

The Microwave Sterilizer Design and Study to the Solidified Media of the Edible Fungi

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Abstract: The microwave sterilization equipment is designed according to the microwave sterilization craft of solid culture medium in fungus growth. The designed microwave sterilization facility contains microwave power generator, microwave sterilizer, control system, transmission system and so on. From the setting-to-work test, the design was success.

Keywords: Microwave sterilization, microwave power generator, microwave sterilizer, microwave control system, the solidified media

INTRODUCTION

Edible fungi have characteristics of a nutrient-rich, high biological efficiency in the three human food sources (plant food, animal food, fungi food). With the improvement of people's living standards and the development of edible fungi deep processing technology, the market demand will be greater (Geng and Ge, 2013). But now, the planting the edible fungi is in individual-based, and there exist the problem of unstable quality and low yields, moreover, almost all labor have to rely on hand to complete, small-scale production, less market competitive, and the quality is difficult to guarantee, the profit is not high (Ge and Liu, 2007). To improve this situation, and automate the edible fungus production, microwave sterilizer is designed according to microwave sterilization test results and the optimum craft on the solidified media of planting the edible fungi.

THE WHOLE STRUCTURE AND PRINCIPLE OF MICROWAVE STERILIZER

The whole structure of microwave sterilizer: The microwave sterilizer is assembled mainly by the microwave generator, control system, transmission system, microwave leakage control mechanism, energy transportation mechanism and framework. The microwave sterilizer structure is shown in Fig. 1.

The microwave generator consists of a magnetron (2M210-M1 Panasonic), high-voltage transformer (700E-1 (AL)) and high-voltage diodes (HVH-12) high-voltage capacitor (CH85 1.0 $\mu F \pm 3\%$ 2100 VAC 50/60 HZ-10/85 internal discharge resistor, fuse (8A250V SICHERUNG FUSE). The microwave generator function is to generate microwave, the solidified media of planting the edible fungi is in high temperature under

the microwave affecting, and then play the effect of sterilization.

The microwave sterilizer size is designed according to the size of the solidified media of planting the edible fungi, and how to make the electric field evenly distributed and sterilization efficiency. The sterilization efficiency determines the maximum size, the size of the solidified media of planting the edible fungi and the uniformity of the electric field determines the minimum size under normal circumstances. Microwave sterilizer is made by stainless steel, the upper wall opened a coupling port for inputting microwave; both sides of the upper wall has two rows of apertures for discharging moisture; in the middle sidewall provided with an observation window for observing the internal running (Wang, 2004).

Control system is used to control the microwave generator, microwave sterilizer can not be work when no-load, and otherwise the microwave generator is easily damaged. When the solidified media along the transmission system entered the sterilizer in turn, there is no the solidified media in the end of the sterilizer, the microwave generator should be sequentially turned on when the sterilizer starts working, so there is no the solidified media in the sterilizer, the microwave generator can not be turned on.

The energy transport mechanism is to ensure the transmission of microwave energy. The microwave energy from the microwave generator can be transmitted to the microwave sterilizer in safe, accurate and efficient.

The microwave leakage control mechanism is disposed at both ends of the microwave sterilizer, the purpose is to control the microwave leakage and absorb the leaking microwave, in order to avoid harm to the human.



Fig.1: The whole structure figure of microwave sterilizer; 1-the conveyor belt, 2- the microwave leakage control mechanism, 3- the microwave sterilizer, 4-the observation window, 5- the microwave generator, 6-the splined shaft, 7- framework

Table 1 Comparison of the edible fungus growth effect

Technical index	Traditional sterilization	Microwave sterilization
The time of Primordia appeared	2011.10.02	2011.10.02
The mushroom cap diameter (cm)	1.0	1.1
The mushroom cap thickness (cm)	0.5	0.5
The mushroom cap color	Milky	Milky
The mushroom stalk length (cm)	7.8	7.9
The mushroom stalk diameter (cm)	0.4	0.6
The mushroom stalk color	Pale-yellow	Pale-yellow

Transmission system consists of the conveyor belt and the splined shaft. The conveyor belts are installed on both ends, to ensure the transmission efficiency. The splined shaft is employed in the middle, to ensure that the solidified media can be thoroughly sterilized and heated evenly.

The principle of microwave sterilizer: The microorganisms in the solidified media of planting the edible fungi contain bacteria, yeast, fungi, actinomycetes. Bacteria, yeast, fungi, actinomycetes are a condensed matter that constitute by water, protein, carbohydrates, fat, and inorganic compounds. In which water is the main component, and account to 75-85%. Water participate various physiological activities of microorganisms, such as cell growth and reproduction, absorption of various nutrients, cytoplasmic diffusion, permeation and absorption etc. The temperature of the microorganisms in the solidified media will be elevated due to the polarization of its own moisture and absorption of microwave energy under certain energy microwave.

The strong interaction between molecules exacerbated the microwave energy conversion for they are condensed matter, so the body proteins, nucleic acids and other substances are subject to the two effects of the promise of thermal motion and polarity changes, and degeneration has caused by changing spatial structure or destruction. Protein's solubility, viscosity, swelling, permeability and stability will change significantly after denaturation, which the cells lose their biological activity, and lead to death (Song *et al.*, 2005).

PERFORMANCE TESTING AND ANALYSIS OF MICROWAVE STERILIZER

Comparison test: Thirty the solidified media bags of $\varphi 75 \times 240$ mm are taken, each bag weights about 500 g,

and divided into three groups on average. Ten bags of the first group do not carry any operation, 10 bags of the sec group sterilized two hours under the conditions of 121°C with high-temperature steam sterilization pot, 10 bags of the third group are sterilized by microwave sterilizer. Then, put away at room temperature. Ten bags of the first group are found the mold growth, the other 20 bags of the second group and the third group no bacteria growth after 7 days. This shows that the microwave can be sterilized thoroughly to the solidified media of planting the edible fungi.

Comparison of the edible fungus growth effect: Fifteen bags of the solidified media of planting the edible fungi sterilized by traditional sterilization method, and 15 bags of the solidified media of planting the edible fungi sterilized by microwave sterilization method, respectively and then planting the *Flammulina*, and record its growth, detailed in Table 1.

It can be seen from Table 1, the growth of the *Flammulina* that is no difference that the solidified media sterilized by microwave sterilization and traditional sterilization, Therefore, the microwave sterilization as one method sterilization on the solidified media of planting the edible fungi in is entirely feasible.

CONCLUSION

- The test results show that the microwave sterilizer can be sterilized the solidified media of planting the edible fungi, and the microwave sterilizer can be achieved for continuous production, and improved the sterilization efficiency.
- In the solidified media transmission process, the splined shaft was employed, the solidified media can be realized linear motion and rotoation, so the sterilization is evenly, the sterilization effect.is better.

REFERENCES

- Ge, X.F. and C.X. Liu, 2007. Experimental study of microwave sterilization craft on the solidified media [J]. *J. Henan Agric. Univ.*, 41(3): 322-325.
- Geng, Y.F. and X.F. Ge, 2013. Experiment study on solid culture medium by microwave sterilization [J]. *Adv. J. Food Sci. Technol.*, 5(5): 561-564.
- Song, A.D., C.X. Liu, X.F. Ge, *et al.*, 2005. Experimental research of microwave disinfection in solid media of edible fungi [J]. *J. Microw.*, 6: 66-70.
- Wang, S.L., 2004. *Application of the Microwave Heating Technology: Dry and Sterilization* [M]. Machinery Industry Press, Beijing.