Developement of macroarray system for the detection of milk pathogenic microorganisms

陳信硯、李世傑

E-mail: 319690@mail.dyu.edu.tw

ABSTRACT

Milk is a high nutritional value of food, there is a lot of dairy products popular among consumers. However, there might have a variety of zoonotic and environmental pollution associated with the presence of pathogenic microorganisms, it will be considerable economic losses which are caused by microbes; freshness is also the focus of emphasis on milk, it has a very short time from process to market, so development of rapid and accurate identification method is also very important. The purpose of this study is to design PCR primers and DNA probes for detection of Brucella spp., Acinetobacter spp., Pseudomonas spp., Aeromonas spp., Enterobacter spp., Moraxella catarrhalis and Pasteurella multocida. By using the macroarray, several pathogenic environmental microbes which might affect the quality of milk can be simultaneously detected, and no cross reactions were observed. Adding more oligonucleotide probes to the array may allow the detection of more bacterial genus in the future. In addition, food poisoning cases occur for many reasons. Salmonella spp., Staphylococcus aureus, Listeria monocytogenes and Escherichia coli are often detected from the food. Among the cases of food poisoning usually involved more than one pathogen, there is generally compounded by environmental pathogens indirectly contaminated food. Therefore, this study tested artificially contaminated food, in the testing of PCR sensitivity, without the pre-enrichment, the detection limit were N×103~104 cfu/ ml, and using multiplex PCR with the microarray for testing hybrid experiments. It was successful in discriminating Listeria monocytogens, Staphylococcus aureus, Streptococcus agalactiae, Enterobacter sakazakii, Escherichia coli O157:H7, Vibrio parahaemolyticus, Salmonella spp. and Pseudomonas fluorescens, even in the presence of other non-target strains, whether it is for a single or mixed-strains experiment, the specificity can be obtained without interference signals, that can be used on food for the detection of pathogenic bacteria to achieve rapid and accurate test results.

Keywords : milk、pathogenic microorganisms、microarray

Table of Contents

REFERENCES

參考文獻 1.梅念祖。1997年。乳牛急性乳房炎之疫情研究。中興大學獸醫學系碩士論文。 2.潘子明。1998年。臺灣北部地區海鮮食品腸炎弧菌之調查研究。疾病管制局疫情報導。 3.洪秋蓮。2002年。以Oligonucleotide array檢測沙門氏菌屬、大腸桿菌、葡萄球菌屬、仙人掌桿菌群及弧菌屬之可行性探討及應用。中興大學食品科學研究所碩士論文。 4.陳佑誠，詹爾昌。2003年。生物晶片。教育部顧問室「生物技術科技教育改進計畫」分子檢驗專書。 5.張雅芳，黃正仲。2004年。「微陣列生物科技」《科學發展》，381 期，34-41頁。 6.蔣育錚。2005年。食品病原菌與金黃色葡萄球菌腸毒素檢測用生物晶片之發展以及金黃色葡萄球菌之分子分類與即時聚合?鏈反應。中興大學食品暨應用生物科技學系博士論文。 7.姚富洲。2007年。新編生物技術。 8.蘇秀卿。2007年。以DNA晶片鑑定葡萄糖非發酵菌。成功大學醫學檢驗生物技術學系碩士論文。 9.白宛玉。2007年。利用熱休克蛋白基因設計Streptococcus agalactiae, Strep. uberis及Strep. bovis之PCR引子組及其應用。弘光科技大學生物科技學系碩士論文。 10.陳志遠。2008年。利用熱休克蛋白基因設計Clostridium tyrobutyricum及Listeria monocytogenes之PCR引子組及其應用。大葉大學分子生物科技學系碩士論文。 11.張予馨。2009年。利用熱休克蛋白基因及其區間序列設計S. aureus, S. saprophyticus, S. epidermidis, S. haemolyticus, Streptococcus agalactiae, Strep. uberis, Strep. bovis之特異性PCR引子組與生物晶片開發及應用。弘光科技大學生物產業科技學系碩士論文。 12.廖繼洲，林雪蓉，曾千芳，陳惠芳，蔡淑貞，蔡佳芬，朱正明。2009年。藥物食品安全週報。行政院衛生署。 13.Anonymous. 1999. Outbreak of Vibrio parahaemolyticus infection associated with eating raw oysters and clams harvested from Long Island Sound-Connecticut, New Jersey, and New York, 1998. JAMA. 281: 603-604. 