

A standardized nomenclature for the mouse and rat prolactin superfamilies

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The prolactin (PRL) locus has undergone species-specific expansions. These expansions are most notable in the mouse, rat, and cow (Soares 2004). In the mouse, the PRL locus spans 1 Mb on Chromosome 13 and includes 23 known genes (Wiemers et al. 2003; Mallon et al. 2004), whereas the rat PRL locus spans 1.7 Mb on Chromosome 17 and includes 24 known genes (Alam et al. 2006). The two loci are mostly orthologous but do exhibit some differences.

Previous nomenclature for the mouse and rat PRL superfamilies is awkward. Names were originally assigned based on biological activities [placental lactogen (PL) and chorionic somatomammotropin (CS); proliferin (PLF)] and on structural similarities to PRL or PLF [PRL-related protein (PRP); PRL-like protein (PLP); PLF-related protein (PLF-RP)]. As the mouse and rat genome databases were established, some improvements were made in the nomenclature but it has remained cumbersome. The previous nomenclature was also confusing when comparisons were made across species. Terms such as CS, PL, and PRP have been used to describe members of the PRL and growth hormone families of other species, including

the human and cow. Human CSs and PLs and bovine PLs and PRPs are not orthologous with CSs, PLs, and PRPs of the mouse and rat.

A standardized nomenclature has been developed in conjunction with staff at the Mouse Genome Informatics (MGI, <http://www.informatics.jax.org>) and Rat Genome Database (RGD, <http://www.rgd.mcw.edu/>). The nomenclature is based on structural relatedness of members of the mouse and rat PRL superfamilies (Table 1, Fig. 1). It is expected that this new standardized nomenclature will provide a logical framework for the naming of new members of the PRL superfamily as they are discovered, including new orthologs and paralogs from other species.

A couple of comments about the new nomenclature are required. The family and subfamily designations are ordered based on multiple sequence analysis (Thompson et al. 1997) and phylogenetic tree construction (Page 1996) using mouse and rat PRL family sequences. If PRL family sequences from other species are included in the analysis, then the ordering of the families and subfamilies exhibit differences (Alam et al. 2006). Consequently, it is important to appreciate that the phylogenetic tree used for development of the new nomenclature may not represent a true phylogeny. Nevertheless, the mouse and rat PRL family tree (Fig. 1) is the best currently available.

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Table 1. Standardized nomenclature for the expanded mouse and rat PRL superfamilies

