Chapter 4

PACKAGING and PRESERVATION

The primary reason for growing mushrooms is to sell them and make profit. If we think of clean-up as the first step in growing, then the last step in growing is harvesting. We might also think of harvesting as the first step in preparation for selling. Then the steps in preparation for selling might look like:

1. Pick the mushrooms
2. Cool the mushrooms (3 – 5°C, 37 - 41°F)
3. Trim them
4. Pack them
5. Ship (Sell) them

Fig. 22. Tills of freshly picked *Agaricus* mushrooms stacked on a cart, to be thaken to packing area. Oyster mushrooms are more fragil.

You must pull the mushrooms to harvest them. You must not cut them. It is very important that the edge of the mushrooms are still curled under when they are picked. When the edges flatten, the spore will be released into the air. The release of spores does two things, it makes the air dangerous for workers, it can result in severe hay fever or asthma when workers breath

Fig. 23. Triming *Agaricus* mushrooms, Taiwan, 1974.

them. Spores represents a significant weight, so there is less to sell. Errors are often made in picking, so although you believe you are picking all, before they release the spores, it is wise to wear a surgical mask in growing rooms. An additional reason to pick early is that after the spores leave, the mushroom has no biological purpose, so it will begin to decline rapidly and will soon look old.

Cooling mushrooms helps them last longer and look better. The best way to cool mushrooms is to place them in a chamber and draw a vacuum. That process is used for leafy vegetables. Of course, expensive equipment is required, but it will cool faster than any other method. The cooling is the result of water being evaporated, that suggests that you will dry the mushrooms, but less water is used than will be lost by evaporation with

Fig. 24. Applying the plastic overwrap to retail trays of *Agaricus*, 1973.

other methods. Faster cooling means that the mushrooms will last longer for the customer. Cooling may also be done with mechanical refrigeration or even by putting them in a container with ice. However, once they are picked they should not be in direct contact with water, including melted ice.

Oyster mushrooms are much more fragile than *Agaricus.* Although it is common to harvest into large tills, it is very unwise with oyster mushrooms, **Fig. 22**. *Agaricus* may even be poured from till to till. Such treatment would break and destroy the appearance of oyster mushrooms.

STEMS AND TRIMMING

Because the mushrooms have been pulled, they will often have a little substrate attached. The substrate must be cut away, **Fig. 23**. Most *Pleurotus*

will have some stem. Stems are generally difficult to chew, so not favored by customers. So you will have a better product, if the stems are removed by trimming. Of course, the stems add weight and if customers do not understand that they are getting a better product, it may be wise to leave the stems. Stems can be used to make other products, but that requires extra equipment and people to do the work. It is not practical with small amounts of stems.

PACKAGING

If we observe the average shopper for a short time, we notice that they will generally buy items that look good to them. It is true for almost everything they purchase. If you do not cut off the stems, you should be certain that they do not interfere with the appearance of your mushrooms. We break eggs in preparation for cooking, but how many people will buy broken eggs to take home? Mushrooms may be broken and bruised by people handling them, so an attractive package will sell more mushrooms than if they are displayed loose.

Some sales may not require an attractive package. Generally bulk sales to restaurants will be loose. Chefs or other restaurant operators usually consider that it is their job to make appealing displays of food. Also, they will not wish to open many small packages. However, they are not much different than other people, so it may be easier to sell them if they see mushrooms in appealing packages first.

It has become almost a universal practice to pack mushrooms in plastic or paper trays and to over wrap the trays with plastic film, **Fig. 24**. The film protects them from the hands of customers and holds in moisture. Mushrooms are still alive as long as they continue to look good. The film will also restrict the oxygen that the living mushrooms require, so we must be certain that there is some place were oxygen can enter the package. Over wrapped trays have been used for more than 30 years for *Agaricus*, but it has now become almost universal for all kinds of mushrooms, **Fig. 25**.

Packing rooms should be clean and comfortable for workers, but then need not be elaborate, **Fig. 26**.

Fig. 25. Retail packages of oyster mushrooms from three continents.

Fig. 26. Simple packing rooms.

Fig. 27. Canned oyster mushrooms, left. Dried oyster mushrooms, right.

EXCESS PRODUCTION

A grower may not be able to fill demand for months and then suddenly find that things go so well that they have more mushrooms than can be sold. There are also times when the demand decrease suddenly. For example, in many places wild mushrooms become abundant and people hunt them, or buy them from those who hunt them. With more more mushrooms suddenly available, some will not be purchased.

