International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 05 | May 2020 www.irjet.net p-ISSN: 2395-0072

Cardamom Dryer Machine

Rejo Daniel[1], Ajaykrishna R[2], Akhil B[3], Rahul U[4], Didymose Poovathumkal[5]

[1,2,3,4]Student Department of Mechanical Engineering , VISAT , Elanji , Ernakulam , Kerala , India
[5]Asssistant Professor, Department of Mechanical Engineering, VISAT, Elanji, Ernakulam, Kerala, India

---

Abstract -Cardamom popularly known as the "Queen of spices". Today, cardamom commands a leading position among the spices of immense commercial importance and is finding its way into the dietary habits of millions around the world. In cardamom processing drying is the most important role as it affects the quality of the final product. It is also important that the drying process is as short as possible so that the mould does not grow on the capsules and the bright green colour its retained. The drying temperature should not be above 50°C as this affects the colour and delicate flavour of the final product. The machine consist of a chamber with heating purpose and a vacuum pump is attached with it for removing the moisture content. A solenoid is used in it for preventing the overheating. This machine will increases the efficiency of the spices industry. The aim of the product is to produce exportable surplus of cardamom as per the quality specifications of importing countries. The specialty of this drying chamber is that the cardamom is able to retain it's natural green colour. It will increase the productivity and sustainability. It will improve the quality of the product. It can satisfy the needs of cardamom farmers.

***Key Words*: Cardamom, efficiency, moisture, machine, vacuum pump**

1. INTRODUCTION

Cardamom (Amomum subulatum Roxb.) is one of the popular spices that comes under the family Zingiberaceae. Eastern Himalayas region as its origin where wild species are still located (Sharma et al., 2000). Cardamom is the world's third-most expensive spice, exceeded in price per weight only by vanilla and saffron. It is an ancient spice cummedicinal herb. India is the largest producer and exporter of large-cardamom (Amomum subulatum Roxb). The other major producers of large-cardamom are Nepal and Bhutan. Its cultivation is confined in Eastern Himalaya covering Sikkim, West Bengal (Darjeeling hills)and Arunachal Pradesh. It is one of the most important livelihood sources for mountain people in the Himalayan region. It has been considered important since many centuries in Ayurvedic preparation and Unani system of medicines (Madhusoodanan and Rao 2001). It is known by various names such as Bhadr (Sanskrit), Bari elaichi (Hindi), Greater or Nepal cardamom(English), Cardamom(French), Ts' ao-k' ou (Chinese). India is the second largest producer and exporter in the world. Total area under cultivation of large cardamom in India is 30,000 ha. and production is 5,000 MT. At the national level, Sikkim contributes 89 % large cardamom area and 86 % production. A farmer can earn of Rs. 25,000 to 30,000 from one-hectare plantations. The crop grows well in the shade of forest trees at altitudes ranging from 6002000 m. with a rainfall of 20003500 mm per annum at temperature 530 0 C. Deep and well-drained soils with a loamy texture are best suited for cardamom. The soil in Sikkim is generally rich in organic matter and nitrogen, medium in available phosphorus and medium to high in available potash.

Fig -1.1: Cardamom

1.1 AIM & OBJECTIVE OF THE PROJECT

- This machine will reduce the curing time of cardamom at 5 hours earlier than the existing machine.
- Th especiality of the drying chamber is to preserve its natural green colour.
- To improve the quality of product.
- It is provided with optimum temperature for drying process and it can be controlled.

The soils have a pH range from 4.5 to 6.0. Even though the crop can be grown in undulating and steep terrains, land with a more moderate slope is preferred. It is a tall, perennial, evergreen, herbaceous monocot plant (Gopal et al., 2012). The height of cardamom plant ranges from 1.5-3.0 m and leaves are found at the upper portion of the stem (Bisht et al., 2011). Large cardamom has a pleasant aromatic odour, due to which it is extensively used for flavouring vegetables and many food preparations in India. It is also used as an essential ingredient in mixed spices preparation. The large cardamom capsule contains 23 % of essential oil. Apart from the aroma, large cardamom also has high medicinal value. The decoction of seeds is used as a mouthwash in infection of teeth and gums. Large cardamom also possesses curative properties and be one of the major spices which are mentioned in Ayurveda and Unani medicine (Chempakam and Sindhu, 2008). Large cardamom seeds are considered as an antidote to either snake venom or scorpion venom.

1.2 COMMON PROCESS OF CARDAMOM DRYING

1.2.1 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 sun light to preserve the green colour (strong sunlight will make the colour fade).

Fig -1.2: Cardamom drying using sun light

1.2.2 Solar Drying

A solar dryer was designed, fabricated, and evaluated for drying of large cardamom (Amomum Subulatum). It was observed that on an average 55.7% of higher temperature was obtained in the solar dryer over the ambient temperature. A total drying time of 24 h (3 sunny days) was required for large cardamom drying in the solar dryer to reduce the moisture content from 75.6% (w.b.) to 10.1% (w.b.) compared to that of 48 h for the open sun drying to obtain the same level of moisture contents resulting in a net saving of about 50% of drying time for the solar dryer in comparison to the open sun drying.

Fig -1.3: Cardamom drying using solar

1.2.3 Wood Combustor Drier

It is a wood fired portable furnace suitable for improvement of the traditional large cardamom (spice) drier in cardamom growing areas of Himalayan states and hilly areas of India. The combustor burns firewood completely in smokeless environment and supply clean hot gas to the stalk of green cardamom capsules for drying. It can be fitted in the traditional bhati (drier) or in improved bhati for drying of large cardamom raw capsules. The combustor reduces 75% of wood consumption, curing period and also pollution, which improves the quality of the dried cardamom. 45% essential oil of the dried cardamom is increased and 90% wood consumption is reduced through the wood combustor.

Fig-1.4: Wood combustor

1.3 CLIMATIC AND SOIL REQUIREMENTS

The crop grows well under the shade of forest trees in the sub Himalayan Mountains with rainfall of 3000 to 3500 mm distributed in about 200 days a year. Cultivars suited to higher altitudes can tolerate lower temperatures and those suited to lower altitudes to marginally higher temperature regimes. Large cardamom grows well in forest loamy soils with gentle to medium slopes. Deep and well-drained soils with loamy texture are best suited. Large cardamom growing soil is generally rich in organic matter and nitrogen, medium in available phosphorous and medium to high in available potash. A pH range of 6-7 is most favourable for the availability and effectiveness of most of the nutrients. Usually cardamom growing soils are acidic with 4.5-6.0 pH. Even though the crop can be grown in undulating and steep terrains, land with moderate slope is preferred. Water logged condition is detrimental to the growth of the plants.

