Studies on Stability of Immunoglobulin G of Microencapsulated Bovine Colostrums and Whey

沈子偉、張基郁

E-mail: 9510791@mail.dyu.edu.tw

ABSTRACT

The bovine colostrums collected from the second to the fourth day postpartum were mixed by equal volume and used as raw materials. A 10 % aqueous solution of gum arabic, β-cyclodextrin (β-CD) or chitosan was added to an equal volume of colostrums or whey, and microencapsulated through freeze drying and spray dryng methods. The effects of pH value, temperature, pepsin and trypsin, lipopolysaccharides (LPS) from E. coli (serotype O55:B5), and storage time on the IgG activity of microencapsulated colostrums and whey were investigated. Results showed that microencapsulated colostrums prepared through freeze drying had higher IgG activity than those prepared through the spray drying. The results for the effects of the five factors on the IgG activity of microencapsulated colostrums and whey were summarized as follows: (1) pH stability: The non-microencapsulated colostrums were found to have higher IgG activity at a pH value of 7~8 than the microencapsulated colostrums; the microencapsulated colostrums with gum arabic were found to have higher IgG residual activity at a pH value of 7~8. (2) Thermal stability: Gum arabic and β-cyclodextrin (β-CD) were found to have a protective effect on the IgG activity of colostrums and whey. (3) Pepsin and trypsin Tolerance: Under the action of pepsin for two hours, the residual IgG activities of microencapsulated colostrums with gum arabic and β-cyclodextrin (β-CD) were higher by 9.8 % and 7.6 %, respectively, than that of non-microencapsulated colostrums. After further action by trypsin for four hours, no significant differences were found between microencapsulated and non-microencapsulated colostrums. However, the action of pepsin and trypsin did not significantly affect the IgG residual activity of microencapsulated whey. (4) Action of LPS from microorganisms: The E. coli (serotype O55:B5 form) was found to have an antigen-antibody affinity with the IgG of colostrums and whey. However, after the action of pepsin and the effect of LPS from E. coli (serotype O55:B5 form), the microencapsulated colostrums with gum arabic was found to have higher IgG activity than the non-microencapsulated colostrums. (5) Storage stability: Storage temperature and packaging materials were found to have a significant impact on the residual IgG activity of colostrums and whey. After being stored for 60 days at 4 ℃, the IgG activity was found to be higher than that stored at room temperature. As for packaging materials, aluminum bag-packaged colostrums and whey were found to have a higher IgG activity than transparent plastic bag-packaged colostrums. After storage for 60 days at 4 ℃, the microencapsulated colostrums with gum arabic were found to have a significantly higher IgG residual activity than the non-microencapsulated colostrums.

Keywords : Bovine colostrums, β-Cyclodextrin (β-CD), Chitosan, Gum arabic, Microencapsulation.

