

5% level in chocolate) or as coating fats at higher levels of use that give improved viscosity characteristics, improved crystallisation rates, enhanced fat bloom resistance, cool-eating sensations and a host of other processing and consumer benefits. Great strides forward have been made in confectionery fat technology, both in methods of production, and in the understanding of how the triglyceride composition of the vegetable fat relates to the processing characteristics and consumer perception of chocolates and coatings. Undoubtedly further developments will continue to be made in the future ensuring that the vegetable fat which, in many cases, controls the functionality of chocolates and coatings, keeps pace with the demands of both the chocolate manufacturer and consumer.

References and further reading

- Adubofuor, J., Sefah, W., Oldham, J.H. (2013) Nutrient composition of *Allanblackia paviflora* seed kernels and oil compared with some plant fats and oils and application of the oil in soap preparation. *J. Cereals and Oil Seeds* **4**(1), 1–9.
- Ali, A.R., Moi, L.M., Fisal, A., Nazaruddin, R., Sabariah, S. (1998) The application of Borneo tallow in dark chocolate shell. *J. Sci. Food. Agric.* **76**, 285–288.
- Best, R.L., Crossley, A., Paul, S., Pardun, H., Soeters, C.J. (1956) Improvements in or relating to cocoa butter substitutes. GB Patent 827 172.
- Bloomer, S., Adlercreutz, P., Mattiasson, B. (1990) Triglyceride interesterification by lipases. 1. Cocoa butter equivalents from a fraction of palm oil. *J. Am. Oil Chem. Soc.* **67**, 519–524.
- Cain, F.W., Hughes, A.D., Talbot, G. (1995) Chocolate-encapsulated fillings. US Patent 5 385 744.
- Chaiseri, S., Dimick, P.S. (1989) Lipid and hardness characteristics of cocoa butters from different geographic origins. *J. Am. Oil Chem. Soc.* **66**(11), 1771–1776.
- Codex Alimentarius (2001) *Codex Standard for Cocoa Butter*. Codex Stan. 86-1981, Rev. 1-2001.
- Codex Alimentarius (2003) *Standard for Chocolate and Chocolate Products*. Codex Stan. 87-1981, Rev. 1-2003.
- Davis, T.R., Dimick, P.S. (1989) Lipid composition of high-melting seed crystals formed during cocoa butter solidification. *J. Am. Oil Chem. Soc.* **66**(10), 1494–1498.
- European Union (2000) *Directive 2000/36/EC of the European Parliament and of the Council of 23 June 2000 Relating to Cocoa and Chocolate Products Intended for Human Consumption*. European Union, Brussels.
- Favre, T.L.F., Kos, H., Bhagga, K., Fages, S.J. (2010) Process for making a triglyceride composition. International patent application WO 2010/130 395 A1.
- Folayan, J.A. (2010) Nigerian cocoa and cocoa by-products: quality parameters, specification and the roles of stakeholders in quality maintenance. *Pakistan J. Nutr.* **9**(9), 915–919.
- Foubert, I., Vanrolleghem, P.A., Thas, O., Dewettinck, K. (2004) Influence of chemical composition on the isothermal cocoa butter crystallization. *J. Food Sci.* **69**(9), E478–E487.
- Gordon, M.H., Padley, F.B., Timms, R.E. (1979) Factors influencing the use of vegetable fats in chocolate. *Fette Seifen Anstrichmittel*. **81**, 116–121.
- Hemavathy, J., Prabhakar, J.V., Sen, D.P. (1988) Drying and storage behaviour of mango (*Mangifera indica*) seeds and composition of kernel fat. *Asean Food Journal* **4**(2), 59–65.
- Jeffrey, B.S.J., Padley, F.B. (1991) Chinese vegetable tallow – characterisation and contamination by Stillingia oil. *J. Am. Oil Chem. Soc.* **68**(2), 123–126.
- Jurriens, G. (1968) *Analysis and Characterisation of Oils and Fats and Fat Production*, vol. **2** (ed. Boekennoogen, H.A.). Interscience, London.
- Koyano, T., Hachiya, I., Sato, K. (1990) Fat polymorphism and crystal seeding effects on fat bloom stability of dark chocolate. *Food Structure* **9**, 231–240.
- Larsson, K. (1966) Classification of glyceride crystal forms. *Acta Chem. Scand.* **20**, 2255–2260.

