

## FRUITS AND FRUIT PRODUCTS

## Part VI.—Evaluation of Certain Seasonal Fruits of East Pakistan for Industrial Uses

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Twenty-four varieties of fruits of East Pakistan have been studied. Percentages of proteins, fats, fibre, reducing sugars, pentose, pectin, vitamin C, and inorganic elements such as calcium, sodium and potassium have been determined. Experiments have also been performed to assess their suitability for juices, syrups, jams, jellies, morabbas, haluas and other valuable food products.

## 1. Introduction

In East Pakistan fruits grow in different seasons. The harvest periods in some cases are very short with variable crop yields. The result is that there is often a glut in the market and consequent deterioration and wastage. In order to prevent such happenings, there should be attempts to handle the fruits in a proper way for storage as well as to preserve them by some means or the other. Such processes demand full knowledge of these fruits in all respects, botanical, chemical and biological. We collected the fruits as the seasons came, selected varieties from a fruit and analysed them according to the standard procedures or procedures modified to suit the purpose. Many fruits of importance have thus been previously subjected to critical studies.<sup>1-5</sup> The present paper relates to another series of fruits.

The varieties in size and quality of the fruit gave somewhat average values characteristic of each fruit. The quality of the fruit was not only judged by the visual characteristics of colour, appearance and maturity, but also by actual tasting. The organoleptic response from different persons made such evaluations easier. Some twenty-four fruits from the Dacca markets were used for analysis during the last half-year period. The analysis was carried out in a very methodical way in all cases, so that the changes in fruits were kept at a minimum.

## 2. Experiments and Discussion

The fruits are collected from the local markets as the seasons come and their edible portions are subjected to analysis as fresh as possible. Protein, fat, fibre, reducing sugar and pentose have been determined according to the methods of A. O. A. C.<sup>6</sup> Pectin has been estimated by the modified method of Carre and Haynes.<sup>7</sup> For the estimation of vitamin C, titrimetric method<sup>8</sup> has been followed.

As for the analysis of inorganic elements, iron and phosphorus have been estimated colorimetrically,<sup>9</sup> calcium volumetrically<sup>10</sup> and sodium and potassium gravimetrically.<sup>11</sup>

As to the proximate analysis, moisture content in a fruit is quite high, it invariably falls in the range of 80-90% with a few in the range 70-80%. In the latter, we got the only fruit called 'bael,' both green and ripe. From Table 1, it is clear that other important constituents, viz., protein, fat, fibre, reducing sugar and pectin ranges

TABLE 2.—ANALYSIS OF THE ASH OF THE FRUITS (CALCULATED ON ASH BASIS).

Serial No. of fruits of Table 1	Ash *	Na <sub>2</sub> O	K <sub>2</sub> O	CaO	P <sub>2</sub> O <sub>5</sub>	Fe <sub>2</sub> O <sub>3</sub>
1	2.11	Trace	36.50	11.26	9.76	1.08
2	5.32	—	—	2.89	7.31	0.43
3	7.91	0.51	38.04	9.37	8.10	0.12
4	5.83	0.41	37.5	4.56	3.92	0.29
5	3.10	0.11	66.77	7.89	11.48	1.38
6	4.01	—	—	14.36	7.40	0.72
7	2.23	0.90	80.7	13.18	8.20	3.04
8	2.92	1.11	38.7	5.75	8.59	3.42
9	4.41	1.21	33.33	6.98	12.97	1.42
10	2.22	0.11	45.04	19.50	20.63	0.63
11	7.20	2.11	30.89	3.08	4.88	0.40
12	4.15	0.12	49.21	1.40	3.75	0.61
13	5.98	0.41	38.97	0.92	3.98	0.52
14	8.50	0.23	48.31	4.20	8.39	0.80
15	1.35	0.15	53.10	3.01	6.21	0.68
16	3.90	2.19	39.82	2.95	10.61	0.33
17	3.92	2.08	51.82	2.08	6.80	0.48
18	6.05	3.10	55.78	11.63	7.01	0.12
19	4.50	1.33	55.68	1.21	9.99	0.03
20	4.00	14.48	15.32	5.60	8.01	0.14
21	5.00	0.95	48.81	8.01	12.24	0.03
22	3.72	1.52	57.91	13.54	12.91	0.17
23	3.21	10.95	14.02	5.06	14.22	0.04
24	2.44	1.09	51.29	13.05	16.98	0.45

