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Fruit Physiochemical Characteristics of Acerola (*Malpighia emarginata*) Clones in Commercial Orchards

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Abstract. The selection was carried out within the orchard of FRUCESA, Ceará State, Brazil. The mass selection allowed choosing of 100 desirable plants. Preliminary fruit analysis of 55 plants was performed with the aim of evaluating their quality potential. A 0.5 kg sample of all selected plants fruiting from February to March 1996 was taken, and frozen. The following characteristics were evaluated: total soluble solids (SS), total titratable acidity (TA), pH and vitamin C. Some of the plants evaluated were considered as promising from the quality point of view, because even during the rainy season, they had vitamin C of greater than 1500 mg/100 g and SS higher than 8.0 ◦Brix. Moreover, there was high variability in quality encountered in our orchards currently as well as the efficiency of the methodology employed in the selection experiment.

Resumen. La selección de clones fue hecha en los cultivos de la empresa FRUCESA, en el estado de Ceará, Brasil. La selección permitió la elección de 100 plantas deseables. Fueron hechas análisis preliminares de frutos de 55 plantas seleccionadas, con el objetivo de evaluar la calidad potencial. Para eso, fueron colectados, congelados y almacenados muestras de 0,5 kg de frutos de cada planta seleccionada que estaba frutificando en los meses de febrero y marzo de 1996. Las siguientes características fueran evaluadas: sólidos solubles totales (SS), acidez total titurable (AT), pH y vitamina C. Algunos de los clones evaluadas fueron considerados promisores del punto de vista, de la calidad, ya que, mismo durante el período de lluvias, donde el contenido celular es diluido, presentaron contenidos de vitamina C superiores a 1500 mg/100g y SS arriba de 8,0 °Brix. Además, los resultados encontrados demostran la alta variabilidad de la calidad encontrada actualmente en nuestros pomares, así como la eficiencia de la metodología empleada en el experimento de selección.

Acerola, despite its great commercial potential, still faces many problems caused by the way it was initiated in Brazil. The first orchards were formed basically from seed propagated plants. This leads to heterogeneity of the orchards, segregation of plant and fruit characteristics, and lack of uniformity in productivity and fruit quality (Alves, 1992 and 1996). Modern fruit culture must search for as high yield and fruit quality as possible, always aiming to minimize costs and to increase competiveness, especially if product is to be destined for export market. The potential of acerola as a natural source of vitamin C and for industrial utilization is undeniable. It is however necessary to have a product of uniform quality, which a difficult to achieve with the current commercial orchards in Brazil. It is known that, in the case of acerola seedlings, there is much variation and final product is not uniform (Alves, 1992; Alves and Menezes, 1994a). That means that both productivity (production/plant/year) and fruit quality (color, sugars, acidity, vitamin C) may vary considerably.

For the establishment of new orchards, it is necessary to count on selected genotypes that combine the desirable characteristics of high productivity and high quality of fruits: large weight and number of fruits, big size, color from red to purple, and high vitamin C and soluble solids contents. Within the commercial orchards there is enough genetic variability to make the identification of superior plants. Despite the narrow genetic basis of the original material, the genetic variability of the orchards has been highly enlarged through recombination processes that favor the appearance of new genetic combinations (Paiva *et al.*, 1996). In the present study, preliminary analyzes were carried out on the chemical and physicochemical characteristics of fruits from 55 selected plants from commercial orchards. The objective of this work was to evaluate quality potential of those selected plants and, consequently, to form the basis for selecting superior quality genotypes. The selected plants were cloned, and when mature will undergo comparison with introduced clones from other parts of the country. The most promising as to fruit quality will be evaluated for postharvest storage life.

Materials and Methods

The selection of the acerola trees was done at the commercial orchard of Frutas do Ceará S/A - FRUCESA, located in Jaguaruana county, Brazil, during the first semester of 1995. The planted area was of 100 ha, divided in sixteen sections of about 6.4 ha. The orchard was established from seed-propagated plants introduced from commercial orchards from State of Pernambuco, Brazil. The following criteria were used in the selection of the experimental area: origin of seedling, plant age, uniform crop management; uniform soil; possibility of identification of seed origin. Based on easily visible and measurable characteristics, the method of individual phenotypic selection was used, in an attempt to explore the genetic variability within the population, according to the criteria established and the methodology described by Paiva *et al.* (1996). The selecting area was 83,2 ha, which covers the genetic variability in about 41,600 plants in 13 sections. By October 1995, a hundred plants have been selected. Both sexually and asexually propagated seedling were taken from each selected plant. At present, 69 clones from the selected plants are under test in three different growing areas (Paiva, 1997). Approximately 0.5 kg samples were taken from the 55 out of 100 selected plants which were fruiting during the rainy season (from February 28 to March 20, 1996). Samples were stored at freezing temperature until later analyzes of the following characteristics: total soluble solids (SS), total titratable acidity (TA), pH and total vitamin C.