1.4 BENEFICIAL USES OF CARDAMOM

The seeds of large cardamom have been used to flavor food, confections, beverages and liquids (Singh et al., 2008). Furthermore, it has been used as an insecticide as well (Satyal et al., 2012). Its usage in Ayurvedic is well known from prehistoric time. It is used as flavoring and preservative to different types of coffee, liquors, confections, beverages and tobacco. Volatile oil (2-4%) is the principal aroma-giving compound in large cardamom and 1,8-cineole is the major active compound after compound, in an extent 60 to 80% of the total volatile oil. Alcohol and aqueous extract of large cardamom have been reported to contain allopathic, analgesic, antiinflammatory, antimicrobial, antioxidant, antiulcer, cardioapoptogenic and hypolipidemic activities. Large cardamom and its powder, oleoresin and essential oils have many culinary and therapeutic uses (Gautam et al. 2016). Large cardamom (Amomum subulatum Roxb.) has been used for the treatment of various diseases and disorders like gastric, ulcer. Hence, the antimicrobial activity of petroleum ether, methanol and aqueous extracts from leaves and roots, essential oil and isolated vasicine from A. vasica were tested against various microorganisms .Antimicrobial activity was done by disc diffusion method. The zone of inhibition observed was compared with that of

standard drugs, ciprofloxacin and fluconazole. Minimum inhibitory concentration was determined against microorganisms. The methanol extract of fruits of large cardamom shows notable antimicrobial activity against Escherichia coli whereas in case of other microorganisms used it was found inferior to the standard drug used. The methanol extract of rind presented good antimicrobial activity against Staphylococcus aureus. It was found that the essential oil isolated was effective against the majority of microorganisms.

2. LITERATURE REVIEW

[1] Prem Ranjan, Jitson Achom, Manjeet Prem, Sajesh Chettri et.al STUDYOF DIFFERENTDRYING METHODS EFFECT ON QUALITY OF LARGE-CARDAMOM (AMOMUM SUBULATUM ROXB.) CAPSULESDepartment of Processing and Food Engineering, College of Agricultural Engineering and Post-Harvest Technology (CAU), Ranipool, East Sikkim, India-737135. (Received: 01.10.17; Revised: 08.11.2017; Accepted: 09.11.2017)

[2] SUPRIYA AGNIHOTRIAND S. WAKODEet.alANTIMICROBIAL ACTIVITY OF ESSENTIAL OIL AND VARIOUS EXTRACTS OF FRUITS OF GREATER CARDAMOMDelhi Institute of Pharmaceutical Sciences and Research (DIPSAR), Pushp Vihar, New Delhi-110 017, India.

[3] K.P Prabhakaran Nair et.al THE AGRONOMY AND ECONOMY OF CARDAMOM(Elettariacaramomum M): The “Queen of Spices”science direct 25 July 2011.

[4] P.B Kulasekera, B.F.A Basnayakeet.alTESTING AND EVALUVATION OF CARDAMOM DRYERResearch gate January 1993

[5] KoraT Sunny, Dr. Kurian Johnet.al DESIGN AND FABRICATION OF SOALR ASSISTED SPICE DRYER1,2 Assistant Professor, Department of Mechanical Engineering, Mar Athanasius College of Engineering, Kothamangaalam, Kerala, India 3,4,5,6 U G Scholars (Bachelor of Technology), Department of Mechanical Engineering, Mar Athanasius College of Engineering, Kothamangaalam, Kerala, India.

Prem Ranjan, Jitson Achomet.al(1) explain that The large cardamom is one of the most important spice crops grown in the Himalayan region of Sikkim, India. India is the second largest producer of large-cardamom in the world nextto Nepal. The dried fruits of large cardamom (Amomum subulatum Roxb.), a high-value spice crop. It is used in foods, beverages, perfumes, and medicines. Production is currently declining, and the improved postharvest process would be one way to help ensure the sustainability of this position crop. The drying by the traditional system have reduces the quality of cardamom capsules (colour, flavor and oil content etc.) and as well as cost. This article reviews the crop's drying by a different system (traditional, improved, electric and diesel operated, and solar drying). In this article, we see that the good quality of the product is found in improved dryers. Also, the solar dryer system has a good quality product and it was reported that solar dryer system saves about 50% of drying time for the solar dryer in comparison to the open sun drying of large cardamom capsules.

SUPRIYA AGNIHOTRIAND S. WAKODEet.al (2) decribes that Greater cardamom (Amomum subulatum Roxb. Zingiberaceae) commonly known as "Bari ilaichi" is a well known plant used in Ayurvedic and Unani medicine. It has been used for the treatment of various diseases and disorders like gastric ulcer. Therefore antimicrobial activity of petroleum ether, methanol and aqueous extracts from leaves and roots, essential oil and isolatedvasicine from A. vasica were tested against various microorganisms. Antimicrobial activity was done by disc diffusion method. The zone of inhibition observed was compared with that of standard drugs, ciprofloxacin and fluconazole. Minimum inhibitory concentration was determined against microorganisms used in the study. The results of this study reveal that methanol extract of fruits of A. subulatum shows remarkable antimicrobial activity against Escherichia coli whereas in case of other microorganisms usedit was found inferior to the standard drug used. Methanol extract of rind showed good antimicrobial activity against Staphylococcus aureus. It was found that the essential oil isolated was effective against majority of microorganisms used viz. Bacillus pumilus, Staphylococcus aureus, Staphylococcus epidermidis, Pseudomonas aeruginosa, Saccharomyces cerevisiae.

