

## REFERENCES

- [1] Dursun, B., Bestan, F., Artac, M., Varan, H.I. and Suleymanlar, G. Severe pulmonary haemorrhage accompanying hepatorenal failure in fulminant leptospirosis. *Int J Clin Pract* 61,1 (2007): 164-167.
- [2] Palaniappan, R.U., Ramanujam, S. and Chang, Y.T. Leptospirosis: pathogenesis, immunity, and diagnosis. *Curr Opin Infect Dis* 20,3 (2007): 284-292.
- [3] Sitprija, V., Losuwanrak, K. and Kanjanabuch, T. Leptospiral nephropathy. *Semin Nephrol* 23,1 (2003): 42-48.
- [4] Lee, S.H., Kim, K.A., Park, Y.G., Seong, I.W., Kim, M.J. and Lee, Y.J. Identification and partial characterization of a novel hemolysin from *Leptospira interrogans* serovar Lai. *Gene* 254,1-2 (2000): 19-28.
- [5] Cullen, P.A., Cordwell, S.J., Bulach, D.M., Haake, D.A. and Adler, B. Global analysis of outer membrane proteins from *Leptospira interrogans* serovar Lai. *Infect Immun* 70,5 (2002): 2311-2318.
- [6] Cullen, P.A., Haake, D.A., Bulach, D.M., Zuerner, R.L. and Adler, B. LipL21 is a novel surface-exposed lipoprotein of pathogenic *Leptospira* species. *Infect Immun* 71,5 (2003): 2414-2421.
- [7] Lee, S.H., Kim, S., Park, S.C. and Kim, M.J. Cytotoxic activities of *Leptospira interrogans* hemolysin SphH as a pore-forming protein on mammalian cells. *Infect Immun* 70,1 (2002): 315-322.
- [8] Matsunaga, J., Barocchi, M.A., Croda, J., Young, T.A., Sanchez, Y., Siqueira, I., et al. Pathogenic *Leptospira* species express surface-exposed proteins belonging to the bacterial immunoglobulin superfamily. *Mol Microbiol* 49,4 (2003): 929-945.
- [9] Nally, J.E., Chow, E., Fishbein, M.C., Blanco, D.R. and Lovett, M.A. Changes in lipopolysaccharide O antigen distinguish acute versus chronic *Leptospira interrogans* infections. *Infect Immun* 73,6 (2005): 3251-3260.
- [10] Werts, C., Tapping, R.L., Mathison, J.C., Chuang, T.H., Kravchenko, V., Saint Girons, I., et al. Leptospiral lipopolysaccharide activates cells through a TLR2-dependent

- mechanism. Nat Immunol 2,4 (2001): 346-352.
- [11] Zhang, Y.X., Geng, Y., Yang, J.W., Guo, X.K. and Zhao, G.P. Cytotoxic activity and probable apoptotic effect of Sph2, a sphingomyelinase hemolysin from *Leptospira interrogans* strain Lai. BMB Rep 41,2 (2008): 119-125.
- [12] Naiman, B.M., Alt, D., Bolin, C.A., Zuerner, R. and Baldwin, C.L. Protective killed *Leptospira borgpetersenii* vaccine induces potent Th1 immunity comprising responses by CD4 and gammadelta T lymphocytes. Infect Immun 69,12 (2001): 7550-7558.
- [13] de Fost, M., Hartskeerl, R.A., Groenendijk, M.R. and van der Poll, T. Interleukin 12 in part regulates gamma interferon release in human whole blood stimulated with *Leptospira interrogans*. Clin Diagn Lab Immunol 10,2 (2003): 332-335.
- [14] Klimpel, G.R., Matthias, M.A. and Vinetz, J.M. *Leptospira interrogans* activation of human peripheral blood mononuclear cells: preferential expansion of TCR gamma delta+ T cells vs TCR alpha beta+ T cells. J Immunol 171,3 (2003): 1447-1455.
- [15] Vernel-Pauillac, F. and Merien, F. Proinflammatory and immunomodulatory cytokine mRNA time course profiles in hamsters infected with a virulent variant of *Leptospira interrogans*. Infect Immun 74,7 (2006): 4172-4179.
- [16] Diamant, D., Brunialti, M.K., Romero, E.C., Kallas, E.G. and Salomao, R. Peripheral blood mononuclear cell activation induced by *Leptospira interrogans* glycolipoprotein. Infect Immun 70,4 (2002): 1677-1683.
- [17] Dorigatti, F., Brunialti, M.K., Romero, E.C., Kallas, E.G. and Salomao, R. *Leptospira interrogans* activation of peripheral blood monocyte glycolipoprotein demonstrated in whole blood by the release of IL-6. Braz J Med Biol Res 38,6 (2005): 909-914.
- [18] Yang, C.W., Wu, M.S., Pan, M.J., Hong, J.J., Yu, C.C., Vandewalle, A., et al. *Leptospira* outer membrane protein activates NF-kappaB and downstream genes expressed in medullary thick ascending limb cells. J Am Soc Nephrol 11,11 (2000): 2017-2026.
- [19] Tian, Y.C., Chen, Y.C., Hung, C.C., Chang, C.T., Wu, M.S., Phillips, A.O., et al. *Leptospira* outer membrane protein induces extracellular matrix accumulation through a TGF-beta1/Smad-dependent pathway. J Am Soc Nephrol 17,10 (2006): 2792-2798.

- [20] Levett, P.N. Leptospirosis. *Clin Microbiol Rev* 14,2 (2001): 296-326.
- [21] Barnett, J.K., Barnett, D., Bolin, C.A., Summers, T.A., Wagar, E.A., Cheville, N.F., et al. Expression and distribution of leptospiral outer membrane components during renal infection of hamsters. *Infect Immun* 67,2 (1999): 853-861.
- [22] Haake, D.A., Mazel, M.K., McCoy, A.M., Milward, F., Chao, G., Matsunaga, J., et al. Leptospiral outer membrane proteins OmpL1 and LipL41 exhibit synergistic immunoprotection. *Infect Immun* 67,12 (1999): 6572-6582.
- [23] Praditpomsilpa, K., Sangjun, N., Kittikowit, W., Phulsuksombati, D., Avihingsanon, Y., Kansanabuch, T., et al. Alleviation of renal and pulmonary injury by immunomodulation in leptospirosis: hamster model. *J Med Assoc Thai* 89 Suppl 2,(2006): S178-187.
- [24] Muensoongnoen, J., Phulsuksombati, D., Parichatikanond, P., Sangjan, N., Pilakasiri, C., Sripaoraya, K., et al. A histopathological study of hearts and spleens of hamsters (*Mesocricetus auratus*) infected with *Leptospira interrogans*, serovar Pyrogenes. *Southeast Asian J Trop Med Public Health* 37,4 (2006): 720-728.
- [25] Cinco, M., Vecile, E., Murgia, R., Dobrina, P. and Dobrina, A. *Leptospira interrogans* and *Leptospira peptidoglycans* induce the release of tumor necrosis factor alpha from human monocytes. *FEMS Microbiol Lett* 138,2-3 (1996): 211-214.
- [26] Yang, C.W., Hung, C.C., Wu, M.S., Tian, Y.C., Chang, C.T., Pan, M.J., et al. Toll-like receptor 2 mediates early inflammation by leptospiral outer membrane proteins in proximal tubule cells. *Kidney Int* 69,5 (2006): 815-822.
- [27] Athanazio, D.A., Santos, C.S., Santos, A.C., McBride, F.W. and Reis, M.G. Experimental infection in tumor necrosis factor alpha receptor, interferon gamma and interleukin 4 deficient mice by pathogenic *Leptospira interrogans*. *Acta Trop* 105,1 (2008): 95-98.
- [28] Petros, S., Leonhardt, U. and Engelmann, L. Serum procalcitonin and proinflammatory cytokines in a patient with acute severe leptospirosis. *Scand J Infect Dis* 32,1 (2000): 104-105.
- [29] De Fost, M., Chierakul, W., Limpiboon, R., Dondorp, A., White, N.J. and van Der Poll, T.

