



CARDAMOM PROCESSING

Introduction

Cardamom is a valuable spice that is obtained from the seeds of a perennial plant (*Elettaria cardamomum*). Cardamom originates from the coastal area of India. It is now grown in Guatemala, Tanzania, Sri Lanka, El Salvador, Vietnam, Laos and Cambodia. India is the main exporter of dried cardamom.

Cardamom must be dried before it is stored and sold for market.

This brief outlines the important steps that should be taken pre-harvest and post-harvest to ensure that the dried cardamom is of top quality for the market.



Figure 1: Small green cardamom (*Elettaria cardamomum*).

Photo credit: Neil Noble / Practical Action

Types of cardamom

There are two main types of cardamom:

Small green cardamom (*Elettaria cardamomum*)

Large red/black cardamom (*Amomum subulatum* Roxb)

The most common type is the small green cardamom while large cardamom is mainly grown in India, with some in Nepal and Bhutan. They both come from the Zingiberaceae family of plants.

Cardamom production

The Cardamom bush grows to a height of about 3m. It grows best in a warm humid place where there is plenty of rain and rich soil. It can grow at altitudes up to 1370m above sea level. The bush requires shade and is usually grown under natural forest cover. The tree produces flowers after it is 2-3 years old. The first crop of seed capsules is harvested in the third year after planting. In India, the tree flowers in April/May and continues until July/August. The seed capsules are harvested at 30 to 40 day intervals.

Harvesting

Harvesting at the correct stage of maturity is essential to produce high quality cardamom capsules. The fruits should only be harvested once they are fully ripe and mature. In some places, farmers harvest the crop before it is fully ripe because they worry that it will be taken by thieves. If the crop is picked when it is mature, the higher yields and higher value of the final product may offset the losses due to theft. A ripe capsule has black seeds inside. An immature capsule has white seeds.

When a cardamom capsule is ripe it can be easily removed from the stem of the plant without too much force. The harvester should start harvesting at the base of each stem and move up the stem, taking off any capsules that easily fall off without pulling. The capsules that do not fall off easily should be left on the plant to ripen.

Cleaning

The crop should 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. A worker who is used to doing this can clean up to 100kg of cardamom in an eight hour day. Small machines are available for cleaning, but they are often not cost effective.

After winnowing the capsules are washed in clean water. Two or three large plastic buckets (15 litre capacity) are sufficient for small amounts but for large quantities, it may be better to use a sink with a drainage hole. Only water that is safe to drink should be used. It should be changed regularly to prevent contamination.

Pre-treatment

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After washing, the stalks are removed from the cardamom capsules by hand.

The capsules can be soaked in a solution of sodium bicarbonate (2-5%) for ten minutes to help retain the green colour. This is an optional step. A 2% solution of sodium bicarbonate is prepared by dissolving 20g (about 4 tea spoons) of sodium bicarbonate in 1 litre of water.

Drying

This is the most important part of the process as it affects the quality of the final product. It is important to dry the cardamom capsules as soon after harvest as possible to prevent the loss of flavour. It is also important that the drying process is as short as possible so that mould does not grow on the capsules and the bright green colour is retained. The drying temperature should not be above 50°C as this affects the colour and delicate flavour of the final product. In most places, cardamom capsules with a good green colour can be sold for a premium price.

The moisture content of a fresh cardamom capsule is about 85%. This needs to be reduced to 10% in the dried product so the cardamom capsules can be stored. If the drying period is too long mould can start to grow on the cardamom. There are several options available to the small-scale processor, depending upon the size of the business and the local weather conditions at the time of processing. Each method has different advantages and disadvantages:

Sun drying. Traditionally, cardamom capsules are spread on a concrete floor to dry using the natural heat from the sun. The capsules should be placed away from direct sunlight to preserve the green colour (strong sunlight will make the colour fade). This is the simplest and cheapest method, but does not produce the highest quality product. It is only successful in places where the climate is dry and hot. During the monsoon season for example, drying will be interrupted by rainfall which can cause mould to grow on the capsules. During drying, the capsules may be contaminated by dirt and dust from their surroundings.

