Electronic Supplementary Material (ESI) for Environmental Science: Nano.

Supporting information for publication

Biotransformation of graphene oxide nanosheets in blood plasma affects their interactions with cells

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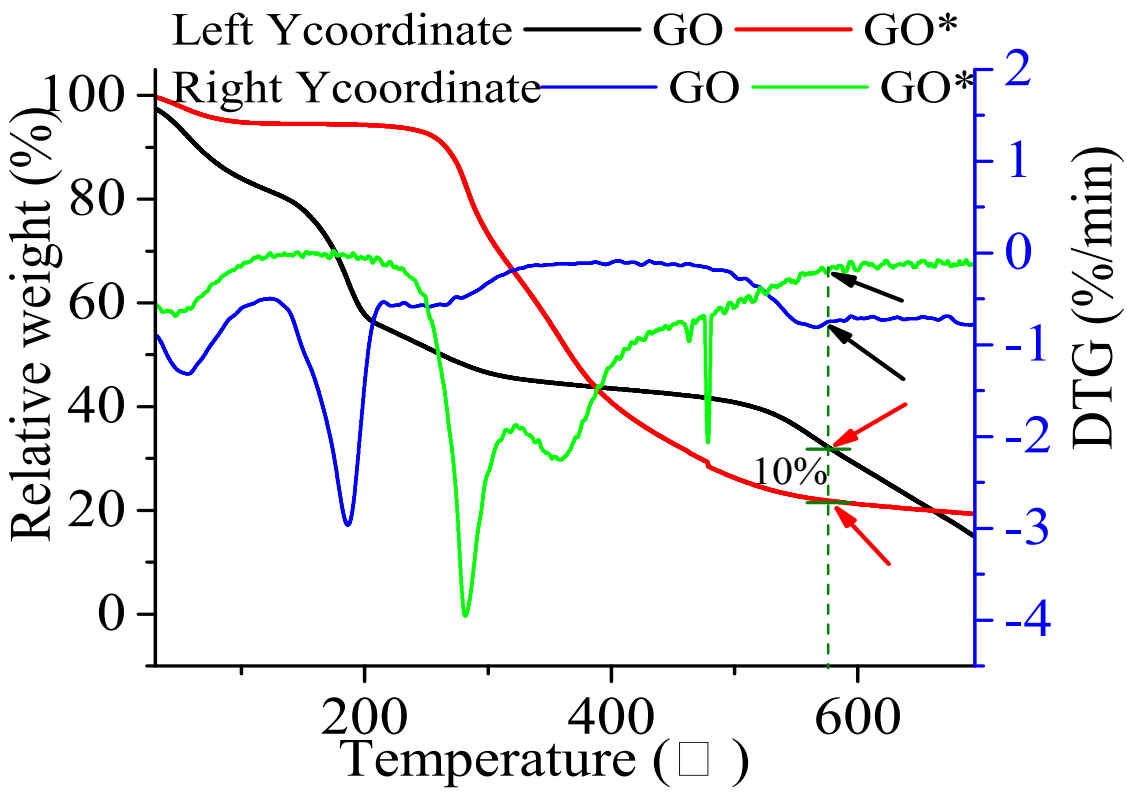

Fig. S1 Thermogravimetric analysis curves of pristine graphene oxide (GO) and GO biotransformed (GO*) in blood plasma after a 14-day reaction. The black and red arrows on the relative weight loss and differential thermal gravity (DTG) curves, respectively, denote the temperature (570°C) at which the graphene structure decomposed.

