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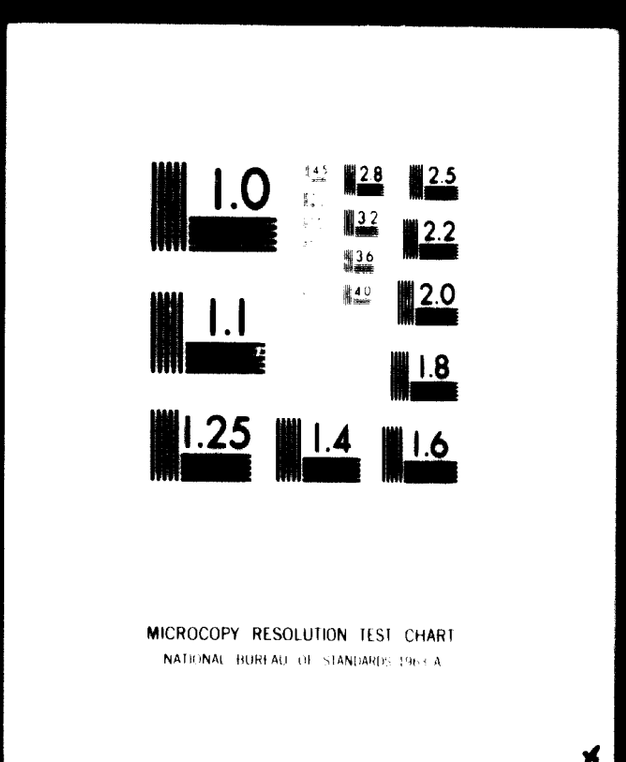

05617

A Profile of Certain Fruit Juices

Processing, Production/ Producing Countries, and Economic Aspects

Srisan Loaharanu
December, 1977

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Preface

This work is expected to give the general picture of the subject mentioned. It is part of the consultancy duty; and based on informations possibly obtained within one month.

1. General terminology :

   a. FDA classification of juices

   b. General types of juices

1. a.

FDA Classification Orange Juices:

The Freezing Preservation of Foods

DONALD K. TRESSLER, WALLACE B. VAN ARSDEL
MICHAEL J. COPLEY,

WESTPORT, CONNECTICUT
THE AVI PUBLISHING COMPANY, INC.
1968 . p 113-149

Food and Drug Administration Classifications

Orange Juices and Drinks

	% Single-Strength Juice
Orange juice	100
Fruit drinks	
Orange juice drink	Not less than 50
Orange ade	Not less than 25
Orange drink	Not less than 10
Orange soda	No juice required—must be true fruit flavor
Imitation orange	No juice required

1. b. General types of juices :

Canned fruit juices (clear or cloudy) : Processed by canning.

Frozen- concentrate : Prepared from evaporation of fruit juice to produce the desired concentration.

Freeze dried juice : Can be defined as juice products processed by freezing, e.g. juice powder.

Single strength juice : Juice prepared from pectolytic enzymatic treatment to pulp under specific conditions.

Apple cider : Fermented drink made from apple, related to juice.

Purées : Can be defined as thick liquid from fruit, prepared from straining the pulp through the seive.

Fruit nectars :

Fruit nectars differ from straight juices in that they designate pulpy fruit juices blended with sugar syrup and citric acid to produce a ready-to-drink beverage. They vary from nearly clear liquids to mixtures high in suspended solids. Fruit drinks contain at least 20 per cent single-strength juice and fruit nectars usually more than 50 per cent. (Cf. Tressler, D.K. and Joslyn, M.A., Fruit and Vegetable Juice Processing Technology, Avi, 1971, Chapters 9 and 10).

2. Processing of certain juices

2. a. General technology

Fruit Processing. Milton, B. 1971. Noyes Data Corporation. Noyes Building. Park Ridge, New Jersey USA. p. 63-64 [English]

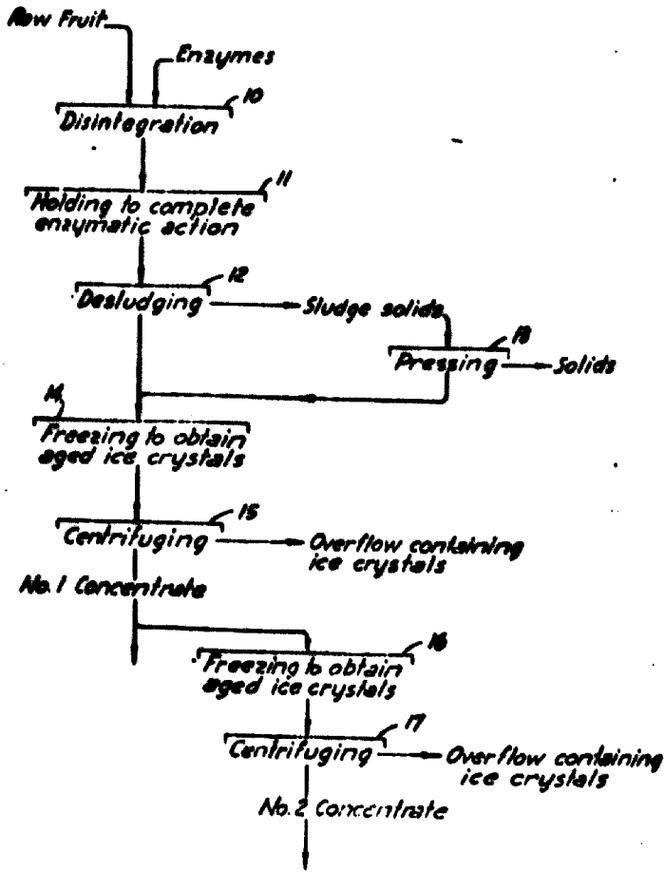
Process for the Manufacture of Fruit Juice Concentrate

Fruit juice concentrates are prepared by pressing or otherwise mechanically extracting the juice from fresh fruit, followed by evaporation of the juice to produce the desired concentrate. During such treatment the flavor of the juice undergoes radical changes due to the time and temperature factors involved. In general the original fresh fruit flavor and odor are lost, and the concentrate takes on a cooked flavor. Also there is an impairment with respect to vitamin and other dietetic values. The use of vacuum evaporation results in some improvement although with the best vacuum evaporating equipment available, there remains a substantial impairment of flavor and freshness. This characteristic of conventional methods has restricted the commercial manufacture and sale of fruit concentrates to certain types of juices, where flavor impairment can be tolerated or where the flavor change may not be too objectionable.

The process of E.B. Huber; U.S. Patent 3,023,111; February 27, 1962 involves the extraction of a juice from raw fresh fruit by procedures which avoid the use of elevated temperatures, oxidation, or additions of objectionable chemical. This juice is then subjected to a special kind of freezing capable of producing a semifrozen material containing separable aged ice crystals. This slurry is then subjected to centrifuging whereby the ice crystals are removed from the remaining concentrate. One or more additional steps of freezing and the centrifugal separation can be applied, until a concentrate is obtained having the desired solids content.

General Techniques

PROCESS FOR THE MANUFACTURE OF FRUIT JUICE CONCENTRATE



Evaporators for Concentration of Juices

BUSINESS ASSOCIATION FOR DESIGNING, CONSTRUCTION AND SALE OF PROJECTS, PLANTS AND EQUIPMENT

ZAGREB — YUGOSLAVIA 1964

Low Temperature Evaporators - types: NTI - 500, NTI - 1000, NTI - 2000, i.e. 500 kgs, 1000 kgs, 2000 kgs evaporated water per hour, destinated for concentration of thermo-sensitive juices.

Commercial single-strength juice preparation

Fruit Processing. Milton. G. 1971. Noyes Data Corporation. Noyes Building. Park Ridge. New Jersey USA. p. 115-116 [English].

Treatment of Waste Citrus Pulp to Increase the Yield of Juice

The process of K.J.S. Villadsen and K.J. Möller; U.S. Patent 3,347,678; October 17, 1967; assigned to Aktieselskabet Grindstadvaerket, Denmark comprises the step of subjecting the pulp remaining after pressing a first batch of juice from the flesh of citrus fruits and, if desired, the shells, from which the flesh or albedo has to be removed, to a treatment with pectolytic enzymes. The enzymatic treatment can be carried out at room temperature for a prolonged period, preferably for a period of 1 to 48 hours, or for a shortened period at an increased temperature, preferably not exceeding 55°C. For treating the pulp, the applied amount of pectolytic enzymes is preferably 0.02 to 0.5% by weight as calculated upon the weight of the pulp. The pectolytic enzyme is commercially available in various degrees of enzymatic strength. The said proportions of pectolytic enzyme to pulp refer to a commercial single strength enzymatic preparation, Pectolase DE 10.

Canning and Food Conservation in the Developing Countries. Stanton, W.R., and Herbert, D.A. 1969. Boy bay Univ. Press, 88-103. [in English].

Sterilizing by Heat

It was stated earlier that the sterilizing time is chosen to destroy all microorganisms capable of growth in the product during its storage life. Amongst the most heat resistant bacteria are the thermophils which grow best at temperatures between about 35°C to 55°C. It will be apparent that these temperatures are not reached in the storage life of canned foods packed and distributed in temperate climates. Since all known pathogens are mesophils, and all mesophilic organisms can be destroyed by a heat process less severe than is required to kill the thermophils, it is reasonable for canners concerned with temperate zone storage to choose sterilizing processes which may permit the survival of some thermophils. By so doing they limit the over-cooking effect of the process.

Hardenmark, J., 1974. Fruit Juice Processing. UNIDO. ID/WG.171/16. p. 7. (English).

What are the basic unit operations in fruit juice processing?

1. Fruit treatment and extraction of juice.
2. Recovery of essential oils (in the case of citrus).
3. Deaeration.
4. Pasteurisation.
5. Aroma recovery.
6. Clarification.
7. Concentration.
8. Preservation of the end product.
9. Packing.

Having already dealt with aroma recovery and concentration, there are other processing operations to be discussed.

Staten, W.R., and Herbert, D.A., 1969. Canning and Food Conservation in the Developing Countries. Bombay. Univ. Press. p. 88-103 (English).

Plant Hygiene

From all that has been said it will be apparent that planned sanitation procedures should be applied to all cannery plants whether in the pre-process, or post-process areas of the cannery. Experience has shown that a supervisor should be in direct charge of this job and that he should report directly to higher management. It is no good leaving unsupervised staff to clean the cannery after production finishes, and good hygiene is as important a responsibility of top management as are good production figures. Spoilage levels and staff morale—both directly affected by plant hygiene—are very much the manager's business.

2. b. Processing of :

Acerola or West Indian cherry juice

Apple juice

Citrus juices : Grapefruit, orange, lime

Guava juice- purées

Mango juice

Passion fruit juice

Pineapple juice

Tomato juice

Some tropical Fruit juices. Charley, V a.S. 1967. Tropical Products Institute Conference. p. 164-165. [English].

Acerola or west Indian Cherry juice

Processing

The main steps of the process are set out below:

The fruit was quickly collected in shallow trays or boxes, and was milled in a way that left the stones intact. The juice was removed in a standard type of rack and cloth press (as for apples) and was then roughly clarified and evaporated under vacuum to one-fifth its original volume. The low gravity of the juice (1.040) was not sufficiently high to provide a self-preserved concentrate, and the only means of stabilizing the product was to freeze it and maintain it in this condition. Any looseness in applying the full low-temperature conditions could lead to loss of character or even microbiological spoilage.

The [illegible] storage behaviour of the concentrate led to its ultimate vacuum dehydration on a standard type of band drier. This produced a light-brown porous mass, extremely hygroscopic, but which could be finely powdered in a moisture-free atmosphere and packed into [illegible] commercial sized cans. With low temperature storage, the safe life of the canned product, containing dessicant bags, was over twelve months. The main interest in this powdered product centred around its very high ascorbic acid content; whilst the average content was 30% w/w, appreciable amounts were prepared at 35%, and some powders reached as high as 38%.

Processing

Frozen Concentrated Apple Juice

Engineering and Process development

RODERICK K. ESKEW, G. W. MACPHERSON PHILLIPS, RICHARD P. HOMILLER, CLIFFORD S. REDFIELD, AND RUDOLPH A. DAVIS
EASTERN REGIONAL RESEARCH LABORATORY, PHILADELPHIA 18, PA.

