APPENDICES

Appendix 1. The composition of anaerobic broth

Yeast extract	2.5g
Peptone from casein	2.5g
Solution A	167 mL
Solution B	167mL
Resazurin solution	1 mL
Hemine solution	5 mL
Tween 80	1 mL
Solution A:	
NaCl	5.4 g
KH_2PO_4	2.7 g
$CaCl_2 \times 2H_2O$	0.16 g
$MgCl_2 \times 6H_2O$	0.12g
$MnSO_4 \times 4H_2O$	0.07 g
$CoCl_2 \times 6H_2O$	0.06 g
$(NH_4)_2 SO_4$	5.4g
$FeSO4 \times 7H_2O$	0.05g per liter.
Solution B:	
$K_2HPO_4 \times 3H_2O$	2.7 g per liter.

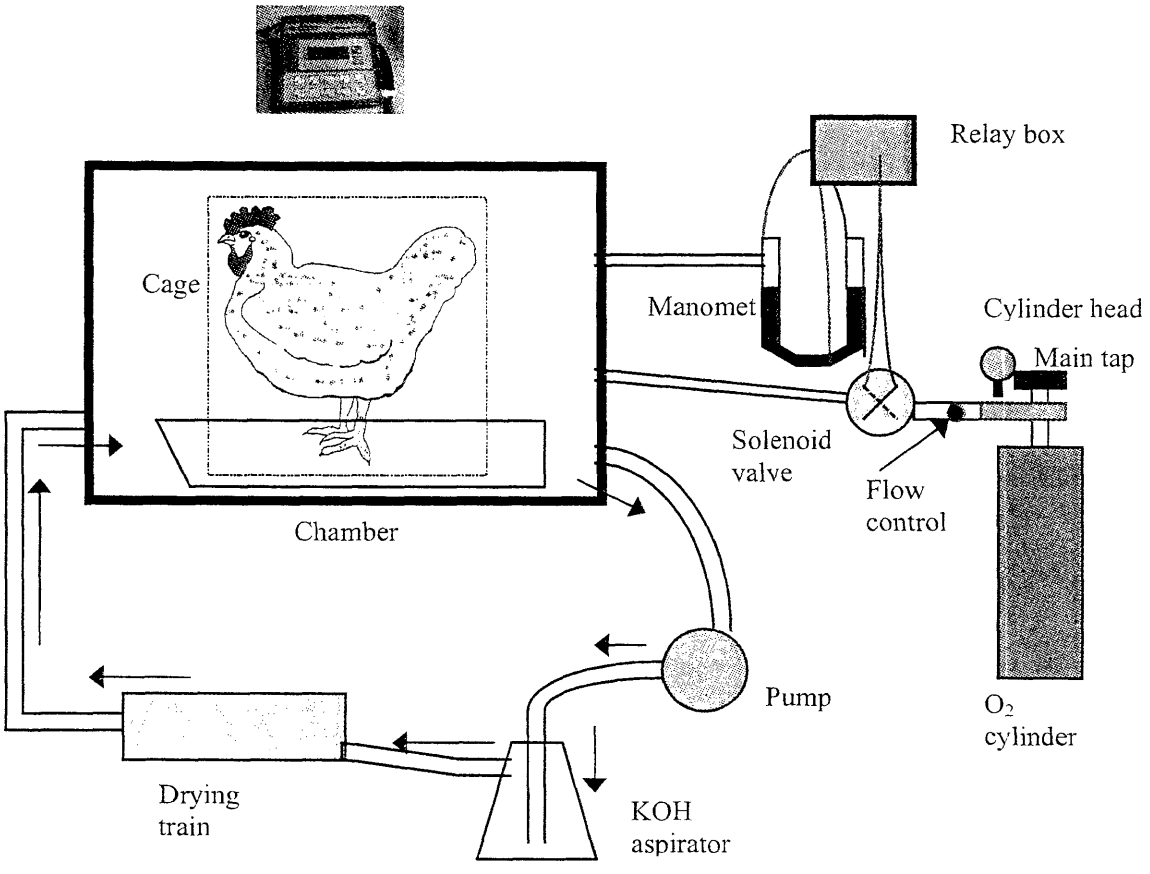
Resazurin solution:

100 mg resazurin in 100mL water

Hemine solution:

0.05 g hemine in 100 mL 0.02% NaOH.

Appendix 2. Diagram of closed-circuit calorimeter



REFERENCES

Acamovic, T. (2001) Commercial application of enzyme technology for poultry production. *World's Poultry Science Journal*, **57:** 225-242.

Acamovic, T. (2002) "Nutrient requirements and standards for poultry." Avian Science Research Centre, SAC, Ayr KA6 5HW, Scotland. 16. (Review nutritional standards for livestock)

Adlerberth, I., Ahrn, S., Johansson, M.-L., Molin, G., Hanson, L. A. & Wold, A. E. (1996) A mannose-specific adherence mechanism in *Lactobacillus plantarum* conferring binding to the human colonic cell line HT-29. *Applied and Environmental Microbiology*, **62:** 2244-2251.

Adlerberth, I., Cerquetti, M., Poilane, I., Wold, A. & Collignon, A. (2000) Mechanisms of colonisation and colonisation resistance of the digestive tract Part 1: Bacteria/host interactions. *Microbial Ecology in Health and Disease*, **12 (Suppl 2):** 223-239.

Adolfsson, O., Meydani, S. N. & Russell, R. M. (2004) Yogurt and gut function. *American Journal of Clinical Nutrition*, **80:** 345-356.

Allen, A., Flemstrom, G., Garner, A. & Kivilaakso, E. (1993) Gastroduodenal mucosal protection. *Physiological Reviews*, **74:** 823-835.

Allen, P. C., Lydon, J. & Danforth, H. (1997) Effects of components of Artemisia annua on coccidia infections in chickens. *Poultry Science*, **76:** 1156–1163.

Alves, A., Guedes, C. M., Gomes, M. J., Mourao, J. L., Pinheiro, V. C., Saavedra, M. J., Gama, A., Oliveira, J. & Pires, I. (2003) "Digestibility and gut development of broiler chickens fed Bio-MOS versus control." Universidade de Tras-os-MOntes e Alto Douro, Vila Real, Protugal. Alltech report, 25 pp.

Ammerman, E., Quarles, C. & Twinning, P. V. (1988) Broiler reponse to the addition of dietary fructooligosaccharides. *Poultry Science*, **67 (Suppl 1):** 46 (Abstract).

Annett, C. B., Viste, J. R., Chirino-Trejo, M., Classen, H. L., Middleton, D. M. & Simko, E. (2002) Necrotic enteritis: effect of barley, wheat and corn diets on proliferation of *Clostridium perfringens* type A. *Avian Pathology*, **31:** 598-601.

Annison, G. (1993) The role of wheat non-starch polysaccharides in broiler nutrition. *Australian Journal of Agricultural Research*, **44:** 405-422.

Annison, G. & Choct, M. (1991) Anti-nutritive activities of cereal non-starch polysaccharides in broiler diets and strategies minimising their effects. *World's Poultry Science Journal*, **47:** 232-242.

References

Ao, Z. (2004) Diet and early nutrition: their effects on immunity and gut development in broiler chickens (*PhD Thesis*). University of New England, NSW, Armidale, Australia.

AOAC (1994) "Official methods of analysis," 15th edition, Washington, D. C.

Apajalahti, J. H. A., Kettune, A. & Graham, H. (2004) Characteristics of the gastrointestinal microbial communities, with special reference to the chicken. *World's Poultry Science Journal*, **60:** 223-232.

Apajalahti, J. H. A., Kettunen, A., Bedford, M. R. & Holben, W. E. (2001) Percent G+C profiling accurately reveals diet-related differences in the gastrointestinal microbial community of broiler chickens. *Applied and Environmental Microbiology*, **67:** 5656-5667.

Armstrong, D. G. (1985) Gut-active growth promoters. In: *Proceedings of the University of Nottingham 43rd Easter School*, London, 21-37.

Baba, E., Tsukamoto, Y., Fukata, T., Sasai, K. & Arakawa, A. (1993) Increase of mannose residues, as *Salmonella typhimurium*-adhering factor, on the cecal mucosa of germ-free chickens infected with *Eimeria tenella. American Journal of Veterinary Research*, **54:** 1471-1475.

Bafundo, K. W. & Cervantes, H. (2006). An update on antibiotic use in animals and apparent risks to man: lessons from the EU experience. *Accessed in 2006.* www.feedinfo.com.

Bailey, J. S., Blankenship, L. C. & Cox, N. A. (1991) Effect of fructooligosaccharide on *Salmonella* colonization of the chicken intestine. *Poultry Science*, **70:** 2433-2438.

Barnes, E. M., Mead, G. C. & Barnum, D. A. (1972) The intestinal flora of the chicken in the period 2 to 6 weeks of age, with particular reference to the anaerobic bacteria. *British Poultry Science*, **13:** 311-326.

Barrow, P. A. (1992) Probiotics for chickens. *In "Probiotics: The scientific basis"* (R. Fuller, ed.), pp. 255-257. Chapman and Hall, London.

Bar-Shira, E. & Friedman, A. (2005a) Ontogeny of gut associated immune competence in the chick. *Israel Journal of Veterinary Medicine*, **60:** 42-50.

Bar-shira, E. & Friedman, A. (2005b). Expression of innate immune funtions in developing broiler gut-associated lymphoid tissue in the immediate post-hatch period. In: *28th WPSA Poultry Science Symposium*, Bristol, UK, 35 (Abstract).

Bartov, I. (1992) Lack of effect of dietary energy-to-protein ratio and energy concentration on the response of broiler chickens to virginiamycin. *British Poultry Science*, **33:** 381-391.

References

Bedford, M. (2000) Removal of antibiotic growth promoters from poultry diets: implications and strategies to minimise subsequent problems. *World's Poultry Science Journal*, **56:** 347-365.

Bedford, M. R. (2001) The role of carbohydrases in feedstuff digestion. *In "Poultry feedstuffs: Supply, composition, and nutritive value"* (J. McNab and K. N. Boorman, eds.), pp. 319-336. CAB international, Edinburgh, UK.