Official name	Official symbol	Official alias symbols	Mouse GenBank Accession No.	Rat GenBank Accession No.	Previous symbols
Prolactin	Prl	Prl1a1	NM_011164	NM_012629	Prl
Prolactin family 2, subfamily a, member 1	Prl2a1	PLP-M	NM_019991	NM_053791	PLP-M, Prlpm
Prolactin family 2, subfamily b, member 1	Prl2b1	PLP-K	NM_025532	NM_138861	PLP-K, Prlpk
Prolactin family 2, subfamily c, member 1	Prl2c1	PLF	–	DQ329281	PLF
Prolactin family 2, subfamily c, member 2	Prl2c2	PLF1	NM_031191	–	PLF1
Prolactin family 2, subfamily c, member 3	Prl2c3	PLF2	K03235	–	PLF2
Prolactin family 2, subfamily c, member 4	Prl2c4	MRP3	NM_011954	–	MRP3
Prolactin family 2, subfamily c, member 5	Prl2c5	MRP4	AF128884	–	MRP4
Prolactin family 3, subfamily a, member 1	Prl3a1	PLP-I	AF525154	NM_153736	PLP-I
Prolactin family 3, subfamily b, member 1	Prl3b1	PL-II	M14647	M13749	PL-II, Csh2
Prolactin family 3, subfamily c, member 1	Prl3c1	PLP-J	NM_013766	NM_031316	PLP-J, Prlpi
Prolactin family 3, subfamily d, member 1	Prl3d1	PL-I α	AF525162	NM_017363	PL-I α , Csh1
Prolactin family 3, subfamily d, member 2	Prl3d2	PL-I β	NM_172155	DQ329283	PL-I β , Plib
Prolactin family 3, subfamily d, member 3	Prl3d3	PL-I γ	NM_172156	–	PL-I γ , Plig
prolactin family 3, subfamily d, member 4	Prl3d4	PL-I ν	–	NM_033233	PL-I ν , Csh111
prolactin family 4, subfamily a, member 1	Prl4a1	PLP-A	NM_011165	NM_017036	PLP-A, Prlpa
prolactin family 5, subfamily a, member 1	Prl5a1	PLP-L	NM_023746	NM_138527	PLP-L, Prlpl
prolactin family 5, subfamily a, member 2	Prl5a2	PLP-P	–	DQ329280	PLP-P, Prlpp
prolactin family 6, subfamily a, member 1	Prl6a1	PLP-B	NM_011166	M31155	PLP-B, Prlpb
prolactin family 7, subfamily a, member 1	Prl7a1	PLP-E	NM_008930	–	PLP-E, Prlpe
prolactin family 7, subfamily a, member 2	Prl7a2	PLP-F	NM_011168	–	PLP-F, Prlpf
prolactin family 7, subfamily a, member 3	Prl7a3	PLP-F α	–	NM_022530	PLP-F α
prolactin family 7, subfamily a, member 4	Prl7a4	PLP-F β	–	AY741310	PLP-F β
prolactin family 7, subfamily b, member 1	Prl7b1	PLP-N	AF525156	NM_153738	PLP-N, Prlpn
prolactin family 7, subfamily c, member 1	Prl7c1	PLP-O	NM_026206	–	PLP-O, Prlpo
prolactin family 7, subfamily d, member 1	Prl7d1	PLF-RP, PRP	NM_011120	NM_053364	PLF-RP, PRP
prolactin family 8 subfamily a, member 1	Prl8a1	PLP-C δ	NM_028477	–	PLP-C δ , Prlpc4
prolactin family 8, subfamily a, member 2	Prl8a2	dPRP	NM_010088	NM_022846	dPRP, Dtrpr
prolactin family 8, subfamily a, member 3	Prl8a3	PLP-C ν	–	NM_020079	PLP-C ν
prolactin family 8, subfamily a, member 4	Prl8a4	PLP-H	–	NM_021580	PLP-H, Prlph
prolactin family 8, subfamily a, member 5	Prl8a5	PLP-C	–	NM_173110	PLP-C, Prlpc
prolactin family 8, subfamily a, member 6	Prl8a6	PLP-C α	NM_011167	–	PLP-C α , Prlpc1
prolactin family 8, subfamily a, member 7	Prl8a7	PLP-D	–	NM_022537	PLP-D, Prlpd
prolactin family 8, subfamily a, member 8	Prl8a8	PLP-C γ	NM_023741	–	PLP-C γ , Prlpc3
Prolactin family 8, subfamily a, member 9	Prl8a9	PLP-C β	NM_023332	NM_134385	PLP-C β , Prlpc2

A special comment is also required for PRL family 2, subfamily c (*Prl2c*, previously known as PLF). A single *Prl2c* gene has been identified in the Brown Norway rat and C57BL/6 mouse; however, evidence exists for four distinct *Prl2c* cDNAs in the mouse. The apparent inconsistency is likely attributed to strain differences at the mouse *Prl2c* locus, including polymorphisms, splicing variations, or strain-specific *Prl2c* gene expansion. The revised nomenclature includes all four mouse *Prl2c* members, which will be revised, if necessary, as new information is garnered.

References

- Alam SMK, Ain R, Konno T, Ho-Chen JK, Soares MJ (2006) The rat prolactin gene family locus: species-specific gene family expansion. *Mamm Genome* 17, 858–877
- Mallon A-M, Wilming L, Weekes J, Gilbert JGR, Ashurst J, et al. (2004) Organization and evolution of a gene-rich region of the mouse genome: a 12.7 Mb region deleted in the Del[13]Svea36H mouse. *Genome Res* 14, 1888–1901
- Page RDM (1996) TREEVIEW: An application to display phylogenetic trees on personal computers. *Comput Appl Biosci* 12, 357–358
- Soares MJ (2004) The prolactin and growth hormone families: pregnancy-specific hormones/cytokines at the maternal-fetal interface. *Reprod Biol Endocrinol* 2, 51
- Thompson JD, Gibson TJ, Plewniak F, Jeanmougin F, Higgins DG (1997) The CLUSTAL X Windows interface: flexible strategies for multiple sequence alignment aided by quality analysis tools. *Nucleic Acids Res* 25, 4876–4882
- Wiemers DO, Shao L-J, Ain R, Dai G, Soares MJ (2003) The mouse prolactin gene family locus. *Endocrinology* 144, 313–325