K.P Prabhakaran Nairet.al (3) decribes that The large cardamom is one of the most important spice crops grown in the Himalayan region of Sikkim, India. India is the second largest producer of large-cardamom in the world next to Nepal. The dried fruits of large cardamom (Amomum subulatum Roxb.), a high-value spice crop. It is used in foods, beverages, perfumes, and medicines. Production is currently declining, and the improved postharvest process would be one way to help ensure the sustainability of this position crop. The drying by the traditional system have reduces the quality of cardamom capsules (colour, flavor and oil content etc.) and as well as cost. This article reviews the crop's drying by a different system (traditional, improved, electric zand diesel operated, and solar drying). In this article, we see that the good quality of the product is found in improved dryers. Also, the solar dryer system has a good quality product and it was reported that solar dryer system saves about 50% of drying time for the solar dryer in comparison to the open sun drying of large cardamom capsulesP.B Kulasekera, B.F.

A Basnayake et.al (4) address the Drying is one of the oldest methods of preserving food and has found continued practice till date. It is one of the cheapest alternatives to other expensive food preservation options like canning, freezing etc. The process of drying of different food commodities varies depending on the nature of product, intended end use, quality parameters and cost economics. Various dryers have been designed and developed keeping in view the appropriate applicable technology, state of food

commodity, time consumption and of course ease of operation. This technical bulletin carries the information on dryers which are mostly developed by AICRP-PHET Coordinating Centres across the country. They employ different technologies and processes to attain the final dried product

KoraT Sunny, Dr. Kurian Johnet.al (5) presents that Spice drying using conventional methods like open air sun drying and smoke drying could lead to insufficient product quality. In order to be marketable, the product meant for sale should meet high quality standards. Solar drying improves the quality of the products in terms of colour, flavour and appearance, reduces the risk of microorganism growth, prevent insect infestation and contamination by foreign matters. The aim of the project is to design and manufacture a solar assisted spice dryer that can deliver good quality products. The preliminary aim is to dry nutmeg which is very sensitive to temperature, along with other fruits such as pepper, cardamom etc. The machine consist of a chamber for heating air, a blower, sieving system, and a solar flat plate Collector.

3. AGRICULTURAL SURVEY

Large cardamom commonly known as 'bada elaichi' is one of the world's most ancient spices. It belongs to the family Zingiberaceae and is a perennial soft stemmed low-volume, high-value crop .Originating in Sikkim (India), the crop is grown only in the eastern Himalayan countries viz., Nepal, northeast India, and Bhutan at altitudes ranging from 1000 to 2000 m MSL. In India, it is cultivated as one of the main cash crops in Sikkim, Nagaland, Uttaranchal, Darjeeling district of West Bengal and some other parts of the North Eastern region. Hence, the worldwide production of this crop is estimated as the sum of production in these three countries. Total world production is about 12,278.20 metric tons. Nepal leads in the production of large cardamom (52%), followed by India (37%), and Bhutan (11%). Taplejung, Panchthar, Ilam, Dhankura, Bhojpur, Terhathum, and Sankhuwasabha are the major large cardamom growing districts of Nepal (ECCOS 2010). Accordingto the Spices Board (2012), the major share of India's production is from Sikkim. Mountain people in the Himalayan region find large cardamom farming as one of the important livelihood sources. The plant grows in the vicinity of mountain streams in swampy, cool, and humid areas in the shade of forest trees, of which nitrogen-fixing trees are the more suitable shade trees. It can grow at altitudes ranging from 600 to 2000 m above mean sea level and in areas with an annual rainfall varying from 2800 to 3500mm. It is a perennial bush having a sheathed stem which may reach upto 1.5 to 2.5 m in height. It has a large tuberous rhizome and leaves of about 30–60 cm length and 5–15 cm width. The trailing leafy stalk which grows from the base of the plant at groundlevel bears the seed pod. Green flowers with a white-purple vein tip are produced in a dense short spikes arising directly from base of the plant. The useful portion of large cardamom is the dried capsule, which has 40 to 50 small seeds and is grayish brown to dark red brown. The capsules are held together inside the spike with viscous sugary pulp and are 20–25 mm long and oval to globule in shape. It is harvested before it ripens to avoid the capsules from splitting during the drying Large cardamom is used as a spice and also in several Ayurvedic preparations including the Unani system of medicine (Madhusoodanan and Rao 2001) [17]. It can be used to treat several ailments. The volatile oil of large cardamom seed contains 1, 8-cineole, α-terpineol, α-pinene, β-pinene, and allo-aromadendrene . It contains 2–3% essential oils. It possesses carminative, stomachic, diuretic and cardiac stimulant properties and is also a remedy for throat and respiratory trouble. The essential oil of large cardamom is reported tohave antimicrobial properties . The seeds have a pleasant aromatic odour for which can extensively be used for flavouring vegetable curries and many food preparations in India. The decoction of seeds is used as a gargle in infection of teeth and gums. Large cardamom seeds are considered as an antidote to either snake venom or scorpion venom and also used as preventive as well as curative measure for throat troubles, congestion of lungs, inflammation of eyelids, digestive disorders and in the treatment of pulmonary tuberculosis. The literature in the areas of value chain and quality study of large cardamom is very much scanty except a few. This article reviews the agrotechniques of cultivation, postharvest processing, quality issues and trade patterns of large cardamom towards increasing its quality and value and thereby to protect and promote the livelihoods of several thousands of people in the value chain.

3.1 CLIMATIC AND SOIL REQUIREMENTS

The crop grows well under the shade of forest trees in the sub Himalayan Mountains with rainfall of 3000 to 3500 mm distributed in about 200 days a year. Cultivars suited to higher altitudes can tolerate lower temperatures and those suited to lower altitudes to marginally higher temperature regimes. Large cardamom grows well in forest loamy soils with gentle to medium slopes. Deep and well-drained soils with loamy texture are best suited. Large cardamom growing soil is generally rich in organic matter and nitrogen, medium in available phosphorous and medium to high in available potash. A pH range of 6-7 is most favourable for the availability and effectiveness of most of the nutrients. Usually cardamom growing soils are acidic with 4.5-6.0 pH. Even though the crop can be grown in undulating and steep terrains, land with moderate slope is preferred. Water logged condition is detrimental to the growth of the plants.

3.2 CULTIVARS

There are mainly four popular cultivars viz. Ramsey, Sawney, Dzongu Golsey, Varlangey etc. The other cultivars which are grown in hilly areas likeSeremna. Bebo, Boklok Tali, Jaker, Belak etc.

