FRUIT JUICE PROCESSING

Introduction

A wide range of drinks can be made using extracted fruit juice or fruit pulp as the base material. Many are drunk as a pure juice without the addition of any other ingredients, but some are diluted with sugar syrup. The types of drink made from fruit can be separated into two basic types;

- those that are drunk straight after opening
- those that are used little by little from bottles which are stored between use.

The former groups should not require any preservative if they are processed and packaged properly. However, the latter group must contain a certain amount of permitted preservatives to have a long shelf-life after opening. The different types of drink are classified according to the following criteria:

Type	Description
Juices	Pure fruit juice with nothing added
Nectars	Normally contain 30% fruit solids and are drunk immediately after opening
Squashes	Normally contain at least 25% fruit pulp mixed with sugar syrup. They are diluted to taste with water and may contain preservatives
Cordials	Are crystal-clear squashes
Syrups	Are concentrated clear juices. They normally have a high sugar content

Each of the above products is preserved by a combination of natural acidity, pasteurisation and packaging in sealed containers. Some drinks (syrups and squashes) also contain a high concentration of sugar which helps to preserve them.

Equipment required

Peeler
Knives (stainless steel)
Cutting boards
Juice extractor
Thermometer
Analytical balance
Stainless steel saucepan
10kg scales
Measuring cylinder
Capping machine
Wooden spoons
Plastic funnels
Plastic buckets
Strainers
Cleaning equipment (brushes, scourers, cloths, hosepipes etc) 2 gas cylinders, 2- or 3- ring burners.

Building with large preparation table, smaller table for gas burners, shelves for products, sink, draining board, taps, cupboard for labels and dry ingredients.

The total capital for equipment and furnishings is likely to be £500-800 ($US900-1440), working capital for fruit purchase, packaging and other materials is likely to be around £600 ($US1080).

The cost of a building is not included, but it should have the following features:

- Sloping concrete floor and proper drainage for washing down each day
- A potable water supply
- Preferably electricity

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- Screened windows and doors to reduce insects
- No horizontal ledges, window sills, or rafters where dust, insects and bird droppings can collect.

This technical brief outlines the basics of fruit juice processing. It does not give specific details or recipes for individual fruits. These can be found in the individual technical briefs (lime cordial, mixed fruit juice manufacture, passion fruit juice).

Method of production

For all the fruit based beverages, the first stage is the extraction of juice or pulp from the fruit. The following are the key manufacturing stages:

Selection and preparation of raw material
Juice extraction
Filtration (optional)
Batch preparation
Pasteurisation
Filling and bottling.

Any fruit can be used to make fruit juice, but the most common ones include pineapple, orange, grapefruit, mango and passion fruit. Some juices, such as guava juice, are not filtered after extraction and are sold as fruit nectars.

Preparation of raw material

Select mature, undamaged fruits. Any fruits that are mouldy or under-ripe should be sorted and removed. Wash the fruit in clean water. It may be necessary to chlorinate the water by adding 1 tablespoon of bleach to 5 litres of water. Peel the fruit and remove stones or seeds. If necessary, chop the fruit into pieces that will fit into the liquidiser or pulper. Remember that at this stage, you are exposing the clean flesh of the fruit to the external environment. Make sure that the utensils are clean. Do not leave the cut surfaces exposed to the air for long periods of time or they may start to turn brown and this will discolour the juice. The fruit pieces can be placed in water that contains lemon juice (250ml lemon juice per litre of water) to stop them browning.

Juice extraction

There are several methods to extract juice depending on the type of fruit you use. For citrus fruits which are naturally juicy, the best option is to use a hand presser (see figure 1) or a revolving citrus 'rose'. Some fruits such as melon and papaya are steamed to release the juice. Apples are pressed and fruits such as mango, guava, soursop, pineapple, strawberry must be pulped to extract the juice. The fruit pieces are pushed through a perforated metal plate that crushes and turns them into a pulp. Some fruits can be pulped in a liquidiser and then filtered to remove the fruit pieces. There is a range of equipment available that varies in size and in the type of power supply (some are manual while the larger ones require electricity). For the small scale processor, the Mouli Legume or a hand-powered pulper/sieve which force the fruit pulp down through interchangeable metal strainers (figures 2 and 3) is sufficient.

