SMALL-SCALE SPICE PROCESSING

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 (e.g. 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 quiet 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.
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.

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

<table>
<thead>
<tr>
<th>Spice</th>
<th>Maximum final moisture content (% wet basis)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mace</td>
<td>6.0</td>
</tr>
<tr>
<td>Nutmeg, cloves</td>
<td>8.0</td>
</tr>
<tr>
<td>Turmeric, coriander</td>
<td>9.0</td>
</tr>
<tr>
<td>Cinnamon</td>
<td>11.0</td>
</tr>
<tr>
<td>Pepper, pimento, chillies, ginger</td>
<td>12.0</td>
</tr>
<tr>
<td>Cardamom</td>
<td>13.0</td>
</tr>
</tbody>
</table>

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
acufilmachines@hotmail.com
Website:
www.indiamart.com/acufilmachines/#products

Bombay Engineering Works
1 Navyug Industrial Estate
185 Tokersey Jivraj Road
Opposite Swan Mill, Sewree (W)
Mumbai 400015, India
Tel: +91 22 24137094/24135959
Fax: +91 22 24135828
E-mail: bomeng@vsnl.com
Website:
www.bombayengg.com/contact.html

Bry-Air (Asia) Pvt Ltd
21C Sector 18
Gurgaon – 122015
India
Tel: +91 124 4091111
Fax: +91 124 4091100
E-mail: enquire@pahwa.com
Website: www.bryair.com/index.htm

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Plot No 2009, Phase IV, GIDC
Vatva, Ahmedabad 382445
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Tel: +91 79 25830836
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www.teriin.org/tech_cardamom.php

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Songpa-gu
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Tel: +82 2 414 0629
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E-mail: drikorea@hanmail.net
Website: www.drikorea.co.kr

Bry-Air (Malaysia) Sdn Bhd (197712-W)
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43650 Bandar Baru Bangi
Selangor, Malaysia
Tel: 603 89256622
Fax: 603 89259957
E-mail: bryair@bryair.com.my
Website: www.bryair.com.my

Bry-Air (Thailand)
448 Richie Tower, 2nd Floor
Ratchaphisek Road
Samsennai Huayekhwang
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Fax: +66 2 9389314
Grinders and mills

Kaps Engineers 831, G.I.D.C.
Makarpura
Vadodara - 390 010
India
Tel: +91 265 644692/ 640785/ 644407
Fax: +91 265 643178/ 642185
E-mail: sales@kapsengineers.com
Website: www.kapsengineers.com

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

Alvan Blanch
UK (See above)

Premium Engineers PVT Ltd
India (see above)

CS Bell Co
170 West Davis Street
PO Box 291
Tiffin
Ohio
USA
Tel: +1 419 448 0791
Fax: +1 419 448 1203
E-mail: sales@csbell.co.com
Website: www.csbellco.com/

Miracle Mills Ltd
Knightsdale Road
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IP1 4LE
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Tel: (01473) 742325
Fax: (01473) 462773
E-mail: sales@miracle-mills.co.uk
Website: www.miracle-mills.co.uk/
Packaging and labelling machines

**Acufil Machines**  
India (See above)

**Gardners Corporation**  
158 Golf Links  
New Delhi 110003  
India  
Tel: +91 11 3344287/3363640  
Fax: +91 11 3717179

**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**  
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E-mail: yusufsvsnl.com; mmmbvsnl.com; yusufmmmb.in

**Narangs Corporation**  
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Tel: +91 11 2336 3547  
Fax: +91 11 2374 6705

**Orbit Equipments Pvt Ltd**  
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Secunderabad - 500011, Andhra Pradesh  
India  
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Fax: +91 40 27742638  
E-mail: info@orbitequipments.com  
Website: www.orbitequipments.com

**Pharmaco Machines**  
B-2/17, 'Anubandh', Near Ramkrishna Math, Danekar Bridge,  
Sinhgad Road, Pune - 411030,  
Maharashtra, India  
Tel: +91 20 65706009  
Fax: +91 20 24391953  
E-mail: response@pharmacomachines.com  
Website: www.pharmacomachines.com/

**Rank and Company**  
India (see above)

**Banyong Engineering**  
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Website: www.teriin.org/tech_cardamom.php

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Tel: +91 495 2731346
+91 495 2730294
E-mail: parthasarathy@iisr.org; rdinesh@iisr.org
Website: www.iisr.org/package/index.php?spice=Cardamom&body=Overview

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Fax: +91 22 2572 3480
Website: www.ircc.iitb.ac.in/webnew/

References and further reading

Practical Action Technical Briefs:
- Drying of Foods
- Food Labelling
- Drying selection of Practical Action Technical Briefs
- Herbs and Spices
- Processing of Black Pepper
- Spice Plants, M. Borget, 1993, CTA/MacMillan
- Ground and Packaged Spices: Options and Difficulties in Processing at Origin. Marketing Series 7, NRI, 1993
- 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.
- Setting up a food drying business P Thuillier, Practical Action Publishing, 2002
- Drying Food for Profit B Axtell, Practical Action Publishing, 2002
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