3.3 AGROTECHNIQUES

Large cardamom grows in hills abundantly, but often without following any scientific agrotechniques. However this area demands greater attention to have a sound value chain of this unique crop. Propagation of large cardamom is done through seed and suckers. The propagation through seeds enables production of large numbers of seedlings. Virus diseases are not transmitted through seeds and therefore seedlings are free from viral diseases, if adequate care is taken to isolate and protect the nursery from fresh infection. Seed are generally shown in September to October. Select a site which is open, well-drained and near a source of water. Dig the land 30 cm deep and prepare beds of 6mx1mx30cm. Spread a thin layer of jungle soil over the nursery. 80-100 gm of seeds is sown in lines 10 cm apart and cover them with another layer of thin fine soil. Mulchwith dry grass and water every day in the morning and evening. Remove the mulch on the commencement of germination and protect the seedlings by providing shade. Ensure regular weeding and plant protection. Nursery beds of 6 m x 1 m x 3 0 cm are prepared. Mix well-decomposed cattle manure and wood ash with top layer of soil. This will help the seedlings to establish well and grow vigorously. Duringspecies most commonly preferred as shade tree (Sharma et al., 2008) [33]. In addition to providing shade, it isalso used for fuelwood. Other species of shade trees are used are Bomchusing (Dzo.) Mecaranga denticulate (decomposes very fast) Ambakay (Nep.) Jambosafarmosa Walp, Sokeyshing (Dzo) Castronopsis indica, Puyum (Dzo.) Schimawallichi, Siris (Nep.) Albizzialebbek etc. The old trees are cut and young plants coming up are allowed to grow in cyclic order. The quick decomposing leaf litter of A. nepalensis also fertilises the cardamom plants. The nitrogen added to the soil in this way has been found to be as high as 249 kg/ha. Planting is done in June-July when there is enough moisture in the soil. The land selected for planting is cleared of all under growth, weeds etc. for new planting or if it is replanting, old plants may be removed. Pits of size 30 x 30 x 30 cm are prepared on contour at a spacing of 1.5 x 1.5 m after the onset of rains. Wider spacing of 1.8 x 1.8 m are recommended for robust cultivars like sawney, varlangey and Ramsey. The pits are left for weathering for a fortnight and then filled with top soil mixed with cowdung or compost @13 kg/pit. Seedlings/suckers are planted in the centre of the pits. Care should be taken not to plant the seedling /rhizome very deep in the pit. After planting the seedling is staked and the base of the plant mulched. For a sustained production the soil fertility should be maintained to its optimum. Well decomposed cattle manure/compost or organic products, nonedible cakes may be applied @ 2 kg/plant at least once in two years in April-may. If all the crop residues are recycled in the plantation, application of inorganic fertilizers may not be necessary. In plantations with high productivity, fertilizers @ 20:30:40 kg NPK per hectare may be applied in two split doses with full P and half of N and K in April and half dose of N& K in September. Mulching the base of plants after application of second dose helps plants in the intake of nutrients. Weed control in the plantations is important for the maximum utilisation of the available moisture and nutrients by the plant. Three rounds of weeding are required for effective control of weed growth in the initial two to three years. Weeding can be either hand weeding or sickle weeding depending upon the intensity of weed growth. In Bhutan weed slashing is done in June July is locally known as Phulghor whereby weeds around clumps are slashed down to expose the flowersto pollinating agents and to enhance better radiation to plantation. The second operation is locallty known as Ngahalghor whereby slashing of weeds is done before harvest (August-September) to enhance picking during harvesting. This crop is mainly grown in highly steep terrain.The topography and climatic condition permits soil erosion to considerable extent. Intensive operations, which loosen and expose soil will increase soil erosion and therefore minimum tillage operations should be followed. In some of the large cardamom plantations water sources are available which can exploit to irrigate the crop by gravity flow, either through pipes, sprinklers or flood irrigation through open channels. It is observed that productivity is higher in plantations whereirrigation is provided. For sustainable and better yield, the plants may be watered during dry months. Depending on availability of water sources hose or sprinkler or flood irrigation through channels can be adopted. Hose irrigation can be done @40-50 litre per plant at fortnightly intervals. In case of sprinkler, irrigation equivalent to 35-45 mm or rain at fortnightly interval is recommended. Although there are many species of insects and pests, large cardamom is free from major attack of any major pestsexcept for June-July the primary seedlings are transplanted to the secondary nursery at a spacing of 2530cm. Shade should be provided before transplanting. Regular watering during dry months, weeding, application of fertilisers, control of pests and diseases and mulching are essential operations for the maintenance of the secondary nursery. One month before uprooting, the overhead shade should be removed to encourage better tillering. Chirke (Mosaic disease) and Foorkey (stunted). Initially the caterpillar of the moth Artona Chorista feeds on the leaf lamina from under the surface of the leaf and finally defoliates the leaf completely leaving only the midribs. Their incidence is noticed in May-July and October-March. At present these insects are kept under control by their natural enemies. If insecticides are used to control them, then their natural enemies will also disappear which may lead to an outbreak of these pests in epidemic form. The best method of control is to inspect the plantations during May-July and October-March, to handpick the infected leaves along with the caterpillars and destroy them by burning. Fungal or bacterial diseases are seldom reportedin large cardamom. Only minor diseases like leaf streak or rot diseases are found in isolated areas. The major threat to large cardamom is the widespread occurrence of viral diseases, viz., chirke and foorkey. These diseases are seen throughout the large cardamom growing tracts of hilly areas and cause considerable crop loss. These diseases have spread due to drastic change in the ecosystem, inadequate rain in dry months and absence of good agricultural practices by the farmers. Many cardamom farmers failed to

plant varieties suitable to their altitude. An insect Micromyzuskalimpongensis (Basu and Ganguly, 1958) is the vector which carries the virus and activity is highest in spring. Flowering and fruiting are also adversely affected. Regular visit of fieldat least once in 15 days during monsoon, use of tolerant variety (Majumder, 1966) [18] roguing and destruction of affected plants, regular sprays of systemic insecticide (Rogor @0.1%) use of disease free, healthy planting materials are required to be done.

