



Efectes de la suplementació dietètica amb proteïnes plasmàtiques sobre la resposta immunitària en un model d'inflamació pulmonar aguda en ratolí

Mònica Maijó Ferré

ADVERTIMENT. La consulta d'aquesta tesi queda condicionada a l'acceptació de les següents condicions d'ús: La difusió d'aquesta tesi per mitjà del servei TDX (www.tdx.cat) ha estat autoritzada pels titulars dels drets de propietat intel·lectual únicament per a usos privats emmarcats en activitats d'investigació i docència. No s'autoritza la seva reproducció amb finalitats de lucre ni la seva difusió i posada a disposició des d'un lloc aliè al servei TDX. No s'autoritza la presentació del seu contingut en una finestra o marc aliè a TDX (framing). Aquesta reserva de drets afecta tant al resum de presentació de la tesi com als seus continguts. En la utilització o cita de parts de la tesi és obligat indicar el nom de la persona autora.

ADVERTENCIA. La consulta de esta tesis queda condicionada a la aceptación de las siguientes condiciones de uso: La difusión de esta tesis por medio del servicio TDR (www.tdx.cat) ha sido autorizada por los titulares de los derechos de propiedad intelectual únicamente para usos privados enmarcados en actividades de investigación y docencia. No se autoriza su reproducción con finalidades de lucro ni su difusión y puesta a disposición desde un sitio ajeno al servicio TDR. No se autoriza la presentación de su contenido en una ventana o marco ajeno a TDR (framing). Esta reserva de derechos afecta tanto al resumen de presentación de la tesis como a sus contenidos. En la utilización o cita de partes de la tesis es obligado indicar el nombre de la persona autora.

WARNING. On having consulted this thesis you're accepting the following use conditions: Spreading this thesis by the TDX (www.tdx.cat) service has been authorized by the titular of the intellectual property rights only for private uses placed in investigation and teaching activities. Reproduction with lucrative aims is not authorized neither its spreading and availability from a site foreign to the TDX service. Introducing its content in a window or frame foreign to the TDX service is not authorized (framing). This rights affect to the presentation summary of the thesis as well as to its contents. In the using or citation of parts of the thesis it's obliged to indicate the name of the author.



UNIVERSITAT DE BARCELONA



Grup de Fisiologia Digestiva i Adaptacions Nutricionals
Departament de Fisiologia
Facultat de Farmàcia
Institut de Nutrició i Seguretat Alimentària de la UB

**EFFECTES DE LA SUPLEMENTACIÓ DIETÈTICA AMB
PROTEÏNES PLASMÀTIQUES SOBRE LA RESPOSTA
IMMUNITÀRIA EN UN MODEL D'INFLAMACIÓ PULMONAR
AGUDA EN RATOLÍ**

Programa de Doctorat: **Biotecnologia Molecular**

Directors:

Dra. Anna Pérez Bosque
Professora associada de Fisiologia

Dr. Miquel Moretó Pedragosa
Catedràtic de Fisiologia

Dr. Javier Polo Pozo
Responsable I+D, APC Europe SA

Mònica Maijó Ferré
Barcelona 2011

VI. BIBLIOGRAFIA

A

Abraham E, Carmody A, Shenkar R, Arcaroli J. Neutrophils as early immunologic effectors in hemorrhage- or endotoxemia-induced acute lung injury. *Am J Physiol Lung Cell Mol Physiol*. 279 (6): L1137-L1145, 2000.

Akdis CA, Blesken T, Akdis M, Wüthrich B, Blaser K. Role of interleukin 10 in specific immunotherapy. *J Clin Invest*. 102 (1): 98-106, 1998.

Allen SJ, Crown SE, Handel TM. Chemokine; receptor structure, interactions, and antagonism. *Annu Rev Immunol*. 25: 787-820, 2007.

Aloisi F, Pujol-Borrell R. Lymphoid neogenesis in chronic inflammatory diseases. *Nat Rev Immunol*. 6 (3): 205-217, 2006.

Anderson NL, Anderson NG. The human plasma proteome: history, character, and diagnostic prospects. *Mol Cell Proteomics*. 1 (11): 845-867, 2002.

Andoh A, Masuda A, Kumazawa Y, Kasajima T. Serum antibody response and nasal lymphoid tissue (NALT) structure in the absence of IL-4 or IFN-gamma. *Cytokine*. 20 (3): 107-112, 2002.

Andonegui G, Bonder CS, Green F, Mullaly SC, Zbytniuk L, Raharjo E, Kubes P. Endothelium-derived Toll-like receptor-4 is the key molecule in LPS-induced neutrophil sequestration into lungs. *J Clin Invest*. 111 (7): 1011-1020, 2003.

Anthoni M, Wang G, Leino MS, Lauerma AI, Alenius HT, Wolff HJ. Smad3 –signalling and Th2 cytokines in normal mouse airways and in a mouse model of asthma. *Int J Biol Sci*. 3 (7): 477-485, 2007.

Aoki k, Ishida Y, Kikuta N, Kawai H, Kuroiwa M, Sato H. Role of CXC chemokines in the enhancement of LPS-induced neutrophil accumulation in the lung of mice by dexamethasone. *Biochem Biophys Res Commun*. 294 (5): 1101-1108, 2002.

Arndt PG, Young SK, Worthen GS. Regulation of lipopolysaccharide-induced lung inflammation by plasminogen activator inhibitor-1 through a JNK-mediated pathway. *J Immunol*. 175 (6): 4049-4059, 2005.

B

Bae HB, Li M, Kim JP, Kim SJ, Jeong CW, Lee HG, Kim WM, Kim HS, Kwak SH. The effect of epigallocatechin gallate on lipopolysaccharide-induced acute lung injury in a murine model. *Inflammation*. 33 (2): 82-91, 2010.

Baggiolini M, Dewald B, Moser B. Human chemokines: an update. *Annu Rev Immunol*. 15: 675-705, 1997.

Bailey M, Haverson K, Inman C, Harris C, Jones P, Corfield G, Miller B, Stokes C. The development of the mucosal immune system pre- and post-weaning: balancing regulatory and effector function. *Proc Nutr Soc*. 64 (4): 451-457, 2005.

Bhagwat SP, Gigliotti F, Xu H, Wright TW. Contribution of T cell subsets to the pathophysiology of Pneumocystis-related immunorestitution disease. *Am J Physiol Lung Cell Mol Physiol*. 291 (6): L1256-L1266, 2006.

Bhandari SK, Xu B, Nyachoti CM, Giesting DW, Krause DO. Evaluation of alternatives to antibiotics using an Escherichia coli K88+ model of piglet diarrhea: effects on gut microbial ecology. *J Anim Sci*. 86 (4): 836-847, 2008.

Bienenstock J, Clancy R. Bronchus-associated lymphoid tissue in mucosal immunology. New York: Elsevier. 2005.

Bienenstock J, McDermott MR. Bronchus- and nasal- associated lymphoid tissues. *Immunol Rev*. 206: 22-31, 2005.

