Provitamin A and Vitamin C Contents of Several Varieties of Mango (*Mangifera Indica* L.) Grown in Puerto Rico

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INTRODUCTION

Mango (*Mangifera indica*, L.) is a tropical fruit of high nutritive value as a good source of vitamins A and C (*1,2,3*)[2]. In Puerto Rico, this fruit grows and shows great adaptability to our warm climate (*4*). The most common varieties grown are the Mayagüezano and Pasote (*5*).

The Agricultural Experiment Station of the University of Puerto Rico has introduced a large number of mango varieties suitable for the fresh market and for processing. As part of these studies, the composition of the varieties grown on the experimental farm at the Fortuna Substation on the Southern Coast of Puerto Rico was determined. This paper presents the data obtained from the analyses of 30 varieties.

REVIEW OF LITERATURE

The vitamin A and vitamin C contents of the mango vary with the origin of the fruit. Indian varieties are reported to contain 12.19 to 42.39 mg. of vitamin A and 13.2 to 80.3 mg. of vitamin C per 100 g. of pulp (*3*). For the Bombay varieties, contents of 6.0 mg. of β-carotene and 10.5 mg. of ascorbic acid per 100 g. of pulp are claimed (*3*). Ascorbic acid values for Florida mangos are reported to range from 5.4 to 19.7 mg. per 100 g. (*6*). Twenty-six West Indian varieties varied in their vitamin C content from 9.3 to 130.81 mg. per 100 g. of pulp (*3*).

MATERIALS AND METHODS

Samples of 30 varieties of mango were picked at random at a full-ripe stage, weighed, hand-peeled, and the proportions of peel, pulp, and seed determined. For analyses, the pulp was homogenized in a blender for 5 minutes. Moisture, total solids, insoluble solids, refractometric solids as ° Brix, total and reducing sugars, vitamin C, β-carotene, pH, and total titratable acidity as citric acid were determined in the homogenate. Moisture and

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[2] Italic numbers in parentheses refer to Literature Cited, pp. 104–5.

total solids were determined by the vacuum-oven method (*7*), and soluble solids were measured as ° Brix with an Abbé-type refractometer. Total and reducing sugars determinations were performed by the Lane and Eynon method (*8*). Column chromatography was used for the β-carotene determinations (*9*). Ascorbic acid was determined by Ballantine's method

TABLE 1.—*Peel, pulp, and seed content of several varieties of mango*

Variety	Fruits	Average weight of fruits	Peel	Pulp	Seed
	Number	*Grams*	*Percent*	*Percent*	*Percent*
Edward	18	444.53	12.73	73.53	13.71
Keitt	19	494.42	12.05	69.88	18.28
Springfels	7	653.18	10.87	68.48	20.65
Parvin	—	—	8.75	66.25	25.00
Palmer	10	453.60	10.41	65.63	25.08
Davis Haden	19	467.28	10.00	65.00	22.50
Zill	30	226.80	13.33	65.00	20.00
Florigon	16	276.70	15.38	64.10	20.51
Kent	17	535.25	10.00	62.50	28.00
Early Gold	127	272.16	18.75	61.58	18.64
Eldon	10	267.62	12.74	60.78	26.47
Carrie	18	281.23	15.89	60.74	23.30
Succidoro	27	325.60	16.25	60.00	22.50
Ruby	39	181.44	11.29	59.68	29.03
Irwin	33	263.09	18.44	57.89	23.68
Julie	10	263.09	15.88	57.14	25.97
Stringless Peach	21	199.58	13.51	56.76	29.73
Bombay Yellow	29	127.01	12.50	56.25	31.25
Haden	35	290.30	16.85	56.18	25.84
Santaella	26	181.44	15.07	56.16	28.77
Adams	55	131.54	17.12	54.79	28.82
Paheri	30	240.41	17.46	53.97	25.40
Jacquelin	19	376.49	14.29	53.97	23.81
Lippens	35	244.94	17.11	53.95	26.32
Pillsbury	27	195.05	17.39	52.17	30.44
Lathrop	103	140.61	16.41	50.78	33.59
Francisque	23	335.66	19.12	50.50	30.88
Corne	42	149.69	23.64	32.73	40.00

(*10*), and pH was measured by the A.O.A.C. glass-electrode method (*7*). Total titratable acidity as citric acid was determined by a potentiometric titration with 0.1 N NaOH standard solution (*7*).

