ITDG
PRACTICAL ANSWERS TO POVERTY

JAMS, JELLIES AND MARMALADE

brief

Introduction

Collectively known as 'preserves', these products are finding an increased market in many countries, particularly in more affluent urban areas. However, it is important to note that before starting production of preserves, the size and requirements of the market must be carefully established. *A surplus of fruit is not sufficient reason for starting project.*

The preservation principles of jam, jelly and marmalade

jelly and marmalade production are quite complex, but in essence involve the correct combination of acidity, sugar level and pectin content. All three must be correct to obtain a satisfactory product.

One important feature of preserves is the high acidity which prevents the growth of food poisoning bacteria and also helps maintain the colour and flavour for most fruits. However, some moulds and yeasts are able to grow at the high acidity and these can spoil the food. They are prevented by ensuring that the sugar content of the preserve is at least 68%. If for any reason the sugar content is lower (eg condensation of water on the surface of the jam during cooling) moulds will quickly spoil the product.

Figure 1: Testing whether the Jam has been boiled enough. ITDG food processing training course - making jam/jelly, Bangladesh. Sue Azam Ali/ITDG

Types of products

Jams

These are solid gels made from fruit pulp or juice, sugar and added pectin. They can be made from single fruits or a combination of fruits. The fruit content should be at least 40%. In mixed fruit jams the first-named fruit should be at least 50% of the total fruit added (based on UK legislation). The total sugar content of jam should not be less than 68%.

Tel +44 (0)1926 634400 Fax +44 (0)1926 634401 E-mail info@idg.org.uk Web http://www.idg.org
Company Reg. No 871954, England Reg. Charity No 267257 VAT No 541 8184 85

Jellies
These are crystal clear jams, produced using filtered juice instead of fruit pulp.

Marmalades
These are produced mainly from clear citrus juices. They have fine shreds of peel suspended in the gel. Commonly used fruits include lime, orange, grapefruit, lemon and orange. Ginger may also be used alone or in combination with these citrus fruits. The fruit content should not be less than 20% citrus fruit and the sugar content is similar to jams.

Quality control
The main areas of quality control that are needed to produce uniformly high quality products are:

Fruit preparation
Fruit should be sorted and cleaned thoroughly. Only mature fruit, without mould, excessive bruising or insect damage should be used. All stems, leaves, skins etc should be removed.

Ingredient mixing
Accurate scales are needed to weigh out the ingredients and care is needed to make sure that the correct weights are used each time. In particular pectin powder should be thoroughly mixed with sugar to prevent lumps forming and resulting in a weak gel.

Production/preparation
Fruit pulp/juice
It is possible, by hand, to peel and pulp the fruit, press and filter the juice but

this level of production is very low (eg 10-20 half kilogram jars per day) and the procedure is both laborious and time consuming. For small-scale commercial production it is better to use small manual or powered equipment to pulp the fruit and/or express the juice. Juice or pulp contains enzymes and in many fruits these cause rapid browning if they are not destroyed or inhibited from acting. The easiest way to control browning is to heat the juice in small batches as it is produced, rather than producing a large amount and storing it for several hours before use. The procedure described under 'batch preparation' and 'boiling' has been found to work very well.

Sugar

Refined, granular, white sugar should be used whenever possible, but even this will often contain small amounts of material (eg black specks) which reduce the value of a preserve. The sugar should therefore be dissolved in water to make a strong syrup and then filtered through muslin cloth or a fine mesh. It is most important that the filters and pans are thoroughly cleaned each day to prevent insects and micro-organisms from contaminating the equipment.

The strength of the sugar syrup can be easily calculated as follows:

$$\% \text{ sugar} = \frac{\text{weight sugar} \times 100}{\text{weight sugar} + \text{weight water}}$$

So for example a 50% sugar solution (50Brix) could be made by dissolving 500g sugar in 500ml water.

Pectin

All fruits contain pectin in the skins and to a lesser extent in the pulp. However, the amount of pectin varies with the type of fruit and the stage of maturity. Apples, citrus peels and passion fruit for example, contain a high concentration of pectin; strawberries and melon contain less. In general, the amount of pectin in fruit decreases as the fruit matures.

Although it is possible to get a good preserve using the pectin already in the fruit, it is better to buy pectin powder or solution and add a known amount to the fruit juice or pulp. This will produce a standardised gel each time and there will be less risk of a batch

failing to set.

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There are many different types of pectin available, but for preserves, a slow setting type is needed to allow the gel to form in the jar during cooling. However, in larger containers (eg 5-10kg jars of jam) or for preserves in which peels or pieces of fruit are suspended in the gel, a faster setting pectin in needed. In both types, the concentration of pectin varies from 0.2-0.7% depending on the type of fruit being used. Pectin is usually supplied as '150 grade' (or 150 SAG) which indicates the ratio of the weight of sugar to weight of pectin that will produce a standard strength of gel when the preserve is boiled to 65% soluble solids. 5 SAG is normally enough to produce a good gel.

An example of a calculation to find the weight of pectin to be added is as follows:

150 SAG pectin is diluted to 5 SAG, ie a 30 fold dilution. Therefore 3.3g pectin would be used for every 100g of material.

However, if commercially produced pectin cannot be obtained it is possible to produce a pectin solution by boiling the sliced skins of passion fruit, lime, lemon, orange or grapefruit in water for 20-30 minutes. The solution should be filtered before adding to the fruit pulp. The amount of solution to be added depends on the type of fruit and a number of other factors, and must be found by trial and error.

Acid

Acids are added to fruit juice to bring the pH within the range 3.0-3.3 which is necessary for jam making (pH is a measure of acidity - lower pH means greater acidity). As the acidity varies in different types of fruit and also in different samples of the same fruit, it maybe necessary to check for the correct acidity if different fruits are used. (NB limes have a lower pH than 3.3

and sodium bicarbonate is needed to reduce the acidity.)