Bisset LR, Schmid-Grendelmeier P. Chemokines and their receptors in the pathogenesis of allergic asthma: progress and perspective. *Curr Opin Pulm Med*. 11 (1): 35-42, 2005.

Borg BS, Capmbell JM, Russel LE, Rodríguez C, Ródenas J. Evaluation of the chemical and biological characteristics of spray-dried plasma protein collected from various locations around the world. *Am Assoc Swine Vet*. 97-100, 2002.

Bosi P, Casini L, Finamore A, Cremokolini C, Merialdi G, Trevisi P, Nobili F, Mengheri E. Spray-dried plasma improves growth performance and reduces inflammatory status of weaned pigs challenged with enterotoxigenic Escherichia coli K88. *J Anim Sci*. 82 (6): 1764-1772, 2004.

Brandtzaeg P, Pabst R. Let's go mucosal; communication on slippery ground. *Trends Immunol.* 25 (11): 570-577, 2004.

Brigham KL, Meyrick B. Endotoxin and lung injury. *Am Rev Respir Dis.* 133 (5): 913-927, 1986.

C

Campbell JM, Quigley JD III, Russell LE, Koehn LD. Efficacy of spray-dried bovine serum on health and performance of turkeys challenged with *Pasteurella multocida*. *J Appl Poult Sci Res.* 13: 388-393, 2004.

Campbell JM, Polo J, Russell LE, Crenshaw JD. Review of spray-dried plasma's impact on intestinal barrier function. *Livestock Sci.* 133: 239-241, 2010.

Carroll JA, Touchette KJ, Matteri RL, Dyer CJ, Allee GL. Effect of spray-dried plasma and lipopolysaccharide exposure on weaned pigs: II. Effects on the hypothalamic –pituitary-adrenal axis of weaned pigs. *J Anim Sci.* 80 (2): 502-509, 2002.

Cary SP, Winger JA, Derbyshire ER, Marletta MA. Nitric oxide signaling: no longer simply on or off. *Trends Biochem Sci.* 31 (4): 231-239, 2006.

Castell JV, Gomez-Lechon MJ, David M, Andus T, Geiger T, Trullenque R, Fabra R, Heinrich PC. Interleukin-6 is the major regulator of acute phase protein synthesis in adult human hepatocytes. *FEBS Lett.* 242 (2): 237–239, 1989.

Chaudhuri N, Sabroe I. Basic science of the innate immune system and the lung. *Paediatr Respir Rev.* 9 (4): 236-242, 2008.

Chen HI, Hsieh NK, Kao SJ, Su CF. Protective effects of propofol on acute lung injury induced by oleic acid in conscious rats. *Crit Care Med.* 36 (4): 1214-1221, 2008.

Chen W, Jin W, Hardegen N, Lei KJ, Li L, Marinos N, McGrady G, Wahl SM. Conversion of peripheral CD4+CD25- naive T cells to CD4+CD25+ regulatory T cells by TGF-beta induction of transcription factor Foxp3. *J Exp Med.* 198 (12): 1875–1886, 2003.

Chung KF. Cytokines in chronic obstructive pulmonary disease. *Eur Respir J Suppl.* 34: 50s-59s, 2001.

Coffey RD, Cromwell GL. The impact of environment and antimicrobial agents on the growth response of early-weaned pigs to spray-dried porcine plasma. *J Anim Sci.* 73 (9): 2532-2539,1995.

Coffey RD, Cromwell GL. Use of spray-dried animal plasma in diets for weanling pigs. *Pig News Info.* 22 (2): 39N-48N, 2001.

Cohen J. The immunopathogenesis of sepsis. *Nature.* 420 (6917): 885-891, 2002.

Cross AS, Opal SM, Sadoff JC, Gemski P. Choice of bacteria in animal models of sepsis. *Infect Immun.* 61 (7): 2741-2747, 1993.

Culley FJ. Natural killer in infection and inflammation of the lung. *Immunology.* 128 (2): 151-163, 2009.

Cuzzocrea S, Mazzon E, Dugo L, Serraino I, Di Paola R, Genovese T, De Sarro A, Caputi AP. Absence of endogenous interleukin- 10 enhances the evolution of acute lung injury. *Eur Cytokine Netw.* 13 (3): 285-297, 2002.

D

D'Alessio FR, Tsushima K, Aggarwal NR, West EE, Willett MH, Britos MF, Pipeling MR, Brower RG, Tudor RM, McDyer JF, King LS. CD4+CD25+FoxP3+ Tregs resolve experimental lung injury in mice and are present in humans with acute lung injury. *J Clin Invest.* 119 (10): 2898-2913, 2009.

D'Ambrosio D, Mariani M, Panina-Bordignon P, Sinigaglia F. Chemokines and their receptors guiding T lymphocyte recruitment in lung inflammation. *Am J Respir Crit Care Med.* 164 (7):1266-1275, 2001.

Dallas DV, Keeney SE, Mathews MJ, Schmalstieg FC. Effects of postnatal dexamethasone on oxygen toxicity in neonatal rats. *Biol Neonate.* 86 (3): 145-154, 2004.

Davis B. Bacterial architecture. En: Davis B, Dulbecco R, Eisen H, Ginsberg H (Eds.). *Microbiology*, 4th Edition J.B. Lippincott Co. Philadelphia, pp 21-50, 1990.

De Rodas BZ, Sohn KS, Maxwell CV, Spicer LJ. Plasma protein for pigs weaned at 19 to 24 days of age: effect on performance and plasma insulin-like growth factor I, growth hormone, insulin, and glucose concentrations. *J Anim Sci.* 73 (12): 3657-3665, 1995.

Deprez P, Van den Hende C, Muylle E, Oyaert W. The influence of the administration of sow's milk on the post-weaning excretion of hemolytic *E. coli* in the pig. *Vet Res Commun*. 10 (6): 469-478, 1986.

Downey GP, Dong Q, Kruger J, Dedhar S, Cherapanov V. Regulation of neutrophil activation in acute lung injury. *Chest*. 116 (1): 46S-54S, 1999.

F

Fey PD, Safranek TJ, Rupp ME, Dunne EF, Ribot E, Iwen PC, Bradford PA, Angulo FJ, Hinrichs SH. Ceftriaxone-resistant salmonella infection acquired by a child from cattle. *N Engl J Med*. 342 (17): 1242-1249, 2000.

Fioretto JR, Campos FJ, Ronchi CF, Ferreira AL, Kurokawa CS, Carpi MF, Moraes MA, Bonatto RC, Defaveri J, Yeum KJ. Effects of inhaled nitric oxide on oxidative stress and histopathological and inflammatory lung injury in a saline-lavage rabbit model of acute lung injury. *Respir Care*. In press, 2011.

Firmansyah A, Dwipoerwantoro PG, Kadim M, Alatas S, Conus N, Lestarina L, Bouisset F, Steenhout P. Improved growth of toddlers fed a milk containing synbiotics. *Asia Pac Clin Nutr*. 20 (1): 69-76, 2011.

