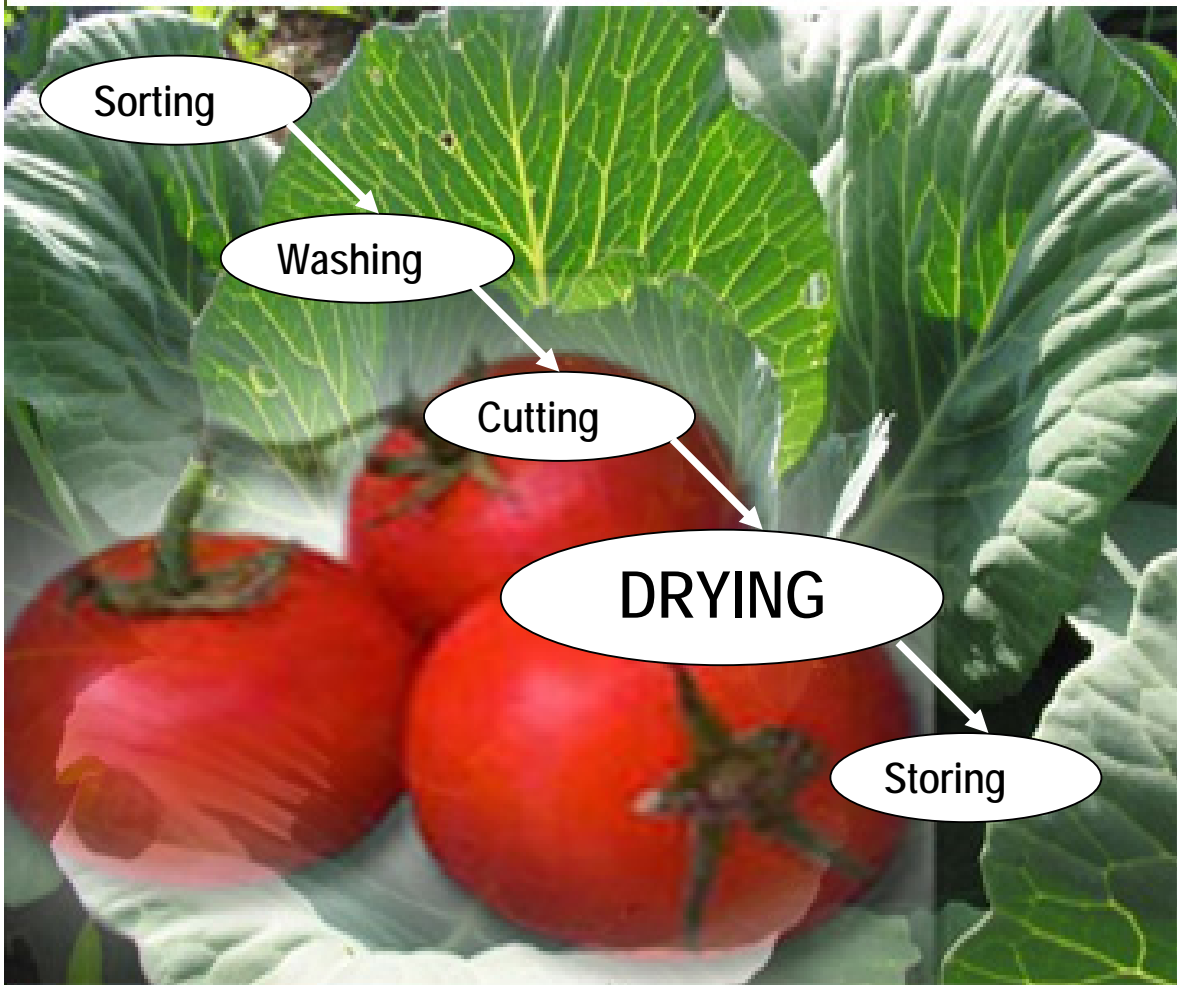


Cities Farming for the Future

How to preserve cabbage and tomato by drying



Published by the RUAFF-CFF West Africa Programme-Accra



Introduction

Vegetables in urban agriculture production

Preserving foods, especially vegetables, by drying is the oldest method of food preservation. A wide variety of vegetables are produced by urban farmers and available on the markets in Accra, Ghana.

