Electronic Supplementary Material (ESI) for RSC Advances.


Table S1 OPLS–DA coefficients and P value derived from the NMR data of plasma metabolites obtained from the (A) control, (B) diquat, (C) glutamine+diquat groups

| Metabolite | OPLS-DA coefficient (r)[a] | | | P value[b] | | |
|---|---|---|---|---|---|---|
| | B (vs A) | C (vs B) | C (vs A) | B (vs A) | C (vs B) | C (vs A) |
| 3,4-Dihydroxymandelate (72) | – | – | –0.603 | >0.05 | >0.05 | <0.05 |
| 3-Hydroxybutyrate (57) | – | – | –0.774 | >0.05 | >0.05 | <0.05 |
| Acetate (12) | – | –0.727 | –0.692 | >0.05 | <0.05 | <0.05 |
| Acetoacetate (16) | – | – | –0.742 | >0.05 | >0.05 | <0.05 |
| Acetone (15) | – | – | –0.762 | >0.05 | >0.05 | <0.05 |
| Citrate (20) | 0.703 | 0.635 | –0.663 | <0.05 | <0.05 | <0.05 |
| Creatine (26) | – | –0.672 | – | >0.05 | <0.05 | >0.05 |
| Formate (51) | – | –0.692 | – | >0.05 | <0.05 | >0.05 |
| Glutamate (63) | 0.736 | –0.685 | –0.759 | <0.05 | <0.05 | <0.05 |
| Isobutyrate (5) | –0.705 | 0.604 | – | <0.05 | <0.05 | >0.05 |
| Isoleucine (54) | – | – | –0.680 | >0.05 | >0.05 | <0.05 |
| LDL (52) | 0.712 | – | –0.630 | <0.05 | >0.05 | <0.05 |
| Leucine (55) | – | –0.733 | – | >0.05 | <0.05 | >0.05 |
| Lipid (triglyceride and fatty acids) | –0.620 | – | –0.836 | <0.05 | >0.05 | <0.05 |

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|---|---|---|---|---|---|---|
| Lysine (60) | 0.681 | – | –0.613 | <0.05 | >0.05 | <0.05 |
| Methylamine (21) | – | – | –0.658 | >0.05 | >0.05 | <0.05 |
| N-Acetyl glycoprotein (61) | – | – | –0.702 | >0.05 | >0.05 | <0.05 |
| O-Acetylglycoprotein (62) | – | –0.685 | –0.848 | >0.05 | <0.05 | <0.05 |
| Phenylalanine (74) | – | –0.616 | –0.759 | >0.05 | <0.05 | <0.05 |
| Pyruvate (17) | – | –0.617 | –0.689 | >0.05 | <0.05 | <0.05 |
| TMAO (33) | 0.647 | – | 0.688 | <0.05 | >0.05 | <0.05 |
| Unsaturated lipid (70) | –0.683 | – | –0.810 | <0.05 | >0.05 | <0.05 |
| Valine (56) | –0.670 | – | –0.661 | <0.05 | >0.05 | <0.05 |
| VLDL (53) | –0.744 | – | –0.880 | <0.05 | >0.05 | <0.05 |
| α-Glucose (40) | 0.736 | –0.765 | 0.706 | <0.05 | <0.05 | <0.05 |
| β-Glucose (39) | 0.689 | –0.731 | 0.777 | <0.05 | <0.05 | <0.05 |

[a]Correlation coefficients were calculated from OPLS-DA results with positive and negative signs indicating positive and negative correlation in the concentrations, respectively. The correlation coefficient of $|r| > 0.602$ was used as the cutoff value. ‘‘–’’ means the correlation coefficient $|r|$ is less than

0.602. [b]Normalized integral of metabolites in the spectrum (normalized to 100). Integrals of the altered metabolites were analyzed statistically using one-way analysis of variance (ANOVA) of SPSS 16.0 software (SPSS Inc., Chicago, IL, USA). Data sets were further analyzed using post hoc tests (least significant difference, LSD) for multiple comparisons to determine the statistical differences between groups. P values are significant at the <0.05 level, and P values are not significant at >0.05.

