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Post Harvest Aspects of Cardamom

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Introduction

✓ Cardamom, known as Queen of Spices is the fruit of *Elettaria cardamomum*, a tropical perennial shrub with a pseudostem and is reported to be the native of India. The aromatic seeds inside the fruit pod form the spice. It is mainly cultivated in Kerala, Karnataka and Tamil Nadu, over an area of 1,15,105 ha (1985-86) producing 9,425 tonnes. In 1986-87 small cardamom worth Rs 27.20 crores were exported. In addition to India, the other cardamom producing countries are Guatemala, Sri Lanka, Tanzania, Papua New Guinea, Costa-Rica and Malawi, El Salvador, Thailand, Vietnam, Laos, Kampuchea etc.

Fruit capsules of cardamom are usually 13 to 19 mm long, green in colour and contain hard brownish black seeds. It is these fruit capsules or the hulled seeds that form the spice cardamom. The fruits are harvested when they are almost fully ripe but still in green colour. Judging the maturity of the capsule is very important. Following characters of panicle/capsule indicate the maturity stage.

1. Distinctly well developed shoulders of the capsule
2. Clear cut line in between two segments of the shell
3. Loose attachment of capsule to the panicle
4. Triangular deep cut at the point of attachment and
5. Change of shell colour to yellow during post maturity stage.

The capsule maturity proceeds from the base of the panicle/branchlet towards the tip. Cardamom capsules are manually picked with stalk end intact just before the point of complete ripeness. Several pickings are made during the season. Over ripe fruits split on drying floors while unripe ones shrink and give a shrivelled appearance. Freshly harvested cardamom capsules contain 80% moisture (wb) which are processed in two ways bleaching and green curing. Both process involve the operation of drying the capsules to safe storage moisture level of 10% (wb).

Processing Technology

After harvesting, cardamom is processed within 24 to 36 hours to avoid deterioration. Processing includes pretreatment, drying, cleaning, packing and grading. Fig.1 shows a typical flow chart of various processing operations of cardamom.

The freshly harvested cardamom fruits are washed in water to remove dirt. Washing capsules with sodium carbonate solution (2%) for about 10 minutes cleans the capsules as well as helps in retaining the green colour during artificial