- Release of granzymes and chemokines in Thai patients with leptospirosis. *Clin Microbiol Infect* 13,4 (2007): 433-436.
- [30] Haake, D.A., Chao, G., Zuerner, R.L., Barnett, J.K., Barnett, D., Mazel, M., et al. The leptospiral major outer membrane protein LipL32 is a lipoprotein expressed during mammalian infection. *Infect Immun* 68,4 (2000): 2276-2285.
- [31] Boonyod, D., Poovorawan, Y., Bhattarakosol, P. and Chirathaworn, C. LipL32, an outer membrane protein of *Leptospira*, as an antigen in a dipstick assay for diagnosis of leptospirosis. *Asian Pac J Allergy Immunol* 23,2-3 (2005): 133-141.
- [32] Zhang, X.Y., Yu, Y., He, P., Zhang, Y.X., Hu, B.Y., Yang, Y., et al. Expression and comparative analysis of genes encoding outer membrane proteins LipL21, LipL32 and OmpL1 in epidemic leptospires. *Acta Biochim Biophys Sin (Shanghai)* 37,10 (2005): 649-656.
- [33] Yang, C.W., Wu, M.S., Pan, M.J., Hsieh, W.J., Vandewalle, A. and Huang, C.C. The *Leptospira* outer membrane protein LipL32 induces tubulointerstitial nephritis-mediated gene expression in mouse proximal tubule cells. *J Am Soc Nephrol* 13,8 (2002): 2037-2045.
- [34] Bomfim, M.R., Ko, A. and Koury, M.C. Evaluation of the recombinant LipL32 in enzyme-linked immunosorbent assay for the serodiagnosis of bovine leptospirosis. *Vet Microbiol* 109,1-2 (2005): 89-94.
- [35] Tahiliani, P., Kumar, M.M., Chandu, D., Kumar, A., Nagaraj, C. and Nandi, D. Gel purified LipL32: a prospective antigen for detection of leptospirosis. *J Postgrad Med* 51,3 (2005): 164-168.
- [36] Flannery, B., Costa, D., Carvalho, F.P., Guerreiro, H., Matsunaga, J., Da Silva, E.D., et al. Evaluation of recombinant *Leptospira* antigen-based enzyme-linked immunosorbent assays for the serodiagnosis of leptospirosis. *J Clin Microbiol* 39,9 (2001): 3303-3310.
- [37] Branger, C., Chatrenet, B., Gauvrit, A., Aviat, F., Aubert, A., Bach, J.M., et al. Protection against *Leptospira interrogans* sensu lato challenge by DNA immunization with the gene encoding hemolysin-associated protein 1. *Infect Immun* 73,7 (2005):

- 4062-4069.
- [38] Gsell, O. The history of leptospirosis: 100 years. Zentralbl Bakteriol Mikrobiol Hyg [A] 257,4 (1984): 473-478.
- [39] Weil, A. Ueber eine eigentümliche, mit Milztumor, Icterus und Nephritis einhergehende akute Infektionskrankheit. Dtsche. Arch. Klin. Med. 39,(1886): 209-232.
- [40] Stimson, A.M. Note on an organism found in yellow-fever tissue. Public Health Reports 22,(1907): 541.
- [41] Yunibandha, J. First report of Weil's disease in Thailand. Med Assoc Thailand 26,(1943): 83-136.
- [42] Swain, R.H.A. The electron-microscopical anatomy of *Leptospira canicola*. J. Pathol. Bacteriol. 73,(1957): 155-158.
- [43] Trueba, G.A., C. A. Bolin, and R. L. Zuerner. Characterization of the periplasmic flagellum proteins of *Leptospira interrogans*. J. Bacteriol. 174,(1992): 4761-4768.
- [44] Ellis, W.A., Hovind-Hougen, K., Moller, S. and Birch-Andresen, A. Morphological changes upon subculturing of freshly isolated strains of *Leptospira interrogans* serovar Hardjo. Zentralbl Bakteriol Mikrobiol Hyg [A] 255,2-3 (1983): 323-335.
- [45] Haake, D.A. Spirochaetal lipoproteins and pathogenesis. Microbiology 146 ( Pt 7),(2000): 1491-1504.
- [46] Shimizu, T., E. Matsusaka, K. Takayanagi, T. Masuzawa, Y. Iwamoto, T. and Morita, I.M., and Y. Yanagihara. Biological activities of lipopolysaccharide-like substance (LLS) extracted from *Leptospira interrogans* serovar Canicola strain Moulton. Microbiol. Immunol. 31,(1987): 727-735.
- [47] Vinh, T., Adler, B. and Faine, S. Glycolipoprotein cytotoxin from *Leptospira interrogans* serovar Copenhageni. J Gen Microbiol 132,1 (1986): 111-123.
- [48] Sonrier, C., Branger, C., Michel, V., Ruvoen-Clouet, N., Ganiere, J.P. and Andre-Fontaine, G. Evidence of cross-protection within *Leptospira interrogans* in an experimental model. Vaccine 19,1 (2000): 86-94.
- [49] Turner, L.H. Leptospirosis. 3. Maintenance, isolation and demonstration of leptospire. Trans R Soc Trop Med Hyg 64,4 (1970): 623-646.

- [50] Ellinghausen, H.C., Jr. and McCullough, W.G. Nutrition of *Leptospira Pomona* and growth of 13 other serotypes: fractionation of oleic albumin complex and a medium of bovine albumin and polysorbate 80. Am J Vet Res 26,(1965): 45-51.
- [51] Johnson, R.C., Walby, J., Henry, R.A. and Auran, N.E. Cultivation of parasitic leptospire: effect of pyruvate. Appl Microbiol 26,1 (1973): 118-119.
- [52] Ellis, W.A., O'Brien, J.J., Pearson, J.K. and Collins, D.S. Bovine leptospirosis: infection by the Hebdomadis serogroup and mastitis. Vet Rec 99,19 (1976): 368-370.
- [53] Johnson, R.C. and Rogers, P. 5-fluorouracil as a selective agent for growth of leptospirae. J Bacteriol 87,(1964): 422-426.
- [54] Palit, A., Haylock, L.M. and Cox, J.C. Storage of pathogenic leptospire in liquid nitrogen. J Appl Bacteriol 61.5 (1986): 407-411.
- [55] Roth, E.E., Linder, D. and Adams, W.V. The use of agar plates as an aid for the isolation of leptospire. Am J Vet Res 22,(1961): 308-312.
- [56] Tripathy, D.N., Hanson, L.E. and Jones, F.C., 3rd Growth of hebdomadis group of leptospire in solid medium. Am J Vet Res 41.7 (1980): 1153-1154.
- [57] Rule, P.L. and Alexander, A.D. Gellan gum as a substitute for agar in leptospiral media. J Clin Microbiol 23.3 (1986): 500-504.
- [58] Thiermann, A.B. Use of solid medium for isolation of leptospire of the Hebdomadis serogroup from bovine milk and urine. Am J Vet Res 42.12 (1981): 2143-2145.
- [59] Stamm, L.V. and Charon, N.W. Plate assay for detection of *Leptospira interrogans* serovar Pomona hemolysin. J Clin Microbiol 10,4 (1979): 590-592.
- [60] Paster, B.J., Dewhirst, F.E., Weisburg, W.G., Tordoff, L.A., Fraser, G.J., Hespell, R.B., et al. Phylogenetic analysis of the spirochetes. J Bacteriol 173,19 (1991): 6101-6109.
- [61] Baril, C. and Saint Girons, I. Sizing of the *Leptospira* genome by pulsed-field agarose gel electrophoresis. FEMS Microbiol Lett 59,1-2 (1990): 95-99.
- [62] Zuerner, R.L. Physical map of chromosomal and plasmid DNA comprising the genome of *Leptospira interrogans*. Nucleic Acids Res 19,18 (1991): 4857-4860.
- [63] Takahashi, Y., Akase, K., Hirano, H. and Fukunaga, M. Physical and genetic maps of the *Leptospira interrogans* serovar Icterohaemorrhagiae strain Ictero no.1 chromosome