Forsythe P, Inman MD, Bienenstock J. Oral treatment with live *Lactobacillus reuteri* inhibits the allergic airway response in mice. *Am J Respir Crit Care Med*. 175 (6): 561-569, 2007.

Forsythe P. Probiotics and lung diseases. *Chest*. 139 (4): 901-908, 2011.

Fox-Dewhurst R, Alberts MK, Kajikawa O, Caldwell E, Johnson MC 2nd, Skerrett SJ, Goodman RB, Ruzinski JT, Wong VA, Chi EY, Martin TR. Pulmonary and systemic inflammatory responses in rabbits with gram-negative pneumonia. *Am J Respir Crit Care Med*. 155 (6): 2030-2040, 1997.

G

Gaffen SL, Liu KD. Overview of interleukin-2 function, production and clinical applications. *Cytokine*. 28 (3): 109-123, 2004.

Gaga M, Bentley AM, Humbert M, Barkans J, O'Brien F, Wathen CG, Kay AB, Durham SR. Increases in CD4+ T lymphocytes, macrophages, neutrophils and interleukin 8 positive cells in the airways of patients with bronchiectasis. *Thorax*. 53 (8): 685-691, 1998.

Gao C, Sun X, Zhang G, Zhang H, Zhao H, Yang Y, Han L, Xu L, Chai W. Hyperoxygenated solution preconditioning attenuates lung injury induced by intestinal ischemia reperfusion in rabbits. *J Surg Res*. 146 (1): 24-31, 2008.

Gatnau R, Paul PS, Zimmerman DR. Spray dried porcine plasma as a source of immunoglobulins for newborn piglets. *J Anim Sci*. 64 (Suppl 1): 244 (abs), 1989.

Gatnau R, Zimmerman DR, Niessen SL, Wannemuehler M, Ewan RC. Effects of excess dietary leucine and leucine catabolites on growth and immune responses in weanling pigs. *J Anim Sci*. 73 (1): 159-165, 1995.

Gauger PC, Lager KM, Vincent AL, Opriessnig T, Kehrli ME Jr, Cheung AK. Postweaning multisystemic wasting syndrome produced in gnotobiotic pigs following exposure to various amounts of porcine circovirus type 2 or type 2b. *Vet Microbiol*. 153 (3-4): 229-239, 2011.

Geurtsvankessel CH, Willart MA, Bergen IM, van Rijt LS, Muskens F, Elewaut D, Osterhaus AD, Hendriks R, Rimmelzwaan GF, Lambrecht BN. Dendritic cells are crucial for maintenance of tertiary lymphoid structures in the lung of influenza virus-infected mice. *J Exp Med*. 206 (11): 2339-2349, 2009.

Gill N, Wlodarska M, Finlay BB. The future of mucosal immunology: studying an integrated system-wide organ. *Nat Immunol*. 11 (7): 558-560, 2010.

Glimcher LH, Murphy KM. Lineage commitment in the immune system: the T helper lymphocyte grows up. *Genes Dev*. 14 (14): 1693-1711, 2000.

Gordon KJ, Blobel GC. Role of transforming growth factor-(beta) superfamily, signaling pathways in human disease. *Biochim Biophys Acta*. 1782 (4): 197-228, 2008.

Gottlob RO, DeRouchey JM, Tokach MD, Goodband RD, Dritz SS, Nelssen JL, Hastad CW, Knabe DA. Amino acid and energy digestibility of protein sources for growing pigs. *J Anim Sci*. 84 (6): 1396-1402, 2006.

Greenberg PD, Cello JP. Treatment of severe diarrhea caused by *Cryptosporidium parvum* with oral bovine immunoglobulin concentrate in patients with AIDS. *J Acquir Immune Defic Syndr Hum Retrovirol.* 13 (4): 348-354, 1996.

Gu PC, Fan XS, Jiang CX, Xu HQ, Yu JH, Tang YP. Effect of San'ao Decoction on the airway inflammation and hyperresponsiveness in a murine model of lipopolysaccharide-enhanced asthma. *Chin J Integr Med.* 17 (7): 537-541, 2011.

Guo RF, Ward PA. Mediators and regulation of neutrophil accumulation in inflammatory responses in lung: insights from the IgG immune complex model. *Free Radic Biol Med.* 33 (3): 303-310, 2002.

H

Halloy DJ, Kirschvink NA, Mainil J, Gustin PG. Synergistic action of *E. coli* endotoxin and *Pasteurella multocida* type A for the induction of bronchopneumonia in pigs. *Vet J.* 169 (3): 417-426, 2005.

Harrod KS, Moundav AD, Whitsett JA. Adenoviral E3-14.7K protein in LPS-induced lung inflammation. *Am J Physiol Lung Cell Mol Physiol.* 278 (4): L631-L639, 2000.

Hazlewood LC, Wood LG, Hansbro PM, Foster PS. Dietary lycopene supplementation suppresses Th2 responses and lung eosinophilia in a mouse model of allergic asthma. *J Nutr Biochem.* 22 (1): 95-100, 2011.

Heinrichs AJ, Wells SJ, Losinger WC. A study of the use of milk replacers for dairy calves in the United States. *J Dairy Sci.* 78 (12): 2831-2837, 1995.

Heinrichs DE, Yethon JA, Whitfield C. Molecular basis for structural diversity in the core regions of the lipopolysaccharides of *Escherichia coli* and *Salmonella enterica*. *Mol Microbiol.* 30 (2): 221-232, 1998.

Henson PM, Hume DA. Apoptotic cell removal in development and tissue homeostasis. *Trends Immunol.* 27 (5): 244-250, 2006.

Heuer OE, Hammerum AM, Collignon P, Wegener HC. Human health hazard from antimicrobial-resistant enterococci in animals and food. *Clin Infect Dis.* 43 (7): 911-916, 2006.

Heyen JR, Ye S, Finck BN, Johnson RW. Interleukin (IL)-10 inhibits IL-6 production in microglia by preventing activation of NF-kappaB. *Brain Res Mol Brain Res*. 77 (1): 138-147, 2000.

Hiramatsu K, Azuma a, Kudoh S, Desaki M, Takizawa H, Sugawara I. Inhalation of diesel exhaust for three months affects major cytokine expression and induces bronchus-associated lymphoid tissue formation in murine lungs. *Exp Lung Res*. 29 (8): 607-622, 2003.

Howell NK, Lawrie RA. Functional aspects of blood plasma proteins. I. Separation and characterization. *J Food Technol*. 18: 747-762, 1983.

Hudson LD, Milberg JA, Anardi D, Maunder RJ. Clinical risks for development of the acute respiratory distress syndrome. *Am J Respir Crit Care Med*. 151 (2 pt 1): 293-301, 1995.

Hug I, Feldman MF. Analogies and homologies in lipopolysaccharide and glycoprotein biosynthesis in bacteria. *Glycobiology*. 21 (2): 138-151, 2011.

