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 (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.
Spice processing

Practical Action

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.

Figure 1: The Exell cabinet solar dryer.

Figure 2: The Brace solar dryer.
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@naphwa.com
Website: www.bryair.com/index.htm

Premium Engineers Pvt Ltd
Plot No 2009, Phase IV, GIDC
Vatva, Ahmedabad 382445
India
Tel: +91 79 25830836
Fax: +91 79 25830965
Website: www.premiumengineers.com/

Rank and Company
A-p6/3, Wazirpur Industrial Estate
Delhi – 110 052
India
Tel: +91 11 7456101/ 27456102
Fax: +91 11 7234126/7433905
E-mail: rank@poboxes.com

Tata Energy Research Institute (TERI)
Darbari Seth Block
IHC Complex, Lodhi Road
New Delhi, India
Tel: +91 11 2468 2100/ 4150 4900
Fax: +91 11 2468 2144/ 2468 2145
E-mail: mailbox@teri.res.in
Website: www.teriin.org/tech_cardamom.php

Bry-Air China
No 951-F Jian Chuan Road
Minhang District
Shanghai 200240
China
Tel: +86 21 51591555
Fax: +86 21 51591559
E-mail: bryairc@online.sh.cn;
bryair@vip.sina.com
Website: www.bryair.com.cn

Bry-Air (Korea)
202 2F DH Building, 174-2 Songpa-dong
Songpa-gu
Seoul, Korea
Tel: +82 2 414 0629
Fax: +82 2 417 2622
E-mail: drikorea@hanmail.net
Website: www.drikorea.co.kr

Bry-Air (Malaysia)
Sdn Bhd (197712-W)
Lot 11, Jalan P/7, Bangi Industrial Estate
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
Ratchadaphisek Road
Samsenmai Huayekhwang
Bangkok 10320
Thailand
Tel: +66 2 5415479, 9389304
Fax: +66 2 9389314
E-mail: info@bryair.co.th
Website: www.bryair.co.th
Industrias Technologicas Dinamicas SA
Av. Los Platinos 228
URB industrial Infantas
Los Olivos
Lima
Peru
Tel: +51 14 528 9731
Fax: +51 14 528 1579

Bry-Air (Africa)
Lower Ground Floor
Lakeside Place
1 Ernest oppenheimer Drive
Bruma-2198, Bedfordview
Johannesburg, South Africa
Tel: +27 11 6150458
Fax: +27 11 6166485
E-mail: bryairafrica@telkomza.net
E-mail: bryairafrica@pahwa.com

Ashoka Industries
Kirama
Walgammulla
Sri Lanka
Tel: +94 71 764725

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

Alvan Blanch
Chelworth, Malmesbury
Wiltshire
SN16 9SG
UK
Tel: +44 1666 577333
Fax: +44 1666 577339
E-mail: enquiries@alvanblanch.co.uk
Website: www.alvanblanch.co.uk

Mitchell Dryers Ltd
Denton Holme, Carlisle
Cumbria
CA2 5DU
UK
Tel: +44 1228 534433
Fax: +44 1228 633555
E-mail: webinfo@mitchell-dryers.co.uk
Website: www.mitchell-dryers.co.uk/

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
USA
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
Ipswich
IP1 4LE
United Kingdom
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**
140 Sarang Street
1st Floor, Near Crawford Market
Mumbai, India
Tel: +91 22 2344 2902
Fax: +91 22 2345 2532
E-mail: yusuf@vsnl.com; mmmb@vsnl.com; yusuf@mmmb.in

**Narangs Corporation**
P - 25, Connaught Place,
New Delhi 600 08
Delhi
India
Tel: +91 11 2336 3547
Fax: +91 11 2374 6705

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

**Pharmaco Machines**
B-2/17, ‘Anubandh’, Near Ramkrishna Math, Dandekar 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**
94 Moo 4 Sukhaphibaon No 2 Rd
Industrial Estate Bangchan
Bankapi
Thailand
Tel: +66 2 5179215-9

**Technology and Equipment Development Centre (LIDUTA)**
360 Bis Ben Van Don St
District 4, Ho Chi Minh City
Vietnam
Tel: +84 8 940 0906
Fax: +84 8 940 0906

**Technology Consultancy Center**
University of Science and Technology
Kumasi
Ghana
Tel: +233 51 60296/7
Fax: +233 51 60137
E-mail: tcc@knut.edu.gh
Website: www.knust.edu.gh/tcc/
Contacts

The following contacts should be able to provide further information:

Tata Energy Research Institute (TERI)
Darbari Seth Block
IHC Complex, Lodhi Road
New Delhi, India
Tel: +91 11 2468 2100/ 4150 4900
Fax: +91 11 2468 2144/ 2468 2145
E-mail: mailbox@teri.res.in
Website: www.teriin.org/tech_cardamom.php

Indian Institute of Spices Research (IISR)
Marikunnu PO, Calicut
Kerala
India 673012
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

Indian Institute of Technology (IIT) Bombay
Powai
Mumbai 400076
India
Tel: +91 22 2572 2545
Fax: +91 22 2572 3480
Website: www.ircc.iitb.ac.in/webnew/

References and further reading

Practical Action Technical Briefs:
- Drying of Foods
- Solar Drying
- Small-scale Drying Technologies
- Cardamom Processing
- Cinnamon Processing
- Cloves Processing
- Cumin Processing
- Nutmeg and Mace Production and Processing
- Turmeric Processing
- Ginger Processing
- Black Pepper Processing

Processing of Black Pepper, ITDG 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
Quality assurance for small-scale rural food industries. Chapter 2.4 Herb and spice products.
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 countries.

Practical Action
The Schumacher Centre for Technology and Development
Bourton-on-Dunsmore
Rugby, Warwickshire, CV23 9QZ
United Kingdom
Tel: +44 (0)1926 634400
Fax: +44 (0)1926 634401
E-mail: inforserv@practicalaction.org.uk
Website: http://practicalaction.org/practicalanswers/

Practical Action is a development charity with a difference. We know the simplest ideas can have the most profound, life-changing effect on poor people across the world. For over 40 years, we have been working closely with some of the world’s poorest people - using simple technology to fight poverty and transform their lives for the better. We currently work in 15 countries in Africa, South Asia and Latin America.