- and sequencing of a 19-kb region of the genome containing the 5S rRNA gene. Gene 215,1 (1998): 37-45.
- [64] Fukunaga, M. and Mifuchi, I. The number of large ribosomal RNA genes in *Leptospira interrogans* and *Leptospira biflexa*. Microbiol Immunol 33,6 (1989): 459-466.
- [65] Baril, C., Herrmann, J.L., Richaud, C., Margarita, D. and Girons, I.S. Scattering of the rRNA genes on the physical map of the circular chromosome of *Leptospira interrogans* serovar Icterohaemorrhagiae. J Bacteriol 174,23 (1992): 7566-7571.
- [66] Fukunaga, M. and Mifuchi, I. Unique organization of *Leptospira interrogans* rRNA genes. J Bacteriol 171,11 (1989): 5763-5767.
- [67] Ding, M. and Yelton, D.B. Cloning and analysis of the *leuB* gene of *Leptospira interrogans* serovar Pomona. J Gen Microbiol 139,5 (1993): 1093-1103.
- [68] Richaud, C., Margarita, D., Baranton, G. and Saint Girons, I. Cloning of genes required for amino acid biosynthesis from *Leptospira interrogans* serovar Icterohaemorrhagiae. J Gen Microbiol 136,4 (1990): 651-656.
- [69] Fukunaga, M., Horie, I., Mifuchi, I. and Takemoto, M. Cloning, characterization and taxonomic significance of genes for the 5S ribosomal RNA of *Leptonema illini* strain 3055. J Gen Microbiol 137,7 (1991): 1523-1528.
- [70] Zuerner, R.L., Hartskeerl, R.A., van de Kemp, H. and Bal, A.E. Characterization of the *Leptospira interrogans* S10-*spe-alpha* operon. FEMS Microbiol Lett 182,2 (2000): 303-308.
- [71] Renesto, P., Lorvellec-Guillon, K., Drancourt, M. and Raoult, D. *rpoB* gene analysis as a novel strategy for identification of spirochetes from the genera *Borrelia*, *Treponema*, and *Leptospira*. J Clin Microbiol 38,6 (2000): 2200-2203.
- [72] Stamm, L.V., Parrish, E.A. and Gherardini, F.C. Cloning of the *recA* gene from a free-living leptospire and distribution of RecA-like protein among spirochetes. Appl Environ Microbiol 57,1 (1991): 183-189.
- [73] Ballard, S.A., Segers, R.P., Bleumink-Pluym, N., Fyfe, J., Faïne, S. and Adler, B. Molecular analysis of the *hsp (groE)* operon of *Leptospira interrogans* serovar Copenhageni. Mol Microbiol 8,4 (1993): 739-751.



- [74] Segers, R.P., van der Drift, A., de Nijs, A., Corcione, P., van der Zeijst, B.A. and Gaastra, W. Molecular analysis of a sphingomyelinase C gene from *Leptospira interrogans* serovar Hardjo. *Infect Immun* 58,7 (1990): 2177-2185.
- [75] Doherty, J.P., Adler, B., Rood, J.I., Billington, S.J. and Faine, S. Expression of two conserved leptospiral antigens in *Escherichia coli*. *J Med Microbiol* 28,2 (1989): 143-149.
- [76] Haake, D.A., Champion, C.I., Martinich, C., Shang, E.S., Blanco, D.R., Miller, J.N., et al. Molecular cloning and sequence analysis of the gene encoding OmpL1, a transmembrane outer membrane protein of pathogenic *Leptospira* spp. *J Bacteriol* 175,13 (1993): 4225-4234.
- [77] Lin, M., Bughio, N. and Surujballi, O. Expression in *Escherichia coli* of flaB, the gene coding for a periplasmic flagellin of *Leptospira interrogans* serovar Pomona. *J Med Microbiol* 48,11 (1999): 977-982.
- [78] Lin, M., Surujballi, O., Nielsen, K., Nadin-Davis, S. and Randall, G. Identification of a 35-kilodalton serovar-cross-reactive flagellar protein, FlaB, from *Leptospira interrogans* by N-terminal sequencing, gene cloning, and sequence analysis. *Infect Immun* 65,10 (1997): 4355-4359.
- [79] Mitchison, M., Bulach, D.M., Vinh, T., Rajakumar, K., Faine, S. and Adler, B. Identification and characterization of the dTDP-rhamnose biosynthesis and transfer genes of the lipopolysaccharide-related rfb locus in *Leptospira interrogans* serovar Copenhageni. *J Bacteriol* 179,4 (1997): 1262-1267.
- [80] Herrmann, J.L., Bakoss, P., Korver, H., Bulu, A.A., Bellenger, E., Terpstra, W.J., et al. A new serovar in the Grippotyphosa serogroup comprising leptospiral isolates from different regions. *Int J Syst Bacteriol* 44,2 (1994): 362-364.
- [81] Ramadass, P., Jarvis, B.D., Corner, R.J., Cinco, M. and Marshall, R.B. DNA relatedness among strains of *Leptospira biflexa*. *Int J Syst Bacteriol* 40,3 (1990): 231-235.
- [82] Brenner, D.J., Kaufmann, A.F., Sulzer, K.R., Steigerwalt, A.G., Rogers, F.C. and Weyant, R.S. Further determination of DNA relatedness between serogroups and serovars in the family Leptospiraceae with a proposal for *Leptospira alexanderi* sp. nov. and



