Flanking signal and mature peptide residues influence signal peptide cleavage by Khar Heng Choo and Shoba Ranganathan

Additional File 2. Amino acid frequency matrix for the SPs and MPs of eukaryotes and bacteria. Percentage occupancy values from P10 to P10' [-10, +10] are shown, with the cleavage site in dotted line at -1/+1. Significant high and low values, in bold font are highlighted: grey: >10%; black: most preferred residue(s); cyan: charged residue group and green: aliphatic group.

A. Eukaryote	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	+1	+2	+3	+4	+5	+6	+7	+8	+9	+10
	P10	P9	P8	P7	P6	P5	P4	P3	P2	P1	P1'	P2'	P3'	P4'	P5'	P6'	P7'	P8'	P9'	P10'
Ala(A)	9.43	16.25	13.43	11.51	13.11	15.18	9.38	**25.84**	7.46	**48.91**	13.53	3.68	4.74	5.33	5.17	5.49	5.01	5.27	5.43	6.23
Cys(C)	3.68	4.05	5.91	5.81	3.68	2.18	3.36	6.50	1.49	3.57	3.41	1.92	7.73	4.16	3.46	5.01	4.85	3.84	3.84	3.89
Asp(D)	0.11	0.16	0.27	0.43	0.69	3.84	1.33	0.27	3.94	0.32	5.33	7.99	5.49	5.59	5.65	5.65	5.97	5.75	4.90	5.59
Glu(E)	0.32	0.32	0.85	1.39	0.69	2.02	2.66	0.37	8.79	0.53	7.83	8.84	5.22	7.19	7.25	6.45	6.02	6.71	5.97	6.07
Phe(F)	9.11	6.87	5.86	6.77	5.91	1.60	2.34	0.64	3.46	0.21	3.57	2.18	3.62	3.36	3.14	3.94	3.09	4.53	3.04	3.94
Gly(G)	4.00	3.94	5.27	4.32	3.46	11.13	13.96	9.43	3.52	**20.72**	7.14	5.01	6.29	8.10	6.66	7.19	5.91	8.15	8.95	8.58
His(H)	0.27	0.48	0.80	0.75	0.59	2.50	1.23	0.16	4.95	0.05	1.81	2.45	2.45	2.61	3.09	2.18	3.62	1.81	2.29	2.40
Ile(I)	5.17	6.18	4.37	4.05	7.94	2.29	3.41	3.78	1.70	0.16	3.30	3.73	6.23	2.72	3.14	3.46	3.14	3.57	4.79	3.52
Lys(K)	0.11	0.00	0.05	0.91	0.16	2.08	1.92	0.37	1.44	0.11	4.64	4.95	2.45	4.79	5.38	4.85	4.85	3.84	5.27	5.22
Leu(L)	**43.79**	**37.93**	**29.89**	**36.49**	**27.22**	7.94	16.41	4.32	15.24	1.39	8.47	4.58	9.11	5.65	5.97	7.46	6.55	7.67	8.26	7.25
Met(M)	2.40	1.97	3.30	2.50	1.81	1.17	1.70	0.27	1.76	0.21	1.12	0.69	1.70	1.28	1.70	1.17	1.33	2.13	1.44	1.70
Asn(N)	0.69	0.48	0.59	1.23	0.75	2.02	0.91	0.69	4.21	0.37	2.50	4.32	3.73	3.94	4.32	3.25	5.43	4.37	4.26	4.95
Pro(P)	1.01	1.17	0.96	2.34	6.29	9.38	9.11	0.21	0.69	2.02	0.27	15.82	7.46	10.66	8.79	8.58	8.68	9.86	6.93	6.55
Gln(Q)	0.64	0.75	1.97	1.65	1.07	5.27	4.48	0.27	7.25	1.33	11.03	4.90	3.52	6.77	5.54	5.54	5.06	3.84	6.93	4.48
Arg(R)	0.11	0.21	0.37	1.17	0.75	2.98	2.88	0.37	5.54	0.96	4.95	4.69	2.29	3.62	5.59	6.13	4.58	5.49	4.00	4.21
Ser(S)	3.30	6.23	7.88	6.29	6.93	12.20	8.47	13.00	11.99	13.48	8.20	9.00	7.62	7.94	7.94	6.55	6.87	8.15	8.31	6.61
