

Onfarm Value addition with CRIDA Herbal Dryer

Herbal dryer with samples



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Introduction

India has been identified as one of the top twelve mega-biodiversity centers of the world with immensely rich medicinal, aromatic plants, fruits and vegetables occurring in diverse ecosystems. India which is the biggest repository of medicinal and aromatic plants in the world has to maintain an important position in the production and trade of raw materials either directly for crude drugs or as the bioactive compound in the formulation of pharmaceuticals and cosmetics. The demand for plant based raw materials has increased enormously in both national and international markets. International markets for medicinal plants are increasing at the rate of 7% annually of which India share is only about 3-5 % while China is one of the leading countries in the world in export of herbal drugs besides meeting its large domestic demands (Rajeshwar Rao and Rajput 2005). India should develop its domestic market as well as exploit international trade, which is large and quickly growing. Hence there is enormous scope for India to emerge as a major player in the global herbal products. But various lacunae pertaining to quality of herbal drugs do exist which are the major hindrances to come up to the expected level of trade of these medicines both within and outside the country. Hence it is necessary to augment the availability of quality raw materials at the first instance and generate value added products that have better commercial value.

The technology adds value to the farm produce by a multiple factor in pharmaceutical industry. An cited illustration based on the price of steroidal Yam marketed as raw material have value at US \$10 M per year which rises to US \$ 100 M at steroid selling stage and goes up to one billion when sold as sex hormone and contraceptives to the consumer (Edward Ayensu (1987)). It is, therefore, desirable that our country which exports raw materials should increasingly produce intermediary value added chemicals and upstream phytochemicals to harness better unit price of the farm produce.

The promotion and development of alternate plants through value addition, domestic processing, by promotion of small-scale forest-based enterprises provide rural income and promote employment. Only a few developing countries have the resources to carry out large-scale, commercial processing of the plants. Historically, most of the raw materials have been exported to industrialized countries where they are processed as final products. However, the semi processed plants may find ready market with herbal dealers /large industries. These products can be processed with inexpensive equipment, and through small-scale operations. Local processing of selected species can be environmentally and economically viable. The medicinal plant growers receive the price on the basis of weight, color and general appearance of the material. Hence they require proper drying to maintain the freshness viability and unchanged textural composition. Proper drying is also very important as this helps in better enzymatic action and also in grinding.

Similarly the modern Crop Production technologies have increased the fruits and vegetable production but this is not meeting the per day requirement of the population as they are produced in plenty in a particular season, area, and moreover they are perishable commodities. In a country like India, the ever-increasing costs of energy, makes the controlled environment storage a difficult and expensive proposition. Hence there is a seasonal wastage and off seasonal shortage of the agricultural products which is leading to wide fluctuation in market prices of these commodities. This situation is leading to poor profits in farming. Very few post harvest technologies exist and they are complex and unaffordable to the farmer (Berinyuy 2004). Till date value addition has not received much attention on a global scale especially in the developing and under developed countries. Appropriate storage and processing methods can curtail post harvest losses. which are contributing to 30% of the total production. Dehydration is a viable low cost alternative technology for a small farmer to prolong the shelf life of the products. This is also the oldest practical method of food preservation practiced by mankind on earth. With the introduction of modern technology, large numbers of fruits, vegetables, herbs, spices etc., are being processed by carrying out advanced and capital-

intensive dehydration processes. Possibly this segment also accounts for largest share of food processing in the world. India can compete in the export of dehydrated produce in the international market by producing the quality material and by adopting suitable dehydration techniques.

Dehydration helps in ensuring continuous availability, by reducing the excessive supply during peak seasons and thus helps in maintaining reasonable price levels for the produce and thus benefiting the farmers. The removal of moisture prevents the growth and re-production of microorganisms that cause decay. It minimizes moisture-mediated deterioration. Dehydration also enables storability of products under ambient temperatures. Different drying methods are available for drying of the agricultural crops.

Sun drying is the traditional method of drying agricultural products in India. The main advantage a this method is low capital and operating costs. The disadvantage is contamination of the produce, laborious and weather dependent. More over the traditional drying methods are normally related only to moisture removal. Along with the moisture some volatile substances present in very small amounts are also lost. UV radiation in the sun rays may cause deterioration of active principle and also affect the texture, color and flavor of the sample. There should be a easier and cheap means of drying to produce a good quality product and fetch good price to the farmer.