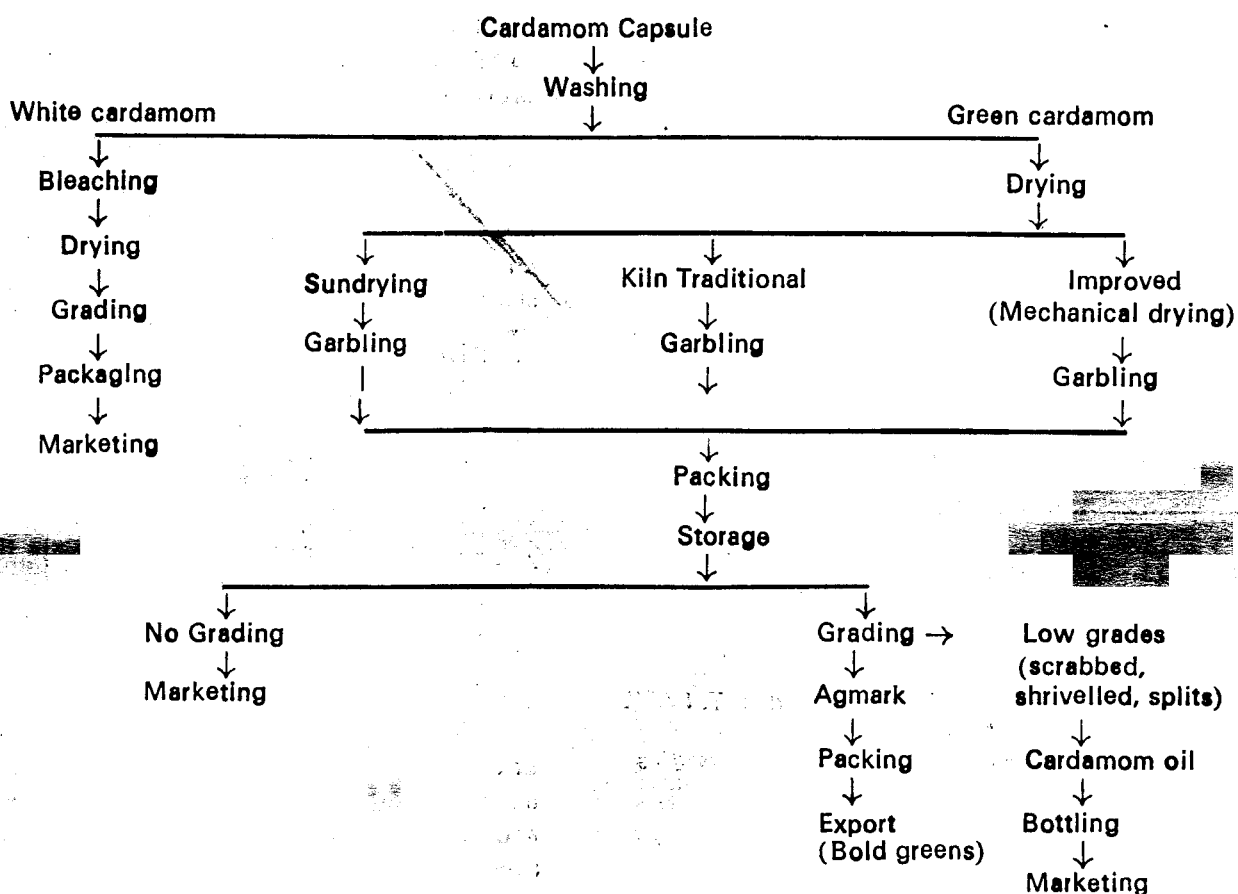


Fig. 1 UNIT OPERATIONS OF CARDAMOM PROCESSING

drying (Anon. 1967, Natrejan, 1968). In case of alkali wash, the capsules may be again washed once or twice in fresh water and the water is completely drained off before drying the capsules. For internal consumption in India, white cardamom, better known as bleached cardamom are produced. The process of bleaching is resorted to, especially in the case of varieties which do not retain their colour during drying and storage. Another advantage with this process is that the drying operation is simple and open sun drying can be practiced. The process consists of pre-treating the freshly harvested capsules by soaking them in 1% solution of bleaching powder for 30 to 60 minutes followed by dipping the lot in dilute solution of hydrochloric acid (HCl, concentration 0.2 + 0.05%) for

23 minutes. The treated capsules are washed and sundried to 8-10% moisture content.

Bleaching is achieved by exposing the capsules to sulphur dioxide (SO₂) fumes by fuming sulphur below the trays containing cardamom capsules. This process produces white coloured cardamoms. There are few other methods also practiced for bleaching of cardamom. These processes include (i) steeping in H₂O₂ (Hydrogen Peroxide) containing 0.5% sodium silicate for 15 minutes (concentration of H₂O₂ 6%), (ii) bleaching with H₂O₂ with SO₂ fuming for 60 minutes (concentration 0.3%), (iii) steeping in acidified bleaching powder solution (concentration 20 g/l) for 75 minutes and (iv) silicate (H₂O₂ subsequent steeping in H₂O₂ contain-

ing 0.5% sodium concentration 1%) for 30 minutes. (Varkey et al. 1980). The main advantage of bleaching is that even after prolonged storage of cardamom, the consumer acceptance is not affected because of white colour. However, there are certain disadvantages also, viz; the samples of cardamom in some cases show high sulphur dioxide content (av. 80 to 800 ppm, even up to 1,200 ppm in few cases) (Varkey et al. 1980). Moreover, bleaching shows slight reduction in oil content as well as may have an adverse effect on the characteristic aroma and flavour. The loss of oil from bleached cardamom as high 40% over a storage period of 1 year are also reported.

The capsules are immediately dried to retain the original colour at which they are harvested, otherwise the colour may tend to change from green to golden yellow up on ripening. This is especially significant in case of Malabar Variety, popularly grown in Karnataka. It retains the golden hue even after drying (Babu et al. 1985). However, the green cardamoms are more in demand in The Middle Eastern Countries. For producing green cardamom, freshly harvested capsules are dried to reduce the moisture content from 80% to 10% without effect-