- four new *Leptospira* genomospecies. Int J Syst Bacteriol 49 Pt 2,(1999): 839-858.
- [83] Perolat, P., Chappel, R.J., Adler, B., Baranton, G., Bulach, D.M., Billingham, M.L., et al. *Leptospira fainei* sp. nov., isolated from pigs in Australia. Int J Syst Bacteriol 48 Pt 3,(1998): 851-858.
- [84] Bharti, A.R., Nally, J.E., Ricardi, J.N., Matthias, M.A., Diaz, M.M., Lovett, M.A., et al. Leptospirosis: a zoonotic disease of global importance. Lancet Infect Dis 3,12 (2003): 757-771
- [85] Gollop, J.H., Katz, A.R., Rudoy, R.C. and Sasaki, D.M. Rat-bite leptospirosis. West J Med 159,1 (1993): 76-77.
- [86] Luzzi, G.A., Milne, L.M. and Waitkins, S.A. Rat-bite acquired leptospirosis. J Infect 15,1 (1987): 57-60.
- [87] Babudieri, B. Animal reservoirs of leptospires. Ann N Y Acad Sci 70,3 (1958): 393-413.
- [88] Chan, O.Y., Paul, D.R. and Sng, E.H. Leptospirosis among abattoir workers--a serological survey. Singapore Med J 28,4 (1987): 293-296.
- [89] Demers, R.Y., Frank, R., Demers, P. and Clay, M. Leptospiral exposure in Detroit rodent control workers. Am J Public Health 75,9 (1985): 1090-1091.
- [90] Babudieri, B. and Smith, D.J. A serological study of the *Leptospira* strain Ictero No. 1 of Inada et al. 1916. Trop Geogr Med 20,4 (1968): 379-384.
- [91] D. W. Johnson, H.E.B., and E. H. Derrick Weil's disease in Brisbane. Med.J.Aust. 1,(1937): 811-818.
- [92] Waitkins, S.A. From the PHLS. Update on leptospirosis. Br Med J (Clin Res Ed) 290,6480 (1985): 1502-1503.
- [93] Gill, N., Waitkins, S.A. and Calder, J.M. Further update on leptospirosis: continuing risk in fish farmers. Br Med J (Clin Res Ed) 290,6486 (1985): 1988.
- [94] Gill, O.N., Coghlan, J.D. and Calder, J.M. The risk of leptospirosis in United Kingdom fish farm workers. Results from a 1981 serological survey. J Hyg (Lond) 94,1 (1985): 81-86.
- [95] Waitkins, S.A. Leptospirosis as an occupational disease. Br J Ind Med 43,11 (1986): 721-

- 725.
- [96] Skilbeck, N.W. and Miller, G.T. A serological survey of leptospirosis in Gippsland dairy farmers. Med J Aust 144,11 (1986): 565-567.
- [97] Ellis, W.A., O'Brien, J.J. and Cassells, J. Role of cattle in the maintenance of *Leptospira interrogans* serotype Hardjo infection in Northern Ireland. Vet Rec 108,26 (1981): 555-557.
- [98] Myers, D.M. and Jelambi, F. Isolation and identification of *leptospira hardjo* from cattle in Argentina. Trop Geogr Med 27,1 (1975): 63-70.
- [99] Prescott, J.F., Miller, R.B., Nicholson, V.M., Martin, S.W. and Lesnick, T. Seroprevalence and association with abortion of leptospirosis in cattle in Ontario. Can J Vet Res 52,2 (1988): 210-215.
- [100] Gregoire, N., Higgins, R. and Robinson, Y. Isolation of leptospire from nephritic kidneys of beef cattle at slaughter. Am J Vet Res 48,3 (1987): 370-371.
- [101] Ellis, W.A., O'Brien, J.J., Neill, S.D., Ferguson, H.W. and Hanna, J. Bovine leptospirosis: microbiological and serological findings in aborted fetuses. Vet Rec 110,7 (1982): 147-150.
- [102] Ellis, W.A. and Michna, S.W. Bovine leptospirosis: infection by the Hebdomadis serogroup and abortion-A herd study. Vet Rec 99,21 (1976): 409-412.
- [103] Ellis, W.A., O'Brien, J.J., Neill, S., Hanna, J. and Bryson, D.G. The isolation of a leptospire from an aborted bovine fetus. Vet Rec 99,23 (1976): 458-459.
- [104] Ellis, W.A., Neill, S.D., O'Brien, J.J., Cassells, J.A. and Hanna, J. Bovine leptospirosis: microbiological and serological findings in normal fetuses removed from the uteri after slaughter. Vet Rec 110,9 (1982): 192-194.
- [105] Ellis, W.A., O'Brien, J.J., Cassells, J.A., Neill, S.D. and Hanna, J. Excretion of *Leptospira interrogans* serovar Hardjo following calving or abortion. Res Vet Sci 39,3 (1985): 296-298.
- [106] Ellis, W.A., Songer, J.G., Montgomery, J. and Cassells, J.A. Prevalence of *Leptospira interrogans* serovar Hardjo in the genital and urinary tracts of non-pregnant cattle. Vet Rec 118,1 (1986): 11-13.

- [107] Ellis, W.A., Cassells, J.A. and Doyle, J. Genital leptospirosis in bulls. Vet Rec 118,12 (1986): 333.
- [108] Elder, J.K. and Ward, W.H. The prevalence and distribution of leptospiral titres in cattle and pigs in Queensland. Aust Vet J 54,6 (1978): 297-300.
- [109] Ellis, W.A. and Michno, S.W. Bovine leptospirosis: a serological and clinical study. Vet Rec 99,20 (1976): 387-391.
- [110] Ellis, W.A. and Thiermann, A.B. Isolation of leptospire from the genital tracts of Iowa cows. Am J Vet Res 47,8 (1986): 1694-1696.
- [111] Mumford, C.J. Leptospirosis and water sports. Br J Hosp Med 41,6 (1989): 519.
- [112] Jevon, T.R., Knudson, M.P., Smith, P.A., Whitecar, P.S. and Blake, R.L., Jr. A point-source epidemic of leptospirosis. Description of cases, cause, and prevention. Postgrad Med 80,8 (1986): 121-122, 127-129.
- [113] Shaw, R.D. Kayaking as a risk factor for leptospirosis. Mo Med 89,6 (1992): 354-357.
- [114] van Crevel, R., Speelman, P., Gravekamp, C. and Terpstra, W.J. Leptospirosis in travelers. Clin Infect Dis 19,1 (1994): 132-134.
- [115] Fuortes, L. and Nettleman, M. Leptospirosis: a consequence of the Iowa flood. Iowa Med 84,10 (1994): 449-450.
- [116] Oliveira, M.A., Caballero, O.L., Dias Neto, E., Koury, M.C., Romanha, A.J., Carvalho, J., et al. Use of nondenaturing silver-stained polyacrylamide gel analysis of polymerase chain reaction amplification products for the differential diagnosis of *Leptospira interrogans* infection. Diagn Microbiol Infect Dis 22,4 (1995): 343-348.
- [117] Alexander, A.D., Evans, L.B., Baker, M.F., Baker, H.J., Ellison, D. and Marriapan, M. Pathogenic *Leptospira* isolated from Malaysian surface waters. Appl Microbiol 29,1 (1975): 30-33.
- [118] Diesch, S.L. and McCulloch, W.F. Isolation of pathogenic leptospire from waters used for recreation. Public Health Rep 81,4 (1966): 299-304.
- [119] Gillespie, R.W. and Ryno, J. Epidemiology of leptospirosis. Am J Public Health Nations Health 53,(1963): 950-955.
- [120] Crawford, R.P., Heinemann, J.M., McCulloch, W.F. and Diesch, S.L. Human infections

