PRACTICAL ACTION
Technology challenging poverty

SMALL-SCALE SPICE PROCESSING

technical brief

Introduction

The processing and trade of spices has a long and important history. Spices are a valuable commodity and have a significant impact on the economy of many countries. Small-scale processing of spices can be economically viable and socially successful.

Most dried foods are comparatively low-risk 'safe' products in term of causing food poisoning and are therefore suitable for production at the small-scale. However, spices are an exception to this. They often contain high levels of micro-organisms that cause food poisoning and quite frequently are contaminated with foreign matter.

Because spices are delicate products that are damaged by high temperature and extreme processing, special care should be taken to ensure products are of top quality. There are several key quality control points that small-scale processors need to be aware of.

Correct harvesting time

It is not possible to produce a high quality spice from low quality, inferior material. Harvesting spices at the correct point of maturity is the key to producing good quality products. Quite frequently spices are harvested when they are immature and before the flavour and aroma compounds have fully developed. This results in spices with an inferior taste and aroma. Early harvesting is usually through fear of the crop being stolen or because the farmer requires money urgently. Every effort should be made to wait until the spices are fully mature before harvesting.

Cleaning

Spice crops are quite often contaminated by dust, dirt, pesticides, insects, animal hair and droppings and a range of microbes. The crop must be cleaned before processing. The first stage is to remove dust and dirt using a winnowing basket. This can be made locally from bamboo, palm or other leaves. Someone used to this work can remove the dust, dirt and stones quickly and efficiently (eg they could clean 100kg of pepper in an eight-hour day). Small machines are available for cleaning but they are rarely cost effective.

After winnowing the crop should be washed in clean, potable water. Washing should be quick so that the spice is not soaked in water as this reduces the quality. The washing water must be changed regularly to prevent recontamination of spices by dirty water. It is essential that clean water is used as spices are not heat treated later on during processing. Dirty water introduces more bacteria, many of which cause food poisoning.

Drying

This is by far the most important part of processing to ensure good quality spices. Inadequately dried produce will lead to mould growth. The sale value of mouldy spices can be less than 50% of the normal value. In addition, the growth of food poisoning bacteria on some spices is a real danger if proper washing and drying is not carried out.

See the Practical Action Technical Brief on *Drying* of *Foods* for further information.

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Spices contain volatile oils that are adversely affected by high temperatures. Therefore the temperature of drying must be tightly controlled to ensure a high quality dried product.

Most small-scale processors dry the crop by spreading it in the sun. This is another opportunity for the crop to become contaminated. All efforts should be made to ensure that the crop is dried in a clean place, away from animals, insects and birds.

Drying during the dry season

During the dry season, sun drying is usually adequate to dry the produce. The simplest and cheapest method is to lay the produce on mats in the sun. However, there are problems associated with this method. Dust and dirt are blown onto the crop and unexpected rainstorms can re-wet the crop. Drying in direct sunlight can adversely affect the colour of some of the more sensitive spices.

A solar dryer can be used to overcome the problems of contamination and spoilage by rain. The simplest type of solar dryer is the cabinet dryer (see Figure 1) which can be constructed out of locally available materials such as bamboo, coir fibre or nylon weave. For larger units (over 30kg/day) a Brace type of solar dryer could be used (Figure 2). However, the construction costs of this type of dryer are greater and a full financial evaluation should be made to see if it is economically viable.

See the Practical Action Technical Brief on *Solar Drying* for further information.

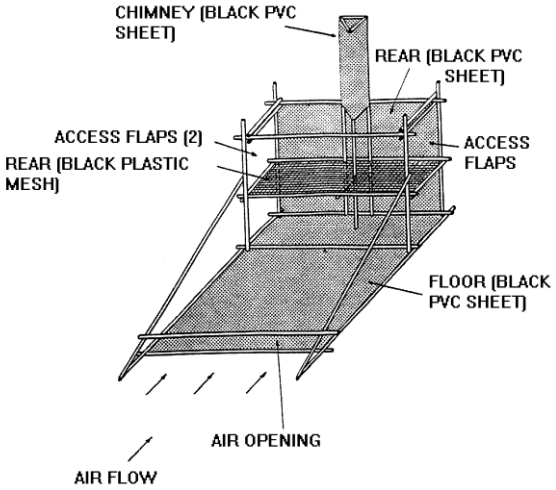

Figure 1: The Exell cabinet solar dryer.

Drying during the wet season

During the wet season or times of high humidity, which often coincides with the harvest of the spices, sun drying or solar drying cannot be used effectively. An artificial dryer that uses a cheap energy source is necessary. This may be a wood or husk burning dryer or a combined wood burning and solar dryer.

See the Practical Action Technical Brief on *Small-scale Drying Technologies* for further information on types of dryer.

It is important to control the temperature and time of drying. The maximum drying temperature for most spices is 50ºC. At higher temperatures than this the volatile compounds that are responsible for the flavour and aroma are driven off. Spices should be dried quickly until they reach their final moisture content. They should not be overdried as this also has a detrimental effect on the final quality. The final moisture contents for several spices are shown in Table 1. Some spices require special drying conditions. For example, cardamom should be dried in the dark to help preserve the green colour.