Table 1. Chemical and physicochemical characteristics of fruits of 55 acerola plants selected from commercial orchard.

Sel. Plants	SS (°Brix)	TA (%)	SS/TA	pH	Vitamin C (mg/100g)
1	6.6	0.970	6.80	3.54**	468.15*
3	6.6	0.843	7.83	3.47	655.41
4	6.1	1.671**	3.65*	3.08*	1544.90
7	6.7	0.979	6.84	3.44	1029.93
8	6.3	1.496	4.21	3.14	1544.90
10	6.3	1.256	5.02	3.26	889.49
12	6.6	0.979	6.74	3.27	889.49
14	5.0*	0.979	5.11	3.31	842.67
15	7.5	1.186	6.32	3.27	795.86
18	8.0	1.533	5.22	3.30	1638.53**
20	7.2	1.262	5.71	3.18	1451.27
21	5.8	0.856	6.77	3.49	702.23
23	5.8	1.152	5.03	3.21	1170.38
24	5.8	1.106	5.24	3.22	842.67
26	6.6	0.866	7.62	3.35	1170.38
27	7.2	1.106	6.51	3.26	1029.93
29	6.4	0.945	6.77	3.28	983.12
30	5.8	1.250	4.64	3.16	1123.56
31	6.4	1.298	4.93	3.23	1076.75
35	6.1	1.098	5.55	3.37	889.49
36	6.3	1.239	5.08	3.15	1029.93
37	6.2	1.142	5.43	3.31	1217.19
38	5.6	0.860	6.51	3.34	795.86
39	6.6	1.100	6.00	3.23	1404.45
48	6.9	0.994	6.94	3.34	1029.93
53	6.9	1.221	5.65	3.28	842.67
54	7.1	1.047	6.78	3.33	1029.93
57	5.8	0.832	6.97	3.35	936.30
58	6.9	1.129	6.11	3.27	1029.93

59	6.9	1.056	6.53	3.34	983.12
60	6.4	0.920	6.96	3.28	936.30
61	6.3	1.149	5.48	3.28	1123.56
62	6.8	1.197	5.68	3.26	1123.56
63	6.5	0.849	7.65	3.51	795.86
64	6.5	1.284	5.06	3.18	1029.93
65	5.9	1.051	5.61	3.19	983.12
66	6.5	0.913	7.12	3.29	749.04
67	6.2	0.862	7.19	3.42	889.49
68	7.0	1.232	5.68	3.29	1451.27
69	6.7	1.435	4.67	3.18	1357.64
70	6.0	0.841	7.13	3.39	795.86
71	6.5	1.087	5.98	3.27	1264.01
72	6.5	1.111	5.85	3.32	1170.38
73	5.8	0.850	6.82	3.38	795.86
74	8.4**	1.244	6.75	3.41	1591.71
75	7.7	1.723	4.47	3.22	1591.71
76	7.9	1.074	7.36	3.36	936.30
77	6.2	1.154	5.37	3.35	1357.64
80	7.4	1.463	5.06	3.10	1170.38
81	7.3	1.392	5.24	3.17	1451.27
82	6.7	0.815	8.22	3.38	1029.93
83	6.5	0.968	6.71	3.35	1076.75
84	7.0	0.935	7.49	3.42	889.49
92	7.0	0.764*	9.16**	3.42	936.30
98	6.5	0.931	6.98	3.40	936.30
M ±	**6.59 ± 0.63**	**1.104 ± 0.22**	**6.15 ± 1.10**	**3.30 ± 0.10**	**1063.13 ± 262.78**

* Minimum - ** Maximum

Results and Discussion

On the average, SS (Table 1) is a little below the average of commercial orchards, which are usually 7.0 ◦Brix (Alves e Menezes, 1994a; Alves et al. 1995; Alves, 1996). Fruit size, soluble solids, total acidity and vitamin C lack of uniformity in Brazilian orchards. They are influenced by environmental factors, especially excessive rainfall (Alves, 1996) that causes SS and vitamin C contents to go down to 5.0 ◦Brix and 800 mg/100 g, respectively. These may explain the results reported in this paper. Nevertheless, some of the genotypes analyzed were quite promising because even during the rainy season, while cell juice is diluted, vitamin C content was above 1500 mg/100g and soluble solids above 8.0 ◦Brix. Among the plants analyzed, 18.2% produced fruits with more than 7.0 ◦Brix and 54.5%with more than 1000mg/100g (Table 1); the average figures in Brazilian orchards. Acerola plant selection has been conducted in USA (Florida and Hawaii) and Puerto Rico, which resulted in the selection of several varieties and clones with desirable characteristics as related to plant height, fruit size, vitamin C content and sugars. In Puerto Rico, Jackson and Pennock (1958), while evaluating clones of acerola plants aged between five and six years, found vitamin C contents from 1580 to 2600 mg/100g of ripe fruits, well above the Brazilian average. The results reported in this paper show that if selection is made it is possible to reach the previous figures. This statement is supported by Alves and Menezes (1994b), who reported an increase in fruit SS and vitamin C content when the producer selected plants for new plantings within his own seed propagated orchard. The correlation analysis (Table 2) revealed that titratable acidity is one of the main characteristics to identify fruit taste and has a highly significant correlation with SS/TA ratio. This was not found for SS. Therefore sweet or sour tastes in acerola fruits correlate best with low or high acid content and not with SS.