Bedford, M. R. & Classen, H. L. (1992) Reduction of intestinal viscosity through manipulation of dietary rye and pentosanase concentrations is effected through changes in the carbohydrate composition of the intesitnal aqueous phase and results in improved rates and food conversion efficiency of broiler chicks. *Journal of Nutrition*, **122:** 137-142.

Belay, T. & Teerer, R. G. (1996) Virginiamycin and caloric density effects on live performance, blood serum metabolite concentration, and carcass composition of broilers reared in thermoneutral and cycling ambient temperatures. *Poultry Science*, **75:** 1383-1392.

Bengmark, S. (2001) Pre-, pro- and synbiotics. *Current Opinion in Clinical Nutrition and Metabolic Care*, **4:** 571-579.

Benson, B. N., Calvert, C. C., Roura, E. & Klasing, K. C. (1993) Dietary energy source and density modulate the expression of immunologistic stress in chicks. *Journal of Nutrition*, **123:** 1714-1723.

Bernet, M. F., Brassart, D., Neeser, J. R. & Servin, A. L. (1993) Adhesion of human bifodobacterial strains to cultured human intestinal epithelial cells and inhibition of enteropathogen-cell interactions. *Applied and Environmental Microbiology*, **59:** 4121-4128.

Bjerrum, L., Pedersen, K. & EngbergB, R. M. (2004) The influence of whole wheat feeding on *Salmonella* infection and gut flora composition in broilers. *Avian Diseases*, **49:** 9–15.

Bojesen, A. M., Nielsen, S. S. & Bisgaard, M. (2003) Prevalence and transmission of haemolytic Gallibacterium species in chicken production systems with different biosecurity levels. *Avian Pathology*, **32:** 503-510.

Bourlioux, P., Koletzko, B., Guarner, F. & Braesco, V. (2003) The intestine and its microflora are partners for the protection of the host. *American Journal of Clinical Nutrition*, **78:** 675-683.

Bradford, M. M. (1976) A rapid and sensitive method for the quantitation of microgram quantities of protein utilizing the principle of protein-dye binding. *Analytical Biochemistry*, **72:** 248-254.

Bradley, G. L., Savage, T. F. & Timm, K. I. (1994) The effects of supplementing diets with *Saccharomyces cerevisiae var. boulardii* on male poult performance and ileal morphology. *Poultry Science*, **73:** 1766-1770.

References

Broz, J. & Beardsworth, P. (2002) Recent trends and future developments in the use of feed enzymes in poultry nutrition. *In "Poultry feedstuffs: Supply, composition and nutritive value"* (J. McNab and K. N. Boorman, eds.), pp. 345-361. CAB international, Edinburgh, UK.

Brzoska, F., Buluchevskij, S. B., Sliwinski, B. & Stecka, K. (2005) Preliminary study of the microbial spectrum of the digestive tract in broilers fed diets with and without antibiotic supplementation. *Journal of Animal and Feed Sciences*, **14 (Suppl 1):** 431-434.

Buddington, R. K. & Weiher, E. (1999) The application of ecological principles and fermentable fibers to manage the gastrointestinal tract ecosystem. *Journal of Nutrition*, **129:** 1446S-1450S.

Bunce, T. J., Howard, M. D., Allee, G. L. & Pace, L. W. (1995) Protective effects of fructooligosaccharide (FOS) in prevention of mortality and morbidity from infectious *E. coli* K:88 challenge. *Journal of Animal Science*, **73 (Suppl 1):** 69 (Abstract).

Butaye, P., Devriese, L. A. & Haesebrouck, F. (2003) Antimicrobial growth promoters used in animal feed: effects of less well known antibiotics on gram-positive bacteria. *Clinical Microbiology Reviews*, **16:** 175-188.

Carre, B., Gomez, J. & Chagneau, A. M. (1995) Contribution of oligosaccharide and polysaccharide digestion, and excreta losses of lactic acid and short chain fatty acids, to dietary metabolisable energy values in broiler chickens and adult cockerels. *British Poultry Science*, **36:** 611-629.

CDC (Center for Disease Control and Prevention) (2002) Diseases and pathogens under surveillance. *Accessed in 2006.* http://www.cdc.gov/narms/pus.htm.

Ceylan, N., Çyftcy, Ý. & Ýlhan, Z. (2003) The effects of some alternative feed additives for antibiotic growth promoters on the performance and gut micro flora of broiler chicks. *Turkish Journal of Veterinary Animal Science*, **27:** 727-733.

Chen, R. C. Y., Reid, G., Irvin, R. T., Bruck, A. W. & Costerton, J. W. (1985) Competitive exclusion of uropathogens from human uroepithelial cells by *Lactobacillus* whole cells and cell wall fragments. *Infection and Immunity*, **47:** 84-89.

Chesson, A. (1994) Probiotics and other intestinal mediators. *In "Principles of pig science"* (D. J. A. Cole, J. Wiseman and M. A. Varley, eds.), pp. 197-214. Nottingham University Press. Nottingham.

Choct, M. (1999) Soluble non-starch polysaccharides affect net utilisation of energy by chickens. In: *Recent Advances in Animal Nutrition in Australia*, **12**:31-35.

Choct, M. (2002) Non-starch polysaccharides: effect on nutritive value. *In "Poultry feedstuffs: Supply, composition, and nutritive value"* (J. McNab and K. N. Boorman, eds.), pp. 221-235. CAB international, Edinburgh, UK.

Choct, M. (2005) The net energy value for poultry diets of commonly used feed in Australia. *In* "Research Rural Industries Research and Development Corporation".

Choct, M. (2006) Enzymes for the feed industry: Past, present and future. *World's Poultry Science Journal*, **62:** 5-15.

Choct, M., Annison, G. & Trimble, R. P. (1992) Soluble wheat pentosans exhibit different anti-nutritive activities in intact and caecectomized broiler chickens. *Journal of Nutrition*, **122:** 2457-2465.

Choct, M., Hughes, R. J., Wang, J., Bedford, M. R., Morgan, A. J. & Annison, G. (1996) Increased small intestinal fermentation is partly responsible for the anti-nutritive activity of non-starch polysaccharides in chickens. *British Poultry Science*, **37:** 609-621.

Christakia, E., Florou-Paneria, P., Giannenasa, I., Papazahariadoub, M., Botsogloua, N. A. & Spaisa, A. B. (2004) Effect of a mixture of herbal extracts on broiler chickens infected with *Eimeria tenella*. *Animal Research*, **53:** 137-144.

Clarkson, K., Jones, B., Bott, R., Bower, B., Chotani, G. & Becker, T. (2001) Enzymes: screening, expression, design and production. *In "Enzymes in farm animal nutrition"* (M. R. Bedford, ed.), pp. 315-352. CABI, Wiltsshire.

Coates, M. E. (1980) The gut microflora and growth. *In "Growth in animals"* (T. L. J. Lawrence, ed.), pp. 176-188. Butterworth, Boston.

Cole, C. B. & Fuller, R. (1984) Bile acid deconjugation and attachment of chicken bacteria: their possible role in growth depression. *British Poultry Science*, **25:** 227-231.

Collier, C. T., van der Klis, J. D., Deplancke, B., Anderson, D. B. & Gaskins, H. R. (2003) Effects of tylosin on bacterial mucolysis, *Clostridium perfringens* colonization, and intestinal barrier function in a chick model of necrotic enteritis. *Antimicrobial Agents and Chemotherapy*, **47:** 3311-3317.

Collins, F. M. & Carter, P. B. (1978) Growth of salmonella in orally infected germfree mice. *Infection and Immunity*, **21:** 41-47.

Collins, M. D. & Gibson, G. R. (1999) Probiotics, prebiotics, and synbiotics: approaches for modulating the microbial ecology of the gut. *American Journal of Clinical Nutrition*, **69:** 1052S-1057S.

Cook, M. E. (2004) Antibodies: Alternatives to antibiotics in improving growth and feed efficiency. *Journal of Applied Poultry Research*, **13:** 106-119.

Cotter, P. F. (1997) Modulation of the immune response: Current perceptions and future prospects, with an example from poultry and Bio-MOS. In: *Biotechnology in the Feed Industry-Alltech 15th Annual Symposium*, Kentucky, USA, 195-204.

Cowan, M. M. (1999) Plant products as antimicrobial agents. *Clinical Microbiology Reviews*, **12:** 564-582.

Cox, E., Cools, V., Thoonen, H., Hoorens, J. & Houvenaghel, A. (1988) Effect of experimentally-induced villus atrophy on adhesion of K88ac-positive *Escherichia coli* in just-weaned piglets. *Veterinary Microbiology*, **17:** 159-169.

Cummings, J. H. & Englyst, H. N. (1995) Gastrointestinal effects of food carbohydrate. *American Journal of Clinical Nutrition*, **61:** 938S-945S.

Dahlqvist, A. (1964) Method for assay of intestinal disaccharidases. *Analytical Biochemistry*, **7:** 18-25.

Danicke, S., Vahjen, W., Simon, O. & Jeroch, H. (1999) Effects of dietary fat type and xylanase supplementation to rye-based broiler diets on selected bacterial groups adhering to the intestinal epithelium, on transit time of feed, and on nutrient digestibility. *Poultry Science*, **78:** 1292-1299.

Davison, T. F. (2003) The immunologists' debt to the chicken. *British Poultry Science*, **44:** 6-21.

Delzenne, N. M. (2002) Oligosaccharides: state of the art. *Proceedings of the Nutrition Society*, **62:** 27-30.

Demir, E., Sarica, S., Zcan, M. A. & Suicmez, M. (2003) The use of natural feed additives as alternatives for an antibiotic growth promoter in broiler diets. *British Poultry Science*, **44 (Suppl 1):** S44-S45.

Deplancke, B. & Gaskins, H. R. (2001) Microbial modulation of innate defense: goblet cells and the intestinal mucus layer. *American Journal of Clinical Nutrition*, **73 (Suppl):** 1131S-1141S.

Deplancke, B., Vidal, O., Ganessunker, D., Donovan, S. M., Mackie, R. I. & Gaskins, H. R. (2002) Selective growth of mucolytic bacteria including *Clostridium perfringens* in a neonatal piglet model of total parenteral nutrition. *American Journal of Clinical Nutrition*, **76:** 1117-1125..

