

References

- Alberts, B., Bray, D., Lewis, J., Raff, M., Roberts, K. and Watson, J. D. 1983. Molecular Biology of the cell. New York: Garland.
- Aljanabi, S. M. and Martinez, I. 1997. Universal and rapid salt-extraction of high quality genomic DNA for PCR-based techniques. Nucleic Acids Res. 25 (22): 4692-4693.
- Altschmied, J., Hornung, U., Schlupp, I., Gadau, J., Kolb, R. and Schartl, M. 1997. Isolation of DNA suitable for PCR for field and laboratory work. BioTechniques 23: 228-229.
- Anderson, I. 1993. The veterinary approach to marine prawns. In L. Brown (ed.), Aquaculture for veterinarians : Fish husbandry and medicine : 271-290. Oxford : Elsevier Science.
- Avise, J. C. 1994. Molecular Markers, Natural History and Evolution. New York: Chapman & Hall, Inc.
- Baily-Brook, J. H., and Moss, S. M. 1992. Penaeid taxonomy biology and zoogeography. In A. W. Fast and L. J. Lester (eds), Marine shrimp culture: Principles and practices: 9-27.
- Bassam, B. J., Caetano-Anolles, G. and Gresshoff, P. M. 1991. Fast and sensitive silver staining of DNA in polyacrylamide gels. Anal. Biochem. 196: 80-83.
- Bethwaite, P. B., Koreth, J., Herrington, C. S. H. and McGee J. O'D. 1995. Loss of heterozygosity occurs at the D11s29 locus on chromosome 11q23 in invasive cervical carcinoma. Br. J. Cancer. 71: 814-818.
- Buth, D. G. 1996. Genetic principles and the interpretation of electrophoretic data. In Whitmore, D. H. (ed.), Electrophoretic and Isoelectric Focusing Techniques in Fisheries Management. Boca Raton: CRP Press. Boca Raton.

- Callen, D. F., Thompson, A. D., Shen, Y., Phillips, H., Richards, R. I., Mulley, J. C. and Sutherland, G. R. 1993. Incidence and origin of 'null' alleles in the (AC)_n microsatellite markers. Am J. Hum. Genet. 52: 922-927.
- Cook, D. I., Kamonrat, W., Paquet, D. and Pitman, E. R. (unpublished) A single tube rapid extraction of DNA from fish blood.
- Cooper, T. G. 1977. The Tools of Biochemistry. Canada: John Wiley & sons Press.
- Department of Business Economics.
- Dore, I. and Frimodt, C. 1987. An illustrated guide to shrimps of the world. New York : Osprey books Press.
- Edwards, A., Civitello, A., Hammond, H. A., and Caskey, C. T. 1991. DNA typing and genetic mapping with trimeric and tetrameric tandem repeats. Am. J. Hum. Genet. 49: 746-756.
- Garcia de Leon, F. J., Canonne, M., Quillet, E., Bonhomme, F. and Chatain, B. 1998. The application of microsatellite markers to breeding programmes in the sea bass, *Dicentrarchus labrax*. Aquaculture 159: 303-316.
- Grey, D. L., Dall, W., and Baker, A. 1983. 'A guide to the Australian Penaeid prawns'. Darwin: Northern Territory Government Printing Office.
- Hauge, X. Y., and Litt, M. 1993. A study of the origin of shadow bands seen when typing dinucleotide repeat polymorphisms by the PCR. Hum. Mol. Genet. 2: 411-415.
- Hearne, C. M., Ghosh, S. and Todd, J. A. 1992. Microsatellites for linkage analysis of genetic traits. Trend. Genet. 8: 288-294.
- Henegariu, O., Heerema, N. A., Dlouhy, S. R., Vance, G. H. and Vogt, P. H. 1997. Multiplex PCR: critical parameters and step-by-step protocol. BioTechniques 23: 504-511.

