Effect of initial pHs on the formation of 2-methyl-3-furanthiol from heating reaction of reducing suger and cysteine /

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ABSTRACT

The Maillard reaction is an important route to many of the aroma volatiles found in cooked meat. It should be realized in this respect that aroma depend on many conditions, the most important ones being the reducing sugar and pH conditions. Among other compounds, the thiols 2-methyl-3-furanthiol belong to the most important aroma impact compounds formed during the thermal reaction of meat aroma. The Maillard reaction is undoubtedly the complexity of the reaction, consisting of many parallel and consecutive reactions. Most literature results dealing with kinetics of the Maillard reaction use simple kinetics to describe changes. Thus, one measures loss of reactants, formation of products and reaction rates. The first part objective of this study was to investigate the effect of thermal treatment (95°C, 120 min) on the Maillard reaction of an aqueous glucose, xylose, ribose – cysteine model system under pH 7 conditions was assessed on the basis of classical kinetic parameters measures loss of reactants and formation of products.The second part objective of this study was to investigate the effect of thermal treatment (95°C, 120 min) on the Maillard reaction of an aqueous ribose – cysteine model system under varying pH conditions (5.0, 7.0 and 8.0) was assessed on the basis of classical kinetic parameters measures loss of reactants and formation of products. The sugar reactivity regarding the sugar consumption was in the declining order: ribose > xylose > glucose. The Amadori contents was in the order: ribose > xylose > glucose. As expected, an increase in pH of the heated solutions led to an increase in the browning development and sugar consumption of increase from ribose and cysteine. The Amadori contents was in the order: pH 7 > pH 9 > pH 5. 2-methyl-3-furanthiol was discovered in the system of ribose and cysteine.The second part of experiment has the following results. With the rise of pH , loss of reducing sugar and browning intensities have increased. Amadori contects in order: pH 7 > pH 9 > pH 5, the result is different with reference;it conjecture to Amadori was the intermediate product of Maillard reaction and then-vtransform to melanoidins, the result correlates with browning intensities experiment. The highest 2-methyl-3-furanthiol formation was in pH 7 .The reason is that it need higher temperature to enhance ribose utility rate, and 2-methyl-3-furanthiol is easier to produce in pH ≦ 7.

Keywords : reducing sugar、cysteine、Maillard reaction、2-methyl-3-furanthiol、kinetic

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REFERENCES

1. 黃寶慧。李茂榮。1996。「固相微量萃取法」。科儀新知 18: 58-67頁。 2. 黃敬德。謝有容。1997。「固相微萃取法」。科儀新知 18: 59-60頁。 3. 范中寧。2001。以淘汰蛋雞酵素水解液製備雞肉香料。大葉大學食品工程所碩士論文。 4. 沈同。2001。生物化學。高等教育出版社。12-19頁。 5. 張旭鬱。2002。寡木糖之化學安定性及吸濕性對玉米脆片物性影響。靜宜大學食品營養所碩士論文。 6. 孫寶國。田?玉。劉玉平。2006。食品香精香料對食品安全的影響。5(1):49-51。 7. 湯菊莉。李寧,。嚴衛星。2006。食品中丙烯?胺的毒理學研

