PRACTICAL ACTION
Technology challenging poverty

TURMERIC PROCESSING

technical brief

Introduction

Turmeric (*Curcuma domestica*) is an erect perennial plant grown as an annual crop for its rhizome (underground rootlike stem bearing roots and shoots). It belongs to the same family as ginger (*Zingiberaceae*) and grows in the same hot and humid tropical climate. The rhizome is a deep bright yellow colour and similar form to the ginger but slightly smaller. The plant originated in the Indian sub-continent and today India is the worlds leading producer and consumer of turmeric. It is also produced in China, Taiwan, Bangladesh, Indonesia, Sri Lanka, Australia, Africa, Peru and the West Indies. Turmeric plays an important role in Indian culture- it is an essential ingredient of curry, used in religious festivals, as a cosmetic, a cloth dye and in many traditional health remedies. The spice is sometimes referred to as 'Indian saffron'.

Figure 1: Fresh turmeric.
Photo: Practical Action / Neil Noble

Turmeric production

The Turmeric plant is propagated by planting pieces of the previous season's rhizome, which grows to form plants of about 0.9 metres tall. The plant has long stemmed leaves and pale yellow flowers and requires a loamy soil. It grows in a wide range of climatic conditions, but does require rainfall of between 1000 and 2000mm a year. It can grow in locations that are up to 1220m above sea level.

Harvesting

Turmeric is harvested when the plants are between 7 and 10 months of age, when the stems and leaves start to dry out and die back. The whole plant is removed from the ground, taking care not to cut or bruise the rhizomes.

Sweating

The leaves are removed from the plant and the roots carefully washed to remove soil. Any leaf scales and long roots are trimmed off. The side (lateral) branches (which are known as the fingers) of the rhizomes are removed from the main central bulb (known as the mother). The mothers and fingers are heaped separately, covered in leaves and left to sweat for one day. The 'mothers' are the preferred material for planting the following year.

Curing

Before drying, the turmeric rhizomes have to be cured. This involves boiling the roots to soften them and remove the raw odour. After curing, the starch is gelatinised, which reduces the drying time required, and the colour is uniformly distributed throughout the rhizome.

The specifications for curing turmeric vary from different places. The Indian Institute of Spice Research and the Agricultural Research Centre recommend boiling in plain water for 45 minutes until froth appears at the surface and the typical turmeric aroma is released. Using this method, the colour will deteriorate if the rhizomes are boiled for too long. However, if not boiled for long enough, the rhizome will be brittle. The optimum stage is reached when the rhizomes are soft to touch or can be pierced by a blunt piece of wood.

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Other researchers recommend boiling the rhizomes in an alkaline solution, made from 0.05% to 1.0% sodium carbonate or lime (calcium carbonate). The alkaline water is thought to improve the final colour of the dried turmeric.

Because the fingers and bulbs are of different size and thickness to each other, it is important that they are cured in different batches. The curing time is dependent on the age, variety and size and thickness of the rhizomes and varies from one to four or sometimes six hours. It is also affected by the size of the batch – smaller batches generally produce a higher quality dried turmeric as the curing process is easier to control and monitor. It is recommended to use perforated containers with a capacity of 50-75kg. The perforated containers are immersed in the boiling water for the required cooking time. This method allows the boiling water to be used for more than one batch of turmeric.

The best time for curing is two to three days after harvest. If it is delayed after this then the rhizomes may start to deteriorate.

The benefits of curing turmeric include the following:

- Reduction of drying time
- More even colour distribution throughout the rhizome
- A more attractive (not wrinkled) product that is easier to polish
- Sterilisation of the rhizomes before drying.

Drying

The rhizomes are sliced before drying to reduce the drying time and improve the quality of the final product (it is easier to achieve a lower final moisture content in small pieces of rhizome without spoiling the appearance of the product). The rhizomes are traditionally sliced by hand, but there are small machines available to carry out this process. Figure 3 shows a simple turmeric slicing machine designed in Bolivia. It is a simple structure that contains a transmission system and two stainless steel circular blades. The machine is easy to build and maintain and can cut up to 120kg turmeric per hour.