Several dryers like solar dryers; cabinet dryers have been developed for drying with different sources of fuel. But most of them either use an expensive source of energy such as electricity or solar energy and combination of solar and other sources of energy. The farmers because of the cost or difficulty in usage do not adopt these. Moreover many rural areas in India suffer from unreliable and poor supply of electricity. Hence, the farmers are facing problems with the existing dryers, which are inappropriate to Indian conditions. As a result the final product is of poor quality with low market acceptability and value. This necessitated for developing a low cost alternative energy based dryer to dry the products with less contamination and minimum post harvest losses.

Design and development of Herbal Dryer:

Keeping in view the constraints in sun drying and shade drying, CRIDA has developed a Herbal Dryer which uses the Liquid Petroleum Gas as fuel. It mainly consists of a drying chamber with eight cubic meters volume made of 16 gauge mild steel. The drying chamber is made in two layers with 1" gap in between in which glass wool is filled for thermal insulation. A removable stand was kept inside the chamber to arrange the trays for keeping the product, which is to be dried. More than 40 trays (40 cm x 40 cm) can be arranged in a zigzag way so that the hot air moves in a S-shape path. A separate furnace is used to heat the atmospheric air, which is then blown in to the drying chamber with the help of 0.5 h.p. blower. A 6mm copper plate is used as a heating element in the furnace. Two burners fuelled with LPG are placed beneath the copper plate and using a



Herbal dryer with samples

thermostat based electronic relay system the gas flow is controlled in to the burner. Always, the threshold level of gas flow is maintained, to keep the burners lighting even when the relay is in off position. The temperature and humidity inside the drying chamber is measured with the help of the sensors attached to the thermostat-relay control system. A control panel is placed outside the dryer to read and set the temperature. The set temperature is maintained accordingly by controlling the gas flow into the burners. If the drying chamber temperature exceeds the temperature, the relay will cutoff the excess flow of gas into the burners. If the temperature reduces inside the drying chamber, the relay will open the gas valve for excess flow in to the burners. The humidity inside the drying chamber is also displayed on the control panel. Opening and closing of ventilators arranged at the bottom and top of the drying chamber

control the humidity. Biogas can also be used in place of LPG, if available

Advantages of the Herbal dryer over conventional methods:

1. Accuracy in maintaining the set or required temperatures.
2. Uniform flow of the hot air into the drying chamber to maintain the required temperature unlike to the normal ovens used for dehydration of the products where the airflow is cut off to maintain the temperatures. Hence the herbal dryer product is superior to other methods of drying.
3. The LPG/Biogas provides quick energy flow of gas to regain the set temperature in short time so that there will be no variation in drying product ambient conditions.
4. The drying cost is reduced as the energy use is optimised since it is automated system.
5. It reduces the labour cost
6. No contamination, no impurities in the dried product.
7. Precision control provides a better quality product, at cheaper rate.

Gas based herbal dryer is farmer friendly as it is weather independent and provides quality products.

Products dried

Experiments carried out at CRIDA indicated that the dryer can be successfully used for drying of medicinal and aromatic, plants, fruits and vegetables. The quality of various materials dried in herbal dryer are discussed.

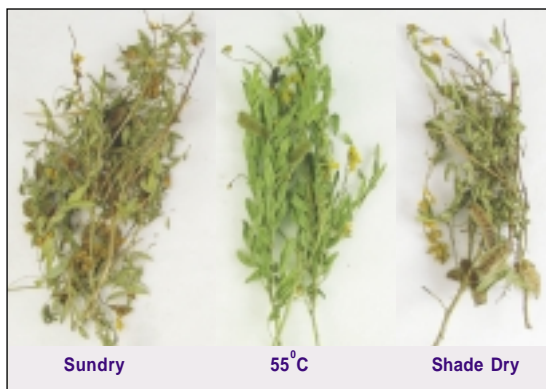
Medicinal Plants

Senna

Senna is a cash crop and earns good foreign exchange. It is native of Saudi Arabia and cultivated in Tamil Nadu, Karnataka, Andhra Pradesh and Gujarat. The crop is well suited to drylands as it is drought tolerant, and can be cultivated throughout year. Large quantities of dried Senna leaves & pods are exported to USA, European Countries, Japan & Australia. The leaves and pods are widely used in Ayurveda, Unani and Allopathy system of medicine

as it has laxative property. This property is mainly due to chemicals viz., sennosides A, B. The demand for Senna is increasing in the international market.

