PRACTICAL ACTION
Technology challenging poverty

PASSION FRUIT JAM
SMALL-SCALE PRODUCTION

technical brief

Introduction

Passion fruit (*Passiflora edulis*) is the edible fruit of a plant that is native to South America but which is widely grown in many tropical or sub-tropical areas. Other common names for passion fruit are Maracuya, Parcha (Spanish) and Maracuja (Portuguese). The passion fruit is round to oval, and either yellow or dark purple at maturity. It has a soft to firm, juicy interior filled with numerous seeds. The fruit can be grown to eat or for its juice, which has a strong exotic flavour and bright orange colour and is often added to other fruit juices to enhance the flavour.

The fruits vary in size, but on average there are 25-35 fruits per kg. The bigger fruits (heavier than 30g) are more suitable for food processing as they have a higher percentage of juice to rind. The juice has a pH between 2.6 and 3.0 and an unusually high starch content.

There are two important commercial varieties, purple passion fruit (*Passiflora edulis*), and yellow passion fruit (*Passiflora edulis flavicarpa*). The latter has larger fruits, more acidic juice and a less preferred flavour. The fruits are most suitable for processing when all greenness has disappeared and the outer skin has a smooth or slightly crinkled surface.

The fresh whole fruit can only be stored for a few days at ambient temperature before it deteriorates. If the storage temperature is reduced to 6.5°C, they can be stored for 3-4 weeks before any major deterioration. The pulp can be stored for long periods in bulk with 1000-1500ppm of sulphur dioxide or benzoic acid or a mixture of both, but there is a reduction in the quality of the flavour. During heat preservation the main problem to overcome is the loss of the extremely heat sensitive flavour, which is susceptible to quick oxidation.

The seeds are not suitable for stock feeding due to their very high crude fibre content. However, they can be refined and used in the manufacture of soap, paint, varnish and cooking oils.

The skin of passion fruit is a good source of pectin, and makes a good manure.

This technical brief should be read together with the brief on jams and marmalades, where there is an overview of the principles of jam making and a general introduction to quality assurance and control.

Recipe

Sugar	49%	
Fruit juice	20%	(starting recipe
Skin pulp	20%	before boiling)
Water	11%	
Sodium bicarbonate	0.015%	

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In most countries, preservative cannot be added to the jam. Only a residue of preservative is allowed in jam which has been made from fruit pulp which has been stored with chemical preservatives (100ppm sulphur dioxide or 500ppm benzoic acid). Sodium bicarbonate is not a preservative. It is added to adjust the pH of the jam if the juice is too acidic. Jams give a gel when there is the correct ratio of pectin to water and the pH is between 2.5-3.45pH. The optimum pH to give a good gel is pH 3.0. Therefore, sodium bicarbonate is generally added to passion fruit juice to decrease the acidity.

Method

Wash whole fruits in clean water and discard any bad fruits.

Cut fruits in half with a stainless steel knife and scoop out the pulp with a stainless steel spoon. Stainless steel equipment is preferred for fruit as it does not stain the flesh and does not react with the acidity of the juice. If stainless steel is not available, make sure the knives and spoons are not rusted. Use a plastic spoon to scoop out the flesh.

Extract the juice from the pulp by liquidising the pulp at a very low speed for about a minute. It is important to use a low speed to prevent the seeds from chipping. Chipped seeds appear as black specks in the jam. They are very difficult to remove and give the product a bad appearance. Tip the contents into a muslin cloth and squeeze out the juice leaving the seeds behind. This method will give a yield of raw juice from whole fruit of between 30 to 35%.

Measure the amount of juice extracted and use this to calculate how much skin pulp is required. Skin pulp is added to the jam as it contains natural pectin and so saves adding artificial pectin which is expensive.