No mater why there are more mushrooms than can be sold, the grower will want to save the extra that he has, so that they can be sold later. Mushrooms are often "canned," that is, sealed in a glass or metal container and cooked under high temperature so that they are sterilized, **Fig. 27**. Some

mushrooms, including *Agaricus* are quite nice when preserved in that manner. However, oyster mushrooms have a poor appearance after being cooked in water. Oyster mushrooms, like most mushrooms, will look quite good when they are dried. It may seem strange, but the one mushroom that dries poorly is *Agaricus.* When *Agaricus* is dried, it "bleeds" and a large part of the solid matter drips out with the moisture.

A third method that has been used is freezing. No mushroom looks good when preserved in this manner, however, a colorful, opaque wrapper may make the product more appealing.

DRYING PROCESS

A number of ways have been developed to dry foods, sun, ovens, vacuum, etc. All are possible with mushrooms, the highest quality is produced by freezing the mushrooms, then placing them in a vacuum where they remain frozen until all water is removed. That process is called freeze-drying and is very expensive, both for energy and for the required equipment. The most efficient drying is called tunnel drying. Tunnel drying will give a high quality product. A tunnel drier can be constructed from ordinary materials, and will use less energy than most other driers.

In some communities, the grower will be able to find a company who dries other food and arrange to have the mushrooms dried by them. However, if the drier's business includes wild mushrooms, the grower may find that the drier is too busy with wild mushrooms to bother with his mushrooms. That suggests an additional activity. Someone must sell the grower's dried mushrooms and if wild mushrooms are dried in the same drying facility, the various mushrooms could be sold at at the same time.

The cross section of a tunnel dryer with dampers to control the amount of fresh air and the exit of moist air, is shown in **Fig. 28**. Thermometers, hygrometers and thermostats are also needed to control the temperature and humidity. Re-circulating the air not only saves the heating fuel, but the somewhat moist air actually dries the food faster.

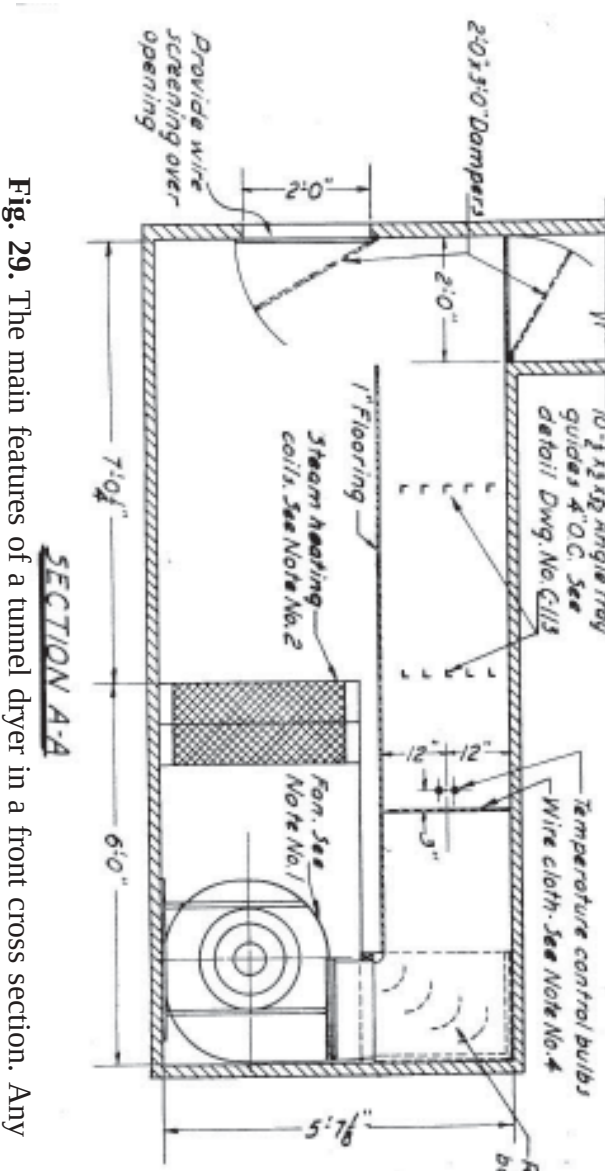

Fig. 29. The main features of a tunnel dryer in a front cross section. Any enclosed heat can be substituted for the steam.

