# OYSTER MUSHROOM CULTIVATION

## Substrate preparation and growing
## In pictures

By Mickey Foley and Victor Yakushenko

# Find information online about oyster mushroom production all over the world

Try **KEY WORD** searches using words: Pleurotus (latin name)

oyster mushroom production, growing, marketing

oyster mushroom substrate

oyster mushroom spawn

oyster mushroom bags

oyster mushroom nutritional value

oyster mushroom temperature, humidity, CO2

oyster mushroom pasteurized substrate

oyster mushroom Phase I

oyster mushroom Phase II

oyster mushroom incubation, fruiting

oyster mushroom diseases, insects

# OYSTER MUSHROOMS production process can be divided into following stages:

1. **Selection and storage of raw materials for substrate**

cellulose waste, straw

2. **Chopping, wetting raw materials for substrate**

increase density, increase moisture to 65-70%

3. **Substrate preparation – 4 methods will be described**

hot water, cooking 70-90 C, natural composting, sterilizing

4. **Substrate inoculation and incubation**

planting spawn (mycelium), colonizing substrate

5. **Oyster mushroom fruiting**

mushroom fruiting, harvesting

6. **Packaging, storage and shipment of oyster mushrooms**

refrigerate, special packaging film

## Selection of Suitable Raw Material

**-STRAW of any grain crops (wheat, rice, barley, rye …)**

**- HULL or HUSK of sunflower, oats, buckwheat …**

**- CELLULOSE containing wastes such as dried leaves**

## Nutrients can increase yield, but also increase risk of contamination

**- 15-20% green hay, alfalfa or other forage crops**

**- 5-10% wheat or rice bran, or the seed coat of other grains**

## Mineral additives

**-1 to 3 % of inorganic mineral, usually chalk ($CaCO_3$)**

# Straw

After harvesting the straw remains on the ground in swaths. While it is dry - it is necessary to bale it quickly.

# Straw Quality

Straw should be pure yellow color, without any mold symptoms. And very DRY, moisture less than 12%.

# Poor quality straw

If straw is in the field for a month, usually some moisture condenses and molds begin to grow. Notice the small black dots, they are molds.

Bale straw quickly after harvesting and move to a dry area for storage.

# Transport bales to storage area

No special machines are needed for 20-30 kg bales,
such small bales can be moved and stacked by people.

## Plan carefully for buying and storing straw: logistics, biology, economics.

Grain crops are usually harvested in summer and early autumn.  So, the straw is available only during one or two months of the year.

Careful planning is needed to arrange for equipment to bale straw, to transport straw from fields, and to find a place to store straw for up to a year.

Financing takes careful planning, too, because money to pay for straw harvesting, transport, and storage will not be available until after the mushrooms are sold.

Expensive straw can be lost during storage

25 to 60 % of straw will rot in the course of winter if straw is stacked on bare ground.

# Triangle shaped piles using round bales

Shape of pile is better for protecting the top layer, but bottom layer still rots away.

# Optimal method for straw storage

## Inside a building with a waterproof roof is the best

# Straw storage at a substrate factory

Special machines are required to move the straw.

# Sunflower Husks (shells or hulls)

Increase density by filling the spaces between pieces of straw. Traces of sunflower oil increase nutrition, too. Hulls can be used 100% for growing oyster mushrooms, or straw can be added to increase water holding capacity.

Cotton seed waste includes some cotton fibers and seed shells. Where available it is the BEST for small mushroom farms.  No chopping is required.  Stores well.

Cotton seed hulls stored in a dry warehouse
Can be used alone to grow mushrooms, or mixed with straw to increase density, nutrition and moisture of substrate.

After storage, first step is chopping straw. Mushrooms do not grow in air.

Increasing the density is the goal of chopping. Straw does not compress easily, and after bales are opened it springs apart.

Even after straw is wet, it does not compress easily. So chopping is necessary in order to tightly pack wet straw into a container for growing mushrooms.

In addition to chopping, density can be increased by using raw materials that are naturally small particles, such as sunflower husks or cottonseed hulls.

# Electric straw grinders (Russia)

20 HP motor can chop about 4-6 tons of straw per day.

# Electric Hammer mill (flail chopper) USA

5 hp motor can chop about 1-2 ton of dry straw per day

Chopping takes time and energy, not cheap, not easy.

Man with a Machete
can chop about 200 kg of dry banana leaves
in one day (Jamaica) for oyster mushroom substrate.

# Big Chopping Machinery (Ukraine)

Produces over 100 tons of substrate per day.

“Tub Grinder” used to prepare feed for livestock is often used in USA for chopping straw and mixing raw materials and minerals.

## How much water is in a ton of “dry” straw?

A ton of “dry” straw ontains about 10% is moisture. So, a ton of straw contains about 100 kg of water and 900 kg straw.

## Laboratory Method to Determine Moisture

Weigh a sample as it comes from field or storage area.
Dry in oven at 80 C for 24 hours, moisture evaporates.
Weigh sample again to find dry weight of sample.

Calculate % moisture of the dry weight of the sample.

DRY WEIGHT / WET WEIGHT = % dry

900/1000 = .90% dry weight (.90/100=90%)

## How much moisture is in a ton of substrate?

A ton of substrate weighs 1,000 kg and has about 65% moisture. So, one ton of substrate has about 300 kg of straw and about 700 kg of water.

## Correct for ASH (dirt) if necessary.

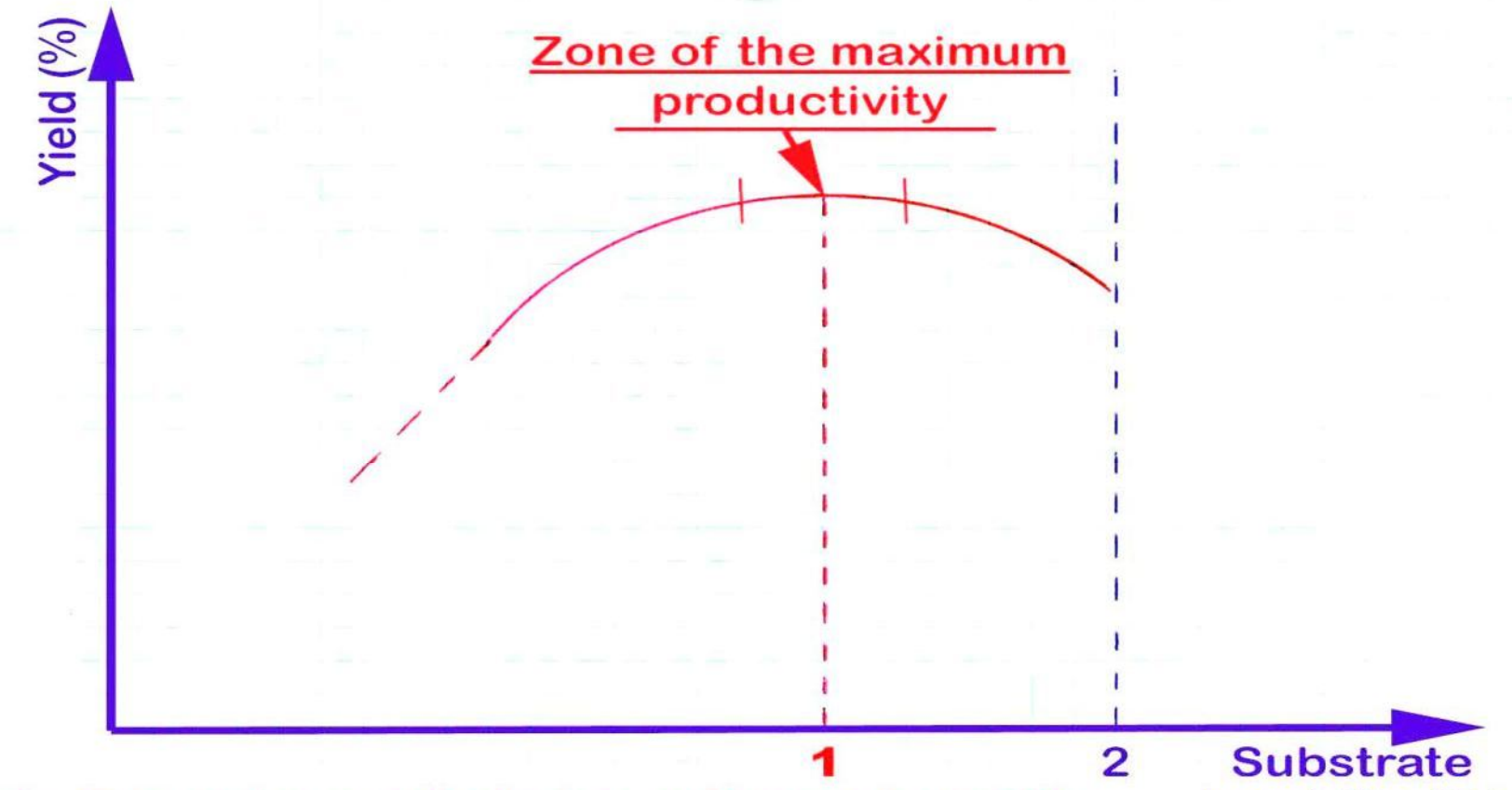
If much sand or dirt is present, weigh sample, then burn at 500-600 C degrees and calculate % of ash. Then subtract ash from the weight before calculating dry weight of the sample.

How many mushrooms can grow from one ton of substrate? One ton Substrate = 300 kg dry straw and 700 kg water.

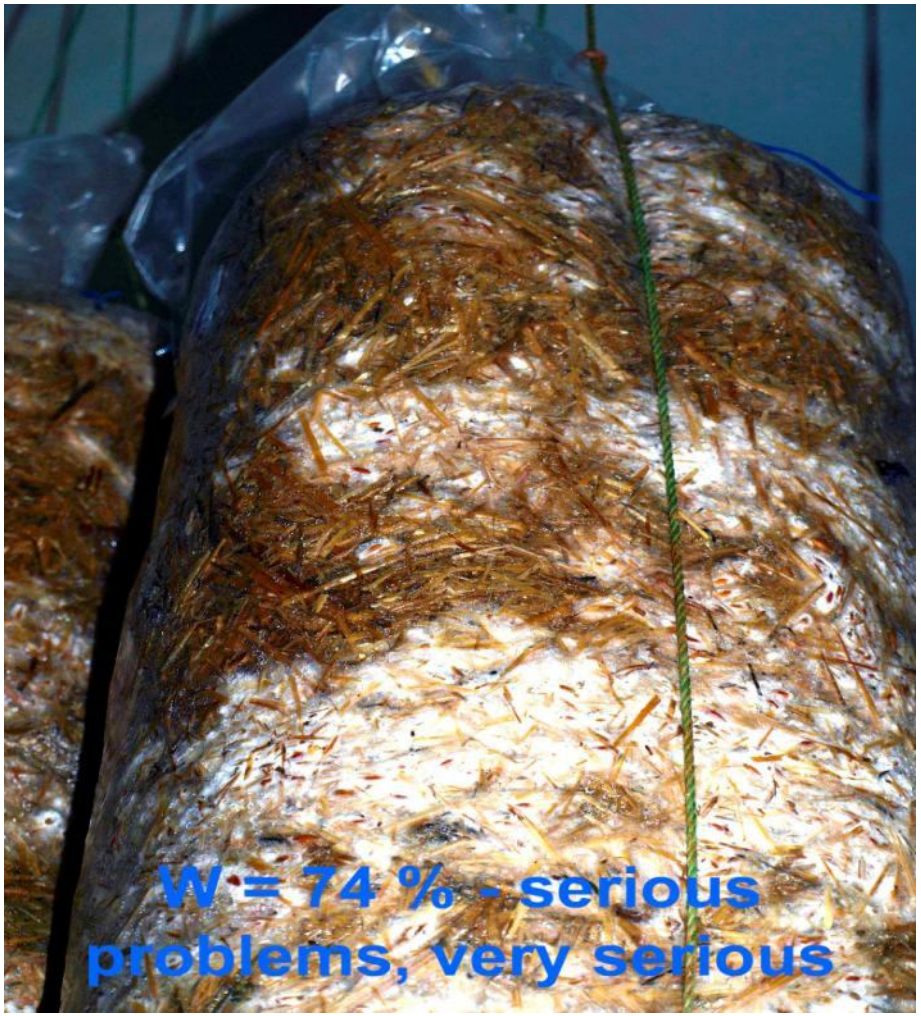
Up to 300 kg of fresh mushrooms can grow from 1,000 kg of substrate if conditions are perfect and there are no diseases.

