

Part I Shiitake

Chapter 7

Shiitake Post Harvest

PROCESSING SHIITAKE

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Fresh Shiitake in the Market

Some people prefer the fresh shiitake, because these mushrooms have a particular taste and delicacy. Shiitake is easy to prepare in dishes with vegetables. Some people enjoy the special fragrance of dried shiitake. Although dried shiitake can be stored for a long time, many farmers, especially those living near cities or shiitake processing factories, prefer to sell fresh mushrooms because they need to see returns on their investment quickly and because they must use additional labor for the drying process.

Fresh shiitake mushrooms have a short shelf life, so they must be sold quickly or preserved in cold storage. Even using cold storage the shelf life of fresh shiitake is limited to 2 weeks. The best method for storing fresh shiitake is to keep them at 1-4 °C, packed in containers wrapped with microporous film. This can minimize respiration, reduce the humidity in the container and diminish spoilage (the growth of bacteria and fungi).

Shiitake Preservation (by Maria Catarina Megumi Kasuya, Brazil)

In the Brazilian market shiitake mushrooms are mostly sold fresh, being packaged in expanded polystyrene trays that are covered with a stretched PVC plastic film. In this condition, the shelf life of the product can be as long as seven days at refrigeration below 10 °C (Santana, 2003). Wrapping the trays with films of lower permeability enhanced the shelf life up to 15 days, under the same refrigeration storage temperature. One, two, three, four and five layers of PVC plastic film have been tested. When one layer is used the result is shown in Figure 1A and when with two, three or four are used the results are similar to those in Figure 1B, but when five layers are used, fermentation begins and the mushrooms are destroyed. Considering the actual demand for fresh and ready to eat products, minimally processed shiitake was evaluated, but the steps of washing and sanitation reduced the shelf life and accelerated the chemical spoilage.

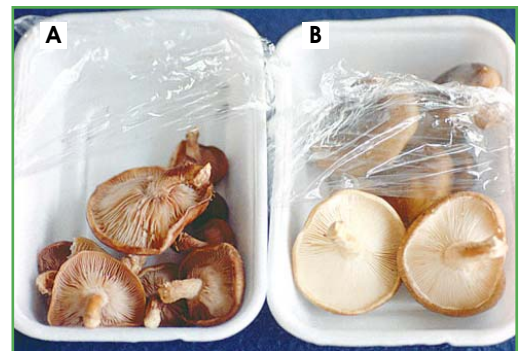


Figure 1. Shiitake in expanded polystyrene trays and covered with a stretched PVC plastic film, one layer of the PVC plastic film (A) and two layers of the PVC plastic film (B), after 15 days storage at 10 °C.

Processing for Long-term Preservation

There are many methods of long-term preservation, including drying, canning, and pickling. The quality of the preserved product is comparable with that of fresh shiitake if the processing and storage are done properly. Some consumers prefer the dried shiitake.

Not only is drying environmentally safe, the technique has been perfected to the extent that the dried shiitake maintain their shape and color. There are several methods commonly employed for shiitake drying.

Drying

Sun drying: Shiitake mushrooms are spread on shelves in such a way that the gills face upward and are directly exposed to sunlight. The drying time required will vary depending on the weather conditions. In general, the quality of the sun-dried shiitake is lower than that dried by the thermal method.

Sun drying is used currently at initials only when the shiitake is over produced or over wetted and when the sunlight is strong. However, the sun dried fruitbodies for one or two days need to be enhanced the flavor and appearance by the thermal process.



Figure 2. Shiitake drying under sunlight

Thermal drying: Thermal drying uses hot air blown into the dryer in which the shiitake is arranged on shelves (Fig. 3). Hot air can be produced by electric power or burning charcoal and then delivered through recirculation vents. The size of the drying chamber varies depending on the production scale. Usually, 15 shelves are installed with an interval of 15cm between shelves. Shiitake are placed on the shelves with gills upward (Fig. 4).



