韓 國 菌 學 會 誌 第 12 卷 第 2 號
Kor. J. Mycol. Vol. 12, No. 2, 53~58, 1984

Selection of *Pleurotus sajor-caju* as Suitable Species for Cultivation under Summer Climatic Conditions in Korea

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夏期 栽培에 알맞는 여름 느타리 버섯의 選拔

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Abstract: This experiment was performed to select the most suitable species of oyster mushroom for cultivation during summer season in Korea. The selection was made based upon mycelial growth on the ricestraw substrates, fruiting under hot weather conditions during the summer season in Korea and potential high productivity using six cultures from South-east Asia. The newly selected strain of *Pleurotus sajor-caju* (ASI 2070) grew well on the rice straw substrates and produced the higher yields of sporophores than other cultures tested. The primordia of the mushroom were formed between 10 to 35°C. The optimal temperature for fruiting ranged from 20 to 25°C.

Keywords: *Pleurotus sajor-caju*, Cultivation.

Oyster mushroom (*Pleurotus* spp.) has been very popular with its unique flavor and tasty, nutritive value among Koreans. Furthermore the mushroom has effects on reducing sarcoma 180 implanted in mice (Kim, Park and Shim, 1979).

The mushroom has been cultivated by many farmers in Korea as a cash crop during their leisure seasons. The cultivation of mushroom has been significantly increased to approximately 1,858 thousands square meters hz of bed area in 1983. Annual products of fresh mushroom reached about 17,920 M/T. a year.

In spite of increased cultivation of mushroom the cultivation periods were limited to spring and autumn season. The temperature was usually above 20°C in the summer season. The *Pleurotus ostreatus* called as common oyster mushroom did not form fruit-body above 15°C (Eger, Eden andWissig, 1976). Therefore, a strain or species of oyster mushroom which is able to grow and form fruit-body above 20°C was necessary to extend the mushroom cultivation period.

Recently, it has been found that several species of oyster mush room grow well and form fruit-body at relatively high temperature (Kurtzmon and Zadrazil, 1982). *Pleurotus sajor-caju*, *P. cystidiosus*, *P. aballonous* and *P. flabellatus*, for instance, formed fruit-body above 20°C (Cheng and Han, 1977; Jandaik, 1974; Kurtzman and Zadrail, 1982; Miller, 1967). *P. cystidiosus* and *P. aballonus* have been grown commercially in Taiwan (Han, 1977; Jong and Peng, 1975). *P. sajor-caju* was successfully cultivated in India and *P. frabellatus* as adapted to cultivation in the Philippines.

The authors have collected some of oyster mushroom species from South-east Asia and tested to select the most suitable species of oyster mushroom for growing under the summer climatic conditions in Korea.

Materials and Methods

Isolates of *Pleurotus* spp.

Six isolates of *Pleurotus* spp. had been collected from South-east Asia for the experiment from 1978 to 1982 as in the following Table I. ASI 2070 from India was received from Dr. Y.R. Lee (1979) and ASI 2085 from Hong Kong was kindly provided by Dr. S.T. Chang (1982), but others were obtained through tissue culture method from their fresh sporophores.

Table I. The list of oyster mushroom used in the experiment.

Stock number	Scientific name	Source	Collection date
ASI 2020	*P. aballonus*	Taiwan	Jul. 1978
ASI 2070	*P. sajor-caju*	India	Sep. 1982
ASI 2078	unknown	Thailand	Sep. 1982
ASI 2079	*P. aballonus*	Thailand	Sep. 1982
ASI 2085	*P. sajor-caju*	Hong kong	Oct. 1982
ASI 2096	*P. sajor-caju*	Thailand	Sep. 1982

Mycelial Growth

The crushed rice straw was used as substrate to evaluate mycelial growth of the oyster mushroom isolates. Because the rice straw was the main substrate used for cultivation of the mushroom in Korea. Water was added to the straw up to about 70% by wet weight basis and 35g of the straw was filled into the column tube (0.15g/cc bulk). The tube was inoculated with one spoonful of sawdust spawn of the cultures on top of the substrate in the tube after autoclaving at 120°C for 30 minutes. The mycelial growth was measured by linear growth after inculbation at 25°C for 10 days.

