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Nomenclature and Overview of the Mouse (*Mus musculus* and *Mus* sp.) Immunoglobulin Kappa (IGK) Genes

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Key Words

Mouse · IMGT · Immunoglobulin · Kappa chain genes · Orphons

Abstract

'Nomenclature and overview of the mouse (*Mus musculus* and *Mus* sp.) immunoglobulin kappa (IGK) Genes', the 19th report of the 'IMGT Locus in Focus' section, provides the first complete list of all the mouse *(M. musculus)* IGK genes. The mouse *(M. musculus)* locus spans 3,200 kb. The total number of mouse *(M. musculus)* IGK genes per haploid genome is 164 (174 if the orphons are included). The functional genomic repertoire comprises 93 IGKV belonging to 18 subgroups, 5 IGKJ and 1 IGKC gene. IMGT gene names and definitions of the mouse *(M. musculus)* IGK genes on chromosome 6 and IGK orphons are provided with the gene functionality and the number of alleles, according to the concepts of IMGT-ONTOLOGY and to rules of the IMGT Scientific chart, with the accession numbers of the IMGT reference sequences. These tables and figures are available at the IMGT Marie-Paule page of IMGT, the international ImMunoGeneTics database (http://imgt.cines.fr) created by Marie-Paule Lefranc, Université Montpellier II, CNRS, France.

Introduction

'Nomenclature and overview of the mouse (*Mus musculus* and *Mus* sp.) immunoglobulin kappa (IGK) Genes' is the 19th report of the 'IMGT Locus in Focus' section launched in the April 1998 issue of *Experimental and Clinical Immunogenetics* [1–19]. This report comprises two figures: (1) 'Representation of the mouse *(Mus musculus)* IGK locus on chromosome 6' (2) 'The classification concept of IMGT-ONTOLOGY exemplified for the mouse *(Mus musculus)* IGKV genes' and eight tables entitled: (1) 'Mouse *(Mus musculus)* germline IGKV genes and alleles'; (2) 'Mouse *(Mus musculus)* IGKV orphons';

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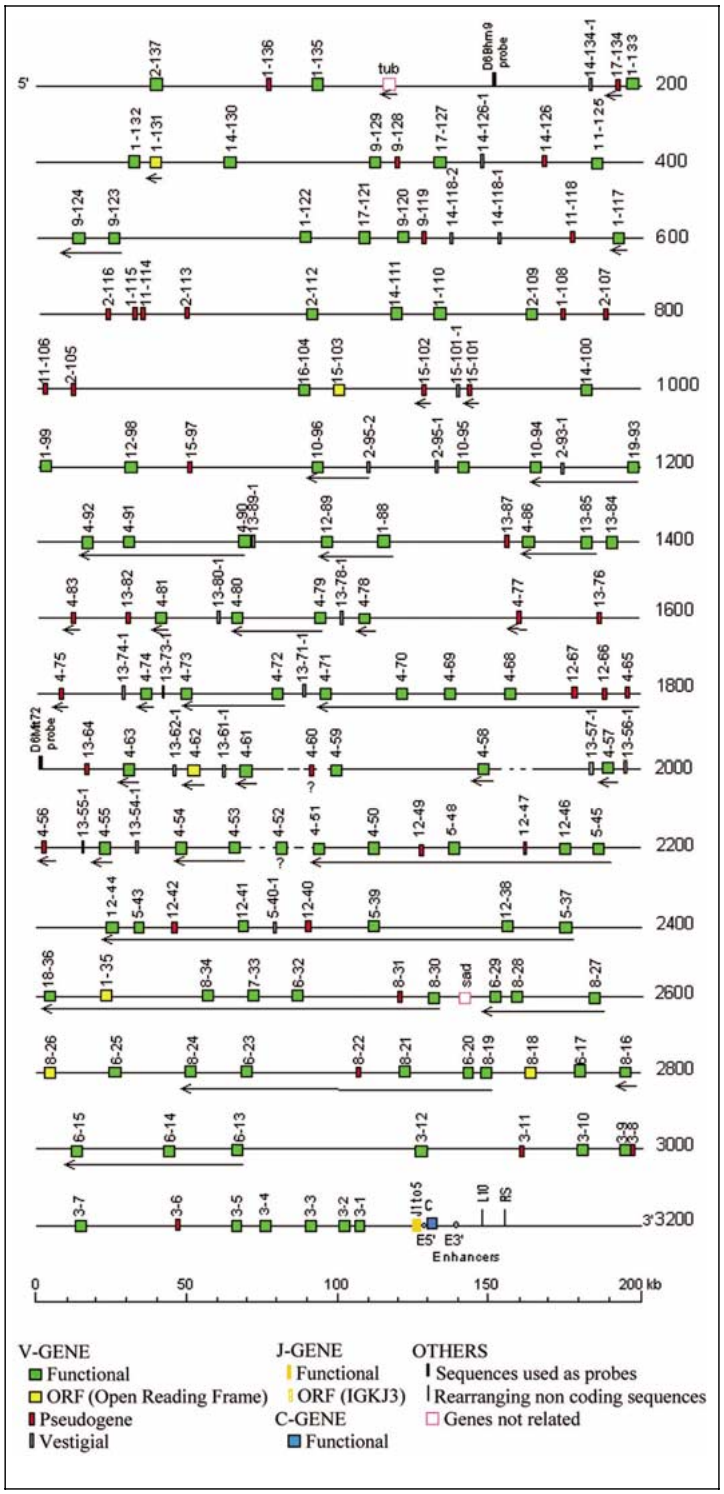

Fig. 1. Representation of the mouse *(M. musculus)* IGK locus on chromosome 6. Horizontal arrows indicate inverse orientation of transcription of the IGKV genes compared to that of the IGKJ genes. A question mark below IGKV4-52 and IGKV4-60 indicates that the orientation of transcription of these genes is unknown. Two enhancers have been identified: E5′ between the IGKJ genes and the IGKC gene [28–30], and E3′ located 8.5 kb downstream of the IGKC gene [31]. The mouse IGKV representation has been set up with data from [20–24] and updated with 'The immunoglobulin κ genes and the κ locus of the mouse' (http://www.med.uni-muenchen.de/biochemie/zachau/kappa.htm) – July 2000 version. These updates, compared to the publications [20–24], include: suppression of the gaps between IGKV14-111 and IGKV2-112, and between IGKV2-116 and IGKV1-117; suppression of the gaps between IGKV1-122 and IGKV9-123, and between IGKV9-124 and IGKV11-125, and change of orientation and position of the IGKV9-123 and IGKV9-124 genes; suppression of gw1, ca9 and cc9, now considered as orphons on the same chromosome 6 (IGKV1/OR6-1, IGKV14/OR6-2 and IGKV14/OR6-3, respectively). The IGKV4-52 gene is located between IGKV4-51 and IGKV4-53, but the exact distance to one or the other gene is not known. The D6Bhm9 probe (EMBL Accession number Z72363) is described in Schupp IW, et al: Immunogenetics 1997;95:180–187. Tub = a-tubulin like (EMBL Accession No. AJ235970). Sad = S-adenosyl methionine decarboxylase like (EMBL Accession No. AJ132684).

(3) 'Correspondence between mouse *(Mus musculus)* IGKV nomenclatures'; (4) 'Number of mouse *(Mus musculus)* germline IGKV genes on chromosome 6 and potential repertoire'; (5) 'Mouse *(Mus musculus)* germline IGKJ genes'; (6) 'Mouse *(Mus musculus)* IGKJ alleles'; (7) 'Mouse (*Mus musculus, Mus saxicola, Mus pahari, Mus minutoides, Mus cookii, Mus spretus*) IGKC genes and alleles' and (8) 'Complete list of the mouse *(Mus musculus)* IGK genes on chromosome 6'.

The mouse *(M. musculus)* IGK locus, located on chromosome 6, spans 3,200 kb. It consists of 158 IGKV genes [20–24], belonging to 19 subgroups, localized on 3,100 kb, 5 IGKJ genes [25–26] and 1 IGKC gene [27]. The potential genomic *M. musculus* IGK repertoire comprises 93 functional IGKV genes belonging to 18 subgroups, 5 IGKJ and 1 IGKC gene. The total number of mouse *(M. musculus)* IGK genes per haploid genome is 164 (174 if the orphons are included), of which 99 are functional. Eighty-one IGKV genes are in opposite orientation of transcription, 59 of them are functional and must rearrange by a mechanism of inversion. IMGT gene names and definitions of the mouse *(M. musculus)* IGK genes on chromosome 6 and IGK orphons are provided with the gene functionality and the number of alleles, according to the concepts of IMGT-ONTOLOGY [32] and to rules of the IMGT Scientific chart, with the accession numbers of the IMGT reference sequences. These tables and figures are available at the IMGT Marie-Paule page of IMGT, the international ImMunoGeneTics database (http://imgt.cines.fr) created by Marie-Paule Lefranc, Université Montpellier II, CNRS, France [33–35]. Description of functionality (FUNCTIONAL, ORF, PSEUDOGENE) and description of mutations are according to the IMGT scientific chart available at the IMGT Marie-Paule page.

IGK Gene Nomenclature and IMGT Scientific Chart

Gene Names

Gene names (tables 1, 2, 5, 7, 8) are according to the IMGT gene name nomenclature for IG and TR of all vertebrates based on the 'CLASSIFICATION' concept of IMGT-ONTOLOGY [32] (Appendix), and according to rules of the IMGT Scientific chart [1] available at http://imgt.cines.fr.

Functionality

Criteria of functionality (F: functional, P: pseudogene, ORF: open reading frame) (tables 1, 2, 5–8) are described in the IMGT Scientific chart [1]. The definition of functionality is based on sequence analysis. As examples, the instances functional (for germline V, D, J, and for C genes) mean that the coding regions have an open reading frame without a stop codon, and that there is no described defect in the splicing sites, and/or recombination signals, and/or regulatory elements. According to the gravity of the identified defects, the functionality can be defined as ORF, pseudogene or vestigial (for germline V, D, J, and for C genes) [1]. Complete definitions are available in the IMGT Scientific chart at the IMGT Marie-Paule page. Information on gene rearrangement, DNA transcription into mRNA, and RNA translation into a polypeptide chain is provided in the IMGT 'Germline gene tables' in the IMGT Repertoire (columns designated as R, T, and Pr, respectively). This information is extracted from the literature and through IMGT/LIGM-DB sequence database search [33–35]. The IMGT/V-QUEST tool, available at the IMGT Home page at http://imgt.cines.fr, allows the identification of the germline IGKV and IGKJ genes from IGKV-J genomic rearrangements and transcripts, and provides translation and 2D representation (Collier de Perles) of the variable regions [33–36].

