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Physical and chemical characteristics of melon in organic farming

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ABSTRACT

Melon farming is characterized as an important family agriculture activity and the organic production of fruits and vegetables has shown a large growth in terms of areas in Brazil and around the world. This work aimed to study the postharvest quality of melon cultivated in an organic system. The organic treatments constituted of base fertilizer with cattle manure vermicompost (recommended dose, ½ dose and double dose) plus the use of biofertilizer (sprayed or sprayed + irrigated), and an additional treatment with chemical fertilization. The postharvest quality was evaluated through physico-chemical and phytochemical attributes. The organic management with half the recommended dose of vermicompost plus the sprayed biofertilizer and the chemical fertilization management produced fruits with higher levels of sugar, total carotenoids, ascorbic acid and folates, obtaining more balanced fruits, with a better phytochemical quality. The antioxidant capacity was defined mainly by the presence of the phenolic compounds, which were influenced by the type and the dose of the evaluated fertilizers, with superiority in the organic treatments with double the dose of cattle manure vermicompost.

Palavras-chave:

Cucumis melo var. *inodorus*
adubação orgânica
pós-colheita
qualidade
fitoquímicos

Características físicas e químicas de melão em cultivo orgânico

RESUMO

A cultura do melão se caracteriza como importante atividade na agricultura familiar; ressalta-se que a produção orgânica de frutas e hortaliças tem apresentado, no Brasil e no mundo, grande crescimento em área. Este trabalho teve, como objetivo, estudar a qualidade pós-colheita de melão cultivado em sistema orgânico. Os tratamentos orgânicos foram constituídos por adubação de base com vermicomposto bovino (dose recomendada, ½ da dose e dobro da dose) mais utilização de biofertilizante na forma pulverizada ou pulverizada e regada, além de um tratamento adicional com adubação química. A qualidade pós-colheita foi avaliada através de atributos físico-químicos e fitoquímicos. O manejo orgânico com a metade da dose de húmus recomendada mais o biofertilizante pulverizado e o manejo de adubação química produziram frutos com maiores teores de açúcares, carotenoides totais, ácido ascórbico e ácido fólico obtendo-se frutos mais equilibrados e de melhor qualidade fitoquímica. A capacidade antioxidante foi definida, sobretudo pela presença dos compostos fenólicos influenciados pelo tipo e pela dose das adubações, com superioridade nos tratamentos orgânicos com o dobro da dose de húmus.

INTRODUCTION

Organic production occupies an area of 37.2 million ha, including transition areas. In Latin America, the area was 6.9 million ha in 2011, which correspond to 18% of the global organic area. The main countries are Argentina (4.2 million ha), Uruguay (0.9 million ha) and Brazil (0.7 million ha). Brazil has 1.8 million ha with organic certification (including native areas). North and south regions amount to 49% of the total organic production units (Willer et al., 2013).

The production of melon in Brazil was equal to 575,386 t in 2012/2013, for an area of 22,810 ha, located mostly in the northeast region. The states of Rio Grande do Norte and Ceará are the main producers, while Rio Grande do Sul occupies the fourth position. Nearly one third of the national production is directed to the internal market (ABF, 2014).

According to Williams (2002), among the main comparative studies on nutrition, just a limited number have compared the nutritional composition of fruits from organic and conventional systems with a good control of the variables.

In general, there is a tendency for reduction in the content of nitrates and increase in the contents of vitamin C in organically produced foods, especially leafy vegetables, which suggests that further research is necessary in this area.

Toor et al. (2006) studied the influence of different types of fertilizers on the main antioxidant components of tomatoes and concluded that fertilizer sources can have an expressive effect on the concentration of these nutrients. The use of organic fertilizers increased the levels of total phenolic compounds and ascorbic acid.

The quality of melon fruits involves attributes related to characteristics of the pulp, such as firmness, content of soluble solids, subjective evaluation regarding the appearance (external and internal), content of soluble sugars (reducing and total) (Filgueiras et al., 2000) and, more recently, the presence of health-promoting phytonutrients, such as ascorbic acid, folic acid and betacarotene (precursor of the vitamin A), predominant in cultivars with salmon-colored pulp (Lester & Hodges, 2008).

