Preserving Locally Harvested Produce in School Meals

Many schools have implemented Farm to School Programs as a way to connect students with locally grown foods and improve regional economies. This guide provides food safety-related information for districts wishing to extend the use of locally harvested produce in school meals through acceptable preservation methods, specifically freezing; an additional benefit to geographic regions with limited growing seasons. Because of food safety risks, home-canned foods are not allowable in school meals program(s). If canned food items are produced and processed in an approved facility, and meet all federal, state, and local food safety and health guidelines, these items may be served in school meals as stated in the USDA Final Rule Questions and Answers, available at http://www.fns.usda.gov/sites/default/files/cn/SP10-2012v9os2.pdf - Question #43. Further, Federal Regulations (21 CFR 108) require commercial processors of shelf stable acidified foods and low-acid canned foods in a hermetically sealed container to register the establishment and file all processing method(s) with the Food and Drug Administration (FDA). More information is available at: http://www.fda.gov/Food/GuidanceRegulation/GuidanceDocumentsRegulatoryInformation/AcidifiedLACF/default.htm. This guidance addresses only food safety and quality concerns related to processing and freezing local produce as part of a retail foodservice operation.

School districts may consider purchasing local produce already processed from reputable, fresh cut vendors, as several nonprofit or economic development entities have started processing companies. Established processors and some food vendors also have begun offering local inventory. Check with your local county extension agent or local regulatory agency for more information on processing operations in your area.

Schools that purchase, process, and preserve local produce in school meal operations should consider these important product outcomes: Safety, quality, cost, and acceptance by customers. It is recommended that local regulatory agencies be contacted prior to starting a food preservation program in your school to ensure all federal, state, and local food safety regulations are followed. Generally, school kitchens that are licensed foodservice establishments may be used to process and preserve all produce items that will be served within the facility. However, if preserved (frozen) produce is to be served and/or sold outside of the district's program, a processing license may be needed. The local health department can provide guidance on specific regulations in your area.

Product quality and product cost should be compared to items available on the market. For example, if locally procured and preserved broccoli florets are of poor quality, the district may consider changes in receiving or processing practices, equipment, or variety of broccoli to correct the problem. Otherwise, preserved produce that is of poor quality may result in less than positive student acceptance. Information is readily available from USDA Cooperative Extension Service.

Districts with centralized kitchens or a commissary may use a systems approach to preserving local produce for the district meals program whereas site-based districts may process and freeze at onsite kitchens. Costs associated with these approaches may differ greatly. Each scenario will be unique to product and local labor costs; therefore, it is recommended that a school district's administrator pre costs food and labor to determine program feasibility.

Other factors to consider when deciding if in-house preserving of fresh produce is an appropriate approach for your district include:

- Availability, and amount of local produce acceptable for freezing;
- documentation of on farm food safety practices or certification of Good Agricultural Practices (GAPs);
- ability to use produce in your menus;
- staff food safety knowledge and culinary skill;
- foodservice facility design, available equipment and adequate storage
- costs of product and labor to process;
- access to safe and tested for quality food preservation methods;

- size and type of packaging needed;
- need for variance if vacuum packaging (written documentation, typically issued by the local health department, approving a modification in your food safety plan);
- need for tracking or traceability system; and
- HACCP plan approval by local regulatory agencies.

For more information regarding outsourcing food processing, cost analysis, and preserving methods, review *Frozen Local; Strategies for Freezing Locally Grown Produce for the K-12 Market*, available at: www.iatp.org/files/2012_12_11_FreezingReport_JB_web.pdf

A foodservice kitchen is similar to a food processing facility in that both have goals of preparing food in a way that ensures safety and quality in a cost effective manner. Food processing facilities will have dedicated processes and specialized equipment for freezing of fresh produce. Yet, including locally grown produce on school menus has been shown to improve students' acceptance of fruits and vegetables (http://www.fns.usda.gov/farmtoschool/farm-school). Child nutrition program administrators have the responsibility to ensure the best decisions are made with regards to safety, quality, cost, and acceptance of meals served to students. Whether buying fresh-cut produce or processing in-house, review the detailed produce processing guide *Food Safety Practices to Expect from your Fresh Cut Produce Processor* at www.fns.usda.gov/ofs/produce-safety-fact-sheets. This Fact Sheet provides an overview of factors to consider when making the decision of whether to purchase locally grown produce processed and preserved by a third party or process and preserved by district school foodservice staff. Facility, staff and product considerations are presented.