Solar drying. The use of a solar dryer should improve the quality of the dried capsules as it is a cleaner, more controlled environment. However, it is not a popular choice as the green colour is lost during drying. The solar dryer is really only useful in dry hot sunny climates. The capsules should be placed in the dryer, out of direct sunlight, and dried until they have a final moisture content of 10%. In places with high humidity the solar dryer can only be used together with an extractor fan to remove the humid air.

Wood-fired dryer. In India, cardamom capsules are traditionally dried in curing houses, using wood to provide the heat. This method puts a huge demand on firewood. The smoke from the fire can give the capsules an unpleasant smoked flavour. The processor must ensure that the capsules closest to the heat source are not burnt or scorched. Cardamom capsules dried by this method are not of the highest quality.

Electric or gas dryer. An electric or gas-fired dryer is an improvement over the use of a wood-fuelled fire and is the best choice for drying large quantities of cardamom, especially in places where there is rainfall during the drying season. It is the most expensive of all options but does produce the highest quality product. It is important that the drying temperature does not exceed 50°C. A range of dryers of different sizes are available depending upon the individual choice and budget.

Figure 2 shows a typical tray dryer.

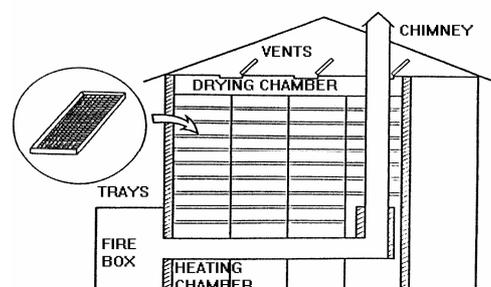


Figure 2: A typical tray dryer

Humidity-controlled drying. A drying chamber has been developed that helps to reduce colour loss and to produce high quality pods. The cardamom capsules are placed in the drying chamber, which is at a temperature of 50°C. During the first two hours of drying, the humidity builds up within the chamber. This allows the cardamoms to 'cook' and

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at the same time destroys the enzymes that break down the chlorophyll (chlorophyll gives the pods their green colour). No light is allowed into the drying chamber. After two hours the humid air is blown out of the chamber and the humidity reduced. The capsules are left in the chamber to dry until they have a final moisture content of 10%. Figure 3 shows a traditional drying chamber.

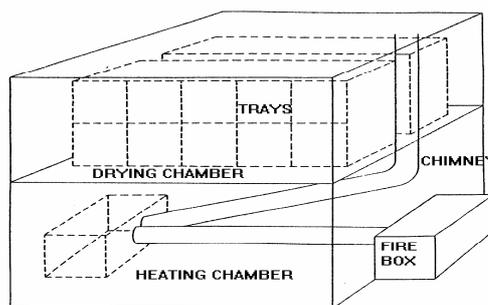


Figure 3: A traditional drying chamber

The use of biomass gasifiers

Electricity and liquefied petroleum gas (LPG) are clean and convenient fuels for drying, but are not cheap or easily available in villages. Firewood, stubble and dry leaves are readily available in villages, but they are smoky and can contaminate the dried product. A gasifier is a device that has been developed by TERI (The Tata Energy Research Institute in India) for use in the drying of cardamom. The gasifier uses briquettes that are made from firewood and other types of biomass and turns them into a gas that burns with a clean smokeless flame. The main advantages of using a gasifier is that it is more efficient in terms of the amount of fuel used. Biomass that burns in an open fire loses about two thirds of its energy as smoke. This system therefore uses less fuel and produces a higher quality dried cardamom. The gasifier for drying cardamom, developed by TERI, can be made locally using recycled oil drums. For more information contact TERI (www.teriin.org).

Grading

Cardamom is graded by colour and size. The deeper the green colour and the larger the capsule size, the higher the grade. All grading is done by hand.