J

Jaffar Z, Ferrini ME, Girtsman TA, Roberts K. Antigen-specific Treg regulate Th17-mediated lung neutrophilic inflammation, B-cell recruitment and polymeric IgA and IgM levels in the airways. *Eur J Immunol*. 39 (12): 3307-3314, 2009.

Janeway CA, Travers P, Walport M, Capra JD. Reconocimiento del antígeno por parte de los linfocitos T. A: Inmunobiología: El sistema inmunitario en condiciones de salud y enfermedad. Masson. SA Ed. pp: 115-162, 2000.

Jiang R, Chang X, Stoll B, Ellis KJ, Shypailo RJ, Weaver E, Campbell J, Burrin DG. Dietary plasma protein is used more efficiently than extruded soy protein for lean tissue growth in early-weaned pigs. *J Nutr*. 130 (8): 2016-2019, 2000.

Joetham A, Takeda K, Taube C, Miyahara N, Matsubara S, Koya T, Rha YH, Dakhama A, Gelfand EW. Naturally occurring lung CD4(+)CD25(+) T cell regulation of airway allergic responses depends on IL-10 induction of TGF-beta. *J Immunol*. 178 (3): 1433-1442, 2007.

Johnson ER, Matthay MA. Acute lung injury: epidemiology, pathogenesis, and treatment. *J Aerosol Med Pulm Drug Deliv*. 23 (4): 243-252, 2010.

Joubert J, Malan SF. Novel nitric oxide synthase inhibitors: a patent review. *Expert Opin Ther Pat.* 21 (4): 537-560, 2011.

Jutel M, Akdis M, Budak F, Aebischer-Casaulta C, Wrzyszc M, Blaser K, Akdis CA. IL-10 and TGF- β cooperate in regulatory T cell response to mucosal allergens i normal immunity and specific immunotherapy. *Eur J Immunol.* 33 (5): 1205-1214, 2003.

K

Kawai T, Takeuchi O, Fujita T, Inoue J, Mühlradt PF, Sato S, Hoshino K, Akira S. Lipopolysaccharide stimulates the MyD88-independent pathway and results in activation of IFN-regulatory factor 3 and the expression of a subset of lipopolysaccharide-inducible genes. *J Immunol.* 167 (10): 5887-5894, 2001.

Kiyono H, Fukuyama S. NALT- versus Peyer's-patch-mediated mucosal immunity. *Nat Rev Immunol.* 4 (9): 699-710, 2004.

Koay MA, Christman JW, Wudel LJ, Allos T, Cheng DS, Chapman WC, Blackwell TS. Modulation of endotoxin-induced NF-kappa B activation in lung and liver through TNF type 1 and IL-1 receptors. *Am J Physiol Lung Cell Mol Physiol.* 283 (6): L1247-L1254, 2002.

Kocks JR, Davalos-Misslitz AC, Hintzen G, Ohl L, Förster R. Regulatory T cells interfere with the development of bronchus-associated lymphoid tissue. *J Exp Med.* 204 (4): 723-734, 2007.

Kojima CJ, Carroll JA, Matteri RL, Touchette KJ, Allee GL. Effects of weaning and weaning weight on neuroendocrine regulators of feed intake in pigs. *J Anim Sci.* 85 (9): 2133-2139, 2007.

Komuro T, Yomota C, Kimura T, Galanos C. Comparison of R- and S-form lipopolysaccharides fractionated from *Escherichia coli* UKT-B lipopolysaccharide in pyrogen and Limulus test. *FEMS Microbiol Lett.* 51 (1): 79-83, 1989.

Korhonen R, Lahti A, Kankaanranta H, Moilanen E. Nitric oxide production and signaling in inflammation. *Curr Drug Targets Inflamm Allergy.* 4(4): 471-479, 2005.

Krause DO, Bhandari SK, House JD, Nyachoti CM. Response of nursery pigs to a symbiotic preparation of starch and an anti-*Escherichia coli* K88 probiotic. *Appl Environ Microbiol.* 76 (24): 8192-8200, 2010.

Kwon HK, Lee CG, So JS, Chae CS, Hwang JS, Sahoo A, Nam JH, Rhee JH, Hwang KC, Im SH. Generation of regulatory dendritic cells and CD4+Foxp3+ T cells by probiotics administration suppresses immune disorders. *Proc Natl Acad Sci USA*. 107 (5): 2159-2164, 2010.

L

Lallès JP, Bosi P, Smidt H, Stokes CR. Nutritional management of gut health in pigs around weaning. *Proc Nutr Soc*. 66 (2): 260-268, 2007.

Larsson R, Rocksén D, Lilliehöök B, Jonsson A, Bucht A. Dose-dependent activation of lymphocytes in endotoxin-induced airway inflammation. *Infect Immun*. 68 (12): 6962-6969, 2000.

Lee JJ, McGarry MP, Farmer SC, Denzler KL, Larson KA, Carrigan PE, Brenneise IE, Horton MA, Haczku A, Gelfand EW, Leikauf GD, Lee NA. Interleukin-5 expression in the lung epithelium of transgenic mice leads to pulmonary changes pathognomonic of asthma. *J Exp Med*. 185 (12): 2143-2156, 1997.

Lefort J, Motreff L, Vargaftig BB. Airway administration of Escherichia coli endotoxin to mice induces glucocorticosteroid-resistant bronchoconstriction and vasopermeation. *Am J Respir Cell Mol Biol*. 24 (3): 345-351, 2001.

Li MO, Wan YY, Saniabis S, Robertson AK, Flavell RA. Transforming growth factor-beta regulation of immune responses. *Annu Rev Immunol*. 24: 99-146, 2006.

Lindén A, Laan M, Anderson GP. Neutrophils, interleukin-17A and lung disease. *Eur Respir J*. 25 (1): 159-172, 2005.

Liu AH. Something old, something new: indoor endotoxin, allergens and asthma. *Paediatr Respir Rev*. 5 Suppl A: S65-71, 2004.

M

Mabley JG, Pacher P, Murthy KG, Williams W, Southan GJ, Salzman AL, Szabo C. The novel inosine analogue INO-2002 exerts an anti-inflammatory effect in a murine model of acute lung injury. *Shock*. 32 (3): 258-262, 2009.

Markowicz P, Wolff M, Djedaïni K, Cohen Y, Chastre J, Delclaux C, Merrer J, Herman B, Veber B, Fontaine A, Dreyfuss D. Multicenter prospective study of ventilator-associated pneumonia during acute respiratory distress syndrome. Incidence, prognosis, and risk factors. ARDS Study Group. *Am J Respir Crit Care Med.* 161 (6): 1942-1948, 2000.

Markowska-Daniel I, Szczotka A, Bednarek D, Pejsak Z. Preliminary study of the influence of plasma proteins on immunological and production parameters in pigs. *Pol J Vet Sci.* 6 (4): 275-277, 2003.

