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Full Length Research Paper

In-silico identification and phylogenetic analysis of auxin efflux carrier gene family in *Setaria italica* L.

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The phytohormone auxin is crucial for plant growth and development. Transportation and distribution of auxin throughout the plant is very important to maintain the auxin homeostasis. Auxin efflux carrier genes play significant roles in auxin transport. In this study, we identified 12 auxin efflux carrier genes from the *Setaria italica* genome, which are similar in number with that of monocotyledonous plant *Oryza sativa*. Twelve (12) *SiPIN* genes are distributed in eight scaffolds. All the identified genes possess the transmembrane auxin efflux carrier domain. Phylogenetic analysis shows that *SiPIN* genes are much closer to *Sorghum bicolor* and *O. sativa PIN* genes of the grass family.

Key words: Auxin efflux carrier, auxin efflux carrier domain, phosphorylation, transmembrane domain.

INTRODUCTION

In the model plant Arabidopsis thaliana, auxin plays a crucial role in regulating and coordinating plant growth and is involved in many developmental processes, meristem includina embryogenesis, maintenance. organogenesis, lateral root initiation, vascular tissue differentiation and tropisms. Specific auxin influx carriers (AUX/LAX proteins) and efflux carriers (PIN and PGP/MDR proteins) mediate a directional, active, cell-tocell auxin transport, creating auxin concentration maxima in specific tissues or cells. PIN auxin efflux carriers play a major role in mediating and regulating polar auxin transport (PAT), creating the auxin gradients that provide positional information for cells and tissues development (Benkova et al., 2003; Michniewicz et al., 2007; Reinhardt et al., 2000).

In *A. thaliana,* there are eight *PIN* genes (At*PIN1– AtPIN8*) coding for proteins that differ in the length of the hydrophilic loop in the middle of their polypeptide chain (Krecek et al., 2009a; Zazimalova et al., 2007). The long PIN proteins of *Arabidopsis* viz., *PIN1,PIN4* and *PIN7* show plasma membrane localization and their polar localization determines direction of auxin flux(Friml 2010). The three *PIN* proteins *PIN5, PIN6*, and *PIN8*, have a shorter central hydrophilic domain and both *PIN5* and *PIN8*, have been shown to localize in the endoplasmic reticulum, suggesting a possible role in regulating intracellular auxin homeostasis(Wabnik et al., 2010; Wabnik et al., 2011). The classification of *AtPIN6* is more controversial since it has a partially reduced hydrophilic loop with high sequence similarities at trans-membrane

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Abbreviations: AtPIN, Arabidopsis thaliana auxin efflux carrier; OsPIN, Oryza sativa auxin efflux carrier; PpPIN, Physcomitrella patens auxin efflux carrier; PtPIN, Populus trichocarpa auxin efflux carrier; SbPIN, Sorghum bicolor auxin efflux carrier; SiPIN, Setaria italica auxin efflux carrier.

regions (Krecek et al., 2009a; Mravec et al., 2009). In addition to the eight *AtPIN* proteins, *Arabidopsis* encodes seven *PIN* like genes and they form a different clusters and the role of these is yet to find out (Paponov et al., 2005).

Many homologous PIN genes were well characterized in monocot species like rice (Oryza sativa) and maize (Zea mays). Both specific features and homologies between monocots and Arabidopsis (eudicot) PIN families have been shown. Monocot-specific features comprise both sequence clustering in phylogenetic analyses and expression pattern at transcript and protein level. In rice, the sequence analysis of the 12 PIN genes present in the genome showed that rice has four PIN1 genes and one OsPIN2, while no OsPIN protein was grouped into the AtPIN3, AtPIN4 and AtPIN7 cluster. Four OsPIN genes encode for rice PIN proteins with a short central hydrophilic domain: three OsPIN5 and one OsPIN8. Furthermore, three OsPIN proteins appear monocot-specific: OsPIN9, OsPIN10a, and OsPIN10b. OsPIN9 has a central hydrophilic domain intermediate in length between long and short PINs of Arabidopsis and its expression analysis at transcription level suggests a possible function in adventitious root differentiation. OsPIN10a and OsPIN10b have a long central hydrophilic domain (Carraro et al., 2006; Forestan et al., 2012; Forestan and Varotto 2010; 2012; Xu and Scheres 2005). So far, three PIN1 genes were described in maize using an antibody raised against AtPIN1 protein (Forestan and Varotto, 2010). Recent studies of PIN genes on Sorghum bicolor revealed the presence of 11 PIN genes; at least there members were grouped in the AtPIN1 cluster and another three in the AtPIN5 cluster (Shen et al., 2010; Wang et al., 2010).

S. *italica* [(L.) P. Beauv.] commonly known as foxtail millet is one of the most cultivated millet species grown worldwide including India, China, Japan, Australia North and South America (Devos et al., 1998). Foxtail millet is a diploid grass with small genome (\approx 515 Mb) and its draft sequences has been published recently (Bennetzen et al., 2012). The major phytohormone auxin is central to plant growth and development. Availability of publicly accessible genome sequences of *S. italica* lead us to find the auxin efflux carrier genes (*PIN*) using an in-silico approach. Here, we used bioinformatics and comparative genomics approaches to find auxin efflux carrier genes in *S. italica*.

MATERIALS AND METHODS

Auxin efflux carrier (*PIN*) genes of *S. italica* were identified from plant genome database (http://www.plantgdb.org) and phytozome (www.phytozome.net) database (Dong et al., 2004; Duvick et al., 2008; Goodstein et al., 2012). To identify *PIN* genes, orthologous auxin efflux carrier genes from *A. thaliana* were used as search query. *Arabidopsis PIN* genes were downloaded from "The Arabidopsis Information Resources" (http://www.arabidopsis.org/). Hidden markov model approach was carried out to find the auxin

efflux carrier genes of S. italica (Altschul et al., 1997). Identified StPIN genes were again confirmed by running BLASTP searches in "The Arabidopsis Information Resources" and presence of auxin efflux carrier domains were confirmed by SWISS MODEL Workspace (www.swissmodel.expasy.org/workspace/). Nomenclature of identified StPIN genes were carried out according to BLASTP similarity found with A. thaliana AtPIN genes. TMMOD (The Hidden Markov Model for Transmembrane Protein Topology Prediction) (http://www.cbs.dtu.dk/services/TMHMM/) analyses were carried out to confirm the presence of transmembrane domains in SiPIN proteins(Kahsay et al., 2005; Kahsay et al., 2004). Orthologous PIN genes from A. thaliana (AtPIN), O. sativa (OsPIN), Physcomitrella patens (PpPIN), Populus trichocarpa (PtPIN), and S. bicolor (SbPIN) were used to analyze protein sequence similarity and construction of phylogenetic trees. OsPIN genes were downloaded from The TIGR Rice Genome Annotation Resources (Ouyang et al., 2007) whereas, PpPIN, PtPIN, SbPIN genes were downloaded from plant genome database and phytozome database. Multiple alignments of PIN genes from the above mentioned species were carried out by using the online available software Multalin (http://multalin.toulouse.inra.fr/multalin/). Phylogenetic tree was constructed by using MEGA5.2 software.

RESULTS AND DISCUSSION

Genome wide analysis of the S. italica genome led to the identification of 12 auxin efflux carrier (SiPIN) genes (Table 1). This result shows, Setaria has the same number of SiPIN genes as of rice and has four more SiPIN genes than A. thaliana. The major genome assembly of S. italica is arranged in 336 scaffolds. The first nine scaffolds are pseudomolecules and 98.9% of sequence data is presented in the nine pseudomolecule. Besides, the Setaria genome has 35,471 loci containing 40,599 protein coding transcripts (Bennetzen et al., 2012). The 12 identified S. italica auxin efflux carrier genes are distributed in eight scaffolds. Scaffold five contains four auxin efflux carrier genes (SiPIN4a, SiPIN5a, SiPIN5b and SiPIN8). The biggest SiPIN gene was SiPIN2 with an ORF (open reading frame) length of 1890 nucleotides present in scaffold 4, whereas the smallest one was SiPIN5c which was present in scaffold 6. Among the 12 SiPIN genes, seven SiPIN genes (SiPIN1a, SiPIN1b, SiPIN4a, SiPIN4b, SiPIN4c, SiPIN4d and SiPIN8) contained five introns each and SiPIN2 and SiPIN5d contained six introns each (Figure 1). SiPIN1 transcript organization matched with that of OsPIN1 and AtPIN1 indicating their close homology (Wang et al., 2009).

Auxin efflux carrier genes are characterized by the presence of a transmembrane auxin efflux carrier domain (Carraro et al., 2006; Forestan et al., 2012). All *SiPIN* genes contain transmembrane auxin efflux carrier domains (Figure 2). Among the 12 *SiPINs*, seven *SiPIN* genes (*SiPIN1a, SiPIN1b, SiPIN2, SiPIN4a, SiPIN4b, SiPIN4c* and *SiPIN4d*) contain a long transmembrane domain. The other *SiPIN* genes (*SiPIN5a, SiPIN5b, SiPIN5c, SiPIN5d* and *SiPIN8*) contained a short transmembrane domain. In *Arabidopsis, AtPIN4* has a short transmembrane domain which is different from that

Locus ID	Gene name	ORF Length	Number Of a.a	Number of Introns	5'-3' Coordinates
Si016714m	SiPIN1a	1785	594	5	scaffold_1: 37807344 - 37810727
Si006110m	SiPIN1b	1794	597	5	scaffold_4: 8906772 - 8909697
Si006060m	SiPIN2	1890	629	6	scaffold_4: 30687696 -30691064
Si000693m	SiPIN4a	1863	620	5	scaffold_5: 30444777 - 30448448
Si009737m	SiPIN4b	1677	558	5	scaffold_7: 34823548 - 34826535
Si025109m	SiPIN4c	1773	590	5	scaffold_3: 9460738 - 9463047
Si026177m	SiPIN4d	1683	560	5	scaffold_8: 1266812 - 1269757
Si001955m	SiPIN5a	1095	364	4	scaffold_5: 44864303 - 44869298
Si003879m	SiPIN5b	1272	423	4	scaffold_5: 39347962 - 39350295
Si015697m	SiPIN5c	1029	342	2	scaffold_6: 33597186 - 33599056
Si033365m	SiPIN5d	1134	377	6	scaffold_2: 36679971 - 36681750
Si003769m	SiPIN8	1081	361	5	scaffold_5: 35148382 - 35150803

 Table 1. Phytozome locus ID and transcript information of SiPIN. Naming of SiPIN were done as found by BLASTP against the Arabidopsis Information Resources database.



Figure 1. Transcript organization of *SiPIN* genes. Blue color boxes indicate the exons and lines indicate the introns of respective *SiPIN* genes. The arrow mark indicate the direction of expression of transcript.

of *SiPIN* genes showing diversification of PIN genes among species. *Arabidopsis AtPIN1*, rice *OsPIN1* and *OsPIN2* were grouped under long transmembrane auxin efflux carrier domain (Wang et al., 2009). *SiPIN1* and *SiPIN2* genes contain a long transmembrane domain, showing close relationship with that of *AtPIN1*, *OsPIN1* and OsPIN2.

Phylogenetic analysis with orthologous PIN genes from A. thaliana (AtPIN), O. sativa (OsPIN), Physcomitrella patens (PpPIN), Populus trichocarpa (PtPIN), S. bicolor (SbPIN) resulted in clustering into three major groups (group I, II and III) (Figure 3). In group I, SiPIN1a and



Figure 2. Transmenrane domain prediction of *SiPIN* genes by TMMOD (Hidden Markov Model for transmembrane protein topology prediction). *SiPIN1a, SiPIN1b, SiPIN2, SiPIN4a, SiPIN4b, SiPIN4c* and *SiPIN4d* contains long transmembrane domain where as *SiPIN5a, SiPIN5b, SiPIN5c, SiPIN5d* and *SiPIN8* contains short transmembrane domain.



Figure 3. Phylogenetic tree of *SiPIN* genes with orthologous PIN genes of *Arabidopsis thaliana* (*AtPIN*), *Oryza sativa* (*OsPIN*), *Sorghum bicolor* (*SbPIN*), *Populus trichocarpa* (*PtPIN*) and *Physcomitrella patens* (*PpPIN*). Statistical method used to construct the phylogenetic tree was neighbor joining method; test phylogeny-boot strap method; no. of boot strap replication -500; substitution type-amino acids and model used was Jones-Taylor-Thornton (JTT).

SiPIN1b clustered with OsPIN1; SiPIN4b and SiPIN4d clustered with SbPIN4c; SiPIN4a clustered with SbPIN4a; SiPIN4c clustered with SbPIN7 and OsPIN10b; SiPIN2 clustered with ObPIN2 and OsPIN2; SiPIN8 clustered with SbPIN8 and OsPIN8. In group II, SiPIN5a clustered with SbPIN5b and OsPIN5b; SiPIN5c clustered with SbPIN5c and OsPIN5c; SiPIN5d clustered with SbPIN5a and OsPIN5c: SiPIN5b clustered with SbPIN3 and OsPIN9. In group III, AtPIN6 clustered with PtPIN6. There is no gene of Setaria or any other grass in this cluster, showing diversification of PIN genes. Cluster analysis reflects, S. italica PIN genes are much closer to PIN genes of grasses Sorghum bicolor and Oryza sativa. Multiple alignment of amino acid sequences shows conserved N and C-terminal domains (Supplementary Figure 1). The N-terminal region shows a conserved S-P/T-P motif, a potential target phosphorylation site for mitogen activated protein kinases (MAPK) (Sinha et al., 2011). The central hydrophilic loop is dynamic in nature and differs from each other in terms of sequence homology, but some *PIN* genes are conserved in this dynamic region with a T-P-R motif (Supplementary Figure 1). The T-P-R motif is a target phosphorylation site of mitogen activated protein kinase 3 and mitogen activated protein kinase 6 (Sorensson et al., 2012). The T-P-R motif is conserved only in the case of long transmembrane auxin efflux carrier domains. This shows that, although the central hydrophilic loop is diverse in nature, its phosphorylation suggesting that evolution of protein phosphorylation is conserved.