Effects of Temperature

The effect of temperature on mycelial growth and fruiting of the oyster mushroom isolates were tested from 5 to 40°C at 5°C interval. The linear growth of the mycelium was evalated on potato surcose agar (PSA) medium in a petri-dish for 7 day at the tes ting temperature controlled with the electronic cooli nics Model CTG 250 Yamamoto. A modified potato sucrose yeast agar medium was used for fruiting of the cultures by adding asparagin to 0.1% of the medium. The cultures were incubated in darkness at 25°C for 15 days and they were placed separately at the testing temperature in light condition. Occurrence of pinheads from the cultures were observed on the medium.

Potential of Productivity

The oyster mushrooms were cultivated on the non-fermented rice straw substrates prepared by Park's methods (1975) to examine their potential productivity in a wooden tray (60×45×20Cm). Some good yielding species from the cultivation were tested again to confirm their productivity with fermented rice straw substrates decribed by Go, Park and Cha (1981) on the cultivation shelves (1.5m²). All the experiments were repeated six tims under the summer climatic conditions. The best species selected by the experiments among the cultures was cultivated again to verify its productivity through commercial scales of the farmer's in local area. In the farm, water was added to the bundle rice straw to give 80% of moisture. The wet rice straw was fermented by piling up to 2m hight and turning when the temperature inside of the rice straw heap rose over 60°C. This process was necessary for prevention of contamination by harmful competitors. The turning of the straw pile was done three times for 6 days. The fermented rice straw was transferred into the cultivating room and continued to ferment from 50 to 55°C for 3 days after peak heating at 60°C for 6 hours.

Results

Among the oyster mushrooms (*Pleurotus* spp.) grown on the crushed rice straw substrates, ASI 2070, *P. sajor-caju* showed the best growth for 10 days and was followed by ASI 2085 *P. sajor-caju*. The unknown species ASI 2078 showed poor growth. (Fig. 1).

Mycelial growth of the *Pleurotus* species at different temperature were summarized in Table II. ASI 2070 and 2085 of *P. sajor-caju* grew in the range from 5 to 35°C, but did not grow at 40°C. The ASI 2020 grew

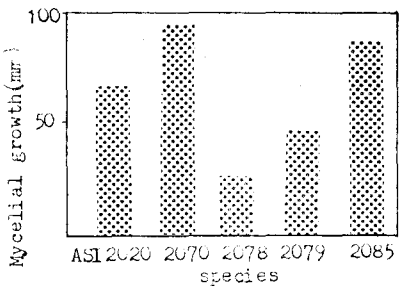

Fig. 1. The mycelial growth of *Pleurotus* spp. on the crushed rice straw substrate for 10 days.

Table II. Effect of temperature on mycelial growth of *Pleurotus* spp. on PSA medium.

Temp. (°C)	mm of mycelial growth of each *Pleurotus* isolate for 7 days.				
	ASI: 2020	2070	2078	2079	2085
5	0	0.1	0	0	0.1
10	4.6	3.0	0	0	3.9
15	11.2	14.5	1.3	2.4	14.4
20	20.5	24.9	4.1	6.0	24.6
25	42.6	49.8	12.9	18.7	43.3
30	42.8	46.3	11.1	19.3	41.8
35	4.9	4.3	2.8	2.1	10.6
40	0	0	0	0	0

Table III. Effects of temperature on primordia formation of *Pleurotus* spp. on PSYA media on 35 day after inoculation.

Temp. (°C)	Stock number of *Pleurotus* spp.				
	ASI: 2020	2070	2078	2079	2085
5	—	—	—	—	—
10	—	+	—	—	—
15	++	##	—	B	##
20	##	##	—	BB	##
25	++	##	—	BBB	##
30	—	##	—	BBBB	##
35	—	+	—	—	—

—: no primordia formation, +: Number of primordia formation, +<## B: Number of black head formation, B<BBBB

in the range from 10 to 35°C, ASI 2078 and 2079 grew in the rangerfrom 15 to 35°C only. The mycelial growth of the species was gradually increased following increase of temperature to 25 or 30°C for each species, but decreased sharply from over 30°C. Although the mycelial growth was different among the species, the optimal range of temperature for mycelial growth of the mushrooms was between 25 and 30°C.