Table 1. Mouse *(Mus musculus)* germline IGKV genes and alleles

Fct: FUNCTIONALITY; F: Functional; P: Pseudogene; ORF: Open Reading Frame; vg: Vestigial; R: Rearranged; T: Transcribed; Pr: Translated into protein. '+' or '–' indicates if the gene sequences have been found (+) or not been found (–) rearranged, transcribed, and/or translated into protein. Arbitrarily that information is shown that on the first line of each gene when the data have been confirmed by several studies.

Functionality is shown between parentheses when the accession number refers to rearranged genomic DNA or cDNA and the corresponding germline gene has not yet been isolated.

Reference sequences in bold have been mapped: 'mapped' refers to sequences which have been obtained from clones (phages, cosmids, YACs...) either by subcloning or PCR, and does not apply to sequences obtained directly from genomic DNA.

In the 'Sequences from the literature' column, names of the sequences are preceded by the designation of the mouse strain.

The orientation of transcription of IGKV genes, compared to that of the IGKJ genes, is indicated in a column on the right of the IGKV gene name:

+ indicates a IGKV gene which is in the same orientation as the IGKJ genes.

– indicates a IGKV gene which is in the opposite orientation of transcription and must rearrange by a mechanism of inversion.

? indicates a IGKV genes for which the orientation is unknown.

o indicates a IGKV gene which is unmapped.

IGKV subgroup	IGKV gene name		IGKV allele name (46)	Fct	R	T	Pr	Strains	Reference sequences	Accession numbers	Sequences from the literature
1	1-35	–	1-35*01	ORF(18)				C3H	**cu2**	AJ231200 [31–34]	
	1-88	–	1-88*01	F	+	+		C57BL/6	**cs1**	AJ231206 [31–34]	
	1-99	+	1-99*01	F	+	+		C3H	**cv1**	AJ231207 [31–34]	
	1-108	+	1-108*01	P(1)				C3H	**cq1**	AJ231204 [31–34]	
	1-110	+	1-110*01	F	+	+	+	BALB/c	**K5.1**	D00080/M15566 [14]	BALB/c, V-1A [M28131][19], C57BL/6, bb1 [AJ231201][31–34]
			1-110*02 (47)	F	+	+	+	NZB/BINJ	**V-1B**	M28132 [19]	
	1-115	+	1-115*01	P(2)				C3H	**cz1**	AJ231208 [31–34]	
	1-117	–	1-117*01	F	+	+	+	BALB/c	**K1A5**	D00081 [14]	BALB/c, [M15567][14], BALB/c, V-1C [M28133][19], C3H, cr1 [AJ231205][31–34]
			1-117*02	F	+	+		CE/J	**V-1Cf**	M28134 [19]	
	1-122	+	1-122*01	F	+	+	+	BALB/c	**K18.1**	D00082 [14]	BALB/c, [M15568][14], C57BL/6, bl1 [AJ231203][31–34]
	1-131	–	1-131*01	ORF(17)				C57BL/6	**bh2**	AJ231197 [31–34]	
	1-132	+	1-132*01	F	+	+		C57BL/6	**bi2**	AJ231198 [31–34]	
	1-133	+	1-133*01	F	+	+	+	129/Sv	**70/1**	Z72382 [27]	C57BL/6, **bj2** [AJ231199][31–34]
	1-135	+	1-135*01	F	+	+	+	129/Sv	**70/3**	Z72384 [27]	C57BL/6, **bd2** [AJ231196][31–34]
	1-136	+	1-136*01	P(3)				C57BL/6	**bc1r**	AJ231202 [31–34]	
2	2-93-1	–	2-93-1*01	P(vg)	–	–	–	C3H	**hh24r**	AJ231265 [34]	
	2-95-1	+	2-95-1*01	P(vg)	–	–	–	C57BL/6	**hb24r**	AJ231261 [34]	
	2-95-2	–	2-95-2*01	P(vg)	–	–	–	C57BL/6	**hi24r**	AJ231266 [34]	
	2-105	+	2-105*01	P(4)				C3H	**hd24**	AJ231262 [31–34]	
	2-107	+	2-107*01	P(5)				C3H	**hc24**	AJ132682 [31–34]	
	2-109	+	2-109*01	F	+	+	+	C3H	**he24**	AJ132683 [31–34]	
			2-109*02 (48)	F	+	+		BALB/c	**24B**	K02418 [8]	

	2-112	+	2-112*01	F	+	+		BALB/c	167	J00562 [6]	BALB/c, **24** [K02415][9], C3H, hg24 [AJ231264][31–34]
	2-113	+	2-113*01	P(6)				C57BL/6	**ha24**	AJ231260 [31–34]	
	2-116	+	2-116*01	P(7)				C57BL/6	**hk24**	AJ277843 [31–34]	
	2-137	+	2-137*01	F	+	+	+	C3H	**hf24**	AJ231263 [31–34]	
	2-a (49)	o	2-a*01	F	+	+		BALB/c	**24A**	K02417 [9]	
3	3-1	+	3-1*01	F	+	+		BALB/c	21G	X16955 [18]	
	3-2	+	3-2*01	F	+	+		BALB/c	21A	X16954 [18]	
	3-3	+	3-3*01	F	+	+		BALB/c	18kb	K02162 [10]	
	3-4	+	3-4*01	F	+	+	+	C57BL/6	**21-4**	Y15968 [29]	
	3-5	+	3-5*01	F	+	+	+	BALB/c	21C	K02161 [10]	
	3-6	+	3-6*01	P(8)				C57BL/6	**21-6**	Y15969 [29]	
	3-7	+	3-7*01	F	+	+	+	BALB/c	1.6kb	K02158 [10]	
	3-8	+	3-8*01	P(9)				C57BL/6	**21-8**	Y15971 [29]	
	3-9	+	3-9*01	F				C57BL/6	**21-9**	Y15972 [29]	
	3-10	+	3-10*01	F	+	+	+	BALB/c	21B	K02160 [10]	
	3-11	+	3-11*01	P(10)				C57BL/6	**21-11**	Y15973 [29]	
	3-12	+	3-12*01	F	+	+		BALB/c	21E	K02159 [10]	
4	4-50	–	4-50*01	F				C57BL/6	**4-50**	AJ235938 [31–34]	R13[11]
	4-51	–	4-51*01	F					**L8**	J00575/V01565 [7]	C3H, **4-51** [AJ235939][31–34]
	4-52 (60)	?	4-52*01	F				C57BL/6	**ko4**	AJ239198 [31–34]	
	4-53	–	4-53*01	F	+	+	+	C57BL/6	**kh4**	AJ231231 [31–34]	
	4-54 (60)	–	4-54*01	F				C57BL/6	**ar4**	AJ231223 [31–34]	
	4-55	–	4-55*01	F	+	+	+	C57BL/6	**at4**	AJ231225 [31–34]	
	4-56	–	4-56*01	P(11)				C57BL/6	**ao4**	AJ231220 [31–34]	
	4-57	–	4-57*01	F	+	+		C57BL/6	**ap4**	AJ231221 [31–34]	
	4-58	–	4-58*01	F	+	+	+	BALB/c	**S107b**	K00884 [4]	R1 [11], C57BL/6, kj4 [AJ231233][31–34]
	4-59	+	4-59*01	F	+	+		BALB/c	**VOx1**	S37664 [11]	H3 [11], C57BL/6, kk4 [AJ231234][31–34]
	4-60	?	4-60*01	P(12)				C57BL/6	**kl4**	AJ235941 [31–34]	
	4-61	–	4-61*01	F	+	+	+	C57BL/6	**aa4**	AJ231209 [31–34]	H4 [11]
	4-62	–	4-62*01	ORF(13)				C57BL/6	**ab4**	AJ231210 [31–34]	
	4-63	–	4-63*01	F	+	+	+	C57BL/6	**ac4**	AJ231211 [31–34]	
	4-65	–	4-65*01	P(14)				C57BL/6	**ki4**	AJ231232 [31–34]	
	4-68	–	4-68*01	F	+	+		C57BL/6	**aq4**	AJ231222 [31–34]	H13 [11]
	4-69	–	4-69*01	F	+	+	+	C57BL/6	**km4**	AJ235942 [31–34]	H9 [11]
	4-70	–	4-70*01	F	+	+	+	C57BL/6	**kn4**	AJ235943 [31–34]	R9 [11]
	4-71	–	4-71*01	F				C57BL/6	**al4**	AJ231218 [31–34]	
	4-72	–	4-72*01	F	+	+		C57BL/6	**am4**	AJ231219 [31–34]	
	4-73	–	4-73*01	F				C57BL/6	**ah4**	AJ231216 [31–34]	

Table 1 (continued)