Month	January	February	March-April	May-june	july	August	September-October	November	December
Activities	Removal of infected plants	Watering at 15 days interval in case of dry conditions water can be sourced from upstream through naturalgradient in hill. Provide mulch	Clearing of leaf litter to facilitate flowering and fruiting. Weeding is to be done	Planting of healthy disease-free suckers and replacement of oldplants	Completion of planting of suckers; checking for pestinfestation; weeding	Removal of diseased plants and destruction; best options are deep burial or burning. Adoption of rodent control measures like clearing of the surroundings; weeding	Harvesting the ripe fruits. Drying/curing of cleaned capsules	Completion of post harvest activities (drying and packing) .Removal of old stumps, infested plants and destroy	Mulching and repairing ofraisers

Tab-3.1: Calendar for quality production of cardamom

4. BENIFICIAL USE OF LARGE CARDAMOM

The seeds of large cardamom have been used to flavor food, confections, beverages and liquids (Singh et al., 2008). Furthermore, it has been used as an insecticide as well (Satyal et al., 2012). Its usage in Ayurvedicis well known from prehistoric time. It is used as flavoring and preservative to different types of coffee, liquors, confections, beverages and tobacco. Volatile oil (2-4%) is the principal aroma-giving compound in large cardamom and 1,8-cineole is the major active compound after compound, in an extent 60 to 80% of the total volatile oil. Alcohol and aqueous extract of large cardamom have been reported to contain allopathic, analgesic, antiinflammatory, antimicrobial, antioxidant, antiulcer, cardioapoptogenic and hypolipidemic activities. Large cardamom and its powder, oleoresin and essential oils have many culinary and therapeutic uses (Gautam et al. 2016). Large cardamom (Amomum subulatum Roxb.) has been used for the treatment of various diseases and disorders like gastric, ulcer. Hence, the antimicrobial activity of petroleum ether, methanol and aqueous extracts from leaves and roots, essential oil and isolated vasicine from A. vasica were tested against various microorganisms. Antimicrobial activity was done by disc diffusion method. The zone of inhibition observed was compared with that of standard drugs, ciprofloxacin and fluconazole. Minimum inhibitory concentration was determined against microorganisms. The methanol extract of fruits of large cardamom shows notable antimicrobial activity against Escherichia coli whereas in case of other microorganisms used it was found inferior to the standard drug used. The methanol extract of rind presented good antimicrobial activity against Staphylococcus aureus. It was found that the essential oil isolated was effective against the majority of microorganisms used viz.

4.1. GRADIND AND QUALITY STANDARDS

For commercial grading in local markets, the finished large cardamom capsules are categorized as badadana (big capsules) or chotadana (small capsules) and as kainchi-cut (capsule tail removed) or non-kainchi-cut (capsule tail intact) (Sharma et al., 2009) [34]. The difference in capsule size may be due to cultivar difference or preharvest conditions. For example, capsules of the Golsey cultivar are generally bigger. Size grading can be done using manual screens. Useof mechanical grading machines is so far not reported, except for manually operated sieves in Nepal.

5. DESIGN

5.1. CAD FIGURE

In the process of drying, heat is necessary to evaporate moisture from the material and a flow of air helps in carrying away the evaporated moisture. There are two basic mechanisms involved in the drying process: the migration of moisture from the interior of an individual material to the surface, and the evaporation of moisture from the surface to the surrounding air.

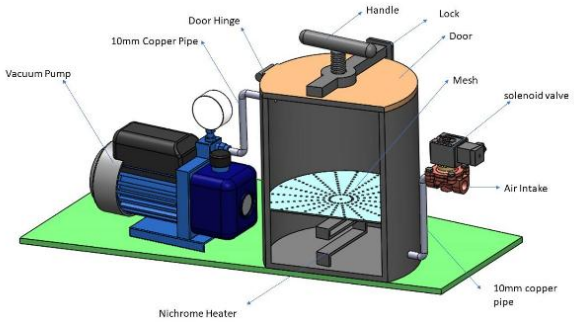

Fig-5.1: Cardamom Drying Machine

The figure shows the cad diagram of cardamom dryer machine, which is used for the process of the drying the cardamom. The main components are mentioned in the above diagram. This is the actual design of the machine and it is created in sold works.

Initial moisture content of cardamom =80%
Requied moisture content for safe storage =10%
Drying Temperature =42-50^{0}C
Airflow rate = piston diameter * stroke length * Rpm of compressor
= .02 * .02 * 2800 = 1.12m/min

5.2. DESIGN OF CHAMBER

The design of the drying chamber is drawn on sold works.
The chamber dimensions are given below,
Height of chamber = 35.5cm
Diameter of the chamber = 14.5cm
Vol of the cylinder = 3.14*7.25*7.25*35.5
= 5859.14cm^3