Figure 3. Large chamber for shiitake drying



Figure 4. Gills face upward on the shelf

The drying chamber should be maintained at 40-50°C during 24 hours. Growers are advised to sort shiitake according to quality grade (thickness and size) before drying. The dried shiitake should be cooled one hour before termination of drying process, and then should be put into polyethylene bags, sealed and kept in a dry, cool and dark place. For prolonged storage, the shiitake should be packed in cartons or wooden boxes and kept in a low temperature storage area. The shiitake produced by this method have better quality including higher hygienic conditions and brighter color compared to sun-dried mushrooms. Dried shiitake easily absorb moisture from the air, so they should be properly stored and examined frequently for insects or molds, especially during the rainy seasons.

Canning and bottling

Canning and bottling are alternate methods of shiitake preservation. The processes of canning and bottling are similar, and differ mainly in procedure during sterilization and handling afterwards. Cans may be sterilized when they are tightly sealed, but bottle must be sterilized with the caps closed halfway. The canning process requires a rapid cooling in the wash sink after the autoclave, while the bottling process requires a slow cooling in fresh air after the caps have been sealed. Both processes are divided into ten basic operations: selection, trimming, cleaning, cooking, canning, sterilization, cooling, labeling, packing and storage.

The shiitake used for canning are generally fresh and healthy. If the mushrooms are not canned immediately, they should

be refrigerated until processing starts. Grading and trimming are required for shiitake product uniformity. The stems should be trimmed to 1cm in length. Cleaning the mushrooms involves washing the mushrooms in water at 90°C for 5 minutes at a ratio of 1:1.5 (shiitake volume: water volume), as this will eliminate the air in the shiitake. The shiitake are then placed in the cans and sodium chloride (2.5%) and citric acid (0.2-0.5%) are added. Before sealing the can, the air is removed. Sterilization of the sealed cans is done in an autoclave at 121-130°C for 15 minutes.

The canning process requires a variety of equipments, so this method is widely used by the larger members of the industry. Small-scale growers perform bottling without difficulty. Canned and bottled shiitake are consumed by restaurant and hotel customers.

Home bottling is a simple procedure of applying heat to food in a closed jar in order to interrupt the natural decaying that would otherwise take place. It requires "preprocessing" or "heat processing" foods. Proper home bottling includes:

1. Placing prepared food in home jars (bottles) which are then sealed with two-piece vacuum caps;
2. Heating the filled jars (bottles) to the designated temperature using the correct type of bottle for the food being processed;
3. Processing the filled jars (bottles) for the required time as stated by an up-to-date, tested recipe in order to destroy the spoilage microorganisms and inactive enzymes;
4. Cooling jars (bottles) properly, allowing the lids to vent excess air from the jars in order to form a vacuum seal.
5. After 24 hours, checking the lids for a seal. Sealed lids curve downward. Press the center of the lid to ensure it does not flex up or down. Reprocess or refrigerate any unsealed jars. Remove bands. Wipe jars and lids with a clean, damp cloth and dry. Wash bands in soapy water, dry and store.
6. Label and store jars in a cool, dry, dark place. For best quality, use home canned foods within one year.

When followed exactly, the processing methods of tested home canning recipes adequately destroy normal levels of heat-resistant microorganisms. After processing and upon cooling, a vacuum is formed and the lid seals onto the jar. This ensures that home canned foods will be free of spoilage when the jars are stored properly and remain vacuum-sealed. This seal prevents other microorganisms from entering and contaminating the food.

Pickling

- 1) Salt: After cleaning and cooking for 2 minutes, the shiitake is drained and transferred to a container (large or small) and salt is added (22% w/w) (Fig. 5). Before eating, the shiitake is rinsed in water and/or prepared with other spices according to personal preference.
- 2) Vinegar: The shiitake for pickling should be firm and fresh. Preparers should always ensure that the mushrooms are as fresh as possible, and are prepared correctly.