Fig. 29

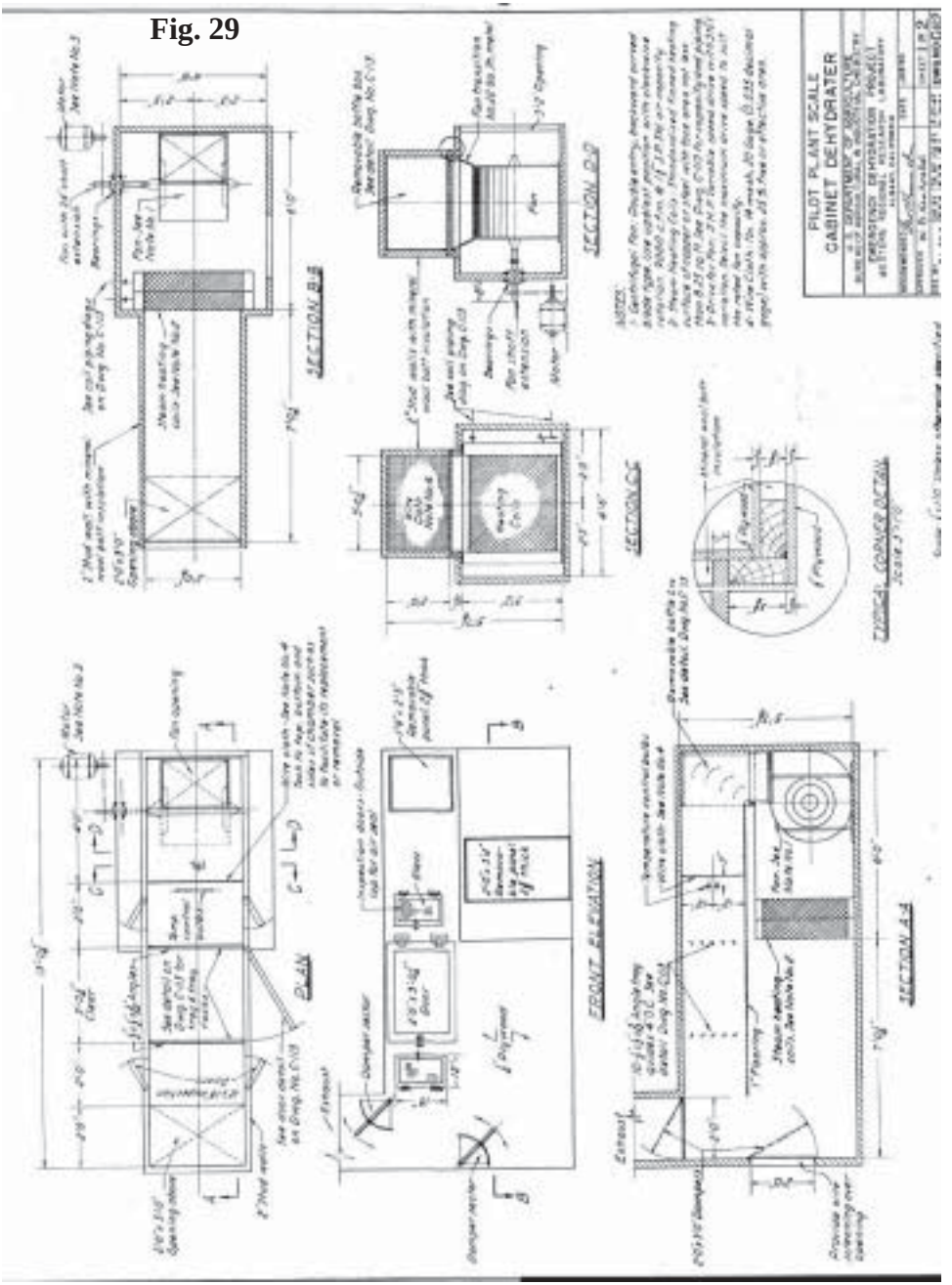
PILOT PLANT SCALE
CABINET DEHYDRATER
SECTION B-B
SECTION D-D
SECTION C-C
DOOR CORNER DETAIL
PLAN
FRONT ELEVATION
SECTION A-A

