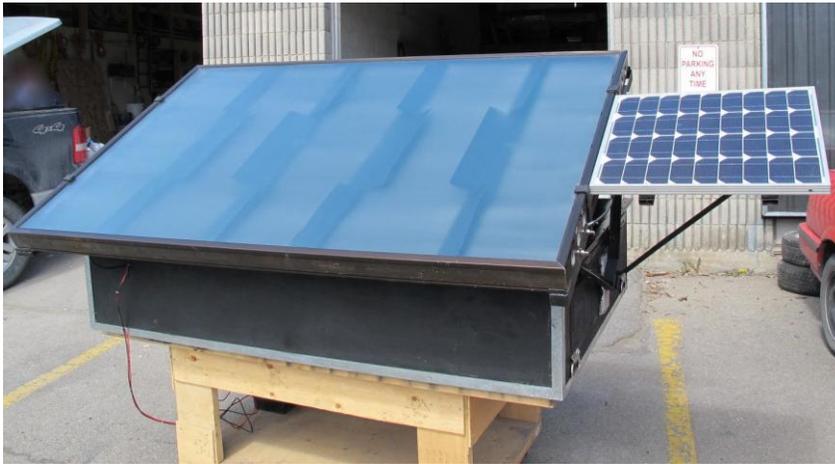


Drying Fruits and Vegetables with the SolarFlex Dryer

Technical Specifications of SolarFlex Small Farm Dryer

- Trays x 8 perforated aluminum.
- Drying area – total tray surface = approx 5 sq. M
- Cabinet Construction – Painted plywood with steel supports and top
- PhotoVoltaic Panel – 40 Watts with charge controller
- Battery – 12 V deep cycle automotive type (optional)
- Fan – 4 PC fans, 6 Watts each
- Glazing Material – tempered solar glass
- Solar collector - corrugated steel absorber w. aluminum frames.
- Solar collector can tilt to 30 degrees
- Entire assembly can swivel 360 degrees



“Small Farm” Dryer shown on work table with collector set at 30 degrees, suitable for temperate latitudes. 0 degree setting would be suitable for tropical latitudes near the equator.

Collector setting can also be easily adjusted for seasonal changes of solar angle.



Rear view showing cabinet doors, aluminum racks and fan switches.

Larger commercial dryers, or their solar air collectors, are unable to be rotated to track the sun. This limitation also favors multiple SolarFlex “Small Farm” units.

1. General Principles

Because drying removes moisture, the food shrinks and decreases in size and weight. Drying also preserves the food without need for refrigeration. Therefore it is ideal to do when the food is fresh and plentiful, to allow for consumption or sale later when it is less available or too expensive.

How quickly the food dries is affected by many variables, especially the amount of sunlight and relative humidity. Drying time is also affected by type of food (water content), and thickness of slices. Generally speaking very wet foods like mango, pineapple and tomato will take two full days of solar heated drying. Some like apple, coconut, potato, onion etc. can be done in one day. Leafy products like herbs take only part of a day.

Yields of dried products are directly related to how much water is in the original product. 80 – 90 % of the moisture must be removed. 10 kg of sliced apples will yield about 1.6 kg of dried apples. 10 kg of onions will yield about 1.25 kg of dried onions. Very wet fruit like mango and tomato will yield about 1kg from 10 kg. When water is added to the dried product, it returns to its original size. This is done with many vegetables, but most fruits are good to consume in their dried form.

2. Selecting and Preparing the Food

Fruits and vegetables selected for drying should be sound, fresh, and in the "peak" of condition; ripe, but still firm and at the right state of maturity. Wilted or inferior material will not make a satisfactory product. Immature fruits will be weak in color and flavor. Over-mature vegetables are usually tough and woody. Over-mature or bruised fruits are likely to spoil before the drying process can be accomplished. Fruit and vegetables that are inferior before drying will be inferior after drying.

Wash fresh fruits and ripe vegetables thoroughly. Ideally a solution of 1 part household bleach containing a chlorine agent mixed with 50 parts water would be used to disinfect the food. Alternatively a mild detergent solution can be used. The cleaning water easily becomes contaminated by the fruit during washing. As a general rule, 10 litres of treated water should be sufficient to clean about 20kg of fruit.

Immediately after washing and rinsing begin the peeling and slicing.

Key points on washing

- Clean all working areas before handling fruit
- Prepare bleach solution according to instructions
- Use clean baskets/buckets to carry washed fruit
- Replace wash water / bleach solution regularly
- Dispose of used solutions safely.

Peeling

Peel foods that normally require peeling such as mango, pineapple. Tomatoes, potato and others can be sliced without peeling.

The main aim of peeling is to remove all the peel, with minimum removal of the flesh. Damaged or bruised parts of the fruit should be removed at this point.

Clean, sharp stainless steel knives must be used for peeling and slicing, although Tomatoes do not need peeling, but should be handled very carefully.

Peelings should be put in buckets and disposed of as soon as possible since they attract flies and other insects. They can be used for animal feed, as a mulch in fields or stored for compost and garden use.



Slices should be not more than approx .5 cm thick and preferably less for very wet food. Some foods like apple can be treated with a citric acid (or lemon juice) solution in water before drying to avoid the browning of the product.

Weigh the prepared food before drying so that after drying it can be weighed again to determine the amount of moisture removed.