Still regarding the qualitative aspects, fruits and vegetables contain distinct antioxidant substances, whose activities have been proved in the last years. The presence of phenolic compounds, such as flavonoids, phenolic acids and anthocyanins, besides the known vitamins C, E and carotenoids, contribute to the beneficial effects of these foods on human health (Podsedeck, 2007).

The content of polyphenols in vegetables, similarly to the contents of other phytochemicals, can be influenced by many factors, such as variety, climatic conditions, cultural practices, maturity and storage conditions (Podsedeck, 2007; Balisteiro et al., 2013). The cultivation under biotic and abiotic stress can stimulate the synthesis of bioactive compounds (Oh et al., 2009).

In this context, this study aimed to evaluate the ecological inputs for the organic production of melon and their effects on fruit quality, providing farmers with safer management options, in order to strengthen the credibility of the system.

MATERIAL AND METHODS

The study was carried out at the Center of Rural Sciences of the University of the Campanha Region, Bagé-RS, Brazil. The experiment was installed in an area of 280 m², using the hybrid Goldex F1[®] of 'Valenciano' melon (*Cucumis melo*, var. *inodorus*). Plants were conducted in beds under drip irrigation and mulching with a spacing of 2.0 x 0.5 m, totaling a density of 10,000 plants ha⁻¹. Melon was planted using seedlings produced in a protected environment, which were transplanted on November 8th 2012, with two true leaves. Plants were conducted without pruning or thinning.

The experiment was set in a randomized block design with four replicates and seven treatments. The treatments constituted of three basal fertilizations, based on the recommendation for the nitrogen demand, and two forms of topdressing application of biofertilizer (spray and spray + irrigation), besides the control treatment, with chemical fertilization. The experiment was composed of 28 plots, with 10 plants each, totaling 280 plants. The recommended dose for the application of cattle manure vermicompost (CMV) was 1.9 kg m⁻². For the 0.25 m² planting pits, the applied amounts were 475 g pit⁻¹ (dose), 237.5 g pit⁻¹ (1/2 dose) and 950 g pit⁻¹ (2x-dose). The treatments with biofertilizers were composed of weekly sprayings, which started 20 days after transplantation (DAT), totaling six.

In the treatments with biofertilizers, 100 mL plant⁻¹ were applied at 32, 56 and 57 DAT. The conventional treatment followed the recommendation of ROLAS (2004), with the application in the row, considering the dose in g m⁻²: 219 g of diammonium phosphate, 272 g of potassium chloride (KCl) and topdressing application of nitrogen (N) at 33 DAT, using 7.95 g of urea plant⁻¹.

The evaluated treatments were: T1 – basal fertilization with cattle manure vermicompost (dose) + sprayed biofertilizer; T2 – basal fertilization with cattle manure vermicompost (dose) + sprayed and irrigated biofertilizer; T3 – basal fertilization with cattle manure vermicompost (1/2 dose) + sprayed biofertilizer; T4 – basal fertilization with cattle manure vermicompost (1/2 dose) + sprayed and irrigated biofertilizer; T5 – basal fertilization with cattle manure vermicompost (2x-dose) + sprayed biofertilizer; T6 – basal fertilization with cattle manure vermicompost (2x-dose) + sprayed and irrigated biofertilizer; and the additional treatment T7 – conventional fertilization, according to ROLAS (2004).

After the main harvest (67 DAT), four fruits were randomly selected in the area, with three replicates per treatment and the following parameters were evaluated: external and internal appearance, pH, total titratable acidity, total soluble solids, soluble solids/acidity, pulp firmness, reducing sugars, total sugars, sucrose, total phenolic compounds, total carotenoids, antioxidant capacity, ascorbic acid and folates.

External and internal appearances were evaluated through subjective analysis using a rating scale, according to Menezes (1998). The evaluation of pulp firmness (PF), expressed in Newton (N), followed the methodology of Filgueiras et al. (2000). For the other analyses, samples were prepared by removing the edible pulp of four equidistant slices of each

fruit, which were divided into pieces. A 10-g sample was removed from the middle part of one of the four fruits and was immediately frozen with liquid nitrogen and kept in a domestic freezer. The rest of the sample was homogenized in a domestic centrifugal machine and the biochemical analyses were performed in the juice, in three replicates.

