

L.J. Kennedy
J.M. Angles
A. Barnes
S.D. Carter
O. Francino
J.A. Gerlach
G.M. Happ
W.E.R. Ollier
W. Thomson
J.L. Wagner

Nomenclature for factors of the dog major histocompatibility system (DLA), 2000: Second report of the ISAG DLA Nomenclature Committee

Key words:

dog; MHC; DLA; nomenclature; genetics

Acknowledgments:

These conclusions were reached after discussion involving input from Philip Hedrick, Steve O'Brien, Peter Parham, Ronald Bontrop, Bob Wayne, Steven Marsh, George Russell, Shirley Ellis and the DLA Nomenclature Committee. The authors gratefully acknowledge the help of S.G.E. Marsh and J. Robinson in preparing the sequence alignments in this report. Comparative sequence alignments were generated by Format/Aln.cgi, which was written by James Robinson for the IMGT/HLA Database.

Abstract: The ISAG DLA Nomenclature Committee met during the "Comparative Evolution of the Mammalian MHC" meeting in Manchester, England on 10th September 2000. The main points discussed were the naming of class I genes and alleles, and the inclusion of alleles from other canidae.

The major histocompatibility complex (MHC) of the dog and other canidae appears to be highly polymorphic, and alleles of these genes are likely to be functionally relevant in regulating the immune response and the susceptibility/resistance to immune-mediated diseases. Considerable effort has recently been made in characterising the extent of the polymorphisms in DLA class II genes. The ISAG DLA Nomenclature Committee met during the recent "Comparative Evolution of the Mammalian MHC" conference in Manchester in September 2000, and the report of this meeting is given below.

Naming of genes within the DLA region

Class I

Since the previous nomenclature report (1, 2) studies by Wagner (unpublished) have identified locus-specific primers for four transcribed class I genes. Thus the previously described alleles (3) can be assigned unequivocally to particular loci. In order to avoid the suggestion that any DLA class I genes were homologues of particular HLA class I genes, it was decided that numbers rather than letters would be used at present to name DLA class I genes. The updated list of DLA genes is shown in Table 1A (with newly named genes in bold type), while Table 1B lists other genes which have yet to be confirmed and do not have official names. Since the first DLA

Authors' affiliations:

L.J. Kennedy¹,
J.M. Angles²,
A. Barnes¹,
S.D. Carter¹,
O. Francino³,
J.A. Gerlach⁴,
G.M. Happ⁵,
W.E.R. Ollier¹,
W. Thomson¹,
J.L. Wagner⁶

¹Mammalian Immunogenetics Research Group, Veterinary Clinical Sciences, University of Liverpool, United Kingdom,

²Small Animal Clinical Studies, University College Dublin, Ballsbridge, Dublin, Ireland,

³Facultat de Veterinaria, Universitat Autònoma de Barcelona, Spain,

⁴Medical Technology Program, Department of Medicine, Michigan State University, East Lansing, Michigan, USA,

⁵Institute of Arctic Biology, University of Alaska, Fairbanks, Alaska, USA,

⁶Thomas Jefferson University, Department of Medicine, Philadelphia, Pennsylvania, USA

Correspondence to:

Lorna Kennedy
ARC Epidemiology Unit
University of Manchester
Stopford Building
Oxford Road
Manchester M13 9PT
UK
Tel: +44 0 161 275 7316
Fax: +44 0 161 275 5043
e-mail:
Lorna.Kennedy@man.ac.uk