ing the colour which is very easily bleached if exposed to sun. Small growers, normally resort to sundrying by spreading the cardamom capsules over mats for about 3-4 days. The colour, obtained by sundrying is, however, not uniform and fetch low price. Artificial drying in such cases becomes a necessity. The drying operation in green curing is done under controlled conditions of temperature and air flow in specially built drying houses by using radiated heat. For this purpose, the devices in use vary from sheltered mud platforms heated by a slow fire from beneath to large drying houses or kilns heated by flue pipes as is mostly done in large plantations. In kiln driers, temperature is maintained at 45 to 55° C and air circulation is achieved by natural convection or with exhaust fans. In electrical driers, temperature is kept at 50 to 65° C and air circulation is done by an electrically operated fan. The time required for drying vary from 24 to 36 hours in kiln driers and 12 to 24 hours in electrical driers (Patil, 1987). The kiln driers (Fig. 2) consists of a wood burning furnace, flue pipes and drying racks in a chamber. The furnace is made of fire bricks or ordinary bricks having about 2.44 m X 0.61 m grate size to facilitate charging with big wood logs. The hot flue gases escape through the chimney after

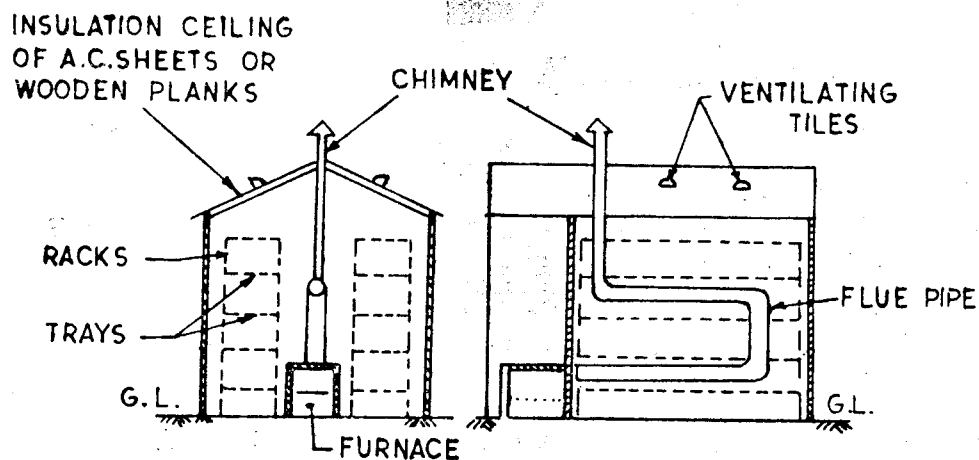


FIG. 2 KILN DRYER FOR CARDAMOM DRYING

circulating through 23 cm-30 cm diameter flue pipes, made of mild steel sheets placed in the centre of the room. The racks containing harvested cardamom capsules are kept at 30 cm distance from the flue pipe to avoid the over-heating. The roofing of the chamber is insulated from inside with wooden planks or A. C. Sheets. The capacity of the kiln depends on the size of plantation. The average firewood requirement is 1 q/1 q of fresh cardamom. However, the kilns have very low thermal efficiency 3-8% (Padlaniappan and Sooria murthy. 1985).

The electrical driers in use for cardamom are tray type cross flow driers (Fig. 3) with a capacity of about 25 kg to 400 kg. The air is heated by 15 KW air heaters and circulated over the material by a fan operated by 0.5 hp motor. The temperature of drying air is kept at 50°C and at full loading capacity, the drying time required is about 18-20 hours. After completing the drying at 50°C, the drier is run at 60°C for 1 hour for easy removal

of the flower stalks. The trays are then cooled for 1 hour and the stalks are removed by a wiremesh cleaner. Important points to be considered while drying are that there should not be excessive shrinkage of cardamom capsules and splitting should not occur during drying.

Infra-red driers are also now being used for this purpose. In this case, the temperature of cardamom is raised to 35 to 40°C both by pad heaters and the infra-red lamp. To remove the moisture, vacuum pump is provided. The heating sources are thermostically controlled. Such driers are available in 50 : 1 holding chamber size and take 8 hours for drying (Paul, 1980).

After drying, the cardamoms are rubbed by hand or with a rough coir matting or a piece of wire mesh for cleaning. This process is known as garbling. This operation can be done in a gunny bag also. The dried cardamoms are filled in the gunny bag with few stones (50 to 100g) and tied.