Reprinted from INDUSTRIAL AND ENGINEERING CHEMISTRY, Vol. 43, Page 2397, October 1951

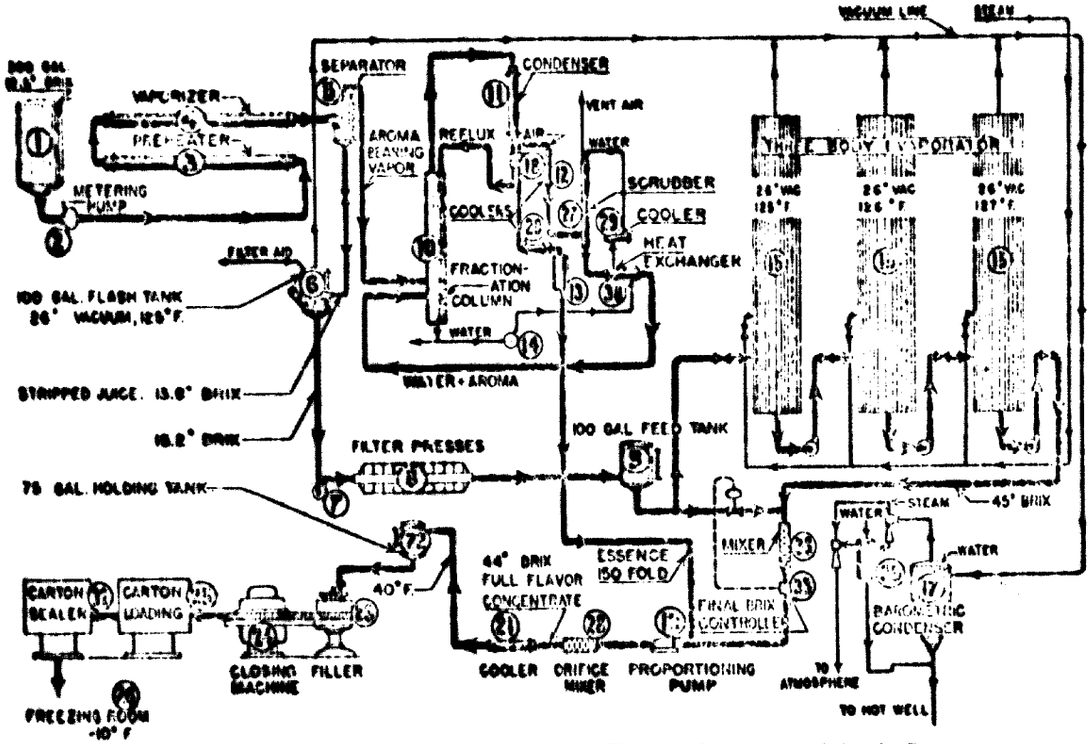
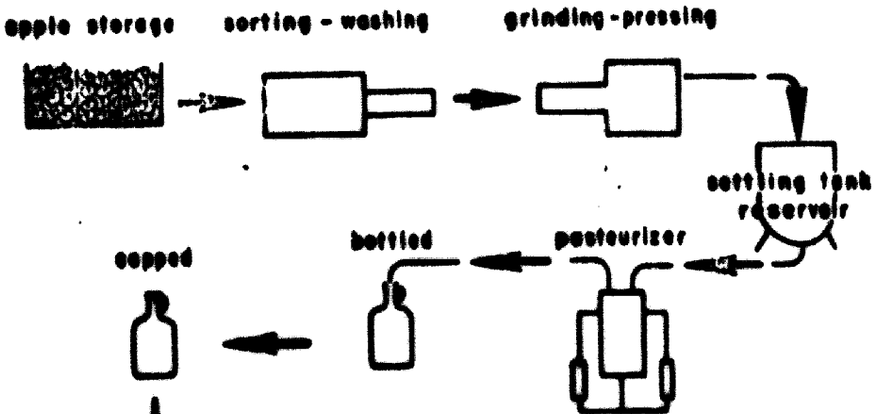


Figure 1. Flow Sheet of Process for Making Frozen Concentrated Apple Juice
627 gallons per hour of juice. 2000 6-ounce cans per hour. 44° Brix full-flavor concentrate

MAKING AND PRESERVING
APPLE CIDER

U.S. DEPARTMENT OF AGRICULTURE · FARMERS' BULLETIN NO. 2125 1971



This flow chart shows the essential steps in the production of cider.

PRESERVATION

Four methods are commonly used for preserving cider: Refrigeration, freezing, pasteurization, and preservation by chemicals.

Processing of Grapefruit,
orange,
lime juices

The canning of Grapefruit Juice. Canning Memorandum. Continental Can Company. Chicago, Illinois. USA. year ____, 1-8 [English].

Processing

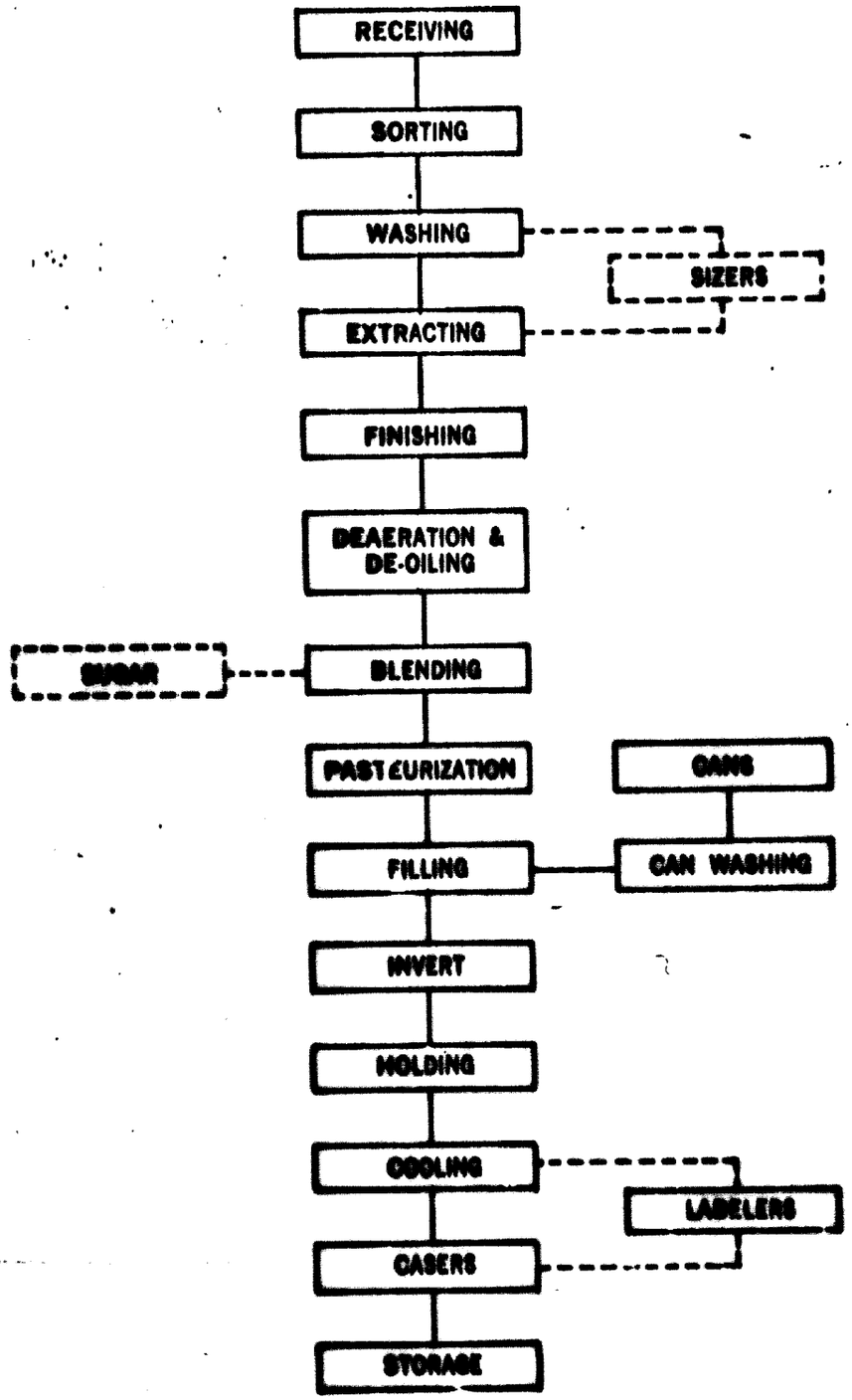
No processing is necessary when grapefruit juice is filled to provide a minimum closing temperature of 190°F. The cans should be inverted and held or rolled for one minute to sterilize the containers before being cooled. For cans smaller than 12 ounces, some means of maintaining the closing temperature for a minimum of 1 minute should be used prior to cooling due to rapid heat loss from small size containers.

In general, the shorter the time interval between filling and closing, and subsequent cooling, the better will be the flavor of the juice.

Cans

Cans made from plain electrotin plate or plain electrotin bodies with enameled electrotin ends are used.

FLOW SHEET



Canning of Grapefruit juice

The canning of Blended Grapefruit Juice and Orange Juice. Canning Memorandum. Continental Can Company Incorporated. Chicago, Illinois. USA years—, 1-8 C English].

Processing

No further processing is necessary when the juice is filled to provide a minimum closing temperature of 185° F. All cans should be inverted and held or rolled for one minute to sterilize the containers before being cooled. For cans containing less than 12 oz, provisions must be provided to maintain a temperature of at least 185° F for the one minute holding period prior to cooling, due to rapid heat loss from small size cans.

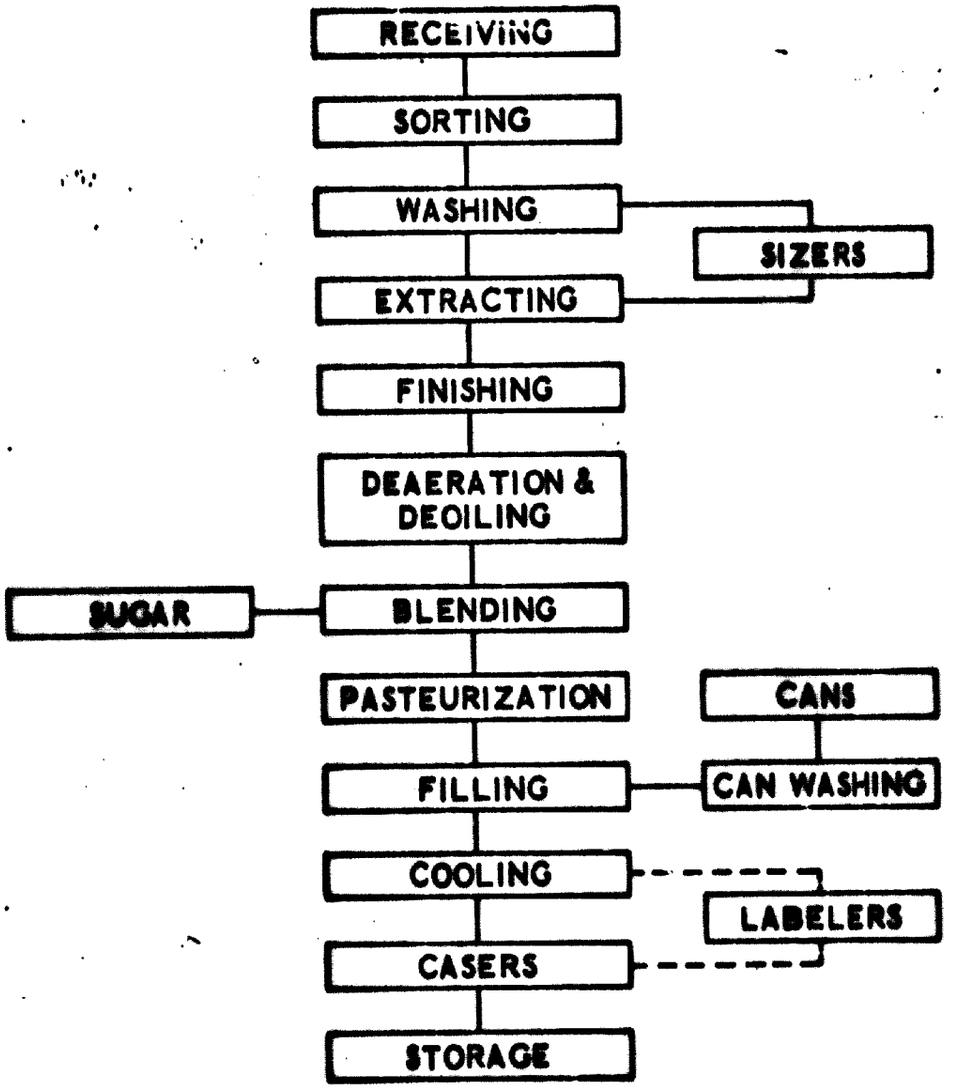
In general, the shorter the time interval between filling and closing and subsequent cooling, the better will be the flavor of the juice.

Cans

Cans made from electrotin plate with plain inside bodies and plain or enameled inside ends are recommended.

Prior to filling, the cans should be spray washed with a relatively large volume of water at a minimum temperature of 180° F to remove any possible dust or other foreign material that may have contaminated the cans during storage.