GENERAL FACILITY CONSIDERATIONS

Infrastructure & Equipment

Your licensed foodservice establishment should currently meet Code requirements related to utilities (i.e. potable water source; sufficient lighting; electricity) and infrastructure (i.e. no opportunities for pest infiltration by having screens on windows, tight fitting doors, solid foundation, etc.). While food production and food processing kitchens are similar, there are some differences. These differences pertain to what and how foods are prepared. In both types of kitchens, layout and design should control access by unauthorized people and minimize opportunities for cross contamination of foods; ideally food flows do not back track in a facility. In a processing facility, separate enclosed areas for different steps in the flow of product (i.e. receiving area, washing room, cutting room, and packaging room) control for unintentional contamination of product. Further, employees are dedicated to each of these steps and work zones; standard operating procedures specify that movement between areas occurs after hands are washed and aprons are changed. Ideally, personnel have an enclosed restroom and locker room area that does not open directly into the food production space. This is a requirement for food manufacturers (21 CFR 110). Foodservice kitchens and processing kitchens require high levels of cleanliness and sanitation. Consider use of equipment that is easy to disassemble and wash, rinse, and sanitize. Standard operating procedures should be in place for these steps with monitoring and verification steps to ensure they are followed.

Because foodservice kitchens are used around meal service times; use of the foodservice kitchen for processing in down times (such as afternoons and evenings or in the summer months) may be more feasible than trying to schedule at the same time as meal preparation. To ensure a safe flow of food, there may be a need to reconfigure work spaces and set up. Equipment on casters provide flexible solutions when resetting work areas. Cleaning and sanitizing procedures should be followed with each reset (as per specific SOPs).

A foodservice kitchen (part of an onsite production/service or centralized system) will generally have hand washing, production and cleaning sinks; dry, refrigerated and freezer storage; and cooking equipment (ovens, steamers, or kettles). It will also have holding (hot and cold) and service equipment such as carts (closed, open and/or insulated), steam tables, and refrigerated table/service bar.

Additional specific equipment needed for preservation by freezing will depend upon type of produce item,

labor availability, as well as packaging unit and processing method. Central processing kitchens may want to consider the purchase of a mechanical produce wash sink. Debris from the produce is removed by placing it into turbulent water created in the sink from power jets. Operators should be mindful of flavor and color mixing. For example, washing blueberries prior to washing cauliflower could result in flavor and color crossover to the cauliflower. Operators may decide to use a produce wash chemical and/or antimicrobial treatment. The FDA has developed Guidance for Fresh Cut Produce Processors (http://www.fda.gov/Food/GuidanceRegulation/GuidanceDocumentsRegulatoryInformation/ProducePlantProducts/ucm064458.htm) yet at this time, only recommends fresh produce in retail food establishments to be washed under running, potable water, and does not require retail foodservice operations to wash fresh fruits and vegetables with an antimicrobial treatment.

Freezing Equipment

Refrigerators and freezers have a compressor, a condenser (air or water cooled), an evaporator, and a fluid called refrigerant. Cold storage is maintained by circulating the refrigerant around the system which withdraws heat from the food product. This heat is then transferred to the condenser and dissipated into air or water. The refrigerant itself is directed into the evaporator, where it is cooled, vaporized into a gaseous state, and then reintroduced into the system. The speed with which the hot air is pumped out will depend on the size of the compressor motor, density of food products, and amount of heat reduction needed. Blast chillers and freezers are specially designed to more quickly cool or freeze the food.

An investment in key large equipment items might be necessary to ensure the product quality because the rate of freezing has a direct impact on the size and the number of ice crystals formed within a food product's cells and extracellular space. Slower freezing leads to fewer and larger ice crystals while faster freezing leads to smaller and more numerous ice crystals. Large ice crystals can puncture the walls of the cells of the food product which will cause a degradation of the texture of the product as well as the loss of its natural juices during thawing. Small ice crystals produce less cell wall rupture, resulting in a better quality product.

