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**Backgrounder: How to keep food fresh for longer**

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**Introduction:**

With restricted movement in most sub-Saharan countries because of COVID-19, many markets for fresh food are closed or restricted. This impacts vendors, traders, and consumers. While, so far, value chains for grains and legumes are not as strongly affected, consumers are much less able to find fresh foods for their family, especially fruit and vegetables, dairy, and meat. These foods are perishable and, without adequate methods of keeping them fresh, can rot fairly quickly. The risk of becoming infected with COVID-19 through contact with foods is actually very low, but the measures that countries have taken to respond to COVID-19 have resulted in difficulties in access to foods, especially for women and especially for fresh foods, and in some cases in transportation of foods between regions.

The food system has been affected directly by thepandemic (COVID 19), with impacts on food supply and demandthrough decreasing purchasing power and the capacity to produce and distribute food.

*Examples of the impact of travel restrictions on movement of food:*

* In Nigeria, travel restrictions are causing losses to small-scale produce traders. In the country’s breadbasket state of Benue, traders are stuck with produce due to lockdowns though demand for produce is high.
* In Kenya, the government has classified movement of food across cities and counties as an essential service, so food prices have not significantly risen.
* In Kenya, small-scale middle-class farmers have been selling farm produce on well-travelled road from their cars to make ends meet during the COVID-19 crisis.
* A trucking logistics company reports that 30% of its trucks in Nigeria, Kenya, Togo, Ghana, and Uganda are not operating due to lack of clarity by governments on what is classified as essential transportation.
* The World Health Organization projects that restriction of movement in African countries due to COVID-19 will worsen the food crisis, especially in low-income households.

It’s difficult to overstate the importance of consuming fresh foods. Fruits and vegetables are an abundant and inexpensive source of energy, body-building nutrients, vitamins, and minerals. Their nutritional value is highest when they are fresh, but most fruits and vegetables stay fresh for a very short time, unless they are promptly and properly preserved.

In countries where fresh foods are only available for part of the year, people have developed a variety of ways to preserve and extend the “shelf life” of fresh foods so that they can be consumed during the lean season when fresh food is less available. These methods are very useful for farmers, vendors, and processors. And during COVID-19, they can also help consumers who are missing fresh foods because of restrictions in movement. It should also be noted that, with climate change and increasing soil degradation, these strategies can also strengthen farmers’ resilience to many different kinds of shock and stress.

Fresh foods naturally rot unless they are processed in some way or stored in special conditions. The rotting process is due to the actions of micro-organisms. But rotting can be slowed by adding preservatives, processing foods, and using effective storage conditions.

Fruits and vegetables should be prepared for preservation as soon as possible after harvesting, within 4 to 48 hours. The likelihood of spoilage increases rapidly as time passes.

*For further information, please see documents 2 and 11.*

**What are some key facts about keeping food fresh?**

* In the context of COVID-19, in many poor countries, the economic consequences of the virus may be more devastating than the disease itself. A lack of fresh foods may have serious food security and nutritional impacts as well. This is especially critical for pregnant and breastfeeding women, but also for women in general since women sometimes eat last and don’t get the best quality foods.
* Adding value through home-based processing can increase the shelf life of perishable fresh foods.
* Fungicides—both chemical fungicides and those based on natural products—can stop decay caused by moulds and bacteria in fresh fruits like apples, bananas, and citrus.
* Fresh fruits and vegetables can be sun-dried after washing/blanching to preserve them longer.
* Fresh meats can be salted and smoked to dry and preserve them.
* Drying fruits and vegetables helps small-scale farmers reduce losses of fresh produce and generate additional income by enabling them to market in the off-season.
* Small-scale farmers can sun-dry mangoes, passion fruit, tomatoes, and vegetables such as collard greens and indigenous African leafy vegetables such as pumpkin leaves, sunn hemp, spider plants, and jute mallow; and cowpea. These can be dried to preserve them during an oversupply, or when movement and access to markets is restricted by governments during emergencies, such as the COVID-19.
* Properly dried fruits and vegetables can last up to a year, but must be stored in a cool, dark, and dry place.

*For further information, please see documents 3, 4, 10, 11, 13, and 14.*

**Predicted impact of climate change on keeping food fresh**

* With climate change causing food shortages, small-scale farmers will need to learn to preserve food during gluts and weather-related disasters in order to cover them during shortages. These and other changes in food availability and household food routines are likely to have a more significant impact on women, given the division of household labour, and could increase their workload.
* Temperature rise due to climate change is interfering with the safety and viability of fresh foods. To extend their shelf-life, cooling and refrigeration or rapid processing is needed.
* Where water is scarce, processing and preparation of fresh food can be done by dry processing and cooking.
* Climate change-related effects such as droughts and erratic rains can cause significant reductions of all kinds of foods, including fresh foods.