FLOW SHEET

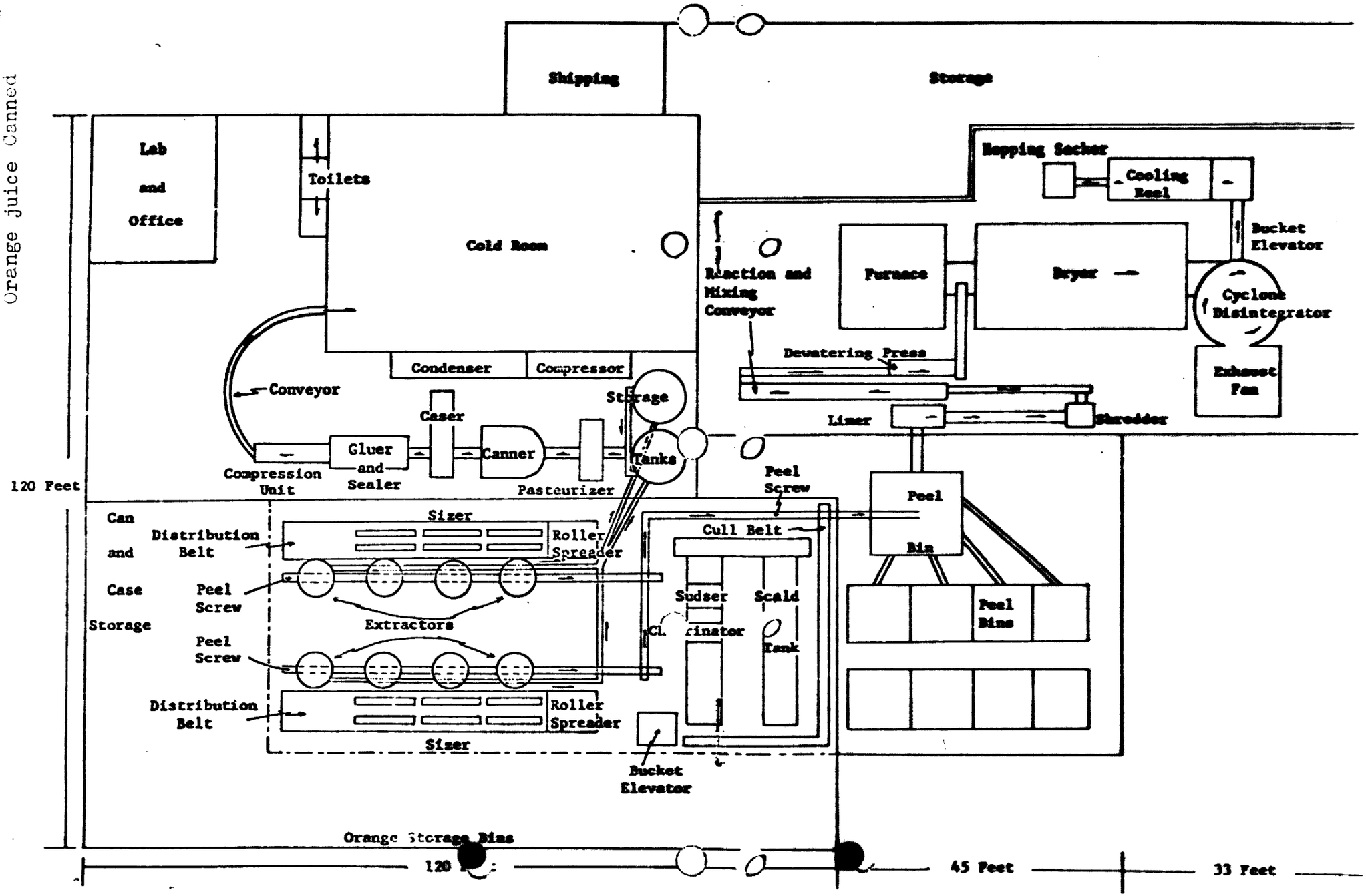


Blended Grapefruit Juice and Orange Juice

UNIDO IT. NO. 66012
1966

PLANT LAYOUT AND WORKFLOW

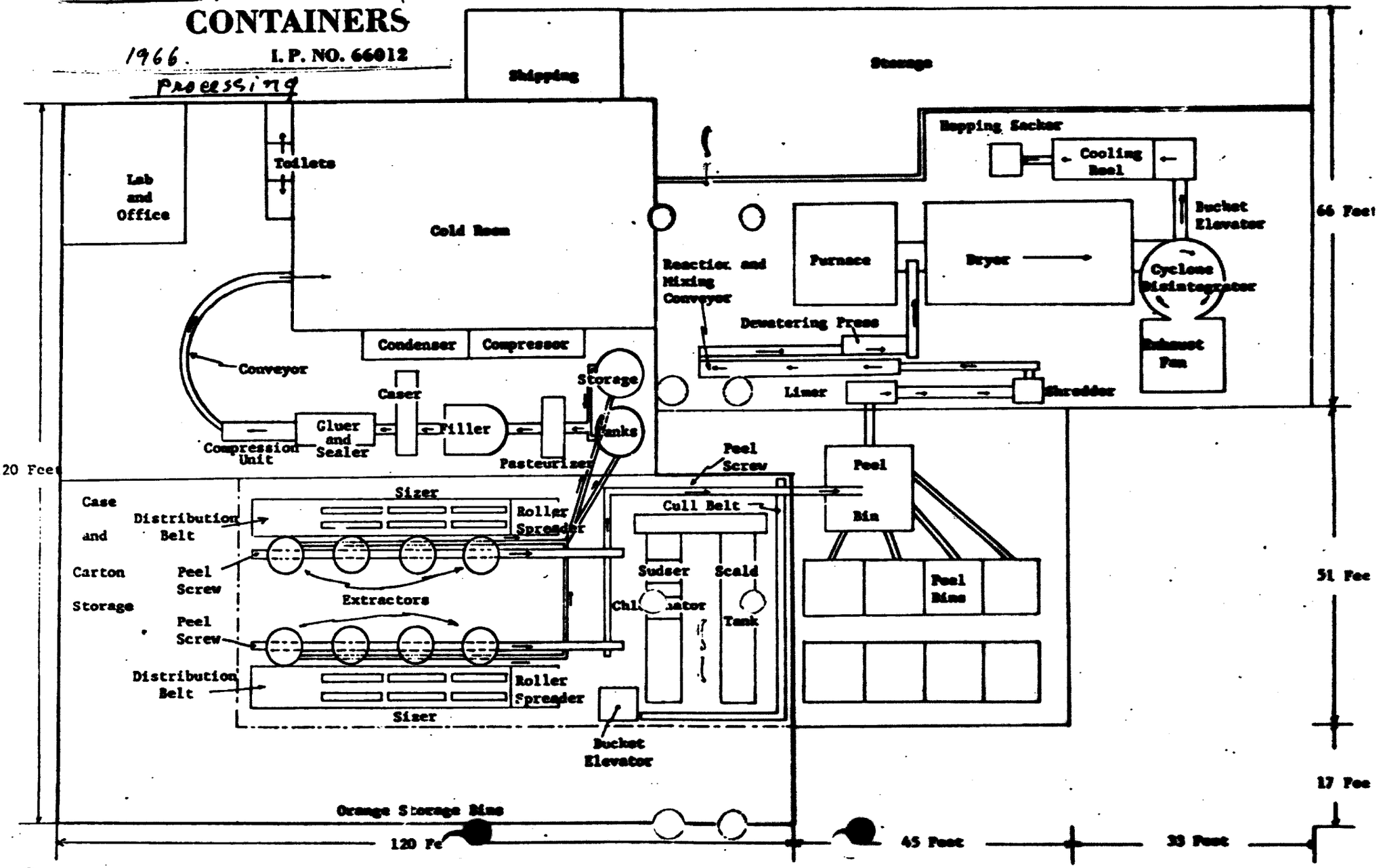
Orange juice Canned



ORANGE JUICE, CHILLED, IN WAXED CONTAINERS

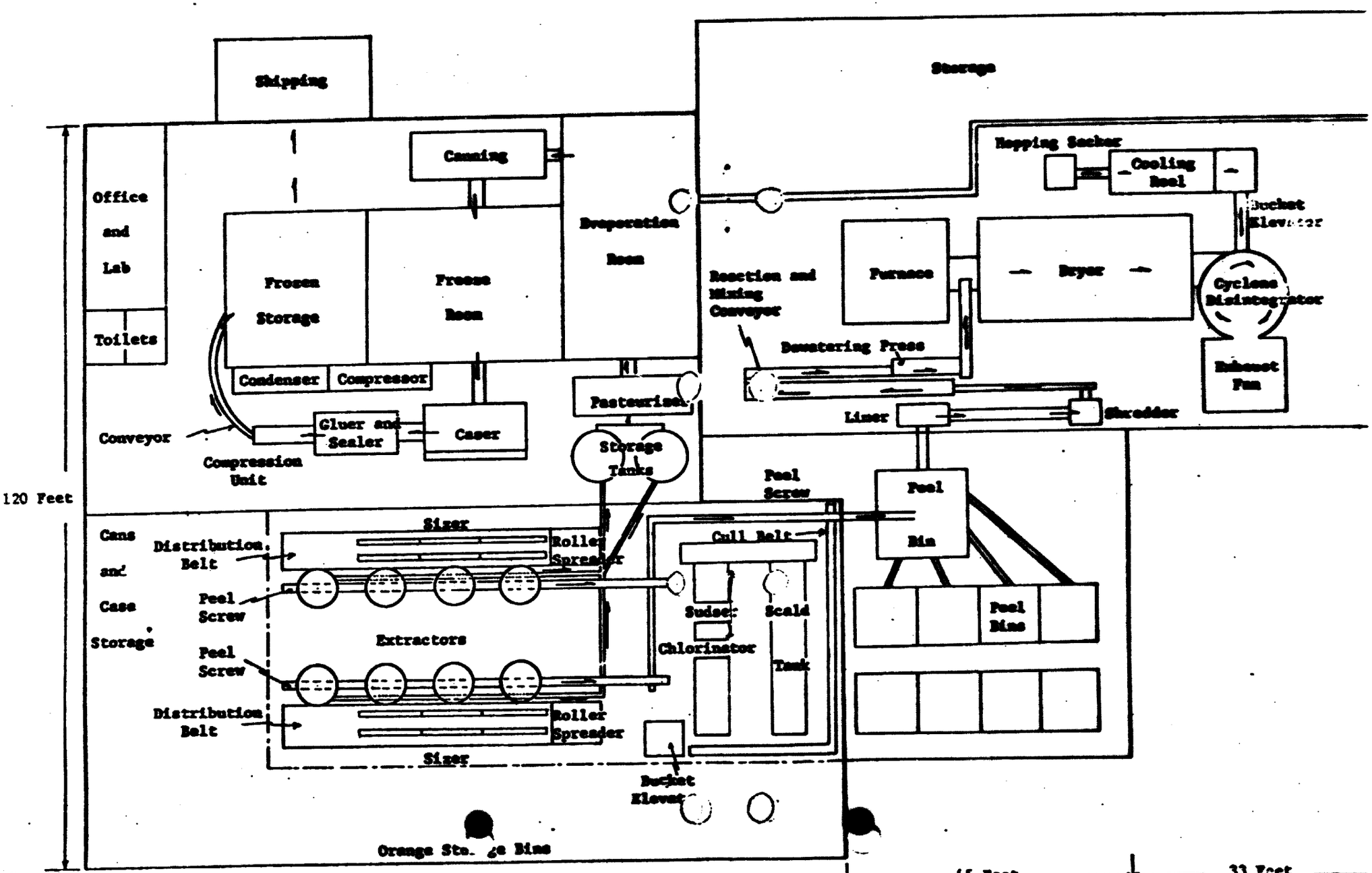
1966. I. P. NO. 66012

Processing



ORANGE JUICE CONCENTRATE: S.I.C. 2033

UNIDO
IP. 66091 1966.



Lime Concentrate Processing

A. L. Shewfelt, 1972

The University of Georgia College of Agriculture

Experiment Stations • Georgia Station

EXPERIMENT, GEORGIA 30212

Lime concentrate has been prepared by adding sucrose to the single strength juice to raise the Brix to 48°. This may be held in pasteurized or frozen form and reconstituted for limeade by adding 4 to 4 1/2 parts of water. This would not be a filtered or clear product.

In the West Indies, a clear lime juice has been prepared by crushing the whole fruit, straining it and storing it in wooden tanks for 2 to 4 weeks.

The sludge settles to the bottom and the light pulp floats to the top leaving a clear juice between. The acid and oil in the product inhibit fermentation. Filtration results in a sparkling clear product. If the acid is still high, say about 8 to 10%, the addition of sugar to this product might provide the type of cordial desired.

PROCESSING LIME JUICE

FMC INTERNATIONAL

A DIVISION OF FMC EXPORT CORPORATION

1105 COLEMAN AVENUE, BOX 1178, SAN JOSE, CALIFORNIA 95108 • TELEPHONE: (408) 289-0111
TELEX: 3464-73 • CABLE: FOODMACHIN SAN JOSE 1972

There has recently been developed a new process utilizing the FMC Inline Juice Extractor, which provides the processor the ultimate degree in control of the formulation of his product.

Lime Juice Processing
(Concentrate)

"Chemistry and Technology of Citrus, Citrus Product and Byproducts," USDA Agriculture Handbook No. 98, revised September 1962. This booklet is a good source of citrus processing ideas.

