

REFERENCES

1. Barros, A.S., Mafra, I., Ferreira, D., Cardoso, S., Reis, A., Lopes da Silva, J.A., Delgadillo, I., Rutledge, D.N. & Coimbra, M. A. Determination of the degree of methylesterification of pectic polysaccharides by FT-IR using an outer product PLSI regression. *Carbohydrate Polymers*, 2002; 50: 85 – 94.
2. Information center food, Department of Medical Sciences [homepage on the Internet]. 2005 May 24. [Cited 2010 June 10] Lemon peel pectin prevents colon cancer. Available from: <http://www.webdb.dmsc.moph.go.th/>
3. Bosaeus, I. Fibre effects on intestinal functions (diarrhea, constipation and irritable bowel syndrome). *Clinical Nutrition Supplement*, 2004; 1: 33-38.
4. FAO Traditional Food Plants. Food and Nutrition Paper No. 42, Food and Agricultural Organisation of the United Nations, Rome, Italy, 1988: 320 – 324.
5. BeMiller, J. N., Whistler, R. L. & Barkalow, D. G. Aloe, Chia, flaxseed, okra, psyllium seed, quince seed, and tamarind gums. *Industrial Gums Polysaccharide and their Derivative*. San Diago: Academic Press(1993). (pp. 235 – 255).
6. Whistler, R. L. and Conrad, H. E. A crystalline galactobiose from acid hydrolysis of okra mucilage. *J. Am. Chem. Soc.*, 1954; 76: 1673 – 1974.
7. Deters, A. M., Lengsfeld, C. & Andreas., H. Oligo- and polysaccharides exhibited a structure-dependent bioactivity on human keratinocytes in vitro. *J. Ethnopharm.*, 2005; 102: 391 –399.
8. Lengsfeld, C., Titgemeyer, F., Faller, G. & Hensel, A. Glycosylated compounds from okra inhibit adhesion of helicobacter pylori to human gastric mucosa. *J. Agric. Food Chem.*, 2004; 52: 1495-1503.
9. Sengkhamparn, N., Verhof, R., Schols, H.A., Sajjaanantakul, T. & Voragen, A.G.J. Characterisation of cell wall polysaccharides from okra (Abelmoschus

- esculentus (L) Moench). Carbohydrate Research., 2008; 344: 1824 – 1832.
10. Sengkhamparn, N., Sagis, L.M.C., de Vries, R., Schols, H.A., Sajjaananatakul, T., & Voragen, A.G.J. Physicochemical properties of pectin from okra (*Abelmoschus esculentus* (L) Moench). Food Hydrocolloids, 2010; 24: 35 – 41.
 11. Levigne, S., Ralet M.C. & Thibault J.F. Characterisation of pectin extracted from fresh sugar beet under different conditions using as experimental design. Carbohydrate polymer. 2002; 49: 145-53.
 12. Woolfe, M. L., Chaplin, M. F. & Otchere, G. Studies on the mucilage extracted from okra fruits (*Hibiscus esculentus* L.) and baobab leaves (*Adansonia digitata* L.). J. Sci. Food Agric., 1976; 28: 519 – 529.
 13. El-Nawawi, S.A. and Shehata, F.R. Extraction of pectin from Egyptian orange peel. Factors affecting the extraction, Biol. Wastes, 1987; 20(4): 281-290.
 14. Wang, Q., Huang, X., Nakamura, A., Burchard, W. & Hallett, F.R. Molecular characterisation of soybean polysaccharides: an approach by size exclusion chromatography, dynamic and static light scattering methods. Carbohydr. Res., 2005; 34: 2637-2644.
 15. Constantino, A. J., and Romanchick-Cerpovicz, J. E. Physical and sensory measures indicate moderate fat replacement in frozen dairy dessert is feasible using okra gum as a milk-fat ingredient substitute. J. Am. Diet. Assoc., 2004; 104 (Suppl. 2): 44.
 16. Romanchik-Cerpovicz, J.E., Tilmon, R. W. & Baldree, K. A. Moisture retention and consumer acceptability of chocolate bar cookies prepared with okra gum as a fat ingredient substitute. J. Am. Diet. Assoc., 2002; 102: 1301-1303.
 17. Romanchik-Cerpovicz, J. E., Costantino, A. C. & Laura, H. G. Sensory evaluation ratings and melting characteristics show that okra gum is an acceptable milk-fat ingredient substitute. J. Am. Diet Assoc., 2006; 106: 594 - 597.
 18. Aspinall, G.O. Isolation and fractionation of polysaccharides. In G.O. Aspinall (ed.), The Polysaccharides, Volume 1, Academic Press, Inc., New York, 1982: pp. 19.