- Herbinger, C. M., Doyle, R. W., Pitman, E. R., Paquet, D., Mesa, K. A., Morris, D. B., Wright, J. M. and Cook, D. 1995. DNA fingerprint based analysis of paternal and maternal effects on offspring growth and survival in communally reared rainbow trout. Aquaculture 137: 245-256.
- Herbinger, C. M., O'Reilly, P. T., Doyle, R. W., Wright, J. M. and O'Flynn, F. 1999. Early growth performance of Atlantic salmon full-sib families reared in single family tanks versus in mixed family tanks. Aquaculture 173: 105-116.
- Jeffreys, A. J., Wilson, V. and Thein, S. L. 1985. Hypervariable minisatellite regions in human DNA. Nature 316: 67-73.
- Jeffreys, A. J., MacLeod, A., Tamaki, K., Neil, D. L. and Monckton, D. G. 1991. Minisatellite repeat coding as a digital approach to DNA typing. Nature 354: 204-209.
- Kirby, L. T. 1992. DNA Fingerprinting: An introduction. New York: W. H. Freeman and Company.
- Koorey, D. J., Bishop, G. A. and McCaughan, G. W. 1993. Alleles non-amplification: A source of confusion in linkage studies employing microsatellite polymorphisms. Hum. Mol. Genet. 2: 289-291.
- Koreth, J., O'Leary, J. J. and O'D. McGee, J. 1996. Microsatellites and PCR genomic analysis. J. Patho. 178: 239-348.
- Lessios, H.A. 1992. Testing electrophoretic data for agreement with Hardy-Weinberg expectations. Mar. Biol. 112: 517-523.
- Lins, A. M., Sprecher, C. J., Puers, C. and Schumm, J. W. 1996. Multiplex sets for the amplification of polymorphic short tandem repeat loci-silver stain and fluorescence detection. BioTechniques 20: 882-889.
- Love, J. M., Knight, A. M., McAleer, M. A. and Todd, J. A. 1990. Towards construction of a high resolution map of the mouse genome using PCR analysed microsatellites. Nucleic Acids Res. 18: 4123-4130.

- Martinez, G., Shaw, E. M., Carrillo, M. and Zanuy, S. 1998. Protein salting-out method applied to genomic DNA isolation from fish whole blood. BioTechniques 24: 238-239.
- Moore, S. S., Whan, V., Davis, G. P., Byrne, K., Hetzel, D. J. S. and Preston, N. 1999. The development and application of genetic markers for the kuruma prawn *Penaeus japonicus*. Aquaculture 173: 19-32.
- Morizot, D. C. and Schmidt, M. E. 1990. Starch gel electrophoresis and histochemical visualization of proteins. In: Whitmore, D. H. Electrophoretic and isoelectric focusing techniques in fisheries management. p. 23-80 Boca Raton: CRP Press.
- Moxon, E. R. and Wills, C. 1999. DNA microsatellites: agents of evolution. Sci. Am.: 72-77.
- Nei, M. 1978. Estimation of average heterozygosity and genetic distance from a small number of individuals. Genetics 23: 341-369.
- O'Reilly, P. and Wright, J. M. 1995. The evolving technology of DNA fingerprinting and its application to fisheries and aquaculture. J. Fish Biol. 47(supplement A): 29-55.
- Park, L. K. and Moran, P. 1994. Developments in molecular genetic techniques in fisheries. Rev. Fish Biol. Fisheries 4: 272-299.
- Pemberton, J. M., Slate, J., Bancroft, D. R. and Barrett, J. A. 1995. Nonamplifying alleles at microsatellite loci: a caution for parentage and population studies. Mol. Ecol. 4: 249-252.
- Perez-Enriquez, R., Takagi, M. and Taniguchi, N. 1999. Genetic variability and pedigree tracing of a hatchery-reared stock of red sea bream (*Pagrus major*) used for stock enhancement, based on microsatellite DNA markers. Aquaculture 173: 413-423.