One possible solution might be careful evaporation at atmospheric pressure with a high surface area/volume ratio and constant stirring to prevent burn-on. The concentrate could be brought to about 5 fold and fresh lime juice added to achieve 4 fold. This add-back technique has been successful in improving vacuum concentrated citrus juices. Provided the concentrate isn't overcooked and the fresh juice added doesn't promote undesirable enzymic activity (in which case pasteurization is suggested), an acceptable product might be produced. Add-back might be appropriate even if tests reveal the need for vacuum concentration. Also, some flavor improvement might be achieved by adding a little peel oil to the finished concentrate.

If lime juice and labor are cheap and plentiful and freezing facilities are available, one could attempt freeze concentration by simply allowing the lime juice to freeze slowly with occasional removal of ice crystals, followed by freezing of the remainder and collecting the initial portions during slow thawing. In this manner a 4 fold concentrate could be built up in yields approaching 30%.

Processing

Commercial guava juice in Hawaii.

Anon. 1957. Bul 111. Univ. Hawaii.

Guava (Psidium guajava L.) This fruit is one of the select group that can show a high ascorbic acid content simultaneously with an intense and attractive (to some people) flavour. People who habitually eat guava appreciate the luscious flavour of the juice, but the inverse proposition unfortunately is true also.

Apart from the simplest procedures, the fruit in South Africa is sometimes milled to a coarse pulp, heated to 37°C.–43°C., and treated with a pectinase enzyme at 0.1–0.2% for twelve hours. With an efficient breakdown of pectin, the resulting pulp can be pressed to provide a cloudy juice at 75% yield. From this a syrup can be produced and will retain its natural flavour at freezing point or just above for up to two years

At ambient temperatures, only one year's shelf-life is obtained. The clarified juice can also be concentrated in vacuum up to 65° Brix. Levels of ascorbic acid up to 2,500 mgs/100 g. can be reached, but such concentrates must be stored at freezing point if development of high pressures of gas in the cans due to decomposition of ascorbic acid is to be avoided.

Guava Purées Processing. Tressler, D. K., Van-Arsdel, W. B., Copley, M. J. 1968. The Freezing Preservation of Foods. Westport, Connecticut, The AVI Publishing Company, Inc. 139-140.

Guavas are one of the easiest fruits to process, since the whole fruit, without peeling or coring, is fed into a paddle-pulper which crushes it into a purée. If the fruit is too firm to pulp by this method it may be necessary to pass it first through a chopper or a slicer. The seeds, fibrous pieces, and skin tissue are screened out with a 0.033 or 0.045-in. perforated screen. The outer flesh of most guava fruits contains a considerable number of hard stone cells. These are removed either by passing the purée through a paddle finisher with a 0.020-in. screen or through a disintegrator which pulverizes the cells. This latter method reduces the graininess but results in a purée whose color is inferior. After removal of the stone cells the purée is passed through a slush freezer and is filled into containers. It is advisable to use plastic-lined enameled containers because of the high acidity of guava purée.

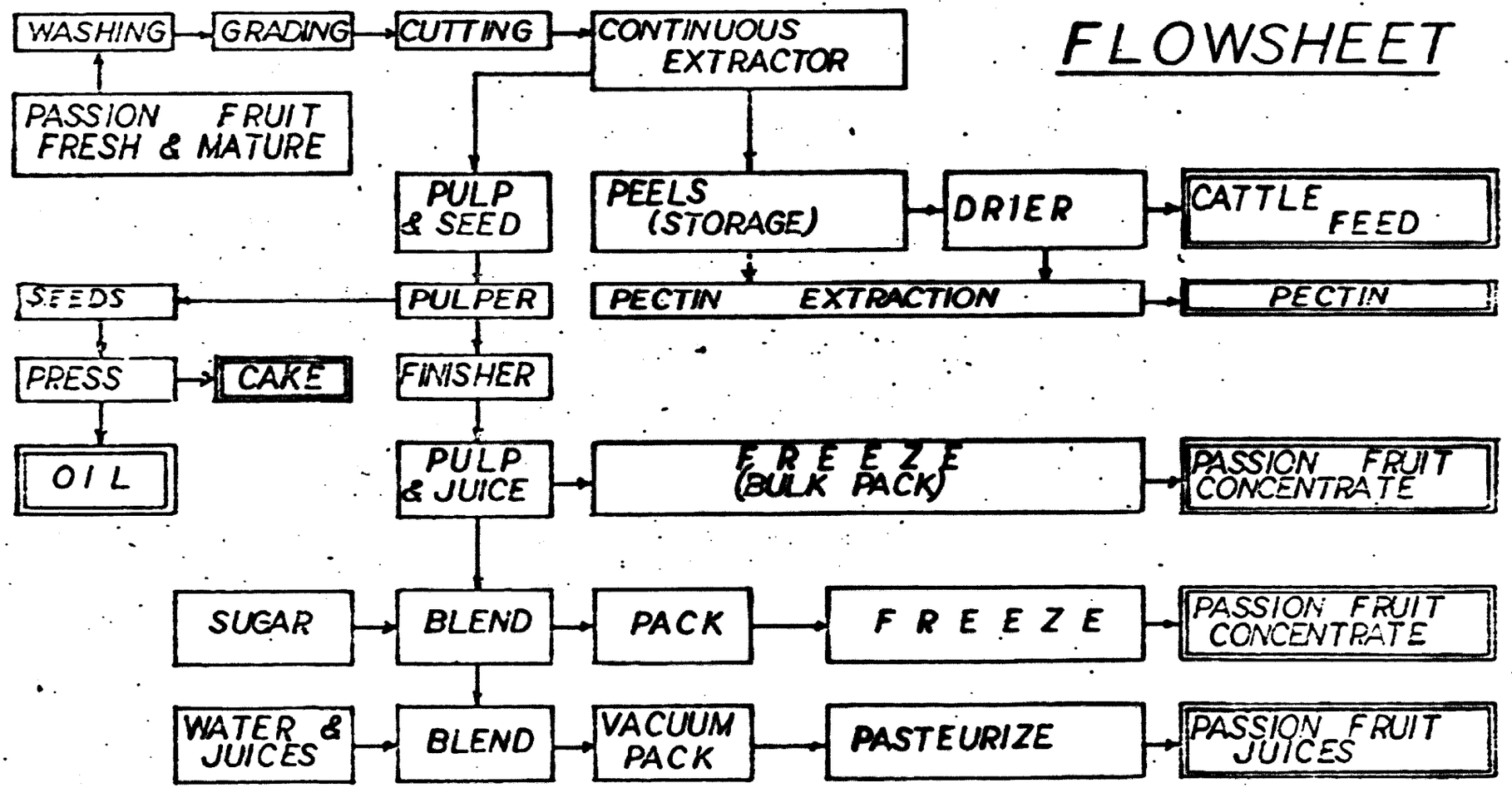
Mango. Anon. 1961. Monograph for the Industry, No. 1, CFTRI, Mysore. [English].

Processing

Mango (Mangifera indica L.) Clear juices are not produced, but the commercial products today are in the form of nectars or very cloudy juices.

PASSION FRUIT PROCESSING

FLOWSHEET



Source: VOLUNTEERS FOR INTERNATIONAL TECHNICAL ASSISTANCE, INC.
College Campus, Schenectady, New York 12308 U. S. A.

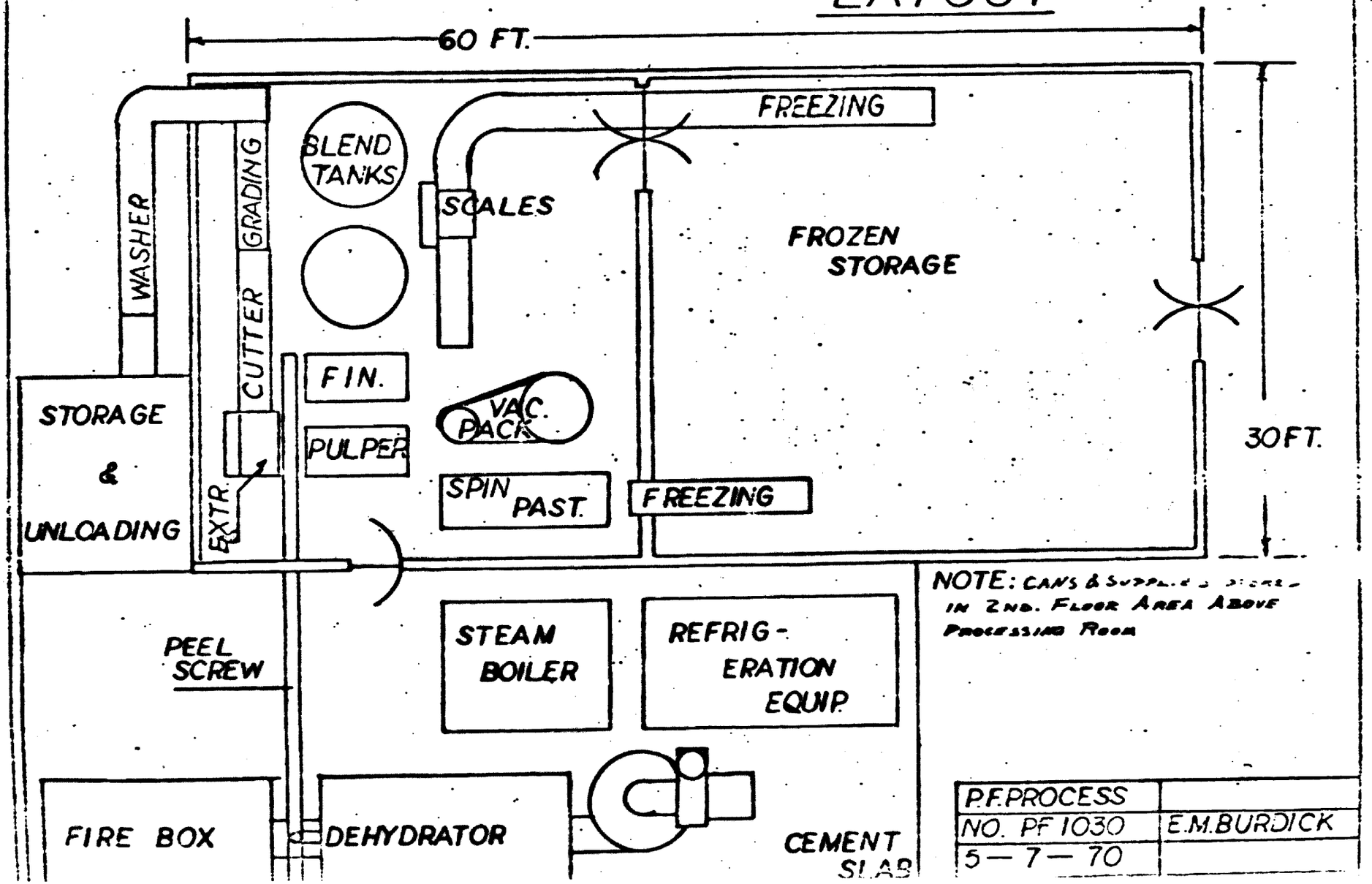
Burdick, E M. 1970

END PRODUCTS

P.F. PROCESS	
NO. PF-1010	
4-27-70	E.M.BURDICK

PASSION FRUIT PROCESSING PLANT

"LAYOUT"



P.F. PROCESS	
NO. PF 1030	E.M. BURDICK
5 — 7 — 70	

Some tropical fruit juices. Charley, V.L.S. 1967. Tropical Product Institute conference. p. 161-166 [English]

Granadilla (passion fruit) juice

Processing

The extraction is done by specially constructed machines devised in Australia and Hawaii; although another quite efficient extractor was designed by a 'trial and error' method by a lone British grower in the Kenyan highlands. It is not *always* necessary to have the services of sophisticated engineering workshops, although they do help!

Process of dehydration of pineapple-juice

Moy, J.H.
"Vacuum-puff freeze drying of tropical fruit juices",
J. Food Science, (1971), 36, p. 906-910.

