US-VIRN References

References of Bioassays Used in Individual Species

Updated July 15, 2008

These references provides evidence/support for bioassays suggested by US-VIRN as their prototypical assay:

- Either the Endogenous OR Exogenous (e.g. human) cytokine/chemokine indicated stimulated cells from the target species indicated in the stipulated assay (e.g. human IL-12 stimulates bovine PBMC to produce IFNγ) OR
- A species' cytokine/chemokine is known to stimulate the Exogenous cell line suggested for the assay (e.g. swine IL-1 stimulates mouse D10 cells)

Alternative BIOassays are those in italics and state assay type in column 2 in italics.

REFERENCE FOR THIS PARTICULAR BIOASSAY FOR THIS SPECIES *[IF NO REFERENCE INDICATE IF AN ALTERNATIVE BIOASSAY EXISTS FOR THAT SPECIES AND PUT REFERENCE IN ITALICS]*					
MOLECULE	**PRINCIPAL OF BIOASSAY**	**CATTLE**	**CHICKEN**	**HORSE**	**SWINE**
CCL2 (MCP1)	**Monocyte chemotaxis**	None found	None found	None found	None found
CCL3 (MIP1α)	**Monocyte chemotaxis**	Widdison S, Watson M, Piercy J, Howard C, Coffey TJ. Granulocyte chemotactic properties of M. tuberculosis versus M. bovis-infected bovine alveolar macrophages. Mol Immunol. 2008, 45,740-9.	None found	None found	None found

REFERENCE FOR THIS PARTICULAR BIOASSAY FOR THIS SPECIES *[IF NO REFERENCE INDICATE IF AN ALTERNATIVE BIOASSAY EXISTS FOR THAT SPECIES AND PUT REFERENCE IN ITALICS]*					
MOLECULE	**PRINCIPAL OF BIOASSAY**	**CATTLE**	**CHICKEN**	**HORSE**	**SWINE**
CCL4 (MIP1β)	**Neutrophil or monocyte chemotaxis** **OR** **induction of mRNA for IL-1, IL-6 or TNFα**	Widdison S, Watson M, Piercy J, Howard C, Coffey TJ. Granulocyte chemotactic properties of M. tuberculosis versus M. bovis-infected bovine alveolar macrophages. Mol Immunol. 2008, 45,740-9. MONOCYTE CHEMOTAXIS: Proost P, Wuyts A, Lenaerts JP, Van Damme J. Purification, sequence analysis, and biological characterization of a second bovine monocyte chemotactic protein-1 (Bo MCP-1B). Biochemistry, 1994 33,13406-12.	None found	None found	None found
CCL4 alternative protocol	***Heterophil/ Lymphocyte chemotaxis***	*None found*	*Lam, KM. The MIP1β in the supernatants of M. gallisepticum-infected chicken leukocytes attracts the migration of chicken heterophils and lymphocytes. Devel Comp Immunol 2002, 26, 85-93*	*None found*	*None found*
CCL5 (RANTES)	**Monocyte chemotaxis**	Widdison S, Watson M, Piercy J, Howard C, Coffey TJ. Granulocyte chemotactic properties of M. tuberculosis versus M. bovis-infected bovine alveolar macrophages. Mol Immunol. 2008, 45,740-9.	None found	None found	Yang J, Cho B, Choi I, Kim DH, Kim SD, Koh HS, Ro H, Oh KH, Chung J, Kim JY, Ahn C, Kim S, Lee JS. Molecular characterization of miniature porcine RANTES and its chemotactic effect on human mononuclear cells. Transplantation. 2006 82,1229-33
CCL20 (MIP3α)	**Lymphocyte chemotaxis**	None found	None found	None found	None found
CXCL9 (Mig)	**T lymphoblast chemotaxis**	None found	None found	None found	None found
CXCL10 (IP-10)	**T lymphoblast chemotaxis**	HuCXCL10 IS CHEMOTACTIC OF BOVINE ENDOTHELIAL CELLS: Strieter RM, Kunkel SL, Arenberg DA, Burdick MD, Polverini PJ. Interferon gamma-inducible protein 10 (IP-10), a member of the C-X-C chemokine family, is an inhibitor of angiogenesis. Biochem Biophys Res Commun, 1995 210,51-7	None found	None found	None found
CXCL11 (I-TAC)	**T lymphoblast chemotaxis**	None found	None found	None found	None found
GM-CSF	**Monocyte proliferation**	None found	None found	None found	Inumaru S, Kokuho T, Denham S, Denyer MS, Momotani E, Kitamura S, Corteyn A, Brookes S, Parkhouse RM, Takamatsu H. Expression of biologically active recombinant porcine GM-CSF by baculovirus gene expression system. Immunol Cell Biol. 1998 76,195-201.

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MOLECULE	**PRINCIPAL OF BIOASSAY**	**CATTLE**	**CHICKEN**	**HORSE**	**SWINE**
GM-CSF alternative protocol	***Bone marrow cell proliferation***	*None found*	*Avery S, Rothwell L, Degen W, Schijns V,Young J, Kaufman J, Kaiser P. Characterization of the First Nonmammalian T2 Cytokine Gene Cluster: The Cluster Contains Functional Single-Copy Genes for IL-3, IL-4, IL-13, and GM-CSF, a Gene for IL-5 That Appears to Be a Pseudogene, and a Gene Encoding Another Cytokinelike Transcript, KK34. J Interferon Cyto Res 2004 24,600–610.*	*Vecchione A, Catchpole B, D'Mello F, Kanellos T, Hamblin A. Modulating immune responses with dendritic cells: an attainable goal in veterinary medicine? 2002. Vet Immunol Immunopathol.87,215- 21.*	Monroy RL, Davis TA, Nielsen TB, Staton AJ. Peripheral blood hematopoietic progenitor/stem cells proliferate to form colonies in liquid culture but require contact with vascular endothelial cells and GM-CSF. Int J Cell Cloning. 1992 10,105-15.
GM-CSF Alternative protocol	***NBT reduction by neutrophils***	*L M Sordillo, G Afseth, G Davies, and L A Babiuk. Effects of recombinant granulocyte-macrophage colony-stimulating factor on bovine peripheral blood and mammary gland neutrophil function in vitro. Can J Vet Res. 1992 56,16–21.*		*None found*	
GM-CSF Alternative protocol	***Human Tf1 cell proliferation***	*None found*		*Steinbach F, Stark R, Ibrahim S, Gawad EA, Ludwig H, Walter J, Commandeur U, Mauel S. Molecular cloning and characterization of markers and cytokines for equid myeloid cells. Vet Immunol Immunopathol. 2005, 108,:227-36.*	
GM-CSF Alternative protocol	***IncreasedMHC class II expression by monocytes***				*Foss DL, Bennaars AM, Pennell CA, Moody MD, Murtaugh MP. Differentiation of porcine dendritic cells by granulocyte-macrophage colony-stimulating factor expressed in Pichia pastoris. Vet Immunol Immunopathol. 2003 91,205-15.*
IFN-α/β	**MDBK cell/CAT reporter assay**	Fray M, Mann GE, Charleston B. 2001. Validation of an Mx/CAT reporter gene assay for the quantification of bovine type-I interferon. J. Immunological Methods 249, 235-244.	None found	NOTE WELL: Since equine type I IFN works with MDBK cells for viral plaque inhibition (see alternative protocol below), it is expected to work for this one since the receptor would be the same.	Fray M, Mann GE, Charleston B. 2001. Validation of an Mx/CAT reporter gene assay for the quantification of bovine type-I interferon. J. Immunological Methods 249, 235-244. – From Bryan Charleston, Pers comm.
IFN-α/β alternative protocol	***Viral plaque inhibition in MDBK cells*** ***OR*** ***Chicken embryonic fibroblasts***	*Not needed*	*Ruttanapumma R, Nakamura M, Takehara K. High level expression of recombinant chicken interferon-alpha using baculovirus. J Vet Med Sci. 2005 67,25-8.*	*Wagner B, Robeson J, McCracken M, Wattrang E and Antczak DF. 2005. Horse cytokine/IgG1 fusion proteins – mammalian expression of biologically active cytokines and a system to verify antibody specificity to equine cytokines. Vet. Immunol. Immunopathol., 105, 1-14.*	*Lefèvre F, L'Haridon R, Borras-Cuesta F, La Bonnardière C. 1990. Production, purification and biological properties of an Escherichia coli-derived recombinant porcine alpha interferon. J. Virol 71,1057-1063*