ASI 2020, ASI 2070, ASI 2085 formed primordia on the potato sucrose yeast agar (PSYA) medium in a petri-dish. On the other hand, ASI 2079 produced black heads on the surface of the medium but others formed neigher primordia nor black head on their solid media (Table Ⅲ). Fruiting temperature ranged 10 to 35°C for the ASI 2070 but 15 to 30°C for ASI 2085. The optimal temperature of the species in *P. sajorcaju* was 20 to 25°C for forming of primordia. The number of black heads from ASI 2079 increased following increase of temperature from 15 to 30°C, but no pin-head was formed at any temperature tested.

In the wooden tray, all the oyster mushroom species except ASI 2078 produced sporophores as shown in the Fig. 2. The ASI 2078 grew poorly on the rice straw substrate and the culture showed severe contamination with harmful organisms. The best yield was obtained from ASI 2070 and ASI 2079, but poor yield was obtained from ASI 2020 (Fig. 2). The stem length and cap diameter of ASI 2070 was about 3.5cm and 7.4cm, respectively, on 5 days after pin-heading.

The first pin-head occurred on the 34th day after

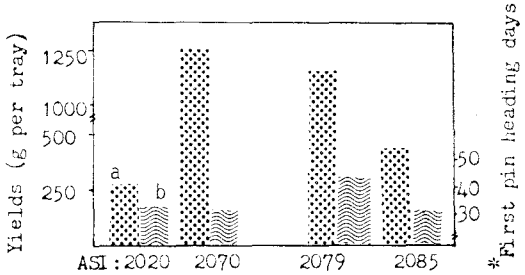

Fig. 2. The yields of sporophore (a) and first pin heading days (b) from spawning of *Pleurotus* spp. cultivated with rice straw bundle in wooden tray (60×45×70cm).
* days from spawing to first pin heading.

spawning in ASI 2070 and ASI 2085. but pin heads of ASI 2079 occurred on the 50th day after spawning (Fig. 2). Mostly, all the cultures did not grow vigo rously on the nonfermented rice straw substrates in the woodentray.

With the above results, some species showing high yields of sporophores and good mycelial growth and favorable charactors for cultivation were selected to examine with fermented rice straw substrates. The cultures selected were ASI 2070, ASI 2079, ASI 2085 and ASI 2096.

These cultures grew well and produced better yields of sporophore on the fermented rice straw than on nonfermented straw bundle, and no contamination by harmful fungi was observed. On the other hand, ASI 2079 formed black head on the surface of the substrates and showed a little resistant to mushroom flies due to its black head, which appeared to be obstacle to the flies.

The best yields of sporophore was obtained from ASI 2070 and the second was followed by ASI 2085 among them (Fig. 3). ASI 2070 produced 20.5kg of

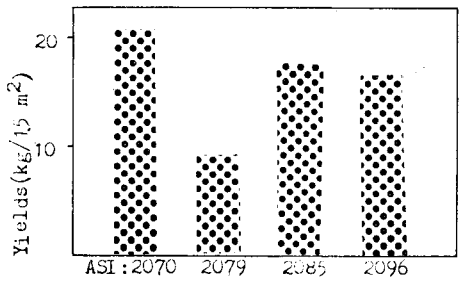

Fig. 3. The yield of sporophores of *Pleourotus* spp. grew on fermented rice straw substrate.

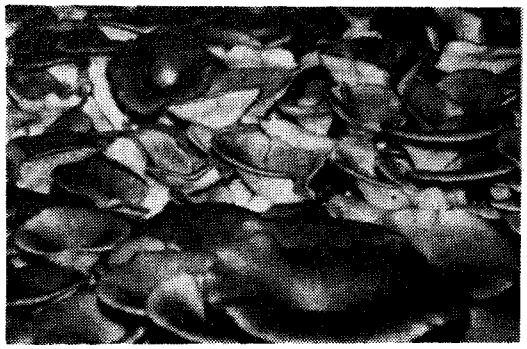

Fig. 4. Occurrence of *P. sajor-caju* (ASI 2070) on the bed of fermented rice straw substrate.