RESULTS AND DISCUSSION

The peel, pulp, and seed contents for the 30 varieties studied are given in table 1. The Edward, Keitt, and Springfels have the highest pulp content,

averaging 73.53, 69.88, and 68.48 percent, respectively. It should be noticed that even though the Springfels produces the largest fruit, with an average weight of 653.13 g., its yield of pulp is only 68.48 percent, which is much lower than for the Edward, the average of which is 73.53 percent. From the standpoint of yield of pulp, these three varieties would be the choice for processing. However, since the overall processing characteristics of these varieties were not studied, further work must be conducted prior to any final selection of fruits for processing.

Values for the chemical analyses performed are given in tables 2, 3, and 4. The varieties have been arranged in three groups according to the β-carotene content. In table 2 are listed the varieties providing the minimum

TABLE 2.—*Chemical composition of different varieties of mango* (**Mangifera indica, L.**) *with β-carotene ranging from 5,000 to 8,000 I.U./100 g. of pulp*[1]

Variety	β-carotene	Vitamin C	°Brix	pH	Total acidity[2]	Reducing sugars	Total sugars	Moisture	Total solids	Insoluble solids	Pulp content
	I.U./100 g.	*Mg./100 g.*			*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Carrie	7,900	45.69	18.4	4.10	0.44	3.52	14.52	81.25	18.25	0.35	60.74
Palmer	7,167	20.14	19.8	4.38	.24	4.51	16.63	77.93	22.07	2.27	65.63
Paheri	6,283	4.64	18.0	4.58	.20	4.95	16.15	80.30	19.70	1.70	53.97
Adams	6,167	8.78	18.1	4.25	.34	3.70	15.55	81.23	18.77	.67	54.79
Zill	5,480	9.99	19.5	4.01	.38	4.06	15.35	80.08	19.92	.42	65.00
Edward	5,200	38.12	19.5	4.35	.32	4.32	16.48	80.24	19.76	.26	73.53
Sensation	5,067	24.89	18.2	4.34	.16	3.95	14.80	81.01	18.99	.72	—

[1] Each figure represents the computed mean of 2 replicates. I.U. = International Unit.

[2] Expressed as percent citric acid.

daily requirement (MDR) of 5,000 I. U. of vitamin A (*11*) per 100 g. of pulp; in table 3 those containing from 2,500 to 4,000 I. U. per 100 g. of pulp; and in table 4, those with the lowest β-carotene content, ranging from 400 to 2,500 I. U. per 100 g. The Carrie had the highest β-carotene content with 7,900 I. U. per 100 g., while the Stringless Peach had the lowest with 417 I. U. per 100 g. of pulp.

The ascorbic acid content ranged from 3.43 to 62.96 mg. per 100 g. of pulp, with the Julie variety showing the highest content and the Keitt variety the lowest. The minimum daily requirement of 75 mg. of vitamin C (*11*) would be surpassed by 200 g. of pulp from the Julie and the Francisque varieties.

The soluble-solids content for all varieties ranged from 14.6 to 23.1 ° Brix, the Julie variety having the highest and the Bombay Yellow the lowest (table 3). The acidity varied from a pH of 4.53 in the Succidoro to a pH of 3.25 in Pillsbury. The varieties having the highest and lowest contents of

TABLE 3.—*Chemical composition of different varieties of mango* (**Mangifera indica, L.**) *with β-carotene ranging from 2,500 to 4,000 I.U./100 g. of pulp*[1]

Variety	β-carotene	Vitamin C	°Brix	pH	Total acidity[2]	Reducing sugars	Total sugars	Moisture	Total solids	Insoluble solids	Pulp content
	I.U./100 g.	*Mg./100 g.*			*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
Pillsbury	4,250	11.87	16.9	3.25	0.46	3.43	14.04	82.33	17.67	0.77	52.17
Bombay Yellow	4,217	11.31	14.6	3.98	.40	4.65	11.95	—	—	—	56.25
Toledo	4,133	20.92	20.9	4.30	.42	7.82	18.15	78.52	21.48	.58	—
Santaella	3,983	15.77	18.4	3.80	.55	6.86	15.94	78.18	21.82	3.42	56.16
Early Gold	3,600	26.42	16.3	3.87	.40	3.80	14.48	82.19	17.81	1.51	61.58
Eldon	3,533	16.27	18.4	4.40	.21	9.56	16.03	81.10	18.90	.50	60.78
Julie	3,250	62.96	23.1	4.34	.25	3.42	18.11	62.53	37.47	14.37	57.14
Irwin	3,150	37.14	15.3	4.03	.28	6.37	13.76	83.11	16.89	1.59	57.89
Francisque	2,933	52.14	16.5	4.33	.17	4.14	14.21	83.04	16.96	.46	50.50
Succidoro	2,917	37.95	16.9	4.56	.22	6.52	14.30	82.19	17.81	.91	60.00
Jacquelin	2,883	5.76	16.2	4.45	.24	2.52	13.29	81.13	18.87	2.67	53.97
Ruby	2,833	9.25	16.3	3.90	.58	4.30	14.13	80.05	19.95	3.65	59.68
Lippens	2,817	17.68	16.4	4.40	.30	5.05	14.78	81.46	18.54	2.14	53.95
Lathrop	2,667	25.50	21.2	3.85	.60	4.45	18.75	75.41	24.59	3.39	50.78

[1] Each figure represents the computed mean of 2 replicates.