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MOLECULE	**PRINCIPAL OF BIOASSAY**	**CATTLE**	**CHICKEN**	**HORSE**	**SWINE**
IFN-α/β alternative protocol	***MAF activity: H2O2 production by peritoneal macrohages or a chicken macrophage cell line***	*Not needed*	*Dijkmans R, Creemers J, Billiau A. Chicken macrophage activation by interferon: do birds lack the molecular homologue of mammalian interferon-gamma? Vet Immunol Immunopathol. 1990 26,319-32.*	*Not needed*	*Not needed*
IFN-γ	**Monocyte/macrophage production of nitric oxide**	Goff, W.L., W.C. Johnson, C.R. Wyatt and C.W. Cluff. 1996. Assessment of bovine mononuclear phagocytes and neutrophils for induced L-arginine-dependent nitric oxide production. Vet Immunol Immunopathol. 55,45-62.	Digby MR, Lowenthal JW. Cloning and expression of the chicken interferon-gamma gene. J Interferon Cyto Res 1995 15(11):939-45. Song KD, Lillehoj HS, Choi KD, Zarlenga D, Han JY. Expression and functional characterization of recombinant chicken interferon-gamma.Vet Immunol Immunopathol 1997 58,321–33.	None found	None found
IFN-γ Alternative protocol	***MHC class II upregulation on PBMC***	*Not needed*	*Not needed*	*Wagner B, Robeson J, McCracken M, Wattrang E and Antczak DF. 2005. Horse cytokine/IgG1 fusion proteins – mammalian expression of biologically active cytokines and a system to verify antibody specificity to equine cytokines. Vet. Immunol. Immunopathol., 2005 105, 1-14.*	*Mateu de Antonio E, Husmann RJ, Hansen R, Lunney JK, Strom D, Martin S, Zuckermann FA. Quantitative detection of porcine interferon-gamma in response to mitogen, superantigen and recall viral antigen. Vet Immunol Immunopathol. 1998 61,265-77.*
IL-1	**Mouse D10 cell line proliferation**	Winstanley FP, Eckersall PD. Bioassay of bovine interleukin-1-like activity. Res Vet Sci. 1992 52, 273-276.	Weining KC, Sick C, Kaspers B, Staeheli P. A chicken homolog of mammalian interleukin-1β:cDNA cloning and purification of active recombinant protein. Eur J Biochem, 1998 *25,*: 994-1000.	None found	Asai T, Okada M, Ono M, Irisawa T, Mori Y, Yokomizo Y, Sato S. Increased levels of tumor necrosis factor and interleukin 1 in bronchoalveolar lavage fluids from pigs infected with Mycoplasma hyopneumoniae. Vet Immunol Immunopathol. 1993 38, 253-260
IL-2	**PBMC proliferation**	Stott JL, Fenwick BW, Osburn BI. Human recombinant interleukin-2 augments in vitro blastogenesis of bovine and porcine lymphocytes. Vet Immunol Immunopathol. 1986 13, 31-8 Olsen, SC, Stevens MG. Effects of recombinant human cytokines on mitogen-induced bovine PBMC proliferation. Cytokine 1993 5, 498-505.	Sundick RS, Gill-Dixon C. A cloned chicken lymphokine homologous to both mammalian *IL-2* and *IL-15*. J Immunol 1997 159,720–5.	Stott ML, Osburn BI. Establishment of equine T-lymphocyte cultures dependent on recombinant human interleukin-2. Am J Vet Res. 1988 49,553-6. Dohmann K, Wagner B, Horohov DW, Leibold W. Expression and characterisation of equine interleukin 2 and interleukin 4. Vet Immunol Immunopathol. 2000 77,243-56	Fong S, Doyle MV. Respnse of bovine and porcine peripheral blood mononuclear cells to human recombinant IL-2. Vet Immunol Immunopathol 1986 11,91-100. Stott JL, Fenwick BW, Osburn BI. Human recombinant interleukin-2 augments in vitro blastogenesis of bovine and porcine lymphocytes. Vet Immunol Immunopathol. 1986 13,31-8. USED CON A LYMPHOBALSTS: Gasbarre LC, Urban JF Jr, Romanowski RD. Porcine interleukin 2: parameters of production and biochemical characterization. Vet Immunol Immunopathol. 1984 Jan; 5(3):221-36.

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MOLECULE	**PRINCIPAL OF BIOASSAY**	**CATTLE**	**CHICKEN**	**HORSE**	**SWINE**
IL-4	**PBMC or splenocyte proliferation**	Olsen, SC, Stevens MG. Effects of recombinant human cytokines on mitogen-induced bovine PBMC proliferation. Cytokine 1993 5, 498-505.	Avery S, Rothwell L, Degen W, Schijns V,Young J, Kaufman J, Kaiser P. Characterization of the First Nonmammalian T2 Cytokine Gene Cluster: The Cluster Contains Functional Single-Copy Genes for IL-3, IL-4, IL-13, and GM-CSF, a Gene for IL-5 That Appears to Be a Pseudogene, and a Gene Encoding Another Cytokinelike Transcript, KK34. J Interferon Cyto Res 2004 24:600–610.	Dohmann K, Wagner B, Horohov DW, Leibold W. Expression and characterisation of equine interleukin 2 and interleukin 4. Vet Immunol Immunopathol. 2000 77,243-56 Steinbach F, Stark R, Ibrahim S, Gawad EA, Ludwig H, Walter J, Commandeur U, Mauel S. Molecular cloning and characterization of markers and cytokines for equid myeloid cells. Vet Immunol Immunopathol. 2005, 108,:227-36.	REQUIRES USE OF T LYMPHOBLASTS: Nuntaprasert, A, Y Mori, Y Muneta, K Yoshihara, K Tsukiyama-Kohara, C Kai. The effect of recombinant swine IL-4 on swine immune cells and on pro-inflammatory cytokine productions in pigs. Comp Immuno Microbiol Inf Dis, 2005, 28, 83-101.
IL-4 alternative protocol	***Suppression of TNFα secretion by alveolar macrophages***	*Not needed*	*Not needed*	*Not needed*	*Zhou Y, Lin G, Baarsch MJ, Scamurra RW, Murtaugh MP. Interleukin-4 suppresses inflammatory cytokine gene transcription in porcine macrophages. J Leukoc Biol. 1994 56,507-13*
IL-4 alternative protocol	***Stimulates human Tf-1 cells***	*Not needed*	*Not needed*	*Not needed*	*Nantaprasert A et al. Expression and purification of recombinant swine IL-4. comp Immunol Microbiol Infect Dis, 2005, 28:17-35.*
IL-5	**Human cell line Tf1 proliferation**	None found	IL-5 IS A PSEUDOGENE IN CHICKENS, SO NO ASSAY [SEE: Kaiser P, Poh TY, Rothwell L, Avery S, Balu S, Pathania US, Hughes S, Goodchild M, Morrell S, Watson M, Bumstead N, Kaufman J, Young JR. A genomic analysis of chicken cytokines and chemokines. J Interferon Cytokine Res. 2005 25,467-84.	R&D Systems. Recombinant Equine IL-5: specifications and use. Catalog Number 2470-EL. 2/28/2005	Sylvin H, Matvienko O, Leonchiks A, Alving K, van der Ploeg I. Molecular cloning, expression, and purification of pig interleukin-5. Immunogenetics. 2000 51,59-64.
IL-6	**Mouse B9 cell line proliferation**	Modat G, Dornand J, Bernad N, Junquero D, Mary A, Muller A, Bonne C. 1980. LPS-stimulated bovine aortic endothelial cells produce IL-1 and IL-6 like activities. Agents Actions 30,403-411	Schneider K, Klaas R, Kaspers B, Staeheli P. Chicken interleukin-6; cDNA structure and biological properties. Eur. J. Biochem. 2001 268, 4200-06.	Swiderski CE, Sobol G, Lunn DP, Horohov DW Molecular cloning, sequencing, and expression of equine interleukin-6. Vet Immunol Immunopathol. 2000 77,:213-20. Nagy E, Mándi Y, Szöke I, Kocsis B. Induction of release of tumor necrosis factor and IL-6 from human mononuclear cells by Bacteroides strains. Anaerobe, 1998 4,133-8	Schwager J, Schulze J. Maturation of the mitogen responsiveness, and IL2 and IL6 production by neonatal swine leukocytes. Vet Immunol Immunopathol. 1997 57, 105-19.
IL-7	**T lymphoblast proliferation**	Olsen, SC, Stevens MG. Effects of recombinant human cytokines on mitogen-induced bovine PBMC proliferation. Cytokine 1993 5, 498-505.	None found	None found	None found