Received 7 February 2001, revised,
accepted for publication 5 May 2001

Copyright © Munksgaard 2001
Tissue Antigens. ISSN 0001-2815

Tissue Antigens 2001; 58: 55–70
Printed in Denmark. All rights reserved

A) Genes in the DLA complex

Official name	Previous equivalents	Molecular characteristics	References
DLA-79	DLA-79	Non-classical class I gene associated with 7.9kb <i>Hind</i> III fragment Not in DLA region	3, 5, 6
DLA-88	DLA-88	Class I gene associated with 8.8kb <i>Hind</i> III fragment	3, 6
DLA-12	DLA-12	Non-classical class I gene associated with 12kb <i>Hind</i> III fragment	3, 6
DLA-64	DLA-64	Non-classical class I gene associated with 6.4kb <i>Hind</i> III fragment	3, 6
DLA-DRA1	DRA	DR alpha chain	7, 8
DLA-DRB1	DRB1, DRBB1	DR beta chain	7, 9, 10, 11
DLA-DRB2	DRB2, DRBB2	DRB pseudogene	7, 12, 10, 11
DLA-DQA1	DQA1	DQ alpha chain	7, 10
DLA-DQB1	DQB1	DQ beta chain	7, 13
LMP2	LMP2	Gerlach, personal communication	

B) Other unconfirmed genes associated with the DLA complex

Name	Molecular characteristics	References
DLA-A	unknown	9
DLA-12a	Class I pseudogene associated with 12kb <i>Hind</i> III fragment	6
C1pg-26	Class I processed gene associated with 2.6kb <i>Hind</i> III fragment. Not in DLA region	6
DLA-53	Class I pseudogene associated with 5.3kb <i>Hind</i> III fragment	6
DQB2	?pseudogene	7, 13
DPA	DP alpha chain	7
DPB1	DP beta chain	7
DPB2	DP beta chain	7
DOB	DO beta chain	7

Table 1

nomenclature report, the DLA region has been mapped to dog chromosome 12 (4), and it has been confirmed that DLA-79 maps to a separate region on chromosome 18. Although DLA-79 and C1pg-26 are orphan genes not located in the DLA region, the DLA Nomenclature Committee considers that naming such genes falls within their remit.

Class II

No new class II gene names were assigned.

Naming of new alleles

The committee reaffirms the published conditions for naming new alleles (1, 2).

Since the last nomenclature report, 48 DLA-88, 16 DLA-DRB1, 6 DLA-DQA1 and 15 DLA-DQB1 alleles have been named. Although there is some evidence for 2, 3 and 4 alleles respectively for DLA-12, DLA-64 and DLA-79 (3), no sequence alignments have been published, and no alleles have been lodged in GenBank to date. Therefore no allele names have been assigned for these class I loci. Tables 2–5 list all the named alleles at the following loci: DLA-88, DLA-DRB1, DLA-DQA1 and DLA-DQB1. The tables show new alleles in bold type, and include previous names, accession numbers, and for class II, the canidae in which each allele has been found to date.

The class I alleles for the DLA-88 locus have been named according to the rules defined in the previous nomenclature report. Some of these alleles have an additional amino acid at codon 156, and these alleles have received names starting at DLA-88*50101. The sequential numbering for the nucleotides and the codons therefore includes codon 156, although many alleles are missing that codon.

Naming of MHC alleles from other canidae

The principles for naming the MHC genes and alleles in different canidae (dog, grey wolf, red wolf and coyote lineages), and how to apply them to sub-species and hybrids have been considered. The principles established here for the canidae group may have applications in other animals which have been domesticated.

At this point in time it is not considered possible to distinguish class II alleles from domestic dogs, grey wolves, red wolves and coyotes. As can be seen from Tables 3–5, there is some overlap (especially for DLA-DQA1) in the occurrence of alleles in these different canidae, at all three of the class II loci studied to date. Given that the sample sizes are small for some of the canidae presently examined, it would seem likely that the degree of overlap will increase. As full-length genomic sequences are not as yet available, there are no data as to whether the other exons and the intron sequences are also identical. Compelling evidence of MHC identity exists between these canidae, since several three-locus haplotypes have been shown to be shared between dogs, wolves and coyotes.

DLA class II alleles found in any of these canidae will be named in a common series, until such time as they can be shown to be different.