Typically, 120-250 kg mushrooms grow from 1,000 kg of substrate due to environmental stress or stress caused by diseases.

Productivity (Yield) of  Oyster mushroom fruit bodies depends on substrate moisture in combination with the level of nutrition. There not an exact number because different substrates have different optimums.



**Too much moisture in the substrate is not good.**
Block on right side has too much moisture. Spawn cannot colonize areas have too much moisture.

Too much moisture, spawn does not grow.
Bag of buckwheat hulls on left side is too wet.

# Methods for Adding Water to Dry Straw, or to Cotton Waste, or Hulls of Sunflower, Buckwheat, Sorghum or Other Seeds

1. spray with a hose and nozzle or overhead sprinkler.

2. submerged under water

3. in screw conveyer with water nozzles

# Overhead Sprinkler **(Russia)**

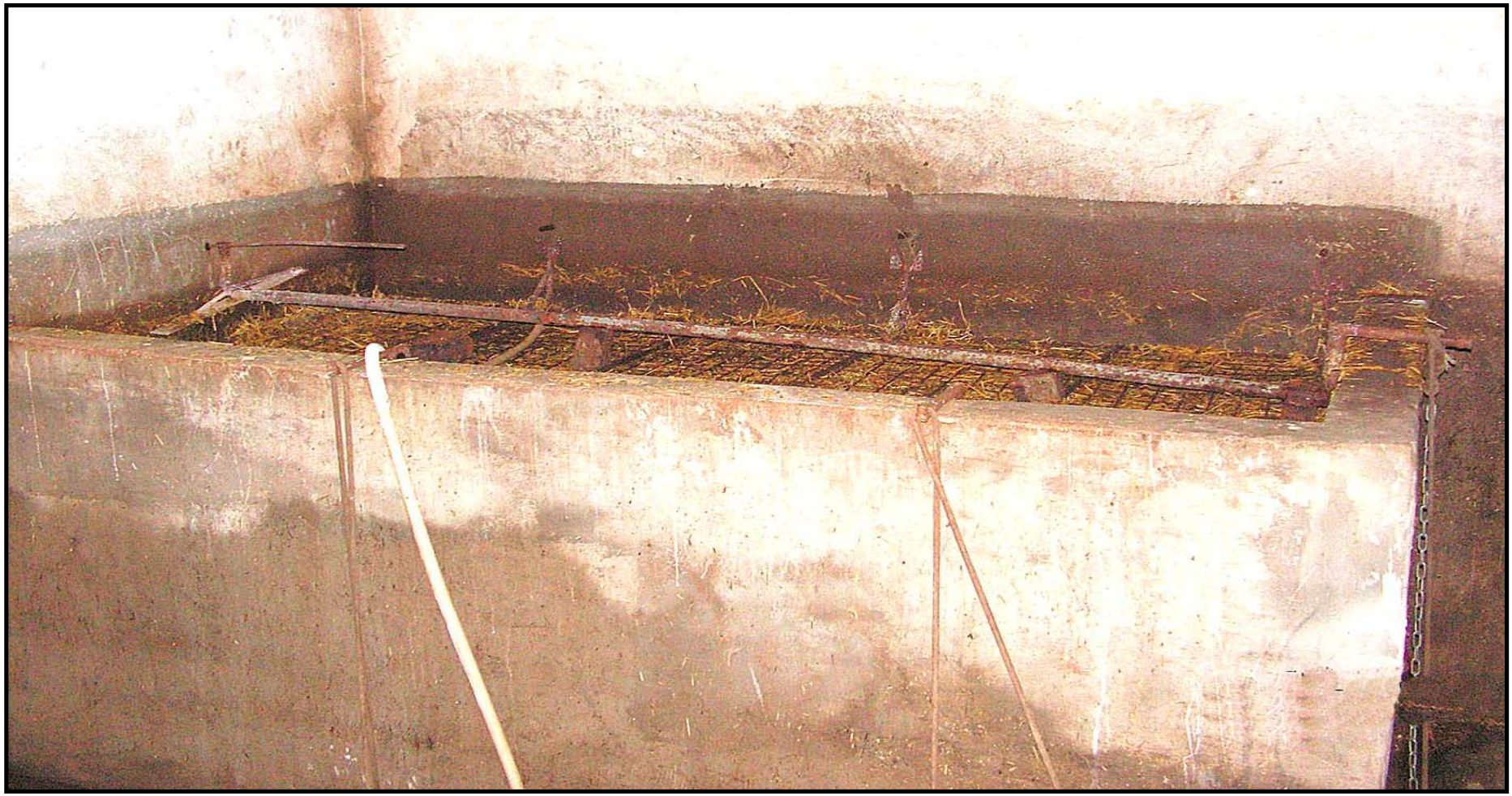
Stack substrate components and minerals on a concrete floor, sprinkling each layer with water. Water drains into a tank and is re-circulated.

# Straw Submerged Underwater (Macedonia)

Soaked was soaked in barrels overnight with weights on top then mixed with minerals before pasteurizing.

# Submerged Underwater (Ukraine)

Stack raw components by layers into the pool, fill pool with warm water. In some hours drain the water out. Works well for all kinds of raw materials.



Submerged under Water

Wire mesh on top prevents straw from floating.

# Submerged under Water (Uganda)

Dry sorghum hulls are filled into plastic mesh feed sacks, then put into 200 liter drums, with a weight put on top to keep bags submerged under water for about 12 hours.

Hot water and buckwheat hulls in bathtub.
Electric water heater provides 80 C degree water.
After soaking, water is drained, tub is wheeled away.

# Hot water for Cottonseed Waste

In Turkmenistan, gas is free for farmers.

Small electric mixer in Turkmenistan

Mineral and cottonseed caste are mixed Dry then **hot water** is poured in.  Mixer operates for about ten minutes, then material is poured out on a clean plastic sheet to cool.

# Add water in the *screw* – conveyor

Slow, but good on the small farm, using sunflower husk or chopped straw. (Russia)

# Water Pours in Top of Screw Conveyor (USA)

Straw is compressed together with water as it moves up conveyor. Compression is a fast way to add water.

# Increase Density (USA)

Green packet is very fine chopped straw, almost like powder.

It is added to increase the density of straw, similar to adding sunflower hulls.

# Industrial twin-screw conveyor (Russia)

Side conveyor is for adding mineral mix to chopped straw

# Outside View of Twin-Screw Conveyor

Truck parks under output, then transports material to pasteurizing area.

# Review Steps for Adding Water to Substrate Raw Materials

Straw is chopped to make it more dense then water is added. Or, dense material such as sunflower hulls and cotton waste, is mixed with water.

Three methods to add water to dry substrate:

1. Overhead sprinkle
2. Submerged under water
3. Compressed in screw conveyor

Four methods to prepare substrate for planting after water has been added.

1. First add hot water to dry material and minerals, then mix in spawn.

2. First wet material, then pasteurize 70-90 C degrees, then mix in spawn.

3. First wet material, then 4-6 days natural composting, then pasteurize at 60 C degrees for 24-48 hours, then mix in spawn.

4. First wet material, then sterilize at 121 C degrees, then mix in spawn.

# Method 1

## Add hot water, then cool, mix in spawn

No special tools needed, just a clean plastic sheet on the ground. (Turkmenistan)

Method 1

# Spawn is mixed, bags are tied shut on each end.

Method 1 – After adding hot water and minerals, then mix in spawn. (India)

# Method 1 (Russia)

Buckwheat hulls were poured out of bathtub and left to cool. Then, spawn is in mixed in and plastic bags are filled.  Used to be a cheese factory.

## Method 2 – Heat to 70-90 C Degrees
## 1. Wet material, 2. heat material, 3.cool material, 4. mix in spawn

This method is more reliable and works with many kinds of raw materials. Temperature is **70-90 C** degrees.

Substrate can be bagged **before or after** pasteurizing.

Kills harmful bacteria and molds, but both **good and bad microbes are killed.**

After 70-90 C pasteurizing, the substrate is **easily recontaminated** and must be protected from dirty air for about two weeks, as spawn colonizes substrate.

Method 2 – (Poland)straw is blown into room, sprinkled byoverhead water nozzles, then steam is added toincrease temperature to 70-80 C degrees.

# Method 2- Inside Pasteurizing Room

Notice holes in the ceiling where straw enters, the overhead water pipe with nozzles, and boards that hold the straw off the floor.  Steam pipe is underneath boards.

# Method 2
# Coal fired boiler

Steam enters room under the wooden floor boards inside the pasteurizing room.

Straw heats to 70-80 C degrees in about 12 hours, then cools for 12 hours and is ready for mixing in spawn.

After pasteurizing, men fork straw onto a conveyor that moves substrate outside to the planting area.

# Method 2 – wet, pasteurize, plant

Outside, straw is arranged on a clean plastic sheet.

Hydraulic machine compresses straw, pushing it in from the side several times during the process.

Then compressed straw is pushed out the end into a plastic bag.

# Method 2
# Incubation Room

Compressed blocks are moved to a room for incubation.

During incubation, bags can be packed close together.

25 C degrees is good for growing spawn.

Method 2 - blocks are moved to fruiting room.
In light and fresh air, mushrooms begin to form.

# Method 2 - Small Pasteurizing Tank

Straw is compressed on a wire mesh about 10 cm above the floor. Steam enters under the mesh floor. (Macedonia)

Home-made boiler uses propane to boil water and make steam to heat straw to 70-80 C degrees.

# Method 2 – wet, steam at 70-90 C (Jamaica)

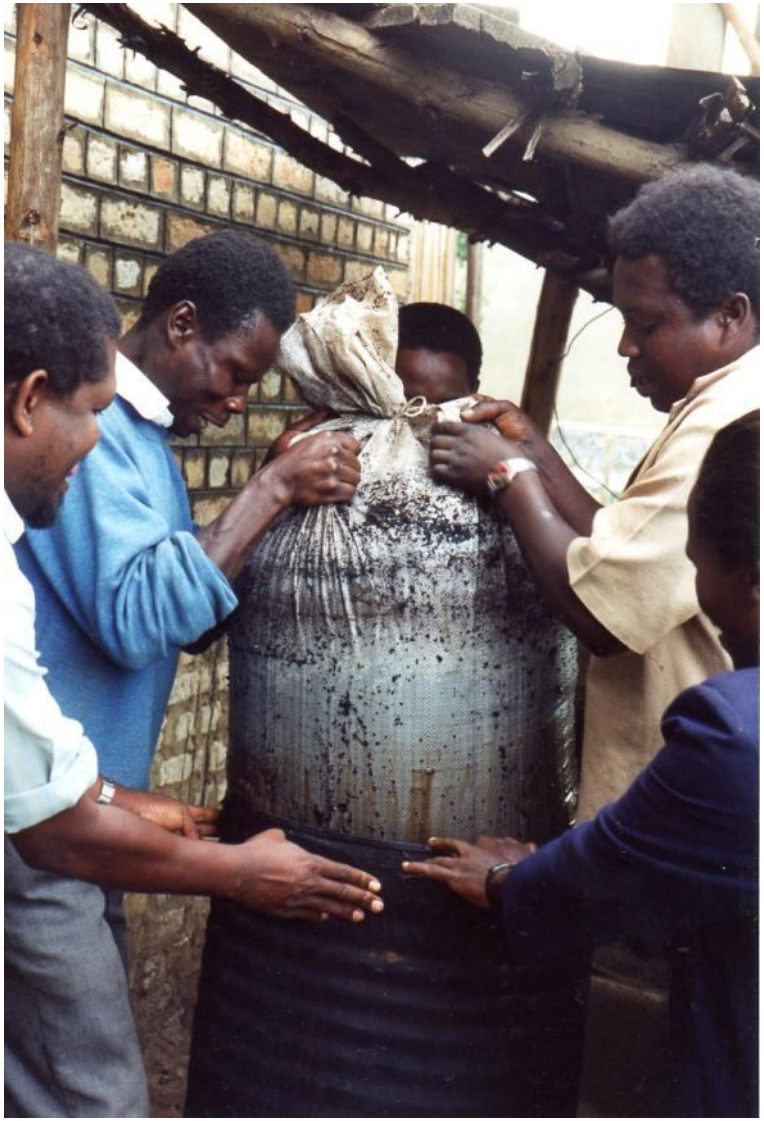
Dry banana leaves are supported on mesh floor 20 cm above bottom of drums.  Water boils until it evaporates.