- Pongsomboon, S., Whan, V., Moore, S. S. and Tassanakajon, A. (2000) Characterization of tri- and tetranucleotide microsatellites in black tiger prawn, *Penaeus monodon*. Science Asia (in press).
- Puers, C., Hammond, H. A., Caskey, T., Lins, A. M., Sprecher, C. J., Brinkmann, B. and Schumm, J. W. 1994. Allelic ladder characterization of the short tandem repeat polymorphism located in the 5' flanking region to the human coagulation factor XIII a subunit gene. Genomics 23: 260-264.
- Rudbeck, L. and Dissing, J. 1998. Rapid, simple alkaline extraction of human genomic DNA from whole blood, buccal epithelial cells, semen and forensic stains for PCR. BioTechniques 25: 588-592.
- Schlotterer, C. and Tautz, D. 1992. Slippage synthesis of simple sequence DNA. Nucleic Acids Res. 20 (2): 211-215.
- Sokal, R. R. and Rohlf, F. J. 1981. Biometry, 2nd ed. W. H. Freeman and company. New York.
- Solis, N.B. 1988. Biology and ecology. In Taki, Y., Premavara, J. H., and Lobera, J. (eds.), Biology and culture of Penaeus monodon: pp. 3-30. Aquaculture Department, Southeast Asia Fisheries Development Center.
- Sprecher, C. J., Puers, C., Lins, A. M. and Schumm, J.W. 1996. General approach to analysis of polymorphic short tandem repeat loci. BioTechniques 20: 266-276.
- Supungul, P. 1998. Genetic variation and population structure of the black tiger prawn P. monodon in Thailand determined by microsatellite markers. M. Sc. Thesis, Department of Biochemistry, Graduate School, Chulalongkorn University. 68 pp.
- Tassanakajon, A., Pongsomboon, S., Rimphanitchayakit, V., Jarayabhand, P., Boonsaeng, V. 1997. Random amplified polymorphic DNA (RAPD) markers for determination of genetic variation in wild populations of the black tiger prawn (*Penaeus monodon*) in Thailand. Mol. Mar. Biol. and Biotechnol. 6 (2):110-115.

- Tassanakajon, A., Tiptawonnukul, A., Supungul, P., Rimphanitchayakit, V., Cook, D., Jarayabhand, P., Klinbunga, S. and Boonsaeng, V. 1998. Isolation and characterization of microsatellite markers in the black tiger prawn *Penaeus monodon*. Mol. Mar. Biol. and Biotechnol. 7 (1): 55-61.
- Tautz, D. 1989. Hypervariability of simple sequences as a general source for polymorphic DNA markers. Nucleic Acid Res. 17 (16): 6463-6471.
- Valdes, A. M., Slatkin, M. and Freimer, M. B. 1993. Allele frequencies at microsatellite loci: te stepwise mutation model revisited: Genetics 133: 737-749.
- Volckaert, F. A. M. and Hellemans, B. 1999. Survival, growth and selection in a communally reared multifactorial cross of African catfish (*Clarias gariepinus*). Aquaculture 171:49-64.
- Walsh, P.S., Metzger, D. A. and Higuchi, R. 1991. Chelex® 100 as medium for simple extraction of DNA for PCR-based typing from forensic material. BioTechniques 10: 506-513.
- Weissenbach, J., Gyapay, G., Dib, C., Vignal, A., Morissette, J., Millasseau, P., Vaysseix, G. and Lathrop, M. 1992. A second generation linkage map of the human genome. Nature 359: 794-801.
- White, H. W. and Kusukawa, N. 1997. Agarose-based system for separation of short tandem repeat loci. BioTechniques 22: 976-980.
- Wolff, R., Plaetke, R., Jeffreys, A. J. and White, R. 1989. Unequal crossing over between homologous chromosomes is not the major mechanism involved in the generation of new alleles at VNTR loci. Genomics 5: 382-384.
- Wolfus, G.M., Garcia, D. K. and Alcivar-Warren, A. 1997. Application of the microsatellie technique for analyzing genetic diversity in shrimp breeding programs. Aquaculture 152: 35-47.
- World shrimp farming, 1998.

