Tennessee State University

Digital Scholarship @ Tennessee State University

Agricultural and Environmental Sciences Faculty Research

Department of Agricultural and Environmental Sciences

8-2020

Porcine cytokines, chemokines and growth factors: 2019 update

Harry D. Dawson
USDA, Agricultural Research Service

Yongming Sang
Tennessee State University

Joan K. Lunney
USDA, Agricultural Research Service

Follow this and additional works at: https://digitalscholarship.tnstate.edu/agricultural-and-environmental-sciences-faculty

Part of the Animal Sciences Commons, and the Cell and Developmental Biology Commons

Recommended Citation

Harry D. Dawson, Yongming Sang, Joan K. Lunney, "Porcine cytokines, chemokines and growth factors: 2019 update", Research in Veterinary Science, Volume 131, 2020, Pages 266-300, ISSN 0034-5288, https://doi.org/10.1016/j.rvsc.2020.04.022.

This Article is brought to you for free and open access by the Department of Agricultural and Environmental Sciences at Digital Scholarship @ Tennessee State University. It has been accepted for inclusion in Agricultural and Environmental Sciences Faculty Research by an authorized administrator of Digital Scholarship @ Tennessee State University. For more information, please contact XGE@Tnstate.edu.

Version of Record: https://www.sciencedirect.com/science/article/pii/S0034528819310008
Manuscript_ea8bde89d3e33f2ac0cb9b7b6f44c50d

Porcine cytokines, chemokines and growth factors: 2019 Update

Harry D. Dawson[1] Yongming Sang[2], Joan K. Lunney[3, 4]

[1] USDA, ARS, Beltsville Human Nutrition Research Center, Diet, Genomics & Immunology Laboratory, Beltsville, MD 20705-2350

[2] Department of Agricultural and Environmental Sciences, College of Agriculture, Tennessee State University, Nashville, TN 37209-1561

[3] USDA, ARS, Beltsville Agricultural Research Center, Animal Parasitic Diseases Laboratory, Beltsville, MD 20705-2350

[4]Corresponding author: Joan K. Lunney, Ph.D.
APDL, NEA, ARS, USDA
Building 1040, Room 103, BARC-East
Beltsville, MD 20705 USA
PH: 301-504-9368; FAX: 301-504-5306
email: Joan.Lunney@usda.gov

Highlights

- identified 289 swine cytokine, chemokine, growth factor proteins with detail annotation of their gene names, sequences and superfamilies.
- identified numerous commercial reagents that are reportedly reactive with 170 pig cytokines, chemokines, growth factors: 118 have at least one Ab reagent, 66 a cloned recombinant peptide, and 97 with quantitative assays.

© 2020 published by Elsevier. This manuscript is made available under the Elsevier user license
https://www.elsevier.com/open-access/userlicense/1.0/

- provide the porcine immune community with valuable update on swine cytokines, chemokines and growth factors

Abstract:

Pigs are a major food source worldwide as well as major biomedical models for human physiology and therapeutics. A thorough understanding of porcine immunity is essential to prevent and treat infectious diseases, and develop effective vaccines and therapeutics. The use of pigs as biomedical models is dependent on the growing molecular and immune toolbox. This paper summarizes current knowledge of swine cytokines, chemokines and growth factors, identifying 289 pig proteins, characterizing knowledge of their gene structures and families. It identifies areas in the current swine genome build that need to be clarified. A broad-based literature and vendor search was conducted to identify defined sets of monoclonal and polyclonal antibodies reacting with porcine cytokines, chemokines, growth factors along with availability of cloned recombinant proteins and assays for their quantitation. This process identified numerous reagents that are reportedly reactive with 170 pig cytokines, chemokines, growth factors: 118 have at least one commercial antibody reagent, 66 a cloned recombinant peptide, and 97 with quantitative assays. This affirms the great need to develop and characterize additional reagents. There are panels of reagents for numerous high priority targets that have been essential reagents for characterizing porcine immunity, disease and vaccine responses, and factors regulating development of innate immune responses, polarized macrophages and lymphoid cells including T regulatory cells. Yet there are many areas requiring investment of efforts to more effectively explore the pig immune system. The development of more reagents to understand the complex of cytokines, chemokines, and growth factors will clearly advance these initiatives.

Keywords: cytokines; chemokines; growth factors; immune cell markers; immunity; antibodies

Introduction

A thorough understanding of porcine immunity is essential for a safe and secure food supply, to prevent and treat infectious diseases, develop effective vaccines and therapeutics, and conduct biomedical studies. The "One Health Initiative" promoted by multiple international bodies like the USDA, CDC and WHO (http://www.onehealthinitiative.com), strongly encourages the study of risk factors for human infectious disease in model species like pigs. To do this it is essential to be able to identify the complexity of cellular immune interactions in pigs (Butler et al., 2017; Mair et al., 2014). This is dependent on having an effective molecular and immune toolbox (Entrican and Lunney, 2012).

The sequencing and analysis of the porcine genome (build 10.2) has been published (Groenen et al., 2012) as well as a detailed analyses of the porcine immunome (Dawson et al., 2013), inflammasome (Dawson et al., 2017b) and Cluster of Differentiation (CD) markers (Dawson and Lunney, 2018) . The latest genome build (build 11.1) for the pig can be found at NCBI (https://www.ncbi.nlm.nih.gov/assembly/GCF_000003025.6) or Ensembl (https://useast.ensembl.org/Sus_scrofa/Info/Index). There is a clear orthology of sequences between most human and swine cytokines, chemokines, and growth factors (Dawson et al., 2017a). Immune research is facilitated by international genome nomenclature, Human Genome Organization (HUGO) Gene Nomenclature Committee (HGNC) (https://www.genenames.org/), as has been affirmed for humans by the International Union of Immunological Societies (IUIS). This nomenclature provides a unified designation system for the immune molecules, cytokines,

70 chemokines, and growth factors, and the antibodies (Abs) which recognize them. These rules
71 have been confirmed for use in food animals by the International Society of Animal Genetics
72 (ISAG).
73 Despite the high homology for the orthologous proteins there are limited Abs against human
74 immune proteins that exhibit cross reaction with porcine or other animal species. It is essential
75 for swine immunologists to prepare swine specific reagents, affirm their bioactivity, and clearly
76 confirm experimentally whether an Ab anti cytokine, chemokine, or growth factor is reactive
77 with swine. With this manuscript, we update the swine cytokines, chemokines, and growth
78 factors data based on the published swine genome (*Sus scrofa* 10.2 build, and the refined 11.1
79 swine genome build http://www.ensembl.org/Sus_scrofa/Info/Index). We confirm gene family
80 and superfamily members and update the swine immune toolkit from cataloging cloned
81 expressed proteins, to polyclonal (pAb) and monoclonal Ab (mAb) reactivities, and quantitative
82 assays of their activity.
83
84 **Materials and Methods**
85 A large-scale, multi-species, literature-based analysis was used to identify genes or proteins
86 classified as cytokines, chemokines and growth factors. The ISAG has established that gene
87 nomenclature for relevant food animal species will follow HUGO/HGNC standards set for
88 human gene nomenclature. One to one porcine orthologs of human genes utilize the approved
89 HGNC name based on the ISAG publishing guidelines. Pseudogenes were defined by the criteria
90 used by Ensembl and ENCODE; namely the presence of one or more stop codons in the open
91 reading frame that disrupt the protein structure, and (usually) a lack of intron structure at the
92 genome level (Dawson et al., 2017a). One to one orthology of protein coding genes was

93 determined by protein structure similarity (best reciprocal BLAST hits) and the presence of a
94 corresponding gene in the syntenic region of the human and or mouse genome, e.g., for pig
95 (Dawson et al., 2017a). This data is available online at our curated DGIL Porcine Translational
96 Research database (PTRD, http://tinyurl.com/hxxq3ur). For the CXCL chemokine cluster and
97 the IL1 Superfamily, phylogenetic tree analysis was constructed in Geneious Prime® 2019.0.3
98 software (Biomatters Ltd) using the Jukes–Cantor algorithm, the Blosum62 matrix and the
99 unweighted pair group method using arithmetic means. Inferred evolutionary distance, based
100 upon amino acid substitution rates, is expressed in arbitrary time units.
101
102 **Results and Discussion**
103 This manuscript provides the first, post-genome analysis of knowledge related to porcine
104 cytokines, chemokines, growth factors, and reagents to detect them. We identified 345 genes or
105 pseudogenes that met the definition of a cytokine, chemokine and/or a growth factor in the 3
106 species (mice, pigs and humans). We present data on protein coding porcine orthologs for 289
107 genes. We found splice variants for 138 of these genes and named them according to their human
108 counterparts whenever possible. These variants are found in our online PTRD. Table 1 lists the
109 characteristics, the swine National Center for Biotechnology Information (NCBI) gene ID,
110 Ensembl ID, gene and protein names and the gene families and superfamilies along with issues
111 on current genome map. Table 2 shows the number of family members among the species. Table
112 3 summarizes the gene family membership in pigs. It also updates and corrects several errors
113 from a previous comparison of the mouse and human immune response (Mestas and Hughes,
114 2004). A summation of the major findings follows.

115 There are 44 genes that have been classified as interleukins (ILs) in humans; pigs have 42
116 of these. Interferon (IFN) lambda 2 (IFNL2 or IL-28A) is missing from pigs, IL-37 is a
117 pseudogene In addition to the traditional ILs, pigs have an additional IL-related gene, IL15L.
118 IL15L is a protein-coding gene of unknown function in pigs and cows but not in mice or humans
119 (Dijkstra et al., 2014); in humans it is an expressed pseudogene. Mice are missing several IL-
120 related genes (IL26, IL29 or IFNL1, IFNL4 and IL32); Gm6518 is a mouse paralog of IL28A.
121 Interleukin 10-related T cell-derived inducible factor beta (Iltifb) is a mouse IL22 paralog,
122 present in some strains (C57Bl/6, FVB and 129) of mice (Dumoutier et al., 2000). For
123 undetermined reasons, sequences for porcine IL32 and IL40 (C17orf99) are present in Ensembl
124 and NCBI builds 11.1 but are not annotated as genes. The sequence for porcine IL3 is missing
125 from Ensembl and NCBI builds 11.1 but is present in BioProject PRJNA351265.
126 There are 11 IL1 Superfamily members (IL18, IL1A, IL1B, IL1F10, IL1RN, IL33,
127 IL36A, IL36B, IL36G, IL36RN, IL37) in humans. Determining the exact number of family
128 members in pigs is problematic for several reasons. Sequences for IL36A, IL36B, IL36RN,
129 IL36G and IL1F10 are missing from Ensembl and NCBI build 11.1. Sequences for IL36B,
130 IL36RN and IL36G are absent from BioProject PRJNA480168 (Gilbert, 2019), a *de novo*
131 assembly reconstruction of the genome based on sequences in the NCBI Sequence Read Archive
132 (SRA). The sequence for IL1F10 is absent, and only partial sequences for IL36B, IL36RN,
133 IL36G are present, in BioProject PRJNA351265, which will be used as a basis for the next
134 porcine genome build. Full-length sequences for IL36A and IL3 are present in BioProject
135 PRJNA351265 and BioProject PRJNA480168 (IL36A, HCZ88661.1). There are problems with
136 additional genes that flank the IL1 cluster, PSD4 and PAX8 are not annotated genes in Ensembl

137 build 11. These data emphasize the value of careful manual annotation and assembly of the
138 genome (Dawson et al., 2017a).
139 Through analysis of other unfinished porcine genomes, and sequences from EST and
140 SRA archives, we have determined that pigs have 11 IL1 Superfamily members (IL18, IL1A,
141 IL1B, IL1B2, IL1F10, IL1RN, IL33, IL36A, IL36B, IL36G, IL36RN). In Figure 1, we have
142 reconstructed the IL1 Superfamily cluster of the pig and compared it to mouse and human. IL33,
143 IL1B2 (in pigs) and IL18 are found outside of this cluster (Rivers-Auty et al., 2018). The gene
144 order of the human genes from centromere to telomere is; IL1A, IL1B, IL37, IL36G, IL36A,
145 IL36B, IL36RN, IL1F10, IL1RN in a cluster within a compact 0.50 Mb region (Nicklin et al.,
146 2002). It was previously reported that there are extensive differences between the mouse and
147 human IL1 gene cluster with respect to orientation, size, and intergenic distance (Taylor et al.,
148 2002). The most prominent difference between the human and the pig/mouse cluster, is the
149 presence of a larger intergenic region between the beginning and end of the cluster (Taylor et al.,
150 2002). The pig insertion is somewhat smaller (88.5 Mb) than the mouse (105 Mb) (Figure 1). In
151 addition, the position and order of the pig clusters on either side of the insertion are reversed.
152 Although IL37 is present in cows, sheep, horse, dog and certain members of the order
153 Cetartiodactyla, it is a pseudogene in pigs and mice (Bufler et al., 2002). Pigs have an additional
154 IL1B paralog, IL1B2, that may exist in multiple copies outside the IL1 gene cluster on
155 chromosome 3 (Liu et al., 2018; Mellink et al., 1994), although it appears that the gene is
156 artificially duplicated in both current builds of the genome. This suggests that there were at least
157 4 events that shaped the porcine IL1 locus over time; IL37 pseudogene, inversions of gene order,
158 insertion of the intergenic region, and duplication of IL1B.

159 The most divergent cytokine gene family is the CCL chemokines (Table 1, Figure 2).
160 This divergence is principally because the mouse Ccl19, Ccl21 and Ccl27 genes have diverged
161 into multiple paralogs (Nakano and Gunn, 2001). Mice also possess Ccl12, a chemokine with
162 biological activities and structural similarities (Figure 2) to murine Ccl2 (Sarafi et al., 1997) and
163 Ccl9 (Poltorak et al., 1995). Conversely, CCL16 (Fukuda et al., 1999) and CCL23 (Patel et al.,
164 1997), genes found in pigs and humans, are missing in mice. The sequence for CCL26 is present
165 in mice but is differentially regulated by IL-4/STAT6 than in pig or human CCL26 (Chen et al.,
166 2019). Pigs and cows are missing CCL3 and CCL7, chemokines found in mouse and humans.
167 The gene for CCL3L1 in the pig has more similarity to human CCL3 mRNA but the porcine
168 protein has more homology to human CCL3L1 (Figure 2). Pigs also have CCL3L2, present in
169 certain other Artiodactyls (*Bos taurus*, *Bos indicus*, *Capra hircus*, *Bison bison*). There are several
170 human only CCL family members (CCL13, CCL15, CCL18, CCL3L3, CCL4L1, CCL4L2).
171 There is better preservation among CXL chemokines among the species (Table 1, Figures
172 3 and 4). There are a few exceptions; human chemokine, PF4V1, arose as a primate-specific
173 gene duplication (Dubrac et al., 2010). CXCL6 and CXCL8 (IL8) are missing from the mouse
174 whereas Cxcl15 is a mouse-specific chemokine with biological activities similarity to IL8 (Rossi
175 et al., 1999). Pigs lack CXCL5. The orthology of the porcine chemokine, first described as
176 alveolar macrophage chemotactic factor-2 (AMCF-2) was definitively assigned as CXCL6 based
177 upon positioning and greater RNA similarity to human CXCL6 although the porcine protein
178 sequence has greater similarity to human CXCL5. This indicates that the gene continued to
179 evolve, post-speciation. The presence and nomenclature of the pig CXCL1, CXCL2, and CXCL3
180 cluster was definitively resolved based upon genomic position relative to the human and mouse
181 CXCL1, CXCL2, and CXCL3 genes (Figure 3). This was especially problematic for several

182 reasons. First, they share more sequence identity within species rather than between species.
183 Next, although Ensembl locus ENSSSCG00000008954 contains sequences for CXCL1
184 (transcript ENSSSCT00000061347.1) and CXCL2 (transcript ENSSSCT00000034640.2),
185 transcripts ENSSSCT00000040395.1, ENSSSCT00000061620.1 and ENSSSCT00000044770.1
186 are chimeric. In the previous version of the genome (build 10.2), these were classified as separate
187 genes. Last, CXCL3 is present in both builds of the genome but is not annotated as a protein-
188 coding gene. A comparative map of the pig, mouse and human CXCL locus is presented in
189 Figure 4.

190 Swine genome build 10.2 revealed 57 potential IFN-coding genes and 16 pseudogenes of
191 type I IFNs (Sang et al., 2014). Further curation of these 57 functional IFN genes indicated that
192 they include 18 potential artifactual duplicates (Sang et al., 2014). Herein we update the number
193 and nomenclature of porcine type I and type III IFNs to 45 potential IFN-coding genes and 18
194 pseudogenes in build 11.1. These IFN-coding genes include 41 non-redundant type I IFNs (i.e.
195 16 IFNA, 11 IFND, 8 IFNW, 1 of each IFNAW, IFNB, IFNE, and IFNK) and 4 distinct type III
196 IFNs (IFNL1, 3, 3L and 4). Pigs are missing IFNL2/IL28A, present in humans and rodents. Pigs
197 and certain species of Cetartiodactyla (cow, ovine, sheep and dolphin), also express an IFNL3
198 paralog of unknown function, IFNL3L*. IFNL4, a type-III IFN found in humans and pigs, is a
199 pseudogene in rodents (Paquin et al., 2016). Notably, in addition to the 18 pseudogenes that
200 contain predicated in-frame stop codons or coding truncations, there also exist three IFN-coding
201 genes (one IFNA and two IFND genes) that are predicated to encoding "low quality proteins",
202 indicating possible protein-altering mismatches or indels in the genome sequence to decoding
203 corresponding peptide sequences. Collectively, our previous and updated assessments on porcine
204 IFN gene family, particularly its type I IFN group, consistently indicate a rapid expansion

205 process in porcine type I IFN evolution, which is well manifested by the significant subtype and
206 isoform specification as well as active emerging of multiple pseudogenes due to natural plus
207 artificial selection in the domestic pigs (Shields et al., 2019).

208 Another ambiguous orthology assignment is that of the adipocytokine, intelectin 1
209 (ITLN1) or omentin. The sequence (EU652941.1) deposited in GenBank and annotated as
210 omentin is actually ITLN2. Liao et al (2007) described intestinal mRNA expression of the
211 putative ITNL1 gene in pigs as a function of age; but the sequence that was used was ITNL2.
212 Wrackmeyer et al. (Wrackmeyer et al., 2006) demonstrated staining of pig intestine with a pAb
213 raised to human ITNL1 but the specificity of this preparation has never been demonstrated. The
214 ITNL genes arose by duplication and are highly homologous. In all species (human, bovine,
215 ovine, murine) where they have been described, ITNL1 and ITNL2 differ in sequence at their C-
216 terminus; ITNL1 is shorter than ITNL2 (313 vs. 325 amino acids in humans). There are 4
217 identified ITNL2-related genes in pigs on chromosome 4 that are merged into one Ensembl loci
218 (ENSSSCG00000025885) but all have the same C-terminus and length and greater homology to
219 ITNL2 than ITNL1.

220 Eighty-six additional genes had errors in assembly and/or annotation (Table 1). There are
221 multiple reasons for this. Our unpublished analysis of the Ensembl and NCBI builds 11.1
222 indicated that there is, on average, an indel every 10,700 bp. NCBI uses the short read archive,
223 transcriptome shotgun assembly and expressed sequence tag databases, as well as sequences
224 from other species, to calculate the correct RNA and protein lengths; however, it indicates the
225 position of the indel with a generic placeholder (N for nucleotides, X for amino acids). As a
226 result, proteins in NCBI build 11.1 are labelled low quality. Although they are usually of the
227 correct size, NCBI does not provide splice variant data for low-quality proteins. Because most

228 porcine cytokines, chemokines and growth factors are transcribed from relatively short RNA,
229 they are less susceptible to the indel issue. Nevertheless, we discovered 13 genes that are
230 annotated as "low quality" in the NCBI genome build 11.1. Because Ensembl does not use SRA,
231 TSA and EST libraries to interpolate missing nucleotides, genes with indels in the open reading
232 frame are often truncated due to a premature stop codon. Although NCBI's use of a placeholder
233 to provide what is thought to be missing information is useful, as in the case of the Type 1 IFNs,
234 where several authentic pseudogenes are annotated as low-quality proteins (IFND4Ps*) or
235 truncated proteins (IFNA14Ps*, IFND2Ps1*, IFND9Ps* in Ensembl build 11.1. Last, sequences
236 for porcine C1QTNF5 and PDGFB, are present in Ensembl and/or NCBI build 11.1, but are not
237 annotated as protein-coding genes.

238 Table 4 presents an incredible variety of products that are commercially available for
239 swine immunity studies. (These data can be found online in the PTRD;
240 http://tinyurl.com/hxxq3ur). For many of the IFNs and ILs there are expressed recombinant (R)
241 proteins to test reactivity of those proteins in immune responses. There are also panels of specific
242 mAbs and pAbs to identify expression of these products with notations as to the assays for which
243 they have proven reactive, from flow cytometry (FC), Western blot (WB), immunohistochemistry
244 (IHC), neutralizing (N) or blocking (Bl) bioactivity. It cannot be assumed that Abs reactive in WB
245 will be positive in FC or IHC; each of these must be confirmed for each mAb or batch of pAb.
246 Based on partial or unknown immunogen sequence we have identified another set of predicted
247 cross reactive antibodies, including potential reagents for 32 immune proteins (Table 4). Finally,
248 there are ELISAs and multiplex bead assays to quantitate amounts of each product produced in
249 vivo or in vitro. Sensitivity of these assays is a major factor, especially for levels in bodily fluids.

