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不同樹種來源單獨與混合木屑對杏鮑菇瓶栽生產影響之研究[1]

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摘要：本研究係以金針菇瓶栽自動化設備進行不同樹種來源單獨及混合木屑對杏鮑菇自動化瓶栽生產影響之測定。第一期試驗以堆積過4個月之杉木與楓木木屑爲原料，經添加20%體積之米糠及適量之碳酸鈣與水，均勻混合後，以自動化裝瓶機裝瓶（1,100ml），每瓶基質約重650公克，含水量約65%，經於20～22°C分別培養42及40天後，以人工去皮栽培，採收兩週期之每瓶產量，前者爲71.8公克，後者爲149.5公克，差異顯著。同期試驗中，另以楓木木屑基質做去皮與不去皮處理，採收兩周期之每瓶平均產量分別爲128與124.3公克，無顯著差異。第二期試驗以堆積過5個月之校欖、杉木、楓木、相思木、山黃麻及楠木等六樹種單種木屑，如第一期配方製作基質及裝瓶，經接種培養43天後，不開蓋不去皮，待降溫至出菇時開蓋，經栽培後，以上各樹種木屑第一周期每瓶平均產量依序爲117.7，95.6，134.8，110.8，150.1及142.0公克，完成第一周期菇之採收分別需要10.0，11.9，6.7，8.6，5.1及6.1天，兩周期之產量依序爲169.3，157.9，207.1，172.0，219.6及214.7公克。其中山黃麻，楓木及楠木三樹種木屑間之兩周期平均產量無顯著差異，而相思木、杉木及校欖三樹種木屑間亦同，但前三者之平均產量顯著高於後三者。第三期之試驗以堆積過7個月之杉木木屑分別與堆積相同時間之山黃麻、楠木、相思木、楓木、臺灣赤楊及校欖木屑各半混合，並添加前述相同體積比之米糠時，以山黃麻單種木屑爲對照，經接種培養33天後，不開蓋不去皮，待降溫至出菇時開蓋，以上各樹種木屑與杉木木屑之混合物第一周期每瓶（1,100cc）之平均產量依序爲141.9，112.6，117.6，150.9，151.2及115.4公克，而對照爲148.2公克，第一周期菇完成採收分別需要14.0，16.7，17.2，11.0，12.5及13.8天，對照爲11.7天，兩周期之產量依序爲202.4，172.5，175.6，212.9，205.2及167.9，對照爲204.9公克，杉木木屑與山黃麻，楓木及臺灣赤楊三樹種木屑各半混合處理間之第一周期及兩周期之平均產量均無顯著差異，而與相思木、校欖及楠木三樹種木屑各半混合處理間之平均產量亦無顯著差異，但杉木木屑與前三樹種木屑之混合處理之平均產量顯著高於後三樹種木屑之混合處理，山黃麻木屑與杉木木屑混合後之產量與該樹種單種木屑間無顯著之差異，但其第一周期菇完成採收之時間則有顯著延遲之現象。

關鍵詞：杏鮑菇、木屑、樹種、瓶栽生產。

杏鮑菇〔*Pleurotus eryngii* (DC.：Fr.) Quêl.〕是高品質之食用菇[3,5,7]，雖然可用麥桿或稻草栽培，但其菌絲對其他雜菌之抵抗力弱，出菇期間因基質與外界接觸面大，極易受雜菌，特別是木黴之感染，而導致栽培失敗[1,6,8]。若以木屑塑包栽培時，其基質裝入塑膠袋中，經高溫或低溫殺菌，雖