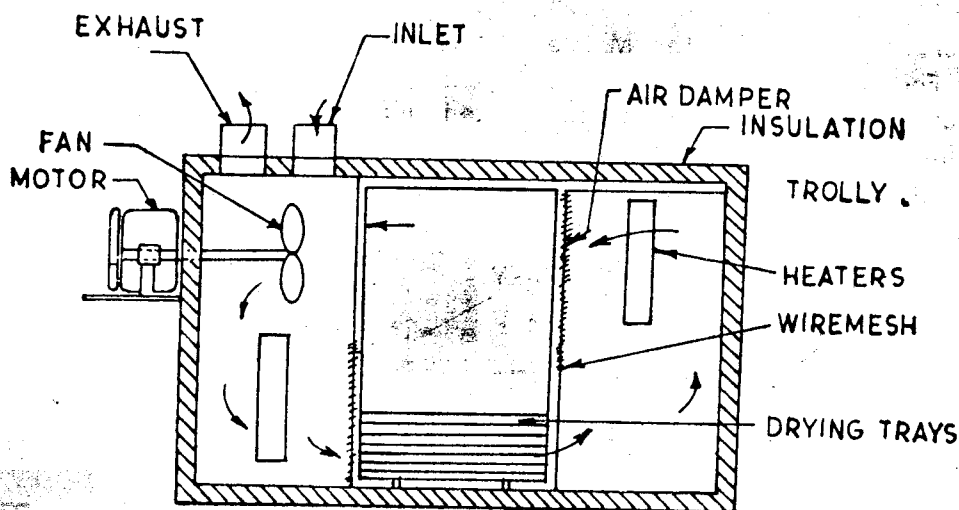


FIG. 3 CROSS-FLOW ELECTRIC DRYER

(SOURCE : PATIL, RT. 1987. CARDAMOM PROCESSING IN SOUTH INDIA
A.M.A. 18 (2) : 55 - 58)

Two people can clean the cardamom by giving jerky shakes for 5 minutes and then winnow the product to remove other plant residues and foreign matter. Fig. 4 shows improved Garbling devices. About 3-5 kg of dried cardamom per batch is put into the wiremesh cleaner where during the swinging, the rubbing action between the capsules and wiremesh and within the capsules, the flower stalks are separated. The rejects such as thrip-marked, shrivelled and small fruits are removed and used for seed extraction. After cleaning, the capsules are sorted according to their size and colour. Grading is done according to the Agmark specifications at the exporters level. Cardamom for export is graded in to 34 grades of which about 6 grades of Alleppey green type and 3 grades of Coorg green are normally exported. Grading is done on the basis of bleached and decorticated cardamom also. As green cardamoms also. As green cardamoms need protection from light and

air during storage and packaging, they are usually stored in gunny bags lined with black polyethylene sheet.

Byproducts Utilization

Cardamom contains 3 to 5% of an aromatic volatile oil, very much valued in food flavouring. The low value grades such as scabbed, malformed, small sizes, splits, discoloured cardamom may be converted to value-added product by extracting cardamom oil maintaining the original flavour. However, this needs through study inclusive of packaging system to be evolved in order to maintain the shelf life. Storage of the byproducts such as powder and volatile oil at room temperature in glass air-tight bottles has been reported to show noticeable differences of aroma and flavour in powder and oil after 3-6 months period (Babu et al. 1985). The effect is less in oil form. The oil, at longer period of storage shows a higher viscosity, offodour, rancidity and high eucalyptus like