DeVinney, R., Knoechel, D. & Finlay, B. (1999) Enteropathogenic *Escherichia coli*: Cellular harassment. *Current Opinion in Microbiology*, **2:** 83-88.

Dibner, J. J. & Richards, J. D. (2005) Antibiotic growth promoters in agriculture: History and mode of action. *Poultry Science*, **84:** 634-643.

Drew, M. D., Syed, N. A., Goldade, B. G., Laarveld, B. & Van Kessel, A. G. (2004) Effects of dietary protein source and level on intestinal populations of *Clostridium perfringens* in broiler chickens. *Poultry Science*, **83:** 414-420.

Droleskey, R. E., Oyofo, B. A., Hargis, B. M., Corrier, D. E. & DeLoach, J. R. (1994) Effect of mannose on *Salmonella typhimurium*-mediated loss of mucosal epithelial integrity in cultured chick intestinal segments. *Avian Diseases*, **38:** 275-281.

Duguid, J. P., Darekar, M. R. & Wheater, D. W. (1976) Fimbriae and infectivity in *Salmonella typhimurium*. *Journal of Medical Microbiology*, **9:** 459-473.

DuPont, H. L. & Steele, J. H. (1987) The human health implication of the use of antimicrobial agents in animal feeds. *Veterinary Quarterly*, **9:** 309-320.

Edens, F. W. (2003) An alternative for antibiotic use in poultry: probiotics. *Review. Brasilian Cienc. Aviculture*, **5:** 75-97.

Elsayed, N. A. A. H. (2002) Investigations on the significance of the gastrointestinal flora for the immune system of chickens (*PhD Thesis*). University of Leipzig, Leipzig.

Elson, C. O. (1985) Induction and control of the gastrointestinal immune system. *Scandinavian Journal of Gastroenterology*, **114:** 1-15.

Emmans, G. C. (1995) Problems in modelling the growth of poultry. *World's Poultry Science Journal*, **51:** 77-89.

Emmerson, D. A. (1997) Commercial approaches to genetic selection for growth and feed conversion in domestic poultry. *Poultry Science*, **76:** 1121-1125.

Engberg, R. M., Hedemann, M. S., Leser, T. D. & Jensen, B. B. (2000) Effect of zinc bacitracin and salinomycin on intestinal microflora and performance of broilers. *Poultry Science*, **79:** 1311-1319.

Englyst, H. N. & Hudson, G. J. (1987) Colorimetric method for routine measurement of dietary fibre as non-starch polysaccharides. A comparison with gas-liquid chromatography. *Food Chemistry*, **24:** 63-76.

Erf, G. F. (1997) Immune system function and development in broilers. *Poultry Science*, **76:** 109-123.

Ewing, W. N. & Cole, D. J. A. (1994) "The living gut: An introduction to microorganisms in nutrition," A Context Publication, Dungannon, N. Ireland.

Eyssen, H., De Prins, V. & De Somer, P. (1962) The growth-promoting action of virginiamycin and its influence on the crop flora in chickens. *Poultry Science*, **41:** 227-233.

Eyssen, H. & De Somer, P. (1963) Effect of antibiotics on growth and nutrient absorption of chicks. *Poultry Science*, **40:** 1373-1379.

Fairchild, A. S., Grimes, J. L., Jones, F. T., Wineland, M. J., Edens, F. W. & Sefton, A. E. (2001) Effects of hen age, Bio-Mos, and flavomycin on poult susceptibility to oral *Escherichia coli* challenge. *Poultry Science*, **80:** 562-571.

Farrell, D. J. (1972) An indirect closed circuit respiration chamber suitable for fowl. *Poultry Science*, **51:** 683-688.

Farrell, D. J. (1974) Calorimetric measurements of chickens given diets with a range of energy concentrations. *British Poultry Science*, **15:** 341-347.

Fawcett, R. H. (1986) The economist's approach to nutritional problems. In: *Nutrient Requirements of Poultry and Nutritional Research*, Butterworths, London, UK, 91-97.

Feighner, S. D. & Dashkevicz, M. P. (1987) Subtherapeutic levels of antibiotics in poultry feeds and their effects on weight gain, feed efficiency, and bacterial cholyltaurine hydrolase activity. *Applied and Environmental Microbiology*, **53:** 331-336.

Ferket, P. R. (1993) Practical use of feed enzyme for turkeys and broilers. *Journal of Applied Poultry Research*, **2:** 75-81.

Ferket, P. R. (2004) Alternatives to antibiotics in poultry production: responses, practical experience and recommendations. In: *Nutritional biotechnology in the feed and food industries: Proceedings of Alltech's 20th Annual Symposium*, Kentucky, USA, 56-67.

Ferket, P. R. (2006) Embrace the changes of the animal feed industry. *Accessed in 2006.* www.feedinfo.com.

Ferket, P. R., Parks, C. W. & Grimes, J. L. (2002) Mannan oligosaccharides *versus* antibiotics for turkeys. In: *Nutritional biotechnology in the feed and food industries: Proceedings of Alltech's 18th Annual Symposium*, Kentucky, USA, 43-64.

Fernandez, F., Hinton, M. & Van Gils, B. (2000) Evaluation of the effect of mannan-oligosaccharides on the competitive exclusion of *Salmonella enteritidis* colonization in broiler chicks. *Avian Pathology*, **29:** 575-581.

Fernandez, F., Hinton, M. & Van Gils, B. (2002) Dietary mannan-oligosaccharides and their effect on chicken caecal microflora in relation to *Salmonella enteritidis* colonization. *Avian Pathology*, **31:** 49-58.

Ferrell, C. L. (1988) Contribution of visceral organs to animal energy expenditures. *Journal of Animal Science*, **66 (Suppl 3):** 23-24.

Finucane, M. C., Spring, P. & Newman, K. E. (1999) Incidence of mannose-sensitive adhesins in enteric bacteria. *Poultry Science*, **78 (Suppl 1):** 139.

Forstner, G. G., Sabesin, S. M. & Isselbacher, K. J. (1968) Rat intestinal microvillus membranes: purification and biochemical characterization. *Biochemical Journal*, **106:** 381-390.

Friedman, A., Bar-shira, E. & Sklan, D. (2003) Ontogeny of gut associated immune competence in the chick. *World's Poultry Science Journal*, **59:** 209-219.

Frost & Sullivan (2006) Antibiotics in animal feed in Australia: the beginning of the end? *Accessed in 2006.* www.feedinfo.com.

Fukata, T., Sasai, K., Miyamoto, T. & Baba, E. (1999) Inhibitory effects of competitive exclusion and fructooligosaccharide, singly and in combination, on *Salmonella* colonization of chicks. *Journal of Food Protection,* **62:** 229-233.

Fuller, R. (1989) Probiotics in man and animals. *Journal of Applied Bacteriology*, **66:** 365-378.

Fuller, R. & Brooker, B. E. (1974) Lactobacilli which attach to the crop epithelium of the fowl. *American Journal of Clinical Nutrition*, **27:** 1305-1312.

Fuller, R., Coates, M. E. & Harrison, G. F. (1979) The influence of specific bacteria and a filterable agent on the growth of gnotobiotic birds. *Journal of Applied Bacteriology*, **46:** 335-342.

Fuller, R., Houghton, S. B. & Coates, M. E. (1983) The effect of dietary penicillin on the growth of gnotobiotic chickens monoassociated with *Streptococcus faecium*. *British Poultry Science*, **24:** 111-114.

Fuller, R. & Jayne-Williams, D. J. (1970) Resistance of the fowl (*Gallus domesticus*) to invasion by its intestinal flora II. Clearance of translocated intestinal bacteria. *Research in Veterinary Science*, **11:** 368-374.

Fuller, R. & Turvey, A. (1971) Bacteria associated with the intestinal wall of the fowl (*Gallus domesticus*). *Journal of Applied Bacteriology*, **34:** 617-622.

Furuse, M. & Yokota, H. (1984a) The effect of the gut microflora on growth of chicks fed diets high or marginally adequate in energy. *Nutrition Reports International*, **29:** 1293-1300.

Furuse, M. & Yokota, H. (1984b) Protein and energy utilization in germ-free and conventional chicks given diets containing different levels of dietary protein. *British Journal of Nutrition*, **51:** 255-264.

Furuse, M., Yokota, H.-o., Tasaki, I. & Okumura, J. (1991) Nitrogen and energy utilization in germ-free and conventional chicks at ealry stages of growth. *Poultry Science*, **70:** 397-400.

Gao, Y. & Shan, A.-s. (2004) Effects of different oligosaccharides on performance and availability of nutrients in broilers. *Journal of Northeast Agricultural University*, **11:** 37-41.

Garrido, M. N., Skjervheim, M., Oppegaard, H. & Sørum, H. (2004) Acidified litter benefits the intestinal flora balance of broiler chickens. *Applied and Environmental Microbiology*, **70:** 5208-5213.

Gaskins, H. R. (1998) Immunological development and mucosal defence in the pig intestine. *In "Progress in Pig Science"* (J. Wiseman, M. A. Varley and J. P. Chadwick, eds.), pp. 81-101. Nottingham University Press, Nottingham, UK.

Gaskins, H. R. (2005) Host and intestinal microbiota negotiations in the context of animal growth efficiency. *Accessed in 2006.* www.feedinfo.com.

Gaskins, H. R., Collier, C. T. & Anderson, D. B. (2002) Antibiotics as growth promotants: Mode of action. *Animal Biotechnology*, **13:** 29-42.

Gauthier, R. (XVIII Congreso Lantioamericano de Avicultura) (2002) Poultry Therapeutics: New alternatives. *Accessed in 2006.* http://www.jefo.ca/pdf/ALA2003_en.pdf.

Ghadban, G. S. (2002) Probiotics in broiler production - a review. *Archiv Fur Geflugelkunde*, **66:** 49-58.

Gibson, G. R. & Roberfroid, M. (1995) Dietary modulation of the human colonic microbiota: introducing the concept of prebiotics. *Journal of Nutrition*, **125:** 1401-1412.