Method 2 - wood fires boil water under wet sorghum hulls for to 70-90 C  Fires burn for about 12 hours, then substrate cools overnight . (Uganda)

# Method 2 - after steam

The next day, after cooling, the bag is lifted out of the and is ready to add spawn.

(Uganda)



# Method 2 – 70-90 C steam before planting

Steamed sorghum hulls cooled, then mixed with spawn and put into plastic bags. (Uganda)

# Method 2 – after planting spawn (Uganda)

Mushrooms are this lady's first cash crop.

# Method 2 – after planting spawn (Uganda)

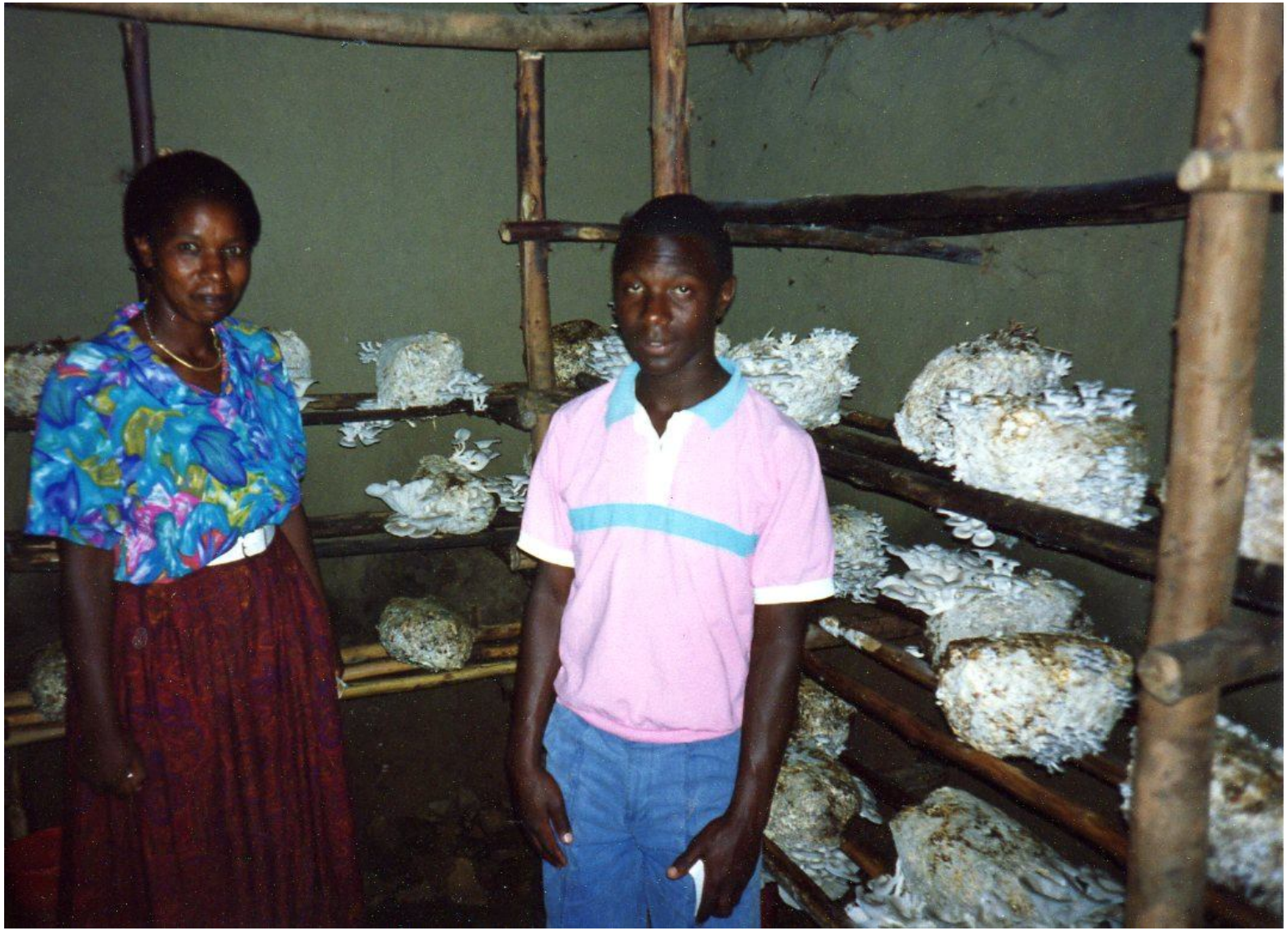
For 3 weeks bags hang until spawn to completely colonizes substrate.  Then bags can be removed.

## Method 2 – after planting spawn (Uganda)

Spawn grows while the bags are suspended from the ceiling.  Bags have been perforated with sewing needles so spawn can breathe.

# Method 2 – harvest begins (Uganda)

After about two weeks, substrate is removed from plastic bags and mushrooms begin to form.



# Method 2 – harvest begins (Uganda)

A happy mushroom grower is proud of her mushrooms.

# Method 2 – different example (USA)
## Bags are filled before steaming at 70-90 C degrees

# Method 2 – “clean room” inoculation area

After pasteurizing and cooling, bags pass into sterile work area for inoculation and tops are sealed closed.

# Method 2 – steam, cool, inoculate

After inoculation, the bags are placed in wheeled carts and moved to the incubation chamber.

# Method 2 – with two filters on each bag

Filter patch is woven poly fabric called Tyvek.

# Method 2
# Incubation room

Incubation chamber, bags are stacked close together.

No light is needed.

Temperature is about 25 C degrees.

Humidity is about 70-75%.

# Method 2 – incubation is finished

Filter patch protects substrate against contamination during incubation cycle.

# Method 2 – refined 2 filters on each bag

Once inside production rooms, filter patches are removed.  All mushrooms will grow from two holes in the bag, where the filter patches are located.

## Method 2 – wet, pasteurize, inoculate

Each bag has two holes, one on each side of the aisle.
This way it is easy and fast to harvest mushrooms.

# Method 2 – refined, harvest is uniform

Each batch of bags is inside production room for only one week. After 3 days in the room, harvest begins and continues for three more days.

# Method 3
# Natural Composting (4-8 days)
# Tunnel Pasteurization (24-48 hours)
# Cool, then mix in spawn

Substrate produced by Method 3 produces higher yields and more consistent yields of mushrooms when compared to Method 1 or Method 2.

But, Method 3 takes more time, more labor and needs expensive specialized equipment.

## Method 3 has two phases, I and II

Phase I - four to six day composting in a protected area on concrete floor in a pile big enough, at least 2-3 cubic meters, to contain heat generated by thermophilic microbes. Air pipes buried underneath the concrete floor blow air intermittently through the pile to supply oxygen.

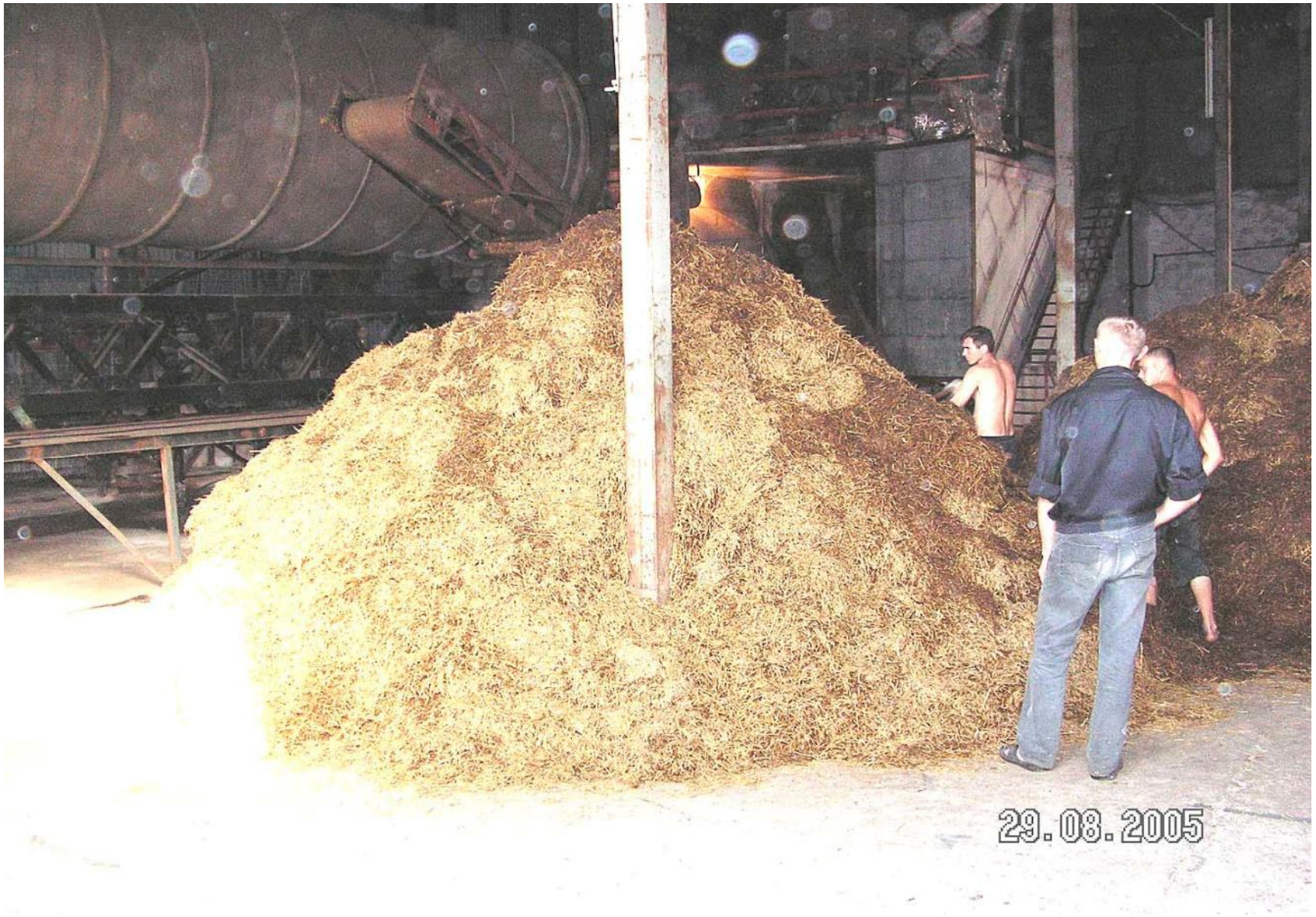
Phase II - carried out inside a special room with an aerated floor called a tunnel. Compost is pasteurized using low temperature, not over 60 C degrees. This kills most fungi and insect eggs without killing beneficial (fungistatic) microbes that have colonized compost during Phase I.

# “Phase I” on the floor (Ukraine)

## Straw substrate - a low-profile heap without air pipes

# “Phase I” on the floor (Ukraine)

## Straw substrate - a cone-shaped pile, no air pipes



# Phase I in small piles (India)without air pipes

# Phase I in small piles move every 24-48 hours

# Phase I compost ready for phase II Tunnel

# “Phase I” on the floor (Ukraine)

Straw substrate - a batch; 10 tons.

# 80% Cottonseed, 18% straw, 2% mineral mix (Ukraine)

**Phase I – in 24 hours the cone will be warmed up -**

Then is time to move substrate into the second cone. Then into the third. So, in 4 days the substrate becomes ready for pasteurization.

# “Phase I” mesh container for loose substrates

About 3 tons sunflower husk substrate (Ukraine)

# “Phase I” in Bunker Aerated Floor (Ukraine)

## Universal method for any kind of raw materials.

**Usually we use this equipment for more than 10 tons.**

Phase I High Pressure Blower (USA) intermittently supplies air through holes in concrete floor according to level of oxygen in compost above.