IGKV subgroup	IGKV gene name		IGKV allele name (46)	Fct	R	T	Pr	Strains	Reference sequences	Accession numbers	Sequences from the literature
	4-74	–	4-74*01	F	+	+	+	C57BL/6	**ai4**	AJ231217 [31–34]	
	4-75	–	4-75*01	P(15)				C57BL/6	**ka4**	AJ231227 [31–34]	
	4-77	–	4-77*01	P(59)				C57BL/6	**aj4**	AJ235940 [31–34]	H8 [11]
	4-78	–	4-78*01	F				C57BL/6	**ad4**	AJ231212 [31–34]	H1 [11]
	4-79	–	4-79*01	F	+	+	+	C57BL/6	**ae4**	AJ231214 [31–34]	
	4-80	–	4-80*01	F	+	+	+	C57BL/6	**af4**	AJ231213 [31–34]	
	4-81	–	4-81*01	F				C57BL/6	**ag4**	AJ231215 [31–34]	R11 [11]
	4-83	–	4-83*01	P(16)				C57BL/6	**kg4**	AJ231230 [31–34]	H2 [11]
	4-86	–	4-86*01	F	+	+		BALB/c	X24	X05555 [15]	H6 [11], C57BL/6, kb4 [AJ231228][31–34]
	4-90	–	4-90*01	F	+	+		C57BL/6	**an4**	AJ231224 [31–34]	R2 [11]
	4-91	–	4-91*01	F	+	+		C57BL/6	**kf4**	AJ231229 [31–34]	
	4-92	–	4-92*01	F				C57BL/6	**ay4**	AJ231226 [31–34]	
5	5-37	–	5-37*01	F	+	+		C57BL/6	**23-37**	AJ235963 [31–34]	
	5-39	–	5-39*01	F(24)	+	+	+	C57BL/6	**23-39**	AJ235964 [31–34]	
	5-40-1	–	5-40-1*01	P(vg)	–	–	–	C57BL/6	**fp23r**	AJ235976 [34]	
	5-43	–	5-43*01	F	+	+	+	C3H	**23-43**	AJ235973 [31–34]	
	5-45	–	5-45*01	F	+	+	+	C57BL/6	**23-45**	AJ235974 [31–34]	
	5-48	–	5-48*01	F	+	+		BALB/c	**L7**	V01564 [5]	C57BL/6, **23-48** [AJ235975] [31–34](44)
6	6-13	–	6-13*01	(F)	+	+			Vtnp	J00569 [8]#g	
	6-14	–	6-14*01	F	+	+		C57BL/6	**19-14**	Y15975 [29]	
	6-15	–	6-15*01	F	+	+		C57BL/6	**19-15**	Y15976 [29]	
	6-17	+	6-17*01	F	+	+	+	C57BL/6	**19-17**	Y15978 [29]	
	6-20	–	6-20*01	F	+	+		C57BL/6	**19-20**	Y15981 [29]	
	6-23	–	6-23*01	F	+	+	+	C57BL/6	**19-23**	AJ235961 [31–34]	
	6-25	+	6-25*01	F	+	+	+	C57BL/6	**19-25**	AJ235962 [31–34]	
	6-29	–	6-29*01	F				C57BL/6	**19-29**	AJ235967 [31–34]	
	6-32	–	6-32*01	F	+	+	+	C57BL/6	**19-32**	AJ235968 [31–34]	
			6-32*02 (50)	F				BALB/c	V-Sera	M14360 [13]	
	6-b	o	6-b*01 (51)	F	+	+		C58	V-Serb	M14361 [13]	
	6-c	o	6-c*01 (51)	F	+	+		SK	SK/CamRK	M24937 [20]	
	6-d	o	6-d*01 (51)	F	+	+		PERA	PERA/Ei	L36249 [20]	
7	7-33	–	7-33*01	F	+	+		BALB/c	**22G**	AF044198 [30]	C57BL/6, **22-33** [AJ235965] [31–34]

8	8-16	–	8-16*01	F	+	+		C57BL/6	**8-16**	Y15977 [29]	
	8-18	+	8-18*01	ORF(20)				C57BL/6	**8-18**	Y15979 [29]	
	8-19	–	8-19*01	F	+	+		C57BL/6	**8-19**	Y15980 [29]	
	8-21	–	8-21*01	F	+	+		C57BL/6	**8-21**	Y15982 [29]	
	8-22	–	8-22*01	P(19)				C57BL/6	**8-22**	Y15983 [29]	
	8-24	–	8-24*01	F	+	+	+	C57BL/6	**8-24**	AJ235944 [31–34]	
	8-26	+	8-26*01	ORF(20)				C57BL/6	**8-26**	AJ235945 [31–34]	
	8-27	–	8-27*01	F	+	+	+	C57BL/6	**8-27**	AJ235946 [31–34]	
	8-28	–	8-28*01	F	+	+	+	C57BL/6	**8-28**	AJ235947 [31–34]	
			8-28*02 (52)	F				MRL	GLvk50	L17135 [24]	
	8-30	–	8-30*01	F	+	+		C3H	**8-30**	AJ235948 [31–34]	
	8-31	–	8-31*01	P(21)				C3H	**8-31**	AJ235957 [31–34]	
	8-34	–	8-34*01	F				129/Sv	**8-34**	AJ235958 [31–34]	
9	9-119	+	9-119*01	P(22)				C57BL/6	**bp9**	AJ231236 [31–34]	
	9-120	+	9-120*01	F	+	+		C57BL/6	**VK41**	V00804/J00566 [1]	[AF003293][26], C3H, bv9 [AJ242670][31–34]
	9-123	–	9-123*01	F	+	+	+		VK9b	AF003295 [26]	C3H, **cy9** [AJ231250][31–34]
	9-124	–	9-124*01	F	+	+			VK9a	AF003294 [26]	C3H, **cw9** [AJ231248][31–34]
	9-128	+	9-128*01	P(23)				C3H	**cl9**	AJ231245 [31–34]	
	9-129	+	9-129*01	F	+	+		BALB/c	M173b	K00880 [2]	C3H, **cj9** [AJ231244][31–34]
10	10-94	–	10-94*01	F	+	+	+	A/J	**AJ2**	M54906 [23]	C3H, **cp9** [AJ231247][31–34]
			10-94*02	F				PERU	**PERU2**	M54908 [23]	
			10-94*03	F	+			AKR	**AKR2**	M54904 [23]	MRL, **MRLB** [AF346760][36]
	10-95	+	10-95*01	F(24)	+	+		BALB/c	**VK10c**	AF029261 [28]	C57BL/6, **by9** [AJ231239][31–34]
	10-96	–	10-96*01	F	+	+	+	A/J	91A3	M15520 [16]	Id(CR) [X05795][17], A/J, AJ1 [M54905][23], 129/Sv, ce9 [AJ239197][31–34]
			10-96*02	F	+			PERU	**PERU1**	M54907 [23]	
			10-96*03	F				AKR	**AKR1**	M54903 [23]	MRL, **MRLA** [AF346761][36]
11	11-106	+	11-106*01	P(25)				C3H	**ia11**	AJ231252 [31–34]	
	11-114	+	11-114*01	P(26)				C3H	**ic11**	AJ231253 [31–34]	
	11-118	+	11-118*01	P(27)				C3H	**ie11**	AJ231255 [31–34]	
	11-125	+	11-125*01	F	+	+	+	129/Sv	**if11**	AJ231256 [31–34]	
12	12-38	–	12-38*01	F	+	+	+	C57BL/6	**12-38**	AJ235951 [31–34]	
	12-40	–	12-40*01	P(28)				C57BL/6	**12-40**	AJ235952 [31–34]	
	12-41	–	12-41*01	F	+	+	+	C57BL/6	**12-41**	AJ235953 [31–34]	
			12-41*02 (53)	F	+	+		BALB/c	**k2**	J00545 /V00778 [3]	
	12-42	–	12-42*01	P(29)				C3H	**12-42**	AJ235954 [31–34]	
	12-44	–	12-44*01	F	+	+		C3H	**12-44**	AJ235955 [31–34]	
	12-46	–	12-46*01	F	+	+		C57BL/6	**12-46**	AJ235956 [31–34]	
	12-47	–	12-47*01	P(30)				C57BL/6	**12-47**	AJ235959 [31–34]	

Table 1 (continued)

IGKV subgroup	IGKV gene name		IGKV allele name (46)	Fct	R	T	Pr	Strains	Reference sequences	Accession numbers	Sequences from the literature
	12-49	–	12-49*01	P(31)				C57BL/6	**12-49**	AJ235960 [31–34]	
	12-66	–	12-66*01	P(32)				C57BL/6	**fr12**	AJ235934 [31–34]	
	12-67	–	12-67*01	P(33)				C57BL/6	**fg12**	AJ235933 [31–34]	
	12-89	–	12-89*01	F	+	+	+	C57BL/6	**fl12**	AJ235950[31–34]	
	12-98	+	12-98*01	F	+	+	+	C3H	**ci12**	AJ235949 [31–34]	
	12-e	o	12-e*01	F				BALB/c	**k3**	J00546 [3]	
13	13-54-1	+	13-54-1*01	P(vg)	–	–	–	C57BL/6	**gy33r**	AJ132680 [34]	
	13-55-1	+	13-55-1*01	P(vg)	–	–	–	C57BL/6	**gx33r**	AJ132679 [34]	
	13-56-1	+	13-56-1*01	P(vg)	–	–	–	C57BL/6	**gg33r**	AJ132675 [34]	
	13-57-1	+	13-57-1*01	P(vg)	–	–	–	C57BL/6	**gz33r**	AJ132681 [34]	
	13-61-1	+	13-61-1*01	P(vg)	–	–	–	C57BL/6	**gh33r**	AJ132676 [34]	
	13-62-1	+	13-62-1*01	P(vg)	–	–	–	C57BL/6	**gc33r**	AJ132672 [34]	
	13-64	+	13-64*01	P(34)				C57BL/6	**gu33**	AJ235969 [31–34]	
	13-71-1	+	13-71-1*01	P(vg)	–	–	–	C57BL/6	**gd33r**	AJ132673 [34]	
	13-73-1	+	13-73-1*01	P(vg)	–	–	–	C57BL/6	**go33r**	AJ132677 [34]	
	13-74-1	+	13-74-1*01	P(vg)	–	–	–	C57BL/6	**gv33r**	AJ132678 [34]	
	13-76	+	13-76*01	P(35)				C57BL/6	**ga33**	AJ231271 [31–34]	
	13-78-1	+	13-78-1*01	P(vg)	–	–	–	C57BL/6	**gb33r**	AJ132671 [34]	
	13-80-1	+	13-80-1*01	P(vg)	–	–	–	C57BL/6	**ge33r**	AJ132674 [34]	
	13-82	+	13-82*01	P(36)				C57BL/6	**gq33**	AJ231276 [31–34]	
	13-84	+	13-84*01	F	+	+		C57BL/6	**gm33**	AJ231273 [31–34]	BALB/c, Vk34C [M35156 [21](45)
	13-85	–	13-85*01	F	+	+		C57BL/6	**gn33**	AJ231274 [31–34]	
			13-85*02 (54)	F				BALB/c	Vk34B	M35154 [21](45)	
			13-85*03 (54)	F				AKR	Vk34A	M35155 [21](45)	
	13-87	+	13-87*01	P(37)				C57BL/6	**gp33**	AJ231275 [31–34]	
	13-89-1	+	13-89-1*01	P(vg)	–	–	–	C57BL/6	**gf33r**	AJ231272 [34]	
14	14-100	+	14-100*01	F	+	+		C3H	**cf9**	AJ231243 [31–34]	
	14-111	+	14-111*01	F	+	+		BALB/c	**L6**	V01563 [5]	VT1 [V01522][35], 9M [M74713][22], C57BL/6, ba9 [AJ231235][31–34]
	14-118-1	+	14-118-1*01	P(vg)	–	–	–	C57BL/6	**bz9**	AJ277844 [34]	
	14-118-2	+	14-118-2*01	P(vg)	–	–	–	C57BL/6	**bq9**	AJ231237 [34]	
	14-126	+	14-126*01	P(38)				C3H	**br9**	AJ231238 [31–34]	
	14-126-1	+	14-126-1*01	P(vg)	–	–	–	C57BL/6	**co9**	AJ231246 [34]	
	14-130	+	14-130*01	F	+	+	+	C57BL/6	**cb9**	AJ231241 [31–34]	
	14-134-1	+	14-134-1*01	P(vg)	–	–	–	C3H	**cx9**	AJ231249 [34]	129/Sv, 294A9 [Z72385][27]