The RUAF-CFF West Africa programme has developed and published simple guides to assist urban dwellers in Accra, Ghana; Freetown, Sierra Leone; and Ibadan, Nigeria to preserve vegetables by drying.

Benefits of preserving vegetables by drying

Drying vegetables can be beneficial for both consumers and also farmers.

Benefits for the consumer:

- Drying ensures continual supply, use and consumption of the vegetables. Fresh vegetables are normally dried during times of excess production. Thus through drying and storage, consumers will have **access to vegetables over a longer period** rather than only during the periods of harvests.
- Fresh vegetables quickly lose their quality immediately after harvesting, through being damaged, wilted and eventually becoming rotten. Drying vegetables makes them **storable for a longer period** and they only take up limited space and do not require refrigeration.
- Dried vegetables provide a ready source of nutritional inputs into the family diet and can contribute to **a well balanced diet throughout the year**.
- Dried vegetables are useful in backpacking, preparing packed lunches, for camping, and for preparing quick snacks. In addition, they are suitable to prepare **special meals with unique flavour and taste**.

Benefits for the farmer:

- Sometimes urban farmers sell vegetables at very low prices during the peak harvest season because they cannot store or preserve the surplus harvests. Drying vegetables adds value to the products and often dried vegetables fetch higher selling prices for urban farmers, who can thus **increase their bargaining power and revenue**.
- In case of overproduction of vegetables, drying can be used to **make the vegetables storable** so that they can be sold later and do not need to be thrown away because there is no demand at the moment.

Remember!!

Save for tomorrow what you do not need today!

Different methods for drying vegetables

a) Sun drying

Sun drying is a process which involves evaporation of water from vegetables by sun assisted by movement of the surrounding air through the wind. Usually the **thin cut vegetables** are placed on a tray or on a grid and **put in the sunshine until they are dry**. This method does not need any investment but also bares a **high risk of product loss**. The losses due to dust, animals, insects, rain, fungi, etc. can reach up to **40%**.

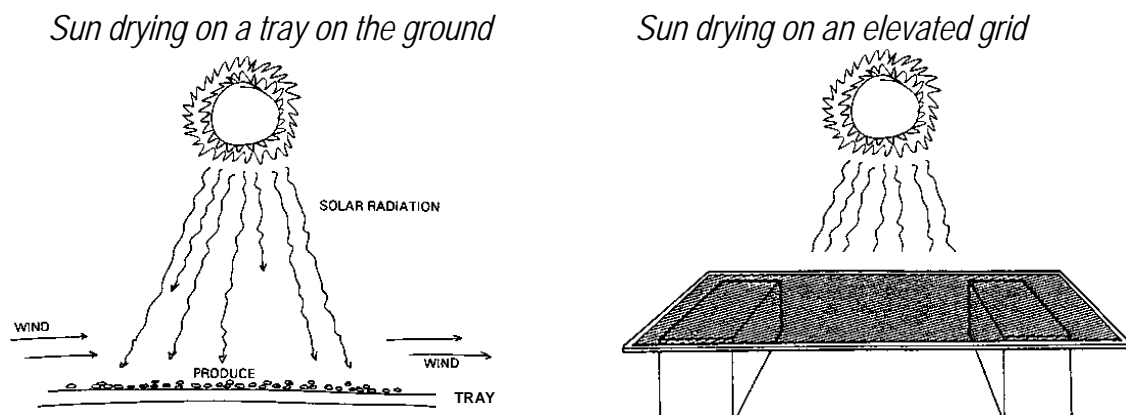
The climate in most parts of Africa is appropriate for sun-drying. In order to perform sun drying successfully it is important to have **bright sunshine and temperatures in the sun above 32°C which is both common in Accra**. However, the drying process is faster the lower the relative humidity of the air is.

Therefore the best time to dry vegetables in Accra, Ghana is **from December to February** because during this time the temperatures are high and there is not a lot of rain. As there is high relative humidity in the morning hours, the **drying should only be done in the afternoon**. During the night and in the morning the vegetables have to be sheltered at a dry place. As sun drying is dependent on the weather conditions, it takes more time (between 2 to 6 days) and in general the drying quality is lower than with oven-drying (see below).

