The Dehydration Handbook

Establishing a Value-added Manufacturing Program & Lessons Learned from the 2023 Dehydration Pilot

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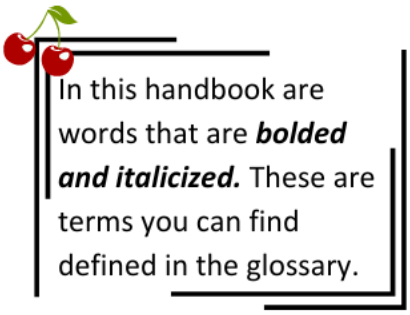
Contents

Section 1 – Introduction

Incorporating ***value-added food*** manufacturing into a food or agriculture enterprise is an exciting and challenging process that might leave you with many questions about where to start. Dehydration is one of the most straightforward methods to preserve food and as such, many produce growers, small businesses, and nonprofit organizations, for example, are interested in raw produce dehydration as an entry-level avenue. However, there are many things to consider before embarking on this endeavor.



This handbook provides information and considerations for entities exploring ***processing*** raw fruits into a final dehydrated produce at a commercial scale to be sold in the State of Colorado. The information is based on a fruit dehydration pilot study between Colorado State University, Delta County, local fruit growers, and Food Bank of the Rockies in 2023. Section 1 of the handbook touches on where to start for understanding state requirements and regulations for food processing, and then takes a deep dive into operational and logistical considerations for the processes on the ground (Sections 2 and 3). In the final section, Section 4, we provide an in-depth summary of labor by taking you through the timeline of tasks required for the whole process. Throughout the handbook, you will find tangible examples and lessons learned from the pilot study as well as helpful resources in the Appendices at the end.

Important note to the reader: If you do not want to process the product yourself, this manual is not intended for you. If you wish to just sell a product that was manufactured in a licensed facility, please refer to the Colorado Department of Public Health and Environment to learn about your regulatory requirements as the seller of the product.

1.1 Study background

In 2022, Delta County and Colorado State University (CSU) were awarded an Economic Development Administration (EDA) Grant to explore, in part, how Delta, Mesa and Montrose counties might develop value-added manufacturing capacity to allow fruit and vegetable growers to derive value from produce that is less-than-perfect for sale. Fruit and vegetable dehydration was identified as a value-added process to further explore, especially as it related to potential capital investments in facilities and availability of labor.

Based on the strong hunger relief partnerships built by the Western Colorado Research Center Community Food Systems Program, an opportunity was identified between CSU and the Western Slope Branch of the Food Bank of the Rockies (FBR), which is the only food bank in the national Feeding America network to have a dehydration program. The objective of the collaborative project was to assess the feasibility of FBR offering fee-based ***dehydration services*** to local fruit growers who would then sell the final product directly to their customers (e.g., through a farmers' market or farm stand). We explored whether the model was *logistically* feasible, and collected data on labor, supplies, materials, information about the labor, logistical

requirements, input costs, and quality of output for the pilot program from February 2023 through January 2024. Different quantities of apricots, cherries, peaches, apples and pears were processed from the four fruit operations participating in the study, Talbott Farms (Mesa Co.), Rancho Durazno (Mesa Co.), Honey Rock Landing (Delta Co.), and Topp Fruits (Delta Co.). A fifth grower, Ela Family Farms (Delta Co.), provided insights about creating a value-added processing program on-farm for considerations around adding an enterprise to an existing farm operation. Upon completion of the study, FBR and participating growers were given project results and recommendations to help inform decisions about whether FBR would undertake such an enterprise in the future.

1.2 Background about the Food Bank of the Rockies Dehydration Program

In 2022, the Western Slope Branch of the Food Bank of the Rockies moved into a custom-built facility, called the Etkin Family Distribution Center, which includes a 1,539 sq foot commercial-grade kitchen and clean space to subpack food. It was custom-built to accommodate three large commercial air and heat dehydrators (94 sq ft total tray area per 30 tray dehydrator) that vented to the outside. The dehydrators are used to preserve fruits and vegetables for distribution to hunger relief partners with permanent staff and volunteers as labor sources. Dehydrated products are typically made from overripe produce that staff determined cannot be distributed in fresh form but is still safe to eat.

FBR obtained their manufactured food license through Colorado Department of Public Health and Environment (CDPHE) and is therefore legally able to sell its dehydrated products. The sale of these products could allow them to augment and diversify the funding required to run the resource-intensive dehydration program. FBR wanted to test whether integrating a small entrepreneurial enterprise of fee-for-service manufacturing could be done without significant disruption to supplying dehydrated produce for hunger relief.

Section 2 – Starting a dehydration business

Before you begin, you need to consider the answers to some standard questions that guide your enterprise: what product you will produce; what type of production space you will use; how you will sell your product; and how you will be licensed? The visual to the right is a simple way you can write out the answers to these questions. They can be interrelated but try to tease the answers out into their own categories. In the following section you dig deeper into these topics to help you determine your answers. The results from these considerations will help you have a conversation with your regulatory authority who can then help you identify the regulatory requirements under which you will operate. After you determine which regulatory requirements apply to you, you can then make final decisions about the specifics of your operation and labor needs. The information in this section does not replace the conversations or requirements from your regulatory authority, as each product and process can change your licensing requirements.

2.1 What is your final dehydrated product?

You will need to articulate a strong vision of what product you are making, including: what food(s) you are processing; how you are processing the food; and how it will be packaged before sale. These considerations will, in part, determine your licensing requirements. For example, dehydrated meat has different regulatory requirements than dehydrated fruits and vegetables. We recommend you start with a strong vision of your final product and then call your local health department as a first step. They are happy to have a conversation about ideas and offer answers to questions about requirements. In the case of FBR, the final product is dehydrated fruit packaged in sealed bags, returned to the fruit growers for a fee-for-service, and the growers sold the final product directly to the consumers.

2.2 Where and how will you make your dehydrated product?

The space in which you make your dehydrated product may be dictated by what product you are making, who your end customers are, and how you are licensed. Tell your regulatory authority about your production space or what you may have access to. If you need a licensed kitchen, consider looking for licensed kitchens made available to community members for a fee (e.g., licensed kitchens for hourly rent through economic development districts, non-profits, or Extension fairgrounds). In the case of FBR, their production space was an onsite, commercial-grade kitchen.

2.3 How will you sell your products?

Your sales models will affect your licensing requirements. Do you want to sell the product you make directly to consumers? Do you want to sell the product to a retailer who then sells it to

consumers? You need to understand who you are selling to and approximately how much you will be selling before calling your regulatory authority. In the case of FBR, it is a manufactured foods license under Colorado Department of Public Health and Environment (CDPHE) who the growers will pay a fee for the service of manufacturing, receive the product back from, and then sell to the consumer (e.g., farmers market, farm stand).

2.4 How will you be licensed?

Very few new business enterprises know exactly what license fits their business best. For example, you may fall under the cottage food category, or you may have to obtain a manufactured foods license. Make a call to your regulatory authority after considering the basic questions above. The authority will provide good information and get you connected with next steps in obtaining the license or adhering to guidelines.

2.5 A note on “organic”

It is important to note that a facility interested in processes and labeling food as “organic" needs to seek further certification and information to use that verbiage. The United States Department of Agriculture (USDA) requires a specific organic certification to process and label foods as organic. It is not sufficient to simply use organic ingredients, as there are many additional requirements that need to be met to use this verbiage on the labels of your food products. For more information, contact your local health department or explore the page for “Labeling Organic Products” on the USDA.gov website or speak with someone from the Colorado Department of Agriculture (CDA) Markets Division about organic labeling.

Section 3 – Operational Considerations

Once you are clear about the regulatory requirements under which you will operate your business, you can consider the details of the operations to create the final product. One of the most attractive aspects of fruit and vegetable dehydration for ***commercial sales*** is the relatively straight-forward elements to consider when designing your operations.

3.1 Sourcing produce

The focus of this handbook is dehydrating raw, whole produce. Begin by contemplating how you will acquire and store the produce. Are you growing the produce or purchasing it? How will the produce be stored prior to processing and after processing? Is the produce seasonal or can you diversify operations to take advantage of many sources of produce available throughout the year? Will you have enough fresh produce to create enough dehydrated product to sell? Whether it be fresh fruit or vegetables, consider that produce will have lost about 80% of its weight in water once finally dehydrated. Do you have a consistent supply of fresh produce to make your investments pay off? Do you have an appropriately climate-controlled space that is easy to inventory and move product out of once it is processed? The answers to these questions inform operational decisions on equipment investments and labor needs.