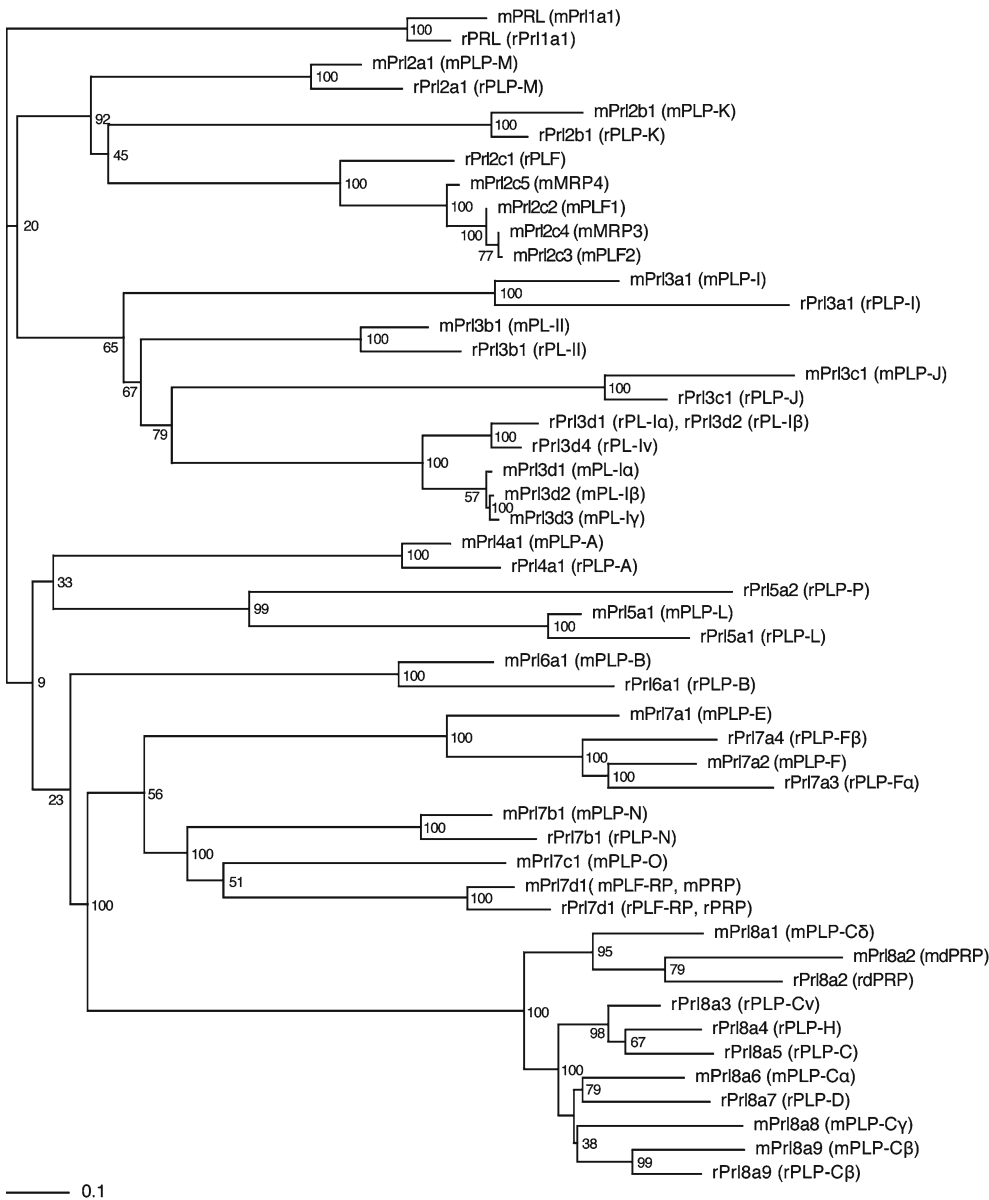


Fig. 1. Phylogenetic analysis of the PRL family in the mouse (*Mus musculus*) and rat (*Rattus norvegicus*). Multiple amino acid sequence alignments and phylogenetic tree construction were performed using the Clustal X and TREEVIEW software programs (Page 1996; Thompson et al. 1997). Bootstrap values are included within the phylogenetic tree. Lower-case "m" or "r" preceding the symbols signifies a mouse or rat member of the PRL superfamily, respectively. Official symbols are provided and official alias symbols are included in parentheses (see Table 1).