Supporting Information to be published online with the following manuscript.

Seasonally-relevant cool temperatures interact with N chemistry to increase microcystins produced in lab cultures of *Microcystis aeruginosa* NIES-843

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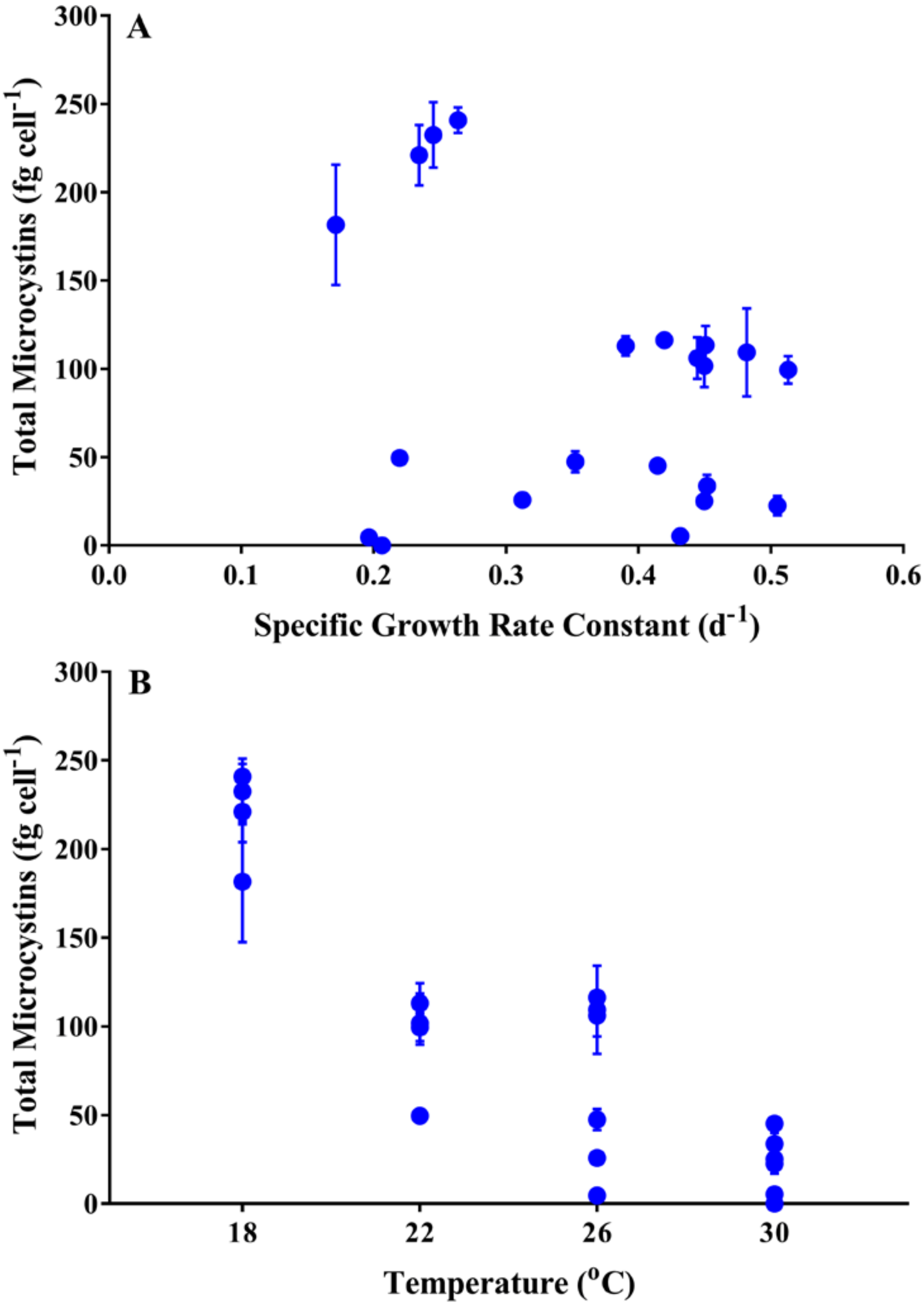

Figure S1. Total microcystins *vs.* A) specific growth rate constant μ (d^{-1}) or B) temperature in *M. aeruginosa* NIES-843. Total microcystins reported as cell quota (fg $cell^{-1}$). Error bars represent one S.E.M.