250 It is essential to affirm whether assays are sensitive enough to measure background, pre-infection
251 levels of these highly regulated immune proteins in in vivo fluids.
252 The data in Table 4 reflect the substantial increase in products for swine immunity. Yet there
253 are substantial holes in this repertoire. For recombinant proteins, there are few that are produced
254 using mammalian expression, most were expressed using bacteria (*E. coli,* Ec) or yeast (*Pichia*
255 *pastoris*, Pp). Moreover, many of those expressed products are not the full amino acid sequence
256 but a selected, likely bioactive, peptide. Tests of bioreactivity of cloned human proteins
257 infrequently shows cross reactivity on swine cells. Scans for reactivity of mAb anti-human
258 immune proteins typically have been negative with their swine orthologues. Table 4 notes
259 instances of such lack of cross reactivity. Thus, much more effort is needed to enhance and
260 complete the swine immune toolkit.
261 When we look closely at individual family members, we note the broad representation of IL
262 products: 23 of 29 identified porcine ILs have at least one mAb/pAb reagent, with 15 having
263 assays for their quantitation, and 21with recombinant (R) peptides available commercially (Table
264 4). This reflects the importance of reagents for measuring innate immune responses, i.e., the role
265 of IL1b, IL6, IL10, IL12, CXCL8 (IL8). For CCL chemokines 22 genes have been identified
266 (Table 4) with only 8 having at least one mAb/pAb reagent, 3 with assays for their quantitation,
267 and 10 with R peptides available commercially. Numbers of reagents for CXCL chemokines are
268 even lower; 16 genes have been identified with only 6 having at least one mAb/pAb reagent, 3
269 with assays for their quantitation and 6 with R peptides available commercially.
270 The high homology of certain IFNs, e.g., IFNAs, make it difficult to verify exactly which
271 gene product has highest bioactivity or whether unique IFNs are expressed with different
272 infectious or vaccination challenges. Our efforts to produce IFNA gene specific mAbs were not

273 successful (J Lunney, B Wagner, personal communication). Assessment of mRNAs indicated
274 differential induction of these genes by various stimuli (Krishna et al., 2015; Sang et al., 2014).
275 Current US UK toolkit efforts are aimed at producing anti-IFNλ3 (IL28B) mAbs (J Lunney,
276 personal communication). There are increasing numbers of reagents for type 1 and Treg
277 cytokines, with type 2 cytokine reagents still in process. Indeed, current toolkit efforts have
278 produced panels of anti-IL13 and IL17A mAbs (Table 4). Characterization of these mAbs is well
279 underway.

280 In addition to the characterized antibodies and assays, a large number of porcine proteins
281 (ANGPT1, ANGPTL2, BDNF, BMP1, BMP2, BMP4, BMP5, BMP7 BMP10, CLCF1, CRLF1,
282 C1QTNF3, C1QTNF5, CXCL14, EDA, FGF1, FGF2, FGF4, FGF6, FGF7, FGF8, FGF9,
283 FGF10, FGF11, FGF12, FGF13, FGF16, FGF17, FGF18, FGF20, GDF5, GDF11, GDNF, HGF,
284 HMGB1, IGF1, IK, IL17B, INHBB, MDK, MIF, MSTN, NAMPT, NGF, NRG1, NRG2, NRG3,
285 NRTN, NTF3, PDGFB, PDGFC, PGF, PTN, RBP4, SFRP1, SFRP2, SFRP5, TGFA, TGFB1,
286 TGFB2, TGFB3, THBS1, TMEFF2, MSANTD3-TMEFF1, TNFSF12, TPT1, VEGFA, VEGFB,
287 WNT2) exhibit 95-100% sequence similarity with the corresponding human protein and, thus, it
288 is expected that the human protein will be active on porcine cells. Moreover, antibodies and
289 assays to the human protein are likely to be cross reactive with the pig protein. In addition to
290 reagents to measure protein levels, we also developed or discovered in the cited literature, 128
291 SYBR green and 164 Taqman real-time PCR assays for these genes. The sequences for these are
292 located in our online PTRD.
293

294 **Conclusion**

295 In conclusion, we have assembled a comprehensive resource for porcine immunologists
296 and members of human biomedical community, providing documentation of known pig
297 cytokines, chemokines, and growth factors. Through extensive analysis of porcine genome builds
298 10.2 and 11.1, BioProjects and NCBI SRA have been used to verify expressed pig genes and
299 pseudogenes as well as genes missing in the pig genome. Comparisons of pig gene sequences to
300 human and mice data have revealed evolutionary relationships. Finally, a thorough literature and
301 web review has been performed to identify proven reagents: expressed cloned proteins,
302 antibodies reactive with each gene product and their proven reactivity to identify protein
303 expression or assay bioactivity. Despite the progress to date, much more work needs to be done.
304 A fully annotated genome build is an essential basic need. Review of our tables verifies that
305 there are many cytokines, chemokines, growth factors for which needed reagents are missing.
306 Overall, there has been major progress in understanding pig immunity and development using
307 current tools, however, there are still numerous opportunities to improve the swine immune
308 toolkit.
309
310 **Disclaimer**
311 The USDA cannot guarantee the performance any PCR assays or Abs that have not been tested
312 in our labs or under conditions not specified in the published literature. We have tried to be as
313 complete as possible in our reagent review; however, there may be alternative vendors for the
314 reagents mentioned. Some vendors were omitted because we could not verify the information on
315 their website or their immunogen sequence was not sufficiently homologous. Mention of trade
316 names or commercial products in this publication is solely for the purpose of providing specific
317 information and does not imply recommendation or endorsement by the USDA.

Acknowledgements

This work was supported by the USDA ARS projects 8040 51000 058 (HD) and 8042 32000 102 (JL) and USDA NIFA US UK Swine toolkit grant #2015-67015-23216. The authors would like to acknowledge their colleagues worldwide who have contributed to swine immune protein assignments through international toolkit workshops supported by the international Union of Immunological Societies (IUIS) Veterinary Immunology Committee (VIC).

Figure Legends

Figure 1. Comparison of the Pig, Mouse and Human IL1 Superfamily Genomic Loci. Human and mouse gene position locations used in constructing the tree were derived from the full-length sequences from their respective genomes (GRCh38.p13 and GRCm38.p6). Porcine sequences, found in our PTRD (build 09/03/19), were mapped to the NCBI sequence from chromosome 3 NPJO01000009.1 derived from BioProject PRJNA392765. Gene orientation is indicated by directional arrows.

Figure 2 Evolutionary relationship of Pig, Mouse and Human CCL chemokines. Phylogenetic tree analysis was constructed in Geneious Prime® 2019.0.3 software (Biomatters Ltd) using the Jukes–Cantor algorithm, the Blosum62 matrix and the unweighted pair group method using arithmetic means. Inferred evolutionary distance, based upon amino acid substitution rates and expressed in arbitrary time units, is shown. Human and mouse protein sequences used in constructing the tree were derived from the full-length sequences from their

340 respective genomes (GRCh38.p13 and GRCm38.p6). Porcine sequences can be found in our
341 PTRD (build 09/03/19).
342
343 **Figure 3 Evolutionary Relationship of Pig, Mouse and Human CXCL Chemokines.**
344 Phylogenetic tree analysis was constructed in Geneious Prime® 2019.0.3 software (Biomatters
345 Ltd) using the Jukes–Cantor algorithm, the Blosum62 matrix and the unweighted pair group
346 method using arithmetic means. Inferred evolutionary distance, based upon amino acid
347 substitution rates and expressed in arbitrary time units, is shown. Human and mouse protein
348 sequences used in constructing the tree were derived from the full-length sequences from their
349 respective genomes (GRCh38.p13 and GRCm38.p6). Porcine sequences can be found in our
350 PTRD (build 09/03/19).
351
352 **Figure 4 Comparison of the Pig, Mouse and Human CXCL1-3 Genomic Loci**. Human and
353 mouse gene position locations used in constructing the tree were derived from the full-length
354 sequences from their respective genomes (GRCh38.p13 and GRCm38.p6). Porcine sequences,
355 found in our PTRD (build 09/03/19) were mapped to NCBI sequence NC_010447.4 derived
356 from BioProject PRJNA28993 build 11.1. Gene orientation is indicated by directional arrows.
357
358 **Table Legends**
359 **Table 1. Major annotation characteristics of porcine cytokines, chemokines and growth**
360 **factors in current Swine Genome Assembly (Sscrofa 11.1).** Data was last collected on
361 September 25, 2019 from Sus scrofa 11.1 build http://www.ensembl.org/Sus_scrofa/Info/Index.

362 Details of analyses are based on Dawson et al., (2017 a,b) and presented in Materials and
363 Methods and in the PTRD (http://tinyurl.com/hxxq3ur).
364
365 **Table 2. The number of family members of cytokines, chemokines and growth factors**
366 **among the species.** Families and superfamilies were assigned based on HGNC Guidelines. More
367 details can be found in our PTRD http://tinyurl.com/hxxq3ur.
368
369 **Table 3. The gene family membership of cytokines, chemokines and growth factors in pigs.**
370 Families and superfamilies were assigned based on HGNC Guidelines. More details can be
371 found in our PTRD http://tinyurl.com/hxxq3ur.
372
373 **Table 4. Research products that are commercially available for swine immunity studies.**
374 Reactivities of mAbs and pAbs are noted: B Blocking; ELISA; FC flow cytometry
375 immunostaining; IF Immunofluorescence; IHC immunohistochemistry; IP immunoprecipitation;
376 N neutralizing Ab; WB Western blot. Other abbreviations: aa amino acids; bo bovine; h human;
377 po porcine; m murine; r rat; BMP Bone Morphogenetic Protein; CSF Colony stimulating factor;
378 GF growth factor; Ec E. coli; IFN interferon; IL Interleukin; mAb monoclonal antibody; mamm
379 Mammalian expressed recombinant protein; NGF Nerve growth factor; pAb polyclonal antibody;
380 pers comm personal communication; Pp Pichia pastoris (yeast); R Recombinant; SCGF Stem cell
381 growth factor; TGF transforming growth factor; TNF Tumor necrosis factor; VEGF Vascular
382 Endothelial Growth Factor; WB Western blot. Sources of products: Abbexa www.abbexa.com/;
383 AbCam https://www.abcam.com; Abnova www.abnova.com; Advanced BioChemicals
384 advancedbiochemicals.com; Aviva Systems Biology www.avivasysbio.com; BD Biosciences

385 Pharmingen http://www.bdbiosciences.com; Biosensis www.biosensis.com; BioVendor
386 www.biovendor.com/; Bertin Bioreagent www.bertin-bioreagent.com; BioLegend
387 www.biolegend.com; Biomatik www.biomatik.com; BioRad Serotec https://www.bio-rad-
388 Abs.com; Bosterbio www.bosterbio.com; Cell Signaling Technology
389 https://www.cellsignal.com/; Cell Sciences https://www.cellsciences.com; Creative Biolabs
390 www.antibody-creativebiolabs.com; Creative Diagnostics http://www.creative-diagnostics.com;
391 EMD Millipore www.emdmillipore.com; Eve Technologies https://www.evetechnologies.com;
392 Fisher Scientific (Chemicon) www.fishersci.com; Fitzgerald Industries www.fitzgerald-fii.com;
393 Gene-Tech Laboratories www.genetechlab.com; Genorise www.genorise.com; GenWay Biotech
394 www.genwaybio.com; IBI Scientific www.ibisci.com; Kingfisher Biotech, Inc.
395 http://www.kingfisherbiotech.com; Gentaur https://gentaur.com; LifeSpan Biosciences
396 https://www.lsbio.com/; Novus Biologicals https://www.novusbio.com/; R&D Systems
397 http://www.rndsystems.com/; OriGene Technologies (Acris) https://www.origene.com/;
398 Milllipore Sigma http://www.sigmaaldrich.com/; ProSpec www.prospecbio.com; Proteintech
399 www.ptglab.com; RayBiotech www.raybiotech.com; Rockland Immunochemicals
400 www.rockland-inc.com; Santa Cruz Biotechnology www.scbt.com; Southern Biotech
401 http://www.southernbiotech.com; Thermo Fisher (eBioscience; Lab Vision; Pierce)
402 https://www.thermofisher.com/; Tridelta Development Ltd www.trideltaltd.com; US Biological
403 https://www.usbio.net.
404

405 **References**

406 Bufler, P., Azam, T., Gamboni-Robertson, F., Reznikov, L.L., Kumar, S., Dinarello, C.A., Kim,
407 S.H., 2002. A complex of the IL-1 homologue IL-1F7b and IL-18-binding protein reduces

408 IL-18 activity. Proceedings of the National Academy of Sciences of the United States of
409 America 99, 13723-13728.
410 Butler, J.E., Wertz, N., Sinkora, M., 2017. Antibody repertoire development in swine. Annual
411 review of animal biosciences. 5, 255-279.
412 Chen, C., Perry, T.L., Chitko-McKown, C.G., Smith, A.D., Cheung, L., Beshah, E., Urban, J.F., Jr.,
413 Dawson, H.D., 2019. The regulatory actions of retinoic acid on M2 polarization of
414 porcine macrophages. Developmental and comparative immunology 98, 20-33.
415 Dawson, H.D., Chen, C., Gaynor, B., Shao, J., Urban, J.F., Jr., 2017a. The porcine translational
416 research database: a manually curated, genomics and proteomics-based research
417 resource. BMC genomics 18, 643.
418 Dawson, H.D., Loveland, J.E., Pascal, G., Gilbert, J.G., Uenishi, H., Mann, K.M., Sang, Y., Zhang,
419 J., Carvalho-Silva, D., Hunt, T., Hardy, M., Hu, Z., Zhao, S.H., Anselmo, A., Shinkai, H., Chen,
420 C., Badaoui, B., Berman, D., Amid, C., Kay, M., Lloyd, D., Snow, C., Morozumi, T., Cheng,
421 R.P., Bystrom, M., Kapetanovic, R., Schwartz, J.C., Kataria, R., Astley, M., Fritz, E., Steward,
422 C., Thomas, M., Wilming, L., Toki, D., Archibald, A.L., Bed'Hom, B., Beraldi, D., Huang, T.H.,
423 Ait-Ali, T., Blecha, F., Botti, S., Freeman, T.C., Giuffra, E., Hume, D.A., Lunney, J.K.,
424 Murtaugh, M.P., Reecy, J.M., Harrow, J.L., Rogel-Gaillard, C., Tuggle, C.K., 2013. Structural
425 and functional annotation of the porcine immunome. BMC genomics 14, 332.
426 Dawson, H.D., Lunney, J.K., 2018. Porcine cluster of differentiation (CD) markers 2018
427 update. Research in veterinary science 118, 199-246.
428 Dawson, H.D., Smith, A.D., Chen, C., Urban, J.F., Jr., 2017b. An in-depth comparison of the
429 porcine, murine and human inflammasomes; lessons from the porcine genome and
430 transcriptome. Veterinary microbiology 202, 2-15.

431 Dijkstra, J.M., Takizawa, F., Fischer, U., Friedrich, M., Soto-Lampe, V., Lefevre, C., Lenk, M.,
432 Karger, A., Matsui, T., Hashimoto, K., 2014. Identification of a gene for an ancient
433 cytokine, interleukin 15-like, in mammals; interleukins 2 and 15 co-evolved with this
434 third family member, all sharing binding motifs for IL-15Ralpha. Immunogenetics 66,
435 93-103.
436 Dubrac, A., Quemener, C., Lacazette, E., Lopez, F., Zanibellato, C., Wu, W.G., Bikfalvi, A., Prats,
437 H., 2010. Functional divergence between 2 chemokines is conferred by single amino
438 acid change. Blood 116, 4703-4711.
439 Dumoutier, L., Van Roost, E., Ameye, G., Michaux, L., Renauld, J.C., 2000. IL-TIF/IL-22:
440 genomic organization and mapping of the human and mouse genes. Genes and
441 immunity 1, 488-494.
442 Entrican, G., Lunney, J.K., 2012. Veterinary Immunology Committee Toolkit Workshop
443 2010: progress and plans. Veterinary immunology and immunopathology 148, 197-201.
444 Fukuda, S., Hanano, Y., Iio, M., Miura, R., Yoshie, O., Nomiyama, H., 1999. Genomic
445 organization of the genes for human and mouse CC chemokine LEC. DNA Cell Biol 18,
446 275-283.
447 Gilbert, D.G., 2019. Genes of the pig, Sus scrofa, reconstructed with EvidentialGene. PeerJ 7,
448 e6374.
449 Groenen, M.A., Archibald, A.L., Uenishi, H., Tuggle, C.K., Takeuchi, Y., Rothschild, M.F., Rogel-
450 Gaillard, C., Park, C., Milan, D., Megens, H.J., Li, S., Larkin, D.M., Kim, H., Frantz, L.A.,
451 Caccamo, M., Ahn, H., Aken, B.L., Anselmo, A., Anthon, C., Auvil, L., Badaoui, B., Beattie,
452 C.W., Bendixen, C., Berman, D., Blecha, F., Blomberg, J., Bolund, L., Bosse, M., Botti, S.,
453 Bujie, Z., Bystrom, M., Capitanu, B., Carvalho-Silva, D., Chardon, P., Chen, C., Cheng, R.,

454 Choi, S.H., Chow, W., Clark, R.C., Clee, C., Crooijmans, R.P., Dawson, H.D., Dehais, P., De
455 Sapio, F., Dibbits, B., Drou, N., Du, Z.Q., Eversole, K., Fadista, J., Fairley, S., Faraut, T.,
456 Faulkner, G.J., Fowler, K.E., Fredholm, M., Fritz, E., Gilbert, J.G., Giuffra, E., Gorodkin, J.,
457 Griffin, D.K., Harrow, J.L., Hayward, A., Howe, K., Hu, Z.L., Humphray, S.J., Hunt, T.,
458 Hornshoj, H., Jeon, J.T., Jern, P., Jones, M., Jurka, J., Kanamori, H., Kapetanovic, R., Kim, J.,
459 Kim, J.H., Kim, K.W., Kim, T.H., Larson, G., Lee, K., Lee, K.T., Leggett, R., Lewin, H.A., Li, Y.,
460 Liu, W., Loveland, J.E., Lu, Y., Lunney, J.K., Ma, J., Madsen, O., Mann, K., Matthews, L.,
461 McLaren, S., Morozumi, T., Murtaugh, M.P., Narayan, J., Nguyen, D.T., Ni, P., Oh, S.J.,
462 Onteru, S., Panitz, F., Park, E.W., Park, H.S., Pascal, G., Paudel, Y., Perez-Enciso, M.,
463 Ramirez-Gonzalez, R., Reecy, J.M., Rodriguez-Zas, S., Rohrer, G.A., Rund, L., Sang, Y.,
464 Schachtschneider, K., Schraiber, J.G., Schwartz, J., Scobie, L., Scott, C., Searle, S., Servin, B.,
465 Southey, B.R., Sperber, G., Stadler, P., Sweedler, J.V., Tafer, H., Thomsen, B., Wali, R.,
466 Wang, J., Wang, J., White, S., Xu, X., Yerle, M., Zhang, G., Zhang, J., Zhang, J., Zhao, S.,
467 Rogers, J., Churcher, C., Schook, L.B., 2012. Analyses of pig genomes provide insight into
468 porcine demography and evolution. Nature 491, 393-398.
469 Krishna, V.D., Roach, E., Zaidman, N.A., Panoskaltsis-Mortari, A., Rotschafer, J.H., O'Grady,
470 S.M., Cheeran, M.C., 2015. Differential induction of type I and type III Interferons by
471 swine and human origin H1N1 influenza A viruses in porcine airway epithelial cells.
472 PloS one 10, e0138704.
473 Liao Y1, Lopez V, Shafizadeh TB, Halsted CH, Lönnerdal B. 2007. Cloning of a pig homologue
474 of the human lactoferrin receptor: expression and localization during intestinal maturation in
475 piglets. Comp Biochem Physiol A Mol Integr Physiol. 148,584-90.

476 Liu, J.L., Zhao, M., Zhang, W.Q., Huang, M.Y., 2018. Expansion of the IL1B gene family in the
477 pig. Proceedings of the National Academy of Sciences of the United States of America
478 115, E5843-E5844.
479 Mair, K.H., Sedlak, C., Kaser, T., Pasternak, A., Levast, B., Gerner, W., Saalmuller, A.,
480 Summerfield, A., Gerdts, V., Wilson, H.L., Meurens, F., 2014. The porcine innate immune
481 system: an update. Developmental and comparative immunology 45, 321-343.
482 Mellink, C., Lahbib-Mansais, Y., Yerle, M., Gellin, J., 1994. Mapping of the regulatory type I
483 alpha and catalytic beta subunits of cAMP-dependent protein kinase and interleukin 1
484 alpha and 1 beta in the pig. Mammalian genome : official journal of the International
485 Mammalian Genome Society 5, 298-302.
486 Mestas, J., Hughes, C.C., 2004. Of mice and not men: differences between mouse and human
487 immunology. Journal of immunology 172, 2731-2738.
488 Nakano, H., Gunn, M.D., 2001. Gene duplications at the chemokine locus on mouse
489 chromosome 4: multiple strain-specific haplotypes and the deletion of secondary
490 lymphoid-organ chemokine and EBI-1 ligand chemokine genes in the plt mutation.
491 Journal of immunology 166, 361-369.
492 Nicklin, M.J., Barton, J.L., Nguyen, M., FitzGerald, M.G., Duff, G.W., Kornman, K., 2002. A
493 sequence-based map of the nine genes of the human interleukin-1 cluster. Genomics 79,
494 718-725.
495 Paquin, A., Onabajo, O.O., Tang, W., Prokunina-Olsson, L., 2016. Comparative functional
496 analysis of 12 mammalian IFN-lambda4 orthologs. Journal of interferon & cytokine
497 research : the official journal of the International Society for Interferon and Cytokine
498 Research 36, 30-36.

