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Evaluation of Four Mango Cultivars for Nectar[1]

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ABSTRACT

Mangoes of the Irwin, Edward, Palmer, and Keitt varieties were evaluated as to their quality for nectar. The pulp yields were 75.07, 76.85, 73.23, and 78.95%; and the soluble solids were 16.0, 21.2, 20.5 and 21.5° Brix, respectively. The quality of the canned nectars stored for as long as 12 months under ambient conditions was acceptable. Compared to the nectars of the other three varieties the variety of Keitt nectar was inferior in quality during the first three months and at the end of the study. During intermediate periods nectars from the Palmer and the Edward cultivars were superior.

INTRODUCTION

Mangoes (*Mangifera indica* L.) are very well adapted to the warm climate of the tropics. In Puerto Rico there are two common varieties; the Mayagüezano, so named for the region where it grows, Mayagüez, in the west of the Island; and the Pasote, so named for its typical flavor. The fruits are mainly utilized as fresh fruits, although some Mayagüezano mangoes are processed into mango bars. Both varieties grow wild and their fruits are very fibrous. Sánchez-Nieva et al. (6) prepared high quality nectars of the Mayagüezano variety. Brekke et al. (2) also describe the preparation of a mango nectar from the Haden cultivar.

The Agricultural Experiment Station has introduced a large number of attractively-colored mango varieties of good size and quality, and is trying to promote the establishment of commercial orchards. Among these varieties are the Palmer, Edward, Irwin, and Keitt cultivars. The fruits of these varieties are almost fiberless.

No information has been found about the preparation, stability and quality of nectars from these varieties. This work was undertaken as part of the evaluation of these cultivars.

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MATERIALS AND METHODS

The fruits used in this study were harvested mature green, from an experimental orchard at the Fortuna Substation of the Agricultural Experiment Station, located on the southern coast of Puerto Rico. The fruits were treated with hot water as described by Pennock et al. (5) and allowed to ripen in ambient conditions.

Only ripe mangos were used for pulping. The fruits were steamed for 5 minutes at 93.3° C in a continuous steam scalder and then fed into an E-Z Adjust Pulper[3] as described by Benero and Rodriguez (1). A 5-minute holding time was used in the steam scalder because of the large size of the fruits. After the fruits were pulped the purees were frozen and stored at −23.3° C until used.

Nectars of 25% pulp, 15° Brix and pH 3.7 were prepared from the thawed pulp after it was polished through a 0.05 cm screen finisher. The pH was standardized to a value of 3.7 with citric acid. The nectars were flash-pasteurized at 85.0–87.5° C for 45 sec, poured into 213 ml plain tin cans, closed, water cooled, air dried, and stored at room temperature.

The quality of chilled canned samples of nectars of each variety was assessed about 15 days after preparation and up to 1 year in storage by a 10–15 member tasting panel, who used a +2, −2 scale where +2 was very acceptable and −2 not acceptable. The samples of the four varieties were ranked in preference periodically during the study by the same panel and rank sum analyses were done as described by Kramer (3).

Samples of the four nectars were analyzed periodically (every other month) for soluble solids, pH, total acidity, sugars, vitamin C, and color. Soluble solids were determined as °Brix with an Abbé type refractometer; pH was determined by the glass-electrode method (4). Total acidity, as citric acid, was determined by a potentiometric titration (4). Total and reducing sugars were determined by the Lane and Eynon method (4). Vitamin C was determined by the 2.6 dichlorophenol titration method (4). Color measurements were done with a Hunterlab Model D 25 color and color-difference meter with a standard yellow tile ($L = 74.5$, $a = 5.8$, $b = 43.0$).