- Wright, J. and Bentzen, P. 1994. Microsatellites: genetic markers for the future. Rev. Fish Biol. Fisheries 4: 384-388.
- Wright, J. M. 1993. DNA fingerprinting of fishes. Hochachka and Mommsen (eds.). Biochemistry and molecular biology of fishes, vol. 2. Elsevier Science Publishers B. V.
- Xu, Z., Dhar, A. K., Wurzykowski, J. and Alcivar-Warren, A. 1999. Identification of abundant and informative microsatellites from shrimp (*Penaeus monodon*) genome. An. Genet. 30:150-156.

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Appendix

I Genotypes of *P. monodon* individuals from Trad province at eight microsatellite loci

Sample	Genotype							
	CSCUPmo1	CSCUPmo2	CSCUPmo3	CSCUPmo4	CSCUPmo6	CSCUPmo7	CSCUPmo9	CSCUPmo11
(1)	254/323	165/185	183/185	240/242	180/216	212/212	312/358	138/162
(2)	242/254	159/159	179/179	238/246	172/200	184/184	302/366	147/156
(3)	242/275	147/181	177/183	240/240	200/216	216/220	306/324	141/150
(4)	242/251	173/173	147/147	230/242	204/214	-	314/380	147/150
(5)	272/272	147/175	217/219	242/244	170/184	216/216	314/340	144/147
(6)	266/266	153/157	-	230/240	208/218	-	-	138/150
(7)	242/278	163/181	177/179	230/242	186/220	206/206	-	135/147
(8)	263/314	157/185	175/181	234/246	214/214	224/224	374/374	144/153
(9)	272/317	177/189	183/183	238/248	170/210	192/192	352/368	147/147
(10)	266/305	177/177	211/211	224/240	208/216	222/234	274/372	135/147
(11)	311/311	179/213	145/175	240/256	180/180	-	306/378	144/144
(12)	284/284	173/175	181/199	230/236	188/242	196/196	312/328	138/156
(13)	242/317	153/177	179/207	210/230	202/208	212/230	318/326	150/156
(14)	239/299	147/173	175/175	240/242	172/206	210/210	318/348	147/147
(15)	278/281	149/159	181/193	240/242	212/212	184/218	300/316	135/147
(16)	266/272	147/147	147/181	242/244	220/220	-	312/312	138/144
(17)	326/326	165/175	181/181	230/242	192/206	-	330/380	135/147
(18)	251/296	159/165	197/197	230/234	174/214	216/216	356/356	141/147
(19)	233/242	173/213	197/197	242/244	208/208	202/222	304/328	144/147
(20)	266/272	165/165	179/179	244/254	182/218	222/222	304/312	138/138
(21)	242/302	159/165	183/183	230/244	198/218	220/220	284/362	141/150
(22)	257/311	217/217	177/193	242/256	200/210	202/202	370/370	147/147
(23)	275/275	153/173	179/193	222/230	208/218	196/196	296/306	144/156
(24)	254/260	171/185	179/181	228/236	200/200	212/226	304/374	141/147
(25)	257/311	165/165	179/179	220/240	204/206	228/228	296/326	135/147

(continued)