Gong, J., Si, W., Forster, R. J., Huang, R., Yu, H., Yin, Y., Yang, C. & Han, Y. (2006) 16S rRNA gene-based analysis of mucosa-associated bacterial community and phylogeny in the chicken gastrointestinal tracts: from crops to ceca. *FEMS Microbiology Ecology*: 1-11.

Gordon, H. A. & Bruckner-kardoss, E. (1961) Effect of the normal microbial flora on various tissue elements of the small intestine. *Acta Anatomica*, **44:** 210-225.

Gotteland, M., Cruchet, S. & Verbeke, S. (2001) Effect of *Lactobacillus* ingestion on the gastrointestinal mucosal barrier alterations induced by indometacin in humans. *Alimentary Pharmacology and Therapeutics*, **15:** 11-17.

Gous, R. M. (1998) Making Progress in the Nutrition of Broilers. *Poultry Science*, **77:** 111–117.

Greko, C. (2000). Safety aspects on non-use of antimicrobials as growth promoters. *In* "Probiotics as an alternative to antibiotics as growth promoters", pp. 220-229, Uppsala, Sweden.

Gülsen, N., Coskun, B., Umucalilar, H. D., Inal, F. & Boydak, M. (2002) Effect of lactose and dried whey supplementation on growth performance and histology of the immune system in broilers. *Archives of Animal Nutrition*, **56:** 131-139.

Guo, F. C., Kwakkel, R. P., Williams, B. A., Li, W. K., Li, H. S., Luo, J. Y., Li, X. P., Wei, Y. X., Yan, Z. T. & Verstegen, M. W. (2004a) Effects of mushroom and herb polysaccharides, as alternatives for an antibiotic, on growth performance of broilers. *British Poultry Science*, **45:** 684-694.

Guo, F. C., Kwakkel, R. P., Williams, B. A., Parmentier, H. K., Li, W. K., Yang, Z. Q. & Verstegen, M. W. (2004c) Effects of mushroom and herb polysaccharides on cellular and humoral immune responses of *Eimeria tenella*-infected chickens. *Poultry Science*, **83:** 1124-1132.

Guo, F. C., Williams, B. A., Kwakkel, R. P., Li, H. S., Li, X. P., Luo, J. Y., Li, W. K. & Verstegen, M. W. (2004b) Effects of mushroom and herb polysaccharides, as alternatives for an antibiotic, on the cecal microbial ecosystem in broiler chickens. *Poultry Science*, **83:** 175-182.

Guy-Grand, D., Rocha, B. & Vassalli, P. (1993) Origin and development of gut intraepithelial lymphocytes. *In "Mucosal Immunology: Intraepithelial lymphocytes"* (H. Kiyono and J. R. McGhee, eds.), pp. 21-31. Raven Press, Ltd., New York.

Hampson, D. J. (1986) Alterations in piglet small intestinal structure at weaning. *Research in Veterinary Science*, **40:** 32-40.

Havenaar, R. & Huis In't Veld, M. J. H. (1992) Probiotics: a general view. *In "Lactic acid bacteria"* (B. J. B. Wood, ed.), Vol. 1. pp. 151-170. Elsevier Applied Science Publishers, Amsterdam.

Heczko, U., Abe, A. & Finlay, B. B. (2000) Segmented filamentous bacteria prevent colonization of enteropathogenci *Escheirchia coli* O103 in rabbits. *Journal of Infection and Disease*, **181:** 1027-1033.

Henning, S. J. (1987) Functional development of the gastrointestinal tract. *In "Physiology of the gastrointestinal tract (2nd Ed.)"* (L. R. Johnson, ed.), 285 pp. Raven Press, New York.

Hernandez, F., Madrid, J., Garcia, V., Orengo, J. & Megias, M. D. (2004) Influence of two plant extracts on broilers performance, digestibility, and digestive organs size. *Poultry Science*, **83:** 169-174.

Hilton, L. S., Bean, A. G. D. & Lowenthal, J. W. (2002) The emerging role of avian cytokines as immunotherapeutics and vaccine adjuvants. *Veterinary Immunology and Immunopathology*, **85:** 119-128.

Hinterleitner, T. A. & Powell, D. W. (1991) Immune system control of intesitnal ion transport. *Proceedings Society of Experimental Biology and Medicine*, **197:** 249-260.

Holdsworth, E. S. (1970) The effect of vitamin D on enzyme acitivities in the mucosal cells of the chick small intestine. *Journal of Membrane Biology*, **3:** 43-53.

Hooge, D. (2004a) Meta-analysis of broiler chicken pen trials evaluating dietary mannan oligosaccharide, 1993-2003. *International Journal of Poultry Science*, **3:** 163-174.

Hooge, D. (2004b) Dietary alternatives for improving live performance of antibiotic-free poultry. *Accessed in 2006.* www.feedinfo.com.

Hooge, D. M., Sims, M. D., Sefton, A. E., Connolly, A. & Spring, P. (2003) Effect of dietary mannan oligosaccharide, with or without bactiracin or virginiamycin, on live performance of broiler chickens at relatively high stocking density on new litter. *Journal of Applied Poultry Research*, **12:** 461-467.

Hooper, L. V., Wong, M. H., Thelin, A., Hansson, L., Falk, P. G. & Gordon, J. I. (2001) Molecular analysis of commensal host-microbial relationship in the intestine. *Science*, **291:** 881-884.

Huan, X.-H. (1999) "Performance and incidence of coliform scours and immunological response in piglets given Bio-Mos alone or in combination with citric acid or Norfloxacin." College of Animal Science Fujian Agricultural University, Fujian. China. Report to Alltech, 5 pp.

Hubener, K., Vahjen, W. & Simon, O. (2002) Bacterial responses to different dietary cereal types and xylanase supplementation in the intestine of broiler chicken. *Archives of Animal Nutrition*, **56:** 167-187.

Hughes, P. & Heritage, J. (2003) Antibiotic growth-promoters in food animals. *Accessed in 2006.* www.feedinfo.com.

Hughes, R. J. (2003) Variation in the digestion of energy (*PhD Thesis*). University of Adelaide, Adelaide, Australia.

Humphrey, B. D. & Klasing, K. C. (2004) Modulation of nutrient metabolism and homeostasis by the immune system. *World's Poultry Science Journal*, **60:** 90-100.

Hunter, K. & Bevins, C. (1999) Antimicrobial peptides as mediators of epithelial host defense. *Pediatric Research*, **45:** 785-794.

Ichikawa, H., Kuroiwa, T., Inagaki, A., Shineha, R., Nishihira, T., Satomi, S. & Sakata, T. (1999) Probiotic bacteria stimulate gut epithelial cell proliferation in rat. *Digestive Disease and Sciences*, **44:** 2119-2123.

Iji, P. A. (1998) Natural development and dietary regulation of body and intestinal growth in broiler chickens (*PhD Thesis*). Adelaide University, Adelaide, Australia.

Iji, P. A., Saki, A. A. & Tivey, D. R. (2001) Intestinal structure and function of broiler chickens on diets supplemented with a mannan oligosaccharide. *Journal of the Science of Food and Agriculture*, **81:** 1186-1192.

Jackson, M. E., Geronian, K., Knox, A., McNab, J. & McCartney, E. (2004) A dose-response study with the feed enzyme beta-mannanase in broilers provided with corn-soybean meal based diets in the absence of antibiotic growth promoters. *Poultry Science*, **83:** 1992-1996.

Jamroz, D., Wiliczkiewicz, A., Orda, J., Wertelecki, T. & Skorupinska, J. (2003) Effect of a feed antibiotic or mannan oligosaccharides in broiler chickens. In: *Alltech's 20th Annual Symposium on Nutritional Biotechnology in Feed and Food Industries*, Kentucky, USA, Poster.

Jensen, D. (1976) "The principles of physiology," Prentice-Hall International, Inc., London, UK.

Jensen, M. T., Cox, R. P. & Jensen, B. B. (1995) Microbial production of skatole in the hind gut of pigs fed different diets and its relation to skatole deposition in backfat. *Animal Science*, **61:** 293-304.

JETACAR (Joint Expert Advisory Committe on Antibiotic Resistance) (1999) "The use of antibiotics in food-producing animals: antibiotic-resistant bacteria in animals and humans." Department of Health and Aged Care and Department of Agriculture, Fisheries and Forestry, Australia, Canberra.

Jiang, H. Q., Gong, L. M., Ma, Y. X., He, Y. H., Li, D. F. & Zhai, H. X. (2006) Effect of stachyose supplementation on growth performance, nutrient digestibility and caecal fermentation characteristics in broilers. *British Poultry Science*, **47:** 516-522.

Jin, L. Z., Ho, Y. W., Abdullah, N., Ali, A. M. & Jalaludin, S. (1998a) Effects of adherent lactobacillus cultures on growth, weight of organs and intestinal microflora and volatile fatty acids in broilers. *Animal Feed Science and Technology*, **70:** 197-209.

Jin, L. Z., Ho, Y. W., Abdullah, N. & Jalaludin, S. (1997) Probiotics in poultry: Modes of action. *World's Poultry Science Journal*, **53:** 351-368.

Jin, L. Z., Ho, Y. W., Abdullah, N. & Jalaludin, S. (1998b) Growth performance, intestinal microbial populations and serum cholesterol of broilers diets containing *Lactobacillus* cultures. *Poultry Science*, **77:** 1259-1265.

Jin, L. Z., Ho, Y. W., Abdullah, N. & Jalaludin, S. (2000) Digestive and bacterial enzyme activities in broilers fed diets supplemented with *Lactobacillus* cultures. *Poultry Science*, **79:** 886-891.

Johnson, R. J. (1981) Physical and nutritional aspects of restricted feeding in poultry (*PhD Thesis*). University of New England, Armidale, Australia.

Jones, F. T. & Ricke, S. C. (2003) Observations on the history of the development of antimicrobials and their use in poultry feeds. *Poultry Science*, **82:** 613-617.

Jorgensen, H., Zhao, X. Q., Knudsen, K. E. & Eggum, B. O. (1996) The influence of dietary fibre source and level on the development of the gastrointestinal tract, digestibility and energy metabolism in broiler chickens. *British Journal of Nutrition*, **75:** 379-395.