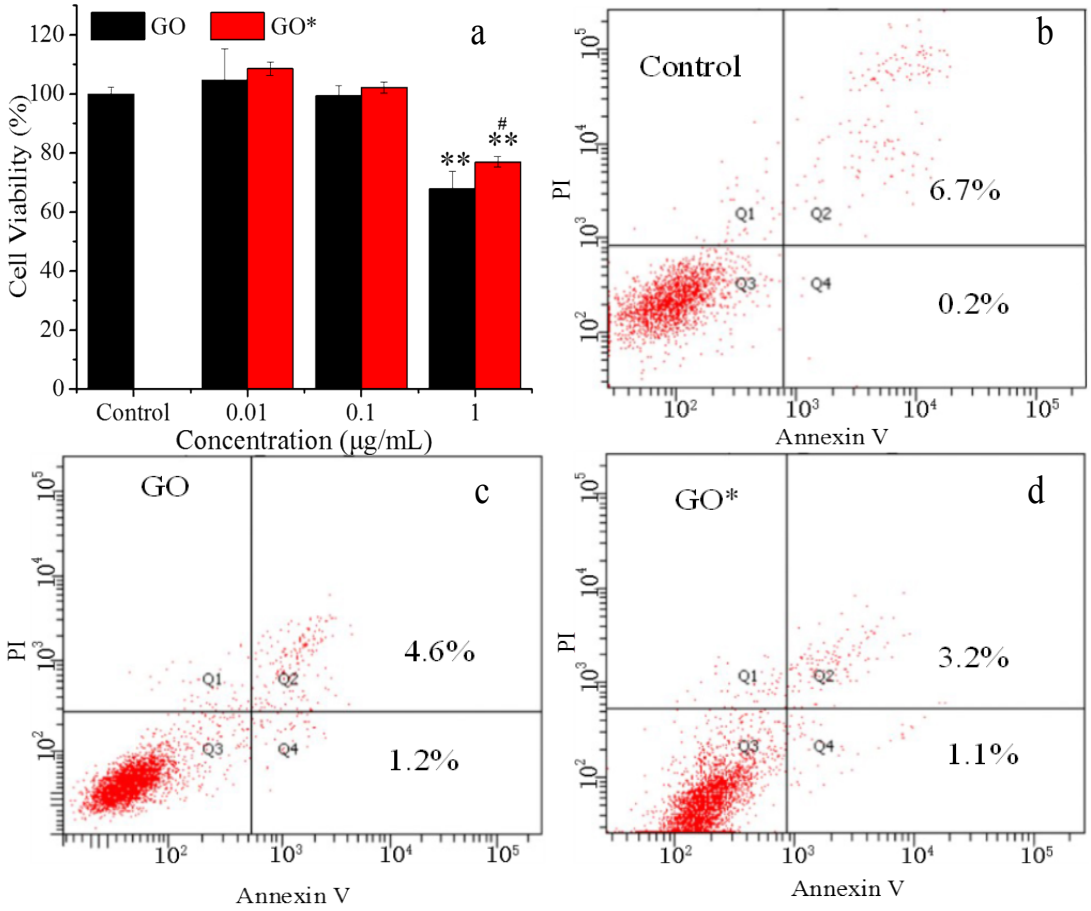

Fig. S2 Cell viability and apoptosis influenced by pristine GO and biotransformed GO (GO*). (a) Cell viability as detected by a lactate dehydrogenase assay; (b-d) apoptosis in the control, GO and GO* groups as detected by flow cytometry. For the flow cytometry images of the exposure groups, the tested concentration was 0.1 μg/ml. $^{**}p < 0.01$ represents the significant level for GO or GO* cultured cells *vs* control cells. $^{\#}p < 0.05$ represents the significant level for GO* *vs* GO cultured cells.