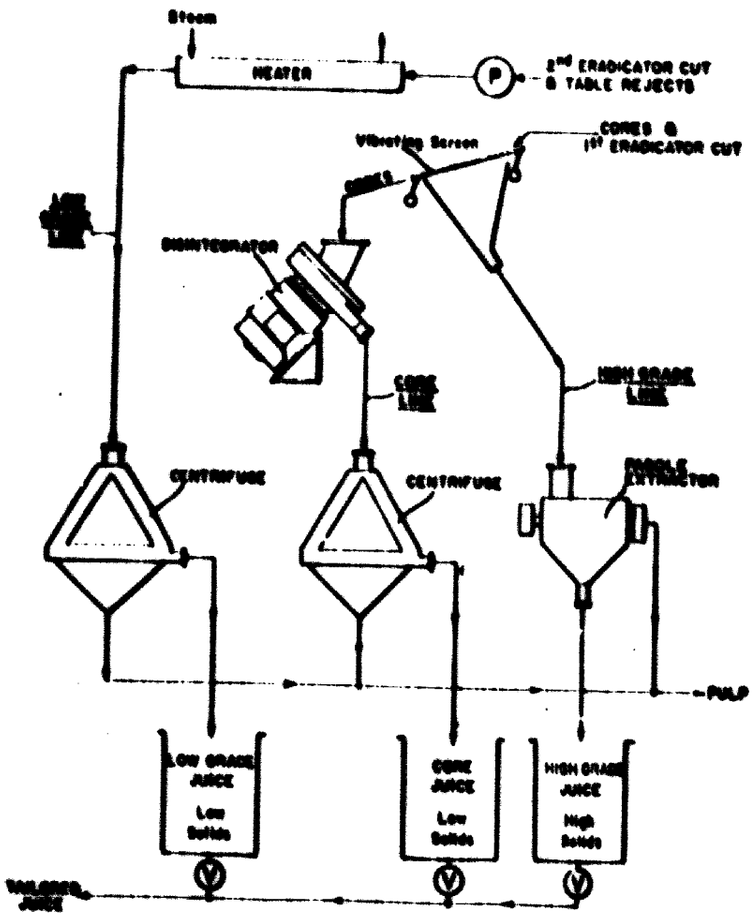
Vacuum-puff freeze drying

The product is dried at a temperature below the freezing point. The difference with ordinary freeze drying is that the latter does not involve a change in volume.

Fruit Processing. Milton, G. 1971. Noyes Data Corporation. Park Ridge, New Jersey. USA. p. 207-209 C. English J

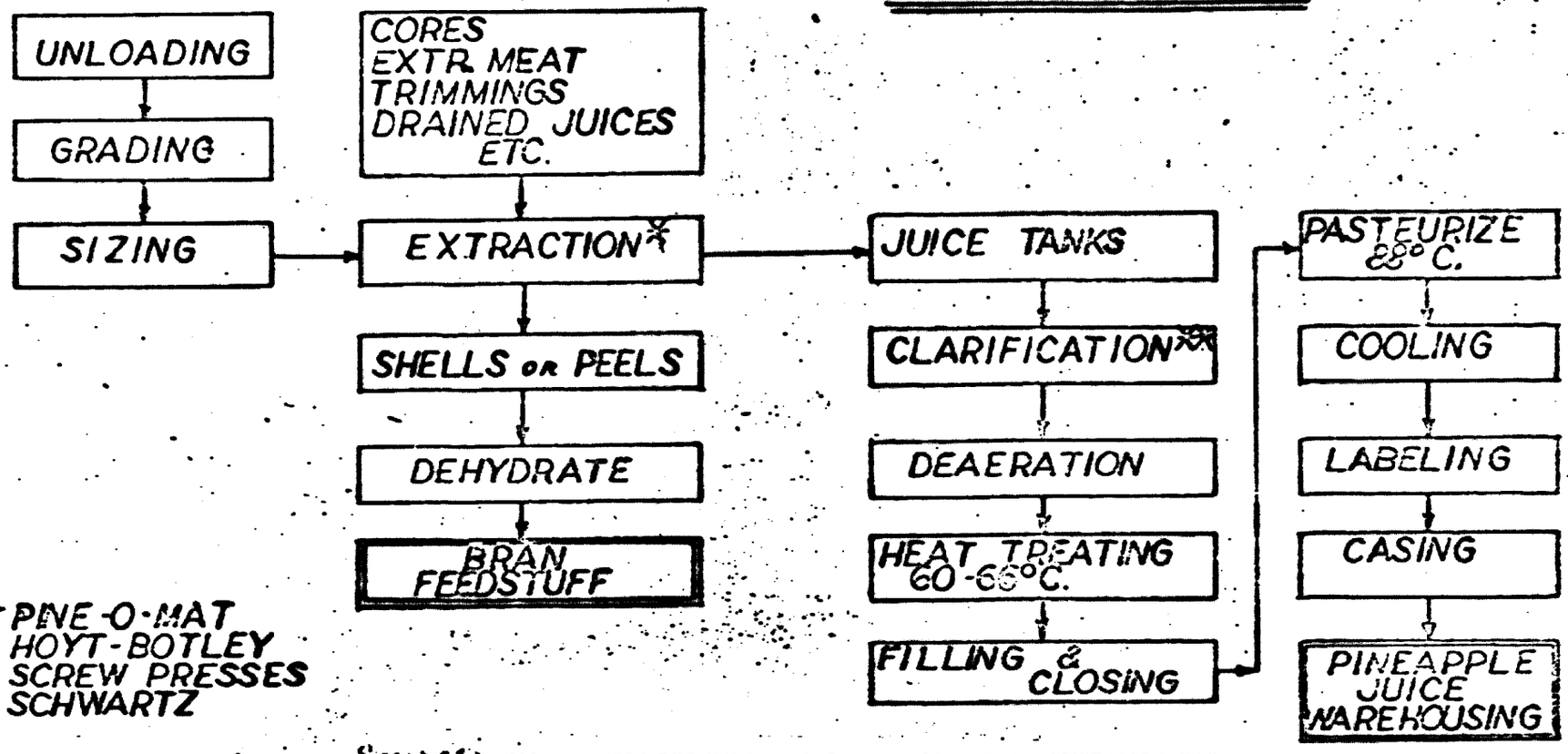
Process for the Production of Pineapple Juice

Many attempts have been made to remove the meat material from adjacent the skin and still leave the eyes in place. In one attempt the meat has been brushed from the skin by rotary brushes leaving the eyes relatively untouched. This procedure, however, proved troublesome and inefficient, partly because of the strong radial fibers which are firmly attached to the skin surface. In another attempt circular knives were attached to the sizing knife to cut the meat from the skin, and the juice close to the skin was squeezed by plastic rollers. This procedure left a large percentage of good fruit on the skin, which was lost to waste, and also squeezed undesirable flavors from the skin into the juice.



PINEAPPLE JUICE PROCESSING

FLOWSHEET



* PNE-O-MAT
HOYT-BOTLEY
SCREW PRESSES
SCHWARTZ

Source: VOLUNTEERS FOR INTERNATIONAL TECHNICAL ASSISTANCE, INC.
College Campus, Schenectady, New York 12308 U. S. A.

** SHARPLES CENTRIFUGES
MERCOID "
WESTFALIA "
DELAVAL "
HOYT-BOTLEY FILTER

Everette M. Burdick 1970

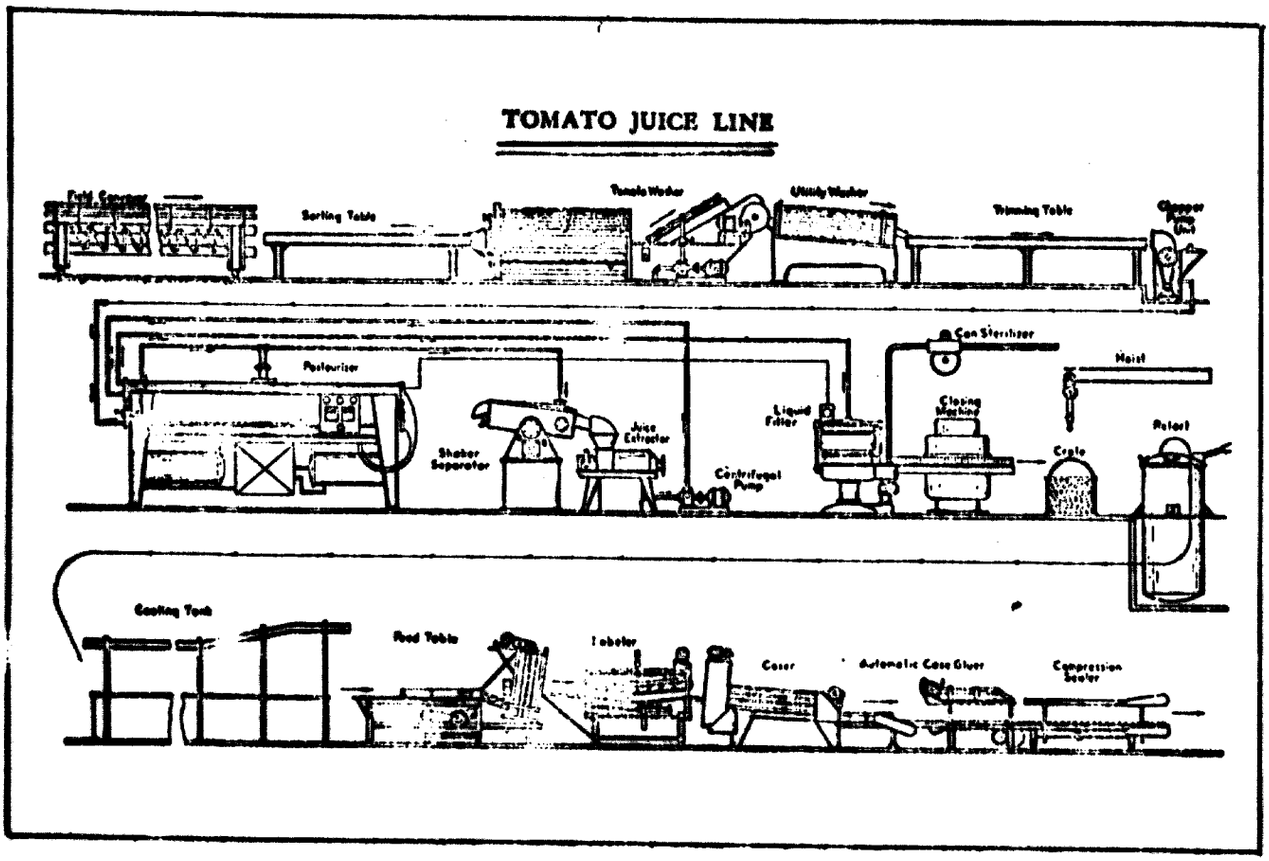
PIN PROCESS	
NO. PIN-2010	E.M.BURDICK
5-7-70	

A COMPLETE COURSE IN CANNING

ANTHONY LOPEZ, PH.D. 1969

THE CANNING TRADE

BALTIMORE, MARYLAND P. 315-346 [English]



3. Production / Producing countries :

FRUIT

LONDON
COMMONWEALTH SECRETARIAT
1972 P 152

Production of fruit juices

	Average 1956-60*a*	1964	1965	1966	1967	1968	1969	1970
	million gallons							
Commonwealth								
United Kingdom	5.5*b*	7.6*g*	7.1*g*	5.3*g*	4.9*g*	4.8*g*	3.9*g*	4.9*g*
Australia *d g*	4.8	8.1	10.1	7.3	9.8	8.8	13.0	(14.0)
Australia *h d*		0.8	0.8	0.9	1.2	1.0	1.8	(2.0)
Australia *c d*		1.4	1.5	1.9	1.9	2.0	2.2	(2.0)
New Zealand	–	0.5	0.6	0.7	0.7	0.7	0.4	0.5
Canada	7.3	12.0	16.7	13.2	19.6	17.0	19.0	20.0
Trinidad	2.3	3.6	2.8	2.2	1.6	1.6	1.5	1.5
Jamaica *e*	1.3	1.8	2.5	2.1	1.6	1.5	1.9	1.4
Dominica *e*	0.4	0.1	0.3	0.3	0.1	0.2	0.2	0.2
British Honduras	0.7	1.7*e*	1.3*e*	0.8*e*	0.8	0.8	1.1	1.2
Cyprus *e*	0.6	0.4	0.7	0.2	0.2	0.4	0.4	0.3
Foreign								
Switzerland *g*	19.2	14.0	13.0	11.0	12.5	9.5	10.0	9.0
Switzerland *h*		2.2	0.6	2.6	5.2	1.2	5.8	3.0
West Germany	38.1	47.1	44.5	46.7	63.0	60.0	65.0	70.0
East Germany	8.7	14.0	15.0	15.0	15.0	15.0	15.0	15.0
Italy *j*	13.9	31.6	27.8	31.0	34.6	35.8	42.0	45.0
Spain	1.3	4.6	5.8	6.0	8.0	10.0	10.0	10.0
France *g*	9.7	24.8	24.2	23.7	23.2	19.5	20.6	21.0
France *h*		2.8	2.7	1.8	0.3	0.3	0.3	0.5
Netherlands	2.5	3.5	3.0	3.0	3.5	3.8	3.8	4.0
Belgium *g*	1.0	1.0	1.4	1.6	3.5	4.4	4.7	5.0
Denmark	1.3	2.0	2.0	2.5	2.7	3.0	3.0	3.0
Sweden	0.1	7.9	8.0	8.0	13.0	6.0	17.0	10.0
Norway	0.6	1.2	1.7	2.0	2.2	2.8	3.0	3.0
Austria	1.9	2.3	2.5	2.5	3.0	4.0	4.5	4.5
Greece	1.0	5.0	5.2	6.4	8.8	9.0	10.0	10.0
Hungary	1.1	2.0	2.0	2.0	2.5	2.5	3.0	3.0
Yugoslavia *e*	0.7	1.5	2.1	1.8	2.0	2.0	2.8	2.5
Bulgaria *h*	1.5	1.4	1.7	1.4	1.6	1.6	1.6	1.5
South Africa	2.7	6.0*f*	6.0*f*	6.0*f*	6.5	6.5	7.0	7.0
South Africa *c*	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5
United States *g*	222.3	209.3	249.8	299.5	265.4	283.4	314.8	303.6
United States *h*	99.9	124.5	115.3	163.2	118.2	143.3	157.8	146.4
Brazil	..	0.8	1.4	2.2	3.6	5.0	4.5	7.0
Philippines *e f*	4.9	3.2	9.7	8.7	8.5	6.2	8.3	9.0
Israel *g*	1.7	7.5	8.0	7.0	9.8	14.6	14.6	16.8
Israel *h*	3.3	2.5	2.6	2.4	3.5	5.2	4.7	5.5
Israel *c*	0.3	1.9	2.0	2.1	2.0	2.0	2.5	2.5
Japan	2.1	20.0	..	..	..	..	..	..
Ivory Coast	0.7	1.5	1.6	1.6	1.7	1.7	2.0	2.0
Algeria *i*	1.0	0.6	0.6	1.0	1.0	1.0	1.0	1.0
Morocco *i*	0.8	2.5	1.9	1.4	2.7	3.0	3.0	3.0
Tunisia	0.3	0.2	0.1	0.1	0.4	0.4	0.1	0.5
Venezuela	5.2	5.5	6.0	6.0	6.0	6.0	6.5	6.0
Commonwealth	22.9	38.0	44.4	34.9	42.4	38.8	45.4	48.0
Europe	102.6	168.9	163.2	169.0	204.6	190.4	222.1	220.0
Other foreign	345.6	386.5	405.5	501.7	429.8	478.8	527.2	510.8
Total	471.1	593.4	613.1	705.6	676.8	708.0	794.7	778.8