15	15-97	+	15-97*01	P(39)				C3H	**gk32**	AJ231267 [31–34]	
	15-101	–	15-101*01	P(40)				C3H	**gl32**	AJ231268 [31–34]	
	15-101-1	+	15-101-1*01	P(vg)	–	–	–	C3H	**gt32r**	AJ231251 [34]	
	15-102	–	15-102*01	P(41)				C3H	**gs32**	AJ231270 [31–34]	
	15-103	+	15-103*01	ORF(42)	+	+		C3H	**gr32**	AJ231269 [31–34]	
16	16-104	+	16-104*01	F	+	+		C3H	**RF**	AJ235936 [31–34]	
17	17-121	+	17-121*01	F	+	+		C57BL/6	**bt20**	AJ231258 [31–34]	
	17-127	+	17-127*01	F	+	+		C57BL/6	**bw20**	AJ231259 [31–34]	
	17-134	–	17-134*01	P(43)				129/Sv	**294A9**	Z72386 [27]	C57BL/6, **bk20** [AJ231257][31–34]
18	18-36	–	18-36*01	F				C3H	**dv-36**	AJ235966 [31–34]	
19	19-93	–	19-93*01	F	+	+		C57BL/6	**gj38c**	AJ235935 [31–34]	

#g: Rearranged genomic DNA.

Mouse *(Mus musculus castaneus)* IGKV

IGKV subgroup	IGKV gene name	IGKV allele name	Fct	R	T	Pr	Strains	Reference sequences	Accession numbers
2	2S4		F					**CaV24**	M80407 [25]
	2S5		P(55)					**CaV24A**	M80408 [25]
	2S6		F					**CaV24B–1**	M80409 [25]
	2S7		F					**CaV24B–2**	M80410 [25]
	2S8		P(56)					**CaV24D–1**	M80411 [25]
	2S9		P(57)					**CaV24D–2**	M80412 [25]
	2S10		P(58)					**CaV24D–3**	M80413 [25]

➤

Table 1 (continued)

MGT notes:

(1) A lot of mutations, DELETIONs in the L-PART2 and in the FR1-IMGT and an INSERTION of 1 nucleotide (t at position 1101) in the FR2-IMGT.
(2) In frame STOP-CODON at codon 10 in L-PART1.
(3) A lot of mutations, DELETIONs and INSERTIONs in the V-REGION.
(4) INSERTION of 1 nucleotide (a at position 672) in the CDR1-IMGT and INSERTION of 1 nucleotide (a at position 833) in the FR3-IMGT.
(5) A lot of mutations, DELETIONs and INSERTIONs in the V-REGION and non canonical V-HEPTAMER: CGCAGTG instead of CACAGTG.
(6) INSERTION of 1 nucleotide (a at position 852) in the FR3-IMGT.
(7) DELETION of 1 nucleotide (between positions 720/721) in FR1-IMGT and DELETION of 22 nucleotides (between positions 781/782) between the FR1-IMGT and the CDR1-IMGT.
(8) INSERTION of 566 nucleotides (positions 706–1271) in CDR3-IMGT.
(9) In frame STOP-CODON (positions 332–334) at codon 17 in FR1-IMGT.
(10) INSERTION of 566 nucleotides (positions 713–1278) in CDR3-IMGT.
(11) DELETION of 3 nucleotides (between positions 178/179) in the L-PART1.
(12) No INIT-CODON and partial FR3-IMGT.
(13) Non canonical V-NONAMER: ACCCTCTAA instead of ACAAAAACC.
(14) STOP-CODON in the FR2-IMGT, DELETION of 1 nucleotide (between positions 594/595), and non canonical OCTAMER, V-HEPTAMER and V-NONAMER.
(15) INSERTION of 1 nucleotide (position 162) in the L-PART1 and STOP-CODONs in the FR2-IMGT.
(16) No INIT-CODON, in frame STOP-CODON (position 686–688) at codon 53 in the FR2-IMGT and non canonical OCTAMER.
(17) Non canonical V-HEPTAMER: CACAGAC instead of CACAGTG and DELETION in the V-SPACER (only 4 nucleotides instead 12 nucleotides).
(18) Non canonical V-NONAMER: AAAAAAAAA instead of ACAAAAATA.
(19) STOP–CODON (positions 561–563) in FR2-IMGT, INSERTION of 1 nucleotide (g at position 600) and INSERTION of 4 nucleotides (positions 606–609) in FR3-IMGT, and DELETION of 3 nucleotides (between positions 715/716) in CDR3-IMGT.
(20) Non canonical V-HEPTAMER: CACAGAG instead of CACAGTG.
(21) INSERTION of 5 nucleotides (positions 698–702) in FR3-IMGT and non canonical OCTAMER: ATTCTCAC instead of NTTTGCAT.
(22) In frame STOP-CODON (571–573) instead of the conserved 1st-CYS in the FR1-IMGT.
(23) In frame STOP-CODON (positions 490–492) at codon 74 in the FR3-IMGT.
(24) Non canonical V-HEPTAMER: CACAATG instead of CACAGTG.
(25) Non canonical DONOR-SPLICE: NGG instead of NGT in the L-PART1 and DELETION of 2 nucleotides (between positions 360/361) in the CDR1-IMGT.
(26) DELETION of 2 nucleotides (between positions 338/339) in the FR1-IMGT and DELETION of 1 nucleotide (between positions 408/409), and non canonical V-HEPTAMER: CACAATG instead of CACAGTG.
(27) INSERTION of 4 nucleotides (positions 455–458) and DELETION of 1 nucleotide (between positions 462/463) in the FR1-IMGT, and non canonical V-HEPTAMER: CAGAGTG instead of CACAGTG, non canonical V-NONAMER: ACATAAGCC.
(28) In frame STOP-CODON (positions 451–453) at codon 43 in the FR2-IMGT.
(29) DELETION of 16 nucleotides (between positions 467/468) in the FR3-IMGT, non canonical V-HEPTAMER: CAAGTG instead of CACAGTG and non canonical V-NONAMER: ATATAAGCA instead of ACATAAACC.
(30) DELETION in the CDR3-IMGT and non canonical V-HEPTAMER: CAAGTG instead of CACAGTG, partial FR3-IMGT.
(31) DELETION of 1 nucleotide in L-PART1, INSERTION of 1 nucleotide (position 474), DELETION of 1 nucleotide (between positions 495/496) and mutations in the FR3-IMGT.
(32) INSERTION of 1 nucleotide (t at position 322) in the FR1-IMGT.
(33) INSERTION of 1 nucleotide (c at position 434) in the FR1-IMGT.

(34) DELETION of 1 nucleotide (between positions 334/335) in the FR1-IMGT, DELETION of 1 nucleotide (between positions 416/417) and non canonical V-HEPTAMER: CACAATG instead of CACAGTG.

(35) In frame STOP-CODON at codon 6 in the FR1-IMGT and in frame STOP-CODONat codon 39 in the FR2-IMGT.

(36) STOP-CODONs in the L-PART1 and STOP-CODONs in the FR1-IMGT and in the FR2-IMGT and non canonical V-HEPTAMER: CACAATG instead of CACAGTG.

(37) STOP-CODONs in the L-PART1 and STOP-CODON in the FR2-IMGT, DELETION of 1 nucleotide (between positions 526/527) in the FR3-IMGT, and non canonical OCTAMER and V-HEPTAMER.

(38) INSERTION of 1 nucleotide (position 418) in the FR1-IMGT and non canonical V-HEPTAMER: CACGTTG instead of CACAGTG.

(39) DELETION of 12 nucleotides (between positions 459/460) in the FR3-IMGT and non canonical V-HEPTAMER: CACATGT instead of CACAGTG.

(40) STOP-CODONs in the FR1-IMGT and the FR3-IMGT and non canonical V-HEPTAMER: TACAGTG instead of CACAGTG.

(41) A lot of INSERTIONs in the L-PART1, in frame STOP-CODONs at codons 3 and 18 in the FR1-IMGT and in frame STOP-CODON at codon 44 in the FR2-IMGT, and non canonical OCTAMER.

(42) Non canonical DONOR-SPLICE: NGC instead of NGT.

(43) DELETION of 4 nucleotides (between positions 497/498) in the FR1-IMGT.

(44) Partial V-REGION: only AA66 to 71 are present (partial FR3-IMGT).

(45) Partial V-REGION: AA102 to 104 are missing (partial FR3-IMGT).

(46) Sequences differing by 8 nucleotides or less than 8 nucleotides from germline mapped reference sequences are temporarily considered as alleles of these sequences. Sequences differing by more than 8 nucleotides from germline mapped reference sequences are considered as new unmapped genes and are designated by a number for the subgroup, followed by a hyphen and a small letter, for example IGKV2-a. These data need to be confirmed by genetic data.

(47) This sequence, which differs from the germline mapped reference sequence by 5 nucleotides, can be considered temporarily as an allele.

(48) This sequence, which differs from the germline mapped reference sequence by 2 nucleotides, can be considered temporarily as an allele.

(49) This sequence, which differs from the nearest mapped germline gene (AJ132683) by 21 nucleotides, can be considered as a new unmapped gene.

(50) This sequence, which differs from the germline mapped reference sequence by 1 nucleotide, can be considered temporarily as an allele.

(51) These sequences, which differ from the nearest mapped germline gene (AJ235968) by respectively 11, 9 and 15 nucleotides, can be considered as new unmapped genes.

(52) This sequence, which differs from the germline mapped reference sequence by 8 nucleotides, can be considered temporarily as an allele.

(53) This sequence, which differs from the germline mapped reference sequence by 1 nucleotide, can be considered temporarily as an allele.

(54) These sequences, which differ from the germline mapped reference sequence by respectively 3 and 7 nucleotides, can be considered temporarily as alleles.