究現狀。中國食品雜誌。18(4):350-253。 8. 吳肖。2007。牛肉風味熱反應體系的建立及穩定性。華南理工大學博士論文。 9. 侯龍。2007。戊糖/半胱胺酸體系 Maillard 反應性質及其應用研究。江南大學糧食油脂與植物蛋白工程所博士論文。 10. 薛菲。彭英雲。2007。食品烹調過程中產生的致突變物雜環胺。科技諮詢。10(36): 221-222。 11. 張亞紅。岳春。劉玉潔。2008。食用香精香料的現狀及發展趨勢。飲料工業。10: (9): 3-6。 12. 林祐生。2008。利用?肉水解產物製備肉類香味料及肉類香氣生成之研究。台灣大學生物資源暨農學院農業化學所碩士論文。 13. 譚志光。黃偉科。張玉萍。2009。影響食用香精香料安全性因素及控制。中國食品質量報。5(6):5-9。 14. 于軍。2009。2-甲基-3-?喃硫醇的合成。青海民族學院化學系 (化學世界) 。5 (2): 104-107。 15. 何玲。劉俊德。朱貴榮。2009。食品添加劑對食品安全性的影響。中國職業醫學。31(8):1009-1010。 16. Ajandouz, E. H., Tchiakpe, L. S., Dalle Ore, F., Benajiba, A. and Puigserver, A. 2001. Effects of pH on caramelization and Maillard reaction kinetics in fructose-lysine model systems. Food Chemistry and Toxicology, 66(7):926-931. 17. Ashoor, S. H. and Zent. 1984. Maillard browning of common amino acids and sugars. Journal of Food Science, 49(1):1206-1207. 18. Bailey, M. E. 1998. Maillard reactions and meat flavor development. Flavor of meat, meat products and seafoods. NewYork:Blackie Academic & Professional,48(2):267-287. 19. Baxter, J. H. 1995. Free amino acid stability in reducing sugar systems. Journal of Food Science, 60(2):405-408. 20. Bell, L. N. 1997. Control of color formation by ionic species in non-enzymic browning reactions. Food Chemistry, 12(1):143-147. 21. Benjakul, S., Visessang, W., Phongkanpai, V. and Tanaka M. 2005. Antioxidative activity of caramelization products and their preventive effect on lipid oxidation in fish mince. Food Chemistry, 90(3):231-239. 22. Benjakul, S., Lertittikul, W. and Bauer, F., 2005. Antioxidant activity of Maillard reaction products from a porcine plasma protein-sugar model system. Food Chemistry, 93(6):189每196. 23. Buera, D. P., Chirife, J., Resnik, S. L. and Wetzler, G. 1987. Nonenzymatic browning in liquid model systems of high water activity: kinetics of color changes due to Maillard reaction between different single sugars and glycine and comparison with caramelization browning. Journal of Food Science, 52(4):1063-1067. 24. Burton, H. S. 1963. Non-enzymatic browning reactions凵consideration of sugar stability. Nature, 197(5):266-268. 25. Cerny, C. and Davidek, T. 2003. Formation of aroma compounds from ribose and cysteine during the Maillard reaction. Journal of Agricultural and Food Chemistry, 51(9):2714-2721. 26. Chen, J., Serafin, F. L., Pandya, R. N. and Daun, H. 1991. Effects of extrusion conditions on sensory properties of cornmeal extrudates. Journal of Food Science, 56(3):84-89. 27. Chevalier, F., Chobert, J. M., Genot, C. and Haertle, T. 2001. Scavenging of free radicals, antimicrobial, and cytotoxic activities of the Maillard reaction products of b-lactoglobulin glycated with several sugars. Journal of Agricultural and Food Chemistry, 49(2):5031每5038. 28. Donald, S. and Mottram. 1998. Flavour formation in meat and meat products : a review. Food Chemistry, 62(4):415-424. 29. Dubois, M., Gilles, K. A., Hamilton, J. K., Rebers, P. A. and Smith, F. 1956. Colorimetricmethod for determination of sugars and related substances. Analytical Chemistry, 28(4):350-356. 30. Dwivedi, B. K. 1975. Meat flavor. CRC Crit. Revs. Food Technology, 5(2):487-535. 31. Elode, K. E., Domseifer, T. P., Keith, K. S. and Powers, J. J. 1966. Effect of pH and temperature on the carbonyls and aromas produced in heated amino acid-sugar mixtures. Journal of Food Science, 31(2):351-358. 32. Farmer, L. J., Mottram, D. S. and Whitfield, F. B. 1989. Volatile compounds produced in Maillard reactions involving cysteine, ribose and phospholipid. Journal of the Science of Food and Agriculture, 49(2):347-368. 