You also must consider the quality of the produce you are sourcing. Dehydration is not a kill step and is therefore not appropriate for produce that is rotting or very poor quality. Produce might be acquired from local growers, third-party distributors, or in the case of FBR, produce from grocery rescue or purchased fresh produce that is becoming too ripe to eat fresh. If you are acquiring produce from a local grower, it is a best practice to verify that growers are following Good Agricultural Practices and any other applicable regulations, such as FSMA compliance or licensing, to their operation and ask for clarification on their operations as you see fit. See the general list of helpful questions in the Appendices. In the pilot study, we verbally communicated our quality standards and then included those standards in writing on our “purchase order” form (see Appendices). Whether you are building relationships with growers, grocery stores or small businesses, it is important to know your desired level of quality, quantity, and ***food safety*** standards ahead of the conversation. Being prepared, thoughtful, and knowledgeable will help build a positive relationship with the supplier.

Finally, it is best practice to receive food in its whole form rather than food that has been processed, such as peeled, cut, or pitted outside of your facility. If you do choose to use pre-processed food,

you should ensure the supplier has the appropriate license to process and store the produce before you receive it.

3.2 Production space and infrastructure

When thinking about your production space and your necessary infrastructure, ask the following:

1. Does it meet **regulatory requirements**? A overview of these can typically be found on the state regulator's website.
2. Can it be **sanitized** and maintained according to regulatory requirements?
3. What types of **signage** do you need to post, or **records** do you need to keep regarding kitchen rules, cleaning procedures and protocols, and cleaning or maintenance records?
4. Can it accommodate the **equipment** you will need for sanitization and processing?
5. Can it accommodate the **staff** required for your process?
6. Can it accommodate all the climate-controlled **steps and spatial capacity** needed to store your food, process your product, and store your final product? (e.g., storage for ripening, cold storage, space for processing and packaging at the same time, washing produce and equipment, and stocking and storing final product)

Once you have a production space that meets the requirements of your license, product, and operations, you will want to explore the types of labor and tools you will need to make your product.

3.3 Labor

As someone considering a manual process of dehydrating produce, you know there will be labor involved. The size of your operation and final product will determine the amount of labor you need and their skill levels, and some important bigger-picture points to consider are:

- You need to have a good understanding of *when* your produce source will be available. If you are processing fresh, seasonal produce, your labor needs may fluctuate.
- Dehydrating is a unique process in that there is a labor-intensive part in which food is received, sorted, stored, washed, and then processed for the dehydrators. After that intensity, the actual dehydration can take 12-24 hours, depending on the machines and food products. Timing your labor needs is important to running an efficient operation.
- If you know someone who has a comparable program, it would be helpful to observe the work being done and record labor information over several weeks to identify likely busy times and down times. The Appendices has an example of a labor log used to track time during operations. You can explore this option for evaluating the pace and efficacy of your labor.

Food safety training is essential for your labor. The exact training, such as ServSafe Managers or food handler's training for your staff will depend on how you are licensed. We recommend that one point person takes responsibility for ensuring labor is trained, is up to date with training, and continuously follows safety protocols.

Volunteer labor is an attractive, low-cost option for nonprofit organizations, such as food banks or pantries, to help run a dehydration program. Since poor practices can compromise food safety and quality, we urge you to consider the amount of paid staff time involved in training and supervision when developing a volunteer program and hire the right kitchen manager experienced in personnel supervision. We recommend that the kitchen supervisor is empowered to shift volunteers to another task or end their service if they are not meeting safety standards.

3.4 Equipment choices

3.4.1 Water activity meter

Water activity measures the amount of water that would be available to support microbial growth, such as bacteria or mold, which would spoil your product. Water activity is different than moisture, so it is important to not use a moisture meter. Remember to follow the manufacturer guidelines when using your water activity meter, including frequent calibration. You must measure samples of your product every time you dehydrate to ensure it is safe. According to the Colorado State University Spur Food Innovation Center, the maximum water activity level for dehydrated produce is 0.6. You can go below this level to play with things like texture, and you can also go lower in case the product absorbs moisture from the air, which can be mitigated by appropriately sized desiccant packets and sealed packages. When readings come back above the acceptable level of 0.6, it is best practice to put the entire **batch** back in for further dehydration time. It is important to take multiple readings from multiple levels of the dehydration racks and any other levels of storage containers once product has been dehydrated.

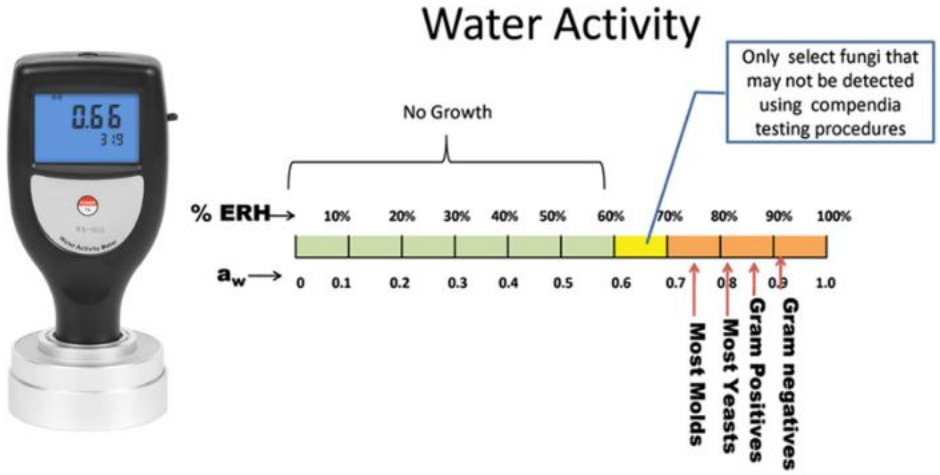
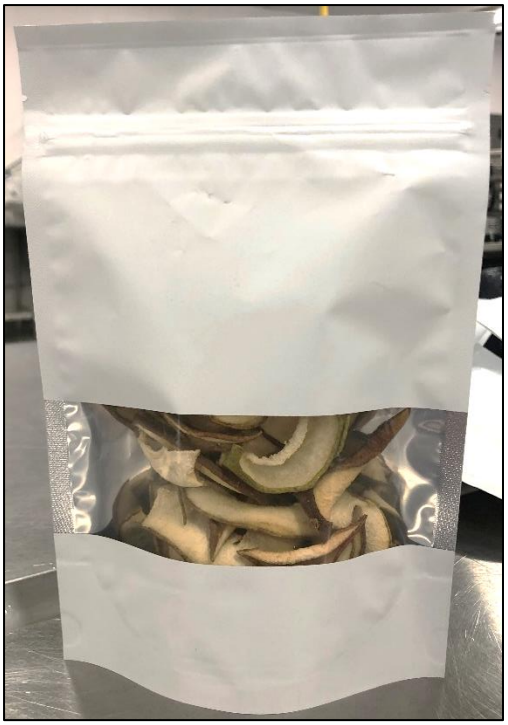


Figure 1. Example of a water activity meter and the associated recommended water activity reference graph for optimal water activity for dehydration standards. In this case, the water activity reading of 0.66 is too high to be considered food safe.

Example from pilot study. *In the pilot study, we utilized a protocol recommended by the CSU Spur Food Innovation Center, which was taking water activity readings at two periods in time during the entire process. The first was done after the dehydration cycle was complete (according to the directions in the manual for that specific dehydrator, taking 3 of the largest, least dry-looking pieces of fruit from a top, middle, and bottom of the dehydration racks and testing each of those (9 samples total) individually and recording each reading. If any of the individual samples came back as 0.6 water activity level or higher, the entire batch would go back in to dehydrate longer based on the best judgement of the dehydration lead. Once that re-run was complete, we would carry out the first step described above again. Once all samples taken were at or below 0.6 water activity level, we would then put the product in large, food grade, airtight, buckets for one week for the residual moisture in the product to "equilibrate" (allowing residual water to even out throughout the product) so that a final test could be taken before putting dehydrated product into its final packaging. A proportionally sized silica packet (desiccant packet) would be placed in each bucket to capture any additional moisture. In the second round of testing, once a week had passed in buckets, product from the top, middle, and bottom of each bucket from the same batch would be tested. We did not ever encounter a bucket with readings greater than 0.6, however, if we did, protocol would likely be to compost that bucket of product given that we could not run such a small amount of product through such a large dehydrator again. Though this is time-consuming, these steps and carrying out a formal* ***shelf-life study*** *were the way we demonstrated our practices post-dehydration for reducing likelihood of microbiological activity.*

3.4.2 Packaging

Your final product will need to be packaged to keep moisture and oxygen out of the product. For the dehydration pilot study, Mylar and Kraft packaging were considered. These are laminate materials made up of various thin layers of materials that generally have good oxygen and moisture barriers, which work well for at least several months.