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可減少雜菌感染，出菇時若僅拔除頸環之棉花塞，使之在頸口出菇，可產生較高品質之菇體，但受限於出菇面積，產量較低，若於木屑塑膠包底部或包身做十字割口，雖可形成較多菇體，且產量較高，但菇體品質較差[2]。此外以木屑塑膠包栽培時，太空包之製作及接種無法自動化，栽培後廢太空包較難處理，每包重達1.2～1.4公斤，搬運時較爲笨重而耗費體力，在農村勞力缺乏，僱工困難之下，恐不利於將來杏鮑菇之商業化栽培[2]。又杏鮑菇之生長發育適溫爲15～19°C，超過20°C時菇體容易死亡，如欲利用低溫之自然氣候下栽培，產量勢必無法穩定，且一年中可栽培季節甚短，恐不利於該產業之發展，惟如果利用金針菇之塑膠瓶在空調條件下栽培，則栽培材料之混合，裝瓶及接種可完全自動化節省勞力，而塑膠瓶可重複使用十年以上，大爲降低生產成本，栽培廢料清除容易，經適當處理可做爲有機肥料，不致破壞環保。此外，在空調條件下栽培，產量穩定，可視市場需要決定生產量，價格較爲平穩，且所需溫度較金針菇爲高，可降低能源成本，一舉數得，是非常值得開發之杏鮑菇生產技術。杉木【*Cunningahmia lanceolata* (Lamb.) Hook. var. *lanceolata*】爲金針菇業者使用最廣泛之木屑樹種，其木屑量多且較任何其他樹種木屑價廉，相思樹【*Acacia confusa* Merr.】則爲香菇菇農使用最普遍之樹種，來源不虞匱乏，楓木【*Liquidamber formosana* Hance】，臺灣赤楊【*Alnus formosana* (Burkill) Makino】及校欖【*Cyclobalanopsis glauca* (Thumb.) Orest.】也是香菇業者採用之樹種，其木屑來源較少，價格較相思樹木屑爲高，山黃麻【*Trema orientalis* (Linn.) Bume】及楠木【*Machilus kusanoi* Hay】則爲木耳及鮑魚菇類菇農使用較多之樹種，其木屑較香菇栽培所使用之樹種木屑便宜，由於不同菇類對其基質成份有不同之要求，其對基質之分解能力，亦有所不同，以上各樹種之木屑何者最爲適合杏鮑菇自動化瓶栽及其等與較便宜之杉木木屑混合後，對杏鮑菇生產之影響爲本研究探討之主題。

材料與方法

一、供試杏鮑菇品系：所使用之杏鮑菇品系爲美國引進的 ATCC 36047（美國菌種保存中心鍾順昌博士贈送）。以馬鈴薯葡萄糖洋菜培養基做定期培養，並以液氮做長久保存。

二、小麥菌種之製作：本試驗供木屑原種接種之小麥菌種以下法製作，小麥先以水洗淨並以冷水煮至沸騰，保持約20分鐘，濾除水分後，隨即填加２％碳酸鈣與１％之石膏，冷卻後裝入四角瓶，塞好棉塞以高壓蒸氣殺菌（121°C，１小時），隔夜冷卻後以上述杏鮑菇品系培養於 PDA 之菌絲塊接種，定溫培養於25°C約15天，當菌絲長滿小麥後即得小麥菌種。

三、供試木屑原種之製作：供自動化接種機大量接種所使用之原種採用山黃麻木屑爲原料，以添加木屑體積四分之一之米糠及每0.5立方公尺之木屑加1.5公斤之碳酸鈣混合加水後，以本方法第(五)項之栽培材料裝瓶殺菌，並採用小麥菌種接種，經培養於24°C一個月而成。

四、栽培材料及配方：栽培主要材料之木屑，其來源樹種包括山黃麻，杉木，楓木，臺灣赤楊，校欖，相思木及楠木等。米糠爲未脫脂之蓬來米米糠，所有不同樹種單獨或混合木屑與米糠體積比均爲４：１，每0.5立方公尺之木屑，添加1.5公斤碳酸鈣與40公斤之米糠，所使用之木屑來源樹種，第一期栽培試驗爲杉木與楓木，第二期栽培試驗爲校欖，杉木，楓木，相思木，山黃麻及楠木，第三期栽培試驗爲杉木，山黃麻，相思木，楓木，臺灣赤楊，校欖及楠木。第一期與第二期試驗爲不同單樹種木屑間之比較，第三期栽培試驗爲杉木與其他樹種木屑各半混合間之比較，以山黃麻木屑爲對照。以上各樹種木屑均爲鋸木廠之木屑，非人工打碎者，其顆粒較後者爲細，使用前均經電動篩選機（孔口大小爲１平方公分）篩選，以除去混雜之木塊、木片及其他雜物等。這些木屑依試驗期別依序堆積４，５及７個月，除第一個月爲加水翻堆外，其後每隔一個月視需要加水翻堆一次。

