เอกสารอ้างอิง

ภาษาไทย

ดวงพร วรสุนทโรสถ, 2530, "การใช้เอนไซม์ในพืชทางการเกษตร", *วิทยาศาสตร์*, 41(7) : พ1-พ9

วันดี ยินดียิ่งยืน, ฐิติมา ตันติกาญจน์ และ สุทธนรรฆตรีรัตน์, 2532, "รูปแบบไอโซไซม์ glutamate dehydrogenase, esterase และ laccase ในเห็ดหอม (*Lentinus edodes*) บางสายพันธุ์," *การประชุมวิทยาศาสตร์ และ เทคโนโลยีแห่งประเทศไทย ครั้งที่ 15*, เชียงใหม่ม 566-567

สุทธนรรฆ ตรีรัตน์ และ ชวนพิศ รักษตุล, 2527, "การศึกษาการเพาะเห็ดหอม (*Lentinus edodes*) ในถุงพลาสติกโดยใช้วัสดุจากการเกษตร," *รายงานการประชุมทางวิชาการของมหาวิทยาลัยเกษตรศาสตร์ ครั้งที่ 22 สาขาพืช*,386-405

อังคณา ปลั่งพัฒนะพานิชย์, 2519, "การศึกษาโปรตีนและเอนไซม์อมิเลสในรา *Candida albicans* (Robin) Berkhout ด้วยดิสอิเลคโตรฟอริซีส," *วิทยานิพนธ์ระดับปริญญาโท*, พฤกษศาสตร์, จุฬาลงกรณ์มหาวิทยาลัย

ภาษาต่างประเทศ

Adaskaveg, J. E. and R. L. Gilbertson, 1987, "Vegetative incompatibility between intraspecific dikaryotic pairings of *Ganoderma lucidum* and *G. tsugae*," *Mycologia*, 79(4) : 603-613.

Bradford, M. M., 1976, "A rapid and sensitive method for the quantitation of microgram quantities of protein utilizing the principle of protein-dye binding," *Anal. Biochem.*, 72 : 248-254.

Bournival, B.L. and S.S. Korban, 1987, "Electrophoretic analysis of

genetic variability in the apple," *Sci. Hort.*, 31 : 233-243.

Burpee, L. L., P. L. Sandders, H. Cole, Jr. and R. T. Sherwood, 1980, "Anastomosis groups among isolates of *Ceratobasidium cornigerum* and related fungi," *Mycologia*, 72 : 689-701.

hang, S. T., 1987, "World production of cultivated edible mushrooms in 1986," *Mush. J. Tropics*, 7(4) : 117-120.

Chang, S. T. and P. G. Miles, 1989, *Edible Mushrooms and Their Cultivation*, pp. 93, 134, 201-202, CRC Press, Boca Raton, Florida.

DeLorenzo, R.J. and F.H. Ruddle, 1969, "Genetic control of two electrophoretic variants of glucosephosphate isomerase in the mouse (*Mus musculus*)," *Biochem. Gen.*, 3 : 151-162.

Diehle, D.A. and D.J. Royse, 1986, "Shiitake cultivation on sawdust : Evaluation of selected genotypes for biological efficiency and mushroom size," *Mycologia*, 78(6) : 929-933.

Doong, J-Y. H. and Y.-T. Kiang, 1987, "Inheritance of aconitase isozymes in soybean," *Genome*, 29 : 713-717.

Esser, K., 1965, "Incompatibility in fungi," *The 10th International Congress of Botany Symposium*, Edinburgh, 1964, (Esser, K. and J.R. Raper eds.), pp. 6-13., Springer-Verlag.

----------, 1977, "Monokaryotic fruiting in higher Basidiomycetes and its relationshipto genetic controlof morphogenesis," Abstr. Second Internat. Mycological CongressTampa/Florida, p.176.

----------, 1981, "Impact of basic research on the practical application of fungal processes," *Developments in Industrial Microbiology*, vol. 22. pp. 19-37.

Esser, K. and R. Kuenen, 1967, *Genetics of Fungi*, Springer-Verlag, New York.

Esser, K., U. Stahl and F. Meinhardt, 1977, "Genetic aspects of differentiation in fungi," *Biotechnology and fungal differentiation.* (Meyrath, J. and J. D. Bu' Lock (eds.), pp. 67-75, FEMS Symp. No. 4 Acad. Press London-New York.

Farr, D.F., 1983, "Mushroom industry : diversification with additional species in the United States," *Mycologia*, 75 : 351-360.

Florkin, M. and E. H. Stotz, 1973, *Comprehensive Biochemistry*, Enzyme Nomenclature, vol. 13, pp. 114-115, Elsevier Scientific Publishing Company, Amsterdam, London, New York, 3rd ed.

Flurky, W. H. and J. Ingebrigtsen, 1989, "Polyphenol oxidase activity and enzymatic browning in mushroom," *ACS Symposium Series No. 405, Quality Factors of Fruits and Vegetables : Chemistry and Tecnology* (Jen, J. J. eds.), pp. 44-54.

Han, Y.H., W.T. Ueng, L.C. Chen and S. Cheng, 1981, "Physiology and ecology of *Lentinus edodes* (Berk.) Sing.," *Mush. Sci.*, 11 : 623-658.

Ingebrigtsen, J., B. Kang and W.H. Flurkey, 1989, "Tyrosinase activity and isozymes in developing mushrooms," *J. Food Sci.*, 54(1) : 128-131.

Kantelinen, A., A. Hatakka and L. Viikari, 1989, "Production of lignin peroxidase and laccase by *Phlebia radiata*," *Appl. Microbiol. Biotechnol.*, 31 : 234-239.

Kerrigan, R. W. and I. K. Ross, 1988, "Extracellular laccases : Biochemical markers for *Agaricus* systematics." Mycologia, 80(5) : 689-695.

Kropp, B.R., 1990, "Variation in acid phosphatase activity among progeny from controlled crosses in the ectomycorrhizal fungus *Laccaria bicolor*," *Can. J. Bot.*, 68 : 864-866.

Laemmli, U. K., 1970, "Cleavage of structural proteins during assembly of head of bacteriophage-T," *Nature*, 227 : 680-685.

Leatham, G. F., 1985a, "Extracellular enzymes produced by the cultivated mushroom *Lentinus edodes* during degradation of a lignocellulosic medium," *Appl. Environ. Microbiol.* 50 : 859-867.

----------, 1985b, "Growth and development of *Lentinus edodes* on a chemically defined medium," In *The British Mycological Society Symposium Series-Developmental Biology of Agarics*, (Moor, D. *et al.*, eds.) pp. 403-427, Press Syndicate of the University of Cambridge, Cambridge, England.

Leatham, G. F. and J. C. Hasselkus, 1989, "Extracellular acid phosphatase of *Lentinula edodes* : correlation of increased activity with fruit body development and enzyme localization, substrates, effectors and stability," *Mush. J. Tropics.*, 9 : 55-78.

Leahtam, G. F. and M. A. Stahmann, 1981, "Studies on the laccase of *Lentinus edodes* : Specificity, location and association with the development of fruiting bodies," *J. Gen. Microbiol.*, 125 : 147-157.

Leonard, T. J., 1971, "Phenoloxidase activityand fruiting body formation in *Schizophyllum commune*," *J. Bacteriol.*, 106 : 162-167.

----------, 1972, "Phenoloxidase in mycelia carrying modifier mutations that affect sporocarp development in *Schizophyllum commune*," *J. Bacteriol.*, 111 : 292-293.

Leslie, J. F., 1979, "Monocaryotic fruiting in *Schizophyllum commune* : phenoloxidases," *Mycologia*, 71 : 1082-1085.

Lu, S. -I., T. J. Leonard, S. Dick and G. F. Leatham, 1988, "A new strategy for genetic improvement of edible fungi through enhancement of their lignocellulose degrading and fruiting abilities," *Mic. Neotrop. Aplic.*, 1 : 5-19.

May, B., D.W. Roberts and R.S. Soper, 1979, "Intraspecific genetic variability in laboratory strains of *Entomophthora* as determined by enzyme electrophoresis," *Exp. Mycol.*, 3 : 289-297.

May, B. and D. J. Royse, 1981, "Application of electrophoretic methodology to the elucidation of genetic life histories of edible mushroom," *Mush. Sci* XI, 799-817, 1981.

----------, 1982, "Confirmation of crosses between lines of *Agaricus brunnescens* by isozyme analysis," *Exp. Mycol.*, 6 : 283-292.

Mennendez, R.A., F.E. Larsen and R. Fritts, J.R., 1986, "Protein and isozyme electrophoresis and isoelectric focusing for the characterization of apple clones," 29 : 211-220.

Nelson, K., R. J. Baker and R. L. Honeycutt, 1987, "Mitochondrial and protein differentiation between cytotype of the white footed mouse,*Peromyscus leucopus*," *Evolution*, 41(4): 845-872.

Nutalaya, S. and S. Pataragetvit, 1981, "Shiitake mushroom cultivation in Thailand," *Mush. Sci.* XI : 723-736.

Ohmasa, M. and H. Furukawa, 1986, "Analysis of esterase and malate dehydrogenase isozymes of *Lentinus edodes* by isoelectric focusing for the identification and discrimination of stocks," *Trans. mycol. Soc.* Japan, 27 : 74-90.