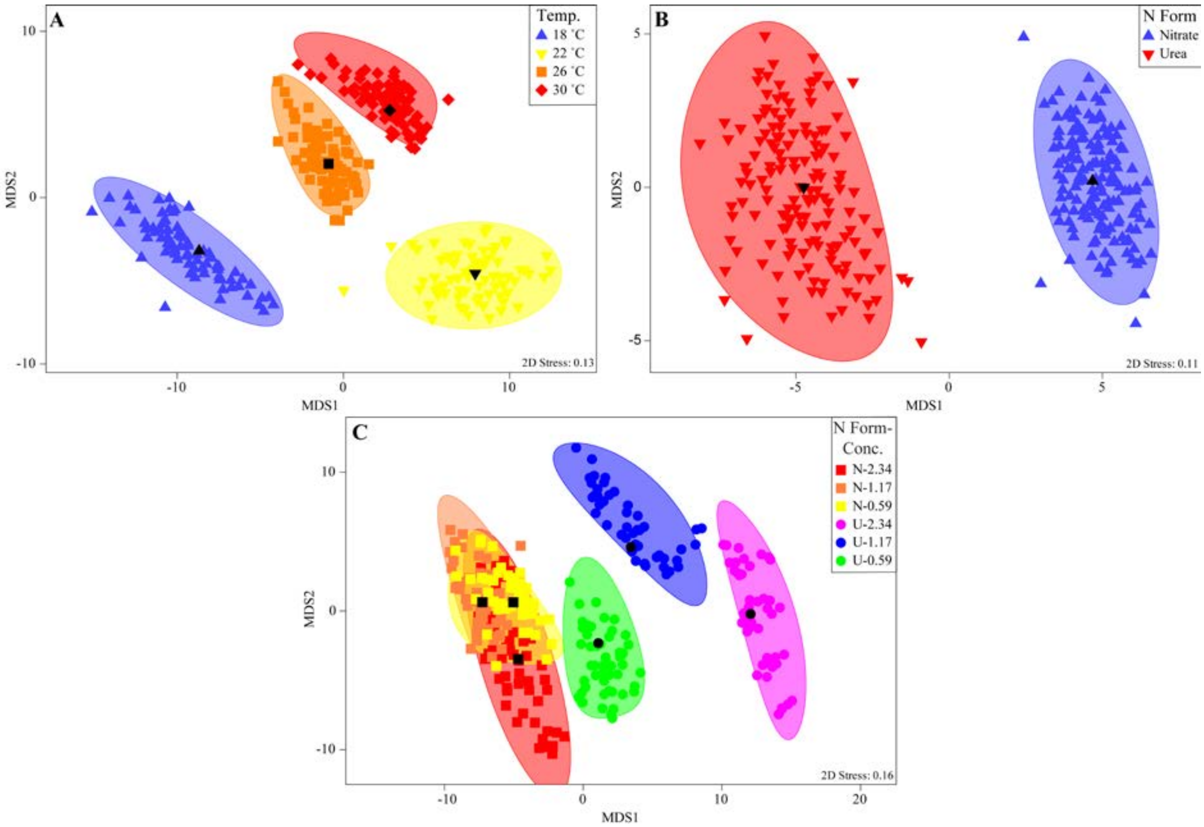

Figure S2. Bootstrapped metric multi-dimensional scaling ordination of temperature (A), N chemistry (B), and N chemistry-concentration groups (C) based on relative abundances of detected metabolites. Bray-Curtis similarity was used in constructing the similarity table after relative abundances were square root transformed. Black symbols represent the bootstrapped centroid. Colored ovals represent the 95% confidence interval of the centroid.

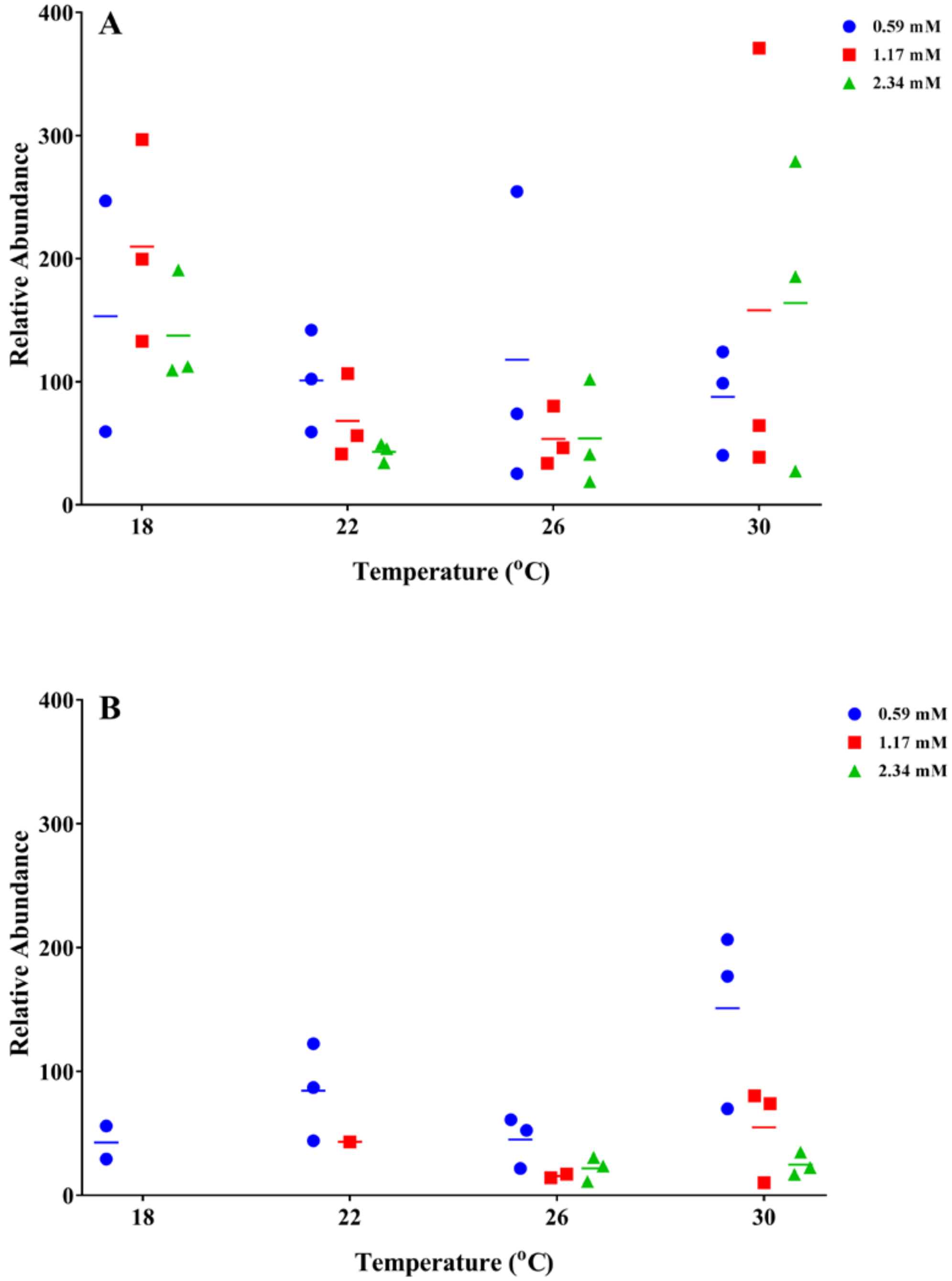

Figure S3. Ratios of glutamate:glutamine in *M. aeruginosa* NIES-843 for cells supplied A) nitrate and B) urea.