The Senna grower receives the price on the basis of weight, color and general appearance of the material. Usually after the harvest of the crop the material is either sun dried or shade dried for 6-7 days. (Sharma 2004). After drying, the leaves maintain light green to greenish yellow colour.



Senna dried in Different Methods. Herbal dryer (Center) maintained excellent green color

Quick drying ensures excellent colour, which is the most preferred material by the traders. Delayed drying changes the Colour to brown and black, which indicates loss of sennosides. At present the grower receives price based on the appearance of the material and sennosides content, so proper drying methods for drying of the material is essential. Hence to compare different methods of drying fresh samples of senna were dried under different methods viz., sun, shade, oven (55°C) and CRIDA herbal dryer (55°C).

The color of leaf was excellent when dried in CRIDA herbal dryer compared to drying in hot air oven or sun/ shade. Sun/ shade drying also resulted in physical contamination. Among different drying methods tried, CRIDA herbal dryer recorded significantly higher sennosides, which was followed by oven drying. Herbal dryer dried material recorded 74, 67, 60% higher sennosides content than the material dried under shade, sun and oven drying respectively. The higher sennosides content in herbal dryer is due to faster drying with the optimum rate of hot draft of air in herbal dryer, where mass transfer of heat takes place uniformly unlike in oven drying in where there is slow heating. Moreover in hot air ovens the hot air is recycled back hence it is difficult to maintain the temperature as

well as humidity. Quick drying in herbal dryer reduces the rate of oxidation of the leaf, which helps in reducing the losses of sennosoides content. (Table1)

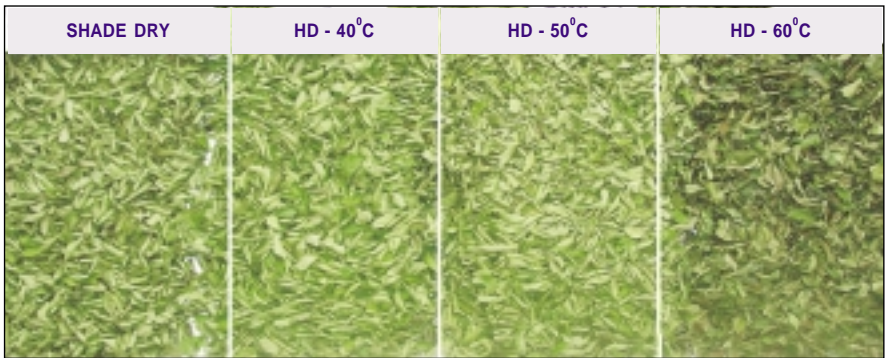
Table 1 Influence of different drying methods on quality of senna leaf

Drying method	Sennosoides (%)	Color of leaf	Time taken for drying (hrs)
Only leaf			
Herbal Dryer	4.42	Excellent green to light yellow	1.5
Sun Drying	1.61	Brownish green	18
Shade Drying	1.15	Light brown	84
Oven Drying	2.48	Green	3
Leaf+Stem			
Herbal Dryer	3.27	Green	3
Sun Drying	0.86	Brownish green	18
Shade Drying	0.80	Dark brown	84
Oven Drying	2.39	Light green	4
	Sem ± CD at 5%		
Material	0.072	0.218	
Drying methods	0.102	0.309	
Material x Drying methods	0.144	0.436	

Herbal dryer dried senna has high export value due to higher sennaosoides & appearance

Curry leaf

Curry leaf is most widely used leafy spice in most Indian cuisine for its characteristic authentic flavor and aroma. It is also widely used in many ayurvedic and unani preparations. The curry leaf can be cultivated as shrub intercropped with arable crops during Kharif in rainfed areas of SAT. Higher returns were obtained when Suwasini variety was cultivated as shrub in SAT (Korwar and Pratibha 1998). The price of leaf is better in winter and summer but low in rainy season. During the period of glut, value addition to curry leaf can be done by making powder or extraction of oil. This increases income to the farmer. Dry powder is used as flavoring agent in curries and for many medicinal preparations. The essence can be used in fast



HD = Herbal Dryer

Curry leaf dried at different temperatures in Herbal dryer

foods. Many people of the world in general and Asians in particular use the leaf for culinary purposes. Interest in use of curry leaf has increased due to its high anti oxidant and anti carcinogenic potential (Khanum *et al* 2000). The changing demographics throughout the world has created market and greater demand for the spice (Palaniswamy *et al* 2004). Thus curry leaf has export potential. However the dry powder loses its flavor and color if it is not dried properly.