Phillips, L. E. and T.J. Leonard,1976,"Extracellular and intracellular phenoloxidase activity during growth and development in

Schizophyllum," *Mycologia*, 68 : 268-276.

Ross, I. K., 1979, *Biologg of the Fungi*, p. 142, McGraw-Hill, U.S.A.

----------, 1982, "The role of laccase in carpophore initiation in *Coprinus congregatus*," *J. Gen. Microbiol.*, 128 : 2763-2770.

Royse, D.J., 1985, "Effect of spawn run time and substrate nutrition on yield and size of the shiitake mushroom," *Mycologia*, 77 : 756-762.

Royse, D. J. and B. May, 1982a, "Use of isozyme variation to identify genotypic classes of *Agaricus brunnescens*," *Mycologia*, 74(1) : 93-102.

----------, 1982b, "Genetic relatedness and its application in selective breeding of *Agaricus brunnescens*," *Mycologia*, 74(4) : 569-575.

----------, 1987, "Identification of shiitake genotypes by multilocus enzyme electrophoresis : catalog lines," *Biochem. Gen.*, 25(9/10) : 705-716.

Royse, D. J., C. Spear and B. May, 1983a, "Cell line authentication and genetic relatedness of lines of the shiitake mushroom, *Lentinus edodes*," *J. Gen. Appl. Microbiol.*, 29 : 205-216.

----------,1983b, "Single and joint segregation of marker loci in the shiitake mushroom, *Lentinus edodes*," *J. Gen. Appl. Microbiol.*, 29 : 217-222.

Shaw, C.R. and R. Prasad, 1970, "Starch gel electrophoresis of enzyme - A compilation of recipes," *Biochem. Gen.*, 4 : 297-320.

Singh, R. P., H. S. Garcha and P. K. Khanna, 1989, "Study of laccase enzyme in degradation of lignocellulosics," *Mush. Sci.* XII (part II) : 35-47.

Spieth, P.T., 1975, "Population genetics of allozyme variation in

Neurospora intermedia," *Genetics*, 80 : 785-805.

Stenlid, J., 1985, "Population struction of *Heterobasidion annosum* as determined by somatic incopatibility, and isozyme patterns," *Can. J. Bot.*, 63 : 2268-2273.

Szaklarz, G. D., R. K. Antibus, R. L. Sinsabaugh and A. E. Linkins, 1989, "Production of phenol oxidases and peroxidase by wood-rotting fungi," *Mycologia*, 81(2) : 234-240.

Triratana, S. and P. Osathaphant, 1988, "The cultivation of shiitake (*Lentinus edodes*) in sawdust substrates from different trees and agricultural wastes," In *Recent Advances in Biotechnology* (Chang, S. T., K. Y. Chan and N. Y. S. Woo eds.), The Chinese University of Hong Kong, pp. 531-541.

Triratana, S. and T. Tantikanjana, 1989, "Effect of some environmental factors on morphology and yield of *Lentinus edodes* (Berk.) Sing.," *Mush. Sci.* XII (part II) : 279-292.

Triratana, S., S. Tontyaporn, A. Chantarasanit, M. Nudasomboon, T. Tantikanjana, S. Navankasattusas and P. Osathaphant, 1988, "Development of cultivation technology of shiitake (*Lentinus edodes*) mushroom from sawdust in Northern Thailand," *International Symposium on Application of Biotechnology for Small Industries Development in Developing Countries*, Bangkok, p. 32.

Triratana, S., S. Tontyaporn and C. Seemakajorn, 1989, "Hybridization of Thai shiitake (*Lentinus edodes*) with introduced strains," *International Symposium on Mushroom Biotechnology*, Nanjing, p. 125.

Toyomasu, T. and A. Zennyozi, 1981, "On the application of isozyme electrophoresis to identification of strains in *Lentinus*

edodes (shiitake)," *Mush. Sci.* XI : 675-684.

Wang, Z. S. and J. H. Liao, 1990, "Study on crossbreeding techniques of *Agaricus bisporus*," *Micol. Neotrop. Apl.*, 3 : 1-12.

Wang, H. C. and Z. S. Wang, 1989, "The prediction of strain characteristics of *A. bisporus* by the application of isozyme electrophoresis," *Mush. Sci.* XII (part I) : 87-100.

Wang, Z. S. and H. C. Wang, 1990, "Isozyme patterns and characteristics of hybrid strains of *Agaricus bisporus*," *Micol. Neotrop. Apl.*, 3 : 19-29.

Wood, D. A., 1980, "Inactivation of extracellular laccase during fruiting of *Agaricus bisporus*," *J. Gen. Microbiol.*, 117 : 339-345.

Wood, D. A. and P. W. Goodenough, 1977, "Fruiting of *Agaricus bisporus*, changes in extracellular enzyme activities during growth and fruiting," *Arch. Microbiol.*, 114 : 161-165.

ภาคผนวก

ภาคผนวกที่ 1

การเตรียมสารละลาย

1. การเตรียมโพลีอคริลาไมด์เจลชนิดแผ่น(Polyacrylamide slab gel)

(Laemmli,1970)

(ขนาดประมาณ 14 x 16 ซ.ม. หนา 1.5 มม.)

Resolving gel (7 % acrylamide) ประกอบด้วย

Tris-chloride buffer, pH 8.9	5	ml
Acrylamide sol.	10	ml
D.W.	25	ml
Ammonium persulfate sol.	175	ul

Stacking gel (3 % acrylamide) ประกอบด้วย

Tris-chloride buffer, pH 6.7	2.5	ml
Acrylamide sol.	2.0	ml
D.W.	15.2	ml
Ammonium persulfate sol.	150	ul

2. สารละลายสีย้อมแอคติวิตีของเอนไซม์ esterase (Toyomasu and Zennyozi, 1981)

0.2 % Fast Blue RR Salt in 0.06 M Phosphate buffer, pH 5.4

0.5 % α-Naphthyl acetate in 50 % acetone

3. สารละลายสีย้อมแอคติวิตีของเอนไซม์ laccase (ดัดแปลงจากวิธีของ Leatham and Stahmann, 1981)

1.0 mM o-Tolidine in 0.1 M Sodium acetate buffer, pH 4.5

4. สารละลายสีย้อมแอคติวิตีของเอนไซม์ glutamate dehydrogenase

(Darnall and Klotz, 1972)

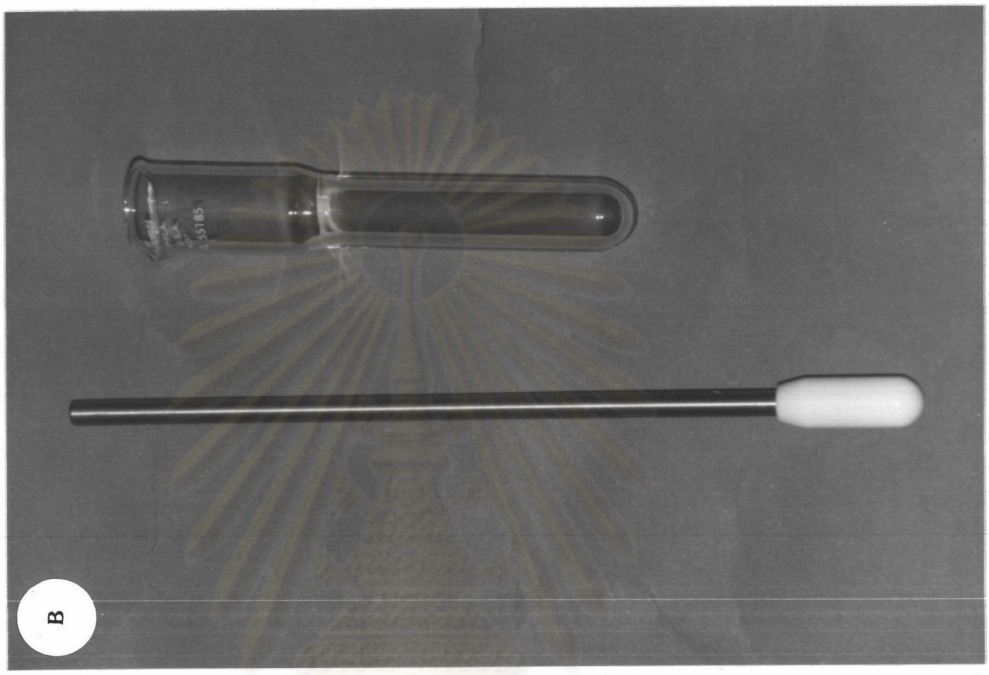
L-glutamic acid	3.68	g
NAD	99.51	mg
PMS	4.99	mg
NBT	35.16	mg
Sod. phosphate (dibasic)	1.95	g
D.W.	100	ml

