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Symptoms of Virus Infected Oyster Mushrooms, *Pleurotus florida*

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느타리 Virus 罹病菌株의 病徵

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ABSTRACT: Although there were differences depending on strains and environmental conditions, virus infected oyster mushroom, *Pleurotus florida* showed slow growth on sawdust and rice straw substrates. Many harmful microorganisms occurred on the cultural bed of virus infected isolates. Pinhead formed too densely or too rarely sometimes. Stipes of the mushrooms were long slightly bent with small cap. The virus infected mushrooms formed branch on their stipes. The first pinheading days of the infeeted mushroom were later than that of healthy culture. The loss of fruit body yield was about 30% compared with that of virus free culture. Spores which contaminated by viruses damaged more seriously than the other source. The authors would like to call these symptoms as a new disease in oyster mushroom culture in the world.

KEYWORDS: virus, oyster-mushroom, symptoms.

Oyster mushrooms have been recognized as excellent cash crop in Korea. The cultivation area has been expending throughout the country. However, many farmers faced with bad crop due to diseases, recently. Therefore, some farmers gave up their mushroom and new farmers are born in another area. Therefore, the total area has been slightly increased. The prominant pathogenic microorganisms are green molds (*Tichoderma* spp.) and *Glyocladium* spp. and yellow bloth (*Pseudomonas agarici*). The success of oyster mushroom culture will be closely related to effective control of the microorganisms in future.

Whereas, the authors observed virus-like particles in *Pleurotus* culture collected from bad crop farm near city of Suweon. The isolate showed abnormal growing characteristics, itself. Ds RNA was extracted from not only the abnormal growing mushroom tissue but also the cell free virus-like particles. Therefore, the bad culture of oyster mushroom was associated with the virus infection.

Fungal viruses exhibit some degrees of virulence ranging from apparent latency to over lysis (Lemke, *at al.*, 1974). In general, fungal viruses appear to be relatively avirulent or latent, since apparently healthy mycelia aften contain high titers of virus particles (Dieleman-van Zaayen, 1972). However, in case of common mmushrooms, *Agaricus* bisporus virus was very serious althongh there were differences depending upon environmental conditions and hos cultivars (Harger, 1969; Hollings, 1965; Hollings, *et al.* 1971). While, virus disease of oyster mushroom is not known yet.

In this experiment, symptoms of virus disease in oyter mushroom, *Pleurotus* spp. were investigated.

Meterials and Methods

Fungal culture: Virus infected oyster mushroom culture, Pleurotus *florida* was described in previous experiments (Go *et al.*, 1992).

Cultural procedure: Rice straw and poplar (*Quercus*) sawdust were used as substrates for cultivation of the oyster mushroom. The cultivation procedure and preparation of rice-straw substrates were followd by the decription of Park *et al.* (1975) with some modifications. The straws were tied up to make bundle and submerged into water to give moisture up to about 70%. The rice shaw was cutted into 20 cm and fermented and door for 15 damp and the fermented straw were filled in a wooden box (60×45×20 cm) and wrapped with polyethylene sheet. The straws were pasteurized at 60℃ for 8 hours with living steam. Spawning on the surface of the straw substrates was done after cooling down into 25℃. The mycelia were grown at 25℃ for 30 days. The fruit bodies were formed at about 15℃ and 90% relative humidity (RH) under ventilation and lighting conditions.

Poplar sawdust and rice bran were mixed at 80 : 20 ratios (v/v). The moisture content of the mixture was adjusted to be 65% by spring water. This sawdust mixture was filled in 800 m*l* polypropylene (PP) bottle at rate of 0.21g/cc balk density. The procedure of cultivation using the sawdust substrate was decribed in a previous paper (Go *at al.*, 1986).

Results and Discussions

On poplar sawdust substrates, mycelia of the virus infected oyster mushroom, *Pleurotus florida* grew very slowly compared to those of the healthy one as shown Fig. 1. Within 15 days, the virus free culture grew up the whole substrates in a bottle, whereas the virus infected culture grew only a third of the whole substrates. During the mycelia of the virus free cultures were growing, virus infected spawn was additionally inoculated on the surface of the growing substrates on 5 and 10 days after spawning. As shown Fig. 1, the mycelial growth of healthy culture was affected by the new virus infected spawn like that of virus infected culture. It was clear that slow growing mycelia of the infected culture was caused by virus infection or virus infected cultures.

Similar results were obtained when rice straw substrates were used. But in this case, the mycelhal growth of virus infected culture showed almost 80% compared to that of healthy culture (Fig. 2). It also showed slow mycelial growth when the healthy culture was additionally inoculated onto it by virus infected culture on 10 days after

Fig. 1. Mycelial growth of virus infected (D) and virus free culture (H) on poplar sawdust substrates in a bottle. The number means the day of additional inoculation with virus infected inoculum after spawning of virus free culture.