# Phase I – Air Holes in Concrete (USA)

Holes 3-5 mm diameter, spaced about 20 cm, blow air up through compost.  Groove prevents damage to the holes from scoop tractors.

# Phase I air supply pipes (USA)

Pipes have system to drain water but maintain air pressure inside the pipes.

# Phase I Bunker in operation

All the heat is generates by natural microorganisms

# Another Phase I Aerated Floor (USA)

Compost is moved every 48 hours for proper mixing.

# Phase I Air Supply Plenum (USA)

When oxygen level decreases to about 10%, air begins and continues until O2 level increases to about 15%

# Constructing Aerated Floor (Turkmenistan)

Thin layer of concrete is ok because no motorized equipment will be used.

# Drilling air holes in pipes for aerated floor

# Constructing air supply channel and drain

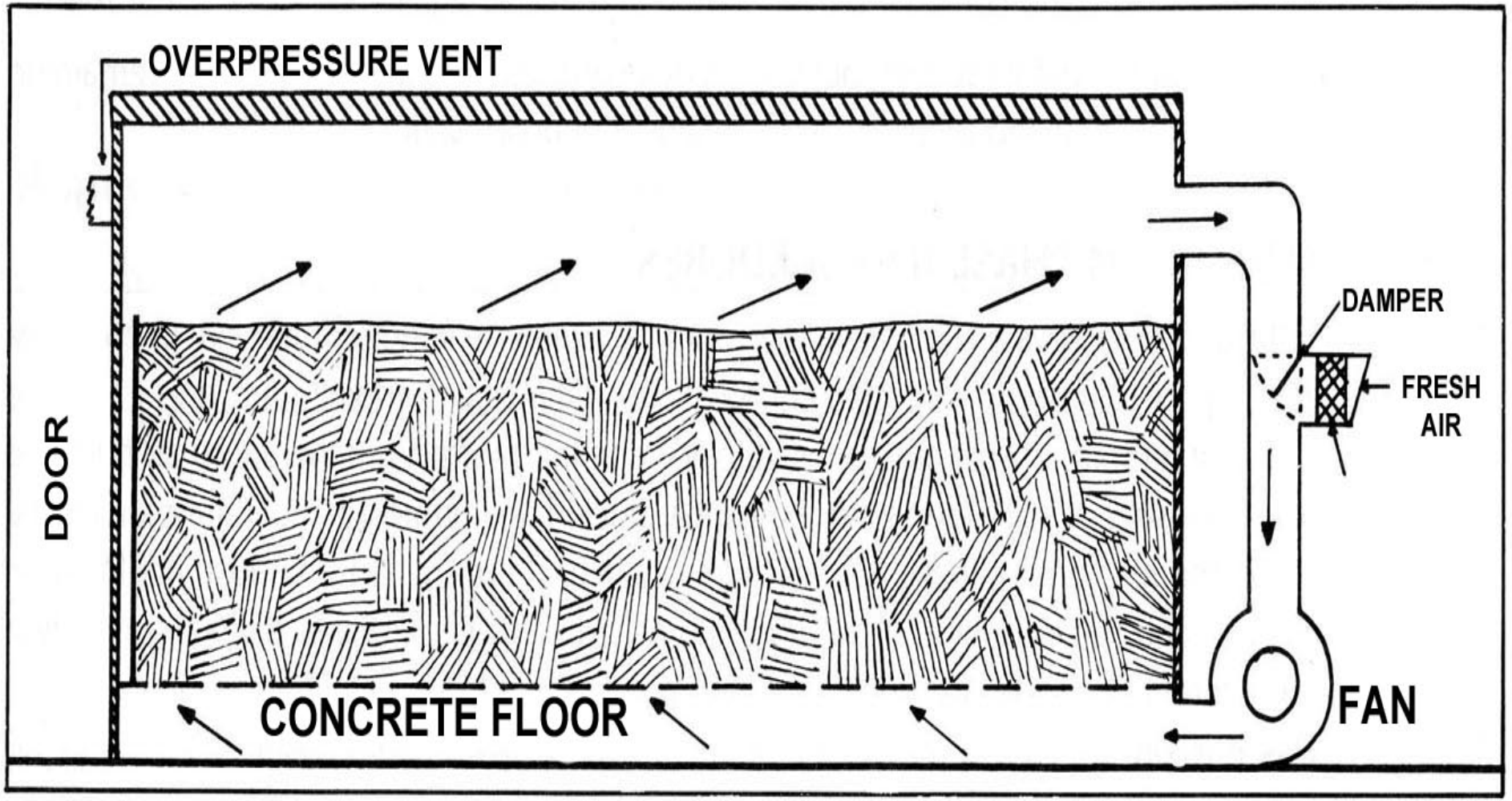
Before final layer of concrete, small pipes keep air holes open until concrete is dry.

# “Phase I” in Bunkers (Ukraine)

Move substrate from bunker one into bunker two, then to bunker three. 48 hours in each bunker is typical.

# “Phase II"

**We move substrate into pasteurization tunnels – in these special rooms we finish substrate preparation process.**



Small Phase II tunnel (USA) Capacity about one half ton, one cubic meter space. On left, is production chamber (about 3 cubic meters space)

Small Phase II tunnel (USA) good for testing raw materials in small batches

Top and back are removed for filling

Box is used at Pennsylvania State university mushroom test and demonstration facility (MTDF)

# Three small Phase II Tunnels
## At Solan Agricultural Experiment Station in India

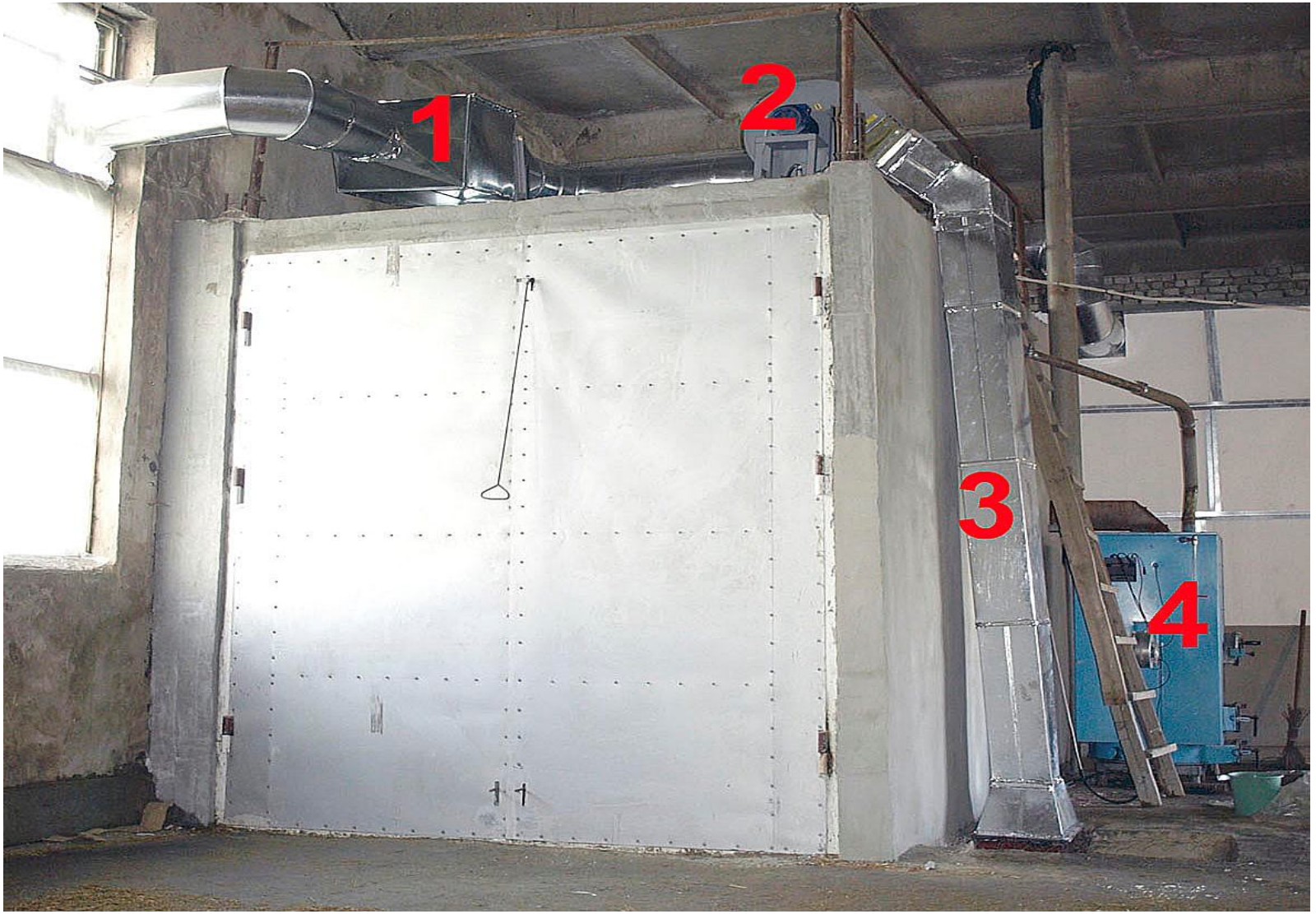
# Phase II - Small mushroom farm (Ukraine)

Two pasteurization tunnels (1 ton - each)
+ the electric steam generator (10 kW).

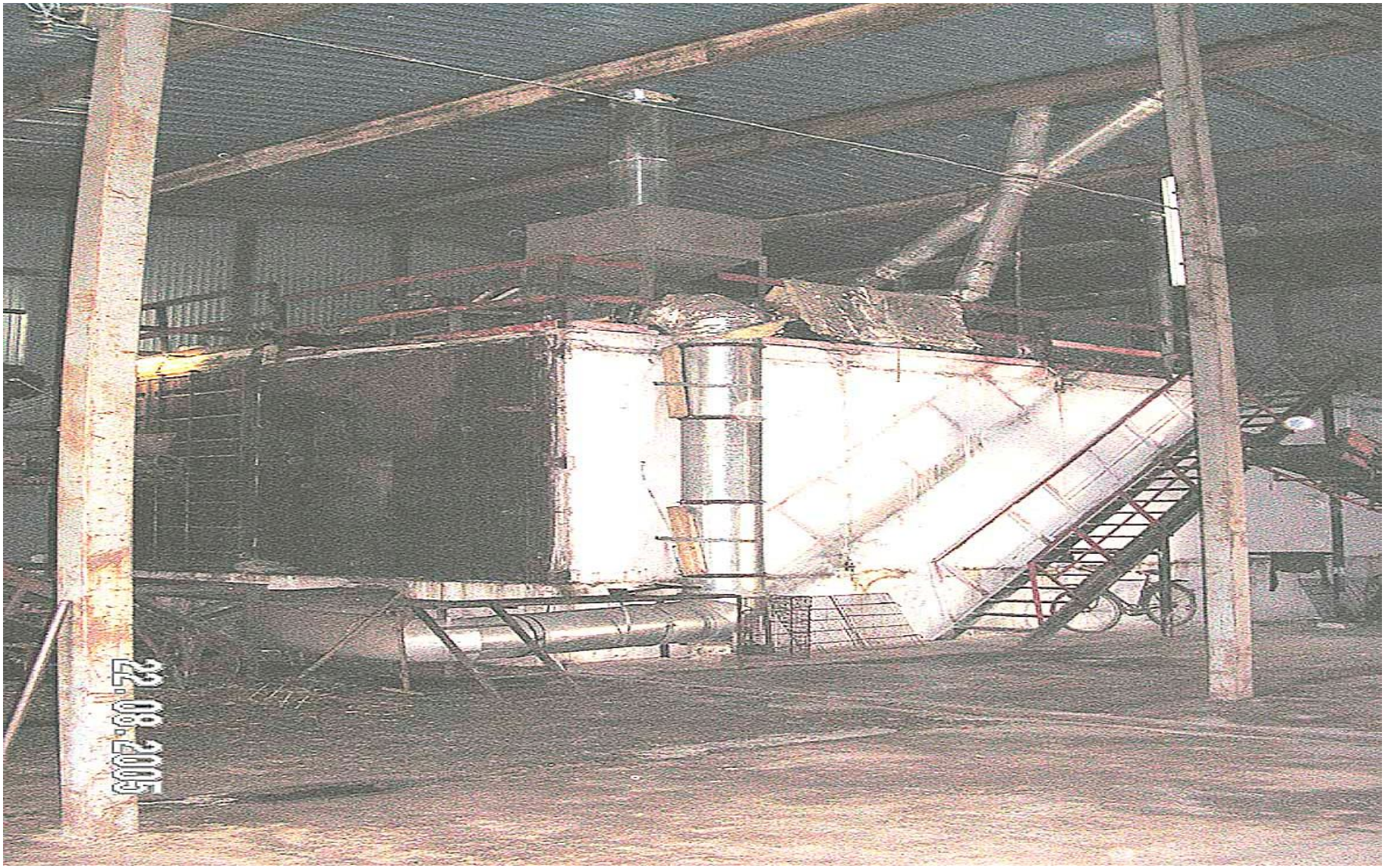
# Phase II Self-made tunnel for 10-12 tons.