Because blast freezers are designed to quickly drop the temperature of the product, thus reducing the number of ice crystals that form, which in turn can negatively affect texture of thawed product, a district planning to preserve large volumes of local produce might consider the purchase of one. Blast freezers are expensive, with a single, full size, reach-in unit starting at $18,000 and a table top model about $10,000. A smaller model blast freezer could be used to create the frozen item with the conventional commercial freezer already in place used for storage of products. However, the smaller blast freezer will limit production capability and number of processing runs. Consider whether there is sufficient freezer space for storage of produce items in addition to inventory used in the school meals program. Also consider whether the operation has sufficient rolling carts, racks, and trays to hold items, particularly if using the Individual Quick Frozen (IQF) method of freezing. IQF foods are frozen individually, then packaged after freezing. This method typically produces a higher quality product than bulk freezing, and customized amounts may be removed from freezer. Number of items needed will be dependent upon type and amount of items to be processed and preserved.

Review Chapter 13 in *Institute of Child Nutrition's Publication, Equipment Purchasing and Facility Design for Child Nutrition Program*, available at http://www.nfsmi.org/documentlibraryfiles/PDF/20090226033958.pdf

Small Equipment

Small equipment needed for processing of fruits and vegetables is likely already available and used in the foodservice kitchen: knives, cutting boards, mechanical and manual vegetable processors, sheet trays, perforated pans and/or colanders, and cleaning items, such as vegetable brushes. Additional food storage racks on casters may be necessary for product movement and storage. Amount of product proposed for processing runs and number of staff assigned to this duty will dictate quantity of small equipment items needed to handle proposed production schedule. A sufficient supply of easy to disassemble small equipment will reduce wait time as all items must be washed, rinsed, and sanitized between uses.

Packaging Equipment

Packaging equipment will include bags to hold processed product and may include a machine to vacuum seal the bags. Boxes for holding bags of processed produce may also be needed. In addition, equipment to label the items with information including name, date processed, location processed, unit weight or volume, ingredients, etc. may be needed. Labeling is important for purposes of traceability, particularly if the district has a centralized or commissary set up. It should be determined in advance whether there is storage space within the food production kitchen for the additional equipment needed for processing. Part of the decision making process should consider what products will be preserved and how they will be frozen and packaged. These decisions will guide equipment needs and development of standard operating procedures. See *Take Advantage of Nature's Bounty: Consider Vacuum Seal* at www.fns.usda.gov/ofs/produce-safety-fact-sheets.

Standard Operations Procedures (SOPs)

Written SOPs should be part of the district's HACCP-based food safety plan. New SOPs related to food processing aspects of the operation may need to be created or modified from the existing food production SOPs. For example, new SOPs for steps involved in processing of fresh produce or cleaning and sanitizing at least every four hours of continued use of food packaging equipment may be needed. SOPs can be developed from approved recipes for processing of product and equipment manufactures guidance.

Personnel Considerations

Human resources is a critical component in ensuring a safe, quality product is made. Standard operating procedures (SOPs) communicate to paid and volunteer staff why and how food safety practices are to be conducted, monitored, and verified. Some school meal processing operations rely on volunteer staff for processing produce, especially during the summer months. Paid staff and volunteers should all receive training about health and hygiene requirements. District policies related to health status and hygiene practices should be the same for volunteers as for paid workers. Policies related to attire should also apply to volunteers. In other words, volunteers must follow the same rules related to health and hygiene practices. Written standard operating procedures communicate the expectations specific to your work place. See sample, modifiable SOPs available at: http://sop.nfsmi.org/HACCPBasedSOPs.php.

Food processing techniques are similar but not quite the same as food production practices; thus, there will be a need to train staff on specific food preservation SOPs. Approved recipes for processing (see Resources Section) or those reviewed by your Process Control Authority ensure risks from improper handling, preparation and packaging are mitigated. A Process Authority must have expert knowledge of thermal processing requirements for low-acid foods acquired through appropriate education, training, and experience. More information may be found at U.S. FDA FCE/SID: 21 C.F.R. sections 108, 109, 113, 114. Further, it is best practice for a nutrition program supervisor with certification in food safety be on site during food production and food processing periods to monitor policies are followed.