499 Patel, V.P., Kreider, B.L., Li, Y., Li, H., Leung, K., Salcedo, T., Nardelli, B., Pippalla, V., Gentz, S.,
500 Thotakura, R., Parmelee, D., Gentz, R., Garotta, G., 1997. Molecular and functional
501 characterization of two novel human C-C chemokines as inhibitors of two distinct
502 classes of myeloid progenitors. The Journal of experimental medicine 185, 1163-1172.
503 Poltorak, A.N., Bazzoni, F., Smirnova, II, Alejos, E., Thompson, P., Luheshi, G., Rothwell, N.,
504 Beutler, B., 1995. MIP-1 gamma: molecular cloning, expression, and biological activities
505 of a novel CC chemokine that is constitutively secreted in vivo. J Inflamm 45, 207-219.
506 Rivers-Auty, J., Daniels, M.J.D., Colliver, I., Robertson, D.L., Brough, D., 2018. Redefining the
507 ancestral origins of the interleukin-1 superfamily. Nature communications 9, 1156.
508 Rossi, D.L., Hurst, S.D., Xu, Y., Wang, W., Menon, S., Coffman, R.L., Zlotnik, A., 1999. Lungkine,
509 a novel CXC chemokine, specifically expressed by lung bronchoepithelial cells. Journal
510 of immunology 162, 5490-5497.
511 Sang, Y., Bergkamp, J., Blecha, F., 2014. Molecular evolution of the porcine type I interferon
512 family: subtype-specific expression and antiviral activity. PloS one 9, e112378.
513 Sarafi, M.N., Garcia-Zepeda, E.A., MacLean, J.A., Charo, I.F., Luster, A.D., 1997. Murine
514 monocyte chemoattractant protein (MCP)-5: a novel CC chemokine that is a structural
515 and functional homologue of human MCP-1. The Journal of experimental medicine 185,
516 99-109.
517 Shields, L.E., Jennings, J., Liu, Q., Lee, J., Ma, W., Blecha, F., Miller, L.C., Sang, Y., 2019. Cross-
518 species genome-wide analysis reveals molecular and functional diversity of the
519 unconventional interferon-omega subtype. Frontiers in immunology 10, 1431.
520 Taylor, S.L., Renshaw, B.R., Garka, K.E., Smith, D.E., Sims, J.E., 2002. Genomic organization of
521 the interleukin-1 locus. Genomics 79, 726-733.

522 Wrackmeyer, U., Hansen, G.H., Seya, T., Danielsen, E.M., 2006. Intelectin: a novel lipid raft-
523 associated protein in the enterocyte brush border. Biochemistry 45, 9188-9197.

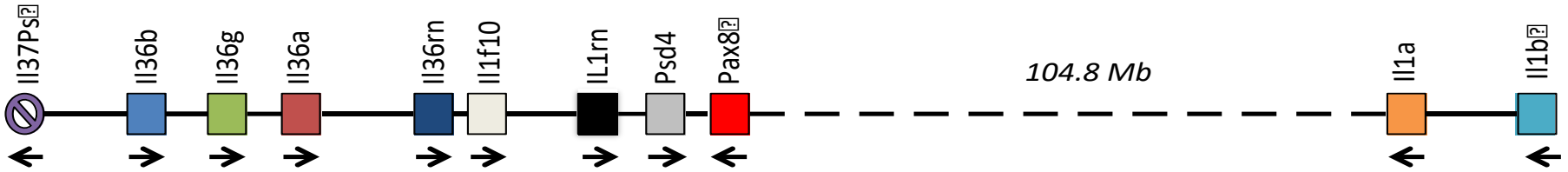
524

Mouse

105.2 Mb

Chr 2, NC_000068.7

24137253-129371164

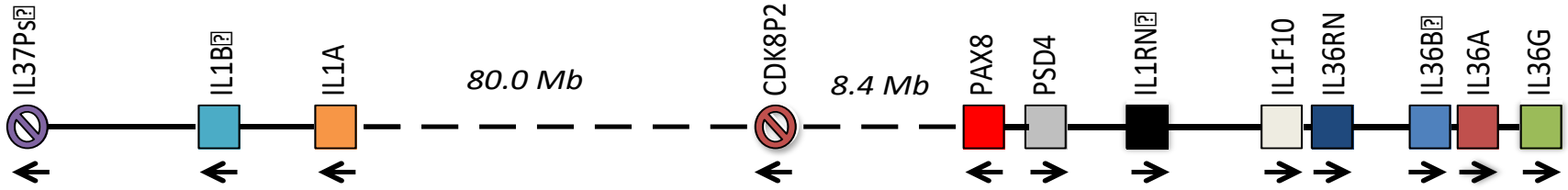


Pig

88.5 Mb

Chr 3, NPJO01000009.1

42733449-131240783

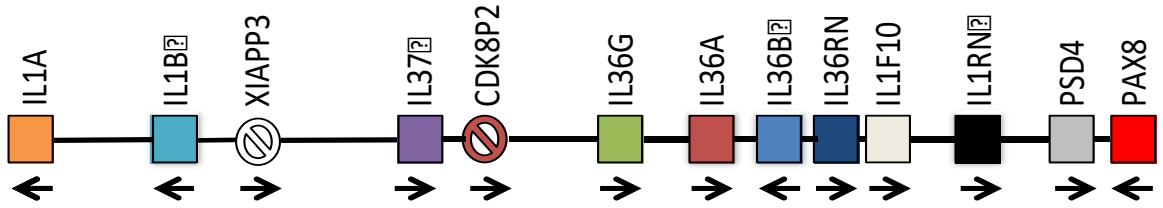


Human

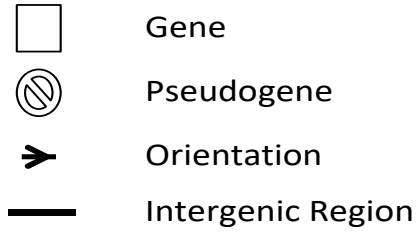
0.50 Mb

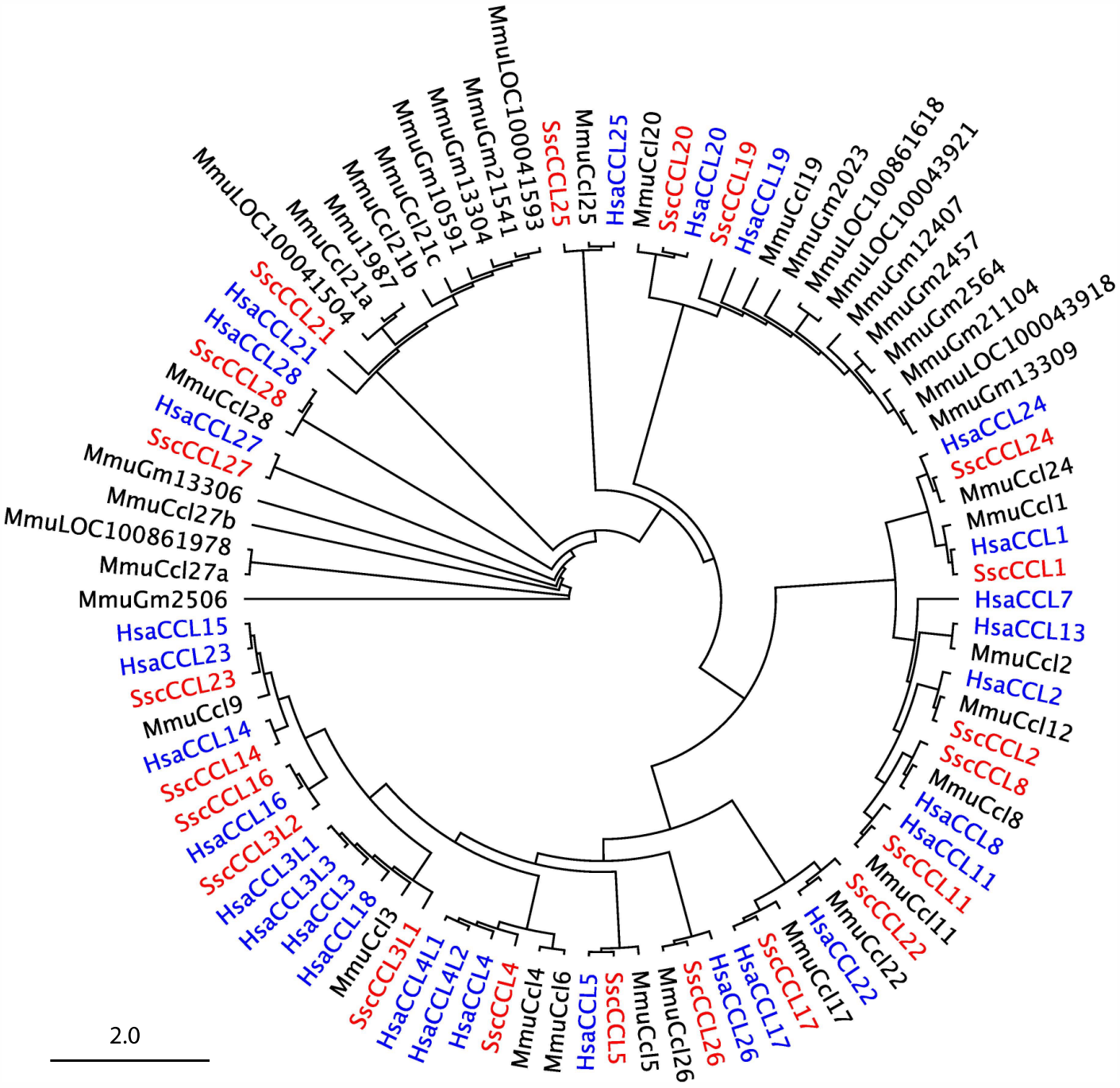
Chr 2, NC_000002.12

73740569-77611834



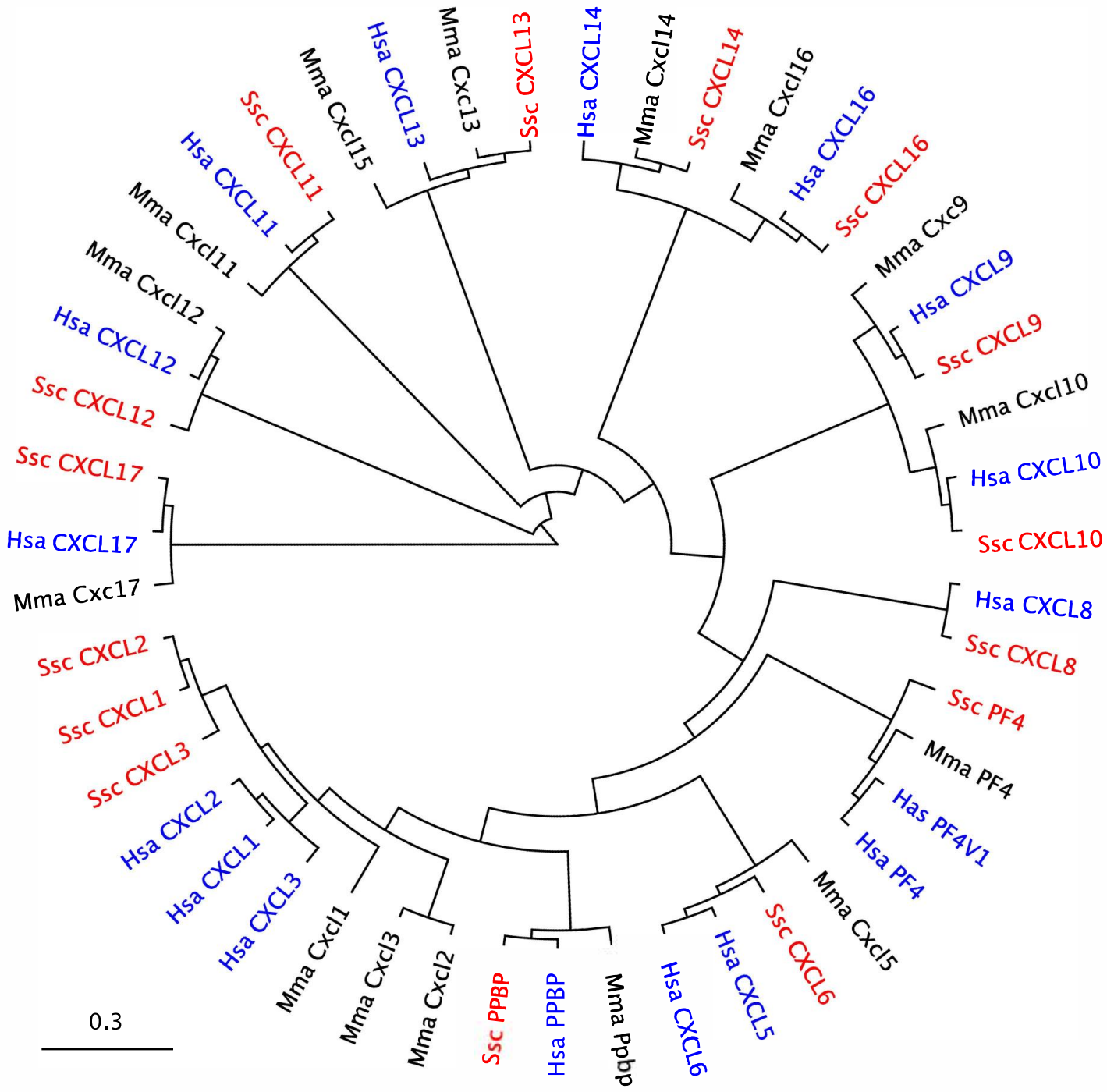
Key





Key

Human = blue
Mouse = black
Pig = red

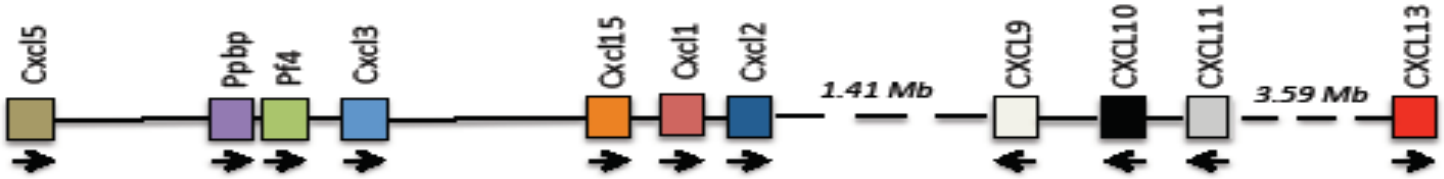


Key

Human = blue
Mouse = black
Pig = red

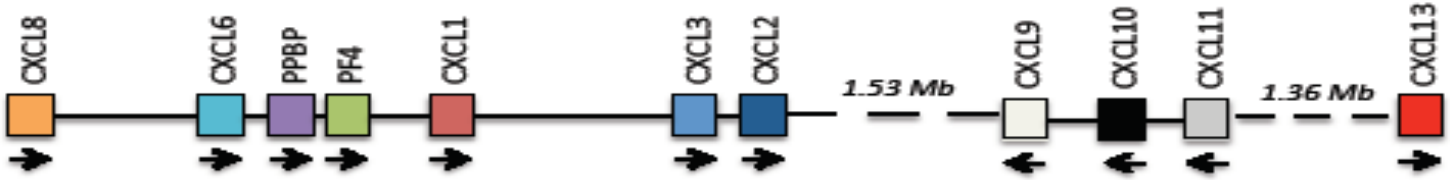
Mouse

5.20 Mb
NC_000071.6
90759298--95961068



Pig

3.14 Mb
NC_010450.4
69932583-73077340



Key

- Gene
- Pseudogene
- Orientation
- Intergenic Region

Human

3.87 Mb
NC_000004.12
73740569-77611834

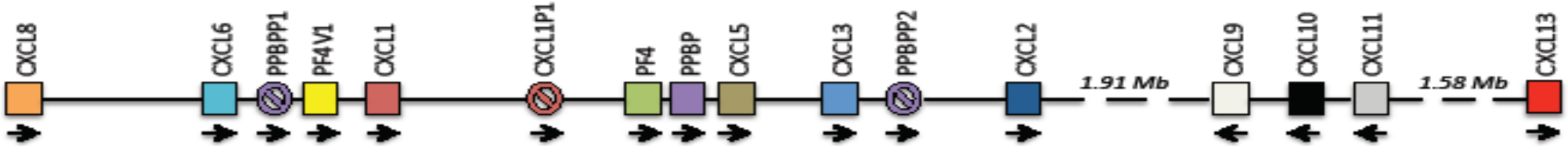


Table 1. Major annotation characteristics of porcine cytokines, chemokines and growth factors in current Swine Genome Assembly (Sscrofa 11.1, Ensembl release 98).

