that values ranged more among cultivars (P < 0.0001) than from differences resulting from production system in the 2 production years. Cultivar differences for ABTS-TEAC among organic cultivars ranged from a low of 49.0 μmol TEAC/100 g FW in organic ‘Arava’ to a high of 220.7 in organic ‘Sweetie #6’ averaged over both years (Table 3). Similarly, conventional ‘Arava’ had the lowest ABTS (55.3 μmol TEAC/100 g FW) with ‘Savor’ having the highest levels (220.5 μmol TEAC/100 g FW). Although large differences were detected among cultivars and between years for both ABTS and DPPH/TEAC radical scavenging capacity (Tables 2 and 3), the interactions were not particularly noteworthy. A significant three-way interaction involving ABTS antioxidant capacity was attributed largely to differences between years and to higher values for conventionally produced cultivars Haogen, Edonis, Savor, and Swan Lake (Table 3). Under organic production, selecting the cultivar with the highest TEAC values, Sweetie#6, over cultivars from the lowest category would enable a 2.6-fold increase in radical scavenging capacity (Table 4). Cultivar comparisons for DPPH/TEAC enabled gains of 1.8-fold for conventional and 2.4-fold for organic production. Except for ascorbic acid, comparing organic with conventional revealed no advantage for organic production (Table 4).

Quality attributes. The percent dry matter and SSC of the 10 melon cultivars for each of the 2 years are shown in Table 5. Although cultivars differed significantly (P < 0.0001) for both dry matter and SSC, values differed significantly (P < 0.01) between years, these important quality traits were not impacted by production system (Table 2). In 2005, cultivars Savor and Sweetie #6 had higher (P < 0.05) dry matter than ‘Arava’, ‘Swan Lake’, and ‘Haogen’. Savor, Sweetie #6, and Honey Orange cultivars also had higher (P < 0.05) dry matter content in 2006 compared with ‘Hybrid’ and ‘Haogen’, and ‘Arava’.

Correlation analyses. Dry matter and SSC were significantly and highly correlated in 2005 (r = 0.78, P < 0.0001) and in 2006 (r = 0.95, P < 0.0001) (Table 6). Cultivars with the highest dry matter and SSC also had the highest AA, TPs, and radical scavenging capacity, although more so in 2006 than in 2005. Although cultivars with the highest AA and TP also had the highest ABTS and DPPH radical scavenging capacity in 2006, this relationship did not hold in 2005 (Table 6).

Discussion

Of the four primary objectives, the most compelling finding is that differences among cultivars contributed the largest range in AA and TP content as well as ABTS and DPPH antioxidant radical scavenging properties, dry matter, and SSC. Although our study was limited to only 10 cultivars, the differences...
Table 6. Correlation matrix (Pearson r) for antioxidant properties, soluble solids, and dry matter for 2005 (upper right) and 2006 (lower left) with organic and conventional production methods combined (n = 60 for each correlation).

|                      | ABTSb (μmol TEAC/100 g FW) | DPPH (μmol TEAC/100 g FW) | Ascorbic acid (AA) (mg/100 g FW) | Total phenolics (TP) (mg GAE/100 g FW) | Soluble solids (SSC) (°Brix) | Dry matter (%) |
|----------------------|------------------------------|----------------------------|---------------------------------|---------------------------------------|-------------------------------|----------------|
| ABTS                 | 0.57***                      | 0.39***                    | 0.24 NS                         | 0.74 NS                               | 0.17 NS                      | 0.29*          |
| DPPH                 |                              |                            | 0.55***                         | 0.48***                               | 0.48***                      | 0.66***        |
| AA                   | 0.42***                      | 0.62***                    | 0.28*                           | 0.48***                               | 0.38***                      |                |
| TP                   | 0.71***                      | 0.79***                    | 0.53***                         | 0.08***                               | 0.14 NS                      | 0.78***        |
| SSC                  | 0.45***                      | 0.40***                    | 0.66***                         | 0.49***                               | 0.23***                      |                |
| Dry matter           | 0.49***                      | 0.44***                    | 0.66***                         | 0.49***                               | 0.08***                      | 0.95***        |

*NS, **, ***Nonsignificant or significant at P ≤ 0.05, 0.01, 0.001, respectively.