PRODUCT FLOW AND HANDLING

Product Selection, Purchasing, Receiving, and Storing Prior to Processing

It is not advised to preserve through freezing produce items with high moisture content, such as lettuce and celery, as the quality will be poor. The support structure of most fruits and vegetables is over 90 percent water. When the water freezes, it expands and the ice crystals cause the fruit or vegetable cell walls to rupture. Consequently, the texture of the produce when thawed will be much softer than it was when raw. This textural difference is noticeable in products which are usually consumed raw. For example, when a frozen tomato is thawed, it becomes mushy and watery. This change in texture is the reason why it is often suggested that uncooked frozen fruits be served before they have completely thawed. Textural changes due to freezing are not as apparent in products which are cooked before eating because cooking also softens cell walls. These changes are also less noticeable in high starch, lower water content vegetables, such as peas, corn, and lima beans.

The flow of foods purchased from local growers with the intended use of freezing is similar to steps followed when product is purchased from local growers for immediate use in the school meals program. Purchasing, receiving, storing before use, processing, storage of finished product, and finally, transportation or service are key steps in the flow of food whether in a food production or processing kitchen.

Steps for purchasing, receiving, and storing are guided by SOPs and are the same whether product is used for production or processed and preserved for later use. The school meals program should purchase from a reputable vendor who has provided food safety assurances (i.e. documentation of completed GAPs training, checklist or written farm food safety plan) and complied with procurement regulations. Written specifications communicate desired product attributes. Quality features, such as inconsistent sizes of product, slight discoloration or other damage, may not require high standards if visual appeal is not necessary. Further processing does allow for some damaged areas to be removed; however, purchase price should reflect quality and condition. Receiving is the step where the foodservice unit accepts or rejects delivered items based on quality and quantity matching written specifications and purchase orders. Received items should be dated and rotated with existing stock using FIFO – First In; First Out. Storage of products should comply with recommended temperatures and humidity levels for the item with shelf life factored into scheduling of processing runs. Products purchased for intended processing should be labeled as such. The kitchen manager should ensure there is adequate storage space for additional product in the foodservice kitchen to accommodate product before and after in-house processing and freezing.

Processing Method

Fresh fruits and vegetables continue to undergo chemical changes even after harvesting. Therefore, products should be processed and frozen as soon after harvest as possible to ensure peak degree of ripeness and to avoid spoilage and deterioration.

Fresh produce contains chemical compounds called enzymes which cause loss of color and nutrients, flavor changes, and result in color changes of frozen fruits and vegetables. Some fruits are blanched to loosen the skin for removal. Most vegetables should be blanched prior to freezing to ensure quality. Blanching is a process of placing the food item into boiling water or steam for a short period of time (typically between one and five minutes) followed by submersion in an ice water bath. The process slows or stops the action of enzymes. Schools may use a steam jacketed kettle, steamer, combi steamer, or tilting/braising skillet for blanching. Access to an onsite ice machine or commercially sold bags of ice may be used to create the ice bath for cooling product.

Some items that are processed may involve the addition of some type of acid, such as lemon juice, to prevent browning. Because additional ingredients may affect the pH and/or water activity level of the product, processing methods may need to be reviewed by a Process Authority. Strict adherence to SOPs and recipes in the freezing process is critical to ensure safety and quality.

Another consideration in processing is how the freezing will occur: bulk freezing of packed product or individually quick freezing of produce items (IQF) prior to packing. From this overview, it is clear the type of product selected for preservation by freezing will affect the processing steps and consequently equipment and supply needs.

Preparing and Packaging

Generally – products are washed, drained, trimmed, cut, blanched if specified, and packed. Package unit (bulk or IQF) of five pounds with four packages per case is typical. It is important to control for moisture and oxygen before packing product as chemical changes can occur. Excess moisture results in ice crystal formation and presence of extra air can increase freezer burn, which is damage caused by dehydration and oxidation through exposure of air on food. This damage affects appearance and is very likely to cause development of off-flavors. Food grade, moisture and vapor proof packaging designed specifically for freezing foods will prevent freezer burn. Packaging materials should be water and vapor proof, which will also protect from assimilation of odors resulting in off-flavors. Some operations may choose to vacuum pack processed product. Be sure to contact your local regulatory agency, and review *Take Advantage of Nature's Bounty: Consider Vacuum Seal* for detailed vacuum pack information, www.fns.usda.gov/ofs/produce-safety-fact-sheets before

purchasing and implementing a vacuum pack system. Deadly foodborne pathogens are associated with vacuum packed foods.