19. Aspinall, G.O. and Stephen A.M. Polysaccharide methodology and plant polysaccharides, MTP International Review of Science: Organic Chemistry, Series I, Vol. 7, Carbohydrates (G.O. Aspinall, ed.), Butterworths, London, 1973: p. 285
20. BeMiller, J.M.. Acid-catalyzed hydrolysis of glycosides, Adv. Carbohydrate Chemistry, 1967; 22 : 25.
21. Aspinall, G.O. Gums and mucilages, Adv. Carbohydrate Chemistry, 1969; 24: 333.
22. Glicksman, M. Gum Technology in the Food Industry, Academic Press, New York, 1969.
23. Stephen A.M., and Churms, S.C. Gums and mucilages, Food and polysaccharides and their application, Marcel Dekker, New York, 2005: p 378.
24. Glicksman, M. Origin and classification of hydrocolloids, Food Hydrocolloids, Vol.1, CRC Press, Boca Raton, FL, 1982: p 3.
25. EI-Mahdy, A.R. and EI-Sebairy, L.A. Preliminary studies on the mucilages extracted from okra fruits, taro tubers, Jew's mallow leaves and fenugreek seeds, Food chemistry, 1984; 14: 237.
26. Woolfe, M.L., Chaplin, M.F. & Otchere, G. Studies on the mucilages extracted from okra fruits (*Hibiscus esculentus* L.) and baobab leaves (*Adansonia digitata* L.). Journal of Agricultural and food chemistry, 1984; 29: 237.
27. Stauffer, K.R. Gum tragacanth, Handbook of Water-Soluble Gums, McGraw-Hill, New York, 1980; 11.
28. Voragen, A.G.J. and Pilnik, W. Pectins: Food and polysaccharides and their application, Marcel Dekker, New York, 2005: 287 - .
29. Christensen, S.H. Pectins. In Food Hydro colloids, Vol.III, M. Glicksman (Ed.), 1986: 212–213.
30. Brejnholt, S.M. Pectins: Food Stabilisers, Thickeners and Gelling Agents, Alan Imeson (Ed.), FMC BioPolymer, UK, 2007: 237 - .
31. McNeil, M., Darvill, A. & Albersheim, P. The structural polymers of the primary cell walls of dicots. Fortschritte der Chemie Organischer Naturstoffe, 1979; 37: 191–249.