Gene Symbol	Porcine NCBI ID	NCBI 11.1 Status	Porcine Ensembl ID	Ensembl 11.1 Status	Gene Symbol	Approved Full Name	Alternate Names	Family / Superfamily
ADIPOQ	397660	Correct	ENSSSCG00000039103	Correct	ADIPOQ	Adiponectin	ACDC; C1RG3; Adipoq; Gbp28; Adipocyte, C1Q and collagen domain containing; Adipocyte complement-related protein of 30 kDa; ACRP30;	C1Q Superfamily; TNF Superfamily; Adipocytokine Superfamily
AIMP1	100135670	Correct	ENSSSCG00000024168	Elongated (321/320 aa)	AIMP1	Aminoacyl tRNA synthetase complex-interacting multifunctional protein 1	Small inducible cytokine subfamily E, member 1 (endothelial monocyte-activating); SCYE1; EMAP2; EMAP1; ARS-interacting multifunctional protein 1; p43	tRNA-binding Domain Superfamily
AMH	397578	Correct	ENSSSCG00000031812	Correct	AMH	Anti-Mullerian hormone; MIF; MIS	MIF; MIS	TGFB Superfamily
ANGPT1	397009	Correct	ENSSSCG00000060035	Missing isoform 1	ANGPT1	Angiopoietin 1	KIAA0003; AGP1; ANG1	FNdD Superfamily
ANGPTL2	100126164	Correct	ENSSSCG00000005608	Correct	ANGPTL2	Angiopoietin-like 2	angiopoietin-related protein 2 (ARP2); (HARP)	ANGPT Family; VEGF Family; Adipocytokine Superfamily
ANGPTL4	397628	Correct	ENSSSCG00000013599	Correct	ANGPTL4	Angiopoietin-like 4	Fasting-induced adipose factor (FIAF); angiopoietin-related protein (PGAR)	ANGPT Family; VEGF Family; Adipocytokine Superfamily
ANGPTL6	100126233	Correct	ENSSSCG00000013663	Correct	ANGPTL6	Angiopoietin-like 6	Angiopoietin-related growth factor (AGF); ARP	ANGPT Family; VEGF Family; Adipocytokine Superfamily
APLN	100621006	Correct	ENSSSCG00000030843	Correct	APLN	Apelin	AGTRL1 ligand (APEJ); aminopeptidase P; XNPEP2	APLN Superfamily; Adipocytokine Superfamily
AREG	397668	Correct	ENSSSCG00000008963	Correct	AREG	Amphiregulin	Schwannoma-derived growth factor (SDGF); colorectal cell-derived growth factor1 (CRDGF); ARGLM; AR	EGF Family PFAM02987 Superfamily
ARTN	100624603	Correct	ENSSSCG00000014778	Elongated (220/224 aa)	ARTN	Artemin	Ensyn EVN; neublastin NBN; neurotrophic factor artemin	GDNF Family of Ligands (GFL); Neurotrophic; TGFB Superfamily
ASIP	414439	Correct	Not annotated as a gene.	Not Assigned	ASIP	Agouti signaling protein	Nonagouti-homolog (mouse); ASP; AGOMI; AGTS; AGTRL; Sim/hair/eye Pigmentation, Variation in, 9 (SHEP9)	Agouti Superfamily
AZGP1	100519648	Low quality protein (176, 1 aa)	ENSSSCG00000007642	Elongated (310/310 aa)	AZGP1	Alpha-2-glycoprotein 1, zinc-binding	Zinc-alpha2-glycoprotein (ZA2G, ZAG)	MHC1 Superfamily; Ig Superfamily; Adipocytokine Superfamily
BDNF	397495	Correct	ENSSSCG00000013333	Correct	BDNF	Brain-derived neurotrophic factor	Neurotrophin; abrineurin; BULN2; ANON2	NGF Superfamily
BMP1	100156461	Low quality protein (1 N, 1 K)	ENSSSCG00000009620	Elongated (987/986 aa)	BMP1	Bone morphogenetic protein 1	Procollagen C-endopeptidase P (CDC2, PCP); Mammalian tolloid protein (mTld, TLD); osteogenics imperfecta (OI13); PCOLC; PCP2	BMP Family; CUB Superfamily; EGF CA Superfamily; ZHM; Superfamily
BMP10	100514573	Correct	ENSSSCG00000032071	Correct	BMP10	Bone morphogenetic protein 10	MGC126783	BMP Family; TGFB Superfamily
BMP15	443811	Correct	ENSSSCG00000012310	Correct	BMP15	Bone morphogenetic protein 15	GDC2; premature ovarian failure 4; POF4; Growth differentiating factor 9; GDF9B	BMP Family; TGFB Superfamily
BMP2	100517183	Correct	ENSSSCG00000035442	Correct	BMP2	Bone morphogenetic protein 2		BMP Family; TGFB Superfamily
BMP3	100512974	Correct	ENSSSCG00000029061	Elongated (713/475 aa)	BMP3	Bone morphogenetic protein 3	Osteogenin	BMP Family; TGFB Superfamily
BMP4	100113425	Correct	ENSSSCG00000005045	Correct	BMP4	Bone morphogenetic protein 4		BMP Family; TGFB Superfamily
BMP5	100131964	Correct	ENSSSCG00000001478	Correct	BMP5	Bone morphogenetic protein 5		BMP Family; TGFB Superfamily
BMP6	100155536	Correct	ENSSSCG00000001027	Truncated (501/506 aa)	BMP6	Bone morphogenetic protein 6	vegetal-related growth factor 1, VGR; VGR1; VG-1; RL-10; VG-1-related protein	BMP Family; TGFB Superfamily
BMP7	492315	Correct	ENSSSCG00000007501	Elongated (610/431 aa)	BMP7	Bone morphogenetic protein 7	osteogenic protein 1	BMP Family; TGFB Superfamily
BMPR1A	100511668	Low quality protein (1 X, 1 N) (residue aa BMPR8	ENSSSCG00000032082	Truncated (360/402 aa)	BMPR1A	Bone morphogenetic protein 8a		TGFb Propeptide Superfamily; TGF beta Superfamily
BMPR8	100620374	Low quality protein (1 X, 1 N)	ENSSSCG00000037514	Truncated (401/402 aa)	BMPR8	Bone morphogenetic protein 8b	osteogenic protein-2 dna (OP2); BMP8	BMP Family; TGFB Superfamily
BTC	100505411	Correct	ENSSSCG00000008965	Elongated (342/184 aa)	BTC	Betacellulin		EGF Family PFAM02987 Superfamily
C17orf99	110255960	Annotated as ncRNA	Not annotated as a gene.	Not Assigned	C17orf99	Chromosome 17 open reading frame 99	UNQ6464; Intelmokin 40 (IL40, IL-40); GENSCAN00000035056; C17orf79	Ig Superfamily
C1QTNF3	100270814	Correct	ENSSSCG00000016823	Correct	C1QTNF3	C1q and tumor necrosis factor related protein 3	Hypothetical 35.9 kDa protein; collagen repeat containing sequence of 29 kDa protein; CORS26; MOP11 11; cartonectin	C1q Superfamily; Adipocytokine Superfamily
C1QTNF5	100520210	Elongated (260/243 aa)	Not annotated as a gene.	Not Assigned	C1QTNF5	Complement c1q tumor necrosis factor-related protein 5	CTRP5; late-onset retinal degeneration, L-ORD; LORD	TNF Superfamily; Adipocytokine Superfamily
CAVIN1	106501427	Elongated (458/393 AA)	ENSSSCG00000015446	Elongated (458/393 AA)	CAVIN1	Caveolae associated protein 1	Polymerase I and transcript release factor (PTRF); Cavin 1; CBL4	Adipocytokine Superfamily
CCL1	100510829	Correct	ENSSSCG00000017720	Correct	CCL1	Chemokine (C-C motif) ligand 1	I-309; CCR-1 ligand; P500 (mi, 5E-6,7CKL1, T-cell activation-3, TCA-3 (mi); CD8+T-cell specific protein	Chemokine Superfamily; CCL Subfamily
CCL11	100038010	Correct	ENSSSCG00000044762	Correct	CCL11	Chemokine (C-C motif) ligand 11	Eotaxin; Eosinophil chemotactic protein; SCYA11	Chemokine Superfamily; CCL Subfamily
CCL14	100516223	Correct	ENSSSCG00000034722	Correct	CCL14	Chemokine (C-C motif) ligand 14	small inducible cytokine subfamily A (Cys-Cys), member 14; SCYA14; NCC-2; Hemofiltrate CC chemokine-1	Chemokine Superfamily; CCL Subfamily
CCL17	780408	Correct	ENSSSCG00000021853	Correct	CCL17	Chemokine (C-C motif) ligand 17	Thymus and activation-regulated chemokine, TARC; a-1120.3, activated B and dendritic cell-derived protein-1, ABCD-1 (mi); dendroneve, SCYA17; T-cell-directed CC chemokine	Chemokine Superfamily; CCL Subfamily
CCL19	494464	Correct	ENSSSCG00000010966	Correct	CCL19	Chemokine (C-C motif) ligand 19	Macrophage inflammatory protein-3b, MIP-3b; Chemokine b-11, CKb-11; Epstein-Barr virus induced gene 1 ligand chemokine, ELC; exodus-3; SCYA19	Chemokine Superfamily; CCL Subfamily
CCL2	397422	Correct	ENSSSCG00000017723	Correct	CCL2	Chemokine (C-C motif) ligand 2	Monocyte chemotactic protein 1, MCP-1; MCP1; DRA;p2; HC11; glioma-derived chemotactic factor-2, GDCF-2; lymphocyte-derived chemotactic factor, LDCF; monocyte chemotactic and activating factor, MCAF; monocyte secretory protein JE (mi); platelet-derived growth factor-inducible gene, SCYA2; small inducible gene JE, Sig JE (mi); smooth muscle cell-derived chemotactic factor, SMC-CF; SPG; TSGB; Monocyte chemotactic protein-1, MCP-1	Chemokine Superfamily; CCL Subfamily, Adipocytokine Superfamily
CCL20	553951	Correct	ENSSSCG00000016254	Elongated (113/97 aa)	CCL20	Chemokine (C-C motif) ligand 20	Macrophage inflammatory protein-3a, MIP-3a; Exodus 1, liver and activation-regulated chemokine, LARC; mexikine; STB1 (r); SCYA20, SCYA201	Chemokine Superfamily; CCL Subfamily
CCL21	448797	Correct	ENSSSCG00000038162	Correct	CCL21	Chemokine (C-C motif) ligand 21	Secondary lymphoid-tissue chemokine, SLC; 6Ckine; chemokine 9-9; CKS-9; exodus-2; SCYA21; thymus-derived chemotactic agent-4 (mi); TCA-4; Efficient immunotherapeutic lymphotactin	Chemokine Superfamily; CCL Subfamily
CCL22	100516016	Correct	ENSSSCG00000002821	Correct	CCL22	Chemokine (C-C motif) ligand 22	Macrophage-derived chemokine, MDC; activated B and dendritic cell-derived protein, ABCD-1 (mi); DCactin-3, DC8-CK; Stimulated T cell chemotactic protein, STCP-1; SCYA22	Chemokine Superfamily; CCL Subfamily
CCL23	100516039	Missing isoform 1	ENSSSCG00000033457	Elongated (243/146 aa)	CCL23	Chemokine (C-C motif) ligand 23	small inducible cytokine subfamily A (Cys-Cys), member 23; SCYA23; CK-BETA-8 CKb8; macrophage inflammatory protein 3; MIP-3; myeloid progenitor inhibitory factor-1, MPIF-1; hmip-2	Chemokine Superfamily; CCL Subfamily
CCL24	780407	Correct	ENSSSCG00000035736	Elongated (135/119 aa)	CCL24	Chemokine (C-C motif) ligand 24	Eotaxin 2; Chemokine b-5, CKb-5; myeloid progenitor inhibitory factor-2, MPIF-2; SCYA24	Chemokine Superfamily; CCL Subfamily
CCL25	448799	Correct	ENSSSCG00000013593	Elongated (202/119 aa)	CCL25	Chemokine (C-C motif) ligand 25	Thymus expressed chemokine; TECK; CKb-15; SCYA25	Chemokine Superfamily; CCL Subfamily
CCL26	780409	Correct	ENSSSCG00000039874	Correct	CCL26	Chemokine (C-C motif) ligand 26	Eotaxin 3; IEOTI; IMAC; macrophage inflammatory protein-4a; MIP-4a; thymic corona chemokine-1, TSC-1; SCYA26	Chemokine Superfamily; CCL Subfamily
CCL27	445453	Correct	ENSSSCG00000010967	Correct	CCL27	Chemokine (C-C motif) ligand 27	Skinkine; CTACK; b-1/18a-locus chemokine, ILC; SCYA27	Chemokine Superfamily; CCL Subfamily
CCL28	554303	Correct	ENSSSCG00000016871	Elongated (174/127 aa)	CCL28	Chemokine (C-C motif) ligand 28	Mucosae-associated epithelial chemokine, MEC; CCK1; SCYA28	Chemokine Superfamily; CCL Subfamily
CCL3L1	494459	Correct	ENSSSCG00000017700	Elongated (123/69 aa)	CCL3L1	Chemokine (C-C motif) ligand 3-like 1	G64.2; D17S1718; G0519-2; LD78; LD78B; SCYA3L; Small inducible cytokine A3-like 1 (SCYA3L1)	Chemokine Superfamily; CCL Subfamily
CCL3L2*	100513857	Correct	ENSSSCG00000032343	Truncated (99/126 aa)	CCL3L2*	Chemokine (C-C motif) ligand 3-like 2		Chemokine Superfamily; CCL Subfamily
CCL4	396668	Correct	ENSSSCG00000032343	Correct	CCL4	Chemokine (C-C motif) ligand 4	Macrophage inflammatory protein-1b, MIP-1b; ATT44.1, ATT44.2, activator gene-2, Act-2; G-26; HMS-HC21; lymphocyte activation gene, LAG-1; MAD-5; SCYA4; SIS-g	Chemokine Superfamily; CCL Subfamily
CCL5	396613	Correct	ENSSSCG00000017705	Correct	CCL5	Chemokine (C-C motif) ligand 5	Regulated on activation, normal T expressed and secreted, RANTES; D17S136E; SCYA5; SIS-d (r); T-cell specific protein p28B, TCP228	Chemokine Superfamily; CCL Subfamily
CCL7P5*	Not Assigned		Not Assigned	Not Assigned	CCL7P5	Chemokine (C-C motif) ligand 7 pseudogene	Monocyte chemotactic protein 3 (MCP-3); Chemotactic protein-3 (r); fibroblast-induced cytokine (FIC, mi), MARC (mi); NC28 (mi); SCYA7	Chemokine Superfamily; CCL Subfamily
CCL8	100302703	Correct	ENSSSCG00000040648	Correct	CCL8	Chemokine (C-C motif) ligand 8	Monocyte chemotactic protein-2, MCP-2; HC14 (mi); SCYA8; MCP-2; MCP2	Chemokine Superfamily; CCL Subfamily
CCN4	100739115	Correct	ENSSSCG00000005946	Correct	CCN4	CCN4	WNT1 inducible signaling pathway protein 1; WISP1c; WNT1-induced secreted protein 1, WISP1; WISP1c; CCN family member 4, CCN4	IGFBP Superfamily; VWC Superfamily; TSP 1 Superfamily; CCN family Superfamily; Adipocytokine Superfamily
CER1	110215508	Correct	ENSSSCG00000039169	Correct	CER1	Cerberus 1 homolog, cysteine knot superfamily (Xenopus laevis)	CAN domain family member 4, DANCR	DAN Superfamily; GHB-like Superfamily; Cystine Knot Superfamily
CLCF1	100513263	Elongated (281/223 aa)	ENSSSCG00000012915	Elongated (282/223 aa)	CLCF1	Cardiotrophin-like cytokine	Novel neurotrophin -1, NNT1; B-cell stimulating factor-3, BSF3	IL6 Superfamily; PRF Superfamily
CLEC11A	100620310	Correct	ENSSSCG00000036814	Missing isoform 1	CLEC11A	C-type lectin domain family 11, member A	Stem cell growth factor; SCGF; C-type lectin, superfamily member 6; CLSCRP3; Lymphocyte-secreted long form of C-type lectin; LSLCL; stem cell growth factor	CLECT Superfamily; Tetranectin Superfamily
CKLF	110260934	Correct	ENSSSCG00000031161	Truncated (113/149 aa)	CKLF	Chemokine-like factor	Chemokine-like factor 1 (CKLF1); chemokine-like factor 2 (CKLF2); chemokine-like factor 3 (CKLF3); chemokine-like factor 4 (CKLF4); transmembrane prosteinjial (CS2); CKLF-like MARVEL transmembrane domain containing 3 (CMTM3)	MARVEL Superfamily
CMTM1	110260932	Elongated (209/263 aa)	ENSSSCG00000033857	Elongated (276/263 aa)	CMTM1	CKLF-like MARVEL transmembrane domain containing 1	Chemokine-like factor super family member 1 (CKLFSF1); transmembrane prosteinjial (CS2); CKLFH; CKLFm1; CMTM1	MARVEL Superfamily
CNTF	100518821	Low quality protein (3 N, 1 D)	ENSSSCG00000011511, merged with ZFPR1	Truncated (139/200 aa)	CNTF	Ciliary neurotrophic factor		CNTF Superfamily
CRLF1	100738750	Correct	ENSSSCG00000013909	Correct	CRLF1	Cytokine receptor-like factor 1	Class I cytokine receptor; cytokine type 1 receptor CRLF-1; cytokine-like factor 1; cold-induced sweating cytokine;CISS; CISS1; CLF; CLF-1, NRL; zcytor5	
CSF1	100513084	Correct	ENSSSCG00000037449	Elongated (816/554 aa)	CSF1	Colony stimulating factor 1 (macrophage)	M-CSF	CSF 1 Superfamily
CSF2	397208	Correct	ENSSSCG00000012737	Correct	CSF2	Colony stimulating factor2 (granulocyte-macrophage)	GM-CSF	CSF2 Superfamily
CSF3	396839	Correct	ENSSSCG00000017488	Elongated (200/195 aa)	CSF3	Colony stimulating factor 3 (granulocyte)	Pluripoietin; Filgrastim; Lenograstim; Granulocyte CSF; G-CSF	IL6 Superfamily
CTF1	100736818	Correct	ENSSSCG00000007774	Correct	CTF1	Cardiotrophin 1	CT-1, CT1	IL6 Superfamily; PRF Superfamily
CTF2	100736868	Elongated (176/154 aa)	ENSSSCG00000007773	Elongated (183/154 aa)	CTF2	Cardiotrophin 2	Neuropoietin, NP; Gm434	IL6 Superfamily; LIF OSM Superfamily
CX3CL1	100621027	Truncated (385/400 aa, low quality protein (1 N, 1	ENSSSCG00000014759	Truncated (331/400 aa)	CX3CL1	Chemokine (C-X3-C motif) ligand 1	Fractalkine, FKN; Activated B and dendritic cell-derived protein-3, ABCD-3 (mi); C3Xkine, neurotactin, NTN; NTT; SCYD1; Type 1 membrane protein	Chemokine Superfamily; CX3CL Subfamily
CXCL1	100525096	Correct	ENSSSCG00000008959	Contains sequences for CXCL1 and CXCL2. transcript ENSSSCT00000061347.2 encodes CXCL1. transcripts ENSSSCT00000403951.2, ENSSSCT00000061610.2 and ENSSSCT00000044792.2 are chimeric (build 11.1).	CXCL1	Chemokine (C-X-C motif) ligand 1	Melanoma growth stimulating activity, alpha; MGSA-a; GRO alpha; Cytokine-induced neutrophil chemoactic factor-1, CINC-1 (r), fibroblast secretory protein, FSP; GRO1 oncogene; keratinocyte derived chemokine, KC (m), NCS (m), neutrophil activating peptide-3, NAP-3; SCYB1	Chemokine Superfamily; CXC Subfamily
CXCL10	494019	Correct	ENSSSCG00000032474	Correct	CXCL10	Chemokine (C-X-C motif) ligand 10	IFN-gamma inducible Protein 10 IOP-10); Cytokine responsive gene-2, crg-2 (m); mob-1 (r); CT (m); 9.D2, APW-p 31; SCYB10	Chemokine Superfamily; CXC Subfamily
CXCL11	100169744	Correct	ENSSSCG00000008978	Correct	CXCL11	Chemokine (C-X-C motif) ligand 11	IFN-inducible T cell alpha chemoattractant, ITAC; IP-9; IP-9; beta-R1; small cytokine B subfamily member 11, SCYB11	Chemokine Superfamily; CXC Subfamily
CXCL12	494460	Correct	ENSSSCG00000034973	Correct	CXCL12	Chemokine (C-X-C motif) ligand 12	Stromal cell-derived factor 1 (SDF-1); intracrine-a, intercrine reduced in hepatoma; IRH; pre-B cell growth stimulating factor; PBSF; SCYB12; thymic lymphoma cell stimulating factor-alb; TLSF-alb; TPA repressed gene 1, TPAR-1	Chemokine Superfamily; CXC Subfamily
CXCL13	100524265	Correct	ENSSSCG00000036445	Correct	CXCL13	Chemokine (C-X-C motif) ligand 13	B-cell chemoattractant; ANGIE; BNDF; BCA-1; BCA1; B lymphocyte chemoattractant, BLC; BLR1; SCYB13	Chemokine Superfamily; CXC Subfamily
CXCL14	494467	Correct	ENSSSCG00000014310	Correct	CXCL14	Chemokine (C-X-C motif) ligand 14	Breast and kidney cell chemokine, BRAK; B cell- and monocyte activating chemokine, BMAC; Bolekine; kidney-expressed chemokine, KEC; K51; NJAC; SCYB14; Macrophage inflammatory protein-2g, MIP-2g	Chemokine Superfamily; CXC Subfamily
CXCL16	396735	Correct	ENSSSCG00000017920	Elongated (241/250 aa)	CXCL16	Chemokine (C-X-C motif) ligand 16	Phosphatidylserine and oxidized low density lipoprotein; SRPSOX; SR-PSOX; CKEU114	Chemokine Superfamily; CXC Subfamily
CXCL17	100737180, 110260995	Artifactually duplicated	ENSSSCG00000033048, ENSSSCG00000037422	Artifactually duplicated	CXCL17	Chemokine (C-X-C motif) ligand 17	Dendritic cell and monocyte chemokine-like protein, DMC; VEGF co-regulated chemokine 1, VCC1; UNQ473	Chemokine Superfamily; CXC Subfamily
CXCL2	414904	Correct	ENSSSCG00000008959	Contains sequences for CXCL1 and CXCL2. transcripts ENSSSCT00000403951.2, ENSSSCT00000061610.2 and ENSSSCT00000044792.2 are chimeric	CXCL2	Chemokine (C-X-C motif) ligand 2	melanoma growth stimulating activity, beta; GRO beta	Chemokine Superfamily; CXC Subfamily
CXCL3	Not Assigned	Not identified	Not Assigned	Not identified	CXCL3	Chemokine (C-X-C motif) ligand 3	GRO gamma; melanoma growth stimulating activity, gamma	Chemokine Superfamily; CXC Subfamily
CXCL6	396900	Correct	ENSSSCG00000008957	Correct	CXCL6	Chemokine (C-X-C motif) ligand 6	Granulocyte chemotactic protein 2, GCP-2; alveolar macrophage chemotactic factor-2, AMCF-2; AMCF-II; AMCF2; CKa-3; lipopolysaccharide-induced CXC chemokine; LIX (m, r); SCYB6	Chemokine Superfamily; CXC Subfamily, Adipocytokine Superfamily
CXCL8	396900	Correct	ENSSSCG00000008957	Correct	CXCL8	Chemokine (C-X-C motif) ligand 8	interleukin 8 (IL8); Axonic neutrophil-activating peptide; ANAP; apoptosis inducing factor, AIF; beta-thromboglobulin-like protein; bTG-like protein; chemokinen, CT; emoctakin; fibroblast-derived neutrophil chemotactic factor, FDNCF; granulocyte chemotactic protein 1, GCP-1; leukocyte adhesion inhibitor, LAI; lung carcinoma-derived chemotaxin, LUCT; lymphocyte-derived neutrophil-activating factor; LYNAP; monocyte-derived neutrophil-activating peptide, MONAP; neutrocrine; NCF; neutrophil activating peptide-1, NAP-1; neutrophil chemotactic factor, NCF; 3-10C; small inducible cytokine subfamily B, member 8, SCYB8	Chemokine Superfamily; CXC Subfamily
CXCL9	100515681	Correct	ENSSSCG00000032777	Correct	CXCL9	Chemokine (C-X-C motif) ligand 9	monokine induced by IFN-gamma, Mig; CMT, Humig, IS120 (m); SCYB9	Chemokine Superfamily; CXC Subfamily
DLK1	397006	Correct	ENSSSCG00000035805	Correct	DLK1	Delta-like homolog (Drosophila)	fetal antigen 1, FA1; zona glomerulosa-specific protein, ZOG; pref-1 preadipocyte factor 1 precursor, pref-1; SCDO1; ZOG;	EGF CA Superfamily
EBI3	100522599	Correct	ENSSSCG00000014498	Correct	EBI3	Epstein-Barr virus induced gene 3	interleukin 27 beta chain precursor; IL-27B	FN3 Superfamily
EDA	100518887	Correct	ENSSSCG00000021647	Elongated (389/386 aa)	EDA	Ectodysplasin A	Ectodermal dysplasia 1, (EDA1); anhidrotic; HE; XHED; ALGHD	TNF Superfamily
EGF	397083	Correct	ENSSSCG00000009114	Truncated (1194/1214 aa)	EGF	Epidermal growth factor	Renal hypomagnesemia 4 (HOMG4); beta-urogastrone (URG)	EGF Family PFAM02987 Superfamily
EPGN	102161388	Correct	ENSSSCG00000008961	Contains sequences for MTMR7E1 and EPGN. transcript ENSSSCT00000079881.1. is chimeric	EPGN	Epithelial mitogen	ALGV3072; Epigen (EPG); PRO9904	EGF Family PFAM02987 Superfamily
EPO	397249	Correct	ENSSSCG00000007673	Correct	EPO	Erythropoietin	EP; MVCD2	EPO TPO Superfamily
EREG	100620969	Correct	ENSSSCG00000018185	Correct	EREG	Epiregulin	EPR; ER; Ep	EGF Family PFAM02987 Superfamily
FGF1	397497	Correct	ENSSSCG00000024954	Correct	FGF1	Fibroblast growth factor 1	Acidic FGF (AFGF); heparin-binding growth factor 1 (HBGF); HBGF-1; ECGF; FGFA; ECGFA; ECGFB; FGF-1; GLIO703; ECGF-beta; FGF-alpha	FGF Superfamily
FGF10	100525086	Correct	ENSSSCG00000016878	Correct	FGF10	Fibroblast growth factor 10	Keratinocyte growth factor 2 (KGF2)	FGF Superfamily
FGF11	100739797	Correct	ENSSSCG00000034757	Correct	FGF11	Fibroblast growth factor 11	Fibroblast growth factor homologous factor 3 (FHF3; hsf-3)	FGF Superfamily
FGF12	100512498	Correct	ENSSSCG00000018584	Elongated (218/243 aa)	FGF12	Fibroblast growth factor 12	FHF1; FGF-12; FGF12B	FGF Superfamily
FGF13	100521833	Correct	ENSSSCG00000022331	Correct	FGF13	Fibroblast growth factor 13	FGF2; FHF-2; FHF2	FGF Superfamily
FGF14	100518844	Correct	ENSSSCG00000009127	Correct	FGF14	Fibroblast growth factor 14	FHF-4; FHF4; SCA27	FGF Superfamily
FGF16	100515223	Correct	ENSSSCG00000022833	Correct	FGF16	Fibroblast growth factor 16	Minkexpr 4-5 fusion (MF4)	FGF Superfamily
FGF17	100515720	Missing isoform 1	ENSSSCG00000009609	Missing isoform 1	FGF17	Fibroblast growth factor 17	Hypogonadotropic hypogonadism 20 (HH20)	FGF Superfamily
FGF18	100525013	Correct	ENSSSCG00000016997	Correct	FGF18	Fibroblast growth factor 18	(FGF5, FGF)	FGF Superfamily
FGF19	100518950	Correct	ENSSSCG00000012871	Correct	FGF19	Fibroblast growth factor 19	FGF15 (mouse)	FGF Superfamily
FGF2	397643	Elongated (198/353 aa, missing 18 kDa isoform	ENSSSCG00000036213	Truncated (116/353 aa, missing 18 kDa isoform	FGF2	Fibroblast growth factor 2	Basic FGF (BFGF); FGFB; HBGF-2	FGF Superfamily
FGF20	100516301	Correct	ENSSSCG00000006980	Truncated (210/211 aa)	FGF20	Fibroblast growth factor 20	Renal hypodysplasia aplasia-2 (RHDA2)	FGF Superfamily
FGF21	100302504	Correct	ENSSSCG00000003140	Correct	FGF21	Fibroblast growth factor 21		FGF Superfamily
FGF22	110259378	Correct	ENSSSCG00000039236	Correct	FGF22	Fibroblast growth factor 22		FGF Superfamily
FGF23	100515339	Correct	ENSSSCG00000039492	Truncated (243/244 aa)	FGF23	Fibroblast growth factor 23	Autosomal dominant hypophosphatemic rickets (ADHR); FGF6; HYPR; HYTC2; HYDR2; PHPTC	FGF Superfamily
FGF3	100519127	Correct	ENSSSCG00000012872	Correct	FGF3	Fibroblast growth factor 3	Murine mammary tumor virus integration site (v-int-2) oncogene homolog2 (FGF3); HBGF-3; INT2	FGF Superfamily
FGF4	100518595	Correct	ENSSSCG00000012870	Correct	FGF4	Fibroblast growth factor 4	Heparin secretory transforming protein 1 (HST-1; HST-1); Kaposi sarcoma oncogene; HBGF-4; K-FGF;	FGF Superfamily
FGF5	100513672	Correct	ENSSSCG00000011272	Correct	FGF5	Fibroblast growth factor 5	HBGF-5; Smag-82; TCMCG;1	FGF Superfamily
FGF6	100152116	Correct	ENSSSCG00000023662	Correct	FGF6	Fibroblast growth factor 6	HBGF-6; HST2	FGF Superfamily
FGF7	397281	Correct	ENSSSCG00000004651	Contains sequences for 2 genes GALK2 and FGF7. transcript ENSSSCT00000056886.2 encodes FGF7	FGF7	Fibroblast growth factor 7	Keratinocyte growth factor (KGF); HBGF-7	FGF Superfamily
FGF8	100156142	Elongated (265/244 aa, low quality (1 N, 1 K)	ENSSSCG00000036146	Truncated (216/244 aa)	FGF8	Fibroblast growth factor 8	Androgen-induced growth factor (AIGF); HBGF-8; HH6; KAL6	FGF Superfamily
FGF9	396717	Correct	ENSSSCG00000009278	Correct	FGF9	Fibroblast growth factor 9	Glia-activating factor; GAF; HBFG-9; SPM;	FGF Superfamily
FLT3LG	780432	Truncated (150/200 aa, chimeric (FLT3LG/RPL13A) protein	ENSSSCG00000031167	Elongated (150/294 aa), chimeric (FLT3LG/RPL13A) protein	FLT3LG	fms-related tyrosine kinase 3 ligand	SL cytokine; FR-3 ligand	FLT3 Lig Superfamily
GDF1	397254	Correct	ENSSSCG00000000363	Correct	GDF1	Growth differentiation factor 1	RAL DORV; GTGA3	TGFB Propeptide Superfamily
GDF11	397254	Correct	ENSSSCG00000000363	Correct	GDF11	Growth differentiation factor 11	bone morphogenetic protein 11 (BMP11)	BMP Family; TGFB Superfamily
GDF15	100379630	Correct	ENSSSCG00000034260	Correct	GDF15	Growth differentiation factor 15	Prostate differentiation factor beta (PTGFB); Macrophage inhibitory cytokine 1 (MIC1); NSAID (nonsteroidal anti-inflammatory drug)-activated protein 1 (NAG-1); PDF; Placental bone morphogenic protein beta (PLAB)	TGFB Superfamily; Adipocytokine Superfamily
GDF2	100519741	Correct	ENSSSCG00000010375	Correct	GDF2	Growth differentiation factor 2	Bone morphogenetic protein 9, BMP9;BMP-9); HHT5	TGFB Superfamily
GDF5	100520988	Correct	ENSSSCG00000023261	Correct	GDF5	Growth differentiation factor 5	Cartilage-derived morphogenetic protein-1, (CDMP1, CDMP-1); BDA1C; Bone Morphogenetic Protein 14 (BMP-14; BMP14); LAP-4; LAP4; DSL; SYM1B; SYNS2	BMP Family; TGFB Superfamily
GDF6	110260154	Correct	ENSSSCG00000034943	Correct	GDF6	Growth differentiation factor 6	KTM; KFS; KTS1; KTS1; SCM1; Bone Morphogenetic Protein 13 (BMP13); CDMP2; MCOPA; SGDOC; MCOPCBA;	BMP Family; TGFB Superfamily
GDF7	100624534	Correct	ENSSSCG00000028931	Correct	GDF7	Growth differentiation factor 7	Bone Morphogenetic Protein 12 (BMP12)	BMP Family; TGFB Superfamily
GDF9	414285	Correct	ENSSSCG00000014288	Correct	GDF9	Growth differentiation factor 9	premature ovarian failure 1X (POF1X)	TGF Beta Superfamily
GDNF	100332894	Truncated (211/228 aa	ENSSSCG00000038727	Truncated (211/228 aa)	GDNF	Glial cell derived neurotrophic factor	ATF1; ATF2; HFB1-GDNF; HSCR3	GDNF Family, TGF Beta Superfamily
GH1	396884	Correct	ENSSSCG00000034212	Elongated (217/216 aa)	GH1	Growth hormone 1	GH; GHN; Somatotropin	Growth Hormone-like Superfamily
HBEGF	397564	Correct	ENSSSCG00000014362	Correct	HBEGF	Heparin-binding epidermal growth factor-like growth factor	Diphtheria toxin receptor (DTR)	EGF Family PFAM02987 Superfamily; Adipocytokine Superfamily
HGF	100525120	Correct	ENSSSCG00000015403	Correct	HGF	Hepatocyte growth factor; hepatocytes A	HPTA; scatter factor; HGFB; F-TCF; preSF	PAN APPLE Superfamily; K9 Superfamily; Trypsin Superfamily;
HMGB1	445521	Correct	ENSSSCG00000009327	Elongated (241/215 aa)	HMGB1	High-mobility group box 1	HMG1, SBP 1; Amphoterin; Sulfoglycuronyl carbohydrate binding protein; high-mobility group (nonhistone chromosome) protein 1	HMG-box Superfamily
IFNA1	397686	Correct	ENSSSCG00000011482	Annotated as lncRNA and contains sequences for IFNA5 and IFNA1.	IFNA1	Interferon, alpha 1	IFN-alf; IFN-alpha-1,	IFNab Superfamily
IFNA1P1*	110255449	Annotated as interferon alpha-1-like	Not Assigned	Not an annotated gene	IFNA1P1*	Interferon, alpha 1 pseudogene 1		IFNab Superfamily
IFNA10	100516561	Correct	ENSSSCG00000034809	Correct	IFNA10	Interferon, alpha 10	IFN-ALPHA-10	IFNab Superfamily
IFNA10P1*	Not Assigned	Not an annotated gene	Not Assigned	Not an annotated gene	IFNA10P1*	Interferon, alpha 10 pseudogene 1		IFNab Superfamily
IFNA17L1	100516936	Correct	ENSSSCG00000034088	Not an annotated gene	IFNA11	Interferon, alpha 11		IFNab Superfamily
IFNA12	100516661	Annotated as interferon alpha-1-like	ENSSSCG00000038797	Annotated as a pseudogene	IFNA12	Interferon, alpha 8	INF-alpha-14; IFNA51L1*	IFNab Superfamily
IFNA13	100512100	Correct	Not Assigned	Not an annotated gene	IFNA13