\*Calculated on dry weight basis of original fruits.

from 2.1 to 18.0%, 1.0 to 10.11%, 2.3 to 22.8%, 2.4 to 65.1% and 9.5 to 46.2%, respectively. Vitamin C content varies from 508 to 41 mg. %. Table 2 represents the mineral contents of the fruits calculated on ash basis. It is apparent that potassium, calcium and phosphorus contents of all fruits are good, and vary from 14.0 to 80.7%, 12 to 19.5%, and 3.9 to 20.6%, respectively; but sodium and iron contents are low and vary from 0.12 to 14.48% and 0.03 to 3.42%, respectively. Of the nutrients, vitamin C draws our particular attention. It was very carefully determined, vitamin C contents of amlaki, green papaya, pineapple, pomelo, limes (kagazis) and oranges are very noteworthy. The spectacular findings relate to amlaki which has the highest quantities of vitamin C. Our experiments over a period of four years established the seasonal variation of this fruit in vitamin C contents contaminated by tannins. Considerable efforts in such a period resulted in successful

removal of tannins by three agents, gelatin, resin and also pectinaceous materials.<sup>12</sup> Moreover, in several experiments we removed just the astringent quantity of tannins and concentrated the juice for various types of syrup making.

Our determinations indicated loss of vitamin C but we kept them to a minimum. Concentrates in syrups<sup>13</sup> with as high as 450-680 mg./per cent were also obtained. The beverages<sup>14</sup> were also enriched in vitamin C by such extracts. The residual pulp was used for morabba, halua and other valuable products. The seed oil was also isolated and found to be good for soap-making. The pectin, and acid contents in the fruits<sup>8-13</sup> (Table 1) gave us clues for jam and morabba making. The jams<sup>15</sup> of papaya, bael, sapeta, guava, kadbael were profitably made. The morabba of green papaya, bael and pomelo peels, and amlaki were quite luscious. One outstanding

TABLE 1.—PROXIMATE ANALYSIS OF THE SEASONAL FRUITS (CALCULATED ON DRY WEIGHT BASIS).