32. Voragen, A., Pilnik,W., Thibault, J., Axelos, M. & Renard, C. Pectins. Food Polysaccharides and Their Applications, A.M. Stephen (ed),. Marcel Dekker, New York, 1995: 287–339.
33. Nussinovitch, A. Hydrocolloid applications: Gum technology in the food and other industries, Blackie Academic & Professional, London, UK, 1977: 86.
34. McCann, M.C. and Roberts, K. Architecture of the primary cell wall. In C.W. Lloyd, ed, The cytoskeletal basis of plant growth and form London: Academic press, 1991:109-129.
35. Pauly, M. and Scheller, H. O-acetylation of plant cell wall polysaccharides: identification and partial characterization of a rhamnogalacturonan O-acetyl transferase from potato suspension-cultured cells. *Planta*, 2000; 210:559–667.
36. Mohnen, D. Biosynthesis of pectins and galactomannas. In: B.M. Pinto (ed), Comprehensive Natural Products Chemistry. Elsevier, Amsterdam, 1999: pp. 497–527.
37. Lin, M.J.Y., Humbert, E.S. & Sosulki, F.W. Extraction of pectin from sunflower heads, *Can. Inst. Food Science Technology*, 1976; 9: 70
38. May, C.D. Industrial pectin: souces, production and applications, *Carbohydrate Polymer*, 1990; 12 :79.
39. Pilnik, W. and Voragen, A.G.J. Gelling Agent (Pectins) from Plants for the Food Industry, *Adv. in Plant Cell Biochem. Biotechnol*, 1992; 1 : 219.
40. Francis, B.J. and Bell, J.M. Commercial pectin: a review, *Trop. Sci*, 1975; 17: 25.
41. Rolin, C. Pectin. In: J. BeMiller and R. Whistler (eds), *Industrial Gums*. Academic Press, New York,1993: 257–293.
42. Morris, E., Gidley, M., Murray, E., Powell, D. & Rees, D. Characterization of pectin gelation underconditions of low water activity, by circular dichroism, competitive inhibition and mechanical properties. *International Journal of Biological Macromolecules*, 1980; 2: 327–330.
43. Oakenfull, D. and Scott, A. Hydrophobic interaction in the gelation of high methoxyl pectins. *Journal of Food Science*, 1984; 49: 1093–1097.

44. Grant, G.T., Morris, E.R., Rees, D.A., Smith, P.J.C. & Thom, D. Biological interactions between polysaccharides and divalent cations: the egg box model. *FEBS Letters*, 1973; 32: 195–198.
45. Thibault, J.F. and Rinaudo, M. Chain association of pectic molecules during calcium-induced gelation. *Biopolymers*, 1986; 25: 455–468.
46. Dische, Z. A new specific color reaction of hexuronic acids. *Journal of Biological Chemistry*, 1947; 167:189-198.
47. Gregory, J.D. The effect of borate on the carbazole reaction. *Arch. Biochem. Biophys*, 1960; 89:157-159.
48. Bitter, T. and Muir, H.M. A modified uronic acid carbazole reaction. *Anal. Biochem*, 1962; 4: 330-334.
49. Galambos, J.T. The reaction of carbazole with carbohydrates. I. Effect of borate and sulfamate on the carbazole color of sugars. *Anal. Biochem*, 1967; 19: 119-132.
50. Blumenkrantz, N. and Asboe-Hansen, G. New method for quantitative determination of uronic acids. *Anal. Biochem*, 1973; 54:484-489.
51. Filisetti-Cozzi, T.M.C.C. and Carpita, N.C. Measurement of uronic acids without interference from neutral sugars. *Anal. Biochem*, 1991; 197: 157-162.
52. Melton, L.D., Smith, B.G. Determination of the Uronic Acid content of Plant Cell Walls Using a Colorimetric Assay. *Food Analytical Chemistry*, 2001; E3.3.1-E3.3.4.
53. Kravtchenko, T.P. and Pilnik, W. A simplified method for the determination of the intrinsic viscosity of pectin solutions by classical viscosimetry, *Gum and Stabilisers for the Food Industry*, 1990; 5: 281.
54. Bociek, S.M. and Welli, D. The quantitative analysis of uronic acid polymer by infrared spectrometry. *Carbohydrate Research*, 1975; 42: 217.
55. Pfeffer, P.E., Doner, L.W., Hoogland, P.D. & McDonald, G.G. Molecular interactions with dietary fiber components. Investigation of the possible association of pectin and bile acid, *J. Agric. Food Chem*, 1981; 29: 455.
56. Cochrane, G.C. Review of the analysis of free fatty acids (C2-C6), *J. Chromatogr. Sci*, 1975; 13:440.