*For further information, please see documents 1, 5, and 6.*

**Gender aspects of keeping food fresh**

* In many countries women, children, and the elderly play a major role in washing, sorting, and peeling fresh foods in order to preserve them.
* Processing of fresh crops provides women with opportunities to be involved in commercial activities and contribute to community development, which positively impacts their families financially, socially, and nutritionally, and provides them with an income that allows them to be more independent, provide for their families, and improve their social status in their communities. On the other hand, women may have little to no control over the products of their labour, and these extra tasks may simply increase their workload.
* In rural Sudan, women are solely responsible for processing fresh vegetables, fruits, and milk in times of plenty to cushion them when food is scarce. Women use processing techniques such as drying and fermentation.
* Female-headed households are more likely to be food insecure, and women are more likely to be undernourished because they prioritize feeding their children over themselves.

*For further information, please see documents 9 and 20.*

**Misinformation/misconceptions about keeping food fresh and extending shelf life**

* That all preserved foods require chemicals to make them last longer or stay fresh.
* That all food preservation methods result in loss of nutrients.
* That it requires expensive equipment to preserve food and keep it fresh. Rural farmers can construct food preservation equipment from locally available materials like wood.

**Key information about keeping food fresh**

**Clay pot coolers**

This is a simple, inexpensive way to keep food fresh, particularly vegetables and fruits. It does not require electricity, works best in hot, dry climates, and is based on the principle of evaporative cooling\*. In hot, dry climates where daily maximum temperatures range from 30- 45°C, food in a clay pot cooler stays at 13-22°C. This extends the shelf life of food by three to four times.

Clay pot coolers are constructed of two different-sized clay pots, wet sand, and a cloth. To make the cooler, place the smaller pot inside the bigger one and fill the space between the spots with coarse sand. Then water the sand and cover the opening of the small pot with a wet cloth.

Because clay is a very porous material, some of the moisture in the sand *diffuses* through the clay. This process of evaporation removes heat from inside the clay pot cooler, resulting in lower temperatures. The evaporation of water requires energy which is taken from the ambient air leading to a fall in air temperature. See the diagram below, and also see FRI’s script about the [Zero Energy Cooling Chamber](http://scripts.farmradio.fm/radio-resource-packs/106-farm-radio-resource-pack/farmers-adopt-eco-friendly-zero-energy-storage-technique-vegetables-northern-ghana/), which also works by evaporative cooling. [Ceramic refrigerators](https://infohub.practicalaction.org/bitstream/11283/314499/1/4de57371-bebc-41c9-9387-1a942e33baf9.pdf) and [Clay refrigerators](https://infohub.practicalaction.org/bitstream/11283/560864/1/clay_based_technology_refrigerator.pdf) work in a similar way.



*For further information, please see document 11.*

**Drying**

There are various ways to dry fresh food to extend its shelf life. Drying works because, when the moisture level in foods is decreased to 10-15%, the microorganisms that cause food to rot cannot thrive. It’s not desirable to reduce moisture level further because food often becomes brittle.

Drying is not difficult. Because products lose water, they become much lighter and easier to handle and transport. However, they do lose vitamins and change in appearance. The most common drying method involves simply exposing food to air. Air absorbs water, and the warmer the air is, the more moisture it will absorb. Thus, for best results, air should be hot, dry, and in motion. In a closed environment, air must be refreshed regularly because it will otherwise become saturated with the moisture it absorbs from the products, so good ventilation is essential. For optimum drying, the relative humidity of air should be less than 65%. If humidity is higher, fruits and vegetables will eventually dry out, but not in the right way. When the sun is shining, the relative humidity is usually lower than 65%, but when it is cloudy and definitely when it is raining, humidity is usually higher. Sunshine is therefore extremely important. For this reason, it is not possible to dry products in this way in every season of the year.

Fruits and vegetables to be dried should be good quality, so remove rotten or damaged fruit. To prevent loss of food quality, minimize the time between harvest and drying. Before drying, thoroughly wash vegetables and fruits and cut into pieces if necessary. It is fine to wait longer before drying hard fruits and root vegetables than before drying soft fruit and leafy vegetables. The time normally allowed between harvesting and consumption can also be understood as the maximum time allowable between harvesting and drying.

To ensure that products do not spoil after being dried, they should be stored in a moisture-free environment.