The Indian grading system for cardamom capsules separates them into different types:

- Alleppey Green Cardamom
- Coorg Green Cardamom
- Bleached or Half-bleached Cardamom
- Bleached White Cardamom
- Mixed Cardamom

Agmark Schedule I for Alleppey Green Cardamom

Grade	Trade name	Colour	Empty and malformed capsules (%)	Immature and shrivelled capsules (%)	Blacks and splits (%)	Size (diameter of sieve hole mm)	Weight (G/L)	General characteristics
AGEB	Cardamom extra bold	Deep green or light green	2.0	2.0	0.0	7.0	435	Cardamoms are the dried capsules of <i>Elletaria</i> grown in South India. The capsules have 3 corners and a ribbed appearance. The capsules are free of insect damage and visible mould. Thrip marks on the capsules do not mean the capsules are infested with insects.
AGB	Cardamom bold	As above	2.0	2.0	0.0	6.0	415	
AGS	Cardamom superior	As above	3.0	5.0	0.0	5.0	385	
AGS-1	Shipment green-1	As above	5.0	7.0	10.0	4.0	350	
AGS-2	Shipment green-2	As above	7.0	9.0	12.0	4.0	320	
AGL	Light	-	-	-	15.0	3.5	260	
AGN		-	-	-	-	-	-	

Definition of terms

1. **Empty and malformed capsules:** Capsules which have no seeds or are scanty filled with seeds. To measure this, 100 capsules are selected at random from the sample, opened and the number of empty and malformed capsules are counted.
2. **Immature and shrivelled capsules:** Capsules which are not fully developed.
3. **Black and splits:** The former includes capsules that have a visible blackish colour and the latter include those which are open at the corners for more than half the length.
4. **Colour:** Cardamom are packed separately according to the colour: deep green, green, light green and pale brownish. If 95% of the cardamoms correspond to one of the colour groups, the relevant colour of the cardamom should be indicated on the Agmark labels. When the cardamoms are not of any one uniform colour, the colour is not indicated on the label.
5. **AGN:** Cardamom that does not conform to any of the grades from AGEB to AGL is packaged under the grade AGN (Non-specified)

Agmark Schedule II for Coorg Green Cardamom

Grade	Trade name	Empty and malformed capsules (%)	Unclipped capsules (%)	Immature and shrivelled capsules (%)	Blacks and splits (%)	Size (diameter of sieve hole mm)	Weight (G/L)	General characteristics
CGEB	Extra bold	0.0	0.0	0.0	0.0	8.0	450	Cardamoms are the dried capsules of <i>Elletaria</i> grown in South India. Colour range from greenish to brown. Global shape, skin ribbed or smooth, pedicels separated. The capsules have 3 corners and a ribbed appearance. The capsules are free of insect damage and visible mould. Thrip marks on the capsules do not mean the capsules are infested with insects.
CGB	Bold	2.0	0.0	3.0	0.0	7.5	435	
CG1	Superior	3.0	0.0	5.0	0.0	6.5	415	
CG2	Coorg green or Motta green	5.0	3.0	10.0	0.0	6.0	385	
CG3	Shipment	10.0	5.0	15.0	10.0	5.0	350	
CG4	Light	-	-	-	15.0	3.5	280	
CGN		-	-	-	-	-	-	

Definition of terms

1. **Empty and malformed capsules:** Capsules which have no seeds or are scanty filled with seeds. To measure this, 100 capsules are selected at random from the sample, opened and the number of empty and malformed capsules are counted.
2. **Immature and shrivelled capsules:** Capsules which are not fully developed.
3. **Black and splits:** The former includes capsules that have a visible blackish colour and the latter include those which are open at the corners for more than half the length.
4. **Unclipped capsules:** Capsules in which the tips have not been trimmed.
5. **CGN:** Cardamom that does not conform to any of the grades from CGEB to CG4 is packaged under the grade CGN (Non-specified).
6. Coorg cardamom is segregated according to colour: 1 – golden to light cream; 2 – cream; 3 – light green to green; 4 – brownish. Where the cardamom are of no uniform colour, there is no mention of colour on the label.