Although the sun drying method is cheap, there are problems associated with it often resulting in a poor quality dried product; these problems include the following:

- No control over the drying process
- Possible contamination of the product by dirt, rodents, straying animals
- Infestation by insects or fungi; and
- Exposure of the product to rain, which causes repeated wetting and rehydrating

SUN DRYING



- In Accra it is best to dry in the sunny afternoons from December to February.
- Drying on an elevated grid allows better air circulation and faster drying.
- Product losses can reach up to 40%.

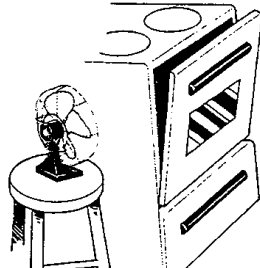
Image source: Kitinoja L, Kader A.A., 1995, Small-scale post-harvest handling practices – A manual for horticultural crops, FAO corporate document repository, <http://www.fao.org/WAIRdocs/x5403e/x5403e0c.htm> 2008-12-02

b) Oven drying

In case an oven is available another possibility to dry vegetables is oven drying. Oven drying can be done **all the year around** as it is not dependent on the weather conditions. The oven should be able to **maintain constant temperature** and it should have **good ventilation**. The oven drying method is quicker (between 6 and 24 hours) than the sun drying and the drying quality is higher.

For oven drying the vegetables are put on the oven trays or better oven grids, and the oven is **preheated to 60°C**. It is possible to put more than one tray into the oven at once but then the trays need to be 5 to 8 cm apart from each other and also from the top and the bottom of the oven. During drying **open the oven door a little bit** (like in the picture below) to allow moisture to go out. In addition, a fan put in front of the oven door can be used to increase ventilation and thereby reduce drying time. Special care has to be taken that the vegetables do not get burned in the oven.

OVEN DRYING



- Can be done all year around.
- Quicker than sun drying.
- Better drying quality than sun drying

Image source: Kitinoja L, Kader A.A., 1995, Small-scale post-harvest handling practices – A manual for horticultural crops, FAO corporate document repository, <http://www.fao.org/WAIRdocs/x5403e/x5403e0c.htm> 2008-12-02

c) Solar drying

Solar drying is like sun drying but is performed with a device called solar dryer which keeps the heat for example under a glass cover. Various types of solar dryers exist. It requires **little investment** to buy or build one. A solar dryer enables to better control the drying process and it is possible to achieve quicker drying compared to the sun drying and the vegetables are protected from dust, animals, insects, rain, fungi, etc. during the drying process.

SOLAR DRYING

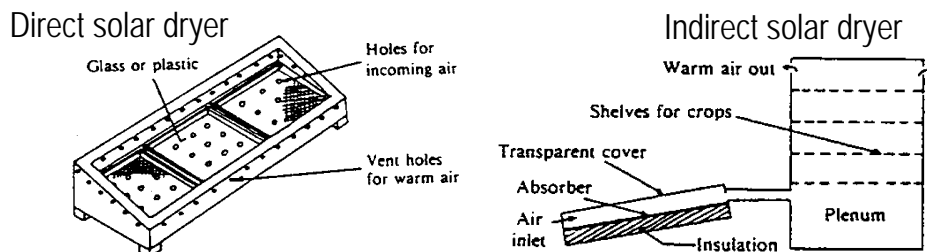
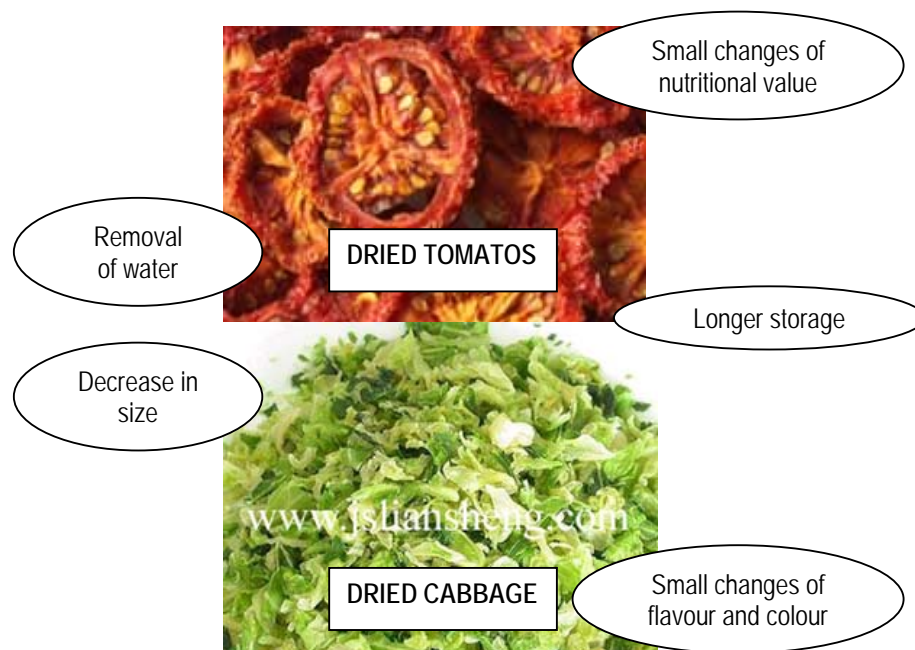