Jozefiak, D., Rutkowski, A., Hojberg, O., Jensen, B. B. & Engberg, R. M. (2005) The effect of exogenous enzyme supplementation to barley and rye based diets on microbiota populations in broiler chicken caeca. In: *28th WPSA Poultry Science Symposium*, Bristol, UK, 75 (Abstract).

Jukes, T. H. (1955) "Antibiotics in nutrition," Medical encyclopedia, New York.

Juskiewicz, J., Zdunczyk, Z. & Jankowski, J. (2003) Effect of adding mannan-oligosaccharide to the diet on the performance, weight of digestive tract segments, and caecal digesta parameters in young turkeys. *Journal of Animal and Feed Sciences*, **12:** 133-142.

Kalavathy, R., Abdullah, N., Jalaludin, S. & Ho, Y. W. (2003) Effects of *Lactobacillus* cultures on growth performance, abdominal fat deposition, serum lipids and weight of organs of broiler chickens. *British Poultry Science*, **44:** 139-144.

Kaldhusdal, M. (2006) Maintaining gut health in meat-type poultry without antibacterial growth promoters and ionophores. *Accessed in 2006.* http://www-afac.slu.se/WPSA%20Lillehammer%20Magne.pdf.

Kaldhusdal, M. & Lovland, A. (2000) The economical impact of *Clostridium perfringens* is greater than anticipated. *World Poultry*, **16:** 50-51.

Kannan, M., Karunakaran, R., Balakrishman, V. & Prabhakar, T. G. (2005) Influence of prebiotics supplementation on lipid profile of broilers. *International Journal of Poultry Science*, **4:** 994-997.

Kaufman, J. (1996) Structure and function of the major histocompatibility complex of chickens. *In "Poultry immunology"* (T. F. Davison, T. R. Morris and L. N. Payne, eds.), pp. 67-82. Carfax Publishing Company, Oxforshire, England.

Kelly, D., Begbie, R. & King, T. P. (1994) Nutritional influences on interactions between bacteria and the small intestinal mucosa. *Nutrition Research Reviews*, **7:** 233-257.

Kelly, D. & Coutts, A. G. (2000) Early nutrition and the development of immune function in the neonate. *Proceedings of the Nutrition Society*, **59:** 177-185.

Kelly, D. & King, T. P. (2001a) Luminal bacteria: regulation of gut function and immunity. *In "Gut Environment of Pigs"* (A. Piva, K. E. Bach Knudsen and J. E. Lindberg, eds.), pp. 113-131. Nottingham University Press.

Kelly, D. & King, T. P. (2001b) Digestive physiology and development in pigs. *In "The weaner pig: Nutrition and management"* (M. A. Varley and J. Wiseman, eds.), pp. 179-206. CAB.

King, W. E. (1905) The bacterial flora of the intestinal mucosa and conjuntiva of the normal chicken. *American Medicine*, **10:** 400-404.

Klasing, K. C. (1997) Interactions between nutrition and infectious disease. *In "Diseases of Poultry"* (B. W. Calnek, ed.), pp. 73-80. Iowa State University Press, Ames, Iowa.

Klasing, K. C., Laurin, D. E., Peng, R. K. & Fry, M. (1987) Immunologically mediated growth depression in chicks: influence of feed intake, corticosterone and interleukin-1. *Journal of Nutrition*, **117:** 1629-1637.

Kleessen, B., Hartmann, L. & Blaut, M. (2003) Fructans in the diet cause alterations of intestinal mucosal architecture, released mucins and mucosa-associated bifidobacteria in gnotobiotic rats. *British Journal of Nutrition*, **89:** 597–606.

Klis, F. M., Mol, P., Hellingwerf, K. & Brul, S. (2002) Dynamics of cell wall structure in *Saccharomyces cerevisiae*. *FEMS Microbiology Reviews*, **26:** 239-247.

Knarreborg, A., Engberg, R. M., Jensen, S. K. & Jensen, B. B. (2002a) Quantitative determination of bile salt hydrolase-activity in bacteria isolated from the small intestine of chickens. *Applied and Environmental Microbiology*, **68:** 6425-6428.

Knarreborg, A., Simon, M. A., Engberg, R. M., Jensen, B. B. & Tannock, G. W. (2002b) Effects of dietary fat source and subtherapeutic levels of antibiotic on the bacterial community in the ileum of broiler chickens at various ages. *Applied and Environmental Microbiology*, **68:** 5918-5924.

Kocher, A., Denev, S. A., Dinev, I., Nikiforov, I. & Scheidemann, C. (2005) Effects of mannanoligosaccharides on composition of the cecal microflora and performance of broiler chickens. In: *4 BOKU-Symposium Tierernährung, Tierernährung ohne antibiotische Leistingsförderer'. Wien*, Universität für Bodenkunde Wien, 216-220.

Kocher, A., Rodgers, N. J. & Choct, M. (2004). Efficacy of alternatives to AGPS in broilers challenged with *Clostridium perfringens*. In: *Proceedings of the Australian Poultry Science Symposium*, **16**:130-133.

Kolida, S., Tuohy, K. & Gibson, G. R. (2002) Prebiotic effects of inulin and oligofructose. *British Journal of Nutrition*, **87:** S193-S197.

Koutsos, E. A. & Arias, V. J. (2006) Intestinal ecology: Interactions among the gastrointestinal tract, nutrition, and the microflora. *Journal of Applied Poultry Research*, **15:** 161-173.

Krom, M. D. (1980) Spectrophotometric determination of ammonia: A study of a modified berthelot reduction using salicylate and dichloroisocyanurate. *The Analyst*, **105:** 305-316.

Kumar, B. S., Vijayasarath, S. K., Gowda, R. N. S. & Satyanarayana, M. L. (2002) Probiotics in the prevention of experimental fowl typhoid in broilers - A pathomorphological study. *Indian Journal of Animal Sciences*, **72:** 528-531.

References

Kumprecht, I. & Zobac, F. (1997a) The effect of mannan-oligosaccharides in feed mixtures on the performance of broilers. *Zivocisna Vyroba*, **42:** 117-124.

Kumprecht, I., Zobac, P., Siske, V. & Sefton, A. E. (1997b) Effects of dietary mannanoligosaccharide level on liveweight and feed efficiency of broilers. *Poultry Science*, **76:** 132 (Abstract).

Lan, Y., Verstegen, M. W., Tamminga, S. & Williams, B. A. (2005) The role of the commensal gut microbial community in broiler chickens. *World's Poultry Science Journal*, **61:** 95-104.

Langhout, D. J., Schutte, J. B., de Jong, J., Sloetjes, H., Verstegen, M. W. A. & Tamminga, S. (2000) Effect of viscosity on digestion of nutrients in conventional and germ-free chicks. *British Journal of Nutrition*, **83:** 533-540.

Larbier, M. & Leclercq, B. (1994) "Nutrition and Feeding of Poultry," Nottingham University Press, Nottingham.

Lee, K.-W., Everts, H. & Beynen, A. C. (2004) Essential oils in broiler nutrition. *International Journal of Poultry Science*, **3:** 738-752.

Lee, M. D., Lu, J.-r. & Cho, Y. J. (2005) Effects of probiotics on the development of the ileal bacterial community of the broiler chicken. *Accessed in 2005.* www.feedinfo.com.

Leeson, S. (1991) The need for growth promoting compounds in poultry meat production. *Journal of Agricultural and Environmental Ethics*, **4:** 89-99.

Lepkovsky, S., Wagner, M., Furuta, F., Ozone, K. & Koike, T. (1964) The proteases, amylase and lipase of the intestinal contents of germfree and conventional chickens. *Poultry Science*, **43:** 722-726.

Lindgren, N. O. (1954) Studies in the growth promoting action of antibiotics in poultry nutrition. *Nordisk Veterinaermedicin*, **6:** 701-706.

Lochmiller, R. L. & Deerenberg, C. (2000) Trade-offs in evolutionary immunology: just what is the cost of immunity? *Oikos*, **88:** 87-98.

Loddi, M. M., Moraes, V. M. B., Nakaghi, L. S. O., Tucci, F. M., Hannas, M. I., Ariki, J. & Bruno, L. D. G. (2002) Mannanoligosaccharide and organic acids on intestinal morphology integrity of broilers evaluated by scanning electron microscopy. In: *Proceeding 11th European Poultry Science Conference*, Bremen, Germany., p.121.

Lu, J., Hofacre, C. L. & Lee, M. D. (2006) Emerging technologies in microbial ecology aid in understanding the effect of monensin in the diets of broilers in the regard to the complex disease necrotic enteritis. *Journal of Applied Poultry Research*, **15:** 145-153.

Lu, J., Idris, U., Harmon, B., Hofacre, C., Maurer, J. J. & Lee, M. D. (2003) Diversity and succession of the intestinal bacterial community of the maturing broiler chicken. *Applied and Environmental Microbiology*, **69:** 6816-6824.

Lu, L. & Walker, W. A. (2001) Pathologic and physiologic interactions of bacteria with the gastrointestinal epithelium. *American Journal of Clinical Nutrition*, **73 (Suppl):** 1124S-1130S.

Lyons, T. P. (1994). Biotechnology in the feed industry: 1994 and beyond: A panorama of techniques, processes and products to address animal production probrems today and tomorrow. In: *Biotechnology in the feed industry: Proceedings of Alltech's 10th Annual Symposium*, Kentucky, USA, 1-50.

Mackie, R., Sghir, A. & Gaskins, H. R. (1999) Developmental microbial ecology of the neonatal gastrointestinal tract. *American Journal of Clinical Nutrition*, **69 (Suppl):** 1035S-1045S.

Macpherson, A. J., Hunziker, L., McCoy, K. & Lamarre, A. (2001) IgA responses in the intestinal mucosa against pathogenic and non-pathogenic microorganisms. *Microbes in Infections*, **3:** 1021–1035.

Mahida, Y. R. (2004) Epithelial cell responses. *Best Practice and Research Clinical Gastroenterology*, **18:** 241-253.

Maisonnier, S., Gomez, J., Bree, A., Berri, C., Baeze, E. & Carre, B. (2003) Effects of microflora status, dietary bile salts and guar gum on lipid digestibility, intestinal bile salts, and histomorphology in broiler chickens. *Poultry Science*, **82:** 805-814.

