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Article

Sexual Dimorphism in Energy Metabolism of Wistar Rats Using Data Analysis

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Table 1. Values of metabolites analyzed in the experiment.

Metabolite (μM)	Female	Male
C0	**17.69 ± 2.431 *****	29.86 ± 4.475
C2	**11.37 ± 1.894 ***	13.01 ± 1.828
C3	**0.5836 ± 0.1106 *****	01.159 ± 0.2450
C3-DC (C4-OH)	**0.06929 ± 0.01176 ****	0.08489 ± 0.01522
C3-OH	**0.008514 ± 0.001295 ***	0.01006 ± 0.0009112
C3:1	0.009329 ± 0.002053	0.0102 ± 0.001154
C4	**0.3979 ± 0.05378 *****	0.5263 ± 0.09839
C4:1	0.01487 ± 0.002644	0.01526 ± 0.001764
C5	**0.1598 ± 0.02957 *****	0.2480 ± 0.04029
C5-DC (C6-OH)	**0.01073 ± 0.0008730 ***	0.01193 ± 0.001342
C5-M-DC	0.02451 ± 0.003700	0.02377 ± 0.001730
C5-OH (C3-DC-M)	**0.03326 ± 0.005317 *****	0.04561 ± 0.004371
C5:1	0.02036 ± 0.001833	0.02173 ± 0.002696
C5:1-DC	0.009457 ± 0.0009395	0.009043 ± 0.001102
C6 (C4:1-DC)	**0.05706 ± 0.006587 *****	0.07064 ± 0.005369
C6:1	**0.02036 ± 0.002069 ****	0.02313 ± 0.002057
C7-DC	0.008143 ± 0.0008751	0.009357 ± 0.001504
C8	**0.06494 ± 0.01176 ***	0.07001 ± 0.007655
C9	0.01111 ± 0.0005960	0.01206 ± 0.001775
C10	0.03496 ± 0.004365	0.03653 ± 0.003538
C10:1	0.05257 ± 0.005530	0.05304 ± 0.01013
C10:2	**0.01919 ± 0.001176 *****	0.02229 ± 0.001755
C12	0.03193 ± 0.002690	0.03333 ± 0.003771
C12-DC	0.04391 ± 0.001279	0.04431 ± 0.002102
C12:1	0.05577 ± 0.006487	0.04981 ± 0.01018
C14	0.04501 ± 0.006896	0.03999 ± 0.004532
C14:1	0.05233 ± 0.005825	0.04761 ± 0.006719

C14:1-OH	0.009529 ± 0.001705	0.008771 ± 0.0009903
C14:2	0.008757 ± 0.001468	0.008486 ± 0.0005586
C14:2-OH	0.007471 ± 0.0008241	0.0068 ± 0.001088
C16	**0.09847 ± 0.01814 ***	0.08574 ± 0.01240
C16-OH	**0.0072 ± 0.0009735 ***	0.006357 ± 0.0008644
C16:1	**0.03349 ± 0.003485 ****	0.02961 ± 0.002455
C16:1-OH	**0.01149 ± 0.001318 ***	0.01003 ± 0.001961
C16:2	0.005786 ± 0.0009404	0.005657 ± 0.0006321
C16:2-OH	0.01043 ± 0.001390	0.01026 ± 0.001503
C18	**0.07547 ± 0.01215 *****	0.05616 ± 0.007502
C18:1	0.1095 ± 0.02569	0.09933 ± 0.01318
C18:1-OH	**0.01391 ± 0.002164 ***	0.0121 ± 0.001870
C18:2	0.02187 ± 0.004628	0.02231 ± 0.003252

Ala	465.7 ± 71.47	421.1 ± 82.94
Arg	157.7 ± 19.25	156.4 ± 26.00
Asn	28.47 ± 3.061	30.80 ± 5.535
Asp	**12.83 ± 2.478 ***	15.94 ± 4.050
Cit	73.44 ± 7.500	69.59 ± 10.53
Gln	**667.4 ± 81.54 ****	561.6 ± 122.3
Glu	81.64 ± 15.76	87.64 ± 11.56
Gly	**519.0 ± 61.26 *****	728.9 ± 111.2
His	53.63 ± 4.078	60.76 ± 9.361
Ile	64.37 ± 8.848	66.70 ± 10.50
Leu	107.0 ± 12.22	117.2 ± 18.41
Lys	481.4 ± 50.77	448.1 ± 89.71
Met	**43.34 ± 4.708 ***	49.86 ± 6.507
Orn	**42.39 ± 5.499 ****	63.20 ± 15.23
Phe	**45.04 ± 5.490 ***	52.04 ± 5.503
Pro	**175.7 ± 20.04 *****	228.7 ± 41.23
Ser	337.3 ± 35.36	358.9 ± 48.96
Thr	230.4 ± 29.50	198.4 ± 50.15
Trp	**80.53 ± 13.92 ****	61.67 ± 14.09
Tyr	**50.24 ± 11.59 *****	72.66 ± 8.965
Val	**124.3 ± 16.32 ***	142.4 ± 22.21