Thr(T)	4.26	3.20	4.53	3.62	4.16	8.90	6.39	10.97	4.05	5.01	4.26	5.59	6.61	7.51	7.46	6.39	6.82	5.59	4.90	7.51
Val(V)	10.28	8.74	10.87	5.81	12.36	5.17	7.46	**22.32**	3.57	0.37	4.48	6.34	8.74	5.11	5.70	7.62	6.39	5.65	6.55	6.39
Trp(W)	0.91	0.64	1.76	2.13	1.65	1.17	1.23	0.05	4.21	0.16	1.01	0.85	1.86	0.80	0.69	0.75	1.07	1.65	1.01	1.76
Tyr(Y)	0.43	0.43	1.07	0.85	0.80	0.96	1.39	0.16	4.74	0.11	3.14	2.45	3.14	2.88	3.36	2.34	4.74	2.13	2.93	3.14
Charged	**0.91**	**1.17**	**2.34**	**4.64**	**2.88**	13.43	10.02	**1.55**	24.67	**1.97**	24.56	28.93	17.90	23.81	26.96	25.25	25.04	23.60	22.43	23.49
Small	16.73	26.43	26.58	22.11	23.49	38.52	31.81	48.27	22.96	**83.11**	28.88	17.69	18.65	21.36	19.77	19.23	17.79	21.58	22.70	21.42
Aliphatic	**68.67**	**69.10**	**58.55**	**57.86**	**60.63**	30.58	36.65	**56.26**	27.97	**50.83**	29.78	18.33	28.82	18.81	19.98	24.03	21.10	22.16	25.04	23.39
Hydrophobic	38.41	41.82	40.60	36.01	49.23	38.04	36.55	**53.49**	24.29	**52.16**	31.91	38.25	36.81	34.04	33.72	35.86	33.56	36.49	34.47	35.32
Polar un-charged	17.00	19.07	27.22	23.76	20.83	42.67	38.95	41.02	37.24	44.59	39.69	33.19	38.63	41.29	38.73	36.28	39.69	36.07	40.12	39.16

B. Gram +ve	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	+1	+2	+3	+4	+5	+6	+7	+8	+9	+10
	P10	P9	P8	P7	P6	P5	P4	P3	P2	P1	P1'	P2'	P3'	P4'	P5'	P6'	P7'	P8'	P9'	P10'
Ala(A)	25.60	16.67	14.88	11.90	19.05	7.14	10.12	51.79	11.31	83.93	36.31	9.52	7.14	6.55	11.90	7.74	10.71	10.71	10.12	5.95
Cys(C)	0.60	1.19	0.60	0.60	0.00	0.00	0.00	0.00	0.60	0.00	0.60	0.00	0.60	1.19	0.60	0.60	0.00	0.60	0.60	0.00
Asp(D)	0.00	0.60	0.60	1.19	2.38	2.98	4.17	0.00	2.38	0.00	11.31	10.71	7.14	6.55	9.52	7.14	8.33	7.14	8.33	7.14
Glu(E)	1.79	0.00	0.60	1.79	1.19	3.57	4.76	1.79	5.36	0.00	9.52	13.69	5.36	4.17	8.33	5.95	5.95	6.55	5.95	8.33
Phe(F)	7.74	9.52	4.76	7.74	1.79	1.19	0.60	1.19	11.90	0.00	2.38	1.19	3.57	2.38	3.57	4.17	1.79	0.00	1.79	2.98
Gly(G)	6.55	5.95	11.90	7.14	7.14	8.33	6.55	1.79	4.17	4.76	1.19	7.74	8.93	8.33	5.36	6.55	4.17	4.76	6.55	7.14
His(H)	0.00	0.00	0.60	1.19	1.79	0.60	1.19	0.00	6.55	0.00	1.19	1.79	0.60	1.19	1.19	0.60	1.19	1.19	1.79	1.19
Ile(I)	5.36	6.55	5.36	5.36	4.76	1.79	3.57	2.98	1.19	0.00	1.79	1.19	3.57	3.57	2.38	4.17	7.14	2.98	2.98	2.98
Lys(K)	0.00	0.00	0.60	0.60	2.38	4.17	5.36	0.60	8.93	2.38	5.36	1.19	13.10	6.55	5.95	5.36	7.14	7.14	8.93	7.14
Leu(L)	19.64	20.83	15.48	11.90	5.36	3.57	4.76	1.19	5.36	1.19	1.19	1.19	5.36	2.98	5.36	4.17	4.76	6.55	8.33	4.76
