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Long life tomato (*Solanum Lycopersicum*): price is quality?

D. C. Gonçalves[1]; C. M. A. Morgado[2]; E. P. da Silva[3]*; G. de C. Corrêa[4]; A. dos R. Nascimento[4]; L. C. Cunha Júnior[4]

[1] Faculdade de Nutrição, Universidade Federal de Goiás
[2] Campus Anápolis de Ciências Exatas e Tecnológicas – Henrique Santillo (CCET), Universidade Estadual de Goiás.
[3]Instituto Nacional de Pesquisas da Amazônia
[4] Escola de Agronomia, Universidade Federal de Goiás

*** Author for correspondence:** edsonpablos@hotmail.com

Abstract. The commercialization of the tomato has significant relevance in the national and international market. Thus, the purpose of this paper was to elucidate if the marketing price of the same is really related to its quality. The fruits were collected monthly from February to August at different points of sale in CEASA-GO, susceptible to variable storage conditions: "Boxe" (wholesale market) and "Pedras" (rural producer) and evaluated for commercial price, origin, firmness, color, vitamin C, soluble solids and acidity. The experimental design was completely randomized in a 2 x 7 factorial scheme (2 collection points and 7 collection periods) in three replications. The tomatoes marketed in the "Pedras" presented lower prices throughout the experiment. Regarding the physical and chemical parameters (color and firmness, vitamin C, soluble solids and acidity), no significant differences were observed between the different collection points. Although there were no significant differences in quality between the marketing points, those marketed in the boxes had a higher commercial value.
Keywords: Commercial Viability, CEASA, Post-harvest, Marketing Standard.

Introduction

The commercialization of tomatoes (*Solanum lycopersicum L.*) has high economic relevance, being among the most cultivated vegetables in the world (FAO, 2018). In Brazil the large volume is traded in the forty-one Supply Centers (CEASA) spread throughout Brazil, being sold in 2016, in Goiás Supply Center (CEASA-GO) 105.7 thousand tons, representing 11.26% of the total of vegetables sold (IBGE, 2018). It is observed that there is an increasing demand for a healthy diet, opting for fresh fruits and vegetables, and its decision-making guided by the price and quality parameters (Teixeira et al., 2006; Ribeiro et al., 2017). Tomato quality is associated with physical characteristics such as size, texture and color that will determine consumer acceptance of the product (Borguini and Silva, 2009; Andreuccetti et al., 2005), as well as its marketing price.

Selling value and quality are parameters influenced by cultivation conditions, climate, transportation, distribution and storage, and when mishandled promote physical damage and injury, leading to qualitative and quantitative losses to the tomato chain (Cantwell et al., 2009; Oliveira et al., 2013). In this reasoning, it becomes possible to interpret the price differences found in the two distinct commercialization places commonly within the CEASAs, "Boxes" and "Pedras". "Boxes" are entrepreneurial-controlled bulk storage, distribution and marketing centers that buy and resell vegetables, often seen as better quality products. The "Pedras" are areas without fixed structure, intended for the rural producer himself to market his products, being seen as lower quality products (Goiás, 2009).

The fruits sold in the "Boxes" are usually of better quality due to the preservation postharvest technologies used (postharvest uniformity, refrigerated storage), which would justify the higher price compared to tomatoes sold in the "Pedras". As there is a scarcity of work on this subject, the present work aimed to evaluate the quality of fruits marketed in CEASAs in different places, as well as to demystify if there are differences in the quality of table tomatoes marketed, since there is a price difference applied between the marketing places.

Methods

Plant material

Type 2 long-life tomatoes (60 to 75 mm in diameter) were collected monthly from February to August 2017, with the criterion of choosing the day and place of sale according to the days of highest

fruit volume in CEASA-GO (Latitude 16 ° 37´S and Longitude 49 ° 12´). Forty-four pounds were sampled from each marketing place ("Pedras" and "Boxes") by date. At the time of collection, the origin of the fruit and the commercialization value were noted. It should be noted that the value was measured by basic tomato sales unit in the CEASAs, which are boxes of 22 kg. Thus, the average value was expressed in R$/22 kg of tomato.

Quality reviews

The tomatoes were packed in plastic bags and immediately transported to the Postharvest Laboratory of Vegetables of the Federal University of Goiás (UFG), located at the College of Agronomy. In the laboratory they were randomly separated into nine replicates, with three fruits and the analyzes performed in triplicate.