14.Alizadeh, A.A., Eisen, M.B., Davis, R.E., Ma, C., Lossos, I.S., Rosenwald, A., Boldrick, J.C., Sabet, H., Tran,T., Yu,X., Powell, J.I., Yang, L., Marti, G.E., Moore, T., Hudson, J., Jr., Lu, L., Lewis, D.B., Tibshirani, R., Sherlock, G., Chan, W.C., Greiner, T.C., Weisenburger, D.D., Armitage, J.O., Warnke, R., Staudt, L.M., and et al. 2000. Nature 403: 503-511. 15.Arcangioli, M.A., Leroy S.S., Martel, J.L. and D.E. Chaslus. 2000. Evolution of chloramphenicol resistance, with emergence of cross-resistance to florfenicol, in bovine Salmonella typhimurium strains implicates definitive phage type (DT) 104. J. Med. Microbiol. 49: 103-110. 16.Agarwal, R.K., Kapoor, K.N., Kumar, A., Bhilegaonkar, K.N. 2000. Aeromonas in foods of animal origin. Indian J. Anim. Sci. 70: 942-943. 17.Arora, S., Agarwal, R.K., Bist, B. 2006. Comparison of ELISA and PCR vis-a`-vis cultural methods for detecting Aeromonas spp. in foods of animal origin. Int. J. Food Microbiol. 106: 177-183. 18.Buchanan, R.L., Palumbo, S.A. 1985. Aeromonas hydrophila and Aeromonas sobria as potential food poisoning species: a review. J. Food Saf. 7: 15-29. 19.Barber, D.M.L., Jones, G.E. and A. Wood. 1986. Microbial flora of the eyes of cattle. Veterinary Record 18: 204-206. 20.Bone, R.C. 1993. Gram-negative sepsis: a dilemma of modern medicine. Clin. Microbiol. Rev. 6: 57-68. 21.Bachhil, V.N., Bhilegaonkar, K.N. 1995. Prevalence of Aeromonas spp. in foods of animal origin. XVI Annual Conference of Indian Association of Veterinary Microbiologists, Immunologists and Specialists in Infectious Disease. October, 3-5, 1995, Mukteswar (Abst. M.P. 17). 22.Brown, P.O. and D. Botstein. 1999. Exploring the new world of genome with DNA microarrays. Suppl. Nat. Genet. 21: 33-37. 23.Bar-Oz, B., Preminger, A., Peleg, O., Block, C., Arad, I. 2001. Enterobacter sakazakii infection in the newborn. Acta Paediatrica 90: 356-358. 24.Bowen, A.B., Braden, C.R. 2006. Invasive Enterobacter sakazakii disease in infants. Emerg Infect Dis 12: 1185-1189. 25.Corbel, M.J. and W.J. Brinley-Morgan. 1984. Genus Brucella Meyer and Shaw 1920, 173, p. 377-388. In N. R. Krieg and J. G. Holt (ed.), Bergey ’ s manual of systematic bacteriology, vol. 1. The Williams & Wilkins Co., Baltimore. 26.Chamberlain, J.S., Gibbs, R.A., Ranier, J.E., Nguyen, P.N. and C. T. Caskey. 1988. Deletion screening of the Duchenne muscular dystrophy locus via multiplex DNA amplification. Nucleic Acids Res. 16: 11141-11156. 27.Clark, N.C., Hill, B.C., O'Hara, C.M., Steingrimsson, O., Cooksey, R.C. 1990. Epidemiologic typing of Enterobacter sakazakii in two neonatal nosocomial outbreaks. Diagnostic Microbiology and Infectious Disease 13: 467-472. 28.Catlin, B.W. 1990. Branhamella catarrhalis: an organism gaining respect as a pathogen. Clin. Microbiol. Rev. 4: 293-320. 29.Chan, S.W., Wilson, S.G., Vera-Garcia, M., Whippie, K., Ottaviani, M., Whilby, A., Shah, A., Johnson, A., Mozola, M.A. and D.N. Halbert. 1990. Comparative study of colorimetric DNA hybridization method and conventional culture procedure for detection of Salmonella in foods. J. Assoc. Off. Anal. Chem. 73: 419-424. 30.Curiale, M.S., Klatt, M.J. and M.A. Mozola. 1990. Colorimetric deoxyribonucleic acid hybridization assay for rapid screening of Salmonella in foods: Colaborative study. J. Assoc. Off. Anal. Chem. 73: 248-256. 31.Chiou. A., Chen, L.H. and S.K. Chen. 1991. Foodborne illness in Taiwan, 1987-1989. Food Australia. 43: 70-71. 32.Cudjoe, K.S., Krona, R. and E. Olsen. 1994. IMS: a new selective

