

SLC22 – Organic cation/anion/zwitterion transporter family

Human gene name	Protein name	Aliases	Predominant substrates	Transport type / coupling ions ¹⁾	Tissue distribution and cellular / subcellular expression	Link to disease	Human gene locus	Sequence accession ID	Splice variants and their features
SLC22A1	OCT1		organic cations, polyspecific	F	liver, (sinusoidal membrane of hepatocytes)	(oxaliplatin-cytotoxicity)	6q26	NM_003057 NM_153187	3 splice variants from liver with no uptake in vitro
SLC22A2	OCT2		organic cations, polyspecific	F	kidney, (basolateral membrane of proximal tubules), brain (neurons)	(cisplatin and oxaliplatin-cytotoxicity)	6q26	NM_003058	hOCT2-A from kidney with uptake in vitro (AB075951)
SLC22A3	OCT3	EMT (uptake-2 system)	organic cations, polyspecific, (monoamine)	F	liver, skeletal muscle, placenta, kidney, heart, lung, brain	(obsessive-compulsive disorder, substance abuse, coronary artery disease)	6q26-q27	NM_021977	
SLC22A4	OCTN1	ETT	ergothioneine, organic cations, polyspecific	C (ergothioneine); F (organic cations)	kidney, skeletal muscle, placenta, prostate, heart, bone marrow, leukocytes, trachea, ileum, brain, lung	(rheumatoid arthritis, Crohn's disease)	5q31.1	NM_003059	
SLC22A5	OCTN2	CT1, CDSP	L-carnitine, organic cations, polyspecific	C / Na ⁺ and L-carnitine; F (organic cations)	skeletal muscle, kidney (apical membrane of proximal tubules), prostate, lung, pancreas, heart, small intestine, adrenal gland, thyroid gland, liver, etc.	primary systemic carnitine deficiency, (Crohn's disease)	5q31	NM_003060	
SLC22A6	OAT1	PAHT, NKT	organic anions, polyspecific, (PAH, α -keto glutarate, etc.)	E / organic anions	kidney: basolateral membrane of proximal tubules, placenta, brain		11q13.1-q13.2	NM_004790 NM_153278 NM_153276 NM_153277	hOAT1-1 from kidney with uptake in vitro (AB009697); 2 further variants with no uptake in vitro
SLC22A7	OAT2	NLT	organic anions, polyspecific, (cGMP)	F or E	liver (sinusoidal membrane of hepatocytes), kidney: basolateral membrane of proximal tubules		6q21.2-p-21.1	NM_006672 NM_153320	kidney- and liver-specific splice variants with no uptake in vitro
SLC22A8	OAT3		organic anions, polyspecific	E / dicarboxylate	kidney (basolateral membrane of proximal tubules), brain (luminal membrane of choroid plexus), skeletal muscle, developing bone		11q11	NM_004254	
SLC22A9	OAT7	UST3, OAT4	estrone sulfate	E / short chain fatty acids	liver		11q13.1	NM_080866	
SLC22A10	OAT5		not determined	O	liver		11q12.3	NM_001039752	
SLC22A11	OAT4		organic anions, polyspecific, (estrone sulfate, urate)	F or E	kidney, luminal membrane of proximal tubules, placenta	(plasma uric acid level)	11q13.1	NM_018484	
SLC22A12	URAT1	RST, OAT4L	urate	E / organic anions	kidney	renal hypo-uricemia, (gout)	11q13.1	NM_144585 NM_153378	2 splice variants
SLC22A13	OAT10	ORCTL3, OCTL1	urate, nicotinate	E / anions	kidney, colon, small intestine, brain, heart	(cyclosporine-A induced hyperuricemia)	3p21.3	NM_004256	
SLC22A14	OCTL2	ORCTL4	not determined	O	kidney, colon, small intestine		3p21.3	NM_004803	

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SLC22A15	FLIPT1		not determined	O	kidney, brain, liver, skeletal muscle, heart, placenta, lung, spleen		1p13.1	NM_018420	
SLC22A16	CT2	FLIPT2 OCT6	carnitine, (doxorubicin)	F	testis, Sertoli cells and epididymal duct cells, bone marrow, leukocytes, kidney	(bipolar I disorder)	6q21-q22.1	NM_033125	
SLC22A17	BOIT	BOCT, NGALR	not determined	O	brain		14q11.2	NM_016609 NM_020372	2 splice variants
SLC22A18		IMPT1, TSSC5, ORCTL2	(chloroquine, quinidine)		kidney (apical)		11p15.5	NM_002555 NM_183233	2 splice variants
SLC22A20	OAT6		(odorant organic anions)	E / dicarboxylate	olfactory mucosa		11q13.1	NM_001004326	
SLC22A23				O			6p25.2	NM_015482 NM_021945	2 splice variants
SLC22A24				O			11q12.3	NM_001136506	
SLC22A25	UST6	HIMTP		O	liver		11q12.3	NM_199352	

*) C: Cotransporter, E: Exchanger, F: Facilitated transporter, O: Orphan transporter

References:

Original version of the SLC table:

[Koeppell H, Endou H.](#) The SLC22 drug transporter family. Pflugers Arch. 2004 Feb;447(5):666-76.

Questions & Comments