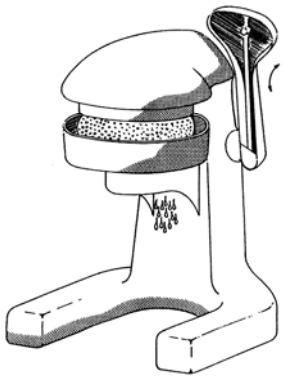

Figure 1: Hand presser

At slightly higher production levels, it is necessary to use a power source to achieve a higher throughput of juice. The multi-purpose Kenwood Chef food mixer, is strongly recommended. This has a pulping attachment that is similar to the Mouli Legume and it can also be used for other operations such as liquidising and mixing.

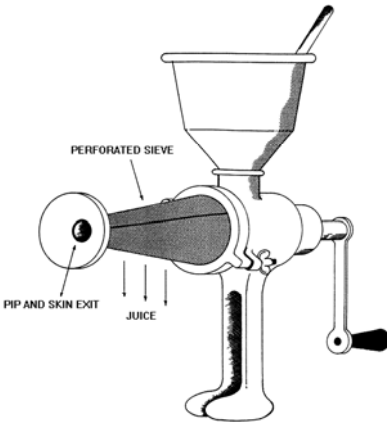

Figure 2: Hand powered pulper

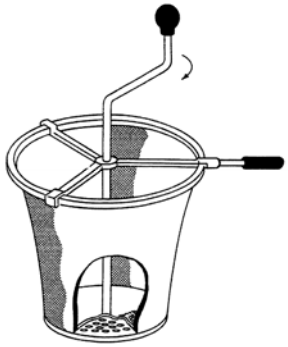

Figure 3: Hand powered pulper

For large-scale production, an industrial pulper-sieving machine is necessary. This also acts by forcing the fruit pulp through a fine cylindrical mesh. However, these cost in excess of £2,500.

Filtering

To make a clear juice, the extracted juice or pulp is filtered through a muslin cloth or a stainless steel filter. Some of the larger filter presses have a filter included. Although juice is naturally cloudy, some consumers prefer a clear product. It may be necessary to use pectic enzymes to break down the pectin and to help clear the juice. Pectic enzymes may be difficult to find and expensive and therefore should only be used if really necessary and readily available.

Batch preparation

When the juice or pulp has been collected, it is necessary to prepare the batch according to the chosen recipe. This is very much a matter of choice and judgement, and must be done carefully to suit local tastes. Juices are sold either pure or sweetened. Fruit squashes would normally contain about 25% fruit material mixed with a sugar syrup to give a final sugar concentration of about 40%. Squashes are diluted with water prior to use and, as the bottle is opened, partly used and then stored, it is necessary to add a preservative (for example 800ppm sodium benzoate).

Another popular product is fruit nectar, which is a sweet mixture of fruit pulp, sugar and water which is consumed on a 'one shot' basis. Essentially, these consist of a 30% mix of fruit pulp and sugar syrup to give a final sugar level of about 12-14%.

All fruits contain sugar, usually around 8-10%. The actual levels vary from fruit to fruit and with the stage of ripeness of the fruit. They also vary within the same fruit grown in different parts of the world. The addition of sugar to the fruit pulp to achieve the recommended levels for preservation must take into account the amount of sugar already present in the juice. It is important to achieve the minimum level that will prevent the growth of bacteria, however, once that level has been achieved, it is possible to add more if the consumers require a sweeter product. The amount of sugar added in practice is usually decided by what the purchasers actually want. The Pearson Square is a useful tool to use to help with batch formulation (see the appendix) and to calculate the amount of sugar to be added for preservation.

In all cases, sugar should be added to the fruit juice as a sugar syrup. The syrup should be filtered through a muslin cloth prior to mixing to remove particles of dirt which are always present. This gives a clearer, higher quality product.