enrichment technique for detection of Salmonella in foods. Int. J. Food Microbiol. 23: 159-165. 33.Coleman, D.J., Chick, K.E. and K.J. Nye. 1995. An evaluation of immunomagnetic separation of the detection of salmonellas in raw chicken carcasses. Lett. Appl. Microbiol. 21: 152-154. 34.Chang, T.C. and S.H. Huang. 1997. An immuno-polymerase chain reaction for the detection of β -glucuronudiase from Escherichia coli. J. Immunol. Meth. 208: 35-42. 35.Carlson, S.A., Bolton, L.F., Briggs, C.E., Hurd, H.S., Sharma, V.K., Fedorka, C.P.J. and B.D. Jones. 1999. Detection of multiresistant Salmonella typhimurium DT104 using multiplex and fluorogenic PCR. Mol. Cell Probes. 13: 213-222. 36.Call, D.R., Brockman, F.J. and D.P. Chandler. 2001. Detection and genotyping Escherichia coli O157:H7 using multiplex PCR and nucleic acid microarrays. 67: 71-80. 37.Campbell, G.R., Prosser, J., Glover, A. and K. Killham. 2001. Detection of Escherichia coli O157:H7 in soil and water using multiplex PCR. 91(6): 1004-1010. 38.Chiang, Y.C., Pai, W.Y. Chen, C.Y. and H.Y. Tsen. 2008. Use of primers based on the heat shock protein genes hsp70, hsp40, and hsp10, for the detection of bovine mastitis pathogens Streptococcus agalactiae, Streptococcus uberis and Streptococcus bovis. Molecular and Cellular Probes 22: 262-266. 39.Conceicao, R.C.S., Moreira A.N., Ramos, R.J., Goularte, F.L., Carvalhal, J.B. and J.A.G. Aleixo. 2008. Detection of salmonella sp in chicken cuts using immunomagnetic separation. Braz. J. Microbiol. 39: 173-177. 40.Donnio, P.Y. 1994. Pasteurella, p. 1371-1395. In J. Freney, F. Renaud, W. Hansen, and C. Bollet (ed.), Manual of clinical bacteriology, 2nd ed. Elsevier, Paris, France. 41.Debouck, C. and P.N. Goodfellow. 1999. DNA microarrays in drug discovery and development. Nat. Genet. 21: 48-50. 42.de Saizieu, A., Gardes, C., Flint, N., Wagner, C., Kamber, M., Mitchell, T.J., Keck, W., Amrein, K.E. and R. Lange. 2000. Microarray-based identification of a novel Streptococcus pneumoniae regulon controlled by an autoinduced peptide. J. Bacteriol. 182: 4696-4703. 43.de Paula, A.M.R., Gelli, D.S., Destro, M.L.M.T. and B.D.G. de Melo Franco. 2002. Detection of Salmonella in foods using Tecra Salmonella VIA and Tecra Salmonella UNIQUE rapid immunoassays and a cultural procedure. J. Food Prot. 65: 552-555. 44.Deng, L., Mo, X.T., Zhou Y.P., Lei, H. 2002. Microbalance-DNA probe method for the detection of specific bacteria in water. Enzy Microbio Tech 30: 583-589. 45.Dogan, B., Boor, K.J. 2003. Genetic diversity and spoilage potentials among Pseudomonas spp. isolated from fluid milk products and dairy processing plants. Applied Environnemental Microbiology 69: 130-138. 46.Dufour, D., Nicodeme, M., Perrin, C., Driou, A., Brusseaux, E., Humbert, G., Gaillard, J.L., Dary, A. 2008. Molecular typing of industrial strains of Pseudomonas spp. isolated from milk and genetical and biochemical characterization of an extracellular protease produced by one of them. International Journal of Food Microbiology 125: 188-196. 