5.3 DESIGN OF THE COMPRESSOR.

Voltage = 220V A
CCurrent = 1 A
Power Consumption = 220W

5.4. DESIGN OF SOLINOIDE.

Voltage = 12V
Current = 1 A
Power = 12 W
Mouth Diameter = 2.5 cm

5.5 OTHER COMPONENTS

Copper tube = 6mm
Halogen Bulb = 500 W

5.6 FRONT VIEW OF CARDAMOM DRYING MACHINE

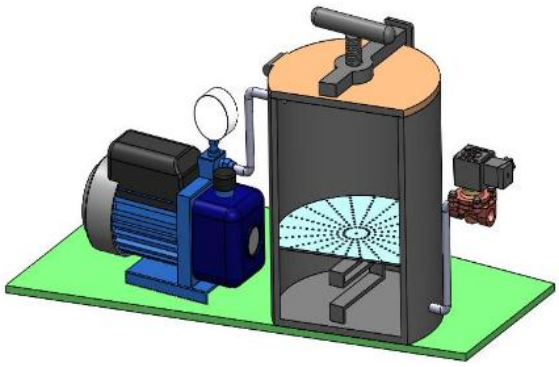

Fig-5.2: Front view of Cardamom Drying Machine

5.7 SIDE VIEW OF CARDOMOM DRYING MACHINE

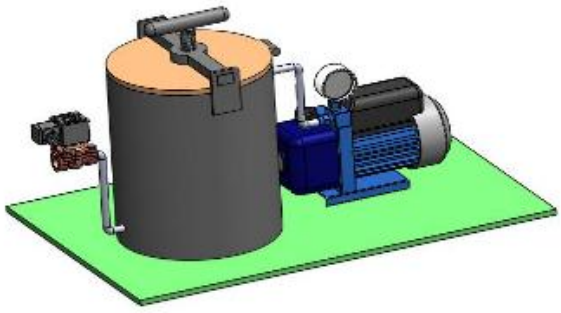

Fig-5.3: Side view of Cardamom Drying Machine

5.8 TOP VIEW OF CARDAMOM DRYING MACHINE

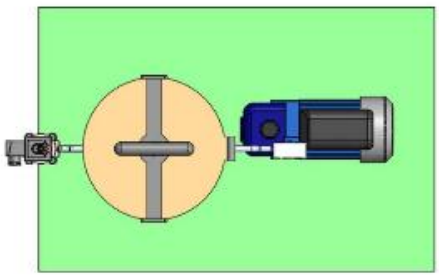

Fig-5.4: Top view of Cardamom Dying Machine

5.9 BACK VIEW OF CARDAMOM DRYING MACHINE

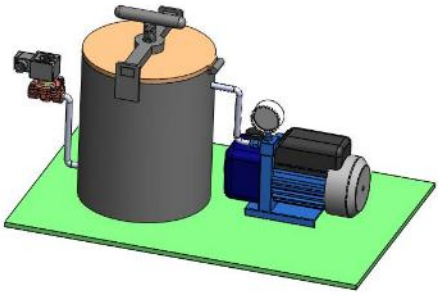

Fig-5.5: Back view of cardamom dryer machine

6. COMPONENTS

The main parts of the Cardamom dryer machine are of:
- Chamber
- Solenoid valve
- Compressor
- Thermostat
- Transformer
- Halogen bulb
- Transistor electronic circuit

6.1 CARDAMOM DRYER MACHINE

Cardamom dryer machine is a machine using for drying the cardomom at their optimam temperature and maintaining the quality. forcardamom processing drying is the most important role as it affects the quality of the final product . 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. 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. The most using processesare sun drying ,solar drying, wood fired dryer.Now we introducing a new machine for drying cardamom to reduce above problems, in this machine we can control the heat so preventing overheating and maintain the natural colour. The machine consist of a chamber with heating

purpose and a vacuum pump is attached with it for removing the moisture content. A solenoid is used in it for preventing the overheating.

Fig-6.1: cardamom dryer machine.

6.2 CHAMBER

The specialty of this drying chamber is that cardamomis able to retain its natural green colour. Chamber is made of MS Plate. It is divided in to two parts .First part is for placing the cardamom where as second part is to for heat application. The length of the chamber is 35.5cm and the diameter of 14.5cm. drying is at the important process in post harvesting of cardamom. Drying process is carried out in this chamber these are divided into 2 by a mesh. The cardamom is placed in upper portion. and the heat is provided at the lower portion . sensors are attached to the chamber. Two copper tubes are attached in top and bottom of the chamber the heat is transmit throught the lower copper tube and vacuum is done at the upper copper tube.

Fig-6.2:chamber

6.3 SOLENOID VALVE

Solenoid valve functioninvolves either opening or closing an orifice in avalvebody, which either allows or prevents flow through thevalve. A plunger opens or closes the orifice by raising or lowering within a sleeve tube by energising the coil.Solenoid valvesconsist of a coil, plunger and sleeve assembly.It is the main part of the project that mainly used for controlling heat which is produced by the halogen bulb. When ever the temperature is increased above 45 degree Celsius, the connection gets automatically terminated which prevents the further flow of heat.

Fig-6.3: Solenoid valve

6.4 COMPRESSOR

A compressor is a mechanical device that increases the pressure of a gas by reducing its volume. An air compressor is a specific type of gas compressor. Compressors are similar to pumps: both increase the pressure on a fluid and both can transport the fluid through a pipe. As gases are compressible, the compressor also reduces the volume of a gas. Liquids are relatively incompressible; while some can be compressed, the main action of a pump is to pressurize and transport liquids. An air compressor is a device that converts power(using an electric motor, diesel or gasoline engine, etc.) into potential energy stored in pressurized air (i.e.,compressed air). By one of several methods, an air compressor forces more and more air into a storage tank, increasing the pressure. In this project compressor is used for sucking the water content of cardamom in the form of vapour.

Fig-6.5: Compressor

6.5. THERMOSTAT

A thermostatis a component which senses the temperature of a physical system and performs actions so that the system's temperature is maintained near a desired set point. Thermostats are used in any device or system that heats or cools to a set point temperature, examples include building heating, air conditioners, HVAC systems, water heaters, as well as kitchen equipment including oven sand refrigerators and medical and scientific incubators. In scientific literature, these devices are often broadly classified as thermostatically controlled loads (TCLs). Thermostatically controlled loads comprise roughly 50% of the overall electricity demand in the United States. A thermostat operates as a "closed loop" control device, as it seeks to reduce the error between the desired and measured temperatures.

Fig-6.5: Thermostat

6.6 TRANSFORMER

A transformer is a passive electrical device that transfers electrical energy from one electrical circuit to another, or multiple circuits. A varying current in any one coil of the transformer produces a varying magnetic flux in the transformer's core, which induces a varying electromotive force across any other coils wound around the same core. Electrical energy can be transferred between separate coils without a metallic (conductive) connection between the two circuits. Transformers are most commonly used for increasing low AC voltages at high current (a step-up transformer) or decreasing high AC voltages at low current (a step-down transformer) in electric power applications, and for coupling the stages of signal processing circuits. Transformers can also be used for isolation, where the voltage in equals the voltage out, with separate coils not electrically bonded to one another. Transformers range in size from RF transformers less than a cubic centimeter in volume, to units weighing hundreds of tons used to interconnect the power grid.

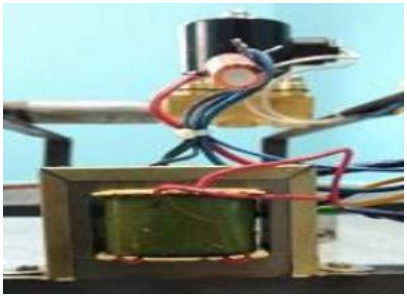

Fig-6.6: Transformer

6.7 HALOGEN BULB

A halogen lamp, also known as a tungsten halogen, quartz-halogen or quartz iodine lamp, is an incandescent lamp consisting of a tungsten filament sealed into a compact transparent envelope that is filled with a mixture of an inert gas and a small amount of a halogen such as iodine or bromine. This allows the filament to operate at a higher temperature than a standard incandescent lamp of similar power and operating life; this also produces light with higher luminous efficacy and color temperature. The small size of halogen lamps permits their use in compact optical systems for projectors and illumination. The small glass envelope may be enclosed in a much larger outer glass bulb for a bigger package; the outer jacket will be at a much lower and safer temperature, and it also protects the hot bulb from harmful contamination and makes the bulb mechanically more similar to a conventional lamp that it might replace.

