

Table 1: Structure parameters of metabolic networks of different organisms.

Full name	Abbreviation	Number of metabolites				Average path length		OCCI
		whole	GSC	substrate	product	whole	GSC	
<i>Homo sapiens</i>	hsa	861	245	86	130	11.3	11	0.0932
<i>Mus musculus</i>	mmu	690	51	53	32	7.34	6.61	0.1766
<i>Rattus norvegicus</i>	rno	664	74	85	8	11	10.5	0.1070
<i>Drosophila melanogaster</i>	dme	638	138	56	132	9.41	7.62	0.1481
<i>Caenorhabditis elegans</i>	cel	645	210	55	82	10.9	10.7	0.1167
<i>Arabidopsis thaliana</i>	ath	535	33	9	143	7.33	4.36	
<i>Saccharomyces cerevisiae</i>	sce	679	206	54	164	9.71	8.58	0.1311
<i>Escherichia coli</i>	eco	811	274	93	161	8.2	7.45	0.1707
<i>Salmonella typhi</i>	sty	775	256	89	163	8.36	7.36	0.1756
<i>Salmonella typhimurium</i>	stm	789	268	90	164	8.22	7.39	0.1772
<i>Yersinia pestis</i>	ype	740	218	95	175	8.15	7.11	0.1747
<i>Haemophilus influenzae</i>	hin	529	139	45	120	8.35	6.91	0.1856
<i>Pasteurella multocida</i>	pmu	566	151	37	147	7.81	6.91	0.1673
<i>Xylella fastidiosa</i>	xfa	517	109	31	130	8.04	7.03	0.1753
<i>Vibrio cholerae</i>	vch	679	199	59	172	7.64	6.4	0.2030
<i>Pseudomonas aeruginosa</i>	pae	733	216	71	142	8.24	6.95	0.1832
<i>Buchnera sp. APS</i>	buc	337	48	7	83	7.55	6.27	0.1640
<i>Neisseria meningitidis</i>	nme	515	128	22	127	7.94	7.07	0.1885
<i>Ralstonia solanacearum</i>	rso	800	250	81	141	9.01	8.37	0.1423
<i>Helicobacter pylori</i>	hpy	447	53	13	120	6.42	4.85	0.2231
<i>Campylobacter jejuni</i>	cje	440	100	8	104	7.98	7.22	0.1480
<i>Rickettsia prowazekii</i>	rpr	277	33	2	14	5.74	6.64	
<i>Rickettsia conorii</i>	rco	299	35	2	14	5.73	6.62	
<i>Mesorhizobium loti</i>	mlo	809	219	68	190	7.72	6.6	0.1838
<i>Sinorhizobium meliloti</i>	sme	846	229	85	173	8.09	6.72	0.1838
<i>Agrobacterium tumefaciens</i>	atu	782	205	77	184	7.91	6.82	0.1788
<i>Brucella melitensis</i>	bme	765	236	56	189	8.21	7.14	0.1756
<i>Caulobacter crescentus</i>	ccr	680	183	51	159	7.86	6.76	0.2038
<i>Bacillus subtilis</i>	bsu	734	198	78	160	7.95	7.06	0.1907
<i>Bacillus halodurans</i>	bha	705	191	77	149	7.74	6.7	0.1945
<i>Staphylococcus aureus</i>	sau	600	174	54	139	7.88	6.95	0.1664
<i>Listeria monocytogenes</i>	lmo	532	158	39	147	8.04	7.15	0.1819
<i>Listeria innocua</i>	lin	513	137	38	152	8.17	7.23	0.1346
<i>Lactococcus lactis</i>	lla	499	120	33	138	7.16	6.44	0.1764
<i>Streptococcus pyogenes</i>	spy	401	67	27	94	6.56	5.2	0.2161
<i>Streptococcus pneumoniae</i>	spn	486	87	42	151	7.73	5.9	0.2242
<i>Clostridium acetobutylicum</i>	cac	547	140	40	138	7.68	6.91	0.1907
<i>Clostridium perfringens</i>	cpe	565	80	47	140	7.42	5.49	0.2082
<i>Mycoplasma genitalium</i>	mge	148	25	2	27	4.43	3.54	
<i>Mycoplasma pneumoniae</i>	mpn	162	28	1	28	4.55	3.74	
<i>Mycoplasma pulmonis</i>	mpu	163	30	6	36	4.75	3.71	
<i>Mycobacterium tuberculosis</i>	mtu	691	177	39	167	7.66	6.57	0.2002
<i>Mycobacterium leprae</i>	mle	554	157	12	133	8.22	7.44	0.1389