Pasteurisation

All the products mentioned above need to be pasteurised at 80-95°C for 1-10 minutes prior to hot-filling into bottles. At the simplest level, this may be carried out in a stainless steel, enamelled or aluminium saucepan over a gas flame, but this can result in localised overheating at the base of the pan, with consequent flavour changes.

Care is needed when producing pineapple juice due to a heat resistant enzyme in the juice. The enzyme damages skin after prolonged contact and workers should therefore wear gloves to protect their hands. The juice must be heated to a higher temperature for a longer time to destroy the enzyme (eg boiling for 20 minutes).

It is best to use stainless steel pans to heat fruit juice as the acidity of the juice can react with aluminium in aluminium pans during prolonged heating. However, large stainless steel pans are very expensive and may not be affordable by the small scale processors. To get round this problem, it is possible to use a large aluminium pan to boil the sugar syrup. The boiling syrup can then be added to a given amount of fruit juice in a small stainless steel pan. This increases the temperature of the juice to 60-70°C. The juice/syrup mixture is then quickly heated to pasteurising temperature.

Bottle size (litres)	Pasteurisation time at 80°C (minutes)
0.33	10
0.5	15
0.75	20

Table 1: Pasteurisation times at 80°C for different bottle sizes

Another option is to pasteurise the juices once they have been bottled. The bottles are placed in a hot water bath which is heated to 80°C. The bottles are held in the hot water for the given amount of time until the contents reach the desired temperature. The length of time required in the water bath depends on the size and volume of the bottles (see table 1). A thermometer should be placed in one of the bottles, which is used as a test bottle per batch, to monitor the temperature and to ensure that the correct temperature has been reached. This method of pasteurisation has benefits but also has problems.

Benefits	Problems
Juice is pasteurised within the bottle so the chance for re-contamination of the juice is reduced	Difficult to ensure the internal temperature of the bottles reaches the desired pasteurising temperature
No need for large stainless steel pans for pasteurisation	Require glass bottles for pasteurising

Table 2: The pros and cons of pasteurising within after bottling

The next industrial jump in pasteurisation is an expensive option that involves the purchase of a double-jacketed steam kettle in stainless steel and a small boiler. The total cost is likely to be in the region of £5-10,000, which is only viable for larger scale operations.

Filling and bottling

In all cases, the products should be hot-filled into clean, sterilised bottles. A stainless steel bucket, drilled to accept a small outlet tap, is a very effective bottle filler. The output can be doubled quite simply by fitting a second tap on the other side of the bucket. This system has been used to produce 500-600 bottles of fruit juice per day in the West Indies.

After filling hot, the bottles are capped and laid on their sides to cool prior to labelling.

Quality control

The freshness and quality of the expressed fruit juice is central to the quality of the final product. As soon as the juice is expressed from the fruit it starts to deteriorate, both as a result of chemical activity (enzyme action) and bacterial spoilage. It is important to move from the juice extraction stage to pasteurisation as quickly as possible to minimise any spoilage.

Extracted fruit juice that is left to stand for long periods in the heat will start to ferment and may start to discolour due to enzyme activity. The juice should be stored in a refrigerator (if one is available) or in a cool place and away from the direct sunlight. It should be collected into a clean, sterile container (food grade plastic buckets is the best option) and covered to keep out dirt, dust and insects. For the best quality product ,it is essential to work quickly between the extraction of the juice and the bottling stage. The longer the juice is out of the bottles, the more chance there is of contamination.

As in all food processing enterprises it is necessary to ensure that the fruit products are correctly formulated and priced to meet the customer's requirements, and that production costs are minimised to ensure that a profit is made. The quality of each day's production should be monitored and controlled to ensure that every bottle of juice has the correct keeping and drinking qualities. In particular the following points should be observed:

- Only fresh, fully ripe fruit should be used; mouldy or insect damaged fruit should be thrown away. All unwanted parts (dirt, skins, stones etc) should be removed.
- All equipment, surfaces and floors should be thoroughly cleaned after each day's production.
- Water quality is critical. If in doubt use boiled water or add one tablespoon of bleach to 5 litres of water to sterilise it. If water is cloudy, a water filter should be used.
- Pay particular attention to the quality of re-usable bottles, check for cracks, chips etc and wash thoroughly before using. Always use new caps or lids.
- The concentration of preservative should be carefully controlled for correct preservation of squashes and cordials, and may be subject to local laws. Check first and use accurate scales to measure the preservative.
- The temperature and time of heating are critical for achieving both the correct shelf life of the drink and retaining a good colour and flavour. A thermometer and clock are therefore needed.
- The correct weight should be filled into the bottles each time.