Table S2 OPLS–DA coefficients and P value derived from the NMR data of urine metabolites obtained from the (A) control, (B) diquat, (C) glutamine+diquat groups

| Metabolite | OPLS-DA coefficient (r)[a] | | | P value[b] | | |
|---|---|---|---|---|---|---|
| | B (vs A) | C (vs B) | C (vs A) | B (vs A) | C (vs B) | C (vs A) |
| 4-Aminohippurate (48) | 0.726 | – | 0.78 | <0.05 | >0.05 | <0.05 |
| Acetamide (13) | 0.626 | – | – | <0.05 | >0.05 | >0.05 |
| Acetate (12) | 0.614 | – | 0.736 | <0.05 | >0.05 | <0.05 |
| Acetoacetate (16) | – | – | 0.672 | >0.05 | >0.05 | <0.05 |
| Alanine (10) | 0.711 | – | 0.686 | <0.05 | >0.05 | <0.05 |
| Allantoin (41) | – | – | –0.714 | >0.05 | >0.05 | <0.05 |
| Benzoate (49) | 0.881 | –0.602 | 0.743 | <0.05 | <0.05 | <0.05 |
| Bile acids (1) | –0.955 | – | –0.776 | <0.05 | >0.05 | <0.05 |
| Citrate (20) | –0.813 | – | –0.642 | <0.05 | >0.05 | <0.05 |
| Citrulline (11) | 0.818 | – | 0.815 | <0.05 | >0.05 | <0.05 |
| Creatine (26) | –0.779 | – | –0.723 | <0.05 | >0.05 | <0.05 |
| Creatinine (27) | 0.643 | – | 0.616 | <0.05 | >0.05 | <0.05 |

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|---|---|---|---|---|---|---|
| Dimethylamine (22) | 0.904 | – | 0.868 | <0.05 | >0.05 | <0.05 |
| Ethanol (6) | 0.672 | – | – | <0.05 | >0.05 | >0.05 |
| Ethanolamine (29) | 0.738 | – | 0.748 | <0.05 | >0.05 | <0.05 |
| Hippurate (37) | 0.93 | – | 0.84 | <0.05 | >0.05 | <0.05 |
| Homogentisate (43) | –0.802 | 0.613 | 0.773 | <0.05 | <0.05 | <0.05 |
| Indoxyl sulfate (46) | 0.898 | – | 0.879 | <0.05 | >0.05 | <0.05 |
| Lactate (9) | 0.612 | – | – | <0.05 | >0.05 | >0.05 |
| Malonate (30) | –0.715 | – | –0.737 | <0.05 | >0.05 | <0.05 |
| Methylamine (21) | 0.848 | – | 0.803 | <0.05 | >0.05 | <0.05 |
| Methylguanidine (23) | 0.844 | – | 0.868 | <0.05 | >0.05 | <0.05 |
| Methylmalonate (7) | 0.795 | – | –0.731 | <0.05 | >0.05 | <0.05 |
| m-Hydroxyphenylacetate (45) | 0.837 | – | 0.844 | <0.05 | >0.05 | <0.05 |
| N-Acetylglutamate (14) | 0.81 | – | 0.745 | <0.05 | >0.05 | <0.05 |
| Nicotinamide (47) | 0.801 | – | 0.737 | <0.05 | >0.05 | <0.05 |
| N-Methylnicotinamide (38) | 0.815 | – | 0.772 | <0.05 | >0.05 | <0.05 |
| Phenylacetyglycine (36) | 0.809 | – | 0.712 | <0.05 | >0.05 | <0.05 |

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|---|---|---|---|---|---|---|
| p-Hydroxyphenylacetate (44) | – | – | 0.647 | >0.05 | >0.05 | <0.05 |
| Propionate (4) | –0.744 | – | –0.624 | <0.05 | >0.05 | <0.05 |
| Succinate (18) | –0.689 | – | – | <0.05 | >0.05 | >0.05 |
| TMAO (33) | – | – | –0.621 | >0.05 | >0.05 | <0.05 |
| Trigonelline (50) | 0.926 | –0.689 | 0.905 | <0.05 | <0.05 | <0.05 |
| α-Hydroxy-iso-valerate (2) | –0.682 | – | – | <0.05 | >0.05 | >0.05 |
| α-Hydroxy-n-valerate (8) | 0.805 | – | 0.658 | <0.05 | >0.05 | <0.05 |
| α-Ketoglutarate (19) | –0.809 | 0.603 | –0.692 | <0.05 | <0.05 | <0.05 |