Martinez, S. W. (Agricultural Economics Report No. AER777) (1999) "Vertical coordination in the pork and broiler industries: Implications for pork and chicken products." 48.

Matsumoto, S., Setoyama, H. & Umesaki, Y. (1992) Differential induction of major histocompatibility complex molecules in mouse intestine by bacterial colonization. *Gastroenterology*, **103:** 1777-1782.

McDonald, P., Edwards, R. A. & Greenhalgh, J. F. D., eds. (1995) "Animal nutrition." Longman Scientific & Technical, New York, USA.

McEwen, S. A. & Fedorka-Cray, P. J. (2002) Antimicrobials use and resistance in animals. *Clinical Infectious Diseases*, **34 (Suppl):** S93-S106.

Mikelsaar, M., Turi, M., Lencner, H., Kolts, K., Kirch, R. & Lencner, A. (1987) Interrelations between mucosal and luminal microflora of gastrointestine. *Nahrung*, **31:** 449-456, 637-638.

Miles, R. D., Butcher, G. D., Henry, P. R. & Littel, R. C. (2006) Effect of antibiotic growth promoters on broiler performance, intestinal growth parameters, and quantitative morphology. *Poultry Science*, **85:** 476-485.

Mitsch, P., Kohler, B., Gabler, C., Losa, R. & Zitterl-eglseer, K. (2002) CRINA poultry reduces colonisation and proliferation of *Clostridium perfringens* in the intestine and faeces of broiler chickens. *In* "Abstracts from the Eleventh European Poultry Conference", pp. 06-10, Bremen, Germany.

Miura, S., Morita, A., Erickson, R. H. & Kim, Y. (1983) Content and turnover of rat intestinal microvillus membrane aminopeptidase: effect of methylprednisolone. Gastroenterology **85:** 1340-1349.

Monsan, P. F. & Paul, F. (1995) Oligosaccharide feed additives. *In "Biotechnology in Animal Feeds and Animal Feeding"* (R. J. Wallace and A. Chesson, eds.), pp. 233-246. VCH, Weinheim.

Montagne, L., Piel, C. & Lalles, J. P. (2004) Effect of diet on mucin kinetics and composition: nutrition and health implications. *Nutrition Reviews*, **62:** 105-114.

Moreau, M.-C. & Gaboriau-Routhiau, V. (2001) Influence of resident intestinal microflora on the development and functions of the gut-associated lymphoid tissue. *Microbial Ecology in Health and Disease*, **13:** 65-86.

Morrow, C. (2001) Solving the problems of necrotic enteritis. *British Poultry Science*, **42:** S64-S67.

Muramatsu, T., Coates, M. E., Hewitt, D., Salter, D. N. & Garlick, P. J. (1983) The influence of the gut microflora on protein synthesis in liver and jejunal mucosa in chicks. *British Journal of Nutrition*, **49:** 453-462.

Muramatsu, T., Nakajima, S. & Okumura, J. (1994) Modification of energy metabolism by the presence of the gut microflora in the chicken. *British Journal of Nutrition*, **71:** 709-717.

NASC (National Academy of Sciences Committee) (1999) "The use of drugs in food animals: benefits and risks," National Academy Press, Washington, DC.

Neish, A. S. (2002) The gut microflora and intestinal epithelial cells: A continuing dialogue. *Microbes and Infection*, **4:** 309-317.

Newell, D. G. & Fearnley, C. (2003) Sources of *Campylobacter* in broiler chickens. *Applied and Environmental Microbiology*, **69:** 4343-4351.

Nisbet, D. J., Corrier, D. E., Ricke, S. C., Hume, M. E., Byrd, J. A. & Deloach, J. R. (1996) Cecal propionic acid as a biological indicator of the early establishment of a microbial ecosystem inhibitory to *Salmonella* in chicks. *Anaerobe*, **2:** 345-350.

Noblet, J., Fortune, H., Shi, X. S. & Dubois, S. (1994) Prediction of Net Energy Value of Feeds for Growing Pigs. *Journal of Animal Science*, **72**: 344-354.

O'Carra, R. (1997) Effects of dietary inclusion of Bio-Mos on growth and immunisation response of border collie pups (*Master Thesis*). National University of Ireland, Galway, Ireland.

O'Carra, R. (1998) Boosting immune response in dogs: a role for dietary mannan sugars. In: *Biotechnology in the feed industry: Alltech 14th Annual Symposium*, Kentucky, USA, 563-573.

Ofek, I. & Beachey, E. H. (1978) Mannose binding and epithelial cell adherence of *Escherichia coli*. *Infection and Immunity*, **22:** 247-254.

Ofek, I., Mirelman, D. & Sharon, N. (1977) Adherence of *Escherichia coli* to human mucosal cells mediated by mannose receptors. *Nature*, **265:** 623-625.

Ouwehand, A. C. (1998) Antimicrobial components from lactic acid bacteria. *In "Lactic acid bacteria: Microbiology and Funtional Aspects"* (S. Solminer and A. V. Wright, eds.), pp. 139-161. Marcel Dekker Inc, New York.

Pabst, R. (1987) The anatomical basis for the immune function of the gut. *Anatomy and Embryology*, **176:** 135-144.

Palmer, M. F. & Rolls, B. A. (1983) The activities of some metabolic enzymes in the intestines of germ-free and conventional chicks. *British Journal of Nutrition*, **50:** 783-790.

Parsons, C. M., Potter, L. M., Brown, R. D. J., Wilkins, T. D. & Bliss, B. A. (1982) Microbial contribution to dry matter and amino acid content of poultry excreta. *Poultry Science*, **61:** 925-932.

Patterson, J. A. & Burkholder, K. M. (2003) Application of prebiotics and probiotics in poultry production. *Poultry Science*, **82:** 627-631.

Pelicano, E. R. L., Souza, P. A., Souza, H. B. A., Leonel, F. R., Zeola, N. M. B. L. & Boiago, M. M. (2004) Productive traits of broiler chickens fed diets containing different growth promoters. *Brazilian Journal of Poultry Science*, **6:** 177-182.

Pesti, G. M. & Miller, B. R. (1997) Modeling for precision nutrition. *Journal of Applied Poultry Research*, **6:** 483-494.

Pesti, G. M., Thomson, E. & Farrell, D. J. (1989) The energy metabolism of two breeds of hens in respiration chambers. In: *Energy Metabolism of Farm Animals: Proceedings of the 11th Symposium, Lunteren, Netherlands*, Wageningen, Netherlands, 45-52.

Peuranen, S., Kocher, A. & Dawson, K. A. (2006) Yeast cell wall preparations prevent the attachment of enteropathogenic *Escherichia coli* on broiler gut mucus. In: *Gut Microbiology 2006: 5th Biennial Meeting, Research to Improve Health, Immune Response and Nutrition*, Aberdeen, UK, in press.

Philips, S. M. & Fuller, R. (1983) The activities of amylase and a trypsin-like protease in the gut contents of germ-free and conventional chickens. *British Poultry Science*, **24:** 115-121.

Privulescu, M. (1999) "Humoral and cellular immune responses to Bio-Mos in piglets." National Institute of Veterinary Medicine, Pasteur Institute, Bucharest, Romania. Report to Alltech 4 pp.

Pusztai, A., Grant, G. & Spencer, R. J. (1993) Kidney bean lectin-induced *Escherichia coli* overgrowth in the small intestine is blocked by GNA, a mannose-specific lectin. *Journal of Applied Bacteriology*, **75:** 360-368.

Pym, R. A. E. & Farrell, D. J. (1977) A comparison of the energy and nitrogen metabolism of broilers selected for increased growth rate, food consumption and conversion of food to gain. *British Poultry Science*, **18:** 411-426.

Ratcliffe, B. (1985) The influence of the gut microflora on the digestive processes. In: *Proceedings of the 3rd International Seminar on Digestive Physiology of Pig*, Copenhagen, 245-267.

Ratcliffe, B. (1991) The role of the microflora in digestion. *In "In vitro digestion for pigs and poultry"* (M. F. Fuller, ed.), pp. 19-34. CAB, Wallingford, England.

Ravindran, V. (2006). Broiler nutrition in New Zealand - Challenges and Strategies. *Accessed in 2006.* www.feedinfo.com.

Ravindran, V., Morel, P. C., Partridge, G. G., Hruby, M. & Sands, J. S. (2006) Influence of an *Escherichia coli*-derived phytase on nutrient utilization in broiler starters fed diets containing varying concentrations of phytic acid. *Poultry Science*, **85:** 82-89.

Reeds, P. J., Burrin, D. G., Davis, T. A. & Fiorotto, M. L. (1993) Postnatal growth of gut and muscle: Competitors or collaborators. *Proceedings of the Nutrition Society*, **52:** 57-67.

Revington, B. (2002) Feeding poultry in the post-antibiotic era. *In* "Multi-State Poultry Meeting May 14-16", pp. 1-14.

Riddell, C. & Kong, X. M. (1992) The influence of diet on necrotic enteritis in broiler chickens. *Avian Diseases*, **36:** 499-503.

Rolfe, R. (1996) Colonization resistance. *In "Gastrointestinal microbiology. Vol 2. Gastrointestinal microbes and host interactions"* (R. I. Mackie, B. A. White and R. E. Isaacson, eds.), pp. 501–536. Chapman and Hall, New York.

Rolls, B. A., Turvey, A. & Coates, M. E. (1978) The influence of the gut microflora and of dietary fibre on epithelial cell migration in the chick intestine. *British Journal of Nutrition*, **39:** 91-98.

Rosen, G. D. (1995) Antibacterials in poultry and pig nutrition. *In "Biotechnology in Animal Feeds and Feeding"* (R. J. Wallace and A. Chesson, eds.), pp. 143-172, Weinheim, Germany.

Rosen, G. D. (2007) Holo-analysis of the efficacy of Bio-Mos® in broiler nutrition. *British Poultry Science*, **48**:21-26.

Rothkotter, H. J., Kirchhoff, T. & Pabst, R. (1994) Lymphoid and non-lymphoid cells in the epithelium and lamina propria of intestinal mucosa of pigs. *Gut*, **35:** 1582-1589.