五、栽培材料之裝瓶、殺菌及接種：以上各配方之材料利用自動混合機混合，並以自動計量設備調節

混合物含水量於約65%後，以輸送帶輸送至自動裝瓶機（協全 KPAC-50-2），經自動裝填，壓緊，打洞，封蓋（每次12瓶，每瓶1,100ml，基質每瓶重約650公克）後，以輸送帶移入具有電腦自動化控制殺菌程式之殺菌釜（廣太源）殺菌（瓶中心溫度達122°C時保持45分鐘）。殺菌完成後移入冷卻室冷卻，隔夜後輸入無菌接種室，以自動化接種機（協全 RS-2000型）接種，所用之原種爲 PP 塑膠瓶裝之山黃麻木屑菌種。

六、栽培菌種之培養與出菇採收：栽培用菌種經接種後輸入菌種培養室，溫度設定於20至22°C，相對溼度控制於75至85%，待菌絲長滿培養材料（約需23天）再保持10至18天後，開蓋檢查瓶內有無雜菌，選取無雜菌之栽培菌種瓶移入出菇室，以每框12瓶，依不同期次試驗，每重覆4至5框，採逢機排列法置於菇架上，菌種瓶暫不開蓋，並依試驗需要做去皮（挖除舊菌種）或不去皮處理。出菇室溫度設定於16.5至18.5°C，相對溼度利用超音波噴霧機控制於95%左右，二氧化碳濃度利用熱交換機輸入新鮮空氣控制於0.06%左右。此時不需光線，待瓶內形成小子實體後，打開瓶蓋並供應光源，光度控制於 250lux 左右，每日光照8小時，待菇體發育適當，菌傘邊緣尚未向上翻時，予以採收並秤重，記錄產量。

結果與討論

在第一期栽培試驗裡，進行杉木與楓木兩種樹種木屑之比較，有去皮之情形下，每瓶採收兩周期之平均產量分別爲71.8與149.5公克（表1），兩樹種木屑間有顯著之差異，杉木木屑出菇較不整齊且慢，可能因爲含有精油，阻礙杏鮑菇菌絲之營養吸收與生長所致。另以楓木木屑爲材料做去皮與不去皮之比較，去皮與未去皮每瓶兩周期之平均產量分別爲128.0與124.3公克，並無顯著之差異（表2）。

表 1. 以杉木與楓木木屑爲基質原料瓶栽杏鮑菇之產量比較

Table 1. Comparison of the productivity of bottle cultivation of the *Pleurotus eryngii* strain ATCC 36047 on two sawdust substrates of *Cunninghamia lanceolata* var. *lanceolata* and *Liquidamber formosana*[z]

Sources of sawdust	Yield (g/60bottles)						Average[y]
	1	2	3	4	5	6	
C. lanceolata	4,200	4,180	4,160	4,440	4,340	4,530	4,308.3 b (71.8)[x]
L. formosana	8,800	8,030	9,430	9,410	8,930	9,220	8,970.0 a (149.5)[x]

[z] Sawdusts and rice bran were mixed in a ratio of 4 : 1 by volume. The mixed sawdusts were heaped for 4 months. Filling and inoculation of substrate were conducted by automatic machines. Each substrate had 6 replicates. Each replicate consisted of 60 1,100ml bottles. Each bottle contained about 650g of substrate (wet) of which moisture content was about 65%. Inoculated substrates were incubated at 20~22°C for 42 days. Top layers (*C. lanceolata*) or 40 days (*L. formosana*). Top layers (ca 1.5cm in depth) of substrates in bottles were removed by hand after cropping room had been cooled down to 16.5~18.5°C for three days. The cropping room was maintained at 16.5~18.5°C in temperature, about 95% in RH, 250 lux in light intensity during cropping. Harvesting period was 28 days for *C. lanceolata* and 32 days for *L. formosana*.

[y] Means with the same letter of a column are not significantly different at 5% level by Duncan's multiple Vauge Vange test.

[x] Means in brackets are the average yield in each bottle (g/bottle).

表 2. 瓶口處理對杏鮑菇菌株 ATCC 36047產量之影響

Table 2. The effect of top layer treatment on the yield of the *Pleurotus eryngii* strain ATCC 36047[z].