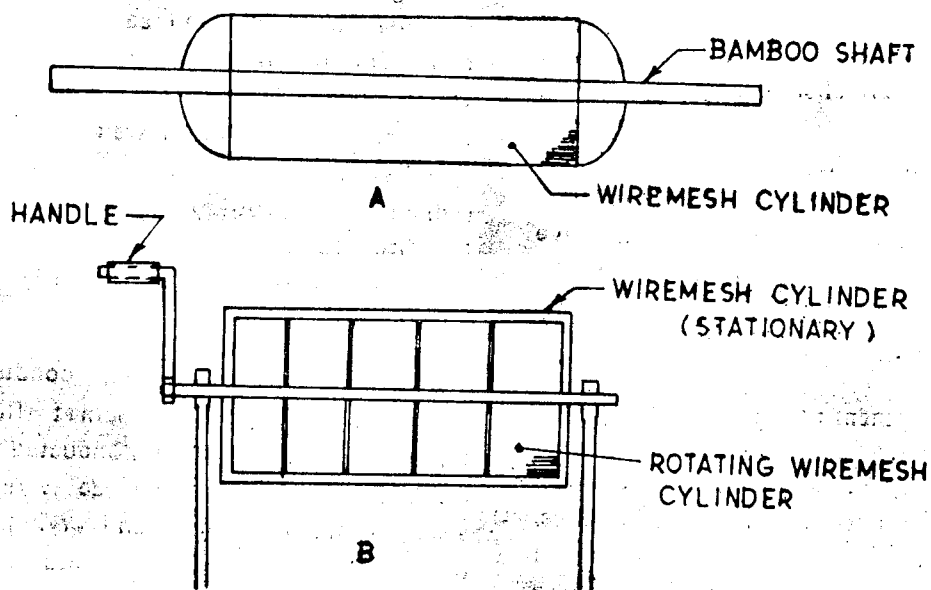


FIG. 4 GARBLING DEVICES FOR DRIED CARDAMOM

(SOURCE : PATIL, R.T. 1987. CARDAMOM PROCESSING IN SOUTH INDIA
A.M.A. 18 (2): 55-58)

smell and taste after 6 months. But in very low quantity of 50 mg or less, this quality gets reduced. It has been reported that the safe shelf life of 6 months for cardamom oil and 4 months for cardamom powder can retain good aroma and flavour. (Babu et al. 1985). For the industrial purposes and large scale food product preparations, cardamom oil can be used more profitably than the powder. Further dilution perhaps up to 3 times is required in suitable dilution media to equate the same with powder form for the aroma and flavour content. The oil is required to be dispersed in suitable dispersing or alcoholic media because excess of oil, if added to the products at home level, would result in adverse effects of bitterness and repulsively strong odour. By dilution, the expenditure of extraction can be compensated. Thus, there is a scope for better utilisation of low grade cardamom by subjecting to the extraction of oil.

Uses :

Cardamom seeds are characterised by a strong and distinctive flavour and strong aroma. Because of these characteristics, they are in demand for flavouring coffee, tea, pastries, confectionary, processed meats etc. It is also used as a carminative in allopathic medicines and as ingredient in perfumes. Cardamom oil (3-5%), an aromatic volatile oil is very much valued in food flavouring.

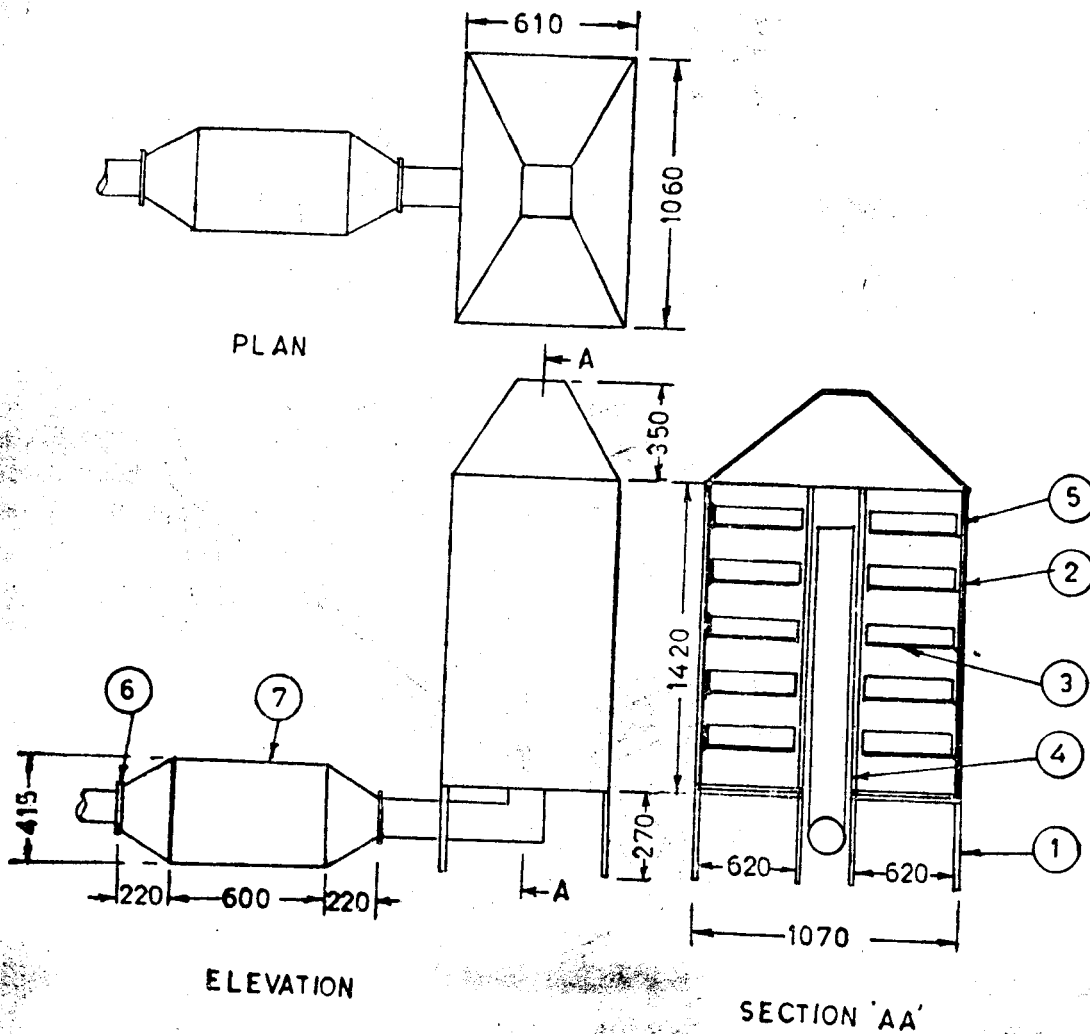
Research and Development :