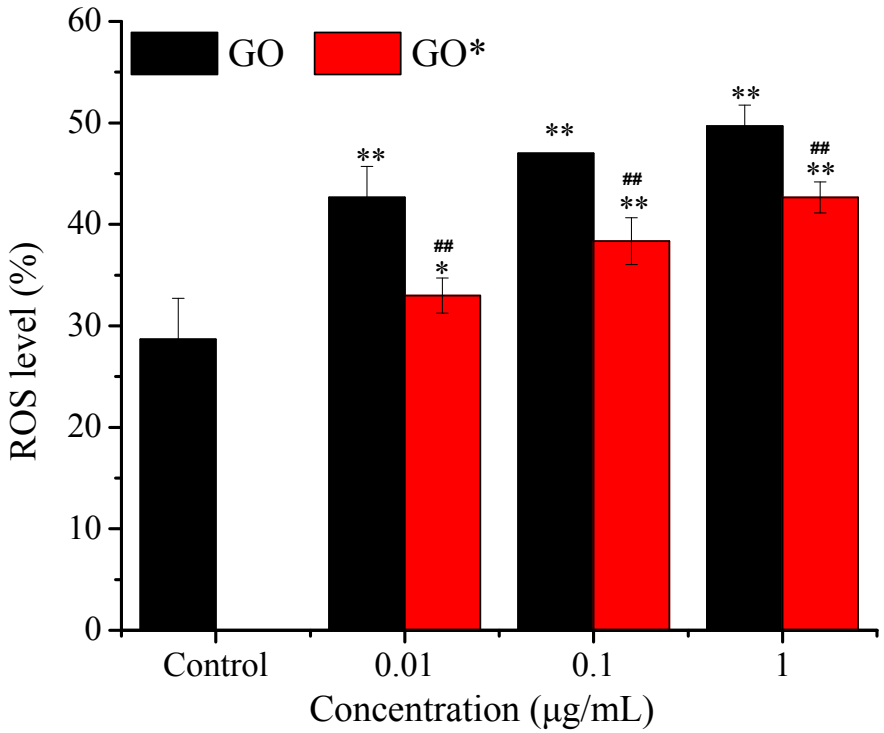

Fig. S3 Reactive oxygen species (ROS) generation induced in human embryonic lung fibroblasts by pristine graphene oxide (GO) and biotransformed GO (GO*). *$p < 0.05$ and **$p < 0.01$ represent the significant levels for GO or GO* group *vs* control group. $^{\#\#}p < 0.01$ represents the significant level for GO* group *vs* GO group.