a Or avialable years.
b 1954 census (partly estimated, including reprocessed imported juice: corresponding value £3.7–£4.5 million at 1958 census).
c Juice for squashes (estimated).
d Twelve months ending 30th June of year shown.
e Exports.
f Estimated.
g Single-strength.
h Concentrate.
i Excluding grape.
j Data for 1960 and subsequent years reported in single-strength equivalent.

promising products from tropical fruits

R. E. Berry, C. J. Wagner, Jr. and P. E. Shaw/U.S. Citrus and Subtropical Products Laboratory*
Winter Haven, Fla. and R. J. Knight/Jr. Subtropical Horticulture Station*/Miami, Fla.

food product development MAY 1977 p. 111 [English]

Acerola, West Indian, Puerto Rican, or Barbados cherry juice Producing countries

Some studies have been directed toward one of the richest fruit sources of vitamin C, the Acerola or West Indian or Barbados cherry (*Malpighia glabra* L.). These small red berry-like fruits are grown in South Florida, the Caribbean Islands, and some areas of Central America. They contain a very high percentage of vitamin C in the juice and pulp, and one processor in southern Florida makes juice from these cherries as a source of natural vitamin C for manufacturers. Sometimes, when pasteurized and bottled in soft drink-type bottles with crown caps, Acerola juice builds up carbon dioxide when stored over a period of time at room temperature. In a few cases, bottles have exploded from the pressure. Studies were made to determine whether inadequate pasteurization and fermentation were responsi-

Citrus Juice Main Producing Countries (Import to the United Kingdom)

Commonwealth Secretariat. 1972. Fruit. A Review of Production and Trade. London. Commonwealth. p. 151 [English].

The overwhelming importance of Israel as a source for citrus juices was apparent; supplies from that country rose from 7.6 million gallons in 1970 to 13.1 million gallons in 1971 and far outweighed in importance entries from other countries. Of particular interest was the increase in juice imports from Greece which reached 3.7 million gallons in the year. The orange concentrate market expanded somewhat and an increase was recorded in 1971 for both canned and casked juices though the former continued to be of greater importance. On the canned side the major supplying countries were the United States and Israel while British Honduras was also of significance. On the casked side Israel remained pre-eminent, followed by Brazil and British Honduras.

Guava Producing Countries. Tressler, D. K., Van Arsdel, W. B., Copley, M. J., 1968. The Freezing Preservation of Foods. Westport, Connecticut. p. 139-140

Guavas are tropical fruits.

Most of the guava purée used in the United States comes from Hawaii. Guavas there are obtained both from wild trees and from cultivated orchards. The guava fruit has a rough-textured yellow

Some tropical Fruit juices. Charley, V.L.S. 1969. Tropical Product Institute conference. # 166 [English].

Lime juice

Producing Countries

For juice products in Europe, the small West Indian (Key or Mexican) lime is much preferred to the Persian (Tahiti) fruit, which grows mainly in Florida and is much larger, being oval and the size of a small lemon.

Papaya. Anon. 1963 Industrial Monographs No. 2. CFTRI, Mysore.

Producing Countries

Papaya or Paw-Paw (Carica papaya L.) This fruit is widely grown in all tropical and semi-tropical areas, and is processed into nectars containing about 40–60% fruit materials and other tissue-containing types of beverages either for dilution or straight consump-

TROPICAL FRUIT PROCESSING INDUSTRY

Case Studies of the Industry in developing countries

by

Henri Vandendriessche

DEVELOPMENT CENTRE
OF THE ORGANISATION
FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

PARIS 1976

ESTIMATED PASSION FRUIT JUICE PRODUCTION
(Tons)

	TIP est. a) 1965-1966	FAO est. 1970
United States (Hawaii)	700 b)	400
Australia	175	816
Fiji, Papua, New Guinea	370	210
New Zealand	...	20
Kenya	500	560
South Africa	200	40
Sri Lanka	...	530
Total	2,000	2,576

a) Converted from imperial gallons on the basis of 200 gallons per m. ton.

b) Revised from original TIP estimate of 1,250 tons on the basis of Hawaii's cannery intake and an extraction rate of 33 per cent.

Passion Fruit Juice

Some tropical fruit juices. Charley, V. L. S. 1969. Tropical Product Institute Conference. p. 161-166 [English].

Producing countries

Over the last thirty years, the centres of activity of growing the fruit have been in Australia, South Africa, Kenya and Hawaii. The juice has been, and still is, mainly used either as an ingredient in a mixed juice drink (i.e. Hawaiian punch or any other form of non-alcoholic punch) or as a straight still or carbonated beverage./

4. a. Market- consumption of fruit juices :

Market- consumption for fruit juices in general :

Fruit juices Market Considerations.

Hardenmark, J. 1974. Processing Fruit Juice - The Quality Way. UNIDO (ID/WG. 172/4) [English]. p. 1.

In the last three decades, the fruit juice and soft drink industries have developed at a phenomenal rate. In less than 35 years, the commercial output of fruit juices and concentrates increased from almost nothing to about 7,000,000 tons, the breakdown being of the following order of magnitude.

	Tons
Orange juice	3,700,000
Apple juice	770,000
Grapefruit juice and other citrus juices	530,000
Pineapple juice	380,000
Grape juice	250,000
Tomato juice	660,000
Tropical fruit juice	260,000

A considerable expansion of the market has been predicted. Although three quarters of the world output of fruit juices is currently produced in the USA, there is every indication of an appreciable increase in some of the developing countries.

TYPES OF MARKET DEMAND FOR PROCESSED FRUIT PRODUCTS AND INTERRELATED FACTORS

Demand type	Types of processed tropical fruit products		
	Type I	Type II	Type III
	World or mass market demand	Regional/limited	Local/scarce
Interrelated factors			
1. Consumption	Large	Limited	Insignificant
2. Production	Plantation/ Cooperative	Small orchard farm	Untended orchards or native trees
3. Processing technology	Multiple	Simple	Underdeveloped
4. Investment requirements	Enormous	Considerable	Low
5. Profit potential	High	Average	Low
6. Minimum transition period	Medium term 3-5 years	Long term 6-10 years	
	Kinds of fruit		
	Citrus	Passion fruit	Jack-fruit
	------	Mango	Soursop
	Pineapple	Guava	Tamarind
	Tomato	Papaya	Hog-plum
		Banana	Mangaba
		Cashew apple	Umbu
			Acerola, etc.

Source : J.C. Clarke, Estrategia basica para programas de desenvolvimento de frutas tropicais, CEPED, Salvador, Bahia, September 1973.

Only orange juice production could be said to be up to supplying a type I export market demand. Potentially in this demand category are to be found pineapple products, thus the emphasis on pineapples throughout this study. It would also appear that passion fruit juice could be in this category if only the remaining supply problems - the Fusarium principally - were ironed out.

Export of Fruit Juices . Fruit.
Commonwealth Secretariat 1972. London.
p. 154 E English 2.

Exports of fruit juices

	Average 1956-60 *a*	1963	1964	1965	1966	1967	1968	1969	1970
	million gallons								
Commonwealth									
Australia *b*	0.9	0.4	0.7	0.6	0.4	0.4	0.6	0.5	0.6
Canada ..	0.3	0.6	0.9	0.3	0.5	0.8	0.8	0.7	0.9
Ghana ..	0.4	0.8	0.6	1.1	1.0	1.2	0.8*i*	0.6*i*	0.6*i*
United Kingdom	0.5	0.6	0.6	0.5	0.8	0.8	0.8	0.9	1.0
Trinidad & Tobago	1.9	2.0	1.8	2.3	2.1	1.9	1.7	1.2	1.4
Jamaica ..	1.3	1.7	1.8	2.5	2.1	1.6	1.5	1.9	1.4
Dominica ..	0.4	0.2	0.1	0.3	0.3	0.1*i*	0.2*i*	0.2*i*	0.2*i*
British Honduras	0.7	1.0	1.7	1.3	0.8	0.8*i*	1.4	1.5*i*	1.5*i*
Malaysia ..	0.2	0.3	0.4	0.2	0.2	0.2	0.2	0.2	0.2*i*
Cyprus ..	0.3	0.6	0.4	0.7	0.6	0.8	0.9	0.8	0.3
Kenya ..	0.1	0.2	0.2	0.1	0.2	0.3	0.2	0.2	0.2
Rhodesia ..	0.1	0.1	0.4	..	..	..	..	..	..
Foreign									
Italy *d* ..	9.3	9.0	10.5	10.6	11.5	12.9	13.0	13.8	14.0
France ..	6.2	10.1	7.8	9.1	8.9	7.1	12.0	11.1	14.8
West Germany	0.3	1.1	2.6	1.9	2.6	3.6	3.8	5.0	5.0
Netherlands	0.6	0.4	0.6	0.8	1.1	4.7	5.7	5.6	7.8
Greece ..	0.1	1.9	2.3	2.9	4.2	3.8	3.9	3.6	4.0*i*
Switzerland *e*	0.9	1.6	1.4	0.9	0.5	0.7	1.4	1.7	2.4
Spain ..	1.4	2.4	4.0	3.6	3.9	4.6	5.0	5.8	9.1
Denmark ..	0.4	0.3	0.3	0.3	0.2	0.2	0.3	0.3	0.5
Yugoslavia ..	0.7	0.4	1.5	2.1	1.8	1.8	1.8	2.8	2.5
Austria ..	0.1	0.1	0.1	0.1	0.1	0.5	2.1	3.8	4.8
Romania *f*	–	1.8	1.9	1.1	1.9	2.1	1.2	1.1	1.5*i*
Bulgaria ..	0.3*f*	0.9*f*	0.8	1.1	2.6	3.8	5.8	7.7	5.5*i*
Hungary ..	–	0.3*g*	0.3*g*	0.4*g*	0.3*g*	0.5	0.6	1.0*i*	1.0*i*
South Africa	2.3	4.6	4.8	4.3	4.7	3.8	3.9	4.8	4.1
United States	28.9	24.4	22.1	19.5	21.5	30.1	27.5	26.3	31.5
Morocco ..	1.1	2.3	3.1	3.8	6.1	5.5	5.2	7.7	6.8
Tunisia ..	0.4	0.2	0.1*i*	1.0	3.1	0.1*f*	1.3*j*	0.2*j*	1.0*j*
Algeria ..	1.0	2.9	2.6	1.2	1.1*i*	2.1*i*	2.6*i*	1.5*i*	2.0*i*
Israel ..	2.6	7.2	9.4	10.6	10.4	13.7	18.2	21.8	22.6
Philippines *c*	5.3	3.4	3.2	9.7	8.7	8.5	6.2	8.3	9.0*i*
Martinique ..	0.2	0.4	0.4	0.4*i*	0.5	0.4	0.5	0.2	0.2*i*
Ivory Coast .	0.6	1.2	1.5	1.6	1.6	1.7	1.7	2.0	2.5
Japan ..	0.1	1.1	0.7	0.8	1.1	1.3	1.1	0.8	0.9
Mexico ..	0.3	0.7	1.2	0.8	1.0	0.6	0.4	0.2	0.5*i*
Brazil ..	–	1.1	0.8	1.2	2.8	3.8	6.0	4.6	6.7
Argentina ..	–	0.7	0.3	0.2	0.2	0.2	1.0	0.5*i*	0.5*i*
China *h* ..	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1*i*	0.1*i*
Total ..	70.4	89.1	93.9	100.0	111.6	127.1	141.1	151.0	169.6

a Or available years.
b Twelve months ending 30th June of year shown.
c Imports into the United States from the Philippines, up to 1962 and in 1965 and 1966.
d Includes tomato juice.
e Includes small quantities of vegetable juice from 1960.
f Imports into Soviet Union, West Germany and Austria.
g Imports into West Germany and Austria.
h Imports into Malaysia and Singapore.
i Estimated.
j Imports into France.

