Supplementary Tables

Supplementary Table 1. Biosynthetic cost of amino acids in bacteria (B20), yeasts (Y20), and human (H11) and rank-based decay rate.

Amino acids	abbreviation	Decay rate*	b20	y20	h11	B20	Y20	H11
NEAAs								
Alanine	Ala, A	1	11.7	14.5	12.5	11.7	14.5	12.5
Arginine	Arg, R	4	27.3	20.5	14.5	109.2	82.0	58.0
Asparagine	Asn, N	10	14.7	18.5	16.5	147.0	185.0	165.0
Aspartate	Asp, D	9	12.7	15.5	13.5	114.3	139.5	121.5
Cysteine	Cys, C	30	24.7	26.5	11.0	741.0	795.0	330.0
Glutamate	Glu, E	5	15.3	9.5	8.5	76.5	47.5	42.5
Glutamine	Gln, Q	8	16.3	10.5	9.5	130.4	84.0	76.0
Glycine	Gly, G	1	11.7	14.5	11.0	11.7	14.5	11.0
Proline	Pro, P	3	20.3	14.5	14.5	60.9	43.5	43.5
Serine	Ser, S	6	11.7	14.5	11.0	70.2	87.0	66.0
Tyrosine	Tyr, Y	7	50.0	59.0	2.5	350.0	413.0	17.5
EAAs								
Histidine	His, H	14	38.3	29.0	-	536.2	406.0	-
Isoleucine	Ile, I	2	32.3	38.0	-	64.6	76.0	-
Leucine	Leu, L	2	27.3	37.0	-	54.6	74.0	-
Lysine	Lys, K	8	30.3	36.0	-	242.4	288.0	-
Methionine	Met, M	13	34.3	36.5	-	445.9	474.5	-
Phenylalanine	Phe, F	4	52.0	61.0	-	208.0	244.0	-
Threonine	Thr, T	6	18.7	21.5	-	112.2	129.0	-
Tryptophan	Trp, W	12	74.3	75.5	-	891.6	906.0	-
Valine	Val, V	2	23.3	29.0	-	46.6	58.0	-

*the AA decay rate is taken from Krick *et al.,* 2014.

The b20, y20, and h11 metric are the energy cost in the biosynthesis process, and the B20, Y20, and H11 metric are the biosynthetic cost normalized by AA decay rates.

Supplementary Table 2. Correlation between the biosynthetic cost and the experimentally quantified abundance of AAs that are hydrolyzed from proteins or free in animal tissues.

Source of AAs	Study	B20				Y20				H11			
		# of AAs	*r*	*P* value	*P′*	# of AAs	*r*	*P* value	*P′*	# of AAs	*r*	*P* value	*P′*
Hydrolyzed from proteins	Rat (Wu et al., 2013)	20	-0.91	3.46E-08	0	20	-0.92	7.92E-09	0	11	-0.63	0.037	0.0169
	Sheep (Wu et al., 2013)	20	-0.91	3.08E-08	0	20	-0.92	7.42E-09	0	11	-0.64	0.036	0.0169
	Pig (Wu et al., 2013)	20	-0.91	3.12E-08	0	20	-0.92	6.32E-09	0	11	-0.65	0.031	0.0145
	Chicken (Wu et al., 2013)	20	-0.91	3.62E-08	0	20	-0.92	9.23E-09	0	11	-0.63	0.038	0.0175
Free AAs in human tissues	Human liver, female (Blekhman et al., 2014)	20	-0.74	1.96E-04	0.0001	20	-0.73	2.33E-04	0	11	-0.78	0.005	0.0021
	Human liver, male (Blekhman et al., 2014)	20	-0.78	5.43E-05	0.0001	20	-0.79	4.07E-05	0	11	-0.80	0.003	0.0019
	Chimp liver, female (Blekhman et al., 2014)	20	-0.74	1.96E-04	0	20	-0.73	2.33E-04	0	11	-0.78	0.005	0.0021
	Chimp liver, male (Blekhman, et al., 2014)	20	-0.78	4.22E-05	0.0001	20	-0.78	4.18E-05	0	11	-0.72	0.012	0.0049
	Rhesus liver, female (Blekhman, et al., 2014)	20	-0.74	1.79E-04	0	20	-0.76	1.03E-04	0	11	-0.75	0.008	0.003