Updated class I sequence alignments

Figs. 1 and 2 show the updated comparative nucleotide and amino acid sequence alignments for the class I gene DLA-88. The hyper-variable regions are highlighted on each alignment.

Updated class II sequence alignments

Figs. 3–8 show the updated comparative nucleotide and amino acid sequence alignments for the class II genes: DLA-DRB1, DLA-DQA1 and DLA-DQB1. The hypervariable regions are highlighted on each alignment.

Sequence database

The DLA allele sequences will be integrated into a non-human section of the IMGT/HLA database. The alignments should also become available on a web site in the near future. In the meanwhile, the alignment files are available by email from Lorna.Kennedy@man.ac.uk.

Accession numbers and references for DLA88 alleles

Allele	Previous equivalent	Accession numbers Exon 2, exon 3	Reference
DLA-88*00101	dla88-01	AF100567, AF101486	3
DLA-88*00201	dla88-02	AF100568, AF101487	3
DLA-88*00301	dla88-03	AF100569, AF101488	3
DLA-88*00401	dla88-04	AF100570, AF101489	3
DLA-88*00402	dla88-12	AF100578, AF101497	3
DLA-88*00501	dla88-05	AF100571, AF101490	3
DLA-88*00601	dla88-06	AF100572, AF101491	3
DLA-88*00701	dla88-07	AF100573, AF101492	3
DLA-88*00801	dla88-08	AF100574, AF101493	3
DLA-88*00901	dla88-09	AF100575, AF101494	3
DLA-88*01001	dla88-10	AF100576, AF101495	3
DLA-88*01301	dla88-13	AF100579, AF101498	3
DLA-88*01401	dla88-14	AF100580, AF101499	3
DLA-88*01501	dla88-15	AF100581, AF101500	3
DLA-88*01601	dla88-16	AF100582, AF101501	3
DLA-88*01602	dla88-40	AF100606, AF101525	3
DLA-88*01701	dla88-17	AF100583, AF101502	3
DLA-88*01801	dla88-18	AF100584, AF101503	3
DLA-88*01901	dla88-19	AF100585, AF101504	3
DLA-88*02001	dla88-20	AF100586, AF101505	3
DLA-88*02201	dla88-22	AF100588, AF101507	3
DLA-88*02301	dla88-23	AF100589, AF101508	3
DLA-88*02401	dla88-24	AF100590, AF101509	3
DLA-88*02501	dla88-25	AF100591, AF101510	3
DLA-88*02601	dla88-26	AF100592, AF101511	3
DLA-88*02701	dla88-27	AF100593, AF101512	3
DLA-88*02801	dla88-28	AF100594, AF101513	3
DLA-88*02802	dla88-29	AF100595, AF101514	3
DLA-88*03001	dla88-30	AF100596, AF101515	3
DLA-88*03101	dla88-31	AF100597, AF101516	3
DLA-88*03401	dla88-34	AF100600, AF101519	3
DLA-88*03501	dla88-35	AF100601, AF101520	3
DLA-88*03701	dla88-37	AF100603, AF101522	3
DLA-88*03801	dla88-38	AF100604, AF101523	3
DLA-88*03901	dla88-39	AF100605, AF101524	3
DLA-88*04101	dla88-41	AF100607, AF101526	3
DLA-88*04201	dla88-42	AF100608, AF101527	3
DLA-88*04301	dla88-43	AF100609, AF101528	3
DLA-88*04401	dla88-44	AF100610, AF101529	3
DLA-88*04801	dla88-48	AF218299, AF218300	14
DLA-88*50101	dla88-11	AF100577, AF101496	3
DLA-88*50201	dla88-33	AF100599, AF101518	3
DLA-88*50301	dla88-36	AF100602, AF101521	3
DLA-88*50401	dla88-46	AF218297, AF218298	14
DLA-88*50501	dla88-32	AF100598, AF101517	3
DLA-88*50601	dla88-47	AF218303, AF218304	14
DLA-88*50701	dla88-49	AF218301, AF218302	14
DLA-88*50801	dla88-21	AF100587, AF101506	3

Table 2

Fig. 2. A) DLA-88 exon 2 amino acid alignment. B) DLA-88 exon 3 amino acid alignment.

