

REFERENCES

1. Hartley, C.W.S., in *The Oil Palm, Chapter 2*, 2nd edn., Longman, London and New York, 1977, pp.37-76.
2. Blaizot, P., and P.A. Cuvier, *J. Am. Oil Chem. Soc.* 30:586 (1953).
3. Choo, Y.M., *Food and Nutr. Bull.* 15:130 (1994).
4. Oil World Annual, 1992.
5. Oil World 1958 - 2007.
6. Mielke, S., *J. Am. Oil Chem. Soc.* 62: 193 (1985).
7. Goh, E.M., in *Proc. of PORIM Intl.Palm Oil Conf.: Chemistry and Technology*, PORIM Press Kuala Lumpur, 1991, p.269.
8. Tan, B.K., and F.C.H. Oh, *Malaysian Palm Oil Chemical and Physical Characteristics*, PORIM Tech. No. 3, PORIM Press, Kuala Lumpur, 1981.
9. Olson, R.E., D.H. Baker and R. Russell, *Nutr. Rev.* 45:205. Publisher: Springer-Verlag, New York, (1987).
10. Goh, S.H., Y.M. Choo and A.S.H. Ong, *J. Am. Oil Chem. Soc.* 62: 237 (1985).
11. Jacobsberg, B., in *Proc. of 1st MARDI Workshop on Oil Palm Technology*, Kuala Lumpur, Malaysia, 1974, p.48.
12. Gapor, A., K.G. Berger, T. Hashimoto, A. Kato, K. Tanabe, H. Mamuro and M. Yamaoka, in *Proc. of The Int. Conf. on Palm Oil Product Technology in The Eighties*, PORIM Press, Kuala Lumpur, Malaysia, 1981, p.145.
13. Rossell, J.B., B. King and M.J. Downes, *J. Am. Oil Chem. Soc.* 60: 333 (1983).
14. Goh, S.H., H.T. Khor and P.T. Gee, *J. Am. Oil Chem. Soc.* 59: 296 (1982).
15. Goh, S.H., S.L. Tong and P.T. Gee, *J. Am. Oil Chem. Soc.* 61:1597 (1984).

16. Itoh, T., T. Tamura and T. Matsumoto, *J. Am. Oil Chem. Soc.* 50: 122 (1973).
17. Itoh, T., T. Tamura and T. Matsumoto, *J. Am. Oil Chem. Soc.* 50: 300 (1973).
18. Goh, S.H., and P.T. Gee, in *Proc. of Priocchem. Asia 1984 Chemical Conference*, Kuala Lumpur, Malaysia. Organised by Malaysian Institute of Chemistry, 1984, p.507.
19. Gee, P.T., *Selected Minor Constituents of Palm Oil*. Ph.D. Thesis, University of Malaya, Kuala Lumpur, Malaysia, 1985.
20. Bauernfeind, J.C., in *Carotenoids as Colorants and Vitamin A Precursors*, Academic Press, New York, (1981).
21. Ong, A.S.H., and E.S. Tee, in *Methods in Enzymology*, Vol. 213, *Carotenoids: Part A, Chemistry, Separation, Quantitation and Antioxidation*, edited by L. Packer, Academic Press, New York, 1992, pp. 142-167.
22. Patte, H.E., and A.E. Purcell, *J. Amer. Oil Chem. Soc.* 46: 629 (1969).
23. Harold, E.P., and A.E. Purcell, *J. Amer. Oil Chem. Soc.* 44:328 (1967).
24. Froehling, P.E., G. Van Den Bosch and H.A. Boekenoogen, *Lipids* 7:447 (1972).
25. Zonta, F., and B. Stancher, *Riv. Ital. Sostanze Grasse* 64:53 (1987).
26. Minguez-Mosquera M.I., and J.Garrido-Fernandez, *Grasas Y Aceites (Seviller)*, 37:337 (1986).
27. Demchenko, A.I., Izv. Vyssh. cheb. Zaved., *Pishch Tekhnol.* 5:18 (1969).
28. Tan, B., *J. Am. Oil Chem. Soc.* 66:770 (1989).
29. Tan, B., in *Proc. of the 1987 Intl. Oil Palm/Palm Oil Conf: Tech. Progress and Prospects*, edited by A.S.H. Ong, PORIM Press, Kuala Lumpur, Malaysia, 1988, p.370.
30. Maycock, J.H., in *Palm oil Critical Reports on Applied Chemistry*, Vol. 15, edited by F. D. Gunstone, John Wiley & Sons, New York, 1987, p.29.