<i>Fusobacterium nucleatum</i>	fnu	479	79	34	91	6.24	5.44	0.1798
<i>Chlamydia trachomatis</i>	ctr	266	27	9	58	6.23	3.4	
<i>Chlamydia muridarum</i>	cmu	251	25	9	62	6.38	3.39	
<i>Chlamydomydia pneumoniae</i>	cpn	276	25	9	57	6.2	3.39	
<i>Treponema pallidum</i>	tpa	230	36	7	31	4.99	4.07	
<i>Synechocystis sp. PCC6803</i>	syn	587	133	25	129	7.79	6.75	0.1896
<i>Anabaena sp. PCC7120</i>	ana	598	135	24	127	7.54	6.84	0.1762
<i>Deinococcus radiodurans</i>	dra	594	127	34	113	7.72	6.88	0.1275
<i>Aquifex aeolicus</i>	aae	486	94	10	107	7.2	6.38	0.1902
<i>Thermotoga maritima</i>	tma	481	99	45	120	7.54	6.53	0.1892
<i>Methanococcus jannaschii</i>	mja	361	91	15	52	10.2	9.96	0.0720
<i>Methanobacterium thermoautotrophicum</i>	mth	386	69	20	78	9.87	8.67	0.0654
<i>Archaeoglobus fulgidus</i>	afu	457	115	26	50	8.13	7.41	0.1190
<i>Halobacterium sp. NRC-1</i>	hal	422	114	31	50	7.58	6.58	0.1794
<i>Thermoplasma acidophilum</i>	tac	452	126	30	22	8.76	8.7	0.1111
<i>Thermoplasma volcanium</i>	tvo	461	128	30	22	9.12	9.17	0.1013
<i>Pyrococcus abyssi</i>	pab	386	46	29	66	8.43	6.96	0.1283
<i>Pyrococcus furiosus</i>	pfu	416	94	32	60	10.5	10.2	0.0793
<i>Aeropyrum pernix</i>	ape	427	124	31	42	8.16	7.51	0.1374
<i>Sulfolobus solfataricus</i>	sso	556	117	57	41	8.37	7.58	0.1506
<i>Sulfolobus tokodaii</i>	sto	496	114	53	45	8.87	8.19	0.1242
<i>Pyrobaculum aerophilum</i>	pai	475	128	29	49	7.78	7.29	0.1680