Studies on drying the curry leaf in different seasons indicated that the time taken for drying under sun and shade differed in the two seasons. In winter season, time taken in shade and sun drying was almost double when compared to summer season. However, time taken for drying during these two seasons in oven and herbal dryer did not differ much. The time taken in hot air oven and herbal dryer on average is 0.22, 0.18 days as against 3.6 and 7.18 days in winter and 1.5 and 3 days in summer under sun and shade drying respectively. The prolonged drying period results in deterioration of quality of leaf. It also gave room for fungal infection. Sun/ Shade drying both resulted in physical contamination of the powder with dust. The flavor, color and aroma of dry powder were best at 50 °C, Any increase and decrease in temperature beyond this recorded low flavor and aroma. Drying at 50°C in herbal dryer had maintained emerald green color. while sun and shade drying lost the color. The results are of practical utility for the industry as it helps in choosing a better drying temperatures in various seasons for drying of the leaf to make into powder (Table 2).

Table 2: Effect of different methods of drying on time and quality of the leaf in different seasons

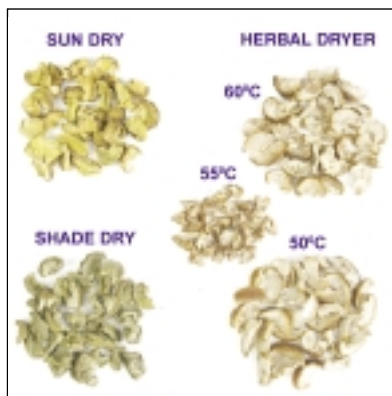
Drying method	Drying period (days)		Quality		Description of color
	Winter	Summer	Flavor	Color	
Oven					
40°C	0.21	0.25	2.3	2.2	Light Green
50°C	0.17	0.21	3.2	3.0	Emerald Green
60°C	0.08	0.13	2.3	3.0	Pale Green
Herbal dryer					
40°C	0.18	0.2	2.8	2.4	Light green
50°C	0.13	0.14	4.0	3.9	Emerald green
60°C	0.08	0.11	1.3	1.8	Ivory Green
Sun Drying	1.50	3.5	2.5	1.2	Blue
Shade Drying	3.00	7.1	2.4	2.7	Pale green

The CRIDA herbal dried leaf can be used in biscuit making. The leaf dried by different methods was used in biscuit preparation. The organoleptic studies indicated that the biscuits made from herbal dried leaf had better flavor, aroma and better keeping quality when compared to other methods of drying.

Post harvest processing of Curry leaf in CRIDA Herbal dryer fetches higher income to the farmers.

Aonla

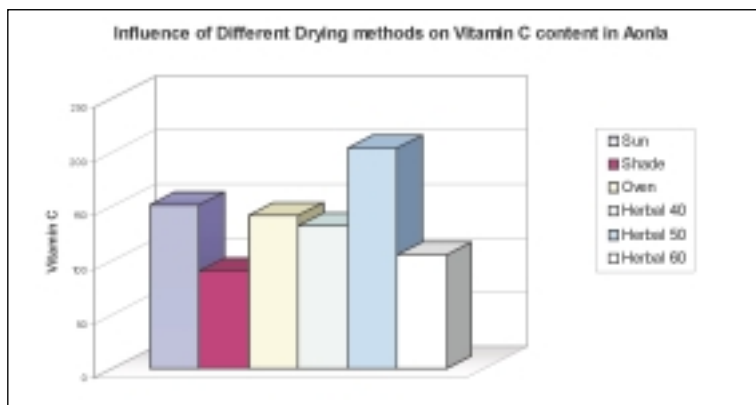
The aonla fruit is widely used for medicinal purposes especially in Ayurvedic and Unani system. It is the richest source of vitamin C. Aonla fruits, owing to its high acidity and astringent taste, are not palatable and hence not suitable for table purpose. It is consumed mainly in the processed form. The excellent nutritive (minerals, vitamins), and therapeutic (phenols and tannins) values of fruit offer its untapped potentiality for processing into several quality products. Aonla is probably the only fruit to fill the gap of