47.Edwards, M.C. and R.A. Gibbs. 1995. Multiplex PCR, p.157-171. In C. W. Dieffenbach and Dveksler, G. S. (ed.), PCR primer a laboratory manual, CSHL Press, Plainview, New York. 48.Erol, I., Kleer, J., Hildebrandt, G. and A. Yurtyeri. 1999. Coupling of immunomagnetic separation and polymerase chain reaction for the rapid detection of salmonellae in minced meat and chicken giblets. Berl. Munch. Tierarztl. Wochenschr. 112: 100-103. 49.Farmer, J.J., Asbury, M.A., Hickman, F.W., Brenner, D.J. 1980. Enterobacter sakazakii: a new species of "Enterobacteriaceae" isolated from clinical specimens. Int J Syst Bacteriol 30: 569-584. 50.Fitts, R., Diamond, M., Hamilton, C. and M. Neri. 1983. DNA-DNA hybridization assay for detection of Salmonella spp. in foods. Appl. Environ. Microbiol. 46: 1146-1151. 51.Fluit, A.C., Widjojoatmodjo, M.N., Box, A.A., Torensma, R. and J. Verhoef. 1995. Rapid detection of Salmonellae in poultry with the magnetic immuno-polymerase chain reaction assay. Appl. Environ. Microbiol. 59: 1342-1346. 52.Fodor, S.P.A. 1997. Massively parallel genomics. Science. 277: 393-395. 53.FDA/CFSAN - Food Safety A to Z Reference Guide - Salmonella. FDA - Center for Food Safety and Applied Nutrition. 2008-07-03. 54.Guenthner, S.H., Hendley, J.O. and R.P. Wenzel. 1987. Gram-negative bacilli as nontransient flora on the hands of hospital personnel. J. Clin. Microbiol. 25: 488-490. 55.Goldstein, E.J.C. 1992. Bite wounds and infection. Clin. Infect. Dis. 14: 633-640. 56.Gilot, P., Hermans, C., Yde, M., Gigi, J., Janssens, M., Genicot, A., Andre, P. and G. Wauters. 1997. Sporadic case of listeriosis associated with the consumption of a Listeria monocytogenes-contaminated 'Camembert' cheese. J Infect. 35(2): 195-197. 57.Gooding, C.M. and P.V. Choudary. 1997. Rapid and sensitive Immunomagnetic separation polymerase chain reaction method for the detection of Escherichia coli O157:H7 in raw milk and ice cream. J. Dairy Res. 64: 87-93. 58.Gonzalez, A.J., Landeras, E., Mendoza, M.C. 2000. Pathovars of Pseudomonas syringae causing bacterial brown spot and halo blight in Phaseolus vulgaris L. are distinguishable by ribotyping. Applied and Environmental Microbiology 66: 850-854. 59.Gahan, C. G., and C. Hill. 2005. Gastrointestinal phase of Listeria monocytogenes infection. J. Appl. Microbiol. 98: 1345-1353. 60.Gaynes, R., and J.R. Edwards. 2005. Overview of nosocomial infections caused by gram-negative bacilli. Clin. Infect. Dis. 41: 848-854. 61.Huang, Y.H., Chang, H.C. and T.C. Chang. 2001. Development of a latex agglutination test for rapid identification of Escherichia coli. Eur. J. Clin. Microbiol. Infect. Dis. 20: 97-103. 62.Janda, J.M., Duffey, P.S. 1988. Mesophilic aeromonads in human disease: current taxonomy, laboratory identification, and infectious disease spectrum. Reviews in Infectious Diseases, 10: 980-987. 63.Janda, J.M., Abbott, S.L. 1996. Human pathogens. In: Austin B et al., eds. The genus Aeromonas. London, Wiley: 151-173. 64.James, B.R., Francisco, D.G. and N.J. Graeme. 2000. Potential effect of cattle diets on the transmission of pathogenic Escherichia coli to human. Micro and Infect. 2: 45-53. 65.Jenikova, G., Pazlarova, J. and K. Demnerova. 