The pH was measured directly in the juice with a digital potentiometer (AOAC, 1992). Total titratable acidity (TTA) was measured through titration and expressed in percentage of citric acid (% CA) (AOAC, 1992). The total soluble solids (TSS) were measured in a refractometer with automatic temperature correction (AOAC, 1992). The ratio between total soluble solids and total titratable acidity (TSS/TTA) was obtained by calculating the relationship between the results of these variables (Filgueiras et al., 2000).

The analysis of bioactive compounds, total sugars, reducing sugars and sucrose was performed at the Laboratory of Fruits and Vegetables Postharvest of the Department of Agroindustrial Science and Technology of the 'Eliseu Maciel' College of Agriculture at the Federal University of Pelotas (DCTA/FAEM/UFPEL), using 10 g samples, according to the methodologies described below.

Total phenolic compounds (TPC) were quantified using the Folin-Ciocalteu reagent, according to the method of Swain & Hillis (1959), and the results were expressed in mg of gallic acid equivalent per 100 g of fresh fruit ($\text{mg GAE } 100 \text{ g}^{-1}$). The antioxidant capacity (AC) was determined based on the capture of the DPPH radical, according to Fetter et al. (2010), and expressed in μg of Trolox equivalent g^{-1} of dry fruit ($\mu\text{g TE g}^{-1}$). The total carotenoids (TC) were extracted according to Rodriguez-Amaya (2001) and expressed in mg of β -carotene per 100 g of dry weight ($\text{mg } 100 \text{ g}^{-1}$). The content of ascorbic acid (ASC) was quantified using a high-efficiency liquid chromatography system (HPLC-Shimadzu), equipped with automatic injector and UV-visible detector (254 nm), and expressed in $\text{mg } 100 \text{ g}^{-1}$ (Vinci et al., 1995). The folates (FOL) were analyzed according to the method of Catharino et al. (2006), and the results were expressed in $\mu\text{g } 100 \text{ g}^{-1}$ of the sample. The contents of total sugars (TSug), reducing sugars (RSug) and sucrose (SUC) were expressed in $\% \text{ m m}^{-1}$ (AOAC, 1992).

A randomized block design with four replicates was used for the field experiment and a completely randomized design

with three replicates was used for the postharvest evaluations, after the main harvest (67 DAT). For the statistical analysis of the results, the software Statistix, version 9.0, was used. Means were compared through the ANOVA ($p < 0.05$) and the orthogonal contrasts defined by the analysis: C1 – conventional x organic; C2 – sprayed x sprayed + irrigated; C3 – dose x $\frac{1}{2}$ dose; C4 – dose x double dose; and C5 – $\frac{1}{2}$ dose x double dose, evaluated by the Bonferroni t-test.

RESULTS AND DISCUSSION

According to the analysis of variance, there was a highly significant effect of the treatments ($p < 0.001$) for the quality attributes, such as the contents of TSug, RSug and SUC. When the chemical composition was detailed, with emphasis on the secondary compounds, the dependent variables were also affected by the treatments. This occurred for the contents of TPC, TC, ASC, FOL and, as a consequence, AC. The treatments did not influence the responses of other attributes, such as ExtAp, PF, pH, TTA, TSS and the TSS/TTA, which were similar between the treatments with mean values of 1.51, 18.33 N, 5.93, 0.10% CA, 9.88 °Brix and 98.57, respectively (Table 1).

According to comparison of the treatments by the orthogonal contrasts (Table 2), the contents of TSug in fruit pulps was significantly different between sprayed and sprayed and irrigated treatments (C2) and between the different CMV doses (C3, C4 and C5). For T1, T3 and T5, the sprayed biofertilizer showed a mean value of $9.34\% \text{ m m}^{-1}$ of TSug, higher than that for sprayed and irrigated treatment, with $8.84\% \text{ m m}^{-1}$. For the studied CMV doses, the treatments T3 and T4 ($\frac{1}{2}$ dose) produced fruits with TSug differences of $1.58\% \text{ m m}^{-1}$ compared with T5 and T6 (2x-dose) and $0.59\% \text{ m m}^{-1}$, compared with T1 and T2 (dose) (Table 2). RSug contents partially followed the behavior of TSug and differed for the contrasts C1, C2, C4 and C5 (Table 2). The conventional treatment (T7) showed difference of $0.4\% \text{ m m}^{-1}$ from the mean of the organic treatments. The treatments with sprayed biofertilizer were $0.22\% \text{ m m}^{-1}$ higher than the sprayed and irrigated treatments (T2, T4 and T6) and, among the doses, the treatments T5 and T6 showed the lowest means of TSug when compared with the groups T1 and T2, differing by 0.73%