31. Young, F.V.K., in *Palm Oil Critical Reports on Applied Chemistry, Vol. 15*, edited by F. D. Gunstone, John Wiley & Sons, New York, 1987, p.29.
32. Wackenroder, H., *Mag. Pharm.* 33:144 (1831).
33. Castillo, R., G. Negre-Sadargues and R. Lenel, in *Carotenoid Chemistry and Biochemistry*, edited by G. Britton and T.W. Goodwin, Pergamon, Oxford, 1982, pp.211-214.
34. Simpson, K.L., *Proc. Nutr. Soc.* 42:7 (1983).
35. Bauernfeind, J.C., C.R. Adams and W.L. Marusich, in *Carotenoids as Colorants and Vitamin A Precursors*, edited by J.C. Bauernfeind, Academic Press, New York, 1981, pp.564-573.
36. Straub, O., in *Key to Carotenoids*, Birkhauser, Basel (1976).
37. Britton, G., *Terpenoids Steroids* 11:133 (1982).
38. Clough, J.M., and P.G. Pattenden, *J.C.S. Chem-Commun.* 616:619(1979).
39. Zechmeister, L., in *Cis-trans isomeric carotenoids, vitamin A and arylpolyenes*, Springer-Verlag, Wein (1962)
40. Isler, O., in *Carotenoids*, Birkhauser, Basel, 1971, p.55.
41. Pfander, H., in *Key To Carotenoids*, 2nd edn., Brikhauser Basel. 1987.
42. Spurgeon, S.L., and J.W. Porter, in *The Biochemistry of Plants*, edited by P.K. Stumpf and E.E. Conn, Academic Press, New York, Vol. 4, 1980, pp. 419-483.
43. Goodwin, T.W., in *The Biochemistry of the Carotenoids, Vol. 2, Animals*, 2nd edn., Chapman & Hall, London (1976).
44. Goodwin, T.W., in *Plant Pigments*, Academic Press, San Diego (1988).
45. Rodriguez-Amaya, D.B., *Dev. Food Sci.* 33:547 (1993).
46. Davies, B.H., in *Chemistry and Biochemistry of Plant Pigments*, edited by T.W. Goodwin, Academic Press, London, 2nd edn., Vol. 11, p. 38 (1976).

47. Moss, G.P., and B.C.L. Weedon, in *Chemistry and Biochemistry of Plant Pigments*, edited by T.W. Goodwin, Academic Press, London, 2nd edn., 1976 pp. 149-224.
48. Isler, O., H. Lindlar, M. Montavon, P. Rueqq and P. Zellar, *Helv. Chim. Acta* 39:249 (1956).
49. Vetter, W., G. Englert, N. Rigassi and U. Schiwieter, in *Carotenoid*, edited by O. Isler, Basle, Birkhauser, 1971, p.189.
50. Bart, J.C.J., and C.H. McGillavry, *Acta Cryst.*, B24:1569 (1968).
51. Frank, H.A., *Ann. N. Y. Acad. Sci.* 691:1 (1993).
52. Munzel, K., in *Carotenoids as Colorants and Vitamin A Precursor*, edited by J.C. Bauernfeind, Academic Press, New York., 1981, p.564.
53. Mathews-Roth, M.M., *Pure Appl. Chem.* 57:7171 (1985).
54. Britton, G., and T.W. Goodwin, *Phytochemistry* 14:2530 (1971).
55. Mathews-Roth, M.M., in *photomedicine, Vol 11*, edited by E. Ben-Hur and Rosenthal, CRC Press, Boca Raton, Fla. (1987).
56. Temple, N.J., and T.K. Basu, *Nutr. Res.* 8:685 (1988).
57. Bendich. A., *Pure App. Chem.* 66:1017 (1994).
58. Peto, R., R. Doll, D. Buckley and M.B. Sporn, *Nature* 290:201 (1981).
59. Arroyave, G., C.O. Chichester, H. Flores, J. Glover, L.A. Mejia, J.A. Olson, K.L. Simpson and B.A. Underwood, in *Biochemical Methodology for the Assessment of Vitamin A status, A report of the International Vitamin A Consultative Group (IVACG)* Washington, 1982, pp.77-84.
60. Petyayer, M.M., M.V. Katsman, A.N. Rozanova, V.S. Skotnikov, O.V. Urnesheva and A.L. Yakobchukov, *Biophysics* 22:682 (1977).
61. Britton, G., and T.W. Goodwin, in *Method in enzymology*, edited by D.B. McCormick and Wright, Academic Press, New York, Vol. 18C, 1971, pp 654 - 701.

62. DeRitter, E., and A.E. Purcell, in *Carotenoids as colorants and Vitamin A Precursors*, edited by J.C. Baurnfeind, Academic Press, New York, 1981, pp 815 - 882.
63. Taylor, R.F., in *Advances in Chromatography*, edited by J.C. Giddin, E. Grushka, J. Cages and P.R. Brown, Dekker, New York, Vol 22, 1983, pp 157 - 213.
64. Britton, G., in *Methods in Emzymology, Steroids and Isoprenoids*, edited by J.H. Law and H.C. Rilling, Academic Press, New York, Vol. 111B, 1985, pp.113 - 149.
65. Liaaen-Jensen, S., in *The Carotenoids*, edited by O. Isler, Birkhauser Verlag, Basel, 1971, p 61.
66. Britton, G., *Methods Enzymol.* 111:113 (1985).
67. Pattes, H.E., and A.E. Purcell, *J. Amer. Oil Chem. Soc.* 44:328 (1966).
68. Halery, G., H. Kath and K. Guggenheim, *Brit. J. Nutr.* 11:409 (1957).
69. Curl, A.L., *J. Argic. Food Chem.* 1:456 (1953).
70. Francis, G.W., and Isaksen, *Chromatographia*, 272:549 (1989).
71. Tswett, M., *Ber. Deutch. Bot. Ges.* 24:384 (1906).
72. Kuhn, R., and E. Ledeser, *Hoppe - Seyler's Z. Physiol. Chem.* 200 :108 (1931).
73. Zechmeister, L., and L. Cholnoky, *Ann. Chem.* 509:269 (1934).
74. Strain, H.H., *J. Am. Chem. Soc.* 63:3542 (1941).
75. Strain, H.H., and W.A. Svec, *Adv. Chromatogr.* 8:119 (1969).
76. Sadowski, R., and W. Wojcik, *J. Chromatogr.* 262:455 (1983).
77. Randerath, K., in *Thin Layer Chromatography*, Academic Press, (1963).
78. Stahl, E., in *Thin Layer Chromatography. A Laboratory Handbook*, 2nd edn., Springer, Berlin (1967).
79. Bobbit, J.M., in *Thin Layer Chromatography*, Reinhold, New York, 1963.