- Lipp, M., Anklam, E. (1998) Review of cocoa butter and alternative fats for use in chocolate. Part A. Compositional data. *Food Chem.* **62**(1), 73–97.
- Lovett, P.N. (2015) Shea butter: properties and processing for use in food. In: *Specialty Oils and Fats in Food and Nutrition* (ed. Talbot G.). Woodhead Publishing, Cambridge.
- Macrae, A.R., How, P. (1983) *Interesterification with Lipase Enzymes as Interesterification Catalyst*. International Patent Application WO83/03844.
- Nzikou, J.M., Kimbonguila, A., Matos, L. *et al.* (2010) Extraction and characteristics of seed kernel oil from mango (*Mangifera indica*). *Res. J. of Environmental and Earth Sci.*, **2**(91), 31–35.
- Peschar, R., Pop, M.M., de Ridder, D.J.A., van Mechelen, J.B., Driessen, R.A.J., Schenk, H. (2004) Crystal structures of 1,3-distearoyl-2-oleoylglycerol and cocoa butter in the β (V) phase reveal the driving force behind the occurrence of fat bloom on chocolate. *J. Phys Chem B*, **108**, 15450–15453.
- Peters, J.C., Holcombe, B.N., Fuller, L.K., Webb, D.R. (1991) Caprenin 3. Absorption and caloric value in adult humans. *Int. J. of Toxicology*, **10**, 357–367.
- Ray, J., Nagy, Z.K., Smith, K.W., Bhagga, K., Stapley A.G. (2013) Kinetic study of the acidolysis of high oleic sunflower oil with stearic–palmitic acid mixtures catalysed by immobilised *Rhizopus oryzae* lipase. *Biochem. Eng. J.*, **73**, 17–28.
- Rossell, J.B., King, B., Downes, M.J. (1983) Detection of adulteration. *J. Am. Oil Chem. Soc.* **60**, 333–339.
- Rossell, J.B., King, B., Downes, M.J. (1985) Composition of oil. *J. Am. Oil Chem. Soc.*, **62**, 221–230.
- Shukla, V.K.S., Nielsen, I.C. (1989) Minor tropical tree crops. In: *Tropical Rainforests: Botanical Dynamics, Speciation and Diversity* (eds Holm-Nielsen, L.B., Nielsen, I.C., Balslev, H.). Academic Press, London, ISBN: 0-12-353550-6.
- Siew, W.-L., Ng, W.-L. (1999) Influence of diglycerides on crystallisation of palm oil. *J. Sci. Food Agric.*, **79**(5), 722–726.
- Slager, H., Favre, L., Talbot, G. (2007) The ultimate confectionery coating. *Food Marketing and Technology*, **2007**(December), 12–14.
- Smith, R.E., Finley, J.W., Leveille, G.A. (1994) Overview of Salatrim: a family of low-calorie fats. *J. Agr. Food Chem.*, **42**, 432–434.
- Smith, K.W., 't Zand, I., Talbot, G. (2008) Effect of antibloom fat migration from a nut oil filling on the polymorphic transformation of cocoa butter. *J. Agr. Food Chem.*, **56**, 1602–1605.
- Smith, K.W., Bhagga, K. (2014) The flow properties of chocolate coating at temper: effect of solid fat content. Poster presentation at EuroFedLipid Congress, Montpellier.
- Talbot, G. (2015) Tropical exotic oils: properties and processing for use in food. In: *Specialty Oils and Fats in Food and Nutrition* (ed. Talbot G.). Woodhead Publishing, Cambridge.
- Talbot, G., Bhagga, K. (2010) The “friendly” way to process fats. *Food Marketing and Technology*, **2010**(May), 4–7.
- Tietz, R.A., Hartel, R.W. (2000) Effects of minor lipids on crystallisation of milk fat-cocoa butter blends and bloom formation in chocolate. *J. Am. Oil Chem. Soc.*, **77**(7), 763–771.
- Timms, R.E., Stewart, I.M. (1999) Cocoa butter: a unique vegetable fat. *Lipid Technology Newsletter*, **1999**(October), 101–107.
- UNCTAD (2014) *Mango*. Available at: <http://www.unctad.info/en/Infocomm/AACP-Products/Commodity-Profile-Mango/> (accessed 3 February 2014).
- US FDA (2015) *Title 21 of the Code of Federal Regulations Part 163: Cacao Products*. Available at: <http://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfcr/CFRSearch.cfm?CFRPart=163> (accessed 26 January 2015).
- US Pharmacopeia Convention (2009) *Food Chemicals Codex*, US Pharmacopeia Convention, Washington, D.C., p. 105.
- Van Malssen, K.F., van Langevelde, A.J., Peschar, R., Schenk, H. (1999) Phase behaviour and extended phase scheme of static cocoa butter investigated with real time X-ray powder diffraction. *J. Am. Oil Chem. Soc.*, **76**(6), 669–676.
- Wille, R.L., Lutton, E.S. (1966) Polymorphism of cocoa butter. *J. Am. Oil Chem. Soc.*, **43**(8), 491–496.