Local name	Botanical name	Water g.	Ash g.	Protein g.	Fat g.	Fibre g.	Reducing sugar g.	Acid <sup>a</sup> g.	Pectin g.	Pentose g.	Vit. C <sup>b</sup> mg.
1. Amlaki	<i>Phyllanthus emblica</i>	82.10	2.11	2.82	4.71	14.02	30.52	14.92	11.52	8.61	508
2. Karamja	<i>Carassa carandas</i>	89.33	5.32	10.52	6.37	11.22	25.11	6.31	9.51	8.42	28.11
3. Kancha pepa	<i>Carica papaya</i>	91.01	7.91	12.41	2.43	13.21	42.12	1.19	21.52	9.13	30.21
4. Paka pepa	"	88.94	5.83	7.93	2.61	5.74	25.8	1.12	46.21	5.01	20.81
5. Kui	<i>Ziglyphus guguba</i>	86.02	3.10	11.10	2.52	5.52	12.01	3.36	13.01	4.10	5.12
6. Anarash	<i>Ananas sativum</i>	90.15	4.01	3.42	2.01	13.02	30.21	9.31	—	5.31	80.42
7. Kancha bael	<i>Aegle mermelos</i>	65.02	2.23	5.34	1.42	—	5.11	2.10	—	6.01	—
8. Paka bael	"	67.03	2.92	11.44	6.35	—	11.10	2.91	—	7.24	7.10
9. Jambura	<i>Citrus decumana</i>	85.04	4.41	3.72	5.54	5.21	40.22	—	23.31	4.01	87.12
10. Kamala	<i>Citrus aurantium</i>	87.01	2.22	9.15	2.12	4.15	33.12	—	12.71	4.31	50.12
11. Kad Bael	<i>Feronia elephantium</i>	74.10	7.20	13.20	2.28	19.64	30.44	0.52	0.84	7.64	15.32
12. Desi plum	<i>Ziglyphus guguba</i>	78.32	4.15	4.55	1.80	6.15	34.05	0.50	1.55	9.05	—
13. Mesta	<i>Hibiscus sabdariffa</i>	84.23	5.98	—	1.80	8.28	2.46	1.38	trace	20.52	13.12
14. Chalta	<i>Dillenia Indica</i>	77.92	8.50	2.10	1.05	9.05	15.05	0.05	0.50	10.05	17.95
15. Sapta	<i>Achras sapata</i>	79.61	6.35	14.05	0.90	16.10	57.10	1.00	0.65	3.60	12.91
16. Sharifa	<i>Anona squamora</i>	86.62	3.90	4.86	1.02	5.22	65.10	trace	trace	2.10	10.48
17. Guava	<i>Psidium guavam</i>	75.41	3.92	2.08	1.52	22.88	16.48	0.60	4.82	3.92	10.99
18. Jalpai	<i>Fr olive</i>	82.52	6.05	18.05	2.55	14.10	10.05	0.10	1.60	10.25	9.33
19. Jamrul	<i>Chrysaphyllum cuenito</i>	90.00	4.50	10.11	9.90	8.92	49.01	16.00	—	—	6.80
20. Musk melon	<i>Cucumis melo</i>	92.72	4.00	14.10	3.91	9.71	23.22	—	trace	—	4.03
21. Amra	<i>Spondias mangifera</i>	87.00	5.00	7.91	10.11	19.12	23.42	—	trace	—	8.81
22. Dumar	<i>Ficus glomerata</i>	85.00	3.72	5.98	6.00	4.92	9.00	—	—	—	11.50
23. Latkau	<i>Baccaurea sapida</i>	91.12	3.21	5.12	3.14	2.33	65.21	—	—	—	8.36
24. Gab	<i>Diaspyros em-pyopteris</i>	75.01	2.44	3.88	4.08	12.84	28.80	trace	—	—	19.20

<sup>a</sup> Calculated as citric acid.

<sup>b</sup> Calculated as mg. per 100 g. of the edible portion.

feature of roselle (mesta) is that its extracts contain both acid and pectin and hence addition of sugar and proper boiling gave good jelly. Guava jelly was also prepared from the pulp freed of seeds, fibre and peels with addition of sugar and acid. Similar products were also obtained from pineapple, kadbael, and sapeta by addition of pectin, sugar and acid, as they contain not enough pectin. Such addition, according to composition, may give various types of delicious products of fruit that

will keep for a long time and at the same time eliminate the wastage of fruits.

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TABLE 3.—SOME SPECIFIC CHARACTERISTICS OF FRUITS AND THEIR SOURCES.