The *PIN*-Formed (*PIN*) proteins are a plant-specific family of transmembrane proteins that transport the phytohormone auxin as substrate molecule. There is very

limited data available which suggests auxin is a signaling molecule of ancient origin. The PIN gene family is found only in genomes of land plants. They act as regulator and play key roles in developmental process including embryogenesis, morphogenesis and organogenesis (Krecek et al., 2009b). The number of PIN genes present in S. italica (12) is equal to that of rice (12) and more than that of Arabidopsis (8) suggesting that the presence of more PIN genes may have some extra role in development and morphogenesis. The predicted structure of a PIN protein is similar to the structure of membrane transport proteins that use the electrochemical gradient across the membrane to transport molecules. All the identified PIN proteins have two hydrophobic domains with cytoplasmic orientation. The transmembrane helices of hydrophobic domains are highly conserved in their amino acid sequence. But substantial differences are present between the long and short PINs. The hydrophobic domains of all long PIN proteins contain the amino acids at invariant position, but these positions are not invariants in short PINs. The presence of invariant amino acid sequences in long PINs may play major roles, which has not been retained in short PIN. The loop between the transmembrane helices being present within the hydrophobic domain exhibits dynamic variability in size and sequence.

Conclusion

S. italica popularly known as foxtail millet is one of the best studied millet species in the world. The genome sequencing project of this plant is going to be completed in the near future. This will open the door for progressing research of this plant at the molecular level. Auxin efflux carrier genes identified in this report will help to understand the role of auxin signaling and its role in growth, development as well as response to different biotic and abiotic stresses. Phylogenetic analysis shows that auxin efflux carrier genes in species of grass family are conserved.

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	1	10	20	30	40	!	50 6	0		70	80	9	0	100	11	0	120	130
OsPIN1a	1		HITGADFYHYHTAH	VPLYVANTI	LAY-GSYKHHRI	ТР	DOCSGINRFYA	LF	AVPLLS	FHFIS	TNNPYTHNLRF	CAADTL		ALLTLASH	LSRR			-GSLEN
SbPIN1			MITGTOFYHVHTAN	YPLYVAMI	LAY-GSYRMARI	TP	DQCSGINRFYA	LF	AVPLLS	FHFIS	TNNPYTMNLRF:	CAADTL	KLIV	ALLTANSY	SRR			-GCLEH
SiPIN1b			MITGTOFYHVHTAN	VPLYVANIL	LAY-GSYRNNRI	TP	DQCSGINRFYA	LF	AVPLLS	FHFIS	TNNPYTHNLRF	CAADTL	KLIV	ALLTANSY	LSRR			-GCLEH
OsPIN1b			MITAADFYHYMTAM	VPLYVAMI	LAY-GSYKHARI	TP	DQCSGINRFYA	LF	AVPLLS	FHFIS	TNNPYTHNLRF.			AML TANSH	LSRR			-GSLEN
S1PINIA SEPTNAE			NT I GHUF THYN I HN	VPLTVHNIL VPLVVANTI	LHT-05YKHHK1 AY_CCVPUUPT	5r Cp	NUCSOTNDEVO		HYPLLS	ENELC.	INNPTIONLEE. TNNPYTHNI DE'	LHHUTL		AMI TAUSH	_SKK			-USLEM -GSLEM
ALPTN1			NTTAADEYHVHTAH	VPI YVANTI		TP	DOCSGENREVA	İF	AV-LLS	FHETA	ANNPYAMNI RFI	AADSI	KVTV		SRN			-651 DH
PtPIN1c			MISLLOFYHYHTAM	VPLYVANI	LAY-GSYKNNKI	TP	DQCSGINRFYA	LF	AVPLLS	FHFIS	TNDPYNMNLRF	TADSL	KIIY	YYLALATK	LSKR			-GCLEN
PtPIN1d			MISLLDFYHYHTAH	VPLYVAMIL	L <mark>ay-gsykhh</mark> kii	TP	DQCSGINRFYA	LF	AVPLLS	FHFIS	TNDPYKMNFRF:	CAADTL	KII	.VY <mark>lafh</mark> th	FSKR			-GCLE <mark>H</mark>
PtPINPIN1a			MISLTOLYHYLTAY	VPLYVAMI	LAY-GSYKNNKI	SP	DQCSGINRFYA	LF	AVPLLS	FHFIS	TNNPYAMNYRF.			YYLAINTR	VISR			-GSLEN
PCPINID AFPIN3			NTSTON AND ALSTON	YPLTYHNII TPI YVANTI	LHT-05YKNNKI AY_65YPUUKT	SP	JUCSGINKFYH		AVPLLS	EHELC.	innpyrnni de'	LHHUTL FOODTI	KTTA	SI VI UAN	155K			-USLEM -GSLEM
ALPIN7			MITHHOLYTYLTAY	TPLYVANTI	LAY-GSVRHHKI	SP	DOCSGINREYA	IF	AVPLLS	FHFIS	SNNPYAMNLRF		KLIM	TLITHAN	FTRS		,	-GSLEN
PtPIN3a			MISHNOLYNYLSAV	IPLYVAMI	LAY-GSYRNNKI	SP	DQCSGINRFYA	IF	AYPLLS	FHFIS	TNDPYAMNFRF	CAADTL	KIIM	IALGINTN	FTKN			-GSLEH
PLPIN3b			MISHNOLYNYLSAV	IPLYVAMI	LA <mark>y-gsvrhh</mark> kti	SP	DQCSGINRFYA	IF	AVPLLS	FHFIS	TNDPYSMNFRF:	CAADTL	KIIM	FALGINTN	FTKN			-GSLEH
ALPIN4			MITHHOLYTYLTRY	VPLYVAMI	LAY-GSYQHHKI	SP	DQCSGINRFYA	IF	AVPLLS	FHFIS	TNDPYAMNFRF	/AADTL	OKIIM	YLLALMAN	LTKN			-GSLEN
PPP1N3-2			MINGHULTNYLSHI	YPLTYHNNI VDI YVONNI	LHT-65YKAA611	TP	ANCCCTNDEVC		HYPLLS	FUF15	UNNPTHINEKE.	LHHUHY	5KYFYL CV1/1 1/1		15KK			
PoPTN3			MTTGHOMYNVI SAM	VPI YVAMMI	AY-ASVKUUGTI	TP	DOCOGTNREVS	TF	AVPLUS	FOFVS	GNNPYEMNERE	raanav	SKVEV		FSKR			-GSLEM
OsPIN2			MITGROIYDYLAAI	YPLYVANFL	LAY-GSYRHHGI	TP	DQCSGINRFYA	ŶF	AVPLLS	FHFIS	TNDPYSMNYRFI	AADSL	KLYI	AALAYHHN	LLSRYR	RNGG-AA-		-ASLDH
SP1N2			MITGRDIYDYLAAI	VPLYVAMFL	LAY-GSYRNNGI	TP	DQCSGINRFYA	ΥF	RYPLLS	FHFIS	sc <mark>opyanqyr</mark> fi	AADSL	KLYI	AALAYHHN	VLSRYR	RGAAA-		-SSLDH
SiPIN2			MITGRDIYDYLAAI	VPLYVANFL	LAY-GSYRHHGI	TP	DQCSGINRFYA	ΥF	AVPLLS	FHFIS	SNDPYAMQYRFI	AADSL	OKLAI	AALAYMHN	YLSRYR	rgaggaa-		-SSLDH
ALPIN2			MITGKOMYDYLAAM	VPLYVAMIL	LAY-GSYRWHGI	TP	DQCSGINRFYA	ΥF		FHFIS	SNDPYAMNYHFI			AALFLAQA	SRR			-GSLEA
PCPINZa OsPINIc			NTTVVNI VHVI TAV	VPL TVHNIL	LAT-05YKAAKI AY-ASVRUURT	IP SP	DOUCCOTNEE AU	IF	AVDLLS	LULT2	SNUPTHINFKF. TNNPFAMNI PFI	AADTI		ALLETRON	- 266C-			-UNLEM
SbPIN4c			MITALDLYHYLTAY	VPLYVANTI	LAY-GSYRNARI	TP	DOCSGINRFYA	LF	AVPLLS	FHFIS	TNNPFAMNLRFI	AADTL	KYAY	ALLFLASR	FSSSA	SRF-		-LGLDH
SiPIN4b			MITALDLYHVLTAV	VPLYVANTI	LAY-GSYRNARI	TP	OPCSGINRFYA	LF	AVPLLS	FHFIS	TNNPFAMNLRFI	AADTL	KLAY	ALLAIASS	RISPYR	RL-		-LGLDH
SiPIN4d			MITALDLYHYLTAV	VPLYVANTI	LAY-GSVRHHRI	TP	DQCSGINRFYA	LF	AVPLLS	FHFIS	TNNPFAMNLRFI	AADTL	KLAA	ALLALASS	RLSPLR	GRL-		-LGLDH
PtPIN2b			MISGKDIYQYYSAL	YPLYAAMIL	LAY-GSYRWWKY	TP	DQCAGINRFYA	ΥF	ATPFLY	FDFIC	SNNPYKMNLRF.		KYYY	YYLFIKA	TARR		DTC	
USPINIUA SEPTNAa			NISCHUFTIYNHHY	VPLTVHNEL VPLVVANEL	LHT-65YKHH61 AY_65YPUUPT	TP	NUCSOTNDEVO		HYPLLS	ENELC.	i Nupthanlikfi TNNPYAMNI DEI	HHUIL		ACI AVUCDI	LP	5 G	KIU	appi nu
SiPTN4a			MTSHKOFYTYL TAM	VPI YVANTI	AY-6SVRHHRT	TP	DOCSGINREYA	TF	AVPLIS	FHFTS	TNDPYAMNI RFI			AALAAUSRI	PS	6	l 6	
OsPIN10b			MISHHELYHYLSAV	VPLYVANN	VAY-GSVRHHGVI	ŤP	EQCSGINREVA	ΫI	ERVPLLS	FHFIS	SSDPYAMNLRF	AADTL	KYLY	AALAANSR	FPARF-		YPPA	HPPLDC
SPIN7			MISHHOLYTYLCRY	vplyvanvi	l <mark>ay-gsyrhh</mark> gyi	TP	DQCAGINRFYA	ΥF	RYPLLS	FHCIS	TS <mark>dpyymnlr</mark> f:	CAADTL	KYLY	.aalayksy	lptarr	ggaaadaa	AGGTNNK	REPLDH
SiPIN4c			MISHHOLYTYLCAY	YPLYVAMI	L <mark>ay-gsyrhh</mark> gyi	TP	DQCSGINRFYA	ΥF	AVPLLS	FHCIA	ASNPYYMNLRF	/AADTL	OKYIY	AALAYHSCI	LPARGG	66	-GGGATR	APPID
HEPING			MITOCOEVENCOM	HPLTEHNEN	VHT-GSVKHUKI	1P TD	HUCSGINKE VS	Y	HYPYLS	FHF15	UNNPYKNUIME.	LHUIL		VLLSLNHV	- KH			-GGLDH
Pt.PTN6h			MTTADDFYKVHCAH	VPI YFAMI V	VAY-GSVKUYKT	TP	FOCSGINREVA	VF	AVPVI S	FHETA	ONNPYONDTKF:		SKVLA	VISVIAV	FFN			-GEEDM
PtPINPIN7			MISIEDLYGYLCAY	VPLYVTHFL	LAY-ASYKHHNI	ŤΡ	EQCSGINREYA	ΥF	AVPLLS	HEFIS	RINPYKHDLLFI	1 <mark>AAD</mark> GY	SKYLI	YYLLCHAN	FSRR			-GSLEN
OsPIN1d																		
OsPIN9			MITGSEVYQYVERH	APLYTAAA	lg <mark>y-gsyrhl</mark> ka	SN	EQCAGINHEYA	LY	AVPYLI	FDMVS	TNNYYKHNGRL	CAADTL	OKAYLI	LGLMANALI	HERSRA	rgagaka-	KAAY	SSPLQH
SDP1N3			TTPGSHYTHYYEHN	HPLYTHHYL ODLYTOOUU		SU	EQCOCTNUE VO	LŢ		FHMYS	INUPTHANERL	LHHUIL	KHYM		ISHERK	KKUGKHS- PPCCDCV	SHSHI	HSP1KH
PoPTN6-1			MI TEGOFYNVI CAV	VPI YVAI FI	GY-GSI KUUGVI	OU TP	FOSAGTSRENA	IT		FFTTA	SAUFTAINERL. FNNPYTMNNRI	CARYCI	SNGTV		400FKK		CTK	USLTVM USLTVM
OsPIN5a			MIGHGDYYKYYAAT	VPLYFALFI	LGY-GSYRMARI	TR	EQCDAYNRLYA	FF	ALPFFT	FEFTLI	HTDPFQYNYRA	AADYI	SKAVI	AVIGALAR	FMSK		6	GCAYSH
SiPIN5a			MIGHGDVYKVVAAT	VPLYFALF	LG <mark>Y-GSYRHH</mark> RI	TR	EQCDAYNRLYA	FF	ALPFFT	FEFTLI	HT <mark>opf</mark> oy <mark>nyr</mark> a	/AADYI	S <mark>K</mark> AYI\	'AYI <mark>AYN</mark> ARI	FAAAKG		86	GSAAG <mark>H</mark>
SbPIN5b			MIGHGDYYKYYAAT	VPLYFALFL	LG <mark>Y-GSYRHH</mark> RI	TR	EQCDAYNRLYA	FF	ALPFFT	FEFTL	htdpfqynyra	/AADYI	SKAYI\	GYI <mark>nch</mark> aa	rytsag	KGAGAGG-	GGGHA	GCAYG <mark>H</mark>
ALPIN5			MINCGDYYKYIEAM		LGY-GSYKWHHI	TR	DOCOAINRLYC	Ϋ́F		IEFTA	HYDPFNMNYRF.			TY <mark>LALN</mark> AK	YSNK			-GSYCH
PCPINSa PEPINSa			NTGUANTYKVVVAN	VPLTVHLNI VPLYVALMI	LUT-USYKHHKYI	TP	FOLCONTNELAC	YF		FEFTA	HYDPFKNNTLF. HYDPFKNNYLF	CONDAT CONDAT		VVI AVUAKI	436K			-6576 <mark>0</mark>
PLPIN56			MTGHEDVYKVVAM	VPL YVAL VI	GY-GSVRHHKV	TP		YF	TI PI FT	FEFTA	HVDPFKMNYRF	GADAY	SKYTT	VVI AFNAK	CSSK			-GSYSH
OsPIN5b			H	APLYFALG	LG <mark>Y-GSVRHH</mark> RF	TA	EQCARINTHYY	YF	SHPFFT	FDFYY	rtopfamnyrv	CAADAY	SKAIAI	aamaamar	TRCGCA	AAKA		AQS <mark>H</mark>
SbPIN5c			MIPHGDIYKYVAAN	APLYFALG	LG <mark>Y-GSYRhh</mark> rfi	TA	EQCARINTLYY	'NF	SMPFFT	FDFLA	ra <mark>npythnyr</mark> yi	. <mark>Aad</mark> ay	s <mark>kal</mark> aj	aaysa <mark>k</mark> g-	CCCR	GGKAA-		AQA <mark>H</mark>
OsPIN5c			H	APLYFALG	LGY-GSYRHHRL	TA	Docdaynrlya	CF	AVPFFA	FDFAA	RIDPFALSYRY	AADAL	SKLAVA	ILALAACAA	AASTRC	CGSGG-	GKRGG	GGGFSH
SDP1N5a		п	NTCHCDVYTKYYHHN NTCHCDVYKVVOOM	APLTENLG			DOCDOANDI AO		CUDEEO	FUFH5	RTURF SESTRAI	HHUHL		ILHLHHHHHII	HHHHHH	HHKPG- PCCCD_		JKHL5M
AF 511, TW20			MISHLOTYHVVSAT	VPL YVSMTI	LGE-LSARHIKI	SP	EQCAGTNKEVA	KF	STPLIS	FOTTS	ENNPEKHSPKI		OKEI VI	YY <mark>l amvi r</mark> i	F	KaaaaD-	PTGGP	GGKI GU
PtPIN8a			MISTADVYHVVAAT	VPLYFAMI	LAY-ISYRNAKL	TP	DQCAGINKFYA	KF	SIPLLS	FOVIS	SINPYKMNLKL	FADEL	KLLA	LYLTALAK	I		SS	RGRLNH
PtPIN8b			MISAADYYHYYTAT	VPLYFAMI	LAY-ISYKHHKL	TP	DQCAGINKFYA	KF	SIPLLS	FQYIS	GI <mark>npykmn</mark> lkl	FADFL	KLLA	LYLTALAK	I		SS	RGRLNH
SPIN8			MISHPTIYHYLEET	YPLYVAMI	YA <mark>y-lsiqhh</mark> kli	TP	EQCSGINKFYA	KF	SIPLLS	FOILS	TNNPYNMNLKL	FSDI	KSLS	LGFRYISK	A		CC	KEKFDH
SIPIN8			MISHPTIYHYLEET	YPLYVAMI\	VHY-LSIQHHKL	TP	EUCSGINKFYA	KF	SIPLLS		INUPYUMNLKL			LGFHYISK	1		CCI	GODECH
0°bthjc	MAETPYG	I GCH	n TGUVNTGKTI SOT	API YEAI VI	LUT-USYKHUKLI GYCSSKRUURTI	TA	EDSEAT-MVA	UF	A PEET	FULLI	HI DPYNVPYCI (T2000	3 NIL] S <mark>K </mark> TT\	TVTGTGVG	TFRKE	cana-	GI C	UNKSSM TAVTNU
OsPIN8		Laon	HYSHKDIYLYLEAT	VPLYVANTI	LAY-LSIKHHKL	TP	EQCSGINKEVA	KF	SIPLLS	FQVIS	TTOPYDHNIKL	YSDI	KSLA	LGFRAISK	ACCA		uLC	-EKFDH
PpPIN6-2		H	TQGEHDKFH i gigd	EPSHAATA\	YSHKDEEHYKN	GS	RORNSFSYANG	ER	RITRENG	TEHGH	EIAPSOMNMKE	AIKYA	KKHLR	PLTYATYM	GIVYS-		LI	AGRYSI