A

	1	10	20	30	40	50	60	70	80	90
DLA-88*00101	GSHSLRYFYT	SVSRPGRGDP	RFIAVGYVDD	TQFVRFDSDA	ATGRMEPRAP	WMEQEGPEYW	DRETRTAKET	AQRYRVLDLT	LRGYNQSEA	
DLA-88*00201					T	V	Q	F	V	
DLA-88*00301		R		LY-S	A	SQKV		S	N	V
DLA-88*00401						V	PO	I	RTF	
DLA-88*00402						V	PO	I	RTF	
DLA-88*00501						T	Q	NP	RNF	
DLA-88*00601						T	PO	I	L	
DLA-88*00701						T		NP	RNF	
DLA-88*00801				A		T				
DLA-88*00901						V	PO	AI	RTF	
DLA-88*01001						T	Q	I	RTF	
DLA-88*01301		A		LY-S	A		G	NV	RTF	N
DLA-88*01401		D	A	LY-T			G	KV	RTF	S
DLA-88*01501						T	Q	F	RTF	
DLA-88*01601						V	PO	I		S
DLA-88*01602						V	PO	I		S
DLA-88*01701						V	PO	I		S
DLA-88*01801				LY-S		V	PO	IR		S
DLA-88*01901		H		LY-S		V	GQ	IS	N	L
DLA-88*02001		R		LY-S	A	SQKV		S	N	V
DLA-88*02201						T	PO	I	RTF	
DLA-88*02301						T	GQ	KV	L	P
DLA-88*02401						T	Q	I	RG	G
DLA-88*02501						T	NP	RG	RG	G
DLA-88*02601						V	NP	RG	RG	G
DLA-88*02701						T	Q	NP	RG	G
DLA-88*02801						V	NP	V	G	
DLA-88*02802				A		L	NP	V	G	
DLA-88*03001				A		L	NP	V	G	
DLA-88*03101						L	NP	V	G	
DLA-88*03401						V	PO	F	L	
DLA-88*03501						T	G	KV	L	
DLA-88*03701						T	Q	I	RTF	
DLA-88*03801				S			Q	F	VF	
DLA-88*03901						V	Q	S	N	VC
DLA-88*04101						V	G	KV	L	
DLA-88*04201						V	G	NL	V	
DLA-88*04301						V	Q	F	RG	G
DLA-88*04401						T				V
DLA-88*04801						V	PO	I	L	
DLA-88*50101				A		V	PO	I	RTF	
DLA-88*50201				A		V	PO	I	RTF	
DLA-88*50301				A		V	Q	I	RTF	
DLA-88*50401						V	PO	I	RTF	
DLA-88*50501				LY-S		V	Q	IS	N	V
DLA-88*50601				LY-S		N	PO	IS	N	V
DLA-88*50701						V	G	KV	V	
DLA-88*50801						T	G	KV	V	
DLA-88*00101	GSHSLRYFYT	SVSRPGRGDP	RFIAVGYVDD	TQFVRFDSDA	ATGRMEPRAP	WMEQEGPEYW	DRETRTAKET	AQRYRVLDLT	LRGYNQSEA	