33. Farmer, L. J. and Mottram, D. S. 1990. Recent studies on the formation of meat-like aroma compounds. Flavour Science and Technology, 21(3):113-116. 34. Farmer, L. J. and Mottram, D. S. 1992. Effect of cysteine and ribose on the volatile thermal degradation products of a triglyceride and three phospholipids. Journal of the Science of Food and Agriculture, 60(3):489-497. 35. Farmer, L. J. and Mottram, D. S. 1994. Lipid-Maillard interactions in the formation of volatile aroma compounds. Trends in Flavour Research, 54(5)313-326. 36. Flament, I., Willhalm, B. and Ohloff, G. 1978. New developments in meat aroma research, flavor of foods and beverages. Chemistry and Technology, 21(9)15-32. 37. Grosch, W., Zeiler-Hilgart, G., Cerny, C. and Guth, H. 1993. Studies on the formation of odorants contributing to meat flavors. Flavor Precursors Studies, 65(5)329-342. 38. Guerard, Fabienne., Inisan, Claude., Berger, Celine., Vouland, Eric., Dufosse, Laurent. and Laroque, Delphine. 2008. Kinetic study on the Maillard reaction. Consideration of sugar reactivity. Food Chemistry, 111(3):1032-1042. 39. Herbach, K. M., Michael, R., Stintzing, F. C. and Carle, R. 2006. Structural and chromatic stability of purple pitaya betacyanins as affected by the juice matrix and selected additives. Food Research International, 216(13):301-311. 40. Ho, C. T. 1996. Thermal generation of Maillard aromas. Food Research International, 21(3):27-53. 41. Hodge, J.E. 1953. Dehydrated foods : Chemistry of browning reactions in model systems. Journal of Agricultural and Food Chemistry, 1(15):928-943. 42. Hornstein, I., Crowe, P. F. and Heimnerg, M. J. 1960. Fatty acid composition of ment tissue lipids. Journal of Food Science, 26(21):581. 43. Hornstein, I. and Crowe, P. E. 1963. Flavour studies on beef and pork. Journal of Agriculture and Food Chemistry, 11(2):147-149. 44. Hurrell, R. F. 1982. Maillard reaction in flavour. Food Flavours, eds I. D. Morton and A. J. MacLeod. Elsevier,Amsterdam, pp. 399-437. 45. Labuza, T. P. and Saltmarch. M. 1981. Kinetics of browning and protein quality loss in whey powders during steady state and nonsteady state storage conditions. Journal of Food Science, 47(2):92-96. 46. Labuza, T. P. and Baisier. W. M. 1992. The kinetics of nonenzymatic browning. Physical Chemistry of Foods, IFT Basic Symposium series, ed. by H. Schwartzberg. Vol. 7:595-640, Marcel Dekker, New York. 47. Lea, C. H. and Hannan, R. S. 1949. Studies of the reaction between proteins and reducing sugars in the dry state. I. The effect of activity of water, of pH and of temperature on the primary raction between casein and glucose. Biochim. Biophys: Acta, 3(12):313. 48. Lee, C. M., Sherr, B. and Koh, Y. N. 1984. Journal of Agricultural and Food Chemistry, 32(5):379-382. 49. Lertittikul, W., Benjakul, S. and Tanaka, M. 2007. Characteristics and antioxidative activity of Maillard reaction products from a porcine plasma protein-glucose model system as influenced by pH. Food Chemistry, 100(11):669-677. 50. Macy, R. L., Naumann, H. D. and Bailey, M. E. 1964. Water-soluble flavour and odour precursors of meat. (I) Qualitative study of certain amino acids, carbohydrates, non amino-acid nitrogen compounds and phosphoric acid esters of beef, pork and lamb. Journal of Food Science, 29(12):136-141. 51. Macy, R. L., Naumann, H. D. and Bailey, M. E. 1964. Water-soluble flavour and odour precursors of meat. (II) Effects heating on amino nitrogen constituents and carbohydrates in lyophilized diffusates from aqueous extracts of beef,

