

# Investigations on the Canning of Bananas

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BANANA IS one of the most important of the tropical fruits. In India it is widely cultivated in the States of Madras, Bombay, Bengal, Assam, Bihar, Travancore and Mysore. Large quantities of surplus fruit, particularly during the peak season, do not fetch reasonable returns to the growers, and occasionally go to waste. Economic utilization of such fruit should, however, be possible by suitably processing and preserving it.

A number of products are reported to have been prepared from both the ripe and unripe fruit (Anon, 1943; Von Loesecke, 1949; Anon, 1950). Some work on the canning of banana puree as a baby food and banana chunks in syrup, has also been reported recently (Guyer and Erickson, 1954; Board & Seale, 1954). Investigations undertaken at the Central Food Technological Research Institute, Mysore (India) on the canning of bananas in syrup alone or in combination with other fruits to form salads have shown that the product obtained in either case is of satisfactory quality and appears to have great possibilities for export to places where fresh bananas are not available. The present paper deals briefly with the experiments carried out in this connection, and the methods finally standardized.

## Experimental

**Raw Material.** Bananas for these experiments were obtained from the local

fruit market. Fully ripe yet firm fruit was used. Banana bunches are normally harvested by the growers when fully developed and mature but still green and hard. This green fruit is artificially ripened in different ways (Von Loesecke, 1949). At the fully ripe stage, the fruit pulp softens and the skin becomes loose and develops yellow, yellowish green, reddish grey or yellowish grey, &c., colour, depending upon varietal characteristics. In most cases, greyish or brownish flecks also start appearing on the surface.

The common varieties available in Mysore market, viz., *Rasbale*, *Salem-bale*, *Pache-bale* and *Chander-bale*, were used in the present studies. Some relevant data collected on a few typical lots of the ripe fruit of these varieties are given in Table I. The usual A. O. A. C. (1950) methods of analysis were employed.

**Preparation for Canning.** The fruit was peeled with hand and cut transversely into slices of  $\frac{1}{2}$  to  $\frac{3}{4}$  inch thickness, with stainless steel knives.

Bigger pieces of about 2 inches long and small sized whole fruits (3-4 inches) as such after peeling, or cut lengthwise into halves, were also used in some packs.

**Pre-treatment.** The fruit was canned as such, as well as after treatment in  $\text{CaCl}_2$  solution (2.5 per cent.) and lime water (saturated, clear solution of calcium hydroxide) for different periods

varying from 15 to 45 minutes. The fruit after treatment in lime water was rinsed in 0.05 per cent. citric acid solution.

Table I—Analysis of Ripe Bananas

<i>Analysis Factor</i>	<i>Variety Pachebale</i>	<i>Variety Rasbale</i>	<i>Variety Salem-bale</i>	<i>Variety Chanderbale</i>
Wt. of 1,000 fruits (lb.) .. ..	280 ..	100 ..	160 ..	195
Wt. of peels (lb.) .. ..	100 ..	20 ..	40 ..	70
Proportion of prepared (peeled) fruit % ..	64.3 ..	80.0 ..	75.0 ..	64.1
<i>Analysis of pulp.</i>				
Reducing sugar % .. ..	6.3 ..	10.4 ..	11.4 ..	—
Total sugar as reducing .. ..	15.8 ..	19.0 ..	18.6 ..	—
Total soluble solids by refractometer % ..	18.0 ..	22.0 ..	22.5 ..	25.0
pH .. ..	5.3 ..	4.7 ..	4.5 ..	4.8
Acidity (as malic acid) % .. ..	0.31 ..	0.42 ..	0.50 ..	—
Ascorbic acid mg. % .. ..	2.0 ..	6.7 ..	8.2 ..	3.5

**Canning Syrup.** Cane sugar syrup of concentrations from 20 to 75 \* per cent., and inverted sugar syrup of 80° Brix, were used as the liquid canning medium. In some solid packs, crystalline cane sugar and in salad packs, orange syrup were also used. The pH of the fruit being rather high, citric acid was added to the canning syrup to bring down the pH of the packs.

To determine the amount of acid required to be added, sugar syrup was acidified to different levels from no acid to 0.50 per cent. Banana slices and acidified sugar syrup were mixed in a waring blender in the ratio † of 2 : 1, and pH of the resultant mixture was determined in each case with a glass electrode. Results are presented in Table II. Final packs, to determine the maximum

palate tolerance limit, were prepared using canning syrup containing 0.15, 0.2, 0.25, 0.30, 0.40 and 0.50 per cent. citric acid. In one lot, 1.0 per cent. calcium chloride was added to the syrup to find the effect on texture and appearance of the canned product. Amyl acetate (0.01 to 0.05 per cent.) and a banana essence (0.05 to 1.0 per cent.) were also added separately to the canning syrup to see if the flavour of the canned product could be improved.