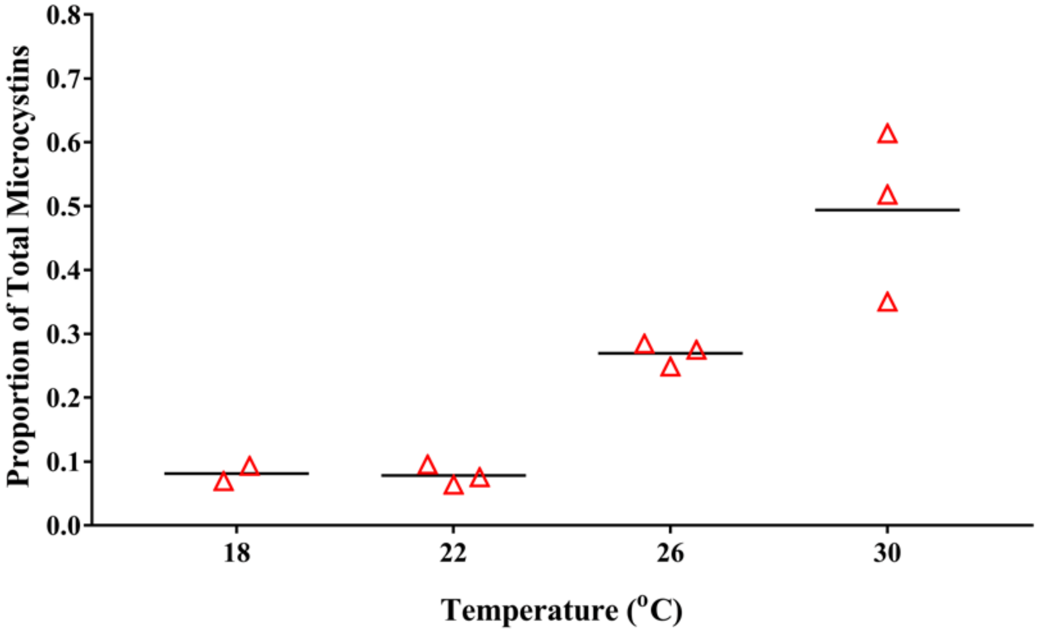

Figure S4. Microcystin-RR as a proportion of total microcystins in cells grown in 0.59 mM urea.

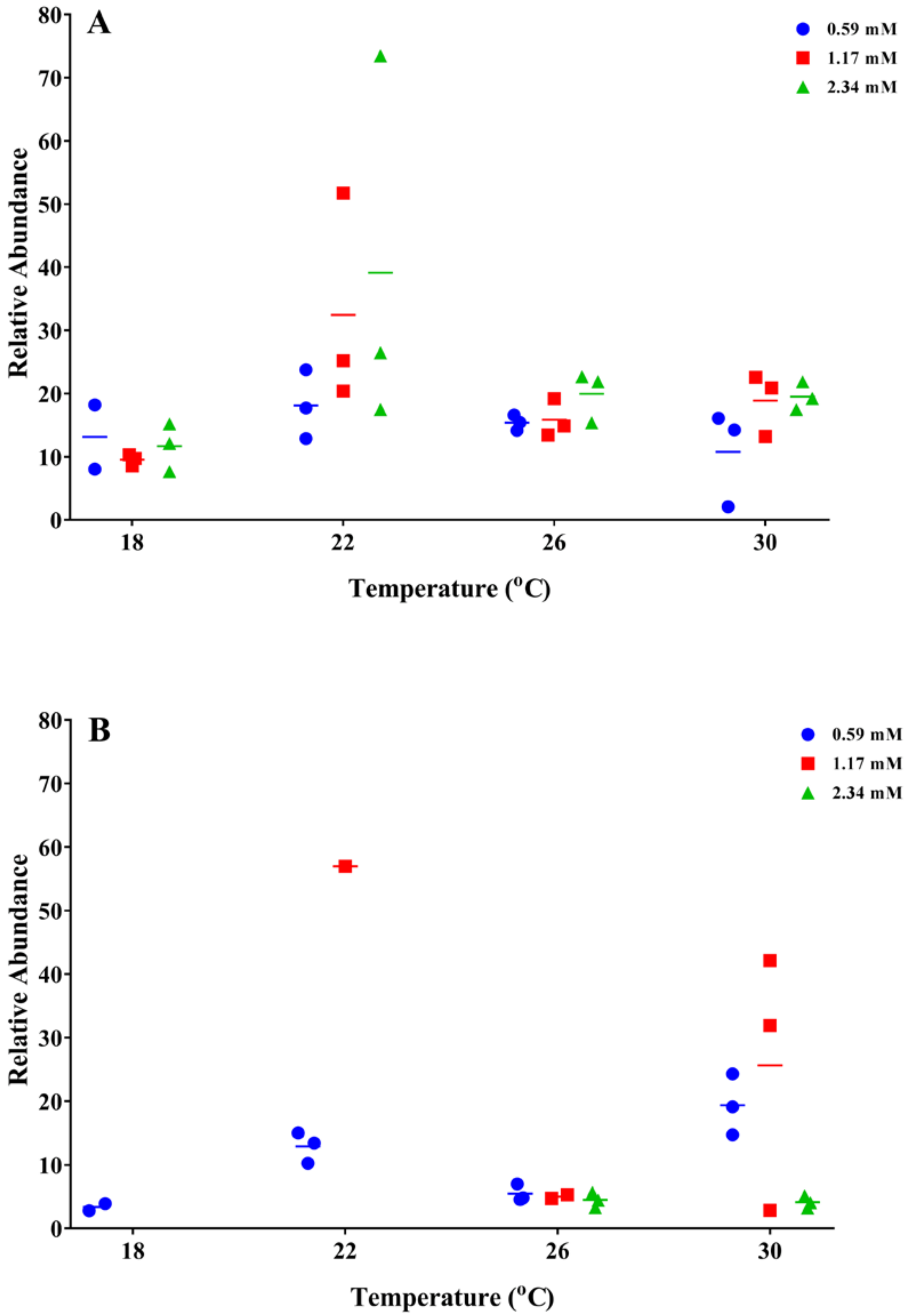

Figure S5. Ratios of leucine:arginine in *M. aeruginosa* NIES-843 for cells supplied A) nitrate and B) urea.