Image source: Kitinoja L, Kader A.A., 1995, Small-scale post-harvest handling practices – A manual for horticultural crops, FAO corporate document repository, <http://www.fao.org/WAIRdocs/x5403e/x5403e0c.htm> 2008-12-02

For use of solar dryers please see www.ared.org/country/ghana/references.pdf and <http://www.knowledgehound.com/topics/solarcoo.htm> or contact the Solar Energy Laboratory, Mechanical Engineering Department, KNUST, or TechnoServe in Accra.

Characteristics of dried vegetables



Appearance

As drying removes water, the dried vegetables shrink and decrease in size and weight, thus requiring less space for storage. For production of 1 kg of dried tomatoes you need 25 kg of fresh tomatoes. When water is added, the dried product returns to its original size, and the taste of dried vegetables can be similar to that of fresh vegetables.

Nutritional value

Fresh vegetables provide essential components of a balanced diet; these include calories, fibre, minerals and vitamins. During the process of drying the majority of these components are retained. The calorie content of the dried food will be higher per unit of weight because nutrients become more concentrated as water is removed.

Spoilage

Dried vegetables have a low water content which limits the growth of microorganisms and prevents spoilage of the vegetables. In addition, chemical processes which result in undesirable changes in flavour and colour of the vegetable can be prevented by drying vegetables. These two factors make dried vegetables storable for up to 12 months. Although dried vegetables can be stored for a longer period they can also spoil. Dried vegetables are susceptible to the growth of fungi which can produce mycotoxins. In case fungi are growing on the dried vegetables it is not safe to eat them anymore and they have to be discarded.

Remember!!

Properly dried vegetables can enrich your diet throughout the year!

Drying vegetables in 5 easy steps

Drying vegetables is a comparatively simple process, requiring little outlay of equipment, time and money. Although drying vegetables is not difficult, it takes time, constant attention, skill, and understanding of the principles of food drying methods.

Before you start

Handling of food always requires that a person is following the basic hygienic rules in order to get a safe product. Observing absolute cleanliness and high levels of sanitation are important in the processing of dried vegetables.

- Wash your hands before preparation of the vegetables.
- Wash your hands with soap after going to the toilet.
- Wash and sanitize all surfaces and equipment you are going to use.
- Protect kitchen areas and food from insects, pests and other animals.
- Exclude any person who is unwell or has infected wounds or sores, or is suffering from any form of gastric disorder such as diarrhoea from the processing operations.

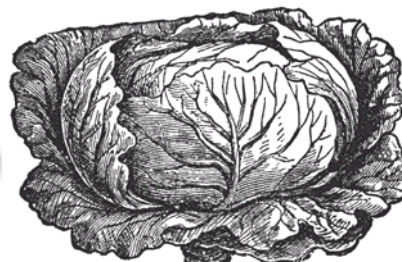
1. Sorting

Fruits and vegetables selected for drying should be fully developed, mature, fresh, and in the best condition; ripe, and firm. Wilted or immature materials are unsuitable for drying because they become flaccid, discoloured, and have unpleasant flavour. Over-mature vegetables are usually tough and woody. Over-ripe or bruised vegetables tend to spoil before the drying can be fully accomplished. The drying process should therefore be initiated while the vegetables are still fresh ideally directly after harvest. Fresh vegetables which are contaminated with moulds must be discarded and can not be used for drying.