Table of Contents

REFERENCES

中文部份 1.大竹繁雄、平澤正知、津田 憲. 1993。雞蛋抗體對於口腔疾病及消化道感染的預防利用。農化67:1437-1439。 2.方鴻明、吳志修。1988。免疫學-第四章:免疫學者使用的方法。大學圖書出版社。台北市。 3.王政光等 編著。2004。免疫學。新文京開發出版股份有限公司。台北縣。 4.王瑞廷 編著。1995。免疫醫用微生物學與免疫學。合記圖書出版社。台北市。 5.王瑞廷。1995。醫用微生物學與免疫學-第五十七章:免疫。合記圖書出版社。台北市。 6.行政院農業委員會。2003。九十二年農業統計年報。第148頁。 7.吳則雄。1980。認識牛的初乳。乳業98/99:9-14。 8.李陽春。1999。以幽門螺旋桿菌(Helicobater pylori)之尿素?免疫處理雞所產雞蛋蛋黃微膠囊化後抗體的安定性研究。台灣大學食品科技研究所碩士論文。台北市。 9.沈明來 編著。2000。生物檢定統計法。九州圖書文物有限公司。台北市。 10.林志城、陳凱萍、林仲聖。2003。生物膠囊化紫紅麴菌的抗氧化活性評估。健康管理學刊1 (1):63-70。 11.林宜慧。1997。以β-環狀糊精移除雞蛋蛋黃中膽固醇的探討。靜宜大學食品營養學系碩士論文。台中縣。 12.林虔宏。2001。蛋黃卵磷脂微膠囊之製作及其物理性質之探討。中興大學畜產學系碩士論文。台中縣。 13.邱少華。2000。幾丁聚醣在藥物控制釋放上的應用以及其微膠囊製備的技術。生物資源 生物技術vol.2 (3):19-23。 14.張長泉。1986。酵素免疫分析方法。食品工業18(3):11-15。 15.張湘文。2000。環狀糊精在食品工業上之應用。食品工業32 (7):30-40頁。 16.陳昭誠、杜豔櫻、張鴻民。1999。牛乳IgG之酵素水解物性質。食品科學26:496-506。 17.陳昭誠。1998。牛乳免疫球蛋白G安定性之研究。台灣大學食品科技研究所博士論文。台北市。 18.曾慶瀛、余哲仁、李錦楓。1994。蜂王乳粉末化之製備與其貯存期間物性變化之研究。中國農業化學會誌32 (1):113-124。 19.楊正護。1983。剩餘初乳利用性之研究。中興大學蓄牧研究所碩士論文。台中市。 20.劉瓊淑。1994。幾丁質，幾丁聚醣及其相關酵素之特性與應用。食品工業26:26-36。 21.蔡育霖。2002。PLGA/Phospholipid 微小球對包覆之蛋白質控制釋放之影響。中原大學醫學工程學系碩士論文。桃園縣。 22.盧冠霖等編著。2002。新編免疫學。永大書局。台北市。 23.賴滋漢、金安兒。1991。食品加工學製品篇第181-196頁。富林出版社。台中市。 24.蘇家愷。1995。自牛初乳中分離免疫球蛋白與乳鐵蛋白博士論 文。台灣大學食品科技研究所。台北市。 英文部份 1.AOAC. 1998. Official methods of analysis, 16th ed. Association of Official Analytical Chemist. Washington, DC. 2.Apinan, S., Kohei, T., Kenji, O., Daisuke, M., Hidefumi, Y., Takeshi, F., Masaaki, O. and Pekka, L. 2004. Microencapsulation of l-menthol by spray drying and its release characteristics. Innovative Food Science and Emerging Technologies 6:163-170. 3.Arguello, A., Castro, N., Capote, J., Tyler, J. W. and Holloway, N. M. 2004. Effect of colostrum administration practices on serum IgG in goat kids. Livestock Production Sci.90:235-239. 4.Bone, R. C. 1991. The pathogenesis of sepsis. Ann. Intern.Med.115: 457-469. 5.Brunner, J. R. 1981. Cow milk proteins: Twenty-five years of progress. J. Dairy Sci.64:1038-1054. 6.Brussow, H., Hilpert, H., Walther, I., Sidoti, J., Mietens, C.,and Bachmann, P. 1987. Bovine milk immunoglobulins for passive immunity to infantile rotavirus gastroenteritis. J. Clin.Immunol. 25: 982-986. 7.Caffin, J. P., Poutrel, B. and Rainard, P. 1983. Physiological and pathological factors influencing bovine immunoglobulin G1 (IgG1) concentration in milk. J. Dairy Sci. 66: 2161-2166. 