The following analyzes were performed: a) Firmness (FIR): determined by the applanation technique (Calbo & Nery, 1995), being expressed in Newton (N); (b) Peel coloration: was obtained by averaging two points from the equatorial region of the fruit using Color Quest XE (CIELab) colorimeter (Hunter Association, Reston, Virginia, USA); c) Vitamin C: determined by the potassium iodate titration method (0.002 M), expressed as mg% (Lutz, 2008); d) Titratable acidity (TA): determined in the ground pulp by titration with NaOH until reaching pH = 8.1 and expressed as a percentage of citric acid (AOAC, 1997 - method 942.15); e) Soluble Solids (SS): quantified in digital refractometer (Atago PR-101 Palette) and results in ºBrix (AOAC, 1997 - method 932.12).

Statistical analysis

The experiment was conducted in a completely randomized design, in a 2 x 7 factorial scheme (2 sites x 7 collection periods). Data were submitted to analysis of variance (ANOVA) and means test between sampling sites and collection period (Tukey at 5% probability level). The Sisvar version 5.6 software was used for data analysis (Ferreira, 2014).

Results and discussion

Most of the tomatoes sold came from the state of Goiás (78.57%), and the rest came from the states of Santa Catarina (10.72%), Distrito Federal, São Paulo and Minas Gerais (3.57% each). The average price of the basic marketing unit (22 kg of tomatoes) was R$ 29.82, and the price practiced on the "Pedra" (R$ 27.50) is lower than the "Boxe" (R$ 32.14), as shown in Table 1. In the off-season months (February to May), which in the state of Goiás is marked by the rainy season, where a large volume of rainfall occurs, impairs the production and quality of fruits (Brasil, 2012). In this period there was the initiative of entrepreneurs ("Boxes") to seek tomatoes from other sources, which highlights the importance of this place of marketing for the constant supply of food.

Table 1. Origin, place and selling price of long-lived tomatoes marketed in different marketing locations from February to May 2017.

Months	Place	Average price (R$/ 22 Kg)	Origin of the fruit
February	[1]Boxes	22.50	Caçador (SC)
	[2]Pedras	15.00	Goianápolis (GO)
March	[1]Boxes	40.00	Caçador (SC)/ Brasília (DF)
	[2]Pedras	35.00	Goianápolis (GO)
April	[1]Boxes	35.00	Lagoa Formosa (MG)
	[2]Pedras	30.00	Corumbá de Goiás (GO)
May	[1]Boxes	32.50	São Paulo (SP)
	[2]Pedras	30.00	Silvânia (GO)
June	[1]Boxes	20.00	Ouro Verde (GO)
	[2]Pedras	17.50	Goianápolis (GO)
July	[1]Boxes	40.00	São João da aliança (GO)
	[2]Pedras	32.25	Goianápolis (GO)
August	[1]Boxes	35.00	São João da Aliança (GO)
	[2]Pedras	32.50	Teresópolis (GO)

[1] Boxes are distribution centers with physical infrastructure for large volumes. [2] "Pedras" are areas with no fixed structure intended for the farmer's own trade.

CEASA-GO's marketing calendar (2018) showed that the months with the highest tomato offerings were from July to October. During this period, the lowest commercialization values are expected. Machado et al. (2008) corroborated that variations in tomato prices are greatly influenced by harvest / off-season periods. However, the average price of tomatoes during the off-season was R$ 32.00, while between July to August was R $ 35.00, which cannot be justified by the offer of the product (Table 1). Another possibility was that the fruits of "Boxes" presented higher prices due to the

supposed better quality and that added the value of transportation, selection, among others. Regarding quality, one of the first items observed by the buyer is appearance, that is, coloration that can be objectively expressed by the brightness variables, a * and b *. The parameters luminosity and a * did not differ in relation to the place of sale, presenting difference only in relation to the period of sale. The fruits collected in March, April, May, July and August presented higher brightness and lower color parameter a * (Figure 1a and 1b, respectively). While the b * parameter had difference with the place and collection period (Figure 1C).

The relation a * / b * allows to identify the predominance of red color and green color in tomatoes, and values > 0 indicate the predominance of red color and < 0 the predominance of green color. Thus, figures 1B and 1C showed that most of the fruits collected had a color closest to green. The luminosity is related to the intensity of the color, darker fruits have a lower luminosity value. Thus, redder and opaque fruits will have a lower luminosity (Arias et al., 2000).