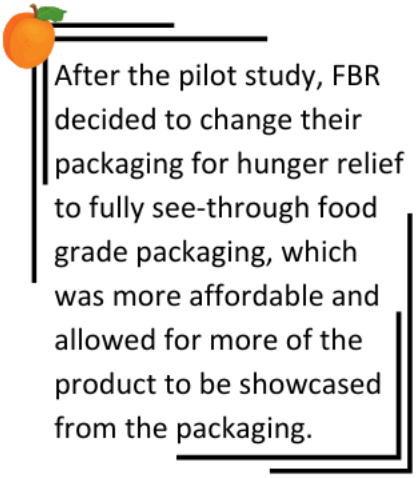


The exact storage life of your product would require a *shelf-life study* (also called a longevity study) for verifying your recommended ***consume by date***. Shelf-life studies can be performed by a laboratory that analyzes food but can also be done by the company manufacturing the product. This is simply done by evaluating a new, unopened package of product on a set schedule (i.e. every 2 months). At a certain point the product will not meet your expectations of high quality and would signal the end of shelf-life. It is best to be conservative with

shelf-life as the end consumer might store your product in extreme environments (i.e. hot car) which would shorten the shelf-life. The end of shelf-life could be from a variety of circumstances like texture is too hard, off-flavors begin to develop (cardboard flavor), product loses flavor, color transformation makes product look unappealing, etc. A self-conducted shelf-life study will take several months to complete. Typical shelf-life of dehydrated fruits can range from 6-24 months and even beyond. A good recommendation is to label a 12-month shelf-life even if the product remains good for much longer as it signifies to the end user to consume within a certain period. A 3rd party laboratory typically has the means to do an accelerated shelf-life test if a real-time self-conducted study is not possible.

To seal out moisture and oxygen and keep the product tamper-proof, either heat- or vacuum-sealing is acceptable. Vacuum sealers remove oxygen from the package. There are even some vacuum sealer models which can replace the ambient oxygen with an inert gas like nitrogen. This is typically recommended for high fat foods (e.g., chips) because it keeps the product from oxidizing and turning rancid. Adding a moisture or oxygen absorbing sachet to the heat-sealed packaging can keep food fresh. Heat sealers tend to be less expensive, are appropriate for dehydrated fruit, and are easy for relatively untrained staff to use; therefore, heat-sealed packaging was used in the FBR pilot study. This is a very detail-oriented and potentially time-consuming step, so do consider your labor available for this aspect of the enterprise.

Also consider the look and feel of the final packaged good. A vacuum sealed product may be attractive to a backpacker, but maybe not to a child looking for a yummy snack at the farmers' market. Packaging that has a window may be more appealing to the potential customer and allows the seller to make sure there are no changes in the product, like fungal growth or discoloration. This is an area where you can get creative with timesaving and/or story-telling opportunities that also make the packaging attractive.



3.4.3 Labels

Packaging also requires labels to identify the manufacturer and the actual product. You need to consider how you will label your product according to regulatory requirements and marketing needs. Please contact your regulatory authority to understand your requirements for labeling your product. It is important to note that regulatory requirements are not static and may change. In the case of FBR, as a holder of a manufactured food license, we consulted its regulatory authority, CDPHE, which had good references for label requirements. At the time of this study, FBR was required to label its final products with specific information, placed in a specific location on the package and printed in a specific font and size, however, also consider how you will deal with information that changes on each packaging, such as "consume by"

dates or lot numbers. In the case of changing information, it was helpful to use a simple sticker printer in-house to be able to make changes on the fly.

The package and label can include sharing the story of your enterprise. For example, we found it would have been beneficial to include a few sentences detailing the story of the collaboration between the food bank and growers for the dehydration project since it helps the consumer connect with the product and the people behind the story. here are companies that provide the option for pre-printed information on the packaging that can be a time saver and visually appealing. However, if you are a small enterprise, we recommend you develop your final design and see physical examples of the final packaging to verify satisfaction of label requirements and visual appeal before investing in a large quantity.

Here is an example of the final labels created for the pilot study based on the manufactured food labeling requirements by CDPHE at the time of manufacturing. Based on the format of the pilot study business model, it was decided that FBR as the manufacturer would provide the required information for **the back label** and the growers would complete the information required on the front label. The back label contained the required information from the manufacturer (ingredients list, manufacturer's name and address) and FBR (the manufacturer) also added information about who the product was "manufactured for," the ***net weight*** in grams (only required on the front of packaging), and the "consume by" date, and "packed on" dates based on their operational infrastructure and for ***traceability***. If you want to include any other information that is not required on the back label by your license, such as "the story behind your product," consult with your regulatory authority about proper placement of the information.

In this pilot, the "consume by" date was determined based on advisement from the CSU SPUR Food Innovation Center, but an official "consume by" date would need to be determined by a formal shelf-life study.

As of regulations at time of the pilot study, the **front label** needed to include an identity statement (e.g., peach, peaches) and a net weight statement (e.g., 2 oz.). For marketing practices, the name of the grower who grew the fruit and sold the product directly to consumers was included on the front; given the exact licensing requirements under FBR, we determined that FBR could add its back label and the fruit grower could add its own label on the front after receiving and before selling. This required communication between FBR (the

manufacturer) and grower (the direct-to-consumer seller) about each entity's labeling requirements. Please consult your own regulatory authority about your situation.

3.4.4 Equipment decision making

You will also need equipment to process the food. Given that there is a spectrum of equipment choices ranging in complexity of operation, price, and output potential that may add labor-saving and product quality improvements, we do not list specific equipment. The Appendices contain a chart listing the equipment used in the FBR pilot, as an example of what could be used in a similar operation.

You will likely need these general types of equipment for processing a dehydrated product:

- Wash basins for cleaning produce
- Food-safe processing tables that can be sanitized according to regulations
- Processing utensils (e.g., paring knives, cutting boards, food prep containers)
- Food-safe, air-tight containers or bags to store dehydrated product

It can be challenging to decide on what equipment you exactly need. Ask yourself a series of questions listed below to try to help your decision-making process.

What is my capacity? Your equipment should match your capacity; otherwise, your equipment is either slowing you down or you have over-invested in equipment that you can never use to its fullest. How much produce that you move through the process depends on many factors: the amount of produce that you can source and store; the amount of labor and time you must process the produce; and how much produce you can dehydrate at one time. For example, if your dehydrator can only handle 30 pounds of fresh fruit, do you really need a high-throughput machine that was designed to pit thousands of pounds of fruit per day?

When determining your ***rate-limiting factor*** that controls your operation, you will need to experiment. Collect the following data for each product you make:

- How much fresh produce can my dehydrator process in one working day?
- How long does it take for my food dehydrator to dehydrate each product to a food safe standard?
- Will I have enough fresh produce available (accounting for parts of produce that will not be put into the dehydrator (e.g., pits, stems) to fill a dehydrator in one day with the labor I have available?
- How long does it take for my labor to fill water a dehydrator in one day?

What do I need for the products I am making? Some equipment is vital for certain types of food products. For example, making fruit leather will require a blender, food processor, or food mill. Do you want to pre-cook vegetables to make them soft or preserve the color? Silicon liners for your dehydration tray may save you time if you are dehydrating sugary foods that will stick. If

you are investing in specialty equipment for one type of fresh food, how often will you be processing that food? If the types of produce you dehydrate vary widely, purchase items that can be used in multiple ways until you are sure you need a specialty item (e.g., apple corer, mechanical cherry pitter).

These decisions require a lot of testing and research before you purchase big items. Before you purchase expensive equipment, try to speak with other kitchens about what they use and have tried. If possible, go see the equipment in action to judge whether it is a good fit for your operation.

During the pilot, we never found a mechanized fruit pitter that was 100% accurate and faster than manual pitting when considering time to prep, calibrate, troubleshoot, and wash equipment and the costs of replacing broken parts.

How skilled is my labor? You will need to determine what processes your labor can do efficiently and safely. You need to know how durable the equipment is, especially if it is used by relatively untrained staff. Given that the bulk of work was carried out by volunteers in the FBR kitchen, it was quickly determined that specialty equipment that quickly processes large amounts of food, such as specialty slicers, was not the safest plan without more consistent people in the kitchen. When used improperly, the equipment broke or *could have* resulted in injury. In addition, the time saved in using this equipment was lost by the time it took FBR staff to train and supervise its use. Moreover, efficiency was reduced when equipment that often broke was continuously out of commission while work still had to be done. Ordinary kitchen tools are easy to teach people how to use, generally simple to clean and sanitize, affordable to replace, and match the capacity of a small-scale kitchen with few staff. For a list of equipment that we used at FBR for processing, slicing, and dehydrating fruit, please see the chart in the Appendices.