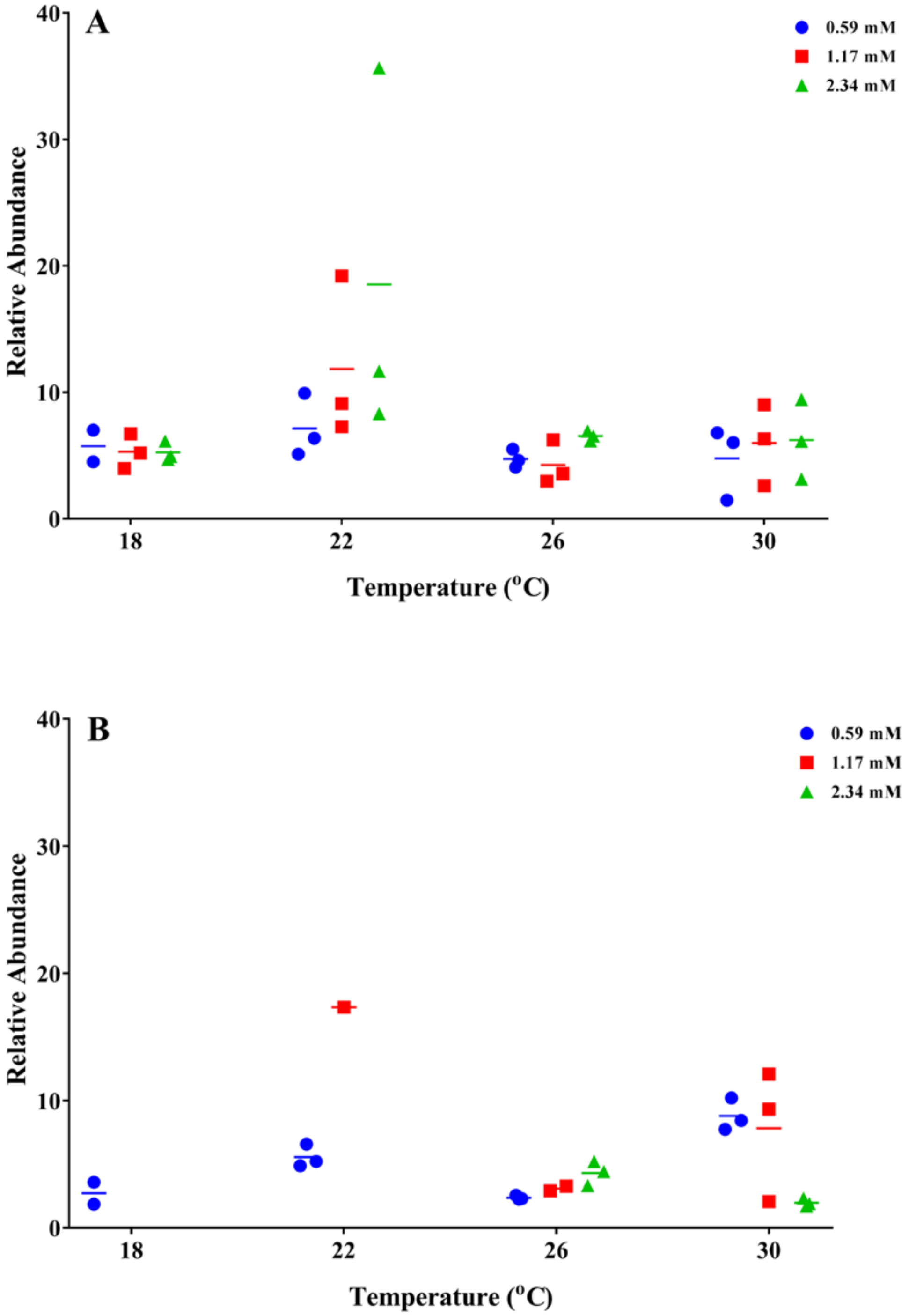

Figure S6. Ratios of tyrosine:arginine in *M. aeruginosa* NIES-843 for cells supplied A) nitrate and B) urea..