2000. Detection of Salmonella in food samples by the combination of Immunomagnetic separation and PCR assay. Int Microbiol. 3(4): 225-229. 66.Johnson, J.R. 2000. Development of polymerase chain reaction-based assays for bacterial gene detection. Journal of Microbiological methods. 41: 201-209. 67.Jay, M.T., Cooley, M., Carychao, D., Wiscomb, G.W., Sweitzer, R.A., Crawford-Miksza, L., Farrar, J.A., Lau, D.K., O ' Connell, J., Millington, A., Asmundson, R.V., Atwill, E.R., and R.E. Mandrell. 2007. Escherichia coli O157:H7 in feral swine near spinach fields and cattle, central California coast. Emerg. Infect. Dist. 13: 1908-1911. 68.Kloos, W.E. and M.S. Musselwhite. 1975. Distribution and persistence of Staphylococcus and Micrococcus species and other aerobic bacteria on human skin. Appl. Microbiol. 30: 381-385. 69.Khan, A.A., Nawaz, M.S., Khan, S.A. and C. E. Cerniglia. 2000. Detection of multidrug-resistant Salmonella typhimurium DT104 by multiplex polymerase chain reaction. FEMS Microbiol. Lett. 182: 355-360. 70.Kumar, A., Bachhil, V.N., Bhilegaonkar, K.N., Agarwal, R.K. 2001. Occurrence of enterotoxigenic Aeromonas species in foods. J. Commun. Dis. 32: 169-174.

71.Kuhnert, P., Christensen, H. 2008. Pasteurellaceae: Biology, Genomics and Molecular Aspects. Caister Academic Press. ISBN 978-1-904455-34-9. 72.Larson, E.L. 1981. Persistent carriage of gram-negative bacteria on hands. Am. J. Infect. Control 9: 112-119. 73.Levine, M.M. 1987. Escherichia coli that cause diarrhea: enterotoxigenic, enteropathogenic, enteroinvasive, enterohemorrhagic, and enteroadherent. J. Infect. Diseases. 155: 377-389. 74.Lin, C.K. and H.Y. Tsen. 1995. Development and evaluation of two novel oligonucleotide probes based on 16S rRNA sequence for the identification of Salmonella in foods. J. Appl. Microbiol. 78: 507-520. 75.Lee, C.Y., Pan, S. F., and C.H. Chen. 1995a. Sequence of a cloned pR72H fragment and its use for detection of Vibrio parahaemolyticus in shellfish with the PCR. Appl. Environ. Microbiol. 61(4): 1311-1317. 76.Lee, C.Y., Chen, C.H., and Y.W. Chou. 1995b. Characterization of a cloned pR72H probe for Vibrio parahaemolyticus detection and development of a nonisotopic colony hybridization assay. Microbiol. Immunol. 39(3): 177-183. 77.Li, X., Boudjellab, N. and X. Zhao. 2000. Combined PCR and slot blot assay for detection of Salmonella and Listeria monocytogenes. Int. J. Food Microbiol. 56: 167-177. 78.Lucchini, S., Thompson, A. and J.C.D. Hinton. 2001. Microarrays for microbiologists. Microbiology. 147: 1403-1414. 79.Lin, C.K. and J.C. Lin. 2007. Development of PCR primers based on a fragment from randomly amplified DNA for the detection of Escherichia coli O157:H7/NM. Mol. Cel. Probes. 21: 182-189. 80.Muytjens, H.L., Kollee, L.A. 1982. Neonatal meningitis due to Enterobacter sakazakii. Tijdschr Kindergeneeskunde 50: 110-112. 81.Mullis, K.B. and F. A. Faloona. 1987. Specific synthesis of DNA in vitro via a polymerase catalyzed chain reaction. In Methods Enzymology (Ed. R. Wu) pp. 335-350. Vol. 155. Academic Press Inc., San Diego, CA. 82.Mawas, F., Ho, M.M., Corbel, M.J. 2009. Current progress with Moraxella catarrhalis antigens as vaccine candidates. Expert Rev Vaccines 8(1): 77-90. 83.Medici, D.D., Anniballi, F., Wyatt, G.M., Lindstro··m, M., Messelha··user, U., Aldus, C.F., Delibato, E., Korkeala, H., Peck, M.W., and L. Fenicia. 