Top layer treatment	Yidld (g/60 bottles)				Average[y]
	1	2	3	4	
removed	7,400	8,050	7,320	7,950	7,680.0 a (128.0)[x]
not removed	6,670	7,380	7,380	8,400	7,457.5 a (124.3)[x]

[z] Sawdusts of *L. formosana* and rice bran were mixed in a ratio of 4 : 1 by volume The sawdusts were heaped for 4 months. Filling and inoculation of substrate were conducted by automatic machines. Each treatment had 4 replicates. Each replicate consisted of 60 1,100ml bottles. Each bottle contained about 650g of substrate (wet) of which moisture content was about 65%. Inoculated substrates were incubated at 20～22°C for 42 days. Top layers (ca 1.5cm in depth) of substrates in bottles in the "removed" treatment were removed by hand after cropping room had been cooled down to 16.5～18.5°C for three days. The cropping room was maintained at the same climatic conditions as those in Table 1. Harvesting period was 32days.

[y] Means with the same letter of a column are not significantly different at 5% level by Duncan's multiple range test.

[x] Means in brackets are the average yield in each bottle (g/bottle) .

第二期栽培試驗爲校欖，杉木，楓木，相思木，山黃麻及楠木等六樹種木屑之比較，在未去皮處理下，第一周期每瓶平均產量依序爲117.7，95.6，134.8，110.8，150.1及142.0公克，以山黃麻之產量最高，次爲楠木與楓木，再次爲屬於硬木類之相思木與校欖，屬於針葉木之杉木最差（表3）。山黃麻與楠木兩樹種之木屑出菇快而整齊，第一周期菇5至6天內即可採收完成，次爲楓木平均須6.7天，而相思木則須8.6天，杉木與校欖更須10至12天之久（表3）。第二周期之採收量，以上六種木屑每瓶平均產量依序爲51.6，61.9，72.2，61.2，70.1及72.6公克，其中相思木，校欖及杉木之產量較差（表3）。以上兩周期之平均產量，上述樹種依序爲169.3，157.9，207.1，172.0，219.6及214.7公克，其中山黃麻，楓木及楠木三樹種木屑間之平均產量並無顯著之差異，而相思木，杉木及校欖三樹種木屑間亦同，但前三種木屑較後三種木屑產量高且有顯著之差異（表3）。屬於硬木類之相思木及校欖木屑，可能杏鮑菇菌絲分解不容易，導致產量較低，而杉木則可能因爲含有精油有礙杏鮑菇菌絲之營養吸收與生長，以致出菇較慢且不整齊。至於降溫至開始採收所需之平均天數，不同樹種間僅有些微差異（表3），但平均產量較低之樹種所需之天數未必較多。第二期試驗之杉木及楓木木屑每瓶平均產量顯然高於第一期試驗（表1），似與刺激出菇方式有關，第一期試驗時，有做去皮處理，即挖除舊菌種或以小鐵匙刮除瓶口木屑表面之大部份菌絲層，然後不蓋回瓶蓋，以噴霧機增加空氣中之溼度促進瓶口木屑表面菌絲再生，惟由於溼度增加似不夠均勻，且不易維持均勻而固定之溼度，以致菌絲再生無法一致，出菇慢而且不整齊，部份栽培用菌種瓶可能僅出菇一次，採收即已結束，因此產量較低。由於第一期試驗時，部份未列入試驗用之楓木木屑栽培用菌種，於降溫後未做去皮處理，也未開瓶蓋，經降溫後7至10天時開蓋，偶然發現絕大部份之菌種瓶內均有小菇形成，經開蓋後，菇體發育整齊，第一周期每瓶產量約可達150公克。因此本期試驗時，於降溫後未立即開蓋，也未做去皮處理，待降溫後7天開始開蓋檢查有無小菇形成，沒有則蓋回瓶蓋，往後隔日檢查至完全出菇取下所有瓶蓋爲止。第一周期菇採收結束後當日蓋回瓶蓋以促進瓶口菌種表面菌絲再生以利出菇，約6至8天即可再形成小菇體。由於兩周期出菇均相當整齊，因此本期試驗無論杉木或楓木木屑之產量均顯著高於第一期試驗。未開蓋有利杏鮑菇出菇，除了瓶內溼度高且較易保持之外，二氧化碳濃度較高可能也是因素之一，杏鮑菇菇蕾之正常發育需要有光線與低濃度之二氧化碳[4,8]，但由營養菌絲集結形成菇蕾，依本試驗觀察是不需要光線或只需極微弱之光線，而且在高濃度二氧化碳下進行，此結論與