**Types of drying**

* *Open air or natural drying:*This is a simple and inexpensive process, not requiring any purchased energy, just sunlight and wind. Place products to be dried in thin layers on trays or on black plastic that is exposed to direct sunlight. Trays are usually made of wood and lined with plastic or galvanized nets. Place trays one metre above the ground on stands set on a flat surface to ensure that no dirt can contact food from below and that the food receives maximum exposure to the sun. If necessary, cover trays to protect from rain, dust, birds, insects, and other pests. Mosquito netting offers the best protection from pests. To ensure that fruits or vegetables dry evenly, turn them regularly or at least gently shake the trays. For tomatoes, cut in half and arrange in a single layer on trays.
* *Improved sun drying:*Products dry quicker when trays are placed in a structure that allows sunlight to enter through a glass cover, thereby trapping heat and raising the temperature to 60-75°C. Avoid overheating by regulating the ventilation. Without ventilation, the temperature can reach 90-100°C, especially towards the end of the drying process. Ventilation must be effective enough to prevent condensation on the glass.

**Sun drying**

Vegetables and dry edible insects can be sun-dried by first dipping them in salted boiling water for a few minutes and then drying them in the sun for about three days. Then store in a cool, dark, and dry place.

*For further information, please see document 11.*

**Salting**

Foods that decay, like meat and tomatoes, can be salted and stored in a dry place at room temperature. Dried tomatoes can then be soaked in warm water to be turned into sauce to preserve them longer.

*For further information, please see documents 8 and 18.*

**Solar drying**

Small-scale farmers can construct a low-cost rectangular solar dryer to dry fresh vegetables and fruits. The dryer is a rectangular, wooden box with a black cloth mounted around it. Place vegetables on square trays made of wire mesh and surrounded by a wooden frame. Place trays on top of the black cloth and cover with a transparent polythene sheet when in direct sun.

* Select the best quality, ripe fruits and vegetables individually.
* Clean the solar dryer and its trays with a household bleach solution after every use.
* Wash and place selected fruits and vegetables in a clean container.
* Blanch\* washed vegetables in steam to deactivate the enzymes that contribute to rotting. Blanching stops nutrient loss and stops blanched vegetables from sticking to each other when drying.
* Peel fruits away from the solar dryer with clean utensils to stop possible contamination.
* Cut fruits in thin slices—but avoid slices that are too thin so that they don’t stick on wire mesh trays during drying.
* Sliced fruit dries in fine sunny conditions after two full days in the dryer. If not totally dry, dry for an additional one or two hours.
* The final moisture content for dried fruit should be about 10 percent.

**Artificial drying:** For effective drying, **t**he temperature of outside air often needs to be increased by only by a few degrees. For example, during a rain shower at 30°C, the air must be heated to at least 37°C to properly dry fruits or vegetables. Heating it further increases the speed at which the product will be dried because the air can absorb more water and because the product releases water faster at higher temperatures. Air can be heated with solar energy or by burning natural or fossil fuels. Different foods have different maximum drying temperatures. It’s important not to exceed these temperatures because the dried product because above this temperature the quality of the dried product will degrade quickly. Another reason for not drying at very high temperatures is that the product dries quickly on the outside but remains moist on the inside.

**When is the drying process finished?**

To test whether a product is sufficiently dry, wait until it has cooled. Warm products are softer and contain more water. Dried fruits may contain 12-14% water, while vegetables should be dryer, at 4-8% depending on the type of fruit. It’s difficult to measure moisture content without a drying oven or moisture meter, but here are some guidelines:

* For fruit, it should not be possible to squeeze out juice.
* Fruits should not be so dry that they rattle when drying trays are emptied.
* It should be possible to knead a handful of fruit pieces, but they should not stick to each other.
* Dried green vegetables should be brittle and easily rubbed into a powder.

**Packing and storing dried fruit and vegetables**

At the end of the drying process, remove all foreign material (stems, etc.), as well as pieces that are not yet dry enough. Dried vegetables easily absorb water from the surrounding air because of their low water content, so pack vegetables in a dry room. It’s a good idea to finish drying during the warmest part of the day when the relative humidity is at its lowest. Cool dried products in the shade and, if the work has been done hygienically, cooled products can be packed immediately. Packing material must be waterproof, airtight, and insect-proof. Dried products will only remain viable if stored so that they remain dry and are protected from insects. Normal plastic bags (properly sealed) are sufficient for a period of time, but are not entirely gas- and waterproof.

**Consuming dried products**

Soak dried products in a small amount of water in a pan. Soak fruit for 8-12 hours at a dried fruit to water ratio of 2:3. Soak vegetables for half an hour at a dried vegetable to water ratio of 2:2.5-4.5. Products in powder form do not need to be soaked before they are consumed. After soaking, cook the product for 10 to 15 minutes. Some types of fruit have a shorter cooking time than this, while others require more time.

*For further information, please see documents 3, 10, 11, 12, and 13.*

**Preserving African leafy vegetables and kale**

During the rains, there is overproduction of African leafy vegetables, while in dry seasons, there is little supply. Dried vegetables take only a short time to cook and taste like fresh ones.