2009. Multiplex PCR for Detection of Botulinum Neurotoxin-Producing Clostridia in Clinical, Food, and Environmental Samples. Appl. Environ. Microbiol. 75: 6457-6461. 84.Nichols, G.L. et al. 1996. Health significance of bacteria in distribution systems-review of Aeromonas. London, UK Water Industry Research Ltd (Report DW-02/A). 85.Neyts, K., Huys, G., Uyttendaele, M., Swings, J., Debevere, J. 2000. Incidence and identification of mesophilic Aeromonas spp. from retail foods. Lett. Appl. Microbiol. 31, 359. 86.Ogunjimi, A.A. and P. V. Choudary. 1999. Adsorption of endogenous polyphenols relieves the inhibition by fruit juices and fresh produce of immuno-PCR detection of Escherichia coli O157:H7. FEMS Immunol. Med. Microbiol. 23: 213-220. 87.Ozbalci, D., Ergene, U., Cetin, C.B. 2010. Brucellosis: a rare cause of febrile neutropenia in acute myeloblastic leukemia. 88.Popoff, M. 1984. Genus III Aeromonas Kluyver and van Niel 1936 398AL. In: Krieg NR, Holt JG, eds. Bergey ' s manual of systematic bacteriology, Vol. 1.Baltimore, MD, Williams & Wilkins: 545-548. 89.Perez, J.L., Pulido, A., Pantozzi, F. and R. Martin. 1990. Butyrate esterase (tributyrin) spot test, a simple method for immediate identification of Moraxella (Branhamella) catarrhalis. J. Clin. Microbiol. 28: 2347-2348. 90.Peterkin, P.I., Idziak, E.S. and A.N. Sharpe. 1991. Detection of Listeria monocytogenes by direct colony hybridization on hydrophobic grid-membrane filters by using a chromogen-labeled DNA probe. Appl. Environ. Microbiol. 57: 586-591. 91.Palleroni, N.J. 1992. Human- and animal-pathogenic pseudomonads. In: Balows, A., Truper, H.G., Dworkin, M., Harder, W., Schleifer, K.H. (Eds.), The Prokaryotes. A Handbook on the Biology of Bacteria: Ecophysiology, Isolation, Identification, Applications. Springer-Verlag, New-York, pp. 3086-3103. 92.Pan, T.M., Wang, T.K., Lee, C.C., Chien, S.W. and C.B. Horng. 1997. Food-borne disease outbreaks due to bacteria in Taiwan, 1986 to 1995. J. Clin. Microbiol. 35: 1260-1262. 93.Pijoan, C. 1999. Pneumonic pasteurellosis, p. 511-520. In B. E. Straw, S. D ' Alliare, W. L. Mengeling, and D. J. Taylor (ed.), Diseases of swine, 8th ed. Iowa State University Press, Ames, Iowa. 94.Park, S.C., Shimamura, I., Fukunaga, M., Mori, K.I., Nakai, T. 2000. Isolation of bacteriophages specific to fish pathogen, Pseudomonas plecoglossicida, as a candidate for disease control. Applied and Environmental Microbiology 66: 1416-1422. 95.Peter, K., Ptrick, B. and F. Joachim. 2000. Target genes for virulence assessment of Escherichia coli isolates from water, food and the environment. FEMS Microbiology Reviews. 24: 107-117. 96.Perez-Roth, E., Claverie-Martin, F., Villar, J. and S. Mendez-Alvarez. 2001. Multiplex PCR for simultaneous identification of Staphylococcus aureus and detection of methicillin and mupirocin resistance. J. Clin. Microbiol. 39(11): 4037-4041. 97.Probert, W.S., Schrader, M.N., Khuong, N.Y., Bystrom, S.L. and M.H. Graves. 2004. Real-time multiplex PCR assay for detection of Brucella spp., B. abortus, and B. melitensis. J. Clin. Microbiol. 42: 1290-1293. 