80. Taylor, R.F., and M. Ikawa, *Methods Enzymol.* 67:233 (1980).
81. DeLeenheer, A.P., H.J. Nelis, W.E. Lambert and R.M. Bauwens, *J. Chromatogr.*, 429:3 (1988).
82. Stewart, I., and T.A. Wheaton, *J. Chromatogr.* 55:325 (1971).
83. Lambert, W.E., H.J. Nelis, M.G.M. DeRuyter and A.P. De Leenheer, in *Modern Chromatographic Analysis of the Vitamins*, edited by A.P. DeLeenher, W.E. Lambert and M.G.M. DeRuyter, Marcel Dekker, New York, 1985, p.1.
84. Fiiksdahl, A., J.T. Mortensen, and S. Liaaen-Jensen, *J.Chromatogr.* 157:111 (1978).
85. Englert, G., and M. Vecchi, *Helv. Chim. Acta* 63:1711 (1980).
86. Braumann, T., and L.H. Grimme, *Biochim. Biophys. Acta* 637:8 (1981).
87. Tyczkowski, J., J.L. Schaeffer, C. Parkhurst and P.B. Halmilton, *Poult. Sci.* 65:2135 (1986).
88. Nelis, H.J.C.F., and A.P. DeLeenheer, *Anal. Chem.* 55:270 (1983).
89. Furr, H.C., A.B. Barua and J.A. Olson, in *Modern Chromatographic Analysis of Vitamins*, edited by A.P. Leenheer, W.E. Lambert, H.J. Nelis, Marcel Dekker Inc., New York, (1992).
90. Nierenberg, D.W., *J. Chromatogr.* 339:273 (1985).
91. Tee, E.S., C.L. Lim and Y.H. Chong, *Int. J. Food Sci. Nutr.* 45:147 (1994).
92. Bieri, J.E., E.D. Brown and Jr. Smith, *J. Liquid Chromatogr.* 8:473 (1985).
93. Stancher, B., F. Zonta and P. Bogoni, *J. Micronutri. Anal.* 3:97 (1987).
94. Packer, R.S., *J. Nutr.* 119:101 (1989).
95. Culling-Berglund, A.J., S.A. Newcomb, M. Gagne, W.S. Mortitt and T.P. Davis, *J. Micronutr. Anal.* 5:139 (1989).
96. Chen, T.M., and B.H. Chen, *Chromatographia* 39:346 (1994).

97. Mairanovsky, V.G., A.A. Engoratov, N.T. Ioffe and G.I. Samokhvalov, *J. Electroanal. Chem.* 66:123 (1975).
98. Khachik, F., G.R. Beecher and W.R. Lusby, *J. Agric. Food Chem.* 37:1465 (1989).
99. Judah, M., et al., *Ind. & Eng. Chem.* 46:2262 (1954).
100. Mann, T.B., *German Pat.* 806.808 (1951).
101. Barnett, H.M., *U.S. Pat.* 2412707 (1946).
102. Barnett, H.M., *U.S. Pat.* 1988031 (1935).
103. Tabor, J.M., et. al., *U.S. Pat.* 2440029 (1948).
104. Tabor, J.M., et al., *U.S. Pat.* 2461300 (1949).
105. Imhoffman, H.H. and F. Bohlmann, *U.S. Pat.* 2671 112 (1954).
106. Ryozo, I., and M. Michiaki, *INFORM* (3)2:210 (1992).
107. Schlipalices, L.E., *Food Australia*, May 742 (1989)
108. Knafo, G., *Bull. Mens. Inst. Tech. Etudes et recherches gras*, 6:323 (1952).
109. Ong, A.S.H., and P.L. Boey, *British Pat.* 1562794 (1980).
110. Unilever Ltd., *British Pat.* 691924 (1953).
111. Desai, B.J., and P.J. Dubash, *J. Food Sci. Technol.* 31:60 (1994).
112. Mamuro, H., Y. Kubota and H. Shiina, *Japan Pat.* 61282357 (1986).
113. Tanaka, Y., I. Hama, A. Oishida and A. Okabe, *British Pat.* 2160874 A (1986).
114. Passino, H.J., *U.S. Pat.* 2615927 (1952).
115. Ooi, T.L., A.S.H. Ong, Y. Mamuro, W. Kubota, H. Shinna and S. Nakasato, *Japan Oil Chem. Soc.* 35: 543 (1986).
116. Sonntag, N.O.V., *J. Am. Oil Chem. Soc.* 61: 229 (1984).

