Farm-Scale Food Dehydration

The author and her husband built and tested an electric dryer (above) and a solar dryer on their farm, Jug Bay Market Garden.

by Tanya Tolchin

This past season, my husband and I built and tested two farm-scale food dehydrators to help reduce waste and increase profit on our small family vegetable farm. We produced kale chips, sundried tomatoes and other products using a passive solar dryer and an electric cabinet dryer that we built for just $600 in materials. Along the way, we faced some challenges, but we are hopeful that we will have some new products ready for market this year. We think that the new products will be a valuable addition to our farm business and that other farms can benefit from building similar dryers.

My husband and I run Jug Bay Market Garden in Maryland, a small farm about 20 miles outside Washington, D.C., where we grow vegetables, herbs, and cut flowers. We now market primarily through a CSA that we deliver to the Capitol Hill neighborhood of Washington, D.C., and to a few restaurants. We began farming shortly before the explosion of interest in local foods, farmers' markets and organics, but we still struggle each year to earn a substantial profit. The interest in local foods is both a blessing and a curse for small farmers. We are now facing ever-increasing competition as corporations of all kinds capitalize on the interest in local food and elbow out small growers. Many companies now compete directly with small CSAs by offering "locally sourced" produce from far flung farms and delivering directly to people's doorsteps.

One of the challenges we face on our farm is that we often produce more produce and flowers than we can market during the peak season. Since we do not have the time to add additional deliveries and markets to our schedule, some of our fresh product goes to waste each year. Also, since the marketplace is changing so quickly, we need to keep adjusting our marketing plan to keep pace. We are hopeful that dehydrating some of our fresh produce and creating new products such as kale chips, dried tomatoes, dried herbs and dried flowers will help our farm be more profitable and resilient in the changing marketplace.

Farmers in the Chesapeake Bay region have trouble drying herbs and other products outside due to high humidity and the resulting mold. Most large commercial-scale food dehydrators are cost prohibitive for small farmers. Commercial dryers begin at $20,000 with

The electric dryer houses 18 trays in two stacked columns.

high operating energy costs. While these dryers are attractive and might be viable for a farm cooperative to buy and operate, they are not the right scale for small family farms. On the other hand, most of the smaller models are designed for homeowners and hunters and are too small to dry the larger quantities produced on a family farm.

THE PLANS & BUILDING

In early 2013, we received a Farmer Grant from USDA's Sustainable Agriculture Research and Education program (SARE) to build and test the two commercial-scale dryers on our farm (*www.nesare.org/grants/get-a-grant/farmer-grant*).

The first model is a passive solar dryer designed by UC Davis Professors James Thompson and Michael Reid that utilizes the chimney effect to dry products with increased air flow. They have helped farmers build and test similar models in California, Thailand and Honduras. They were able to achieve excellent results with this incredibly low-cost and low-tech model for drying products like tomatoes and mangoes. Thompson is optimistic the dryer design offers promising new low-tech solutions for farmers. According to Thompson, "The UC Davis Chimney Dryer is a significant improvement in solar drying technology. It heats the drying air like all solar dryers, but it also moves the air past the product at high speed. A chimney provides the air movement and the drying chamber design squeezes air through a small area so it flows five times faster than a typical cabinet drier. A test with sliced tomatoes proved the chimney dryer dried fruit in half the time compared with a cabinet dryer. The fast drying and simple design give it a significant cost advantage over competing designs."

Since we have such high humidity in our area, we also built and tested a more conventional electric cabinet-style food dehydrator. There are many options for electric dryers available with plans online for small scale farmers and gardeners. We chose to follow a design that also came out of UC Davis (see resources). We decided to use stainless steel trays instead of plastic for better food safety and to modify the dimensions so we could use the same trays interchangeably between the two dryers. This worked out well because most of the time we used one dryer or the other and did not need two sets. The stainless steel trays we purchased are produced to fry donuts. They are 24 square inches and have a wire mesh for air circulation.

TESTING

Beginning in late July we began testing both dryers using greens, tomatoes, flowers, sweet potatoes, eggplant, hot peppers, basil and other herbs. Overall, we found both dryers to be a great asset to our farm and each has particular strengths and weaknesses depending on the crop we are drying, weather and other factors. We packed our products using a vacuum sealer in plastic and glass and held tastings to get feedback on six of our dried products: two kale chip recipes, dried tomatoes, basil, spearmint and sweet potato chips. We received useful feedback and are now poised to make adjustments and continue testing this year. Since we are not yet certified to sell the dried food products, we did some experimental marketing of decorative dried products this season. The dried grass and flower market is volatile, but there is potential for small farmers to add them to their operations with little additional labor.