98.Phrommanich, S., Suanjit, S., Upatham, S., Grams, S.V., Kruatrachue, M., Pokethitiyook, P., Korge, G., Hofmann, A. 2009. Quantitative detection of the oil-degrading bacterium Acinetobacter sp. strain MUB1 by hybridization probe based real-time PCR. Microbiol Res 164(4): 486-92. 99.Rijpens, N., Herman, L., Vereecken, F., Jannes, G., Smedt, J.D. and L. D. Zutter. 1999. Rapid detection of stressed Salmonella spp. in dairy and egg products using immunomagnetic separation and PCR. Int. J. Food Microbiol. 46: 37-44. 100.Russo, T.A., Beanan, J.M., Olson, R., MacDonald, U., Luke, N.R., Gill, S.R., and A. Campagnari. 2008. Rat Pneumonia and Soft-Tissue Infection Models for the Study of Acinetobacter baumannii Biology. Infect. Immun. 76: 3577-3586. 101.Simmons, B.P., Gelfand, M.S., Haas, M., Metts, L., Ferguson, J. 1989. Enterobacter sakazakii infections in neonates associated with intrinsic contamination of a powdered infant formula. Infection Control Hospital Epidemiology 10: 398-401. 102.Schena, M., Shalon, D., Davis, R.W. and P.O. Brown. 1995. Quantitative monitoring of gene expression patterns with a complementary DNA microarray. Science. 270: 467-470. 103.Shaw, S.J., Blais, B.W. and Nundy, D.C. 1998. Performance of the Dynabeads anti-Salmonella system in the detection of Salmonella species in foods, animal feeds, and environmental samples. J. Food Prot. 61: 1507-1510. 104.Schlosser, W., Hogue, A., Ebel, E., Rose, B., Umholtz, R., Ferris, K. and W. James. 2000. Analysis of Salmonella serotypes from selected carcasses and raw ground products sampled prior to implementation of the pathogen reduction; hazard analysis and critical control point final rule in the US. Int. J. Food Microbiol. 30: 107-111. 105.Sargeant, J.M., Sanderson, M.W., Smith, R.A. and D.D. Griffin. 2003. Escherichia coli O157 in feedlot cattle feces and water in four major feedercattle states in the U. S. A. Prev. Vet. Med. 61: 127-135. 106.Sears, P.M. and K.K. McCarthy. 2003. Management and treatment of staphylococcal mastitis. Vet. Clin. Food Anim. 19: 171-185. 107.Sasaki, T., Tsubakishita, S.,

Tanaka, Y., Sakusabe, A., Ohtsuka, M., Hirotaki, S., Kawakami, T., Fukata, T., and K. Hiramatsu. 2010. Multiplex-PCR Method for Species Identification of Coagulase-Positive Staphylococci. J. Clin. Microbiol. 48: 765-769. 108.Tsen, H.Y., Wang, S. J., Roe, B. A., and Green, S. S. 1991. DNA sequence of a Salmonella-specific DNA fragment and the use of oligonucleotide probes for Salmonella detection. Appl. Microbiol. Biotechnol. 35(3):339-47. 109.Tsai, G.J., Chen, T.H. 1996. Incidence and toxigenicity of Aeromonas hydrophila in seafood. Int. J. Food Microbiol. 31: 121-131. 110.Tsen, H.Y., Jian, L.Z., Chi, W.R. 1998. Use of a multiplex PCR system for the simultaneous detection of heat labile toxin I and heat stable toxin II genes of enterotoxigenic Escherichia coil in skim milk and porcine stool. J Food Prot. 1; 61(2): 141-145. 111.Talan, D.A., Citron, D.M., Abrahamian, F.M., Moran, G.J., and E.J.C. Goldstein. 1999. Bacteriologic analysis of infected dog and cat bites. N. Engl. J. Med. 340: 85-92. 112.Trijbel-Smeulders, M.A.J.M., Adriaanse, A.H., Gerards, L.J., Kimoen, L.L. 2003. Strategy to prevent neonatal early-onset group B streptococcal disease in the Netherlands. Rev Med Microbiol 14: 35-39. 113.Tsai, T., Luo, W., Wu, F. and T. Pan. 2005. Molecular subtyping for Escherichia coli O157:H7 isolated in Taiwan. Microbiol. Immunol. 