117. Choo, Y.M., A.S.H. Ong, K.Y. Cheah and A. Bakar, *Australian Pat.* 626014 (1992).
118. Choo, Y.M., S.H. Goh and A.S.H. Ong, *U.K. Pat.* 2218989 (1992).
119. Hara, N., I. Hama, H.A. Izumimoto and Nakamura, *Japan Pat.* 6305074 (1988).
120. Choo, Y.M., and Ab. Gapor Md. Top, *Palm Oil Development*, 14: 39 (1991).
121. Foote, C.S., R.W. Denny, L. Weaver, Y. Chong and J. Peters, *Ann N. Y. Acad. Sci.* 171:139 (1970).
122. DiMascio, P., S. Kaiser and H. Sies, *Arch. Biochem. Biophys.* 279:532 (1989).
123. Palozza, P., and N.I. Krinsky, *Carotenoids (part A)*, in *Method in Enzymology*, edited by L. Packer, Academy Press Inc., London, Vol. 213, 1992, p. 403. (1992).
124. Lieble, D., in *Carotenoids in Human Health*, edited by L.M. Canfield, N.I. Krinsky and J.A. Olson, New York Academic of Science, 1993, p.20.
125. Yamamoto, Y., S. Haga, E. Niki and Y. Kamiya, *Bull. Chem. Soc. Jpn.* 57:1260 (1984).
126. Stocker, R., Y. Yamamoto, A.F. MC.Donagh, A.N. Glazer and B.N. Ames, *Science* 235:1043 (1987).
127. Cabrini, L., P. Pasquali, B. Tadolini, A.M. Sechi and L. Landi, *Free Radical Res. Common.* 2:85 (1986).
128. Vile, G.F., and C.C. Winterbourn, *Biochem. Pharmacol.* 37:2893 (1988).
129. Halevy, O., and D. Sklan, *Biochim. Biophys. Acta* 918:304 (1987).
130. Yamane, T., and A.A. Lamola, in *Proc. Annu. Meet., Am. Soc Photobiol.*, 1st abstr. MAMBIO (1973).
131. Lux-Nevwirth, O., and T.J. Millar, *Curr. Eye Res.* 9:103 (1990).
132. Kunnert, K.J., and A.L. Tappel, *Lipids* 18:271 (1983).
133. Zamora R., F.J. Hidalgo and A.L. Tappel, *J. Nutr.* 121:50 (1991).

134. Alam, S.Q., and B.S. Alam, *J. Nutr.* 113:2608 (1983).
135. Lomnitski, L., M. Bergman, I. Schoii and S. Grossman, *Biochim, Biophys. Acta* 1082:101 (1991).
136. Leibovitz, B., M.L. Hu and A.L. Tappel, *J. Nutr.* 120:97 (1990).
137. Mayne S.T., and R.S. Parker, *Nutr. Cancer* 12:225 (1989).
138. Weitberg, A.B., S.A. Weitzman, E.P. Clark and T.P. Stossel, *J. Clin. Invest.* 75:1835 (1985).
139. Kellogg E.W., and I. Fridovich, *J. Biol. Chem.* 250:8812 (1975).
140. Miki, W., *Pure Appl. Chem.* 63:141 (1991).
141. Dixit, R., H. Mukhtar and D.R. Bickers, *J. Invest. Dermatol.* 81:369 (1983).
142. Kim (Jun), H., *Korean J. Nutr.* 23:434 (1990).
143. Krinsky, N.I., and S.M. Deneke, *J. Natl. Cancer Inst.* 69:205 (1982)
144. Searle, A.J.F., and R.L. Willson, *Biochem. J.* 212:549 (1983).
145. Kurashige, M., E. Okimasu, M. Inove and K. Utsumi, *Physiol. Chem. Phys. Med. NMR* 22:27 (1990).
146. Krinsky, N.I., *Free Radical Biol. Med.* 7:617 (1989).
147. Kennedy, T. A., and D. C. Liebler, *J. Biol. Chem.* 267:4658 (1992).
148. Burton, G.W., and K.U. Ingold, *Science* 224:569 (1984).
149. Burton, G.W., *J. Nutr.* 119:109 (1989).
150. Krinsky, N.N., in *Carotenoids*, edited by O. Isler, Birkhauser Verlag, Basel, 1971, pp. 699-716.
151. Mathis, P., and C.C. Schenck, in *Carotenoid Chemistry and Biochemistry*, edited by G. Britton and T.W. Goodwin, IUPAC, Pergamon Press, Oxford, 1982, pp.339-351.

152. Thommem, H., in *Carotenoids*, edited by O. Isler, Birkhaeuser, Basel, 1971, p.637.
153. Bauernfeind, J.C., *J. Agric. Food Chem.* 20:456 (1972).
154. Lakshmann, M.R., N. Chansang and J. Olson, *J. Lipid Res.* 13:477 (1972).
155. Glover, J., and E.R. Redfearn, *Biochem. J.* 58 XV (1954).
156. Glover, J. *Vitams. Horm.* 18:371 (1960).
157. Krinsky, N.I., X.D. Wang, G. Tang and R.M. Rusell, *Ann. N. Y. Acad. Sci.* 691:167 (1993).
158. Ganguly, J., and P.S. Sastry. *Wld. Rev. Nutr. Diet* 45:198 (1985).
159. Zachman, R.D., and J.A. Olson, *J. Biol. Chem.* 238:541 (1965).
160. Scott, M.L., in *Nutrition of Human and Selected Animal Species*, John Wiley & Sons, New York, 1986, p.123.
161. Sistrom, W.R., M. Griffith and R.Y. Stanier, *J. Cell. Comp. Physiol.* 48:473 (1956).
162. Mathews-Roth, M.M., M.A. Pathak, T.B. Fitzpatrick, L.C. Harber and E.H. Kass, *J. Am. Med. Assoc.* 228:1004 (1974).
163. Thomsen, K., H. Schmidt and A. Fisher, *Dermatologica* 159:82 (1979).
164. Sneddon, I.B., *Proc. R. Soc. Med.* 67:593 (1974).
165. Baart de la Faille, H., and J.J. Remme, *Br.J. Dermatol.* 101:224 (1979).
166. Schwartz, J., D. Suda and G. Light, *Biochem. Biophys. Res. Comm.* 136:1130 (1986).
167. Schwartz, J., and G. Shklar, *J. Oral Maxillofac. Surg.* 45:510 (1987).
168. Tomita, Y., K. Hlmeno, K. Nomoto, H. Endo and T. Hirohata, *J. Natl. Cancer Inst.* 78:679 (1987).
169. Seifter, E., G. Rettura, J. Padawer, F. Stratford, P. Goodwin and S.M. Levenson, *J. Natl. Cancer Inst.* 71:409 (1983).