Supplementary Figure 1. Multiple sequence alignment of amino acid shows presence of N and C-terminal conserved region. N-terminal region shows presence of conserved S-P/T-P motif, target phosphorylation site of mitogen activated protein kinase. The central hydrophilic region is very dynamic in nature and differ from each other, but still contains conserved S-P-R/T-P-R motif, target phosphorylation site of mitogen activated protein kinase 3 and mitogen activated protein kinase 6. S-P-R/T-P-R motifs are conserved only in long transmembrane domain containing PIN gene.

	131	14	0	150	160	170	180	190	2	200	210	220	230	240	250	260
0-DTM -	1	CLCT	+	инстрии			+		урсорті	-+	+	тостичнориче	+	+	+	 TUDDCNOC
CPTN19	TTTL			VHCTPL	KGMYCDES	GSI MVOTV		IVTI NI ENEL	VDCOPTI	TTEOED	0180-8	-142144040443	L-DGKKUNJ 1 _NGPNNA1	IETEREVK-	EDGKINY	TYPPSNAS
SIPTNIL	TTTL	SI STI		VHGTPL	KGMYGDES	GSI MVOTA		YTI NI ENER	YRGARTI		DTAG-A	-TASTVVNPNVVG	L-DORNDAJ	ETEREVK-	EDGKIN	TURRSNAS
OsPIN16	TITL	SLST	PNTI	VIGTPL	KGMYGEFS	GSL MVOTY		IYTLHLFHF	YRGARMI	TTEOFP	DTAA-N	-TASTVVDPDVVS	L-DGRRDA	ETETEVK-	EDGRTHY	TYRRSNAS
SiPIN1a	TITL	SLST	PNTL	VHGTPL	KGMYGDFS	GSLMVOTV	VLOCTI	IYTLNLFHF	YRGARML	ITEOFP	DTAG-A	-IASIYYDPDYYS	L-DGRRDAJ	ETEREVK-	EDGKIHY	TYRRSNAS
SbPIN4b	TITL	SLST	PNTL	YHGIPL	KGHYGDFS	GSLMYQIY	YLOCII	YTLHLFHF	YRGARLL	ITEQFP	DNAG-A	-IASIYYDPDYYS	L-DGRRDA)	ETEREYK-	EDGKIHY	TYRRSNAS
ALPIN1	TITL	SLSTI	LPNTL	YHGIPLI	KG <mark>myg</mark> nfs	GDLMYQIY	VLOCII	IYTLHLFLF	- Y <mark>rga</mark> kll	ISEQFP	'DTAG-S	-IVSIHVDSDIN <mark>S</mark>	L-DGRQP-L	ETEREIK-	EDGKLHY	TYRRSNAS
PtPIN1c	TITL	SLSTI	LPNTL	YHGIPL	_KG <mark>hyg</mark> dys	GSLMVQV\	VLQCII	IYTLHLFHF	Yrga kll	.ISEQFP	'DTAG-S	-IVSIHVDSDIMS	L-DGRQP-L	ETEAAIK-	EDGKLHY	TYRKSNAS
PtPIN1d	TITL	SLSTI	LPNTL	YHGIPL	KGMYGDYS	GSLMYQY	YLQCII	IYTLMLFLF	YRGAKLL	ISEQFP	'DTAG-S	-IYSIHYDSDIMS	L-DGRQP-L	ETEREIK-	EDGKLHY	TYRKSNAS
'tPINPIN1a	SITL	SLSTI	LPNTL	YNGIPL	KGMYGEAS	GSLMVQI	VLQCII	IYTLNLFLF	YRGARIL	IGEQFP	'DTAG-S	-IISFRYDSDILS	L-DGREP-L	QTDAEYG-	EDGKLHY	TYRKSTSS
Ptpin1b	SIIL	SLSS		VIGIPL	KGMYGHSS	GSLMVQIV	VLUCII	YILMLFLF	YRGHRIL	.IGEQFP	UTHG-S	-IISERYDSDILS	L-DGREP-L	QTEREVG-	EDGKLHY	TYRKSTSS
HEPIN3	SIII	SLST		YNGTPL	TOWYCEVC					THEALL	'ETHH-5	-IYSEKYESUYYS	L-D6H-DFL	ETDOOTC	DDCKLHY	TYRKSNHS
DEDINO-	9T1T	CUCTI		VHCTPL					ADCONNI ADCONNI	.10EQFP	CT00_C	-145FK4E5U445	1_000_001			TUDICIDC
PEPTN36	MTTT	CI CTI		VHGTPL		GSL MVOV			YDGOKHI	THEOFF	ETAA_S	-TISEKVDSDVVG	L-DUK-DFL 1 _NGP_NFI	ETDAEIG-	DDGKLHY	TYPKSNAS
ALPTN4	HTTT	SIST	PNTI	VHGTPL	TAMYGTYA	GSI MVQVV		YTI I FI FI	YRGAKI I	THEOFP	ETGA-S	-TVSEKVESDVVS	I -DGH-DFI	FTDAFTG-	NDGKLHY	TYRKSNAS
PpPIN3-2	HITL	VLIT	IPNTL	VHGTPL	AAMYGPGP	GDLTIOR	VLOCTT	YTLLLMY	YRAAKIL	INDOFP	ENAG-S	-IVSFKYDSDYNS	L-DGREPVI	-TEAEIG-	DDGKLHY	KYRRSVSS
PpPIN3-1	HITL	YLIT	IPNTL	YHGTPLI	AAMYGAGP	GDLTYQA	YLOCIT	IYTLLL YMY	YRAAKIL	INQOFP	ENAA-S	-IYSFKYDSDYMS	L-DGREPYL	-TEAEIG-	DDGKLHY	KYRRSYSS
PpPIN3	VITL	FHLTT:	IPNTL	VIGTPLI	AAMYGSKP	GQLTYQAY	YLOCII	IYTLLL VHY	YRAARIL	IMHRFP	'ENAA-S	-IYSFKYESDYMS	L-DGPDPYL	-TEAEFR-	NDGKLHY	RYRRSYSS
OsPIN2	TITL	SLSTI	LPNTL	VHGIPL	_Ramygdfs	GSLMVQI\	VLQSVI	IYTLHLFLF	Y <mark>rga</mark> kal	.ISEQFP	PDYGAS	IASFRYDSDYY <mark>S</mark>	L-NGREA-L	.QADAEYG-	RDGRYHY	VIRRSASA
SPIN5	TITL	SLST	LPNTL	YHGIPL	_Ramygdfs	GNLMYQI\	YLQSYI	IYTLMLFLF	Yrgakal	ISEQFP	PDYGAS	IASFRYDSDYYS	L-NGREA-L	.QADAEYG-	SDGRYHY	YIRRSASA
SiPIN2	TITL	SLST	LPNTL	YHGIPL	RAMYGDFS	GNLMYQI	YLQSYI	IYTLHLFLF	Yrgakal	ISEQFP	PDYGAS	-IASFRYDSDYYS	L-NGREA-L	.QADAEYG-	SDGRYHY	YIRRSASA
HEPIN2	MITL	SLST		VIGIPL	RAMYGDES	GNLMVQIV	VLQSII	IYTEMEFEF	FRGHKLL	ISEQFP	ETAG-S	-ITSERVDSDVIS	L-NGREP-L	QTDHEIG-	DDGKLHY	YYRRSSAA
PtPIN2a 0-DTM1-	NULL	SLST		YNGIPL	KHITGULS		YLUSYI)		TRUNKLL	LSEQFP	'ETHG=5	-11SERVDSDVVS	L-NGKEP-L	-UHUHEIG-	DUGKLHY	YYKKSNH-
CPLINIC	CTTL	OLO II CLO II	LPNIL I DNTI	VHCTPL	PCHYCCCCCCCCC	CTRACTL MUQU		IVTI NI ELE	T KUMKLL	YILLUFF VI DOED	D-1883	-142EBAU20442	LAUGUGUH	FONOVOVO	UDUUKNKY OCCNCCDVDI	TUDVCTCC
SIPTNAL	STTL	SI STI		VHGTPL	RGMYGPDSA	GTI MVQVV		IYTI NI FI FI	YPAAPAI	VHDQFF	DGAAAS	-TVSFRVDSDVVS	LADAAKGEI	FADAHVA-	DNGPHPU	TVRKSTSS
SiPTN4d	STTL	SIST	PNTI	VIGTPL	RGHYGPDSA	GTI MVQVV		IYTI NI FI FI	YRAARAI	VHDQFP	DGAAAS	-TVSFRVDSDVVS	I ADAAKGFI	FADAHVA-	DOGRVRY	TYRKSTSS
PtPIN2b	TITL	SLST	PNTL	VHGVPL	KSHYGEFT	SPLHIOVO	FHOSYL	YTLLLSHF	YRGAKRL	VAGOFP	ETAA-S	-ISSEKYDSAYYS	LGGHEPL	ETDAEID-	DDGKLRY	/VVRRSSAT
OsPIN10a	SITL	SLST	PNTL	VHGIPL	IAMYGPYS	GSLMVQIV	VLOCITI	YTLHLFLF	FRAARML	IADQFP	DTAAS	-IYSLHYDPDYYS	LEGGHf	ETEREYA-	ADGRLHY	TYRRSSYS
SbPIN4a	SITL	SYSTI	LPNTL	YHGIPLI	IAMYGPYA	GSLMYQY]	IVLOCITI	IYTLLLFLF	FRAARML	IADQFP	DTAAA	-IASLHYDADYYS	LEGGRf	HETEAEYA-	EDGRLHY	TYRRSSAS
SiPIN4a	SITL	SYSTI	LPNTL	VHGIPL	IAMYGPYA	GSLMVQVJ	IVLOCITI	IYTLLLFLF	Fraarml	IADQFP	'DSAAA	IASLRYEPDYYS	LEGGRf	ieteaeva-	EDGRLHY	TYRRSSYS
	CTTI I	CUCTI		UNCTO I	UCHYCDVC					TOOOFD	001000		1 ECCU0	COUOCVO_	DRODUDI DH	WUCDCCV_
SDP1N/ C:DTN/o	STIL	FSLST FCL CT	LPNIL I DNTI	THETPL	LYHNTGUTS			ITTLLLYLTE IVTLLLVLTE	FRHHKYL	TOCOCD	HU I HHHHL NTOOO	TTHNAKANDNAA22	Hu5QH 0CC00	EHQHEYH		VDDCTCV
AF PTNG	ITTI	FSTAT		VHGTP	DAMYGNYT				I RAARI I		60AA6S	-TAKTOVNNNVTSI	_NGMDP-I	RTETETD		TRRSVSS
PtPIN6a	LITL	FSIAT	LPNTI	VHGIPL	LKANYGDFT	OSLHYOY	VLOCII	YTLLLFLFE	YRAATLL	IKTOFP	GPKAAS	-ISKIELDNDYIS	-DGRDP-L	RTESETD	GNGRLRYF	RRSTSS
PtPIN6b	LITL	FSYAT	LPNTL	VHGIPL	LKAMYGDFT	QSLHYQYY	VLOCII	IYTLLLFLFE	YRAATLL	IKAQFP	GPTAAT	-ISKIELDDDYI <mark>s</mark>	-DGRDP-L	RTESETD	GNGRIRVE	RRSTSS
PtPINPIN7	AITL	FSLST	LPNTL	YHGIPL	LKS <mark>MYG</mark> DDK	EGLMIQY\	YLQCII	IYTLLLFLFE	YREARLA	IHLKNFK	GSSSSSS	SFSNSERSKG	SFKGYGEYL	GSRGSNA	DEYYNY]	LYSTPTSQ
OsPIN1d					HOMEOUC		WOFOT		VUOODDO	MEQFP	DTAAS	-IYSFRYDSDYY <mark>s</mark> i	_agggggaa	ELQAEAEY.	GDDGKMRV1	VRKSTSS
CPLINA	VUTN	CCVOC		THEVPL	LNGNTGPYS		WHOECTL		CHOODDC	TOPTCD	H55 ATV			DD00000	P55PYKI	INNHHHHUI
SIPTNS	VVTN	F SYRS		THEVPL	DGHYGSVS	GGI MKOTY	VHOFCT	YNUUTEI YE	FMAARDG	CAKTOP	niy V			588888P8	FKRDR-	TGENGGS
PpPIN6-1	VITL	FOLSY	MPNT	IVGIPV	SPLYSYTE	SGIAA1	FIGOVL	LFPTLFLYE	LKEVRKM	GOPAYG	SYA			OYODDGP	RSLHSGE	TTESAAE
OsPIN5a	SITS	FSLST	LTNS	YYGYPH	AR <mark>amyg</mark> eha	QQ <mark>LYYQ</mark> LS	SYFQAIY	LTLLLFYLE	YRKAAIG	iH						YY
SiPIN5a	SITS	FSLST	LTNS	YYGYPLI	Ar <mark>amyg</mark> eha	QQLYYQLS	SYFQAIY!	LTLLLFYLE	YRKAAIG	iH						YY
SbPIN5b	SITG	FSLST	LTNS	VYGYPH	ARAMYGEWA	QQLYVQLS	SVFQAIN	LTLLLFYLE	IRKAAIG	iH						·YY
DED THES	5115 CTTC	FSLUT			HKHNTGQQH	YULYYUSS	WTOCTTI		FRKHuf S							5N
PEPTN5a	STIS	FGLCT		VI GVPL	TKANYGPTA		VTOSTI VTOSTI		FRRSULU	V						55
PtPIN5b	SITS	FSLCT	TNS	VYGYPT	IKAMYGPAA	YDL YYOSS	VTOATT		FRRTGLG	F						SS
OsPIN5b	SITG	FSLAA	LNNTL	YYGYPL	LDAMYGRHA	QDLYYQIA	YYQSHY	FPLLLMAFE	LRKANYY	'G		G	iGG			ŸĞ
SbPIN5c	AITG	F <mark>SL</mark> AG	FNNTL	VYGYPL	ly <mark>anyg</mark> kha	QDLIVQIA	VYQSLF	FPLLLLGFE	L <mark>rka</mark> hhy	GIPSAQ	GGGGGGSRC	NSSNSDDDDDSAG	iGR			YG
OsPIN5c	CITG	FSLAT	LNNTL	YYGYPL	ld <mark>amyg</mark> kha	RDLIYQIS	SYYQTIY)	FPLLLLAFE	YRRATTA	A						·AA
SbPIN5a	CITY	FSLAT	LNNTL	YYGYPL	LDAMYGKWA	RDLIVQIS	SYYQFIY)	FPALLLALE	ARRAGKM	A						AA
51P1N50		FSLHH							HKKHHUH	DCCCO_		C	CU			KR
PEPTNSa	TTTG	L SI ST		TI GI PI	RAMYGAFA		GI OSI TI	INCLUE FOR		TVAPS-		C				FT
PLPINB	IITG	LSLST	LPNTI	ILGTP	RAMHGAEA	EPLL SOT	GLOSET	YNLLLFLFF	LNATKEA	TYRPS-		S				ES
SPLINS	LITG	FSLST	LPNTI	IYGIPL	KGMYGDEA	YKLLSQT	ALQSLT	YTLLLFLFE	FRAARGH	AITTS-		Š				ET
SiPIN8	LITG	FSLST	LPNTL	IVGIPL	KG <mark>my</mark> gner	YKLLSQI	ALQSLI	IYTLLLFLFE	FRAARGL	ATTTS-		S-				GT
SiPIN5c	CYTG	FSLAA	FNNT	YYGYPL	LDAMYGAWA	RDLVVQLF	IVYQAL VI	VPLLLLGFE	L <mark>rka</mark> hvy	RNGIAS	AAAGDGQA	AAGGGRYEPAYSS)AK			КА
USPIN7	CISG	FSLAS		TUCTO	HKHATGNHA	GUYYYQLS		LISLNYYLE	YKKHFYS	UHHUES	NKHEEG		JSGI SEDHQ	SLEEGYSDF	TINUULKGEEF	IVIVHGYN
DSP1N8		F SL S I F YI MO	LPNIL	TAPTA	LKONTOLUH	uKLLSUI	YLUSLI	GILLEFEFE	LKHHNGN	m11155	CITOLINH	-LYGEKANIKLPL.	LADNOTKUL	ουσαταμμ	IF SLULF I HLU	(IKTTHCQ
1 PL TH0-5	1 1/30	1 1110														