The only acids that are allowed to be added to jam are *citric acid, tartaric acid and malic acid.* In practice citric acid is usually used and this is widely available from chemists or pharmacies.

Food colours

Some fruit pulps/juices do not substantially change colour during boiling and in others the colour change is acceptable. In both cases it is not necessary to add artificial colours. However, some fruits become dark brown and are not sufficiently attractive to customers. In these cases, small quantities of permitted colours may be added if no other fruits are available for use. The list of permitted colours differ throughout the world and it is necessary to check with the local Bureau of Standards to see which colours are allowed.

Batch preparation

First thoroughly mix pectin powder with 5 times its weight of sugar, this will allow the pectin to fully dissolve without forming lumps. The amount of sugar, pectin, fruit pulp/juice and acid needed will depend on the type of fruit and the customers' requirements. However, as an example of a typical product, the following recipe has been successfully used to make water melon jam:

115kg	water melon
55kg	sugar
0.9kg	ginger
0.47kg	citric acid
0.66kg	pectin

Mix together the sugar/pectin, fruit juice/pulp and adjust the pH to 3.3-3.6 using citric acid. A pH meter may be necessary to establish the recipe but afterwards the ingredients may simply be weighed out.

For marmalade, or jams which contain fruit pieces, it is necessary to soak the peel or fruit for 2-3 days in a concentrated (60%) sugar solution. This causes the peel/fruit to achieve the same density as the preserve and, as a result, it is evenly distributed through the jar and

does not float to the surface.

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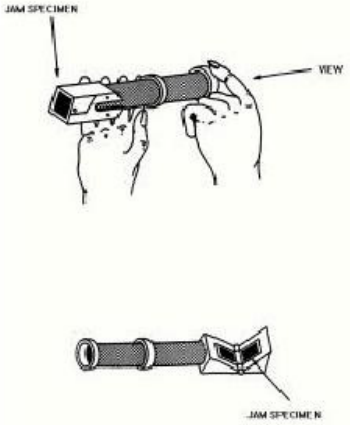
Boiling

Pour the batch into a stainless steel boiling pan and heat as quickly as possible with constant stirring to prevent the product burning onto the pan.



It is important to use stainless steel to prevent the acids in the preserve reacting with the pan and causing off-flavours.

The mixture is boiled until the sugar content reaches 68%. This is most conveniently measured using a hand-held refractometer see Figure 1 or a sugar thermometer (68% sugar corresponds to a jam temperature of 129C).

The correct sugar content is critical for proper gel formation, repeated checks with a refractometer or thermometer are needed to make sure that:

the sugar level reaches 68% (otherwise mould will grow on the product or a gel will not form)

brief

form)
that 68% sugar is not exceeded by a large amount (otherwise the jam will crystallise).
The sugar concentration increases rapidly at the end of boiling and particular care is needed.

Filling and packaging

In many countries there are laws concerning the weight of food sold in a package and accurate filling to the correct weight is therefore important. The weight, cleanliness of the container and appearance of the product after filling should be routinely checked. In particular it is important to avoid getting preserve around the rim of the jar as this may prevent a vacuum forming, and will look unsightly and attract insects.

The preserve should be hot-filled into suitable containers which are then sealed with a lid. Temperature of filling is important, too hot and steam will condense on the lid and drop down onto the surface of the preserve, this will dilute the sugar on the surface and allow mould growth. If the temperature is too low the preserve will thicken and be difficult to pour and a partial vacuum will not form in the jar. Ideally the temperature should be 82-85C.

The packaging is likely to be one of the main costs involved in production. Ideally glass jars should be used with new metal lids.

Metal cans are also suitable but very expensive. Cheaper alternatives include plastic (PVC) bottles or plastic (polythene) sachets. However, these cannot be filled with hot jam as they will soften or melt. Technical advice should be sought if these packs are being considered.

It is possible to use paper, polythene, or cloth tied with an elastic band or cotton, to cover jam jars. The appearance of the product is however, less professional and there is a risk of contamination by insects. This is not recommended unless metal lids are impossible to obtain.

Finally, the jars are held upright and the gel is formed during cooling. This can be done by standing the jars on shelves, or more quickly using a low cost water cooler. A partial vacuum should form between the surface of the jam and the lid when the product cools. This can be seen by a slight depression in the lid. If a vacuum does not form it means that the jar is

leaking or the temperature of filling is too low.

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Equipment required

Mesh sieves, strainers
Jelly bags
Aluminium or enamelled pan (for sugar syrup)
Accurate 2kg scales (eg + or - 10g)
pH meter or pH paper (optional)
Spoons, jugs, knives, plastic buckets etc
Juice extractors
Stainless steel boiling pan
Hand held refractometer or sugar thermometer
Gas bottles and burner
Jar filler and capper
Jar cooler (optional)

Equipment suppliers

Note: This is a selective list of suppliers and does not imply ITDG endorsement.

Jelly bag
Britam
5 Ferry Lane Ind Est
Brentford
Middlesex
TW8 0AW
United

Scales
Gallenkamp Limited
Bishops Meadow Road
Loughborough
Leicester
LE11 ORG
United

Kingdom

Refractometer
AMBESCO
5600 W Raymond Street
Indianapolis 46241
USA

Sugar thermometer
Gallenkamp Limited
Bishops Meadow Road
Loughborough
Leicester
LE11 ORG
United Kingdom

Kingdom

Gallenkamp Limited
Bishops Meadow Road
Loughborough
Leicester
LE11 ORG
United Kingdom

Jar capper
GRET (for information)
203 Rue Lafayette
Paris 75010
France

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