Table II—Addition of Citric Acid to the Canning Syrup to bring down the pH of the Canned Product

<i>Citric Acid added to Syrup %</i>	<i>pH of the Mixture of Fruit and Syrup (in the ratio of 2:1)</i>
0.00 ..	4.80
0.05 ..	4.70
0.10 ..	4.65
0.15 ..	4.52
0.20 ..	4.40
0.30 ..	4.30
0.40 ..	4.15
0.50 ..	4.00

\* 75 per cent. sugar syrup was prepared by taking sugar and water in the ratio of 3:1 and bringing the mixture to a boil to dissolve the sugar. The boiling hot syrup obtained was added immediately to the fruit in the cans.

† In actual canning experiments, fruit and syrup were packed in the ratio of 3:2. In the preliminary tests to determine the amount of acid required to be added to syrup, the fruit and syrup were taken in the ratio of 2:1 to allow for a safe margin.

*Filling and Syruping.* The fruit after peeling was found to discolour and become brownish if kept exposed. This was found to be due to a strong oxidase action. In the preparation of canned packs, therefore, the fruit slices were cut immediately after peeling, put directly into the cans and covered with hot syrup in the usual way. Plain tin cans of sizes 1 lb. short (301 × 309), A2½ (401 × 411) and 1 lb. squat form (401 × 300) were used in these experiments. Amount of fruit packed in each of these cans was 8 oz., 20 oz., and 12 oz. respectively. Enough canning syrup was added to fill the cans within about ¼" headspace. This gave roughly a fruit syrup ratio of 3 : 2 in the final packs.

Solid packs in 1 lb. short cans were prepared with 11 oz. fruit and 1-2 oz. syrup of concentrations from 60 to 80 per cent. (sucrose or invert sugar), and containing 0.2 per cent. added citric acid. Sugar syrup in some packs was replaced with 1 oz. crystalline sugar.

*Exhausting.* The filled cans were exhausted as usual in boiling water to get a temperature of about 175°F in the centre of the cans. It took about 5, 8 and 7 minutes respectively, in case of 1 lb. short, A2½ and 1 lb. squat cans to attain the above temperature.

*Processing.* Processing temperature employed ranged between 207°F (Boiling point of water at about 2,700 ft. altitude, at Mysore) and 240°F. Normally, fruits are processed in boiling water (212°F). Processing temperatures higher than this were employed in these studies because in some cases the quantity of acid added was not enough to bring the pH below the

border line value of 4.5. Times of processing employed ranged between 15 and 45 minutes, for different temperatures and can sizes. After processing, the cans were cooled as usual in running cold water.

*Testing and Examination of the Canned Product.* The canned product prepared under each of the treatments employed in these studies was stored at room temperature (25-30°C) and tested periodically during a storage period of over one year, by the cut out technique of Hirst and Adam (1932). Incubation tests of the product prepared by the method finally evolved and as recommended in this article, were carried out at 37° and 50°C for 6 weeks. Microbiological examination was also conducted to test the sterility of the packs.

*Results and Discussion.* Due to the presence of tannins in the fruit, the peeled and cut fruit darkens if allowed to come in contact with iron. It is, therefore, very important to avoid iron from all equipment coming in contact with the fruit. To prevent enzymic discolouration, the peeled and cut fruit should be immediately put in the can and covered with hot syrup. This is not difficult in commercial practice where the entire canning process is a continuous one.

Sugar syrup of 25-30° Brix (i.e., about 5° higher than the soluble solids content of the fruit pulp), acidified with 0.15 to 0.2 per cent. added citric acid, is regarded as the best canning medium. No adverse effect on the natural flavour of the fruit could be detected under these conditions. With higher propor-

tion of acid, the flavour became rather unnatural. With canning syrup of higher sugar concentrations, there was no material improvement in the quality of the packs. Solid packs with regard to flavour were slightly superior to the product packed under specifications given above. At the same time, these were regarded as too sweet and also suffered from gelation and clot formation, turbidity of syrup and disintegration of fruit.

Packs of all the four varieties in 1 lb. squat and 1 lb. short cans, employing canning syrup of 0.15 to 0.20 per cent. acidity (citric acid), and processed for 15 minutes at 228°F did not show any spoilage in incubation tests carried out for six weeks at 37° and 50°C. Microbiological examination also did not reveal the presence of any spoilage organisms. Higher processing temperatures in which case the amount of acid necessary could be reduced further, produced pinkish discolouration in the product during 15 minutes process.