Cailleux & Diop 兩氏[4]之試驗結果相符合，即杏鮑菇菇蕾在二氧化碳濃度爲1,000～1,500ppm 下可形成，但由菇蕾發育爲正常之子實體，則二氧化碳之濃度須在800ppm 之下。因此在商業經營上，杏鮑菇之生產若採用僅收獲一次之方式，爲節約能源消耗，栽培用菌種培養結束後似可直接降溫至產生菇蕾時，方移至出菇室並提供適量光線與適量之二氧化碳濃度，使菇體發育至吾人所期望之形態，以節省栽培用菌種佔用出菇室之時間，提高出菇室利用效率，降低生產成本。此外在栽培過程中也發現，杏鮑菇之菇蕾甚少形成於舊菌種（即母種）之上，因此若栽培用菌種之舊菌種佔滿瓶口時，有出菇嚴重延遲現象，而菇蕾絕大部份形成於未被原種覆蓋之瓶口表面濃密菌絲層上。因此杏鮑菇栽培用菌種製作時，如不欲去皮而使菇蕾直接形成於瓶口菌絲表面時，菌種量不宜太多以致佔滿瓶口，延遲出菇。

第三期栽培試驗爲杉木木屑分別與山黃麻，楠木，相思木，楓木，臺灣赤楊及校欖等之六樹種木屑各半混合之產量比較，以山黃麻單樹種木屑爲對照。第一周期之每瓶平均產量以上六樹種木屑依序爲141.9，112.6，117.6，150.9，151.2及115.4公克，對照爲148.2公克，杉木木屑與山黃麻，楓木及臺灣赤楊三樹種木屑各半混合處理間之平均產量無顯著差異，而與相思木，校欖及楠木三樹種木屑各半混合處理間之平均產量亦無顯著之差異，但杉木與前三樹種各半混合處理之平均產量均較其與後三樹種各半混合處理之平均產量爲高且有顯著之差異（表４）。第二周期之每瓶平均產量上述六種樹種混合木屑，依序爲60.5，59.9，57.9，61.9，54.0及53.2公克，對照爲56.7公克，杉木木屑與該六樹種木屑各半混合處理間之平均產量並無顯著之差異（表４）。兩周期之每瓶平均產量上述六種樹種混合木屑依序爲202.4，172.5，175.6，212.9，205.2及167.9公克，對照爲204.9公克，兩周期之每瓶平均產量，杉木木屑與六樹種木屑各半混合處理間之比較結果與第一周期之每瓶平均產量相同（表４）。降溫至第一周期菇開始採收所需時間，除與相思木木屑混合之處理較長外，杉木木屑與其他樹種木屑混合處理間並無顯著之差異（表４），此與各樹種單種木屑爲材料時略有不同，因此添加杉木木屑似有降低不同樹種木屑間差異之效果。山黃麻木屑無論有否與杉木木屑混合，其降溫至第一周期菇開始採收所需時間均相同（表４）。杉木木屑與其他樹種木屑混合處理間，其第一周期菇採收完成所需時間有顯著之差異（表４），其中杉木木屑與山黃麻、楓木、臺灣赤楊及校欖各樹種木屑之混合處理較與楠木及相思木之混合處理爲短，其差異達５％顯著水準。杉木木屑與楓木木屑之混合處理，其第一周期菇完成採收所需時間最短，但若與杉木木屑與臺灣赤楊之混合處理或山黃麻單樹種木屑比較，則無顯著之差異（表４）。山黃麻木屑與杉木木屑混合後，其第一周期菇完成採收所需時間延長且達５％之顯著水準。由表４結果顯示，山黃麻木屑與杉木木屑混合後，其第一周期及兩周期菇之產量略減，但未達５％之顯著水準，因爲杉木木屑較其他木屑便宜甚多，可直接降低杏鮑菇之生產成本，惟會延長第一周期菇採收完成所需時間，若栽培經營上採用只採收一次之作業，類似金針菇之栽培時，可能會增加能源消耗，在經濟上之效益尚待進一步重複試驗後評估。