SOLAR DRYER

The solar dryer is very simple and can be built for less than $100. Most farms will have the materials on hand with the exception of the drying trays. The plans include making a 100-foot x 2-foot soil berm that is covered in plastic. We used our raised bed maker and adjusted the berm by hand. The chimney is a 2-square-foot x 6-foot tall wood frame that is also covered in plastic with openings at the top and bottom. The drying trays are laid on some wood framing that is placed on the plastic covered berm and covered with a second layer of plastic sheeting.

The solar dryer performed very well during our first tests in June and July. We were able to dry greens and herbs within hours and pull them out before nightfall. The color remained vibrant and the materials appeared fully dried and crumbly to the touch. The solar dryer excelled at drying herbs and flowers with an initial low moisture content. The basil, rosemary and spearmint all dried within hours and had similar color to the herbs dried in the electric dryer. Another advantage to the solar dryer is the elbow room and variable headspace. The plastic cover could be raised and lowered and larger items could span more than one tray. In this way we were not limited by tray size and could pile on some awkward, large items like 3-foot stems of larkspur or branching basil.

Later in the season we ran into several challenges with this dryer, especially when trying to dry tomatoes. The tomatoes required more than one full day in the dryer and if left overnight would attract insects. When the dryer is hot insects seem to stay out but as it cools at night they will be drawn to the product. Unloading and reloading is labor intensive so it seems ideal to dry products in the solar dryer that take one day or less like the herbs and flowers.

A second problem with this dryer is that the area did not drain well after heavy rains. Since we dug around the area to create a raised bed area for drying, the rain pooled near the dryer and took several days to dry after a hard rain. We plan to modify this dryer by building a platform to dry the product on. This should reduce moisture since it will be off the ground and reduce pest pressure as well.

Growers may consider offering value-added products such as dried floral arrangements.

ELECTRIC DRYER

The electric dryer we built was based on a graduate student's design from University of California at Davis (see resources). It is a cabinet which can accommodate 18 trays in two stacked columns. The dryer has a small electric heater, fan, thermostat and vents. We hired a carpenter to build this model with supplies that cost about $500 but many farmers could build similar models on their own or by converting a small shed or outbuilding.

The electric dryer did very well for us, with just a few hitches along the way. Everything we put in the electric dryer dried very nicely within 24-48 hours, and we could leave it running consecutively. The dryer is very clean and pest-free. On the downside, we were limited to the tray size which meant a little more preparation for loading the dryer efficiently was needed. It did require checking, especially when the greenhouse it was sited in was already hot, to make sure it wasn't getting too hot. We want to modify the electric dryer by replacing the fan and possibly installing a device to help the vent open automatically as needed.

TASTING & UPCOMING PLANS

We plan to get our farm certified to sell value-added products. In the meantime, we sold dried flowers to a large regional green craft fair and sold arrangements at the farmers' market. At the tastings with chefs and customers, the tomatoes, kale and basil all received great reviews, and we hope to have these products market ready this year. Some of the dried flowers like the cornflower also have potential for sale as decorative food items. We are working to refine our packaging and design a label. We would like to try shifting to mason jars and also

selling "fresh" dried kale chips in paper bags for immediate consumption at the farmers' market.

We have shown our dryers to neighbors and friends in the farming community and allowed other farmers and gardeners to dry some of their excess harvest in our dryer. We hope to continue to share this resource as a community dryer so others can benefit and learn from the process. There is great potential for other farmers to build similar low-tech and low-cost dehydrators for a range of products such as dried vegetables, medicinal and culinary herbs and decorative items. These value-added products can help farmers respond to the changing market place and reduce some of the time pressure to sell fresh produce during the months of a particular season. If you are interested in building one of these dryers, feel free to contact me with questions.

Resources:

SARE: *www.sare.org*

James Thompson and Michael Reid's UC Davis solar chimney dryer: *hortcrsp.ucdavis.edu/2013/other/Reid%20Innovative%20Energy%20Solutions.pdf*

Cabinet dryer based was based on this design by Allen Dong:
ltras.ucdavis.edu/files/Farm-scale%20food%20dehydrator.pdf

ATTRA has a good summary publication on food dehydration options that lays out some of the challenges for commercial operations:
www.clemson.edu/sustainableag/IP147_food_dehydration.pdf

For more information about Jug Bay Market Garden call 301-237-7538 or visit *mysite.verizon.net/vzetp5so/jugbaymarketgarden*.