Fig- 6.7: Halogenbulb

6.8. TRANSISTOR ELECTRONIC CIRCUIT

A transistor is a semiconductor device used to amplify or switch electronic signals and electrical power. It is composed of semiconductor material usually with at least three terminals for connection to an external circuit. A transistor is a device that regulates current or voltage flow and acts as a switch or gate for electronic signals. Transistors consist of three layers of a semiconductor material, each capable of carrying a current. A transistor is a miniature electronic component that can do two different jobs.

Fig-6.9: Transistor electronic circuit

7. WORKING

The drying is the most critical process in the production of dried herbs and spices. The aim of drying is to reduce the moisture content of the product from actively growing in the field to a level that prevents deterioration of the product and allows storage in a stable condition. Drying is a two stage process: firstly the transfer of heat to the moist product to vaporize the water in the product and secondly mass transfer of moisture from the interior to the product surface where it evaporates. The most important and immediate management concern is to ensure the harvested crop will not rot or become grossly invaded with yeasts, bacteria and mould (producing aflatoxins) or become contaminated by pests. This is the start of the preservation process, which for most spice crops requires drying that will enable the long-

term crop storage and the opportunity for further processing. The drying phase of post-harvest management can include four preliminary stages -the selection of high quality produce from the field; cleaning the crop by washing and disinfection; preparing the crop for drying by peeling or slicing; pre-treating with anti-oxidants, blanching or sulfurizing. In some cases, washing prior to processing is desirable to remove field contaminants (dust, soil) using antimicrobial solutions to reduce the microbial populations to a low level prior to the drying process. Cardamom capsule colour and the retention of greenness are important for highest quality. Capsules cured immediately after picking retained greener colour and the loss of greenness was more significant if the capsules were stored for more than 12 hours. Bagging of the capsules in jute bags, and cool storage, aids the retention of greenness. Cardamom capsules at picking contain 70-80% moisture and to enable storage the moisture has to be. Sun-drying is generally undesirable for cardamom because of bleaching and capsule splitting. The most widely-adopted drying system is a slow dry over 18-30 hours using a number of methods of artificial drying (electric, kiln, bin) with various methods of hot air flow. A temperature between 40-50°C helps retain the green colour and an increase in temperature significantly increases the percentage of yellow capsules, split capsules, and heat injury. There are four main types of drying. The most basic method of drying is to spread the crop on a surface exposed to the sun. In this case, the process is aided by a cover system that prevents wetting with rainfall. An improved method, speeding up the drying, is to use a fuel source (wood, oil/diesel, gas or electricity) to heat the drying room. Solar drying systems together with solar powered fans are also available. The drying process should dry the crop as quickly as possible, at temperature levels which do not drive off the volatile flavor compounds. The drying temperature regime will be specific to each crop as will be the final moisture percentage for storage .The traditional open sun drying that is widely used in developing countries has major inherent limitations when trying to preserve product quality. High crop loss and low product quality result from inadequate drying, long drying times, fungal spoilage, insect infestations, bird and rodent damage and contamination plus the effects of sunlight and the weather. Even in the most favorable climate it is often not possible to get the moisture content of the product low enough for safe storage. In the tropics the high relative humidity of the air prevents drying of harvested crop products during the wet season. The objective of a dryer is to supply the product with more heat than is available under ambient conditions. A relatively small amount of heating can greatly enhance the moisture carrying capability of the air. For example, heating air from 20°C at 59% relative humidity (RH) to a 35°C at 25% RH increases the moisture holding capability three times. In a dryer the major requirement is the transfer of heat to the moist product by convection and conduction. The absorption of the heat by the product supplies the energy necessary for the vaporization of water from the product. The process that occurs at the surface of the product is simply the evaporation of the moisture. The moisture replenishment to the surface is by diffusion from the interior and this process depends on the nature of the product. Spices and essential oil crops derived from leaves or flowers are relatively thin and therefore relatively easy to dry due to their small diffusion thickness. Conversely in thick and fleshy materials such as roots, the drying process requires much more careful control of temperature, temperature ramp rate and airflow rate. If the temperature is too high, elevated too quickly or the airflow rate is too high when drying thick fleshy products, 'case hardening' may result, and only the outer surface will dry. This dry layer becomes impervious to subsequent moisture transfer. The ultimate aim for this machine to produce better quality product and maintain its natural green colour. Cardamom popularly known as the "Queen of spices". Today cardamom commands a leading position among the spice of immense commercial importance and is finding its way into the dietary habits of millions around the world. For cardamom processing drying is the most important role as it affects the quality of the final product . 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. 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. The most using processes are sun drying ,solar drying, wood fired dryer. For reducing these problems we are introducing a new machine, in this machine we can control the heat so preventing overheating and maintain the natural colour. The machine consist of a chamber with heating purpose and a vacuum pump is attached with it for removing the moisture content. A solenoid is used in it for preventing the overheating. This machine will increases the efficiency of the spices industry. The aim of the product is to produce exportable surplus of cardamom as per the quality specifications of importing countries. The specialty of this drying chamber is that the cardamom is able to retain it's natural green colour. It will increase the productivity and sustainability. It will improve the quality of the product.it can satisfy the needs of cardamom farmers. It will prevent deforestation. The main components are a chamber, halogen bulb, compressor solenoid valve, copper tubes, mesh etc.., The main component is a chamber it is divided into two by a mesh or a net. The drying process is carried out in this chamber, the chamber having two portion, upper and lower. The cardomom is placed over the net in the upper portion and the heat is provided at the lower. A compressor is used as a vacuum pump for removing the moisture content in the cardamom. A 220V AC compressor is used, cardamom have 80% of moister content. It will be removed by vacuum process using the compressor .A solenoid valve is used to this process for preventing over-heating. Heat is passing through the solenoid valve from the halogen bulb to the chamber. Copper tubes are used for transfer the heat and the vapour content. When the power supply is on 500w halogen bulb is to be lighted and the heat is generated, halogen bulb