170. Schwartz, J., and G. Shklar, *Nutr. Cancer* 11:35 (1988).
171. Bendich, A., *Clin. Nutr.* 7:113 (1988).
172. Alexander, M., H. Newmark and R.G. Miller, *Immunol. Lett.* 9:221 (1985).
173. Gaby, S.K., and V.N. Singh, in *Vitamin Intake and Health, A Scientific Review*, edited by S.K. Gaby, A. Bendich, V.N. Singh and L.J. Machlin, Marcel Dekker Inc., New York, 1991, pp.29-47.
174. Davison, A., E. Rousseau and B. Dunn, *Can. J. Physiol. Pharmacol.* 71:732 (1993).
175. Blot, et al. *J. Natl. Cancer Inst.* 85:1483 (1993).
176. Nomura, A.M., G. Stemmermann, L.K. Heilbrun, R.M. Salkeld and J.P. Vuilleumier, *Cancer Res.* 45:2369 (1985).
177. Wald, N.J., S.G. Thompson, J.W. Densem, J. Boreham and A. Bailey, *Br. J. Cancer* 57:428 (1988).
178. Mettlin, C., *Int. J. Cancer* 43:608 (1989).
179. LeMarchand, L., C.N. Yoshizawa, L.N. Kolonel, J.H. Hankin and M.T. Goodman, *J. Natl. Cancer Inst.* 81:1158 (1989).
180. Shekelle, R., S. Liu, W. Raynor, M. Lepper, C. Maliza, A. Rossof, O. Paul, A. Shryock and J. Stamler, *Lancet* 2:1185 (1981).
181. Rusell-Briefel, R., M.W. Bates and L.H. Kuller, *Am. J. Epidemiol.* 122:741 (1985).
182. Davies, C., E. Brittain, D. Hunninghake, K. Graves, M. Buzzard and H. Tyroler, *Am. J. Epidemiol.* 118:445 (1983)
183. Stryker, S., E.A. Stein, L. Kaplan, M. Stampfer, A. Sober and W.C. Willett, *J. Am. Coll. Nutr.* 6:73 (1987).
184. Stryker, W.S., L.A. Kaplan, E.A. Stein, M.J. Stampfer, A. Sober and W.C. Willett, *Am. J. Epidemiol.* 127:283 (1988).

185. Heinonen, O.P., J.K. Huttunen, D. Albanes *et al.*, *N. Engl. J. Med.* 330:1029 (1994).
186. Wylie-Rosett, J.A., S.L. Romney, S. Slagle, S. Wassertheil-Smoller, G.L. Miller, P. Palan, D.J. Lucido and C. Duttagupta, *Nutr. Cancer* 6: 49 (1984).
187. Orr, J.W., K. Wilson, C. Bodiford, A. Cornwell, S.J. Soong, K.L. Honea, K.D. Hatch and H.M. Shingleton, *Am. J. Obstet. Gynecol.* 153:775 (1985).
188. Verreault, R., J. Chu, M. Mandelson and K. Shy, *Int. J. Cancer* 43:1050 (1989).
189. LaVecchia, C., A. Decarli, M. Fasoli and A. Gentile, *Cancer* 57:1248 (1986).
190. Hirayama, T., *Nutr. Cancer* 1:67 (1979).
191. Rohan, T.E., A.J. McMichael and P.A. Baghurst, *Am. J. Epidemiol.* 122:741 (1985).
192. Stich, H.F., W. Stich, M. Rosin and M. Vallejera, *Intl. J. Cancer* 34:745 (1984).
193. Stich, H.F., M.P. Rosin, A.P. Hornby, B. Mathew, R. Sankaranarayanan and M.K. Nair, *Intl. J. Cancer* 42:195 (1988).
194. Colditz, G.A., L.G. Brach, R.J. Lipnick, W.C. Willett, B. Rosner, B.M. Posner and C.H. Hennekens, *Am. J. Clin. Nutr.* 41:32 (1985).
195. Varma, S.D., D. Chand, Y.R. Sharma, J.F. Kuck and R.D. Richard, *Current Eye Res.* 3:3557 (1984).
196. Jacques P.F., S.C. Hartz, L.T. Jr. Chylack, R.B. MacGandy and J.A. Sadowski, *Am. J. Clin. nutr.* 48:152 (1988).
197. Goodwin T.W., in *The Biochemistry of the Carotenoids. Vol. II: Animals*, Chapman and Hall, New York, 1984, pp. 173.
198. Heywood, R., A.K. Palmer, R.L. Gregson and H. Hummler, *Toxicol.* 36:91 (1985).
199. Bendich, A., *Nutr. Cancer* 11:207 (1988).