[2] Expressed as percentage citric acid.

TABLE 4.—*Chemical composition of different varieties of mango* (**Mangifera indica, L.**) *with β-carotene ranging from 400–2,500 I.U./100 g. of pulp*[1]

Variety	β-carotene	Vitamin C	°Brix	pH	Total acidity[2]	Reducing sugars	Total sugars	Moisture	Total solids	Insoluble solids	Pulp content
	I.U./100 g.	*Mg./100 g.*			*Percent*	*Percent*	*Percent*	*Percent*	*Percent*	*Per cent*	*Percent*
Corne	2,467	45.17	20.8	4.15	0.46	9.96	16.55	75.16	24.84	4.04	32.73
Haden	2,367	14.96	14.8	4.10	.37	3.72	12.75	83.18	16.82	2.02	56.18
Springfels	2,267	22.59	16.2	4.16	.37	3.13	13.20	—	—	—	68.48
Kent	1,950	26.34	16.9	3.35	.57	4.66	14.18	79.36	20.64	3.74	62.50
Davis Haden	1,900	4.01	19.0	4.25	.22	2.78	15.25	—	—	—	65.00
Florigon	1,750	23.50	17.8	3.86	.29	4.92	14.66	81.75	18.25	.45	64.10
Keitt	1,300	3.43	15.5	3.55	.50	4.77	12.98	81.01	18.99	3.49	69.88
Stringless Peach	417	22.81	16.6	4.38	.18	3.47	14.35	—	—	—	56.76
Parvin	—	6.92	15.5	4.15	.27	4.97	13.88	82.40	17.60	2.10	66.25

[1] Each figure represents the computed mean of 2 replicates. I.U. = International Unit.

[2] Expressed as percent citric acid.

total acidity were the Lathrop and the Sensation with 0.60 and 0.16 percent, respectively. The Lathrop had the highest total sugar content, with 18.75 percent, and the Bombay Yellow the lowest with 11.95 percent.

Six samples of the 30 varieties analyzed in the first test were studied

again a year later. Although some differences were found in the composition when compared with previous values, these variations were probably due to differences in the degree of ripeness of the fruit when harvested.

SUMMARY

The chemical composition of 30 mango varieties from the Fortuna Substation in the Southern Region of Puerto Rico was studied. The proportion of peel, pulp, and seed, as well as the moisture content, total and soluble solids, ascorbic acid, total and reducing sugars, pH, total titrable acidity, and β-carotene were determined for each variety.

Of these varieties, the Edward gave the highest pulp yield; and the Julie and the Francisque had the highest vitamin C values, providing the MDR with 200 g. of pulp. The Carrie, Palmer, Paheri, Adams, Zill, Edward, and Sensation surpassed the MDR of 5,000 I.U. for vitamin A, with the Carrie showing the highest with 7,900 I. U. per 100 g. of pulp.

Six of these varieties were again analyzed the following year. The resulting differences between the same varieties in the 2 years that they were analyzed could be attributed to an error in the visual evaluation of the degree of ripeness of the fruit at harvesttime.

RESUMEN

Se estudiaron 30 variedades de mangó cosechadas en la Subestación de Fortuna en la Región Sur de Puerto Rico, para determinar la proporción de semilla, cáscara y pulpa, y analizar el contenido de humedad, los sólidos solubles y totales, la vitamina C, las azúcares totales y reductoras, el pH, la acidez total y el β-caroteno.

De las variedades estudiadas la Edward dio el mayor rendimiento de pulpa; la Julie y la Francisque revelaron poseer el mayor contenido de vitamina C, proveyendo el requisito mínimo diario (MDR) con 200 g. de pulpa; y la Carrie, Palmer Paheri, Adams, Zill, Edward, y Sensation sobrepasaron el requisito mínimo de 5,000 U. I. de vitamina A por cada 100 g. de pulpa, siendo la Carrie la de mayor contenido con 7,900 U. I. por cada 100 g.

Seis de estas variedades fueron analizadas nuevamente el siguiente año. Las diferencias que se encontraron entre los resultados de los dos análisis de las muestras de la misma variedad, podrían atribuirse a un error en la evaluación visual del grado de madurez de la fruta al cosecharse.

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