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MOLECULE	**PRINCIPAL OF BIOASSAY**	**CATTLE**	**CHICKEN**	**HORSE**	**SWINE**
IL-7 alternative protocol	***Proliferation of mouse bone marrow cells***	*Not needed*	*None found*	*None found*	*Ueha, S., H. Kitazawa, Y. Tomioka, Y. Kawai, T. Saito, T. Itoh. cDNA cloning and expression nof swine IL-7 from neonatal intestinal epithelium. Biochimica et Biophysica Acta 2001 1517,468-71.*
IL-8 (CXCL8)	**Neutrophil chemotaxis**	Loftus, J, Black, SJ, Baldwin, CL. Unpublilshed – see protocol for graph	Min W, Lillehoj HS. Identification and characterization of chicken interleukin-16 cDNA. Devel Comp Immunol , 2004 28:153–162 (this has the chemotaxis protocol)	Loftus, J, Black, SJ, Baldwin, CL. Unpublilshed – see protocol for graph Van de Walle GR, May ML, Sukhumavasi W, von Einem J, Osterrieder N. Herpesvirus chemokine-binding glycoprotein G (gG) efficiently inhibits neutrophil chemotaxis in vitro and in vivo. J Immunol. 2007 179,4161-4169	Shirai J, Ogihara K, Masumoto A, Morioka K, Naya Y, Tsuchiya Y, Yokomizo Y. Continuous large-scale production of the cytokine CXCL8 from a novel porcine cell line. Eur Cytokine Netw. 2007 18,14-22.
IL-10	**Inhibition of IFNγ mRNA in response to rIL-12**	Collins RA, Howard CJ, Duggan SE, Werling D. Bovine IL-12 and modulation of IFNγ production. Vet Immunol Immunopathol. 1999 68,193-207. White AM, Blumerman S, Naiman B, Baldwin CL. Expression of the bovine high affinity IL-12Rβ2. Vet Immuno Immunopathol. 2002 84,127-142.	Rothwell L, Young JR, Zoorob R, Whittaker CA, Hesketh P, Archer A, Smith AL, Kaiser P. Cloning and characterization of chicken IL-10 and its role in the immune response to Eimeria maxima. J Immunol 2004 173,2675-82.	None found	Raymond CR, Sidahmed AM, Wilkie BN. Effects of antigen and recombinant porcine cytokines on pig dendritic cell cytokine expression in vitro. Vet Immunol Immunopathol. 2006, 111, 175-85.
IL-10 alternative protocol	***Inhibition of TNF production in response to LPS stimulation of monocytes***	*Not needed*	*Not needed*	*Hawkins DL, MacKay RJ, MacKay SL, Moldawer LL. Human interleukin 10 suppresses production of inflammatory mediators by LPS-stimulated equine peritoneal macrophages. Vet Immunol Immunopathol. 1998 66,1-10.*	*Not needed*
IL-12 p70	**Production of IFNγ by PBMC or splenocytes or lymph node cells**	Collins RA, Howard CJ, Duggan SE, Werling D. Bovine IL-12 and modulation of IFNγ production. Vet Immunol Immunopathol. 1999 68,193-207. White AM, Blumerman S, Naiman B, Baldwin CL. Expression of the bovine high affinity IL-12Rβ2. Vet Immuno Immunopathol. 2002 84,127-142.	Degen WG et al. Identification and Molecular Cloning of Functional Chicken IL-12. J. Immunology 2004 172, 4371–4380.	McMonagle EL, Taylor S, van Zuilekom H, Sanders L, Scholtes N, Keanie LJ, Hopkins CA, Logan NA, Bain D, Argyle DJ, Onions DE, Schijns VE, Nicolson L. Production of biologically active equine interleukin 12 through expression of p35, p40 and single chain IL-12 in mammalian and baculovirus expression systems. Equine Vet J. 2001 33,693-8.	REQUIRES IL-2 AS WELL: Pintaric M, Gerner W, Saalmüller A. Synergistic effects of IL-2, IL-12 and IL-18 on cytolytic activity, perforin expression and IFN-gamma production of porcine natural killer cells. Vet Immunol Immunopathol. 2008 121,68-82 Cho D, Lee WJ, Halloran PJ, Trinchieri G, Kim YB. Enhancement of porcine natural killer cell activity by recombinant human and murine IL-12. Cell Immunol. 1996 172,29-34.