Harvest and Post Harvest Technology Scheme centre, located at University of Agricultural Sciences, Bangalore has designed and developed a mechanical drier for cardamom (Fig. 5), consisting of a drying chamber, blower with motor and electrical heating unit. The cost of drier is reported to be Rs 12,000/= and cost of drying is Rs 0.66/kg (RamKumar et al. 1984). The capacity of drier is 10 kg dried cardamom and it takes 14 hours to reduce moisture content of cardamom from 79% to 19% level. About

14% splits are obtained in comparison to 12% splits in case of conventional method and 11% by sundrying.

Patil (1987) has reported the use of a direct type solar drier, developed for copra drying (Fig.6). The area of drying surface of 1 m² was made of black painted wiremesh tray over black painted corrugated GI sheet inclined at 12.5°. The Aluminium foil reflectors of 1.5 m² area were provided from 3 sides of the drier. Castor wheels were provided for manual sun tracking throughout the day. The spreading density in the drier was 3 times higher compared to outside open drying (12 kg/m²). Complete drying of cardamom could be achieved within 3 days in solar cabinet drier compared to 5 days in the open sun. To check the discolouration of cardamom by a particular wave length, if any, in solar radiation spectrum, three glass paper filters, namely; blue, green and red were used on small samples of 500 g in open sun. The red filter was found effective upto a certain extent in retaining the green colour during open sundrying. This shows that solar drier (direct type) with radiation shield of red transparent glass (which helps in cutting off the radiation responsible for discolouration or bleaching) may be effective in sundrying of the green cardamom without changing the colour.

Varkey et al. (1980) has conducted studies on artificial drying of cardamom at RRL, Trivandrum. Initial drying trials were conducted in a cabinet drier. Trays of 82 X 41 cm size were loaded with 2.5 kg of fresh capsules and drying was carried out at 50° and 60° C temperatures. Drying time was about 10 hours in case of 60° and 14 hours in case of 50° C. Alkali treated capsules gave a better green colour. From the results of this trial and subsequent analysis of product with respect to colour and quality, it was concluded that green cardamom can be dried in a bin drier up to a bed thickness of 20 cms with a drying temperature of