(55) DELETION of 5 nucleotides (between positions 21/22) in the FR1-IMGT leading to a frameshift and mutations in the V-REGION.

(56) INSERTION of 1 nucleotide (position 879) in FR3-IMGT leading to a frameshift.

(57) INSERTION of 1 nucleotide (position 828) in FR3-IMGT leading to a frameshift.

(58) STOP-CODONs in FR2-IMGT and INSERTION of 1 nucleotide (position 780) in FR3-IMGT.

(59) In frame STOP-CODON (positions 540–542) at codon 40 in FR2-IMGT .

(60) The IGKV4-52*01 (AJ239198) and the IGKV4-54*01 (AJ231223) V-REGION nucleotide sequences are 100% identical. These two genes differ by one nucleotide in their L-PART2 (at position 12 according to the IMGT numbering).

Table 1 (continued)

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Table 2. Mouse *(Mus musculus)* IGKV orphons

Fct: FUNCTIONALITY; P: Pseudogene; ORF: Open Reading Frame

Reference sequences in bold have been mapped: 'mapped' refers to sequences which have been obtained from clones (phages, cosmids, YACs...) either by subcloning or PCR, and does not apply to sequences obtained directly from genomic DNA.

In the 'Sequences from the literature' column, names of the sequences are preceded by the designation of the mouse strain.

IGKV subgroup	IGKV gene name	Fct	Strain	Reference sequences	Accession numbers	Sequences from the literature
1	1/OR6-1	P (1)	C57BL/6	**gw1**	AJ235937 [3]	BALB/c, Psi 1.7 [X58991][1]
	1/OR16-1	P (2)	129/Sv	**68**	Z72381 [2]	C57BL/6, **be2** [AJ235971][3]
	1/OR19-1	P (3)	129/Sv	**70/2**	Z72383 [2]	C57BL/6, **bn2** [AJ235972][3]
14	14/OR6-2	P (4)	C57BL/6	**ca9**	AJ231240 [3]	BALB/c, 9B.8 [X58992][1]
	14/OR6-3	P (5)	C57BL/6	**cc9**	AJ231242 [3]	
	14/OR16-2	P (6)	C57BL/6	**bg9**	AJ235977 [3]	
17	17/OR16-3	P	C57BL/6	**bf20part1**	AJ235930 [3]	
	17/OR16-4	ORF	C57BL/6	**bf20part2**	AJ235929 [3]	
	17/OR19-2	P	C57BL/6	**bu20part1**	AJ235931 [3]	
	17/OR19-3	ORF (7)	C57BL/6	**bu20part2**	AJ235932 [3]	

IMGT notes:

(1) A lot of mutations, DELETIONs and INSERTIONs.

(2) INSERTION of 1 nucleotide (position 645) in CDR1-IMGT and DELETION of 1 nucleotide (between positions 796/797) in FR3-IMGT.

(3) DELETION of 2 nucleotides (between positions 518/519) in FR1-IMGT and DELETION of 1 nucleotide (between positions 742/743) in FR3-IMGT.

(4) INSERTION of 2 nucleotides (positions 560-561) in FR3-IMGT.

(5) INSERTION of 1 nucleotide (positions 385) in CDR1-IMGT and DELETION of 3 nucleotides (between positions 427/428) in FR2-IMGT.

(6) DELETION or INSERTION leading a frameshift in the CDR3-IMGT.

(7) CONSERVED-TRP (codon 41 in FR2-IMGT) is replaced by a Gly and 2nd-CYS (codon 104 in FR3-IMGT) is replaced by a Tyr.

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Mouse *(Mus musculus)* IGKV orphons by chromosome

Chromosome	IGKV subgroup	IGKV gene name
6	IGKV1	IGKV1/OR6-1
	IGKV14	IGKV14/OR6-2
		IGKV14/OR6-3
16	IGKV1	IGKV1/OR16-1
	IGKV14	IGKV14/OR16-2
	IGKV17	IGKV17/OR16-3
		IGKV17/OR16-4
19	IGKV1	IGKV1/OR19-1
	IGKV17	IGKV17/OR19-2
		IGKV17/OR19-3

Table 3. Correspondence between mouse *(Mus musculus)* IGKV nomenclatures

A Correspondence between mouse IGKV subgroup designations

Information on the related human IGKV subgroups is shown in the right column.

IMGT mouse IGKV subgroups	Previous mouse IGKV subgroup designations		IMGT related human IGKV subgroups
	Ref. [1]	Ref. [2–6]	
IGKV1	VK1 and VK2	VK1 and VK2	IGKV2
IGKV2	VK24/25	VK24/25	IGKV2
IGKV3	VK21	VK21	IGKV7
IGKV4	VK4/5	VK4/5	IGKV1, IGKV2, IGKV3
IGKV5	VK23	VK23	IGKV6
IGKV6	VK19/28	VK19/28	IGKV4
IGKV7	VK22	VK22	IGKV4
IGKV8	VK8	VK8	IGKV4
IGKV9	VK9A	IGKV9/10	IGKV1
IGKV10	VK10	IGKV9/10	IGKV1
IGKV11	VK11	VK11	IGKV1
IGKV12	VK12/13	VK12/13	IGKV1
IGKV13	VK33/34	VK33/34	IGKV1
IGKV14	VK9B	IGKV9/10	IGKV1
IGKV15	VK32	VK32	IGKV1
IGKV16	VKRF	VKRF	IGKV1
IGKV17	VK20	VK20	IGKV5
IGKV18		dv	IGKV3
IGKV19		38c	IGKV1

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[4] Röschenthaler, F. et al., Eur. J. Immunol., 29, 2065–2071 (1999).
[5] Thiebe, R. et al., Eur. J. Immunol., 29, 2072–2081 (1999).
[6] Schäble, K.F. et al., Eur. J. Immunol., 29, 2082–2086 (1999).

Reference Sequences

For each gene, an IMGT reference sequence accession number is given (tables 1, 2, 5–8). For the functional or ORF genes, the IMGT reference sequence accession number is that corresponding to the allele *01. Note that the number *01 does not necessarily mean that other alleles are already known, but it signifies that any new polymorphic sequence will be described by comparison to that allele *01. Although the IMGT accession numbers are the same as those from the EMBL/GenBank/DDBJ generalist databases, the content of the IMGT/LIGM-DB flat files differs by the expertized annotations, added by IMGT.

Alleles

The number of alleles of the IGKV, IGKJ and IGKC genes (tables 1, 6–8) is according to 'Tables of alleles and Alignments of alleles, in the IMGT Repertoire. Alignments of all known germline functional and ORF sequences assigned to the different alleles, by comparison to the allele *01, are displayed at http://imgt.cines.fr. A dash (–) indicates that allele polymorphism of the pseudogenes has not been studied.

B Correspondence with the previous provisory mouse *(Mus musculus)* IMGT IGKV gene names

Only mouse *(Mus musculus)* gene names quoted in [4] are shown in this table.

IGKV subgroup	IMGT mouse IGKV gene and allele name	Previous provisory IMGT mouse gene name [4]
1	1-110*01	1S1
	1-110*02	1S4
	1-117*01	1S2
	1-117*02	1S5
	1-122*01	1S3
	1-133*01	1S7
	1-135*01	1S6
2	2-109*02	2S3
	2-112*01	2S1
	2-a*01	2S2
3	3-1*01	3S7
	3-2*01	3S6
	3-3*01	3S5
	3-4*01	3S8
	3-5*01	3S4
	3-6*01	3S9
	3-7*01	3S3
	3-8*01	3S10
	3-9*01	3S11
	3-10*01	3S2
	3-11*01	3S12
	3-12*01	3S1
4	4-50*01	4S10
	4-51*01	4S1
	4-58*01	4S2
	4-59*01	4S4
	4-61*01	4S8
	4-68*01	4S6
	4-69*01	4S7
	4-70*01	4S5
	4-77*01	4S9
	4-78*01	4S13
	4-81*01	4S14
	4-83*01	4S12
	4-86*01	4S3
	4-90*01	4S11
5	5-48*01	5S1
6	6-14*01	6S5
	6-15*01	6S6
	6-17*01	6S7
	6-20*01	6S8
	6-32*02	6S1
	6-b*01	6S2
	6-c*01	6S3
	6-d*01	6S4
7	7-33*01	7S1
8	8-16*01	8S2
	8-18*01	8S3
	8-19*01	8S4
	8-21*01	8S5
	8-28*02	8S1
9	9-120*01	9S1
	9-123*01	9S4
	9-124*01	9S3
	9-129*01	9S2
10	10-94*01	10S4
	10-94*02	10S6
	10-94*03	10S3
	10-95*01	10S7
	10-96*01	10S1
	10-96*02	10S5
	10-96*03	10S2
12	12-41*02	12S1
	12-e*01	12S2
13	13-84*01	13S3
	13-85*02	13S1
	13-85*03	13S2
14	14-111*01	14S1
	14-134-1*01	14S4
17	17-134*01	17S1

Table 4. Number of mouse *(Mus musculus)* germline IGKV genes on chromosome 6 and potential repertoire

- 158 IGKV genes belonging to 19 subgroups, on 3200 kilobases:
  93 FUNCTIONAL
  59 PSEUDOGENE
  6 ORF
- Potential repertoire: 93 FUNCTIONAL IGKV genes belonging to 18 subgroups

Five unmapped genes (IGKV2-a, IGKV6-b, IGKV6-c, IGKV6-d, IGKV12-e), potentially functional, are not included.

A - Potential repertoire (overview)

Subgroup	Functional	ORF	Pseudogene	Total
IGKV1	8	2	3	13
IGKV2	3		7	10
IGKV3	9		3	12
IGKV4	26	1	6	33
IGKV5	5		1	6
IGKV6	9			9
IGKV7	1			1
IGKV8	8	2	2	12
IGKV9	4		2	6
IGKV10	3			3
IGKV11	1		3	4
IGKV12	6		6	12
IGKV13	2		16	18
IGKV14	3		5	8
IGKV15		1	4	5
IGKV16	1			1
IGKV17	2		1	3
IGKV18	1			1
IGKV19	1			1
Total	93	6	59	158

B - Potential repertoire with orientation of transcription

Among the 93 functional genes, 33 are in the same orientation of transcription as the IGKJ genes, 59 are in the opposite orientation of transcription and must rearrange by a mechanism of inversion. The orientation of two IGKV4 genes (IGKV4-52 (F) and IGKV4-60 (P)) is unknown.

