



POSTHARVEST FOOD DRYING TECHNIQUE USING A SOLAR TUNNEL DRYER

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Food drying is not a new preservation and value adding technique, for decades people have sundried fruit and vegetables. This is thus a fruit and vegetable preservation technique for future use (Mnkeni et al. 2001). During the drying process, water is removed from the produce below levels at which microbial growth and development is favoured, therefore by keeping the produce free from microbial spoilage and extending shelf life when produce is packed in sealable packaging. This is more relevant to small-scale fruit and vegetable growers who have limited access to funding for expensive and sophisticated food preservation methods, such as refrigeration. New technologies brought changes in drying techniques by providing mechanical dryers that can be operated by electricity. However, small-scale growers still cannot afford this technique since it is expensive, especially for commercial purposes. The currently increasing demand for healthy, low-cost natural foods, and need for sustainable income has demonstrated a need for low cost drying techniques.

Open sun drying is a traditional method that has been used for decades. However, some areas where drying should take place, environmental conditions do not allow for it. This is due to conditions such as high moisture content in the atmosphere, animal pests, dusty winds etc. Due to ever increasing costs of electricity and uncertainty regarding the future costs and availability thereof, the use of a solar tunnel dryer for fruit and vegetables is possibility. It is economically feasible because it uses freely available solar radiation. In many countries of the world, the use of a tunnel dryer in agricultural areas to preserve

vegetables, fruits, and other crops has shown to be practical, economical and the environmentally responsible approach. A typical process for such fruit involves washing, grading, peeling under lemon juice-treated water, removing of seed if required, slicing and drying.

A solar heated tunnel improves the quality of the product being dried by protecting it from foreign matter. It reduces wasted produce and electricity costs, and thus improves the quality of shelf life. However, the availability of relevant information is lacking for small scale growers with limited input resources in many of the countries of the world where food processing systems are most needed.

Solar tunnel dryers have some advantages over sun drying when correctly designed. They give faster drying rates, by heating the air to 10-30°C above ambient, reducing its humidity and deters foreign objects that can spoil the produce. The faster drying reduces the risk of spoilage, improves quality of the product and gives a higher throughput, so reducing the drying area that is needed. However care is needed when drying produce to prevent too rapid drying, which will prevent complete drying and would result in case hardening and subsequent mould growth. A tunnel dryer can be constructed from locally available materials at a relatively low capital cost and there are no fuel costs. Thus, they can be useful in areas where fuel or electricity is expensive or unavailable, land for sun drying is in short supply or expensive, sunshine is plentiful but the air humidity is high. Appropriate clothing for food processing is also

required. The following are steps to follow when drying fruits and vegetables.

Washing fresh produce

Use of chlorine treated water is important to kill any fungi and bacteria present on fruit surface. Different products contain different levels of chlorine concentration per volume of water therefore, recommendations with regards to time required to wash are based on the chlorine concentration in the product used.

Peeling

Hygiene is of utmost importance when peeling. Peeling should not take place in the area where the raw materials are washed. The area should be swept thoroughly and washed with a disinfectant before handling the fruit. Peeling knives and working surfaces should be cleaned with a disinfectant. The operator should wash his/her hands and arms thoroughly with clean water and food grade disinfectant. Clean, sharp stainless steel knives must always be used. Careful peeling with minimum removal of the flesh is important. Peel and seeds should be disposed as soon as possible if not used as they attract insects. Peels can be used for animal feed or as mulch in crops that do not suffer from similar diseases, or be buried if there is no alternate use.

Cutting and slicing

The thickness of the slices is very important since very thin slices results in hardening and a brownish colour in the final product, whereas, if too thick do not dry properly. Thickness of fruit pieces depends upon the kind of fruit or vegetable being dried. Thicker slices will dry at a slower rate than thinner pieces. Very thin pieces tend to stick to the drying trays and will be difficult to remove. Thicker slices may not dry fully and may subsequently deteriorate after packing. Packages of dried pieces of varying thickness appear relatively unattractive. Cutting knives and working surface have to be cleaned with a bleach solution before use. Slices should be placed in clean bowls

which have been rinsed with clean water, ready for loading onto the drying trays. Before loading the trays, these have to be brushed clean and washed.