Whole fruits like grapes and berries require brief blanching (dipping in boiling water) to break their skin and allow drying.

All the above preparation should be done early in the morning to allow immediate drying to begin when the sun shines on the solar air collector.

Key points on peeling operations

- Clean preparation area before handling fruit
- Wash hands with clean water and soap
- Remove damaged portions during peeling
- Dispose of peelings and debris promptly to a separate area.

3. Loading the Dryer

Loading the trays

The trays should be loaded almost fully with food, but there should be spaces between the slices to allow air flow for drying. At least about 10% of the space on the rack should be open between slices. The trays should be brushed clean to remove any old fruit pieces. They should start to be loaded as the fruit is being sliced rather than waiting until all the fruit has been sliced or cut. This reduces the problem of the pieces sticking together in the bowls and will allow the drying process to start as soon as possible.



Key points on loading the trays

- Clean trays before loading
- Always have clean hands for handling food
- Load each tray as sliced food is produced
- Place slices close together on the trays but leave air spaces between
- Place loaded trays directly into the dryer.
- It is important to keep away flies and insects and to load the trays promptly.

Loading of the trays in the dryer should take place in the morning when it is clear that the sun is warming the solar air collector. The fans should be turned on immediately before loading to allow the cabinet to begin heating up.

Once all the trays are loaded into the dryer cabinet, allow the dryer to heat inside and all the food.

4. Operating the Dryer

After the first two or three hours, when heat has been allowed to build in the cabinet and food, check the moisture of the produce by hand. If there is a noticeable difference between the trays on the left side of the dryer and the right side, exchange the trays from one side to the other. The center trays can remain where they are.

Rotate the trays once again three hours later, if there is a difference in moisture, to ensure equal drying throughout each cabinet compartment. Trays can also be rotated horizontally if some product is drying more quickly at one end of the tray.



Temperature ranges of 40 – 70 C will effectively kill bacteria and inactivate enzymes, although temperatures of approximately 45 degrees are recommended for solar dryers. This temperature is easily achievable in the SolarFlex dryer as it will normally deliver temperatures of about 25-30 degrees higher than the outside temperature.

For fruits and vegetables that require a second day of drying, simply leave the product in the dryer. Allow the fans to continue running for some time after the sun has stopped heating the dryer, to allow for additional circulation before stopping. Start the drying process as soon as possible again the next day.

Testing for Dryness

You can determine when the product is dry by feel or by calculation of the amount of water remaining in the product.

By Feel

Fruits should be dried until leathery, but not hard. The time required for drying will range considerably. Fruit always feels softer and less dry when warm in the dryer, therefore remove a piece from the dryer and let cool before testing. The sample will show no moisture when cut and pressed. When a few pieces are squeezed together they fall apart when the pressure is released. They have a leathery or suede-like feel. High sugar fruits, like figs and cherries, will feel slightly sticky.

Vegetables are generally brittle or tough when they are dry enough. If there is a question as to whether vegetables are dry enough, dry the product a little longer. There is no danger of damage being done by this extra drying time.

By Calculation

If the contents of an individual tray are weighed before drying, then the same tray contents can be weighed again after drying.

If fruit is dried to an 80% solids level (only 20% or less moisture remaining), it will be safe from microbial spoilage with the exception of mould growth. To completely control mould growth (for long storage), the food product must be vacuum packed.

Key points on drying operations

- Check the slices are dry before removing trays
- Never leave loading doors open at night
- Prevent insects entering the chamber.

If the slices are not properly dried, drying should be allowed to continue for one to two hours and then checked again. The final moisture content of the dried fruit should be approximately 10% on a wet basis.

5. Unloading the dryer

When the fruit is considered to be dry, the dryer should be unloaded as soon as possible. This must not be carried out in the early morning since overnight dew and high humidity may cause condensation of moisture onto the fruit.



Trays should be removed from the dryer and taken into a clean and dry covered area for removal of the dried fruit. Operators must have clean hands and, ideally, wear clean gloves when handling the fruit. Over-dried (crisp), and discoloured slices need to be separated from the remainder. Under-dried slices should also be removed and, if space permits, replaced in the drier.

6. Packing and Storage

Allow food to cool completely before packing and storing.



Packing should be carried out immediately after unloading the trays since the dried slices will re-absorb moisture and be susceptible to attack by insects and other pests.

Store food in air-tight jars or plastic containers or bags, and do not expose dried food to air, light or moisture. Dried products will keep for a year if sealed in moisture-proof containers and stored in a cool, dark, dry place. Heat and light have an adverse effect on the quality of dried foods. Dried foods must be protected from moisture absorption and from insect infestation. Glass jars, tin cans with tight-fitting lids and plastic containers are all satisfactory containers for storing dried foods. Containers should be filled as full as possible without crushing.

For extra protection against damage, if using plastic bags, it is recommended to 'double-bag' the fruit inside a second bag. If vacuum packing is available, it is best for long storage and commercial sales.

Each bag or container should be clearly marked with the date when it is packed and the name of the producer.

Most fruits taste great dried and eaten just as they are. Vegetables are best reconstituted by covering with cold water until they are near original size. They can be added in their dry form to soups/stews. Vegetables can also be ground into powders and used for instant soups or flavoring.