200. Tamai, H., T. Murata, T. Morinobu, M. Manago, H. Takenaka, K. Hayashi and M. Mino, *Ann. N. Y. Acad. Sci.* 691:239 (1993).
201. Terao, J., *Lipids*, 24:659 (1989).
202. Bockennoogen, H.A., in *Analysis and Characterization of Oils, Fats and Fat Products*, Interscience, New York, Vol.2, 1974, p.648.
203. Tan, B., *Nutr. Res.* 12:5163 (1992).
204. Murakoshi, M., and R. Iwasaki, *Inform* 3:210 (1992).
205. Someya, K., Y. Totsuka, M. Murakoshi, H. Kitaro and T. Miyazawa, *J. Nutr. Sc. Vitaminol* 40:315 (1994).
206. Muller-Mulot, W., *Fette. Seifen. Anstrichmittel* 78:18 (1976).
207. Tan, B., C.M. Grandy and A.M. Gawienowski, *J. Am. Oil Chem. Soc.* 63:1175 (1986).
208. Jose, A.T., B.R-A. Delia, W.E-S. Esteves and F.P. Gerhard, *Fat. Sci. Technol.* 92:222 (1990)
209. Ng, J.H., and B. Tan, *J. Chromatogr.* 26:463 (1988).
210. Bushway, R.J., *J. Agric. Food Chem.* 34:409 (1986).
211. Sweeney, J.P., and A.C. Marsh, *J. Ass. Off. Analyt. Chem.* 53:937 (1970).
212. Tam, T.K., C.S. Lim, G.H. Yeoh and S.C. Ooi, in *Proc. of the Malaysia Int. Agric. Oil Palm Conf.*, edited by D.A. Earp and W. Newall, Kuala Lumpur, Malaysia, 1976, pp.27-38.
213. Serbinova, E.A., M. Tsuchiya, S. Goth, V.E. Kagen and L. Packer, in *Vitamin E in Health and Disease*, edited by L. Packer and J. Fuchs, Marcel Dekker Inc., New York, 1993, p.235.
214. Scott, M.L, in *The Fat-Soluble Vitamins*, edited by H.F. DeLuca, Plenum Press, New York, pp.133-210 (1976)

215. Kato, A., M. Yamaoka, A. Tanaka, K. Komoyama and I. Umezawa, *J. Jpn. Oil Chem. Soc.* 34:375 (1985).
216. Qureshi, A.A., W.C. Berger, D.M. Peterson and C.E. Elson, *J. Biol. Chem.* 261:10544 (1986).
217. Qureshi, A.A., Qureshi, N., *et al.*, *Am. J. Clin. Nutr. Supplement* 53:10215 (1991).
218. Rimm, E.B. et al., *New Eng. J. Med.* 328:1450 (1993).
219. Holub, B.J., F. Sicilia and V.G. Mahadevappa, in *1989 PORIM Int. Palm Oil Dev. Conf.*, PORIM Press, Kuala Lumpur, 5-9 Sept. 1989.
220. Welzel, P., K. Hobert, A. Pontry and T. Mikova, *Tetrahedron Lett.* 24:3199 (1983).
221. Choo, Y.M., A. Gapor and A.S.H. Ong, *Palm Oil Dev.* 14:39 (1991).
222. Moris, C.E., *Food Engineering*, April p.89 (1982).
223. Sidek, B.B., *Oleagineux* 45:559 (1990).
224. Serbinova, E., V. Kagan, D. Han and L. Packer, *Free Rad. Biol. Med.* 10:263 (1991).
225. Khoo, L.E., F. Morsingh and K.Y. Liew, *J. Am. Oil Chem. Soc.* 56:672 (1979).
226. Khor, H. T., unpublished data.
227. Zurcher, K. and H. Hadorn, *Jordian* 79:182 (1979).
228. Ma, A.N., unpublished data.
229. Harman, D., *J. of Gerontology* 12:257 (1957).
230. Duthie, G.G., K.W.J. Wahle and P.T. James, *Nutr. Res. Rev.* 2:51 (1989).
231. Floyd, R.A., in *Free Radical in Biology*, edited by W.A. Pryor, Academic Press, New York, Vol. IV, 1980, pp.187-208.
232. Fridovich, I., in *Free Radicals in Biology*, edited by W. A. Pryor, Academic Press, New York, Vol. IV, 1980, pp.239-277.

233. Mead, J.F., in *Free Radicals in Biology*, edited by W.A. Pryor, Academic Press, New York, Vol. IV, 1980, pp. 52-68.
234. Ames, B.N., *Science* 221:1256 (1983).
235. Neff, W.F., E.N. Finkel and D. Weisleder, *Lipids* 17:780 (1982).
236. Mathis, P., and J. Kleo, *Photochem. Photobiol.* 18:343 (1973).
237. Schauenstein, E., H. Esterbauer and H. Zollner, in *Aldehydes in biological systems : Their Natural Occurrence and Biological Activities*, Pion, London (1977).
238. Esterbauer, H., in *Free Radicals, Lipid Peroxidation and Cancer*, edited by D.C.H. McBrien and T.F. Slater, Academic Press, London, 1982, pp. 101-122.
239. Esterbauer, H., K.H. Cheeseman, M.U. Dianzanni, G. Poli and T.F. Slater, *J. Biochem.* 208:129 (1982).
240. Steinberg, D., S. Parthasarathy, T.E. Carew, J.C. Khoo and J.L. Witztum, *N. Engl. J. Med.* 320:915 (1989).
241. Esterbauer, H., J. Gebicki, H. Puhl and G. Jurgens, *Free Rad. Biol. Med.* 13:341 (1992).
242. Esterbauer, H., M. Dieder-Rotheneder, G. Waeg, G. Striegl and G. Jurgens, *Chem. Res. Toxicol.* 3:77 (1990).
243. Jurgen, G., J. Lang and H. Esterbauer, *Biochim. Biophys. Acta* 875:103 (1986).
244. Esterbauer, H., G. Jurgens, O. Quehenberger and E. Koller, *J. Lipid Res.* 28:495 (1987).
245. Palinski, W., M.E. Rosenfeld, S. Yla-Hertuala, G.C. Gurtner, S.A. Socher, S.W. Butler, S. Parthasarathy, T.E. Carew, D. Steinberg and J.L. Witztum, *Proc. Natl. Acad. Sci. USA* 86:1372 (1989).
246. Haberland, M.E., D. Fong and L. Cheng., *Science* 241:215 (1988).