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MOLECULE	**PRINCIPAL OF BIOASSAY**	**CATTLE**	**CHICKEN**	**HORSE**	**SWINE**
IL-12 p70 alternative protocol	***PBMC proliferation***	*Not needed*	*Not needed*	*Not needed*	*WORKS FOR PORCINE IL12P70 ON HUMAN OR BOVINE BLASTS, BUT NOT PORCINE BLASTS:* *Solano-Aguilar GI, Zarlenga D, Beshah E, Vengroski K, Gasbarre L, Junker D, Cochran M, Weston C, Valencia D, Chiang C, Dawson H, Urban JF, Lunney JK. Limited effect of recombinant porcine interleukin-12 on porcine lymphocytes due to a low level of IL-12 beta2 receptor. Vet Immunol Immunopathol. 2002, 89,133-48.* *AND* *Foss DL, Murtaugh MP. Molecular cloning and mRNA expression of porcine interleukin-12. Vet Immunol Immunopathol. 1997 57,121-34.*
IL-13	**Increase in class II MHC expression on monocytes or B cells**	Trigona, W.L., A. Hirano, W.C. Brown and D.M. Estes. Immunoregulatory roles of IL-13 in cattle. J. Inter Cyto Res 1999, 19:1317-24.	None found	None found	Bautista, E.M., C. Nfon, G.S. Ferman and W.T. Golde. IL-13 replaces Il-4 in development of monocyte derived dendritic cells (MoDC) of swine. Vet Immunol Immunopathol 2007 115:56-67.
IL-13 alternative protocol	***T cell proliferation***	*Not needed*	*Avery S, Rothwell L, Degen W, Schijns V,Young J, Kaufman J, Kaiser P. Characterization of the First Nonmammalian T2 Cytokine Gene Cluster: The Cluster Contains Functional Single-Copy Genes for IL-3, IL-4, IL-13, and GM-CSF, a Gene for IL-5 That Appears to Be a Pseudogene, and a Gene Encoding Another Cytokinelike Transcript, KK34. J Interferon Cyto Res 2004 24:600–610.*	None found	*Not needed*
IL-15	**PBMC proliferation**	See our unpublished data in protocol for this	Choi, K. D., H. S. Lillehoj, K. D. Song, and J. Y. Han. 1999. Molecular and functional characterization of chicken IL-15. Dev Comp Immunol 1999 23,165-177	None found	*None found*
IL-15 alternative protocol	***IFNγ production with co-stimulation with IL-12***	*Price SJ, Sopp P, Howard CJ, Hope JC. Workshop cluster 1+ γδ TCR$^+$ T cells from calves express high levels of IFNγ in response to stimulation with IL-12 and IL-18.*	*Not needed*	None found	
IL-16	**T cell chemotaxis**	None found	Min W and H Lillehoj. Identification and characterization of chicken interleukin-16 cDNA. Developmental & Comparative Immunology 2004 28,153-162.	None found	None found

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MOLECULE	**PRINCIPAL OF BIOASSAY**	**CATTLE**	**CHICKEN**	**HORSE**	**SWINE**
IL-17	**Induce IL-6 expression in murine 3T3 cell line** **OR** **species fibroblasts, epithelial cell lines or splenocytes**	Riollet C, Mutuel D, Duonor-Cérutti M, Rainard P. 2006. Determination and characterization of bovine interleukin-17 cDNA. J Interferon Cytokine Res. 2006 26,141-9.	Min W, Lillehoj HS. Isolation and characterization of chicken interleukin-17 cDNA. J Interferon Cytokine Res.2002 22:1123-8.	None found	Katoh S, Kitazawa H, Shimosato T, Tohno M, Kawai Y, Saito T. Cloning and characterization of Swine interleukin-17, preferentially expressed in the intestines. J Interferon Cytokine Res. 2004 24,553-9.
IL-18	**Production of IFNγ by PBMC or splenocytes**	Shoda LK, Zarlenga DS, Hirano A, Brown WC. Cloning of a cDNA encoding bovine rIL-18 and analysis of IL-18 expression in macrophages and its IFNγ-inducing activity. J. Interferon Cytokine Res 1999 19,1169-1177. Price SJ, Sopp P, Howard CJ, Hope JC. Workshop cluster 1+ γδ TCR^+ T cells from calves express high levels of IFNγ in response to stimulation with IL-12 and IL-18. Immunology. 2007 120,57-65	Schneider K, Puehler F, Baeuerle D, Elvers S, Staeheli P, Kaspers B, Weining KC. cDNA cloning of biologically active chicken interleukin-18. J. Interferon Cytokine Res. 2000 20, 879 Puehler F, Go¨bel T, Breyer U, Ohnemus A, Staeheli P, Kaspers B. A sensitive bioassay for chicken interleukin-18 based on the inducible release of preformed interferon-γ. J Immunol Meth 2003 274: 229–232	Wu D, Murakami K, Liu N, Konishi M, Muneta Y, Inumaru S, Kokuho T, Sentsui H. Expression of equine interleukin-18 by baculovirus expression system and its biologic activity. Microbiol Immunol. 2004; 48, 471-476.	Muneta Y, Mori Y, Shimoji Y, Yokomizo Y. Porcine interleukin 18: cloning, characterization of the cDNA and expression with the baculovirus system. Cytokine. 2000 Jun;12(6):566-72. Pintaric M, Gerner W, Saalmüller A. Synergistic effects of IL-2, IL-12 and IL-18 on cytolytic activity, perforin expression and IFN-gamma production of porcine natural killer cells. Vet Immunol Immunopathol. 2008 121,68-82
IL-18 alternative protocol	*IFNγ productin by the human myelomonocytic KG-1 cells*	*Not needed*	*Not needed*	*O'Donovan LH, McMonagle EL, Taylor S, Argyle DJ, Nicolson L. Bioactivity and secretion of interleukin-18 (IL-18) generated by equine and feline IL-18 expression constructs.* *Vet Immunol Immunopathol. 2004 102,421-8.*	
IL-23	**Production of IL-17 mRNA by PBMC**	None found	None found	None found	None found
LITAF		Not needed	Hong YH, HS Lillehoj, SH Lee, DW Park, EP Lillehoj, Molecular cloning and characterization of chicken lipopolysaccharide-induced TNF-α factor (LITAF) . Developmental & Comparative Immunology. 2006 30,919-929.	Not needed	Not needed
Lymphotactin (XCL1)	**Chemotaxis of T cells**	Not needed	Rossi D, Sanchez-Garcia J, McCormack WT, Bazan JF, Zlotnik A. Identification of a chicken C chemokine related to lymphotactin. J Leukoc Biol 1999 65:87–93.	Not needed	Not needed

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MOLECULE	**PRINCIPAL OF BIOASSAY**	**CATTLE**	**CHICKEN**	**HORSE**	**SWINE**
TGF-β	**Proliferation of mink CCL64 cell line**	Adler H, Frech B, Thöny M, Pfister H, Peterhans E, Jungi TW. Inducible nitric oxide synthase in cattle. Differential cytokine regulation of nitric oxide synthase in bovine and murine macrophages. J Immunol. 1995 154,4710-4718.	None found	Chesters PM, Hughes A, Edington N. Equid herpesvirus 1: platelets and alveolar macrophages are potential sources of activated TGF-B1 in the horse. Vet Immunol Immunopathol. 2000 75, 71-79.	Gupta A, Dekaney CM, Bazer FW, Madrigal MM, Jaeger LA. Beta transforming growth factors (TGFbeta) at the porcine conceptus-maternal interface. Part II: uterine TGFbeta bioactivity and expression of immunoreactive TGFbetas (TGFbeta1, TGFbeta2, and TGFbeta3) and their receptors (type I and type II). Biol Reprod. 1998 59, 911-7.
TGF-β alternative protocol	***Proliferation of embryonic bone marrow cells of chickens***	*Not needed*	*Lundy MW, Hendrix T, Wergedal JE, Baylink DJ. Growth factor-induced proliferation of osteoblasts measured by bromodeoxyuridine immunocytochemistry. Growth Factors. 1991 4,257-64.*	*Not needed*	*Not needed*
TNF-α **OR chicken TNSF15**	**Cytotoxicity of cells:** **(a) WEHI-13VAR in the presence of actinomycin D, or** **(b) WEHI-164, or** **(c) for swine TNF, using PK15 cell line, or** **(d) for chicken TNF using fibroblasts** OR	Adams JL, Czuprynski CJ Bacterial lipopolysaccharide induces release of tumor necrosis factor-alpha from bovine peripheral blood monocytes and alveolar macrophages in vitro. J. Leuk Biol 1990 48,549-56	Park SS, HS Lillehoj, YH Hong, SL Lee. Functional characterization of TNFSF15 induced by lipopolysaccharide and Eimeria infection. Developmental & Comparative Immunology 2004 31,934-944.	*None found*	Bertoni, G. *et al*. (1993) Improved bioassay for the detection of porcine tumor necrosis factor using a homologous cell line: PK(15). J. Immunol. Methods 1993 160, 267.
TNFα alternative protocol	*Increase in class I MHC on porcine aortic endothelial cell (PAEC) monolayers*	*None found*	*None found*	*None found*	*Kwiatkowski P, Artrip JH, John R, Edwards NM, Wang SF, Michler RE, Itescu S. Induction of swine major histocompatibility complex class I molecules on porcine endothelium by tumor necrosis factor-alpha reduces lysis by human natural killer cells. Transplantation. 1999 67,211-8.*

References for Full Length CDS

Updated March 6, 2008

The following tables give references to publications in which full-length copy DNA sequences (CDS) acquired from mRNA were cloned and characterized.