Use only the best quality vinegar with an acetic acid content of 5-7%. Malt vinegar is recommended for general pickling purposes, but white wine or cider vinegar can be used for a more delicate flavor and color. More adventurous preparers could try vinegar flavored with herbs and spices. Always use stainless steel knives and utensils. Peel and trim the mushrooms where required. Remove any moldy or marked parts. If cooking is required, steam them in light syrup.

In some cases the shiitake will need salting to extract excess moisture in order to the vinegar can preserve the mushrooms. The recipe followed should indicate either dry-salting or wet-salting. For dry-salting, shiitake are placed in a non-metallic bowl, covered with salt and left overnight. For wet-salting, a brine solution is poured over the shiitake and then left to soak overnight. After salting, rinse shiitake several times to remove all salt, and pat dry with kitchen paper.

Pack the prepared shiitake into sterilized containers. Do not pack too tightly. Cover the packed shiitake with vinegar, and tap the sides to release any pockets of air. Leave at least 1.5cm space at the top of the container after packing, so that you can pour the vinegar or syrup in to almost the top of the jar.

Ensure everything is well covered. If necessary use a crumpled piece of greaseproof paper to push down the mushrooms until they are completely under the liquid. This paper can be removed after 2 weeks. Tightly seal the containers with the lids.



Figure 5. Shiitake pickling

Frozen slices or pieces

Nowadays, frozen food products are widely accepted by urban consumers due to their convenient preparation. Shiitake is also entering the frozen food industry. Some shiitake products are mixed with legumes like green beans or with corn. The processing is the same as for the other legume or corn frozen product. After cleaning, the shiitake is sliced or cut in pieces by a machine, then, it is cooked. After draining the water off, the mushrooms are frozen immediately. After packing, they can be stored in a frozen storage for a long period, and can be sold in all seasons (Fig. 6).



Figure 6. Frozen pieces of shiitake

Shiitake powder

During harvesting and processing, there are many broken shiitake pieces, cut stems and deformed shiitake. These are either incorporated into the processed products or they are ground into powder. Shiitake powder is generally used as a food additive (Fig. 7).



Figure 7. Shiitake powder as food additive



Figure 8. Mushroom tea including shiitake

Shiitake tea

To make a tea from dried shiitake, cover a handful of the dried mushrooms with boiling water, steep for 10-30 minutes, and strain. The leftover mushrooms may be used in cooking.

Some people like to boil dried shiitake in water and simmer for 15 minutes. Season the shiitake with soy sauce and eat it. Drink the water hot. Some like to soak 2-3 dried mushrooms for an hour, or until they are soft, then add 4 cups of water, and bring to a boil with a pinch of sea salt. They simmer this for about 20-30 minutes, until 3 cups of tea are left, and then drink half a cup at a time.

Instant shiitake is available in either powder or granulated form in glass jars or in sachets. Powders and granules are preferred by both producers and consumers because of the ease of dissolving in hot water. It is up to the user to control how much is used.

Dried shiitake is ground and then put into solution with water. This stage is called the extraction. This solution may be further concentrated before the drying process begins by either vacuum evaporation or freeze concentration.

Drying is a very important step and two different methods are used in the processing plants: freezing and spray drying. Each has its own advantages and disadvantages.

Freeze-drying: the basic principle of freeze-drying in the process for producing instant shiitake is the removal of water by sublimation. Freeze-drying has grown in popularity to become a very common method. Although it is frequently more expensive than other methods of drying it generally results in a higher quality product, a factor which is very important in the instant product market. Freezing too fast leads to large ice crystals and a very porous product and can also affect the color of the shiitake granules.

Spray drying: This method of drying is preferred to freeze-drying in some cases because of its cost effectiveness, short dry-

ing time, usefulness when dealing with such a heat sensitive product, and the fine, rounded particles it produces. Spray drying produces spherical particles of size roughly equal to $300\mu\text{m}$ with a density of $0.22\text{g}/\text{cm}^3$. To achieve this, nozzle atomization is used. Various methods of nozzle atomization can be used in combination with high-speed rotating wheels.

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