Agmark Schedule III for bleached or half bleached cardamom

Grade	Empty and malformed capsules (%)	Immature and shrivelled capsules (%)	Size (diameter of sieve hole) (mm)	Weight (G/L)	General characteristics
BL1	0.0	0.0	8.50	340	The cardamom is fully developed, dried capsules of <i>Elleteria</i> cardamom, bleached and/or half bleached by sulphuring. Colour ranging from pale cream to white. Global or three cornered with skin ribbed or smooth. The capsules are free of insect infestation and visible mould. Thrip marks on the capsules do not lead to the conclusion that the capsules are infested with insects.
BL2	0.0	0.0	7.00	340	
BL3	0.0	0.0	5.00	300	
BL Non specified	10.0	15.0	5.0		

Definition of terms

- 1. Empty and malformed capsules:** Capsules which have no seeds or are scanty filled with seeds. To measure this, 100 capsules are selected at random from the sample, opened and the number of empty and malformed capsules are counted.
- 2. Immature and shrivelled capsules:** Capsules which are not fully developed.
- 3. BL Non-specified:** Cardamom that does not conform to grades BL1 to BL3 is packed under the grade BLN.
- 4.** Cardamom are packed separately according to whether they are fully bleached or half bleached. In the latter case the colour of the capsules may be indicated at the request of the packer; 1- pale creamy; 2 – dull white.
- 5.** The word special can be affixed to grades BL1 and BL2 if at least 95% of the capsules do not have thrip marks over 50% of their body surface.

Agmark Schedule IV for Bleached White Cardamom

Grade	Trade name	Empty and malformed capsules (%)	Immature and shrivelled capsules (%)	Size (diameter of sieve hole mm)	Weight (G/L)	General characteristics
BW1	Mysore/Mangalore bleachable cardamom clipped	1.0	0.0	7.0	460	The cardamom is fully developed, dried capsules of <i>Elleteria</i> cardamom grown in Karnataka State. Reasonable uniform shade of white, light green or light grey colour and suitable for bleaching. The capsules are free from insect infestation and visible mould. Thrip marks alone do not lead to the conclusion that the capsules have been infested with insects.
BW2	Mysore/Mangalore bleachable cardamom unclipped	1.0	0.0	7.0	460	
BW3	Mysore/Mangalore bleachable bulk cardamom clipped	2.0	0.0	4.3	435	
BW4	Mysore/Mangalore bleachable bulk cardamom unclipped					
BW Non specified						

Definition of terms

1. **Empty and malformed capsules:** Capsules which have no seeds or are scanty filled with seeds. To measure this, 100 capsules are selected at random from the sample, opened and the number of empty and malformed capsules are counted.
2. **Immature and shrivelled capsules:** Capsules which are not fully developed.
3. **BW Non-specified:** Cardamom that does not conform to any of the grades from BW1 to BW4 are packed under the grade BW Non-specified.

Agmark Schedule V for Mixed Cardamom

Grade	Trade name	Empty and malformed capsules (%)	Immature and shrivelled capsules (%)	Blacks and splits (%)	Size (diameter of sieve hole mm)	Weight (G/L)	General characteristics
MEB	Mixed Extra Bold	2.0	2.0	0.0	7.0	435	The cardamom is fully developed, dried capsules of <i>Elleteria</i> cardamom grown in Karnataka State. Reasonable uniform shade of white, light green or light grey colour and suitable for bleaching. The capsules are free from insect infestation and visible mould. Thrip marks alone do not lead to the conclusion that the capsules have been infested with insects.
MB	Mixed Bold	2.0	2.0	0.0	6.0	415	
MS	Mixed Superior	3.0	5.0	0.0	5.0	385	
MS1	Mixed Shipment 1	5.0	7.0	10.0	4.0	350	
MS2	Mixed Shipment 2	7.0	9.0	12.0	4.0	320	
ML	Mixed Light			15.0	3.5	260	
MN							