Equine

Equine Gene	Alternate Name	Previous Acc #	US VIRN Acc #	Publication: Cloning and Characterization
CCL2	MCP-1	NM_001081931	EU438774	Benarafa,C., Cunningham,F.M., Hamblin,A.S., Horohov,D.W. and Collins,M.E. Cloning of equine chemokines eotaxin, monocyte chemoattractant protein (MCP)-1, MCP-2 and MCP-4, mRNA expression in tissues and induction by IL-4 in dermal fibroblasts. Vet. Immunol. Immunopathol. 76 (3-4), 283-298 (2000)
CCL3	MIP-1a		EU438775	**US-VIRN, in preparation**
CCL5	RANTES	AF506970		Gilger et al. Expression of a chemokine by ciliary body epithelium in horses with naturally occurring recurrent uveitis and in cultured ciliary body epithelial cells. Am J Vet Res. 2002 Jul;63(7):942-7.
CCL11	Eotaxin	NM_001081871		Benarafa,C., Cunningham,F.M., Hamblin,A.S., Horohov,D.W. and Collins,M.E. Cloning of equine chemokines eotaxin, monocyte chemoattractant protein (MCP)-1, MCP-2 and MCP-4, mRNA expression in tissues and induction by IL-4 in dermal fibroblasts. Vet. Immunol. Immunopathol. 76 (3-4), 283-298 (2000)
CXCL9	MIG		EU438776	**Hudgens, T., Tompkins, Boyd, P., Lunney, J., D., Horohov, D., Baldwin, C. Expressed gene sequence of the IFNγ-response chemokine CXCL9 of cattle, horses, and swine. In preparation for VII.**
CXCL10	IP-10		EU438777	**Expressed gene sequences of the bovine and equine IFNγ-response chemokine CXCL10. Tompkins, D., Hudgens, T., Horohov, D., Boyd, P., Lunney, J., Baldwin, C. In press, VII.**
CXCL11	IP-9			**No reference available.**
GM-CSF		AY040203	EU438778	Mauel,S., Steinbach,F. and Ludwig,H. Monocyte-derived dendritic cells from horses differ from dendritic cells of humans and mice. Immunology 117 (4), 463-473 (2006)
IFN-alpha-1		M14540		Himmler,A., Hauptmann,R., Adolf,G.R. and Swetly,P. Molecular cloning and expression in Escherichia coli of equine type I interferons DNA 5 (5), 345-356 (1986)
IFN-beta		M14546		Himmler,A., Hauptmann,R., Adolf,G.R. and Swetly,P. Molecular cloning and expression in Escherichia coli of equine type I interferons. DNA 5 (5), 345-356 (1986)
IFN-gamma		U04050		Grunig,G., Himmler,A. and Antczak,D.F. Cloning and sequencing of horse interferon-gamma cDNA. Immunogenetics 39 (6), 448-449 (1994)
IL1-beta		U92481	EU438767	Howard,R.D., McIlwraith,C.W., Trotter,G.W. and Nyborg,J.K. Cloning of equine interleukin 1 alpha and equine interleukin 1 beta and determination of their full-length cDNA sequences. Am. J. Vet. Res. 59 (6), 704-711 (1998)
IL2		NM_001085433	EU438768	Vandergrifft,E.V. and Horohov,D.W. Molecular cloning and expression of equine interleukin 2. Vet. Immunol. Immunopathol. 39 (4), 395-406 1993)
IL4		NM_001082519	EU438769	Vandergrifft,E.V., Swiderski,C.E. and Horohov,D.W. Molecular cloning and sequencing of equine interleukin 4. Vet. Immunol. Immunopathol. 40 (4), 379-384 (1994)
IL5		U91947		Cunningham,F.M., Vandergrifft,E., Bailey,S.R., Sepulveda,M.F., Goode,N.T., and Horohov,D.W. Cloning, expression and biological activity of equine interleukin (IL)-5. Vet Immunol Immunopathol. 2003 Sep 15;95(1-2):63-72.
IL6		U64794	EU438770	Swiderski,C.E., Sobol,G., Lunn,D.P. and Horohov,D.W. Molecular cloning, sequencing, and expression of equine interleukin-6. Vet. Immunol. Immunopathol. 77 (3-4), 213-220 (2000)
IL10		U38200	EU438771	Swiderski,C.E., Klei,T.R., and Horohov,D.W. Quantitative measurement of equine cytokine mRNA expression by polymerase chain reaction using target-specific standard curves. J Immunol Methods. 1999 Jan 1;222(1-2):155-69.
IL12p35		Y11130		Nicolson,L., Penha-Goncalves,M.N., Keanie,J.L., Logan,N.A., Argyle,D.J. and Onions,D.E. Cloning and sequencing of horse interleukin-12 and interleukin-18 cDNAs. Immunogenetics 50 (1-2), 94-97 (1999)

Equine Gene	Alternate Name	Previous Acc #	US VIRN Acc #	Publication: Cloning and Characterization
IL12p40		Y11129		Nicolson,L., Penha-Goncalves,M.N., Keanie,J.L., Logan,N.A., Argyle,D.J. and Onions,D.E. Cloning and sequencing of horse interleukin-12 and interleukin-18 cDNAs. Immunogenetics 50 (1-2), 94-97 (1999)
IL13		EF645663		**US-VIRN, in preparation**
IL15		AY682849		**US-VIRN, in preparation**
IL17	CTLA-8			**US-VIRN, in preparation**
IL18		Y11131	EU438772	Nicolson,L., Penha-Goncalves,M.N., Keanie,J.L., Logan,N.A., Argyle,D.J. and Onions,D.E. Cloning and sequencing of horse interleukin-12 and interleukin-18 cDNAs. Immunogenetics 50 (1-2), 94-97 (1999)
IL23		AY704416	EU438773	**US-VIRN, in preparation**
TGF-beta		NM_001081849		Penha-Goncalves,M.N., Onions,D.E. and Nicolson,L. Cloning and sequencing of equine transforming growth factor-beta 1 (TGF beta-1) cDNA. DNA Seq. 7 (6), 375-378 (1997)
TNF-alpha		NM_001081819	EU438779	Su,X.Z., Morris,D.D. and McGraw,R.A. Cloning and characterization of gene TNF alpha encoding equine tumor necrosis factor alpha. Gene 107 (2), 319-321 (1991)

Poultry (Chicken)