	261 270	280	290	300	310	320		330	340	350	360	370	380	390
	+			+-		+		+	+	+	+	+		
OsPIN1a	RSDVYSRRSHGF	SS	-TTPRPS	NLTNA <mark>e</mark> iysl	QSSRNPTPR	GSS-FNHTDF	YSHYG	RSSNF	AAG	DAFGY	RTGATPR	PSNYEEDAA	APNKI	AGS
SbPIN1	RSDIYSRRSHGF	<u>55</u>	-TTPRPS	NLTNAEIYSL	QSSRNPTPR	GSS-FNHTDF	YSHVG-	RSSNF	AAG	DAFGL	RTGATPR	PSNYEEEAQ	GGKA	ANK
SIPIN16	RSULYSRRSMGE	55	TTPRES	NLINHEIYSL	USSENFTPR	GSS-FNHTUF	YSMYG	RSSNF	·HHG	UHF GY-	RIGHIPR	PSNYEEDHQ	GK	HNK
USPINID C;DTN1 >	KSULTSKKSRUF:	5 5 -		NLINHELTSL	USSKNI IPK NCCDNDTDD	222-ENNNUL,	TONYU YCHVC	KSSNF	'UHH 	DHFGY	KIGHIPK DTCOTPD	PONTEDUHO	KP-K	VDI DVVN
ShPTNdb	RENTYERRENGE	5S	-TTPRPS	NI TNAFTYSI	OSSENETER	GSS-FNHNDF	YSHVG	RSSNF	GAA	DAFGT	RTGATPR	PSNYFNDAA	KPAK'	
ALPIN1	RSDIYSRRSOGL	5A	-T-PRPS	NLTNAEIYSL	OSSRNPTPR	GSS-FNHTDF	YSMMA-	-SGGGRNSNF	GPG	EAY	FGSKGPTPR	PSNYEEDGGPA	KPTAAGTAA	GAGREHY
PtPIN1c	RSDIFSRRSQGL	SS	-TTPRPS	NLTNAEIYSL	QSSRNPTPR	GSS-FNHTDF	YSHHA-	-AGRNSNF	GAS	DYYGLS	SASRGPTPR	PSNFEEEHG	GSI	NKPRFHH
PtPIN1d	RSDIFSRRSQGL	SS	-TTPRPS	NLTNA <mark>e</mark> iysl	QSSRNPTPR	GSS-FNHTDF	YSMMA	-AGRNSNF	GAS	DYYGLS	SASRGPTPR	PSNFEEENG	GSI	NKPRFH-
PtPINPIN1a	RSDYFSRMSHGL	NSGL	Shtpres	NLTNAEIYSL	QSSRNPTPR	RSS-FNHTDF	YSK-N-				ASNASPR	HSNFSNLQF	D	EESGGLG
PtPIN1b	RSEVFSHMSHGL	NSGL	SLTPRES	NLTNAEIYSL	QSSRNPTPR	RSS-FNHTDF	YSHYN-				GKNASPR	HSNFTNLQF	DI	EESGGLG
HEPIN3	RKSFUGPND DDCEVCCCCTNM		IPRES			DSN-FNHSUF	YCHMCEI	PGGRESNE	-62H	UNTSY	USSKUP IPK	PSNFEENUH		-MHSSPR
PEPTN3a	PPSI GPGSESGM		TPRIS	NLTUHEITSL NI TGAETYSI	SSCRNPTPR	CCN-ENDCUE	T SANGUI YSMMGVI	ra==aklonr NGEPGDHSNI	GPA	DITSY	USSKUP I PK	PSNFFFNCA	PT(TI SCPR
PLPTN3b	RRSL GPGSESGL		TPRPS	NETGAETYSE	SSSRNPTPR	GSN-FNPSDF	YSHNGVI	0GGRHSNI	GPA	DL YSVI	DSSRGPTPR	PSNFFFNCA	PM	ATTTSPR
ALPIN4	RRSLMM		TPRPS	NLTGAEIYSL	SSTPR	GSN-FNHSDF	YSYMGFI	PGGRLSNF	GPA	DLYSY	DSSRGPTPR	PSNFEENNA	YK'	YGFYNNT
PpPIN3-2	RSQGMHSAHHSM	PSSK	al t <mark>p</mark> rps	NLTGAEIYSM	HSSYNLTPR	DSS-FNQGEY	FSMMAQ	RS-PHRQSNF	DIS	DYYSL	SSRGPTPR	TSNFNEENSKD	MHTHHRGLN	LTSPRFY
PpPIN3-1	RSOGMHSAHHSM	PSSK	alt <mark>p</mark> rpsi	NLTGA <mark>e</mark> iysh	HSSYNLTPR	DSS-FNQGEF	HSHMSQ	RS-PHRQSNF	DTS	DYYSL(QSSRGPTPR	SSNFNEENSKD	IHTHHRGLN	HNSPRFA
P _P PIN3	RSQGYHSANHSI	PSSK	al t <mark>p</mark> ros	NLSNAEIYSM	NSSYNLTPR	GSS-FDRGED	CSTHAH	RD-PNRKSNF	DTS	DIYSL	QSSRGPTPR	NSNFNEENSKE	YHNHRGALN	YNIPRFA
OsPIN2	STTGGGGGAARS	gysraygasn	aht <mark>p</mark> ras	NLTGYEIYSL	QTSREPTPR	ASS-FNQADF	YANFSG	skhasqh		ASPH	AQHGGAGGR	AQGLDEQYTN-	K	Fasgk
SbPIN2	STTGGGHGGARS	GYGGYRPYGPSS	ANTPRIS	NLTGYEIYSL	QTSREPTPR	GSS-FNQSDF	YAMENG	SKMASPL		AQP	GAR	APGLDEQYAN-	KI	FASGK
51P1N2	STIL-HUHHKS	0766TKPT6H55	HEIPKIS MITDOC	NETGYETYCY	UTSKETTPK	122-LNM2204	THEFNU: VOMENO(5KNH5PL	TNEVCC	OCOCDCCDUVCI	USUNK Лесиситор	TONEDEEVING	OVVOCDCCD	HSUK
DF DIN2a	2211222LMK2HC	NSTTS	H_TPDIC	NI TGV <mark>e</mark> tycv	NCCRETTER	133-FNQTDF 999-FNQTDF	1006003 7006-09	SKAACDKHCA SVUL SLKUA I	TNSEOG	GTGDVYSI (ASSVATAD	TSNYDEENIKI	CKKKCDT	NMSGELF
OsPTN1c	RSEAACSHGTQS	HSQS	MO-PRES	NI SGYETYSI	OSSRNPTPR	GSS-ENHAFE	FNTVG-				NGK06	DFFKG		
SbPIN4c	RSEAACSH-SHS	HSQS	MQ-PRTS	NLSGYEIYSL	OSSRNPTPR	GSS-FNHTDF	FNIYG-				AGAKGGAAA	AAAGDEEKG		
SiPIN4b	RSEAACSH-SHS	HSQS	HQQPRVS	NLSGVEIYSL	QSSRNPTPR	GSS-FNHAEF	FNIYG-				AKG	-AGGDEEKG		
SiPIN4d	RSEAACSH-SHS	HSQS	HQQ <mark>P</mark> rysi	NLSGY <mark>e</mark> iysl	QSSRNPTPR	GSS-FNHAEF	FNI¥G-•				-GAKG	-AGGDEEKG		
PtPIN2b	SSNFSSRDRFDG	HNPYLSY	hlppris	NFSSY <mark>e</mark> yfsy	QSSPR	ASS-YRQTDL	PNLTNS	FG		DIYSL	QSSRNSYPR	ISSNLEEEMR-		
OsPIN10a	-RRSLLYT		PRPS	NLTGAEIYSL	SSSRNP TPR	GSN-FNHADF	FAM	GGGPPPPTP	PAAY-RG	SSFGASELYSLQ	SS-RGPTPR	QSNFDEHSARP	-PKPPATTT(GALNHDA
SbPIN4a	SRRSLLMYTT		IPR S	NLTGHEIYSM	SSSRQ ISPR	GSN-FNHADF	FAAMAM	VDGHPPPPPP VDCOPPPPPT	'AGGARA	SSFGARELYSMH	SS-RGPTPR	QSNFDERSASA	RSSSRPHGH	PSCHDA
51P1N4a	-KKSALUYI		OTDDDC	NLIGHEITSA NLIGUETVET	555КЦ ІЗРК СССРИПТРВ	DON-FNHHUF	FHN	PCUODDW	'Huu-Ku 	SSFUHHEYFSAH	55-KUP1PK CCCDOUTDD	QSNFDEHSHSH	DODOCOT	НҮРЗНИН ИОРТЫЛІ
SPINIO SPINIO	PSPPSI AAAT		AATPRIS	NLTGVETTSL	SSSKNIITER SSSRNITER	SSCRTAHADT	GU	runyrrn- PAAAPI HG	OULKU Sacci dh	ISSFGAANI ESI HI	эээкцптгк РТРР	PSSENENAV		VAPSNDP
SiPTN4c	-SRRSI A		TPRPS	NI TOVETYSY	SSSRNITPR	GSS-FAYGDY	SA	-TGAAPPI H	IGASHRH	SSEGAADI ESI H	SS-ROHTPR	PSSEDENAY	RARSAAA	VAPSYDP
ALPING	VPDSVHSSSLCL		TPROS	NLSNAEIFSY	NTPN	N-RFFHGGGG	SGTLQF	INGSNEINFC	NGDL	GGFGFT	RPGLGASPR	RLSGYASSD		
PtPIN6a	APDSALSSSICL		TPRPS	NLSNA <mark>e</mark> yfsy	STPA	PLQEYHGYNG	RFSI	HGPNNEIMLC	NGDL	G-FGYH	RSGTSPR	-LSGYRSSD		
PtPIN6b	APDSALSSSICL		TPRPS	NLSNAEYFSY	NTPY	PLHEYHGYNG	HFSI	HGPNNEIYLC	:NGDL	G-LAY-I	RSGTSPR	-LSGYASSD		
PEPINPIN7	EITENYNTKY		<mark>apn</mark> PQ	ofrshvaaav	DG									
USPIN1d	RSEAACSHGTQS	HSQ:	SHUPRYS	NLSGYEIYSL	USSRNPTPR	GSS-FNHHEF	FNIYG-				N	GKHGDEEKG		