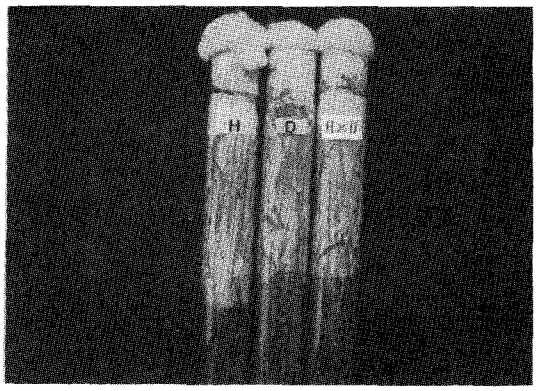

Fig. 2. Mycelial growth on rice straw substrates of virus infected (D) and virus free (H) cultures in *P. florida* HxD means that the virus free culture was inoculated additionally on 10 days after spawning by the virus infected culture.

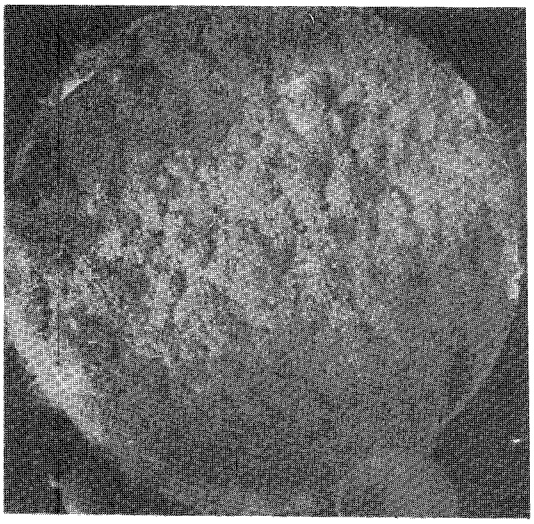

Fig. 3. Primodia formed too densely on sawdust substrates in virus infected culture.

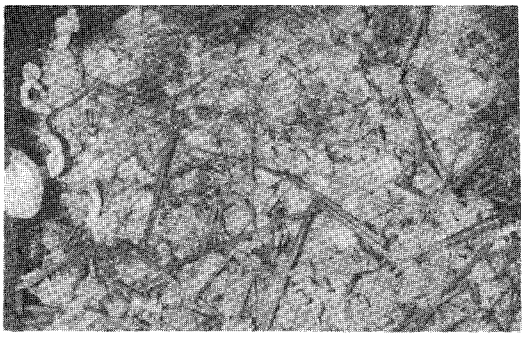

Fig. 4. Mushroom cultural bed of virus infected *P. florida.*

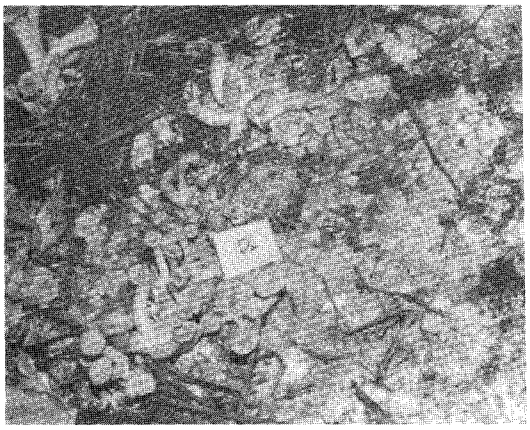

Fig. 5. Fruiting bodies of virus infected culture in *P. florida.* (bent stipe).

spawning. The mycelial density of both culture was similar each other.

Although there were some differences depending upon their growing substrates, virus affected on the mycelial growth in oyster mushroom as the obove results. When the virus infected culture was grown on sawdust substrates, primodia formed too densely and resulted in poor growth of fruit bodies (Fig. 3). The primodia soon died except quite a few fruiting bodies which survived and developed into mature sporophores.

On the surface of growing substrates in virus infected culture, many pathogenic molds especially green mold, *Trichoderma,* spp. was much contaminated than virus free cultural bed (Fig. 4) and resulted in bad crop. Bacterial yellow bloth was often occurred on the virus infection cultural bed. This is a reason for confusing between virus disease and bacterial yellow bloth. The yellow bloth caused *Psudomonas agarici* made clean yellow fluid on the surface of cluster at first and then deformed when they were severe (Bessette *at al.*, 1985). The stipes tended to recurve near the base and sporocarp was upright.