IL17C	100961588	Correct	ENSSSCG00000040606	Correct	IL17C	Interleukin 17C	IL-21, Interleukin 21, IL21
IL17D	100738902	Correct	ENSSSCG00000031308	Correct	IL17D	Interleukin 17D	IL27, IL(IL6IL6, IL-17D, IL-22
IL19	100037933	Correct	ENSSSCG00000031748	Correct	IL19	Interleukin 19	MI-1; Interferon-24
IL18	397057	Correct	ENSSSCG00000015037	Correct	IL18	Interleukin 18	IFN-gamma-inducing factor; IL1F4; IL-1 gamma, IL1G
IL19	100038024	Correct	ENSSSCG00000015653	Correct	IL19	Interleukin 19	MDA1; (MDA1; IL-10C; Melanoma differentiation associated protein-like protein; NG.1
IL1A	397094	Correct	ENSSSCG00000000890	Correct	IL1A	IL1 alpha	IL1F1
IL1B	397122	Correct	ENSSSCG00000000888	Correct	IL1B	Interleukin 1, beta	IL1B, IL1F2, IL-F2; catabolin
IL1B2	396565, 110258376, 110255300, 110258379, 110259156, 110258582, 110258125	Artifactually duplicated	ENSSSCG00000000887, ENSSSCG00000000888, ENSSSCG00000040808, ENSSSCG00000034182, ENSSSCG00000033667, ENSSSCG00000036388, ENSSSCG00000036704	Artifactually duplicated	IL1B2	Interleukin 1, beta 2	IL-1 beta like, IL1BL1
IL1F10	Missing from NCBI build 11.1		Missing from Ensembl build 11.1		IL1F10	Interleukin 1 family, member 10 (theta)	IL-1 receptor antagonist like PL1 theta;1B-1 theta; PL1 theta; Interleukin-1 HY2 (IL-1HY2; IL-1B; PRO275
IL1RN	397409	Correct	Missing from Ensembl build 11.1		IL1RN	Interleukin 1 receptor antagonist	intracellular IL-1 receptor antagonist type II;IL1-TY1; IRAP1; IL1RA; IC5-1RA; IL1-RA4;IL1F3; IL1F3; intracellular IL-1 receptor antagonist (IC5-1);IL-type II IL-1 receptor antagonist; IL-1ra; Microvascular complications of diabetes 4 (MVCD4); Deficiency of IL-1 Receptor Antagonist (DIRA)
IL2	396868	Correct	ENSSSCG00000033267	Correct	IL2	Interleukin 2	T-cell growth factor (TCGF)
IL20	100522695	Low quality protein (1 N, 1 S)	ENSSSCG00000015654	Truncated (171/178 aa)	IL20	Interleukin 20	four alpha-helix cytokine (ZCYTO10); IL10D; MGC96907
IL21	403123	Missing isoform 1.	ENSSSCG00000009087	Truncated (152/153 aa)	IL21	Interleukin 21	IL21; common variable immunodeficiency-11, CVID11; cytokine CX2
IL22	595104	Correct	ENSSSCG00000000482	Correct	IL22	Interleukin 22	IL-10-related T-cell-derived inducible factor-5; D110; IL-TIF; IL19 IL-10-related T-cell-derived inducible factor-5; D110; IL-TIF; IL19; IL-10; IL-10-related T-cell-derived inducible factor-5; D110; IL-TIF; IL22; IL22; MGC79364; TIFa; TIFA; CRF2-10; zcytor5
IL23A	100155540	Correct	ENSSSCG00000033520	Correct	IL23A	Interleukin 23 subunit alpha	p19; SGRF; IL23 induced upon T-cell activation
IL24	100739374	Truncated (183/207 AA)	ENSSSCG00000015655	Truncated (200/207 aa)	IL24	Interleukin 24	C49A, FDF, IL-24, IL10B, melanoma differentiation association protein 7, MDA7, MDA-7; Mda-5; suppression of tumorigenicity 16, ST16
IL25	100154561	Correct	ENSSSCG00000015427	Correct	IL25	Interleukin 25	IL17E
IL26	100037251	Correct	ENSSSCG00000033976	Correct	IL26	Interleukin 26	AK155
IL27	443167	Correct	ENSSSCG00000039300	Correct	IL27	Interleukin 27 p28 subunit	IL30; IL-27p28
IL3	Not Assigned	Not an annotated gene.	Not Assigned	Not an annotated gene.	IL3	Interleukin 3	CSF, multiple
IL31	102167534	Elongated (204/163 AA)	ENSSSCG00000009795	Truncated (138/163 aa)	IL31	Interleukin 31	
IL32	Not Assigned	Not an annotated gene.	Not Assigned	Not an annotated gene.	IL32	Interleukin 32	Natural killer cell transcript 4, NK4, TAIF; TNFSL TNFd
IL33	100518643	Missing isoform a.	ENSSSCG00000005203	Missing isoform a.	IL33	Interleukin 33	Nuclear factor from high endothelial venules NF-HEV; DVS27; Chromosome 9 open reading frame 26 (C9orf26); C9orf26; DVS27-related protein, IL-1 family member 11 (IL-1F11); DKFZp586H0523
IL34	100737468	Correct	ENSSSCG00000040629	Correct	IL34	Interleukin 34	Chromosome 16 open reading frame 77, C16orf77
IL36A	Missing from NCBI build 11.1	Not assigned	Missing from Ensembl build 11.1	Not assigned	IL36A	Interleukin 36 alpha	IL1 family, member 6 (epsilon) (IL1F6); FIL1; FIL1E; IL-1E
IL36B	Missing from NCBI build 11.1	Not assigned	Missing from Ensembl build 11.1	Not assigned	IL36B	Interleukin 36, beta	Interleukin 1 family, member 8 (eta) (IL1F8); IL-1H2
IL36G	Missing from NCBI build 11.1	Not assigned	Missing from Ensembl build 11.1	Not assigned	IL36G	Interleukin 36 gamma	IL1 family, member 9 (IL1F9); IL-1H1; IL-1F9
IL36RN	Missing from NCBI build 11.1	Not assigned	Missing from Ensembl build 11.1	Not assigned	IL36RN	Interleukin 36 receptor antagonist	IL1 family, member 5 (delta) (IL1F5); IL-1 receptor antagonist homolog 1 (IL1RP1); FIL1, FIL1(IL0176), FIL1(), IL-36Ra, IL1F5, IL1L1, IL1RP3, IL36RA, PSORP, PSORR14
IL37P1*	Not assigned	Not an annotated gene	Not assigned	Not an annotated gene	IL37P1*	Interleukin 37 pseudogene	IL1 family, member 7 (eta) (IL1F7); FIL1; IL-1 homolog 4 (IL-1H4); IL-1RP1; IL-37
IL4	397225	Correct	ENSSSCG00000014282	Correct	IL4	Interleukin 4	B-cell stimulatory factor 1 (BSF-1);Lymphocyte stimulatory factor 1 (LSF-1);B-Cell Growth Factor 1 (BCGF1, BCGF-1)
IL5	397409	Correct	ENSSSCG00000014278	Correct	IL5	Interleukin 5	B-cell differentiation factor I; BCDF (m); BCGF(; T-cell replacing factor, TRF; Eosinophil differentiation factor, EDF; Ex-CSF; TRFB cell differentiation factor I
IL6	399500	Correct	ENSSSCG00000020970	Elongated (241/212 aa)	IL6	Interleukin 6	IFN-beta 2 (IFNB2); IFN-beta-2); B-cell stimulatory factor 2 BSF-2); CDF; HGF; HSF
IL7	397253	Correct	ENSSSCG00000006161	Correct	IL7	Interleukin 7	
IL9	100144594	Correct	ENSSSCG00000021818	Correct	IL9	Interleukin 9	T cell and mast cell growth factor P40; mP40
INHA	397286	Correct	ENSSSCG00000022771	Correct	INHA	Inhibin, alpha	
INHBA	397093	Correct	ENSSSCG00000035077	Correct	INHBA	Inhibin, beta A	Activon A; activon AB alpha polypeptide; erythroid differentiation factor; EDF; FSH-releasing protein;
INHBB	397490	Correct	ENSSSCG00000038610	Correct	INHBB	Inhibin, beta B	Activon AB beta polypeptide, INHBB
INHBC	100620084	Elongated (214/152 aa)	ENSSSCG00000037446	Elongated (214/152 aa)	INHBC	Inhibin, beta C	INBC
INHBE	100518554	Low quality protein (1 N, 1 S)	ENSSSCG00000000442	Truncated (350/351 aa)	INHBE	Inhibin subunit beta E; MGC4638, activin	INH subunit beta E; MGC4638, activin
KITLG	397509	Correct	ENSSSCG00000015495	Elongated (276/274 aa)	KITLG	KIT ligand	Mast cell growth factor; MGF; Stem cell factor precursor; SCF; SF; FPH2; KIT; KL-1; SHEP7; KITL; DFW68; FPH2; KL-1; KIT; SLF
LCN2	100515501	Correct	ENSSSCG00000005638	Elongated (214/199 aa)	LCN2	Lipocalin 2	oncogene 24p3; Neutrophil gelatinase-associated lipocalin; NGAL; NGI-related lipocalin; Neutrophil gelatinase-associated lipocalin precursor; NGAL; p25, 25 kDa alpha-2-microglobulin-related subunit of MMP-9; uterocalin; uterocalin; secreted inducible protein 24; SIP24; 24P3; human neutrophil lipocalin; HNL
LEFTY2	100337677, 100524117	Artifactually duplicated	ENSSSCG00000038188, ENSSSCG00000032299	Artifactually duplicated	LEFTY2	Left right determination factor 2	Factor 4; Endometrial bleeding associated factor; EBAF; TGFbeta superfamily; TGFB4
LEP	396832	Correct	ENSSSCG00000040464	Missing several isoforms	LEP	Leptin	OB; OBS; Obesity factor; Obese protein
LIF	399503	Correct	ENSSSCG00000040961	Correct	LIF	Leukemia inhibitory factor	Cholinergic differentiation factor, CDF; DIA; HILDA
LTA	407742	Correct	ENSSSCG00000001403	Correct	LTA	Lymphotoxin alpha	LT-a; TNF superfamily member 1, TNFSF1; tumour necrosis factor beta, TNFB, TNF-b
LTB	100515581	Correct	Not Assigned	Not an annotated gene	LTB	Lymphotoxin beta	LT-b; LT-beta; TNF superfamily member 3, TNFSF3; TNF3; TNF-c;
MDK	100359358	Correct	ENSSSCG00000015260	Elongated (135/142 aa)	MDK	Midkine	Neurite growth-promoting factor 2, NEGF2; Amphiregulin-associated protein, ARAP
METRNL	100512305	Low quality (1 N, 1 S) protein	ENSSSCG00000017137	Truncated (326/327 aa)	METRNL	Meteorin, glial cell differentiation regulator-like	Subfatin
MIF	397412	Correct	ENSSSCG00000010067	Correct	MIF	Macrophage migration inhibitory factor	Glycosylation-inhibiting factor (GIF, GLIF), MMIF
MSANTD3-TMEFF1	Not assigned	Not assigned	ENSSSCG00000005391	Ensembl locus contains sequences for 3 genes (TMEFF1, MSANTD3-TMEFF1, and MSANTD3)	MSANTD3-TMEFF1	MSANTD3-TMEFF1 readthrough	TR-1; HT383; C9orf72; TMEFF1; C9orf3-TMEFF1; C9orf30-TMEFF1
MST1	100512987	Correct	ENSSSCG00000011386	Correct	MST1	Macrophage stimulating 1	Hepatocyte growth factor-like, HGFL; Macrophage-stimulating protein, MSP; ZSF1SSC; DNF15S2; MS1S2
MSTN	399534	Correct	ENSSSCG00000016047	Correct	MSTN	Myostatin	Growth differentiation factor 8 (GDF8); MSLHP
MYDGF	110259358	Correct	ENSSSCG00000034898	Correct	MYDGF	Myeloid-derived growth factor	Chromosome 19 open reading frame 10 (C19orf10); FLJ7Ac, Murine FLJ5; IL-25; stromal cell-derived growth factor SF20; UPF0556 protein
NAMPT	595123	Correct	ENSSSCG00000015435	Correct	NAMPT	Nicotinamide phosphoribosyl transferase	Pre-B-cell colony-enhancing factor 1, PBEF1; PBEF; NAmPRTase, NAMPT; Visfatin; Vaspin
NGF	100738968	Correct	ENSSSCG00000021417	Elongated (244/241 aa)	NGF	Nerve growth factor	beta polypeptide, NGFB; Beta-NGF; HSAN5
NODAL	110256843	Truncated (280/348 AA)	ENSSSCG00000039399	Truncated (316/348 aa)	NODAL	Nodal growth differentiation factor	
NRG1	102164569	Correct	ENSSSCG00000015839	Correct	NRG1	Neuregulin 1	Glial growth factor (GGF); heregulin, alpha (HRG, HRG1); HRG4; Neu differentiation factor (NDF); Sensory and motor neuron derived factor (SMDF); Acetylcholine receptor-inducing activity (ARIA); GGF2; breast cancer cell differentiation factor p45
NRG2	100625643	Correct	ENSSSCG00000021082	Missing isoform 3	NRG2	Neuregulin 2	Divergent of neuregulin 1 (DON1); heregulin 2 (HRG2); neural- and thymus-derived activator for ErbB kinases (NTAK)
NRG3	100158106	Low quality (1 N, 1 S) protein	ENSSSCG00000010344	Truncated (718/719 aa)	NRG3	Neuregulin 3	Heregulin 3 (HRG3); pro-NRG3
NRG4	100516621	Correct	ENSSSCG00000044227	Elongated (139/116 aa)	NRG4	Neuregulin 4	Heregulin 4 (HRG4)
NRTN	110513045	Correct	ENSSSCG00000033413	Correct	NRTN	Neurturin	NTN
NTF3	100144453	Correct	ENSSSCG00000033544	Correct	NTF3	Neurotrophin	NT3
NTF4	100511083	Correct	ENSSSCG00000001160	Correct	NTF4	Neurotrophin 4	GLC10; NT-4; NT-4/5; NT-5; NT5
OSM	100510358	Correct	ENSSSCG00000009957	Truncated (234/237 aa)	OSM	Oncostatin M	
PAEP	396596	Correct	ENSSSCG00000040042	Elongated (268/178 aa)	PAEP	Progestagen-associated endometrial protein	placental protein 14; pregnancy-associated endometrial alpha-2 globulin; alpha uterine protein; Glycodelin; beta lactoglobulin; BLG; LGB; beta lactoglobulin D; LBCR
PDGFA	100519764	Correct	ENSSSCG00000007541	Elongated (236/211 aa)	PDGFA	Platelet-derived growth factor alpha polypeptide	
PDGFB	NA	Not an annotated gene	Not assigned	Correct	PDGFB	Platelet-derived growth factor beta polypeptide	Simian sarcoma viral (v-sis) oncogene homolog; Becaplermin; oncogene SSpolypeptide
PDGFC	100515267	Elongated (336/345 aa)	ENSSSCG00000024960	Elongated (336/345 aa)	PDGFC	Platelet derived growth factor	FALLOTRN; SCDGF; VEGF-E
PF4	100520680	Correct	ENSSSCG00000037579	Contains sequences for 2 genes PPBP and PF4; transcript ENSSSCT00000096809.4 encodes PF4, transcript ENSSSCT00000045412.6 is chimeric	PF4	Platelet factor 4	Chemokine (C-X-C motif) ligand 4 (CXCL4); Oncostatin A; tropilex; Platelet microbicidal protein 1
PGF	100156404	Correct	ENSSSCG00000002376	Annotated as a lncRNA	PGF	Placental growth factor	vascular endothelial growth factor-related protein (PlGF, PlGF2, D12S1900, PGFL, PAX, PLGF, PGF-2, DKSC-10760)
PLACB	100525175	Correct	ENSSSCG00000009240	Correct	PLACB	Placenta-specific 8	C15, C-15; Orcim; PLACB (b); down-regulated in gastrointestinal cancer protein (DGIC); PNAS-144
PLACBL1	100525635	Correct	ENSSSCG00000014608	Correct	PLACBL1	Placenta-specific 8-like 1	
PLACBL1*	100524999	Correct	ENSSSCG00000009239	Correct	PLACBL1*	Placenta-specific 8-like 2	
PPBP	399870	Correct	ENSSSCG00000037579	Contains sequences for 2 genes PPBP and PF4; transcript ENSSSCT00000041161.2 encodes PPBP; transcript ENSSSCT00000045412.2 is chimeric	PPBP	Pro-platelet basic protein	Chemokine (C-X-C motif) ligand 7; CXCL7; Connective tissue activation peptide III, CTAP III; CTAP3; Neutrophil activating peptide, NAP-2; beta thromboglobulin, B-TG1; Beta-TG; low-affinity platelet factor IV; LA-PF4; leukocyte-derived growth factor; LDGF; macrophage-derived growth factor, MDGF; PBP; small inducible cytokine subfamily B, member 7, SCYB7; thrombocidin-1, TC1; TC2; thrombogobulin, beta-1; TGB; TGB1; THBGB1
PRL	396965	Correct	ENSSSCG00000039721	Correct	PRL	Prolactin	Growth hormone-like Superfamily
PSPN	100518237	Elongated	ENSSSCG00000015540	Correct	PSPN	Persephin	PSP
PTN	397609	Correct	ENSSSCG00000016522	Correct	PTN	Pleiotrophin	Neurite growth-promoting factor 1; Heparin-binding growth-associated molecule, HB-GAM; Heparin-binding growth factor 8, HBGF-8; Osteoblast specific factor 1, OSF-1; Heparin-binding neutrophic factor, HBNF; Heparin-binding brain mitogen, HBM
RARRES2	100141314	Correct	ENSSSCG00000015419	Correct	RARRES2	Retinoic acid receptor responder 2	Tazarotene induced 2 (TIG-2); chemerin; HP10413
RBP4	397124	Correct	ENSSSCG00000010479	Correct	RBP4	Retinol binding protein 4	RBP
RETN	396674	Correct	ENSSSCG00000013575	Correct	RETN	Resistin	RSTN; RETN1; C/EBP-epsilon regulated myeloid-specific secreted cysteine-rich protein precursor 1, HXCP1; found in inflammatory zone 3, FIZ3; Adipose tissue-specific secretory factor, ADSF; Cysteine-rich secreted protein A12 alpha-like 2
SCGB3A1	100511999	Correct	ENSSSCG00000014008	Correct	SCGB3A1	Secretoglobin, family 3A, member 1	Uteroglobin-related protein 2, UGRP2; high in normal lung; HIN-1; LUSD5; pneumo secretory protein 2, PSP-2
SERPINE1	396945	Correct	ENSSSCG00000025698	Truncated (401/402 aa)	SERPINE1	Serine (or cysteine) proteinase inhibitor; clade E	Nexin, plasminogen activator inhibitor-1, PAI1; PAI-1; PLANH1
SFRP1	100621622	Correct	ENSSSCG00000021822	Correct	SFRP1	Secreted frizzled-related protein 1	secreted apoptosis-related protein 2, SARP2; FRP; FRP-1; frz1
SFRP2	100516027	Correct	ENSSSCG00000009004	Correct	SFRP2	Secreted frizzled-related protein 2	secreted apoptosis-related protein 1, SARP1
SFRP5	100515176	Correct	ENSSSCG00000010529	Correct	SFRP5	Secreted frizzled-related protein 5	secreted apoptosis-related protein 3, SARP3
SPP1	397087	Correct	ENSSSCG00000009216	Correct	SPP1	Secreted phosphoprotein 1	Osteopontin, OPN; bone sialoprotein I, BNSP; BSPI; early T-lymphocyte activation 1, ETA-1; ETA-1
TGFA	397484	Correct	ENSSSCG00000008326	Correct	TGFA	Transforming growth factor, alpha	
TGFB1	397078	Correct	ENSSSCG00000003017	Correct	TGFB1	Transforming growth factor, beta 1	Camurati-Engelmann disease, CED; DPD1; LAP; TGFB; TGFB1
TGFB2	397084	Correct	ENSSSCG00000018916	Elongated (443/442 aa)	TGFB2	Transforming growth factor, beta 2	Glioblastoma-derived T-cell suppressor factor; G-TSF; BSC-1 cell growth inhibitor; Polyergic; Cetermin; LDS4
TGFB3	397400	Correct	ENSSSCG00000021385	Correct	TGFB3	Transforming growth factor, beta 3	ARVD
THBS1	492313	Correct	ENSSSCG00000004789	Correct	THBS1	Thrombospondin 1	TSP; THBS; TSP1
THNSL2	100737616	Low quality (1 N, 1 S) protein	ENSSSCG00000025106	Truncated (482/484 aa)	THNSL2	Threonine synthase-like 2	Secreted osteoclastogenic factor of activated T cells (SOFAT), TKSL, TBK2
THPO	100620258	Correct	ENSSSCG00000023909	Truncated (477/481 aa)	THPO	Thrombopoietin	Myeloproliferative leukemia virus oncogene ligand; megakaryocyte growth and development factor
TMEFF1	102106024	Correct	ENSSSCG00000005391	Contains sequences for 3 genes (TMEFF1, MSANTD3-TMEFF1, and MSANTD3); transcript ENSSSCT00000059840.2 encodes TMEFF1	TMEFF1	Transmembrane protein with EGF-like and two follistatin-like domains 1	Tomorregulin-1 (TR-1); HT383; C9orf72; CT120.1
TMEFF2	614831	Correct	ENSSSCG00000016064	Elongated (403/374 aa)	TMEFF2	Transmembrane protein with EGF-like and two follistatin-like domains 2	TR; HPP1; TPEF; tomorregulin-2 (TR-2); TENB2; CT120.2
TNF	397086	Correct	ENSSSCG00000001404	Correct	TNF	Tumor necrosis factor	TNF superfamily member 2, TNFSF2; TNFA; TNF-a; Cachectin; DIF; TNF-alpha
TNFSF10	406191	Correct	ENSSSCG00000020906	Contains sequences for 2 genes, TNFSF10 and DHX8 (build 11.1); transcript ENSSSCT00000042390.2 encodes TNFSF10; transcript ENSSSCT00000034499.2 is chimeric	TNFSF10	Tumor necrosis factor (ligand) superfamily member 10	TRAIL; APO-2L; CD253
TNFSF11	100037976	Correct	ENSSSCG00000009429	Correct	TNFSF11	Tumor necrosis factor (ligand) superfamily, member 11	Receptor activator of NFkB ligand (RANKL); TNF-related activation-induced cytokine (TRANCE); RANKL2; osteoprotegerin ligand (OPGL); osteoclast differentiation factor (ODF); sTRF; CD254
TNFSF12	100127153	Correct	ENSSSCG00000023124	Truncated (233/249 aa)	TNFSF12	Tumor necrosis factor (ligand) superfamily, member 12	APO3L; DR3LG; TNF-related WEAK induce of apoptosis (TWEAK); CD255
TNFSF13	100127162	Correct	ENSSSCG00000016521	Correct	TNFSF13	Tumor necrosis factor (ligand) superfamily, member 13	A proliferation-inducing ligand (APRIL); TNF and APOL-related leukocyte-expressed ligand 2 (TALL-2); TNF-related death ligand 1; (TRDL-1); Tumor necrosis factor-like protein (TNF2); TWE-PRIL; CD256
TNFSF13B	100038026	Incorrect	ENSSSCG00000009542	Truncated (233/281 aa)	TNFSF13B	Tumor necrosis factor (ligand) superfamily, member 13b	B-cell Activating Factor; BAFF; B-lymphocyte Stimulator; BLYS; NF and Apoc related ligand; TALL1; TALL-1; TNAMC (TNFSF13); Dendritic Cell-derived TNF-like; DTL; CD257
TNFSF14	100519468	Correct	ENSSSCG00000026695	Correct	TNFSF14	Tumor necrosis factor (ligand) superfamily, member 14	LIGHT; Herpesvirus entry mediator ligand, HVEML; CD258
TNFSF15	100624969	Correct	ENSSSCG00000034087	Correct	TNFSF15	Tumor necrosis factor (ligand) superfamily; member 15	Vascular endothelial cell growth inhibitor, VEGI; TNF superfamily ligand, TL1A; TNF ligand-related molecule 1, (TL1 ligand
TNFSF9	100738831	Correct	ENSSSCG00000022370	Correct	TNFSF9	TNF (ligand) superfamily; member 9	4-1BB ligand; 4-1BBL; CD137L; TNLG5A; ABI4BE17; CD137
TPT1	397664	Correct	ENSSSCG00000007053	Correct	TPT1	Tumor protein, translationally controlled 1	Fortilin; histamine-releasing factor; P21 TCTP
TSLP	100511591	Elongated (214/158 aa)	ENSSSCG00000014198	Truncated (58/154 aa)	TSLP	Thymic stromal lymphopoietin	Eosinophilic esophagitis 2 (EOE2)
TNLNA	100522017	Correct	ENSSSCG00000033617	Elongated (643/558 aa)	TNLNA	Tastin alpha	IL-14; high molecular weight B cell growth factor; HMW-BCGF; lymphotoxin-alpha-specific response 5; DKFZp451J0118
VEGFA	397157	Missing isoform h	ENSSSCG00000001695	Elongated (427/114 aa)	VEGFA	Vascular endothelial growth factor A	VEGF; VPF
VEGFB	100521837	Correct	ENSSSCG00000013037	Elongated (461/207 aa)	VEGFB	Vascular endothelial growth factor	VEGFL; VRF
VEGFC	100525960	Correct	ENSSSCG00000015770	Correct	VEGFC	Vascular endothelial growth factor C	FLT4 L; VRP
VEGFD	100515670	Correct	ENSSSCG00000012135	Correct	VEGFD	Vascular endothelial growth factor D	c-fos induced growth factor (FIGF)
WNT2	100516839	Correct	ENSSSCG00000016628	Correct	WNT2	Wingless-type MMTV integration site family, member 2	INT11; IRP
XCL1	100513155	Correct	ENSSSCG00000006298	Correct	XCL1	Small inducible cytokine subfamily C, member 1 (lymphotactin)	SCYC1; XCL1; Activation-induced, T cell-derived, and chemokine-related (ATAC); CD8+ T cell specific protein; CL1; LPTN; lymphotaxin; single cysteine motif-1a (SCM-1a); -1b (SCM-1b); SCM-2; SCYC1; XCL2; SCYC2