Subgroup	Functional			ORF			Pseudogene			Total
	same orientation as IGKJ	opposite orientation	subtotal	same orientation as IGKJ	opposite orientation	subtotal	same orientation as IGKJ	opposite orientation	subtotal	
IGKV1	6	2	**8**		2	**2**	3		**3**	**13**
IGKV2	3		**3**				5	2	**7**	**10**
IGKV3	9		**9**				3		**3**	**12**
IGKV4	1+1?	24	**26**		1	**1**	1?	5	**6**	**33**
IGKV5		5	**5**						**1**	**6**
IGKV6	2	7	**9**							**9**
IGKV7		1	**1**							**1**
IGKV8		8	**8**	2		**2**		2	**2**	**12**
IGKV9	2	2	**4**				2		**2**	**6**
IGKV10	1	2	**3**							**3**
IGKV11	1		**1**				3		**3**	**4**
IGKV12	1	5	**6**					6	**6**	**12**
IGKV13	1	1	**2**				16		**16**	**18**
IGKV14	3		**3**				5		**5**	**8**
IGKV15				1		**1**	2	2	**4**	**5**
IGKV16	1		**1**							**1**
IGKV17	2		**2**					1	**1**	**3**
IGKV18		1	**1**							**1**
IGKV19		1	**1**							**1**
Total	33+1?	59	**93**	3	3	**6**	39+1?	19	**59**	**158**

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Table 5. Mouse *(Mus musculus)* germline IGKJ genes

Fct: FUNCTIONALITY
F: Functional
ORF: Open Reading Frame

Reference sequences in bold have been mapped: "mapped" refers to sequences which have been obtained from clones (phages, cosmids, YACs...) either by subcloning or PCR, and does not apply to sequences obtained directly from genomic DNA.

IGKJ name	IGKJ allele name	Fct	Strains	Reference sequences	Accession numbers	Sequences from the literature
IGKJ1	IGKJ1*01	F		**J1**	V00777 [3]	A/J, [M15521][5], [V00805][6](3), C58, [M27036][4], SJL, [M27037][4], SK, [M27038][4], [X68864][1](4), [X68866][1], [X68867][1]
	IGKJ1*02	F	C58	**J1**	M15559 [2](2)	
IGKJ2	IGKJ2*01	F		**J2**	V00777 [3]	SJL, [M27037][4], SK, [M27038][4], [X68859][1](4)
	IGKJ2*02	F	C58	**J2**	M15559 [3]	
	IGKJ2*03	F	C58	**J2**	M27036 [4]	
IGKJ3	IGKJ3*01	ORF (1)		**J3**	V00777 [3]	C58, [M15559][2], C58 [M27036][4], SK, [M27038][4]
	IGKJ3*02	ORF (1)	SJL	**J3**	M27037 [4]	
IGKJ4	IGKJ4*01	F		**J4**	V00777 [3]	SJL, [M27037][4], SK, [M27038][4], [X68854][1], [X68861][1](4)
	IGKJ4*02	F	C58	**J4**	M15559 [2]	C58, [M27036][4]
IGKJ5	IGKJ5*01	F		**J5**	V00777 [3]	C58, [M15559][2], C58, [M27036][4], SJL, [M27037][4], SK, [M27038][4]

IMGT notes:

(1) Non canonical DONOR-SPLICE: nct instead of ngt.
(2) Partial J-REGION: one nucleotide missing in 5'.
(3) Partial J-SEGMENT: no J-NONAMER.
(4) Partial J-REGION: 3 amino acids missing in 3'.

References:

[1] Blackwell, T.K. et al., EMBO J., 8, 735-742 (1989).
[2] Boyd, R.T. et al., Immunogenetics, 29, 150-157 (1986).
[3] Max, E.E. et al., J. Biol. Chem., 256, 5116-5120 (1981).
[4] Ponath, P.D. et al., Immunogenetics, 29, 389-396 (1989).
[5] Sanz, I. et al., Proc. Natl. Acad. Sci. USA, 84, 1085-1089 (1987).
[6] Seidman, J.G. et al., Nature, 280, 370-375 (1979).

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Table 6. Mouse *(Mus musculus)* IGKJ alleles

Fct: FUNCTIONALITY **F**: Functional **ORF**: Open Reading Frame

IMGT numbering and description of alleles for germline J-REGIONs start with the first nucleotide of the first codon.
The accession number of a reference sequence is given for each allele.

IGKJ name	IGKJ allele name	Fct	Strains	Accession numbers	Confirmed by genetics and/or data	Description of mutations
IGKJ1	IGKJ1*01	F		V00777	+	t2 ,W1 |g3 ,W1 |a37 ,K12 |
	IGKJ1*02	F	C58	M15559		t2>c,W1>P|g3>c,W1>P|a37>t,K12>N|
IGKJ2	IGKJ2*01	F		V00777	+	c5 |g15 ,G5 |g16 ,G5 |a35 ,I11 |
	IGKJ2*02	F	C58	M15559		c5>t|g15>t,G5>S|g16>c,G5>S|a35>g,I11>M|
	IGKJ2*03	F	C58	M27036		c5>t|g15>t,G5>S|g16>c,G5>S|
IGKJ3	IGKJ3*01	ORF		V00777	+	t3 ,I1 |
	IGKJ3*02	ORF	SJL	M27037		t3>c,I1>T|
IGKJ4	IGKJ4*01	F		V00777	+	t14 ,S5 |g25 |
	IGKJ4*02	F	C58	M15559	+	t14>a,S5>T|g25>a|
IGKJ5	IGKJ5*01	F		V00777	+	

Table 7. Mouse *(Mus musculus, Mus saxicola, Mus pahari, Mus minutoides, Mus cookii, Mus spretus)* IGKC genes and alleles

Fct: FUNCTIONALITY **F**: Functional

Alleles are described at the species level.

Mouse *(Mus musculus)* IGKC

IGKC gene name	IGKC allele name	Fct	Strains	Reference sequences	Accession numbers	Sequences from the literature
IGKC	IGKC*01	F			V00807 [2]	[V00777][3], BALB/c [V01569][5], A/J [X67003][6], CE [X67004][6](3), CBA [X67005][6](3), RIII [X67006][6](4), C57BL/10 [X67007][6](5), NZB [X67010][6](8), DBA/2 [X67012][6](3), [V00806][1](1)
	IGKC*02	F	AKR		X67002 [6](2)	C58 [X67008][6](6), PL [X67009][6](7)
	IGKC*03	F	SJL		X67011 [6](9)	

Mouse *(Mus saxicola)* IGKC

IGKC gene name	IGKC allele name	Fct	Strains	Reference sequences	Accession numbers	Sequences from the literature
IGKC	IGKC*01	F			M21792 [4]	

Mouse *(Mus pahari)* IGKC

IGKC gene name	IGKC allele name	Fct	Strains	Reference sequences	Accession numbers	Sequences from the literature
IGKC	IGKC*01	F			M21793 [4]	

Table 7 (continued)

Mouse *(Mus minutoides)* IGKC

IGKC gene name	IGKC allele name	Fct	Strains	Reference sequences	Accession numbers	Sequences from the literature
IGKC	IGKC*01	F			M21794 [4]	

Mouse *(Mus cookii)* IGKC

IGKC gene name	IGKC allele name	Fct	Strains	Reference sequences	Accession numbers	Sequences from the literature
IGKC	IGKC*01	F			M21795 [4]	

Mouse *(Mus spretus)* IGKC

IGKC gene name	IGKC allele name	Fct	Strains	Reference sequences	Accession numbers	Sequences from the literature
IGKC	IGKC*01	F			M21796 [4]	

IMGT notes:

(1) Partial C-REGION.

(2) The sequence described in the manuscript is different from the one submitted to the EMBL data library.We refer to the sequence published in the original manuscript. a78, t153, g229, c305 are missing in EMBL flat file (Position numbering according to the present EMBL sequence).

(3) The sequence described in the manuscript is different from the one submitted to the EMBL data library.We refer to the sequence published in the original manuscript. a75, t150, g226, c302, g378 are missing in EMBL flat file (Position numbering according to the present EMBL sequence).

(4) The sequence described in the manuscript is different from the one submitted to the EMBL data library.We refer to the sequence published in the original manuscript. a74, a150, a226, t302, a378 are missing in EMBL flat file (Position numbering according to the present EMBL sequence).

(5) The sequence described in the manuscript is different from the one submitted to the EMBL data library.We refer to the sequence published in the original manuscript. g75, c152, a227, t303 are missing in EMBL flat file (Position numbering according to the present EMBL sequence).

(6) The sequence described in the manuscript is different from the one submitted to the EMBL data library.We refer to the sequence published in the original manuscript. a75, a152, a227, c303 are missing in EMBL flat file and nucleotides 170 to 172 are unresolved (Position numbering according to the present EMBL sequence).

(7) The sequence described in the manuscript is different from the one submitted to the EMBL data library.We refer to the sequence published in the original manuscript. t74, g150, c226, a302 are missing in EMBL flat file (Position numbering according to the present EMBL sequence).

(8) The sequence described in the manuscript is different from the one submitted to the EMBL data library.We refer to the sequence published in the original manuscript. a74, a149, a226, t302, a378 are missing in EMBL flat file (Position numbering according to the present EMBL sequence).

(9) The sequence described in the manuscript is different from the one submitted to the EMBL data library.We refer to the sequence published in the original manuscript. a75, t150, g226, c302 are missing in EMBL flat file (Position numbering according to the present EMBL sequence).

References:

[1] Seidman, J.G. et al., Nature, 280, 370-375 (1979).

[2] Hieter, P.A. et al., Cell, 22, 197-207 (1980).

[3] Max, E.E. et al., J. Biol. Chem., 256, 5116-5120 (1981).

[4] Jouvin-Marche, E. et al., Mol. Biol. Evol., 5, 500-511 (1988).

[5] Der Loo, W. et al., Genetics, 132, 1105-1117 (1992).

[6] Solin, M.L. and Kaartinen, M., Immunogenetics, 37, 401-407 (1993).

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Table 8. Complete list of the mouse *(Mus musculus)* IGK genes on chromosome 6

IGKV gene nomenclature: IGKV genes are designated by a number for the subgroup, followed by a hyphen and a number for the localization from 3 to 5 in the locus.