Figure 2: A simple slicing machine used in Bolivia.

The cooked fingers or bulbs are dried until they have a final moisture content of 5-10%. An experienced turmeric processor will know when the rhizome is dry enough as the fingers will snap cleanly with a metallic sound. Traditionally the rhizome pieces are laid on clean concrete floors and dried in the sun. This method can take anything from 10 to 15 days, depending on the climate and the size of the rhizome pieces. It is important that the rhizome pieces are not placed in direct sunlight as this will cause the colour to fade. Using a mechanical drier will result in a better colour and a higher quality product.

There are several different types of mechanical drier that are suitable for drying turmeric. These include the tray drier, cross flow air tunnels, solar driers and cabinet driers. The optimum drying temperature is 60°C – temperatures higher than this result in a darker coloured product. See the Practical Action Technical Brief on drying for further general information on driers.

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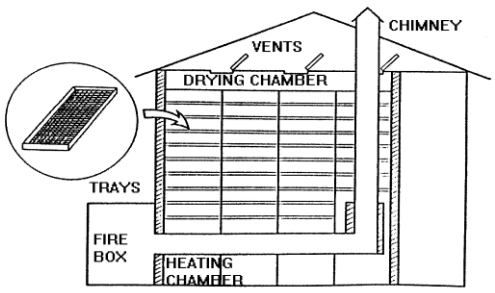

Figure 3: A typical tray drier

Figure 4: A typical solar drier developed in Bolivia

Polishing

After drying the rhizomes are polished to remove the rough surface. This can be done by hand or by shaking the rhizomes in a gunny bag filled with stones. Polishing drums are used in many places – these are very simple, power driven drums that have an abrasive metallic mesh lining. In some places the rhizomes are sprinkled with a solution of ground turmeric in water during the final polishing, to give the rhizomes a good colour.

Grading

Quality specifications for turmeric are imposed by the importing country. They refer to the cleanliness of the product rather than on the eating quality.
Bulk rhizomes are graded into fingers, bulbs and splits. The Indian standards for turmeric follow the Agmark Specifications (Agricultural Directorate of Marketing) to ensure quality and purity of the products.

Grade	Flexibility	Broken pieces, fingers <15mm	Foreign matter	Defectives	Percentage of bulbs by weight max
		No more than (% by weight)	No more than (% by weight)	No more than (% by weight)	
Alleppey fingers[a]					
Good	Hard to touch	5	1	3	4
Fair	Hard	7	1.5	5	5
Fingers other than Alleppey					
Special	Hard to touch, metallic twang on break	2	1	0.5	2

Good	Same	3	1.5	1	3
Fair	Hard	5	2	1.5	5
Rajapore fingers[b]					
Special	Hard to touch, metallic twang on break	3	1	3	2
Good	Same	5	1.5	5	3
Fair	Hard	7	2	7	5
Non-specified	-	-	4	-	-
Bulbs[c]					
Special	-	-	1	1	-
Good	-	-	1.5	3	-
Fair	-	-	2	5	-

Table 1. Agmark standards for turmeric rhizomes (www.turmeric.8m.com/standards.html)

[a] Fingers shall be of secondary rhizomes of *Curcuma longa* L.; shall be well set and close grained; free from bulbs; be perfectly dry and free from weevil damage and fungus attack and not be artificially coloured with chemicals.
[b]. Same as (a); have the characteristics of the variety; admixture of varieties of turmeric allowed at a maximum of 2%, 5%, 10% and 10% for the four grades respectively.
[c]. Bulbs shall be primary rhizomes of *Curcuma longa* L.; shall be well developed, smooth and free from rootlets; have the characteristics of variety; be perfectly dry and free from weevil damage and fungus attack; not artificially coloured with chemicals.

