REFERENCES

Agrawal, G.K., Pandey, R.N. and Agrawal, V.P. 1992. Isolation of DNA from *Cheorospondias asillaris* leaves. Biotech. Biodiv. Lett. 2 : 19-24.

APG. 2003. An update of the angiosperm phylogeny group classification for the orders and families of flowering plants: APG II. Botanical Journal of the Linnean Society 141 : 339-436.

Baldwin, B.G., Sanderson, M.J., Porter, J.M., Wojciechowski, M.F., Campbell, C.S. and Donaghue, M.J. 1995. The ITS region of nuclear ribosomal DNA: a valuable source of evidence on angiosperm phylogeny. Annals of the Missouri Botanical Garden 82 : 247-277.

Bân, N.T. 1974a. On the taxonomy of the genus *Goniothalamus* (Blume) Hook.f. et Thoms.(Annonaceae). II. Bot. Zhurn. (Moscow & Leningrad) 59(4) : 547-555.

Bân, N.T. 1974b. On the taxonomy of the genus *Goniothalamus* (Blume) Hook.f. et Thoms. (Annonaceae). II. Bot. Zhurn. (Moscow & Leningrad) 59(5) : 660-672.

Bentham, G. and Hooker, J.D. 1862. Annonaceae. Genera Plantarum 2 : 20-29.

Besendahl, A., Qiu, Y.-L., Lee, J., Palmer, J.D. and Bhattacharya, D. 2000. The cyanobacterial origin and vertical transmission of the plastid $tRNA_{LUE}$ group-I intron. Current Genetics 37 : 12-23.

Blunden, G.A.K. and Jewers, K. 1973. The comperative leaf anatomy of *Goniothalamus andersonii*, *G. macrophyllus*, *G. malayanus* and *G. velutinus*. Botanical Journal of the Linnean Society 67 : 361-376.

Blunden, G.A.K. and Jewers, K. 1974a. The comperative stem and root anatomy of *Goniothalamus andersonii*, *G. macrophyllus*, *G. malayanus* and *G. velutinus* (Annonaceae) from peat swamps of Sarawak. Botanical Journal of the Linnean Society 68 : 209-225.

Blunden, G.A.K. and Jewers, K. 1974b. The morphology and anatomy of the fruit of *Goniothalamus andersonii*. Lloydia 37 : 17-22.

Boerlage, J.G. 1899. Notes sur les Annonacees du Jardin Botanique de Buitenzorg. Icon. Bogor. 1 : 79-208.

Burkill, I.H. 1935. A dictionary of the economic products of the Malay Peninsula. 2 vols. Kuala Lumpur: Ministry of Agriculture and Co-operative.

Bygrave, P.C. 2000. Molecular systematics of Annonaceae Juss. Ph.D. dissertation, University of Reading, Reading, UK.

Chase M.W. et al. 1993. Phylogenetics of seed plants: an analysis of nucleotide sequences from the plastid gene *rbc*L. Annuals of the Missouri Botanical Garden 80 : 528-580.

Chatrou, L.W., Pirie, M.D., Erkens, R.H.J., Niet van der T., Mols, J.B. and Maas, J.W. 2002. Species-level phylogenetics in Neotropical Annonaceae. Annonaceae Newsletter No.14 page15-36.

Chesters, K.I.M. 1955. Some plant remains from the Upper Cretaceous and Tertiary of West Africa. Annals and Magazine of Natural History 12 : 489-504.

Clegg, M.T., Learn, G.H. and Golenberg, E.M. 1991. Molecular evolution of chloroplast DNA. In Evolution at the Molecular Level (eds Selander, R.K., Clark, A.G. and Whittam, T.S.), pp. 135-149. Sinauer associates, Sunderland, MA.

Corlett, R.T. 2004. Flower visitors and pollination in the Oriental (Indomalayan) Region. Biol. Rev. 79 : 497-532.

Corner, E.J.H. 1988. Wayside Trees of Malava. 3rd Edn. Malayan Nature Society, Kuala Lumpur, Malaysia.