CLDTNO	CTUEUDUDC		PQE	YHYNIEITEN	HH51HKUU= 0000!!0CT_									
SIPTN56	THAFRS		0NO	VVVNTETTEV	AAAANASP-									
PpPIN6-1	HGFEGHESG		ÌPÀ	LLTOGEHNDF	RIGIGDEP-									
OsPIN5a	DGAEAAAA	AGKD'	YEAAGAA	RAAGTYYYAA	AA									
SiPIN5a	-AAEPPYK	DYEA	Asadaap	RAAAYYYYPY	AS									
SbPIN5b	DYPDSPYK	DYEA	AADAASA	ATYYYYPYYY	AS									
HEPIN5	NISDYQYD	NINI	ESGKRET	γ τ	γγ νe									
PCPIN5a	SNPUKULE		UNHUS	 T	¥5									
PEPTN56			GCVNN	i T	75 FS									
OsPTN5b	PAVMSSSS	PPFK	OSOVENN	GAVVAAPGGG	66									
SbPIN5c	PYSSSSASSSSP	PPSPPPKKDAAA	EKDYEMN	REETAAAAAAG	Щ									
OsPIN5c	PPPPPTGT		-D-DDDY	edgaaaaata	AA									
SbPIN5a	AAVEPAGD		-DYDESG	GGGSGGEITA	AH									
SiPIN5d	PAAE		EEG	AGGDY <mark>e</mark> esgg	ET									
ALPIN8	NDQEEANI		-EDEPKE	EEDEEEYAIY	RT									
PtP1N8a			-ESQ	TKEUUEYHSR	T									
CLUTHO	TNEGECCT		-ENQ -TG <mark>D</mark> HOO	NKUULUYUKK	CO									
21110 21110	-NEGESGT		- 1 0 1 1144 - PG P HEEI	RHEEGRAKCV	58									
SiPTN5c	SSPPPAAF		KGDYFHN	AAAEPNAPPP	AG									
OsPIN7	GARLPLFKSVAR	KL	ACNPNLH	RSYIGISHAC	ISNRSHLTL	PPALEGSYOT	MSR							
OsPIN8	AKRMLLALAIRF	FLGPALNGNSSY	AIGHRGY	LLKIAIYQAA	LPQGIVPFV	FAKEYNYQAD	ILSTAI	IVGHHVAVPV	/ALAYYF	AMIIPAIK				
PpPIN6-2				-										

	391	400	41	0 42	0 43	0 440	450) 460) 4	70	480	490	500	50	10 520
OcPTN1 a			YPAP-NP	+ A	+	++·				-+	+ 	+		ngkni hmer	
ShPTN1		YGG(YPAP-NP	A					MAAO	PHPTKO	gi kkaaan			IGKOLINII	VUSSSASPVSD-
SiPTN1h		YG-(YPAP-NP						MAA-	PAK-	GOPKKAAN		GOAKGEI	OGKOL HMF	VUSSSASPVSD-
OsPIN1b	AAP	HAGI	IYPAP-NP	 A					YSS-	APK	GAKKAATN		GOAKGE) LHMF'	VWSSSASPVSD-
SiPIN1a	AAP	GAGI	IYPAP-NP						YAA-	APK	GAKKAATN		GOAKGE	DLHMF	YKSSSASPYSD-
SbPIN4b	AAAPY	PGAAAGI	IYPAP-NP	A					YAA-	APK	-KKAAGTN		GQAKGE)LHMF	YKSSSASPYSD-
ALPIN1	QSGGS	GGGGGGAI	IYPAP-NP	G					HFSP	NTGGGG	GTAAKGN-	AP1	/YGGKRODG	NGRDLHMF	VHSSSASPVSD-
PtPIN1c	YHAP-	GGATI	IYPAP-NP	G					MFSP	TTAASK	GYSANANN	TAAAAAKKPI	IGQAQQKAEI	DGRDLHMF	YKSSSASPYSD-
PtPIN1d	YHAP-	GGATI	IYPAP-NP	G					HFSP	TTR-SK	GYAANANN	AAAKKPI	IGQAQQKAEI	DGRDLHMF	YKSSSASPYSD-
PtPINPIN1a	YFGNY	PRANGSI	YPTPPNA	G					IFSP		GGKKKANG		TE	NGKOLHMF	YWSSSASPYSE-
PtPIN1b	YFGNY	PRANGSI	YPAPPNA	G					·IFSP		GGKKKANG		AE	NGKOLHMF	YKSSSASPYSE-
ALPIN3	FGYYP	GGG - AG	SYPAPNPE	F					·SSTT	TSTANK	SYNKNPKD	YNTNQQTTLI	PTGGKSNSH	DAKELHMF	YHSSNGSPYSDR
ALPIN7	FGYYP	GGA-PG	SYPAPNPE	F					S	TGNK	tgskapke	NHHHY	GKSNSN	Dakelhmf	YHGSNGSPYSDR
PtPIN3a	FGFYP	AQTYPTS	SYPAPNPE						·ASTY	TTKT	AKNQQQQN		SKANH	DAKELHMF	YKSSSASPYSEG
PtPIN3b	FGFYP	AQTYPT	SYPAPNPE	L					ASTI	TSKT	TKNOQQQN	HQQQLLQPQI	PQQNSKYNH	DAKELHMF	YKSSSASPYSEG
AtPIN4	NSSVP PDI VD	PAAG	SYPAPNPE	F		транарпартт	VPGSOTATS	VTPGGTGNT	STGT -атрі 5551	GYST	KPNKIPKE	NQQQLQE	KDSKASH	dakelhnf Dakelhnf	VHSSSASPVSD-
PpPIN3-1	PPLYR	RNGMGAR	MFTPRPGL	GGIGYPGTD	CTGHGTLSTLG	APGMGPDGRTI	YPGSQTAIN	ELTLGGAANY	NATAPSTA	/NTQIYN	PYYSPQAS	QIAKKYKDP	Kas-Prade	DAKELHNF	YNSANASPYSE-
PpPIN3 OsPIN2	PPLYR -AA	RNGSGGR	lfmarsdl -Ypapnpg	.GGYGALSFEI	PAAHS	MGPDGRTI	YPGIT'	VVTNS	vaavpasg\ mm pf	/STHIIN	IPYFSPLYS •Prkkelgg	QVAKKYNDPI ISNSN	RASIPKTDE	eakelhnf Snkelhnf	VSSANPTSVSE- VNSSSASPVSE-
S5PIN2	-66	DATA	AYPAPNPO								PRKKELGG	SNSN		SNKELHMF	VHSSSASPYSE-
ALPIN2	-QG NNN	S-YP	SYPPPNP						FTG9	STSGASG	YKKKELGG	GGSG		SNKELHITF QNKEMNMF	VHSSSHSPVSE- VHSSSASPVSE-
PtPIN2a	NGG	SLYS	SYPPPNPh	 V					FSGS	6TSG G	PKKKESGS	GAM	G	PNKELHMF	VHSSSASPVSE-
SbPIN4c		GAGG	HSPQPQAY	A									AYAA	KRKDLHHL	VHSSSASPYSE-
SiPIN4b SiPIN4d		AGGG AGGG	YSPQPHAQ HSPOPHAQ	A A									A A	krkdlhnf Krkdlhnf	VHSSSASPYSE- VHSSSASPYSE-
PtPIN2b		RKNGY	AFPGSPSC	A						·	VPQKEGGG	i	APA	PNKDLHMF	WSSSISSNIS-
USPINIVa SbPIN4a	KELHI	1FYHSSS 1FYHSSS	ASPYSEVS	G						L	PYF SGGGG PYF TGGAG		GGHLDY GG-YNY	GAKEIRMY	1PHULPUNN- VPAELPLPQNG-
SiPIN4a	KELH	IFYHSSS	ASPYSEVS	G						L	PVFTGGAA		VNV		VHADLPQNG-
SPINIOD SPIN7	RDYH	IIEMSSG	ASTTSEVE	G						L	.PYFHGGDL		H	RGMDSRRL	VPSEVPP
SiPIN4c ALPIN6	KDHPT	FENSSG	asaaseys 1 optpras	G N						L	PYFRGGE-		H ENFL DV-	rakdyrrl Ngngtpyh	YPSEAPPYGHS- Mkspaagrtyr-
PtPIN6a		AYS	LOPTPRTS	N									FNEHDLT	NATNTPFH	ARSPVAGKISR-
PEPINED PEPINPIN7		HTS	LUPTPRHS	N									FNELUL I	DDKEYHLF	VRSPVHGKITR- INRCVCCTSQG-
OsPIN1d		-AAGGGG	HSPQPYYG	i										KRKDLHMF	VWSSSASPVSE-
SPIN3															PTAPYDGAA-
SiPIN55 PoPTN6-1															TAPPESGAE- Shaatevsh-
OsPIN5a															
SLPINSA SbPINSb															
ALPIN5															
PtPIN5c															
PtPIN5b OsPIN5b															
SbPIN5c															
USPIN5C SbPIN5a															
SiPIN5d															
PtPIN8a															
PtPIN8b SbPTN8															
SIPINS															
0sPIN5c														SGLGLAMF	SHGCNTSYYF
OSPIN8															
Lbi.Tuo-5															