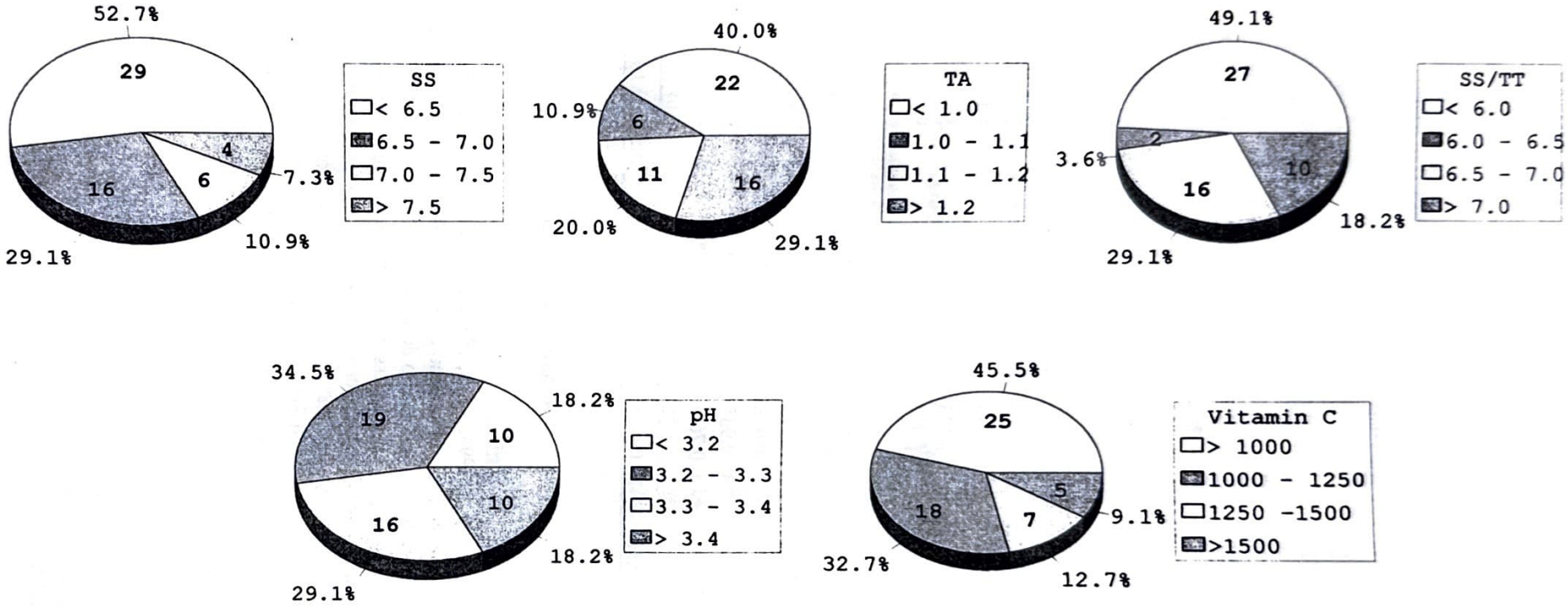

Figure 1. Frequency distribution of chemical and physicochemical characteristics evaluated in fruits of 55 acerola plants selected from commercial orchards.

Another important remark is that the more acidic fruit are higher in vitamin C. The taste classification made in field (Paiva, 1997), that indicated 33.3% acidic fruits and 7.1% sweet fruits, did not correspond to the results of chemical and physicochemical analysis, since more than 50% of the samples had SS/TA ratio > 6.0 and 49.1% had TA > 1.1 (Figure 1). These figures are characteristic of acidic acerola fruit (Alves, 1993; Alves *et al.*, 1995).

Table 2. Correlation matrix of chemical and physicochemical characteristics evaluated in fruit of 55 acerola plants selected from commercial orchards.

Factor	SS	TA	SS/TA	pH
TA	0.362**	-		-
SS/TA	0.142ns	-0.847**	-	-
pH	0.002ns	-0.728**	0.771**	-
Vitamin C	0.405ns	0.732**	-0.534**	-0.542**

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