Varieties of turmeric

Alleppey	Comes from Kerala. Has a deep yellow colour with a high pigment content (6.5% curcumin). This type is popular in the USA.
Madras	Comes from Tamil Nadu. Is a mustard colour with a lower pigment content (3.5% curcumin). This type is popular in the UK.
West Indian	Comes from the Caribbean. It is a dull yellowish brown colour.

Table 2. Varieties of turmeric.

Grinding

Grinding can be a method of adding value to a product. However, in general it is not advisable to grind spices as they become more vulnerable to spoilage. The flavour and aroma compounds are not stable and will quickly disappear from ground products. The storage life of ground spices is much less than for the whole spices. It is very difficult for the consumer to judge the quality of a ground spice. It is also very easy for unscrupulous processors to contaminate the ground spice by adding other material. Therefore most consumers, from wholesalers to individual customers, prefer to buy whole spices.

Turmeric is one of the few spices that is usually purchased in a ground form. The whole rhizome pieces may be exported and then ground in the country of destination. Alternatively, the dried rhizomes may be ground at the place of origin.

Figure 5: Ground Turmeric Photo credit: Practical Action / Neil Noble

Grinding is a very simple process that involves cutting and crushing the rhizomes into small particles, then sifting it through a series of screens of different mesh size, to get a fine powder. There are a range of grinding mills available, both manual and powered, of different capacities and which work in different ways. The traditional way to grind would be between two stones. The advantage of this method is that the turmeric does not get too hot during the grinding process. With some

of the mechanical mills, such as a hammer mill, heat is generated during the grinding process, which can cause some of the volatile taste and aroma compounds to be lost. For higher quality ground turmeric, the grinding temperature should be kept as low as possible.

After grinding the powder is sieved through different mesh screens until a uniform, fine powder is obtained.

Grade	Moisture (%w/w) max	Total ash (%w/w) max	Acid insoluble ash (%w/w) max	Lead (ppm) max	Starch (%w/w) max	Chromate test
Turmeric powder[a]						
Standard	10	7	1.5	2.5	60	Negative
Coarse ground powder[b]						
Standard	10	9	1.5	2.5	60	Negative

Table 3: Agmark standards for turmeric powder (www.turmeric.8m.com/standards.html)

[a]. Ground to pass through a 300 micron sieve
[b]. Ground to pass through a 500 micron sieve

Packaging

Dried rhizomes and rhizome pieces are packed in jute sacks, wooden boxes or lined corrugated cardboard boxes for shipping.

Ground turmeric should be packaged in moisture proof, air-tight polyethylene packages. The packages should be sealed and labelled with attractive labels. The label needs to contain all relevant product and legal information – the name of the product, brand name (if appropriate), details of the manufacturer (name and address), date of manufacture, expiry date, weight of the contents, added ingredients (if relevant) plus any other information that the country of origin and of import may require (a barcode, producer code and packer code are all extra information that is required in some countries to help trace the product back to its origin). See the Practical Action Technical Brief on labelling for further information on labelling requirements.

Storage

The bulk rhizomes are stored in a cool and dry environment, away from direct sunlight.
The bright colour of ground turmeric will fade when it is left in the light for a long period of time. Therefore the packets should be stored in a cardboard box, away from the sunlight.
The storage room should be clean, dry, cool and free from pests. Mosquito netting should be fitted on the windows to prevent pests and insects from entering the room. Strong smelling foods, detergents and paints should not be stored in the same room.