Chicken Gene	Alternate Name	Previous Acc#	US VIRN Acc#	Publication: Cloning and Characterization
CCL4	MIP-1beta	NM_001030360		Petrenko, O., Ischenko, I. and Enrietto, P.J. 1995. Isolation of a cDNA encoding a novel chicken chemokine homologous to mammalian macrophage inflammatory protein-1 beta. Gene 160 (2), 305-306.
CCL20	MIP-3alpha	NM_204438		
CD80		NM_001079739		Caldwell, R.B., Kierzek, A.M., Arakawa, H., Bezzubov, Y., Zaim, J., Fiedler, P., Kutter, S., Blagodatski, A., Kostovska, D., Koter, M., Plachy, J., Carninci, P., Hayashizaki, Y. and Buerstedde, J.M. 2005. Full-length cDNAs from chicken bursal lymphocytes to facilitate gene function analysis. Genome Biol. 6 (1), R6
CD83		XM_418929		Hansell C, Zhu XW, Brooks H, Sheppard M, Withanage S, Maskell D, McConnell I. Unique features and distribution of the chicken CD83+ cell. J Immunol. 2007 Oct 15;179(8):5117-25.
CD86		NM_001037839		
CXCR4		NM_204617		Liang TS, Hartt JK, Lu S, Martins-Green M, Gao JL, Murphy PM. Cloning, mRNA distribution, and functional expression of an avian counterpart of the chemokine receptor/HIV coreceptor CXCR4. J Leukoc Biol. 2001 Feb;69(2):297-305.
IFN-gamma		AH009942		Yun, C. H., H. S. Lillehoj, and K. D. Choi. 2000. Chicken IFN-gamma monoclonal antibodies and their application in enzyme-linked immunosorbent assay. Vet Immunol Immunopathol 73:297-308.
IL-1beta		Y15006		Weining, K.C., Sick, C., Kaspers, B. and Staeheli, P. 1998. A chicken homolog of mammalian interleukin-1 beta: cDNA cloning and purification of active recombinant protein. Eur. J. Biochem. 258 (3), 994-1000.
IL-2		AF017645		Miyamoto, T., W. Min, and H. S. Lillehoj. 2002. Kinetics of interleukin-2 production in chickens infected with Eimeria tenella. Comp Immunol Microbiol Infect Dis 25:149-158
IL-2R alpha		NM_204596		Teng,Q.Y., Zhou,J.Y., Wu,J.J., Guo,J.Q. and Shen,H.G. 2006. Characterization of chicken interleukin 2 receptor alpha chain, a homolog to mammalian CD25. FEBS Lett. 580 (17): 4274-4281.
IL-4		NM_001007079		Avery, S., Rothwell, L., Degen, W.D., Schijns, V.E., Young, J., Kaufman, J. and Kaiser, P. 2004. Characterization of the first nonmammalian T2 cytokine gene cluster: the cluster contains functional single-copy genes for IL-3, IL-4, IL-13, and GM-CSF, a gene for IL-5 that appears to be a pseudogene, and a gene encoding another cytokinelike transcript, KK34. J. Interferon Cytokine Res. 24 (10), 600-610
IL-10		NM_001004414		Rothwell, L., Young, J.R., Zoorob, R., Whittaker, C.A., Hesketh, P., Archer, A., Smith, A.L. and Kaiser, P. 2004. Cloning and characterization of chicken IL-10 and its role in the immune response to Eimeria maxima. J. Immunol. 173 (4), 2675-2682
IL-12p35		NM_213588		Degen, W.G., van Daal, N., van Zuilekom, H.I., Burnside, J. and Schijns, V.E. 2004. Identification and molecular cloning of functional chicken IL-12. J. Immunol. 172 (7), 4371-4380.
IL-12p40		AY262752		Degen, W.G., van Daal, N., van Zuilekom, H.I., Burnside, J. and Schijns, V.E. 2004. Identification and molecular cloning of functional chicken IL-12. J. Immunol. 172 (7), 4371-4380.
IL-15		NM_204571		Lillehoj, H. S., W. Min, K. D. Choi, U. S. Babu, J. Burnside, et al. 2001. Molecular, cellular, and functional characterization of chicken cytokines homologous to mammalian IL-15 and IL-2. Vet Immunol Immunopathol 82:229-244
IL-16		AJ508678		Min, W., and H. S. Lillehoj. 2004. Identification and characterization of chicken interleukin-16 cDNA. Dev Comp Immunol 28:153-162.

Chicken Gene	Alternate Name	Previous Acc#	US VIRN Acc#	Publication: Cloning and Characterization
IL-17		AJ493595		Min, W., and H. S. Lillehoj. 2002. Isolation and characterization of chicken interleukin-17 cDNA. J Interferon Cytokine Res 22:1123-1128.
IL-17D	IL-27	EF570583		Yeong Ho Hong, Hyun S. Lillehoj, Dong Woon Park, Sung Hyen Lee, Jae Yong Han, Ji Hye Shin, Myeung Sun Park and Jin-Kyoo Kim. 2008. Cloning and functional characterization of chicken Interleukin-17D. Veterinary immunology and Immunopathology. doi:10.1016/j.vetimm. 2008.06.002.
IL-18		AJ277865		Schneider, K., Puehler, F., Baeuerle, D., Elvers, S., Staeheli, P., Kaspers, B. and Weining, K.C. 2000. cDNA cloning of biologically active chicken interleukin-18. J. Interferon Cytokine Res. 20 (10), 879-883.
IL-21R		NM_001030640		Caldwell, R.B., Kierzek, A.M., Arakawa, H., Bezzubov, Y., Zaim, J., Fiedler, P., Kutter,S., Blagodatski,A., Kostovska,D., Koter,M., Plachy,J., Carninci,P., Hayashizaki,Y. and Buerstedde,J.M. 2005. Full-length cDNAs from chicken bursal lymphocytes to facilitate gene function analysis. Genome Biol. 6 (1), R6.
LITAF		AY765397		Hong, Y. H., H. S. Lillehoj, S. Hyen Lee, D. Woon Park, and E. P. Lillehoj. 2006. Molecular cloning and characterization of chicken lipopolysaccharide-induced TNF-alpha factor (LITAF). Dev Comp Immunol 30:919-929.
Lymphotactin		AF006742		Rossi, D., Sanchez-García, J., McCormack, W.T., Bazan, J.F, Zlotnik, A. 1999. Identification of a chicken "C" chemokine related to lymphotactin. J Leukoc Biol. 65(1):87-93.
MIF		M95776		Wistow, G.J., Shaughnessy, M.P., Lee, D.C., Hodin, J. and Zelenka, P.S. 1993. A macrophage migration inhibitory factor is expressed in the differentiating cells of the eye lens. Proc. Natl. Acad. Sci. U.S.A. 90 (4), 1272-1275.
TNFSF15	TL1A	NM_001024578		Park, S. S., H. S. Lillehoj, Y. H. Hong, and S. H. Lee. 2007. Functional characterization of tumor necrosis factor superfamily 15 (TNFSF15) induced by lipopolysaccharides and Eimeria infection. Dev Comp Immunol 31:934-944.