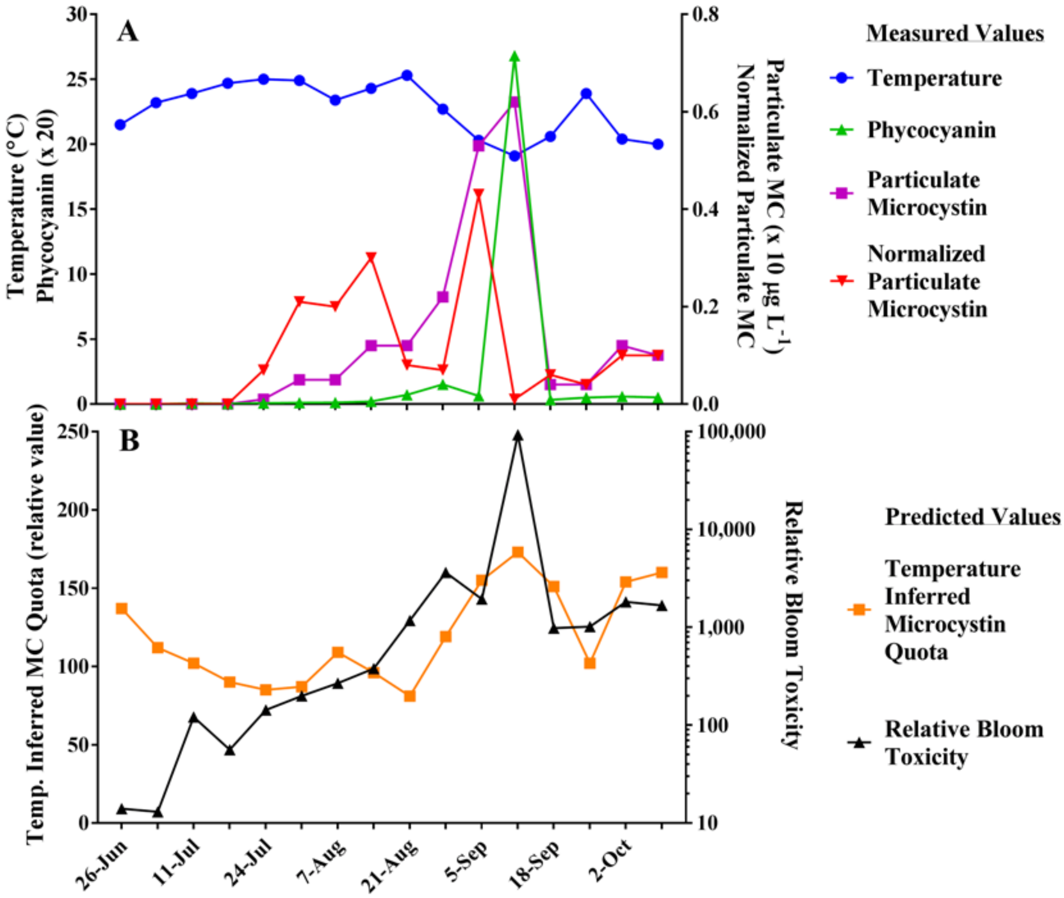

Figure S7. Temperature inferred changes to microcystin quota *vs.* normalized particulate microcystin from 2017 Lake Erie *Microcystis* bloom. (A) 2017 data from the Great Lakes Environmental Research Laboratory Station WE12 in the western basin of Lake Erie. Normalized particulate microcystin is a derived parameter and is the quotient of measured particulate microcystin and measured phycocyanin. Units of phycocyanin were not provided in the data. (B) Temperature inferred microcystin quota as a function of temperature based on linear regression of the experimental data produced in this study. See SI Figure S1. This parameter indicates expected relative change in microcystin quota if bloom responds to temperature in a manner similar to lab observations in this study. Relative bloom toxicity is a derived parameter and is the product of temperature inferred microcystin quota and measured phycocyanin.

Table S1. Summary of literature investigating the effects of temperature on microcystin (MC) production or on *mcy* gene expression. Only studies that compared effects of two or more temperatures are included.

Strain	Temperatures tested (°C)	Affect on MC quota, *mcy* expression, or congener profile	Reference
Microcystis aeruginosa NRC-1	25, 28, 32.5	Peak toxicity[1] at 25°C dropping 3-fold at 28°C and almost non-toxic at 32.5°C.	Gorham 1964.[1]
M. aeruginosa UV-006	16, 20, 24, 28, 32, 36	Toxicity[1] highest at 20°C; toxicity notably reduced at 32°C, 36°C.	Van der Westhuizen and Eloff 1985.[2]
M. aeruginosa M228	18, 25, 30	Toxicity[1] slightly highest at 18°C, lowest at 30°C.	Watanabe and Oishi 1985.[3]
M. aeruginosa UV-006	16, 20, 28, 36	Toxicity[1] highest at 20°C, but concentration of "toxic peptides" highest at 28°C. Toxic peptide composition shifted with temperature.	Van der Westhuizen et al. 1986.[4]
M. aeruginosa 7813	10, 25, 34	Toxicity[1] highest at 25°C, dropped ~5- & 4-fold at 10° and 34°C, respectively.	Cood and Poon 1998.[5]
Oscillatoria agardhii 97 & CYA 128	15, 20, 25, 30	MC quota in CYA 128 was near equal at 15°, 20°, 25°C; ~3x lower at 30°. Quota in strain 97 highest at 25° and ~4x lower at 30°C; quota intermediate at 15° and 20°C.	Sivonen 1990.[6]
Anabaena sp. 90 and 202A1	12.5, 20, 25, 30	MC quota highest at 25°C in both strains, lowest at 30°C. Proportion of MCRR increased while MCLR decreased with temperature.	Rapala et al. 1997.[7]
Anabaena sp. 90 & 202A1	10, 13, 16, 19, 21, 23, 25, 28	Total MC quota highest at 25°C, lowest at 10°C, and declined notably from 25° to 28°C.	Rapala and Sivonen 1998.[8]
Enrichment culture of natural *M. aeruginosa* bloom	20, 28	Total MC quota not influenced by temperature. MCRR:MCLR increased at 20°C but constant at 28°C.	Ame and Wunderlin 2005.[9]
M. aeruginosa NIER10039	20, 25, 30	*mcyB* copies ~2x higher at 25°C compared to 20°C; copies dramatically reduced at 30°C. MC content not reported.	Kim et al. 2005.[10]
M. aeruginosa Lake Dianchi, China strain	23, 32	Temperature had no effect on MC quota in initial screening of variables using Plackett-Burmann design.	Jiang et al. 2008.[11]
M. aeruginosa PCC7806; *Anabaena* 90	20, 30	MCLR quota decreased ~2x at 30°C in *M. aeruginosa* but unchanged in *Anabaena*. MCRR increased slightly at 30°C in *Anabaena*.	Tonk et al. 2009.[12]
M. aeruginosa HUB W333	20, 26, 32	MCLR congener increased with temperature in xenic and axenic cultures; decreased in co-culture with non-toxic strain of *M. aeruginosa*[2].	Dziallas and Grossart 2011.[13]

M. aeruginosa MASH-01A19	15, 26, 30	MC quota decreased with increasing temperature. Temperature did not affect MC production coefficient. MC quota and growth rate not correlated at 15°C.	Jähnichen, et al. 2011. [14]
Mixed-species cyanobacterial mats from Artic and Antarctic	4, 8, 16, 23	Increased MC production at 8° and 16°C.	Kleinteich et al. 2012. [15]
Four species of *Microcystis* including *M. aeruginosa*. All were tropical strains	27, 30, 33, 36	In *M. aeruginosa*, MC quota decreased with increasing temperature at day 28; stable at 27°, 30°, and 33° and dropped at 36 °C at day 20. MC quota increased with temperature in some species.	Mowe, et al. 2015. [16]
M. aeruginosa CAAT-2005-3	23, 26, 29	MC quota declined with time at all temperatures, but decreased more rapidly at 29°C. MCLR proportion increased with time at 29° and decreased with time at 26°C.	Giannuzzi, et al. 2016 [17]
M. aeruginosa SAG14.85	20, 30	*mcyB* expression increased 1.7x at 30°C relative to 20°C, *mcyD* 1.3x but not significant. MC quota not measured.	Scherer, et al. 2017 [18]
M. aeruginosa CAAT-2005-3	26, 28, 30, 35	MC quota at end of log phase was ~2.5x higher (~75 fg/cell) at 26°C compared to 28°, 30°, or 35°C.	Melina Celeste, et al. 2017 [19]

[1]Toxicity (LD_{50}) of whole cell extracts, and not microcystin (MC) specifically, measured via mouse bioassay.