IMGT gene group	IMGT gene subgroup	IMGT gene name	IMGT Functionality	IMGT reference sequence accession numbers (1)	Number of alleles (2)	IMGT gene definition
IGKC		IGKC	F	V00807	3	Immunoglobulin kappa constant
IGKJ		IGKJ1	F	V00777	2	Immunoglobulin kappa joining 1
		IGKJ2	F	V00777	3	Immunoglobulin kappa joining 2
		IGKJ3	ORF	V00777	2	Immunoglobulin kappa joining 3
		IGKJ4	F	V00777	2	Immunoglobulin kappa joining 4
		IGKJ5	F	V00777	1	Immunoglobulin kappa joining 5
IGKV	IGKV1	IGKV1-35	ORF	AJ231200	1	Immunoglobulin kappa variable 1-35
		IGKV1-88	F	AJ231206	1	Immunoglobulin kappa variable 1-88
		IGKV1-99	F	AJ231207	1	Immunoglobulin kappa variable 1-99
		IGKV1-108	P	AJ231204	1	Immunoglobulin kappa variable 1-108
		IGKV1-110	F	D00080/M15566	2	Immunoglobulin kappa variable 1-110
		IGKV1-115	P	AJ231208	1	Immunoglobulin kappa variable 1-115
		IGKV1-117	F	D00081	2	Immunoglobulin kappa variable 1-117
		IGKV1-122	F	D00082	1	Immunoglobulin kappa variable 1-122
		IGKV1-131	ORF	AJ231197	1	Immunoglobulin kappa variable 1-131
		IGKV1-132	F	AJ231198	1	Immunoglobulin kappa variable 1-132
		IGKV1-133	F	Z72382	1	Immunoglobulin kappa variable 1-133
		IGKV1-135	F	Z72384	1	Immunoglobulin kappa variable 1-135
		IGKV1-136	P	AJ231202	1	Immunoglobulin kappa variable 1-136
	IGKV2	IGKV2-93-1	P	AJ231265	1	Immunoglobulin kappa variable 2-93-1
		IGKV2-95-1	P	AJ231261	1	Immunoglobulin kappa variable 2-95-1
		IGKV2-95-2	P	AJ231266	1	Immunoglobulin kappa variable 2-95-2
		IGKV2-105	P	AJ231262	1	Immunoglobulin kappa variable 2-105
		IGKV2-107	P	AJ132682	1	Immunoglobulin kappa variable 2-107
		IGKV2-109	F	AJ132683	2	Immunoglobulin kappa variable 2-109
		IGKV2-112	F	J00562	1	Immunoglobulin kappa variable 2-112
		IGKV2-113	P	AJ231260	1	Immunoglobulin kappa variable 2-113
		IGKV2-116	P	AJ277843	1	Immunoglobulin kappa variable 2-116
		IGKV2-137	F	AJ231263	1	Immunoglobulin kappa variable 2-137
		IGKV2-a	F	K02417	1	Immunoglobulin kappa variable 2-a
	IGKV3	IGKV3-1	F	X16955	1	Immunoglobulin kappa variable 3-1
		IGKV3-2	F	X16954	1	Immunoglobulin kappa variable 3-2
		IGKV3-3	F	K02162	1	Immunoglobulin kappa variable 3-3
		IGKV3-4	F	Y15968	1	Immunoglobulin kappa variable 3-4
		IGKV3-5	F	K02161	1	Immunoglobulin kappa variable 3-5
		IGKV3-6	P	Y15969	1	Immunoglobulin kappa variable 3-6
		IGKV3-7	F	K02158	1	Immunoglobulin kappa variable 3-7
		IGKV3-8	P	Y15971	1	Immunoglobulin kappa variable 3-8
		IGKV3-9	F	Y15972	1	Immunoglobulin kappa variable 3-9
		IGKV3-10	F	K02160	1	Immunoglobulin kappa variable 3-10
		IGKV3-11	P	Y15973	1	Immunoglobulin kappa variable 3-11
		IGKV3-12	F	K12159	1	Immunoglobulin kappa variable 3-12
	IGKV4	IGKV4-50	F	AJ235938	1	Immunoglobulin kappa variable 4-50
		IGKV4-51	F	J00575/V01565	1	Immunoglobulin kappa variable 4-51
		IGKV4-52	F	AJ239198	1	Immunoglobulin kappa variable 4-52
		IGKV4-53	F	AJ231231	1	Immunoglobulin kappa variable 4-53
		IGKV4-54	F	AJ231223	1	Immunoglobulin kappa variable 4-54
		IGKV4-55	F	AJ231225	1	Immunoglobulin kappa variable 4-55
		IGKV4-56	P	AJ231220	1	Immunoglobulin kappa variable 4-56
		IGKV4-57	F	AJ231221	1	Immunoglobulin kappa variable 4-57
		IGKV4-58	F	K00884	1	Immunoglobulin kappa variable 4-58
		IGKV4-59	F	S37664	1	Immunoglobulin kappa variable 4-59
		IGKV4-60	P	AJ235941	1	Immunoglobulin kappa variable 4-60
		IGKV4-61	F	AJ231209	1	Immunoglobulin kappa variable 4-61

Table 8 (continued)

		IGKV4-62	ORF	AJ231210	1	Immunoglobulin kappa variable 4-62
		IGKV4-63	F	AJ231211	1	Immunoglobulin kappa variable 4-63
		IGKV4-65	P	AJ231232	1	Immunoglobulin kappa variable 4-65
		IGKV4-68	F	AJ231222	1	Immunoglobulin kappa variable 4-68
		IGKV4-69	F	AJ235942	1	Immunoglobulin kappa variable 4-69
		IGKV4-70	F	AJ235943	1	Immunoglobulin kappa variable 4-70
		IGKV4-71	F	AJ231218	1	Immunoglobulin kappa variable 4-71
		IGKV4-72	F	AJ231219	1	Immunoglobulin kappa variable 4-72
		IGKV4-73	F	AJ231216	1	Immunoglobulin kappa variable 4-73
		IGKV4-74	F	AJ231217	1	Immunoglobulin kappa variable 4-74
		IGKV4-75	P	AJ231227	1	Immunoglobulin kappa variable 4-75
		IGKV4-77	P	AJ235940	1	Immunoglobulin kappa variable 4-77
		IGKV4-78	F	AJ231212	1	Immunoglobulin kappa variable 4-78
		IGKV4-79	F	AJ231214	1	Immunoglobulin kappa variable 4-79
		IGKV4-80	F	AJ231213	1	Immunoglobulin kappa variable 4-80
		IGKV4-81	F	AJ231215	1	Immunoglobulin kappa variable 4-81
		IGKV4-83	P	AJ231230	1	Immunoglobulin kappa variable 4-83
		IGKV4-86	F	X05555	1	Immunoglobulin kappa variable 4-86
		IGKV4-90	F	AJ231224	1	Immunoglobulin kappa variable 4-90
		IGKV4-91	F	AJ231229	1	Immunoglobulin kappa variable 4-91
		IGKV4-92	F	AJ231226	1	Immunoglobulin kappa variable 4-92
	IGKV5	IGKV5-37	F	AJ235963	1	Immunoglobulin kappa variable 5-37
		IGKV5-39	F	AJ235964	1	Immunoglobulin kappa variable 5-39
		IGKV5-40-1	P	AJ235976	1	Immunoglobulin kappa variable 5-40-1
		IGKV5-43	F	AJ235973	1	Immunoglobulin kappa variable 5-43
		IGKV5-45	F	AJ235974	1	Immunoglobulin kappa variable 5-45
		IGKV5-48	F	V01564	1	Immunoglobulin kappa variable 5-48
	IGKV6	IGKV6-13	(F)	J00569	1	Immunoglobulin kappa variable 6-13
		IGKV6-14	F	Y15975	1	Immunoglobulin kappa variable 6-14
		IGKV6-15	F	Y15976	1	Immunoglobulin kappa variable 6-15
		IGKV6-17	F	Y15978	1	Immunoglobulin kappa variable 6-17
		IGKV6-20	F	Y15981	1	Immunoglobulin kappa variable 6-20
		IGKV6-23	F	AJ235961	1	Immunoglobulin kappa variable 6-23
		IGKV6-25	F	AJ235962	1	Immunoglobulin kappa variable 6-25
		IGKV6-29	F	AJ235967	1	Immunoglobulin kappa variable 6-29
		IGKV6-32	F	AJ235968	2	Immunoglobulin kappa variable 6-32
		IGKV6-b	F	M14361	1	Immunoglobulin kappa variable 6-b
		IGKV6-c	F	M24937	1	Immunoglobulin kappa variable 6-c
		IGKV6-d	F	L36249	1	Immunoglobulin kappa variable 6-d
	IGKV7	IGKV7-33	F	AF044198	1	Immunoglobulin kappa variable 7-33
	IGKV8	IGKV8-16	F	Y15977	1	Immunoglobulin kappa variable 8-16
		IGKV8-18	ORF	Y15979	1	Immunoglobulin kappa variable 8-18
		IGKV8-19	F	Y15980	1	Immunoglobulin kappa variable 8-19
		IGKV8-21	F	Y15982	1	Immunoglobulin kappa variable 8-21
		IGKV8-22	P	Y15983	1	Immunoglobulin kappa variable 8-22
		IGKV8-24	F	AJ235944	1	Immunoglobulin kappa variable 8-24
		IGKV8-26	ORF	AJ235945	1	Immunoglobulin kappa variable 8-26
		IGKV8-27	F	AJ235946	1	Immunoglobulin kappa variable 8-27
		IGKV8-28	F	AJ235947	2	Immunoglobulin kappa variable 8-28
		IGKV8-30	F	AJ235948	1	Immunoglobulin kappa variable 8-30
		IGKV8-31	P	AJ235957	1	Immunoglobulin kappa variable 8-31
		IGKV8-34	F	AJ235958	1	Immunoglobulin kappa variable 8-34
	IGKV9	IGKV9-119	P	AJ231236	1	Immunoglobulin kappa variable 9-119
		IGKV9-120	F	V00804/J00566	1	Immunoglobulin kappa variable 9-120
		IGKV9-123	F	AF003295	1	Immunoglobulin kappa variable 9-123
		IGKV9-124	F	AF003294	1	Immunoglobulin kappa variable 9-124
		IGKV9-128	P	AJ231245	1	Immunoglobulin kappa variable 9-128
		IGKV9-129	F	K00880	1	Immunoglobulin kappa variable 9-129
	IGKV10	IGKV10-94	F	M54906	3	Immunoglobulin kappa variable 10-94
		IGKV10-95	F	AF029261	1	Immunoglobulin kappa variable 10-95
		IGKV10-96	F	M15520	3	Immunoglobulin kappa variable 10-96