Some cultivars had higher antioxidant properties regardless of production method. The antioxidant index presented in Figure 2 compares the antioxidant potential of the melon cultivars evaluated by combining AA and TP with the average of TEAC values obtained from DPPH and ABTS assays to incorporate free radical scavenging capacity. Examination of rank based on the index over both years reveals that cultivars with the highest and lowest rank generally occupied similar positions among the 10 examined. This suggests that the index provided a reasonably consistent estimate of antioxidant properties for the 10 cultivars. The top index ranks of cultivars Savor, Sweetie #6, and Early Queen parallel their averaged TEAC ranks. All three cultivars have orange-colored flesh from high concentrations of carotenoids (Lester and Eischen, 1996; Robinson and Decker-Walters, 1999; Saftner et al., 2006), which likely contributed to their high TEAC values. The lowest ranked cultivars, Swan Lake, Haagen, and Arava, have greenish white flesh.
Melons grown in organic and conventional plots did not display significant differences in dry matter. Magkos et al. (2003) suggested significant differences in dry matter could not be expected between organic and conventional produce because fruits have low ability to absorb and assimilate nitrogen. SSC also was not significantly influenced by different production systems, but the interactive effects (year × cultivar) were observed to have a significant effect on dry matter and soluble solids. Not surprisingly, high dry matter melons also had the highest soluble solids. The highest dry matter cultivars also had the highest antioxidant properties, AA, and TP content.

Studies that evaluate attributes of produce grown under organic and conventional practices (Asami et al., 2003; Lombardi-Boccia et al., 2006) have encountered heritism, often for valid but unavoidable reasons related to difficulties in making unambiguous comparisons. Accordingly, after examination of our data and recent literature (Lester, 2006; Magkos et al., 2003; Zhao et al., 2006), the following may provide some guidelines to help avoid pitfalls and improve interpretation. To the extent possible, research targeted at comparing organic production to conventional management should strive to meet the following conditions: 1) locate research plots on soils with similar texture, fertility status, drainage, and exposure to each other as practical while meeting organic certification requirements for the organic plots; 2) include comparison of known identical cultivars within a genotype and crop to minimize complications of genetic traits from unknown cultivars as a variable; 3) repeat the experiment at least 2 years or growing seasons; 4) apply similar production practices, including planting time, planting methods, plot design, spacing, row orientation, irrigation source, application method, and scheduling with care to avoid water stress conditions; 5) to the extent possible, apply similar quantities of major nutritional elements (organic matter will of necessity vary from farm to farm, as in all likelihood it will those minor elements associated with organic sources); 6) use similar postproduction harvest methods, including physiological maturity, fruit size, harvest time of day, fruit location on plants, storage conditions, and handling for samples collected for analytical purposes; 7) minimize potential losses by: a) rapid cooling and freezing, b) holding tissue at –20 °C or lower, c) preparing liquid nitrogen powders or freeze drying of tissues in a temperature controlled freezer drier after initial freezing to at least –40 °C, and d) analyzing material within 6 to 12 months from harvest; and 8) use at least three standard analytical methods to assess antioxidant properties with sufficient biological replication and laboratory precision to facilitate statistical analysis.

Drawing appropriate conclusions on the effect of production system on antioxidant properties and fruit quality attributes relies on good experimental design and sampling; nevertheless, year-to-year environmental effects complicate interpretation of data. The results of this study indicate that in general, production system had less effect than cultivar and year differences. Choice of cultivar, unlike weather can largely be controlled by the producer and is the simplest decision with a large potential impact to optimize nutritional attributes of melon production. Local organic and/or conventional producers who want to take advantage of markets for more nutritious produce can benefit by selecting appropriate cultivars. Additional unbiased research data on adapted cultivars is available through university extension programs. Although producers are often in a good position to assess local adaptability, assessment of unbiased nutritional properties requires analytical data that are likely best provided by research laboratories.

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