* To make one kilogram of dried African leafy vegetables, you need seven kilograms of fresh vegetables.
* In Kenya, a farmer can sell a kilogram of dried vegetables for 600 shillings (about $6 US).
* *Clean:* Cut off the stalks of harvested vegetables. Remove any dry leaves and foreign materials. Then wash and rinse the vegetables with lots of water.
* *Blanch:* Heat water. For each litre of water, add one teaspoonful of salt and mix thoroughly while heating. Put the vegetable in cotton cloth then immerse in the boiling water and stir them for five minutes to ensure they all have full contact with water.
* *Rinse:* Rinse the vegetables with cold, clean water and spread them in thin layers on solar drier trays or any clean, flat surface. Leave the vegetables to dry for 2-5 days, depending on the weather conditions. When dry, remove the vegetables and store them in a cool, dry place before packaging them.
* *Packaging:* Pack the vegetables in 100 gram units in self-sealing polythene bags. Store in airtight containers in a cool, dry place. Vegetables can last for at least six months when stored in this state.

**Kale**

After harvest, wrap fresh kale in damp paper towels, place in a large plastic bag, and store in a refrigerator for 14-21 days. Do not wash before storing or kale will become limp. Store in an area with adequate air circulation.

* Add one teaspoon of salt to five litres of cold water and dip the kale in the water for one minute.
* Drain the kale and spread them in the shade for 2-3 days, depending on the weather.
* Dried kale can be stored for up to six months.

*For further information, please see documents 4, 10, 11, and 13.*

**Green banana flour**

Rural farmers can process green bananas into low-gluten flour at home when they have too many to immediately sell or eat, and in order to provide a cushion during lockdowns or curfews. Here is how to process green bananas into flour:

* Remove the bananas from the bunch.
* Steam for about 10 minutes to decrease the amount of sticky sap, improve the colour, and make peeling easier.
* Peel and slice into small pieces.
* Soak the pieces in a 5% citric acid solution for about 30 minutes, then drain.
* Sun-dry on a plastic rack until the bananas contain 10% moisture. Farmer groups can collectively buy a moisture meter to test moisture levels. Alternatively, after continual drying, the banana slices become brittle and easily breakable when totally dry.
* Mill dried bananas and sift the flour.
* Package banana flour and store in a closed, cool, and dry place.

*For further information, please see document 7.*

**Preservation by heating**

One of the most common and effective ways to preserve fruits and vegetables is to prepare them and place them in airtight containers, which are then heated. The high temperatures ensure that microorganisms are killed and the enzymes that contribute to rotting are inactivated. The heating method for fruit is different than for most vegetables. Fruits can be heated in boiling water (100° C), whereas most vegetables have to be heated at temperatures above 100° C because they have a higher pH and are thus more susceptible to bacterial contamination.

The advantages of heat preservation are:

* Most micro-organisms are destroyed so there is less chance of spoilage.
* After being sterilized and stored, the food can be kept longer and more safely.

The disadvantages are that:

* + Heat preservation requires an investment in heat-resistant storage containers such as cans or (reusable) glass jars, cooking utensils such as a steamer, and fuel.
  + It’s labour-intensive.
  + It requires access to abundant clean water.
* Preserved fruits and vegetables have lower nutritional value and generally less taste than fresh products. However, heat preservation results in relatively little loss of nutrients.

*For further information, please see document 11.*

**Homemade refrigeration**

Small-scale farmers who have fresh produce but lack an immediate market can use locally-available materials to make a homemade refrigerator. Such a refrigerator is a wooden shelter with walls of wire mesh or net, and is padded with charcoal. A pipe with small holes runs over the charcoal, dripping water droplets. The structure cools on the inside where fruits, vegetables, and other perishable food items stay cool even when it’s hot outside.

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*For further information, please see document 3.*

**Key definitions**

*Blanching:* This involves scalding vegetables in boiling steam or water for a short time and before freezing. Blanching stops or slows enzymes that cause loss of flavour, texture, and colour. It also cleans dirt off vegetables and stops loss of vitamins. Blanching wilts the vegetables, making them easier to pack. Blanching takes from 10 seconds to 10 minutes, depending on the vegetable.

*Evaporative cooling:* This occurs when air with low humidity passes over a wet surface and absorbs moisture which evaporates from the wet surface. The faster the rate of evaporation, the greater the cooling. The efficiency of evaporative cooling depends on the humidity of the surrounding air.

*Multi-storey garden:* These are gardens with different sized circles layered on top each other. The soil is held in place by hardened black polythene. On these gardens vegetables like kales, spinach, coriander, tomatoes, can be grown as well as strawberries.

*Sterilization*: Preservation method in which bottled or canned food is heated at a temperature of 100 – 121°C. This process kills all micro-organisms, and extends the product’s shelf life up to a maximum of one year, but it does not kill the spores, which can grow into bacteria once the container is reopened.

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