1 - air filter; 2 - air fan; 3 - pressure air line;

4 – wood steam generator  (Ukraine)



# Two 25 ton Phase II Pasteurization Tunnels Russia



# Steam boiler for 3 pasteurization tunnels.

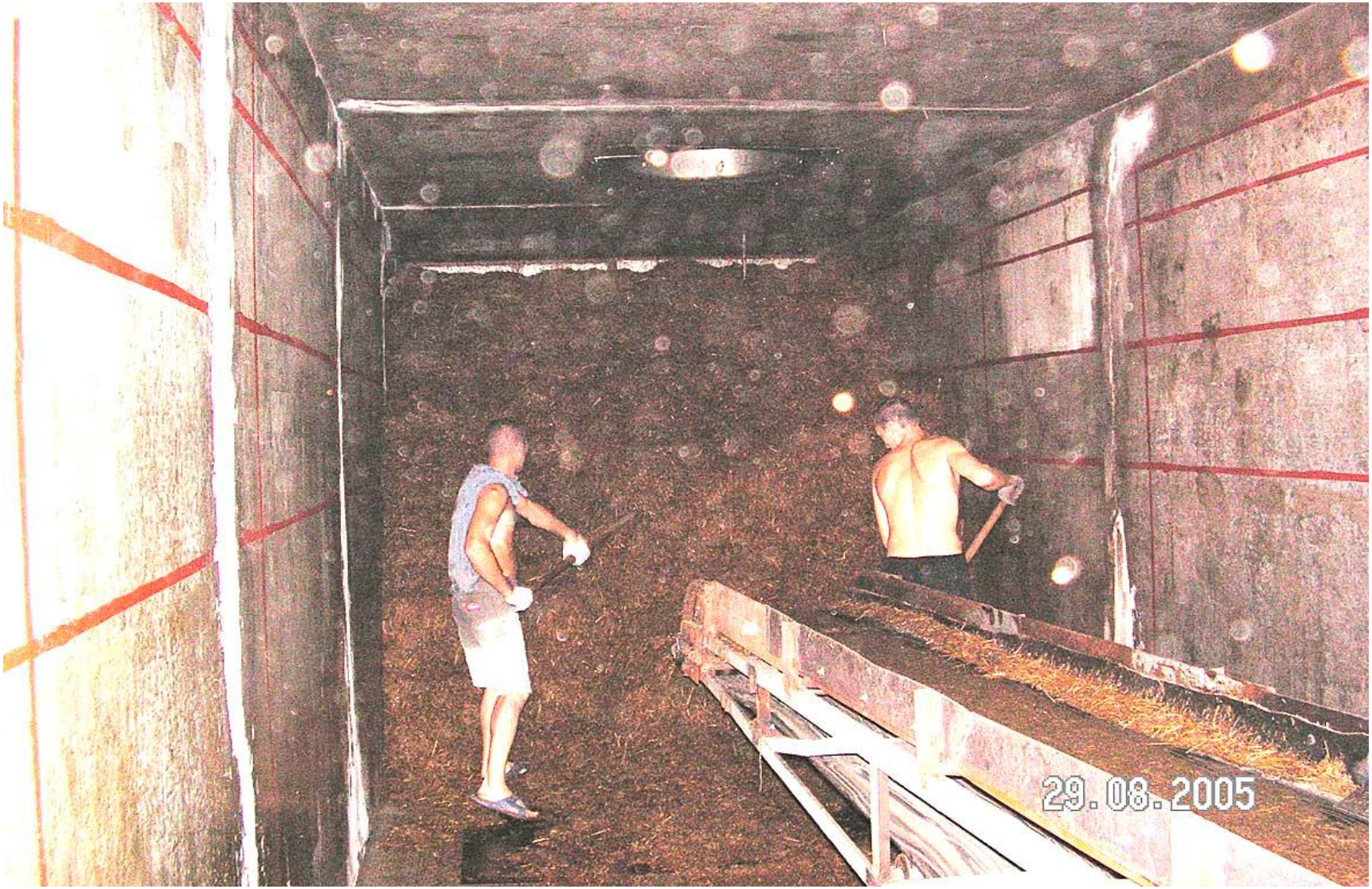
**(each = 22 tons of substrate) Russia**

# Loading Compost into Phase II Tunnel

Four workers load 10-12 tons of substrate within 6-7 hours. Main equipment: 4 pitchforks. (Ukraine)

# Filling Phase II Tunnel (Ukraine)

Four guys + conveyor load this tunnel (25 tons) in 6 hours. The pitchfork - the main equipment also.



# Filling Phase II Tunnel (Russia)

Two men load this tunnel (30 tons) for 4 hours.
Equipment: tractor + the adapted potato conveyor.

# Filling Phase II Tunnel (Russia)

Two men load this tunnel (30 tons) for 4 hours.
Equipment: tractor + the adapted potato conveyor.

# Filling Phase II Tunnel (Poland)

## The professional equipment for 150 tons tunnels loading.

## Planning configuration of substrate manufacture is very important.

## The Weekly Schedule

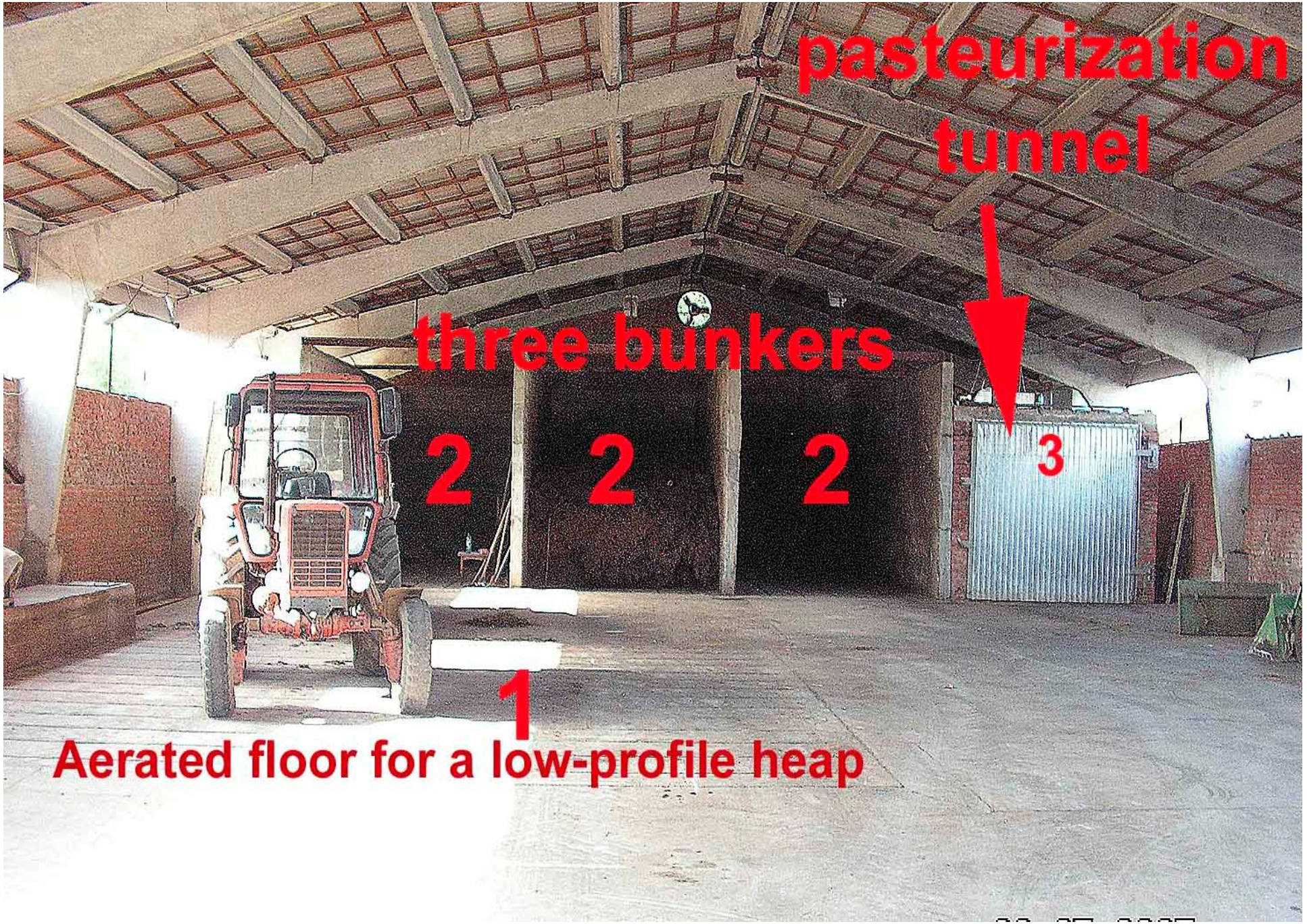
For continuous production, mushroom farmers must plant new crop at least one time each week.

## Advice for Beginners

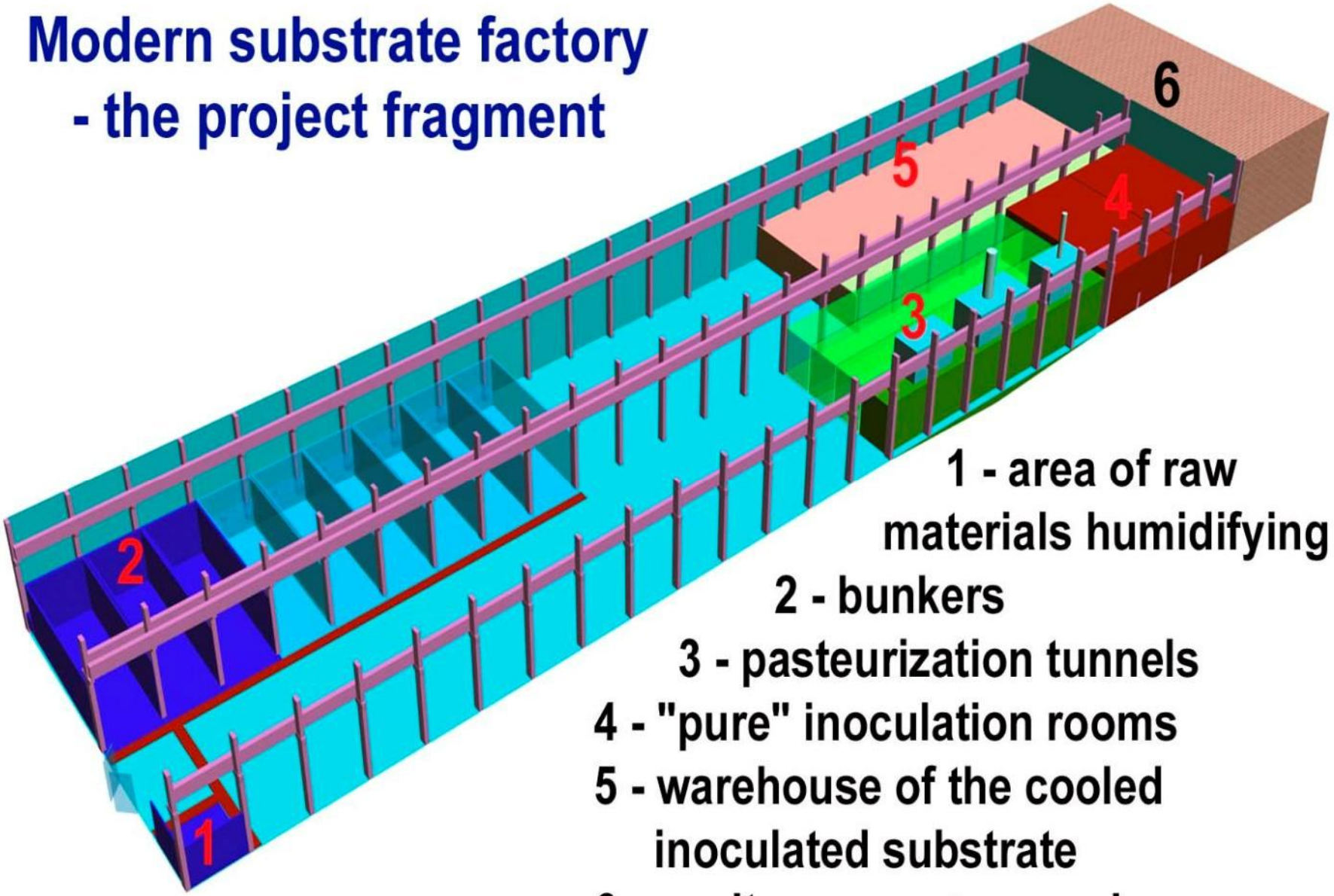
Experiment with small crops before investing in commercial production facility.