247. Bold, H.C., A.M. Gown, G. Wolfbauer and A. Chait, *Am. J. Pathol.* 135:815 (1989).
248. Giray, J.I., *J. Am. Oil Chem. Soc.* 55:539 (1978).
249. Gaziano, J.M., J.E. Manson, P.M. Ridker, J.E. Buring and C.H. Hennekens, *Circulation* 80:207 (1990).
250. Bendich, A., L.J. Machlin, O.Scandurra, G.W. Burton and D.M. Wayner, *Adv. Free Radical Biol. Med.* 2:419 (1986).
251. Bendich, A., P.Diapoirro, E. Gabriei and L.J. Machlin, *J. Nutr.* 114:1588 (1984).
252. Willson, R.L., in *Proc. of The Nutr. Soc.* 46:27 (1987).
253. Frei, B., L. England and B.N. Ames, *Proc. Natl. Acad. Sci. USA* 86:6377 (1989).
254. Halliwell, B., and J.M.C. Gutteridge, *Arch. Biochem. Biophys.* 280:1 (1980).
255. Frei, B., T.M. Forte, B.N. Ames and C.E. Cross, *Biochem. J.* 277:133 (1991).
256. Stadtman, E.R., and C.N. Oliver, *J. Biol. Chem.* 266:2005 (1991).
257. Davies, K.J.A., *J.Biol. Chem.* 262:9895 (1987).
258. Halliwell, B., and O.I. Aruoma, *FEBS J.* 281:9 (1991).
259. Murphy, M.E., and J.P. Kehrer, *Biochem. J.* 260:359 (1989).
260. Mathewa-Roth, M., *Nutr. Rep. Int.* 177:419 (1977).
261. Shapiro, S., D. Mott and L. Machlin, *J. Nutr.* 114:1924 (1984).
262. Huang, H.S., and D.S. Gooodman, *J. Biol. Chem.* 240:2839 (1965).
263. Beadle, B.W., O.H.M. Wilder and H.R. Kraybill, *J. Biol. Chem.* 175:221 (1948).
264. Anderson, A.E., D.E. Medin and D.C. Bowden, *Comp. Biochem. Physiol.* 41B:745 (1972).
265. Leong, A.K.C., *Adv. Pediatr.* 34:223 (1987).

266. DeVries-DeMol, E.C., L.N. Went and H.J. Volker-Dieben, *Mod. Prog. Ophthalmol.* 13:349 (1974).
267. Micozzi M.S., E.D. Brown, P.R. Taylor and E. Wolfe, *Am. J. Clin. Nutr.* 48:1061 (1988).
- 267a. McAnally, J.S., *Nature* 210 June 25 1966.
- 267b. Olson, J.A., Vitamin A. Handbook of Vitamins, edited by Machlin, L.J. (2nd edition) Marcel Dekker, Inc. New York, 1986, pg.8.
268. Simpson, K.L., and T.W. Goodwill, *Phytochemistry* 4:193 (1965).
269. Quackenbush, F.W., R.P. Cox and H. Steenbock, *J. Biol. Chem.* 145:169 (1942).
270. Dubouloz, P., G. Pistone and R. Marville, *Bull. Soc. Chim. Biol.* 31:1273 (1949).
271. Hickman, K.C.D., and P.L. Harris, *Adv. Enzymol. Relat. Subj. Biochem.* 6:469 (1946).
272. Furr, H.C., D.A. Cooper and J.A. Olson, *J. Chromatogr.* 378:45 (1986).
273. Woppard, D.C., and H. Indyk, *J. Micronutr. Anal.* 5:35 (1989).
274. Ribaya-Mercado, J.D., J.G. Fox, W.D. Rosenblad, M.C. Blanco and R.M. Russell, *J. Nutr.* 122:1898 (1992).
275. Furr, H.C., A.J. Clifford L.M. Smith and J.A. Olson, *J. Nutr.* 119:581 (1989).
276. Steinbrecher, U.P., J.L. Witztum, S. Parthasarathy and D. Steinberg, *Arteriosclerosis* 7:135 (1987).
277. Hew, N.F. *et al.*, unpublished data.
278. Esterbauer, H., M. Rotheneder, G. Striegl, G. Wang, A. Ashy, *et al.*, *Fat. Sci. Technol.* 91:316 (1989).
279. Hazura, H., Y.M. Choo and S.H. Goh, Paper presented in AOCS Meeting, May 1994, Atlanta, Georgia, USA.