Is the equipment easy to use after many repetitions? You will need to assess the "ergonomic" effect of the tool on the users of the tool. A good ergonomic situation will adapt workstations, tools, equipment, and ways of doing things to be compatible with human anatomy and physiology to prevent injuries. The U.S. Department of Labor, Occupational Safety and Health Administration (OSHA) summarizes this idea as "fit the job to the person" instead of the "person to the job" (https://www.osha.gov/ergonomics).

Does the equipment save *useful* time? Before purchasing equipment, consider if it will save you time or make your processes simpler. Is this benefit worth the cost of the equipment? If the equipment saves you time, can you reallocate that time to another task? Does that process align well with your other steps? For example, if you have a high throughput slicer that can slice 100 pounds of peaches very quickly, can you move those peaches on to trays ("traying") and into the dehydrator at a fast enough pace to keep the food safe and prevent unwanted changes like browning? This was an issue we found with bananas (outside of the pilot study) as the bananas

tend to get slimy if sitting too long at room temperature after being sliced. Instead of slicing all the peaches (or bananas) at once, we worked in batches of slicing and traying.

Example from pilot study. *Being in a fruit growing valley, we anticipated that FBR might be asked to process sweet cherries into a dehydrated product. We tested a hand-held manual pitter versus pitting with a paring knife. Although, the plastic manual pitter resulted in whole cherries that made an end-product with a nicer mouthfeel, it often missed the pits. We had to slice the cherries in two halves to ensure the pit was fully removed, negating the whole purpose of the speedier pitter. Additionally, the tool required a great deal of manual force to remove the pit, and the light weight of the pitter made it so the equipment would not remain still. The person pushing the pitter had to hit the pitter so hard, it hurt the operator's hand over time. You might determine that a crop, like cherries, brings such high returns that it is worth it to you to purchase specialty equipment or cope with a difficult process. FBR decided not to dehydrate cherries because of the equipment difficulties we described, and for two other reasons. 1) The cherries shrunk so much during dehydration that the amount of effort did not seem worth the final product and 2) cherry trees in Western Colorado are prone to experiencing spring killing frosts that wipe out that year's harvest.*

What upkeep and cleaning does the equipment require? Can you quickly repair the equipment if it breaks? Do you have staff that can do in-house repairs or are the repairs simple to learn? Is the equipment affordable to repair, either in-house or by contract? Do you have service providers in your area that can repair the equipment in a timely manner? This includes considering the availability of parts that are most likely to break (e.g., blades, springs, handles). Can you easily and affordably purchase "back up" equipment so that your processes do not stop if you have a breakdown? Even with the best consideration, parts will break. Keep track of parts you most frequently replace and consider having some backstock on hand for quick fixes. You can also see if you can source some equipment from local manufacturers or suppliers, who may have parts on hand faster than ordering.

Example from pilot study. *In our case with FBR, a high throughput slicer would not have freed up extra time and would have been counterproductive to the process. This was compounded by the fact that the high throughput slicer was often out of commission because it was very sensitive to use and often broke when trained staff thought they were using it correctly. This caused a delay in processing flow and was a danger to staff using the equipment and a potential risk for metal contamination in the final product.*

All equipment must be cleaned and sanitized. You need to consider the ease of cleaning, how to clean it, and who will be doing that cleaning. For example, extra-large cutting boards are great when you are cutting fruit, but you may not be able to properly clean them in your sink if the sink basin does not accommodate a very large cutting board. Some equipment has tight spaces that contain hard to reach blades or points where juice or produce collects over time. For example, specialty slicers, like those used in a professional deli, can be difficult to take apart for cleaning. The time gained in making fast, even slices of a product might be lost when you need

to clean it. The more challenging it is to wash your equipment means a higher likelihood of having unsanitary equipment, so you must factor this additional time and training into your operation if you are going to use specialty equipment or tools.

Section 4 – Personnel Tasks and Roles

This section outlines the big picture activities that your personnel will manage and implement in processing a dehydrated product. Note we are only describing this from an operational standpoint and not including general duties needed to run a business.

4.1 Managing logistics and client relationships

Communication and relationship building will drive the way logistics flow in tandem with the movement of produce throughout the operation. This human-centered activity will drive the culture of your operation, essential food safety and quality standards, and the optimal use of the tools and resources you have grown for your operation. This directly translates directly to the quality of a client's experience and the quality of the product.

4.2 Ensuring food safety and quality

Ensuring food safety begins with having personnel who are familiar with regulatory requirements and oversee all processes for compliance. These duties can involve management of the facilities all the way to monitoring day-to-day activities that start when you receive the produce and end when the product is delivered.

When receiving produce your first step is carry-out a "triage" process where you inspect, sort, and weigh it based on different categories:

- must be processed right away;
- can be stored;
- requires further ripening; or
- must be composted or turned away.

We recommend you do this triage and document the results right when the food is received. This allows you to manage your workflow, decrease the amount of wasted product, and improve your quality control. If you are manufacturing products for a third party, as in a fee-for-service arrangement, you will want to be able to tell your client how much food you were able to process *and* why you could not process some of it if that is the case. This is a time-consuming

step that is often overlooked. Give some thought in advance to how and who will play this role. See the Appendices for an example of the product intake form (called the Purchase Order form in the pilot).

When receiving food, always inspect for signs of deterioration, contamination, and quality. Contamination may be physical contaminations (e.g., insects, glass shards, metal pieces), microbial (e.g., molds, yeasts, bacteria, or viruses), or chemical (e.g., cleaning products, pest control products, etc.). Your staff's ability to be knowledgeable about food safety, Good Agricultural Practices, and licensing requirements should be taken into consideration when making these decisions. If you have a question about whether you should process received produce, contact your regulatory authority.

Example from pilot study: *We unexpectedly received a batch of unripe fruit that had to ripen for nearly a week and a half. Because of this delay in processing, we ended up not being able to process a certain percent of the product due to scheduling for other processing in the kitchen. We relied on communication in advance of the delivery and during processing and sound documentation to ensure the client was not surprised and preserved our working relationship with the client.* Quality control is important with your final product.

When you are packaging the final product, taste test to "spot check" and make sure it is up to expected quality. Be very clear about what sizes and shapes of the product can go into final packaging, for example, small, less palatable textured pieces can be left out of packaging for snack products. These final packaging standards should be indicated on your recipe where the size and shape of the cut product is described. Lastly, take care to have a system of multiple quality control checks for final approval including looking for accuracy of information on stickers/labeling and visual appeal of final packaging before being packed into bulk transport like cardboard boxes.

4.3 Record keeping

Record keeping is universal. Clear and consistent record keeping is a best practice and may be required under your license, improve the efficiency of your operation, improve the quality of your product, and ensure the safety of your process. Good records help you answer questions like are you moving product fast enough? Are you using your equipment as efficiently as possible? Where there are areas of improvement? In summary, by having accurate records, you can trace back to what part in the process there might have been a problem. With this documentation, you can also find opportunities to improve quality.

4.3.1 Traceability

The main purpose of traceability records is to enable you to recall a specific product from your customers if there is a problem. Traceability records must be able to tell the entire "story" of the product, so you must document where your fresh food came from, all the steps taken to create that product (i.e. the recipe), the people involved in processing the product, and where and who final product was returned to. Important information to maintain copies of information on will include identifying information placed on your final product, such as a packaged date or lot number to be able to trace back the final product to your records. Consult your regulatory authority to learn your traceability requirements.

4.3.2 Recipes

These are protocols involved in making a single product, such as dehydrated sliced peaches. You will first need to have an idea of what kind of product your consumer will want. Are you making fruit leather that might appeal to kids? Are you dehydrated sliced peaches with the skin on to appeal to adults? Do some experimenting and then taste testing and market research with your products. This could be as simple as offering three different formats (thin slices, thick slices and wedges) to people at a farmers' market as asking their opinion on which they prefer. There are also a variety of web-based resources that can get you started on developing a recipe. For example, the CSU Spur Food Innovation Center can help with product development questions (Food.innovation@colostate.edu). They can give you a starting point for considering options like food preparation (peeled vs. unpeeled, blanching), slicing thickness, or optional additives such as lemon juice, citric acid, sugar or spices.

Example from pilot study: *As a part of the pilot study, we were able to do some official food sensory testing of FBR products with a random sample of consumers through the CSU Spur campus Food Innovation Center. The results of these consumer feedback surveys included information about for overall preferences for appearance, flavor, texture using a 9-point scale, and sweetness, sourness, crispness, and chewiness was evaluated using a "Just-about-right" (JAR) sensory scale. JAR scores were compared to overall liking scores for matching descriptive attributes. Consumers also provided open comment responses to what they liked/disliked, likeliness to consume each product, and willingness to pay for each product. Businesses can pay companies to solicit consumer feedback information, or they can collect some of their own.*

Once you have an idea of your product, document your experimental recipes so you know what worked and what did not. The recipes outline every step of the process and include details such as: the optimal ripeness of the peaches; how many pounds could be processed in a day to fill one dehydrator; how to wash; how to pit and slice; what extra ingredients are added and how; how to place on a tray (density and spacing); how long and what temperature to dehydrate; directions about how and when to measure water activity; how long to store after dehydrating; packaging norms; and how many labor hours the whole process should require. Once these recipes are developed you should not deviate. Sticking to your recipe is important for traceability reasons and to ensure your product is properly labeled per your regulations.