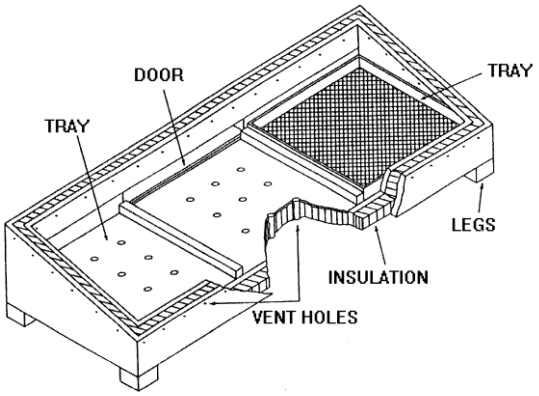

Figure 2: The Brace solar dryer.

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Grading

Spices can be graded by size, density, colour, shape and flavour. Machines are available for larger scale production units.

Spice	Maximum final moisture content (% wet basis)
Mace	6.0
Nutmeg, cloves	8.0
Turmeric, coriander	9.0
Cinnamon	11.0
Pepper, pimento, chillies, ginger	12.0
Cardamom	13.0

Table 1: Spice moisture content

Grinding

Spices can either be sold whole or ground into powder. Grinding can add value to the product, but it can also detract from the quality of the product. Many consumers are wary of ground spices since they are frequently contaminated or adulterated. There is no easy way to determine whether ground spices are pure or have been adulterated. In general, ground spices are made by grinding inferior and broken spices. Also, ground spice has a much shorter shelf life than the whole spice. Once it is ground, the flavour and aroma of spice soon deteriorate. It is better for the small-scale processor to sell whole spices. This also removes the need for moisture proof packaging materials and sealing machines.

For small-scale production (up to 100kg/day) manual grinders are adequate. Small Chinese or Indian models designed for domestic spice grinding are suitable. A treadle or bicycle could be attached to make the work easier.

For larger scale production a small, powered grinding mill is needed and models are available that can grind 25kg/hour. A grinding mill needs to be placed in a separate and well ventilated room because of the dust. Great care is needed to ensure uniform sized pieces/powders after grinding and also to prevent heating of spices during grinding.

Packaging and storage

After drying, the material should be packed quickly into clean heavy gauge polypropylene sacks to avoid any moisture pick up. The spices must be cool before they are packed into the sacks and they must be stored out of direct sunlight to prevent condensation forming on the inside of the sack. Workers should not directly handle the spices, but should use clean gloves and scoops. Sacks should be labelled and dated.

The packaging requirements depend on: 1) the type of spice, 2) whether it is ground or intact and 3) the humidity of storage. Most intact spices will store adequately in sacks/boxes if the humidity of the air is not too high. Ground spices can also be stored without special packaging if humidity is low but over long periods there is a loss of flavour and risk of contamination and spoilage.

It is therefore better to store spices in a barrier film such as polypropylene (essential in areas of high humidity) to provide an attractive package, retain spice quality and prevent contamination and losses. If polypropylene is not available, cellulose film is adequate if it is heat sealable. Polythene is a poor substitute and should only be used for short term storage as it allows the flavour/aroma of the spices to escape.

Equipment suppliers

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

This website includes lists of companies in India who supply food processing equipment.
www.niir.org/directory/tag/z,,1b_0_32/fruit+processing/index.html

Dryers

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
E-mail: acufilmachines@yahoo.co.in
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Website:
www.indiamart.com/acufilmachines/#products

Bombay Engineering Works
1 Navyug Industrial Estate
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Opposite Swan Mill, Sewree (W)
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Tel: +91 22 24137094/24135959
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Bry-Air (Asia) Pvt Ltd
21C Sector 18
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Fax: +44 1228 633555
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Website: www.mitchell-dryers.co.uk/

Grinders and mills

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E-mail: sales@kapsengineers.com
Website: www.kapsengineers.com

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UK (See above)

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Website: www.miracle-mills.co.uk/

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Packaging and labelling machines

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India (See above)

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Gurdeep Packaging Machines
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India
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E-mail: info@orbitequipments.com
Website: www.orbitequipments.com

Pharmaco Machines
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Sinhgad Road, Pune - 411030,
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Tel: +91 20 65706009
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Website: www.pharmacomachines.com/

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Website: www.teriin.org/tech_cardamom.php

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Website: www.iisr.org/package/index.php?spice=Cardamom&body=Overview

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Website: www.ircc.iitb.ac.in/webnew/

References and further reading

Practical Action Technical Briefs:
Drying of Foods Practical Action Technical Brief
Food Labelling Practical Action Technical Brief
Drying selection of Practical Action Technical Briefs
Herbs and Spices selection of Practical Action Technical Briefs
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Processing of Black Pepper, Practical Action Food Chain No. 3
Spice Plants, M. Borget, 1993, CTA/MacMillan
Ground and Packaged Spices: Options and Difficulties in Processing at Origin. Marketing Series 7, NRI, 1993
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Producing Solar Dried Fruit and Vegetables for Micro and Small scale Rural Enterprise Development, A Series of Practical Guides' written by the Natural Resources Institute.
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Drying Food for Profit B Axtell, Practical Action Publishing, 2002

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This document was produced by Dr. S Azam Ali for Practical Action in January 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

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