280. Hew, N.F., H.K. Khor, Y.M. Choo, S.F. Yap and S.H. Goh, *Malaysian Journal of Science*, 15:73 (1994).
281. Komiyama, K., K. Iaquka, M. Yamaoka, H. Watanabe, N. Tsuchiya and I. Umezawa, *Chem. Pharm. Bull.* 37:1369 (1989).
282. Serbinova, E.A., and L. Packer, *Food and Nutr. Bull.* 15:138 (1994).
283. Ingold, K.U., V.W. Bowry R. Stocker and C. Walling, *Proc. Natl. Acad. Sci. USA* 90:45 (1993).
284. Chait, A., R.L. Brazg, D.L. Tribble and R.M. Krauss, *Am. J. Med.* 94:350 (1993).
285. Parthasarathy, S., J.C. Khoo, E. Muller, J. Barnett, J.L. Witztum and D. Steinberg, *Proc. Natl. Acad. Sci. USA* 87:3894 (1990).
286. Gey, K.F., E.B. Rimm, M.J. Stampfer, A. Ascherio, E. Giovannucci, G.A. Colditz and W.C. Willet, *New Engl. J. Med.* 328:1450 (1993).
287. Frankel, E.N., J. Kanner, J.B. German, E. Parks and J.E. Kinsella, *The Lancet* 341:454 (1993).
288. Willet, W.C., M.J. Stampfer, *et al.*, *Lancet* 341:581 (1993).
289. Havel, R.J., H.A. Eder and J.H. Bragdon, *J. Clin. Invest.* 34:1345 (1955).
290. Lowry, etc., *J. Biol. Chem.* 193:265 (1927).
291. Folch, J., M. Lees and G.H.S. Stanley, *J. Biol. Chem.* 226:497 (1957).
292. Yamamoto, Y., M.H. Brodsky, J.C. Baker and B.N. Ames, *Anal. Biochem.* 160:7 (1991).
293. Dhariwal, K.R., W.O. Hartzell and M. Levine, *Am. J. Clin. Nutr.* 54:712 (1991).
294. Levine, R.L., D. Garland, C.N. Oliver, etc., *Methods in Enzymology*, 186:464 (1990).

List of Publications

The work presented in this thesis has been published/presented either wholly or in part in the following articles:

- 1 Choo, Y.M., S.C. Yap, A.S.H. Ong, C.K. Ooi and S.H. Goh, *Palm Oil Carotenoids : Chemistry and Technology*. In Proc. of 1989 PORIM Intl.Palm Oil Dev. Conf., 5-9 Sept. 1989, pp. 42-47 K.Lumpur.
- 2 Choo, Y.M., S.C. Yap, A.S.H. Ong, S.H. Goh and C.K. Ooi, *Extraction of Carotenoids from Palm Oil*. In Proc. of AOCS World Conf. of Edible Fats and Oil, 1-6 Oct. 1989 pp. 436-440, Maastricht, The Netherlands.
- 3 Choo, Y.M., A.S.H. Ong and S.C. Yap, *Palm Oil Carotenoids and Degenerative Diseases*. In Intl. Conf. on Antioxidants and Diseases, 26-27 Jan 1990, Berkeley, U.S.A.
- 4 Yap, S.C., Y.M. Choo, C.K. Ooi, A.S.H. Ong and S.H. Goh, *Quantitative Analysis of Carotenes from different Oil Palm Sources*, Elaeis 3:369 (1991).
- 5 Choo, Y.M., S.C. Yap, C.K. Ooi, A.S.H. Ong and S.H. Goh, *Production of Palm Oil Carotenoid Concentrate and its Potential Application in Nutrition*. in UNESCO/COSTAM Workshop on Lipid-Soluble Antioxidants in Biochemistry of Nutrition and Environment Health, 20-22 Sept. 1991, K.Lumpur.
- 6 Choo, Y.M., and S.C. Yap, *Valuable Components from Palm Pressed Fibre*. Paper presented at Seminar on Dev. in Management. 16-17 May 1991 Genting Highlands, Malaysia.
- 7 Choo, Y.M., S.C. Yap, C.K. Ooi, A.S.H. Ong and S.H. Goh, *Production of Palm Oil Carotenoid Concentrate and its Potential Application in Nutrition*. in Lipids Soluble Antioxidants: Biochemistry and Clinical Applications, edited by A.S.H. Ong and L. Packer, Birkhauser Verlay, pp. 243-254 (1992).
- 8 Choo, Y.M., and S.C. Yap, *Composition of Palm Oil Carotenoids by HPLC*. Paper presented at 6th Asian Congress of Nutrition. 16-19 Sept. 1991. K.Lumpur.

- 9 Choo, Y.M., A.N. Ma, S.C. Yap, C.K. Ooi and Y. Basiron, *Production and Applications of Deacidified and Deodorised Red Palm Oil*. Palm Oil Dev. 19:30 (1993).
- 10 Choo, Y.M., C.K. Ooi, S.C. Yap, A.N. Ma and Y. Basiron, *Production of Carotene Enriched Processed Palm Oil*. Paper presented at 1993 PORIM Intl. Palm Oil Congress, Sept. 1993, Kuala Lumpur.
- 11 Ooi C.K., Y.M. Choo, S.C. Yap, A.N. Ma and Y. Basiron, *Production of Palm Oil Carotene Concentrate*. Paper presented at 1993 PORIM Intl. Palm Oil Congress, Sept. 1993, Kuala Lumpur.
- 12 Yap, S.C., Choo, Y.M., N.F. Hew, S.F. Yap, H.T. Khor, A.S.H. Ong and S.H. Goh, *Oxidative susceptibility of LDL from rabbits fed atherogenic diets containing coconut, palm or soybean oils*. Paper presented at 1993 PORIM Intl. Palm Oil Congress, Sept. 1993, Kuala Lumpur.
- 13 Ooi, C.K., Y.M. Choo, S.C. Yap, Y. Basiron and A.S.H. Ong, *Recovery of Carotenoids from Palm Oil*. J.Amer. Oil Chem. Soc. 71:423 (1994).
- 14 Yap, S.C., Y.M. Choo, N.F. Hew, S.H. Goh and S.H. Ong. *Retinol, retinyl esters and carotene distribution in rabbits*. Paper presented in Oil and Fats International Congress' 94. Kuala Lunmpur, Malaysia, 1994