Ruminant (Bovine)

Bovine Gene	Alternate Name	Previous Acc#	US VIRN Acc#	Publication: Cloning and Characterization
CCL2	MCP-1	NM_174006	EU276069	Wempe,F., Einspanier,R. and Scheit,K.H. Characterization by cDNA cloning of the mRNA of a new growth factor from bovine seminal plasma: acidic seminal fluid protein. Biochem. Biophys. Res. Commun. 183 (1), 232-237 (1992)
CCL3	MIP-1a	AY050252		Werling D, Koss M, Howard CJ, Taylor G, Langhans W, Hope JC. Role of bovine chemokines produced by dendritic cells in respiratory syncytial virus-induced T cell proliferation. Vet Immunol Immunopathol. 2002 Sep 10;87(3-4):225-33.
		AY077840		
CCL5	RANTES	NM_175827	EU276060	Aust,G., Brylla,E., Lehmann,I., Kiessling,S. and Spanel-Borowski,K. Cloning of bovine RANTES mRNA and its expression and regulation in ovaries in the periovulatory period. FEBS Lett. 463 (1-2), 160-164 (1999)
CCL11	Eotaxin	AJ132003		Vogel,B., Klinder,A., Sittig,D. and Aust,G. Bovine eotaxin (CCL11)--an unusual member of the eotaxin group--attracts eosinophils in vitro but is not responsible for eosinophilia in the ovary. Vet. Immunol. Immunopathol. 107 (1-2), 67-77 (2005)
CXCL9	MIG		EU276061	**Hudgens, T., Tompkins, Boyd, P., Lunney, J., D., Horohov, D., Baldwin, C. Expressed gene sequence of the IFNγ-response chemokine CXCL9 of cattle, horses, and swine. In preparation for VII.**
CXCL10	IP-10	BC112547	EU276062	**Expressed gene sequences of the bovine and equine IFNγ-response chemokine CXCL10. Tompkins, D., Hudgens, T., Horohov, D., Boyd, P., Lunney, J., Baldwin, C. In press, VII.**
CXCL11	IP-9		EU276063	**Hudgens, T., Tompkins, D., Boyd, P., Wysocki, M., Lunney, J., Baldwin, C. Expressed gene sequence of the IFNγ-response chemokine CXCL11 of cattle and swine. In preparation for VII.**
IFN-alpha		NM_001017411	EU276064	Velan,B., Cohen,S., Grosfeld,H., Leitner,M. and Shafferman,A. Bovine interferon alpha genes. Structure and expression. J. Biol. Chem. 260 (9), 5498-5504 (1985)
IFN-beta		M15477	EU276065	Leung,D.W., Capon,D.J. and Goeddel,D.V. The structure and bacterial expression of three distinct bovine interferon-beta genes. Biotechnology (N.Y.) 2, 458-464 (1984)
IFN-gamma		NM_174086	EU276066	Cerretti,D.P., McKereghan,K., Larsen,A., Cosman,D., Gillis,S. and Baker,P.E. Cloning, sequence, and expression of bovine interferon-gamma. J. Immunol. 136 (12), 4561-4564 (1986)
IL1-beta		NM_174093	EU276067	Maliszewski,C.R., Baker,P.E., Schoenborn,M.A., Davis,B.S., Cosman,D., Gillis,S. and Cerretti,D.P. Cloning, sequence and expression of bovine interleukin 1 alpha and interleukin 1 beta complementary DNAs. Mol. Immunol. 25 (5), 429-437 (1988)
IL2		NM_180997	EU276068	Reeves,R., Spies,A.G., Nissen,M.S., Buck,C.D., Weinberg,A.D., Barr,P.J., Magnuson,N.S. and Magnuson,J.A. Molecular cloning of a functional bovine interleukin 2 cDNA. Proc. Natl. Acad. Sci. U.S.A. 83 (10), 3228-3232 (1986)
IL4		NM_173921	EU276069	Heussler,V.T., Eichhorn,M. and Dobbelaere,D.A. Cloning of a full-length cDNA encoding bovine interleukin 4 by the polymerase chain reaction. Gene 114 (2), 273-278 (1992)
IL5		NM_173922	EU276070	Mertens,B., Gobright,E. and Seow,H.F. The nucleotide sequence of the bovine interleukin-5-encoding cDNA. Gene 176 (1-2), 273-274 (1996)

Bovine Gene	Alternate Name	Previous Acc#	US VIRN Acc#	Publication: Cloning and Characterization
IL6		NM_173923	EU276071	Droogmans,L., Cludts,I., Cleuter,Y., Kettmann,R. and Burny,A. Nucleotide sequence of bovine interleukin-6 cDNA. DNA Seq. 2 (6), 411-413 (1992)
IL7		NM_173924	EU276072	Cludts,I., Droogmans,L., Cleuter,Y., Kettmann,R. and Burny,A. Sequence of bovine interleukin 7. DNA Seq. 3 (1), 55-59 (1992)
IL8	CXCL8	NM_173925	EU276073	Morsey,M.A., Popowych,Y., Kowalski,J., Gerlach,G., Godson,D., Campos,M. and Babiuk,L.A. Molecular cloning and expression of bovine interleukin-8. Microb. Pathog. 20 (4), 203-212 (1996)
IL10		NM_174088	EU276074	Hash,S.M., Brown,W.C. and Rice-Ficht,A.C. Characterization of a cDNA encoding bovine interleukin 10: kinetics of expression in bovine lymphocytes. Gene 139 (2), 257-261 (1994)
IL12p35		U14416	EU276075	Zarlenga,D.S., Canals,A., Aschenbrenner,R.A. and Gasbarre,L.C. Enzymatic amplification and molecular cloning of cDNA encoding the small and large subunits of bovine interleukin 12. Biochim. Biophys. Acta 1270 (2-3), 215-217 (1995)
IL12p40		U11815	EU276076	Zarlenga,D.S., Canals,A., Aschenbrenner,R.A. and Gasbarre,L.C. Enzymatic amplification and molecular cloning of cDNA encoding the small and large subunits of bovine interleukin 12. Biochim. Biophys. Acta 1270 (2-3), 215-217 (1995)
IL13		AF072807	EU276077	Trigona,W.L., Brown,W.C. and Estes,D.M. Functional implications for signaling via the IL4R/IL13R complex on bovine cells. Vet. Immunol. Immunopathol. 72 (1-2), 73-79 (1999)
IL15		U42433		Zarlenga,D.S., Canals,A., Boyd,P. and Gasbarre,L.C. Cloning and expression of bovine IL15: distribution and modulation of transcription in animals infected with gastrointestinal nematodes. Interferon Cytokine Res. 1997 Aug;17(8):473-80
IL17	CTLA-8	AF412040		Riollet C, Mutuel D, Duonor-Cérutti M, Rainard P. Determination and characterization of bovine interleukin-17 cDNA. J Interferon Cytokine Res. 2006 Mar;26(3):141-9.
IL18		NM_174091	EU276078	Shoda,L.K., Zarlenga,D.S., Hirano,A. and Brown,W.C. Cloning of a cDNA encoding bovine interleukin-18 and analysis of IL-18 expression in macrophages and its IFN-gamma-inducing activity. J. Interferon Cytokine Res. 19 (10), 1169-1177 (1999)
IL23				**Chen, C., Herzig, C., Baldwin, C. Expressed gene sequence of bovine IL-23p19 and IL-23 receptor. In press, VII.**
TNF-alpha		NM_173966	EU276079	Mertens,B., Muriuki,C. and Gaidulis,L. Cloning of two members of the TNF-superfamily in cattle: CD40 ligand and tumor necrosis factor alpha. Immunogenetics 42 (5), 430-431 (1995)
Cell surface molecules				
CCR7		NM_001024930		Blumerman SL, Wang F, Herzig CT, Baldwin CL. Molecular cloning of bovine chemokine receptors and expression by WC1+ gammadelta T cells. Dev Comp Immunol. 2007;31(1):87-102. Epub 2006 May 2.
IL10R				**No reference available.**
IL23R				**Chen, C., Herzig, C., Baldwin, C. Expressed gene sequence of bovine IL-23p19 and IL-23 receptor. In press, VII.**
TCRa				Ishiguro N, Tanaka A, Shinagawa M. Sequence analysis of bovine T-cell receptor alpha chain. Immunogenetics. 1990;31(1):57-60.
TCRb				Tanaka A, Ishiguro N, Shinagawa M. Sequence and diversity of bovine T-cell receptor beta-chain genes. Immunogenetics. 1990;32(4):263-71.
TCRg				Herzig C, Blumerman S, Lefranc MP, Baldwin C. Bovine T cell receptor gamma variable and constant genes: combinatorial usage by circulating gammadelta T cells. Immunogenetics. 2006 Apr;58(2-3):138-51.
TCRd				Herzig CT, Blumerman SL, Baldwin CL. Identification of three new bovine T-cell receptor delta variable gene subgroups expressed by peripheral blood T cells. Immunogenetics. 2006 Sep;58(9):746-57.

