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EFFECT OF PROCESSING OPERATIONS ON THE NUTRITIVE VALUE OF CANNED GUAVA AND JACK FRUIT*

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Jack fruit (*Artocarpus integrifolia*), a tropical fruit tree, is found widely grown in several parts of India, particularly in the South. Reputed both for its exceptionally large individual fruit size (weighing 10-60 lbs. each) as well as for the high yield per tree, according to Naik[8], the jack is believed to rank foremost amongst the South Indian fruits in the quantity of food produced per unit area. Besides the numerous uses to which the different parts of the fruit are put, the flesh or bulbs can be utilised in the manufacture of jams, beverages, candies, preserves and dehydrated products etc[4]. No data are available on the nutritive value of jack as affected during processing.

Likewise, guavas, which are an excellent source of vitamin-C (containing 200-400 mg./100 g. of fruit [3,5,7]) and are grown practically all over the country, have not yet received much attention of the workers in this field. In India, no data are available on the effect of different processing operations on the overall nutritive value of canned guavas. In the present paper, some data are presented on this subject.

Experimental

Methods of Processing

(i) *Jack fruits.*—Ripe, medium sized jack fruits obtained from the Mysore market were canned according to the method of Bhatia[4] in 1 lb. jam size plain tin cans at the rate of 227 g. (8 oz.) per can to each of which was added 128 g. (4½ oz.) of hot 40° Brix cane sugar syrup of 0.5% acidity. The cans were given an exhaust of 6-8 minutes at 206°F and processing of about 25 minutes at the same temperature.

Technical data on processing of jack fruits: Number of fruit, 8; weight of each fruit, 19 to 28 lbs.; bulbs, 30.5 to 38.5%; peels, 47.5 to 52.9%; stones,

Work conducted jointly by the C.F.T.R.I., Mysore and the Institute of Science, Bombay, under a scheme of C. S. I. R. (India), on the 'Nutritive value of canned fruits' to be worked at the latter Institute. Fruits were processed at C.F.T.R.I., and analysed both during and immediately after processing. The canned material was then passed on to the Institute of Science, Bombay for analysing the same during subsequent storage at different temperatures.

6.2 to 8.6% ; waste from bulbs, 3.5 to 5.7% ; total weight of 8 fruits, 180.5 lbs. ; number of jam size cans made, 100.

(*ii*) *Guava.*—Ripe, firm and sound guavas of a local variety, obtained from the Mysore market, were employed for this investigation. The fruits were washed thoroughly in running cold water, peeled thinly and uniformly by hand with stainless steel knives and kept immersed in 2% brine to prevent enzymatic browning. The peeled fruits were then halved, cored with stainless steel coring knives, washed gently in water to remove the salt, quartered, mixed and packed by random sampling into 1 lb. jam size plain tin cans @ 220 g. per can, to each of which 110 g. of hot 40° Brix cane sugar syrup containing 0.1% acidity was added. They were then exhausted till the centre of each can could acquire a temperature of 168°-170°F, immediately after which they were sealed, processed in boiling water (206°F) for 20 minutes, cooled as usual in water, and wiped dry. The data obtained on the preparation of fruits of 3 different grades for canning are presented in Table I.

TABLE I

Sl. No.	Particulars.	Lot I Grade A.	Lot II Grade B.	Lot III Grade C.	Total.
1.	No. of fruits	50	93	215	388
2.	Total wt. of fruits	21 lb. 2 oz.	32 lb. 10 oz.	64 lb. 12 oz.	118 lb. 8 oz.
3.	Average wt./fruit (oz.)	6.8	5.6	4.2	4.9
4.	Peels and cores (%)	42.0	43.9	49.4	46.6
5.	Material suitable for canning (%)	58.0	56.1	50.6	53.4
6.	No. of cans made (1 lb. jam size)	...	...	...	130

It will be seen that the size of fruit has considerable influence on the % recovery of the material fit for canning, which has been found to be higher in large sized (A grade) fruit than in smaller fruits (C grade), the comparative figures being 58.0% and 50.6% respectively.

Sampling and Analytical Procedures

(*a*) *Fresh fruit.*—From the entire lot, made homogeneous by gentle mixing of the prepared fruit both in the case of jack and guavas, about one lb. material was sampled at random, blended in a waring blendor into a fine pulp, aliquots from which were withdrawn and analysed according to A.O.A.C. methods[1]. Ascorbic acid was estimated colorimetrically by the method of Robinson and Stotz[9], while carotene by that of Association of Vitamin Chemists[2].

(*b*) *Canned fruits.*—The 'cut-out' data of six cans, picked at random from the bulk lot, in either case, were collected according to the method of Hirst and Adam[6]. The well-drained fruit pieces from each can were separately homogenized in a waring blendor. For ascorbic acid, sugars, total solids

and proteins, aliquots were withdrawn immediately in both the cases, while for rest of the analysis, the samples were stored at a low temperature till required for other analysis, which was usually completed within about 7-10 days. Likewise, aliquots from drained syrup from each can, in either case, were also analysed. The results are presented in Table II.

TABLE II

(Results based on the analysis of 6 cans individually examined 24 hours after processing).