Donoghue, M.J. and Doyle, J.A. 1989. Phylogenetic analysis of angiosperms and the relationships of Hamamelidae. Pp. 17-45 in Evolution. systematics and fossil history of the Hamameilidae. vol. 1, ed. P.R. Crane and S. Blackmore, Oxford: Clarendon Press.

Doyle, J.A. and Le Thomas, A. 1994. Cladistic analysis and pollen evolution in Annonaceae. Acta Botanica Gallica 141 : 149-170.

Doyle, J.A. and Le Thomas, A. 1996. Phylogenetic analysis and character evolution in Annonaceae. Bulletin du Museum National d'Histoire Naturelle, 4e serie, Sect. B, Adansonia 18 : 279-334.

Doyle, J.A. and Endress, P.K. 2000. Morphological phylogenetic analysis of basal angiosperm: comparison and combination with molecular data. International Journal of Plant Sciences 16(Supplement) : S121-S153.

Doyle, J.A., Bygrave, P. and Le Thomas, A. 2000. Imbrications of molecular data for pollen evolution in Annonaceae. Pollen and spores: morphology and biology (ed. By M.M. Harley, C.M. Morton and S. Blackmore), pp. 259-284. Royal Botanical Garden, Kew, UK.

Doyle, J.A., Sauquet, H., Scharaschkin, T. And Le Thomas A. 2004. Phylogeny, molecular and fossil dating, and biogeographic history of Annonaceae and Myristicaceae (Magnoliales). International Journal of Plant Sciences 165 : S55-S67.

Ehrendorfer, F., Kendall, F., Habeler, E.E. and Suer, W. 1968. Chromosome numbers and evolution in primitive angiosperm. Taxon 17 : 337-353.

Erkens, R.H.J. 2002. A central America origin for *Guatteria* (Annonaceae) based on 5 chloroplast markers. Annonaceae Newsletter No.14 page16.

Felsenstein, J. 1985. Confidence limits on phylogenies: an approach using the bootstap. Evolution 39 : 783-791.

Francisco-Ortega, J., Park, S.-J., Santos-Guerra, A., Benabid, A. and Jansen R.K. 2001. Origin and evolution of the endemic Macaronesian Inuleae (Asteraceae): evidence from the internal transcribed spacers of nuclear ribosomal DNA. Biological Journal of the Linnean Society 72 : 77-97.

Fries, R.E. 1959. Annonaceae. In Die Naturlichen Pflanzenfamilien Band. 17a II : 1-171. Duncker & Humblot, Berlin.

Gielly, L. and Taberlet, P. 1994. The use of chloroplast DNA to resolve plant phylogenies: noncoding versus *rbcL* sequences. Molecular Biology and Evolution 11 : 768-777.

Hodges, S.A. and Arnold, M.L. 1994. Columbines: A geographically widespread species flock. Proceeding of the National Academy of Sciece (USA) 91 : 5129-5132.

Holmgren, P.K., Keuken, W. and Schofield, E.K. 1981. Index Herbariorum I. Edition 7, Frans A. Stafleu, Utrecht, The Netherlands.

Hutchinson, J. 1923. Contributions towards a phylogenetic classification of flowering plants 2. The genera of Annonaceae. Kew Bulletin 7 : 241-261.

Hutchinson, J. 1964. The genera of flowering plants. Dicotyledons 1. Clarendon Press, Oxford, UK.

Keßler, P.J. A. 1993. Annonaceae, In K. Kubitzki, J.G. Rohwer, and V. Bittrich [eds.], The families and genera of vascular plants. vol. 2, 93-129. Springer-Verlag, Berlin, Germany.

Keßler, P.J. A. 1996. *Goniothalamus majestatis*, a new species of Annonaceae from Sulawesi, Indonesia. Blumea 41 : 27-28.

Kitamura, S. Post-doctoral Student, Hornbill Thailand Project, Mahidol University. Personal communication, 27 April 2006.

Koek_Noorman, J., Van Setten, A.K. and Van Zuilen, C.M. 1997. Studies in Annonaceae XXVI. Flower and fruit morphology in Annonaceae. Their contribution to patterns in cluster analysis. Botanische Jahrbücher für Systematik 119(2) : 213-230.