To make skin pulp take the same quantity of skins, as skin pulp required. Boil the skins for approximately 30 minutes, until the flesh of the skin is soft and translucent. Then remove the skins from the water and scoop out the flesh from the outer cuticle. Liquidise this softened flesh with water (2 parts softened flesh to 1 part water) until it forms a smooth cream. Use the water in which the skins were boiled as this will contain pectin washed out during the boiling. Squeeze the mixture through a muslin cloth to remove hard pieces of pith.

Mix the raw juice with sodium bicarbonate ($NaHCO_3$) before boiling (if the $NaHCO_3$ is added during boiling the jam will bubble-up over the top of the saucepan). Add the sugar and water and heat gently at first to ensure the sugar has dissolved. Then boil rapidly to evaporate the water and continue until the jam thickens. Keep stirring during boiling to make sure the jam does not stick to the base of the pan. Jam should not be boiled for more than 12-15 minutes as this can give rise to caramel flavours, over sweetness and discolouration, apart from being a waste of energy. By reducing the amount of water in the starting recipe, the boiling time can be reduced.

Boiling to reach the final sugar concentration

The aim of boiling is to reduce the water content of the mixture and concentrate the fruit and sugar in as short a time as possible. The final Total Soluble Solids (TSS) content of a jam (also known as the "Degrees Brix" or "end-point of the jam") should be 65 to 68% (the TSS is a measure of the amount of material that is soluble in water. It is expressed as a percentage -a product with 100% soluble solids, has no water and one with 0% soluble solids is all water).

The correct sugar content is critical for proper gel formation and for preservation of the jam or jelly. If the final TSS of jam is lower than 65-68% the shelf life will be reduced. The jam will have a runny consistency and bacteria and moulds will be able to grow in the product. If the TSS is higher than 68%, the jam will be very stiff and the sugar might start to form crystals in the jam.

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The end-point of boiling is measured in different ways. The most accurate method is to use a refractometer to measure the total sugar concentration. Remove the pan from the heat during testing as the jam will continue to cook and may become over-cooked. It is always possible to cook the jam a little bit more, but once it is over-cooked (and too thick) it cannot be reversed.

Cool the sample before it is measured by smearing it on a cold dry plate or saucepan lid. All implements used to take the sample must be dry otherwise the reading will be reduced. It is important to stir the jam at all times during heating, otherwise it may burn at the bottom of the saucepan, causing off flavours and discoloration.

This method is not really suitable for home-use as a refractometer costs about US$ 150. It is only when making jam for sale that a refractometer is necessary, to ensure consistency between different batches of the jam. When making jam for home consumption, other methods can be used to determine the end point: these include the drop test, the skin wrinkle test, or the use of a jam thermometer to test the temperature (68% sugar corresponds to a jam temperature of 105°C).

When the jam starts to thicken, it is important to test for the end point at frequent intervals. Remember to remove the pan from the heat source while you test or it will continue to thicken and may burn.

Filling into jars, cooling and labelling

Wash and sterilise the glass jars and lids by placing in a pan of water and boiling for 10 minutes. Remove the jars from the water with a pair of tongs and stand upside down to drain. Do not dry with a towel as this could contaminate the jars. If glass jars are not available, use plastic jars. These cannot be sterilised with boiling water as they will melt. They should be thoroughly cleaned in warm soapy water and rinsed with a weak solution of sodium metabisulphite. Sterilising tablets (made of sodium metabisulphite) can be bought for this purpose.

Allow the jam to cool slightly (to about 80°C for glass jars and 60°C for plastic jars) and then pour it into clean, sterilised jars. The jars should still be warm to prevent them from cracking when the hot jam is poured in. If the jam is cooled too much it will be difficult to pour. Place the clean lids on top and fasten. Invert the jars to form a seal. The filled jars can be placed in water to cool down the jam so that it does not keep cooking in the jar. The water should not be too cold or the glass may crack. Also, the water level must be kept below the lid of the jar. The gel starts to form as the temperature of the jam reduces (about 55°C) and continues until it is cold. The jars should not be moved or shaken while they are cooling or the gel will not form and the jam will not set.