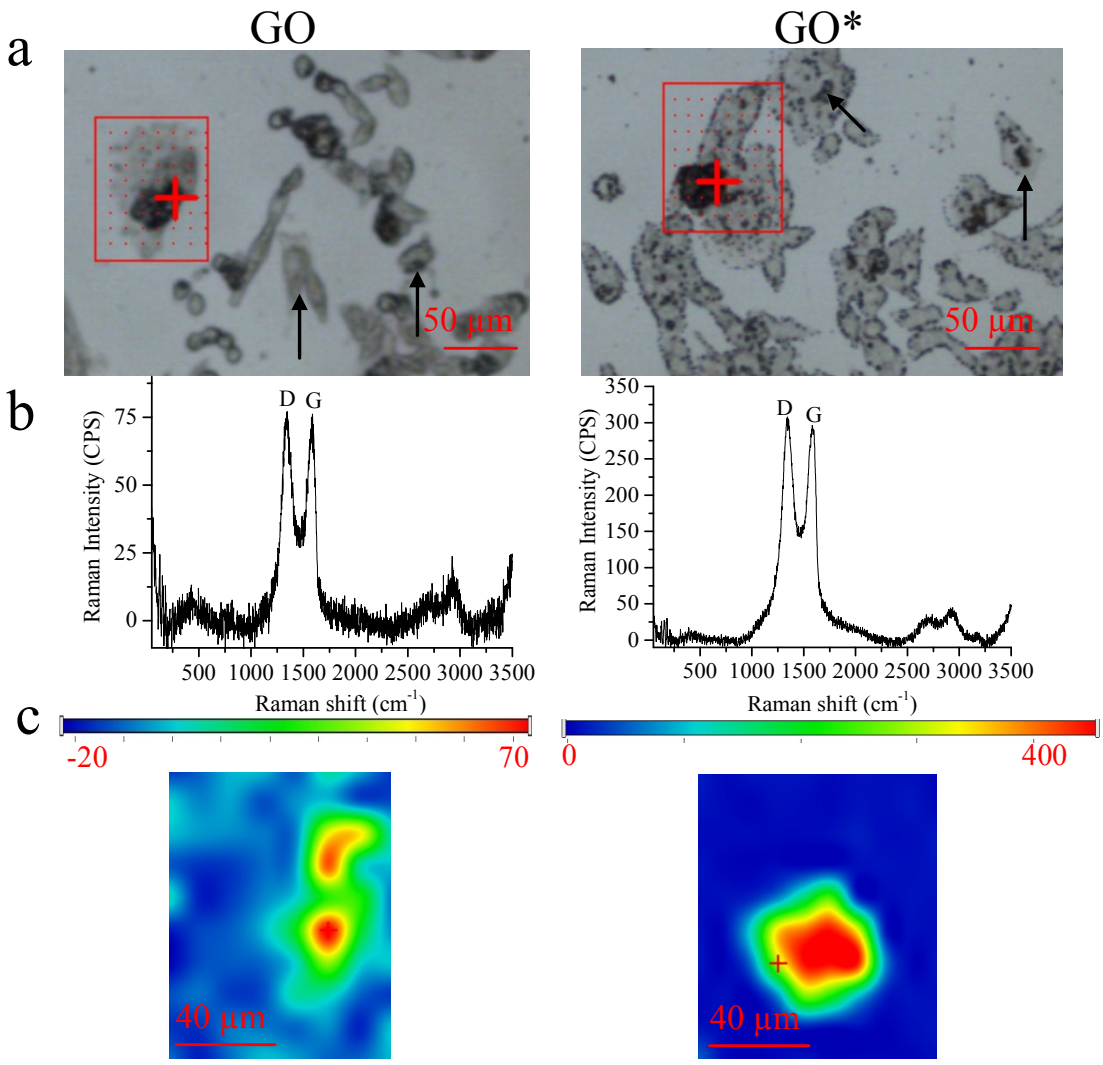

Fig. S4 Confocal Raman imaging results showing the uptake of pristine graphene oxide (GO) (left) and biotransformed GO (right). (a) Bright-field imaging of human embryonic lung fibroblasts; the red box denotes the scanning area; (b) Raman spectrum of cells from the location of the plus sign in (a); (c) the scanning image at 1557 cm^{-1} for the area denoted by the red box in (a). In (b), the Raman bands at 1557 cm^{-1} and 1373 cm^{-1} denote the sp^2 and sp^3 GO structures, respectively. In (c), blue and red denote the cell matrix and GO-based aggregates, respectively.

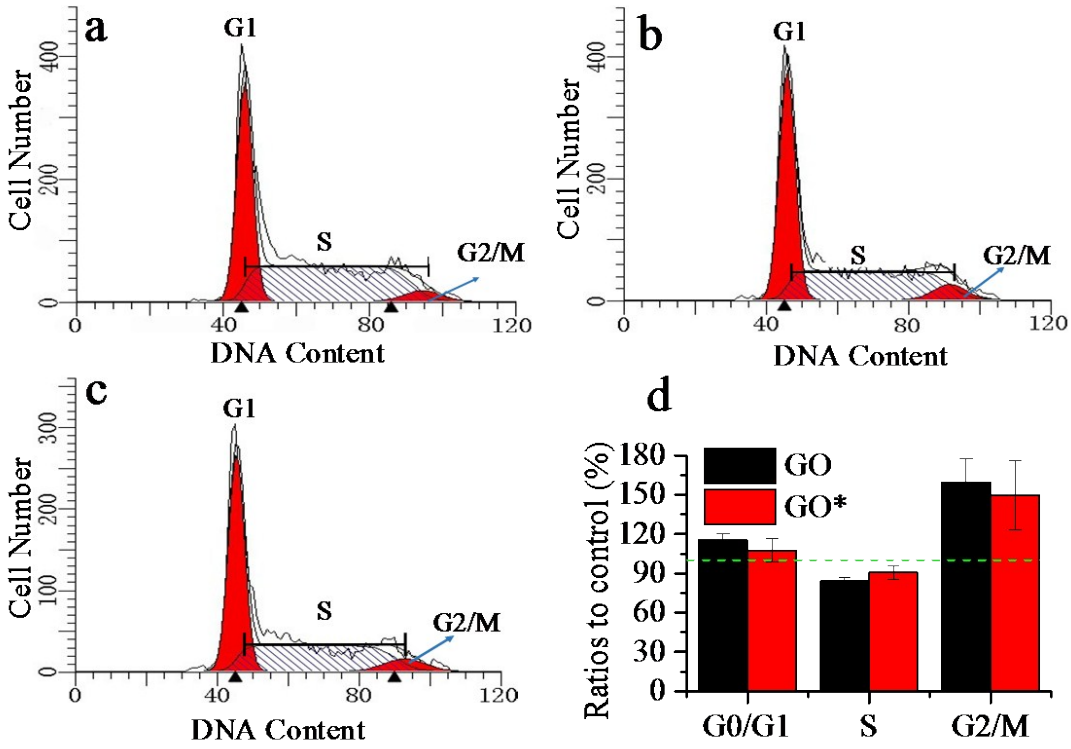

Fig. S5 Cell cycle arrest of human embryonic lung fibroblasts induced by pristine graphene oxide (GO) and biotransformed GO (GO*). (a) Cell cycle phase in the control group; (b) cell cycle phase in the pristine graphene oxide (GO) group (1 μg/ml); (c) cell cycle phase in the biotransformed GO group (1 μg/ml); (d) the cell cycle phase ratio of the exposure groups relative to that of the control group (the yellow line indicates a cutoff of 100%).