Ac-Orn	0.02914 ± 0.04828	0.05171 ± 0.06201
ADMA	0.5843 ± 0.07151	0.5789 ± 0.07936
alpha-AAA	0.9631 ± 0.2185	1.067 ± 0.1510
c4-OH-Pro	**0.1077 ± 0.07170 ***	0.1477 ± 0.06590
Carnosine	0.1889 ± 0.06601	0.1854 ± 0.1144
Creatinine	17.11 ± 1.754	15.94 ± 1.803
DOPA	0.04057 ± 0.01726	0.04814 ± 0.002742
Dopamine	0.1006 ± 0.006223	0.07414 ± 0.04883
Histamine	0.6670 ± 0.1389	0.5460 ± 0.1507
Kynurenine	**2.363 ± 0.4258 ****	2.736 ± 0.2339
Met-SO	**3.820 ± 0.4884 ****	5.391 ± 1.364
Putrescine	0.5493 ± 0.09430	0.5763 ± 0.1630
Sarcosine	**5.500 ± 0.9958 *****	8.637 ± 1.281
SDMA	**0.2100 ± 0.03215 ****	0.1729 ± 0.01706
Serotonin	0.04986 ± 0.03872	0.04929 ± 0.03820
Spermidine	**2.159 ± 0.3407 *****	3.021 ± 0.5259

Spermine	**0.4237 ± 0.05173 ****	0.5463 ± 0.1290
t4-OH-Pro	**78.29 ± 9.469 ****	101.7 ± 21.77
Taurine	**177.1 ± 34.34 ****	127.6 ± 39.33

Data are expressed as mean ± SD. Significance versus male is by *P < 0.05; **P < 0.01 and ***P < 0.001, respectively.

Table 2. Abbreviations of metabolites analyzed.

BC code	Analyte
Amino acids	
Ala	Alanine
Arg	Arginine
Asn	Asparagine
Asp	Aspartate
Cit	Citrulline
Gln	Glutamine
Glu	Glutamate
Gly	Glycine
His	Histidine
Ile	Isoleucine
Leu	Leucine
Lys	Lysine
Met	Methionine
Orn	Ornithine
Phe	Phenylalanine
Pro	Proline
Ser	Serine
Thr	Threonine
Trp	Tryptophan
Tyr	Tyrosine
Val	Valine
Biogenic Amines	
Ac-Orn	Acetylornithine
ADMA	Asymmetric dimethylarginine
SDMA	Symmetric dimethylarginine
alpha-AAA	alpha-Aminoadipic acid
Histamine	Histamine
Met-SO	Methionine-Sulfoxide
Kyn	Kynurenine
Putrescine	Putrescine
Sarcosine	Sarcosine
Spermidine	Spermidine
Spermine	Spermine
Serotonin	Serotonin
PEA	Phenylethylamine
Nitro-Tyr	Nitrotyrosine
c4-OH-Pro	cis-4-Hydroxyproline
t4-OH-Pro	trans-4-Hydroxyproline
Creatinine	Creatinine
Carnosine	Carnosine
Taurine	Taurine
DOPA	Dihydroxyphenylalanine

Dopamin	Dopamin
Acylcarnitine	
C0	Carnitine (free)
C2	Acetylcarnitine
C3	Propionylcarnitine
C3:1	Propenoylcarnitine
C3-OH	Hydroxypropionylcarnitine
C4	Butyrylcarnitine / Isobutyrylcarnitine
C4:1	Butenoylcarnitine
C4-OH (C3-DC)	Hydroxybutyrylcarnitine (Malonylcarnitine)
C5	Isovalerylcarnitine / 2-Methylbutyrylcarnitine / Valerylcarnitine
C5:1	Tiglylcarnitine / 3-Methyl-crotonylcarnitine
C5:1-DC	Glutaconylcarnitine / Mesaconylcarnitine
C5-DC (C6-OH)	Glutarylcarnitine (Hydroxyhexanoylcarnitine [= Hydroxycaproylcarnitine])
C5-M-DC	Methylglutarylcarnitine
C5-OH (C3-DC-M)	Hydroxyisovalerylcarnitine / Hydroxy-2-methylbutyryl /Hydroxyvalerylcarnitine (Methylmalonylcarnitine)
C6 (C4:1-DC)	Hexanoylcarnitine [= Caproylcarnitine] (Fumarylcarnitine)
C6:1	Hexenoylcarnitine
C7-DC	Pimelylcarnitine
C8	Octanoylcarnitine [= Caprylylcarnitine]
C9	Nonanoylcarnitine [= Pelargonylcarnitine]
C10	Decanoylcarnitine [= Caprylcarnitine]
C10:1	Decenoylcarnitine
C10:2	Decadienoylcarnitine
C12	Dodecanoylcarnitine [= Laurylcarnitine]
C12:1	Dodecenoylcarnitine
C12-DC	Dodecanedioylcarnitine
C14	Tetradecanoylcarnitine [= Myristylcarnitine]
C14:1	Tetradecenoylcarnitine [= Myristoleylcarnitine]
C14:1-OH	Hydroxytetradecenoylcarnitine [= Hydroxymyristoleylcarnitine]
C14:2	Tetradecadienoylcarnitine
C14:2-OH	Hydroxytetradecadienoylcarnitine
C16	Hexadecanoylcarnitine [= Palmitoylcarnitine]
C16:1	Hexadecenoylcarnitine [= Palmitoleylcarnitine]
C16:1-OH	Hydroxyhexadecenoylcarnitine [= Hydroxypalmitoleylcarnitine]
C16:2	Hexadecadienoylcarnitine
C16:2-OH	Hydroxyhexadecadienoylcarnitine
C16-OH	Hydroxyhexadecanolycarnitine [= Hydroxypalmitoylcarnitine]
C18	Octadecanoylcarnitine [= Stearylcarnitine]
C18:1	Octadecenoylcarnitine [= Oleylcarnitine]
C18:1-OH	Hydroxyoctadecenoylcarnitine [= Hydroxyoleylcarnitine]
C18:2	Octadecadienoylcarnitine [= Linoleylcarnitine]