Salanitro, J. P., Blake, I. G., Muirhead, P. A., Maglio, M. & Goodman, J. R. (1978) Bacteria isolated from the duodenum, ileum, and cecum of young chicks. *Applied and Environmental Microbiology*, **35:** 782-790.

Salanitro, J. P., Blake, I. G. & Murihead, P. A. (1974) Studies on the cecal microflora of commercial broiler chickens. *Applied Microbiology*, **28:** 439-447.

Salter, D. N. & Fulford, R. J. (1974) The influence of the gut microflora on the digestion of dietary and endogenous proteins: studies of the amino acid composition of the excreta of germ-free and conventional chicks. *British Journal of Nutrition*, **32:** 625-637.

Samarasinghe, K., Wenk, C., Silva, K. F. S. T. & Gunasekera, J. M. D. M. (2003) Turmeric (Curcuma longa) root powder and mannanoligosaccharides as alternatives to antibiotics in broiler chicken diets. *Asian-Australasian Journal of Animal Sciences*, **16:** 1495-1500.

Santin, E., Maiorka, A., Macari, M., Grecco, M., Sanchez, J. C., Okada, T. M. & Myasaka, A. M. (2001) Performance and intestinal mucosa development of broiler chickens fed diets containing *Saccharomyces cerevisiae* cell wall. *Journal of Applied Poultry Research*, **10:** 236-244.

Santos, E. C. D. & Teixeira, A. S. (2004) Effect of growth beneficial additives on cecal volatiel fatty acids in broilers. In: *Alltech 21st Annual Symposium Biotechnology in Feed and Food industry*, Kentucky, USA, Poster.

Savage, T. F., Cotter, P. F. & Kakrzewska, E. I. (1996a) The effect of feeding mannan oligosaccharide on immunoglobulins, plasma IgG and bile IgA of Wrolstad MW male turkeys. *Poultry Science*, **75 (Suppl 1):** 143 (Abstract).

Savage, T. F., Zakrzewska, E. I. & Andersen, J. R. J. (1996b) The effects of feeding mannan oligosaccharide supplemented diets to poults on performance and the morphology of the small intestine. *Poultry Science*, **75 (Suppl 1):** 139 (Abstract).

Schauer, D. B. (1997) Indigenous microflora: paving the way for pathogens? *Current Biology*, **7:** R75-R77.

Schiffrin, E. J. & Blum, S. (2002) Interactions between the microbiota and the intestinal mucosa. *European Journal of Clinical Nutrition*, **56 (Suppl 3):** 560-564.

Schrezenmeir, J. & de Vrese, M. (2001) Probiotics, prebiotics, and synbiotics—approaching a definition. *American Journal of Clinical Nutrition*, **73:** 361S-364S.

Shafey, T. M., Al-Mufarej, S., Shalaby, M. I. & Jarelnabi, A. J. (2001b) Effects of mannan oligosaccharides on antibody response to infectious bronchitis, infectious bursal disease and newcastle disease in chickens. *Journal of Applied Animal Research*, **19:** 117-127.

Shafey, T. M., Al-Mufarej, S., Shalaby, M. I. & Jarlenabi, A. J. (2001a) The effect of feeding mannan-oligosaccharides (Bio-Mos) on the performance of meat chickens under two different vaccination programs. *Asian-Australasian Journal of Animal Sicences*, **14:** 559-563.

Shanahan, F. (2002) The host-microbe interface within the gut. *Best Practice and Research Clinical Gastroenterology*, **16:** 915-931.

Shane, S. M. (2006). The world broiler industry: a perspective on the future. *Accessed in 2006.* www.feedinfo.com.

Shapiro, S. K. & Sarles, W. B. (1949) Microorganisms in the intestinal tract of normal chickens. *Journal of Bacteriology*, **58:** 531-544.

Shirazi-Beechey, S. P., Hirayama, B. A., Wang, Y., Scott, D., Smith, M. W. & Wright, E. M. (1991) Ontogenic development of lamb intestinal sodium-glucose co-transporter is regulated by diet. *Journal of Physiology*, **437:** 691-698.

Short, F. J., Gorton, P., Wiseman, J. & Boorman, K. N. (1996) Determination of titanium dioxide added as an inert marker in chicken digestibility studies. *Animal Feed Science and Technology*, **59:** 215-221.

Simon, O., Jadamus, A. & Vahjen, W. (2001) Probiotic feed additives—effectiveness and expected modes of action. *Journal of Animal and Feed Sciences*, **10:** 51-67.

Sims, M. D., Dawson, K. A., Newman, K. E., Spring, P. & Hooge, D. M. (2004) Effects of dietary mannan oligosaccharide, bacitracin methylene disalicylate, or both on the live performance and intestinal microbiology of turkeys. *Poultry Science*, **83:** 1148-1154.

Sinlae, M. (2000) Gut microflora and performance of broilers fed wheat-based diets with or without enzyme supplementation (*Master Thesis*). University of New England. NSW, Armidale, Australia.

Sklan, D. (2001) Development of the digestive tract of poultry. *World's Poultry Science Journal*, **57:** 415-428.

Smirnov, A., Perez, R., Amit-Romach, E., Sklan, D. & Uni, Z. (2005) Mucin dynamics and microbial populations in chicken small intestine are changed by dietary probiotic and antibiotic growth promoter supplementation. *Journal of Nutrition*, **135:** 187-192.

Smithard, R. (2002) Secondary plant metabolites in poultry nutrition. *In "Poultry feedstuffs: Supply, composition and nutritive value"* (J. M. McNab and K. N. Boorman, eds.), Vol. 26, pp. 237-278. CABI.

Smits, C. H. M., Veldman, A., Verstegen, M. W. A. & Beynen, A. C. (1997) Dietary carboxymethylcellulose with high instead of low viscosity reduces macronutrient digestion in broiler chickens. *Journal of Nutrition*, **127:** 483-487.

Smyth, C. J., Marron, M. & Smith, S. G. J. (1994) Fimbriae of *Escherichia coli*. *In "Escherichia coli in domestic animals and humans"* (C. L. Gyles, ed.). pp. 399-435. CAB International, Wallingford, Oxon.

Snel, J., Harmsen, H. J. M., van de Wielen, P. W. J. J. & Williams, B. A. (2002) Dietary strategies to influence the gastrointestinal microflora of young animals, and its potential to improve intestinal health. *In "Nutrition and health on the gastrointestinal tract"* (M. C. Blok, ed.), pp. 37-69. Wageningen Academci Publishers, Wageningen, Netherlands.

Song, J.-y. & Li, W.-f. (2001) The preparation of mannan-oligosaccharide from *Saccharomyces cerevisiae* and its effect on intestinal microflora in chicken. *Journal of Zhejiang University (Agric.&Life Sci.)*, **27:** 447-450.

Spring, P. (1996) Effects of mannanoligosaccharide on different cecal parameters and on cecal concentrations of enteric pahtogens in poultry (*PhD Thesis*). Swiss Federal Institute of Technology Zurich, Zurich, Switzerland.

Spring, P. & Privulescu, M. (1998) Mannanoligosaccharide: its logical role as a natural feed additive for piglets. In: *Biotechnology in the feed industry: Proceedings of Alltech's 14th Annual Symposium*, Kentucky, USA.

Spring, P., Wenk, C., Dawson, K. A. & Newman, K. E. (2000) The effects of dietary mannonoligosaccharides on cecal parameters and the concentrations of enteric bacteria in the ceca of *Salmonella*-challenged broiler chicks. *Poultry Science*, **79:** 205-211.

Staley, T. E., Jones. E. W. & Corley, L. D. (1969) Attachment and penetration of *Escherichia coli* into intestinal epithelium of the ileum in the newborn pigs. *American Journal of Pathology*, **56:** 371-392.

Stanley, V. G., Chuwu, H., Gray, C. & Thompson, D. (1996) Effects of lactose and Bio-Mos in dietary application on growth and total coliform bacteria redcution in broiler chicks. In: *Southern Poultry Science Society 17th Annual Meeting*, Louisville, Kentucky, USA, Abstract.

Steenfeldt, S., Hammershoj, M., Mullertz, A. & Jensen, F. J. (1998) Enzyme supplementation of wheat-based diets for broilers 2. Effect on apparent metabolisable energy and nutrient digestibility. *Animal and Feed Science Technology*, **75:** 45-64.

Steiner, M., Bourges, H. R., Freedman, L. S. & Gray, S. J. (1968) Effect of starvation on the tissue composition of the small intestine in the rat. *American Journal of Physiology*, **215:** 75-77.

Stutz, M. W., Johnson, S. L. & Judith, F. R. (1983) Effects of diet, bacitracin and body weight restriction on the intestine of broiler chicks. *Poultry Science*, **62:** 1626-1632.

Summers, M. (1991) Energy metabolism in the broiler chick (*PhD Thesis*). University of Guelph, Ontario, Canada.

Svihus, B. & Hetland, H. (2001) Ileal starch digestibility in growing broiler chickens fed on a wheat-based diet is improved by mash feeding, dilution with cellulose or whole wheat inclusion. *British Poultry Science*, **42:** 633-637.

Swanson, K. S., Grieshop, C. M., Flickinger, E. A., Bauer, L. L., Healy, H. P., Dawson, K. A., Merchen, N. R. & Fahey, G. C. J. (2002) Supplemental fructooligosaccharides and mannanoligosaccharides influence immune function, ileal and total tract nutrient digestibilities, microbial populations and concentrations of protein catabolites in the large bowel of dogs. *Journal of Nutrition*, **132:** 980-989.

Tablante, N. L., Myint, M. S., Johnson, Y. J., Rhodes, K., Colby, M. & Hohenhaus, G. (2002) A survey of biosecurity practices as risk factors affecting broiler performance on the Delmarva Peninsula. *Avian Diseases*, **46:** 730-734.

Takeda, T., Fukata, T., Miyamoto, T., Sasai, K., Baba, E. & Arakawa, A. (1995) The effects of dietary lactose and rye on cecal colonization of *Clostridium perfringens* in chicks. *Avian Diseases*, **39:** 375-381.

Teeter, R. & Wiernuz, C. (2003) "Cobb Broiler Nutrition Guide," Cobb-Vantress Inc., Siloam Springs, Arkansas.