[2]Methodology makes reported MC quota difficult to interpret. Results suggest MC quota of those cells identified as "toxin producing" increased with temperature, while MC quota calculated based on total cells in culture changed little or declined with temperature.

[3]Cells were grown to late exponential phase at 26 °C, subjected to temperature treatments over time, and MC quota monitored from start of treatment.

Table S2. PCR primers used in this study.

Primers for RT-qPCR in this studyPrimer	Nucleotide sequence (5'to3')	Amplification size (bp)	Reference
mcyB F	CCTACCGAGCGCTTGGG	78	This study
mcyB R	AAAATCTCCTAAAGATTCCTGAGT		
mcyD F	ACCCGGAACGGTCATAAATTGG	80	
mcyD R	CGGCTAATCTCTCCAAAACATTGC		
ureC F	CAGACTGACCGGGGAAACGGG	204	This study
ureC R	GCGATTAAACCGCCTTTCAGGACA		

Table S3. Results of one-way ANOVAs testing effects of temperature on growth rate and microcystin quota.

			Growth Rate			Microcystin Quota		
Form	Conc. (mM N)	Temp. (°C)	Mean Growth Rate (day^{-1})	SE	Significance* (p < 0.05)	Mean Total MC (fg $cell^{-1}$)	SE	Significance* (p < 0.05)
nitrate	0.59	18	0.26	0.004	a	240.8	7.185	a
		22	0.51	0.003	b	99.41	7.782	b
		26	0.48	0.009	c	109.3	24.86	b
		30	0.41	0.011	d	45.11	2.518	b
nitrate	1.17	18	0.25	0.003	a	232.5	18.49	a
		22	0.45	0.004	b	101.7	12.01	b
		26	0.42	0.005	c	116.3	3.334	b
		30	0.45	0.007	b	33.71	6.197	c
nitrate	2.34	18	0.23	0.011	a	221.1	17.12	a
		22	0.39	0.024	b	113	5.633	b
		26	0.44	0.004	b	106.1	11.72	b
		30	0.45	0.007	b	25.08	1.233	c
urea	0.59	18	0.17	0.010	a	181.6	34.09	a
		22	0.45	0.013	b	113.5	10.96	a
		26	0.35	0.004	c	47.37	5.978	b
		30	0.50	0.007	d	22.46	5.584	b
urea	1.17	18	-	-	-	-	-	-
		22	0.22	0.019	a	49.58	#	a
		26	0.31	0.023	a	25.83	0.58	a
		30	0.43	0.027	b	5.32	#	a
urea	2.34	18	-	-	-	-	-	-
		22	-	-	-	-	-	-
		26	0.20	0.009	a	4.623	4.623	a
		30	0.21	0.030	a	0	0	a

* Means with the same letter are not significantly different. p-values adjusted with Holm Method.
# n=1

Table S4. Results of one-way ANOVAs testing effects of nitrogen concentration on growth rate and microcystin quota.

			Growth Rate			Microcystin Quota		
Form	Temp. (°C)	Conc. (mM N)	Mean Growth Rate (day^{-1})	SE	Significance* ($p < 0.05$)	Mean Total MC (fg $cell^{-1}$)	SE	Significance* ($p < 0.05$)
nitrate	18	0.59	0.26	0.004	a	240.8	7.185	a
		1.17	0.25	0.003	a	232.5	18.49	a
		2.34	0.23	0.011	a	221.1	17.12	a
nitrate	22	0.59	0.51	0.003	a	99.41	7.782	a
		1.17	0.45	0.004	b	101.7	12.01	a
		2.34	0.39	0.024	c	113	5.633	a
nitrate	26	0.59	0.48	0.009	a	109.3	24.86	a
		1.17	0.42	0.005	b	116.3	3.334	a
		2.34	0.44	0.004	c	106.1	11.72	a
nitrate	30	0.59	0.41	0.011	a	45.11	2.518	a
		1.17	0.45	0.008	b	33.71	6.197	a
		2.34	0.45	0.007	b	25.08	1.233	a
urea	18	0.59	0.17	0.010	a	181.6	34.09	a
		1.17	-	-	-	-	-	-
		2.34	-	-	-	-	-	-
urea	22	0.59	0.45	0.013	a	113.5	10.96	a
		1.17	0.22	0.019	b	49.58	#	-
		2.34	-	-	-	-	-	-
urea	26	0.59	0.35	0.004	a	47.37	5.978	a
		1.17	0.31	0.023	a	25.83	0.58	ab
		2.34	0.20	0.009	b	4.623	4.623	b
urea	30	0.59	0.50	0.007	a	22.46	5.584	a
		1.17	0.43	0.027	a	5.32	#	a
		2.34	0.21	0.030	b	0	0	a

* Means with the same letter are not significantly different. p-values adjusted with Holm Method.
\# n=1

Table S5. Results of T-tests testing effects of nitrogen form on growth rate and microcystin quota.

			Growth Rate			Microcystin Quota		
Temp. (°C)	Conc. (mM N)	Form	Mean Growth Rate (day^{-1})	SE	Significance* ($p < 0.05$)	Mean Total MC (fg $cell^{-1}$)	SE	Significance* ($p < 0.05$)
18	0.59	nitrate	0.26	0.004	a	240.8	7.185	a
		urea	0.17	0.010	b	181.6	34.09	a
18	1.17	nitrate	0.25	0.003	a	232.5	18.49	a
		urea	-	-	-	-	-	-
18	2.34	nitrate	0.23	0.011	a	221.1	17.12	a
		urea	-	-	-	-	-	-
22	0.59	nitrate	0.51	0.003	a	99.41	7.782	a
		urea	0.45	0.013	b	113.5	10.96	a
22	1.17	nitrate	0.45	0.004	a	101.1	12.01	a
		urea	0.22	0.019	b	49.58	#	a
22	2.34	nitrate	0.39	0.024	a	113	5.633	a
		urea	-	-	-	-	-	-
26	0.59	nitrate	0.48	0.009	a	109.3	24.86	a
		urea	0.35	0.004	b	47.37	5.978	a
26	1.17	nitrate	0.42	0.005	a	116.3	3.334	a
		urea	0.31	0.022	b	25.83	0.58	b
26	2.34	nitrate	0.44	0.004	a	106.1	11.72	a
		urea	0.20	0.009	b	4.623	4.623	b
30	0.59	nitrate	0.41	0.011	a	45.11	2.518	a
		urea	0.50	0.007	b	22.46	5.584	a
30	1.17	nitrate	0.45	0.008	a	33.71	6.197	a
		urea	0.43	0.027	a	5.32	#	a
30	2.34	nitrate	0.45	0.007	a	25.08	1.233	a
		urea	0.21	0.030	b	0	0	b