RESULTS AND DISCUSSIONS

Table 1 shows the composition of the fruits and some properties of the pulp. Two outstanding findings were revealed; the remarkable pulp yield of all four varieties and the high soluble solids of the pulps. In all cases, the pulp yields were well over 70% of the whole fruit, as compared to about 53% for the Mayagüezano variety, as reported by Sánchez Nieva et

[3] Trade names in this publication are used only to provide specific information. Mention of a trade name does not constitute a warranty of equipment or materials by the Agricultural Experiment Station of the University of Puerto Rico, nor is this mention a statement of preference over other equipment or materials.

al. (6) and Benero and Rodríguez (1). Edward, Palmer and Keitt are very sweet fruits with degrees Brix of 21.2, 20.5, and 21.5 respectively. Even Irwin, not as sweet, with a 16° Brix, has more soluble solids than the Mayagüezano, Redondo, and Pasote mangoes, as reported by Sánchez-Nieva et al. (6).

Table 2 shows the results of the chemical and physical analyses of the nectars. The most noticeable change during storage occurred in the

TABLE 1.—*Fruit size, pulp yields, and composition of pulp*

Variety	Mean fruit weight	Pulp recovered	Pulp moisture	Pulp total solids	Pulp soluble solids °Bx
	g	%	%	%	
Irwin	259.14	75.07	84.35	15.65	16.0
Edward	421.33	76.85	78.98	21.02	21.2
Palmer	451.81	73.23	78.89	21.11	20.5
Keitt	586.66	78.95	77.58	22.42	21.5

TABLE 2.—*Chemical and physical analyses of mango nectars during storage*

Variety	Days in storage	°Brix	pH	Total acidity	Reducing sugars	Total sugars	Color			Ascorbic acid
							L	*a*	*b*	
				%	%	%				*mg/100 ml*
Keitt	Fresh	15.0	3.85	0.190	1.53	14.90	39.50	1.46	22.72	Traces
	60	15.2	3.80	.199	2.75	15.76	38.01	.83	21.05	Traces
	120	15.2	3.82	.195	4.17	14.60	47.20	3.74	27.96	None
	180	15.4	3.81	.194	5.35	14.83	—	—	—	
	240	15.3	3.80	.200	6.44	14.59	46.36	4.31	27.41	
	300	15.4	3.85	.183	6.81	14.32	48.11	4.77	28.82	
	360	15.5	3.81	.190	8.24	14.63	48.58	5.60	29.17	
Palmer	Fresh	15.8	3.80	0.173	1.41	15.98	44.49	5.75	28.86	2.88
	60	16.5	3.78	.183	2.71	16.83	44.94	6.15	28.75	1.13
	120	16.4	3.78	.182	4.43	15.82	46.78	7.03	30.63	1.24
	180	16.7	3.73	.186	5.71	16.24	—	—	—	Traces
	240	16.5	3.75	.170	6.12	14.62	45.72	6.91	29.26	None
	300	16.6	3.79	.173	7.66	15.58	46.26	7.18	29.68	
	360	16.5	3.75	.178	8.65	15.78	45.81	7.77	29.32	
Edward	Fresh	15.5	3.76	0.209	1.04	15.15	48.85	4.02	30.82	7.43
	60	15.2	3.76	.213	2.44	15.47	54.13	6.00	33.72	3.93
	120	15.3	3.78	.213	3.94	15.19	55.19	6.75	34.86	3.16
	180	15.8	3.80	.215	5.18	15.23	—	—	—	Traces
	240	15.5	3.75	.200	6.43	16.13	52.84	7.12	33.14	None
	300	15.5	3.80	.202	7.08	14.34	54.69	6.81	34.56	
	360	15.6	3.78	.210	8.76	14.56	54.55	7.29	34.41	
Irwin	Fresh	15.2	3.78	0.159	1.67	15.81	45.56	3.10	29.38	4.83
	60	14.8	3.77	.159	2.73	15.80	45.36	2.15	28.64	.51
	120	15.2	3.78	.159	4.28	14.96	49.08	1.81	31.86	Traces
	180	15.4	3.74	.157	5.51	15.17	—	—	—	None
	240	15.3	3.77	.150	6.23	14.73	48.57	1.56	31.02	
	300	15.2	3.80	.149	7.21	14.64	47.65	1.96	30.22	
	360	14.9	3.79	.150	8.33	14.71	47.76	2.15	30.38	

reducing sugars, which rose from 1-2% to a 7 or 8% at the end of the study period. This was an expected change which happens in all fruit nectars, because of the inversion of sucrose.