Main Juice Varieties

Commonwealth Secretariat. 1972. Fruit. A Review of Production and Trade. London. Commonwealth. P. 145 [English].

The major packs of citrus, apple, pineapple and grape juices account for the bulk of overall juice production though in addition a wide range of tropical juices and of deciduous juices and nectars including berry fruit juices and syrups are packed.

Developing countries have a particular interest in the export possibilities of exotic juices one instance of this being the opening of a new passion fruit processing factory at Thika in Kenya in 1971 and the conclusion of a marketing agreement with a major food chain store organisation and a Kenya cannery which it is hoped will lead to an increase in exports of processed pineapple and passion fruit.

Soft and Carbonated Drinks. Problems of Food Processing Industries in Developing Countries. IBRD. May 1969. Report No. EC-169. p. 44 [English].

Economy

The production of soft and carbonated drinks and brewing are generally among the first manufacturing activities established in developing countries. Once these products are introduced into a country, demand grows rapidly. Most developing countries have hot climates and inadequate drinking water supplies.

Market- consumption for certain juices:

Some tropical fruit juices. Charley, V. L. S. Tropical Products Institute conference. 1969. P. 165 [English].

Acerola, West Indian Cherry juice

Economy - (Market)

Concentrates stored at freezing point were also widely distributed from Puerto Rico to East Coast areas in the USA where direct shipping lines were available.

The acerola powder has many uses. It can be diluted **to juice and made into sucrose-syrups with guaranteed ascorbic acid contents for children or, more recently into sucrose-free syrups (but containing glucose solids) which are highly acceptable to the dental authorities in view of the caries-forming potentialities of sucrose. The powder is an acceptable raw material to introduce into high vitamin C level powdered health product with multiple vitamin content.**

Usage of Apple Juice

Commonwealth Secretariat 1972. Fruit. A Review of Production and Trade. London: Commonwealth. P. 146-147. [English].

Generally throughout east and west Europe apple usage for juice is an important sector in the utilisation pattern leading in some cases to very high consumption levels as in Switzerland

Europe's surplus crop supplies and in these conditions the reported trials in the Soviet Union, for example of aseptic conservation of apple juice in hermetically closed tanks without refrigeration may eventually effect radical changes in processing practices and juice marketing possibilities.

World Usage of Citrus Juice

Commonwealth Secretariat 1972. Fruit. A Review of Production and Trade. London, Commonwealth. p. 145 [English]
p 151, 221

Approximate indications of world usage of fruit for juice yield an overall intake level of possibly 15 million tons of which two thirds would be accounted for by citrus though the margin of error in these calculations is great dependent as it is on the use of rough estimates of around one fifth for the proportion of juice production on a world basis packed in concentrate form.

MARKETING

World fruit juice trade has been characterised by the apparently increasing relative movements of citrus concentrates which offer transport and packaging economies and have benefited from the generally high growth rate in demand for ingredient juices.

	1969–70 £ (c.i.f.)	Period	1970–71 £ (c.i.f.)	Period	1971–72 £ (c.i.f.)	Period
Grapefruit and orange juices ..	300,000 (excluding frozen orange concentrate)	Oct.–Sept.	300,000 (excluding frozen orange concentrate)	Oct.–Sept.	300,000 (excluding frozen orange concentrate)	Oct.–Sept.

The separate quota for imports of fresh grapefruit from Cuba has been repeated at $70,000 f.o.b. annually.

Guava Purées consumption. Tressler, D. K., Van Arsdel, W. B., Copley, M. J. 1968. The Freezing Preservation of Foods. Westport Connecticut. 139-140.

Guava purée is a component in many of the tropical fruit juice drinks which have become so popular in recent years. Although guavas are processed in Australia and Africa,

The Market for Mango Products. Kay, D. E. 1966. Tropical Products Institute (UK) Report No. G 17. [English].

Mango juice Economy

[Squashes made from juices are popular in India, whilst South Africa and Puerto Rico make extensive use of this fruit for a variety of canned and bottled beverages.

Passion Fruit Juice.

Some tropical Fruit Juices. Charley, V.L.S. 1969. Tropical Product Institute Conference. p. 161-166. C English 3.

Economy

As an example of enlightened enterprise on the part of a European firm of fruit juice producers now operating the Kenyan factory previously mentioned, may be quoted the fact that, without any previous experience of growing fruit, either of European or tropical character, they decided to make a determined attempt to effect a botanical cross between the purple and yellow type of grenadilla, thus combining in one fruit all the advantages and none of the disadvantages of either of the two 'parents'. The overall economics of such a fusion of characteristics may well provide a valuable economic asset to the project.

Exotic tropical fruit juice - Pineapple Consumption. Tropical Fruit Processing Industry. Vandendriessche, H. 1976. Development Centre of the Organisation for Economic Co-operation and Development Paris. [English].

Trade in canned juices for direct consumption has been essentially limited to Hawaiian shipments of guava and papaya drinks.

If the world's solid pack grows by 3.2 per cent up to 1980, the world's output (and consumption !) of pineapple juice would have to expand by about 11 per cent a year to ensure an optimum utilisation of projected levels of pineapple input by 1980 This is clearly an unattainable goal, and yet, for many individual processors, it shall remain the key to profitability in a fiercely competitive industry.

IMPORTS AND CONSUMPTION OF PINEAPPLE PRODUCTS, 1960-61 AND 1970-71

	Pineapple Juice (single strength basis)		
	1960-61 Av.	1970-71 Av.	Annual Growth from 1960-61 to 1970-71
United States :			
- Imports	19.5	51.6	10.2%
- Consumption	219.2	265.3	1.9%
Japan	1.0 e)	3.4	13.0%
Canada	7.0	8.5	2.0%
E.E.C. :	6.5 e)	20.7	12.3%
- France	5.2	15.7	
- Germany	n.a.	1.6	
- Belgium	n.a.	1.4	
- Italy	n.a.	1.4	
- Netherlands	n.a.	.6	
EFTA a) :	10.0 e)	22.0 e)	8.2%
- United Kingdom	7.5 e)	13.0	
- Denmark	n.a.	.4 e)	
- Sweden	n.a.	.9 e)	
- Switzerland	n.a.	7.7 e)	
New Zealand	n.a.	n.a.	
TOTAL IMPORTS (of listed countries)	44.0	106.0	9.2%
Total consumption (of listed countries)	243.7	320.0	3.8%

Sources : National Trade Statistics.

Notes : a) Excluding Portugal, but including Finland.
e) Estimates.
r) Revised estimate, adjusted from gross weight to net weight (difference 20%).

4. b. Estimated investments :

Fruit juice plant investment. Anad, y. 1972. (sept). National Center of scientific and technology information - Tel-Aviv. Israel.

1. If one has no experience in fruit juice production, the suitable project to start with, would be to built a bottling plant which will utilize industrial semifinished products (such as fruit concentrates, beverages bases, etc.) for the beverages production.

2. The basic investment for a moderate capacity bottling equipment (about 6000 bottles/hour) will be about $ 150.000. An increase of 50% in production rate will increase the cost about 10% only.

3. The above investment does not include buildings, water and sewage systems, power plant, tool slop, etc.

Fruit juice Drinks Plant investment. Bertuzzi, S.A. Sept. 1972. Binghesio (Milano) Italy.

To the cost of the mixing, carbonating and bottling plant similar to the plant already settled in Gahana, one has to add the cost of the fruit juice processing plant a minimum capacity of 500/600 kg/h of fresh fruits will be no less than 80.000/100.000 U.S.$.

Orange Juice Canned · 1966 UNIDO
I.P. NO. 66C90

Investment and

PRODUCTION REQUIREMENTS

ANNUAL CAPACITY - ONE 10 HOUR SHIFT, 160 DAYS ANNUALLY: 20,500,000 Cans

1. CAPITAL REQUIREMENTS

a. FIXED CAPITAL

		Cost
Land. About 4 acres.		$ --
Building. One story, 21,000 sq. ft.		126,000
Equipment, Furniture & Fixtures.		
Prodn. tools & equipmt.	$290,000	
Other tools & equipmt.	6,000	
Furniture & fixtures	1,000	
Transportation equipmt.	100,000	397,000
Total (excl. Land)		$ 523,000

Principal Items. Conveyors, elevators, fruit bins, roller graders, scald tank, washer, distributing belt, roller spreads, roll sizers, 8 extractors, screw conveyors, stainless steel tanks, heat exchanger, canning equipment, spinner can closer, cases palletizer, filling equipment, cold room, packer, peel meal equipment.

b. WORKING CAPITAL

	No. of Days	
Direct Materials, Direct Labor, Mfg. Overhead(a)	30	$ 506,600
Admin. Costs(b), Contingencies, Sales Costs(c)	30	12,100
Training Costs		3,300
Total Working Capital		$ 522,000

c. TOTAL CAPITAL (EXCL. LAND) $1,045,000

2. MATERIALS AND SUPPLIES

a. Direct Materials	Annual Requirements	Annual Cost
Oranges	1,600,000 Boxes	$5,120,000
Cans-32 oz.	20,500,000	549,000
Cartons	812,000	128,000
Labels		11,000
Total		$5,808,000

b. Supplies	
Lubricants & hand tools	$ 200
Cutting tools & abrasives	500
Maintenance & spare parts	22,000
Office supplies	300
Total	$ 23,000

3. POWER, FUEL AND WATER

	Annual Cost
a. Electric Power. 200 hp. connected load.	$ 1,000
b. Fuel. About 50,000 gals. oil annually.	$ 6,000
c. Water. For production, sanitation and fire prevention.	$ 400

4. TRANSPORTATION

	Annual Operating Cost
a. Own Transport Equipment. 10 trucks & 15 trailers.	$ 10,000

b. External Transport Facilities. Fruit must be trucked to plant. Good highway necessary.

5. MANPOWER

a. Direct Labor	Number	Annual Cost
Skilled	4	$ 16,000
Semi-skilled	23	76,700
Unskilled	23	61,300
Total	50	$ 154,000

b. Indirect Labor		
Manager & supervisor	2	$ 18,000
Office & inspector	6	22,000
Truck drivers	11	36,700
Total	19	$ 76,700

c. Training Needs. Manager & supervisor must be well experienced. With 4 skilled workers, they should be able to train all workers and reach full production in 15 days.

6. TOTAL ANNUAL COSTS AND SALES REVENUE

a. Annual Costs	
Direct Materials	$5,808,000
Direct Labor	154,000
Manufacturing Overhead(a)	117,100
Admin. Costs(b), Contingencies	75,000
Sales Costs(c), Bad Debts	70,000
Depreciation on Fixed Capital	61,600
Total	$6,285,700

b. Annual Sales Revenue $6,900,000

NOTES. (a) Includes Supplies, Power, Fuel, Water, Transportation, Indirect Labor. (b) Includes Interest, Insurance, Legal & Audit Charges. (c) Includes Sales Commissions, Freight Out, Travel.

Orange Juice Chilled, IN Waxed Containers. 1966. UNIDO IP. NO. 66012.

Investment +

PRODUCTION REQUIREMENTS

ANNUAL CAPACITY - ONE 10 HOUR-SHIFT OPERATION: 20,500,000 WAXED CONTAINERS

1. CAPITAL REQUIREMENTS

a. FIXED CAPITAL

		Cost
Land. 4 acres.		$ --
Building. One story, 21,000 sq. ft.		126,000
Equipment, Furniture & Fixtures.		
Prodn. tools & equipmt.	$270,000	
Other tools & equipmt.	6,000	
Furniture & fixtures	1,000	
Transportation equipmt.	100,000	377,000
Total (excl. Land)		$503,000

Principal items. Conveyors, elevators, fruit bins, roller graders, scald tank, washers, distribution belt, roller spreader, roll sizers, 8 extractors, screw conveyor, empty carton feed belt, stainless steel tanks, pumps, heat exchangers, refrigeration compressor, condensers, brine chillers, stainless steel filling equipment, cold room, boiler 61 hp. 125 p.s.i., storage tank and peel meal equipment.

b. WORKING CAPITAL

	No. of Days	
Direct Materials, Direct Labor, Mfg. Overhead(a)	60	$810,000
Admin. Costs(b), Contingencies, Sales Costs(c)	30	11,300
Training Costs		2,200
Total		$823,500

c. TOTAL CAPITAL (EXCL. LAND) $1,426,500

2. MATERIALS AND SUPPLIES

	Annual Requirements	Annual Cost
a. Direct Materials		
Oranges	1,600,000 bxs.	$4,640,000
Containers, waxed	20,500,000 qts.	455,000
Cases, cardboard and labels	$12,000	128,000
Total		$5,223,000
b. Supplies		
Lubricants & hand tools		$ 200
Cutting tools & abrasives		400
Maintenance & spare parts		6,000
Gas, oil & maintenance		30,100
Office supplies		300
Total		$ 37,000

3. POWER, FUEL AND WATER

	Annual Cost
a. Electric power. Connected load 165 hp.	$ 1,800
b. Fuel. 80,000 gals. oil.	$ 6,000
c. Water. Washing fruit, boiler and sanitary purposes.	$ 400

4. TRANSPORTATION

	Annual Operating Cost
a. Own Transport Equipment. 10 tractors and 15 trailers.	$ 10,000

b. External Transport Facilities. Fruit must be trucked to the plant. Good highway needed.