Data was last collected on September 25, 2019 from Sus scrofa 11.1 build http://www.ensembl.org/Sus_scrofa/info/index. Details of analyses are based on Dawson et al., (2017 a,b) and presented in Materials and Methods and in the PTRD (http://tinyurl.com/huwq3ur).

Table 2. The number of family members of cytokines, chemokines and growth factors among the species.

Superfamily/Classification	Pig	Human	Mouse
Adipocytokines	28	29	29
CCL Chemokines	21	27	35
CSF1 Superfamily	1	1	1
CSF2 Superfamily	1	1	1
CX3CL Chemokines	1	1	1
CXCL Chemokines	16	17	17
EGF Superfamily	13	13	13
EPO Superfamily	2	2	2
FGF Superfamly	23	23	23
FN3 Superfamily	1	1	1
Growth Hormone-like	2	2	2
Hepatokines	7	7	7
IGF Superfamily	2	2	2
IL1 Superfamily	11	11	10
IL10 Superfamily	6	6	7
IL12 Superfamily	1	1	1
IL15 Superfamily	2	1	1
IL17 Superfamily	6	6	6
IL2G Receptor Binding	6	6	6
IL3 Superfamily	1	1	1
IL32 Superfamily	1	1	1
IL34 Superfamily	1	1	1

Superfamily/Classification	Pig	Human	Mouse
IL4 Superfamily	2	2	2
IL5 Superfamily	1	1	1
IL6 Superfamily	7	7	7
LIF OSM Superfamily	3	3	3
Miscellaneous	30	30	30
NGF Superfamily	4	4	4
PDGF Superfamily	7	7	7
PDZ Superfamily	1	1	1
PLAC8 Superfamily	3	2	2
TGFB Superfamily	30	30	30
TNF Superfamily	12	12	12
Type I Interferons	39	18	27
IFNA	17	14	14
IFNB	1	1	1
IFND	11	0	0
IFNE	1	1	1
IFNK	1	1	1
IFNW	8	1	0
IFNZ	0	0	10
Type II Interferons	1	1	1
Type III Interferons	4	4	2
XCL Chemokines	1	2	1

Families and superfamilies were assigned based on HGNC Guidelines. More details can be found in our PTRD http://tinyurl.com/hxxq3ur.

Table 3. The gene family membership of cytokines, chemokines and growth factors in pigs.

Superfamily/Classification (Total # genes)	Genes			
Adipocytokines (28)	ADIPOQ	C1QTNF5	IL18	RARRES2
	ANGPTL2	CAVIN1	IL6	RBP4
	ANGPTL4	CCL2	INHBB	RETN
	ANGPTL6	CCN4	LCN2	SERPINE1
	APLN	CXCL6	LEP	THBS1
	AZGP1	GDF15	METRNL	TNF
	C1QTNF3	HBEGF	NAMPT	WISP1
CCL Chemokines (21)	CCL1	CCL2	CCL25	CCL4
	CCL11	CCL20	CCL26	CCL5
	CCL14	CCL21	CCL27	CCL8
	CCL16	CCL22	CCL28	
	CCL17	CCL23	CCL3L1	
	CCL19	CCL24	CCL3L2*	
CXCL Chemokines (16)	CXCL1	CXCL14	CXCL5	PPBP (CXCL7)
	CXCL10	CXCL16	CXCL6	
	CXCL11	CXCL17	CXCL8	
	CXCL12	CXCL2	CXCL9	
	CXCL13	CXCL3	PF4 (CXCL4)	
EGF Superfamily (13)	AREG	EREG	NRG2	TMEFF2
	BTC	HBEGF	NRG3	
	EGF	MSANTD3-TMEFF1	TGFA	
	EPGN	NRG1	TMEFF1	
EPO Superfamily (2)	EPO	THPO		
FGF Superfamily (22)	FGF1	FGF7	FGF13	FGF20
	FGF2	FGF8	FGF14	FGF21
	FGF3	FGF9	FGF16	FGF22
	FGF4	FGF10	FGF17	FGF23
	FGF5	FGF11	FGF18	
	FGF6	FGF12	FGF19	
Growth Hormone-like (2)	GH1	PRL		
Hepatokines (7)	AHSG	FETUB	INHBE	SELENOP
	ANGPTL4	FGF21	LECT2	
IGF Superfamily (2)	IGF1	IGF2		
IL1 Superfamily (11)	IL33	IL36G	IL1A	IL1F10
	IL36A	IL36RN	IL1B	IL1RN
	IL36B	IL18	IL1B2*	
IL10 Superfamily (6)	IL10	IL20	IL24	
	IL19	IL22	IL26	
IL15 Superfamily (2)	IL15	IL15L*		
IL17 Superfamily (6)	IL17A	IL17C	IL17F	IL25
	IL17B	IL17D		
IL2G Receptor Binding (6)	IL15	IL21	IL7	IL9
	IL2	IL4		
IL4 Superfamily (2)	IL4	IL13		
IL6 Superfamily (7)	CSF3	CTF2	IL23A	IL6
	CTF1	IL11	IL31	
LIF OSM Superfamily (3)	LIF	CTF2	OSM	
Miscellaneous (30)	AIMP1	CRLF1	MST1	SPP1
	ASIP	DLK1	MYDGF	TGFA
	BMP1	FLT3LG	PAEP	THNSL2
	C13H17orf99	HGF	PTN	TPT1
	CER1	HMGB1	SCGB3A1	TXLNA
	CKLF	IK	SFRP1	WNT2
	CLEC11A	KITLG	SFRP2	
	CMTM1	MDK	SFRP5	
NGF Superfamily (4)	BDNF	NTF3	NGF	NTF4
PDGF Superfamily (8)	PDGFA	PDGFC	VEGFA	VEGFC
	PDGFB	PGF	VEGFB	VEGFD
PLAC8 Superfamily (3)	PLAC8	PLAC8L1	PLAC8L2*	
TGFB Superfamily (30)	AMH	BMP6	GDF5	MSTN
	ARTN	BMP7	GDF6	NODAL
	BMP10	BMP8A	INHA	NRTN
	BMP15	BMP8B	INHBA	TGFB1
	BMP2	GDF1	INHBB	TGFB2
	BMP3	GDF11	INHBC	TGFB3
	BMP4	GDF15	INHBE	
	BMP5	GDF2	LEFTY2	
TNF Superfamily (12)	EDA	TNF	TNFSF12	TNFSF14
	LTA	TNFSF10	TNFSF13	TNFSF15
	LTB	TNFSF11	TNFSF13B	TNFSF9
Type I Interferons (39)				
IFNA (17)	IFNA1	IFNA6	IFNA12	IFNA17*
	IFNA2	IFNA8	IFNA13	IFNAW*
	IFNA3	IFNA9*	IFNA14	
	IFNA4	IFNA10	IFNA15*	
	IFNA5	IFNA11	IFNA16*	
IFNB (1)	IFNB			
IFND (11)	IFND1*	IFND2*	IFND5*	IFND8*
	IFND10*	IFND3*	IFND6*	IFND9*
	IFND11*	IFND4*	IFND7*	
IFNE (1)	IFNE			
IFNK (1)	IFNK			
IFNW (8)	IFNW1	IFNW4*	IFNW7*	
	IFNW2*	IFNW5*	IFNW8*	
	IFNW3*	IFNW6*		
Type III Interferons (4)	IFNL1	IFNL3	IFNL3L*	IFNL4

Families and superfamilies were assigned based on HGNC Guidelines. More details can be found in our PTRD http://tinyurl.com/hxxq3ur. * = porcine-specific genes