These factors are important because a customer will stop buying the products if the quality varies with each purchase.

The use of chemical preservatives in fruit juices and fruit drinks

As the name suggests, pure fruit juice is solely the extracted juice of fruit and should not have any preservative, or any other ingredients (such as sugar) added.

Fruit drinks that are not consumed in one go can have preservatives added to help prolong the shelf life once they have been opened.

There are several chemical preservatives that can be added to fruit juices. Processors need to check with local authorities or standards agencies to find the maximum permitted levels.

Compound	Comments	Commonly used levels
Sulphites and sulphur dioxide	Sulphur dioxide gas and the sodium or potassium salts of sulphite, bisulphite or metabisulphite are the most commonly used forms. Sulphurous acid inhibits yeasts, moulds and bacteria. Sulphur dioxide is mainly used to preserve the colour of fruits during drying.	0.005-0.2%
Sorbic acid	Sorbic acid and sodium and potassium sorbate are widely used to inhibit the growth of moulds and yeasts. The activity of sorbic acid increases as the pH decreases. Sorbic acid and its salts are practically tasteless and odourless in foods when used at levels less than 0.3%.	0.05-0.2
Benzoic acid	Benzoic acid, in the form of sodium benzoate is a widely used preservative. It occurs naturally in cranberries, cinnamon and cloves and is well suited for used in acid foods. It is often used in combination with sorbic acid at levels from 0.05-0.1% b y weight.	0.03-0.2%
Citric acid	Citric acid is the main acid found naturally in citrus fruits. It is widely used in carbonated beverages and as an acidifier of foods. It is a less effective anti-microbial agent than other acids.	No limit

Table 3: Permitted preservatives used in fruit juices and beverages.

Equipment suppliers

Note: This is a selective list of suppliers and does not imply endorsement by Practical Action.

Juice extractors and pulpers

A variety of juice extractors and pulpers is available from a wide range of suppliers. They are available in different capacities and either manual or powered (either electric of diesel).

Kenwood Limited
New Lane
Havant
Hampshire, PO9 2NH
United Kingdom
Tel: +44 (0) 23 9247 6000
Fax: +44 (0) 23 9239 2400
Website: http://www.kenwood.co.uk

Alvan Blanch
Chelworth
Malmesbury
Wiltshire, SN16 9SG
United Kingdom
Tel: +44 (0) 666 577333
Fax: +44 (0) 666 577339
E-mail: info@alvanblanch.co.uk
Website: http://www.alvanblanch.co.uk

Kenwood Limited
New Lane
Havant
Hampshire, PO9 2NH
United Kingdom
Tel: +44 (0) 23 9247 6000
Fax: +44 (0) 23 9239 2400
Website: http://www.kenwood.co.uk

Buhler (India) Pvt Ltd
13-D, K A I D B Industrial Area, Attibele
Bangalore
Karnataka 562107
India
Tel: +91 80- 27820000
Fax: +91 80-7820001
Website: www.buhlergroup.com

Lehman Hardware and Appliances Inc.
P.O. Box 41
Kidron
Ohio 44636
USA
Tel orders: +1 877 438 5346
Tel enquiries: +1 888 438 5346
E-mail: info@lehmans.com
Website: http://www.lehmans.com

Robot Coupe
12 Avenue Cal Leclerc
BP 134
71303 Montceau-les-Mines
France
Tel: +33 3 85 58 80 80

DISEG (Diseno Industrial y Servicios Generales)
Av Jose Carlos Mariategui 1256
Villa Maria del Triunfo
Lima
Peru
Tel: +51 14 283 1417