* Means with the same letter are not significantly different. p-values adjusted with Holm Method.
# n=1

Table S6. Results of one-way ANOVAs testing effects of temperature on transcript copy number.

			mcyB			*mcyD*			*ureC*		
Form	Conc. (mM N)	Temp. (°C)	Mean Copies ($cell^{-1}$)	SE	Significance* (p < 0.05)	Mean Copies ($cell^{-1}$)	SE	Significance* (p < 0.05)	Mean Copies ($cell^{-1}$)	SE	Significance* (p < 0.05)
nitrate	0.59	18	1,883	544	a	1,807	796	a	2,880	1,715	a
		22	5,907	1,940	a	3,393	1,045	a	16,470	5,354	a
		26	6,209	576	a	3,910	401	a	8,578	1,389	a
		30	8,552	2,007	a	4,939	932	a	9,494	2,103	a
nitrate	1.17	18	15,555	3,646	a	8,884	1,938	a	14,946	1,857	a
		22	5,195	2,640	a	2,636	1,351	a	17,073	9,752	a
		26	6,583	2,890	a	3,423	1,426	a	6,684	5,607	a
		30	3,960	1,512	a	2,348	893	a	3,439	1,336	a
nitrate	2.34	18	8,574	5,500	a	4,220	2,575	a	6,695	6,098	a
		22	6,646	3,669	a	4,724	2,109	a	13,112	8,644	a
		26	11,041	2,826	a	4,312	1,660	a	10,040	4,485	a
		30	4,025	2,519	a	1,932	1,053	a	4,072	2,421	a
urea	0.59	18	24,720	2,517	a	19,992	373	a	33,487	10,090	a
		22	4,010	1,011	bc	3,875	1,089	bc	17,335	4,424	a
		26	12,616	3,293	b	6,080	1,346	b	18,713	6,943	a
		30	1,591	329	c	1,170	176	c	3,451	976	a
urea	1.17	18	-	-	-	-	-	-	-	-	-
		22	9,347	#	a	4,988	#	a	10,919	#	a
		26	12,908	1,240	a	5,249	902	a	16,916	2,494	a
		30	1,868	412	a	1,299	638	a	4,212	570	a
urea	2.34	18	-	-	-	-	-	-	-	-	-
		22	-	-	-	-	-	-	-	-	-
		26	3,616	496	a	1,929	320	a	7,456	1,800	a
		30	4,771	1,141	a	2,834	636	a	6,169	2,472	a

* Means with the same letter are not significantly different. p-values adjusted with Holm Method.
# n=1

Table S7. Results of one-way ANOVAs testing effects of nitrogen concentration on transcript copy number.

Form	Temp. (°C)	Conc. (mM N)	*mcyB* Mean Copies ($cell^{-1}$)	*mcyB* SE	*mcyB* Significance* ($p < 0.05$)	*mcyD* Mean Copies ($cell^{-1}$)	*mcyD* SE	*mcyD* Significance* ($p < 0.05$)	*ureC* Mean Copies ($cell^{-1}$)	*ureC* SE	*ureC* Significance* ($p < 0.05$)
nitrate	18	0.59	1,883	544	a	1,807	796	a	2,880	1,715	a
		1.17	15,555	3,646	a	8,884	1,938	a	14,946	1,857	a
		2.34	8,574	5,500	a	4,220	2,575	a	6,695	6,098	a
nitrate	22	0.59	5,907	1,940	a	3,393	1,045	a	16,470	5,354	a
		1.17	5,195	2,640	a	2,636	1,351	a	17,073	9,752	a
		2.34	6,646	3,669	a	4,724	2,109	a	13,112	8,644	a
nitrate	26	0.59	6,209	576	a	3,910	401	a	8,578	1,389	a
		1.17	6,583	2,890	a	3,423	1,426	a	6,684	5,607	a
		2.34	11,041	2,826	a	4,312	1,660	a	10,040	4,485	a
nitrate	30	0.59	8,552	2,007	a	4,939	932	a	9,494	2,103	a
		1.17	3,960	1,512	a	2,348	893	a	3,439	1,336	a
		2.34	4,025	2,519	a	1,932	1,053	a	4,072	2,421	a
urea	18	0.59	24,720	2,517	a	19,992	373	a	33,487	10,090	a
		1.17	-	-	-	-	-	-	-	-	-
		2.34	-	-	-	-	-	-	-	-	-
urea	22	0.59	4,010	1,011	a	3,875	1,089	a	17,335	4,424	a
		1.17	9,347	#	a	4,988	#	a	10,919	#	a
		2.34	-	-	-	-	-	-	-	-	-
urea	26	0.59	12,616	3,293	a	6,080	1,346	a	18,713	6,943	a
		1.17	12,908	1,240	a	5,249	638	a	16,916	2,494	a
		2.34	3,616	496	a	1,929	320	a	7,456	1,800	a
urea	30	0.59	1,591	329	a	1,170	176	a	3,451	976	a
		1.17	1,868	412	a	1,299	45	a	4,212	570	a
		2.34	4,771	1,141	a	2,834	636	a	6,169	2,472	a

* Means with the same letter are not significantly different. p-values adjusted with Holm Method.
# n=1

Table S8. Results of T-tests testing effects of nitrogen form on transcript copy number.