Fig. 30

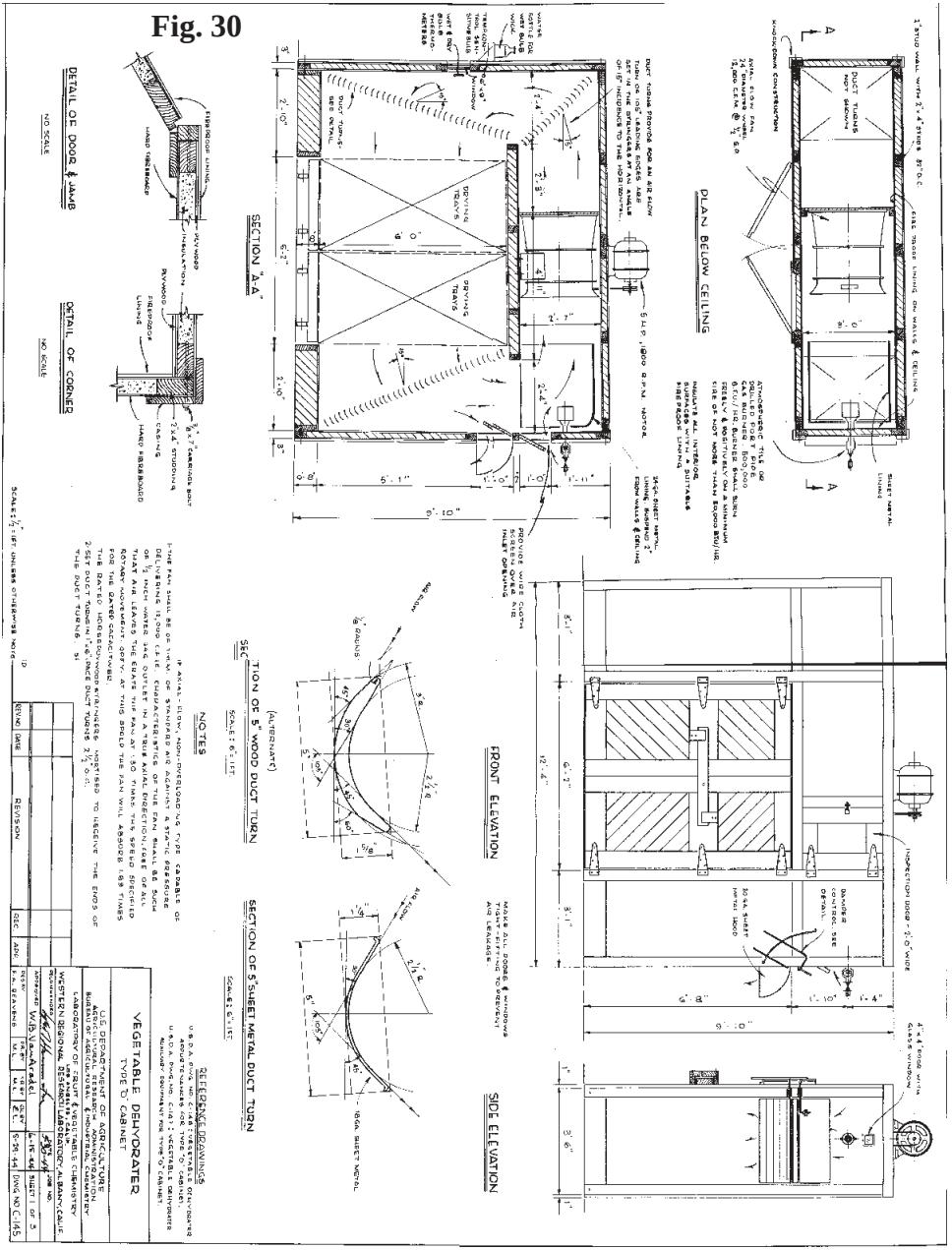
DETAIL OF DOOR & JAMB
NO SCALE
DETAIL OF CORNER
NO SCALE
SECTION A-A'
PLAN BELOW CEILING
FRONT ELEVATION
SIDE ELEVATION
SECTION OF 5" WOOD DUCT TURN (ALTERNATE)
SECTION OF 5" SHEET METAL DUCT TURN
NOTES
REFERENCE DRAWINGS
VEGETABLE DEHYDRATER
TYPE 'O' CABINET
U.S. DEPARTMENT OF AGRICULTURE
WESTERN REGIONAL RESEARCH LABORATORY, ALBANY, CALIF.

Fig. 31 Tunnel dried oyster mushrooms packaged in a plastic bag for retail sales.

The design for two driers of different sizes are shown**, Fig. 28, 29, 30**.

TUNNEL DRIER CONSTRUCTION

A tunnel drier consists of a blower to circulate air, a heater to increase the temperature of the air to approximately 40 to 50°C (104 to 122°F), a place to put the food to be dried and is shown in a large cross-section (**Fig. 28**)**,** as well as in all views combined, **Fig. 29**. Anyone contemplating the construction of a drier would do well to study these drawings carefully. If the second is built as a mirror image of the first, they can share a common wall and access will be through the walls opposite.

THE DRY PRODUCT

Like the fresh product the dried mushrooms should appeal to the shopper, **Fig. 31**. If they are sealed in a clear plastic bag, they will show off well.

However, dried mushrooms are fragile too, so placing them in a tray with a sealed over-wrap may be of value.

If mushrooms are well dried at the low temperature of a tunnel drier, they may have little smell. Some people may expect them to have a smell and be dissatisfied. It may be necessary to alter the conditions to sell to such customers.

SUMMARY

Mushroom growers need to avoid wastes and sell the best possible products. It is necessary to pick mushrooms at the proper time, handle them with care, packaged them and save all that can not be sold while they are fresh.

Picking affects quality and quantity. Handling may make some difference in quantity, but it will have a great influence on quality. Packaging will have a great affect on the quality. Preserving may have a very large affect on quantity and the resulting profits.