CHAPTER 5

CONCLUSIONS

The objective of the study was to investigate the physicochemical and antioxidant activities of roselle extracts by different grinding method (OG and NG). The roselle extracts was selected to study under citric acid-Na_2HPO_4 (Mcllvaine) buffer solution (pH 3.0 and 4.0) with and without sucrose (20 %) and heat treatment between 50 to 70 °C. The changes of anthocyanins content, pigment concentration, antioxidant activity and anthocyanins degradation kinetics during heat treatment were determined. The OG roselle extracts was selected for next objective to evaluated the effect of sweeteners on oxidative stability of roselle extracts and determine the physicochemical properties and sensory quality of Chinese-style sausage during storage. The scavenging of reactive nitrogen species (RNS) *in vitro* by roselle extract and anthocyanins from black carrot and grape were determined in next objective. Moreover, nitrite scavenging activity by roselle extracts was monitor in meat model system including Vienna pork sausage and Nham. The results were concluded as follows:

5.1 To study physicochemical and antioxidant activity of roselle extract from difference grinding method were original-grinding (OG) and nano-grinding (NG) method. The NG roselle extracts showed high level of anthocyanins; delphinidin 3-sambubioside and cyanidin 3-sambubioside, and exhibited the higher in color pigment (UV-spectrum) and visual color at similar extracts concentration. Antioxidant activity of roselle extracts tended higher in NG roselle extracts. The temperature and pH were found influenced on physicochemical and antioxidant activity of roselle extracts. Increasing temperature during storage tended to rapidly degradation of roselle extracts in buffer solution, and roselle extract solution was more stable in system pH 3.0 than system pH 4.0. The sugar addition (20 %) into system did not play as the main effect on physicochemical properties of roselle extracts. The observed in each model system with sugar added showed the higher in antioxidant activity. Therefore sugar added could be increase antioxidant of roselle extracts solution during heating. Overall, NG roselle extracts was found better in physicochemical and antioxidant activity. When consideration in degradation rate, the NG roselle extracts exhibited the rapid degradation than OG roselle extracts. Thus, the extraction method should be considered for developing natural antioxidant extract.

5.2 The used of sugar alcohols with roselle extracts did not showed negative effect on physicochemical properties of Chinese-style sausage. However, xylitol added exhibited the similar sausage qualities which are closer the control sausage than other sugar alcohol. Moreover, xylitol added did not effect on antioxidant of roselle extracts in Chinese-style sausage. Thus, xylitol would be a suitable sugar; among the three sugar alcohols studied, to be used as a replacer for sucrose when the RAE is incorporated as a natural antioxidant in Chinese-style sausage. The xylitol concentration was found slightly effective on quality of RAE treated Chinese-style sausage. An equal concentration (16.6 %) between sucrose and xylitol. Xylitol added samples showed similar physicochemical properties compared to control sample (sucrose added), but sucrose added samples showed negative effect on lipid oxidation by TBARS and protein oxidation by total carbonyl contents. However, at high concentration (21.6 %) xylitol play the pro-oxidant activity, which can see the higher in lipid oxidation by TBARS. Thus, 16.6 % xylitol is the suitable level of concentrate was used to replace sucrose in Chinese-style sausage and results showed similar quality compared to original sausage sample. The using xylitol incorporated with roselle extracts in Chinese-style sausage did not showed negative effect on sensory evaluation by quantitative descriptive analysis (QDA) and 7-point hedonic scale. The xylitol added sausage with roselle extracts exhibited a good quality in all sensory parameter including flavor, texture, taste and overall acceptability. This indicated that the xylitol can be used as an alternative sweetener in Chinese-style sausage without unacceptable overall qualities.

5.3 To evaluate the reactive nitrogen species (RNS) scavenging, these species are nitrite scavenging, nitric oxide radical scavenging and peroxynitrite radical scavenging. The roselle extracts can be scavenging these RNS species *in vitro* similar to the anthocyanins from grape but tended more scavenging than anthocyanins from black carrot. Moreover, these anthocyanins were found high activity than BHA, ascorbic acid and gallic acid. However, the nitrite scavenging of roselle extracts in meat model depend on the type of meat products. The roselle extracts exhibited higher reduced nitrite in Nham more than Vienna pork sausage. Nitrite residue in Vienna pork sausage was found slightly decreased when refrigerated storage for 28 day, while nitrite residue in Nham was found decrease after the 3 days fermentation. During storage the RAE treated Vienna pork sausage and Nham were found lower in TBARS value. The effect of roselle extracts on nitrite residue in Nham was monitor with difference nitrite concentration. The residue nitrite in Nham model was found similar trend for nitrite reduction in all Nham model with difference

nitrite concentration when fermentation time increased. However, the result showed that the nitrite degradation was rapid degrade when roselle extracts was presented in the Nham model.