Martin-Oru  SM, P rez-Bosque A, G mez Segura A, Moret  M. Feed added sprayed dried porcine plasma (SDPP) modifies cecal microbiota in rats. *Gut Microbiome Meeting, Clermont-Ferrand, France, 2008.*

Matute-Bello G, Frevert CW, Kajikawa O, Skerrett SJ, Goodman RB, Park DR, Martin TR. Septic shock and acute lung injury in rabbits with peritonitis: failure of the neutrophil response to localized infection. *Am J Respir Crit Care Med.* 163 (1): 234-243, 2001.

McKinley L, Logar AJ, McAllister F, Zheng M, Steele C, Kolls JK. Regulatory T cells dampen pulmonary inflammation and lung injury in an animal model of pneumocystis pneumonia. *J Immunol.* 177 (9): 6215-6226, 2006.

Meduri GU, Kohler G, Headley S, Tolley E, Stenz F, Postlethwaite A. Inflammatory cytokines in the BAL of patients with ARDS. Persistent elevation over time predicts poor outcome. *Chest.* 108 (5): 1303-1314, 1995.

Menne E, Guggenbuhl N, Roberfroid M. Fn-type chicory inulin hydrolysate has a prebiotic effect in humans. *J Nutr.* 130 (5): 1197-1199, 2000.

Mestecky J, Blumberg R, Kiyono H, McGhee JR. The mucosal immune system. Inc: *Fundamental Immunology* chapter 31 (Ed. Paul, W. E) Academic, San Diego, USA. 2003.

Mikhak Z, Farsidjani A, Luster AD. Endotoxin augmented antigen-induced Th1 cell trafficking amplifies airway neutrophilic inflammation. *J Immunol.* 182 (12): 7946-7956, 2009.

Mirzapoiiazova T, Kolosova IA, Moreno L, Sammani S, Garcia JG, Verin AD. Suppression of endotoxin-induced inflammation by taxol. *Eur Respir J.* 30 (3): 429-435, 2007.

Miyamoto M, Prause O, Sjöstrand M, Laan M, Lötvall J, Lindén A. Endogenous IL-17 as a mediator of neutrophil recruitment caused by endotoxin exposure in mouse airways. *J Immunol.* 170 (9): 4665-4572, 2003.

Miyara M, Sakaguchi S. Natural regulatory T cells: mechanisms of suppression. *Trends Mol Med.* 13 (3): 108-116, 2007.

Mizutani N, Fuchikami J, Takahashi M, Nabe T, Toshino S, Kohno S. Pulmonary emphysema induced by cigarette smoke solution and lipopolysaccharide in guinea pigs. *Biol Pharm Bull.* 32 (9): 1559-1564, 2009.

Montagnoli C, Fallarino F, Gaziano R, Bozza S, Bellocchio S, Zelante T, Kurup WP, Pitzurra L, Puccetti P, Romani L. Immunity and tolerance to *Aspergillus* involve functionally distinct regulatory T cells and tryptophan catabolism. *J Immunol.* 176 (3): 1712-1723, 2006.

Moore BB, Moore TA, Toews GB. Role of T- and B-lymphocytes in pulmonary host defences. *Eur Respir J.* 18 (5): 846-486, 2001.

Moore BB, Hogaboam CM. Murine models of pulmonary fibrosis. *Am J Physiol Lung Cell Mol Physiol.* 294: L152-L160, 2008.

Moretó M, Pérez-Bosque A. Dietary plasma proteins, the intestinal immune system and the barrier functions of the intestinal mucosa. *J Anim Sci.* 87: E92-E100, 2009.

Morrill JL, Morrill JM, Feverherm AM, Laster JF. Plasma proteins and a probiotic as ingredients in milk replacer. *J Dairy Sci.* 78 (4): 902-907, 1995.

Mouricot M, Petit JM, Carias JR, Julien R. Glycoprotein glycans that inhibit adhesion of *Escherichia coli* mediated by K99 fimbriae: treatment of experimental colibacillosis. *Infect Immun.* 58 (1): 98-106, 1990.

Moyron-Quiroz JE, Rangel-Moreno J, Harston L, Kusser K, Tighe MP, Klonowski KD, Lefrancois L, Cauley LS, Harmsen AG, Lund FE, Randall TD. Persistence and responsiveness of immunologic memory in the absence of secondary lymphoid organs. *Immunity.* 25 (4): 643-654, 2006.

Murakami D, Yamada H, Yajima T, Masuda A, Komune S, Yoshikai Y. Lipopolysaccharide inhalation exacerbates allergic airway inflammation by activating mast cells and promoting Th2 responses. *Clin Exp Allergy*. 37 (3): 339-347, 2007.

Murphy TJ, Ni Choileain N, Zang Y, Mannick JA, Lederer JA. CD4+CD25+ regulatory T cells control innate immune activity after injury. *J Immunol*. 174 (5): 2957-2963, 2005.

Murtaugh MP, Baarsch MJ, Zhou Y, Scamurra RW, Lin G. Inflammatory cytokines in animal health and disease. *Vet Immunol Immunopathol*. 54 (1-4): 45-55, 1996.

N

Nakae S, Ho LH, Yu M, Monteforte R, Iikura M, Suto H, Galli SJ. Mast cell-derived TNF contributes to airway hyperreactivity, inflammation, and Th2 cytokine production in an asthma model in mice. *J Allergy Clin Immunol*. 120 (1): 48-55, 2007.

Nathan C. Neutrophils and immunity: challenges and opportunities. *Nat Rev Immunol*. 6 (3): 173-182, 2006.

Navarro S, Cossalter G, Chiavaroli C, Kanda A, Fleury S, Lazzari A, Cazareth J, Sparwasser T, Dombrowicz D, Glaichenhaus N, Julia V. The oral administration of bacterial extracts prevents asthma via the recruitment of regulatory T cells to the airways. *Mucosal Immunol*. 4 (1): 53-65, 2011.

Neumann EJ, Kliebenstein JB, Johnson CD, Mabry JW, Bush EJ, Seitzinger AH, Green AL, Zimmermann JJ. Assessment of the economic impact of porcine reproductive and respiratory syndrome on swine production in the United States. *J Am Vet Med Assoc*. 227 (3): 385-392, 2005.

Neurath MF, Finotto S, Glimcher LH. The role of Th1/Th2 polarization in mucosal immunity. *Nat Med*. 8 (6): 567-573, 2002.

Nofrarias M, Manzanilla EG, Pujols J, Gibert X, Majó N, Segalés J, Gasa J. Effects of spray-dried porcine plasma and plant extracts on intestinal morphology and on leukocyte cell subsets of weaned pigs. *J Anim Sci*. 84 (10): 2735-2742, 2006.

Nollet H, Deprez P, van Driessche E, Muylle E. Protection of just weaned pigs against infection with F18+ *Escherichia coli* by non-immune plasma powder. *Vet Microbiol*. 65 (1): 37-45, 1999.

O

O'Garra A, Barrat FJ, Castro AG, Vicari A, Hawrylowicz C. Strategies for use of IL-10 or its antagonists in human disease. *Immunol Rev.* 223: 114-131, 2008.