- associated with waterborne Leptospire, and survival studies on serotype pomona. J Am Vet Med Assoc 159,11 (1971): 1477-1484.
- [121] Adler, B., Faine, S. and Yanagawa, R. Comparative studies on two antigens (F4 and TM) extracted from leptospire. J Clin Microbiol 12,1 (1980): 7-9.
- [122] Diesch, S.L. Survival of leptospire in cattle manure. J Am Vet Med Assoc 159,11 (1971): 1513-1517.
- [123] Everard, C.O., Bennett, S., Edwards, C.N., Nicholson, G.D., Hassell, T.A., Carrington, D.G., et al. An investigation of some risk factors for severe leptospirosis on Barbados. J Trop Med Hyg 95,1 (1992): 13-22.
- [124] Douglin, C.P., Jordan, C., Rock, R., Hurley, A. and Levett, P.N. Risk factors for severe leptospirosis in the parish of St. Andrew, Barbados. Emerg Infect Dis 3,1 (1997): 78-80.
- [125] Weekes, C.C., Everard, C.O. and Levett, P.N. Seroepidemiology of canine leptospirosis on the island of Barbados. Vet Microbiol 57,2-3 (1997): 215-222.
- [126] Agrawal, P.K. and Srivastava, D.K. Outbreak of Weil's disease in a food fad commune in India. Br Med J (Clin Res Ed) 293,6562 (1986): 1646-1647.
- [127] Park, S.K., Lee, S.H., Rhee, Y.K., Kang, S.K., Kim, K.J., Kim, M.C., et al. Leptospirosis in Chonbuk Province of Korea in 1987: a study of 93 patients. Am J Trop Med Hyg 41,3 (1989): 345-351.
- [128] Turner, L.H. Leptospirosis. I. Trans R Soc Trop Med Hyg 61,6 (1967): 842-855.
- [129] Heath, C.W., Jr., Alexander, A.D. and Galton, M.M. Leptospirosis in the United States. N Engl J Med 273,16 (1965): 857-864.
- [130] Ramos-Morales, F., Diaz-Rivera, R.S., Cintron-Rivera, A.A., Rullan, J.A., Benenson, A.S. and Acosta-Matienzo, J. The pathogenesis of leptospiral jaundice. Ann Intern Med 51,(1959): 861-878.
- [131] Edwards, C.N., Nicholson, G.D., Hassell, T.A., Everard, C.O. and Callender, J. Leptospirosis in Barbados. A clinical study. West Indian Med J 39,1 (1990): 27-34.
- [132] Abdulkader, R., Sabbaga, E., Meireles, L. and Radu, A. Vascular injury in acute renal failure due to leptospirosis is not associated with antineutrophil cytoplasmic antibody.

- Nephron 65,1 (1993): 156.
- [133] Winearls, C.G., Chan, L., Coghlan, J.D., Ledingham, J.G. and Oliver, D.O. Acute renal failure due to leptospirosis: clinical features and outcome in six cases. Q J Med 53,212 (1984): 487-495.
- [134] Silverstein, C.M. Pulmonary manifestations of leptospirosis. Radiology 61,3 (1953): 327-334.
- [135] Im, J.G., Yeon, K.M., Han, M.C., Kim, C.W., Webb, W.R., Lee, J.S., et al. Leptospirosis of the lung: radiographic findings in 58 patients. AJR Am J Roentgenol 152,5 (1989): 955-959.
- [136] Sanders, E.J., Rigau-Perez, J.G., Smits, H.L., Deseda, C.C., Vorndam, V.A., Aye, T., et al. Increase of leptospirosis in dengue-negative patients after a hurricane in Puerto Rico in 1996 [correction of 1966]. Am J Trop Med Hyg 61,3 (1999): 399-404.
- [137] Wang, C.P., Chi, C.W. and Lu, F.L. Studies on Anicteric Leptospirosis. 3. Roentgenologic Observations of Pulmonary Changes. Chin Med J (Engl) 84,(1965): 298-306.
- [138] Poh, S.C. and Soh, C.S. Lung manifestations in leptospirosis. Thorax 25,6 (1970): 751-755.
- [139] Du Couedic, L., Courtin, J.P., Poubeau, P., Tanguy, B., Di Francia, M. and Arvin-Berod, C. [Patent and occult intra-alveolar hemorrhage in leptospirosis]. Rev Mal Respir 15,1 (1998): 61-67.
- [140] Yersin, C., Bovet, P., Merien, F., Clement, J., Laille, M., Van Ranst, M., et al. Pulmonary haemorrhage as a predominant cause of death in leptospirosis in Seychelles. Trans R Soc Trop Med Hyg 94,1 (2000): 71-76.
- [141] Sodeman, W.A. and Killough, J.H. The cardiac manifestations of Weil's disease. Am J Trop Med Hyg 31,4 (1951): 479-488.
- [142] Lin, C., Ma, T.L., Chen, Y.C. and Cheng, W.J. Studies on Anicteric Leptospirosis. Ii. Observations on Electrocardiograms. Chin Med J (Engl) 84,(1965): 291-298.
- [143] Rajiv, C., Manjuran, R.J., Sudhayakumar, N. and Hancef, M. Cardiovascular involvement in leptospirosis. Indian Heart J 48,6 (1996): 691-694.
- [144] Vijayachari, P., Sugunan, A.P., Umaphathi, T. and Schgal, S.C. Evaluation of darkground microscopy as a rapid diagnostic procedure in leptospirosis. Indian J Med Res

- 114,(2001): 54-58.
- [145] Merien, F., Amouriaux, P., Perolat, P., Baranton, G. and Saint Girons, I. Polymerase chain reaction for detection of *Leptospira* spp. in clinical samples. J Clin Microbiol 30,9 (1992): 2219-2224.
- [146] Gravekamp, C., Van de Kemp, H., Franzen, M., Carrington, D., Schoone, G.J., Van Eys, G.J., et al. Detection of seven species of pathogenic leptospires by PCR using two sets of primers. J Gen Microbiol 139,8 (1993): 1691-1700.
- [147] Merien, F., Baranton, G. and Perolat, P. Comparison of polymerase chain reaction with microagglutination test and culture for diagnosis of leptospirosis. J Infect Dis 172,1 (1995): 281-285.
- [148] Brown, P.D., Gravekamp, C., Carrington, D.G., van de Kemp, H., Hartskeerl, R.A., Edwards, C.N., et al. Evaluation of the polymerase chain reaction for early diagnosis of leptospirosis. J Med Microbiol 43,2 (1995): 110-114.
- [149] Bal, A.E., Gravekamp, C., Hartskeerl, R.A., De Meza-Brewster, J., Korver, H. and Terpstra, W.J. Detection of leptospires in urine by PCR for early diagnosis of leptospirosis. J Clin Microbiol 32,8 (1994): 1894-1898.
- [150] Merien, F., Perolat, P., Mancel, E., Persan, D. and Baranton, G. Detection of *Leptospira* DNA by polymerase chain reaction in aqueous humor of a patient with unilateral uveitis. J Infect Dis 168,5 (1993): 1335-1336.
- [151] Vinetz, J.M., Glass, G.E., Flexner, C.E., Mueller, P. and Kaslow, D.C. Sporadic urban leptospirosis. Ann Intern Med 125,10 (1996): 794-798.
- [152] Romero, E.C., Billerbeck, A.E., Lando, V.S., Camargo, E.D., Souza, C.C. and Yasuda, P.H. Detection of *Leptospira* DNA in patients with aseptic meningitis by PCR. J Clin Microbiol 36,5 (1998): 1453-1455.
- [153] Brown, P.D., Carrington, D.G., Gravekamp, C., van de Kemp, H., Edwards, C.N., Jones, S.R., et al. Direct detection of leptospiral material in human postmortem samples. Res Microbiol 154,8 (2003): 581-586.
- [154] Smythe, L.D., Smith, J.L., Smith, G.A., Dohnt, M.F., Symonds, M.L., Barnett, L.J., et al. A quantitative PCR (TaqMan) assay for pathogenic *Leptospira* spp. BMC Infect Dis