produced 80% heat and 20% of light, so the halogen bulb is used for generating heat. This produced heat is transmitted through the copper tube to the solenoid valve, solenoid valve transfer the heat to the lower portion of the chamber. The basic principle is, a moisture contented object can be dried by heating . In vacuum at low temperature the water will vaporized easily, This principle is used in this process. cardomom is placed in the upper portion of the chamber close the cap of the chamber. Then the heat is produced and it is passed through the cardamom they get dried the moisture contents in the cardamom are dried and vaporized easily, compressor is working continuously at suck the vapour content from the chamber and realising to outside. When the temperature is increased above the optimum temperature the sensor will active and close the solenoid valve. Then preventing the heat flow to the chamber. When the temperature is decreased at the range of the optimum temperature the sensor will active again and solenoid will remain open. The the heat flow will start again. Then the process will continuously repeating.

8. RESULT

Cardamom Dyer Machine reduce the expense and energy by less time consuming process. It required less time for drying the cardamom than existing machines The Machine maintain the natural green colour of the cardamom. Which give the good quality of cardamom so it can achieve good market price. When the wood is used to fuel in dyer it leads to deforestation. Here deforestation is reduced by electrical energy Cardamom processing drying is the most important role as it affects the quality of the final product. 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.. This machine give reduce time, energy and labour cost which give innovative product to agriculture industry.

Fig-8.1 cardamom dryer machine.

9. CONCLUSION AND FUTURE WORK

The drying process of large cardamom is primitive one. Drying in traditional dryer imparts inferior quality produce. It is a direct heating process. Because of direct heating in traditional dryer, capsules could not so far reach its consumers with its original color, aroma and flavor. The traditional dryer curing system takes away its color and unique flavor, leaving it with smoky smell and charred unattractive color. But farmers are using the system as it is acquainted with them. Moreover there was no other viable alternative of the system The worldwide production of large cardamom, a high-value, low-volume crop, has fallen in recent years due to several factors, including diseases and pests. Adoption of proper postharvest processing techniques can help to compensate for decreased production by reducing postharvest losses and adding value. Improved dryer yield better quality than traditional dryer, but these devices have not been well accepted by farmers. Farmers need a low-cost curing system that can produce good-quality capsules. Several other labor intensive postharvest processing operations—such as separating capsules from spikes, cleaning, tail cutting, and grading—have not received the attention they need from researchers. Mechanical systems that reduce human drudgery and make postharvest processing more efficient will decrease losses and increase the value of the capsules produced. Apart from primary processing, it is also necessary to explore other ways to add value to this crop, such as production of essential oil and oleoresin. Large cardamom capsules have great demand in the international market due to his pleasant aromatic odor, and flavor. It is a medicinal measure for throat troubles, congestion of lungs, inflammation of eyelids, digestive disorders and in the treatment of lung tuberculosis. Drying of capsules is generally done by the traditional dryer. Which greatly affect the quality (color and oilcontent etc.) of capsules. These traditional Bhatti's are made of locally available material. Now, many improved Bhatti's, gasifier, electric or diesel operated and solar dryer are designed by the research institutes. These dryers produce dried capsules that have a more attractive color and larger volatile oil content. These improved dryers cost is more than the traditional bhatti's, it is not being afforded by the small farmers. Also, due to lack of knowledge, the farmers not used these improved dryers. The Indian Cardamom Research Institute developed an improved bhatti, an indirect heating system that uses heated air and a flue gas pipe arrangement to dry the capsules. The capacity of this bhatti varies from 200 kg to 400 kg of fresh capsules. Drying time is reported as 17–24 hours, and it gives excellent product quality with maroon color and volatile oil content of 2–2.4%. One such unit costs about US$ 102 (Deka et al., 2003) [12].

Improved bhattis are used by a few farmers in Arunachal Pradesh state in India. They were also introduced in the state of Sikkim by the Spices Board of India, but farmers are reluctant to adopt those. Use of a similar curing system in Nepal has also been reported .As compared with 2013–2014, the quantity of the cardamom traded in 2013–2014 decreased. However, the export value was greater in 2013–2014, which shows the increased value and demand for the crop. Therefore, an increase in production of this important crop will improve the livelihoods of many mountain people in the sub-Himalayan region. Large cardamom farmers still face difficulties in postharvest management. Better extension services by NGOs or government agencies or both will improve awareness about the policies among farmers and help ensure their successful implementation. Organizations like the North Eastern Regional Agricultural Marketing Corporation can also help farmers get better prices by acting

as a link between farmers and traders. Finally, proper pricing for high quality product can also help to make large cardamom farming an attractive and profitable livelihood. Our future work is to extract cardamom oil by the process of "STEAM DISTILLATION". Most of the essential oils are extracted by this process .Steam distillation was invented on 1000AD by Persian alchemist and healer AVICENNA ,it is often used now because it is one of the best process for the extraction of oil and the process is as follows ,when the cardamom is passed with the steam and these steam will contains the essential oil and it is then passed to a cooling chamber where the temperature of the steam is lowered and is then converted into water, where the oil will sink in the top of the water and can be extracted easily

REFERENCES

[1] Agnihotri, "wakodantimicrobial activity of essential oil and various extracts of fruits of greater cardamom"Indian journal of pharmaceutical sciences 2010.

[2] F. K. Forson, M. A. A. Nazha, F. O. Akuffo, and H. Rajakaruna. "Design of mixed-mode natural convection solar crop dryers"Application of principles and rules of thumb," Renewable Energy32, 2306–2319 (2007).

[3] Muhammed, A. S.(1987). "India's Cardamom Trade with Middle East Countries". MBA Project Report, Calicut: University of Calicut.

[4] Nair, T. R., & Kutty, M. G. (2004). Cardamom (Elettaria cardamomom) in Kerala, India. Forest Products, Livelihoods and Conservation, 1, 130-147.

[5] P.B Kulasekera, B.F.A Basnayake"Testing and evaluvation of cardamom dryer"Research gate January 1993

[6] Prem Ranjan ,Jitson Achom, Manjeet Prem "Study of different drying methods affect on quality of large cardamom (amomum subulatum roxb) capsules"Research gate January 2018.