Storage

Jam that is hygienically prepared, boiled until it reaches the correct final total soluble solids (68%) and which is packaged in sterilised glass jars can be stored for up to a year so long as it is kept in a cool place away from direct sunlight. Jam that is packaged in plastic containers has a shorter shelf life – up to 4 months.

Equipment list

Glass jars, Omnia lids and labels
Omnia capper
Cooking facilities, gas ring, electric ring, etc
Stainless steel saucepan
Thermometer in protective jacket
Stainless steel cutting knife and spoon
Wooden spoon for stirring
Refractometer
Cutting board
Scales
Liquidiser or mashing tool

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Equipment suppliers

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

Cutting and slicing equipment

A range of manual and powered cutting and slicing machinery is available.

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

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

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

Juice filters, strainers and sieves

A range of filtering and straining equipment can be used. The simplest is the filter bag (or jelly bag) made of terylene or muslin cloth. More sophisticated are the filter presses and strainers which may be mechanised.

Gauthier
Parc Scientifique Agropolis
34397 Montpellier
Cedex 5
France
Tel: +33 4 67 61 11 56
Fax: +33 4 67 54 73 90

Lakeland Mail order kitchenware
38 Alexandra Buildings
Windermere
LA23 1BQ
United Kingdom
Tel: +44 (0)15394 88100
Website: www.lakeland.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

Gardners Corporation
India (see above)

Weighing machines

It is important to have accurate weighing machines. Quite often more than one machine is required - -a large one to weigh the fruit and a small one for weighing out the dry ingredients such as pectin and spices.

Fisher Scientific
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

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Alvan Blanch
UK (see above)

Lakeland
UK (see above)

Gardners Corporation
India (see above)

Essae-Teraoka Ltd
377/22 6th Cross Wilson Garden
Bangalore 560027
India
Tel: =91 80 2216185/2241165

Narangs Corporation
India (see above)

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 or 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
UK (see above)

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

Bajaj Machine Private Limited
7/20, 7/27, Jai Lakshmi Industrial Estate,
Side-IV
Sahibabad Industrial Area
Ghaziabad-201301
U.P
India
Tel: +91 120 22775119/22775137
Fax: +91 120 22775137
Website: www.indiamart.com/bajajmachine

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

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

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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
India (see above)

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

Gardners Corporation
India (see above)

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

Narangs Corporation
India (see above)

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

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

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

For boiling

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 boiling large quantities of jam and are available in a range of sizes (from 5 to 500litres).

Gardners Corporation
India (See above)

Alvan Blanch
United Kingdom (See above)

HRS Process Systems Pvt Ltd
Asia Division, Praj House,
Bavdhan, Pune
Maharashtra 411021India
Tel: +91 20- 22951511
Fax: +91 20- 22951718
Website: www.hrsasia.co.in

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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

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

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

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

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

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/

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
Website: www.indiamart.com

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
Website: www.autopackmachines.com

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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

Eastend Engineering Company
India (See above)

Gardners Corporation
India (see above)

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

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

Narangs Corporation
India (see above)

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

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

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)

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

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)

Refractometers
The refractometer is used to measure the sugar content.

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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

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

Gardners Corporation
India (see above)

References and further reading

Practical Action Technical Briefs:

- Jams, Jellies and Marmalades
- Lime marmalade
- Pineapple jam
- Strawberry jam
- Watermelon jelly
- Food labelling
- Fruit waste utilisation
- Juices and Drinks
- Snack Foods

Technical manual on small-scale processing of fruits and vegetables, Food and Agriculture Organization of the United Nations (FAO)
Setting up and Running a Small Fruit or Vegetable Processing Enterprise: Opportunities in Food Processing CTA
Starting a Small Food Processing Enterprise by Peter Fellows, Ernesto Franco & Walter Rios Practical Action Publishing/CTA 1996
Small Scale Food Processing 2nd Ed. P Fellows & S Azam Ali, Practical Action Publishing, 2003
Fruit and Vegetable Processing UNIFEM Practical Action Publishing, 1993

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