Sample	Genotype							
	CSCUPmo1	CSCUPmo2	CSCUPmo3	CSCUPmo4	CSCUPmo6	CSCUPmo7	CSCUPmo9	CSCUPmo11
(26)	233/233	177/183	183/183	238/240	204/234	176/176	308/318	144/147
(27)	245/245	153/165	181/203	206/236	192/216	230/230	312/328	138/147
(28)	233/251	167/183	179/195	206/226	188/188	194/194	304/322	141/150
(29)	257/284	177/195	177/177	240/246	194/200	186/186	304/312	138/147
(30)	254/257	169/177	191/197	236/238	166/166	192/192	326/354	147/156
(31)	317/317	157/181	185/185	230/250	178/206	192/196	306/314	135/138
(32)	248/248	165/185	181/213	222/240	176/202	182/182	312/372	-
(33)	257/257	165/173	147/175	222/224	216/232	216/216	306/322	132/147
(34)	263/302	213/217	135/181	240/240	170/198	184/184	326/372	138/147
(35)	260/260	153/153	169/185	242/244	180/210	196/196	-	135/147
(36)	230/233	169/177	173/177	242/242	176/212	192/192	306/308	138/141
(37)	257/302	173/179	177/193	210/210	206/206	172/172	-	-
(38)	224/254	165/165	173/187	242/244	178/200	220/220	300/316	138/147
(39)	251/254	153/203	173/175	230/246	218/218	186/186	-	147/147
(40)	242/272	165/173	199/199	224/242	166/198	182/182	-	-
(41)	245/266	151/167	187/189	232/242	200/210	186/186	292/298	147/147
(42)	251/263	177/177	179/189	232/240	214/214	202/216	-	144/147
(43)	251/257	165/169	191/197	230/242	202/202	-	316/318	147/150
(44)	236/317	165/201	171/197	232/238	182/218	182/182	324/380	141/156
(45)	248/257	167/207	185/191	240/250	176/212	232/232	306/322	141/147
(46)	239/254	175/209	187/205	230/246	210/216	216/216	-	147/150
(47)	281/281	177/177	177/177	230/240	206/206	-	312/328	138/147
(48)	239/278	161/167	179/223	212/242	206/206	232/232	296/302	135/150
(49)	242/257	153/163	179/179	240/240	184/184	186/216	-	135/135
(50)	269/281	177/185	179/179	210/236	176/176	202/202	-	-
(51)	266/269	153/217	175/175	236/240	206/220	-	-	138/138

II Genotypes of *P. monodon* individuals from Trang province at six microsatellite loci

Sample	Genotype					
	CSCUPm01	CSCUPm02	CSCUPm04	CSCUPm06	CSCUPm09	CSCUPm11
(1)	245/245	147/173	-	204/214	-	144/147
(2)	275/275	161/185	-	184/184	376/376	147/150
(3)	266/299	177/177	-	190/212	308/374	147/150
(5)	245/281	153/181	-	210/210	304/322	-
(6)	239/257	177/181	240/256	208/210	290/364	147/150
(8)	245/332	147/175	238/238	168/206	310/352	147/162
(10)	254/269	175/181	238/244	164/214	302/318	144/150
(11)	254/293	159/187	238/252	184/204	298/322	138/150
(12)	278/278	165/215	220/228	174/206	298/322	144/150
(13)	254/254	165/219	238/242	-	302/358	141/150
(14)	251/269	147/173	-	194/236	314/324	147/162
(17)	260/269	177/185	226/232	172/218	-	144/150
(18)	299/299	213/213	226/244	186/220	302/352	141/144
(19)	245/272	173/173	234/236	180/218	366/366	141/147
(20)	239/272	147/165	232/246	196/222	258/338	147/147
(21)	266/308	153/159	-	200/212	298/306	147/150
(25)	260/260	153/219	228/238	190/190	298/308	138/150
(26)	275/275	177/181	-	-	-	138/147
(27)	251/317	177/181	226/244	204/208	298/306	-
(28)	263/266	157/215	220/240	204/210	352/356	138/138
(29)	266/266	177/177	222/242	-	362/368	138/147
(30)	239/254	167/177	206/240	208/218	-	141/147
(31)	242/272	165/173	206/242	174/216	284/360	147/150
(32)	263/326	181/213	238/238	-	300/308	141/150
(33)	266/275	165/167	242/244	178/212	340/368	-