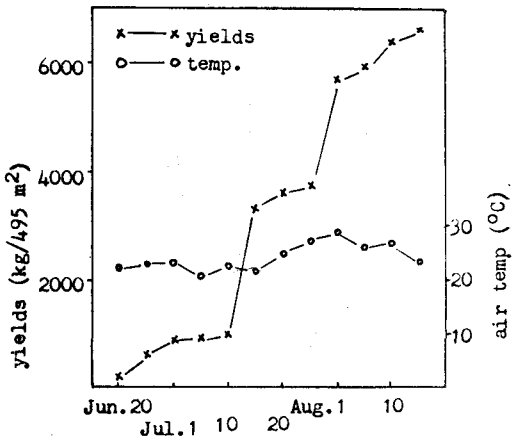

Fig. 5. The change of accumulated yield of *P. sajor-caju* (ASI 2070) sporophores and air temperature during the havesting periods in the farm.

fresh mushroom from 1.5 square meters of bed area. Thus the ASI 2070, *P. sajor-caju* from India was selected as suitable species among those oyster mushrooms tested for growing during the summer season in Korea(Fig. 4).

The productivity of the ASI 2070 was verified through cultivation by farmers in local area with commercial scale during summer season. The *P. sajor-caju* produced considerably good yields of sporophore from the farms as shown in the Fig. 5. The total yields of fresh mushroom were about 6,550kg from about 500m² of bed area. On the other hand, the air temperature during the cultivation period ranged between 20 and 30°C.

Discussion

P. sajor-caju has been favored by the South-east Asians and Indians for its tasty. Jandaik and Kapoor (1976) reported that the edible mushroom was potentially a valuable source of food and fodder protein.

The oyster mushroom contained about 47.93 percent of protein with all essential amino acid. This mushroom has been cultivated using various agricultural wastes such as rice straw, hulled maize cobs, banana pseudostem in the South-east Asia and Africa (Bano and Rajarathnam, 1982; Jandaik and Kapoor, 1974;

Mueller and Gawley, 1983; Nout and Koya 1983; Sivara kasam and Kandaswamy, 1981).

On the rice straw substrates, *P.sajor-caju* (ASI 2070 and ASI 2085) grew very well in our experiments but the other species such as *P. aballonus* and unidentified oyster mushroom did not grew very well(Fig. 1). The rice straw was major substrate for the cultivation of mushroom because it was abundant resources of agricultural waste in Korea. Thus, it was very important for the oyster mushroom to grow very well on the rice straw substrate because the mushroom cultivation area can be extended to commercial scale in the country.

Since the *P. sajor-caju* showed a wider range of growing temperature than that of *P. aballonus* and unidentified oyster mushroom, it might as well cultivate in the country. Even though *P. ostreatus* has a wide range of temperature for mycelial growrng (Zadrazil 1974), the oyster mushroom was not available to grow in summer seasonin Korea due to fruiting formation below 15°C(Egar and Wissig 1976). The newly selected *P. sajor-caju* (ASI 2070) among six cultures from South-east Asia formed fruit body from 10 to 35°C in the range of optimal temperature between 20 and 25°C for fruiting body. This results were simillar to that of Jandaik (1974). The edible mushroom was regarded as a suitable species for cultivation during the summer season in Korea, because of high yields of sporophores (Fig. 3 and 4) on the rice straw substrates in hot weather conditions.

With the results, the cultivation of oyster mushroom in Korea was possible almost all around the year. The cultivation of *P. sajor-caju* was recommendable as an alternative crop of *P. ostreatus* during summer season in the country.

摘　要

夏期栽培에 알맞는 느타리버섯은 東南亞細亞 및 印度에 自生하는 느타리버섯(*Pleurotus* spp.) 6菌株를 蒐集하여, 볏짚培地에서의 菌絲生長 程度, 發茸溫度 및 여름철 氣候下에서 子實體 生産力 等을 調査하여 選拔하였다.

새로選拔된 *Pleurotus sajor-caju* (Fr.) Sing. (ASI 2070)은 試驗된 菌株 中 볏짚培地에서 가장 양호한 菌絲生長을 보였고, 子實體收量은 13.7kg/m²으로 높았다. 發茸溫度範圍는 10～35°C 였으며 最適溫度는 20～25°C였다. 이와같은 試驗結果는 農家栽培로 實證하였으며 이버섯을 "여름느타리버섯"으로 命名하였다.

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〈Received April 10, 1984〉