B

	100	110	120	130	140	150	160	170	180	
DLA-88*00101	GSHTRQTMYG	CDLGGGRLL	RGYSQDAYDG	ADYIALNEDL	RSWTAADTAA	QITRRKWEAA	GTAEH.DRNY	LETTTCVEWLR	RYLEMGKETL	LRA
DLA-88*00201					A					
DLA-88*00301		TP			A	R	D	G	L	
DLA-88*00401					A					
DLA-88*00402					A					
DLA-88*00501	A-L-W			L	T	R	D	L		Q
DLA-88*00601					Y					Q
DLA-88*00701	A-L-W			L	T	R	D	L		Q
DLA-88*00801						T	V	L	M	
DLA-88*00901										
DLA-88*01001					A					
DLA-88*01301	F-W-F				A		D	G	L	Q
DLA-88*01401	I-WTS	V-D			Y	A	V			
DLA-88*01501					A					
DLA-88*01601					A			EK		Q
DLA-88*01602					A			EK		Q
DLA-88*01701	I			D			D	E	M	
DLA-88*01801	I			D			D	E	M	
DLA-88*01901					A		V			Q
DLA-88*02001	F				A		R	D	G	L
DLA-88*02201					Y					Q
DLA-88*02301	I									Q
DLA-88*02401	I						D	R		Q
DLA-88*02501								EK		Q
DLA-88*02601	I									Q
DLA-88*02701	I									Q
DLA-88*02801	I					R	D	G	L	Q
DLA-88*02802	I					R	D	G	L	Q
DLA-88*03001	I					R	D	R		Q
DLA-88*03101					T					
DLA-88*03401	I				A	L	D	G	L	Q
DLA-88*03501					A		D			Q
DLA-88*03701					A					
DLA-88*03801							D	R		
DLA-88*03901							R	H		
DLA-88*04101	I				Y					Q
DLA-88*04201	I						D	G	L	Q
DLA-88*04301							D	E		Q
DLA-88*04401					A					
DLA-88*04801					A		R	D	G	L
DLA-88*50101							V	LQW		
DLA-88*50201							V	LQW		
DLA-88*50301							V	LQW		
DLA-88*50401	I						V	LQW		
DLA-88*50501	I			S		A	V	LQW		
DLA-88*50601	I			S		A	V	LQW		Q
DLA-88*50701						A	V	LQW		
DLA-88*50801	I						V	LQW		Q
DLA-88*00101	GSHTRQTMYG	CDLGGGRLL	RGYSQDAYDG	ADYIALNEDL	RSWTAADTAA	QITRRKWEAA	GTAEH.DRNY	LETTTCVEWLR	RYLEMGKETL	LRA

Accession numbers and references for DLA-DRB1 alleles and their distribution in different canidae

Allele	Previous equivalents	Accession numbers	Ref	Allele found in				
				Dog n>800	Grey wolf n=50	Red wolf n=2	Mexican wolf n=5	Coyote n=4
DRB1*00101	Dw4, D1	M57529	15	+				
DRB1*00102	Dw3, D3	M57528, S76138	15, 19	+				
DRB1*00201	Dw1, D2	M57537	15	+				
DRB1*00202	D2a	U44777	11	+				
DRB1*00301	0902	AJ003012	17	+				
DRB1*00401	D4, D4m	M57532	15, 11	+				
DRB1*00501	D24, 2302	AJ003017, AF098496	17, a	+				
DRB1*00601	D6, D6m	M57534	15, 11	+	+		+	
DRB1*00701	D7	M57533	15	+				
DRB1*00801	D8, D8m	M57535	15, 11	+				
DRB1*00802		AJ012456	18	+				
DRB1*00901	D9	M57531	15	+	+			
DRB1*010011	D25	AF016910	b	+				
DRB1*010012	Cafa-10, 1102	X93572	16	+				
DRB1*01101	2102, Cafa-11, 1112	X93573	16	+				
DRB1*01201	1902	AJ003015	17	+	+			
DRB1*01301	D13	U44778	11	+				
DRB1*01401	D14	U44779	11	+				
DRB1*01501	D15/Dw8, D15m, D24 (partial sequence)	M57536 AF016912	15, 11, b	+				
DRB1*01502	1502	AJ003013	17	+				
DRB1*01503	1503	AJ003014	17	+				
DRB1*01601		AJ012454	18	+				
DRB1*01701	D17	U44780	11	+				
DRB1*01801	D18	U44781	11	+				
DRB1*01901	D19	U44782	11	+				
DRB1*02001	D20	U58684	11	+				
DRB1*02101	D21	U44783	11	+				
DRB1*02201	D22	U58685	11	+				
DRB1*02301	2301	AJ003016	17	+				
DRB1*02401	2401	AJ003018	17	+				
DRB1*02501	2501	AJ003019	17	+				
DRB1*02601	2601	AJ003020	17	+				
DRB1*02701	drb 26	AF061039	20	+				
DRB1*02801	drb 25	AF061038	20	+				
DRB1*02901		AJ012455	18	+	+			
DRB1*03001	D23	AF016911	b	+				
partial sequence	1-Dob-A	M30129	c	+				
partial sequence	1-Dob-B	M30130	c	+				
partial sequence	2-Dob	M30131	c	+				
partial sequence	3-Lab	M30132	c	+				
partial sequence	4-Pood	M30133	c	+				