Kumar, S., Tamura, K. and Nei, M. 2004. MEGA3: Integrated software for Molecular Evolutionary Genetics Analysis and Sequence Alignment. Briefings in Bioinformatics 5:150-163.

Le Thomas, A. 1981a. Ultrastructure characters of the pollen grains of African Annonaceae and their significance for the phylogeny of primitive angiosperm (first part). Pollen Spores 22 : 267-342.

Le Thomas, A. 1981b. Ultrastructure characters of the pollen grains of African Annonaceae and their significance for the phylogeny of primitive angiosperm (second part). Pollen Spores 23 : 5-36.

Maddison, D.R. and Maddison, W.P. 2001. MacClade4: analysis of phylogeny and character evolution. Version 4.03. Sunderland: Sinauer Associates.

Mat-Salleh, K.B. 1989. Ethnobotanical significance of Asiatic Annonaceae. Pp. 80-87 in Malaysian Traditional Medicines, eds. Soepadmo, E., Goh, S.H., Wong, W.H., Din, L.B. and Chuah, C.H. Kuala Lumpur: Institute of Advanced Studies, Universiti Malaya.

Mat-Salleh. K.B. 1993. Revision of the genus *Goniothalamus* (Annonaceae) of Borneo. Michigan State University, 261 pp.

Mat-Salleh, K.B. 2001. New and noteworthy species of Bornean *Goniothalamus* (Annonaceae). Folia Malaysiana 2 : 75-116.

Mat-Salleh, K.B., Lim, J.S.H. and Ratnam, W. 2000. Genetic relatedness between populations of *Goniothalamus umbrosus* J. Sinclair (Annonaceae). Proceeding International Conference on in-situ and ex-situ Biodiversity Conservation in the New Millennium. 19-22 June 2000, Shangri La Tanjung Aru Resort, Kota Kinabalu.

McCarthy, C. 1997. Chromas version 1.45. School of Biomolecular and Biomedical Science, Brisbane, Queensland, Australia.

McCauley, D.E. 1995. The use of chloroplast DNA polymorphism in studies of gene flow in plants. Tree 10 : 198-202.

Meade, C.V. 2000. A systematic revision of the *Uvaria* L. group (Annonaceae) in continental Asia. Ph.D Thesis of the University of Dublin. 311 pp.

Mickevich, M.F. and Ferris, J.S. 1981. The implications of congruence in Menidia. Systematic Zoology 30 : 351-370.

Mols, J.B., Gravendeel, B., Chatrou, L.W., Pirie, M.D., Bygrave, P.C., Chase, M.W. and Keßler, P.J.A. 2004. Identifying clades in Asian Annonaceae: monophyletic genera in the polyphyletic Miliuseae. American Journal of Botany 91 :590-600.

Mols, J.B., Keßler, P.J.A. and Gravendeel, B. 2002. Identifying clades in Asian soursops-molecular phylogeny of *Miliusa* and *Polyalthia* (Annonaceae). Annonaceae Newsletter No.14 page19-20.

Morawetz, W. 1988. Karyosystematics and evolution of Australian Annonaceae as compared with Eupomatiaceae, Himantandraceae and Austrobaileyaceae. Plant Systematic Evolution. 159 : 19-79.

Morton, B.R. and Clegg, M.T. 1993. A chloroplast DNA mutational hotspot and gene conversion in a non-coding region near *rbc*L in the grass family (Poaceae). Current Genetics 24 : 357-365.

Nicholas, K.B. and Nicholas H.J.B. 1997. Genedoc: a tool for editing and annotating multiple sequence alignment. www.psc.edu/biomed/genedoc.

Okada, H. and Ueda, K. 1984. Cytotaxonomical studies on Asian Annonaceae. Plant Systematic Evolution 144 : 165-177.

Pennington, R.T. and Dick, C.W. 2004. The role of immigrants in the assembly of the South American rainforest tree flora. Philosophical Transactions of the Royal Society of London, Series B 359 : 1611-1622.