4.3.3 Time per batch

For each recipe developed, it is helpful to determine how many pounds of fruit could be dehydrated in one consistent run of one food dehydrator (a ***batch***). From there, you can collect information on the topics below to create work plans that detail the amount of time required to make one batch. This list is based on the specific steps we recorded time in labor logs for in the pilot study (available in the Appendices):

- Receiving, sorting, documenting, and storing fruit;
- Washing fruit;
- Pitting, coring, halving, slicing, or processing fruit;
- Putting fruit onto trays; and
- Packaging and labeling final product.

In general, the set up and clean up during and after processing may not significantly differ by the product, but it may be impacted by the amount of food processed and how many people are involved. Take an average amount of time for these tasks and build them into the schedule of time it takes per batch. When you understand how long tasks take, you can judge how much food you can accept, when it should be taken from cold storage, how to plan your labor needs, and how to optimally schedule your time around the long downtime around running dehydrators.

Section 5 – Tips for success: what we wish we knew when we started

Make time for record keeping. You will be collecting a lot of information – documenting operational procedures required for your license (e.g., cleaning times and products), operational details to optimize efficiency and traceability data. Collecting, recording, and analyzing your data takes a lot of time. Carve time out in your day to make sure you are keeping good records. Refer to the Appendices for record-keeping documents created during the pilot study that can be a good starting place if you need a visual. Creating new protocols and record-keeping systems can be overwhelming. When you are starting a new program, consider taking steps to make it easier to recall information when you make time to sit and update records. For example, if you are organizing all cleaning and sanitization products, snap a photo of the group of products so you can refer to it later when you're at the computer.

Composting and Food Waste. Even if your fresh food was perfect to begin with, you will have food waste from pits, cores, peels, rinds, stems, and small bruises. We recommend you weigh and report the food waste to be transparent with the food supplier on what could be processed and what was wasted (and why-this can be a good opportunity to motivate standards around quality). You will need to have a plan for disposing or composting these food scraps.

Know your customers. We have already mentioned how important it is to understand what the end consumer wants to buy. It takes communication with your client, maybe some market research, and perhaps some taste testing of your experimental products. Appearance and mouth feel (e.g., the tenderness or chewiness of product) are important indicators that influence whether a customer buys and then continues to buy a product.

Don't underestimate cleaning and sanitization. Of course, cleaning and sanitization is a non-negotiable priority in any kitchen. Do not underestimate the amount of time cleaning and sanitization takes and how exhausting that step can be at the end of a long processing day. You will have cleaning and sanitizing that needs to be done daily and other tasks that can happen more periodically. Consider how you will build large tasks on a periodic and consistent basis like cleaning dehydrators, sink drains, or vents. You will want to develop a cleaning schedule with both daily, monthly, and quarterly tasks to ensure compliance. We have provided an example schedule from the pilot study in the Appendices. You might consider services that can take some of this burden from you (e.g., laundry service for aprons and cleaning towels). Our final tip on cleaning is that some items for dehydration are challenging to clean. Silicon sheets that prevent food from sticking to trays are easy to clean but very hard to dry unless there is a drying rack system (and a space for that system to fit). Prepare for those challenges.

Section 6 – FBR case study

This section reflects the operational activities provided above, now in context with the specific labor involved with the pilot fee-for-service dehydration program at FBR. This is intended to help you visualize the timeline, tasks, and labor involved in the study (herein referred to generally as FBR). As you read this, keep in mind:

- FBR had one paid full time kitchen manager who worked closely with an operations supervisor for big picture planning and logistics.
- At least one CSU employee was present for pilot data collection, but often filled a support role to the kitchen manager for daily pilot processing operations.
- FBR volunteers were in the kitchen about 1-2 days mid-week (Tuesday-Thursday) per week, and there typically were at least 1-2 volunteers available to help for about 3 hours minimum per day. There was one consistent volunteer who would often do a 6-hour shift per week during the height of the season (July, August).

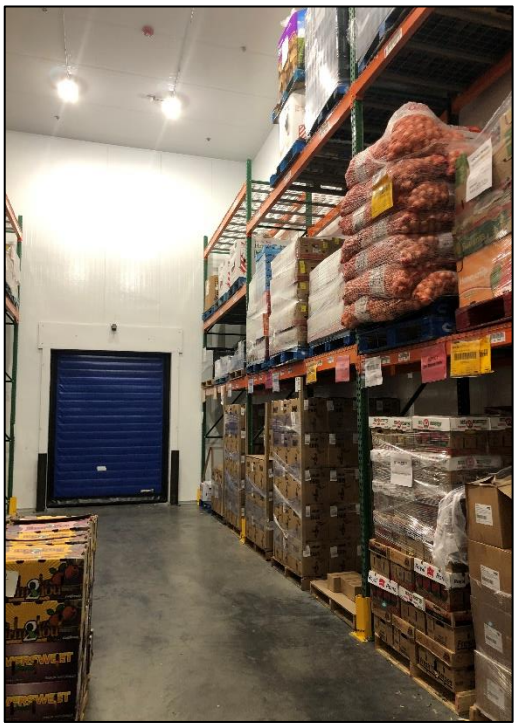
6.1 Food sourcing and grower communication

This task required FBR staff to interface with each grower to discuss the types of produce that can be dehydrated, the type of final product that will be made (e.g., dehydrated slices), the condition the produce must be in upon delivery, and coordinate delivery or pick up of the fresh produce and finished product. In late April/early May, participating growers were contacted to cover these details and to identify an anticipated week to schedule time when growers would get a certain crop dehydrated. In this case, the pilot aimed for accepting up to 300 pounds per week from one grower, which turned out to be a good maximum given the labor capacity and availability of one to two 30-rack commercial dehydrators per week. A semi-final delivery schedule was created at this time, and they were contacted one more time in late May (when growers begin to have a sense about their expected crop) to confirm final delivery dates and quantities. This required staff to be knowledgeable about the whole process and have time to interact with the growers.

Generally speaking, the staff person leading these communications may be required to manage the financial arrangement between the organization and the grower. We recommend this position be filled by a paid staff member who is in a supervisory or managerial role.

6.2 Receiving and storing food

The FBR kitchen manager did the following: assessed food for quality and safety; labeled containers with grower's name, the content and date of receipt; decided on appropriate storage; and communicated with kitchen manager regarding food receipt.



This staff role was easy to overlook, with the tendency to default to whomever was available to receive the food. However, given the responsibilities required, we recommend this role be filled by a paid staff member who is in a supervisory or managerial role and knowledgeable about produce safety standards, the organization's policies regarding food quality, and dehydration operations and current workload. We recommend that this role be led by the kitchen manager because sorting and scheduling decisions can be made at the time of receipt, which we recommended above as best practice.

6.3 Produce cleaning

We washed produce to ensure that it is free from contaminants and discarded any fruit that was too ripe or overly damaged. Produce that could not be properly cleaned because it is too damaged or pre-processed (i.e. pre-pitted) was not accepted. Washed produce was transferred to sanitized containers and moved to a processing area for immediate processing. If washed produced needed to be stored, it was dried completely and then placed into sanitized and labeled containers in cold storage. It is best practice to air dry produce before storage to prevent growth of microorganisms. This role can be filled by a trained staff member or skilled volunteer and should be overseen by the kitchen manager.

6.4 Produce preparation and loading onto trays

Produce should be prepared according to the "recipe" that has been tested and developed for the particular end product, so in the FBR program the kitchen manager would manage standards including maintenance of uniform thickness of slices and culling pieces that did not meet standards like having too much skin or being too small, resulting in a less palatable product. In the FBR program, products were typically sliced. Fruit was not peeled prior to slicing. Uniform thickness was critical to dehydration and dictated the length of dehydration and quality of product.

FBR found it most efficient to have one team process the produce while another team trayed. Not only was the product more consistent, but since the steps paced each other, it minimized the amount of time when produce sat after cutting. Sliced produce, especially fruit like peaches,

lose their firmness and begin to brown after cutting. Slicing all the fruit in advance and then putting produce on trays lead to poor quality and food safety risks. Even worse, if you run out of time to tray the sliced produce, you might have to throw the produce away because not all cut produce will keep its quality if it is refrigerated and stored overnight.

These roles can be filled by trained staff, which includes volunteers, and overseen for safety and compliance by the kitchen manager.