5. MANPOWER

	Number	Annual Cost
a. Direct Labor		
Skilled	3	$ 18,000
Semi-skilled	17	56,700
Unskilled	17	45,300
Total	37	$ 114,000
b. Indirect Labor		
Manager & supervisor	2	$ 16,000
Office & inspector	6	22,000
Truck drivers	11	36,700
Total	19	$ 76,700

c. Training Needs. Manager and supervisor must have years of experience. With 3 skilled workers, they should be able to train all workers and reach full production in 2 weeks.

6. TOTAL ANNUAL COSTS AND SALES REVENUE

a. Annual Costs	
Direct Materials	$5,223,000
Direct Labor	114,000
Manufacturing Overhead(a)	121,900
Admin. Costs(b), Contingencies	75,000
Sales Costs(c), Bad Debts	60,000
Depreciation on Fixed Capital	59,000
Total Annual Costs	$5,652,900
b. Annual Sales Revenue	$6,150,000

NOTES: (a) Includes Supplies, Power, Fuel, Water, Transportation, Indirect Labor. (b) Includes Interest, Insurance, Legal and Audit Charges. (c) Includes Sales Commissions, Freight Out, Travel.

ORANGE JUICE CONCENTRATE

UNIDO I.P. NO. 66091

1966

Investment +

PRODUCTION REQUIREMENTS

ANNUAL CAPACITY - THREE-SHIFT OPERATION, 18 TO 20 WEEKS ANNUALLY: 17 Million 6-oz. and 2.67 Million 12-oz. Cans

1. CAPITAL REQUIREMENTS

a. FIXED CAPITAL

		Cost
Land. About 4 acres.		$ --
Building. One story, 21,000 sq. ft.		126,000
Equipment, Furniture & Fixtures.		
Prodn. tools & equipmt. $787,000		
Other tools & equipmt.	9,000	
Furniture & fixtures	1,000	
Transportation equipmt.	72,000	869,000
Total (excl. land)		$995,000

Principal Items. Conveyors, elevators, fruit bins, roller graders, scald tank, washer, distribution belt, roller spreads, roll sizers, 8 extractors, screw conveyors, stainless steel tanks, heat exchanger, canning equipment, spinner can closer, cases palletizer, filling equipment, packer, refrigeration, evaporators, peel meal machine.

b. WORKING CAPITAL

	No. of Days	
Direct Materials, Direct Labor, Mfg. Overhead(a)	30	$334,600
Admin. Costs(b), Contingencies, Sales Costs(c)	30	14,400
Training Costs		5,000
Total Working Capital		$354,000

c. TOTAL CAPITAL (EXCL. LAND) $1,349,000

2. MATERIALS AND SUPPLIES

a. Direct Materials

	Annual Requirements	Annual Cost
Oranges	100 million	$3,200,000
Cans 6-oz.	17,000,000	352,000
Cans 12-oz.	2,670,000	67,000
Cartons 6-oz.	500,000	35,500
Cartons 12-oz.	111,250	7,900
Labels		9,000
Total		$3,671,400

b. Supplies

Lubricants & hand tools	$ 200
Cutting tools & abrasives	500
Maintenance & spare parts	24,000
Office supplies	300
Total	$ 25,000

3. POWER, FUEL AND WATER

	Annual Cost
a. Electric Power. 300 hp. connected load.	$ 2,000
b. Fuel. About 50,000 gals. oil annually.	$ 6,000
c. Water. For production, sanitation and fire prevention.	$ 400

4. TRANSPORTATION

	Annual Operating Cost
a. Own Transport Equipment. 7 trucks & 11 trailers.	$ 7,000

b. External Transport Facilities. Fruit must be trucked to plant. Good highway necessary.

5. MANPOWER

	Number	Annual Cost
a. Direct Labor		
Skilled	9	$ 27,000
Semi-skilled	60	120,000
Unskilled	60	90,000
Total	129	$237,000
b. Indirect Labor		
Manager & supervisor	2	$ 18,000
Office & inspector	2	11,000
14 truck drivers & maintenance	15	27,000
	19	$ 56,000

c. Training Needs. Manager & supervisor must be fully experienced. With 9 skilled workers, they should be able to train others & reach full production in 2 weeks.

6. TOTAL ANNUAL COSTS AND SALES REVENUE

a. Annual Costs

Direct Materials	$3,671,400
Direct Labor	237,000
Manufacturing Overhead(a)	106,400
Admin. Costs(b), Contingencies	116,000
Sales Costs(c), Bad Debts	60,000
Depreciation on Fixed Capital	105,400
Total	$4,296,200

b. Annual Sales Revenue $5,000,000

NOTES. (a) Includes Supplies, Power, Fuel, Water, Transportation, Indirect Labor. (b) Includes Interest, Insurance, Legal & Audit Charges. (c) Includes Sales Commissions, Freight Out, Travel.

Lime Juice Processing
Estimated Plant/operation costs
Tropical Products Institute. 1975.
56/62 Grays INN Road, London. WC1X 8LU.
(UNIDO Q 7805)
(The figures were estimated in 1970)

Minimum economic size of processing plant/operation costs

A small plant in the West Indies which processes about 1,000,000 lb (453,514 kilos) of limes per annum to distilled lime oil and settled lime juice has been observed to be just about economic to operate. This operation employs two or three men full time throughout the year and a further four men for the six month period of the crop.

Rounded-out figures obtained from this operation for the 1974-5 season are shown:

LIMES
1,000,000 lb (453,514 kg.)
@ EC$0.04 per lb.

Process

SETTLED JUICE	DISTILLED LIME OIL
ca. 30,000 gallons (136,200 l.)	ca. 3,000 lb. (1360 kg.)
@ EC$3.50 per gallon	@ EC$15.00 per lb.

INCOME	
Distilled lime oil	EC$ 45,000
Settled lime oil	EC$ 105,000

OUTGOINGS		
Limes		EC$ 40,000
Factory costs	(salaried $ 12,500	EC$ 25,000
	(fuel, electricity, admin etc	
Containers for juice and oil		EC$ 12,000
Shipping costs and duty		EC$ 43,000
	TOTAL	$ 120,000

Processing of lime fruit in the West Indies. Anon. 1962. Tropical Products Institute (UK) Report NO. 53/62. [English]

Economy

Lime *(Citrus aurantifolia* (Christon,) Swing)

There is a current interest in lime juice production.

The economical processing of the fruit into juice and cold-pressed varies from year to year according to current price.

5. Suggestions for fruit juices industry development:

PROCESSING FRUIT JUICE - THE QUALITY WAY

J. Hardenmark* 1974. UNIDO (ID/WG 172/9) p. 4. (English).

Modern technology :

1. **Efficient** processing
   a) continuous flow
   b) preserving the natural properties of the raw material (taste, flavour, colour, aroma, vitamins)
   c) easy change-over from one product to another without large losses in raw material and end product, i.e. no waste of time.
2. **Easy**-to-handle compact machines with flexible performance.
3. **Highest** sanitary standards through use of cleaning-in-place (CIP).
4. **Remote** control and automation, thus minimizing the human error factor.

Freeze dried juices

Commonwealth Secretariat 1972. Fruit. A Review of Production and Trade. London, Commonwealth Secretariat. p. 145 [English].

In addition to the packs of pure fruit juices the development of new techniques has led to the introduction of powders, etc. which may be reconstituted into juice by the addition of cold water. The advantages of these products derive largely from savings in bulk and weight and their comparatively simple storage requirements compared with frozen concentrates. Freeze dried juices have been marketed, notably citrus freeze dried juice in Switzerland in 1971.

Miracle Fruit. Inglett, G. E., Dowling, D. Albrecht, J. J. and Hoglan, F. A. 1965 J. Agr. Fd Chem. 12, 284. C English J.

Miracle fruit

Rather as an example of a fruit curiosity than a current commercial success, a brief reference is made here to the discovery in 1964 of the reputed power of the fruit of a small bush, Miracle Fruit (*Synsepalum dulcificum* (Schum) Daniell) of 'inactivating' all acid-orientated taste buds in human beings.

This example of a fruit material possessing a definitive physiological action in human beings may not have any obvious commercial application at the present time; but such new knowledge of any potentialities of fruit products must be expected to arise from time to time as a result of a systematic examination of the natural fruits of various areas, thus emphasizing the fundamental value of a continuing examination of natural fruit material wherever they may occur.

Suggested fruit juices industry to be developed :

Pineapple juice, lime juice, and other tropical fruit juices industry should be developed to meet the world demand.

Countries :

Development emphasis should be put on Tropical- developing countries, e.g. African countries,

South American countries, Latin American countries etc., where there are reasonably economically and politically sound conditions.

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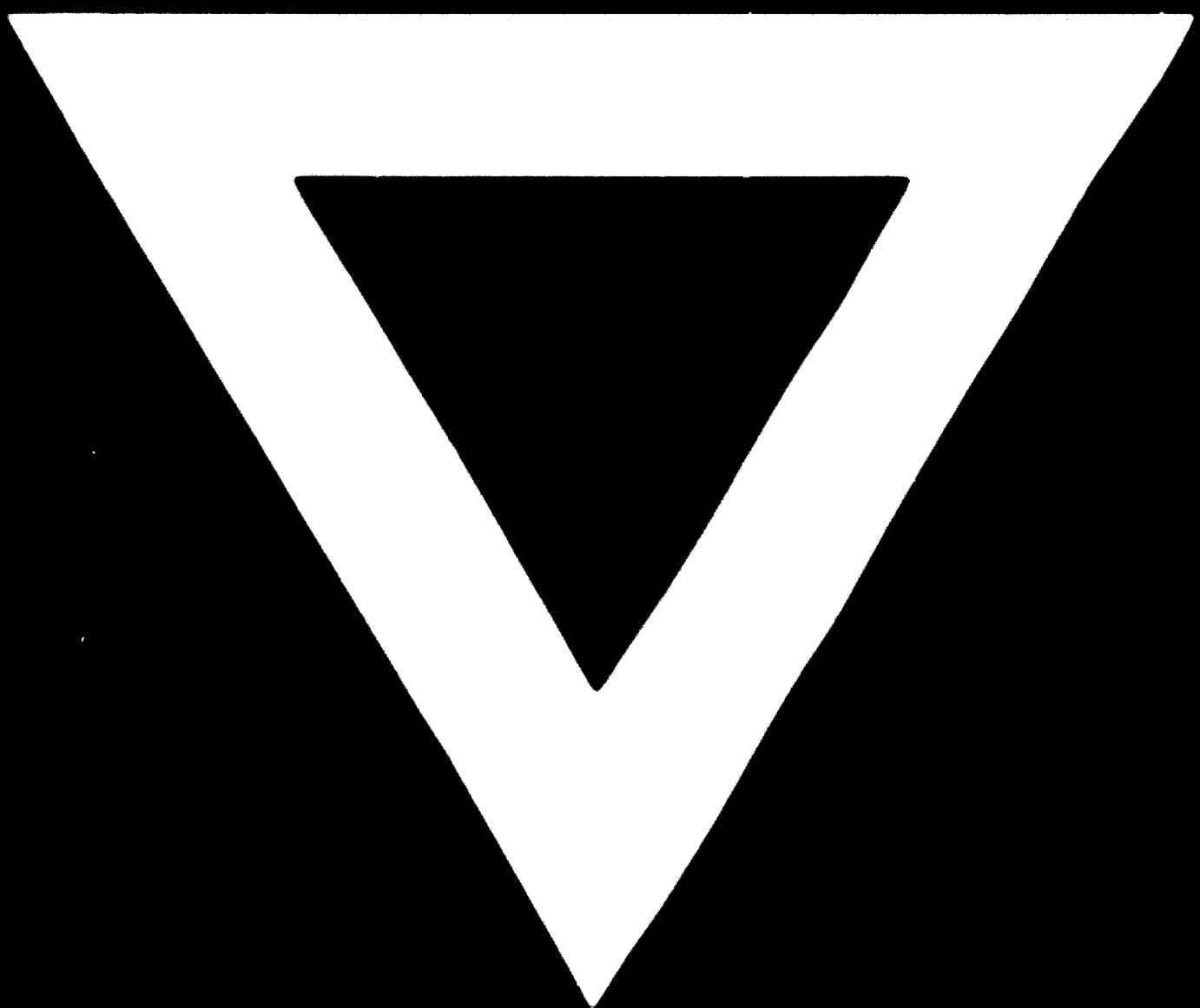

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