Servifabri SA
JR Alberto Aberd
No. 400 Urb Miguel Grau (ex Pinote)
San Martin de Porres
Lima
Peru
Tel: +51 14 481 1967

Gardners Corporation
158 Golf Links
New Delhi 110003
India
Tel: +91 11 2334 4287/2336 3640
Fax: +91 11 2371 7179

Food Packs Indiana
Thrikkariyoor, Kothamangalam, Ernakulam
Kerala 686692
India
Tel: +91 485-2522134, 2523610

Geeta Food Engineering
Plot No C-7/1 TTC Area
Pawana MIDC Thane Belapur Road
BehindDavita Chemicals Ltd
Navi Mumbai 400 705
India
Tel: +91 22 2782 6626/2766 2098
Fax: +91 22 2782 6337

Delhi Industries
4 Paharganj Lane,
New Delhi 110055
India
Tel: +91 11 2529720, 27525200, 27536888
Fax: +91 11 25791291

Do-All-Engineering Industries
87/12, Industrial Suburb, Yeshawanthpur
Bangalore
Karnataka 560022
India
Tel: +91 80 23345754, 23372298
Fax: +91 80 23346138

Eastend Engineering Company
173/1 Gopal Lal Thakur Road
Calcutta 700 035
India
Tel: +91 33 2553 6397

Florachem
Flat No. 1119, Hemkunt Chambers, 89, Nehru Place
New Delhi 110019
India
Tel: +91 11 25589502

Praj Industries Ltd
Praj House Bavdhan
Pune, Maharashtra 411021
India
Tel: +91 20-22951511, 22952214
Fax: +91 20-22951511 / 22952214
Website: www.praj.net

Techno Equipments
Saraswati Sadan
1st Floor, 31 Parekh Street
Mumbai 400004
India
Tel: +91 22 2385 1258

Kundasala Engineers
Digana Road
Kundasala
Kandy
Sri Lanka
Tel: +94 8 420482

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Narangs Corporation
P-25 Connaught Place
New Delhi 110001
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Tel: +91 11 2336 3547
Fax: +91 11 2374 6705

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348/1 Dilu Road
Mokbazar
Dhaka 1000
Bangladesh
Tel: +880 2 9331778/835629/835578
Fax: +880 2 842048
Email: markind@citechco.net

Udaya Industries
Uda Aludeniya, Welligalla
Gampola
Sri Lanka
Tel: +94 8 388586
Fax: +94 8 388909

For pasteurisation

Boiling pans should be made of aluminium, enamelled metal or stainless steel. For larger quantities it is necessary to buy equipment which does not cause burning or sticking of the product to the bottom of the pan.

Stainless steel steam jacketed kettles, which are double walled pans are suitable for pasteurising juice and are available in a range of sizes (from 5 to 500litres). Tubular heat exchangers are also suitable for pasteurisation, but are more expensive.

Gardners Corporation
India (See above

Raylons Metal Works
Kondivita Lane
J. B. Nagar Post Office
Post Box No. 17426
Andheri (E) Andheri - Kurla Road,
Mumbai - 400 059
India
Tel: +91 22 26323288 / 6325932

Sri Rajalakshmi Commercial Kitchen Equipment
No.57, (old No. 30/1) Silver Jubilee Park Road
Bangalore - 560 002
India
Tel: +91 (0)812 2222 1054/223 9738
Fax: +91 (0)812 2222 2047

Israel Newton Limited
Summerley Works
All Alone Road
Bradford
West Yorkshire, BD10 8TT
United Kingdom
Tel: +44 (0)1274 612059
Fax: +44 (0)1274 612059

United Engineering (Eastern) Corporation
Shantiniketan Site No.2 & 3
(10th Floor) 8 Camac Street
Kolkata, West Bengal 700017
India
Tel: +91 33-22823914, 22820157
Fax: +91 33-22823742

APV Baker Limited
Manor Drive
Paston Parkway
Peterborough
Cambridgeshire, PE4 7AP
United Kingdom
Tel: +44 (0)1733 283000
Fax: +44 (0)1733 283005