## There is no substitute for experience

Mushroom growing is like swimming or riding a bicycle.  You CANNOT learn to do it by reading, listening to a teacher, or by watching someone else.


pasteurization tunnel
three bunkers
2
2
2
3
1
Aerated floor for a low-profile heap

# Modern substrate factory
## - the project fragment




1 - area of raw materials humidifying
2 - bunkers
3 - pasteurization tunnels
4 - "pure" inoculation rooms
5 - warehouse of the cooled inoculated substrate
6 - sanitary zone + everyday rooms

# Unloading Phase II Tunnels is Risky

The finished substrate should be unloaded from a tunnel in microbiological pure zone. But, mushroom farmers do not have hospital operating rooms.

Inoculate and make the substrate blocks in a very clean way, the cleaner the better.

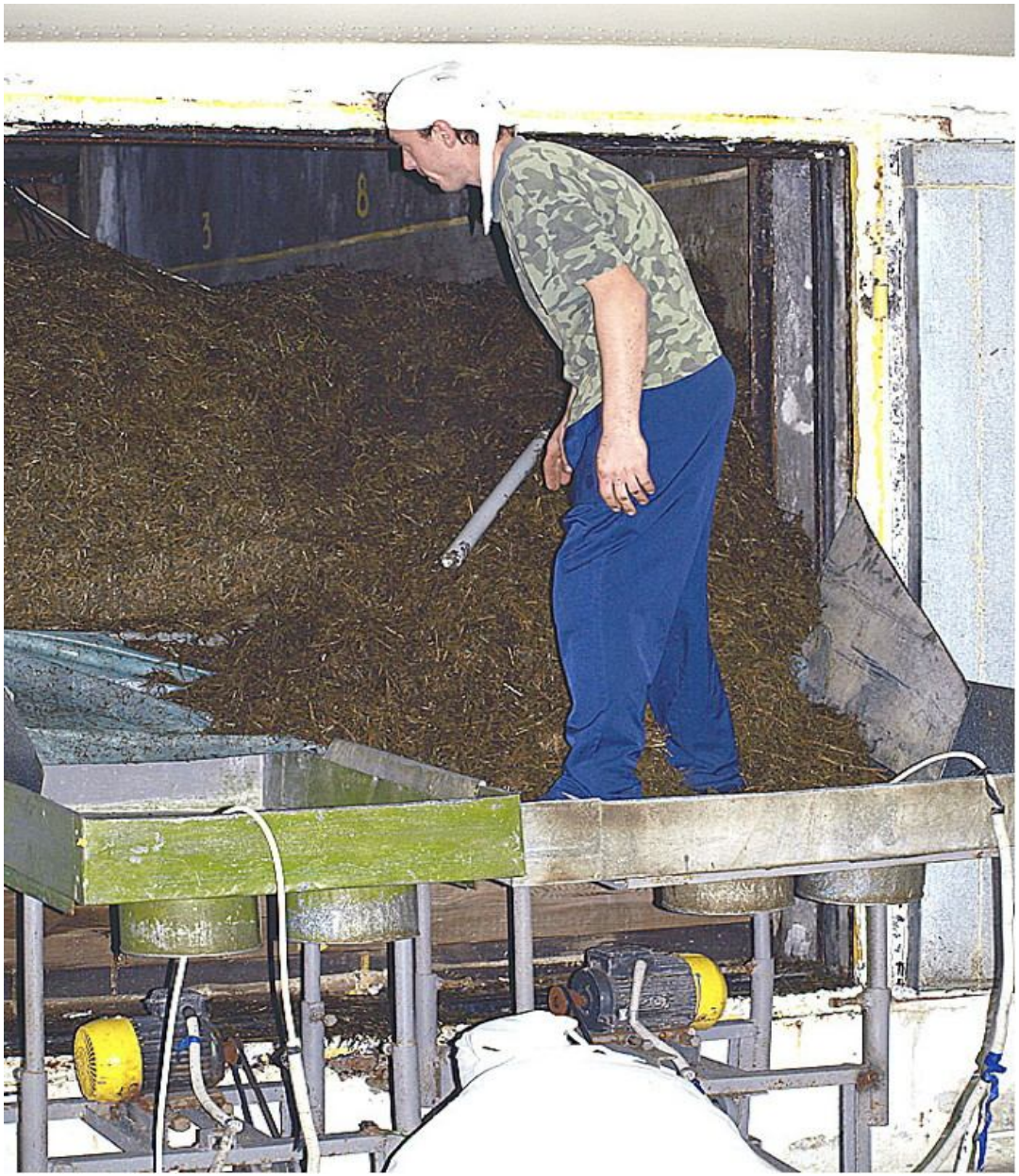
Filter the air, give workers clean clothes, sanitize all the hand tools and conveyors.

# Unloading Phase II Tunnel

Phase I followed by Phase II makes the compost selective.

Good microbes have colonized compost.

But sanitation is still important, clean air, clean tools, clean clothes are needed.



# Unloading Phase II Tunnel

Mechanical tunnel unloading (27 tons). Power mesh is reeled up on a shaft and it pulls out all substrate from tunnel. Unloading takes about 6 - 7 hours.


13.07.2005

# Unloading Phase II hydraulic presses

Two press + 10 men = 25 - 30 tons inoculated substrate for a day.

# Substrate Block Compressing Machine

Small hydraulic press makes 5 substrate blocks/minute.

**Large Oyster mushroom substrate factories use the equipment for an inoculation and substrate blocks forming from Italy, Poland… Productivity of such lines from 50 to 150 tons/day.**

# Substrate Block Compressing Machine (8 - 10 tons of Oyster mushroom / month) farm.

# Substrate Block Compressing Machine

2-way hydraulic press is standard design

# Substrate block making in Macedonia

Substrate block making with old livestock feed blenders. Substrate is spread on a table and spawn is mixed in, then bags are filled.

# Substrate block making on a table

# Substrate block making on a table

# Substrate block making in Turkmenistan

Small Phase II tunnel with brick walls.

Substrate is on an elevated removable floor.

# Substrate block making in Tajikistan

# Size of Blocks in Important

Substrate blocks with diameter greater than 15 cm can overheat during incubation

# After Substrate is Inoculated and Bagged

Manufactured substrate blocks are transported incubation chambers.

# With Refrigerated Transport
## Bags can be shipped up to 500-800 km.

At the end of the process, fruiting is simple. After incubation, mature substrate blocks ready for fructification.

# Many Different Arrangements Are Possible

Air flow are humidity are important factors.

# Blocks can hang up by cords or wires:

Special shelves allow us to load the chamber more densely, and for easy harvesting, too.

# Method 4 - Sterilize first, then plant

Most reliable method, give the same result each time.

Is usually mechanized, fewer laborers needed.

Level of nutrition in substrate is much higher because sterilizing kills everything and inoculation is done under sterile conditions.

Big initial investment in machinery, high energy cost for sterilizing substrate

# Method 4 – Wet substrate, then Sterilize

Sterilizing temperature is 120 C degrees, must be in a pressurized container, at 1.2 a.t.u.

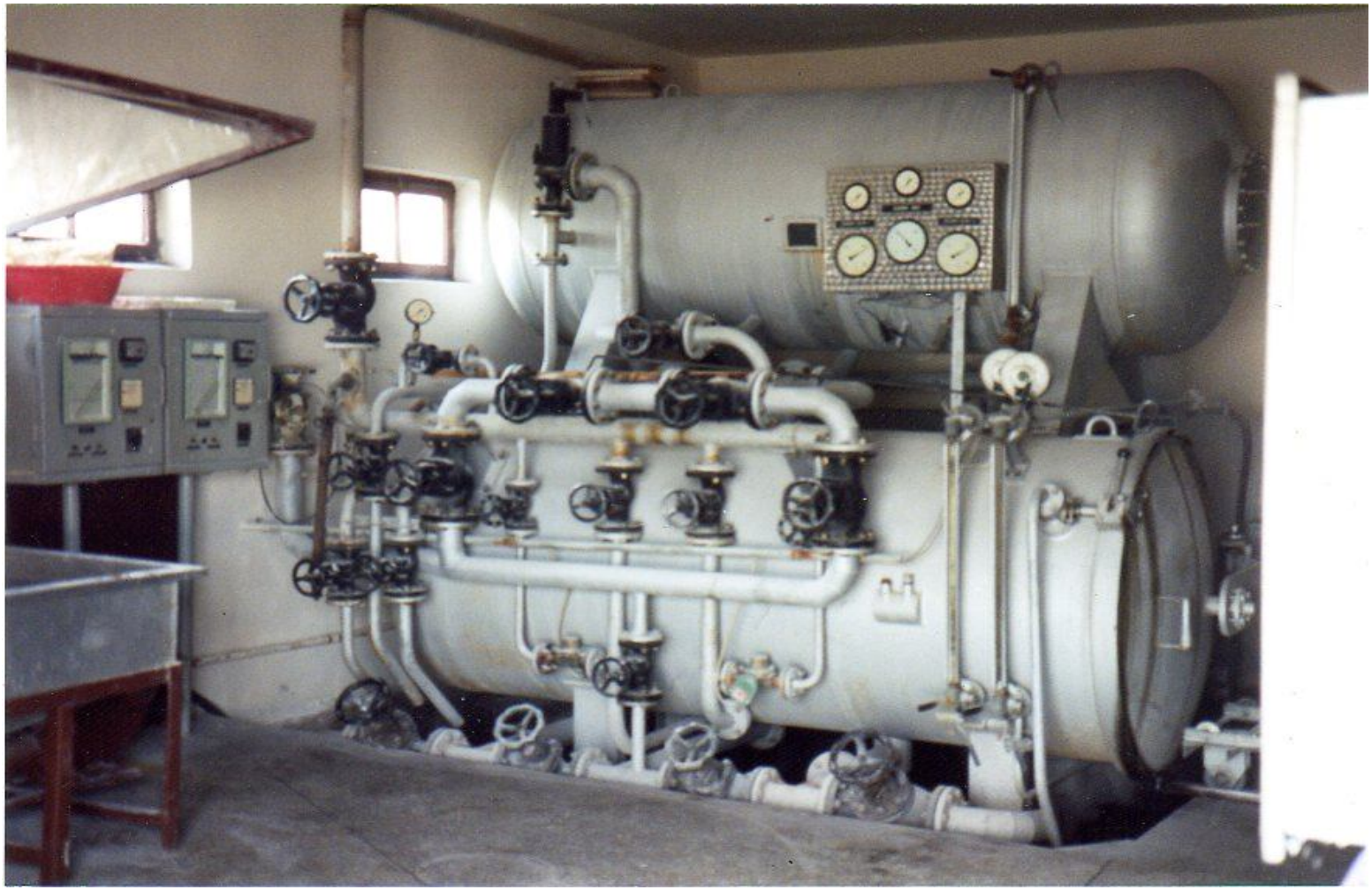
This method produced the highest yields of mushrooms per kg of substrate, as high protein and carbohydrate supplements are used without risk of contamination.