Table 3

Allele	Previous equivalents	Accession numbers	Ref	Allele found in				
				Dog n>800	Grey wolf n=50	Red wolf n=2	Mexican wolf n=5	Coyote n=4
DRB1*03101		AF336108	e		+			
DRB1*03201		AY009941	f	+				
DRB1*03301		AF343737	f	+				
DRB1*03501		AF336109	e		+			
DRB1*03601		AF336110	e		+			
DRB1*03701		AF343738	d		+			
DRB1*03801		AF343739	d		+		+	
DRB1*03901		AF343740	d, g		+	+		
DRB1*04001		AF343741	d	+				
DRB1*04101		AF343742	d, g		+			
DRB1*04201		AF343743	d, g		+			
DRB1*04301		AF343744	d, g					+
DRB1*04401		AF343745	d, g				+	
DRB1*04501		AF343746	d, g		+			+
DRB1*04601		AF343747	d	+				
DRB1*04701		AF343748	d	+				

a=Wagner, GenBank 1998, unpublished, b=Francino, GenBank 1997, unpublished, c=Motoyama, GenBank 1996, unpublished. d=L.J. Kennedy, unpublished. e=L.J. Kennedy and J.M. Angles, unpublished. f=J.M. Angles, unpublished. g=L.J. Kennedy and P. Hedrick, unpublished

Table 3 continued

Accession numbers and references for DLA-DQA1 alleles and their distribution in different canidae

Allele	Previous equivalents	Accession numbers	Ref	Allele found in				
				Dog n>800	Grey wolf n=57	Red wolf n=1	Mexican wolf n=6	Coyote n=2
DQA1*00101	0101, Dqa2	M74907, U44786	21, 23	+	+		+	+
DQA1*00201	0201, Dqa9	M74909, U75455	21, a	+	+		+	
DQA1*00301	0301	Y07944	22	+			+	
DQA1*00401	0203, Dqa4	Y07943, U44788	22, 23	+	+			
DQA1*005011	0202, Dqa3	M74910, U44787	21, 23	+	+		+	
DQA1*005012	Dqa5	U44789	23	+				
DQA1*00601	0103, Dqa6	Y07942, U44790	22, 23	+	+			
DQA1*00701	Dqa7	U44842	23	+	+	+		
DQA1*00801	Dqa8	U61400	a	+				
DQA1*00901	0102, Dqa1	M74908, U44785	21, 23	+			+	+
DQA1*01001		AJ130870	18	+	+			
DQA1*01101		AF343733	b		+			
DQA1*01201		AF343734	c	+	+			+
DQA1*01301		AF343735	b		+			
DQA1*01401		AF336107	b	+	+			
DQA1*01501		AF343736	c	+				

References: a=Wagner, GenBank 1996, unpublished. b=L.J. Kennedy and J.M. Angles, unpublished. c=L.J. Kennedy, unpublished

Table 4

Accession numbers and references for DLA-DQB1 alleles and their distribution in different canidae