O'Neil LA, Dinarello CA. The IL-1 receptor/toll-like receptor superfamily: crucial receptors for inflammation and host defense. *Immunol Today.* 21 (5): 206-209, 2000.

Osek J. Prevalence of virulence factors of *Escherichia coli* strains isolated from diarrheic and healthy piglets after weaning. *Vet Microbiol.* 68 (3-4): 209-217, 1999.

Ouyang W, Kolls JK, Zheng Y. The biological functions of T helper 17 cell effector cytokines in inflammation. *Immunity.* 28 (4): 454-467, 2008.

P

Pabst R, Tscherning T. Perivascular capillaries in the lung: An important but neglected vascular bed in immune reactions? *J Allergy Clin Immunol.* 110 (2): 209-214, 2002.

Pabst R. Plasticity and heterogeneity of lymphoid organs. What are the criteria to call a lymphoid organ primary, secondary or tertiary? *Immunol Lett.* 112 (1): 1-8, 2007.

Peace RM, Campbell J, Polo J, Crenshaw J, Russell L, Moeser A. Spray-dried porcine plasma influences intestinal barrier function, inflammation, and diarrhea in weaned pigs. *J Nutr.* 141 (7): 1312-1317, 2011.

Pepe PE, Potkin RT, Reus DH, Hudson LD, Carrico CJ. Clinical predictors of the adult respiratory distress syndrome. *Am J Surg.* 144 (1): 124-130, 1982.

Pérez-Bosque A, Pelegrí C, Vicario M, Castell M, Russell L, Campbell JM, Quigley JD, Polo J, Moretó M. Dietary plasma protein affects the immune response of weaned rats challenged with *Staphylococcus aureus* Superantigen B. *J Nutr.* 134 (10): 2667-2672, 2004.

Pérez-Bosque A, Amat C, Vicario M, Polo J, Campbell JM, Crenshaw J, Russell L, Moretó M. Spray-dried animal plasma prevents the effects of *Staphylococcus aureus* enterotoxin B on intestinal barrier function in weaned rats. *J Nutr.* 136 (11): 2838-2843, 2006.

Pérez-Bosque A, Miró L, Polo J, Russell L, Campbell J, Weaver E, Crenshaw J, Moretó M. Dietary plasma protein supplements prevent the release of mucosal proinflammatory mediators in intestinal inflammation in rats. *J Nutr.* 140 (1): 25-30, 2010.

Pérez-Bosque A, Moretó M. A rat model of mild intestinal inflammation induced by *Staphylococcus aureus* enterotoxin B. *Proc Nutr Soc.* 69 (3): 447-53, 2010.

Piccirillo CA, Shevach EM. Cutting edge: control of CD8+ T cell activation by CD4+CD25+ immunoregulatory cells. *J Immunol.* 167 (3): 1137-1140, 2001.

Pierce JL, Cromwell GL, Lindermann MD, Russell LE, Weaver EM. Effects of spray-dried animal plasma and immunoglobulins on performance of early weaned pigs. *J Anim Sci.* 83 (12): 2876-2885, 2005.

Pietropaoli A, Georas SN. Resolving lung injury: a new role for Tregs in controlling the innate immune response. *J Clin Invest.* 119 (10): 2891-2894, 2009.

Pluske JR, Hampson DJ, Williams IH. Factors influencing the structure and function of the small intestine in the weaned pigs: a review. *Livest Prod Sci.* 51: 215-236, 1997.

Ponath PD, Qin S, Ringler DJ, Clark-Lewis I, Wang J, Kassam N, Smith H, Shi X, Gonzalo JA, Newman W, Gutierrez-Ramos JC, Mackay CR. Cloning of the human eosinophil chemoattractant, eotaxin. Expression, receptor binding, and functional properties suggest a mechanism for the selective recruitment of eosinophils. *J. Clin. Invest.* 97 (3): 604-612, 1996.

Prado CM, Yano L, Rocha G, Starling CM, Capelozzi VL, Leick-Maldonado EA, Martins Mde A, Tibério IF. Effects of inducible nitric oxide synthase inhibition in bronchial vascular remodeling-induced by chronic allergic pulmonary inflammation. *Exp Lung Res.* 37 (5): 259-268, 2011.

Puljic R, Benediktus E, Plater-Zyberk C, Baeuerle PA, Szelenyi S, Brune K, Pahl A. Lipopolysaccharide-induced lung inflammation is inhibited by neutralization of GM-CSF. *Eur J Pharmacol.* 557 (2): 230-235, 2007.

Puneet P, Moochhala S, Bhatia M. Chemokines in acute respiratory distress syndrome. *Am J Physiol Lung Cell Mol Physiol.* 288 (1): L3-L15, 2005.

Q

Quigley JD 3rd, Drew MD. Effects of oral antibiotics or bovine plasma on survival, health and growth in dairy calves challenged with *Escherichia coli*. *Food Agric Immunol*. 12: 311-318, 2000.

Quigley JD 3rd, Wolfe TM. Effects of spray-dried animal plasma in calf milk replacer on health and growth of dairy calves. *J Dairy Sci*. 86 (2): 586-592, 2003.

Quigley JD 3rd, Campbell JM, Polo J, Russell LE. Effects of spray-dried animal plasma on intake and apparent digestibility in dogs. *J Anim Sci*. 82 (6): 1685-1692, 2004.

R

Randall TD. Bronchus-associated lymphoid tissue (BALT): structure and function. *Adv Immunol*. 107: 187-241, 2010.

Randolph DA, Carruthers CJ, Szabo SJ, Murphy KM, Chaplin DD. Modulation of airway inflammation by passive transfer of allergen-specific Th1 and Th2 cells in a mouse model of asthma. *J Immunol*. 162 (4): 2375-2383, 1999.

Redford PS, Murray PJ, O'Garra A. The role of IL-10 in immune regulation during *M. tuberculosis* infection. *Mucosal Immunol*. 4 (3): 261-270, 2011.

Reutershan J, Basit A, Galkina EV, Ley K. Sequential recruitment of neutrophils into lung and bronchoalveolar lavage fluid in LSP-induced acute lung injury. *Am J Physiol Lung Cell Mol Physiol*. 289 (5): L807-L815, 2005.

Ricciardolo FL, Di Stefano A, Sabatini F, Folkerts G. Reactive nitrogen species in the respiratory tract. *Eur J Pharmacol*. 533 (1-3): 240-252, 2006.

Rietschel ET, Brade H, Holst O, Brade L, Müller-Loennies S, Mamat U, Zähringer U, Beckmann F, Seydel U, Brandenburg D, Ulmer AJ, Mattern T, Heine H, Schletter J, Loppnow H, Schönbeck U, Flad HD, Hauschildt S, Schade UF, Di Padova F, Kusumoto S, Schumann RR. Bacterial endotoxin: Chemical constitution, biological recognition, host response, and immunological detoxification. *Curr Top Microbiol Immunol*. 216: 39-81, 1996.