57. Voragen, A.G.J., Schols, H.A. & Gruppen, H. Structural studies of plant cell wall polysaccharides using enzymes, Proceedings Intern. Symp. on Plant Polymeric Carbohydrates, Berlin, July 1-, (F.Meuser, D.J. Mamhers, S. Seibel, eds.), Royal Society of Chemistry, Cambridge, UK, 1993;3-15.
58. Pippen, E.L., McCready, R.M. & Owens, H.S. Determination of acetyl in pectin, *Anal. Chem.*, 1950; 22:1457.
59. Barros, A. S., Mafra, I., Ferreira, D., Cardoso, S., Reis, A., Lopes da Silva J.A., Delgadillo, I., Rutledge, D. N., & Coimbra, M.A. Determination of the degree of methylesterification of pectic polysaccharides by FT-IR using an outer product PLSI regression. *Carbohydrate Polymers*, 2002; 50: 85-94.
60. Gnanasambandam, R., and Proctor, A. Determination of pectin degree of esterification by diffuse reflectance Fourier transform infrared spectroscopy. *Food Chemistry*, 2000; 68: 327-332.
61. Hansen, K. M., Thuesen, A. B., & Soderberg, J. R. Enzyme assay for identification of pectin and pectin derivatives, based on recombinant pectate lyase. *Journal of AOAC International*, 2001; 84(6): 1851-1854.
62. Filippov, M.P. Practical infrared spectroscopy of pectic substances. *Food Hydrocolloids*, 1992; 6(1): 115-142.
63. Manrique, G. D., and Lajolo, F. M. FT-IR spectroscopy as a tool for measuring degree of methyl esterification in pectins isolated from ripening papaya fruit. *Postharvest Biology and Technology*, 2002; 25: 99-107.
64. Dea, I.C.M. and Madden, J.K. Acetylated pectic polysaccharides of sugar beet. *Food Hydrocoll*, 1986; 1: 71.
65. Ministry of Environment and Forests, Department of Biotechnology. Series of Crop Specific Biology Document: Biology of Okra, 2010; 1-2.
66. Hirose, K., Endo, K. & Hasegawa, K. A convenient synthesis of lepidimoide from okra mucilage and its growth-promoting activity in hypocotyls. *Carbohydrate Research*, 2004; 339: 9-19.
67. International Board for Plant Genetic Resources IBPGR. Report on International Workshop on OkraGenetic resources held at the National bureau for Plant Genetic Resources, New Delhi, India, 1990.
68. Nandkarni, K.M. Indian Meteria Medica. Nadkarni and Co Bombay, 1927.

69. Adams, C.F. Nutritive value of American foods in common units, U.S. Department of Agriculture, Agric Handbook, 1975; 425: pp 29.
70. Wu, A.M., Jiang, Y., Hwanga, P.Y. & Shen, F. Characterization of the okra mucilage by interaction with Gal, Ga1NAc and GlcNAc specific lectins. *Biochimica et Biophysica Acta (BBA) - General Subjects*, 1995;1243(2): 157-160.
71. Mishra, A., Yadav, A., Pal, S. & Singh, A. Biodegradable graft copolymers of fenugreek mucilage and polyacrylamide: A renewable reservoir to biomaterials. *Carbohydrate Polymers*, 2006; 65: 58-63.
72. Tomada, M., Shimada, K., Saito, Y. & Sugi, M. Plant mucilages. XXVI. Isolation and structural features of a mucilage, "Okra mucilage", from the immature fruit of *Abelmoschus esculentus*. *Chem. Pharm. Bull.*, 1980; 28: 2933-2940.
73. Gopalan, C., Rama, S.B.V. & Balasubramanian, S. Nutritive Value of Indian Foods, published by National Institute of Nutrition (NIN), ICMR, 2007.
74. Putthama, M. and Temsiri, S. Properties and applications of okra gum powder. Mahodol University, 2008.
75. Baht, U.S. and Tharathan, R.N. Functional properties of okra (*Hibiscus esculentus*) mucilage. *Starch/starke*, 1987; 39: 165-167.
76. Romanchik-Cerpovisz, J., Tilmon, R., & Baldree, K. Moisture Retention and Consumer Acceptability if Chocolate Bar Cookies Prepared with Okra Gum as Fat Ingredient Substitute. *Journal of the American Dietetic Association*, 2002; 102(9) : 1301-1303.
77. AOAC International. AOAC Official Method 990.19 Solids (Total) in Milk, 18th Edition, Chapter 33.2.43. Association of Official Analytical Chemistry, 2006.
78. Arkarapanthu, A., Chavasit, V., Sungpuag, P. & Phuphanaphong, L. Gel extracted from Khrua-ma-noi (*Cyclea barbata* Miers) leaves: chemical composition and gelation properties. *Journal of the Science of Food and Agriculture*, 2005; 85 (10): 1741-1749.
79. Gnanasambandam, R. and Proctor A. Determination of pectin degree of esterification by diffuse reflectance Fourier transform infrared