Swine

Swine Gene	Alternative Name	Previous Acc#	US VIRN Acc#	Related Publication
CCL2	MCP-1	X79416 Ssc.657		Hosang et al. Porcine luteal cells express monocyte chemoattractant proteins-1 (MCP-1): analysis by PCR and cDNA cloning. 1994, Biochem Biophys Res Comm 199, 962-968.
CCL3L1	MIP-1a	AY643423 Ssc.43937	EU364893	**US-VIRN, in preparation**
CCL4	MIP1b	AJ311717 Ssc.23797	EU364894	**US-VIRN, in preparation**

Swine Gene	Alternative Name	Previous Acc#	US VIRN Acc#	Related Publication
CCL5	RANTES	AJ583704 Ssc.22030		Yang J, Cho B, Choi I, Kim DH, Kim SD, Koh HS, Ro H, Oh KH, Chung J, Kim JY, Ahn C, Kim S, Lee JS. Molecular characterization of miniature porcine RANTES and its chemotactic effect on human mononuclear cells. 2006, Transplantation. 82,1229-33
CXCL9	MIG	BP169836	EU364897	**Hudgens, T., Tompkins, Boyd, P., Lunney, J., D., Horohov, D., Baldwin, C. Expressed gene sequence of the IFNγ-response chemokine CXCL9 of cattle, horses, and swine. In preparation for VII.**
CXCL10	IP-10	AY789646 Ssc.35257	EU364898	Liu an dXiong. Isolation, sequence analaysis and expression profile of a novel porcine gene, CXCL10, differentially expressed in the Longissimus dorsi muscle tissues from Meishan, Meishan x Large White cross and Large White pigs. 2007, DNA Sequence 18, 415-22. Yang et al. Molecular characterization of cDNA encoding porcine IL-10 and induction of porcine endothelial IP-10 in response to human TNFα. 2007, Vet Immunol Immunopathol. 117, 124-8.
CXCL11	IP-9	BX914688		**Hudgens, T., Tompkins, D., Boyd, P., Wysocki, M., Lunney, J., Baldwin, C. Expressed gene sequence of the IFNγ-response chemokine CXCL11 of cattle and swine. In preparation.**
GM-CSF				Inumaru and Takamatsu. cDNA cloing of porcine GM-CSF. Immunol Cell Biol 1995, 73, 474-6.
IFN1@	IFNa	AY345969 Ssc.19264	EU364896	Balmelli C, Ruggli N, McCullough K, Summerfield A. Fibrocytes are potent stimulators of anti-virus cytotoxic T cells. 2005, J. Leukoc. Biol. 77, 923-933.
IFNB1	IFNB	AY687281 Ssc.42778		**US-VIRN, in preparation**
IL-5				Sylvin H, Matvienko O, Leonchiks A, Alving K, van der Ploeg I. Molecular cloning, expression, and purification of pig interleukin-5. 2000, Immunogenetics. 51,59-64.
IL 7	IL-7	AB035380 AB040441 Ssc.15904	EU364895	Ueha S et al. cDNA cloning and expression of swine IL-7 from neonatal intestinal epithelium. 2001, Biochim. Biophys. Acta 1517: 468-471. Uenishi H, Hiraiwa H, Sawazaki T, Kiuchi S, Yasue H. Genomic organization and assignment of the interleukin 7 gene (IL7) to porcine chromosome 4q11-->q13 by FISH and by analysis of radiation hybrid panels. Cytogenet. Cell Genet. 93 (1-2), 65-72 (2001)
IL13	IL-13	AF385625 Ssc.15877		**US-VIRN, in preparation**
IL15	IL-15	U58142 Ssc.8833		Canals et al. Molecular cloning of cDNA encoding porcine IL-15. 1997, Gene 195, 337-339.
IL17	CTLA-8	AB040441 Ssc.42770		Katoh et al. Cloning and characterization of swine IL-17, preferentially expressed in intestines. 2004, J. Interferon Cyto Res 24, 553-9.
IL18	IL-18			Fournout et al. Cloning, chromosomal location and tissue expression of the gene for pig IL-18. 2000, Immunognetics 51, 358-65.
IL21	IL-21			Munesta et al. Molecular cloining, chromosomal location and biological activity of porcine IL-21. 2004, J Vet Med Sci 66, 269-75.
TNF	TNFA	X57321 Ssc.100		Kuhnert P, Wuthrich C, Peterhans E, Pauli U. The porcine tumor necrosis factor-encoding genes: sequence and comparative analysis. 1991, Gene 102, 171-178.
Cell surface molecules				
IL4Ra	CD124	AY266143 Ssc 55298		Zarlenga DS, Dawson H, Kringel H, Solano-Aguilar G, Urban JF Jr. Molecular cloning of the Swine IL-4 receptor alpha and IL-13 receptor 1-chains: effects of experimental Toxoplasma gondii, Ascaris suum and Trichuris suis infections on tissue mRNA levels. 2004, Vet. Immunol. Immunopathol. 101, 223-234.
IL7Ra	CD127	BP157102		Uenishi H, Eguchi T, Suzuki K, Sawazaki T, Toki D, Shinkai H, Okumura N, Hamasima N, Awata T. PEDE (Pig EST Data Explorer): construction of a database for ESTs derived from porcine full-length cDNA libraries. 2004, Nucleic Acids Res. 32, D484-D488.

Swine Gene	Alternative Name	Previous Acc#	US VIRN Acc#	Related Publication
IL13Ra1	CD213A1	AY266142 Ssc. 17245		Zarlenga DS, Dawson H, Kringel H, Solano-Aguilar G, Urban JF Jr. 2004, Molecular cloning of the Swine IL-4 receptor alpha and IL-13 receptor 1-chains: effects of experimental Toxoplasma gondii, Ascaris suum and Trichuris suis infections on tissue mRNA levels. Vet. Immunol. Immunopathol. 101, 223-234.
CCR7	CD197	AB090356 Ssc. 16629		Shinkai H, Muneta Y, Eguchi T, Suzuki K, Awata T, Uenishi H. Molecular cloning and chromosomal assignment to SSC12p13-->p11 of swine chemokine receptor CCR7. 2003, Cytogenet. Genome Res. 101, 155-160.
CD45RO	PTPRC	AY444871		PARTIAL SEQUENCES: Schnitzlein WM, Zuckermann FA. Defining the isoforms of porcine CD45. In: Schook, L. tumbleson, ME (Eds), Swine in Biomedical Research, Vol. 1, Plenum, NY –345-357.
CXCR3	CD183&182	AJ851240, AK237352 Ssc.45624		Revilla C, Alvarez B, López-Fraga M, Chamorro S, Martínez P, Ezquerra A, Alonso F Domínguez J. Differential expression of chemokine receptors and CD95 in porcine CD4+ T cell subsets. Vet. Immunol. Immunopathol. 106 (3-4), 295-301 (2005); Uenishi H, Eguchi T, Suzuki K, Sawazaki T, Toki D, Shinkai H, Okumura N, Hamasima N, Awata T. PEDE (Pig EST Data Explorer): construction of a database for ESTs derived from porcine full-length cDNA libraries. Nucleic Acids Res. 32 (1): D484-D488 2004
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