Names for P1PK (ISBT 003) Blood Group Alleles

Intro

General description: The gene *A4GALT* encodes 4-α-galactosyltransferase, the enzyme that synthesizes P1 and P^k antigens (1-3). The carbohydrate P1 antigen occurs on both glycolipids and glycoprotein whilst P^k is only known as a globoseries glycolipid. P1 glycolipid is synthesized with paragloboside as acceptor substrate and P^k antigen on lactosylceramide. Transcriptional regulation determines the two most frequent phenotypes in the P1PK blood group system, P_1 and P_2. A single nucleotide variant, rs5751348:G>T located in intron 1, found in homozygous form in P_2 individuals, disrupts a binding motif for at least two transcription factors (EGR1, RUNX1) and results in decreased levels of enzyme-encoding *A4GALT* transcripts (2,4). P^1 alleles encode both P1 and P^k antigens whilst P^2 encodes only P^k. The rare NOR-encoding allele also encodes P1 and P^k (3). Null alleles encode a nonfunctional galactosyltransferase, resulting in the p (P1-P^k-NOR-) phenotype if inherited on both chromosomes.

Gene name:	*A4GALT*
Number of exons:	3 (in the enzyme-encoding transcript)
Initiation codon:	Beginning of exon 3
Stop codon:	Within exon 3
Entrez Gene ID:	53947
LRG:	NG_007495.1 (genomic)
LRG sequence:	NM_017436.4 (transcript)
Reference allele:	*A4GALT*01*
	Acceptable:
Reference allele *A4GALT*P1.01* encodes:	P1, P^k
Antithetical antigens:	-
Antigens	P1, P^k, NOR

Phenotype	Allele Name	Nucleotide change	Exon Intron	Predicted amino acid change	(Reference No.) PMID	Accession number	rs number
P1+ P^k+	*A4GALT*01*				PMID: 10747952	NG_007495.2	
P1+ P^k+	*A4GALT*01.02*	c.109A>G	3	p.Met37Val	PMID: 10747952		rs11541159
P1– P^k+ (P_2)	*A4GALT*02*	rs5751348:G>T	i1	n.a. (lower transcript levels)	PMID: 29438961		rs5751348
P1– P^k+ (P_2)	*A4GALT*02.02*	rs5751348:G>T c.109A>G	i1,3	p.Met37Val	PMID: 29438961		rs5751348 rs11541159
P1+ Pk+ NOR+	*A4GALT*01.04*	c.631C>G	3	p.Gln211Glu	PMID: 22965229		rs397514502
Null alleles are given consecutive numbers and names including *A4GALT*01N* or *02N* indicate P^1/P^2 status of allele in intron 1 (rs5751348) if known, otherwise *A4GALT*0X*. The P2 alleles have rs5751348:G>T displayed in the rs column.							
p	*A4GALT*0XN.01.01*	c.241_243del c.903C>G	3	p.Phe81del	PMID:1189631	AF513326	rs387906279
p	*A4GALT*02N.01.02*	c.241_243del	3	p.Phe81del	PMID:12823750	AF513327	rs5751348:G>T rs387906279
p	*A4GALT*01N.03.01*	c.299C>T c.903C>G	3	p.Ser100Leu	PMID: 10993874	n.a.	rs776304817 rs11541159
p	*A4GALT*01N.03.02*	c.299C>T	3	p.Ser100Leu	PMID: 10993874	n.a.	rs776304817
p	*A4GALT*0XN.04*	c.301delG	3	p.Ala101Profs*13	PMID: 14692982	n.a.	n.a.
p	*A4GALT*0XN.06*	c.470_496delins	3	p.Asp157Alafs*120	PMID: 12823750	AF513325	n.a.
p	*A4GALT*01N.10*	c.559G>C	3	p.Gly187Arg	PMID: 23927681	EF217316	n.a.
p	*A4GALT*01N.11*	c.560G>A	3	p.Gly187Asp	PMID: 10993874	AY166863	rs28940572
p	*A4GALT*01N.09.01*	c.548T>A	3	p.Met183Lys	PMID: 10993874	AY166862	rs74315453
p	*A4GALT*0XN.09.02*	c.548T>A c.987G>A	3	p.Met183Lys	PMID: 10747952	AY166862	rs74315453