Table 4: Research products that are commercially available for swine immunity studies.						
Gene Symbol	Approved Full Name	Specific Porcine Antibodies Tested or 100% immunogen sequence identical	Predicted Cross-reactive Antibodies Partial or unknown immunogen identical	Porcine Non Reactive Antibodies	Porcine Protein Assay	Porcine Protein Sources
ADIPOQ	Adiponectin	pAb (PHD: 18535936)	anti-human pAb (HB), Anna Systems Biology # AFP32799		ELISA (PHD: 18535936)	R (marers Bioenetor # RDS73525)38
AMFR	Autocrugi tRNA synthetase complex interacting multifunctional protein 1	anti-human/porcine pAb (WB), Novus # NBP2-2336 anti-human/porcine pAb (WB), Origene # TA346896	anti-human pAb (HB), Anna Systems Biology # AFP40542			
APOA1	Anti-Atherogenic hormone	anti-human/porcine pAb (WB, IHC), Origene # TA336315	anti-human pAb (WB, IHC), Anna Systems Biology # AFP40542			
ANGPT1	Angiopoietin 1	anti-human/porcine pAb (WB), Invitrogen # PA5-50908 anti-human/porcine pAb (WB) LifeSpan BioSciences # LS-C303878	anti-mouse pAb (WB) Anna Systems Biology # AFP60328 anti-mouse pAb (WB) Anna Systems Biology # CA6F00298 anti-mouse pAb (WB), Abcam # ab8451 anti-human pAb (WB) United States Biological # 135857		ELISA (Invitrogen # PA4107) ELISA (Millipore Sigma # RA60073) Porcine Cytokine Antibody Array Q6, Raybiotech # QAP-CYT-4-1 Porcine Cytokine Antibody Array Q50, Raybiotech # QAP-CAA-50-1	
ANGPTL1	Angiopoietin like 1	anti-human/porcine pAb (WB), Novus # NBP2-15389	anti-human pAb (WB), Anna Systems Biology # AFP40535		ELISA (Lifespan # LS-F42801-1)	
ANGPTL2	Angiopoietin like 2	anti-human/porcine pAb (WB), Anna Systems Biology # AFP40535	anti-human pAb (WB), Anna Systems Biology # AFP40535			
ANGPTL4	Angiopoietin like 4	anti-porcine pAb (WB), Lifespan # LS-C200630 anti-porcine pAb (WB, IHC), LifeSpan # LS-C200630				
ARG1	Arginin	anti-human/porcine pAb (WB), LifeSpan # LS-C313656			ELISA Genie Technologies # F5056	
BDNF	Brain derived neurotrophic factor	anti-mouse/porcine mAb (WB), Lifespan # LS-C340103 anti-human/porcine pAb (WB), Origene # TA346303 anti-human/porcinemouse pAb (WB), Lifespan # LS-C125203 anti-porcine pAb (WB), US Biological # 130403 anti-human/mouse pAb (WB), Santa Cruz # sc-2514 (PHD: 27695800)	anti-human pAb (WB), Anna # AFP41089 anti-human/mouse pAb (WB), Anna # AFP41070 anti-human mAb 9H8 (WB), Santa Cruz# sc-65514 anti-human mAb BC1 (WB), Santa Cruz # sc-65513 anti-human pAb (WB), Anna Systems Biology # AFP50878		ELISA (Genesis # GR106003) ELISA (Advanced BioChemicals # ABCE-EL-P2036	Mature BDNF Rapid ELISA kit Biosensis Pty Ltd # BEK-2211-1P (PHD: 30837128) Human BDNF is active on porcine cells; mature forms identical (PHD: 18762731)
BMP10	Bone morphogenetic protein 10	anti-human/porcine pAb (WB) LifeSpan BioSciences # LS-C127031 anti-human/porcine pAb (WB) LifeSpan BioSciences # LS-C449484 anti-human/porcine pAb (WB) OriGene Technologies # TA341935 anti-human/porcine pAb (WB) OriGene Technologies # TA341943			ELISA (Advanced BioChemicals # ABCE-EL-P2036	
BMP2	Bone morphogenetic protein 2	anti-porcine pAb (WB), Invitrogen # PA5-69903 anti-porcine pAb (WB, IHC) United States Biological # 136438	anti-rat pAb (WB) Anna Systems Biology # AFP40969 anti-human pAb (ELISA) Creative Diagnostics # CPBT-65014HU anti-human pAb (WB) Bio-Rad # VMA-0613		ELISA Anna Systems Biology # DKC000737 ELISA (Genesise # GR106206)	
BMP3	Bone morphogenetic protein 3		anti-human pAb (WB, ELISA) Anna Systems Biology # DAE000750 anti-human pAb (WB) Anna Systems Biology # AFP60714		ELISA (Genesise # GR106207)	
BMP4	Bone morphogenetic protein 4	anti-porcine pAb (WB, IHC) United States Biological # 362301 anti-human pAb (IHC) (Abcam # 39073, PHD: 22280612)	anti-human pAb (WB) Anna Systems Biology # AFP60960 anti-human pAb (WB) OriGene Technologies # AP20623PU-N		ELISA (Genesise # GR106208)	
BMP5	Bone morphogenetic protein 5	anti-human/porcine mAb 10A2-10 (WB, ELISA) Proteintech Group # 66757-1-Ig anti-mouse/human/swine pAb (WB, IHC) Fitzgerald Industries International # 30R-AG035	anti-mouse pAb (WB, IHC) OriGene Technologies # TA343441		ELISA (Genesise # GR106209)	
BMP6	Bone morphogenetic protein 6	anti-human/mouse/pig pAb (WB, IHC), Origene # TA346218	anti-human mAb Hm3F-5-1 (Abcam # ab10540) anti-human pAb (WB, IHC), Origene # TA344317		ELISA (Genesise # GR106210)	
BMP7	Bone morphogenetic protein		anti-human pAb (WB), Anna # AFP32938 anti-human pAb (WB), Creative Diag # CPBT-65003RH		ELISA (Genesise # GR106211)	
BMP8a	Bone morphogenetic protein 8a	anti-porcine pAb (ELISA) (Genesise # 106041)			ELISA (Genesise # GR106212)	
CAQTNF3	C-q and tumor necrosis factor related protein 3	anti-human/porcine pAb (WB) (Anna Systems Biology # AFP60924)				
CAQTNF5	C-q and tumor necrosis factor related protein 5	pAb (WB, IHC) (PHD: 22278969)				
CCL11	Chemokine (C-C motif) ligand 11	anti-porcine pAb (ELISA) Kingfisher # KP11074S-100				Recombinant (P. pastoris) (partial sequence 74997 AA), Kingfisher Biotech # RP10875-100 Recombinant (P. pastoris) (partial sequence 77153 AA), Kingfisher Biotech # RP10338-100
CCL19	Chemokine (C-C motif) ligand 19					
CCL2	Chemokine (C-C motif) ligand 2	anti-human mAb 5D3-F7 (WNAI,) (IHC) abbiocenice # 14-7089 (PHD: 12794178) anti-porcine mAb CCL2-5-2 (ELISA) (J Lunney, B Wagner, pers comm) anti-porcine mAb CCL2-10 (J Lunney, B Wagner, pers comm) anti-porcine mAb CCL2-18-1 (J Lunney, B Wagner, pers comm) anti-porcinemAb CCL2-74-1 (J Lunney, B Wagner, pers comm) anti-porcine mAb CCL2-18-1 (ELISA) (J Lunney, B Wagner, pers comm) anti-porcine mAb CCL2-33-2 (J Lunney, B Wagner, pers comm) anti-porcine mAb CCL2-33-3 (J Lunney, B Wagner, pers comm) anti-porcine mAb CCL2-46-1 (J Lunney, B Wagner, pers comm) anti-porcine mAb CCL2-46-2 (J Lunney, B Wagner, pers comm) anti-porcine mAb CCL2-56-1 (J Lunney, B Wagner, pers comm) anti-porcine mAb CCL2-83 (J Lunney, B Wagner, pers comm) anti-porcine pAb (ELISA) Kingfisher Biotech # RB0089S-100. anti-bovine pAb (ELISA, WB) Biorad # AHP2381 anti-porcine pAb (ELISA, WB) Biorad # AHP3284			ELISA (Cayman # 404433) ELISA (Kingfisher # RB0089S-100) ELISA (Millipore Sigma # RA60061) ELISA (Raybiotech # ELP-CCL2-1) Porcine Cytokine Antibody Array 6L, Raybiotech # QAP-CYT-3-1 Porcine Cytokine Antibody Array Q50, , Raybiotech # QAP-CAA-50-1	P (Rb) (partial 76 aa), Kingfisher # RP00275-100; (Rb) (partial 75aa), Seratec #PPP0168; (MoRP) 100
CCL20	Chemokine (C-C motif) ligand 20					Recombinant (P. pastoris) (partial sequence 116/127 AA), Kingfisher Biotech # RP0875S-100)
CCL21	Chemokine (C-C motif) ligand 21		anti-human pAb (WB), US Biological # 35257A			Recombinant (P. pastoris) (partial sequence 116/127 AA), Kingfisher Biotech # RP0875S-100)
CCL23	Chemokine (C-C motif) ligand 23					R (MoRP) (Kingfisher Biotech # RP0875S-100) (PHD: 28884168)
CCL28	Chemokine (C-C motif) ligand 28					P (Rb) (partial 52/101 AA), Kingfisher # RP10891-100
CCL28	Chemokine (C-C motif) ligand 28	anti-human mAb 62705 (WB) R & D Systems # MAB1717, PHD # 17918257				Recombinant (P. pastoris) (partial sequence 116/127 AA), Kingfisher Biotech # RP0875S-100)
CCL3L1	Chemokine (C-C motif) ligand 3 like 1	anti-porcine pAb (WB, ELISA), Kingfisher # PR0391S-100 anti-porcine pAb (WB, ELISA) Biorad # AHP2385			Porcine Cytokine Antibody Array 6L, Abcam # ab197480 Porcine Cytokine Antibody Array 6L, Raybiotech # QAP-CYT-3-1	
CCL4	Chemokine (C-C motif) ligand 4	pAb (WB, ELISA) Kingfisher Biotech # PR0395-100 pAb (ELISA), Seratec # AHP2386 Porcine Chemokine Array C1 Raybiotech # AAP-CHE-1-2 Porcine Cytokine Antibody Array 6L Abcam # ab197480			ELISA (Millipore Sigma # RA60063)	R (Rb) (partial 69 aa), Kingfisher # RP00695-100; R (Rb) (partial 68 aa), Seratec #PPP0167; (MoRP) 100
CCL5	Chemokine (C-C motif) ligand 5	anti-human pAb (IB), R&D (PHD: 17332777) anti-porcine pAb (WB), Lifespan # LS-C372475 anti-porcine pAb (WB), US Biological # 35486	anti-mouse pAb (WB), Anna # AFP37191		Porcine Chemokine Antibody Array Q4 Raybiotech # QAP-CHE-4-1 Porcine Cytokine Antibody Array Q50, Raybiotech # QAP-CAA-50-1 ELISA Anna Systems Biology # DKC000720	R (Rb) (partial 69 aa), Kingfisher # RP00695-100; R (Rb) (partial 68 aa), Seratec #PPP0167; (MoRP) 100
CCL6	Chemokine (C-C motif) ligand 6	anti-porcine pAb (WB), US Biological # 35487				
CCN4	CCN family member 4	anti-human pAb (WB) Anna Systems Biology # AFP62960	anti-human pAb (WB) Anna Systems Biology # AFP62960			
CCR7	C-C chemokine receptor type 7				ELISA LifeSpan BioSciences # LS-F42886-1	
CLEC11A	C-type lectin domain family 11, member A	anti-human/porcine pAb (WB), Lifespan # LS-C373825				
CNTF	Ciliary neurotrophic factor	anti-porcine pAb (WB), Lifespan # LS-C372403 anti-porcine pAb (WB), US Biological # 130408				
CRLF1	Cytokine receptor like factor 1	anti-human/porcine pAb (WB), Origene # TA346188 anti-human/porcine pAb (WB) Lifespan # LS-C310363			ELISA LifeSpan BioSciences # LS-F42031-1	
CSF1	Colony stimulating factor 1 (macrophage)	anti-human/porcine pAb (WB, IHC), Thermo # PA5-42057	anti-human pAb (WB, IHC), Thermo # PA5-42057			P (rpg) (AHM), CSF1-Fc, Biorad # PPP031, (PHD:27448344)
CSF2	Colony stimulating factor 2 (granulocyte macrophage)	anti-porcine mAb 211B2 (ELISA, N, WB) R & D Systems # mAb7211(); mAb 1, Waddell, pers comm) anti-porcine pAb (ELISA, N, WB) R & D Systems # AF711			ELISA (Invitrogen # ESCSF2) ELISA (Sigma Millipore # RA60066) Porcine Cytokine/Chemokine Multiplex Assay (EMD Millipore # PCYTMG-23K-13PX) Porcine Cytokine / Chemokine Array 13-plex (Eve Technologies #PCG3) Porcine Cytokine Array Q1 (Ray Biotech # QAP-CYT-1-1)	P (Rb) (partial 77 aa), Kingfisher # RP00275-100; R (mares) (partial 77 aa), Seratec #PPP0168; R (Rp), BioRPS-300
CSF3	Colony stimulating factor 3	anti-porcine pAb (WB), Lifespan # LS-C200664 anti-porcine pAb (WB), US Biological # 138848				
CTF1	Cardiotrophin 1		anti-human pAb (WB), Anna # AFP51942 anti-human pAb (WB), Origene # TA340633		ELISA LifeSpan BioSciences # LS-F42863-1	
CXCL1	Chemokine (C-X-C motif) ligand 1	anti-porcine mAb CXCL1-1-2 (J Lunney, pers comm) anti-porcine mAb CXCL1-1-2 (J Lunney, pers comm) anti-porcine mAb CXCL1-1-4 (IB) (ELISA) (J Lunney, pers comm)				R (Rb) (partial 77aa) Kingfisher # RP00865-100
CXCL10	Chemokine (C-X-C motif) ligand 10	anti-porcine mAb CXCL10- 1-1 (J Lunney, pers comm) anti-porcine mAb CXCL10-1-2 (J Lunney, pers comm) anti-porcine mAb CXCL10-1-3 (J Lunney, pers comm) anti-porcine mAb CXCL10-1-4 (J Lunney, pers comm) anti-porcine mAb CXCL10-1-6 (J Lunney, pers comm) anti-porcine mAb CXCL10-1-8 (J Lunney, pers comm) anti-porcine mAb CXCL10-1-9 (J Lunney, pers comm) anti-porcine mAb CXCL10-2-10 (J Lunney, pers comm) anti-porcine mAb CXCL10-2-11 (J Lunney, pers comm) anti-porcine mAb CXCL10-2-36 (J Lunney, pers comm) anti-porcine pAb (ELISA) Kingfisher Biotech # PR1095-100) anti-porcine pAb (ELISA, WB), Biorad AHP2385			ELISA (Millipore Sigma # RA60132) ELISA (Kingfisher Biotech # DYC9220-003) ELISA (Berlin Bioreagents # A35419)	R (Rb) (partial 82 aa), Kingfisher # RP00945-100; R (Rp) (partial 82 aa), Seratec #PPP0182; R (Rp) BioRPS-300
CXCL11	Chemokine (C-X-C motif) ligand 11					R (Rb) (partial 79 aa), Kingfisher # RP00955-100; R (Rp) (partial 78 aa), Creative Biomart # RPA00551-100; R (Rp), BioRPS-100
CXCL12	Chemokine (C-X-C motif) ligand 12	anti-porcine/mouse/human pAb (WB), Lifespan # LS-B943 anti-porcine/mouse/human pAb (WB), Anna Systems Biology # AVAP07031			ELISA Novus Biologicals # NBP2-70377 ELISA LifeSpan BioSciences # LS-F47758 ELISA Anna Systems Biology # DKC000697	
CXCL13	Chemokine (C-X-C motif) ligand 13					R (Rb) (partial 88 aa), Kingfisher # RP10965-100
CXCL14	Chemokine (C-X-C motif) ligand 14	Anti-human/porcine (WB) Lifespan # LS-C 80558				
CXCL8 (IL8)	Chemokine (C-X-C motif) ligand 8 (IL-8)	mAb 10D6N (ELISA, N, WB) R&D # mAb6001 mAb 2B11/B (ELISA, N, WB) R&D # MAb6035 mAb G9.B1 G9.D4 (PHD: 12778873) mAb 2B4-2L2 (WB) Thermo # 701276 pAb (ELISA) Cell Sciences # CP115 pAb R&D # AF535 pAb Biorad # AHP8362 pAb (ELISA) Kingfisher # PR0545S-100 pAb (ELISA, N, WB) R&D # AB-208-NA	anti-swine mAb (IMH (IHC) Biorad # MCA1800		ELISA R&D # P8000 ELISA Tridelta # TCF 40 ELISA, Invitrogen # KSC8081 ELISA, Kingfisher # Y 002545-002 LuminexMultiplex Assay (PHD: 18604043) ProcartaPlex™ Cytokine / Chee Porcine Panel, Thermo # LSC0002M MILLIPLEX MAP Porcine Cytokine/Chemokine Multiplex Assay EMD Millipore #PCYTMG-23K-13PX Porcine Cytokine / Chemokine Array 13-plex, Eve Technologies #PCG3 Porcine Cytokine Array Q1, Ray Biotech # QAP-CYT-1-1	R (Ec) Cell Sciences # CR1031A R&D # E36-PI-025; Seratec # PPP0168 R (Ec), Prospec #CHM-340 P (Rb) (partial 78 aa), Kingfisher # RP00265-100 P (Rb) (partial 77 aa), Seratec #PPP024; R (Rp), BioRPS-300
CXCL9	Chemokine (C-X-C motif) ligand 9	anti-porcine pAb (WB), Kingfisher # PR0535S-100 anti-porcine pAb (ELISA, WB), Biorad AHP2387 Porcine Chemokine Array C1 Raybiotech # AAP-CHE-1-2 Porcine Cytokine Antibody Array 6L Abcam # ab197480			ELISA (Kingfisher Biotech # DYC9220-003) ELISA (Sigma Millipore # RA60064) ELISA (Berlin Bioreagents # A35419)	R (Rb) (partial 104 aa), Kingfisher # RP00395-100; , R (Rp) (partial 104 aa), Seratec #PPP018; R (Rp), BioRPS-170
DLK1	Delta like non canonical Notch ligand 1	anti-human pAb (WB) Anna Systems Biology # AFP40970; anti-human pAb (WB) OriGene Technologies # TA328811			ELISA LifeSpan BioSciences # LS-F42291-1	
EBI3	Epstein Barr virus induced gene 3		anti-human mAb 3F3H10, Proteintech Group # 66354		ELISA (IL-35) Genesise # GR110308	
EDA	Ectodysplasin A	anti-human/porcine pAb (WB), Lifespan # LS-C102510 anti-human/porcine pAb (WB), Origene # TA336108				
EGF	Epidermal growth factor	anti-porcine mAb (WB) Biorad # LAA12606 anti-porcine pAb (WB) Biorad # AHP2388 anti-human/porcine pAb (WB) Origene # LS-C369867	anti-human pAb (WB) Origene # TA346685		ELISA Anna Systems Biology # DKC000645	Recombinant (Cell Sciences # PN21-AWU100)
EPO	Erythropoietin	anti-porcine pAb (WB, ELISA), Kingfisher # KP10503-100 anti-porcine pAb (ELISA, WB), Biorad AHP2389			ELISA Anna Systems Biology # DKC000644 ELISA (Kingfisher Biotech # DYC10955-003) ELISA (Genesise # GR106213)	R (Rb) (partial 168 aa), Kingfisher # RP10503-100; R (Rp) (partial 167aa), Seratec #PPP021
EPRG	Epiregulin	anti-human/porcine pAb (IHC) PHD: 23671122			ELISA Biotin Bio # EK13bk-PO ELISA LifeSpan BioSciences # LS-F42811-1	
FGF1	Fibroblast growth factor 1	anti-rat pAb (WB) United States Biological # 48108			ELISA LifeSpan BioSciences # LS-F22276-1 ELISA Anna Systems Biology # DKC000680	Recombinant (E. coli) (LifeSpan BioSciences # LS-G11336)
FGF10	Fibroblast growth factor 10		anti-human pAb (WB) LifeSpan BioSciences # LS- C306110		ELISA (IL-35) Genesise # GR110308	human FGF1 is active on porcine cells.
FGF11	Fibroblast growth factor 11	anti-human/porcine pAb (WB) LifeSpan BioSciences # LS-C101602 anti-human/porcine pAb (WB) LifeSpan BioSciences # LS-C136310				
FGF13	Fibroblast growth factor 13	anti-human/porcine pAb (WB) Abnova # PAB27503 anti-human/porcine pAb (WB), Lifespan # LS-C189495				
FGF16	Fibroblast growth factor 16	anti-human/porcine pAb (WB) LifeSpan BioSciences # LS-C101602				
FGF18	Fibroblast growth factor 18	anti-human/porcine pAb (WB) LifeSpan BioSciences # LS-C188751				
FGF21	Fibroblast growth factor 21	anti-human/porcine pAb (WB, IHC) LifeSpan BioSciences #LS- B14507				
FGF23	Fibroblast growth factor 23	anti-human/porcine pAb (WB) LifeSpan BioSciences #LS- C101006 anti-human/porcine pAb (WB) OriGene Technologies # TA343340				
FGF23	Fibroblast growth factor 23	anti-porcine mAb 9F8 E12 F2 C8 Raybiotech # 126-0022			ELISA (Cusabio Biotech Co, Ltd) (PHD: 24478031) ELISA (ELP- FGF-23, Raybiotech Inc.) (PHD: 33664445)	
FGF2	Fibroblast growth factor 2	anti-human/porcine pAb (WB) LifeSpan BioSciences # LS-C12354	anti-human mAb MC-GF1 (ELISA, IHC) Abcam # ab165		ELISA LifeSpan BioSciences # LS-F 22276 ELISA Novus Biologicals # NBP2-66991	
FGF20	Fibroblast growth factor 20	anti-human/porcine pAb (WB, IHC) LifeSpan BioSciences #LS- C115596				
FGF21	Fibroblast growth factor 21	anti-human/porcine pAb (WB, IHC) LifeSpan BioSciences #LS-B5884			ELISA (PHD: 22984956) ELISA LifeSpan BioSciences # LS-F 23643	
FGF23	Fibroblast growth factor 23	anti-human/porcine pAb (WB) Hualbio # E91308-92	anti-human pAb (WB, IHC) Hualbio # E91308-92		ELISA LifeSpan BioSciences # LS-F 35368	
FGF3	Fibroblast growth factor 3	anti-human/porcine pAb (WB) LifeSpan BioSciences # LS-B11823 anti-human/porcine pAb (WB) OriGene Technologies # TA340387				
FGF4	Fibroblast growth factor 4	anti-human/porcine pAb (WB) LifeSpan BioSciences # LS-C108664	anti-human mAb (IHC) Thermo Fisher # 701804		ELISA LifeSpan BioSciences # LS-F43904	
FGF5	Fibroblast growth factor 5	anti-human/porcine pAb (WB) LifeSpan BioSciences # LS-C108334			ELISA LifeSpan BioSciences # LS-F43837	
FGF7	Fibroblast growth factor 7	anti-human/porcine pAb (IHC, WB) LifeSpan BioSciences # LS-C 286724				
FGF8	Fibroblast growth factor 8	anti-mouse/human pAb (WB) United States Biological # 48157	anti-human pAb (WB) United States Biological # 48157		ELISA Abbexa # abx254870	
FGF9	Fibroblast growth factor 9	anti-mouse/human/porcine pAb (WB) Anna # AFP54809 anti-human/porcine pAb (WB), Lifespan # LS- C368948 anti-human/porcine pAb (WB), Origene # TA339235			ELISA Abbexa # abx254870	
FLT3LG	Fms-related tyrosine kinase 3 ligand	anti-porcine pAb (ELISA, WB), Kingfisher KP11475-100				R (PHD: 29315454) R (EC), Prospec #CYT-104;
GDF1	Growth differentiation factor 1				ELISA LifeSpan BioSciences # LS-F44536-1	
GDF11	Growth differentiation factor 11	anti-mouse/porcine pAb (WB) BioVyt # bs4024G anti-mouse/porcine pAb (ZWB) LifeSpan BioSciences # LS-C 49931				
GDF15	Growth differentiation factor 15	anti-mouse/human/porcine pAb (WB), LifeSpan BioSciences # LS-C 354428			ELISA LifeSpan BioSciences # LS-F 38595-1	
GDF2	Growth differentiation factor 2		anti-mouse/human pAb (WB) Anna Systems Biology # AFP55308 anti-mouse/human pAb (WB) OriGene Technologies # TA333768 anti-mouse/human pAb (WB) United States Biological # 481712		ELISA LifeSpan BioSciences # LS-F 44606-1	
GDF5	Growth differentiation factor 5		anti-mouse/human pAb (WB) OriGene Technologies # TA342655			
GDF9	Growth differentiation factor 9		anti-human pAb (WB) Abcam # ab38962			
GH1	Growth hormone 1	anti-porcine mAb PSB.5 (ELISA), Genisar # YV5400-35 anti-porcine pAb (WB), Avea # AFP41750 anti-porcine pAb (WB), Lifespan # LS-C123670			ELISA Fitzgerald Industries # 30R-1038 ELISA LifeSpan BioSciences # LS-F5337	
HBEGF	Heparin-binding epidermal growth factor-like growth factor				ELISA (Anna Systems Biology # DKB000348)	
HGF	Hepatocyte growth factor, hepapoietin A	anti-human/porcine pAb (WB), Avea # AFP44317 anti-human/porcine pAb (WB), Origene # TA335252 anti-human/porcine Ab (WB), Lifespan # LS-B4867			ELISA Abbexa # abx252740	R (EC), ProSpec #CYT-322
HMGB1	High mobility group box 1	anti-porcine mAb F21 (WB) OriGene Technologies # AM08447AF-N	anti-mouse human mAb EPR3507 (IHC) Abcam # EPR3507 anti-human mAb 2F1 (WB) OriGene Technologies # TA337531, United States Biological # 031375		ELISA 18L International # ST10311, PHD: 15950136	
IFNA		anti-porcine mAb F17 (ELISA, IHC, IP, N, WB), R&D # 27100-1 anti-porcine mAb G10, Biorad # MCA10952 anti-porcine mAb K9 (ELISA, IHC, IP, N, WB), R&D #27100-1 anti-porcine pAb (ELISA), Kingfisher # PR11225-100 anti-porcine pAb (ELISA), Kingfisher # PR0845S-100			ELISA, Lifespan Biosciences # LS-F5458 ELISA, PBL Assay Sciences #47100-1 ELISA, Raybiotech # ELP-IFNa-1 ELISA, Millipore Sigma # RA60135; (IHT Procarta, Plex™ Simplex Kit, Thermo # FCSC0001N Porcine Cytokine Antibody Array 6L Abcam # ab197480	P (Ec), Cell Sciences # CR1035A, P (Rp)(partial 166/189 aa), Kingfisher # RP00695-100, Abcam # ab28514 R (mares) PBL Assay Sciences #17100-1; Cell Sciences # CR1035A (mares), R&D #27100-1, Avea # PBL-17100-1; R (Rb), BioRPS-180
IFNB1	Interferon beta 1	anti-porcine pAb, Kingfisher # PR0124S-100 anti-porcine pAb (WB), Abcam # ab19285 anti-porcine pAb (WB) Rockland Immunochemicals # 214-401-C40 anti-porcine pAb, (WB) US Biological # 140908 anti-porcine mAb IFNb-1.2 (J Lunney, pers comm) anti-porcine mAb IFNb-1.4 (J Lunney, pers comm) anti-porcine mAb IFNb-1.25 (J Lunney, pers comm) anti-porcine mAb IFNb-1.23 (J Lunney, pers comm) anti-porcine mAb IFNb-1.28 (J Lunney, pers comm) anti-porcine mAb IFNb-1.29 (J Lunney, pers comm) anti-porcine mAb IFNb-1.40 (J Lunney, pers comm) anti-porcine mAb IFNb-1.42 (J Lunney, pers comm) anti-porcine mAb IFNb-9G2 (A Garmendia, pers comm) anti-porcine mAb IFNb-9G2 (A Garmendia, pers comm)			ELISA (Kingfisher # DYC20655-003)	P (Rb) (partial 164/186 aa), Kingfisher # RP00115-100; R (Rp), BioRPS-200
IFNG	Interferon gamma	mAb 2G4B20 (IHC) PHD: 15737172 anti-porcine mAb (ELISA) Thermo Fisher # ASC4504, Cell Sciences # CR4008 Biorad # MCA2076 anti-porcine mAb A32/D3/C5 (ELISA) Cell Sciences # CM4009, Biorad # MCA2308B anti-porcine mAb P21 Biorad # MCA1793 mAb G47 (ELISA, IHC, IP, N, WB) Chemicon International # mAb 1153 anti-porcine mAb IFNg-1.1.11 (J Lunney, pers comm) anti-porcine mAb IFNg-1.2.1 (J Lunney, pers comm) anti-porcine mAb IFNg- 23.2.1 (J Lunney, pers comm) anti-porcine mAb IFNg- 23.2.2 (J Lunney, pers comm) anti-porcine mAb IFNg- 26-1.1 (J Lunney, pers comm) anti-porcine mAb IFNg- 27.2.1 (J Lunney, pers comm) anti-porcine mAb IFNg- 27.2.2 (J Lunney, pers comm) anti-porcine mAb IFNg- 35.2.1 (J Lunney, pers comm) anti-porcine mAb IFNg- 45.2.1 (J Lunney, pers comm) anti-porcine mAb PSC11 (IHB) PHD: 9612445, PierceEndogen # MP7030 anti-porcine mAb PSC10 (PHD # 9612440) anti-porcine mAb PSG9 (CFC, ELISA) BD Biosciences # 559961) anti-porcine mAb PZR6 (IHB) PierceEndogen # MP7030 mAb IsFna (ELISA, WB, and IHC) PHD: 24588845 pAb (ELISA) Thermo Fisher # ACC4002,			ELISA Invitrogen # KSC4021 ELISA (Kingfisher # Y 002596-002) ELISA Millipore Sigma # RA60133 ELISA Raybiotech # ELP-IFNg- G ELISA 29 & 0 Systems # PPX03 ELISA Millipore Sigma # RA60135 ProcartaPlex # EPX014-38847-90 Porcine Cytokine / Chemokine Array 13-plex, Eve Technologies #PCG3 EMD Millipore #PCYTMG-23K-13PX Porcine Cytokine / Chemokine Antibody Array 13-plex, Eve Technologies #PCG3 Porcine Cytokine Antibody Array Q1 (Ray Biotech # QAP-CYT-1-1 Porcine Cytokine Antibody Array B, Abcam # ab197480	P (Ec), R&D 985-IN-050 Cell Sciences # CR4008A; P (Rp), BioRPS-280 P (Pig), Seratec #PPP022
IFNL2	Interferon lambda 3	pAb (ELISA, WB), Kingfisher KP10855-100			ELISA, Kingfisher # DYC20575-003 ELISA, Berlin Bioscience # A35425	P (Rp)(partial 136/179 aa), Kingfisher RP10920-100;
IFNL4	Interferon lambda 4			mAb MAB-IFN-14 (PHD: 26308381), mAb MAB-IFN-44 (PHD:		
IFNW1	Interferon omega 1					R (Rp) (partial 136 aa), Kingfisher # RP10440-100
IFNW5*	Interferon omega 5					No Kingfisher protein being sold as IFNW5 is identical IFNW8
IFNW8*	Interferon omega 8					R (Rp) (partial 171/186 AA) Kingfisher # RP10245
IGF1	Insulin like growth factor 1	anti-porcine pAb (WB), Lifespan # LS-C298256 anti-porcine pAb (WB), US Biological # 145918	anti-human mAb SH1.2 (ELISA, WB), Millipore # 05-172 anti-bovine pAb (WB), Bio-Rad # AHP2371 anti-human pAb (WB), US Biological # 17561-08S		ELISA (PHD: 10751765) ELISA, Avea # CHEH00799	R (Rb) (partial 70/100 aa), Kingfisher # RP11430
IGF2	Insulin like growth factor 2	anti-human/porcine pAb (WB), US Biological # 17561-12Q	anti-mouse/human pAb (WB), Avea # AFP54342		ELISA (PHD: 12118788) ELISA, Avea # CHCC00814 ELISA R&D # MG200 ELISA (PHD: 30481248)	R (Rb)(partial 67/100 aa), Kingfisher # RP10471-100
IK	IK cytokine	anti-human/porcine pAb (WB) OriGene Technologies # TA339163				
IL10	Interleukin 10	Anti-porcine mAb 148B01 (ELISA, N), R&D # mAb6001 Anti-porcine mAb 148B08 (ELISA, WB), R&D # mAb6003 Anti-porcine mAb 3G7/J8 (ELISA, IHC, WB), R&D # mAb6002 Anti-porcine mAb 4C4-378 (ELISA), Cell Sciences # CM1575, Thermo # ASC0004 Anti-porcine mAb MSA 1A6 (BC2) (ELISA, FC), Cell Sciences # CM1002 (PHD: 22718916) anti-porcine mAb(Mt.Ab pair, Invitrogen # CSC15103 anti-porcine pAb (ELISA, WB), Biorad # AHP2383 anti-porcine pAb (ELISA, IHC, WB), R&D # AF860 Anti-porcine pAb (ELISA, IHC, WB), GeneTex # GTX27557			ELISA (Berlin Bioreagent # A35414) ELISA (R & D Systems # P1000) ELISA (Thermo Fisher # ICSC0102) BioplexLuminex Assay (Thermo Fisher # EPX014-38849-90) BioplexLuminex Assay (Millipore Sigma # PCYTMG-23K-13PX) Porcine Cytokine / Chemokine Array 13-plex, Eve Technologies #PCG3 Porcine Cytokine Antibody Array B (Abcam # ab197480)	R (Ec) (partial 157/175 aa) R (Ec), Genway # GWB-C77693 R (Rb) (partial 157/175 aa), Seratec #PPP025 R (Rp) (partial 157/175 aa), Kingfisher # RP0425 R (Rp) (partial 157/175 aa), AbCam # ab107797 R (Rp) (partial 157/175 aa), Kingfisher # RP0425-100;
IL12A	Interleukin 12A	anti-porcine pAb mAb 13E2/9 (ELISA, FC, IHB) (PHD: 15737172, R & D Systems # MAB2171) anti-human pAb (pAb (IHC, ELISA) Origene # AP20385PU-N pAb anti-porcine mAb 237/32 (ELISA) Creative Diagnostics # DCABY-4270 anti-porcine mAb C3 anti-porcine pAb (WB), (ELISA, N) Invitrogen # PA5-47961 anti-porcine pAb (WB, ELISA) R & D Systems AAF612 anti-porcine pAb (WB, ELISA, IHC), United States Biological # 363623			ELISA (Invitrogen # ESIL12A) pAb ELISA, Raybiotech, Inc. # ELP-IL12-1 ProcartaPlex™ Simplex Kit, BioplexLuminex Assay Millipore # PCYTMG-23K-13PX Porcine Cytokine Antibody Array 6L, Abcam # ab197480 Porcine Cytokine/Chemokine Antibody Array 13-plex, Eve Technologies #PCG3 Porcine Cytokine Antibody Array Q1 (Ray Biotech # QAP-CYT-1-1	p20 R (Rb) (partial 202 aa), Kingfisher # RP00755-100