	521	530	540	550	560	570	580	590	600	610	620	630	640	650
0oPTN1 a	11	ECNG_OEV	NNAAAVVEVD	HOVOSPDV	.enc		DUDECECND-		EKCABBAN-	CCENCKDC				
CSPTN1		ECNCOREY	NDAAAVKEVD	MAVASPRKVA	INDU	TE	EDDI SI UNK-		EK999_	JULIIUKI U	V999209	MPPTSVMTPI		
SIPTN16		FGNGNAEY	NDAAAVKEVD	MAVASPRKVA	AUCDKKEKGE-	DFAF	PROFISEGND-	GGAERDAEAGD	EKAAV-	ACOCNA_C	VGA_PAA	MPPTSVHTPI		
OsPTN1b		FGGGGAPNY	NDAAA	-V-KCPRKMD	IGAKNR-F-		PRODESEGNR-	GVMDRDAFAGD	EKAAAA	-AGANPSK	АМААРТА			
SiPTN1a		FGGGGAPNY	NDAAA	-A-KCEBKHD	16AKFR-D-	DYVE	PREFSEGNR-	GAMORDAFAGO	FKAAVA	-GGGDPN-	AVAAPTA			
SPLINIA		FGGGGAPNY	NDAAA	-07KCDDKMD	ICCCAKUD-U-	DTTC DYVF	PREFSEGND-	GAMORDAFAGO	EKAAAATA-	VAGGDPN-	AVAAPTA	MPPTSVHTRL		
AF PTN1		FGGGGGGNH	HANYSTA		TCVPNGNGN_		DEFECTION			-GGNNTSN	KTTOAKV	MPPTSVHTPI		
PE PTN1c		FCCHDYCA	HDI KUVP	-VANCDCKA-	_ECODENCE_		EDDDESEGND_			-GEKVG	ENCKORD-			
DE DIN14		ECCUDACO	UDOKOYK		VEGUTENOE_		ENDERSEGND_			-GEVVC	00CVDVD			
PE PTNPTN1 a		-GGI HVER	660¥6		IDI GGVANOK-		SPREESEGNPP	VPNGVNRNGPVI S	KI ASSSTAF	I HPKSAAN	IGEPKPTA			
PEPTN16		-GGL HVEK	GCD¥C	N	IDI CCADANK-		SDREESEGNDDI	CONCUNDICOUL LO	IN CCCCTAF	L H PKCOON	ICEAKPTY			
OF DENS		ECCODN	NUUCCDCUUC		DCGG THINK-	VOUDOCCNE	CCENNEGEOCI	VEEEDEDDVNDEN	ICI NVI ODNO	TOOLOGVT		IFFTSTITKL		
AF PTN7	AGLOV	'NNGA	NEUNCKZDÓG	GAKETRHI TS	DUSINGENKA	GPMNGDY	466F	-FESERVKEVPN	IGI HKI RCNS	TAFI NPKE	ATETGETVP	KHMPPASVHTRI		
PEPTN3a	GGI HU	FGGADFGA	SEOSGRSDOG	-AKETRHI VA	DHPONGETKT	TPOONGDEA	AGENESEAGRG	FGDDDDDRFKFGPT	GI NKI GSSS	TAFI OPK-	AAFAPNSGG	SRKMPPASVMTRI		
PLPTN3b	GGL HV	FGGTDFGA	SEQUERCE	-AKETRHI VA	DHPONGDSKT	TPOA-GNEA	GEDESEAGRG	EGENNOREKEGPT	GENKEGSSS	TAFI HPK-	AVGAPDSGG	SKOMPPASVHTRI	TI THVURK	
ALPTN4		F6668-60	NVATEOSEOG	-AKETRHVVS	DOPRKSNAR-			SGEGERETEKATA	GL NKHGSNS	TAFI FAAG	GDGGGNNG-	-THMPPTSVHTRI	TI THVURK	
PoPTN3-2	AGL HV	FGGNDTSA	NI HOSEDPKE	VRHI VHPOSO	I RHP-FANP-	RTYDNYA	OFDESEGNEN	ni ki fni nkngpr	I DNKEGSTS	TAFI TPKV	PEDEAKKS-	MPPSAVNTKI	TAVHTERK	VUNPNTY
PpPTN3-1	AGLHY	FGGNDTSA	NLOORFDPKE	VRML VHPOL D	RGLA-AASP-	RTYDEYT	REDESEGNRN	DI KI EDI DKOGPR	LD-KEGSTS	TAFL TPKI	AEDEAKKS-	MPPSAVMTKL	TAVHTERK	VHNPNTY
PpPTN3	GFLHY	FGGSDTST	NI QQSYNPKE	HYHYHPOSE	'HHI PGAANH-		ROGESEGNRR	NI KVEDVDNNGSK	INKKERSTI	TAFI APKH	PHDEGKTS-	MPPSSVHTKI	TCYNTERK	TRNPNTY
OsPTN2	ANI	RNAVNHAA	STDEASAPPP	AAVPVGGATP	KGYSGSYTPA	AKNG	GGELETEDGL	KSPAAGL AAKEPV	SGSPYVAPR	KKGGGADY	PGLAEAAH-	PHPPTSVHTRL	TI THVHRK	TRNPNTY
SbPIN2	ANL	RNAVNHAA	STDFAAVPPP	PH-PYDGATP	KGYSGTYTPA	KKPDPAANG	G-GDLETEDGL	KSPATGLAAKEPV	SGSPYVAPR	KKGADA	PGLEEAAH-	PMPPASVHTRL	TI THVHRK	IRNPNTY
SiPIN2	ANL	RNAYNHAA	STDFAGYPPP	AA-PYDGATP	KGYSGTYTPI	KKYDAAAAA	NGDYETEDGL	KSPATGLGAKFPY	SGSPYYAPR	KKGADA	PGLEEAAH-	PMPPASYMMRL	TLIMVHRK	LIRNPNTY
ALPIN2	ANA	KNAHTRGS	STDVS-TDPK	VSIPPHDNLA	TKAMONLIEN	MSPGRKGHV	ENDODGNNG-	GKSPY	MGKKGS	DYED	GGPGPRKQ-	OMPPASYNTRL	TLIMVHRK	LIRNPNTY
PtPIN2a	GNL	RHAVNRAA	STDFGYTDPS	KAAFOPESAA	SKAMNOLIEN	MSPSGKHSG	GEKEHDVEDG-	CKFP0	NYSPFTCOK	KHDH	AADGSKKH-	OMPPASYNTRL	TLIMVHRK	LIRNPNTY
OsPIN1c			R	AAAAAAGAYH	YFGGGGADHG	DAKGAQA	AYDEYSF	GNKNEKDGP	TLSKLGSNS	TAOLRPKD	DGEGMAAA-	MPPASYNTRL	ILIMYHRK	LIRNPNTY
SbPIN4c			R	AAGAAYH	IYFGAGAADHA	DYLAKGTOA	AYDEYGRDDFS	RTKNGNGADKGGP	TLSKLGSNS	TAQLYPKD	DGEGRPAAA	MPPASYMTRL	ILIMVHRK	LIRNPNTY
SiPIN4b			R	AAYH	VFGGGA-EHG	DYLAKGTQA	AYDEYGRDDFSI	RTKNGNGADKGGP	TLSKLGSNS	TAQLYPKD	DGEGRPAA-	MPPASYMTRL	ILIMVHRK	LIRNPNTY
SiPIN4d			R	AAYH	IYFGAGA-EHG	DYLAKGTOA	AYDEYGRDDFSI	rtkngngadkggp	TLSKFGSNS	TAOL YPKD	DGEGRPAA-	MPPASYMTRL	ILIMYHR <mark>k</mark>	LIRNPNTY
PtPIN2b						DHRYLR	RADQINGRHTY	PDPFNGADPQEDN	IAAAASTAK	KQQ		MPPAT <mark>Y</mark> YARL	IAMMYGR K	LVRNPNTY
OsPIN10a		GSGKEHEE	YGAYALGGGG	-GGENFSFGG	GKTYDGAEAY	DEEAAL	PDGLTKMGSS	5TAELHPKY	YDYDGPNAG	GGA	AGAG	QYQMPPAS <mark>y</mark> mtrl	ILIMVWR <mark>k</mark>	LIRNPNTY
SbPIN4a		SAGKEKES	NGAYAAAATG	EAAEAFGFGG	GKTATAEDAA	EAYEAGGGG	GPEQYTKLYGS	SCSTTAAEYRYKD	YDGYADGGG	GGGYDPDD	AGGGGGGGRA	QQMPPASYMTRL	ILIMYARK	LIRNPNTY
SiPIN4a		SAGKENEN	dgaysatay-	-EGEAFRFSG	GKTYEDAEAG	KAGGA	PEALTKLGSS	5 TAELRYKD	YDGAADGGG	GYAD	AGRAGA	-HQMPPASYMTRL	ILIMYHR <mark>k</mark>	LIRNPNTY
OsPIN10b		-RYIRPPP		GATG	Geraasfnka	YGG	godelakleagi	AKTEQQTTA	IVTTTTKGGG	AAG	AERARG	-QQNAPAG <mark>y</mark> hlrl	ILTTVHRR	LIRNPNTY
SPIN2		RAMRP		G	ERYYTGFPAD	AAG	godaltklesg:	5TEEERK	-DDKDAGAG	A-G	·GQQTAA·	-AAPAGYMMRL	<u>iythv</u> urr	LIRNPNTY
SiPIN4c		RAMRP		G	iervas-fkae	AY-	-QDALAKLESG	5 Adqrqnyk	DDGGENGGG	A-G	AGRAGG	-QAPAG <mark>y</mark> mmrl	i lth <mark>y</mark> hrr	LIRNPNTY
ALPIN6				QSSPK	HHHESGQRHA	AKDINGSYP	PEKEISFRDALI	Kaapqataaggga	ISHEEGAAGK	DTTPYAAI	GKQE	MPSAIYHMRL	i ltyygrk	LSRNPNTY
PtPIN6a				HPSPAYPELR	LYNGESPYNC	PNGGGKEIA	IEKEISFRDSC	KMP	APE	ETNSKERY	TSQE	MPHAIYMLRL	ILLYYGRK	LSRNPNTY
PtPIN6b				QPSPAYPEYK	LYNGESPYIC	PNGGGKDYP	PGKEISFRDSC	KMP	APE	ESNSKESY	'SNQE	MPHAIYMIRL	ILYYYGRK	LSRNPNTY
PEPINPIN7						FC	CEQSYQYLRKE	ESMKRGVESEKTE	GIENNTAAI	SSL		SSVMLLQ	ILKTVHLK	LYRNPNSY
OsPIN1d			RA	AAAAAAGAYH	YFGGGGADHG	DAKGAQA	IYDEYSFGNK-	NEKDGP	TLSKLGSNS	TAQLRPKD	DGEGRAAA-	MPPRSYMTRL	ILIMYHRK	LIRNPNTY
USPIN9						KE	YSSGEVHP	ү	EEEEHSHPH			PSHKHVIH	MHYKK	
SDP1N3						HH	IKELASHUUHG	Jedhohnnnkhhä	UVVPPPIPV	ų		PUYPSYNHYYH		LLUIPNIT
SIPINOD						EH	HHHHHHHEE=	рисссионсссот	пнурррнрн	ų				
PPTN6-1						KU	JEEHYKNGSKU	KNSFSYMNUESUI	KENGIENGH			THP SUTNLKE		
C:DTNE-														
STLTN29														
OF DINE														LOKAFAII
DE DENES												GPPAFUC		
Pt PTN5c												SPPAFUC		
PE PTN56												SPPAFUC	I MRTVUVK	AMNPNCY
OsPTN5b												VRI PFUA	TARTVGI K	
ShPTN5c												TRIUP	I VRTVGI K	AGNPNVY
OsPTN5c												ARRSI HP	i vravul k	VARNPNVY
ShPIN5a												QSSSEHP	I VRAVGTK	VARNPNTY
SiPTN5d												AARSFUP	LYRAVHMK	VAKNPNVY
ALPIN8												RSVGTHK	TLLKAWRK	LIINPNTY
Pt.PTN8a												RKVKAMI	YLLTYGKK	LISNPNFY
Pt.PIN8b												RKYKAMY	ILLTYGRK	LISNPNFY
SP1N8												RCYGAFO	FLLYYGKK	LYTNPNHY
SiPIN8												RCYSAFC	FLLYYGRK	LVINPNHY
SiPIN5c												HIRRLHP	IYRTYGLK	LAGNPNYY
OsPIN7					ILHI	CQGIHIACR	RPEYSKTGGA	RYPYRLICRHGTA	HRGATKGHY	RERDLHIG	HYDIGKILS	AITLLYFALALGY	CSSRRHHQ	IFTAEDSE
OsPIN8														