Phenotype	Allele Name	Nucleotide change	Exon Intron	Predicted amino acid change	(Reference No.) PMID	Accession number	rs number
p	*A4GALT*01N.13*	c.657del	3	p.Phe220Serfs*130	PMID:12823750	AY166864	n.a.
p	*A4GALT*0XN.12*	c.656C>T	3	p.Ala219Val	PMID: 15142124	AY496230	rs374580731
p	*A4GALT*01N.16*	c.752C>T	3	p.Pro251Leu	PMID: 10993874	n.a.	rs28940571
p	*A4GALT*02N.14*	c.732dup	3	p.Ile245Aspfs*38	PMID: 12823750	AF513328	rs5751348:G>T n.a
p	*A4GALT*0XN.15*	c.751C>T	3	p.Pro251Ser	PMID: 15142124	AY496228	n.a.
p	*A4GALT*01N.17*	c.769delG	3	p.Val257Serfs*93	PMID: 12823750	AF513324	n.a.
p	*A4GALT*01N.18*	c.783G>A	3	p.Trp261Ter	PMID: 10993874	n.a.	rs74315454
p	*A4GALT*01N.19*	c.972_997del	3	p.Arg325Alafs*113	PMID: 15142124	AY496234	n.a.
p	*A4GALT*02N.20*	c.1029dup	3	p.Thr344Hisfs*103	PMID: 1189631	AF513329	rs5751348:G>T rs387906280
p	*A4GALT*02N.21*	c.201dup	3	p.Thr68Hisfs*215	PMID: 23927681	FR871177	rs5751348:G>T n.a
p	*A4GALT*02N.22*	c.418C>T	3	p.Gln140Ter	PMID: 23927681	HE818931	rs5751348:G>T rs1418757198
p	*A4GALT*02N.23*	c.498G>A	3	p.Trp166Ter	PMID: 23927681	HE818932	rs5751348:G>T rs1322916904
p	*A4GALT*02N.24*	c.287G>A	3	p.Cys96Tyr	PMID: 15142124	AY496229	rs5751348:G>T rs762949801
p	*A4GALT*02N.25*	c.418_428delins	3	p.Gln140Trpfs*73	PMID: 15142124	AY496232	rs5751348:G>T n.a
p	*A4GALT*02N.26*	c.473G>A	3	p.Trp158Ter	PMID: 15142124	AY496227	rs5751348:G>T n.a
p	*A4GALT*02N.27*	c.504dupC c.914C>T	3	p.Tyr169Leufs*114	PMID: 15142124	AY496231	rs5751348:G>T n.a

Phenotype	Allele Name	Nucleotide change	Exon Intron	Predicted amino acid change	(Reference No.) PMID	Accession number	rs number
p	*A4GALT*01N.28*	c.68dupT c.109A>G	3	p.Phe24Valfs*31 p.Met37Val	PMID: 15142124	AY496226	n.a. rs11541159
p	*A4GALT*0XN.29*	c.290C>T c.109A>G	3	p.Ser97Leu p.Met37Val	PMID: 12823750	AF513323	rs776304817 rs11541159
p	*A4GALT*0XN.30*	c.752C>T c.109A>G	3	p.Pro251Leu p.Met37Val	PMID: 10993874	n.a.	rs28940571 rs11541159
p	*A4GALT*0XN.31*	c.903del c.109A>G	3	pGlu302Argfs*48 p.Met37Val	PMID: 15142124	AY496233	n.a. rs11541159
p	*A4GALT*0XN.32*	c.972_997del c.109A>G	3	p.Arg325Alafs*113 p.Met37Val	PMID: 15142124	AY496235	n.a. rs11541159
p	*A4GALT*0XN.33*	c.388dupA c.109A>G	3	p.Ile130Asnfs*153 p.Met37Val	PMID: 23927681	HE818934	n.a. rs11541159
p	*A4GALT*01N.34*	c.547_548del c.109A>G c.367T>C	3	p.Ser123Pro p.Met183Valfs*99 p.Met37Val	PMID: 23927681	HE818933	n.a. rs11541159 rs114722809
p	*A4GALT*01N.35*	c.480_495dup c.109A>G	3	p.Trp166Glyfs*122 p.Met37Val	n.a.	n.a.	n.a. rs11541159
p	*A4GALT*0XN.36*	c.955A>T	3	p.Lys319Stop	n.a.	MN032335	n.a.
Null phenotypes – Gene deletions, Exon deletions							
p	*A4GALT*N.01*	NC_000022.10: g.43097156_43129968del (Exon 1 deleted)		p.0	PMID:24417201	HG326231	
p	*A4GALT*N.02*	NC_000022.10: g.43103896_43124759del (Exon 1 deleted)		p.0	PMID:24417201	HG326232	
p	*A4GALT*N.03*	NC_000022.10: g.43095125_43120758del (Exon 1 deleted)		p.0	PMID:24417201	HG326233	