Sl. No.	Particulars.	Canned guava. Range Max.	Range Min.	Average.	Canned Jack fruit. Range Max.	Range Min.	Average.
I	Vacuum (inches)	18.0	14.0	15.8	15	14	14.5
II	Head-space (inches)	1/4	1/8	3/16	1/4	1/8	3/16
III	Drained weight (%)	68.1	73.2	71.0	72.8	69.2	71.2
IV	Analysis of syrup :						
(1)	Corrected Brix (at 68°F)	21.4	20.4	20.9	30.4	27.4	28.2
(2)	Total solids (%)	21.6	20.6	21.1	30.7	27.7	28.5
(3)	Ascorbic acid (mg./100 g.)	71.7	59.9	64.5	8.2	7.0	7.4
(4)	% Acidity (w/w, as citric acid)	0.16	0.14	0.15	0.44	0.40	0.42
(5)	Reducing sugars (%)	3.5	2.9	3.1	12.1	11.7	11.9
(6)	Non-reducing sugars (as % sucrose)	16.0	13.2	15.1	13.2	11.7	12.4
(7)	Total sugars (as invert)	19.3	19.1	19.2	27.10	25.0	26.05
(8)	Carotene (mg./100 g.)	...	...	...	Negligible		
(9)	% Proteins (N × 6.25)*	0.79	0.53	0.67	0.98	0.96	0.97
(10)	Calcium (Ca) (mg./100 g.)*	55.0	38.0	46.0	40.4	32.1	35.6
(11)	Iron (Fe) (mg./100 g.)*	0.53	0.08	0.26	0.60	0.42	0.56
(12)	Phosphorus (P) (mg./100 g.)*	36.3	21.4	27.5	7.0	5.1	6.6
V	Analysis of solids (fruit)						
(13)	Total solids (%)	25.6	22.7	23.9	29.9	27.5	28.9
(14)	Ascorbic acids (mg./100 g.)	64.2	52.9	59.0	6.4	4.4	5.2
(15)	% Acidity (w/w, as citric acid)	0.13	0.09	0.11	0.48	0.42	0.45
(16)	Reducing sugars (%, w/w)	3.88	2.36	2.91	12.4	11.0	11.3
(17)	Non-reducing sugars (w/w as % sucrose)	13.95	11.02	11.71	12.9	11.9	12.6
(18)	Total sugars w/w (as % invert)	16.82	14.51	16.07	24.4	24.1	24.3
(19)	Carotene (mg./100 g)	...	...	...	0.14	0.13	0.133†
(20)	% Protein (N × 6.25)*	1.87	1.44	1.66	0.44	0.42	0.43
(21)	Calcium (Ca) (mg./100 g.)*	41.5	32.7	36.2	24.8	24.0	24.4
(22)	Iron (Fe) (mg./100 g.)*	30.8	12.6	19.5	0.82	0.40	0.62
(23)	Phosphorus (P) (mg./100g.)*	41.5	30.4	36.2	17.0	15.1	16.5

*On dry-weight basis. ... not determined †×0.03 mg.

Physico-chemical Composition

(i) *Jack fruit.*—Total solids, 22.8% ; ascorbic acid, 7.6 mg./100 g. ; %acidity w/w (as anhydrous citric acid), 0.30 ; reducing sugars, 6.1% ; total sugars (as invert), 15.9% ; p_H, 5.5 ; carotene, 0.13 mg./100g. ; protein (N × 6.25), 0.44% ;

calcium (Ca)*, 35.1 mg./100 g.; iron (Fe)*, 1.01 mg./100 g.; phosphorus (P)*, 14.8 mg./100 g.

(*ii*) *Guava.*—Corrected refractometric solids (T.S.S) at 68°F, 7.4; total solids, 24.01; ascorbic acid, 129.9 mg./100 g.; % acidity w/w (as anhydrous citric acid), 0.18; total sugars (as invert), 5.4%; reducing sugars, 2.1%; non-reducing sugars, 3.14%; protein (N × 6.25), 2.62%*; calcium (Ca)*, 79.0 mg./100 g.; iron (Fe)*, 0.31 mg./100 g.; phosphorus (P)*, 18.9 mg./100 g.

Cut-out Examination

The cut-out examination (Table II) revealed that both the products were of high quality, had a high vacuum of 14-18 inches, normal head-space, good drained weight (on an average about 71.0% in either case) and the drained syrup had good appearance and the normal cut-out brix. In actual canning practices, however, there are possibilities of variation in the chemical composition of the raw material (fruit) which will affect the 'cut-out' brix. In order to get a product of uniform cut-out brix it will therefore be advisable to first determine experimentally the approximate cut-out brix before commencing canning on a commercial scale.

Jack fruit is a poor source of ascorbic acid and carotene, the respective figures being 7.6 and 0.13 mg., while guava (local variety) is fairly rich in ascorbic acid (129.9 mg.). During canning it was noticed that a considerable amount of the ascorbic acid was passed on to the covering syrups (about 50%) and the retention of ascorbic acid in jack and guava was found to be 89.9% and 76.9% respectively. The comparative lower percentage retention in guava might perhaps be due to the partial leaching of some ascorbic acid during immersion of peeled guavas in 2% brine on the preparation table, which was not the case in jack fruit. There was no material change in carotene, proteins and mineral content. There was a considerable diffusion of sugars from syrup to fruit. Thus, the total sugar content of guava and jack increased from an initial figure of 5.4 and 15.9 to 16.07 and 24.3% respectively, while correspondingly, the brix of drained syrup was reduced to average figures of 21.1° and 28.5°, the initial brix of the syrup in either case being 40°. Likewise, there was an equalisation of acidity between the two phases.

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SUMMARY

Results of the studies made on the effect of processing operations on the overall nutritive value of canned guava and jack fruits have been reported. Samples, in replicates of six, drawn at random, were analysed for

* on dry weight basis.