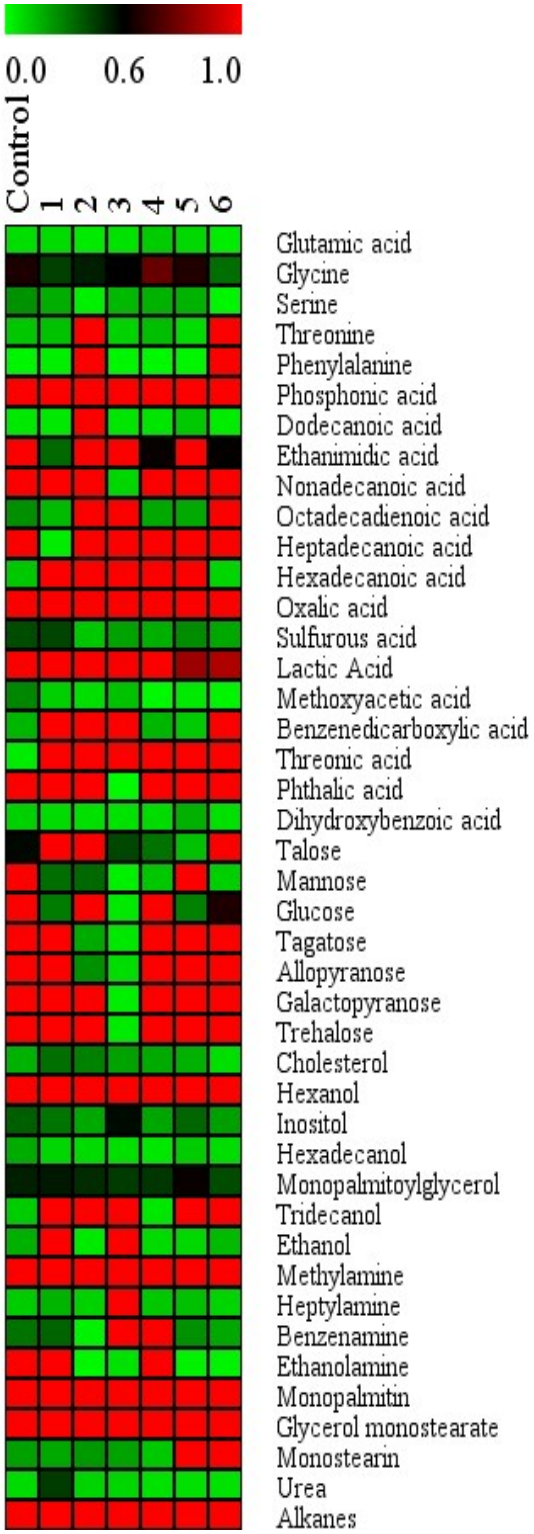

Fig. S6 Heat map representing the relative abundance of metabolites. The numbers 1-3 represent pristine graphene oxide (GO) at 0.01, 0.1 and 1 µg/ml, respectively. The numbers 4-6 represent biotransformed GO at 0.01, 0.1 and 1 µg/ml, respectively.

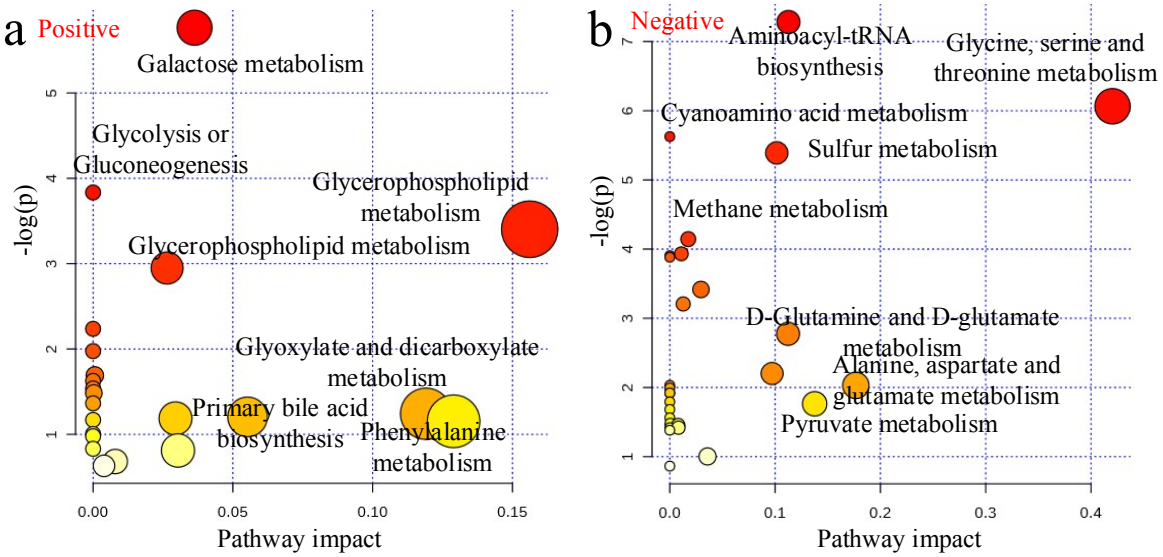

Fig. S7. Connections between metabolic pathways and reactive oxygen species (ROS) levels. (a) Metabolic pathways positively related to ROS levels; (b) metabolic pathways negatively related to ROS levels.