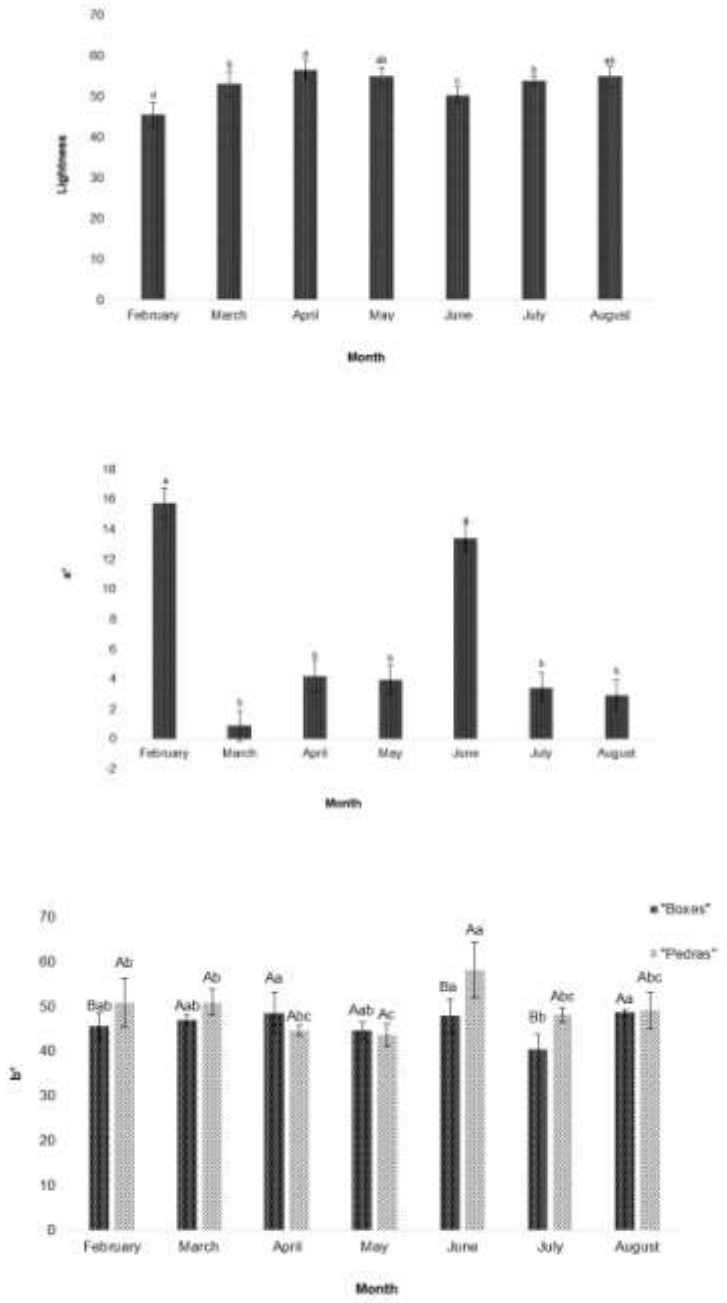

Figure 1. Lightness, a * and b * value of long-lived tomato peel marketed in different months and locations in 2017. Different letters represent significant difference by Tukey's t-test ($p < 0.05$). Uppercase letters when comparing the locations ("Boxes" and "Pedras") and lowercase letters when comparing the months of fruit collection. Vertical bars represent the standard deviation of the mean.

Another noticeable parameter that influences at the time of purchase is firmness. In tomatoes, there was no difference in relation to the collection sites. However, there was a difference in relation to the collection period ($p < 0.05$), with the highest values of March, May, July and August (Figure 2). Chitarra & Chitarra (2005) reported that firmness in fruits is susceptible to changes according to production and marketing times, directly affecting product quality.

There were no differences in color and firmness between the fruits sold in the "Boxes" and "Pedras" justifying the difference in prices. The soluble solids content was higher in the fruits obtained in the "Boxes" between March, May, July and August (Figure 3A), but the acidity did not differ according to the collection sites, with February being the lowest value. (Figure 3B). Soluble solids and titratable acidity influence the taste and aroma of fruits, affecting the quality and consumer acceptance of the product (Rosales et al., 2011). This is because, the greater the relationship between soluble solids content and titratable acidity, the sweeter the fruit (Borguini & Silva, 2009; Rosales & Cervilla, 2011). Given the results obtained, it can be stated that the differences found in quality are not related to the place of sale, but rather to the time of production.

Vitamin C levels were similar at the marketing sites, with values ranging from 20.41 to 31.12 mg% (Figure 3C). However, the fruits collected in “Pedras” in March had more vitamin C than those sold in Boxes. These results may have been influenced due to the different storage conditions (refrigerated or not), which results in a greater loss of water during this month, added to the high temperatures found in this period of the year.

The vitamin C content is an important parameter of tomato nutritional quality, which according to the Brazilian Table of Food Composition (Nepa, 2011), the average content is 21 mg / 100 g, lower than the one found (Figure 3C). Vitamin C content may be related to the quality of production of a vegetable since the climate, cultivation practices and post-harvest handling are related to this content (Lee & Kader, 2000; Chitarra & Chitarra, 2005).