Rittirsch D, Flierl MA, Day DE, Nadeau BA, McGuire SR, Hoesel LM, Ipaktchi K, Zetoune FS, Sarma JV, Leng L, Huber-Lang MS, Neff TA, Bucala R, Ward PA. Acute lung injury induced by lipopolysaccharide is independent of complement activation. *J Immunol.* 180 (11): 7664-7672, 2008.

Rogério AP, Dora CL, Andrade EL, Chaves JS, Silva LF, Lemos-Senna E, Calixto JB. Anti-inflammatory effect of quercetin-loaded microemulsion in the airways allergic inflammatory model in mice. *Pharmacol Res.* 61 (4): 288-297, 2010.

Rosenberg HF, Phipps S, Foster PS. Eosinophil trafficking in allergy and asthma. *J Allergy Clin Immunol.* 119 (6): 1303-1310, 2007.

Rudzik R, Clancy RL, Perey DY, Day RP, Bienenstock J. Repopulation with IgA-containing cells of bronchial and intestinal lamina propria after transfer of homologous Peyer's patch and bronchial lymphocytes. *J Immunol.* 114 (5): 1599-1604, 1975.

Russell LE, Weaver EM. Strategic application of blood proteins in feeding strategies for early weaned pigs and calves. *Amer Assoc Swine Vet.* 37-45, 1996.

S

Safdar Z, Yiming M, Grunig G, Bhattacharya J. Inhibition of acid-induced lung injury by hyperosmolar sucrose in rats. *Am J Respir Crit Care Med.* 172 (8): 1002-1007, 2005.

Sakaguchi S. Naturally arising FoxP3 expressing CD25+CD4+ regulatory T cells in immunological tolerance to self and non-self. *Nat Immunol.* 6 (4): 345-352, 2005.

Sakaguchi S, Powrie F. Emerging challenges in regulatory T cell function and biology. *Science.* 317 (5838): 627-629, 2007.

Sánchez R, Kanarek L, Koninkx J, Hendriks H, Lintermans P, Bertels A, Charlier G, Van Driessche E. Inhibition of adhesion of enterotoxigenic *Escherichia coli* cells expressing F17 fimbriae to small intestinal mucus and brush-border membranes of young calves. *Microb Pathog.* 15 (6): 207-219, 1993.

Sato K, Kawasaki H, Morimoto C, Yamashima N, Matsuyama T. An abortive ligand-induced activation of CCR1-mediated downstream signaling event and a deficiency of CCR5 expression are

associated with the hyporesponsiveness of human naive CD4⁺ T cells to CCL3 and CCL5. *J Immunol.* 168 (12): 6263-6272, 2002.

Savill J. Apoptosis in resolution of inflammation. *J Leukoc Biol.* 61 (4): 375-380, 1997.

Schnyder-Candrian S, Quesniaux VF, Di Padova F, Mallet I, Noulin N, Couillin I, Moser R, Erard F, Vargaftig BB, Ryffel B, Schnyder B. Dual effects of p38 MAPK on TNF-dependent bronchoconstriction and TNF-independent neutrophil recruitment in lipopolysaccharide-induced acute respiratory distress syndrome. *J Immunol.* 175 (1): 262-269, 2005.

Schoenborn JR, Wilson CB. Regulation of interferon-gamma during innate and adaptive immune responses. *Adv Immunol.* 96: 41-101, 2007.

Schroemm AB, Brandenburg K, Loppnow H, Moran AP, Koch MH, Rietschel ET, Seydel U. Biological activities of lipopolysaccharides are determined by the shape of their lipid A portion. *Eur J Biochem.* 267 (7): 2008-2013, 2000.

Segal AW. How neutrophils kill microbes. *Annu Rev Immunol.* 23: 197-223, 2005.

Serrano-Hernández A. Helper (Th1, Th2, Th17) and regulatory cells (Treg, Th3, NKT) in rheumatoid arthritis. *Reumatol Clin.* 5 (S1): 1-5, 2009.

Shevach EM. CD4⁺CD25⁺ suppressor T cells: more questions than answers. *Nat Rev Immunol.* 2 (6): 389-400, 2002.

Shimoyama T, Tabuchi N, Chung J, Koyama T, Sunamori M. Matrix metalloproteinase inhibitor (ONO-4817) attenuates ischemia-reperfusion injury in rat lung. *Med Sci Monit.* 12 (2): BR51-BR56, 2006.

Singleton KD, Serkova N, Beckey VE, Wischmeyer PE. Glutamine attenuates lung injury and improves survival after sepsis: role of enhanced heat shock protein expression. *Crit Care Med.* 33 (6): 1206-1213, 2005.

Skerrett SJ, Liggitt H D, Hajjar AM, Ernst RK, Miller SI, Wilson CB. Respiratory epithelial cells regulate lung inflammation in response to inhaled endotoxin. *Am J Physiol Lung Mol Physiol.* 287 (1): L143-L152, 2004.

Sminia T, van der Brugge-Gamelkoorn GJ, Jeurissen SH. Structure and function of bronchus-associated lymphoid tissue (BALT). *Crit Rev Immunol.* 9 (2): 119-150, 1989.

Spencer JD, Touchette KJ, Liu H, Allee GL, Newcomb MD, Kerley MS, Pace LW. Effect of spray-dried plasma and fructooligosaccharide on nursery pig performance and small intestinal morphology of weaned pigs. *J Anim Sci.* 75 (Suppl.1): 199 (Abs), 1997.

Steenwinckel V, Louahed J, Lemaire MM, Sommereyns C, Warnier G, McKenzie A, Brombacher F, Van Snick J, Renauld JC. IL-9 promotes IL-13-dependent paneth cell hyperplasia and up-regulation of innate immunity mediators in intestinal mucosa. *J Immunol.* 182 (8): 4737-4743, 2009.

Strieter RM, Kunkel SL, Keane MP, Standiford TJ. Chemokines in lung injury: Thomas A. Neff Lecture. *Chest.* 116 (1 Suppl): 103S-110S, 1999.

Suzuki T, Chow CW, Downey GP. Role of innate immune cells and their products in lung immunopathology. *Int J Biochem Cell Biol.* 40 (6-7): 1348-1361, 2008.

T

Takabayshi K, Corr M, Hayashi T, Redecke V, Beck L, Guiney D, Sheppard D, Raz E. Induction of a homeostatic circuit in lung tissue by microbial compounds. *Immunity.* 24 (4): 475-487, 2006.

Tanaka A, Seki M, Yamahira S, Noguchi H, Kosai K, Toba M, Morinaga Y, Miyazaki T, Izumikawa K, Takeya H, Yamamoto Y, Yanagihara K, Tashiro T, Kohda N, Kohno S. Lactobacillus pentosus strain b240 suppresses pneumonia induced by Streptococcus pneumoniae in mice. *Lett Appl Microbiol.* 53 (1): 35-43, 2011.