The small amounts of vitamin C remaining after pasteurization in Palmer, Edward, and Irwin nectars decreased sharply. Four months later, only negligible traces could be detected. The nectar of the Keitt variety

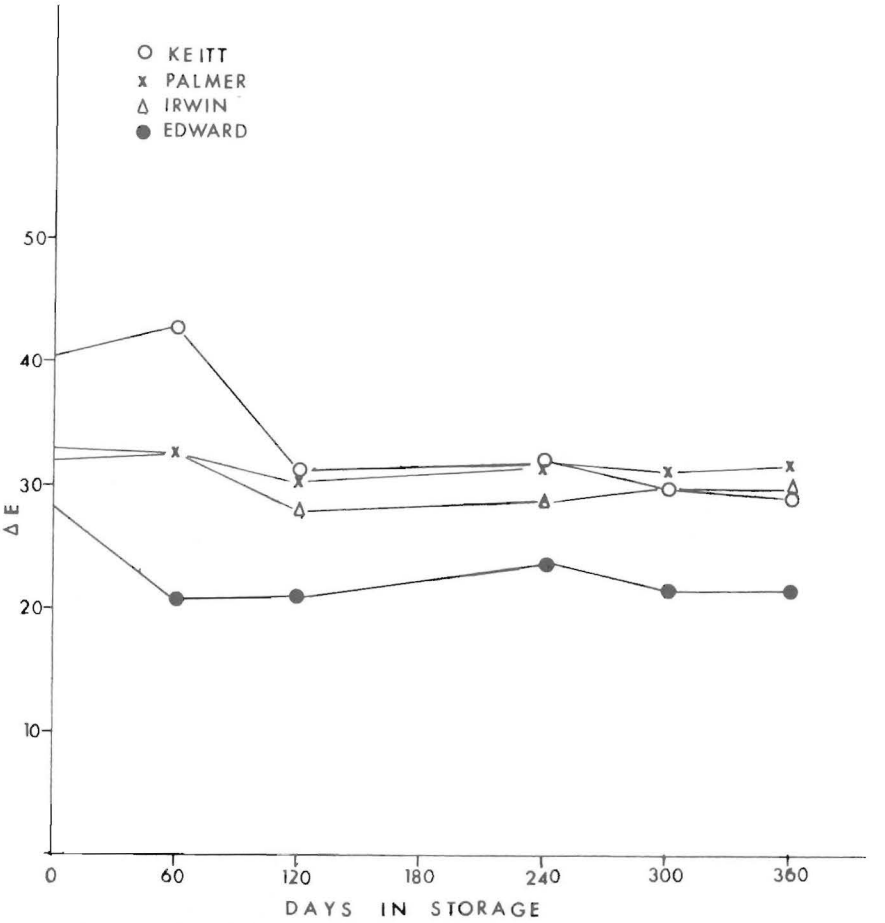

FIG. 1.—Color difference values (ΔE) of the different nectars during storage.

was completely devoid of vitamin C after pasteurization, because of the very small original amount of this vitamin in the pulp.