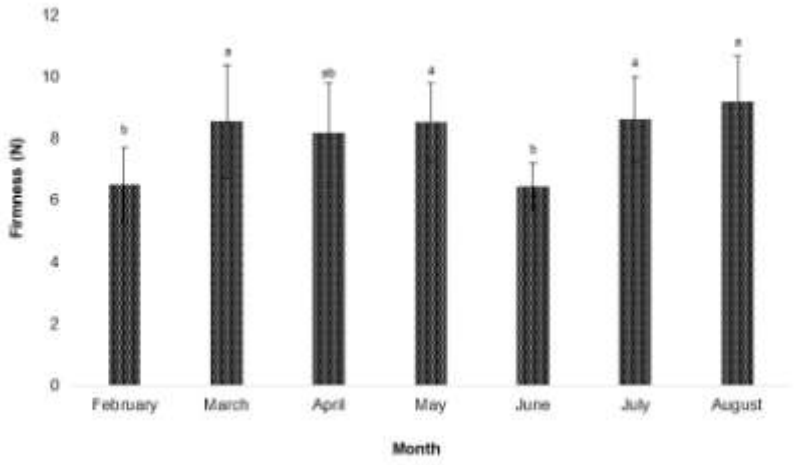

Figure 2. Firmness of long-life tomatoes marketed in different months and places in 2017. Different letters represent differences by Tukey's t-test ($p < 0.05$) when compared the months of fruit collection. Vertical bars represent the ± SD.

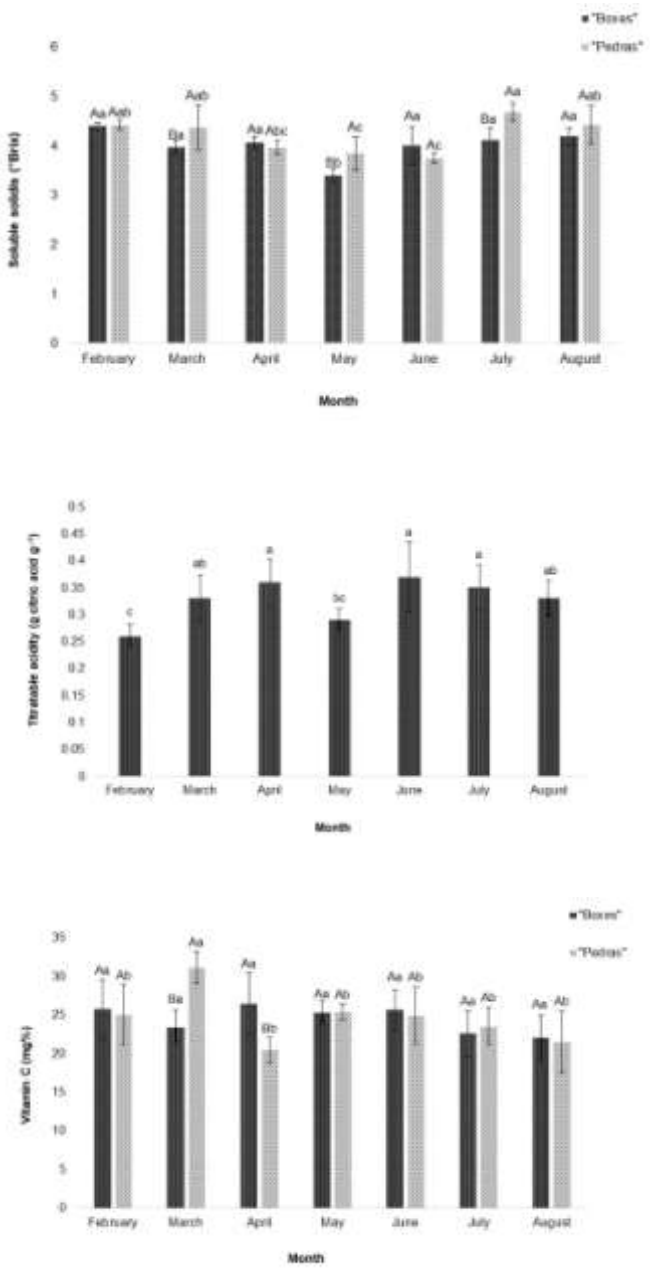

Figure 3. Soluble solids, titratable acidity and vitamin C contents of long-lived tomatoes sold in different months and locations in 2017. Different letters represent significant difference by Tukey's t-test ($p < 0.05$). Upper case letters when comparing the locations ("Boxes" and "Pedras") and lower case letters when comparing the months of fruit collection. Vertical bars represent the ± SD.

Conclusion

It is concluded that long-life tomatoes sold in "Boxes" at CEASA-GO have higher value per basic unit (box of 22 Kg of tomatoes) when compared to those sold at "Pedras". The quality of tomatoes does not influence the final value of the marketed product, so higher marketing price does not mean better quality.

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