Table 2: List of Currency metabolites considered in this paper

Metabolites	Situation in which the metabolite is regarded as a currency metabolite
H ₂ O	always
CO ₂	always
H ₂ CO ₃	always
O ₂	always
H ₂ O ₂	always
NH ₃	always
Nitrite	always
Nitrate	always
Nitric oxide	always
H ₂ S	always
Sulfite	always
Sulfate	always
H ⁺	always
H ₂	always
Phosphate	always
Pyrophosphate	always
CoA	Except reactions in CoA synthesis pathway
NTP/NDP	As carrier for phosphate group transfer
NTP/NMP	As carrier for phosphate group transfer
NAD(P)H/NAD(P) ⁺	As carrier for hydrogen transfer
FADH/FAD ⁺	As carrier for hydrogen transfer
Ferrocyanochrome/Ferricyanochrome	As carrier for hydrogen transfer
Reduced ferredoxin/Oxidized ferredoxin	As carrier for hydrogen transfer
Glutathione/Oxidized glutathione	As carrier for hydrogen transfer
Dihydrobiopterin/Tetrahydrobiopterin	As carrier for hydrogen transfer
Glutamate/Oxoglutarate	As carrier for amino group transfer
Glutamine/Glutamate	As carrier for amino group transfer
Pyruvate/Alanine	As carrier for amino group transfer
5,10-Methenyl-THF, 5,10-Methylene-THF /THF	As carrier for one carbon unit transfer
10-Formyl-THF, 5-Formyl-THF /THF	As carrier for one carbon unit transfer
5-Formimino-THF, 5-Methyl-THF /THF	As carrier for one carbon unit transfer
S-Adenosyl-L-methionine/S-Adenosyl-L-homocysteine	As carrier for methyl group transfer
Adenosine 3',5'-bisphosphate/3'-Phosphoadenylyl sulfate	As carrier for sulfate group transfer

Table 3: A list of Metabolite abbreviations

Abbreviation	Full name
2KD6PG	2-Dehydro-3-deoxy-6-phospho-D-gluconate
2PG	Glycerate 2-phosphate
3PG	Glycerate 3-phosphate
AcCoA	Acetyl-CoA
ACD	Acetaldehyde
ACLAC	2-Acetolactate
ACON	cis-Aconitate
ACP	Acetyl phosphate
AKG	2-Oxoglutarate
AN	Anthranilate
ARGSUC	L-Argininosuccinate
ASP	L-Aspartate
ASPSA	Aspartate semialdehyde
bF6P	beta-D-Fructose 6-phosphate
bFDP	beta-D-Fructose 1,6-biphosphate
bG6P	beta-D-Glucose 6-phosphate
CAASP	N-Carbamoyl-ASP
CHOR	Chorismate
CIT	Citrate
CITR	Citrulline
CPHEdORL5P	1-(2-Carboxyphenylamino)-1-deoxy-D-ribulose 5-phosphate
CVPSHK	5-O-(1-Carboxyvinyl)-3-phosphoshikimate
D23PIC	2,3-Dihydrodipicolinate
DAHP	2-Dehydro-3-deoxy-D-arabino-heptonate 7-phosphate
DHOMB	(R)-2,3-Dihydroxy-3-methylbutanoate
DHORO	(S)-Dihydroorotate
dHQT	3-Dehydroquininate
dHSHK	3-Dehydroshikimate
dR5P	2-Deoxy-D-ribose 5-phosphate
E4P	D-Erythrose 4-phosphate
F1P	Fructose 1-phosphate
FUM	Fumarate
G3P	Glyceraldehyde 3-phosphate
G3PP	1,3-Bisphospho-D-glycerate
G6P	D-Glucose 6-phosphate
GL	Glycerol
GL3P	Glycerol 3-phosphate
GLAL	D-Glyceraldehyde
GLN	L-Glutamine
GLU	L-Glutamate
HOAKG	D-4-Hydroxy-2-oxoglutarate
HOMOB	(R)-3-Hydroxy-3-methyl-2-oxobutanoate
ICIT	Isocitrate
IGP	Indoleglycerol phosphate
MAL	Malate
NPRAN	N-(5-Phospho-D-ribosyl)anthranilate
OAA	Oxaloacetate
OMP	Orotidine 5'-phosphate

OROA	Orotate
OXSUC	Oxalosuccinate
PASP	Aspartate phosphate
PEP	Phosphoenolpyruvate
PRPP	5-phospho-alpha-D-ribose 1-diphosphate
PYR	Pyruvate
R5P	Ribose 5-phosphate
RL5P	Riblose 5-phosphate
S7P	D-Sedoheptulose 7-phosphate
SHK	Shikimate
SHK5P	Shikimate 5-phosphate
T3P2	Glycerone phosphate
TBP	D-Tagatose 1,6-bisphosphate
X5P	D-Xylulose 5-phosphate
