Nurk, E., Refsum, H., Drevon, C.A., Tell, G.S., Nygaard, H.A., Engedal, K., Smith, A.D. (2009) Intake of flavonoid-rich wine, tea, and chocolate by elderly men and women is associated with better cognitive test performance. *J. Nutr.*, **139**, 120–127.

O'Neil, C.E., Fulgoni, V.L., 3rd, Nicklas, T.A. (2011) Candy consumption was not associated with body weight measures, risk factors for cardiovascular disease, or metabolic syndrome in US adults: NHANES 1999–2004. *Nutr. Res.*, **31**, 122–130.

Pase, M.P., Scholey, A.B., Pipingas, A., Kras, M., Nolidin, K., Gibbs, A., Wesnes, K., Stough, C. (2013) Cocoa polyphenols enhance positive mood states but not cognitive performance: a randomized, placebo-controlled trial. *J. Psychopharmacol.*, **27**, 451–458.

Ritchie, K., Carriere, I., De Mendonca, A., Portet, F., Dartigues, J.F., Rouaud, O., Barberger-Gateau, P., Ancelin, M.L. (2007) The neuroprotective effects of caffeine: a prospective population study (the Three City Study). *Neurology*, **69**, 536–545.

Sales-Campos, H., Souza, P.R., Peghini, B.C., Da Silva, J.S., Cardoso, C.R. (2013) An overview of the modulatory effects of oleic acid in health and disease. *Mini. Rev. Med. Chem.*, **13**, 201–210.

Sanchez, D., Quinones, M., Moulay, L., Muguerza, B., Miguel, M., Aleixandre, A. (2010) Changes in arterial blood pressure of a soluble cocoa fiber product in spontaneously hypertensive rats. *J. Agric. Food Chem.* **58**, 1493–1501.

Smit, H.J., Rogers, P.J. (2000) Effects of low doses of caffeine on cognitive performance, mood and thirst in low and higher caffeine consumers. *Psychopharmacology (Berl.)*, **152**, 167–173.

Sokolov, A.N., Pavlova, M.A., Klosterhalfen, S., Enck, P. (2013) Chocolate and the brain: neurobiological impact of cocoa flavanols on cognition and behavior. *Neurosci. Biobehav. Rev.*, **37**, 2445–2453.

Stote, K.S., Clevidence, B.A., Novotny, J.A., Henderson, T., Radecki, S.V., Baer, D.J. (2012) Effect of cocoa and green tea on biomarkers of glucose regulation, oxidative stress, inflammation and hemostasis in obese adults at risk for insulin resistance. *Eur. J. Clin. Nutr.*, **66**, 1153–1159.

Van Praag, H., Lucero, M.J., Yeo, G.W., Stecker, K., Heivand, N., Zhao, C., Yip, E., Afanador, M., Schroeter, H., Hammerstone, J., Gage, F.H. (2007) Plant-derived flavanol (–)epicatechin enhances angiogenesis and retention of spatial memory in mice. *J. Neurosci.*, **27**, 5869–5878.

West, S.G., Mcintyre, M.D., Piotrowski, M.J., Poupin, N., Miller, D.L., Preston, A.G., Wagner, P., Groves, L.F., Skulas-Ray, A.C. (2014) Effects of dark chocolate and cocoa consumption on endothelial function and arterial stiffness in overweight adults. *Br. J. Nutr.*, **111**, 653–661.

Yamada, T., Yamada, Y., Okano, Y., Terashima, T., Yokogoshi, H. (2009) Anxiolytic effects of short- and long-term administration of cacao mass on rat elevated T-maze test. *J. Nutr. Biochem.*, **20**, 948–955.

Yamashita, Y., Okabe, M., Natsume, M., Ashida, H. (2012) Cacao liquor procyanidin extract improves glucose tolerance by enhancing GLUT4 translocation and glucose uptake in skeletal muscle. *J. Nutr. Sci.*, **1**, e2.

CHAPTER 23

Quality control and shelf life

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23.1 Introduction

This chapter focuses on the quality parameters required to manufacture industrial chocolate from the cocoa bean to the finished user of bulk chocolate. Meeting the quality parameters for chocolate must follow the government regulations specific to the country the product is being manufactured in or is shipped to as well as quality requirements to meet customer specifications.

Areas of discussion will include but are not limited to: United States Code of Federal Regulation (CFR) requirements, United States Food Safety Modernisation Act (FSMA) quality aspects, Codex regulations, particle size, roasting controls, sensory, physical quality properties of cocoa and chocolate, tempering and shelf life. The process of manufacturing chocolate will be discussed from bean to chocolate ready to be made into fine confections with an emphasis on control of quality throughout manufacturing.

The chocolate manufacturer receives specific varieties of cocoa beans dependent on the final chocolate outcome desired by either the candy maker or the consumer (Table 23.1). Chocolate manufacturers around the world supply bulk chocolate to retail confectioners to make their special products. There are two types of chocolate manufacturers. One processes the cocoa bean to finished chocolate and supplies retail confectioners with everything from chocolate to chocolate liquor, cocoa butter, and/or cocoa powder. The other type may take the cocoa beans direct to finished chocolate products for retail sale.

23.2 Finding the perfect bean

Before the chocolate manufacturer receives cocoa beans into their factory, selection and sampling must occur. This is typically at the port of entry of the ship transporting the cocoa beans or through pre-ship sampling. Certified Samplers will perform the "Cut test," sampling individual lots of cocoa beans to assess the internal bean quality, size, and moisture (see Chapter 2).

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