Tray loading

Trays should be washed and cleaned to remove any fragments of dried fruit or contamination. Start loading during slicing, rather than waiting until all the fruit has been sliced or cut. This reduces the problem of sticking together in the bowls and allows drying to start as soon as possible. Lay the pieces of fruit on trays carefully and close to each other, without overlapping, to ensure the trays are loaded fully. Keep insects and flies away, load trays quickly and continuously and ensure the tunnel dryer is closed.

Any openings for ventilation can be closed with a net which should not reduce air movement, but should be able to block insects from coming inside and spoiling the produce. The results from ongoing studies at Cedara show that a tunnel dryer can be used in most areas, but the speed at which the fruit dries is affected by many variables, especially the amount and duration of ambient sunlight, temperature and relative humidity. Typical drying times in tunnel dryers range from 1 to 4 days depending on sun, air movement, humidity and the type of food being dried.

Types of solar dryers

There are mainly three types of solar dryers, namely:

- The absorption or hot box type dryers in which the product is directly heated by sun,
- The indirect or convection dryers in which the product is exposed to warm air which is heated by means of a solar absorber, or heat exchanger,
- Dryers combining the principles of the above two, where the product is exposed to the sun and a stream of pre-heated air simultaneously.

The process of solar tunnel drying in details

The principle that lies behind the design of solar dryers is as follows:

- In food drying, relative and absolute humidity are

of great importance. Air can take up moisture, but

- Only up to a limit. This limit is the absolute (maximum) humidity, and it is temperature dependent. When air passes over a moist food it will take up moisture until it is virtually fully saturated, that is until absolute humidity has been reached. The capacity of the air for taking up this moisture is dependent on its temperature. The higher the temperature, the higher the absolute humidity, and the larger the uptake of moisture. If air is warmed, the amount of moisture in it remains the same, but the relative humidity falls; and the air is therefore enabled to take up more moisture from its surroundings.
- Air movement in the drying tunnel is very important, inlet and outlet vents are important.
- Dense cool and dry air is let in at the bottom end vent of the solar tunnel and warm moist light air rises and is let out at the top vent at the opposite end to the bottom vent.
- To economically produce a high-quality product, it must be dried fast, but without using excessive heat, which could cause product degradation.
- Drying time can be shortened by two main procedures: one is to raise the product temperature so that the moisture can be readily vaporised, while at the same time the humid air is constantly being removed. The second is to treat the product to be dried so that the moisture barriers, such as dense hydrophobic skin layers or long water migration paths, will be minimised.

Dryer loading

- The dryer should be positioned in a level area, free of trees or buildings so that it is fully exposed to the sun throughout the day. Usually north-south longitudinal direction is required.
- If the wind blows predominantly in one direction for long periods, the dryer should be placed end-on to the wind. This will reduce the cooling effect of the wind blowing direct into the drying cabinet, lengthening drying times. It will also reduce the possibility of dust entering the cabinet.
- Before loading, the inside of the drying cabinet

should be swept clean and then wiped out with a clean, damp cloth (sanitizer).

- The plastic covers outside should be brushed or washed clean of dust because dirty plastic will reduce dryer performance and increase drying times and obstruct the sun's rays.
- The doors should be closed immediately after each tray has been loaded and not left open until the next tray is fetched.

Conclusion

Solar drying is a very economical method to preserve food, especially for small scale growers.

References

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Date accessed: 14th March 2016.

Acknowledgment

The authors thank and appreciate the team at Horticulture Section for constructing the tunnel and Value Adding section for post-harvest activities of tunnel dehydration of peaches at Cedara Research Station. Pictures are available on request. Steps on construction of the tunnel dryer are available on request.

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Published March 2015