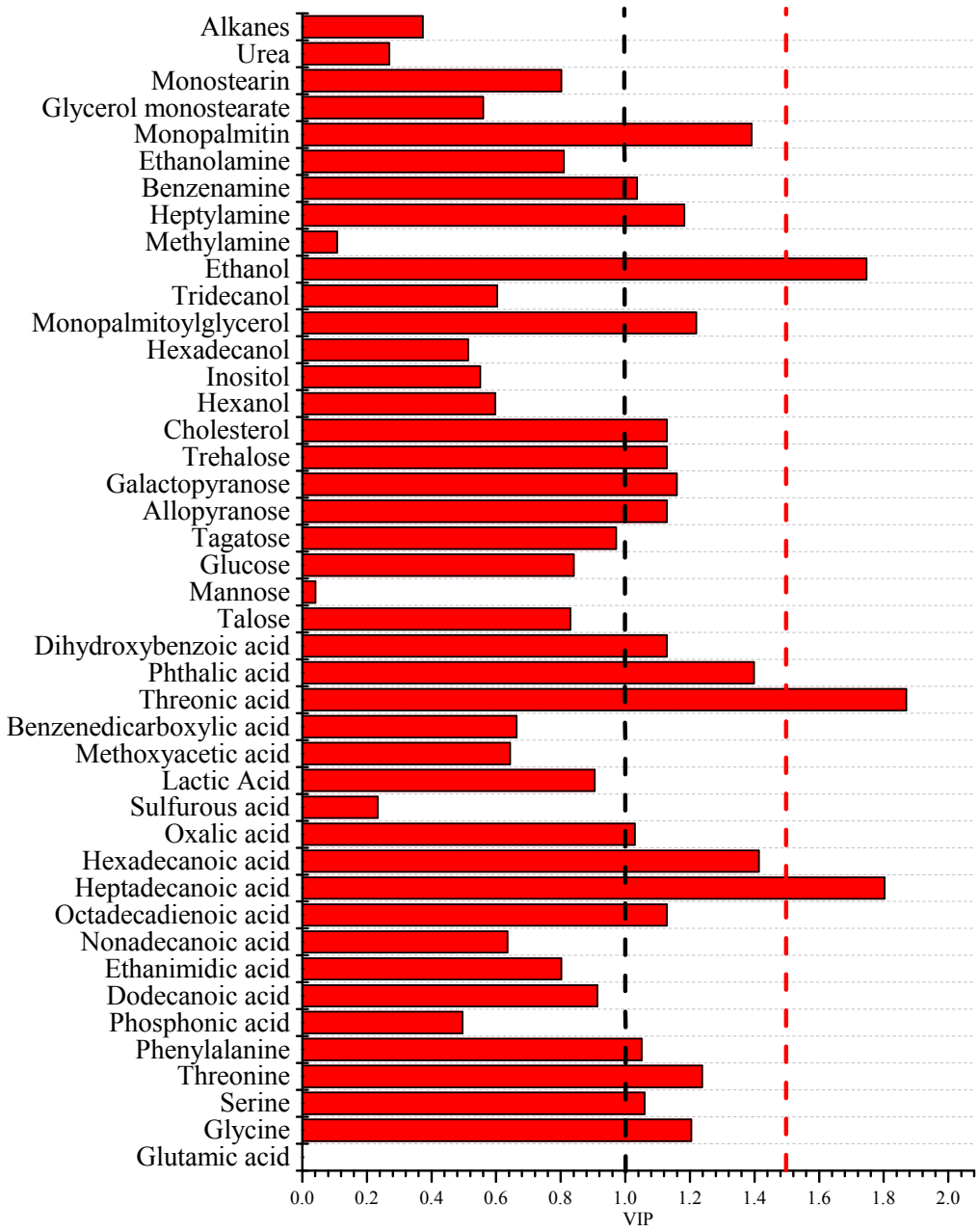

Fig. S8 Variable importance in the projection (VIP) from the orthogonal partial least squares discriminant analysis using SIMCA-P 11.5 software. Reactive oxygen species level is the Y variable, and the abundance of metabolites is the X variable. The black and red dotted lines indicate VIP values of 1 and 1.5, respectively.