Definition of terms

1. **Empty and malformed capsules:** Capsules which have no seeds or are scanty filled with seeds. To measure this, 100 capsules are selected at random from the sample, opened and the number of empty and malformed capsules are counted.
2. **Immature and shrivelled capsules:** Capsules which are not fully developed.
3. **Black and splits:** The former includes capsules that have a visible blackish colour and the latter include those which are open at the corners for more than half the length.
4. A tolerance of 5% of the next lower size is permissible.
5. **MN:** Cardamom that does not conform to any of the grades from MEB to ML is packaged under the grade MN (Non-specified).

Grinding

Cardamom capsules are usually sold whole. Grinding can be a method of adding value to a product. However, it is not advisable to grind spices. After grinding, spices are 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.

Packaging

Cardamom capsules can be packaged in polythene bags of various sizes according to the market demand. The bags should be sealed to prevent moisture entering. Sealing machines can be used to seal the bags. Attractive labels should be applied to the products. 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

Dried cardamom capsules must be stored in moisture-proof containers away from direct sunlight. For long term bulk storage, polythene-lined gunny bags (strong sacks made from jute fibres) inside wooden boxes are used. The polythene bags help to preserve the green colour of the pods. It is essential that the capsules are fully dry before they are placed in the gunny bags for storage. Any moisture within the bags will cause the capsules to rot. The stored cardamoms should be inspected regularly for signs of spoilage or moisture. If they have absorbed moisture, they should be re-dried to a moisture content of 10%.

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 as they will spoil the delicate aroma and flavour of the cardamom.

Standards

	US Government requirements and ASTA	British Standard
Moisture (%)	<11.0	<13.0
Volatile oil (%)	<3.0	<4.0
Extraneous matter (% by weight)	0.5	
Mould (% by weight)	1.0	

Equipment suppliers

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

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

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<http://www.indiamart.com/acufilmachines/#products>

Bombay Engineering Works

1 Navyug Industrial Estate
185 Tokersey Jivraj Road
Opposite Swan Mill, Sewree (W)
Mumbai 400015
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Tel: +91 22 24137094/24135959

Fax: +91 22 24135828

bomeng@vsnl.com

<http://www.bombayengg.com/contact.html>

Bry-Air (Asia) Pvt Ltd

21C Sector 18
Gurgaon – 122015
India

Tel: +91 124 4091111

Fax: +91 124 4091100

enquire@pahwa.com

<http://www.bryair.com/index.htm>

Premium Engineers Pvt Ltd

Plot No 2009, Phase IV, GIDC
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Cardamom processing

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Mitchell Dryers Ltd

Denton Holme, Carlisle
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UK
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Fax: +44 1228 633555
webinfo@mitchell-dryers.co.uk
<http://www.mitchell-dryers.co.uk/>

technical brief

Packaging and labelling machines**Acufil Machines**

India (See above)

Gardners Corporation

158 Golf Links

New Delhi 110003

India

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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 Buxabhoj & Co

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1st Floor, Near Crawford Market

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Tel: +91 22 2344 2902

Fax: +91 22 2345 2532

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Orbit Equipments Pvt Ltd

175 - B, Plassy Lane

Bowenpally

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Website: <http://www.orbitequipments.com>**Pharmaco Machines**

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Rank and Company

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technical brief

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parthasarathy@iisr.org; rdinesh@iisr.org
<http://www.iisr.org/package/index.php?spice=Cardamom&body=Overview>

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Powai
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Fax: +91 22 2572 3480
<http://www.ircc.iitb.ac.in/webnew/>

For information on the Agmark grading system;
www.indianspices.com/html/agmark_cardamom.htm

Further reading

Practical Action Technical Brief – Drying
Practical Action Technical Brief – Spice processing
Practical Action Technical Brief – Labeling food products

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