Better quality of Aonla dried in Herbal Dryer

astringent food for balanced diet and sound health. A number of products like murabba (whole fruit preserve), pickle, candy, juice, squash, etc. can be prepared (Nath and Sharma, 1988). However, a substantial quantity of vitamin C is lost during processing. Presently aonla fruit has great significance in medicinal and cosmetic products and little attention has been paid towards processing into quality products as food items. To make it a fruit for common people, products need to be developed which are attractive, tasty and consumed as food items, but at the same time retain its nutritive and therapeutic values (Tandon and Sanjay Kumar, 2005).

Murrabba is most popular product that dominates Indian market. It is reputed for its delicacy but is laborious and heavy losses of nutrients during preparation are reported. Aonla supari a spiced mouth freshener is introduced by few industries in the market. Usually they are dried in sun/shade. This method of drying darkens the color of the produce and there is possibility of contamination by dust, microbial spores resulting in deterioration of physical and nutritional quality (Tandon, *et al* 2003). Thus defying the purpose of the product itself. Hence a new method was tried to dry the aonla segments at CRIDA. The aonla segments were cut and were dipped in 2% salt solution for two hours and dried in different methods through herbal, Sun, shade and oven drying. The product dried at 50° c in herbal dryer maintained light color, and was soft in texture compared to other methods of drying. The herbal dried product recorded 36.1 and 44.6 % higher vitamin C over sun shade and oven drying respectively.



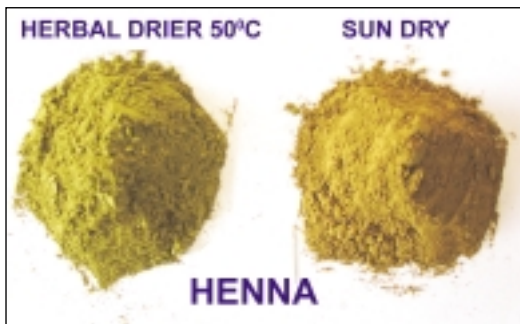
This product has good potential to replace health hazards associated with chewing substances like ghutkha, Pan masala etc., available in the market which have posed serious threat to man.

Value addition to aonla in CRIDA dryer has good potential as nutritive supplement.

Henna

Natural dyes from plants were extensively used in many industries like textile, cosmetic and food industry.

Henna, (*Lawsonia inermis*) is an important dye-yielding crop. The leaves of the plant yield an orange color. Prior to wide spread availability of



Better color of Henna dried in Herbal dryer

synthetic dyes this crop was widely used in textile dyeing, and as hair dye. The plant is non grazable by cattle hence it can be grown as fence to protect crops and orchards from animals. Henna cultivation has been proved to be a profitable enterprise for farmers of arid & SAT Regions (Rao, *et al* 2002). India is th major producer & exporter of henna. About 31% of the produce is exported to U.S., UAE, Turkey and Middle East (Singh, *et al* 2005). However proper drying & storage methods are required to maintain the quality of the leaves otherwise the leaves loose color & faster deterioration.

Retention of a desirable attractive green colour is assisted by drying in the shade but this is impractical when a large area is cultivated. More over the crop is normally harvested in December, the temperatures during December are low and there may be unseasonal rains, hence shade or sun drying not only takes longer period but also affects the quality and colour of the leaf. Hence, for maintaining post-harvest quality & fetch good price there is a need for use of simple, in-expensive dryers in humid climates. Studies at CRIDA revealed that drying henna at optimum temperature of 50°C

maintains the colour and higher lawsone content (Table 3). Compared to sun and shade drying.

Table 3 : Influence of Different drying methods on Lawsone content in Henna

Temperature & Methods	Time (hours)	Gas consumed (kgs)	Lawsone (%)
Sun	72	-	1.69
Shade	86	-	2.19
40°C Herbal Dryer	5	2.5	2.03
50°C Herbal Dryer	3	1.5	2.49
60°C Herbal Dryer	2.5	1.1	2.23

Herbal dryer dried henna has higher lawsone content

Vegetables

Tomatoes

Tomato is the second largest vegetables crop in India and contributes to 7% of world production. This is a highly perishable crop and accounts to 40% post harvest losses (Gisele *et al.*, 2004). In the cropping season large quantities are produced and there is a glut in the market. This leads to fall in prices as a result of which there is loss to the farmers. Hence there is a need to efficiently utilize this crop for production of shelf stable value added products. Drying is not a popular way of processing tomatoes due to its adverse effect on the final product and quality. Of late the interest in dried tomatoes is increasing due to its use as pizza toppings, salads, and soups (Lewicki *et al.*, 2002). The high moisture content in the fresh tomatoes makes Sun drying an inefficient process and there is a drastic reduction in vitamin C. Therefore it is important to establish an efficient drying method, which yields products with higher sensory and sanitary quality in a shorter period compared to the conventional sun drying method.