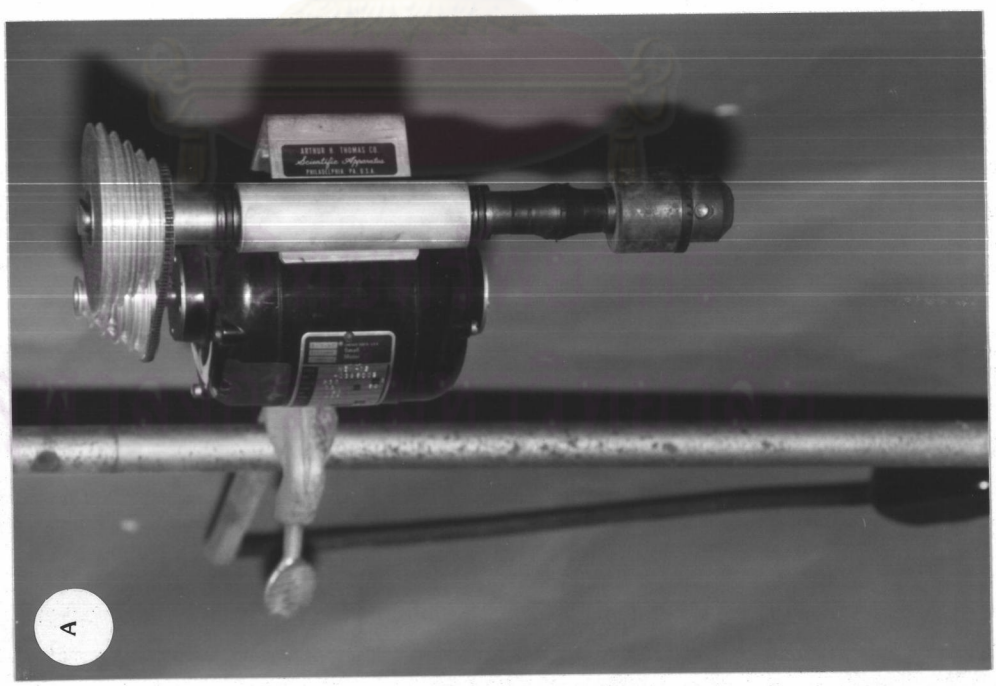
5. สารละลายวัดโปรตีน (Bradford,1976)

Coomassie Brilliant Blue G-250	0.1	g
95 % Ethanol	50	ml
85 % Phosphoric acid	100	ml
D.W. up to	1000	ml

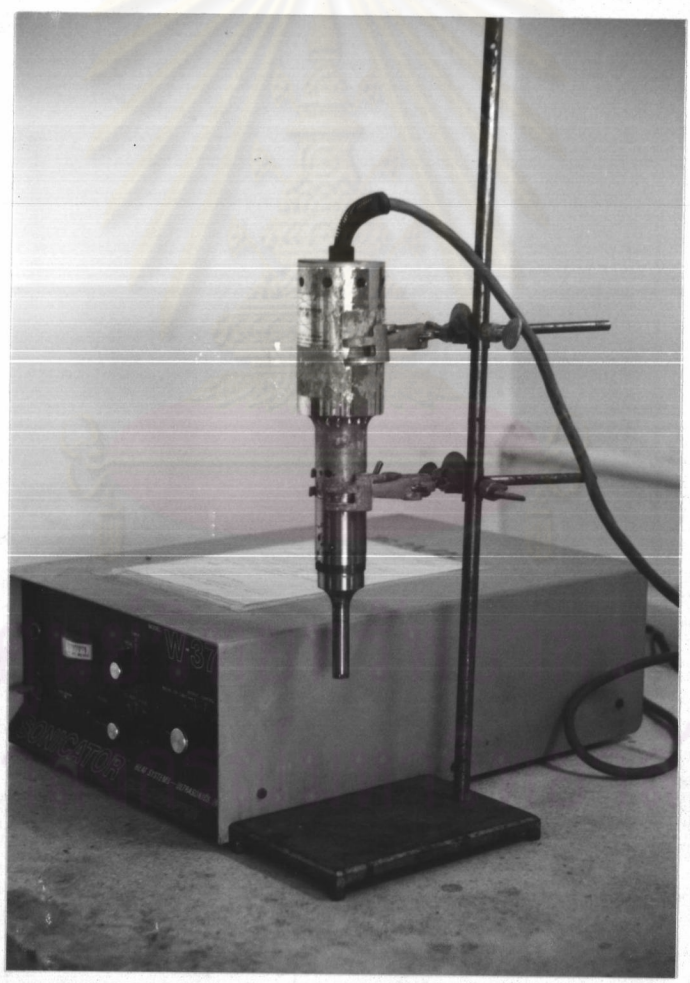
ภาคผนวกที่ 2 A. Thomas homogenizer apparatus

B. Tissue grinding pestle and vessel

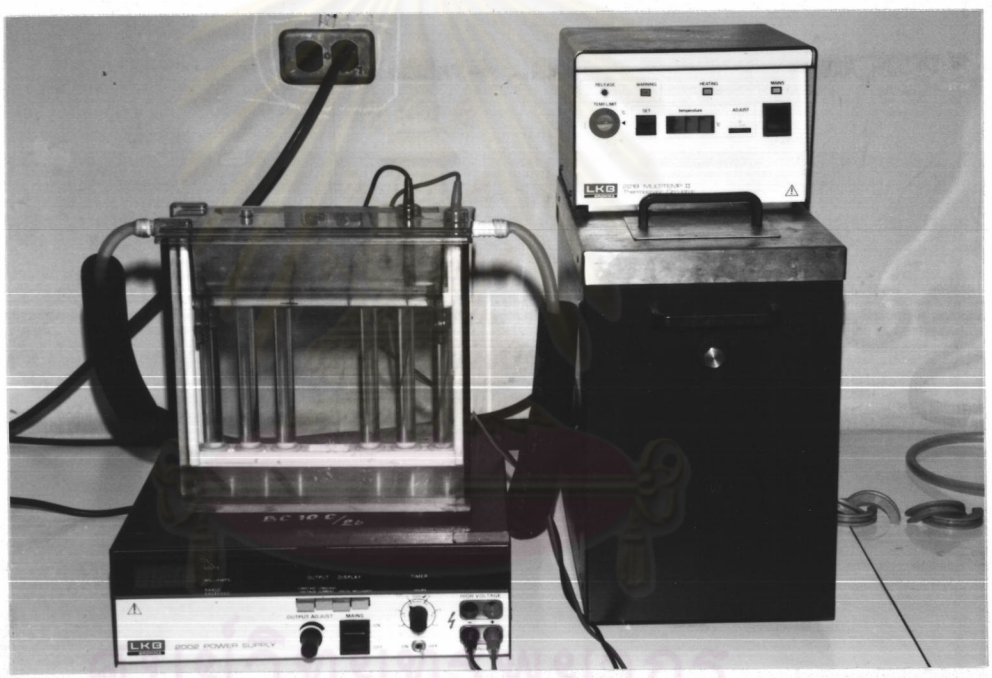




ภาคผนวกที่ 3 Sonicater (Heat system)



ภาคผนวกที่ 4 LKB Electrophoretic apparatus



ภาคผนวกที่ 5 Protein content(mg/ml) in L.edodes mycelia after breaking with homogenizer and sonicater

A. Dikaryotic culture : parents (MU2,MU12) ; hybrids (C364,C366,C359,C373,C369,C377) and Monokaryotic culture (E6,E8,E1,E5,E9,N9,N10)

Age(days)	10			20			30			40			50		
Strains or isolates	homogenized	sonicated	total	homogenized	sonicated	total	homogenized	sonicated	total	homogenized	sonicated	total	homogenized	sonicated	total
MU2	0.69	0.79	1.48	1.48	5.01	6.49	1.21	1.63	2.84	1.88	4.67	6.55	1.25	2.64	3.89
MU12	2.38	2.73	5.11	3.18	10.76	13.94	2.47	3.33	5.80	2.66	6.61	9.27	1.99	4.21	6.20
C364	5.93	6.80	12.73	8.60	29.09	37.69	3.93	5.31	9.24	2.26	5.61	7.87	1.77	3.74	5.51
C366	3.51	4.02	7.53	2.35	7.95	10.30	1.12	1.51	2.63	0.32	0.79	1.11	0.24	0.51	0.75
C359	2.14	2.45	4.59	3.51	11.87	15.38	2.69	3.63	6.32	2.51	6.24	8.75	0.42	0.89	1.31
C373	3.37	3.86	7.23	2.17	7.34	9.51	0.76	1.03	1.79	1.18	2.93	4.11	0.17	0.36	0.53
C369	0.40	0.46	0.86	3.02	10.21	13.23	0.60	0.81	1.41	1.55	3.85	5.40	0.62	1.31	1.93
C377	3.08	3.53	6.61	2.97	9.26	12.23	0.90	1.22	2.12	0.83	2.06	2.89	0.27	0.57	0.84
E6	0.39	0.07	0.46	0.36	0.15	0.51	0.23	0.11	0.34	0.17	0.19	0.36	0.13	0.21	0.34
E8	1.59	0.28	1.87	1.13	0.44	1.57	0.84	0.38	1.22	0.50	0.57	1.07	0.22	0.35	0.57
E1	4.39	0.77	5.16	4.75	1.86	6.61	4.15	1.88	6.03	2.95	3.35	6.30	2.14	3.44	5.58
E5	1.01	6.22	7.23	0.60	8.91	9.51	0.25	1.54	1.79	0.22	3.89	4.11	0.14	0.39	0.53
E9	4.83	0.85	5.68	5.50	2.16	7.66	3.95	1.79	5.74	3.12	3.54	6.66	2.35	3.78	6.13
N9	0.93	0.17	1.10	3.27	1.70	4.97	2.65	1.77	4.42	1.26	1.00	2.26	0.43	0.56	0.99
N10	2.84	0.53	3.37	3.80	1.97	5.77	3.43	2.29	5.72	2.35	1.87	4.22	0.30	0.39	0.69