After sterilizing, lignin can be digested by mycelium, so sawdust can be used to produce oyster mushrooms.

Special inoculation chambers with biologically clean air are required and substrate containers need micro filters.

# Method 4 - Sterilizing

Autoclave (pressure cooker) is a  big investment and energy use is high compared to pasteurizing.



# Method 4 - Sterilizing

Sterilized substrate has much higher level of nutrition.  So, more mushrooms do grow from the same volume of substrate.

This complicates ventilation, as more fresh air is needed to dilute carbon dioxide (CO2) produced by mycelium as it digests the substrate.

Introducing fresh air usually lowers humidity. So, more misting devices are needed to keep the air humid.

# Method 4 - Sterilize

$CO_2$ is metabolic byproduct of mushroom mycelium, as carbohydrates and protein in substrate are increased more $CO_2$ is produced.

Fresh air is needed to dilute $CO_2$ or mushrooms will stop growing. The stems will lengthen and the caps will remain small.

For oyster mushrooms, $CO_2$ level under 700 ppm is important for quality..

# CO2 inside cluster of mushrooms is 1690 ppm

# Air at top of the bottle is 660 ppm CO2

# Climate Control in Production Rooms

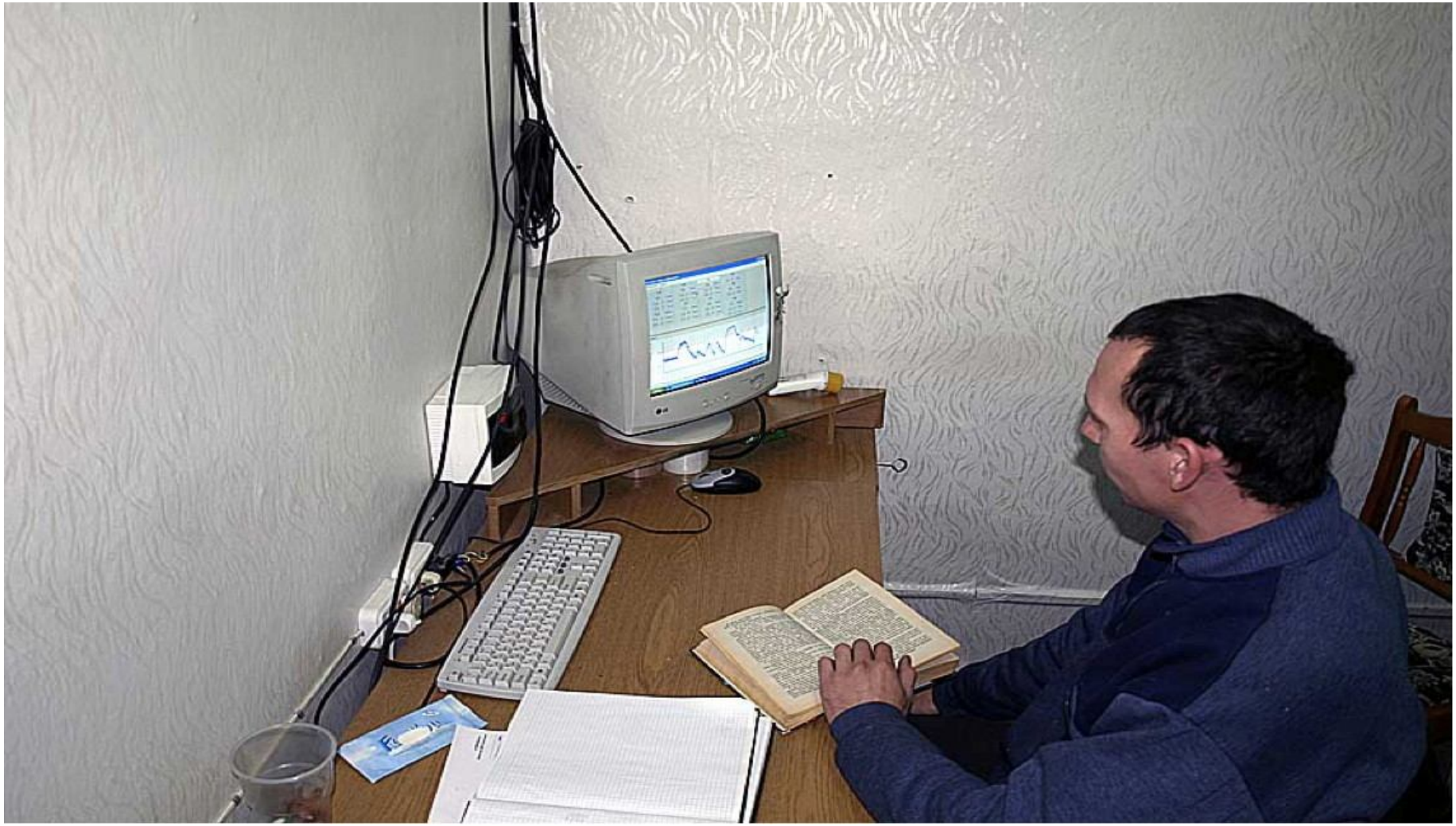
1. Temperature 15-20 C degrees

2. Relative Humidity 85-95%

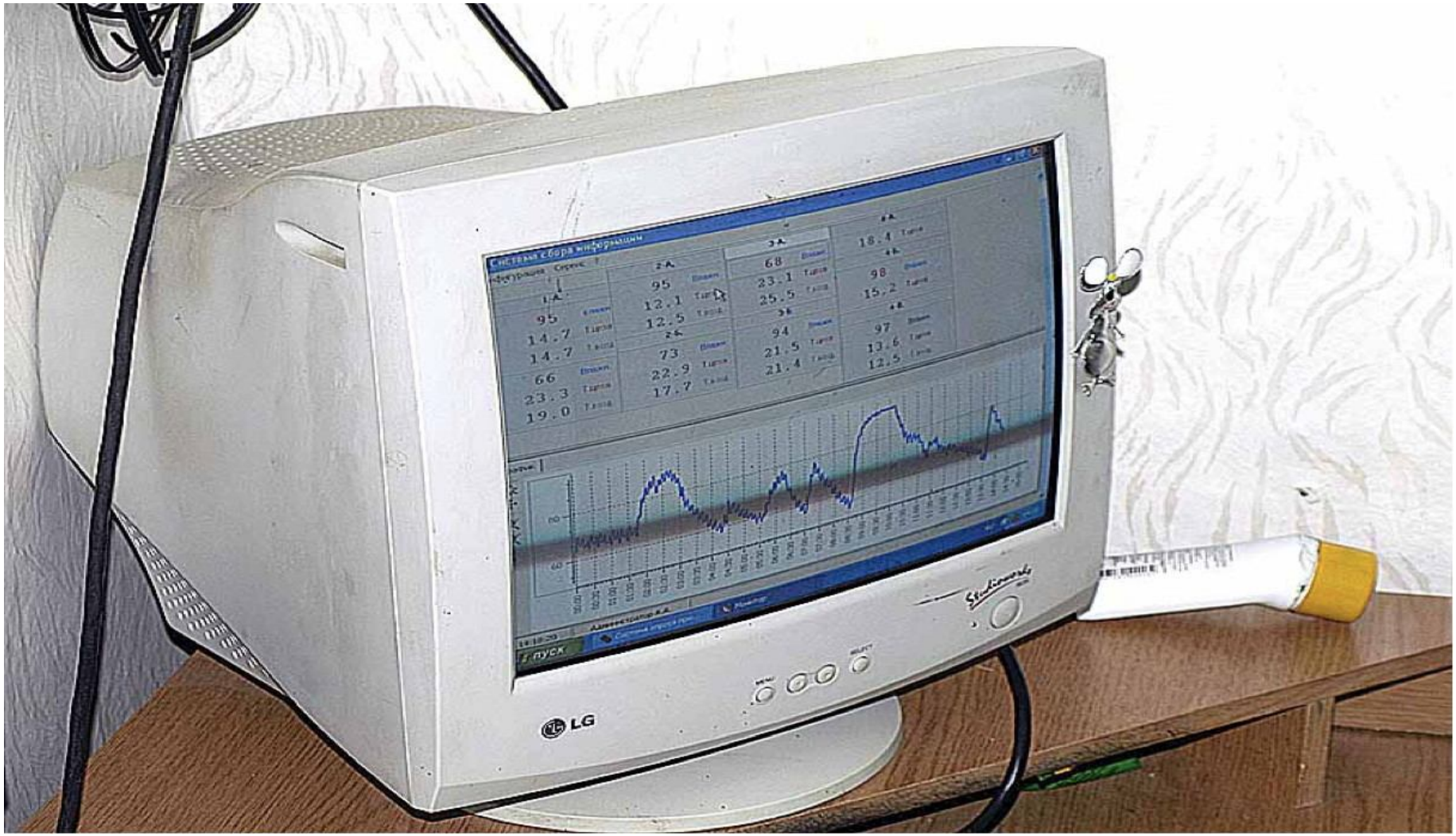
3. Carbon Dioxide 600-700 ppm

# This operator control the climate in 13 cultivations chambers.

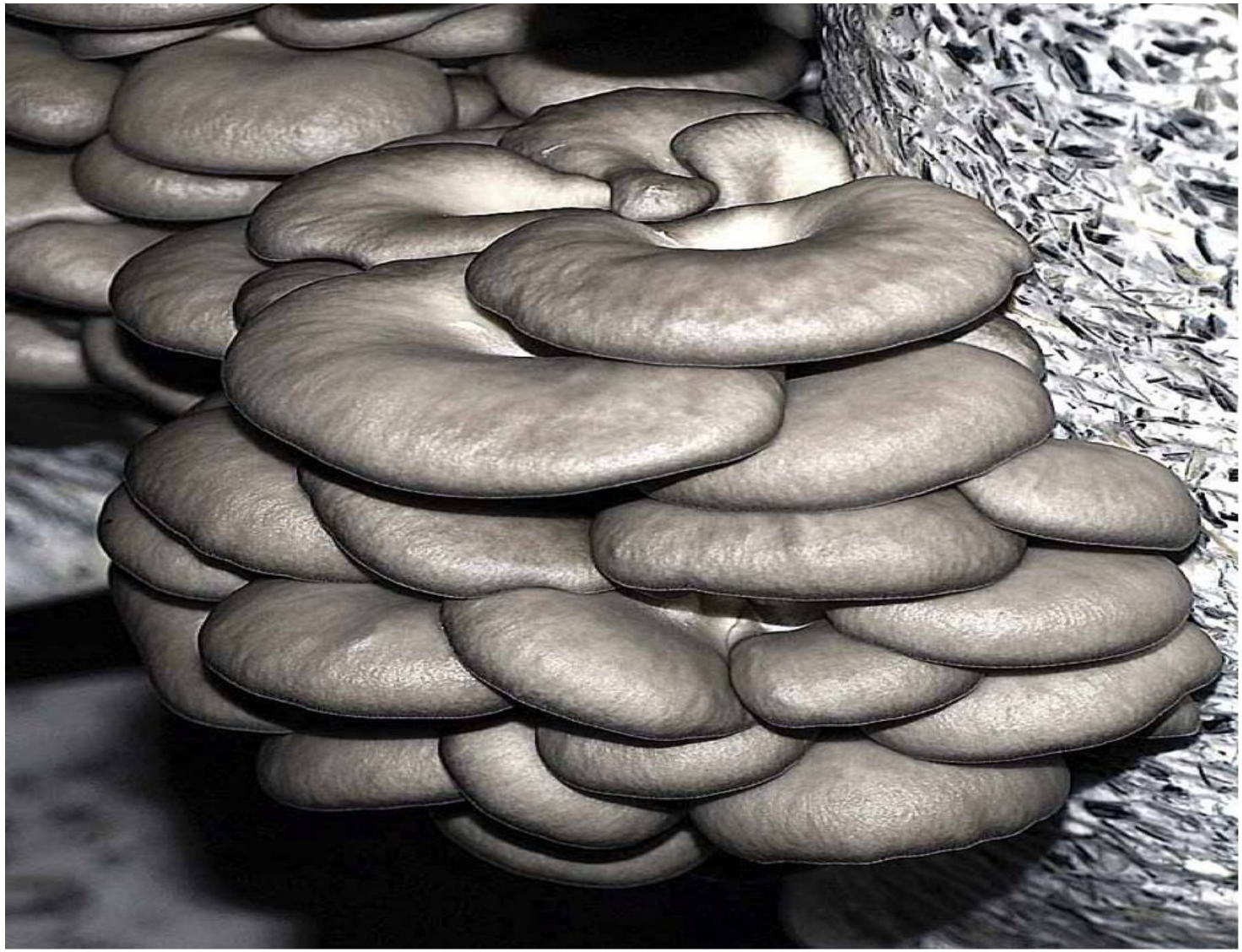
**(each 60 tons of a substrate)**



**All climatic parameters of every cultivation chamber are traced on the computer monitor online.**



With an optimum climate, fruit bodies of high quality are produced = the best price of sales!