Met(M)	1.19	2.98	5.95	3.57	1.19	0.60	3.57	0.60	1.79	0.00	0.60	0.00	0.60	0.60	0.60	0.60	1.79	1.79	1.79	1.19
Asn(N)	2.38	2.98	1.79	4.76	1.79	7.74	5.36	0.00	4.76	0.00	2.98	4.17	5.95	7.14	9.52	5.95	4.17	8.93	5.36	6.55
Pro(P)	0.00	5.95	4.76	5.95	17.26	11.90	12.50	0.00	0.60	0.60	0.00	13.10	7.14	14.29	3.57	9.52	7.74	7.14	7.14	2.38
Gln(Q)	0.60	0.60	1.19	5.36	5.36	5.95	3.57	0.60	11.90	0.00	5.36	1.79	4.17	4.17	4.17	7.74	3.57	2.98	3.57	5.95
Arg(R)	1.19	0.00	0.00	0.00	0.60	1.19	1.19	1.79	2.38	1.19	1.79	0.60	2.38	1.19	1.19	1.19	2.38	1.79	1.19	4.17
Ser(S)	6.55	10.71	10.12	7.14	7.74	16.07	6.55	9.52	12.50	3.57	10.71	10.71	8.33	5.36	7.74	4.17	8.93	8.93	8.93	8.33
Thr(T)	7.74	4.76	10.71	10.71	13.10	16.07	16.67	2.38	1.79	1.19	2.38	14.29	7.74	14.29	8.93	10.12	11.31	8.93	7.74	9.52
Val(V)	11.90	9.52	7.74	11.90	6.55	6.55	8.33	23.81	3.57	1.19	4.17	5.95	6.55	7.14	3.57	9.52	6.55	7.74	5.95	9.52
Trp(W)	0.60	1.19	1.19	1.19	0.60	0.60	0.60	0.00	0.60	0.00	0.60	0.00	0.00	0.60	1.19	1.79	1.19	0.00	0.60	1.79
Tyr(Y)	0.60	0.00	1.19	0.00	0.00	0.00	0.60	0.00	2.38	0.00	0.60	1.19	1.79	1.79	5.36	2.98	1.19	4.17	2.38	2.98
Charged	2.98	0.60	2.38	4.76	8.33	12.50	16.67	4.17	25.60	3.57	29.17	27.98	28.57	19.64	26.19	20.24	25.00	23.81	26.19	27.98
Small	38.69	33.33	36.90	26.19	33.93	31.55	23.21	63.10	27.98	92.26	48.21	27.98	24.40	20.24	25.00	18.45	23.81	24.40	25.60	21.43
Aliphatic	62.50	53.57	43.45	41.07	35.71	19.05	26.79	79.76	21.43	86.31	43.45	17.86	22.62	20.24	23.21	25.60	29.17	27.98	27.38	23.21
Hydrophobic	52.38	52.38	45.24	48.21	53.57	33.93	44.64	80.95	39.88	88.10	51.19	32.14	41.67	41.67	32.74	42.86	44.05	37.50	39.29	33.93
Polar un-charged	25.00	26.19	37.50	35.71	35.12	54.17	39.29	14.29	38.10	9.52	23.81	39.88	37.50	42.26	41.67	38.10	33.33	39.29	35.12	40.48

C. Gram -ve	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	+1	+2	+3	+4	+5	+6	+7	+8	+9	+10
	P10	P9	P8	P7	P6	P5	P4	P3	P2	P1	P1'	P2'	P3'	P4'	P5'	P6'	P7'	P8'	P9'	P10'
Ala(A)	22.48	23.45	16.94	16.94	30.62	16.94	16.61	61.89	6.19	93.16	41.69	5.86	8.14	8.14	11.40	8.79	9.45	8.47	7.49	11.40
Cys(C)	1.95	1.95	3.58	0.65	1.30	0.98	0.65	0.65	0.00	0.00	0.00	0.00	1.30	0.00	0.65	0.65	0.00	0.98	0.65	1.95
Asp(D)	0.33	0.33	0.33	0.00	0.00	0.00	0.33	0.00	0.00	0.00	7.17	17.26	3.58	9.45	5.21	6.19	6.51	5.21	4.56	6.84
Glu(E)	0.65	0.00	0.65	0.00	0.65	0.65	0.33	0.00	0.65	0.00	6.19	16.94	4.56	5.86	8.14	8.14	6.51	5.54	6.19	5.54