ภาคผนวกที่ 5 (ต่อ)

B. Dikaryotic culture : parents (MU4,MU12) ; hybrids (C508,C507,C513,C502,C502,C516,C504) and Monokaryotic culture (E6,E8,E1,E5,E9,N9,

Age(days)	10			20			30			40			50		
Strains or isolates	homogenized	sonicated	total	homogenized	sonicated	total	homogenized	sonicated	total	homogenized	sonicated	total	homogenized	sonicated	total
MU4	2.38	2.73	5.11	0.47	1.44	1.91	0.71	0.96	1.67	0.95	2.36	3.31	0.20	0.42	0.62
MU12	2.02	2.31	4.33	2.54	8.59	11.13	2.39	3.23	5.62	2.28	5.66	7.94	0.96	2.03	2.99
C508	0.76	0.87	1.63	3.02	10.21	13.23	1.48	2.00	3.48	0.75	1.86	2.61	0.31	0.66	0.97
C507	3.71	4.25	7.96	4.29	14.51	18.80	3.23	4.57	7.80	3.25	8.07	11.32	1.41	2.14	3.55
C513	4.80	5.50	10.30	4.92	16.64	21.56	7.84	10.59	18.43	4.95	12.30	17.25	4.61	9.75	14.36
C502	3.38	3.87	7.25	3.22	10.89	14.11	4.01	5.41	9.42	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
C516	4.25	4.87	9.12	4.19	14.17	18.36	4.09	5.52	9.61	2.73	6.78	9.51	0.71	1.50	2.21
C504	2.73	3.26	5.99	6.83	23.10	29.93	1.30	1.76	3.06	2.07	5.14	7.21	0.38	0.80	1.18
FF10	2.39	1.00	3.39	2.12	1.88	4.00	0.88	1.20	2.08	1.08	1.21	2.29	1.21	0.95	2.16
FF9	0.62	0.26	0.88	2.52	2.24	4.76	2.03	1.50	3.53	0.79	0.89	1.68	1.44	1.13	2.57
FF7	1.13	0.48	1.61	0.96	0.85	1.81	0.36	0.27	0.63	0.47	0.53	1.00	0.65	0.51	1.16
FF2	0.29	0.12	0.41	0.29	0.26	0.55	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
FF5	1.11	0.47	1.58	0.84	0.75	1.59	1.02	0.76	1.78	0.21	0.24	0.45	1.76	1.38	3.14
N9	1.78	0.33	2.11	3.02	1.57	4.59	1.13	0.76	1.89	1.08	0.86	1.94	1.12	1.45	2.57
N10	1.67	0.31	1.98	2.14	1.11	3.25	3.25	2.17	5.42	1.05	0.84	1.89	2.10	2.71	4.81

ภาคผนวกที่ 6 Intracellular laccase activity (units/mg prot.) in L.edodes mycelia after breaking with homogenizer and sonicater

A. Dikaryotic culture : parents (MU2,MU12) ; hybrids (C364,C366,C359,C373,C369,C377) and Monokaryotic culture (E6,E8,E1,E5,E9,N9,N10)

Age(days)	10			20			30			40			50		
Strains or isolates	homogenized	sonicated	total	homogenized	sonicated	total	homogenized	sonicated	total	homogenized	sonicated	total	homogenized	sonicated	total
MU2	118	24	142	1572	63	1635	1327	35	1362	6235	272	6507	13445	1305	14750
MU12	422	87	509	2907	117	3024	9938	261	10199	14073	614	14687	11585	1125	12710
C364	107	21	128	481	19	500	1158	30	1188	2125	93	2218	1170	113	1283
C366	1222	251	1473	20360	12965	33325	132118	3471	135589	281860	12296	294156	237400	23049	260449
C359	6749	1386	8135	1003	40	1043	12004	315	12319	11396	497	11893	35036	3402	38438
C373	1664	342	2006	7169	288	7457	47215	1241	48456	13512	590	14102	416891	40477	457368
C369	904	185	1089	1992	80	2072	6010	158	6168	5796	253	6049	30052	2918	32970
C377	12856	2639	15495	23797	958	24755	205035	5387	210422	235860	10289	246149	449999	43692	493691
E6	12911	11696	24607	25089	45299	70388	50479	94162	144641	88306	46942	135248	115003	34831	149834
E8	1160	1050	2210	19487	35190	54677	43379	80916	124295	129934	69077	199011	325050	98468	423518
E1	75	68	143	123	222	345	281	525	806	229	122	351	138	42	180
E5	114	103	217	911	1645	2556	728	1359	2087	603	321	924	1454	441	1895
E9	304	275	579	76	138	214	173	322	495	211	112	323	441	133	574
N9	249	0	249	287	71	358	445	356	801	421	438	859	1466	1220	2686
N10	128	0	128	180	45	225	1126	900	2026	851	877	1728	1539	1281	2820

ภาคผนวกที่ 6 (ต่อ)

B. Dikaryotic culture : parents (MU4,MU12) ; hybrids (C508,C507,C513,C502,C502,C516,C504) and Monokaryotic culture (E6,E8,E1,E5,E9,N9,

Age(days)	10			20			30			40			50		
Strains or isolates	homogenized	sonicated	total	homogenized	sonicated	total	homogenized	sonicated	total	homogenized	sonicated	total	homogenized	sonicated	total
MU4	512	105	617	20690	832	21522	67989	1786	69775	36526	1594	38120	17822	1730	19552
MU12	356	73	429	1169	47	1216	4282	113	4395	9739	425	10164	18545	1801	20346
C508	861	177	1038	1349	55	1404	83057	2182	85239	90186	3934	94120	257235	24975	282210
C507	330	67	397	653	27	680	11803	311	12114	2748	120	2868	25708	2496	28204
C513	105	21	126	480	20	500	301	8	309	308	13	321	597	58	655
C502	1022	209	1231	2062	83	2145	3164	83	3247	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
C516	308	64	372	35	1	36	260	6	266	195	8	203	119	12	131
C504	1003	206	1209	352	14	366	1538	41	1579	5435	237	5672	5841	567	6408
FF10	585	192	777	234	188	422	563	299	862	411	380	791	586	600	1186
FF9	1060	350	1410	960	775	1735	9935	5266	15201	5349	4949	10298	3570	3656	7226
FF7	1877	618	2495	125428	101302	226730	142845	75706	218551	93328	86322	179650	20730	21234	41964
FF2	228	35	263	2138	1728	3866	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
FF5	107	36	143	275	222	497	113	59	172	632	584	1216	15	15	30
N9	228	0	228	267	68	335	902	721	1623	421	439	860	472	392	864
N10	83	0	83	84	20	104	92	74	166	62	65	127	95	79	174

ภาคผนวกที่ 7 Acid phosphatase activity (units/mg prot.x 0.01) in L.edodes mycelia after breaking with homogenizer and sonicater

A. Dikaryotic culture : parents (MU2,MU12) ; hybrids (C364,C366,C359,C373,C369,C377) and Monokaryotic culture (E6,E8,E1,E5,E9,N9,N10)

Age(days)	10			20			30			40			50		
Strains or isolates	homogenized	sonicated	total	homogenized	sonicated	total	homogenized	sonicated	total	homogenized	sonicated	total	homogenized	sonicated	total
MU2	5.09	3.68	8.77	7.31	0.39	7.70	7.17	2.66	9.83	5.13	1.87	7.00	4.54	1.17	5.71
MU12	4.12	2.98	7.10	3.88	1.36	5.24	3.74	1.38	5.12	4.47	1.90	6.37	3.61	0.93	4.54
C364	2.58	1.86	4.44	2.65	0.92	3.57	2.19	0.81	3.00	1.55	0.56	2.11	2.67	0.69	3.36
C366	1.81	1.30	3.11	3.63	1.28	4.91	11.53	4.27	15.80	11.63	4.24	15.87	12.36	3.17	15.53
C359	3.10	2.24	5.34	3.87	1.36	5.23	3.76	1.40	5.16	3.04	1.11	4.15	9.64	2.47	12.11
C373	3.23	2.33	5.56	5.98	2.10	8.08	18.53	6.86	25.39	3.75	1.37	5.12	69.79	17.93	87.72
C369	31.84	23.00	54.84	3.94	1.39	5.33	22.89	8.49	31.38	17.34	6.33	23.67	25.75	6.62	32.37
C377	3.64	2.62	6.26	4.14	1.46	5.60	6.24	2.31	8.55	7.77	2.84	10.61	22.08	5.67	27.75
E6	1.88	3.39	5.27	2.72	10.49	13.21	3.51	12.51	16.02	13.18	16.54	29.72	5.63	7.32	12.95
E8	2.95	5.35	8.30	3.39	13.10	16.49	6.24	22.27	28.51	8.24	10.32	18.56	18.87	24.53	43.40
E1	6.06	10.97	17.03	6.14	23.69	29.83	9.33	33.32	42.65	11.10	13.91	25.01	7.67	9.97	17.64
E5	4.03	7.30	11.33	5.94	22.92	28.86	17.62	62.93	80.55	19.27	24.15	43.42	28.80	37.45	66.25
E9	2.48	4.48	6.96	0.98	1.34	2.32	0.99	3.51	4.50	1.34	1.68	3.02	1.32	1.72	3.04
N9	5.12	1.84	6.96	5.76	4.13	9.89	4.56	3.86	8.42	6.67	7.81	14.48	12.57	9.54	22.11
N10	15.88	5.73	21.61	4.99	3.57	8.56	2.88	2.43	5.31	6.50	7.60	14.10	3.60	2.73	6.33