GOOD QUALITY is...



- + ripe
- + fresh
- + firm
- + in best condition



- not overripe
- not bruised
- not spoiled
- not diseased

Remember!!

Drying cannot improve poor-quality vegetables!

2. Washing

Vegetables from urban agriculture can contain a dangerous amount of microorganism on their surface. Therefore it is necessary that the vegetables are washed properly with a washing solution before they are dried.

Different washing solutions for washing the vegetables:

- Half a tablet of chlorine in 5 litres of water to wash.
- A knife tip or one small tablet of potassium permanganate in 5 litres of water.
- A tea spoon of bleach (Eau de javel) in 5 litres of water.
- One part of vinegar in 5 parts of clean water.

Washing procedure:

- Wear plastic gloves and wash the selected vegetables by scrubbing them individually in one of the washing solutions described above.
- Let the vegetables soak in the washing solution for 5 to 10 minutes.
- Rinse the vegetable with clean water after washing.
- Take special care to avoid breaking the skin of the vegetables during cleaning and thereby contaminating the flesh.
- Place the washed vegetables in a clean basket or bucket.

For GOOD WASHING use...



- + chlorine tablets
- + potassium permanganate
- + bleach (Eau de javel)
- + vinegar

Let the vegetable soak for 5 to 10 minutes in the solution!

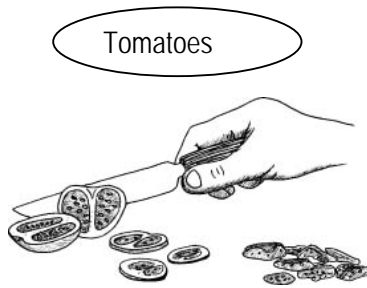
Remember!!

Proper washing of the vegetables reduces the amount of harmful microorganisms!

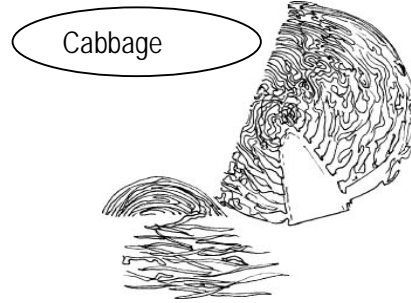
3. Cutting

There are different ways how to cut different vegetables for drying. It is advisable to cut the vegetables in very fine stripes or slices, because the thinner the pieces are the faster they dry.

GOOD CUTTING...



- + cut the tomato in halves
- + remove the seeds if you want
- + cut tomatoes in 5 mm (= 0.5 cm) or thinner slices



- + cut the cabbage in two
- + remove the central part (= the core) of the cabbage
- + cut the cabbage leaves into thin strands

Remember!!

The thinner the slices/strands are the faster they dry!

4. Drying

Before the actual drying is started it is advisable for some vegetables (e.g. cabbage) to blanch them whereas for others no blanching is necessary (e.g. tomatoes).

How to blanch Cabbage:

- Heat water until its boiling
- Put the strands of the cabbage inside (not too many!)
- Boil the cabbage for 4 minutes
- Afterwards immediately put the cabbage into cold water for 4 minutes
- Let the cabbage dry on cloth

Independent of which drying method you use (sun drying, oven drying, solar drying) always remember that the **drying time should be kept as short as possible** in order to prevent spoilage of the vegetables during drying. To achieve a short drying time it is best to cut the vegetables thin, to keep the temperature at a constant level, to have good air flow around the vegetables and to prevent the vegetables from moisture.

Drying procedures:

Sun drying:

- Put the cut vegetables on a tray or grid (a grid allows better air circulation) in a single layer.
- Place the vegetables into the sun during the afternoons (take care to protect them from animals, rain, etc.).
- Cover vegetables with fine netting to keep off insects.
- For even drying turn the vegetables over at least once a day.
- Shelter vegetables at night and during the morning.