Perry, L.M. 1980. Medicinal Plants of East and Southeast Asia. Cambridge: MIT Press.

Powell, W.M., Morgante, M. and Andre, C. 1995. Hypervariable microsatellites provide a general source of polymorphic DNA markers for the chloroplast genome. Current Biology 5 : 1023-1029.

Qiu, Y.L., Lee, J., Bernasconi-Quadroni, F., Soltis, D.E., Soltis, P.S., Zanis, M., Zimmer, E.A., Chen, Z., Savolainen, V. and Chase, M.W. 2000. Phylogeny of basal angiosperm: analysis of five genes from three genomes. International Journal of Plant Sciences 161. Supplement 6 : 3-27.

Quandt, D., Muller, K., Stech, M., Fraham, J.-P., Frey, W., Hilu, K. And Borsch, T. 2004. Molecular evolution of the chloroplast *trn*L-F region in land plants. Annals of the Missouri Botanical Garden 13-37.

Richardson, J.E., Chatrou, L.W., Mols, J.B., Erkens, R.H.J. and Pirie, M.D. 2004. Historical biogeography of two cosmopolitan families of flowering plants: Annonaceae and Rhamnaceae. Philosophical Transactions of the Roval Society of London, Series B 359 : 1495-1508.

Ridley, H.N. 1922. The Flora of the Malay Peninsula. L. Reeve&Co., London.

Sambrook, J., Fritch, E.F. and Maniatis, T. 1989. Molecular Cloning a Laboratory Manual 2nd eds. Cold Springs Harbor, New York: Cold Spring Harbor Laboratory Press.

Sang, T., Crawford, D.J. and Stuessy, T.F. 1997. Documentation of reticulate evolution in peonies (*Paeonia*) using internal transcribed spacer of nuclear ribosomal DNA: implications for biogeography and concerted evolution. Proceeding of the National Academy of Sciences (USA) 92 : 6813-6817.

Saunders, R.M.K. 2002. The genus *Goniothalamus* (Annonaceae) in Sumatra. Botanical Journal of the Linnean Society 139 : 225-254.

Saunders, R.M.K. 2003. A synopsis of *Goniothalamus* species (Annonaceae) in Peninsular Malaysia, with a description of a new species. Botanical Journal of the Linnean Society 142 : 321-339.

Sauer, W. and Ehrendirfer, F. 1984. Notes on Karyosystematics of Annonaceae. Plant Systematic Evolution 146 : 47- 55

Sauquet, H., Doyle, J.A., Scharaschkin, T., Borsch, T., Hilu, K.W., Chatrou, L.W. and Le Thomas, A. 2003. Phylogenetic analysis of Magnoliales and Myristicaceae based on multiple datasets: implication for character evolution. Botanical Journal of the Linnean Society 142 : 125-186.

Scharaschkin, T. and Doyle, J.A. 2005. Phylogeny and Historical Biogeography of Anaxagorea (Annonaceae) Using Morphology and Non-Coding Chloroplast Sequence Data. Systematic Botany 30 : 712-735.

Scharaschkin, T. and Doyle, J.A. 2006. Character evolution in Anaxagorea (Annonaceae). American Journal of Botany 93 : 36-54.

Sinclair, J. 1955. A revision of the Malayan Annonaceae. Grad. Bull. Singapore 14 : 149-516.

Sobha, V. and Ramachandran, K. 1979. IOPB chromosome number reports LXVI. Taxon 28 : 269.

Sole de Porta, N. 1971. Algunos generos nuevos de polen procedentes de la Formacion Guaduas (Maastrichtiense-Paleoceno) de Colombia. Studia Geologica Salmanticensia 2 : 133-143.

Soltis, P.S., Soltis, D.E., Zanis, M.J. and Kim, S. 2000. Basal lineages of angiosperms: relationships and imbrications for floral evolution. International Journal of Plant Sciences 161(Supplement) : S97-S107.

Swofford, D.L. 1998. PAUP*: phylogenetic analysis using parsimony. Sinauer Associates, Sunderland, Massachusetts, USA.