6.5 Quality check

It is important to ensure your product tastes good and is safe. FBR staff monitored the dehydrators to ensure optimal drying and operations. Post-dehydration quality check was performed after the product cooled to room temperature to assess the texture, color, and quality. As the product was transferred into a sterilized holding container with a sealable lid, any substandard pieces were removed.

Quality checks should be performed by the kitchen manager to ensure quality and ensure the proper records are being kept.

6.6 Packaging

FBR used packages that have a transparent panel, could be reclosed by Ziplock, and heat sealed. FBR added a silica packet to each package to preserve quality. This packet was not a substitute for ensuring proper water activity levels, as it will not prevent mold growth if the water activity levels are too high. Product was packaged to a specified net weight as agreed upon with the growers. The product was packaged manually, by zeroing out a sanitized, table-top scale with the bag and silica packet. The product to the final net weight.

The task was done by volunteers with supervision and training from the kitchen manager. The kitchen manager supervising the product and should occasionally assess quality control for weight added.

6.7 Labeling

FBR processed the fruit into dehydrated products that they packaged and labeled with their manufacturing label. The grower applied their front label and sold the product directly to the consumer in accordance with their own licensing requirements. FBR labeled their product immediately after packaging so that traceability was ensured. FBR used a portable label maker to custom create a label for each manufactured product. FBR ensured the growers understood their obligation to apply their label to the front of the package and referred growers to proper resources.

The kitchen manager should be responsible for creating the labels and ensuring the label is complete. Staff can apply the labels to the bags.

6.8 Product storage

Dehydrated products were stored at FBR in a controlled environment to protect them from moisture, light and temperature fluctuations. FBR ensured the growers were informed of proper storage conditions for the product, especially given that growers might be selling the product at an outdoor farmers market.

6.9 Volunteer oversight and staff communication

The kitchen manager was the lead for training and supervising volunteers working in the kitchen. The kitchen manager was also the point person responsible for communicating with other FBR staff who might have supported the dehydration program through auxiliary means such as receiving food, recruiting volunteers, supply procurement, and support cleaning. We created a written checklist (see Appendices) to aid in the training before volunteers entered the kitchen and to document who was involved in the processing that day. We also used signage throughout the kitchen to remind volunteers of their responsibilities. Examples of the signs are in the Appendices section of the handbook. No exemptions to this process were made even if volunteers had been trained before.

We recommend this position be led by a managerial level staff person who has responsibility for the kitchen and understanding of all the requirements under the license.

6.10 Record keeping and developing recipes

All the records regarding product traceability (including recipes) and documentation required for licensure were maintained by the kitchen manager. The kitchen manager developed all the recipes through experience, resource consultation, and experimentation. We recommend that the recipes be developed by a staff member with the most experience in a culinary setting and an organized record-keeper.

We recommend that record keeping be the primary responsibility of one paid staff member who has managerial responsibility, understands all aspects of the operation (including licensing standards), and has time in their schedule to maintain records.

6.11 Labor Log Results from the Pilot

Based on our labor log effort (described previously), we were able to capture some preliminary information about the baseline labor required to process apricots, peaches, and apples. This is summarized in Table 1 and Figure 1 to follow. As you consider the information, keep in mind that these numbers are often only based on 1-2 days of observation in the kitchen. More observations would be needed to consider these numbers accurate but given the attention to detail and accuracy during data recording, the numbers can serve as a place to start. Peaches were the fruit we had the most observations for, so if you consider generalizing any numbers from these tables and visual, peaches are supported with the most observations. Also consider that these numbers are based on the 30-rack commercial dehydrator model and equipment we used (see "equipment" Appendix). A nice thing about the labor hours estimates is that they are based on a range of skill sets and experience with fruit processing.

Table 1. Summary of weights and processing rates by fruit

Fruit	***Max. accepted gross wt.*** *(lbs.)*	***Processing Rate-Fresh*** *(lbs./hour)*	***Processing Rate-Dry*** *(lbs./hour)*	***Total labor required*** *(hours)*	***Dry Yield*** *(lbs.)*
Apricot	232	137	5	51	150
Peach	128	139	3	34	80
Apple	107	114	3	39	94

Table note: The maximum accepted ***gross weight*** (column 2) is based on our estimate of how many pounds (gross) could be accepted to then process and fit in the 30-rack commercial dehydrator used in the pilot study (see equipment **Appendix**). This accounts for the expected pounds to be composted, which will vary by quality standards. Fruit processed in the pilot study was mostly "grade 2" type produce (minor bruising, no cuts/juice, easily washed). Secondly, tasks accounted for in the "Total labor required" column are sort (before wash), wash (continuing sorting as necessary), pit or core/cut/compost/tray, fill/seal/label bags. So, this labor totals do not include general kitchen prep and closing tasks.

Figure 1. Visual representation of yield and time for processing tradeoffs by fruit

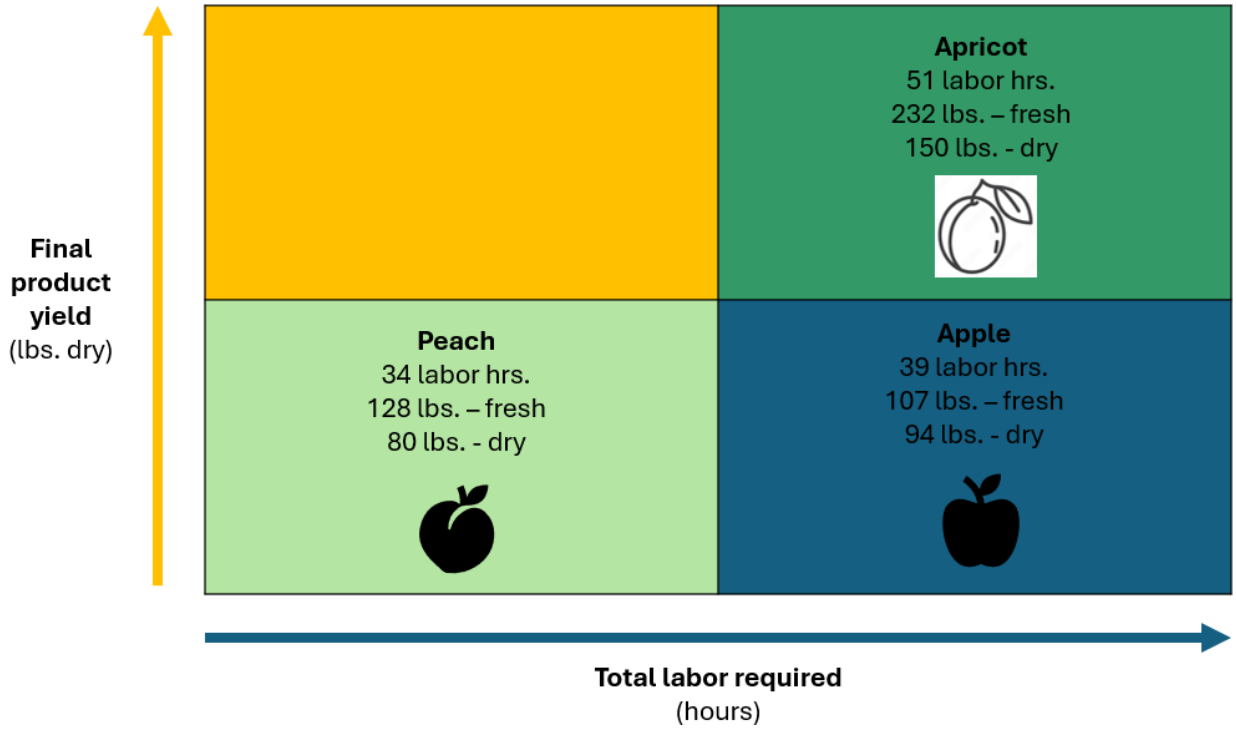


Figure note: Figure 1 compares the yield and processing time tradeoffs by fruit type for apricots, peaches, and apples. The y-axis represents the final dehydrated product yield (dry pounds) and is represented in yellow. The x-axis represents the total labor hours required to process product from start to finish for the labor task times recorded in the study (discussed above). This axis is blue. Overall, the graph shows that peaches required the least labor hours and yielded the least final product (light green bottom left quadrant), apples took more time than peaches and yielded a similar level of product as peaches (dark blue bottom right quadrant), and apricots took more time than peaches and apples and yielded more product (dark green top right quadrant). There is no fruit in the top left quadrant (dark yellow) for less labor and more product).

Section 7 – Summary & Acknowledgements

Creating a value-added manufacturing enterprise is a complex adventure, but when thoughtfully considered, it is not without reward. When all elements are thoroughly considered and identified, a platform for organized and productive activities is laid. The collaborative Dehydration Pilot Study Project is a great example of how a large challenge can be addressed by starting with the resources available and growing strategically from there. For more information or questions, you can contact CSU Extension Western Region office at the Western Colorado Research Center-Orchard Mesa at (970) 241-3346 or email Nicole.Didero@colostate.edu.