Oven drying:

- Put the cut vegetables on a tray or grid (a grid allows better air circulation) in a single layer.
- Preheat the oven to 60°C.
- Place tray or grid in the oven and leave the oven door a little bit open to allow moisture to go out.
- Leave the vegetables in the oven until they are dry.
- Be careful to not burn the vegetables in the oven.

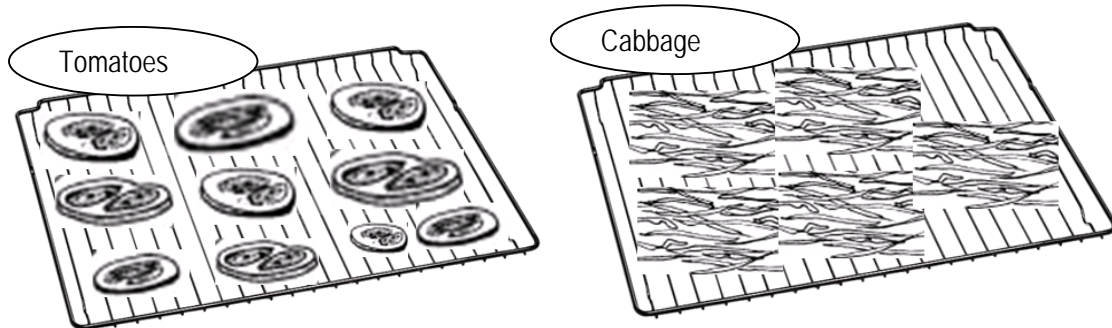
How to see that the vegetables are dry?

For oven drying a drying time for cabbage of 10 to 12 hours and for tomatoes of 6 to 24 hours is suggested. Sun drying takes much longer and can last up to 6 days. As the drying time can vary it is necessary to check the vegetables for dryness to know when the drying is finished. For testing if the vegetable is dry let it cool down to ambient temperature.

Cabbage should be crispy and brittle. When you touch the outer part of the strands they should crumble to pieces.

Properly dried tomatoes have a dark red colour and feel dry and leathery but not hard or brittle. They should not be “tacky” or moist. You should be able to bend them easily back and forth. When you touch a properly dried tomato in the centre, no pulp should stick to your finger.

For GOOD DRYING...



- + Distribute the blanched cabbage leaves and tomato slices on a tray or a grid
- + Take care to have the right conditions (constant temperature, good air circulation, protection from moisture, animals, etc.)
- + Test the vegetables for being dry

Remember!!

The right conditions while drying are important to get dried vegetables of good quality!

5. Storage

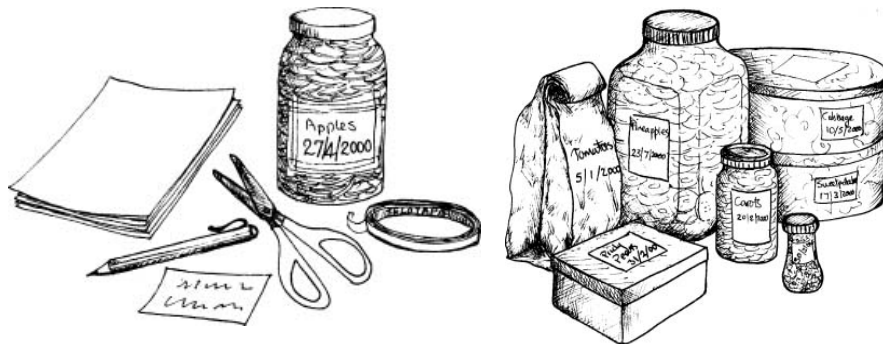
Vegetables that are dried outdoors can become contaminated with insects. Therefore you must destroy any insects and their eggs before storage of sun dried vegetables. To destroy insects and their eggs, place the packaged dried vegetables in a freezer for 48 hours or spread unpackaged dried vegetables on a cookie sheet or in a shallow pan in a preheated 50°C oven for 2 hours or 70°C oven for 30 minutes.

To add value to dried vegetables and to prolong their shelf life they can be converted into flakes and powders. Dried vegetable flakes and powders can be added to soups, stews, and other foods for colouring and flavouring.