ภาคผนวกที่ 7 (ต่อ)

B. Dikaryotic culture : parents (MU4,MU12) ; hybrids (C508,C507,C513,C502,C502,C516,C504) and Monokaryotic culture (E6,E8,E1,E5,E9,N9,

Age(days)	10			20			30			40			50		
Strains or isolates	homogenized	sonicated	total	homogenized	sonicated	total	homogenized	sonicated	total	homogenized	sonicated	total	homogenized	sonicated	total
MU4	7.87	5.68	13.55	13.58	4.77	18.35	30.68	11.37	42.05	40.99	14.95	55.94	26.99	6.94	33.93
MU12	2.72	1.97	4.69	3.41	1.20	4.61	2.62	0.96	3.58	4.14	1.51	5.65	7.29	1.87	9.16
C508	7.94	5.73	13.67	4.22	1.48	5.70	6.31	2.34	8.65	7.34	10.88	18.22	17.90	16.83	34.73
C507	1.87	1.36	3.23	1.89	1.87	3.76	7.25	2.68	9.93	3.65	1.33	4.98	10.00	2.57	12.57
C513	2.72	1.96	4.68	0.82	0.16	0.98	0.91	0.33	1.24	1.11	0.40	1.51	3.14	0.77	3.91
C502	1.89	1.37	3.26	1.34	0.47	1.81	1.58	0.58	2.16	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
C516	3.24	2.35	5.59	2.91	1.02	3.93	5.01	1.86	6.87	6.27	2.29	8.56	14.73	3.79	18.52
C504	5.16	3.72	8.88	1.41	0.50	1.91	22.93	8.49	31.42	4.73	1.73	6.46	48.70	12.51	61.21
FF10	2.30	0.51	2.81	3.62	2.19	5.81	8.03	2.72	10.75	6.64	3.01	9.65	10.27	8.13	18.40
FF9	9.65	0.85	10.50	1.52	0.93	2.45	3.73	1.14	4.87	2.65	1.20	3.85	1.86	1.48	3.34
FF7	4.50	0.40	4.90	4.03	2.44	6.47	9.27	3.15	12.42	12.64	5.73	18.37	17.48	13.86	31.34
FF2	24.57	2.16	26.73	33.65	20.41	54.06	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
FF5	3.30	0.29	3.59	2.67	1.62	4.29	3.34	1.13	4.47	2.13	29.36	31.49	3.40	2.70	6.10
N9	4.93	1.78	6.71	5.77	4.12	9.89	10.40	8.81	19.21	7.42	10.84	18.26	4.71	3.57	8.28
N10	4.72	1.70	6.42	5.15	3.69	8.84	2.51	2.13	4.64	7.15	8.36	15.51	6.32	4.79	11.11

ภาคผนวกที่ 8 Comparison of extracellular laccase activies (units/100 ml media x 1000)

A. Dikaryotic culture : parents (MU2,MU12) ; hybrids(C364,C366,C359,C373,C369,C377) and Monokaryotic culture (E6,E8,E1,E5,E9,N9,N10

Strains or isolates	Age(days) 10	20	30	40	50
MU2	0.6	52.0	150.0	440.0	480.0
MU12	0.2	40.0	0.4	0.9	0.5
C364	0.0	7.2	21.4	24.0	133.5
C366	7.6	166.5	1216.5	1066.5	1333.0
C359	2.6	9.0	133.5	188.5	232.0
C373	3.7	71.0	320.0	176.0	760.0
C369	0.8	15.2	143.0	400.0	540.0
C377	17.0	180.0	1494.0	1500.0	813.5
E6	2.4	140.0	200.0	680.0	1120.0
E8	1.3	83.0	760.0	1750.0	3200.0
E1	0.0	0.0	0.0	0.0	0.0
E5	0.0	0.0	0.0	0.0	0.3
E9	0.0	0.0	0.0	0.4	0.5
N9	0.0	2.8	9.4	24.0	50.0
N10	0.0	2.1	20.0	37.8	56.0

B. Dikaryotic culture : parents (MU12,MU4) ; hybrids (C508,C507,C513,C502,C516,C504) and Monokaryotic culture (FF10,FF9,FF7,FF2,FF5, N9,N10)

N10)

Strains or isolates	Age(days) 10	20	30	40	50
MU4	1.6	53.5	260.0	347.0	400.0
MU12	1.4	32.0	116.0	2200.0	880.0
C508	0.0	24.0	1440.0	853.0	640.0
C507	0.0	16.0	193.5	144.0	840.0
C513	0.0	2.6	10.0	22.0	10.1
C502	4.5	46.8	66.0	N.D.	N.D.
C516	0.0	0.0	0.6	1.0	9.6
C504	28.0	34.5	10.0	63.5	21.5
FF10	2.0	2.5	12.7	20.0	16.5
FF9	0.0	23.0	240.0	416.0	226.5
FF7	0.0	34.5	260.0	880.0	880.0
FF2	0.0	7300.0	N.D.	N.D.	N.D.
FF5	0.0	0.0	0.0	0.0	0.0
N9	0.0	1.4	4.5	11.0	20.0
N10	0.0	1.3	14.0	97.8	36.0

ภาคผนวกที่ 9

Relative mobility (Rf) of laccase isozymes from L.edodes mycelia
Dikaryotic culture : parents (MU2,MU12) ; hybrids (C364,C366,C359,C373,C369,C377)
and Monokaryotic culture (E6,E8,E1,E5,E9,N9,N10)

At 30 days of growth period

	intracellular laccase													extracellular laccase							
band no.	MU2	MU12	C364	C366	C359	C373	C369	C377	E6	E8	E1	E9	N9	N10	MU2	MU12	C366	C359	C373	C369	C377	E6	E8
1																							
2											0.77												
3																							
4																							
5		0.73																					
6		0.72																					
7	0.71		0.71	0.71	0.71	0.71		0.71		0.71		0.71											
8															0.70								
9																							
10	0.68	0.68	0.68	0.68	0.68	0.68			0.68	0.68					0.68								
11	0.66																						
12	0.63		0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63		0.63	0.63	0.63		0.63	0.63	0.63
13																							
14		0.61																					
15			0.55	0.55		0.55	0.55	0.55	0.55	0.55		0.55	0.55	0.55					0.55	0.55		0.55	
16													0.54	0.54									
17																							
18	0.45								0.45	0.45		0.45											
19	0.42		0.42			0.42			0.42	0.42		0.42											
20																							
21	0.38		0.38			0.38			0.38	0.38													
22																							
23																							
24																							

ภาคผนวกที่ 10

Relative mobility (Rf) of laccase isozymes from L.edodes mycelia
Dikaryotic culture : parents (MU2,MU12) ; hybrids (C364,C366,C359,C373,C369,C377)
and Monokaryotic culture (E6,E8,E1,E5,E9,N9,N10)

At 50 days of growth period

	intracellular laccase															extracellular laccase									
band no.	MU2	MU12	C364	C366	C359	C373	C369	C377	E6	E8	E1	E5	E9	N9	N10	MU2	MU12	C364	C366	C359	C373	C369	C377	E6	E8
1																									
2							0.77																		
3																									
4																									
5																									
6		0.72																							
7	0.71			0.71	0.71	0.71		0.71		0.71	0.71	0.71	0.71	0.71	0.71										
8																									
9																									
10			0.68		0.68	0.68			0.68			0.68	0.68					0.68							
11			0.66						0.66																
12	0.63		0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.63		0.63	0.63	0.63	0.63	0.63			0.63	0.63	0.63	0.63	0.63		0.63
13																									
14		0.61															0.61								
15			0.55	0.55		0.55	0.55	0.55	0.55	0.55	0.55			0.55	0.55			0.55	0.55		0.55			0.55	0.55
16														0.54	0.54										
17																									
18	0.45		0.45				0.45	0.45	0.45	0.45		0.45	0.45												
19			0.42				0.42		0.42			0.42	0.42												
20																									
21	0.38		0.38				0.38		0.38	0.38		0.38	0.38												
22																									
23																									
24																									

ภาคผนวกที่ 11

Relative mobility (Rf) of laccase isozymes from L.edodes mycelia
Dikaryotic culture : parents (MU4, MU12) ; hybrids (C508,C507,C513,C502,C516,C504)
and Monokaryotic culture (FF10,FF9,FF7,FF2,FF5,N9,N10)