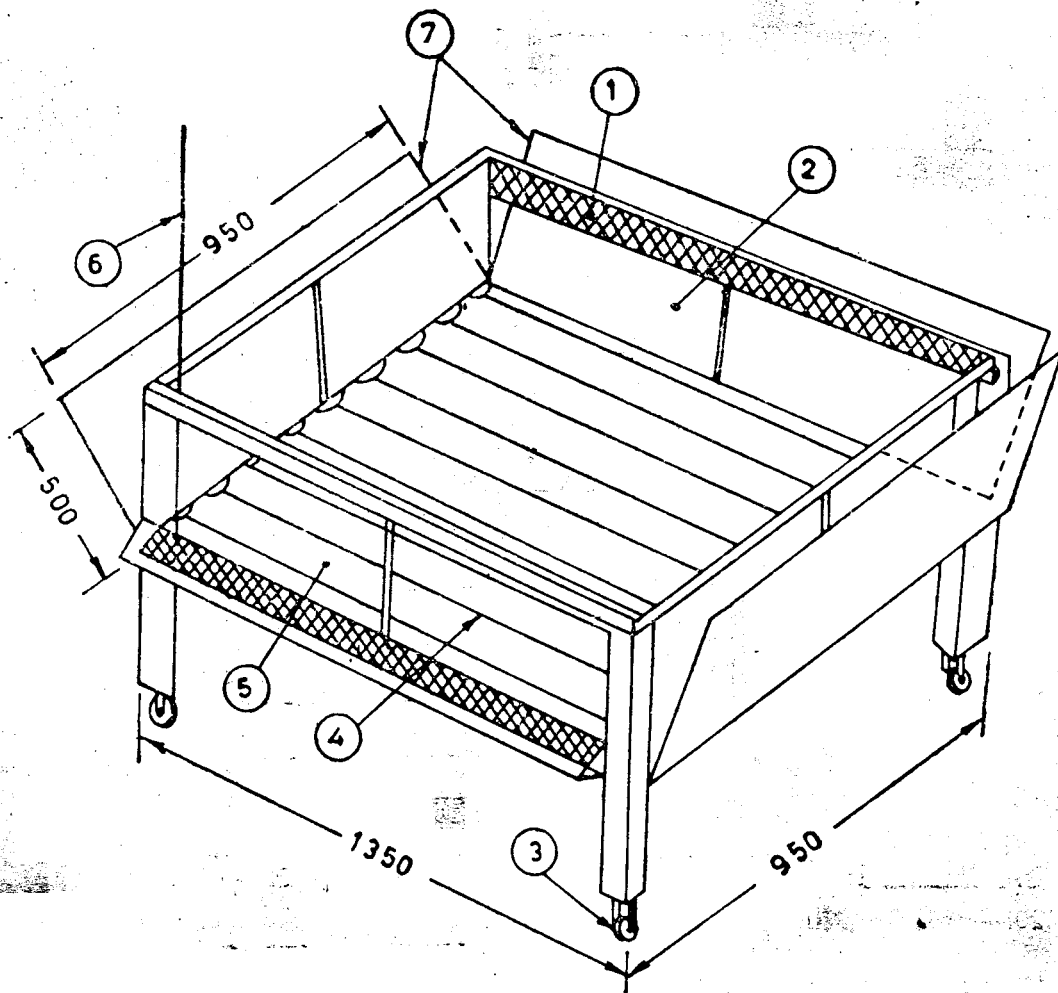


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|----------------------|--------------------|
| (1) M.S. ANGLE FRAME | (5) PLY WOOD SHEET |
| (2) ASBESTOS SHEET. | (6) M.S. FLANGE |
| (3) WOODEN TRAYS | (7) HEATING UNIT |
| (4) G.I. PIPE | |

DIMENSIONS IN mm

FIG. 5 U.A.S. MECHANICAL CARDAMOM DRIER

(SOURCE: BABU, C.K. ETAL 1985 HARVEST AND POST HARVEST TECHNOLOGY OF CARDAMOM U.A.S. BANGALORE RES. BULL. NO. UAS/HPHT/85/13)



- | | |
|---|--|
| (1) WIRE MESH COVERED EXHAUST | (5) 3 mm WINDOW GLASS |
| (2) 3 mm PLASTIC SHEET | (6) SUN TRACKING ROD |
| (3) CASTOR WHEEL | (7) 24 GAUGE COMMERCIAL GRADE
ALU. FOIL REFLECTOR |
| (4) 22 GAUGE CORRUGATED G.I.
SHEET (BLACK PAINTED) | |

DIMENSIONS IN mm

FIG. 6. CPCRI SOLAR CARDAMOM DRIER

(SOURCE: PATIL, R.T. 1987. CARDAMOM PROCESSING IN SOUTH INDIA.
A.M.A. 18 (2):55-58)

50 to 60° C. The scientists have developed a mechanical drier (Fig.7). The drier consists of a centrifugal blower, electrical furnace, ducting with arrangements to distribute the flow of hot air uniformly and a drying chamber where 120 kg fresh cardamom capsules can be loaded. With an air velocity of 60 cm/h and temperature adjusted at 50° C, the drier takes 22 h for complete drying. The dried capsules have been found to be acceptable to the trade in superior green colour, flavour and appearance. Kishore and Rastogi (1987) have conducted the thermal analysis of kiln driers and have reported that the heat exchanger efficiency of 11.3%, furnace efficiency of 60% and efficiency of drier as a whole is 6.8%. The actual efficiency on the basis of water evaporated and fuel consumed is reported to be 2.57% only.