Table 1. Analysis of variance for the studied post-harvest parameters in the production of the melon hybrid Goldex®, in organic and conventional production systems

Parameters	Abbrev.	Units	F	Overall mean	CV
Total Sugars	TSug	$\% \text{ m m}^{-1}$	54.50 ($p = 0.00$)	9.34	2.57
Reducing Sugars	RSug	$\% \text{ m m}^{-1}$	19.60 ($p = 0.00$)	4.86	3.59
Sucrose	SUC	$\% \text{ m m}^{-1}$	15.41 ($p = 0.00$)	4.48	6.48
Total Phenolic Compounds	TPC	$\text{mg GAE } 100\text{g}^{-1}$	74.32 ($p = 0.00$)	12.26	3.06
Total Carotenoids	TC	$\text{mg } 100\text{g}^{-1}$	82.04 ($p = 0.00$)	20.19	3.06
Antioxidant Capacity	AC	$\mu\text{g TE g}^{-1}$	34.60 ($p = 0.00$)	17.37	2.86
Ascorbic Acid	ASC	$\text{mg } 100\text{g}^{-1}$	19.91 ($p = 0.00$)	13.04	4.33
Folates	FOL	$\mu\text{g } 100\text{g}^{-1}$	23.31 ($p = 0.00$)	5.37	4.89
External Appearance	ExtAp	Index	2.09 ($p = 0.12$)	1.5	13.97
Pulp Firmness	PF	N	1.99 ($p = 0.13$)	18.33	9.27
pH	pH	pH	0.34 ($p = 0.90$)	5.93	1.58
Total Titratable Acidity	TTA	% CA	1.67 ($p = 0.20$)	0.10	7.14
Total Soluble Solids	TSS	°Brix	1.26 ($p = 0.34$)	9.88	5.77
Ratio of Total Soluble Solids/Total Acidity	TSS/TTA	index	2.44 ($p = 0.08$)	98.57	9.89

Abbrev. - Abbreviation; $p < 0.05$ - significant; $p < 0.01$ and $p < 0.001$ - highly significant; F – Snedecor's F value

Table 2. Mean contents of total sugars (TSug, % m m⁻¹); reducing sugars (RSug, % m m⁻¹); sucrose (SUC, % m m⁻¹); total phenolic compounds (TPC, mg GAE 100g⁻¹); total carotenoids (TC, mg 100g⁻¹); ascorbic acid (ASC, mg 100g⁻¹); folates (FOL, µg 100g⁻¹); antioxidant capacity (AC, µg TE g⁻¹) and the respective contrasts (C) obtained for the melon hybrid Goldex®, cultivated in organic and conventional systems