Packaging of the processed local produce must maintain product safety and integrity throughout the process until the item is served. Mechanical packing may improve efficiencies and ensure consistent quality; however these types of machines are expensive and require storage space, which may not be readily available in the foodservice kitchen.

Labelling

All units should be labeled with name of product, location and date processed, lot number, ingredients, and weight or volume of unit. Purchasing and receiving records should identify source/vendor of raw produce and date received. This information could be included on the package label for ease in promotion of products at service. A log should also be kept of workers (paid or volunteer) involved with the product (harvesting and processing), their contact information, and dates and times worked. This information is needed for traceability.

Storing

Other considerations in processing are determination of amount that can be preserved and kept frozen until use, and the amount of product that can be processed per run. Space in the freezing unit will guide these decisions. A general rule of thumb is that 28 pounds of food will fit in a cubic foot of storage space. For every 250 lunches, 159 cubic feet of storage is estimated. Further, it is generally recommended that no more than 3 pounds of product per cubic foot of freezer space be frozen within a 24 hour period. Overloading the freezer with unfrozen items will result in a long, slow freezing process and a poor quality product due to ice crystal formation. To maintain top quality, it is important frozen products stay in the frozen state; commercial freezers maintain temperatures below 0 °F as temperatures higher than 0° F increase the rate at which deteriorative reactions can take place which may shorten the shelf life of frozen foods. ICN recommends maintaining frozen foods between minus 10° F and 0°F. Freezer thermometers (internal and external) can ensure proper temperatures are maintained; recording of these storage temperatures on a log is likely part of the district's HACCP plan. If the storage freezer is used daily within the foodservice operation, there will be fluctuations of temperatures. Fluctuating temperatures in the freezer can cause the migration of water vapor from the product to the surface of the container. Management should determine the best location in the site's frozen storage units for the processed items considering quantity and length of time product will be held. The cold chain must be maintained. Child nutrition program management can decide to add processed product into inventory levels immediately after processing or maintain a separate log of processed items. Remember, processed items must be stored on the site of the licensed foodservice and used by that facility. Limited access to foodservice area(s) will minimize risks of intentional food contamination and theft of product.

Thawing and Reheating

Frozen products may require thawing and/or reheating prior to service. It is best practice to thaw frozen, ready-to-eat products in the refrigerator at 41˚F or below. Prevent cross contamination by thawing on shelves above any raw poultry, meats or shell eggs. Products may be thawed under running water at 70˚ F, however this method should only be used when necessary, as resources (water) are wasted. IQF product may be thawed as part of the cooking process, often through steaming or boiling.

When reheating thawed, previously frozen foods, reheat to 165˚F within 2 hours. Use a calibrated, sanitized thermometer to check the temperature of foods. When maintaining sealed reheated boil-in-bag products is desired, lay two bags together and place the thermometer between the bags to obtain final reheating temperature.

SUMMARY

School operations considering a food preservation program are encouraged to contact the local food safety regulatory agency prior to implementation. Customized, site-specific HACCP SOPs should be written for all activities, and all personnel should receive instruction on the required food safety procedures.

Local availability and amounts of product suitable for freezing should be investigated. The local county extension service may be contacted for providing assistance in identifying local sources and processing methods.

Central and/or site-based kitchens should be evaluated for required and desired processing equipment. All equipment should be approved by the National Sanitation Foundation or other entity ensuring safe use in commercial kitchens.

School nutrition administrators are responsible for operating a fiscally sound program. Food and labor costs should be identified, and included in the final decision to process. Ultimately, only safe, quality products should be served to customers in school meal operations.

RESOURCES

Freezing Basics, University of Rhode Island, available at: http://www.uri.edu/ce/ceec/food/documents/GH%201501.pdf
National Center for Home Food Preservation, available at: http://nchfp.uga.edu/

Science of Freezing Foods, University of Minnesota Extension, available at: http://www.extension.umn.edu/food/food-safety/preserving/freezing/the-science-of-freezing-foods/

USDA Food Storage and Preservation, available at: http://www.nutrition.gov/shopping-cooking-meal-planning/food-storage-and-preservation