The L values in table 2 show that the nectars changed little in color after the second or third month in storage. When the total color difference $\Delta E = \sqrt{(\Delta L)^2 + (\Delta a)^2 + (\Delta b)^2}$ was calculated and plotted (fig 1) the curves indicated the same thing, but it is more evident that there is a

TABLE 3.—*Quality of mango nectars when fresh and after 12 months*

Variety	Fresh score	Rating	12 months score	Rating
Keitt	0.6[1]	Acceptable	1.1[1]	Acceptable
Palmer	1.2	Acceptable	1.5	Between acceptable and very acceptable
Edward	1.0	Acceptable	1.1	Acceptable
Irwin	1.2	Acceptable	1.2	Acceptable

[1] (+2, −2 scales; +2 very acceptable; +1 acceptable; 0 questionable, −1 slightly unacceptable; −2 not acceptable).

TABLE 4.—*Ranking evaluations of mango nectars during storage*

Days in storage	Variety	Tasters	Sums of ranks	Totals required for significant difference	Comments
		Number			
Fresh	Keitt	16	56		Keitt is inferior
	Palmer	16	26	5% ($p < 0.05$) 30–50	Palmer is superior at 1%
	Edward	16	39	1% ($p < 0.01$) 28–52	Edward and Irwin no significant difference
	Irwin	16	39		
90	Keitt	8	28		Keitt is inferior at 5%
	Palmer	8	20	5% ($p < 0.05$) 13–27	Edward is superior at 5%
	Edward	8	12	1% ($p < 0.01$) 11–29	Palmer and Irwin no significant difference
	Irwin	8	20		
120	Keitt	10	31		No significant difference
	Palmer	10	19	5% ($p < 0.05$) 17–33	among the four nectars
	Edward	10	25	1% ($p < 0.01$) 15–35	
	Irwin	10	25		
240	Keitt	10	20		No significant difference
	Palmer	10	18	5% ($p < 0.05$) 17–33	among the four nectars
	Edward	50	50	1% ($p < 0.01$)	
	Irwin	10	32		
300	Keitt	9	27		Palmer is superior at 1%
	Palmer	9	12	5% ($p < 0.05$) 15–30	No significant difference
	Edward	9	22	1% ($p < 0.01$) 13–32	among the other three
	Irwin	9	29		nectars.
360	Keitt	8	19		Irwin is inferior at 5%
	Palmer	8	15	5% ($p < 0.05$) 13–27	No significant difference
	Edward	8	18	1% ($p < 0.01$) 11–29	among the other three
	Irwin	8	28		nectars

stabilization period of about 2 or 3 months. During this period, all nectars suffered some kind of change, but the Keitt nectar suffered a marked change in one direction, which later reversed itself to become similar in color to the other varieties.

Table 3 shows that the quality of the nectar was good through the long period in storage. The low score when fresh, but still acceptable, for the Keitt nectar was due to a darkening during the stabilization period, which

later reverted to a lighter color. The nature of the reactions which produced the marked change in color of this nectar was not determined. The darkening of this nectar when fresh, may be due to the absence of vitamin C to react with the dissolved oxygen in the nectar so as to protect it from other oxidative reactions.

Ranking of the nectars corroborates the change in color of variety Keitt (table 4), where it ranked inferior during the first 3 months of storage. Palmer and Edward ranked superior at the fresh and 3-month period, respectively. From the fourth month on, no significant difference was noted among the four varieties until up to the tenth month when Palmer was ranked superior. At the end of the storage period Irwin and Keitt were ranked inferior.

RESUMEN

Mangos de las variedades Irwin, Edward, Palmer y Keitt se evaluaron en cuanto a su calidad para la preparación de néctares. El rendimiento de pulpa fue de 75.07, 76.85, 73.23 y 78.95 por ciento; y los sólidos disueltos fueron de 16.0, 21.2, 20.5 y 21.5 grados Brix, respectivamente. La calidad de los néctares enlatados se mantuvo aceptable por un período de almacenamiento de 12 meses en condiciones ambientales. El néctar de la variedad Keitt resultó ser inferior a los de las otras variedades durante los primeros tres meses. Al finalizar el período de estudio (I año), el néctar de la variedad Irwin resultó ser inferior. En períodos intermedios los néctares de las variedades Palmer y Edward resultaron ser superiores.

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