

## OPTIMIZATION OF SUBSTRATE COMPOSITION AND STERILIZATION METHODS FOR ENHANCING ECONOMIC EFFICIENCY OF OYSTER MUSHROOM (PLEUROTUS OSTREATUS) CULTIVATION IN UZBEKISTAN

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### Abstract

The increasing demand for oyster mushrooms (*Pleurotus ostreatus*) in dietary nutrition and their high export potential underscore the importance of optimizing cultivation technologies. This study aims to improve the economic efficiency of oyster mushroom production through the selection of optimal substrate components and sterilization methods. Three experiments were conducted: 1) selection of plant-based substrate components from furniture production waste (poplar, maple), 2) evaluation of autoclaving regimes (1-2 atm, 1-2 hours) and ethylene oxide fumigation on substrate sterilization, and 3) assessment of mycelium viability during storage on various grain substrates (wheat, barley, rye, millet). Results demonstrated that millet provides superior mycelial viability up to 7 months and higher contamination resistance. Ethylene oxide fumigation (1000 mg/m<sup>3</sup> for 90 minutes) preserved substrate structure and ensured 100% colonization, increasing yields by 14.3% compared to autoclaved controls. This method reduced contamination by 15%, with stable yields of 3.2 kg per 10 kg substrate. The findings support millet-based substrates and ethylene oxide sterilization as effective solutions for improving the efficiency and sustainability of mushroom production in Uzbekistan.

**Keywords:** *Pleurotus ostreatus*, substrate optimization, sterilization, millet, ethylene oxide, mycelium viability, Uzbekistan

### 1. Introduction

The growing interest in mushrooms such as *Pleurotus ostreatus* is linked to their high nutritional value, low caloric content, and demand in dietary nutrition. Mushroom cultivation plays an important role in the agro-industrial complex of Uzbekistan due to its ecological purity and export potential. However, existing research focuses mainly on basic cultivation technologies for limited species like *Agaricus bisporus*, leaving gaps in the optimization of substrates and sterilization methods specifically for oyster mushrooms.

### 2. Materials and Methods

#### 2.1. Substrate Composition

The plant-based components selected for the substrate included waste from furniture production using common hardwoods in Uzbekistan (poplar, maple). These were mixed with 18% corn cobs, 20% millet, 1-2% gypsum or chalk, and optionally 10% hay to improve texture.

Component	Proportion (%)
Wood sawdust (poplar + maple)	60%
Corn cobs	18%
Millet	20%
Gypsum or chalk	1-2%
Hay (optional)	up to 10%

**Table 1. Composition of substrate components for oyster mushroom cultivation**

## 2.2 Sterilization Regimes

Substrates were sterilized using either autoclaving (1-2 atm, 1-2 hours, 121°C) or fumigation with a gas mixture of 10% ethylene oxide and 90% CO<sub>2</sub> at varying concentrations and exposure times.

## 2.3 Mycelium Storage

Viability of mycelium grown on wheat, rye, barley, and millet substrates was evaluated over 7 months at +1°C. Growth was assessed by colony diameter and percentage of colonized grains monthly.

## 2.4 Evaluation Parameters

- Contamination rate post-sterilization
- Mycelium colonization percentage
- Substrate structural integrity post-treatment
- Yield of fruiting bodies per 10 kg substrate

## 3. Results

### 3.1 Substrate Efficacy

Millet showed superior performance with 100% colonization sustained up to 7 months. Other grains exhibited declining viability beyond 3-5 months.

Substrate	1 month	2 months	3 months	4 months	5 months	6 months	7 months
Wheat	100%	84.1%	32.4%	–	–	–	–
Barley	100%	84.7%	69.7%	57.4%	–	–	–
Rye	100%	89.1%	76.8%	68.3%	61.4%	–	–
Millet	100%	100%	100%	100%	100%	94.1%	72.1%

**Table 2. Mycelium viability on different grain substrates during storage at +1°C**

### 3.2 Sterilization Outcomes

Autoclaving at 2 atm for 1.5 hours ensured sterility but degraded substrate structure, especially for wheat and barley. Ethylene oxide fumigation at 1000 mg/m<sup>3</sup> for 90 minutes preserved structure and achieved 100% colonization with zero contamination.

Treatment	Infection	Colonization (%)
Autoclaving (control)	Sterile	100%
1000 mg/m <sup>3</sup> , 90 min	Sterile	None
700 mg/m <sup>3</sup> , 300 min	Sterile	20%
700 mg/m <sup>3</sup> , 180 min	Sterile	40%
400 mg/m <sup>3</sup> , 300 min	Sterile	40%
100 mg/m <sup>3</sup> , 90 min	Sterile	100%

**Table 3. Effect of fumigation regimes on substrate sterility and colonization rate**

Regime	Wheat	Barley	Rye	Millet
2 atm / 2 h	Sterile	Sterile	Sterile	Sterile
2 atm / 1.5 h	Sterile	Sterile	Sterile	Sterile
2 atm / 1 h	Contaminated	Contaminated	Contaminated	Sterile
1.5 atm / 2 h	Sterile	Sterile	Sterile	Sterile
1.5 atm / 1.5 h	Contaminated	Contaminated	Contaminated	Sterile
1 atm / 1 h	Contaminated	Contaminated	Contaminated	Contaminated

**Table 4. Effect of autoclaving regimes on substrate sterility and structure.**

### 3.3 Yield assessment

Substrates sterilized via fumigation yielded 3.2 kg per 10 kg substrate, a 14.3% increase over autoclaved controls (2.8 kg). Contamination rates decreased by 15% with fumigation.

Treatment	Colonization (14 days)	First harvest (days)	Contamination (%)	Yield (kg/10 kg substrate)
Traditional autoclaving	100%	32	15%	2.8
Fumigation	100%	30	0%	3.2

**Table 5. Effect of fumigation on oyster mushroom yield**

### 4. Discussion

Millet-based substrates provided optimal conditions for prolonged mycelial viability and colonization efficiency. Ethylene oxide fumigation proved superior in preserving substrate integrity and enhancing yield, aligning with sustainable agricultural practices. These findings offer practical recommendations for improving mushroom production efficiency in Uzbekistan's agro-industry.

### 5. Conclusion

The combination of millet-based substrates and ethylene oxide sterilization significantly enhances the economic efficiency and sustainability of *Pleurotus ostreatus* cultivation. This approach reduces contamination, improves yields, and aligns with modern agricultural sustainability standards.

### References

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