Treatments	TSug	RSug	SUC	TPC	TC	ASC	FOL	AC
T1	9.53	5.30	4.23	12.00	19.73	11.90	5.33	18.00
T2	8.93	4.83	4.10	12.40	17.30	12.73	4.73	17.43
T3	10.50	5.30	5.20	10.33	24.10	14.50	5.73	15.30
T4	9.13	4.77	4.37	10.70	20.77	14.13	6.07	15.03
T5	8.00	4.13	3.87	14.13	17.40	11.87	4.77	18.87
T6	8.47	4.47	4.00	15.30	17.17	11.27	4.53	19.53
T7	10.80	5.20	5.60	11.03	24.83	14.90	6.43	17.43
6	0.14	0.10	0.17	0.22	0.36	0.33	0.15	0.29
Contrasts	Ŷ	Ŷ	Ŷ	Ŷ	Ŷ	Ŷ	Ŷ	Ŷ
C1	1.71 ^{ns}	0.40 ^{**}	1.30 ^{ns}	-1.45 ^{ns}	5.42 ^{ns}	2.17 ^{**}	1.24 ^{ns}	0.07 [*]
C2	0.5 ^{**}	0.22 [*]	0.28 ^{ns}	-0.68 ^{**}	2.00 ^{***}	0.04 ^{ns}	0.17 ^{ns}	0.06 ^{ns}
C3	-0.59 ^{**}	0.033 ^{ns}	-0.62 ^{**}	1.74 ^{***}	-3.92 ^{***}	-2.00 ^{***}	-0.87 ^{**}	2.56 ^{***}
C4	0.99 ^{***}	0.77 ^{***}	0.23 ^{ns}	-2.52 ^{***}	1.24 ^{***}	0.75 [*]	0.38 [*]	-1.48 ^{**}
C5	1.58 ^{***}	0.73 ^{***}	0.84 ^{**}	-4.26 ^{***}	5.16 ^{***}	2.75 ^{***}	1.25 ^{***}	-4.04 ^{***}

Contrasts are significant if $p < 0.05$ (*), highly significant if $p < 0.01$ (**) or $p < 0.001$ (***), and not significant (ns) by Bonferroni t-test; C1 – Conventional (T7) vs Organic (T1,T2,T3,T4,T5,T6); C2 – Sprayed (T1,T3,T5) vs Sprayed and Irrigated (T2,T4,T6); C3 – Dose (T1,T2) vs ½ dose (T3,T4); C4 – Dose (T1,T2) vs Double dose (T5,T6); C5 – ½ Dose (T3,T4) vs Double dose (T5,T6); T1 [recommended dose of cattle manure vermicompost (CMV dose) + sprayed biofertilizer]; T2 [CMV dose + sprayed and irrigated biofertilizer]; T3 [½ CMV dose + sprayed biofertilizer]; T4 [½ CMV dose + sprayed and irrigated biofertilizer]; T5 [2x CMV dose + sprayed biofertilizer]; T6 [2x CMV dose + sprayed and irrigated biofertilizer]; T7 [conventional fertilization]

m m⁻¹, and T3 and T4, differing by 0.77% m m⁻¹, while these two did not differ.

SUC content was affected by the doses and showed significant C3 and C4 contrasts. T3 and T4 (½ CMV dose) showed higher SUC contents, with a difference of 0.84% m m⁻¹ compared with T5 and T6 (2x CMV dose) and 0.62% m m⁻¹ compared with T1 and T2 (CMV dose), similarly to the behavior of TSug.

TPC contents showed a behavior contrary to the one of TSug and were significantly different between sprayed and sprayed + irrigated treatments (C2), where the latter produced fruits with TPC of 0.68 mg GAE 100 g⁻¹, which is higher than the TPC of the former. For the CMV doses, the TPC was higher for T5 and T6 (2x CMV dose), with a value of 14.72 mg GAE 100 g⁻¹, compared with 12.20 mg GAE 100 g⁻¹ for T1 and T2 (dose) and 10.46 mg GAE 100 g⁻¹ for T3 and T4 (½ CMV dose), while these were significantly different in 1.74 mg GAE 100 g⁻¹ from the recommended dose.

TC contents showed a behavior similar to the one of TSug and contrary to the one of TPC, and were significantly different between sprayed and sprayed + irrigated treatments, in 2 mg 100 g⁻¹. For the doses, the treatments T3 and T4 (½ CMV dose) showed higher TC contents than T1 and T2 (dose) and T5 and T6 (2x CMV dose), in 3.92 mg 100 g⁻¹ and 5.16 mg 100 g⁻¹, respectively.

ASC contents, in relation to the doses, were also similar to TSug and TC, for which the group T3 and T4 (½ CMV dose) differed from the others and was superior to the other doses, with differences of 2 mg 100 g⁻¹ from the mean of T1 and T2 (dose), and 2.75 mg 100 g⁻¹ from the mean of T5 and T6 (2x CMV dose). For the contrast C1, the mean ASC content in the conventional treatment was higher than in the organic treatments, with a difference of 2.17 mg 100 g⁻¹.