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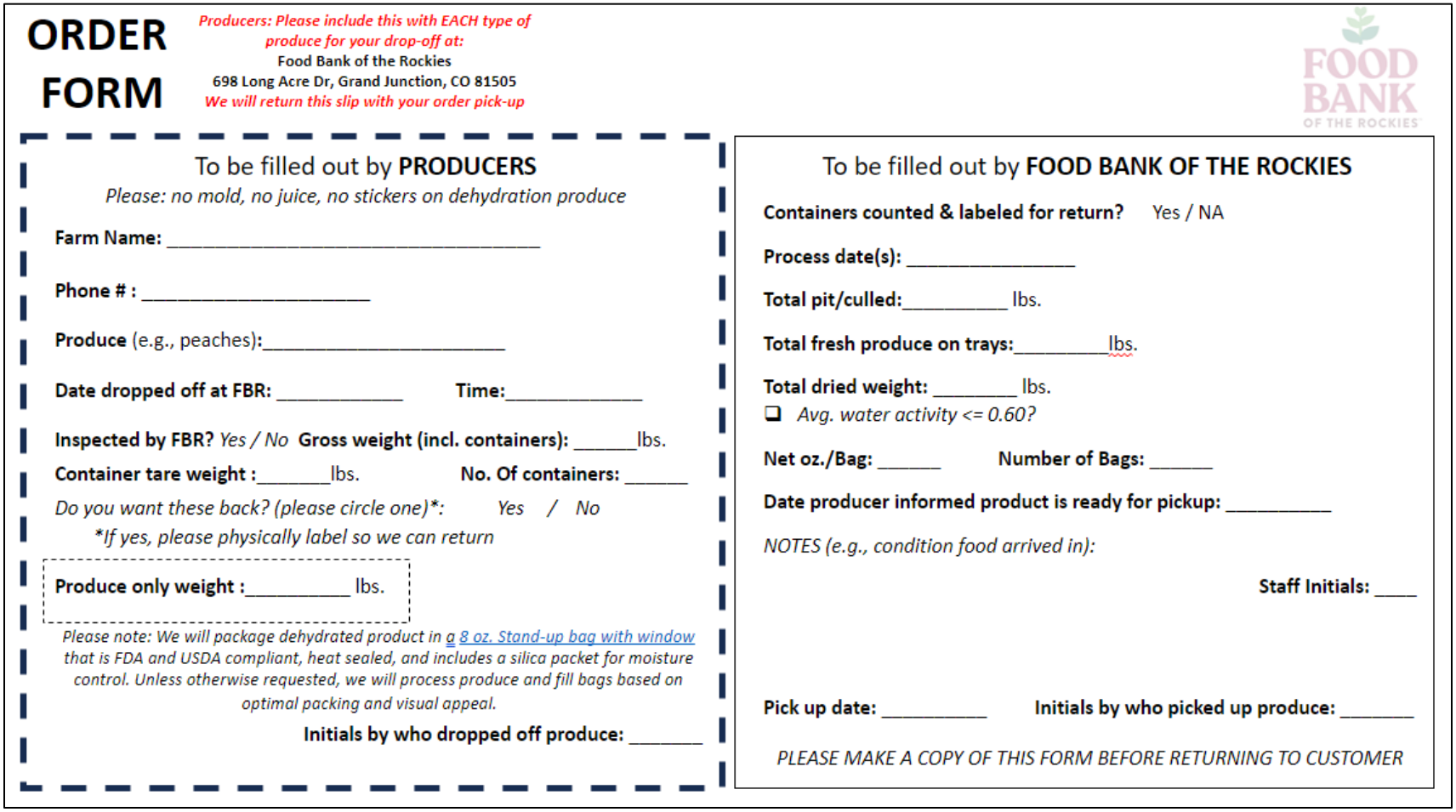
Appendices

A. Checklist of best produce safety practices for organizations that aggregate fresh produce to review with providers of fresh produce. https://coproducesafety.org/produce-safety-rule/psr-resources/

B. Example Purchase Order form



ORDER FORM

Producers: Please include this with EACH type of produce for your drop-off at:
Food Bank of the Rockies
698 Long Acre Dr, Grand Junction, CO 81505
We will return this slip with your order pick-up

FOOD BANK OF THE ROCKIES

To be filled out by **PRODUCERS**

Please: no mold, no juice, no stickers on dehydration produce

Farm Name: _____

Phone # : _____

Produce (e.g., peaches)**:**_____

Date dropped off at FBR: _____ **Time:**_____

Inspected by FBR? *Yes / No* **Gross weight (incl. containers):** _____lbs.

Container tare weight :_____lbs. **No. Of containers:** _____

Do you want these back? (please circle one): Yes / No*

**If yes, please physically label so we can return*

Produce only weight :_____ lbs.

Please note: We will package dehydrated product in a 8 oz. Stand-up bag with window that is FDA and USDA compliant, heat sealed, and includes a silica packet for moisture control. Unless otherwise requested, we will process produce and fill bags based on optimal packing and visual appeal.

Initials by who dropped off produce: _____

To be filled out by **FOOD BANK OF THE ROCKIES**

Containers counted & labeled for return? Yes / NA

Process date(s): _____

Total pit/culled:_____ lbs.

Total fresh produce on trays:_____lbs.

Total dried weight: _____ lbs.

❑ *Avg. water activity <= 0.60?*

Net oz./Bag: _____ **Number of Bags:** _____

Date producer informed product is ready for pickup: _____

NOTES (e.g., condition food arrived in):

Staff Initials: ____

Pick up date: _____ **Initials by who picked up produce:** _____

PLEASE MAKE A COPY OF THIS FORM BEFORE RETURNING TO CUSTOMER

C. Example labor log for dehydration activities

Recorder Name: **Date:**

Farm Name, Produce:

How many containers were processed today?

Gross weight (container + produce):

1._____lbs
2._____lbs
3._____lbs
4._____lbs
5._____lbs
6._____lbs
7._____lbs
8._____lbs
9._____lbs
10._____lbs

Total gross weight: _____lbs.

Total crate weight: Container weight ____ lbs. X # crates today = _____lbs.

Net produce weight (Total gross weight – total crate weight): _____lbs.

Composted: _____lbs.

Final weight of produce on trays (Net – Compost): _____lbs.

Notes from today:

Why was produce composted/not processable? (e.g., bird pecks, bruising)

Other comments (including notes back to client via Purchase Order form):

1

Key to using this log is, "when there is a change, write it down and record time"

Date: **Farm:** **Product:** **ACTIVITY** Choose from: • Wash produce • Pit/peel/cut/tray • Load/unload dehydrator • Fill/seal/label bags • Cleanup/wash • Other: (describe)	**TIME (start-stop)** (Example, 10:08-11:32)	**TOTAL Minutes**	**# STAFF**	**#VOLS**

2

D. FBR Pilot Study equipment list

Equipment	Uses	Pros	Cons / Suggestions
Water activity meter	Measuring water activity of dehydrated product	-Necessary for food safety and quality -Simple to use	-Must be checked for accuracy and battery life periodically
Weight scales (large and small sizes)	Large weighs raw fruit (50+ pounds) Small weighs final product (2-8 oz, grams as needed)	-Necessary for data collection and meeting packaging requirements	-Must be easily cleaned/sterilized -Portable is best -Some scales power down on their own within 1-2 minutes of non-use. Seek scales that do not do this, it causes room for error during packaging if packager forgets to re-tare.
Heat sealer (packaging)	Keeps product fresh and food safe	-Relatively affordable -Easy to use/train	-Ensure staff know how to use properly -Tends to be plug in, account for chord length and table distance
Label/sticker maker	Provides adhesive label with product information	-In-house labeling is quick and can be adjusted to be used on all your products	-In-house labels may lack the professional design you might want -Test adhesiveness of labels before mass-ordering/producing. -You can consider ordering pre-printed/labeled bags to remove the "labeling" labor step once you have a certain design
Cherry pitter	Removes pit from cherries	-If used properly, removes pit with whole cherry relatively intact -Manual (hand-held) ones are easily washed	-Pit not always removed -Requires additional labor to double check all pitted product for fractured pits (and even then, some may be missed which is a health concern) -Manual single cherry pitters take a long time to use, can be sharp -Automated pitters add water to process which must be tested and verified for following food safety standards -Automated pitters can required grease on machinery for smooth