			mcyB			*mcyD*			*ureC*		
Temp. (°C)	Conc. (mM N)	Form	Mean Copies ($cell^{-1}$)	SE	Significance* ($p < 0.05$)	Mean Copies ($cell^{-1}$)	SE	Significance* ($p < 0.05$)	Mean Copies ($cell^{-1}$)	SE	Significance* ($p < 0.05$)
18	0.59	nitrate	1,883	544	a	1,807	796	a	2,880	1,715	a
		urea	24,720	2,517	b	19,992	373	b	33,487	10,090	a
18	1.17	nitrate	15,555	3,646	a	8,884	1,938	a	14,946	1,857	a
		urea	-	-	-	-	-	-	-	-	-
18	2.34	nitrate	8,574	5,500	a	4,220	2,575	a	6,695	6,098	a
		urea	-	-	-	-	-	-	-	-	-
22	0.59	nitrate	5,907	1,940	a	3,393	1,045	a	16,470	5,354	a
		urea	4,010	1,011	a	3,875	1,089	a	17,335	4,424	a
22	1.17	nitrate	5,195	2,640	a	2,636	1,351	a	17,073	9,752	a
		urea	9,347	#	a	4,988	#	a	10,919	#	a
22	2.34	nitrate	6,646	3,669	a	4,724	2,109	a	13,112	8,644	a
		urea	-	-	-	-	-	-	-	-	-
26	0.59	nitrate	6,209	576	a	3,910	401	a	8,578	1,389	a
		urea	12,616	3,293	a	6,080	1,346	a	18,713	6,943	a
26	1.17	nitrate	6,583	2,890	a	3,423	1,426	a	6,684	5,607	a
		urea	12,908	1,240	a	5,249	638	a	16,916	2,494	a
26	2.34	nitrate	11,041	2,826	a	4,312	1,660	a	10,040	4,485	a
		urea	3,616	496	a	1,929	320	a	4,072	2,421	a
30	0.59	nitrate	8,552	2,007	a	4,939	932	a	9,494	2,103	a
		urea	1,591	329	a	1,170	176	a	3,451	976	a
30	1.17	nitrate	3,960	1,512	a	2,348	893	a	3,439	1,336	a
		urea	1,868	412	a	1,299	45	a	4,212	570	a
30	2.34	nitrate	4,025	2,519	a	1,932	1,053	a	4,072	2,421	a
		urea	4,771	1,141	a	2,834	636	a	6,169	2,472	a

* Means with the same letter are not significantly different. p-values adjusted with Holm Method.
# n=1

Table S9. List of small metabolites different due to treatment.

Metabolite	Source of Difference	FDR Adjusted *p*-value
2-aminoadipate	temperature	0.0013
2-dehydro-D-gluconate	temperature	0.0111
2-hydroxy-2-methylsuccinate	temperature	0.0013
2-isopropylmalate	temperature	0.0013
2-oxo-4-methylthiobutanoate	specific growth rate	0.0013
2-oxo-4-methylthiobutanoate	temperature	0.0013
2-oxoglutaric acid	specific growth rate	0.0114
2-oxoglutaric acid	temperature	0.0089
3-phosphoglycerate	nitrogen form	0.0214
3-phosphoglycerate	specific growth rate	0.0114
3-phosphoserine	nitrogen concentration	0.0156
3-phosphoserine	specific growth rate	0.0493
3-phosphoserine	temperature	0.0157
4-pyridoxate	nitrogen form	0.0022
4-pyridoxate	temperature	0.0045
aconitate	specific growth rate	0.0013
aconitate	temperature	0.0013
ADP	temperature	0.0206
alanine-sarcosine	nitrogen form	0.0037
allantoin	nitrogen form	0.0022
AMP-dGMP	temperature	0.0195
arginine	specific growth rate	0.0111
arginine	temperature	0.0157
aspartate	specific growth rate	0.0022
aspartate	temperature	0.0013
cAMP	temperature	0.0013
citrate-isocitrate	specific growth rate	0.0142
CMP	nitrogen concentration	0.0037
CMP	temperature	0.0108
cysteate	nitrogen concentration	0.0290
cysteate	nitrogen form	0.0022
cysteate	temperature	0.0013
cysteine	specific growth rate	0.0134
cysteine	temperature	0.0158
dihydroorotate	temperature	0.0068
glucosamine phosphate	specific growth rate	0.0437
glucosamine phosphate	temperature	0.0013
glucose-6-phosphate	temperature	0.0031
glutamate	temperature	0.0013
glutamine	temperature	0.0083

glutathione disulfide	temperature	0.0037
glycerate	nitrogen form	0.0206
glycerate	temperature	0.0273
homocysteic acid	nitrogen form	0.0158
homocysteic acid	temperature	0.0013
IMP	nitrogen concentration	0.0022
IMP	specific growth rate	0.0331
IMP	temperature	0.0013
L-methionine	specific growth rate	0.0013
L-argininosuccinate	nitrogen form	0.0389
L-argininosuccinate	specific growth rate	0.0272
L-argininosuccinate	temperature	0.0013
L-methionine	temperature	0.0013
lysine	nitrogen form	0.0234
microcystin-LR	nitrogen form	0.0045
microcystin-LR	temperature	0.0013
N-acetyl-beta-alanine	nitrogen form	0.0013
N-acetyl-beta-alanine	temperature	0.0444
N-acetylglucosamine	temperature	0.0013
N-acetylglucosamine-1,6-phosphate	specific growth rate	0.0013
N-acetylglutamate	specific growth rate	0.0385
N-acetylglutamate	temperature	0.0013
N-carbamoyl-L-aspartate	temperature	0.0022
ophthalmate	temperature	0.0013
orotate	nitrogen form	0.0013
phenylalanine	nitrogen form	0.0469
pyruvate	nitrogen concentration	0.0216
pyruvate	nitrogen form	0.0013
S-adenosyl-L-homocysteine	nitrogen concentration	0.0142
sedoheptulose-1,7-bisphosphate	nitrogen form	0.0013
sn-glycerol-3-phosphate	nitrogen form	0.0013
sn-glycerol-3-phosphate	temperature	0.0346
trehalose-sucrose-cellobiose	nitrogen concentration	0.0434
trehalose-sucrose-cellobiose	nitrogen form	0.0037
trehalose-sucrose-cellobiose	specific growth rate	0.0444
tryptophan	temperature	0.0130
UMP	nitrogen concentration	0.0356
UMP	nitrogen form	0.0061
UMP	temperature	0.0126
xanthine	nitrogen form	0.0434
xanthosine	nitrogen form	0.0103
xylitol-5-phosphate	nitrogen concentration	0.0408
xylitol-5-phosphate	temperature	0.0146

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