8.Chiang, S. H. and Chang, C. Y. 2005. Antioxidant properties of caseins and whey proteins from colostrums. J. Food Drug Anal. 13(1): 57-63. 9.Conway, P. L., Corbach, S. L. and Godin, B. R. 1987. Survival of lactic acid bacteria in the human stomach and adhesion to intestinal cells. J. Dairy Sci. 70: 1-12. 10.Crowther, J. R. 1995. ELISA:theory and practice. 1st ed. Humana press Inc. Totowa, New Jersey, USA. 11.Cruz, J. R. and Arevalo, C. 1985. Fluctuation of specific IgA antibodies in human milk. Acta Paediatrica Scandinavia 74: 897-903. 12.Debeaufort, F. and Voilley, A. 1995. Effect of formulation parameters and drying conditions or mechanical and barrier properties of emulsified model edible films. Int. J. Food Sci. Tech., 30(2): 183-190. 13.Donhowe, I. G. and Fennema, O. 1996. Edible films and coatings: characteristics formation,definitions and testing methods. Krochta, J. M. and Baldwin, E. A. Nisperos-Carriedo MO, editors. p. 1-24. Edible coatings and films to improve food quality. Capter1.Techhomic Publishing Co Inc, USA. 14.Dziezak, J. D. 1988. Microencapsulation and encapsulated ingredients. Food Tech. April: 136-148. 15.Ebina, T., Sato, A., Umezu, K. and Ishida, N. 1985. Prevention of rotavirus infection by oral administration of cow colostrums containing anti-human rotavirus antibody. Medical Microbil. And Immunol. 174: 177-185. 16.Facon, M., Skura, B. J. and Nakai, S. 1993. Potential for immunological supplementation of foods. Food Agric. Immunol. 5: 85-91. 17.Foley, N. and Otterby, S. 1978. Availability, storage, treatment, composition and feeding value of surplus colostrum:a review. J. Dairy Sci.61: 1033-1060. 18.Gennadios, A., Mchugh, T., Weller, C. L. and Krochta, J. M. 1994. Edible coatings and films based on proteins. Edible coatings and films to improve food quality. Capter 9. p. 201-277. Techhomic Publishing Co Inc., USA. 19.Glover, F. A. 1985. Ultrafiltration and Reverse Osmosis for the Dairy Industry. Technical Bulletin 5, National Institute for research in Dairying, Reading, UK. 20.Goldsmith, R. M., Ahlstert, S., Carlsson, B., Hanson, L.A.,Jodal, U., Lidin-Janson, G.. and Sohl-Akerlund, A. 1975. Antibody-forming cells in