Tomatoes dried in Herbal dryer

Drying of tomatoes in CRIDA dryer has better flavor, quality and appearance - best for toppings & salads

Tomatoes are cut in to slices and are dipped in 2% salt solution for 30 min. The samples are dried by different drying methods.

Tomatoes dried at 55°C maintained the same color of the fresh fruit unlike in sun or shade drying, where there is deterioration of color.

Organoleptic studies of the dried product showed that the herbal dryer dried tomatoes were superior in terms of color, flavor when compared to sun and oven drying.

Okra

Okra is one of the most important popular vegetable consumed in tropical and subtropical countries. The vegetable is cut into pieces and is blanched in sugar solution for 15 minutes and is dried by different methods. It was observed that the product dried in herbal dryer had better quality in terms of color and taste. The product can be consumed directly as salad or can be cooked.



Okra dried in herbal dryer

Leafy vegetables

In Indian culinary green leafy vegetables are one of the most valued components for their color flavor vitamins and minerals and they are rich source of vitamin A & C. Leafy vegetables are highly seasonal. The preservation of the leafy vegetables prevents huge wastage and help in availability during lean season. The green leafy vegetables like methi, Mint, coriander, and drumstick can be dried, effeciently

The vegetables are dried under different conditions like sun drying, shade, oven, (50°C) and Herbal dryer 55°C. The quality of the leaf is superior in herbal dryer when compared to other methods of drying. In organoleptic studies the respondents rated the herbal dryer



Green leafy vegetables dried in Herbal dryer

samples as good and had only minor deviation when compared to the fresh sample. When the off season use was considered the respondents appreciated the quality of the leafy vegetables dried in herbal dryer in terms of their color, flavor and aroma.

Shelf life

Post harvest deterioration in quality of the products was monitored for one year. The products dried under different methods were stored and quality was estimated after one year.

After one year of storage of henna loss in the lawsone content in sun shade, drying (60%) was faster when compared to herbal dryer (30%) similarly significant reduction in quality of senna was observed in sun and shade drying as compared to herbal dryer.

The deterioration of quality of green leaf vegetables in terms of color and flavor is fast in sun and shade drying whereas the herbal dried curryleaf, methi, mint not only retained the color but also flavor for longer period.

Economics

The drying cost in herbal dryer depends on the gas consumption only. The consumption of gas varies according to the product to be dried and the duration of drying, temperature and atmospheric temperature and humidity. Normally green leafy vegetables takes

only 1 hour time for drying where the drying cost varies from Re 0.5 to 1 per kg of dried product. The curry leaf, senna etc require Re 1.5 to 2. The other products costs around Rs 2 to 5. Normally the gas consumption varies from 30 grams to 300 grams per hour at minimum and maximum set temperatures. The time taken for drying tomatoes in herbal dryer was 5 hrs and gas consumed was 3 kg for a batch.

Commercialisation

CRIDA herbal dryer design has been licensed to Lakshmi engineering works. The address of the firm is :

Lakshmi engineering works
Plot No :6, Sainagar Phase 1. Opp. Autonagar,
Vanasthalipuram, Hyderabad - 500 070, A.P

Conclusion

Herbal dryer has the potential for application in drying of various other crops like chilies, ginger, figs, pineapple etc., as the products retain their quality, flavour and better shelf life. The deviation in quality of the dried product from fresh is only marginal. Hence drying provides opportunity to use the products in off season. This also prevents post harvest losses and provide better returns. The drying period is considerably reduced by this method and is independent of all the external factors like weather, electricity etc., This dryer is more farmer friendly and has practical value as the products can be dried independent of weather and without any electricity.

Post harvest processing in CRIDA dryer is a win-win situation -
Hygienic, quality consumer products & extra income

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