At 30 days of growth period

	intracellular laccase														extracellular laccase							
band no.	MU4	MU12	C508	C507	C513	C502	C516	C504	FF10	FF9	FF7	FF2	FF5	N9	N10	MU4	MU12	C508	C507	C502	FF9	FF7	N9	N10
1																								
2																								
3																								
4											0.75													
5		0.73																						
6		0.72																						
7	0.71					0.71																		
8			0.70	0.70						0.70	0.70	0.70					0.70							
9								0.69																
10	0.68	0.68														0.68	0.68							
11			0.66																					
12	0.63		0.63	0.63	0.63	0.63		0.63		0.63	0.63	0.63		0.63	0.63	0.63		0.63			0.63			
13			0.62	0.62																				
14		0.61																						
15			0.55	0.55	0.55	0.55	0.55		0.55	0.55		0.55		0.55	0.55			0.55	0.55	0.55	0.55	0.55	0.55	0.55
16			0.54	0.54						0.54				0.54	0.54								0.54	0.54
17								0.47					0.47											
18	0.45																							
19	0.42																							
20					0.40		0.40		0.40		0.40													
21	0.38							0.38					0.38											
22										0.35														
23							0.34		0.34															
24					0.31						0.31													

ภาคผนวกที่ 12

Relative mobility (Rf) of laccase isozymes from L.edodes mycelia
Dikaryotic culture : parents (MU4, MU12) ; hybrids (C507,C516)
and Monokaryotic culture (FF10,FF9,N9,N10)

At 50 days of growth period

band no.	intracellular laccase								extracellular laccase			
	MU4	MU12	C507	C516	FF10	FF9	N9	N10	MU4	MU12	C507	FF9
1	0.79											
2												
3												
4												
5												
6		0.72										
7	0.71						0.71	0.71	0.71			
8			0.70			0.70						
9												
10												
11												
12	0.63		0.63			0.63	0.63	0.63	0.63		0.63	0.63
13												
14		0.61								0.61		
15			0.55			0.55	0.55	0.55			0.55	0.55
16			0.54				0.54	0.54				
17												
18	0.45											
19	0.42											
20					0.40	0.40	0.40					
21	0.38											
22												
23												
24												

ภาคผนวกที่ 13

Relative mobility (Rf) of esterase isozymes from L. edodes mycelia :
Dikaryotic culture : parents (MU2,MU12) ; hybrids (C364,C366,C359,C373,C369,C377)
and Monokaryotic culture (E6,E8,E1,E5,E9,N9,N10)

At 30 days of growth period

band no.	MU2	MU12	C364	C366	C359	C373	C369	C377	E6	E8	E1	E5	E9	N9	N10
1															
2															
3	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94		0.94		0.94	0.94
4												0.81			
5	0.79	0.79	0.79	0.79	0.79	0.79	0.79		0.79	0.79	0.79	0.79			
6	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77			0.77
7															
8	0.74		0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74
9	0.73														
10			0.71		0.71	0.71		0.71	0.71			0.71	0.71	0.71	0.71
11	0.69		0.69		0.69		0.69	0.69	0.69	0.69	0.69		0.69	0.69	0.69
12	0.67	0.67		0.67			0.67	0.67	0.67	0.67	0.67	0.67			0.67
13	0.65	0.65		0.65	0.65		0.65			0.65		0.65			
14	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62		0.62	0.62
15	0.60			0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
16	0.59														
17														0.58	
18	0.57	0.57					0.57		0.57						
19						0.56				0.56		0.56		0.56	0.56
20		0.55													
21	0.54		0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54		0.54	0.54	0.54	0.54
22		0.53													
23													0.52		
24	0.51		0.51		0.51		0.51	0.51	0.51			0.51			
25		0.50													
26	0.49		0.49		0.49		0.49					0.49		0.49	
27	0.46		0.46		0.46		0.46		0.46					0.46	0.46
28	0.41				0.41		0.41				0.41				
29	0.39				0.39		0.39								
30	0.37				0.37		0.37								

ภาคผนวกที่ 14

Relative mobility (Rf) of esterase isozymes from L. edodes mycelia :
Dikaryotic culture : parents (MU2,MU12) ; hybrids (C364,C366,C359,C373,C369,C377)
and Monokaryotic culture (E6,E8,E1,E5,E9,N9,N10)

At 50 days of growth period

band no.	MU2	MU12	C364	C366	C359	C373	C369	C377	E6	E8	E1	E5	E9	N9	N10
1							0.98								
2							0.96								
3	0.94	0.94	0.94	0.94	0.94		0.94		0.94	0.94		0.94		0.94	0.94
4															
5	0.79	0.79	0.79	0.79	0.79		0.79		0.79	0.79	0.79				
6	0.77	0.77	0.77	0.77	0.77		0.77		0.77	0.77	0.77				0.77
7							0.75								
8	0.74	0.74	0.74	0.74	0.74	0.74		0.74	0.74	0.74		0.74	0.74	0.74	0.74
9	0.73	0.73													
10			0.71		0.71	0.71		0.71	0.71			0.71	0.71	0.71	0.71
11	0.69		0.69		0.69		0.69		0.69	0.69	0.69		0.69	0.69	0.69
12	0.67	0.67		0.67			0.67		0.67	0.67		0.67			0.67
13		0.65		0.65	0.65		0.65			0.65		0.65			
14	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62		0.62	0.62
15	0.60			0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60		0.60	0.60
16	0.59														
17	0.58													0.58	
18	0.57	0.57					0.57		0.57						
19										0.56		0.56		0.56	0.56
20															
21	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54		0.54	0.54	0.54	0.54
22															
23													0.52		
24	0.51		0.51		0.51		0.51	0.51	0.51	0.51					
25		0.50													
26	0.49		0.49		0.49		0.49			0.49		0.49		0.49	
27	0.46		0.46		0.46		0.46		0.46					0.46	0.46
28	0.41				0.41		0.41								
29	0.39				0.39		0.39								
30	0.37				0.37										

ภาคผนวกที่ 15

Relative mobility (Rf) of esterase isozymes from L. edodes mycelia :
Dikaryotic culture : parents (MU4, MU12) ; hybrids (C508,C507,C513,C502,C516,C504)
and Monokaryotic culture (FF10,FF9,FF7,FF2,FF5,N9,N10)

At 30 days of growth period

band no.	MU4	MU12	C508	C507	C513	C502	C516	C504	FF10	FF9	FF7	FF2	FF5	N9	N10
1															
2															
3	0.94	0.94	0.94					0.94		0.94	0.94	0.94	0.94	0.94	0.94
4															
5	0.79	0.79													
6	0.77	0.77													0.77
7					0.75			0.75			0.75				
8	0.74													0.74	0.74
9	0.73		0.73	0.73	0.73		0.73	0.73	0.73	0.73	0.73				
10			0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71		0.71		0.71	0.71
11	0.69		0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69		0.69		0.69	0.69
12	0.67	0.67	0.67	0.67	0.67	0.67		0.67		0.67	0.67	0.67	0.67		0.67
13	0.65	0.65	0.65	0.65				0.65		0.65	0.65		0.65		
14	0.62	0.62	0.62	0.62	0.62	0.62		0.62		0.62	0.62	0.62	0.62	0.62	0.62
15	0.60		0.60	0.60	0.60	0.60		0.60		0.60	0.60	0.60	0.60	0.60	0.60
16														0.58	
17															
18	0.57	0.57		0.57				0.57		0.57			0.57		
19											0.56			0.56	0.56
20		0.55						0.55							
21	0.54		0.54	0.54	0.54	0.54				0.54	0.54		0.54	0.54	0.54
22		0.53						0.53				0.53			
23															
24	0.51			0.51		0.51		0.51		0.51		0.51	0.51		
25		0.50													
26	0.49				0.49				0.49	0.49					
27	0.46						0.46		0.46			0.46		0.49	
28	0.41				0.41									0.46	0.46
29	0.39														
30	0.37														