本試驗研究結果顯示，栽培杏鮑菇所使用之木屑樹種，以屬於軟木闊葉樹種，如山黃麻，楠木，楓木及臺灣赤楊最適合，屬於硬木類闊葉樹種，如相思木，校鑽則比較差，屬於針葉樹種的杉木，雖然亦可使用，但產量較差且出菇慢而不整齊，不過後者之木屑若與山黃麻或楓木木屑等量混合，則產量與後兩樹種木屑單獨使用並無顯著之差異，可做爲日後栽培杏鮑菇之參考，因此杉木木屑通常較闊葉樹木屑便宜，可顯著降低生產成本，惟兩種木屑應以何種比例混合最具經濟價值，則尚待進一步之研究。此外屬於軟木類之楠木木屑與杉木木屑混合後，其產量顯然較單樹種木屑（表３）爲低，且與杉木木屑和其他硬木類之木屑，如相思木或校欖木屑之混合處理無顯著之差異（表４），而完成第一周期菇之採收也顯然延長，此是否因爲楠木木屑不耐長期堆積，容易分解，導致不利杏鮑菇生長發育之物理或化學變化而使產量降低，其原因有待進一步探討。

表 3. 不同來源樹種木屑對杏鮑菇瓶栽生產之影響

Table 3. Effects of the sources of sawdusts on the production of the *Pleurotus eryngii* strain ATCC 36047 using bottle cultivation technology[z].

Sources of sawdusts	Average Yidld (g/bottle) [y]			Interval between 1st picking and starting cooling[y]	Days for finishing the harvest of 1st flush mushrooms[y]
	1st flush	2nd flush	1+2 flush		
Cyclobalanopsis glauca	117.7 c	51.6 c	169.3 b	17.0 days ab	10.0 b
Cunninghamia lanceolata	95.6 d	61.9 b	157.5 b	17.3 days a	11.9 a
Liquidamber formosana	134.8 b	72.2 a	207.1 a	16.6 days b	6.7 c
Acacia confusa	110.8 c	61.2 b	172.0 b	16.6 days b	8.6 b
Trema orientalis	150.1 a	70.1 ab	219.6 a	16.7 days ab	5.1 c
Machilus kusanoi	142.0 ab	72.6 a	214.7 a	17.0 days ab	6.1 c

[z] Sawdusts of different sources and rice bran were mixed in a ratio of 4 : 1 by volume. All sawdusts were heaped for 5 months before use. Filling and inoculation of the substrates thus prepared were conducted by automatic machines. Each substrate had 7 replicates and each replicate consisted of 36~48 bottles. Each bottle contained about 650g of substrate of which moisture content was about 65%. Inoculated substrates were incubated at 20~22°C for 43 days. Top layers of substrates in bottles were not removed and caps were not removed until primordia or young fruit bodies had been formed. The cropping room was maintained at about 95% in RH, 16.5~18.5°C in temperature and 250lux in light intersity (8 hours per day) .

[y] Means with the same letter of a column are not significantly different at 5% level by Duncan's multiple range test.

表 4. 杉木木屑與其他六種樹種木屑混合對杏鮑菇瓶栽生產之影響

Table 4. Effects of mixing the sawdusts of *Cunninghamia lanceolata* with those of other six species of trees on the production of the *Pleurotus eryngii* strain ATCC 3607 using bottle cultivation technology[z].

Combination of sources of sawdusts	Average Yidld (g/bottle) [y]			Interval between 1st picking and starting cooling[y]	Days for finishing the harvest of 1st flush mmushrooms[y]
	1st flush	2nd flush	1+2 flush		
C. lanceolata+*T. orientalis*	142 a	61 a	202 a	16.0 b	14.0 b
C. lanceolata+*M. kusanoi*	113 b	60 a	173 b	16.2 b	16.7 a
C. lanceolata+*A. confusa*	118 b	58 a	176 b	16.7 a	17.2 a
C. lanceolata+*L. formosana*	151 a	62 a	213 a	16.0 b	11.0 c
C. lanceolata+*Alnus formosana*	151 a	54 a	205 a	16.0 b	12.5 bc
C. lanceolata+*C. glauca*	115 b	53 a	168 b	16.2 b	13.8 b
T. orientalis (as control)	148 a	57 a	205 a	16.0 b	11.7 c

[z] The sawdust of *C. lanceolata* was mixed with equal volume of those of other six tree species respectively. Each mixture thus resulted and the sawdust of *T. orientalis* were mixed with rice bran in a ratio of 4 : 1 by volume respectively. All the sawdusts were heaped for 7 months before use. Filling and inoculation of substrates thus prepared were conducted by automatic machines. Each substrate had 6 replicates and each replicate consisted of 48 bottles and each bottle contained about 650g of substrate of which moisture content was about 65%. Inoculated substrates were incubated at 20~22 °C for 33 days. Top layers of substrates in bottles were not removed and caps were not removed until primordia or young fruit bodies had been formed. The cropping room was maintained at about 95% in RH, 16.5~18.5°C in temperature and 250lux in light intensity (8 hours per day) .