For the FOL contents, the contrasts were only significant for the doses. FOL showed a behavior similar to those of TSug, ASC and TC. The highest FOL contents were obtained in T3 and T4 (½ CMV dose) and the lowest ones in T5 and T6 (2x CMV dose) with a difference of 1.25 mg 100 g⁻¹ between the means.

The AC was significantly different in the fruits produced conventionally in 0.07 µg TE g⁻¹, when compared with organic fruits. For the CMV doses, the highest AC was observed in T5 and T6 (2x CMV dose), which were superior to the other organic doses, with a behavior similar to the one of TPC.

Given the above, the concentration of phenolic compounds and the antioxidant capacity are higher in organic fruits produced with double the recommended dose of cattle manure vermicompost (T5 and T6), in comparison to fruits produced with ½ dose (T3 and T4), with a behavior contrary to those of TC, ASC and FOL, which showed higher contents for T3 and T4 and lower contents for T5 and T6. The interference of the nutrients available was also observed when the treatments with only sprayed biofertilizer produced fruits with more sugar and carotenoids, at the expense of phenolic compounds. When the means of the organic system were compared with the conventional one (T7), the latter only differed for TPC and ASC.

The treatments with ½ CMV dose and sprayed biofertilizer, together with the conventional, produced fruits with higher contents of TSug, TC, ASC and FOL, while fruits produced with 2x CMV dose showed higher TPC contents and higher AC.

The mean TPC contents of 12.46 mg GAE 100 g⁻¹, for the organic treatments, and 11.03 mg GAE 100 g⁻¹, for the conventional treatment, are lower than the results reported by Barreto (2011), who observed mean value of 140 mg GAE 100 g⁻¹ for 22 melon hybrids and 120 mg GAE 100 g⁻¹ for the Goldex hybrid. The contents were relatively low, but range around an expected value for a fruit that is not a rich source of bioactive compounds (Kevers et al., 2007).

On the other hand, the mean values for TC of 19.41 mg 100 g⁻¹ in the organic treatments and 24.83 mg 100 g⁻¹ in the conventional treatment are much higher than those reported by Barreto (2011), for the same Goldex hybrid (0.39 mg 100 g⁻¹). The author points out that the hybrids with salmon-colored pulp showed the highest mean contents of TC, especially the type Charentais: Magritte (2.49 mg 100 g⁻¹) and Magistro (2.56 mg 100 g⁻¹). As for the composition of TSug, Barreto (2011) also reported mean value of 6.63% for yellow hybrids and the

Goldex hybrid showed 7.27% of TSug and 3.43% of RSug. The values of TSug and RSug observed in this study were 9.13 and 4.8%, respectively, considering only the organic treatments. These means are higher than those reported by Barreto (2011) and those reported by Tomaz et al. (2009), in different hybrids of yellow melon, who observed values of 7.37 and 8.71% of TSug and mean value of 4.53% for RSug.

The highest ASC contents observed in the treatments T7, T3 and T4 were 14.9, 14.5 and 14.13 mg 100 g⁻¹, respectively. The ASC contents reported in the literature are very diverse; Barreto (2011) observed ASC mean values of 4.75 mg 100 g⁻¹ for hybrids of yellow melon and 4.26 mg 100 g⁻¹ for the hybrid Goldex, the object of this study. In comparison to the mean value of 12.73 mg 100 g⁻¹ found for the organic treatments, these values are 198.8% higher; however, Silva et al. (2010) observed values from 14.4 to 17.7 mg 100 g⁻¹.

Aroucha et al. (2007) observed values of 19.01, 36.96, 24.64 and 48.40 mg 100 mL⁻¹ for the melons AF 1749, Hymark, Rochedo and Caipira. Vargas et al. (2008), studying the muskmelon hybrids 'Maxim', 'Bônus n°2', 'Shinju 200', 'Fantasy' and 'Louis', as a function of the cultivation system (substrate and soil), observed a mean content of 15.77 mg of vitamin C 100 mL⁻¹, for the cultivation in soil. Kevers et al. (2007) observed 4 mg of vitamin C 100 g⁻¹, 70 mg GAE 100 g⁻¹ for TPC and 56 µg TE 100 g⁻¹ for AC, in Charentais melons. These values do not agree with the ones in this study, but refer to aromatic types of melon, in which the levels of secondary compounds are naturally higher.