- spectroscopy - quantitative evaluation of uronic acid and acetamido-deoxyhexose moieties. *Food Chemistry*, 2000; 68(3): 327-332.
80. Chatjigakis, A. K., Pappas, C., Proxenia, N., Kalantzi, O., Rodis , P., & Polission, M. FT-IR spectroscopic determination of the degree of esterification of cell wall pectins from stored peaches and correlation to textural changes. *Carbohydrate Polymers*, 1998; 37: 395-408.
81. Singthong, J., Cui, S., Ningsanond, S. & Goff, H.D. Structural characterization, degree of esterification and some gelling properties of Krueo Ma Noy (*Cissampelos pareira*) pectin. *Carbohydrate Polymers*, 2004; 58 (4): 391-400.
82. Be'douet, L., Courtois, B., Courtois, J. Rapid quantification of O-acetyl and O-methyl residues in pectin extracts. *Carbohydrate Research*, 2003; 338: 379–383.
83. McComb, E.A. and McCready, R.M. Determination of Acetyl in Pectin and in Acetylated Carbohydrate Polymers. *Analytical Chemistry*, 1957; 29(5): 819-821.
84. Migliori, M., Gabriele, D., Checchetti, A. & Battipede, B. Compatibility analysis of pectin at different esterification degree from intrinsic viscosity data of diluted ternary solutions. *Reactive & Functional Polymers*, 2010; 70: 863–867.
85. Chamberlain, E.K. and Rao, M.A. Effect of concentration on rheological properties of acid-hydrolyzed amylopectin solutions. *Food Hydrocolloids*, 2000; 14 (2): 163-171.
86. Ng, W.K., Tam, K.C. & Jenkins, R.D. Evaluation of intrinsic viscosity measurements of hydrophobically modified polyelectrolyte solutions. *European Polymer Journal*, 1999; 35: 1245–1252.
87. Pagan, J., and Ibarz, A. Extraction and rheological properties of pectin from fresh peach pomace. *Journal of Food Engineering*, 1999; 39:193–201.
88. Urias-Orona, V., Rascón-Chu, A., Lizardi-Mendoza, J., Carvajal-Millán, E., Gardea, A.A. & Ramírez-Wong, B. A Novel Pectin Material: Extraction,

- Characterization and Gelling Properties. *Int. J. Mol. Sci.*, 2010; 11: 3686-3695.
89. Fournier, E. Colorimetric Quantification of Carbohydrates. Current Protocols in Food Analytical Chemistry., 2001: E1.1.1-E1.1.8.
90. AOAC 991.42. Insoluble Dietary Fiber in foods and food product, Enzymatic-gravimetric method, phosphate buffer. Official Methods of Analysis of the Association of official Analytical Chemists, 15th ed., 3rd suppl. The Association: Arlington, VA, 1992.
91. Brandrup, J. and Immergut, E.H. Polymer handbook. A Wiley Interscience publication. New York, Wiley, 1975
92. Lih-Shiu, L. and Hui-Yuan, L. Chemical compositions and some physical properties of the water and alkali-extracted mucilage from the young fronds of *Asplenium australasicum* (J. Sm.) Hook. *Food Hydrocolloids*, 2012; 26(2): 344-349.
93. Yujaroen, P., Supjaroenkul, U. & Rungrodnimitchai, S. Extraction of Pectin from Sugar Palm Meat. *Thammasat Int. J. Sc. Tech. Special Edition*, 2008; 13, 44 – 47.
94. Chatshawal, C., Nualkaew, N., Preeprame, S., Porasuphatana, S. & Priprame, A. Physical and Biological Properties of Mucilage from *Basella alba* L. Stem and Its Gel Formulation. *IJPS*, 2010; 6(3): 104 – 112.
95. Mohmai, L. Separation, Quality Control and Health Product Development of Mucilage from Hairy Basil Seeds. Thesis of pharmaceutical, Faculty of graduate studies, Chiang Mai University, 2002.
96. Ameena, K., Dilip, C., Saraswathi, R., Krishnan, P.N, Sankar, C. & Simi, S.P. Isolation of the mucilages from *Hibiscus rosasinensis* linn. and Okra (*Abelmoschus esculentus* linn.) and studies of the binding effects of the mucilages. *Asian Pacific Journal of Tropical Medicine*, 2010; 539 – 543.
97. Thanatcha, R. and Pranee, A. Extraction and characterization of mucilage in *Ziziphus mauritiana* Lam. *International Food Research Journal*, 2011; 18: 201-212.

