

UTILIZATION OF SOME RARE VARIETIES OF EAST PAKISTAN LIMES

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As a result of preliminary botanical and physical investigations,¹ the general properties of some of the citrus fruits found in East Pakistan have shown them to be similar to limes. However, they are not same as those already described in the literature.² The different varieties of the locally available limes were carefully chosen and subjected to analysis for their major constituents. One typical variety called "gandharaj" (king of odour) is shown in Fig. 1. It

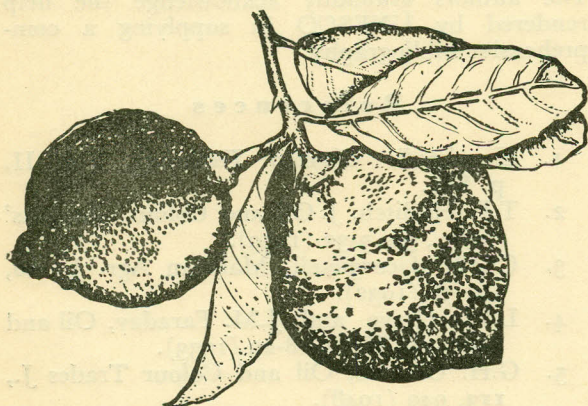


Fig. 1.—Gandharaj ($\frac{1}{2}$ size).

was thoroughly analyzed and the different data was then compared with those of others in order to establish their significance in commerce. The identification and characterization of the constituents of gandharaj left no doubt about their value for human consumption.

Experimental

Materials.—These citrus fruits are grown all over Chittagong and Dacca sub-divisions, and were collected from Dacca markets and around. Three freshly distilled solvents, (1) alcohol over KOH + pinch of Na_2O_2 , (2) ethyl ether over KOH, and (3) petroleum ether, 40-60°C., alone were used. The other chemicals were at least chemically pure.

Apparatus and Methods.—The total content of acid, sugar, pectin, vitamin C, iron, calcium and phosphorus have been estimated by the standard methods^{1,3-5}. The quantity of essential oil in the peel was also determined.⁶

The pure pectin from gandharaj albedo was

prepared by a modification of the existing procedures. The fresh albedo 700 g. was refluxed with 95% alcohol for 24 hours. The alcohol was then decanted off. The procedure was repeated four times, the residue filtered dry over a Buchner funnel and further refluxed with ethyl ether three times in succession. A portion of the solid samples (100 g.) was ground, suspended in 0.05 N HCl, using 20 ml. per g. of dry material and heated to 80°C. (critical) on water bath for 2 hours with occasional stirring. On cooling, the material was filtered through a linen cloth and the residue was treated another three times with such hot acid media in order to extract all pectinic acid substances (water-soluble pectin). This pectin solution was mixed with alcohol until 60% alcohol concentration was attained. After keeping for 12 hours (or overnight), the mixture was filtered through a silk cloth of fine mesh, washed free of acid with water-ethanol (1:2) and resuspended in 95% alcohol. The dry pectin was recovered by filtration and washing with 95% alcohol and ether in succession, and then subjected to different analyses: estimations of uronic acid,⁸ calcium pectate⁹ and methyl ester.¹⁰

A column of activated charcoal plus filter-paper pulp in place of filter aid (18.0 × 3.4 cm.) was used¹¹ to separate the sugars in the gandharaj aqueous extracts purified by basic lead acetate procedures.¹² All possible mono-saccharides were tested in water eluates and disaccharides in the eluate of 5% ethanol solution. The organic acids in the total water extracts were neutralized by milk of lime (1.5%). The preprecipitated calcium salts were decomposed by 0.1 N sulphuric acid and the resulting mother liquor after decolorization with activated charcoal was analyzed for different acids according to the methods of Mollow Perkin.¹³

The preparation of beverages from essential oils; of jams, jellies and marmalades from pectin and peels of gandharaj; preservation of deaerated juice and 'gandharaj' hearts (unbroken juice cells); preparation of dried pomace and 'morabba' from albedo, and of citric and ascorbic acids from aqueous extracts were attempted through the standard procedures.¹⁴