Flakes can be made by pounding the dried vegetables with a mallet or by crushing them in your hands or with a rolling pin. Powders can be made by using a food processor or blender.

Dried vegetables require very little storage space. They can be stored in sealed plastic bags, air-tight jars or other suitable containers. If you use coffee cans, place the vegetables in plastic bags first and seal each bag individually. Pack the vegetables tightly and squeeze out all excess air. Label the bags with the date and store them in a cool (15°C), dry, and dark place. The dried vegetables are storable for up to 1 year. Well-wrapped vegetables can be stored in the freezer for longer periods.

For GOOD STORAGE...



- + Pack the dried vegetables in sealed plastic bags or air tight jars
- + Label the containers with the date of production
- + Store containers in a dark, dry, and cool place

Remember!!

Proper packaging and storage is necessary to have good quality dried vegetables!

Review: From fresh to dried vegetable in 5 steps



1. Step: Sorting

Select ripe, fresh, firm, not overripe, not spoiled, not diseased, not bruised vegetables.

Good quality



2. Step: Washing

Wash with chlorine tablets, potassium permanganate, bleach or vinegar solution. Soak vegetables for 5 to 10 minutes.

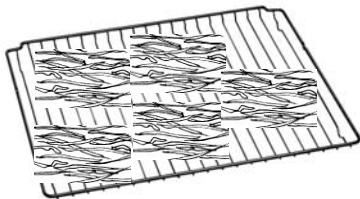
Good washing



3. Step: Cutting

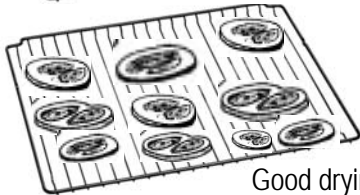
Cut the vegetable in as thin slices or strands as possible.

Good cutting



4. Step: Drying

Put the slices in a single layer, well distributed on a tray or grid. Take care about the right drying conditions (constant temperature, good air circulation, protection from moisture and animals, etc.).



Good drying



5. Step: Storing

Pack vegetables in sealed plastic bags or air tight jars. Label them with the date of production and store them at a dark, cool, dry place.

Good storing

Cooking dried vegetables

Dried vegetables can be eaten when they are incorporated directly in soups and stews during cooking. They can also be converted into powdered forms using a mortar and pestle and then added to salad dressings, dips, and broths.

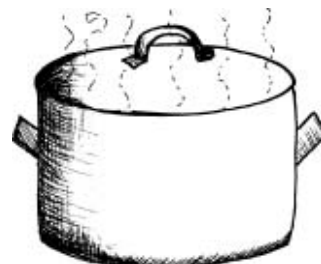
Useful tips for cooking dried vegetables

- Water removed during drying must be replaced either by soaking, cooking or a combination of both.
- Roots, stems, and seeds of vegetables should be soaked covered in cold water for half an hour to two hours until nearly restored to their original texture.
- Never supply more water than they can take up and always cook in the water they have been soaked in.
- Greens, cabbage and tomatoes do not need to be soaked. Add only sufficient water to cover the dried slices, and then simmer until tender.
- Many vegetables lose their fresh flavour during drying. For this reason, you may add flavouring such as basil, garlic, onions, and chili sauce during cooking to restore the flavour.

Preparing dried vegetables...



- Soaking:
- Put vegetables in cold water
 - Soak them for up to 2 hours
 - Use water for cooking



- Cooking:
- Put vegetables in water
 - Cook until tender

Remember!!

If drying vegetables is done properly it can result in a storable, healthy, safe, and tasty product!

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For more information please contact

*The Regional Coordinator
Dr. Olufunke Cofie
International Water Management Institute
PMB CT 112 Cantonments, Accra, Ghana
Email: o.cofie@cgiar.org
Tel. +233-21-784753/4*

*The City Coordinator
Mrs. Evelyn Adzorkor Doku
Ministry of Food and Agriculture, Accra Metropolitan Assembly,
Accra – Ghana.
Email: dokuadzorkor@yahoo.com
Tel... +233-20-8232267*

Design and editing:

Richard Kumassah and Regina Jeitler