98. Medina-Torres, L., La Fuente, E.B., Torrestiana-Sanchez, B. & Katthain, R. Rheological properties of the mucilage gum (*Opuntia ficus indica*). *Food Hydrocolloids*, 2000; 14: 417–424.
99. Chen, R.H. and Chen, W.Y. Rheology properties of the water-soluble mucilage of a green laver, *Monostroma nitidum*. *Journal of Applied Phycology*, 2001; 13: 481-488.
100. Shi, X. Q., Chang, K. C., Schwarz, J. G. & Wiesenborn, D. Effect of countercurrent ethanol washing on sunflower pectin quality. *Carbohydrate Polymers*, 1995; 27: 171–175.
101. Paga'n, J., Ibarz, A., Llorca, M., & Coll, L. Quality of industrial pectin extracted from peach pomace at different pH and temperatures. *Journal of the Science of Food and Agriculture*, 1999; 79: 1038–1042.
102. Kumar, R., Patil, M.B., Patil1, S.R. & Paschapur, M.S. Evaluation of *Abelmoschus Esculentus* Mucilage as Suspending Agent in Paracetamol Suspension. *International Journal of PharmTech Research*, 2009; 1(3): 658-665.
103. Wu, A.M., Jiang, Y., Hwang, P.Y. & Shen, F. Characterization of the okra mucilage by interaction with Gal, GalNAc and GlcNAc specific lectins. *Biochimica et Biophysica Acta*, 1995; 1243: 157-160.
104. Oosterveld, A., Beldman, G., Schols, H.A. & Voragen, A.G.J. Arabinose and ferulic acid rich pectic polysaccharides extracted from sugar beet pulp. *Carbohydrate Research*, 1996; 288: 143-153.
105. Duarte, M.L., Ferreira, M.C., Marvão, M.R. & Rocha, J. An optimised method to determine the degree of acetylation of chitin and chitosan by FTIR spectroscopy. *International Journal of Biological Macromolecules*, 2002; 31: 1-8.
106. Lih-Shiu, L. and Hui-Yuan, L., Chemical compositions and some physical properties of the water and alkali extracted mucilage from the young fronds of *Asplenium australasicum* (J. Sm.) Hook. *Food Hydrocolloids*, 2012; 26(2): 344-349.

107. Somboonpanyakul, P., Wang, Q., Cui, W., Barbut, S. & Jantawat, P. Malva nut gum. (Part I): Extraction and physicochemical characterization. *Carbohydrate Polymers*, 2006; 64: 247–253.
108. Urias-Orona, V., Rascón-Chu, A., Lizardi-Mendoza, J., Carvajal-Millán, E., Gardea, A.A. & Ramírez-Wong, B. A Novel Pectin Material: Extraction, Characterization and Gelling Properties. *Int. J. Mol. Sci.*, 2010; 11: 3686-3695.
109. Kurita, O., Fujiwara, T. & Yamazaki, E. Characterization of the pectin extracted from citrus peel in the presence of citric acid. *Carbohydrate Polymers*, 2008; 74(3): 725-730.