Virus infected culture produced bent, thin and long stip with small cap which was a little darker in color than that of healthy one and plane not upright in *P. florida* (Figs. 5 and 6). Branching stipes occurred in virus infected culture as shown in Fig. 7. Some time the stipes were big and short in *P. ostreatus.* The symptomes differently occurred depending on strain and environmental factors. Stipe branchng might be used for virus diagnosis in *Pleurotus* spp. by morphological observation.

Above all the symptoms of virus infected oyster mushroom were very comparable to those of *A. bisporus.* The most frequent virus symptoms in the common mushroom were long slightly bent stipes with small early maturing and off white caps (Annemaria, 1978; Nair, 1972). Ross (1979) reported an infecious disorder for meiosis in Coprinus congregatus. But in oyster mushroom, *P. florida* no evidence of disorder for meiosis was

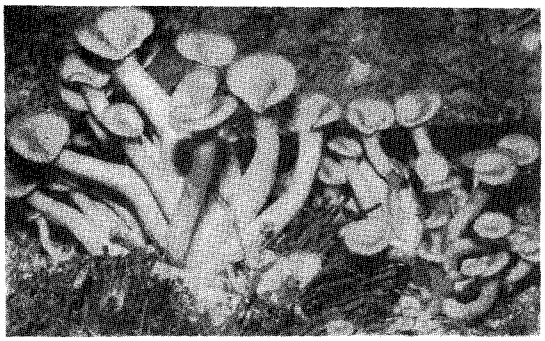

Fig. 6. Friuting bodies of virus infected culture in *P. florida* (long stipe with small cap).

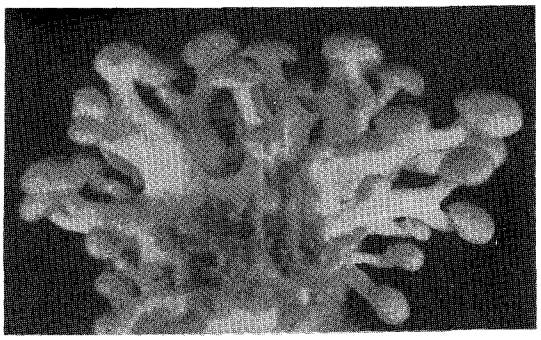

Fig. 7. Branching stipes of virus infected culture in *P. florida.*

Table 1. Comparison of fruiting bodies yields between virus infected culture and virus free one in *P. florida.*

Culture	Yields		First fruiting days
	gr/0.275 m^2	Index	from spawning (days)
Virus infected	1550	70	51
Virus free	2200	100	40

Table 2. Effects of virus inoculum sources on the yields of fruiting body and first fruiting days from spawning.

Inoculum	Yields of fruiting bodies (g/0.275 m)	First fruiting days from spawning (days)
Spore	750	51
Spawn	1460	47
Control*	2660	40

*Only sterized water was spraied additionally

found.

The fruiting body yields of virus infected culture was lower than those of healthy one when they were grown on rice straw substrates (Table 1). The virus infected culture produced 1550g of fruiting bodies from 0.275 m^2 of cultural box, while the virus free culture produced 2200g from the same area. The yield was lost by about 30% in virus infected culture than in virus free one. The first fruiting days from spawning of virus infected culture were different from those of virus free one. The virus infected culture formed fruiting body on 51 day after spawning. It was 11 days later than that of virus free culture. It might be due to slow growing characteristics caused by virus infection.

Infection sources affected the yields of fruiting body and first fruiting days (Table 2). When spores of virus infected were inoculated additionally on the growing surface of substrates lost about 70% of fruiting bodies compared to that of virus free culture. Meanwhile, virus infected spawn as a infection source lost about 45% of the fruiting bodies compared with the control one. In common mushroon, *A. bisporus,* some individual cropping rooms showed crop loss of over 50% in England (Gandy, 1972; Hollings, 1972). The crop loss by virus infection in the Netherland was 4% (Dieleman van Zaayen, 1972). Therefore, the case of fruiting body in *P. florida* by virus infection was more serious than in *A. bisporus.*

摘 要

Virus에 感染된 느타리버섯은 系統이나 栽培環境에 따라서 差異가 있으나 대체로 菌絲生長이 不振하며 버섯 原基形成이 過密하거나 不良하였다. 菌床은 雜菌 발생이 많았으며 대는 길고 굽으며 가지를 形成하였다. 갓은 대에 比하여 작으며 平形이고 갓

色은 다소 짙은 경향이였다. 初發芽가 늦고 子實體 收量은 健全菌株에 비하여 약 30% 程度 減收하였으며 罹病된 胞子로 接種하였을 때 減收率이 높았다.

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