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Track of changes

1	**Version**		**v3.1 170105**	**v4.0 30-SEP-2022**
2	Author	created		Åsa Hellberg, September 2022
3	Review	reviewed		Martin Olsson, September 2022
4	General	Document created		First version. Spread-sheets "Intro", "Allele Table", "References", and "Versioning" created. The way "Nucleotide change" and "Predicted amino acid change" is written has been updated for some variants to better reflect current nomenclature.
5	Intro	Intro added		Generel description, gene name, number of exons, initiation codon, stop codon, Entrez Gene Id and Reference allele information added.
6	Allele Table	Table created		Table columns "Phenotype", "Allele name", "Nucleotide change", "Exon Intron", "Predicted amino acid change", "(Reference No.) PMID", "Accession number" and "rs-number" created and content to table columns added.
7	References	added		PMID: 10747952, PMID: 29438961, PMID: 22965229, PMID: 29399809, PMID: 24417201, PMID: 1189631
8	References	added		PMID: 12823750, PMID: 15142124, PMID: 10993874, PMID: 14692982, PMID: 23927681
9	Allele	removed	*A4GALT*P1.01;* c.42C>T;	n.a.
10	Allele	removed	*A4GALT*P2.02;* c.42C>T; c.122T>G	n.a.
11	Allele	renamed	*A4GALT*P1 and A4GALT*01*	*A4GALT*01*
12	Allele	renamed	***A4GALT*02***	*A4GALT*01.02* **(important change of ref-allele naming)**
13	Allele	renamed	*A4GALT*P2*	***A4GALT*02*** **(important change of ref-allele naming)**
14	Allele	added	n.a.	*A4GALT*02.02*

1	Version		v3.1 170105	v4.0 30-SEP-2022
15	Allele	renamed	*A4GALT*04*	*A4GALT*01.04*
16	Allele	renamed	*A4GALT*01N.01.01*	*A4GALT*0XN.01.01*
17	Allele	renamed	*A4GALT*01N.01.02*	*A4GALT*02N.01.02*
18	Allele	renamed	*A4GALT*01N.03.01*	*A4GALT*01N.03.01*
19	Allele	renamed	*A4GALT*01N.03.02*	*A4GALT*01N.03.02*
20	Allele	renamed	*A4GALT*01N.04*	*A4GALT*0XN.04*
21	Allele	renamed	*A4GALT*01N.06*	*A4GALT*0XN.06*
22	Allele	renamed	*A4GALT*01N.10*	*A4GALT*01N.10*
23	Allele	renamed	*A4GALT*01N.11*	*A4GALT*01N.11*
24	Allele	renamed	*A4GALT*01N.09.01*	*A4GALT*01N.09.01*
25	Allele	renamed	*A4GALT*01N.09.02*	*A4GALT*0XN.09.02*
26	Allele	renamed	*A4GALT*01N.13*	*A4GALT*01N.13*
27	Allele	renamed	*A4GALT*01N.12*	*A4GALT*0XN.12*
28	Allele	renamed	*A4GALT*01N.16*	*A4GALT*01N.16*
29	Allele	renamed	*A4GALT*01N.14*	*A4GALT*02N.14*
30	Allele	renamed	*A4GALT*01N.15*	*A4GALT*0XN.15*
31	Allele	renamed	*A4GALT*01N.17*	*A4GALT*01N.17*
32	Allele	renamed	*A4GALT*01N.18*	*A4GALT*01N.18*
33	Allele	renamed	*A4GALT*01N.19*	*A4GALT*01N.19*
34	Allele	renamed	*A4GALT*01N.20*	*A4GALT*02N.20*
35	Allele	renamed	*A4GALT*01N.21*	*A4GALT*02N.21*
36	Allele	renamed	*A4GALT*01N.22*	*A4GALT*02N.22*
37	Allele	renamed	*A4GALT*01N.23*	*A4GALT*02N.23*
38	Allele	renamed	*A4GALT*01N.02*	*A4GALT*02N.24*
39	Allele	renamed	*A4GALT*01N.05*	*A4GALT*02N.25*
40	Allele	renamed	*A4GALT*01N.07*	*A4GALT*02N.26*
41	Allele	renamed	*A4GALT*01N.08*	*A4GALT*02N.27*
43	Allele	renamed	*A4GALT*02N.01*	*A4GALT*01N.28*
44	Allele	renamed	*A4GALT*02N.02*	*A4GALT*0XN.29*
45	Allele	renamed	*A4GALT*02N.03*	*A4GALT*0XN.30*

1	**Version**		**v3.1 170105**	**v4.0 30-SEP-2022**
46	Allele	renamed	*A4GALT*02N.04*	*A4GALT*0XN.31*
47	Allele	renamed	*A4GALT*02N.05*	*A4GALT*0XN.32*
48	Allele	renamed	*A4GALT*02N.06*	*A4GALT*0XN.33*
49	Allele	renamed	*A4GALT*02N.07*	*A4GALT*01N.34*
50	Allele	renamed	*A4GALT*02N.08*	*A4GALT*01N.35*
51	Allele	added	n.a.	*A4GALT*0XN.36*
52	Allele	renamed	*A4GALT*N.01*	*A4GALT*N.01*
53	Allele	renamed	*A4GALT*N.02*	*A4GALT*N.02*
54	Allele	renamed	*A4GALT*N.03*	*A4GALT*N.03*
55	**End Version**		**v3.1 170105**	**v4.0 30-SEP-2022**