(continued)

Sample	Genotype					
	CSCUPmo1	CSCUPmo2	CSCUPmo4	CSCUPmo6	CSCUPmo9	CSCUPmo11
(34)	239/263	157/217	240/246	-	-	141/147
(35)	263/272	213/213	-	-	312/322	138/147
(36)	254/272	-	246/254	-	-	-
(37)	278/323	165/169	238/254	-	-	-
(38)	236/290	165/177	240/242	-	-	-
(39)	239/254	177/179	220/236	-	-	-
(40)	260/260	153/179	234/246	-	-	-
(42)	302/302	153/169	-	-	-	-
(43)	284/287	173/213	-	-	-	-
(44)	239/314	147/151	-	-	-	-

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III Genotypes of *P. monodon* individuals from Chumporn province at six microsatellite loci

Sample	Genotype					
	CSCUPmo1	CSCUPmo2	CSCUPmo4	CSCUPmo6	CSCUPmo9	CSCUPmo11
(4)	263/290	147/167	228/238	210/210	296/346	138/147
(5)	218/284	163/165	226/236	176/214	302/322	135/153
(6)	242/284	153/157	232/238	-	340/364	138/153
(8)	266/266	147/217	194/212	194/212	296/304	135/144
(9)	239/275	153/153	228/230	216/216	288/340	138/147
(10)	272/272	151/157	226/228	206/216	274/274	147/153
(11)	248/272	167/175	236/238	192/210	-	138/156
(12)	236/308	153/175	206/232	-	294/294	147/150
(13)	299/323	181/181	-	-	294/296	144/147
(14)	254/317	-	-	218/218	-	147/150
(15)	296/296	147/175	236/238	176/200	322/330	147/150
(16)	233/266	-	236/240	182/210	294/358	144/147
(17)	257/260	179/179	230/232	184/184	298/356	141/141
(18)	269/281	147/189	240/240	176/208	276/360	144/150
(21)	296/323	153/161	226/240	176/176	288/380	135/141
(22)	236/290	153/169	210/240	186/212	262/360	135/147
(24)	251/278	153/153	238/238	194/216	310/378	135/138
(25)	311/311	153/165	232/238	216/218	-	141/153
(26)	284/314	153/157	236/240	212/234	286/338	138/138
(29)	239/296	153/161	230/238	194/208	308/312	147/156
(30)	257/326	177/203	246/252	216/216	306/306	147/150
(31)	248/302	171/181	230/242	174/208	306/306	141/147
(32)	251/302	171/181	234/244	174/208	290/304	144/147
(33)	257/302	169/173	230/238	210/210	296/296	141/147
(34)	242/272	167/175	-	-	296/324	144/147

(continued)

Sample	Genotype					
	CSCUPmo1	CSCUPmo2	CSCUPmo4	CSCUPmo6	CSCUPmo9	CSCUPmo11
(35)	263/272	181/181	-	-	304/326	138/147
(36)	242/323	175/203	-	-	312/320	-
(37)	275/308	167/213	-	-	340/374	-
(38)	266/305	169/185	-	-	-	-
(39)	251/251	175/177	-	-	-	-
(40)	251/257	147/165	-	-	-	-
(41)	233/332	165/167	-	-	-	-
(42)	263/263	173/207	-	-	-	-
(43)	275/293	207/211	-	-	-	-
(44)	269/281	147/177	-	-	-	-
(45)	266/266	177/217	-	-	-	-
(46)	260/323	161/181	-	-	-	-
(47)	239/287	173/197	-	-	-	-



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Biography

Mr. Pitak Sootanan was born on July 19, 1974 in Saraburi. He graduated with the degree of Bachelor of Science from the Department of Biochemistry at Chulalongkorn University in 1996. He has studied for the degree of Master of Science at the Department of Biochemistry, Chulalongkorn University since 1995.

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