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Alvan Blanch
United Kingdom (See above)

T Giusti and Son Limited
Rixon Road, Finedon Road Industrial Estate
Wellingborough,
Northamptonshire, NN8 4BA
United Kingdom
Tel: + 44 (0)1933 229933
Fax: + 44 (0)1933 272363
Website: www.giusti.co.uk

Bottle filling and packaging equipment

H Erben Limited
Lady Lane
Hadleigh
Suffolk
IP7 6AS
United Kingdom
Tel: +44 (0)1473 823011
Fax: +44 (0)1473 828252
Website: http://www.erben.co.uk

Autopack Machines Pvt Ltd
101-C Poonam Cambers
A Wing, 1st Floor
Dr Annie Besant Road, Worli
Mumbai 400018
India
Tel: +91 22 2493 4406/2497 4800/2492 4806
Fax: +91 22 2496 4926
E-mail: autopack@bom3.vsml.net.in
www.autopackmachines.com

Sussex and Berkshire Machinery Company PLC
Blacknest
Alton, Hants GU34 4PX
United Kingdom
Tel: + 44 (0)1420 22669
Fax: + 44 (0)1420 22687
E-mail: technical@sabplc.uk
Website: http://www.sabplc.co.uk/

Bombay Engineering Industry
R NO 6 (Extn) Sevantibai Bhavan
Chimatpada
Marol Naka Andheri (East)
Mumbai 400059
India
Tel: +91 22 2836 9368/2821 5795
Fax: +91 22 2413 5828

Acufil Machines
S. F. No. 120/2, Kalapatty Post Office
Coimbatore - 641 035
Tamil Nadu, India
Tel: +91 422 2666108/2669909
Fax: +91 422 2666255
Email : acufilmachines@yahoo.co.in,
acufilmachines@hotmail.com
http://www.indiamart.com/acufilmachines/#products

Gurdeep Packaging Machines
Harichand Mill compound
LBS Marg, Vikhroli
Mumbai 400 079
India
Tel: +91 22 2578 3521/577 5846/579 5982
Fax: +91 22 2577 2846

Eastend Engineering Company
India (See above)

Gardners Corporation
India (see above

MMM Buxabhoy & Co
140 Sarang Street
1st Floor, Near Crawford Market
Mumbai, India
Tel: +91 22 2344 2902
Fax: +91 22 2345 2532
yusufs@vsnl.com; mmmb@vsnl.com;
yusuf@mmmb.in

Rank and Company
A-p6/3, Wazirpur Industrial Estate
Delhi – 110 052
India
Tel: +91 11 27376101
Fax: +91 11 7234126
Rank@poboxes.com

Mark Industries (Pvt) Ltd
Bangladesh (See above)

Narangs Corporation
India (see above)

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Alfa Technology Transfer Centre
301 Cach Mang Thang 8
Tan Binh District
Ho Chi Minh City
Vietnam
Tel: +84 8 9700868
Fax: +84 8 8640252

Technology and Equipment Development Centre (LIDUTA)
360 Bis Ben Van Don St
District 4
Ho Chi Minh City
Vietnam
Tel: +84 8 9400906
Fax: +84 8 9400906

Orbit Equipments Pvt Ltd
175 - B, Plassy Lane
Bowenpally
Secunderabad - 500011, Andhra Pradesh
India
Tel: +91 40 32504222
Fax: +91 40 27742638
Website : http://www.orbitequipments.com

Banyong Engineering
94 Moo 4 Sukhaphibaon No 2 Rd
Industrial Estate Bangchan
Bankapi
Thailand
Tel: +66 2 5179215-9

John Kojo Arthur
University of Science and Technology
Kumasi
Ghana

Alvan Blanch
UK (see above)

Pharmaco Machines
Unit No. 4, S.No.25 A
Opp Savali Dhaba, Nr.Indo-Max
Nanded Phata, Off Sinhagad Rd.
Pune – 411041, India
Tel: +91 20 65706009
Fax: +91 20 24393377

Refractometers
The refractometer is used to measure the sugar content.