PpPIN6-2

	651	660	670	680	690	700	71	0 720	730	740	750	760	770	780
OsPIN1a	SSLI	GLIH	SLYCFRANE	EMPATILK <mark>ST</mark> ST	LSDAG	LGHAMFSLGL	FMALO	PRTTACGNKY	'ATFAM	AY <mark>RFL TGPAY</mark>	IAAASTAYGLR	GTLLHYAIYO	A	
SbPIN1	SSLI	GLY <mark>H</mark>	SLYCFRANE	EMPATILKSIST	LSDAG	lghamfsl <mark>g</mark> l	FMALQ	PRTIACGNKY	ATFAM	ay <mark>rfltgpay</mark>	IAAASLAYGLR	GTLLHYAIYO	A	
SiPIN1b	SSLI	GLIH	SLYCFRANE	EMPATILK <mark>ST</mark> ST	LSDAG	lghamfsl <mark>g</mark> l	FMALQ	PR <mark>IIACG</mark> NKY	ATFAM	av <mark>rfltgpav</mark> i	IAAASFAYGLR	GTLLHYAIYO	A	
OsPIN1b	S <mark>S</mark> LI	GLIH	SLYC <mark>fra</mark> nf	EMPAIYLKSISI	LSDAG	lghamfsl <mark>g</mark> l	.FMALQ	PH <mark>IIACG</mark> NKY	ATYAM	ay <mark>rflagpay</mark> i	IAAASFAYGLR	GTLLHY <mark>riyq</mark>	A	
SiPIN1a	SSLI	GLI <mark>H</mark>	SLYCFRANE	EMPAIYLKSISI	LSDAG	lghamfsl g l	FMALQ	PRIIACGNKY	ATFAM	ay <mark>rfltgpay</mark> i	iaaasfayglr	GTLLHYAIYQ	A	
SPIN4P	SSLI	GVI <mark>H</mark>	SLYCFRANF	QMPAIVLQSISI	LSDAG	LGHAMFSLGL	FMALQ	PRIIACGNKY	ATFAM	AVRFLTGPAVI	AAASFAYGLR	STLLHVAIVQ	R	
ALPIN1	SSLF	GITH	SLISFKANI	EMPALIAKSISI	LSDAG	LGMAMFSLGL	FMALN	PRIIACGNRR	AAFAA	amrfyyg <mark>p</mark> ayn	ILYASYAYGLR	SYLLHYAIIQ	A	
PtPIN1c	SSLI		SLYSERANY	KMPLIIHKSISI	LSUHG	LGMHMF SLGL	FINHLU	PRIINCENSI	HHFSN	HYKELIGPHIN	IHHHS1HYG1R	STLLHIHIYU	H	
PCP1N1d	SSLI	6L H	SLYSEKHUY	UNPHILHKSISI	LSUHu	LUNHNFSLUL Lenoneelel	FUHLQ	PKIIHUUNSY	H====HFHN	HYKELTOPHYF CUDEL TEDOUN	INNNSINYULK		6	
PUPINPINIA DEDINIE	22LT	UL I M		ENPOILINHSISI	LSDHu	LUNNNE SLUL	FINLQ	PKIINUMSY	0CEOM	SYKELTOPHYL CVDCLTCDOVA	INNNSENYULK IOOOCEOVELD		5	
AF DIN3			. OL VOEDUHU	AMPKITANSIAI	Lonnu	L GMAMESI G I	EMAL 0	PKI TACGNSU	0TEAM	AVDEL TOPAVI	AVAATATCI P		0 9	
ALPTN7	SSLT		AI VAFRUNV	AMPKTTOOSTST	I SDAG	I GHAMESI GI	FMAL 0	PKI TACGNST	ATEAM	AVREETGPAV	AVAAMATGI R		A	
Pt.PTN3a	SSLT		SLYAFRHHY	EMPKTTKOSTST	LSDAG	L GHAMESL GL	FMALO	PKL TACGNSY	ATFAM	AVREL TOPAV	IAAASTAYGI R	GTLLHVATVO	R	
PtPIN3b	SSLI	GL IH	SLIAFRAHY	EMPKIIKOSISI	LSDAG	LGHAMFSLGL	FMALO	PKTTACGNSV	ATFAM	AVRFLTGPAV	AAASTAVGLR	GTLLHVAIVO	A	
ALPIN4	SSLI	GLIH	ALYAYRHHY	AMPKILQQ <mark>SI</mark> SI	LSDAG	lghamfsl <mark>g</mark> l	FMALQ	PKTTACGNSY	ATFAM	AY <mark>rfitgpai</mark>	AYAGIAIGLH	GDLLRIAIVO	R	
PpPIN3-2	S <mark>S</mark> LL	GYI <mark>H</mark>	·S l yan <mark>rh</mark> hf	TMPLILYKSYHI	LSDAG	lghamfsl <mark>g</mark> l	FIGLG	DR <mark>IYYCG</mark> RKM	AIFGM	sl <mark>rflagpa</mark> yf	AAASYLYGLR	GYPLKYSIY0	A	
PpPIN3-1	S <mark>S</mark> LL	GVI <mark>H</mark>	SLYANRHHL	S <mark>mplilyksyht</mark>	LSDAG	lghamfsl <mark>g</mark> l	FMGLG	DR <mark>IIVCG</mark> TKH	AYFGM	al <mark>rflagpa</mark> yf	AAASYLYGLR	GYPLKYSIYQ	A	
PpPIN3	SSLL	<u> G</u> YY <mark>H</mark>	SLISFKCHL	DMPLILYKSYHI	ISDAG	IGMAMFSL <mark>g</mark> l	FMGMG	DR <mark>IIACG</mark> TKH	ALFAM	ll <mark>rflyg</mark> payf	AAASYLYGLR	AYSLNYSTY	R	
OsPIN2	SSLI	GLY <mark>M</mark>	SLYSFRANI	QMPSIIKGSISI	LSDAG	lghamfsl g l	FMALQ	PKIISCGKTY	ATFAM	AY <mark>rfltgpa</mark> y]	AATSIAIGLR	<u>avllhvaivq</u>	A	
SbPIN2	SSLI	GLYH	SLYSFRFNI	QMPSIIKGSISI	LSDAG	LGMAMFSLGL	FMALQ	PKIISCGKRV	ATFAM	AVRFLTGPAVJ	AATSIAIGLR	GYLLHYAIYO	A	
S1PIN2	SSLV		HLYSERAND	UNPSIIKUSISI	LSUHu	LGMHMF SLGL	FIHLU	PKIISUGKRY		HYRELIGPHYJ	LHHISTHTCLK	AAFTER AND AND AND AND AND AND AND AND AND AND	H	
HUPINZ DEDINO-	SSLF	0LHH===	SLYSPKANI	KNP I INSUSISI	LSDHu	LUNNING SLUL	FINLU	PKIIHUGKSY	HUF HI	HYKELTOPHYJ OVDELTEDOVI	INNI SINI UK	ADELHINOTVC	H	
noPTN10			OLYSIKMAT	EMPOTTOPCTCT		LUIINIIF SLUL I CHOMECI CI				OVDEL VEDOVA			n 9	
SPERIC	SCI T		SI VSYDUGT	OMPATTAPSTST	LSDNu	L GMAMESI GI	FMALO		AVTAM	AVDEL AGPAV	INNISTRYCLK	GVI I HTATVO	0 0	
SiPTN4h	SSLT	GVTU	SI VSERUGT	EMPATTARSTST	I SDAG	I GHAMESI GI	FMALQ	PRTTACGNKI	AAYAM	AVREI VGPAVI	AAASTAVGI R	GVI I HTATVO	A	
SiPIN4d	SSLI	GVIN	SLYSFRIGI	EMPATIARSIST	LSDAG	LGMAMFSLGL	FMALO	PRTTACGNKL	AAVAM	AVRFLYGPAV	AAASIAYGLR	GYLLHIAIVO	n. A	
PtPIN2b	ASLL	GLLH	SLISFRISI	KLPLIYDG <mark>sy</mark> rt	LSNAG	LGMAMFSLGL	FAALQ	PKYIASGKYL	ALISM	AIKFLIGPAYL	AATSLAYGLR	GDLLRIAIVO	A	
OsPIN10a	SSLL	GLAH	SLYAFRIYH	GAAAQHHRYHQ <mark>1</mark>	SRRRLHGRP	LPRGPCRH <mark>g</mark> r	RYNRHRTP	RDAPARRH <mark>C</mark> SGGS	TTRDCAFCF	CK <mark>riqcpp</mark> ghf	PEHSGNFWHAN	5SSNHI <mark>rv</mark> lh	P	
SbPIN4a	SSLI	GLAH	SLIAFRHHI	SMPAVVAKSISI	LSDAG	lghamfsl <mark>g</mark> l	FMALQ	PNTTACGHRA	TGISM	GY <mark>rflagpay</mark>	ITAASLAIGLR	GNLLRYAIYO	A	
SiPIN4a	SSLI	GLA <mark>H</mark>	SLIAFRAHI	SMPAYYAKSISI	LSDAG	lghamfsl g l	FMALQ	PNLIACGHRA	TGIS	gy <mark>rflagpa</mark> y)	AAASLAIGLR	SLLQYAIYQ	A	
OsPIN10b	ASLI	GLTH	SLIAFRFHI	THPIIYAKSISI	LSDAG	lghamfsl g l	FMATQ	PKIIACGYSY	AAASM	GYRFFFGPAI	AAASAAYGIR	STLLRIAIVO	A	
S5PIN7	HSYY	GLTH	SLISFRFHY	AMPYLYKNSISI	LSDAG	LGMAMFSLGL	FMATQ	PKIIACGNKY	HHITH	RIRFLFGPHY	IAATSAALGLR	STLLRYHIYO	A	
S1PIN4C	HSYY	6L M	SLISPREHI	HMP11VKNS151	LSUHG	LGMHMFSLGL	FUHU	PKIYHUGNSY		HIKFLLGPHY	1HH I SHHYGLK		H	
HCPING	SOLL	0LYM	SLISPKHNI		150Hu	LUNHNF SLUL I CHOMECL CL	FANLQ	PKN1PUGHKK	HI NUN 0 THOM	LIKE 150PLFF	HUHSLLYULK		H	
PE PTNG6	SCAL		SLISPARIN	GMPSI VKYSTKT	TSDNU	LONNIFSLOL I GNAMESI GI	FINLQ		ATHAM	ATPETCOPTY	IST ISLAVUIK		A	
PLPTNPTN7			ALVSCRYGT	MKPOTVNNSVTT	I SKAG	I GHAMESI GI	FMALQ		ATYGM	ARFI AGPAV	AVASTGVGI R	GTHI KI STVC	A	
OsPIN1d	SSLL	GVIH	SLYSYRHGI	EMPATTARSTST	LSDAG	L GHAMFSL GL	FMALO	PRTTACGNSL	ASYAM	AVRFLYGPAV	AAASTAVGLR	GYLLHIAIVO	A	
OsPIN9	ASFL	GLIH	SLIAFKCGF	SMPKIYEDSLFT	IRTTA	VGL SMFSSG1	FIARQ	SRFYPCGYKI	ASFSM	YIKFLIG P YY	LFASLYIGHH	GTLLHIAVYO	A	
SP1N3	ASFL	GLIH	SLMAFKIGF	SMPKIYGDSLF1	IYTTA	Y <mark>glsmfasg</mark> t	FIARQ	SRFYPCGYTI	ASLSM	YLKFLIG <mark>p</mark> II	ILLASLAYGNH	GTLLHIAYYO	R	
SiPIN5b	as fl	GLIH	SLMAFKIGF	S <mark>mpki</mark> ydd <mark>s</mark> lft	IHTTA	v <mark>glsm</mark> fasgt	FIARQ	SRFYPCGYTI	ASLSM	YLKFLIG <mark>p</mark> yi)	ILLY <mark>slatgm</mark> h	GTLLHIAVVO	A	
PpPIN6-1	ATYM	GIVY	SLIAGRAGF	DPLRILRNSLD1	IGRIT	LGLTMYSIGL	FMAGQ	KKL <mark>y</mark> -Ashhy	AFYGA	FC <mark>rfiygp</mark> gt)	GYASLLLGLR	adtlrfaflq	A	
OsPIN5a	ASFY	GITH	ACLANRLHI	ALPSAFEGSYLT	MSKSG	TGHAMF SH <mark>g</mark> l	FMAQQ	EKIIACGTSF	AALGL	YLKFALG <mark>paa</mark>	AIGSIAYGLR	DYLRYAIIQ	R	
SIPINSa	HSEV	611 H	HCYHNKLHL	ELPSHFEGSVL1	hSKSG	I GMHMF SMGL	FMHUU	EKYLHUGPUH	HHLGL	YLKFHLGPHH	HIGSTHYGER	UVLKVHIIU	H	
SDP1NSD	HSF Y		HUYHNKLHI	ELPSHFEUSYLI	NSK50	TETONENNET	.FAHUU	EKYLHUUPSH	HHLUL	YLKFHLUPHH	HIGSTHARK		Y	
DF DT ND	DCTT DCTT	0TUM	HF13MKHHL	ELPUILEUSILI ENDETNECETI T		TCTONECNCI	EMOLO		TVTC	VI DETOCDOO	INTEGLATOREL D		0	
Pt PTN5c			AFTAKDURF	EMPSTNEGSTI T		TGTAMESMGT	FINLQ	EKYTACGASI		VI PETAGPAA	ATGSTAVGI P		A	
PL PTN5h	ACTT		AFTSNRUHF	EMPAMMEGSTI T	MSKAG	TGTAMESHGI	FMALQ	FKVTSCGASI	AVIGN	TI RETAGPAA	ATESTAVELO		A	
OsPIN5b	ASYL	GVVH	ACTAYRHHL	SLPGTVTGSLOV	MSRTG	TGHSHFSHGL	FMG00	ERVIACGAGL	TALG	ALREVAGPLAT	LYGAAALGLR	GDYLHLATTO	R	
SbPIN5c	ASYL	GYY H	ACIAYRY-Y	RGTGIYTGSLDY	MSKTG	TGHSHLSHGL	FMAQQ	EKHIACGSGL	AALGM	ALRFYAGPLA1	LYGAAAFRLR	GDYLRFAIIO	A	
OsPIN5c	AGYL	GYA <mark>H</mark>	ACYTNRHHY	ETPSIIEGSYLI	MSKTG	VGLSMFSMGL	FMALQ	DKTTYCGAGL	TYLGM	al <mark>rf</mark> yag <mark>pa</mark> at	r <mark>a</mark> ygafal <mark>glr</mark>	GDLLRLATIC	RYTHLHEIHSP	SSFFLLS
SbPIN5a	AGIL	GYS <mark>H</mark>	ACYTN <mark>RH</mark> HI	ETPSIIEG <mark>SV</mark> LV	<mark>MS</mark> KTG	vglamfsm <mark>g</mark> l	FMALQ	EK <mark>IIYCG</mark> AGP	TMLGM	al <mark>rf</mark> yag <mark>pa</mark> at	r <mark>a</mark> agayal <mark>glr</mark>	DYLRLAYHO	A	
SiPIN5d	AGYL	GYA <mark>H</mark>	ACYTNRAHI	ETPSIIEG <mark>sv</mark> lv	<mark>MS</mark> KT <mark>G</mark>	vglamfsm <mark>g</mark> l	FMALQ	EK <mark>IIYCG</mark> AGP	TFLGM	al <mark>rf</mark> yag <mark>pa</mark> at	r <mark>a</mark> agalam <mark>glr</mark>	GDYLRLATIC	A	
ALPIN8	ATLI	GIIH	ATLHFRLGH	NLPEMIDKSIHL	LSDGG	lghamfsl <mark>g</mark> l	FMASQ	SS <mark>tiacg</mark> tkh	AIIT	llkfylg <mark>pal</mark> i	IASAYCIRLK	STLFKY <mark>rilq</mark>	A	
PtPIN8a	ATHA	ALI <mark>H</mark>	ASIHFRAGY	K <mark>lpdiydksiyi</mark>	LSTGG	lghamfsl g l	FMALR	PSIISCGIRM	AAAAA	ANKFIYG <mark>pal</mark> i	AVASFAVALE	TYLKYAIYO	A	
PtPIN8b	HTLY	HLIH	HSTHSKHGY	NLPUIYDKSYRI	LSTGG	LGMHMFSLGL	FMHSR	PSIIACGIRM	HMYAM	HMKF1YGPAL]	HYHSIAYGLK	TYLKYAIYO	H	
SEPINS	HSLI		HL15FRHRI	ULPSIVNNSIRI	LSDGG	LGMHMFSLGL		IKIYHCGIKK		GTREFLGPHL	WTCCYOTCY		H	
51P1N8 C; DTNE-	H5L1	CVVV	NL15FKHKY	NECONCECT ON	LSUGU	сопнпн 5661 тененеске	F 1 HLU			OT DEVOCOL OF	11722147794		TVI CCV	
D~DTN2C	ALND	UYY H	DEETCEET	HI NOVNUOCCI T	ISKIU 880570/1 T	T_VOOTETEI	M KEDV		TSCECI OC	I TNSI VVCND	CHUNNIN ULK	OTVVOI CTEC	ATVUI TCI	
OSPIN/ OsPINS	THK			ILDI INYKUJLI	MUDJINKLI	T-11012101		-LULCINY I DR	eran, arua	LINJLITUNFI		STILE OTLE	ILTALI JL	
PpPIN6-2														