Sl. No. of fruits of Table 1	Total wt. of the fruits g.	Peel %	Edible portion %	Seed %	Colour		Acceptability as food	Popularity	Availability & statistics		
					Green	Ripe			Season	Approx. amount	Locality
1	105	0	70	30	Light green	Light green	+++	+++	Winter	Abundant.	E. Pak. (all over)
2	250	0	100	—	„	Yellow	+++	+++	Winter.	„	„
3	750	7	91	2	Deep green	Green with yellow	+++	+++	Whole year.	„	„
4	755	9	90	3	„	„	+++	+++	„	„	„
5	10	10	60	40	Green	Yellow	+++	+++	„	„	„
6	1500	10	90	—	Green	Brown	+++	+++	„	„	„
7	800	10	90	—	Green	Yellow	+++	+++	Winter	„	„
8	800	10	90	—	—	—	+++	+++	Summer	„	„
9	2500	12	86	2	Green	Yellow	+++	+++	Winter	„	„
10	200	5	94	1	Green	—	+++	+++	Winter	Small quantities	Sylhet Chittagong Hill Tracts
11	435	42.52 (sheel)	50.57	6.71	Dark green	Dark brown	+	+	Rainy season	Abundant.	Chitg. Dacca
12	5.9	21.23	38.41	40.35	Green	Red	++++	++++	Winter	„	E. Pak.
13	10.12	—	49.40 (calyx)	50.59 red.	Light red	Scarlet red	+++	++++	„	„	E. Pak.
14	1200	15.79	59.2	9 25.00 (seed + mucilage + seed cover)	Light green	Yellowish green.	+++	+++	Winter	„	E. Pak.
15	74.32	13.44	80.73	5.85	—	Dark red	++++	++++	—	Small quantities	Chitg. Jessore Rajshahi
16	190	22.10	71.05	8.40	Green	Brownish green	++++	++++	Winter.	„	„
17	105	18.09	78.09	3.80	Green	Yellow	++++	++++	Rainy season	Abundant	E. Pak.
18	12.82	2.0	5.62	5.2	Deep green	Light green	++++	++++	Winter.	Small quant.	E. Pak.
19	30.9	17.54	81.96	0.50	Milk white	Yellowish white	++	++	„	„	E. Pak.
20	840	5.71	93.41	.88	Light green.	Yellowish green.	++++	++++	Summer	Abundant.	E. Pak.
21	100	2.1	40.0	57.9	Green	Yellow	+++	+++	„	Appreciable quant.	E. Pak.
22	9.80	24.48	55.08	21.44	Green	Reddish green	+	+	„	Small quant.	E. Pak.
23	12.20	4.30	4.30	1.60	Green	Ghee-yellow	++	++	„	„	E. Pak.
24	120.12	15.5	79.0	5.5	Green	Brown	++	++	Winter	„	E. Pak.

+ Very slight  
++ Slight

+++ Moderate  
++++ Very much

## References

1. B.D. Mukherjee, A. K. M. Moslem Ali, S.F. Rubbi, H. Rahman and N.A. Khan, Pakistan J. Sci. and Ind. Research, **1**, 228 (1958).
2. S. F. Rubbi, B. D. Mukherjee, A. K.M. Moslem Ali, H. Rahman and N. A. Khan, Pakistan J. Biol. and Agr. Sci., **11**, 73 (1959).
3. B. D. Mukherjee, S. F. Rubbi, H. Rahman and N. A. Khan, Scientist, **3**, 31 (1959).
4. B. D. Mukherjee and N. A. Khan, Chem. and Ind. (London), 1413 (1959).
5. B. D. Mukherjee and N. A. Khan, Nature (London), **184**, 1140 (1959).
6. *Official and Tentative Methods of Analysis of A. O. A. C.*, 4th edition, pp. 25, 339, 340, 341, 344 (1935).
7. M. H. Carre and Haynes, Biochem. J., **16**, 60 (1922).
8. Bessey, J. Assoc. Official Agr. Chem., **27**, 537 (1944).
9. P. B. Hawk, B. L. Oser and W. H. Summerson, *Practical Physiological Chemistry*, (McGraw-Hill Book. Com., Inc., N. Y.), 13th Ed., pp. 630, 656, (1954).
10. Ref. 6, p. 123.
11. C.S. Piper, *Soil and Plant Analysis*, (Interscience Publishers, N. Y., 1950), pp. 176, 287.
12. Z. I. Kertesz, *The Pectic Substances*, Interscience Publishers Inc., N. Y., p. 209 (1951).
13. J.B.S. Braverman, *Citrus Products*, (Interscience Publishers Inc., N.Y., 1949) p. 144.
14. Ref. 13, p. 302.
15. Ref. 13. p. 368.