Phe(F)	4.56	7.49	7.17	14.33	1.95	7.17	2.93	0.98	11.40	0.00	0.98	0.98	3.58	1.30	1.95	1.95	4.89	3.26	1.95	2.61
Gly(G)	6.51	3.91	14.98	6.84	4.23	17.26	5.21	0.98	0.98	2.93	6.19	6.51	7.49	6.51	5.54	8.14	6.51	12.38	10.42	6.84
His(H)	0.00	0.00	0.33	0.65	0.00	1.63	0.65	0.33	11.40	0.33	0.98	0.33	0.98	0.98	1.63	2.61	1.95	0.98	1.30	0.65
Ile(I)	4.89	4.89	2.28	7.17	2.61	0.33	1.95	1.30	1.95	0.00	0.33	2.93	4.56	5.21	6.51	4.56	6.51	6.19	6.19	5.21
Lys(K)	0.00	0.33	0.00	0.33	0.00	0.33	0.65	0.00	0.98	0.00	2.93	1.63	6.19	3.58	2.93	8.14	4.23	7.17	6.51	10.75
Leu(L)	26.71	30.29	28.01	19.54	2.93	9.45	3.58	5.86	17.59	0.33	3.26	1.63	8.14	7.82	6.84	5.21	4.89	7.17	5.54	4.89
Met(M)	3.26	3.58	3.58	5.21	3.91	3.91	1.30	0.00	6.19	0.00	0.00	0.00	1.30	0.98	1.30	0.98	3.26	0.98	1.30	1.63
Asn(N)	0.65	0.65	0.00	0.98	0.98	3.26	4.56	0.33	4.56	0.33	3.58	5.86	5.21	6.19	9.45	6.19	4.23	3.91	8.47	4.89
Pro(P)	0.98	0.98	0.33	1.30	6.51	5.21	16.61	0.00	0.33	0.00	0.00	10.75	7.82	7.17	7.82	8.14	4.56	3.58	6.51	2.61
Gln(Q)	0.98	1.30	0.33	0.33	0.33	3.91	5.54	0.65	14.33	1.30	12.05	4.89	7.49	3.58	4.56	3.26	6.19	7.82	5.21	4.23
Arg(R)	0.00	0.65	0.65	0.33	0.00	0.98	0.65	0.98	0.98	0.00	0.65	0.33	0.98	2.28	0.65	2.93	3.58	1.95	0.98	1.95
Ser(S)	11.73	7.82	7.49	12.05	33.22	14.33	24.10	9.12	5.54	1.30	4.23	5.54	5.21	5.86	5.86	4.23	4.56	5.21	7.82	8.79
Thr(T)	4.89	4.23	5.86	4.89	5.86	8.47	6.84	4.56	3.91	0.33	3.91	10.75	11.07	13.03	6.19	9.77	6.84	7.49	7.49	6.84
Val(V)	7.82	7.49	6.84	6.19	4.23	4.56	4.56	12.38	5.86	0.00	3.26	5.86	9.77	6.51	9.45	6.84	10.10	6.84	6.19	8.47
Trp(W)	1.30	0.33	0.65	0.98	0.33	0.65	0.00	0.00	2.28	0.00	0.65	1.63	0.65	1.95	0.33	0.98	1.63	1.30	1.30	1.30
Tyr(Y)	0.33	0.33	0.00	1.30	0.33	0.00	2.93	0.00	4.89	0.00	1.95	0.33	1.95	3.58	3.58	2.28	3.58	3.58	3.91	2.61
Charged	**0.98**	**1.30**	**1.95**	**1.30**	**0.65**	**3.58**	**2.61**	**1.30**	14.01	**0.33**	17.92	36.48	16.29	22.15	18.57	28.01	22.80	20.85	19.54	25.73
Small	40.72	35.18	39.41	35.83	**68.08**	48.53	45.93	**71.99**	12.70	**97.39**	**52.12**	17.92	20.85	20.52	22.80	21.17	20.52	26.06	25.73	27.04
Aliphatic	**61.89**	**66.12**	**54.07**	49.84	40.39	31.27	26.71	**81.43**	31.60	**93.49**	48.53	16.29	30.62	27.69	34.20	25.41	30.94	28.66	25.41	29.97
Hydrophobic	45.28	48.53	37.79	**52.44**	**50.16**	39.09	44.63	**76.55**	35.18	**93.16**	49.84	29.64	42.02	34.85	41.69	40.39	44.63	37.79	37.46	43.97
Polar un-charged	27.04	20.20	32.25	27.04	46.25	48.21	49.84	16.29	34.20	**6.19**	31.92	33.88	39.74	38.76	35.83	34.53	31.92	41.37	43.97	36.16