[y] Means with the same letter of a column are not significantly different at 5% level by Duncan's multiple range test.

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Study on the Effects of Single and Mixed Sawdusts of Different Origins on the Production of *Pleurotus eryngii*[1]

Jin-Torng Peng[2]

Summary

Study on the effects of single and mixed sawdusts of different origins on the production of *Pleurotus eryngii* was conducted using the automatic bottle cultivation technology for *Flammulina velutipes*. Sawdusts of differet origins, including *Cyclobalanopsis glauca, Cunninghamia lanceolate* var. *lanceolata, Liquidamber formosana, Acacia confusa, Trema orientalis* and *Machilus kusanoi,* were heaped for 5 months and mixed respectively with 20 % of rice bran (by volume) and proper amount of calcium carbonate and water. The substrates thus prepared were filled into polypropane bottles (1,100 CC) and capped with automatic machines, then sterilized at 122°C for 45 minutes in a programmable autoclave. Each bottle contained about 650g of substrate of which moisture content was about 65%. After cooling down the substrates were inoculated with sawdust spawn of the fungus by an automatic inoculating machine. The inoculated substrates were incubated at 18~21.5°C for 43days before moving into cropping room. Top layers of substrates in bottles were not removed and caps were not removed until primordia or young fruit bodies had been formed after cooling down of the cropping room. The cropping room was maintained at about 95 % in RH, 16.5~18.5°C in temperature and 250lux in light intensity. After cultivation the average total yields per bottle of the substrates consisted of the sawdusts of the above mentioned tree species were 169.3, 157.9, 207.1, 172.0, 219.6 and 214.7g in order, while the time for finishing the harvest of the lst fresh mushrooms were 10.0, 11.9, 6.7, 8.6, 5.1 and 6.1 days in order.The differences of yields among the substrates consisted of the sawdusts from *T. orientalis, M. kusanoi* and *L. formosana* were not significant at 5% level, while those of yields among the substrates consisted of the sawdusts from *C. glauca, C. lanceolata,* and *A. confusa* were not significant at 5% level either. However, the substrate consisted of the sawdusts from the former three tree species were significantly more productive than those consisted of the sawdusts from the latter three tree species at 5% level.

In another experiment, the sawdust of *C. lanceolata* was mixed with equal volume of the sawdusts of *T. orientalis, M. kusanoi, A. confusa, L. formosana, A. formosana,* and *C. glauca* and supplemented with same amount of rice bran as mentioned above. The inoculated substrates were incubated for 33days and cropped under the same climatic conditions as mentioned above. The average total yields per bottle of the substrates consisted of the

sawdusts of *C. Lanceolata* and equal volume of the above mentioned tree species were 202.4, 172.5, 175.6, 212.9, 205.2 and 167.9g in order, while the time for finishing the harvest of lst fresh mushrooms were 14.0, 16.7, 17.2, 11.0, 12.5 and 13.8days respectively. The average yield per bottle of the substrate consisted of the sawdusts of *T. orientalis* alone was 204.9g, while the time for finishing the harvest of the lst flush mushrooms was 11.7 days. The differences of the yields among the substrates consisted of the sawdust of *C. lanceolata* and equal volume of those from *T. orientalis, L. formosana* and *A. formosana* were not significant at 5% level, while the differences of the yields among the substrates consisted of the sawdust of *C. lanceolata* and equal volume of those from *C. glauca, M. kusanoi,* and *A. confusa* were not significant at 5% level either. However, the former three substrates were significantly more productive than the latter three ones at 5% level. The average yield of the substrate consisted equal volume of the sawdusts from *C. lancelata* and *T. orientalis* was not significantly different from that of the substrate consisted of the sawdust of the latter tree species alone, however, finishing the harvest of lst flush mushrooms of the former substrate took more days than the former one and was significantly different at 5% level.

Key words : *Pleurotus eryngii,* Sawdust, Tree species, Bottle cultivation.

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