human colostrums after oral immunisation. Nature 257: 797-798. 21.Gontard, N., Guilbert, S. and Cuq, J. L. 1993. Water and glycerol as plasticizers affect mechanical and water vapor barrier properties of an edible wheat gluten film. J. Food Sci. 58(1): 206-211. 22.Grant, L. A. and Burns, J. 1994. Application of coating. Krochta JM, Baldwin EA, Nisperos-Carriedo MO, editors. Edible coatings and films to improve food quality. Capter 8. p. 189-200. Techhomic Publishing Co Inc., USA. 23.Greener, I. K. and Fennema, O. 1989. Evaluation of edible,bilayer films for use as moisture barriers for food. J. Food Sci. 54(6): 1400-1406. 24.Gurr, M. I.1981. Review of the progress of dairy science: Human and artificial milks for infant feeding. J. Dairy Res.51: 267-278. 25.Hilpert, H. 1977. Bovine milk immunoglobulins, their possible utilization in industrially prepared infants milk formula. In food and immunology, L. Hambraeus.p.182-196.Almqvist and Wiksell International, Stockholm, Sweden. 26.Hudson, L. and Hay, F.C. 1989. Practical Immunology. 3rd ed. Blackwell Scientific Co., London, UK. 27.Jenness, R. 1988. Composition of milk. In Fundamentals of Dairy Chemistry, 3rd ed. N.P. Noble, p. 1-38. Van Nostrand Reinhold Co., New York, USA. 28.Juma, M. and Muller, B. W. 1999. Phsicochemical properties of chitosan-lipid emulsions and their stability. Int. J. Pharm. 183: 175-184. 29.Kaneko, T., Wu, B. T. and Nakai, S. 1985. Selective concentration of bovine immunoglobulins and α-lactalbumin from acid whey using FeCl3. J. Food Sci. 50: 1531-1536. 30.Katsuro, H., Satoshi, K., Hitoki, Y., Rikio, K. and Hiroshi, I. 2000. Detection of cytokines in bovine colostrum. Veterinary Immunology and Immunopathology. 76:183-190. 31.Kuby, J. 2002. Immunology. 2nd ed. W.H. Freeman Co., New York, USA. 32.Kummer, A., Kitts, D. D., Li-Chan, E., Losso, J. N., Skura, B. J. and Nakai, S. 1992. Quantification of bovine IgG in milk using enzyme-linked immunosorbent assay. Food Agric. Immunol. 4: 93-102. 33.Li-Chan, E., Kummer, A., Losso, J. N. and Nakai, S. 1994. Servey of immunoglobulin G (IgG) content and antibody specificity in cow ' s milk from British Columbia. Food and Agri. Immunol. 6: 443-451. 34.Li-Chan, E., Kummer, A., Losso, J. N., Kitts, D. D. and Nakai, S. 1995. Stability of bovine immunoglobulins to thermal treatment and processing. Food Research International. 28(1): 9-16. 35.Manuela, E. Pintado, J. A. Lopes da Silva. and Xavier, M. F. 1999. Comparative Characterization of Whey Protein Concentrates from Ovine, Caprine and Bovine Breeds. Lebensm.-Wiss.u. Technol. 32: 231-237. 36.Maynes, J. R. and Krochta, J. M. 1994. Properties of edible films from total milk protein. J. Food Sci. 59(4): 909-911. 37.Nicholas, P., David. R., Remon, F. and Pessen, H.1995. Composition factors affecting the water vapor permeability and tensile properties of hydrophilic films. J. Agric Food Chem. 43: 1432-1435. 38.Porter, R. R. 1959. The hydrolysis of rabbit γ-globulin and antibodies with crystalline papain. Biochem. J. 73: 119-123. 39.Pothakamury, U. R. and Barbosa-Canovas, G. V. 1995. Fundamental aspects ofcontrolled release in foods. Trends in Food Science and Technology. 6: 397-406. 40.Ribud, M., Hardikar, A., Bhat, S. R. and Bhond, R. 2000b. pH-sensitivefreeze-dried chitosan-polyvinyl pyrrolidone hydrogels as controlled release system for antibiotic delivery. J. Control Release. 68: 23-30. 41.Rietschel, E., Holst, O., Brade, L., Muller-Loennies, S., Mamat, U., Zahringer, U. and Beckmann, F. 1996. Bacterial endotoxin: chemical constitution, biological recognition, host response and immunological detoxification. Curr. Top Microbiol. Immunol. 216: 39-81. 42.Roitt, I., Brostoff, J. and Male, D.1993. Immunology, 3rd. Mosby-Year Book Europe, Inc., UK. 43.SAS. 2001. SAS User ' s guide: Statistics. 8th ed. SAS Inst. Cary, NC, USA. 44.Shimizu, M., Nagashima, H., Sano, K., Hashimoto, K., Ozeki, K., Tsuda, K. and Hatta, H. 1992. Molecular stability of chicken and rabbit immunoglobulin G. Biosci. Biotech. Biochem. 56: 270-274. 45.Sissons, J. G. P. and Oldstone, M. B. A. 1980. Medical perspective dilling ofvirus-infected cells: the role of antiviral antibody and complement in limiting virus infection. J. Infect. Dis. 142: 442-446. 46.Smith, K. L., Muir, L. A., Ferguson, L. C. and Conrad, H. R. 1971. Selectivetransport of IgG into the mammary gland: role of estrogen and progesterone. J. Dairy Sci. 54: 1886-1894. 47.Tacket, C. D., Losnsky, G., Link, H. and Levine, M. M. 1988. Protection by milkimmunoglobulin concentrate against oral challenge with enterotoxigenic E.coli. New Eng. J. Med. 318: 1240-1243. 48.Tinsley-Bown, A. M., Fretwell, R., Dowsett, A. B., Davis, S. L. and Farrar, G. H.2000. Formulation of poly (D,L-lactic-co-glycolic acid) microparticles for rapid plasmid DNA delivery. J. Control. Rel. 66: 229. 49.Varnam, H. and Sutherland, P. 1994. Milk and milk products. Chapman and Hall, London, UK. 50.Wu, J. P. and Ding, X. L. 2002. Characterization of inhibition and stability ofsoy-protein-derived angiotensin Ⅰ-converting enzyme inhibitory peptides. Food Res. Int. 35: 367-375.