A process of 15 minutes in boiling water (at 2,700 ft. altitude of Mysore corresponding to about 10 minutes at sea level) for 1 lb. short cans, or 20 minutes (about 15 minutes at sea level) for 1 lb. squat cans, was found adequate, when the fresh fruit had a pH of 4.8 or less and the canning syrup an acidity of 0.2 per cent. These packs had a maximum equilibrium pH of 4.4.

Out of the four varieties used in these experiments, *Pachebale* and *Chanderbale* were found to be good canners. *Salembale* and *Rasbale* did not yield canned products of good texture and flavour, although the latter is a good table variety. When fruit of a suitable variety was used, the overall quality of the product packed and processed

according to the details recommended in this article was good; the flavour closely resembled that of the fresh fruit. Results of a typical cut out test of the canned product of all the varieties after 12 months storage are presented in Table III.

Treatment of the fruit in lime water or  $\text{CaCl}_2$  solution prior to canning; as also addition of  $\text{CaCl}_2$  to the canning syrup, did not materially improve the quality of the final packs with regard to texture. As the texture of the packs without any of these treatments was quite satisfactory, none of these treatments is regarded as necessary in the canning of bananas. Addition of amyl acetate to the canning syrup at 0.03 per cent. was found to improve the flavour of the product and thus guard considerably against adverse changes in flavour during storage. Plain tin cans proved quite satisfactory for canning.

*Canning of Fruit Salads.* Banana slices canned in combination with orange segments, papaya slices and jack fruit segments, employing sugar syrups of 45°, 40° and 35° Brix, respectively gave fruit salads of good quality with mixed flavours. Orange juice, of which the Brix had been raised to 45 degrees with added sugar, when added as canning syrup for banana slices, did not give a good product, mainly due to the development of bitterness in orange juice.

*Recommendations.* On the basis of investigations reported in this paper, the following method is recommended for the canning of bananas both on a small and large scale.

Table III—Cut-out Data on Canned Bananas (1 lb. short plain cans) after 12 Months' Storage at 25-30°C

Variety	Vacuum (Inch.)	Drained weight		Strength of Syrup (Deg. Brix)	Appearance		Texture	Taste and odour
		Fruit (oz.)	Syrup (oz.)		Fruit	Syrup		
Pachebale	8.0	7.0	6.0	22	Normal, creamy white	Slightly turbid	Good soft texture; no fibrous peel	Pleasant taste and odour
Chanderbale	8.5	7.0	5.5	23	Normal, pinkish white	Cloudy	Fairly soft; no fibrous peel	Good taste; odour rather weak
Salembale	9.5	7.5	5.25	24	Normal colour	Cloudy	Rough and some- what fibry	Starchy taste; very weak odour
Rasbale	6.5	7.25	5.5	26	Good colour; rough appea- rance	Cloudy	Fibrous; natural creamy texture completely changed	Starchy taste; odour weak and un- natural

Note.—The condition of the cans in all cases was sound: there was only light feathering of the tinplate.

1. Select fully ripe but firm and sound fruit of a suitable variety. \*
2. Peel the fruit by hand and cut immediately into slices of  $\frac{1}{2}$ " to  $\frac{3}{4}$ " thickness. Contact of the fruit with iron should be avoided at all stages to prevent darkening.
3. As soon as the fruit is cut, put it in the cans. In case of 1 lb. squat cans, 12 to 13 oz. slices may be packed in each can. Fill in boiling hot syrup of 25-30° Brix, containing 0.2 per cent. added citric acid, leaving about  $\frac{1}{4}$ " head space.
4. Exhaust the filled cans in boiling water for 6-7 minutes (until the temperature in the centre of the can reaches 175°F).
5. Seal the cans immediately in a double seamer and process them for 15 minutes in steam at 5 lbs. pressure (sea level); or in boiling water, if the pH of the fresh fruit is not more than 4.8.
6. After processing, cool the cans immediately in running cold water, dry, and store in a cool dry place.

### Summary

Banana is an important tropical fruit of India and many other countries. Investigations carried out at the Central Food

\* Variety trials on a number of important varieties grown in important banana growing regions of India are in progress and will be reported elsewhere in due course.

Technological Research Institute, Mysore (India), revealed that banana slices can be successfully canned like any other fruit. Details of the method of canning have been standardized. To bring down the high pH of the fruit for safe processing conditions consistent with the quality of the final pack, addition of 0.2 per cent. citric acid to the canning syrup is necessary.

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