Bellingham + Stanley Ltd.
Longfield Road, North Farm Industrial Estate
Tunbridge Wells, Kent TN2 3EY
United Kingdom
Tel: +44 1892 500400
Fax: +44 1892 543115
E-mail: sales@bs-ltd.com
Website: http://www.bs-ltd.com

Fisher Scientific UK Ltd
Bishop Meadow Road
Loughborough
LE11 5RG
UK
Tel: +44 1509 231166
Fax: +44 1509 231893
Email: fisher@fisher.co.uk
Web: www.fisher.co.uk

Gardners Corporation
India (see above)

International Ripening Company
1185 Pnieridge Road
Norfoplk
Virginia 23502-2095
USA
Tel: +1 757 855 3094
Fax: +1 757 855 4155
Email: info@QAsupplies.com
Web: www.qasupplies.com

References and further reading

Practical Action Technical Briefs:
Mixed fruit juice manufacture
Lime juice
Lime cordial
Nas naran lime juice
Passion fruit juice
Liquids filling and packaging

Small-scale processing of ready to drink pineapple juice. Food Chain No 27
http://practicalaction.org/docs/agroprocessing/food_chain_27.pdf

Principles and practices of small and medium-scale fruit juice processing. FAO Agricultural Services Bulletin 146, Food and Agriculture Organization of the United Nations (FAO), (2001).
http://www.fao.org/Docrep/005/Y2515e/y2515e00.htm

Technical manual on small-scale processing of fruits and vegetables, Food and Agriculture Organization of the United Nations (FAO)
http://www.fao.org/docrep/x0209e/x0209e07.htm

Setting up and Running a Small Fruit or Vegetable Processing Enterprise: Opportunities in Food Processing CTA
http://www.anancy.net/documents/file_en/CTA_OFP-Dairy_prF_amended(l-r).pdf

This document was produced by Dr. S. Azam Ali for Practical Action in March 2008. Dr. S Azam-Ali is a consultant in food processing and nutrition with over 15 years experience of working with small-scale processors in developing countries.

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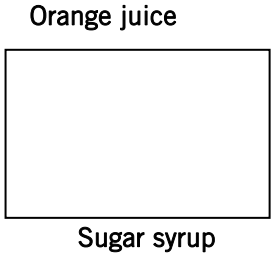
Appendix – The Pearson Square

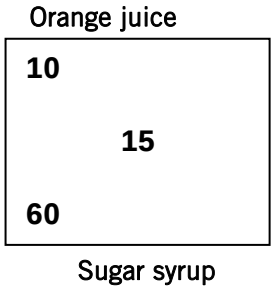
The Pearson Square is a method that processors can use to calculate the amounts of **two** components that should be mixed together to give a final known concentration.
For example, it can be used to calculate the amounts of fruit pulp and sugar syrup to make a fruit drink. The method can only be used for blending two components. When more than two components are involved, it becomes more complex.

Example of how to use the Pearson Square
You wish to produce a sweetened fruit juice with a final sugar content of 15%. You use orange juice (that contains 10% sugar), mixed with a 60% sugar syrup (that contains 60% sugar).

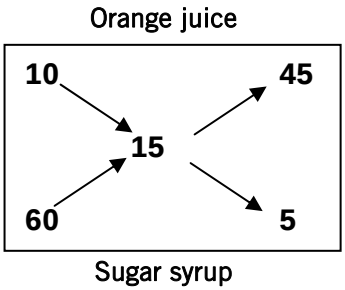
1. Draw a rectangle and label the two horizontal lines with the names of the two products to be blended (fruit juice and sugar syrup)



2. Enter the sugar composition of each product in the rectangle as shown below and put the desired final concentration of sugar in the centre of the box:



3. Mix the two components by crossing diagonally through the centre of the rectangle.



4. Following the arrows, subtract the smaller number from the larger one to give two new numbers (45 and 5) in the opposite corners of the rectangle. These numbers (45% orange juice and 5% sugar syrup) are the amounts that need to be mixed to give a fruit drink with a final sugar concentration of 15%.