➤

Table 8 (continued)

	IGKV11	IGKV11-106	P	AJ231252	1	Immunoglobulin kappa variable 11-106
		IGKV11-114	P	AJ231253	1	Immunoglobulin kappa variable 11-114
		IGKV11-118	P	AJ231255	1	Immunoglobulin kappa variable 11-118
		IGKV11-125	F	AJ231256	1	Immunoglobulin kappa variable 11-125
	IGKV12	IGKV12-38	F	AJ235951	1	Immunoglobulin kappa variable 12-38
		IGKV12-40	P	AJ235952	1	Immunoglobulin kappa variable 12-40
		IGKV12-41	F	AJ235953	2	Immunoglobulin kappa variable 12-41
		IGKV12-42	P	AJ235954	1	Immunoglobulin kappa variable 12-42
		IGKV12-44	F	AJ235955	1	Immunoglobulin kappa variable 12-44
		IGKV12-46	F	AJ235956	1	Immunoglobulin kappa variable 12-46
		IGKV12-47	P	AJ235959	1	Immunoglobulin kappa variable 12-47
		IGKV12-49	P	AJ235960	1	Immunoglobulin kappa variable 12-49
		IGKV12-66	P	AJ235934	1	Immunoglobulin kappa variable 12-66
		IGKV12-67	P	AJ235933	1	Immunoglobulin kappa variable 12-67
		IGKV12-89	F	AJ235950	1	Immunoglobulin kappa variable 12-89
		IGKV12-98	F	AJ235949	1	Immunoglobulin kappa variable 12-98
		IGKV12-e	F	J00546	1	Immunoglobulin kappa variable 12-e
	IGKV13	IGKV13-54-1	P	AJ132680	1	Immunoglobulin kappa variable 13-54-1
		IGKV13-55-1	P	AJ132679	1	Immunoglobulin kappa variable 13-55-1
		IGKV13-56-1	P	AJ132675	1	Immunoglobulin kappa variable 13-56-1
		IGKV13-57-1	P	AJ132681	1	Immunoglobulin kappa variable 13-57-1
		IGKV13-61-1	P	AJ132676	1	Immunoglobulin kappa variable 13-61-1
		IGKV13-62-1	P	AJ132672	1	Immunoglobulin kappa variable 13-62-1
		IGKV13-64	P	AJ235969	1	Immunoglobulin kappa variable 13-64
		IGKV13-71-1	P	AJ132673	1	Immunoglobulin kappa variable 13-71-1
		IGKV13-73-1	P	AJ132677	1	Immunoglobulin kappa variable 13-73-1
		IGKV13-74-1	P	AJ132678	1	Immunoglobulin kappa variable 13-74-1
		IGKV13-76	P	AJ231271	1	Immunoglobulin kappa variable 13-76
		IGKV13-78-1	P	AJ132671	1	Immunoglobulin kappa variable 13-78-1
		IGKV13-80-1	P	AJ132674	1	Immunoglobulin kappa variable 13-80-1
		IGKV13-82	P	AJ231276	1	Immunoglobulin kappa variable 13-82
		IGKV13-84	F	AJ231273	1	Immunoglobulin kappa variable 13-84
		IGKV13-85	F	AJ231274	3	Immunoglobulin kappa variable 13-85
		IGKV13-87	P	AJ231275	1	Immunoglobulin kappa variable 13-87
		IGKV13-89-1	P	AJ231272	1	Immunoglobulin kappa variable 13-89-1
	IGKV14	IGKV14-100	F	AJ231243	1	Immunoglobulin kappa variable 14-100
		IGKV14-111	F	V01563	1	Immunoglobulin kappa variable 14-111
		IGKV14-118-1	P	AJ277844	1	Immunoglobulin kappa variable 14-118-1
		IGKV14-118-2	P	AJ231237	1	Immunoglobulin kappa variable 14-118-2
		IGKV14-126	P	AJ231238	1	Immunoglobulin kappa variable 14-126
		IGKV14-126-1	P	AJ231246	1	Immunoglobulin kappa variable 14-126-1
		IGKV14-130	F	AJ231241	1	Immunoglobulin kappa variable 14-130
		IGKV14-134-1	P	AJ231249	1	Immunoglobulin kappa variable 14-134-1
	IGKV15	IGKV15-97	P	AJ231267	1	Immunoglobulin kappa variable 15-97
		IGKV15-101	P	AJ231268	1	Immunoglobulin kappa variable 15-101
		IGKV15-101-1	P	AJ231251	1	Immunoglobulin kappa variable 15-101-1
		IGKV15-102	P	AJ231270	1	Immunoglobulin kappa variable 15-102
		IGKV15-103	ORF	AJ231269	1	Immunoglobulin kappa variable 15-103
	IGKV16	IGKV16-104	F	AJ235936	1	Immunoglobulin kappa variable 16-104
	IGKV17	IGKV17-121	F	AJ231258	1	Immunoglobulin kappa variable 17-121
		IGKV17-127	F	AJ231259	1	Immunoglobulin kappa variable 17-127
		IGKV17-134	P	Z72386	1	Immunoglobulin kappa variable 17-134
	IGKV18	IGKV18-36	F	AJ235966	1	Immunoglobulin kappa variable 18-36
	IGKV19	IGKV19-93	F	AJ235935	1	Immunoglobulin kappa variable 19-93

(1) IMGT reference accession numbers for mouse genes refer to sequences from *Mus musculus*.
(2) The number of alleles refer to alleles described in *Mus musculus*.

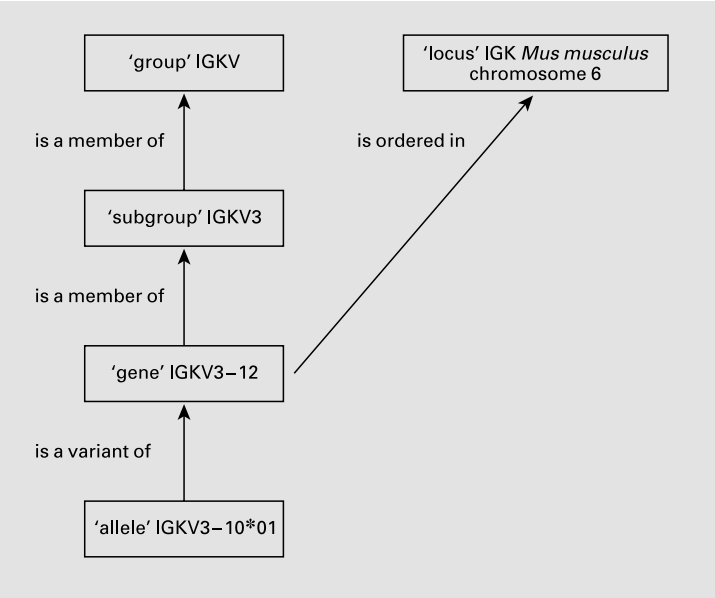

Fig. 2. The 'CLASSIFICATION' concept of IMGT-ONTOLOGY, exemplified for the mouse IGKV genes.

Correspondences between Nomenclatures and Numberings

Correspondence between the mouse IGKV group and gene nomenclatures is reported in table 3.

In order to easily compare sequences of immunoglobulins and T cell receptors, a unique numbering has been defined for the variable regions [36, 37]. Correspondence between the IMGT unique numbering and other numberings for the IGKV genes is available from the IMGT Scientific chart. The IMGT unique numbering relies on the high conservation of the structure of the variable region. This numbering takes into account and combines the definition of the framework (FR) and complementarity determining regions (CDR) [38], structural data from X-ray diffraction studies [39], and the characterization of the hypervariable loops [40]. The unique numbering has allowed the redefinition of the limits of the FR and CDR [36]. The FR-IMGT and CDR-IMGT lengths themselves become crucial information characterizing the variable regions belonging to a group, a subgroup, and/or a gene. For example, for a germline gene of the mouse *(M. musculus)* IGKV1 subgroup, the lengths of the 3 CDR-IMGT, in number of amino acids is designated as [11.3.7] (IMGT Repertoire>2D and 3D structures) [36]. The unique numbering is used as the output of the IMGT/V-QUEST alignment tool, and in the 'Alignments of alleles (IMGT Repertoire>Proteins and alleles).

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Appendix

The 'CLASSIFICATION' concept of IMGT-ONTOLOGY

The 'CLASSIFICATION' concept of IMGT-ONTOLOGY (fig. 2) organizes the immunogenetics knowledge useful to name and classify the immunoglobulin genes [32].

'Locus': A locus is a group of immunoglobulin genes that are ordered and are localized in the same chromosomal location in a given species. The 'locus' IGK on chromosome 6 is one of the three main immunoglobulin loci in the mouse genome. Immunoglobulin genes have also been identified in other chromosomal locations outside the main loci which represent new instances of the concept locus. However, the genes they contain, designated as orphons, are not functional.

'Group': A group is a set of genes which share the same 'gene type' (V, D, J or C) and participate potentially in the synthesis of a polypeptide of the same 'chain type'. By extension, a group includes the related pseudogenes and orphons. A 4-letter root designates the 'group': for example, IGKV, IGKJ, and IGKC for the immunoglobulin kappa genes.

'Subgroup': A subgroup is a set of genes which belong to the same group, in a given species, and which share at least 75% identity at the nucleotide level (in the germline configuration for V, D, and J). For example, the mouse *(M. musculus)* IGKV genes belong to 19 subgroups.

'Gene': A gene is defined as a DNA sequence that can be potentially transcribed and/or translated (this definition includes the regulatory elements in 5′ and 3′, and the introns, if present). Instances of the 'gene' concept are gene names. By extension, orphons and pseudogenes are also instances of the 'gene' concept. For each gene, IMGT has defined a reference sequence. For the V, D, and J genes, the reference sequence corresponds to a germline entity. The rules for the choice of the reference sequences are described at http://imgt.cines.fr in the IMGT Scientific chart.

'Allele': An allele is a polymorphic variant of a gene. Alleles are described, exhaustively and in a standardized way, for the four 'core' coding regions, that is the germline V-REGIONs, D-REGIONs, and J-REGIONs, and for the C-REGIONs, from immunoglobulin genes. These alleles refer to sequence polymorphisms, with mutations described at the sequence level [1]. Their sequences are compared to the reference sequence designated as *01 (see IMGT Scientific chart at http://imgt.cines.fr for IMGT description of mutations, and IMGT allele nomenclature for sequence polymorphisms).

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