ภาคผนวกที่ 16

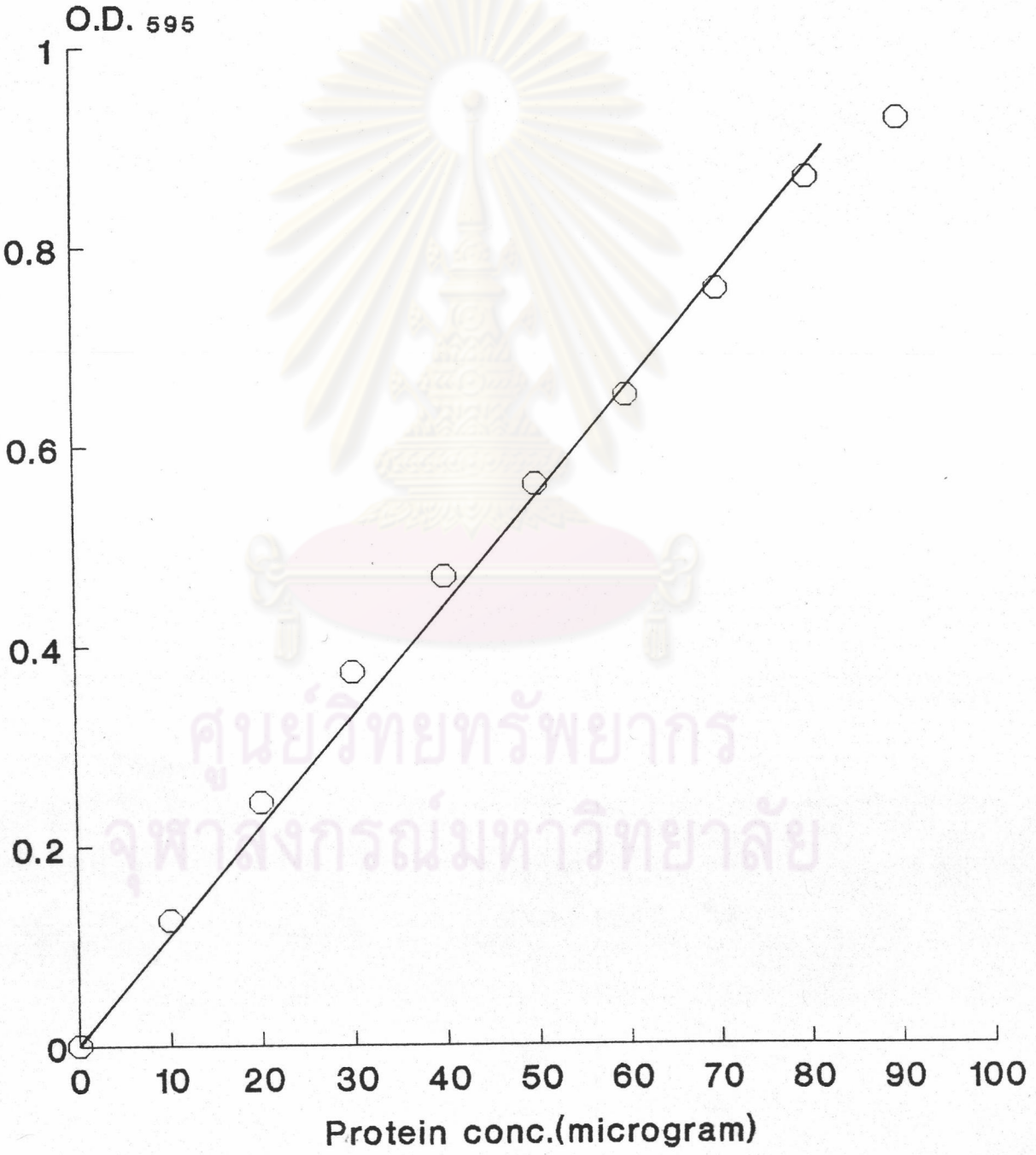
Relative mobility (Rf) of esterase isozymes from L. edodes mycelia
Dikaryotic culture : parents (MU4,MU12) ; hybrids (C508,C507,C513,C502,C516,C504)
and Monokaryotic culture (FF10,FF9,FF7,FF2,FF5,N9,N10)

At 50 days of growth period

band no.	MU4	MU12	C508	C507	C513	C502	C516	C504	FF10	FF9	FF7	FF2	FF5	N9	N10
1	0.98					N.D.						N.D.			
2	0.96														
3	0.94	0.94								0.94	0.94			0.94	0.94
4															
5		0.79													
6	0.77	0.77													0.77
7											0.75				
8		0.74												0.74	0.74
9		0.73	0.73	0.73	0.73		0.73	0.73	0.73	0.73	0.73		0.73		
10			0.71	0.71	0.71		0.71	0.71	0.71	0.71			0.71	0.71	0.71
11			0.69	0.69	0.69		0.69	0.69	0.69	0.69			0.69	0.69	0.69
12		0.67	0.67	0.67	0.67			0.67			0.67		0.67		0.67
13		0.65						0.65			0.65		0.65		
14		0.62	0.62	0.62	0.62			0.62		0.62	0.62		0.62	0.62	0.62
15			0.60	0.60				0.60		0.60	0.60		0.60	0.60	0.60
16															
17														0.58	
18		0.57						0.57					0.57		
19											0.56			0.56	0.56
20								0.55							
21	0.54	0.54	0.54	0.54						0.54	0.54		0.54	0.54	0.54
22								0.53							
23															
24	0.51		0.51	0.51				0.51		0.51	0.51		0.51		
25		0.50													
26									0.49	0.49	0.49			0.49	
27	0.46						0.46	0.46	0.46					0.46	0.46
28					0.41						0.41				
29															
30															