Equipment	Uses	Pros	Cons / Suggestions
			operation and could contaminate product -We found manual pitting (with paring knife) was faster and safer
Apple corers (manual)	Coring apples	-Removes most of the core of the apple -Can be easily washed	-Misuse can result in injury -Labor must check for core that was not removed -Apple corers that also slice the apple while peeling & coring may be advantageous to use, but we found apple rings with skin on were a delicious final product. Test for desired thickness of slice before investing in corers that also slice (or seek one that can adjust slice size)
Pairing knives	Slicing fruit in half	-Affordable compared to specialty equipment -Relatively intuitive and safe to use with training -Can be easily washed and sharpened	-Misuse can result in injury -Unreliable for slicing in uniform shapes or thickness (depends on person slicing)
Manual commercial fruit slicer	Cutting slices	-Creates uniform slices based on blade spacing (usual set size) -Quicker than cutting with knives	-Can be very dangerous. We allowed only trained staff to operate this, no volunteers. -Can break easily if fruit is too hard or equipment is misused -Repairs are time consuming and costly -Difficult and dangerous to clean -No ability to adjust slice size quickly
Food grade, plastic cutting board	Processing surface that can be easily cleaned and sanitized	-Required for cutting fruit by hand	-Extra-large sizes can be challenging to wash -Consider that multiple boards will be needed for multiple people processing

Equipment	Uses	Pros	Cons / Suggestions
Stainless steel kitchen mixing bowls	Containers that can be easily cleaned and sanitized to hold fruit throughout processing stages	-Bowls of various sizes found to have many uses. Medium to large are better, small not necessary. -Can also use stainless steel steaming table bins instead	-Having space to properly store cleaned and sanitized bowls (especially large ones) can be challenging
Sealable food grade buckets or containers	Storing dehydrated product prior to packaging	-Properly stores dehydrated food prior to packaging	-Lids can be hard to take off and put on again. There are tools for doing this ergonomically.
Silica pouches	Moisture moderation of properly stored and packaged dehydrated fruit (once at a passing water activity level)	-Absorbs water in stored or packaged fruit to help preserve. --Pouch size must be appropriate for quantity of food it is with.	-Item that can be easy to forget to add, so must train processes for consistency and quality control -Will not prevent microbial growth if water activity is too high
Silicon liners for trays	Liners that prevent foods from sticking to tray	-Highly suggested. It makes traying produce and removing dehydrated produce from dehydration trays much faster	-Can change dehydrating times -Can be a challenge to clean and dry (e.g., we did not have a drying line and had to manually dry and hang on non-used dehydration racks)
General hygiene equipment	PPE as required under licensing (e.g., Hair nets, beard nets, single-use food grade gloves, aprons)	-Necessary - Keeps food and personnel safe and clean and meets regulatory requirements	-Expense that can add up -Must periodically check supply
Boxes for final product	Holds multiple fruit packages and material (e.g., cardboard) keeps them from direct sunlight	-Keeps fruit order dry, in the dark, and organized for delivery -Clean design and clear labeling are a must for returning to client	-Expense that can add up -Must periodically check supply

E. Example list of weekly cleaning & sanitization activities during pilot study

1. Clean, sanitize and set up 3 bay sinks according to directions and before and after use
2. All dishes, pots, pans, utensils, equipment and food contact surfaces are cleaned and sanitized before beginning work, after completing work or after 4 hours of continuous use of the same product.
3. Sanitizer buckets are prepared before preparing food and changed when dirty or concentration is not adequate. Place several around kitchen but away from food.
4. Clean towels are stocked and ready for use. Ones used for sanitizer should be kept in sanitizer between uses (refer to in place cleaning handout for more information)
5. Trash can has proper liner, is emptied at end of day and as needed. The trash can is cleaned as needed.
6. Employees and volunteers are in good health and have signed volunteer form (refer to sick employee process reference and sign to prevent illness)
7. All workers wash their hands and wear gloves during food preparation. Check stock of gloves daily and provide a variety of sizes.
8. Wash hands and change gloves when they become dirty, torn, worn for 4 hours of doing the same task OR when you change a task (i.e. using cell phone, prepare different product, touching unwashed produce etc.).
9. Ensure the handwashing sink is only used for handwashing and is equipped with proper supplies (soup, hot/cold water, disposable paper towels or air drier, signage, trash can).
10. Clean up spills quickly and have a plan for diarrheal and vomiting events.
11. Ensure all volunteers drinks and food have lids are kept in a designated area away from food contact surfaces and food.
12. Cover, label, cool and refrigerate cut, processed and washed produce to 41 degrees or lower.
13. Sweep floors as they become soiled and at the end of each day.
14. Clean and sanitize dehydrating trays in between different batches of food, product types and at the end of the day.
15. Sweep and mop floors daily and as needed.
16. Review facility for signs of pest and address as needed.
17. Ensure volunteers notify and attend to wounds immediately.
18. Check that proper signage is located next to handwashing sinks (handwashing sign), three bay sink (how to set up and use a three-bay sink), and bathrooms (handwashing sign and employee health).
19. Ensure you only process/cut/wash as much produce as can be dehydrated at a single time (do not large batches sit out at room temperature for extended periods of time). Keep produce whole and unwashed if it cannot be processed in a timely fashion OR it can be washed, cut and stored for longer than 24 hours if it is covered, dated and refrigerated.
20. Track product from different producers/sources, fill out tracking sheets for FBR and CSU, separate batches from each other and sort and identify packaged foods per source/producer.

F. Example information for volunteer traceability checklist & acknowledgement

Date:

Agreements:

- I will wash my hands and wear gloves when in the kitchen
- I will change my gloves when they have touched and unclean surface, become dirty/torn or if doing the same task for more than four hours
- I will not work if I have any flu-like symptoms, have been diagnosed with a food borne illness or other contagious condition
- I will wear comfortable, non-slip shoes and clean clothing
- I will restrain my hair with a hairnet or hat. I will wear a beard net if applicable
- I will follow the verbal and written protocols and practices of the kitchen and kitchen manager
- I will report and attend to injuries immediately

By writing your name you are confirming that you have read and understand these statements:

Volunteer Name	**Phone number**

Helpful Links for Resources & Information

- **Colorado State University Extension resources**
    - Tri-River Area Extension, Food & Health information including certification classes, food safety, and recipes

https://tra.extension.colostate.edu/family-and-consumer-science/about-food-health/

    - Colorado Farm to Market

https://cofarmtomarket.com/

- **Colorado Department of Public Health & Environment**
    - Webpage for food safety and licensing

https://cdphe.colorado.gov/food-safety-and-licensing

    - Webpage for food manufacturing and food storage including food labeling guidelines under “Product labeling requirements” and commercial kitchen layout minimum requirements

https://cdphe.colorado.gov/food-manufacturing-and-storage

https://drive.google.com/file/d/1tBR2XG5a77sHrKRiqtbXOtBaEs4kiZb6/view

Glossary

Below are definitions for ***terms used in this handbook*** often specific to context. Where definitions are standardized by another entity, we include a reference for further reading.

Batch - fruit of the same type, from the same farm, run on the same day, at the same time, in the same dehydrator. If peaches from one farm are run on the same day at the same time in two dehydrators, there are two batches.

Commercial sales – sale of a food product (in this project's case, dehydrated fruit) that is regulated by Colorado Department of Public Health and Environment (COPHE)

Consume by date - Consume by is for highly perishable products where food safety is a concern. Best by dates are used for products where food quality is the limiting factor, which would be the case for dehydrated fruits.

Dehydration services – receiving, processing, and dehydrating fresh produce and packaging and labeling final dehydrated products in accordance with appropriate regulatory requirements and on a fee-for-service basis in this pilot.

Food Safety is the "scientific method used to reduce and eliminate foodborne illness and injury" according to Food Safety resources at Ohio State University Extension.

Gross weight – weight of a product including the container weight.

Net weight – weight of a product without container weight.

Processing – in this context, this entails all steps (e.g., wash, cut, dehydrate, store, bag) to get raw fruits and vegetables into their final value-added form for commercial sale as per proper regulatory guidelines.

Rate-limiting factor – the slowest step in a process involving several steps, which thereby controls the speed of the process.

Shelf-life study – study performed to evaluate how long the product is good for from a food safety aspect (product will spoil and may potentially cause harm to consumer) or from a food quality aspect (product has defects which makes it less palatable).

Traceability – the ability, through record keeping, to tell the entire "story" of the product: the source of the fresh food; all the steps taken to create that product (i.e. the recipe); the people involved in processing the product; and where and who final product was returned to.

Value-added – "raw agricultural products that have been modified or enhanced to have a higher market value and/or longer shelf life" (cofarmtomarket.org). In this handbook, the final product includes both characteristics, and the product enhances "value" (monetary or otherwise) as a part of multiple business plans for multiple organizations (e.g., higher value/unit weight, reducing food waste, maximizing local produce offerings).