PDGFB	Platelet-derived growth factor beta polypeptide		Anti-human pHi (rx, WB); R & D Systems # AB-23-NA		ELISA (Invitrogen # ESPDGFB ELISA (Raybiotech # ELP-PDGFB-1	
PDGFC	Platelet-derived growth factor C	pAb (WB) OriGene Technologies # TA343189 pAb (WB) Thermo Fisher Scientific # PA5-45229				
PF4	Platelet factor 4				ELISA Assay Systems Biology # CKC0037SP	
PRL	Prolactin	Anti-human/porcine pAb (WB) LifeSpan BioSciences Technologies # LS-C108693			ELISA LifeSpan BioSciences # LS-F30512-1	
RIBPA	Ribosol binding protein A	Anti-human/porcine pAb (WB) OriGene Technologies # TA346183	Anti-human pAb (WB) United States Biological # 48057		ELISA # Assay Systems Biology # CKC0088B	
RETN	Resistin	Anti-human/porcine pAb (WB) LifeSpan BioSciences # LS-C40847			ELISA Abnova Corporation # KA0304	
SERPINE1	Serine (or cysteine) proteinase inhibitor, clade E	Anti-human/porcine pAb (WB) United States Biological # 36850	Anti-human mAb 9.7B2 (WB) Creative Biolabs # CBMAB-P3958-PC Anti-human mAb CBYY-0280 (WB) Creative Biolabs # CBMAB-0520-YY Anti-human mAb CBXS-4219 (WB) Creative Biolabs # CBMAB-4219-XS Anti-human mAb MA-5MATC10 (ELISA, B) Creative Biolabs # CBMAB-5647-CQ		ELISA, Cell Sciences # CS1995XA	
SFRP1	Secreted frizzled-related protein		Anti-human pAb (WB) Avea Systems Biology # GHLA03885			
SPP1	Secreted phosphoprotein 1		Anti-human pAb (IHC-P, WB) Rockland Immunochemicals # 100-401-A450			
TGFA	Transforming growth factor, alpha				ELISA (Millipore Sigma # RA0108E)	
TGFB1	Transforming growth factor, beta 1	Anti-TB21 (ELISA) Abcam # ab27968 Anti-2G11 (ELISA) BioLegend # 652301 Anti-9016 (WB, IHC, FC, N) R & D Systems # MAB240-100 Anti-F-9882 (WB) Thermo Fisher # MA5-15065 pAb (ELISA) Cell Sciences # CPT0581 CPT0582 pAb (ELISA) R & D Systems # AB-100-NA)			ELISA (Active) BioLegend # 437707 ELISA (Active) Assay Systems Biology # CKC0065M ELISA (Total) BioLegend # 436707 ELISA (Total) LifeSpan BioSciences # LS-F51014 ELISA (Total) R & D Systems # KB100 LuminexBioplex Assay, R&D Systems # LTGH00 LuminexBioplex Assay, Luca # TGF3-MA-15 LuminexBioplex Assay, Cleveex # LSC0001M Porcine Cytokine Antibody Array Q1, Ray Biotech # QAP-CYT-1-1	Platelet-derived, R & D Systems (# 101-B1-001)
TGFB2	Transforming growth factor, beta 2		Anti-human mAb 8957 (IHC, WB) R & D Systems # MAB612 Anti-human pAb (IHC, WB) R & D Systems # AB-112-NA Anti-human pAb (IHC, WB) GeneTex # GTX10389		ELISA R & D Systems # MB200	
TGFB3	Transforming growth factor, beta 3	Anti-porcine pAb #4822 (WB) United States Biological # 360274	Anti-human mAb #4822 (WB) R & D Systems # BAF643			
THBS1	Thrombospondin 1		Anti-human mAb A6.1 (IFC, IHC, IP, WB) Abcam # ab3421 Calbiochem # BA24-100UG, Thermo Fisher # MA5-13398 Anti-human mAb C6.7 (1) Lab Vision Product # MS-425-P1 Anti-human mAb Sp4/2D1 (IFC) Thermo Scientific Pierce # MA1-90763			R (Harris plasmin), R&D #301-81
TNF	Tumor necrosis factor	Anti-7T00 (ELISA, N, WB) - R&D #mAb860 Anti-32330 (ELISA) R&D #mAb860 Anti-10314 (ELISA, N, WB) R&D #mAb801 Anti-#4, Series # HCA2050 Anti-hA61 (ELISA), ELISPOT, IC, IHC), Biolegend # 502001 Anti-8E10 (ELISA, N, WB), Series # MCA2062 Anti-10300 (FC) (PMID: 15737573) Anti-51B40 (ELISA, WB) Thermo # M375Fat AV Adalimmab (B) (PMID: 23738746) Infliximab (B) (PMID: 23738746) pAb (ELISA, IHC, N, WB), R&D #AF690 pAb (ELISA, WB), Kingfisher # R6033ZS-100			ELISA, R&D # PTA60 ELISA, Tridelta # TCF-48 ELISA, Raybiotech # ELP-TNFa-1 ELISA, Invitrogen #KOC3011 LuminexBioplex Assay (PMID: 16864540) LuminexBioplex Assay BAO Millipore #PCYTMG-23K-13Px Porcine Cytokine / Chemokine Antibody Array Eve Technologies #PCI3 Porcine Cytokine Antibody Array B, Abcam # ab197940 Porcine Cytokine Antibody Array B, Ray Biotech # QAP-CYT-1-1	R (BD), R&D # 690-PT-025 R (Pd) (partial 155/232 aa), Kingfisher # RP0885S-100 R(Pd) (partial 155/232 aa), Series # PPR029 R (Hp) (partial 155/232 aa) BHRPS-310
TNFSF10	Tumor necrosis factor (ligand) superfamily, member 10		pAb (IHC) Sigma, PMID: 14967926 Anti-human pAb (WB) Genhelix Biotech, Inc. # GMB-CB3MED			
TNFSF11	Tumor necrosis factor (ligand) superfamily, member 11		Anti-human pAb (WB, IP) Cell Signaling Technology # 40151 Anti-human pAb (WB, IP) Cell Signaling Technology # 39501		ELISA (Biomedica, PMID # 16176565)	
TNFSF12	Tumor necrosis factor (ligand) superfamily, member 12				ELISA Sigma # RA61083	R (Pd), Kingfisher #RPP4895-005
TNFSF13	Tumor necrosis factor (ligand) superfamily, member 13		Anti-human pAb (1) (WB) Avea Systems Biology # AFPR0877			R (Hp), Kingfisher #RPP4231-005
TNFSF13B	Tumor necrosis factor (ligand) superfamily, member 13b	Anti-human pAb (FC), R&D # AF124 (PMID: 17696918)	Anti-human pAb (WB) Acris Antibodies # AP10132PU-N			R (PMID 17696918) R (Pd) (partial 152 aa), Kingfisher # RPP4825-005 R (Pd) (partial 154 aa), Kingfisher # RPP4435-005 R (Pd) (partial 154 aa), Series #PPR030
VEGFA	Vascular endothelial growth factor A	Anti-VG7bb, Calbiochem # GF-80 pAb (WB, ELISA), Kingfisher # R6080S-100 pAb (ELISA), Series #AHR2586				
VEGFB	Vascular endothelial growth factor B		Anti-human pAb (WB) Thermo Fisher Scientific # PA5-44952			
VEGFC	Vascular endothelial growth factor C		pAb (WB) United States Biological # 48086			
XCL1	Small inducible cytokine subfamily C, member 1 (lymphotactin)					#CL1-mCherry-timer (FC) (PMID 27345688)

Reactivities of mAbs and pAbs are noted: B Blocking, ELISA, FC flow cytometry immunostaining, IF immunofluorescence, IHC immunohistochemistry, IP immunoprecipitation, N neutralizing, Rb, WB Western blot. Other abbreviations: aa amino acids, bc bovine, h human, pc porcine, m murine, r rat, BMP Bone Morphogenetic Protein, CSF Colony-stimulating factor, GF growth factor, EL E cell, IFN interferon, IL Interleukin, mAb monoclonal antibody, mann Mannheimian exposed recombinant protein, NGF Nerve growth factor, pAb Polyclonal antibody, pers contemporaral commercation, Pp Pichia pastoris, PDGF Platelet-derived growth factor, rec recombinant, TGF Transforming growth factor, TNF Tumor necrosis factor, VEGF Vascular endothelial growth factor. Vendors: Abcam www.abcam.com; Acris Antibodies www.acrisantibodies.com; Alpha Diagnostic www.intrinsicbiosciences.com; BioLegend www.biolegend.com; Bioreagents www.bioreagents.com; BioSciences www.biosciences.com; Bioseros www.bioseros.com; Biotrends www.biotrends.com; Berin Bioreagent www.berin-bioreagent.com; BioLegend www.biolegend.com; Biorealm www.biorealm.com; Biothal Series https://www.bio-rad-rdu.com; Biotertec www.biotertec.com; Cell Signaling Technology https://www.cellsignal.com/; Cell Sciences https://www.cellsciences.com; Creative Biolabs www.antibody-creativebiolabs.com; Creative Diagnostics http://www.creative-diagnostics.com; EMD Millipore www.emdmillipore.com; Eve Technologies https://www.evetechnologies.com/; Fortier Scientific (Chemicon) www.fortierscs.com; Fitzgerald Industries www.fitzgeraldir.com; Gene-Tech Laboratories www.genetechlab.com; Genscript www.genscript.com; Genhelix Biotech www.genwaybio.com; BD Scientific www.bdsci.com; Kingfisher Biotech, Inc. http://www.kingfisherbiotech.com; Genetar https://genetar.com/; LifeSpan Biosciences https://www.lsbio.com/; Novus Biologicals https://www.novusbio.com/; R&D Systems http://www.rndsystems.com/; OriGene Technologies (Acris) https://www.origene.com/; Millipore Sigma http://www.sigmaaldrich.com/; ProSpec www.prospecbio.com; Proteintech www.ptglab.com; Raybiotech www.raybiotech.com; Rockland Immunochemicals www.rockland-inc.com; Santa Cruz Biotechnology www.scbt.com; Southern Biotech http://www.southernbiotech.com; Thermo Fisher (Invitrogen, Lab Vision, Pierce) https://www.thermofisher.com/; Tridelta Development Ltd www.tridelta0.com; US Biological https://www.usbio.net.