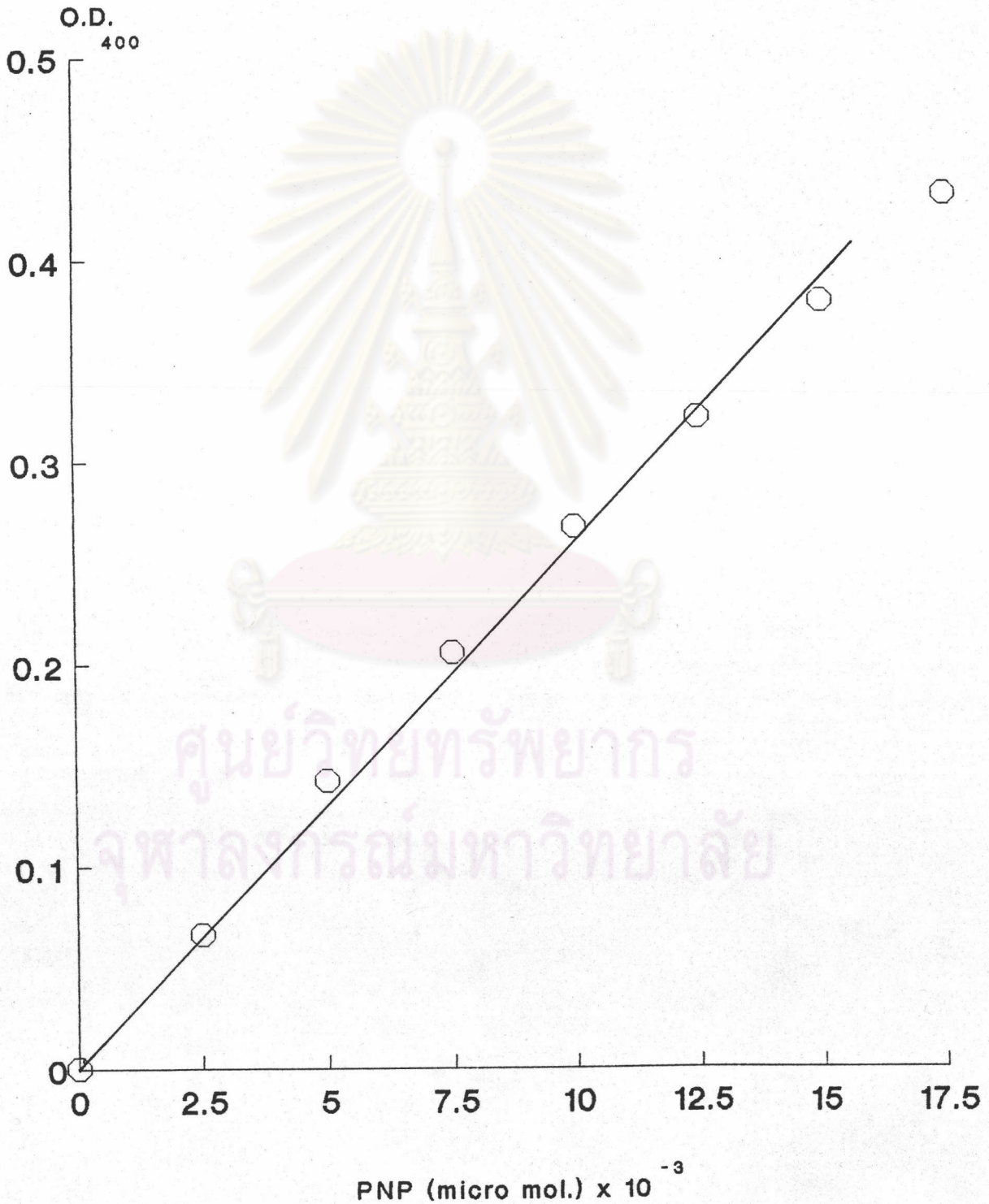
ภาคผนวกที่ 17

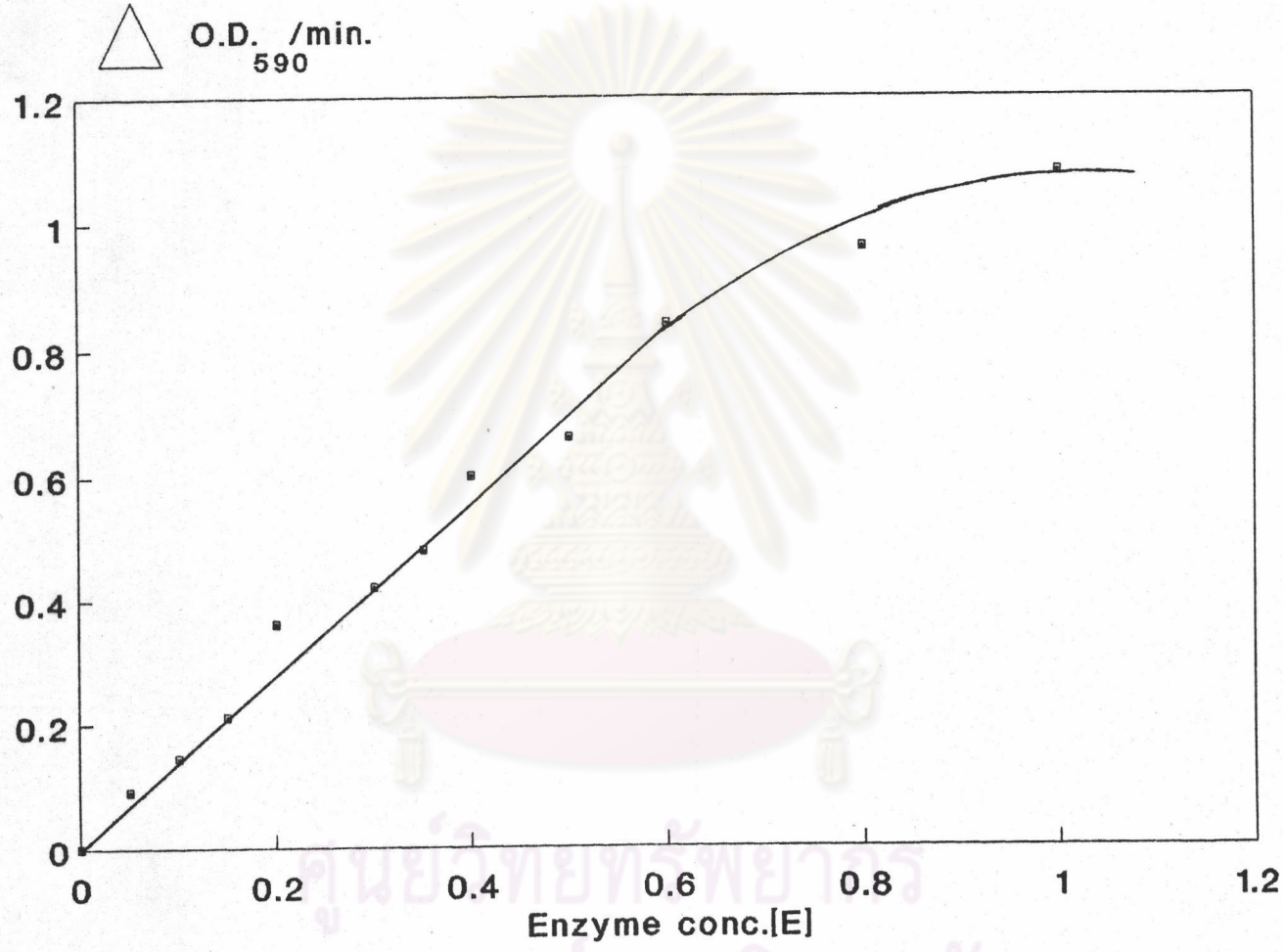
Protein standard curve using protein-dye binding method (Bradford,1976), bovine serum albumin was used as standard protein



ภาคผนวกที่ 18

PNP standard curve using p-Nitrophenol as standard





Changes of O.D. /min. in laccase enzyme assay according to various enzyme concentration
590

ภาคผนวกที่ 20

Rate of oxidation of substrates by a whole fresh mushroom homogenate (Leatham and Stahmann, 1981)

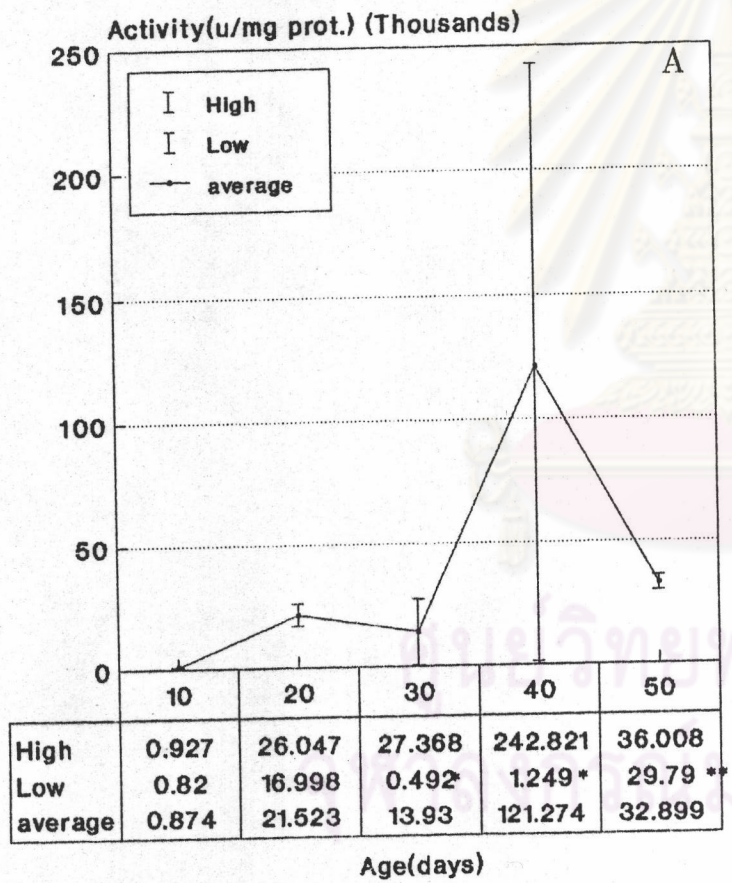
The oxidation rate are expressed as the mean steady-statetate of substrates (0.42 mM) for duplicate assays. Buffer were 21 mM-sodium acetate, pH 4.5, and 21 mM-sodium phosphate, pH 6.5. The assay wavelength was that of the maximal absorbance for the oxidized substrate. The molar absorption coefficients (E^{o}) for the oxidized substrates were examined by sodium periodate oxidation.

Substrates	Oxidation rate ($\Delta A\ min^{-1}$)		Assay wavelength (nm)	$10^{-3} x E^{o}$ ($l\ mol^{-1} cm^{-1}$)	
	pH 4.5	pH 6.5		pH 4.5	pH 6.5
p-Anisidine	0.026	0.000	460	-	-
p-Anisidine + 1 mM H_2O_2	0.026	0.000	460	-	-
Tyrosine	0.027	0.020	460	-	-
L-DOPA	0.075	0.070	460	3.85	3.96
Caffeic acid	0.064	0.024	390	-	-
Chlorogenic acid	0.054	0.000	390	-	-
o-Phenylenediamine	0.500	0.000	440	7.60	-
p-Phenylenediamine	0.706	0.000	460	-	-
Dimethylenediamine	0.640	0.090	510	-	-
Benzidine	0.943	0.000	600	8.87	-
Benzidine + 1 mM H_2O_2	0.950	0.000	600	8.87	-
3,3′-Dimethylbenzidine	1.640*	0.000	600	6.34	-
3,3′-Dimethoxybenzidine	2.836	2.040	375	not stable	
1,3-Dihydroxynaphthalene	0.036	0.000	440	-	-

-, Not determined.

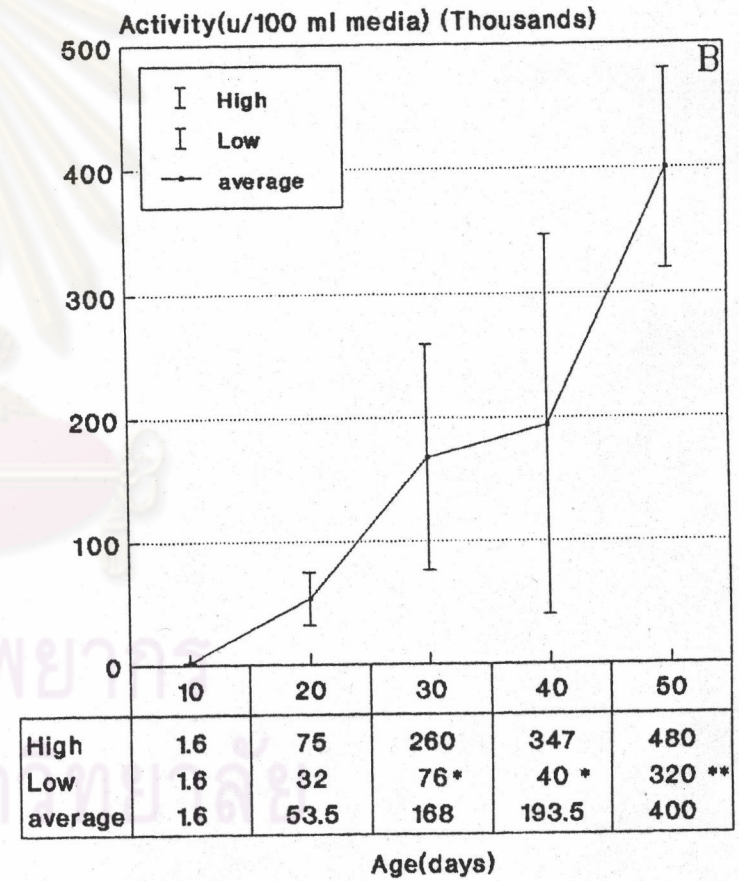
* Base on the oxidation of 3,3′-dimethylbenzidine at pH 4.5, the activity of laccase was 34.2 umol substrate oxidized min^{-1} (g^{-1} fresh weight tissue).

Fluctuation of laccase activty in some replication of *L. edodes* strain MU4, cultivated in PDYB medium (static culture), at 25 C. A. Intracellular B. Extracellular



	10	20	30	40	50
High	0.927	26.047	27.368	242.821	36.008
Low	0.82	16.998	0.492*	1.249*	29.79 **
average	0.874	21.523	13.93	121.274	32.899

* primodia formation



	10	20	30	40	50
High	1.6	75	260	347	480
Low	1.6	32	76*	40 *	320 **
average	1.6	53.5	168	193.5	400

** mycelial maturation

ประวัติผู้เขียน

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