Similarly to what occurred with TPC, the contents of ASC, a precursor of vitamin C, are highly variable among the reports; this is due to methods of detection and quantification, genotypes, cultivation systems and maturation stage, among other factors (Alhaghdow et al., 2007). In addition, most of the cited studies (Aroucha et al., 2007; Vargas et al., 2008; Barreto, 2011) used vitamin C data obtained using a method that is not equivalent to the one used in this study, the HPLC.

The differences between the results of phenolic compounds and ascorbic acid observed here and those widely variable among the cited references can also have a hypothetical explanation. Holistic studies (Alhaghdow, et al., 2007; Oh et al., 2009; Aluru et al., 2009; Borowski et al., 2014) on integrative metabolomics have shown that the adaptive mechanisms of plants follow the logic of cell homeostasis, with maximum economy, i.e., when a protection metabolism is induced, another one is saved. In this case, for example, the studied melons show relatively high values of ascorbic acid, but relatively low values of total phenolic compounds. It is possible, through the metabolic perspective, that the melons have directed their defense priorities to one of the aforementioned metabolic pathways, since both produce polar metabolites, highly reactive to reactive oxygen species. This claim is made based on studies that show that, when a plant protects itself with a group of metabolites, it saves others (Borowski et al., 2014). This claim is also true when slightly polar metabolites are compared, such as the carotenoids. The synthesis of these compounds, besides genotypic and environmental interferences, is the result of the metabolic balance, i.e., they are produced to establish the antioxidant balance between hydrophilic and hydrophobic molecules (Alhaghdow et al.,

2007; Aluru et al., 2009). Thus, finding high values of ASC and TC is consistent; similarly, finding high contents of ASC and relatively low contents of TPC is a reasonable physiological tendency.

The AC was higher in the organic treatments with 2x CMV dose, with mean value of 19.2 µg TE g⁻¹, while treatments with ½ CMV dose and the conventional treatment showed lower values (15.17 and 17.43 µg TE g⁻¹, respectively). Barreto (2011) observed mean value of 0.67 µM TE g⁻¹ among 22 commercial hybrids evaluated. The yellow melons showed mean values below the overall mean, with AC of 0.41 µM TE g⁻¹ and the hybrid Goldex showed a value of 0.43 µM TE g⁻¹.

The AC was influenced by the type and by the dose of fertilization, as occurred for the TPC contents. These results agree with those described in the literature (Toor et al., 2006; Wang et al., 2008; Perin et al., 2014), which claim that products from organic production systems can have higher amounts of TPC. In addition, the different fertilizations used in the organic system influenced the behavior of these variables.

Most studies report similar tendencies. For example, Arbos et al. (2010) compared the AC and TPC contents between lettuce, rocket and chicory, in organic and conventional cultivation, and observed that the organic system contributed, simultaneously, to the highest TPC content and a more effective AC for all the evaluated species. In addition, mango fruits from conventional systems showed lower contents of phenolic compounds, flavonoids, antioxidant capacity, lower concentration of soluble solids, total and reducing sugars and fixed mineral residue in comparison to the fruits from organic and biodynamic cultivation systems (Maciel et al., 2011). Wang et al. (2008), when evaluating organic and conventional cultivations of blueberry, concluded that the contents of total phenolic compounds, flavonoids and antioxidant capacity were higher in the organic cultivation.

Further studies are still needed in order to better elucidate the interferences from the use of biofertilizers on plant metabolism, development and defense.

CONCLUSIONS

1. Organic and conventional cultivation systems influenced the postharvest quality, especially regarding the composition of phytochemical compounds.
2. The organic management with ½ the recommended dose of cattle manure vermicompost (237.5 g) plus the sprayed biofertilizer and the management with conventional fertilization produced more balanced fruits, with higher phytochemical quality, higher contents of sugars, total carotenoids, ascorbic acid and folates.
3. The organic management with double the recommended dose of cattle manure vermicompost (950 g) produced fruits with higher contents of phenolic compounds and higher antioxidant capacity.

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