- 2,(2002): 13.
- [155] Levett, P.N., Morey, R.E., Galloway, R.L., Turner, D.I., Steigerwalt, A.G. and Mayer, I., W. Detection of pathogenic leptospires by real-time quantitative PCR. J Med Microbiol 54,Pt 1 (2005): 45-49.
- [156] Guidelines for the control of leptospirosis. WHO Offset Publ 67 (1982): 1-171.
- [157] Teigland, M.B. An experience with a *Leptospira pomona* bacterin in dairy cattle. J Am Vet Med Assoc 129,6 (1956): 259-260.
- [158] Hoag, W.G. and Bell, W.B. An immunogenic agent for the protection of cattle against *Leptospira pomona*. Am J Vet Res 16,60 (1955): 381-385.
- [159] Shenberg, E. and Torten, M. A new leptospiral vaccine for use in man. I. Development of a vaccine from *Leptospira* grown on a chemically defined medium. J Infect Dis 128,5 (1973): 642-646.
- [160] Broughton, E.S. and Scarnell, J. Prevention of renal carriage of leptospirosis in dogs by vaccination. Vet Rec 117,12 (1985): 307-311.
- [161] Viriyakosol, S., Matthias, M.A., Swancutt, M.A., Kirkland, T.N. and Vinetz, J.M. Toll-like receptor 4 protects against lethal *Leptospira interrogans* serovar Icterohaemorrhagiae infection and contributes to in vivo control of leptospiral burden. Infect Immun 74,2 (2006): 887-895.
- [162] Matsuo, K., Isogai, E. and Araki, Y. Control of immunologically crossreactive leptospiral infection by administration of lipopolysaccharides from a nonpathogenic strain of *Leptospira biflexa*. Microbiol Immunol 44,11 (2000): 887-890.
- [163] Seixas, F.K., Fernandes, C.H., Hartwig, D.D., Conceicao, F.R., Aleixo, J.A. and Dellagostin, O.A. Evaluation of different ways of presenting LipL32 to the immune system with the aim of developing a recombinant vaccine against leptospirosis. Can J Microbiol 53,4 (2007): 472-479.
- [164] Natarajascenivasan, K., Vijayachari, P., Sharma, S., Sugunan, A.P. and Sehgal, S.C. Phenotypic & genotypic conservation of ompL1 & lipL41 among leptospiral isolates of Andaman Islands. Indian J Med Res 122,4 (2005): 343-347.
- [165] David A. Haake, J.M. Characterization of the leptospiral outer membrane and description of



- three novel leptospiral membrane proteins. *Infection and Immunity* 70,9 (2002): 4936-4945.
- [166] Zhang XY, Y.Y., He P, Zhang YX, Hu BY, Yang Y, Nie YX, Jiang XG, Zhao GP, Guo XK. Expression and comparative analysis of genes encoding outer membrane proteins LipL21, LipL32 and OmpL1 in epidemic leptospires. *Acta Biochim Biophys Sin (Shanghai)*. 37,10 (2005): 645-656.
- [167] K. Natarajaseenivasan, P.V., S. Sharma, A.P. Sugunan & S.C. Sehgal Phenotypic & genotypic conservation of ompL1 & lipL41 among leptospiral isolates of Andaman Islands. *Indian J Med Res* 112,4 (2005): 343-347.
- [168] Nally, J.E., Whitelegge, J.P., Bassilian, S., Blanco, D.R. and Lovett, M.A. Characterization of the outer membrane proteome of *Leptospira interrogans* expressed during acute lethal infection. *Infect Immun* 75,2 (2007): 766-773.
- [169] Fernandes, C.P., Seixas, F.K., Coutinho, M.L., Vasconcellos, F.A., Seyffert, N., Croda, J., et al. Monoclonal antibodies against LipL32, the major outer membrane protein of pathogenic *Leptospira*: production, characterization, and testing in diagnostic applications. *Hybridoma (Larchmt)* 26,1 (2007): 35-41.
- [170] Bomfim, M.R., Barbosa-Stancioli, E.F. and Koury, M.C. Detection of pathogenic leptospires in urine from naturally infected cattle by nested PCR. *Vet J* (2007).
- [171] Branger C., C.B., Gauvrit A., Aviat F., Aubert A., Bach J.M., Andre-Fontaine G. Protection against *Leptospira interrogans* sensu lato challenge by DNA immunization with the gene encoding hemolysin-associated protein I. *Infection and Immunity* 73,7 (2005): 4062-4069.
- [172] Haake, D.A., Martinich, C., Summers, T.A., Shang, E.S., Pruetz, J.D., McCoy, A.M., et al. Characterization of leptospiral outer membrane lipoprotein LipL36: downregulation associated with late-log-phase growth and mammalian infection. *Infect Immun* 66,4 (1998): 1579-1587.
- [173] Nally, J.E., Timoney, J.F. and Stevenson, B. Temperature-regulated protein synthesis by *Leptospira interrogans*. *Infect Immun* 69,1 (2001): 400-404.
- [174] Shang, E.S., Summers, T.A. and Haake, D.A. Molecular cloning and sequence analysis of the

- gene encoding LipL41, a surface-exposed lipoprotein of pathogenic *Leptospira* species. Infect Immun 64,6 (1996): 2322-2330.
- [175] Mariya, R., Chaudhary, P., Kumar, A.A., Thangapandian, E., Amutha, R. and Srivastava, S.K. Evaluation of a recombinant LipL41 antigen of *Leptospira interrogans* serovar Canicola in ELISA for serodiagnosis of bovine leptospirosis. Comp Immunol Microbiol Infect Dis 29,5-6 (2006): 269-277.
- [176] Ruan, P., Yan, J., Mao, Y.F., Peng, H.Q. and Zhou, X.H. Identification on the immunogenic activity of recombinant rLTB/CTB-LipL41 to *Leptospira interrogans* and detection of lipL41 gene with its production. Zhonghua Liu Xing Bing Xue Za Zhi 26,8 (2005): 608-612.
- [177] Cheemaa, P.S., Srivastava, S.K., Amutha, R., Singh, S., Singh, H. and Sandey, M. Detection of pathogenic leptospires in animals by PCR based on lipL21 and lipL32 genes. Indian J Exp Biol 45,6 (2007): 568-573.
- [178] Feresu, S.B., Steigerwalt, A.G. and Brenner, D.J. DNA relatedness of *Leptospira* strains isolated from beef cattle in Zimbabwe. Int J Syst Bacteriol 49 Pt 3,(1999): 1111-1117.
- [179] Yasuda, P.H., Hoshino-Shimizu, S., Yamashiro, E.H. and De Brito, T. Experimental leptospirosis (*L. interrogans* serovar Icterohaemorrhagiae) of the guinea pig: leptospiral antigen, gamma globulin and complement C3 detection in the kidney. Exp Pathol 29,1 (1986): 35-43.
- [180] Parma, A.E., Fernandez, A.S., Santisteban, C.G., Bowden, R.A. and Cerone, S.I. Tears and aqueous humor from horses inoculated with *Leptospira* contain antibodies which bind to cornea. Vet Immunol Immunopathol 14,2 (1987): 181-185.
- [181] Lucchesi, P.M. and Parma, A.E. A DNA fragment of *Leptospira interrogans* encodes a protein which shares epitopes with equine cornea. Vet Immunol Immunopathol 71,3-4 (1999): 173-179.
- [182] Kalsow, C.M. and Dwyer, A.E. Retinal immunopathology in horses with uveitis. Ocul Immunol Inflamm 6,4 (1998): 239-251.
- [183] Law-Koune, J.D., Picard, P., Van Der Linden, T., Michault, A., Corbin, J.C. and Duval, G.