Taberlet, P., Gielly, L., Pautou, G. and Bouvet, J. 1991. Unversal primers for amplification of three non-coding regions of Chloroplast DNA. Plant Molecular Biology 17 : 1105-1109.

Van Heusden, E.C.H. 1992. Flowers of Annonaceae: morphology, classification and evolution. Blumea Supplement 7 : 1-218.

Van Setten, A.K. and Koek-Noorman, J. 1992. Fruits and seeds of Annonaceae: morphology and its significance for identification. Bibliotheca Botanica 142 : 1-101.

Walker, G.H.K. 1971. Pollen morphology, phytogeography and phylogeny of the Annonaceae. Contributions from the Gray Herbarium of Harvard University 202 : 1-132.

Wikstrom, N., Savolainen, V. and Chase, M.W. 2001. Evolution of the angiosperms: calibrating the family tree. Proceedings of the Royal Society of London, Biological Sciences 1482 : 2211-2220.

White, T.J., Bruns, T., Lee, S. and Taylor, J. 1990. Amplification and direct sequencing of fungal ribosomal RNA genes for phylogenetics. Pp. 315-322. In PCR protocols: a guide to methods and amplifications eds. M. Innis, D. Gelfand, J. Sninsky and T. White. Academic Press, San Diego, California, USA.

Wyk, R.W. van der and Canright, J.E. 1956. The anatomy and the relationship of the Annonaceae. Tropical Woods 104 : 1-24.

APPENDICES

APPENDIX A

PROTOCOL FOR DNA EXTRACTION OF HERBARIUM SPECIMENS

This is a protocol for DNA extraction from herbarium specimens using a combination of CTAB method (Agrawal et al., 1992) and QIAquick PCR Purification Kit (QIAGEN).

Materials:

1. Pestles and mortars
2. 1.5 µl microcentrifuge tubes
3. CTAB buffer
4. ß-mercaptoethanol
5. Chloroform : isoamylalcohol (24 :1) mixture
6. QIAquick PCR Purification Kit (QIAGEN)
7. Water-bath
8. Liquid nitrogen
9. RNase A (100mg/ml)

Preparation:

1. Preheat CTAB buffer in water-bath to 65°C
2. Set the microcentrifuge tube filled with extraction buffer containing 650 µl CTAB buffer, 20 µl ß-mercaptoethanol and 10 µl RNase A at 65 °C
3. Clean leaf with 70% alcohol, then remove midrib and weigh 50 mg leaf material of each sample

Extraction:

1. Add liquid nitrogen to a pestle containing leaf material and grind to powder with a mortar.

2. Transfer powder to extraction buffer in a microcentrifuge tube, vertex 10 second, and incubate 65 ^{o}C for 3 hours, mixing every 10 minutes.

3. Add 650 µl of Chloroform : Isoamylalcohol mixture, invert gently 5 times and incubate by gently shaking at room temperature. Leave for at least 1½ hours

4. Centrifuge at 10,000 rpm at RT for 10 minutes

5. Transfer supernatant into a new microcentrifuge tube

6. Add 1ml Buffer PB (provided in QIAquick PCR Purification Kit) and mix by pipetting

7. Place a QIAquick spin column in a collecting tube

8. To bind DNA, apply the sample from step 6. to the QIAquick column and centrifuge for 30-60 second

9. Discard flow-through and place the QIAquick column back into the same tube

10. To wash, add 500 µl Buffer PE to the QIAquick column and centrifuge for 30-60 second

11. Discard flow-through and place the QIAquick column back into the same tube. Centrifuge the column for an additional 1 minute

12. Place QIAquick column in a clean microcentrifuge tube

13. To elute DNA, add 30 µl Buffer EB or H_2O to the center of the QIAquick membrane, let the column stand for 1 minute and centrifuge the column for 1 minute