Teimouri, A., Rezaei, M., Pourreza, J., Sayyahzadeh, H. & Waldroup, P. W. (2005) Effect of diet dilution in the starter period on performance and carcass characteristics of broiler chicks. *International Journal of Poultry Science*, **4:** 1006-1011.

Ten Bruggencate, S. J. M., Bovee-Oudenhoven, I. M. J., Lettink-Wissink, M. L. G. & Van der Meer, R. (2003) Dietary fructo-oligosaccharides dose-dependently increase translocation of salmonella in rats. *Journal of Nutrition*, **133:** 2313-2318.

Theander, O. & Westerlund, E. (1993) "Determination of individual components of dietary fiber," Second/Ed. CRC Press, Boca Raton, Florida, USA.

Thomke, S. & Elwinger, K. (1998a) Growth promotants in feeding pigs and poultry. II. Mode of action of antibiotic growth promotants. *Annales De Zootechnic*, **47:** 153-167.

Thomke, S. & Elwinger, K. (1998b) Growth promotants in feeding pigs and poultry. I. Growth and feed efficiency responses to antibiotic growth promotants. *Annales De Zootechnie*, **47:** 85-97.

Tucker, L. A., Esteve-garcia, E. & Connolly, A. (2003) Dose response of commercial mannanoligosaccharides in broiler chickens. In: *Proceedings of the World's Poultry Science 278 Association 14th European Symposium on Poultry Nutrition*, Lillehammer, Norway, **279**:193-194.

Turk, D. E. (1982) The anatomy of the avian digestive tract as related to feed utilization. *Poultry Science*, **61:** 1225-1244.

Udayamputhoor, R. S., Hariharan, H., Lunen, T. A. V. & Lewis, P. J. (2003) Effects of diet formulations containing proteins from different sources on intestinal colonization by *Campylobacter jejuni* in broiler chickens. *Canadian Journal of Veterinary Research*, **67:** 204-212.

Umesaki, Y., Okada, Y., Imaoka, A., Setoyama, H. & Matsumoto, S. (1997) Interactions between epithelial cells and bacteria, normal and pathogenic. *Science*, **276:** 964-965.

Uni, Z., Platin, R. & Sklan, D. (1998) Cell proliferation in chicken intestinal epithelium occurs both in the crypt and along the villus. *Journal of Comparative Phsiology*, **169:** 241-247.

Untawale, G. G. & Mcginnis, J. (1979) Effect of rye and levels of raw and autoclaved beans (*Phaseolus vulgaris*) on adhesion of microlfora to the intestinal mucosa. *Poultry Science*, **58:** 928-933.

Untawale, G. G., Pietraszek, A. & Mcginnis, J. (1978) Effect of diet on adhesion and invasion of microflora in the intestinal mucosa of chicks. *Proceedings of the Society for Experimental Biology and Medicine*, **159:** 276-280.

USDANASS (2003). National pounds produced United States, 1962-02. *Accessed in 2003.* http://www.usda.gov/nass/aggraphs/brlprd.htm.

Vahjen, W., Glaser, K., Schafer, K. & Simon, O. (1998) Influence of xylanase-supplemented feed on the development of selected bacterial groups in the intestinal tract of broiler chicks. *Journal of Agricultural Science*, **130:** 489-500.

van de Wiele, T., Boon, N., Possemiers, S., Jacobs, H. & Verstraete, W. (2004) Prebiotic effects of chicory inulin in the simulator of the human intestinal microbial ecosystem. *FEMS Microbiology Ecology*, **51:** 143-153.

van der Wielen, P. W. J. J., Keuzenkamp, D. A., Lipman, L. J. A., Knapen, F. V. & Biesterveld, S. (2002) Spatial and temporal variation of the intestinal bacterial community in commercially raised broiler chickens during growth. *Microbial Ecology*, **44:** 286-293.

Vanbelle, M. (2000) Current status and future perspectives in E. U. for antibiotics, probiotics, enzymes and organic acids in animal nutrition. *In* "Feed additives and probiotics as an alternative to antibiotics as growth promoters", pp. 232-256, Uppsala, Sweden.

Verdonk, J. M. A. J., Shim, S. B., van Leeuwen, P. & Verstegen, M. W. A. (2005) Application of inulin-type fructans in animal feed and pet food. *British Journal of Nutrition*, **93:** S125-S138.

Vidanarachchi, J. K., Mikkelsen, L. L., Sims, I. M., Iji, P. A. & Choct, M. (2006) Selected plant extracts modulate the gut microflora in broilers. In: *Proceedings of Australian Poultry Science Symposium*, Sydney, Australia, **18**:145-148.

Visek, W. J. (1964) Investigations upon the mode of action of antibiotics and other growth stimulants. In: *Proceedings of Cornell nutrition conference*, Buffalo, New York,

Wagner, D. D. & Thomas, O. P. (1978) Influence of diets containing rye or pectin on the intestinal flora of chicks. *Poultry Science*, **57:** 971-975.

Wallinga, D. (2002) Antimicrobial use in animal feed. *Minnesota Medicine*, **85:** 12-16.

Wang, R., Li, D. & Bourne, S. (1998). Can 2000 years of herbal medicine history help us solve problems in the year 2000? In: *Biotechnology in the feed industry: Proceedings of Alltech's 14th Annual Symposium*, Kentucky, USA, 273-291.

Watkins, B. A. & Kratzer, F. H. (1984) Drinking water treatment with commercial preparation of a concentrated *Lactobacillus* culture for broiler chickens. *Poultry Science*, **63:** 1671-1673.

Williams, B. A., Verstegen, M. W. A. & Tamminga, S. (2001) Fermentation in the large intestine of single-stomached animals and its relationship to animal health. *Nutrition Research Reviews*, **14:** 207-227.

Williams, P. E. V. (1995) Digestible amino acids for non-ruminat animals: theory and recent challenges. *Animal Feed Science and Technology*, **53:** 173-187.

Williams, R. B. (2005) Intercurrent coccidiosis and necrotic enteritis of chickens: rational, integrated disease management by maintenance of gut integrity. *Avian Pathology*, **34:** 159-180.

Willis, W. L., Murray, C. & Talbott, C. (2002) Campylobacter isolation trends of cage versus floor broiler chickens: a one-year study. *Poultry Science*, **81:** 629-631.

Windisch, W. & Kroismayr, A. (2006). The effects of phytobiotics on performance and gut function in monogastrics. *Accessed in 2006.* www.feedinfo.com.

Wostman, B. S. (1981) The germfree animal in nutritional studies. *Annual Review of Nutrition*, **1:** 257-279.

Wu, Y. B., Ravindran, V., Thomas, D. G., Birtles, M. J. & Hendriks, W. H. (2004a) Influence of phytase and xylanase, individually or in combination, on performance, apparent metabolisable energy, digestive tract measurements and gut morphology in broilers fed wheat-based diets containing adequate level of phosphorus. *British Poultry Science*, **45:** 76-84.

Wu, Y. B., Ravindran, V., Thomas, D. G., Birtles, M. J. & Hendriks, W. H. (2004b) Influence of method of whole wheat inclusion and xylanase supplementation on the performance, apparent metabolisable energy, digestive tract measurements and gut morphology of broilers. *British Poultry Science*, **45:** 385-394.

Xie, Z. Q. & Niu, S. Q. (1996) "Comprehesive Book of Natural Resources and Chinese Herb Feed Additives," Xueyuan Science and Techonology Press, Beijing, China.

Xing, X. L. (2004) A comparative study on the effects of different chinese herbal medicinal feed additives in broiler chickens. *Accessed in 2006.* www.feedtrade.com.cn.

Xu, Z. R., Hu, C. H., Xia, M. S., Zhan, X. A. & Wang, M. D. (2003) Effects of dietary fructooligosaccharides on digestive enzyme activities, intestinal microflora and morphology of male broilers. *Poultry Science*, **82:** 1030-1036.

Xue, M. & Meng, X. S. (1996) Review on research progress and prosperous of immune acitivities of bio-active polysaccharides. *Journal of Traditional Veterinary Medicine*, **3:** 15-18.

Yamauchi, K., Isshiki, Y., Zhou, Z. X. & Nakahiro, Y. (1990) Scanning and transmission electron microscopic observations of bacteria adhering to ileal epithelial cells in growing broiler and White Leghorn chickens. *British Poultry Science*, **31:** 129-137.

Yasar, S. & Forbes, J. M. (1999) Performance and gastro-intestinal response of broiler chickens fed on cereal grain-based foods soaked in water. *British Poultry Science*, **40:** 65-76.

Youn, H. J. & Noh, J. W. (2001) Screening of the anticoccidial effects of herb extracts against *Eimeria tenella*. *Veterinary Parasitology*, **96:** 257-263.

Zdunczyk, Z., Juskiewicz, J., Jankowski, J., Biedrzycka, E. & Koncicki, A. (2005) Metabolic response of the gastrointestinal tract of turkeys to diets with different levels of mannan-oligosaccharide. *Poultry Science*, **84:** 903-909.

Zhang, W. F., Li, D. F., Lu, W. Q. & Yi, G. F. (2003) Effects of isomalto-oligosaccharides on broiler performance and intestinal microflora. *Poultry Science*, **82:** 657-663.

Zhu, X. Y. & Joergert, R. D. (2003) Composition of microbiota in content and mucus from cecae of broiler chickens as measured by fluorescent in situ hybridization with group-specific, 16S rRNA-targeted oligonucleotide probes. *Poultry Science*, **82:** 1242-1249.

Zoetendal, E. G., Cheng, B., Koike, S. & Mackie, R. I. (2004b) Molecular microbial ecology of the gastrointestinal tract: from phylogeny to function. *Current Issues in Intestinal Microbiology*, **5:** 31-48.

Zoetendal, E. G., Collier, C. T., Koike, S., Mackie, R. I. & Gaskins, H. R. (2004a) Molecular ecological analysis of the gastrointestinal microbiota: A review. *Journal of Nutrition*, **134:** 465-472.

Zopf, D. & Roth, S. (1996) Oligosaccharide anti-infective agents. *Lancet*, **347:** 1017-1021.