- Thrombocytopenia in leptospirosis. Role of anti-platelet antibodies. Presse Med 17,25 (1988): 1315-1316.
- [184] Davenport, A., Rugman, F.P., Desmond, M.J, and Ganta, R. Is thrombocytopenia seen in patients with leptospirosis immunologically mediated? J Clin Pathol 42,4 (1989): 439-440.
- [185] Rugman, F.P., Pinn, G., Palmer, M.F., Waite, M. and Hay, C.R. Anticardiolipin antibodies in leptospirosis. J Clin Pathol 44,6 (1991): 517-519.
- [186] Constantin, A., Marin, F., Oksman, F. and Bouteiller, G. Antineutrophil cytoplasmic antibodies in leptospirosis. J Rheumatol 23,2 (1996): 411.
- [187] Isogai, E., Hirose, K., Kimura, K., Hayashi, S., Kubota, T., Fujii, N., et al. Role of platelet-activating-factor (PAF) on cellular responses after stimulation with leptospire lipopolysaccharide. Microbiol Immunol 41,3 (1997): 271-275.
- [188] Estavoyer, J.M., Racadot, E., Couetdic, G., Leroy, J. and Grosperin, L. Tumor necrosis factor in patients with leptospirosis. Rev Infect Dis 13,6 (1991): 1245-1246.
- [189] Khalil, N. TGF-beta: from latent to active. Microbes Infect 1,15 (1999): 1255-1263.
- [190] Moore, K.W., de Waal Malefyt, R., Coffman, R.L. and O'Garra, A. Interleukin-10 and the interleukin-10 receptor. Annu Rev Immunol 19,(2001): 683-765.
- [191] Girndt, M. Humoral immune responses in uremia and the role of IL-10. Blood Purif 20,5 (2002): 485-488.
- [192] Roncarolo, M.G., Battaglia, M. and Gregori, S. The role of interleukin 10 in the control of autoimmunity. J Autoimmun 20,4 (2003): 269-272.
- [193] Neville, L.F., Mathiak, G. and Bagasra, O. The immunobiology of interferon-gamma inducible protein 10 kD (IP-10): a novel, pleiotropic member of the C-X-C chemokine superfamily. Cytokine Growth Factor Rev 8,3 (1997): 207-219.
- [194] Palaniappan, R.U., Chang, Y.F., Chang, C.F., Pan, M.J., Yang, C.W., Harpending, P., et al. Evaluation of lig-based conventional and real time PCR for the detection of pathogenic leptospires. Mol Cell Probes 19,2 (2005): 111-117.
- [195] Hung, C.C., Chang, C.T., Chen, K.H., Tian, Y.C., Wu, M.S., Pan, M.J., et al. Upregulation of chemokine CXCL1/KC by leptospiral membrane lipoprotein preparation in renal

- tubule epithelial cells. Kidney Int 69,10 (2006): 1814-1822.
- [196] Nally, J.E., Whitelegge, J.P., Aguilera, R., Pereira, M.M., Blanco, D.R. and Lovett, M.A. Purification and proteomic analysis of outer membrane vesicles from a clinical isolate of *Leptospira interrogans* serovar Copenhageni. Proteomics 5,1 (2005): 144-152.
- [197] Harvey C.E., P.J.J., Palladinetti P., Freeman A.J., French R.A., Kumar R.K., Marinos G., Andrew R.L. Expression of the chemokine IP-10 (CXCL10) by hepatocytes in chronic hepatitis C virus infection correlates with histological severity and lobular inflammation. Journal of Leukocyte Biology 74,(2003): 361-369.
- [198] Zeremski M., P.L.M., Chiriboga L., Brown Q.B., Yee H.T., Kinkhabwala M., Jacobson I.M., Dimova R., Markatou M., Tatal A.H. Intrahepatic levels of CXCR3-associated chemokines correlate with liver inflammation and fibrosis in chronic hepatitis C. Hepatology 48.(2008): 1-11.
- [199] Gao, B., Jeong, W.I. and Tian, Z. Liver: An organ with predominant innate immunity. Hepatology 47,2 (2008): 729-736.

## APPENDICES

## APPENDIX A

## REAGENTS AND PREPARATIONS

1. **DEPC- treated water for RNA work 100 ml**

DEPC	0.1	ml
Distilled water	100	ml

Incubate for 12 hours at 37°C and sterilized by autoclaving for 15 min at 15 psi.
2. **75% ethanol 100 ml**

Absolute ethanol	75	ml
Distilled water	25	ml
3. **10 mM dNTP 100 µl**

100 mM dATP	10	µl
100 mM dCTP	10	µl
100 mM dGTP	10	µl
100 mM dTTP	10	µl
Distilled water	60	µl
4. **50X TAE buffer for agarose gel electrophoresis**

Tris buffer	242.0	g
Glacial acetic acid	57.1	g
Na <sub>2</sub> EDTA.2H <sub>2</sub> O	37.2	g

and adjust volume to 1,000 ml with distilled water.
5. **1X TAE buffer for agarose gel electrophoresis**

50X TAE buffer	20	ml
Distilled water	980	ml
6. **1.5% agarose gel preparation**

Agarose gel	0.6	g
1X TAE buffer	40	ml
7. **Ethidium bromide solution (For staining agarose gel)**

Ethidium bromide (10µg/µl)	5	µl
Distilled water to	100	ml

The gel was soaked in ethidium bromide solution for 15 minutes followed by two washes in water for ten minutes each.

## APPENDIX B

### SEQUENCES OF PCR PRODUCTS

#### 1. 16S rRNA sequence

CTCGCGGACTGTTGAGTACACGTGGGTATCTTCCTCTGAGTCTGGTATACTTTCCGATA  
 CGGGAAGCTAATACTGGATGGTCCCGAGAGATCACAAGATTTTTCGGGTAAAGATTTATT  
 GCTCGGAGATGAGCCCGCGTCCGATTAGCTAGTTGGTGAGGTAAAGGCTCACCAAGGCGA  
 CGATCGGTAGCCGGCCTGAGAGGGTGTGGCCACAATGAACTGAGACACGTCCTCTCT

#### 2. LipL32 sequence

CATGTCAGCGCCGGACGGTTTAGTCGATGGAAACAAAAAGCATACTATCTCTATGTTTG  
 GATTCCTGCCGTAATCGCTGAAATGGGAGTTCGTATGATTTCCCAACAGGCGAAATCGG  
 TGAACCAGGCGATGGAGACTTAGTAAGCGACGCTTTCAAAGCGGCTACCCAGAAAGAAA  
 ATCAATGCCACATTGGTTTGATACTGGATCCGTGTAGAAAGAATGTCGGCGATTATGCC  
 TGACCAAATCGCCAAAGCTGCGAAAGCAAACCCGTTCAAAATTGGACGATGATGATGA  
 TGGTGACGATACTTATAAAGAAGAGAGACACAATAAGTACAACCTCTCTACTAGAATCAA  
 GATCCCTAATCCTCCAAAATCTTTTGACGACCTGAAAAACATCGATACTAAAAACTTTT  
 AGTAAGAGGTCTTTACAGAATTTCTTTCACTACCTACAAACCAGGTGAAGTGAGAAAGAA  
 ATTCTGTAAAGACCTCTTACTAAAAA