14. DNA is ready to use

APPENDIX B

CHARACTER SCORING FOR MORPHOLOGICAL DATA MATRIX

1. Habit: (0) shrubs or small trees; (1) large trees
2. Indument of young primary shoots: (0) generally glabrous to hairy;
   (1) invariably densely hairy/velutinous
3. Glossiness of leaf lamina (adaxially): (0) matt; (1) nitid
4. Prominence of secondary veins (adaxially):
   (0) impressed to slightly prominent; (1) distinctly prominent
5. Tertiary vein arrangement: (0) reticulate; (1) percurrent
6. Flower position: (0) axillary; (1) (slightly) supra-axillary
7. Occurrence of flower fascicles: (0) absent; (1) present
8. Flower position on branches: (0) young growth only; (1) also older growth
9. Flower position on trunk: (0) not exclusively at base; (1) exclusively at base
10. Number of flowers: (0) solitary (occasionally paired); (1) invariably paired
11. Flower orientation: (0) pendent; (1) erect
12. Flower pedicel length: (0) up to 20 mm maximum; (1) 21-50 mm maximum;
    (2) 51-110 mm maximum
13. Sepal fusion: (0) free; (1) (sometimes) basally connate
14. Sepal venation: (0) indistinct; (1) (sometimes) distinct
15. Sepal refexion: (0) not reflexed; (1) reflexed
16. Outer petal length: (0) up to 45 mm maximum; (1) 50-85 mm maximum;
    (2) over 100 mm maximum
17. Shape of outer petal base: (0) not distinctly clawed; (1) distinctly clawed
18. Indument of basal adaxial region of outer petals:
    (0) glabrous or sparsely hairy; (1) velutinous
19. Shape of inner petals: (0) without extensive contiguous area:
    (1) extensive contiguous area
20. Indument of inner petal (adaxially): (0) glabrous; (1) velutinous; (2) woolly
21. Presence of glabrous basal flanges on inner petal claw:
    (0) absent; (1) present

22. Stamen number per flower: (0) up to 320 maximum; (1) 450-570 maximum
23. Staminal connective shape: (0) truncate; (1) apiculate;
(2) very long apiculate
24. Apiculate staminal connective shape:
(0) not distinctly tapered; (1) distinctly tapered
25. Carpel number per flower: (0) up to 60 maximum; (1) 90-105 maximum
26. Ovary indument: (0) essentially glabrous; (1) hairy
27. Style indument: (0) glabrous; (1) hairy
28. Stigma shape: (0) funnel-shaped or subulate; (1) large, convoluted
29. Stigma indument: (0) (sub-) glabrous; (1) hairy
30. Sepal persistence in fruit: (0) caducous; (1) persistent
31. Monocarp shape: (0) not moniliform; (1) slightly moniliform (when > 2 seeds)
32. Monocarp width: (0) up to 15 mm maximum; (1) 15-25 mm maximum;
(2) 26-30 mm maximum
33. Occurrence of longitudinal ridge on monocarp: (0) absent; (1) present
34. Monocarp ornamentation: (0) smooth; (1) verrucose
35. Pericarp thickness: (0) thin; (1) (medium-) thick
36. Seed width: (0) up to 16 mm maximum; (1) 17-20 mm maximum
37. Seed number per monocarp: (0) 1-2 (-3); (1) 4-5
38. Seed shape around micropyle: (0) not elongated; (1) elongated
39. Indument of seed testa: (0) glabrous; (1) hairy
40. Seed micropylar plug: (0) sunken; (1) flush; (2) protruding
41. Mucilage around seeds: (0) slight; (1) copious
42. Inner petal arrangement: (0) not mitriform; (1) mitriform
43. Stamen septation: (0) aseptate; (1) septate

BIOGRAPHY

Maliwan Nakkuntod was born in Nakhon Ratchasima Province, Thailand, on 7 January 1975. She earned her Bachelor Degree in Science in Biology from the Department of Biology, Faculty of Science, Khon Kaen University, Khon Kaen, in 1995. In 1998, she received her Master of Science Degree in Botany from Department of Botany, Kasetsart University, Bangkok. After graduation, she worked as lecturer at Department of Biology, Faculty of Science, Naresuan University, Phitsanulok. Since June 2001, she pursued her Ph.D. study in Biological Science Ph.D. program, Faculty of Science, Chulalongkorn University, Bangkok.