49: 579-588. 114.Teel, L.D., Daly, J.A., Jerris, R.C., Maul, D., Svanas, G., O ' Brien, A.D. and C.H. Park. 2007. Rapid Detection of Shiga Toxin-Producing Escherichia coli by Optical Immunoassay. J. Clin. Microbiol. 45: 3377-3380. 115.Uraz, G., Citak, S. 1998. The isolation of Pseudomonas and other Gram(?) psychrotrophic bacteria in raw milks. Journal of Basic Microbiology 38: 129-134. 116.Verger, J.M., Grimont, F., Grimont, P.A.D. and M. Grayon. 1985. Brucella, a monospecific genus as shown by deoxyribonucleic acid hybridization. Int. J. Syst. Bacteriol. 35: 292-295. 117.Vaneechoutte, M., Verschraegen, G., Claeys, G., Weise, B. and A.M. Van den Abeele. 1990. Respiratory tract carrier rates of Moraxella (Branhamella) catarrhalis in adults and children and interpretation of the isolation of M. catarrhalis from sputum. J. Clin. Microbiol. 28: 2674-2680. 118.van Acker, J., de Smet, F., Muyldermans, G., Bougatef, A., Naessens, A., Lauwers, S. 2001. Outbreak of necrotizing enterocolitis associated with Enterobacter sakazakii in powdered milk formula. Journal of Clinical Microbiology 39: 293-297. 119.Wernars, K., Heuvelman, C.J., Chakraborty, T. and S.H.W. Notermans. 1991. Use of the polymerase chain reaction for direct detection of Listeria monocytogenes in soft cheese. J. Appl. Bacteriol. 70: 121-126. 120.Widjojoatmodjo, M.N., Fluit, A.C., Torensma, R., Verdonk, G.P. and J. Verhodf. 1992. The magnetic immuno polymerase chain reaction assay for direct detection of Salmonellae in fecal samples. J. Clin. Micrbiol. 30: 3195-3199. 121.Watanabe, H., Wada, A., Inagaki, Y., Itoh, K. and K. Tamura. 1996. Outbreaks of enterohaemorrhagic Escherichia coli O157:H7 infection by two different genotype strains in Japan, 1996. Lancet 348: 831-832. 122.Wilson, M., DeRisi, J., Kristensen, H.H., Imboden, P., Rane, S., Brown, P.O. and G.K. Schoolnik. 1999. Exploring drug-induced alterations in gene expression in Mycobacterium tuberculosis by microarray hybridization. Proc Natl Acad Sci USA 96: 12833-12838. 123.Weir, E. 2002. Powdered infant formula and fatal infection with Enterobacter sakazakii. Canadian Medical Association Journal 166: 1570. 124.Whelan, C. et al. 2008. Multiplex Immunoassay for Serological Diagnosis of Mycobacterium bovis Infection in Cattle. Clin. Vaccine Immunol. 15: 1834-1838. 125.Ye, R.W., Tao, W., Bedzyk, L. and K. M. Croker. 2001. Applications of DNA microarrays in microbial systems. Journal of Microbiological Methods. 47: 257-272. 126.Yucel, N., Citak, S. 2003. The occurrence, hemolytic activity and antibiotic susceptibility of motile Aeromonas spp. isolated from meat and milk samples in Turkey. J. Food Saf. 23: 189-200. 127.Yucel, N., Erdem, B. 2004. The isolation and identification of motile Aeromonas spp. from meats in Ankara Turkey. Indian Vet. J. 81: 967-970. 128.Yu, S., Gu, X.X. 2007. Biological and immunological characteristics of lipooligosaccharide-based conjugate vaccines for serotype C Moraxella catarrhalis. Infect. Immun. 75(6): 2974-2980. 129.Zeng, X., Kong, F., Wang, H., Darbar A., and G. L. Gilbert. 2006. Simultaneous detection of nine antibiotic resistance-related genes in Streptococcus agalactiae using multiplex PCR and reverse line blot hybridization assay. Antimicrob. Agents Chemother. 50(1): 204-209.