# Abnormal Fruiting

CO2 concentration is too high, 1,500-2,000 parts per million (ppm)

**Picture 001.**
**CO2 concentration within the first day has risen up to 1 500 ppm, second day - up to 2 000 ppm. rH = 90 - 92%; t = 14°C. (Pleurotus HK 35)**

Abnormal Fruiting – not enough air movement when mushrooms grow

# Abnormal Fruiting

$CO_2$ level too high, 900-1,000 ppm

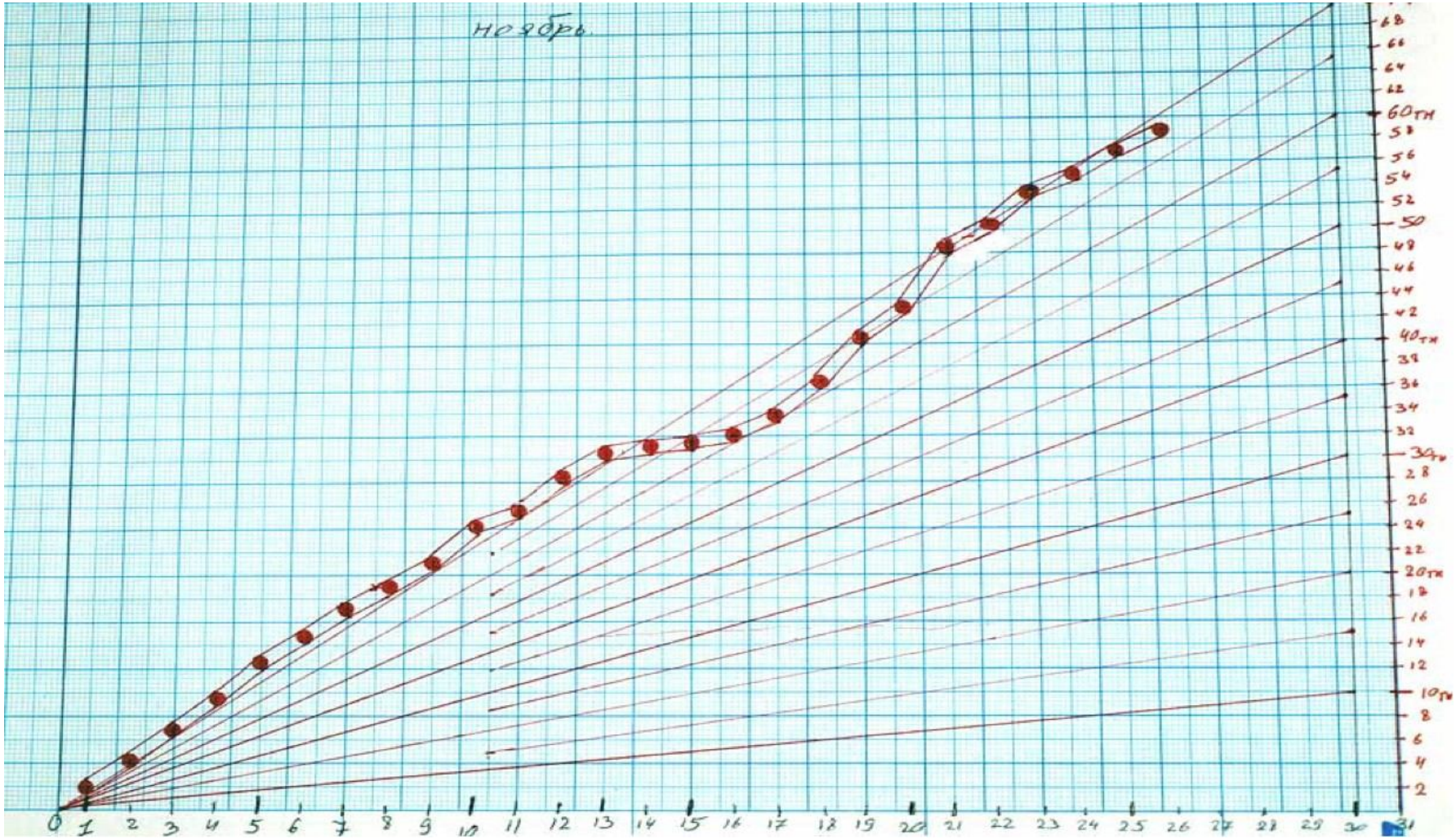
# Abnormal Fruiting

Too much moisture, due sudden drop in temperature causing water to condense

# Ten Commandments for Successful Oyster Mushroom Production

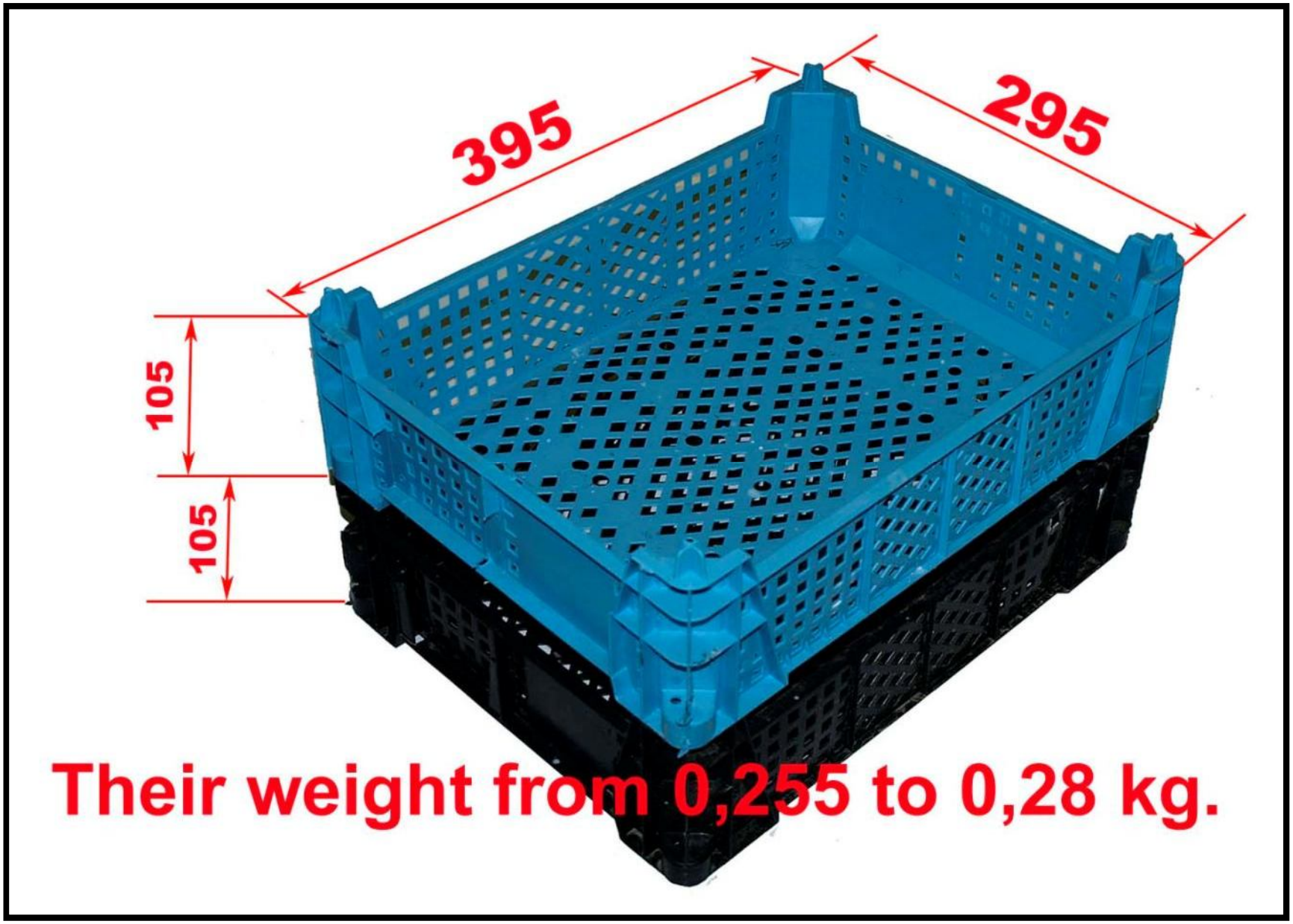
**+ quality substrate**
**+ quality spawn**
**+ pure inoculation**
**+ careful substrate block movement**
**+ good incubation climate**
**+ careful substrate block movement**
**+ optimal climate of cultivation chambers**
**+ careful harvesting**
**+ attractive packaging**
**+ refrigerated storage and transport**

**... for example, the real monthly yield diagram of Oyster mushroom growing by the mushroom farm in Millerovo.**



# We pick mushrooms into the plastic boxes

# Example of harvesting box



Harvested mushrooms transported to a refrigerating chamber quickly.

# Referigerated storage room 3-5 C degrees

Pack the refrigerated mushrooms under a special vapor-permeable film.

# Do not crush mushroom packages into the transport boxes

Verify weight of each package is more than amount written on the label.  Add or take away one or two mushrooms.

All this work is needs a special, clean packing area.

Pallet the boxes with ready-made packages and load them into refrigerator truck.

# Within 24 hours, the truck will go to wholesale market.

# Small farmers must be real entreprenuers

OK, you've made spawn, substrate, grew the mushrooms.  Now what are you going to do with them?

At 6 a.m. Monday through Friday, Ron takes sales calls at the office in the basement of his house.

Transporting mushrooms to market is just as important as growing them.

Reliable transportation is essential to make deliveries two or three times a week.

# Don't forget refrigerated storage.

Mushrooms are sold by weight, so loss of moisture means loss of money. Unless you sell all your mushrooms everyday, you should refrigerate them.

Don't forget packing boxes either.

Packing supplies are a big investment.

And, it takes time to fold the cardboard sheets into shipping boxes.

# Simple Packing room and Equipment

Food packaging areas must pass Health Department Inspections for sanitation and correct labeling.

# Governments usually require labels

Labels must show name of product, weight, and location where grown and packed.

# Weight of mushrooms must be accurate

In USA, scales used to measure weight of product must be inspected and licensed.

Drying mushrooms is sometimes the best way to preserve them for future sales.  But,China is a fierce competitor inthe world market for dried mushrooms.

Solar dryer in Uganda is carefully designed to keep insects out and allow air exchange to keep temperature below 50 C degrees

Making a profit with dried mushrooms is not easy.

Everyday, small mushroom growers must remember their most important asset.

Most important asset of every small businessman is a loving and patient wife.

The party is over.  Now, time for about cleaning up.
What to do with the old bags of substrate?

This presentation is result of collaboration between two mushroom growers/consultants, Mickey Foley and Viktor Yakushenko.

**You may contact us by email anytime you have questions about growing oyster mushrooms.**

**Mickey Foley - micfoley43@gmail.com**

**Viktor's contact information is below:**

**ВЕШЕНКА**

промышленное производство;
технологический аудит и сопровождение предприятий

ЯКУШЕНКО
Виктор Васильевич

Россия +7 918 998-89-92
+7 962 861-31-16
Украина +3 8 093 757-75-30
+3 8 068 829-21-33
E-mail: viktor_yakush@mail.ru
viktor_yakush@yahoo.com