Allele	Previous equivalents	Accession numbers	Ref	Allele found in				
				Dog n=200	Grey wolf n=40	Red wolf n=2	Mexican wolf n=7	Coyote n=0
DQB1*00101	0101, dqb2, dqb0102	M90802, AF043147, AF016905	24, 13, a	+				
DQB1*00201	0201, dqb3, dqb0203	M90803, AF043148, AF016908	24, 13, a	+				
DQB1*00301	0301, dqb6	M90804, AF043151	24, 13	+				
DQB1*00401	0401, dqb5	M90805, AF043150	24, 13	+				
DQB1*00501	0501, dqb12	Y07947, AF043157	22, 13	+				
DQB1*00502		AF336111	e	+				
DQB1*00701	0701, dqb4, dqb1001	Y07949, AF043149, AF016907	22, 13, a	+	+		+	
DQB1*008011	0801, dqb1	AF043492, AF043167	b, 13	+	+		+	
DQB1*008012		AF336112	e					
DQB1*00802		AF343731	d	+				
DQB1*01101	dqb1101	AF016904	a	+				
DQB1*01201		AY009942	e	+				
DQB1*01301	dqb13	AF043158	13	+				
DQB1*01302	dqb14	AF043159	13	+				
DQB1*01303	dqb7, dqb0901	AF043152, AF016906	13, a	+			+	
DQB1*01401		AF343732	c		+			
DQB1*01501	dqb15	AF043160	13	+		+		
DQB1*01601	dqb16	AF043161	13	+				
DQB1*01701	dqb17	AF043162	13	+	+			
DQB1*01801	dqb18	AF043163	13	+				
DQB1*01901	dqb9	AF043154	13	+				
DQB1*02001	dqb20, dqb23	AF043165, AF113705	13, 25	+				
DQB1*02002	dqb19	AF043164	13	+	+			
DQB1*02101	dqb11	AF043156	13	+				
DQB1*02201	dqb10	AF043155	13	+				
DQB1*02301	dqb8, dqb0303	AF043153, AF016909	13, a	+	+			
partial sequence	0302	Y07946	22	+				
partial sequence	0601	Y07948	22	+				
partial sequence	0202	Y07945	22	+				
DQB1*02401		AY009940	e		+			
DQB1*02601	dqb22	AF113704	25	+				
DQB1*02701	dqb24	AF113706	25	+				
DQB1*02801		AF343730	d	+				
DQB1*03001	dqb26	AF241781	25	+				
DQB1*03101	dqb27	AF241529	25	+				
DQB1*03201		AJ311104	c		+			
DQB1*03301		AJ311105	c		+			
DQB1*03401		AJ311106	c		+			
DQB1*03501		AJ311107	c	+	+			

a=Francino, GenBank 1997, unpublished, b=Polvi, GenBank 1998, unpublished. c=L.J. Kennedy and J.M. Angles unpublished. d=L.J. Kennedy unpublished. e=J.M. Angles unpublished