Thacker EL. Lung inflammatory responses. *Vet Res.* 37 (3): 469-486, 2006.

Tollefson L, Fedorka-Cray PJ, Angulo FJ. Public health aspects of antibiotic resistance monitoring in the USA. *Acta Vet Scand.* 92: 67-75, 1999.

Torrallardona D, Conde MR, Badiola I, Polo J, Brufau J. Effect of fishmeal replacement with spray-dried animal plasma and colistin on intestinal structure, intestinal microbiology, and performance of weanling pigs challenged with Escherichia coli K99. *J Anim Sci.* 81 (5): 1120-1126, 2003.

Touchette KJ, Allee GL, Newcomb MD, Pace LW, Ellersieck MR. Impact of feed intake and spray-dried plasma on nursery performance and intestinal morphology of weaned pigs. *J Anim Sci.* 75 (Suppl 1): 198 (Abs), 1997.

Touchette KJ, Carroll JA, Allee GL, Matteri RL, Dyer CJ, Beausang LA, Zannelli ME. Effect of spray-dried plasma and lipopolysaccharide exposure on weaned pigs: I. Effects on the immune axis of weaned pigs. *J Anim Sci.* 80 (2): 494-501, 2002

Tshering T, Pabst R. Bronchus associated lymphoid tissue (BALT) is not present in normal adult lung but in different diseases. *Pathobiology.* 68 (1): 1-8, 2000.

Twigg HL 3rd. Humoral immune defense (antibodies): recent advances. *Proc Am Thorac Soc.* 2 (5): 417-421, 2005.

V

Vallbracht S, Unsöld H, Ehl S. Functional impairment of cytotoxic T cells in the lung airways following respiratory virus infections. *Eur J Immunol.* 36 (6): 1434-1442, 2006.

Van der Brugge-Gamelkoorn G, van de Ende M, Sminia T. Uptake of antigens and inert particles by bronchus associated lymphoid tissue (BALT) epithelium in the rat. *Cell Biol Int Rep.* 9 (6): 524, 1985.

Van Dijk AJ, Niewold TA, Margry RJ, Van den Hoven SG, Nabuurs MJ, Stockhofe-Zurwieden N, Beymen AC. Small intestinal morphology in weaned piglets fed a diet containing spray-dried porcine plasma. *Rev Vet Sci.* 71 (1): 17-22, 2001.

Van Dijk AJ, Niewold TA, Nabuurs MJ, Van Hees J, De Bot P, Stockhofe-Zurwieden N, Ubbink-Blanksma M, Beynen AC. Small intestinal morphology and disaccharidase activities in early-weaned piglets fed a diet containing spray-dried porcine plasma. *J Vet Med A Physiol Pathol Clin Med.* 49 (2): 81-86, 2002.

Venet F, Chung CS, Huang X, Lomas-Neira J, Chen Y, Ayala A. Lymphocytes in the development of lung inflammation: a role for regulatory CD4 T cells in indirect pulmonary lung injury. *J Immunol.* 183 (5): 3472-3480, 2009.

Venet F, Huang X, Chung CS, Chen Y, Ayala A. Plasmacytoid dendritic cells control lung inflammation and monocyte recruitment in indirect acute lung injury in mice. *Am J Pathol.* 176 (2): 764-773, 2010.

Verstegen MW , Williams BA. Alternatives to the use of antibiotics as growth promoters for monogastric animals. *Anim Biotechnol.* 13 (1): 113-127, 2002.

W

Williams NH, Stahly TS, Zimmerman DR. Effect of level of chronic immune system activation on the growth and dietary lysine needs of pigs fed from 6 to 112 kg. *J Anim Sci.* 75 (9): 2481-2496, 1997.

Wills-Karp M. Immunologic basis of antigen-induced airway hyperresponsiveness. *Annu Rev Immunol.* 17: 255-281, 1999.

Woodland DL, Randall TD. Anatomical features of anti-viral immunity in the respiratory tract. *Semin Immunol.* 16 (3): 163-170, 2004.

Wu CL, Lin LY, Yang JS, Chan MC, Hsueh CM. Attenuation of lipopolysaccharide-induced acute lung injury by treatment with IL-10. *Respirology.* 14 (4): 511-521, 2009.

X

Xie YC, Dong XW, Wu XM, Yan SF, Xie QM. Inhibitory effects of flavonoids extracted from licorice on lipopolysaccharide-induced acute pulmonary inflammation in mice. *Int Immunopharmacol.* 9 (2): 194-200, 2009.

Xu CQ, Liu BJ, Wu JF, Xu YC, Duan XH, Cao YX, Dong JC. Icariin attenuates LPS-induced acute inflammatory response: Involvement of PI3K/Akt and NK- κ B signaling pathway. *Eur J Pharmacol.* 642 (1-3): 146-153, 2010.

Y

Yasuda A, Inoue KI, Sanbongi C, Yanagisawa R, Ichinose T, Yoshikawa T, Takano H. Dietary supplementation with fructooligosaccharides attenuates airway inflammation related to house dust mite allergen in mice. *Int J Immunopathol Pharmacol.* 23 (3): 727-735, 2010.

Yeh CC, Lin CC, Wang SD, Hung CM, Yeh MH, Liu CJ, et al. Protective and immunomodulatory effect of Gingyo-san in a murine model of acute lung inflammation. *J Ethnopharmacol.* 111 (2): 418-426, 2007.

Yin H, Jin XB, Gong Q, Yang H, Hu LY, Gong FL, Zhu JY. Fructose-1,6-diphosphate attenuates acute lung injury induced by lipopolysaccharide in mice. *Int Immunopharmacol.* 8 (13-14): 1842-1847, 2008.

Yuki Y, Kiyono H. New generation of mucosal adjuvants for the induction of protective immunity. *Rev Med Virol.* 13 (5): 293-310, 2003.

Z

Zarbock A, Allegretti M, Ley K. Therapeutic inhibition of CXCR2 by Reparixin attenuates acute lung injury in mice. *Br J Pharmacol.* 155 (3): 357-364, 2008.

Zemans RL, Colgan SP, Downey GP. Transepithelial migration of neutrophils: mechanisms and implications for acute lung injury. *Am J Respir Cell Mol Biol.* 40 (5): 519-535, 2009.

Zhao J, Harper AF, Estienne MJ, Webb KE Jr, McElroy AP, Denbow DM. Growth performance and intestinal morphology responses in early weaned pigs to supplementation of antibiotic-free diets with an organic copper complex and spray-dried plasma protein in sanitary and nonsanitary environments. *J Anim Sci.* 85 (5): 1302-1310, 2007.

Zlotnik A, Yoshie O. Chemokines: a new classification system and their role in immunity. *Immunity.* 12 (2): 121-127, 2000.

Zuercher AW, Coffin SE, Thurnheer MC, Fundova P, Cebra JJ. Nasal-associated lymphoid tissue is a mucosal inductive site for virus-specific humoral and cellular immune responses. *J Immunol.* 168 (4): 1796-1803, 2002.