[a]Correlation coefficients were calculated from OPLS-DA results with positive and negative signs indicating positive and negative correlation in the concentrations, respectively. The correlation coefficient of $|r| > 0.602$ was used as the cutoff value. ‘‘–’’ means the correlation coefficient $|r|$ is less than 0.602. [b]Normalized integral of metabolites in the spectrum (normalized to 100). Integrals of the altered metabolites were analyzed statistically using one-way analysis of variance (ANOVA) of SPSS 16.0 software (SPSS Inc., Chicago, IL, USA). Data sets were further analyzed using post hoc tests (least significant difference, LSD) for multiple comparisons to determine the statistical differences between groups. P values are significant at the <0.05 level, and P values are not significant at >0.05.

**Additional information**

**Table S3. Effects of glutamine on concentrations of amino acids in the plasma of rats under oxidative stress**

| Item | Control | Diquat | Diquat+glutamine |
|---|---|---|---|
| Taurine (μM $L^{-1}$) | 361.29±9.42$^{a}$ | 398.19±12.89$^{b}$ | 387.30±6.79$^{ab}$ |
| Aspartate (μM L-1) | 50.73±3.95$^{a}$ | 79.08±4.79$^{b}$ | 39.58±6.83$^{a}$ |
| Threonine (μM L-1) | 184.68±8.06$^{a}$ | 247.35±14.76$^{b}$ | 220.08±7.29$^{b}$ |
| Serine (μM L-1) | 215.53±7.28$^{a}$ | 297.08±22.79$^{b}$ | 310.86±15.52$^{b}$ |
| Glutamate (μM L-1) | 148.58±4.61$^{a}$ | 240.44±16.44$^{c}$ | 183.60±7.05$^{b}$ |
| Glycine (μM L-1) | 367.90±12.62$^{a}$ | 432.12±13.61$^{b}$ | 354.18±11.61$^{a}$ |
| Alanine (μM L-1) | 517.08±10.83$^{b}$ | 622.01±12.37$^{c}$ | 480.24±6.28$^{a}$ |
| Citrulline (μM L-1) | 71.17±5.11$^{b}$ | 74.03±9.53$^{b}$ | 31.04±4.50$^{a}$ |
| Valine (μM L-1) | 252.16±4.26 | 236.88±5.51 | 233.86±8.79 |
| Cysteine (μM L-1) | 7.30±0.95$^{a}$ | 21.01±0.25$^{c}$ | 14.42±0.74$^{b}$ |
| Methionine (μM L-1) | 88.65±5.69 | 96.49±3.80 | 94.74±5.82 |
| Isoleucine (μM L-1) | 161.79±4.84$^{b}$ | 141.31±4.86$^{a}$ | 133.19±8.06$^{a}$ |
| Leucine (μM L-1) | 204.71±4.29 | 194.51±7.34 | 200.10±6.79 |
| Tyrosine (μM L-1) | 93.26±2.98 | 102.07±11.24 | 98.33±6.22 |
| Phenylalanine (μM L-1) | 100.07±3.96$^{a}$ | 111.89±7.52$^{a}$ | 139.72±4.50$^{b}$ |
| Ornithine (μM L-1) | 80.39±5.16$^{a}$ | 118.54±2.98$^{b}$ | 71.31±5.54$^{a}$ |
| Lysine (μM L-1) | 318.23±5.49$^{a}$ | 365.79±19.54$^{ab}$ | 357.28±9.30$^{b}$ |
| Histidine (μM L-1) | 45.50±2.97$^{a}$ | 72.34±7.62$^{b}$ | 73.73±4.45$^{b}$ |

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|---|---|---|---|
| Arginine (μM L-1) | 172.39±12.22 | 203.53±4.40 | 160.26±20.37 |
| Proline (μM L-1) | 137.08±14.90[a] | 329.22±57.43[ab] | 363.76±24.26[b] |

[a] Data are expressed as mean±SEM for six rats per treatment group. Different superscript letters (a-c) show significant difference ($P < 0.05$) between groups.