Results and Discussion

Table I shows the distribution of major con-

stituents in gandharaj as compared with the other varieties of limes in East Pakistan. The different varieties are very similar in their composition. Furthermore gandharaj consists of substances almost identical with those of California lime (Table 2). Only the protein content being somewhat different. Table 3 records the distribution of valuable chemicals in the different segments of gandharaj. The percentages of uronic acid, calcium pectate and methyl ester, as 72%, 98% and 9.2% respectively, leave no doubt about the characteristic nature of pure fruit pectin in

gandharaj that also possesses glucose and fructose as monosaccharides and sucrose as only disaccharide. The presence of citric, tartaric and malic acids has been established, but the presence of oxalic acid is doubtful.

The beverages, jams, jellies, marmalades and juices have been found to possess good flavours and have a long shelf life (over three months). The preserved hearts were also pleasant to taste. The pomace yielded pectin whenever needed. The production of citric acid was successful but

TABLE 1.—COMPARATIVE ANALYSIS OF DIFFERENT VARIETIES OF EAST PAKISTAN LIME (CALCULATED ON DRY WEIGHT BASIS).

Sample	Local name	Total weight of fruit g.	Moisture %	Sugar %	Acid %	Pectin %	Vitamin C mg. %
1	Lamba kagji	45.0	81.0	8.5	26.4	19.1	966.2
2	Goal kagji	38.5	81.0	8.5	25.9	22.2	695.0
3	Kalambia	162.5	76.0	10.8	32.7	8.8	633.0
4	Bara pati	273.0	76.0	16.0	29.0	13.8	713.0
5	Ghora	325.0	75.0	11.9	31.52	11.8	413.0
6	Godha	352.0	75.0	12.2	30.5	11.8	397.8
7	Bara alachi	135.0	76.0	13.0	30.0	17.4	5.8
8	Chota kagji	25.7	81.0	3.7	25.9	24.6	103.9
9	Ghandharaj	80.0	78.0	5.11	26.9	17.2	483.6

* Local designation of the varieties by physical shapes : lamba = long, goal = round, bara = large, chota = small, kagji = lime, ghandharaj = king of odour.

TABLE 3.—SUGAR, ACID, PECTIN, AND VITAMIN C CONTENT OF DIFFERENT PARTS OF GANDHARAJ (CALCULATED ON FRESH WEIGHT BASIS).

Different portions	Weight g.	Moisture average %	Total sugar %	Acid %	Pectin %	Vitamin C mg. %
Flavedo	15.5	75.0	2.3	0.3	3.6	16.6
Albedo	17.0	79.0	4.6	0.30	4.2	9.9
Pulp	47.5	88.0	1.4	4.90	3.8	168.0
Whole fruit	80.0	78.0	2.3	5.80	3.8	106.8

TABLE 2.—COMPARATIVE ANALYSIS OF LIME
(DRY WEIGHT BASIS; VALUES PER 100 G.).

	Lime (California)		Ghandharaj (E. Pakistan)	
	Dried peel	Juice	Dried peel	Juice
Protein	6.39	—	10.50	—
Crude fat	1.23	—	1.40	—
Crude fibre	15.00	—	15.40	—
Ash	5.04	—	5.25	—
Water	7.10	—	0	—
N-Free — extract	65.24	—	76.45	—
Minerals	{ Fe	—	—	0.02
	{ Ca	—	—	1.51
	{ P	—	—	0.17
Total sugar	—	2.2-6.0	11.5	1.4
Acid	—	6.0-7.0	1.7	4.9
Vitamin C (mg.)	—	67.0	83.0	168.7
Essential oil	0.7 cc*	—	3.5 cc.	—

*Fresh weight basis.

that of ascorbic acid was only partially so. The albedo portions of the fruits produced luscious 'morabba' and candied materials, which were appreciated by a panel of tasters. Further work is in progress and will be published later.

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