Table 5

References

1. Kennedy LJ, Altet L, Angles JM et al. Nomenclature for factors of the Dog Major Histocompatibility System (DLA), 1998: first report of the ISAG DLA Nomenclature Committee. *Tissue Antigens* 1999; **54**: 312–21.
2. Kennedy LJ, Altet L, Angles JM et al. Nomenclature for factors of the Dog Major Histocompatibility System (DLA), 1998: First report of the ISAG DLA Nomenclature Committee. *Anim Genet* 2000; **31**: 52–61.
3. Graumann MB, DeRose SA, Ostrander EA, Storb R. Polymorphism analysis of four canine MHC class I genes. *Tissue Antigens* 1998; **51**: 374–81.
4. Mellersh CS, Hitte C, Richman M et al. An integrated linkage-radiation hybrid map of the canine genome. *Mamm Genome* 2000; **11**: 120–30.
5. Burnett RC, Geraghty DE. Structure and expression of a divergent canine class I gene. *J Immunol* 1995; **155**: 4278–85.
6. Burnett RC, DeRose SA, Wagner JL, Storb R. Molecular analysis of six dog leukocyte antigen class I sequences including three complete genes, two truncated genes and one full-length processed gene. *Tissue Antigens* 1997; **49**: 484–95.
7. Sarmiento UM, Storb RF. Characterization of class II alpha genes and DLA-D region allelic associations in the dog. *Tissue Antigens* 1988; **32**: 224–34.
8. Wagner JL, DeRose SA, Burnett RC, Storb R. Nucleotide sequence and polymorphism analysis of Canine DRA cDNA clones. *Tissue Antigens* 1995; **45**: 284–7.
9. Sarmiento UM, Storb R. Nucleotide sequence of a dog class I cDNA clone. *Immunogenetics* 1990; **31**: 400–4.
10. Wagner JL, Burnett RC, Storb R. Molecular analysis of the DLA DR region. *Tissue Antigens* 1996; **48**: 549–53.
11. Wagner JL, Burnett RC, Works JD, Storb R. Molecular analysis of DLA-DRBB1 polymorphism. *Tissue Antigens* 1996; **48**: 554–61.
12. Sarmiento UM, Storb R. Nucleotide sequence of a dog DRB cDNA clone. *Immunogenetics* 1990; **31**: 396–9.
13. Wagner JL, Hayes-Lattin B, Works JD, Storb R. Molecular analysis and polymorphism of the DLA-DQB genes. *Tissue Antigens* 1998; **52**: 242–50.
14. Wagner JL, Creer SA, Storb R. Dog class I gene DLA-88 histocompatibility typing by PCR-SSCP and sequencing. *Tissue Antigens* 2000; **55**: 564–7.
15. Sarmiento UM, Sarmiento JI, Storb R. Allelic variation in the DR subregion of the canine major histocompatibility complex. *Immunogenetics* 1990; **32**: 13–9.
16. Francino O, Amills M, Sanchez A. Canine Mhc DRB1 genotyping by PCR-RFLP analysis. *Anim Genet* 1997; **28**: 41–5.
17. Kennedy LJ, Carter SD, Barnes A et al. Nine new dog DLA-DRB1 alleles identified by sequence based typing. *Immunogenetics* 1998; **48**: 296–301.
18. Kennedy LJ, Hall LS, Carter SD et al. Identification of further DLA-DRB1 and DQA1 alleles in the dog. *Eur J Immunogenet* 2000; **27**: 25–8.
19. He YW, Ferencik S, Grosse-Wilde H. A research on DLA-DRB1 genotyping by PCR-RFLP. I. To select an appropriate oligonucleotide primer pair. *J Tongji Med Univ* 1994; **14**: 24–8.
20. Wagner JL, Works JD, Storb R. DLA-DRB1 and DLA-DQB1 histocompatibility typing by PSR-SSCP and sequencing. *Tissue Antigens* 1998; **52**: 397–401.
21. Sarmiento UM, DeRose S, Sarmiento JI, Storb R. Allelic variation in the DQ subregion of the canine major histocompatibility complex: I. DQA. *Immunogenetics* 1992; **35**: 416–20.
22. Polvi A, Garden OA, Elwood CM et al. Canine major histocompatibility complex genes DQA and DQB in Irish setter dogs. *Tissue Antigens* 1997; **49**: 236–43.
23. Wagner JL, Burnett RC, DeRose SA, Storb R. Molecular analysis and polymorphism of the DLA-DQA gene. *Tissue Antigens* 1996; **48**: 199–204.
24. Sarmiento UM, DeRose S, Sarmiento JI, Storb R. Allelic variation in the DQ subregion of the canine major histocompatibility complex: II. DQB. *Immunogenetics* 1993; **37**: 148–52.
25. Wagner JL, Storb R, Storer B, Mignot E. DLA-DQB1 alleles and bone marrow transplantation experiments in narcoleptic dogs. *Tissue Antigens* 2000; **56**: 223–31.