#### 3. HPRT sequence

TTGCGATGTCATGGTAGAGATGGGAGGCCATCACATTATGGCCCTCTGTGTGCTGAAGGG  
 STGCTATAAATTCCTTTCTAGTCTGCTTTACATTAAGCACTGAATAGAAATTGTGATAG  
 ATCCACTCCCATAACTGTAGATTTTATCAGACTGAAGAGCTACTGTAACGATCCGTCAAC  
 AGGGGACTTAAAAATTAATGGTGC GGATGATATCTCAACTTAACTGGAAAGAATGCTCTT  
 GATTGTTGAAGGTAAAACCTGACATTGGTATGACAATACAAACCTTGCTTTCCCTTGTCAA  
 ACAGTACAACCCCAAATGTTTAAGATTGCAAACCTGTTGGTGAACA

#### 4. TNF- $\alpha$ sequence

AGCCAGTTGCGTTCATTTCAATGATCTGAGTGTGAGTGTCTGGGCCATGGAGCCGATGAT  
 AGGGTTGGGGAACCTTCTCTCCCTTTGGGATTCGGTAGTTGAGAAGAAAACACACACAAA  
 GCACAC

#### 5. TGF- $\beta$ sequence

GATGTGTGTGCGGAGCTGTCGACTTTCGCAGGACCTGGTGCAGTGGATTCACGAGCCCAA  
 GGGCTACCACGCCAACTTCTGTCTGGGGCCCTGTCCCTACATTTGGAGCCTGGACACACA  
 GTACAGTAAGGTCCTTGCCCTGTACAGATGCTATATAGAACGCACGAAACTCTGGGTTAG  
 ATAATA



**6. IL-10 sequence**

GCCAACCTTATCAGAAATGATCCAGTTTTACCTGGTAGAAGTGATGCCCCAGGCAGAGAA  
 CCACGGCCCAGAAATCAAGGAGCATTGAACTCCCTAGGAGAGAAGCTGAAGACCCTCAG  
 GAGGCAACTGCAGCGCTGTCATCGATTTCTCCC

**7. IP-10 sequence**

ACTCATAATTACTATTGCACAACTATGTCCTTACTCCTCTTCTAAACTGGACAATATAT  
 AATTTTATTATATTGATATTATTTGGACAAATATATAAACTTCACAAAACAAAATAAATA  
 ATATAAAATCTTACACAATATATACTAATTAACAAATAATCAATTATTAATTAATAACTA  
 TATATATCATTTTCTATATATTTTCAATTCAATATACATGATTAATAACCTAAACATTGT  
 GATATATTGAATAAATAAAAATTACTTTCTCTAAAAATTAGTCTACTGACTATAATACAT  
 ATTCCTAATTTATAATTACAGATATTTTTTATACTTATTAATTTTATGTGATAAATAATA  
 TAGAGTATCTATCGAGAACTTGCACGCAAGATAATATAATAACTCCTAAGATTAATACT  
 TTATCTATTTTTATTTTTAAATTCTAATTTTTATTTTTAAGACAAATATATACAAAACAC  
 TTACAA

**8. IP-10 sequence (real-time PCR)**

TTTATACGTCGGCCTATGGCTACTCCTAATTGTCCCTGGTTCCCCTGAAAGGTGACCAGC  
 CATGGTCACATCAGCTGCTATCCCTAGTGACATCAGGTCACTATTCTCCAGGACGATGGG  
 CAGCTCCTCGTCCTGAGACAACAGTAACTCCAGTGACAAGAGTCCCCAACTCTACTA

**9. LipL32 sequence (real-time PCR)**

AAAAACGTTCCCTTCCCTATGGATCTGTGATCAACTATTACGGATATGTAAAGCCAGGACA  
 AGCGCCGGACGGTTTAGTCGACGGAAACAAAAAAGCATACTATCTCTATGTTTGGATCCC  
 AGCTGTAATCGCTGAAATGGGAGTTC



## Biography

Alisa Lowanitchapat was born in Bangkok, Thailand on May 11, 1984. She graduated with the Bachelor Degree of Science from Genetics Program, the Department of Botany, and Faculty of Science at Chulalongkorn University in 2005; she enrolled in the Master Degree of Medical Science, Faculty of Medicine at Chulalongkorn University in 2006

Poster presentation and publications acquired while she was in the Master Degree of Medical Science are as follows

### **Poster presentation**

1. Lowanitchapat A., Phulsuksombati D., Poovorawan Y., Chirathaworn C. Expression of TNF- $\alpha$ , IL-10, TGF- $\beta$  and IP-10 in kidneys of hamsters infected with pathogenic *Leptospira*. The 8<sup>th</sup> Graduate Research Conference, 7-8 September 2007. Mahidol University Salaya, Nakhon-pathom Thailand.
2. Suksomyos N., Utivamek S., Keelawat S., Lowanitchapat A., Chirathaworn C., LipL21 mRNA expression in lungs of hamsters infected with pathogenic *Leptospira*. The 32<sup>nd</sup> annual meeting of the Medical Technologist Association of Thailand, 6-9 May 2008. Ambassador Chomtien Pattaya Hotel, Chonburi Thailand.
3. Lowanitchapat A., Sereemaspun A., Ekpo P., Phulsuksombati D., Chirathaworn, TNF- $\alpha$ , IL-10 and IP-10 mRNA expression in kidneys and livers of hamsters infected with pathogenic *Leptospira* The 24<sup>th</sup> Congress on Allergy and Immunology, 15-16 May 2008, Radisson Hotel, Bangkok Thailand.
4. Lowanitchapat A., Keelawat S., Ekpo P., Phulsuksombati D., Chirathaworn. Collagenase gene expression in lungs of hamsters infected with pathogenic *Leptospira*. The 10<sup>th</sup> Graduate Research Conference, 11-12 September 2008. Sukhothai Thammathirat Open University, Bangkok Thailand.

### **Publications**

1. Chirathaworn, C., Kongcharoensuntorn, W., Dechdougchan, T., Lowanitchapat A., Sa-nguanmoo, P., Poovorawan, Y., 2007. *Myristica fragrans* Houtt. methanolic extract induces apoptosis in a human leukemia cell line through SIRT1 mRNA downregulation. *J Med Assoc Thai* 90:2422-2428
2. Lowanitchapat, A. Ekpo, P., Sereemaspun, A., Phulsuksombati, D., Poovorawan, Y., Chirathaworn, C. 2008. LipL32 mRNA expression in kidneys, livers and lungs of hamsters infected with pathogenic *Leptospira*. *Asian Biomed.* 2:141-146
3. Lowanitchapat, A., Payungporn, S., Keelawat, S., Sereemaspun, A., Phulsuksombati, D., Poovorawan, Y., Chirathaworn, C. Expression of TNF- $\alpha$ , IL-10, and IP-10 in kidneys of hamsters infected with pathogenic *Leptospira*. (Submitted)