pork and lamb. Journal of Food Science, 29(5):142-148. 52. Modi, V. K. and Kavitha S. 2007. Effect of water activity and temperature on degredation of 5'-inosine monophosphate in a meat model system. Journal of Food Science and Technology, 40(2):1280-1286. 53. Mottram, D. S. and Leseigneur, A. 1990. The effect of pH on the formation of aroma volatiles in meat-like Maillard systems. In Y. Bessiere. & A.F. Thomas, Flavour science and technology (pp. 121-124). New York:John Wiley. 54. Mottram, D. S. and Whitfield, F. B. 1994. Aroma volatiles from meat-like Maillard systems. In T. H. Parliment, M. J. Morello, & R. J. McGorrin (Eds.), Thermally generated flavors-Maillard, microwave, and extrusion processes. American Chemical Society symposium series, 543(2):180-191. 55. Mottram, D. S. and Nobrega, I. C. C. 2002. Formation of sulfur aroma compounds in reaction mixtures containing cysteine and three different forms of ribose. Journal of Agricultural and Food Chemistry, 50(3):4080-4086. 56. Pawliszyn, J. 1990. ※Solid Phase Microextraction with Thermal Desorption Using Fused Silica Optical Fibers § , Analytical Chemistry, 62(2):2145-2148. 57. Pawliszyn, J. 1997. Solid Phase Microextraction Theory and Practive, Wiley-VCH, New York. 58. Petriella, C., Resnik, S. L., Lozano, R. D. and Chirife, J. 1985. Kinetics of deteriorative reactions in model food systems of high water activity: Color changes due to nonenzymatic browning. Journal of Food Science, 50(3):622-625. 59. Rooney, L. W., Slaem, A. and Johnson, J. A.1967. Studies ofthe carbonyl compounds produced by sugar-amino acid reactions. 1. Model systems. Cereal Chemistry, 44(3):539 60. Saunder, J. and Jervis, F. 1966. The role of buffer salts in non-enzymic browning. Journal of the Science of Food and Agriculture, 17(3):245. 61. Silwar, R. and Tressl, R. 1989. Gas chromatographic-mass spectrometric investigation of aroma compounds formed in the cysteine-methionine-furfural model system under roasting conditions. Z. Lebensm. Unters. Forsch, 189(2):205-211. 62. Spark, A. A. 1969. Role of amino acids in non-enzymic browing. Journal of the Science of Food and Agriculture, 20(5):308. 63. Supelo., 1998. ※Solid Phase Miroextraction : Theory and Optimization of Conditions § , Bulletin 923(11):1-5. 64. Tai, C. Y. and Ho, C. T., 1997. Influence of cysteine oxidation on thermal formation of Maillard aromas. Journal of Agricultural and Food Chemistry, 45(9):3586-3589. 65. Van, M. A. J. S. 2001. Kinetic aspects of the Maillard reaction: A critical review. Nahrung/Food, 45(3):150-159. 66. Van, M. A. J. S. 2006. Formation of flavour compounds in the Maillard reaction. Biotechnology Advances, 24(10):230- 233. 67. Xu, H., Gao, Y., Liu, X. and Zhao, J. 2008. Effects of ribose to cysteine ratios on the formation of volatile compounds from the Maillard reaction in supercritical carbon dioxide. Journal of the Science of Food and Agriculture, 41(6):730-737. 68. Xu, H., Gao, Y., Liu, X. and Zhao, J. 2008. Effects of supercritical carbondioxide on volatile formation from Maillard reaction between ribose and cysteine. Journal of the Science of Food and Agriculture, 88(2):328-335. 69. Zhang, Z. 1993. ※Headspace Solid-Phase Microextraction § . Analytical Chemistry, 65(7):1843-1852.