Pruthi et al. (1962) have systematically studied the packaging requirements of green cardamom and large cardamom. They have reported that mould growth takes place at critical moisture level of 14-22% in larger cardamom (at relative humidity of 73% and above) and at 16.9-22.8% in green cardamom at the same critical relative humidity level. Pruthi (1985) has suggested the use of wooden chests lined with tinfoil or PE 300 gauge or craft paper coated with bitumin for bulk packaging of green cardamom with a shelf life of 2-3 months. For retail packaging of green cardamom, the author has recommended the use of 300 gauge black polyethylene lined packages stored in wooden chests lined with in foil or craft paper (Shelf life 4-5 months). Babu et al (1983) have also reported that polyethylene and poly-propylene perform better storage/packaging media for cardamoms.

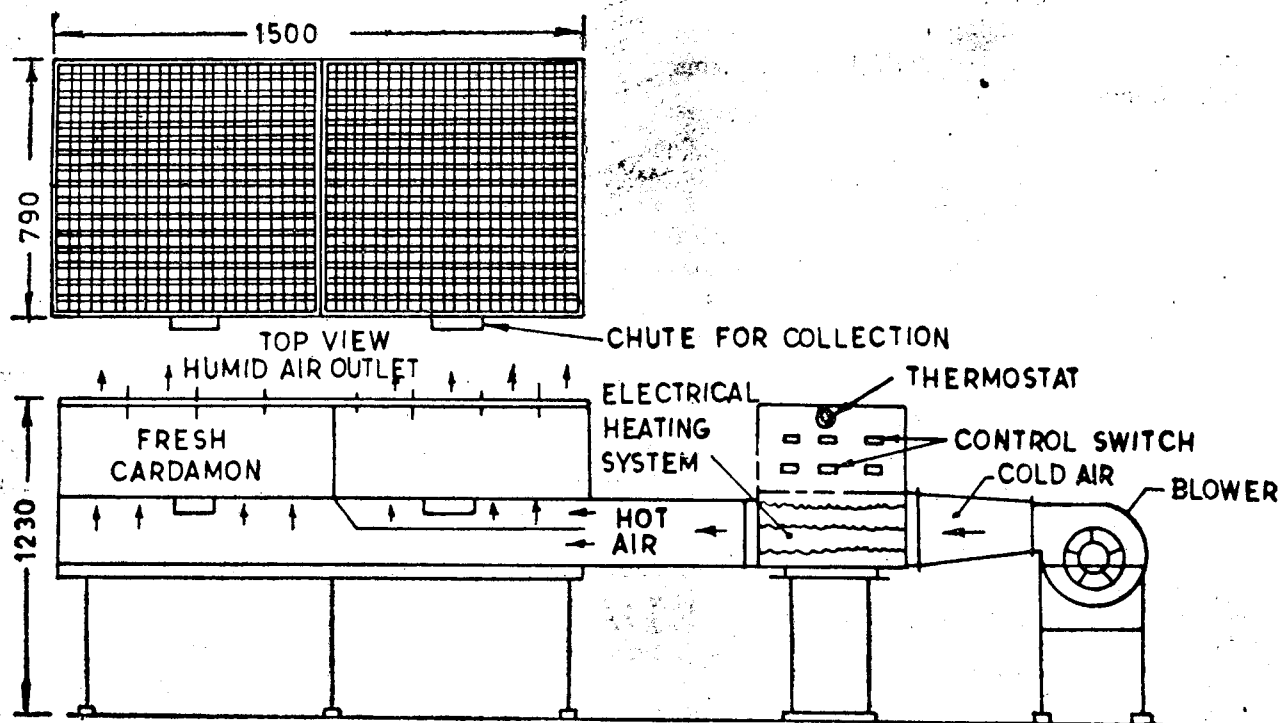


FIG.7 R.R.L. MECHANICAL CARDAMOM DRIER

(SOURCE : VARKEY, A.G. ETAL. 1980, ARTIFICIAL DRYING OF CARDAMOM PROCESSING
THIRD ANNU. SYMP. ON PLANTATION CROPS : 245-253)

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