	781	790	800	810	820	830	840	850	860	870	880	890	899
OsPIN1a				ALPQGIVPF		EYSYHPDILS	TAVIFGHLI		а. ЭL				
S6PIN1				ALPQGIVPF	YFA)	EYGYHPDILS	TAVIFGHLI	(ALPITLY <mark>yyı</mark> lm	GL				
SiPIN1b				ALPQGIYPF	YFA)	EYGYHPDILS	TAVIFGHLI	(ALPITLY <mark>YYI</mark> LL)	GL				
OsPIN1b				ALPQGIYPF-	YFA)	EYSYHPSILS	TAVIFGHLI	ALPITLY <mark>yyı</mark> llı	GL .				
SiPIN1a				ALPQGIVPF	YFA)	EYNYHPDILS	TAVIFGHLI	(ALPITLY <mark>yyı</mark> ll)	GL				
SPIN4P				ALPQGIYPF	YFA	EYNYHPDILS	TAVIFGHLI	ALPITLY <mark>yyı</mark> ll	GL				
ALPIN1				ALPQGIYPF	YFA	EYNYHPDILS	TAVIFGHL	ALPITLLYYILL	<u>iL</u>				
PtPIN1c				ALPQGIYPF	YFA)	EYNYHPEILS	TGVIFGMLJ	ALPITLYYYILL	iL				
PtPIN1d				ALPQGIYPF	YFAN	EYNYHPUILS	THYIFGMLI		iL				
				HLPUGIYPF	YEHR		TOTTOM		iL N				
PUPINID				HLPQUIYPF	YEHA	ETNYHPUILS	TOTTOM		JL N				
HCPIN3				HLPQUIYPF	YENR		TOTTOM		JL N				
HCPIN/					YEHA		TOVICCHLI		aL M				
DF DT NOP					YF M	CVNUUDOTI CI	TOTECHI 1		3L 21				
DF DTNA					1/201		TOVIECHI I	INCENTINA AND A CONTRACT OF DETTING	3L 21				
DPDIN3-3					VEOL	ELUAUL LTEO	TOVIECHI I		3L 31				
PoPTN3-2					VEOL	EVENUETI CI	TAVTECHI 1						
PDDING					VEAL		TAVTEGNT						
Depting				AL POGTVPF-	VFA	FYNCHPOTI S	TAVTEGHI		T				
SPLINE					VFA	FYNCHPOTI S	TAVTEGHI 1		T				
SiPTN2					VFA	FYNCHPOTI S	TAVTEGHI 1	AL PTTTI YYVI I	T				
ALPTN2					VEA	EYNVHPDTL S	TAVTEGHL	AL PVTVL YYVL L					
Pt.PTN2a					VFA)	EYNVHPDTL S	TAVTEGHI 1	ALPTTVI YYVI I	v				
OsPIN1c				ALPOGIVPF-	YFA	EYNYHPNILS	TAVIFGHLI	ALPITLYYYTLL	GL				
SbPIN4c				ALPOGIVPF-	YFA	EYNVHPDILS	TAVIFGHLI	ALPITLYYYTLL	GL .				
SiPIN4b				ALPQGIYPF	YFA)	EYNYHPDILS	TAVIFGHLI	ALPITLYYYILL	GL.				
SiPIN4d				ALPQGIYPF-	YFA	EYNYHPDILS	TAVIFGHLI	ALPITLY <mark>YYI</mark> LL	GL				
PtPIN2b				ALPSGILPF-	IFA	EYNLHANIQS	TSVIFGMV\	'A <mark>lp</mark> ytii <mark>yyyll</mark> i	DL				
OsPIN10a				SHTMIKKAYO	GRSHIKR	KHGQRERKKS	DP <mark>y</mark> hlkori	ILICIACCRTLP <mark>H</mark>	1TRQRSCYR	AIYLCDICTR	DNDRMYSNITI	DIRYYFC	
SbPIN4a				ALPQGIYPF	YFA)	EYNYHPAILS	THVIFGHLI	ALPITLL YYILL	LKPY				
SiPIN4a				ALPQGIYPF	YFAI	EYNYHPAILS	THVIFGHLI	(ALPITLL <mark>YYI</mark> YL)	GLGPY				
OsPIN10b				ALPQGIYPF	YFA)	EYNLHATILC	TLVIFGHLI	(ALPITLY <mark>YYII</mark> L)	GLL				
SPIN7				ALPQGIYPF	YFG	EYNLHAAILC	TGYIFGMLJ	ALPITLYYYIIL	GLL				
SiPIN4c				ALPQGIYPF	YFA	EYDLHAAILC	TGVIFGMLJ	GLPIAL VYYIIL	GLL				
ALPIN6				ALPQGIYPF	YFA	REYNLHPOLLS	TLVIFGMI	SLPYTILYYYLL	<u>il</u>				
PtPIN6a				ALSQGIYPF	YFAI	REYGLHPDIMS	TGYIFGHL	SLPYTLLYYIFI	iL				
PtPIN6b				ALSQGIYPF	YFA	REYGLHPDIMS	TGVIFGML	SLPYTLIYYIFL	iL				
PEPINPIN/				HLPUGIYPH	YEH	ETGLHPUYLS	THATERNEY		jL				
USPINIC				HLPUGIYPH	YHH	ETNYHPNILS	THATPOL		jL N				
USPINS				HLPLHYISH	YTH		I GATE CILL		aL N				
SDP1N3				HLPLHY15h	YTHL		IGATE CIEL						
51P1N3D				HLPLHYISH	YTH		TO	ISCHALTALLE	JL				
0-DINE-					TEOL		іП Тоутесыі і						
CIDINE-					TEO		TOVICON	ICI DI I VCENTULI					
CPDINER 2TLIN39						CTULNNUYLS	INATUOUT	JEFELYUFTIYL					
OF THOU						EYGI HADVI QI	TAVTECHI 1	ici pvi vavvaai i	FTH				
PEPTN5-						EYGI HAEVI CI	TAVTEGTT	I PVI TAVVATI I	DEVH				
L CI THING					TLUE	(LTULINETLJ	ULTURIT/	IICI TETUI IUTE	711				

SbPIN5b	SLLAFFFI
ALPIN5	ALPQSITSFIFAKEYGLHADYLSTAYIFGHLYSLPYLYAYYAALEFIH
PtPIN5a	AFPQAIISFIFAQEYGLHAEYLSTAYIFGTIYALPYLIAYYAILDFYH
PtPIN5c	AFPQAIISFIFAQEYGLHAEYLSTAYIFGTIYALPYLIAYYAILDFYH
PtPIN5b	PILPQSITSFIFAKEYGLHAEYLSTAYIFGHLAALPYLITYYAILEFYP
OsPIN5b	ALPQSIASFYFAKEYGLHADYLSTAYIFGTLISLPILIAYYAYLGFY
SbPIN5c	ALPQSIRSFYFAKEYGLHADYLSTAYIFGTLYSLPYLIAYYAYLGIL
OsPIN5c	PEICLNSNGCMHDTSPHDETARDEQAALPQSITTFYFAKEYGLHAEILSTAYIFGTLASLPYLIYYYIYLGFIR
SbPIN5a	ALPQSITTFYFAREYGLHADYLSTAYIFGTLASLPYLIYYYIYLGLIRC
SiPIN5d	ALPQAITTFVFAKEYSLHADYLSTAYIFGTLASLPYLIYYYIYLGLIRC
ALPIN8	ALPQGYYPFYFAKEYNLHPEIISTGYIFGHLIALPTTLAYYFLLDL
PtPIN8a	ALPQGIYPFYFAKEYNYHPDTLSTGYIFGHLIAHPIALAYYSLLAL
PtPIN8b	ALPQGIYPFYFAKEYNYHPDTLSTGYIFGMLISMPIALAYYSLLAL
SbPIN8	ALPQGIYPFYFAKEYNYHADILSTAIILGMIYAYPYALGYYFYHDHPRL
SiPIN8	ALPQGIYPFYFAKEYNYHADIYSTAIIYGMMYAYPYALGYYFYIDHPRF
SiPIN5c	
OsPIN7	VYYLEYRKAFYSDAHDESNSYEEGSFIDDDTYYGSSGTSEDNQSLEEGYSDATNQDLRGEEAYSYAYYNGARLPLFKSYARRTSLCHQLARGRC
OsPIN8	
PpPIN6-2	