Standards

	US Government requirements and ASTA
Moisture (%)	<9.0
Curcumin (%)	5-6.6
Volatile oil (%)	<3.5
Extraneous matter (% by weight)	0.5
Mould (% by weight)	3.0

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Equipment suppliers

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

This website includes lists of companies in India who supply food processing equipment.
http://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
Email : acufilmachines@yahoo.co.in,
acufilmachines@hotmail.com
http://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
bomeng@vsnl.com
http://www.bombayengg.com/contact.html

Planters Energy network (PEN)
No 5, Power House 3rd Street
N R T Nagar
Theni 625531
Tamil Nadu
India
Tel: +91 4546 255272
Fax: +91 4546 255271
info@pen.net.in
http://www.pen.net.in/Contactus.asp

Premium Engineers Pvt Ltd
Plot No 2009, Phase IV, GIDC
Vatva, Ahmedabad 382445
India
Tel: +91 79 25830836
Fax: +91 79 25830965

Rank and Company
A-p6/3, Wazirpur Industrial Estate
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Fax: +91 11 7234126/7433905
Rank@poboxes.com

Industrias Technologicas Dinamicas SA
Av. Los Platinos 228
URB industrial Infantas
Los Olivios
Lima
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Tel: +51 14 528 9731
Fax: +51 14 528 1579

Ashoka Industries
Kirama
Walgammulla
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Kundasala Engineers
Digana Road
Kundasala
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enquiries@alvanblanch.co.uk
www.alvanblanch.co.uk

Mitchell Dryers Ltd
Denton Holme, Carlisle
Cumbria

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UK
Tel: +44 1228 534433
Fax: +44 1228 633555
webinfo@mitchell-dryers.co.uk
http://www.mitchell-dryers.co.uk/

Slicing machines

Central Institute of Agricultural Engineering
Nabi Bagh
Berasia Road
Bhopal 462 038
Madhya Pradesh
India
Tel: +91 755 2737191
Fax: +91 755 2734016
director@ciae.res.in
http://www.ciae.nic.in/

Eastend Engineering Company
173/1 Gopal Lal Thakur Road
Calcutta 700 035
India
Tel: +91 33 25536937
Fax: +91 33 23355667

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

Narangs Corporation
P-25 Connaught Place
New Delhi 110 001
India
Tel: +91 11 2336 3547
Fax: +91 11 2374 6705

DISEG
Av Jorge Carlos Mariategui 1256
Villa Maria del Triunfo
Lima
Peru
Tel: +51 14 283 1417

Servifabri
JR Alberto Aberd
No 400 Urb Miguel Grau (Ex Pinote)
San Martin de Porres
Lima
Peru
Tel/Fax: +51 14 481 1967

Cleaning/abrasive machines

Central Institute of Agricultural Engineering
India (see above)

Gardners Corporation
India (see above)

Rajan Universal Exports
Post Bag no 250
162 Linghi Chetty Street
Chennai 600 001
India
Tel: +91 44 25341711/25340731/25340751
Fax: +91 44 25342323
rajeximp@vsnl.com
http://rajeximp.com/rajeximp/contact.html

Servifabri SA
Peru (see above)

Crypto Peerless Ltd
Bordesley Green Road
Birmingham
B9 4UA
UK

Milling and grinding machines

Central Institute of Agricultural Engineering
India (see above)

Gardners Corporation
India (see above)

Premium Engineers PVT Ltd
India (see above)

Rajan Universal Exports PVT Ltd
India (see above)

Kundasala Engineers
Sri Lanka (see above)

Alvan Blanch
UK (see above)

C S Bell Co
170 West Davis Street
PO Box 291
Tiffin
Ohio 44883
USA
Tel: +1 419 448 0791
Fax: +1 419 448 1203

Packaging and labelling machines

Acufil Machines
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
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
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
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http://www.iisr.org/package/index.php?spice=Turmeric&body=Overview

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

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
Drying UNIFEM Practical Action Publishing 1995
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
Quality assurance for small-scale rural food industries. *Chapter 2.4 Herb and spice products*. FAO agricultural services bulletin 117, 1995.
Try Drying It! Case Studies in the Dissemination of Tray Drying Technology, B Axtell,Practical Action Publishing 1991
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
FAO InPHO Indian Spices

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