

Reporting Summary

Nature Portfolio wishes to improve the reproducibility of the work that we publish. This form provides structure for consistency and transparency in reporting. For further information on Nature Portfolio policies, see our [Editorial Policies](#) and the [Editorial Policy Checklist](#).

Statistics

For all statistical analyses, confirm that the following items are present in the figure legend, table legend, main text, or Methods section.

n/a Confirmed

- ☐ ☒ The exact sample size (n) for each experimental group/condition, given as a discrete number and unit of measurement
- ☐ ☒ A statement on whether measurements were taken from distinct samples or whether the same sample was measured repeatedly
- ☐ ☒ The statistical test(s) used AND whether they are one- or two-sided
Only common tests should be described solely by name; describe more complex techniques in the Methods section.
- ☒ ☐ A description of all covariates tested
- ☒ ☐ A description of any assumptions or corrections, such as tests of normality and adjustment for multiple comparisons
- ☐ ☒ A full description of the statistical parameters including central tendency (e.g. means) or other basic estimates (e.g. regression coefficient) AND variation (e.g. standard deviation) or associated estimates of uncertainty (e.g. confidence intervals)
- ☐ ☒ For null hypothesis testing, the test statistic (e.g. F , t , r) with confidence intervals, effect sizes, degrees of freedom and P value noted
Give P values as exact values whenever suitable.
- ☒ ☐ For Bayesian analysis, information on the choice of priors and Markov chain Monte Carlo settings
- ☒ ☐ For hierarchical and complex designs, identification of the appropriate level for tests and full reporting of outcomes
- ☒ ☐ Estimates of effect sizes (e.g. Cohen's d , Pearson's r), indicating how they were calculated

Our web collection on [statistics for biologists](#) contains articles on many of the points above.

Software and code

Policy information about [availability of computer code](#)

Data collection

A CHI1000C potentiostat and associated electrochemical software chi1000c (version 17.2.0.0) were used for electrochemical data collection. A CHI660E electrochemical workstation was used for CV and LSV analysis. A Cary 60 UV-VIS spectrophotometer (Agilent Technologies, CA, USA) was used to measure the cell optical density and NADH produced by enzymes. A Thermo Ultimate3000 HPLC system (Thermo Fisher Scientific, MA, USA) was used to quantify the concentrations of α -ketoglutarate, D-xylose and L-arabinose. TCSsp5?03040101 Laser Scanning Confocal Microscope (Agilent Technologies, CA, USA) was used to confirm the location of enzymes on cell surface. LI-COR Odyssey CLx imaging system was used to detect fluorescent bands on PVDF membrane in Quantitative Immunoassay.

Data analysis

Origin 2022, GraphPad Prism 8, one-way ANOVA and Microsoft Excel software (version 2021) were used for data analysis and graphing.

For manuscripts utilizing custom algorithms or software that are central to the research but not yet described in published literature, software must be made available to editors and reviewers. We strongly encourage code deposition in a community repository (e.g. GitHub). See the Nature Portfolio [guidelines for submitting code & software](#) for further information.

Data

Policy information about [availability of data](#)

All manuscripts must include a [data availability statement](#). This statement should provide the following information, where applicable:

- Accession codes, unique identifiers, or web links for publicly available datasets
- A description of any restrictions on data availability
- For clinical datasets or third party data, please ensure that the statement adheres to our [policy](#)

Data supporting the findings of this work are available within the paper and its Supplementary Information files. A reporting summary for this Article is available as a Supplementary Information file. Source data are provided with this paper.

Research involving human participants, their data, or biological material

Policy information about studies with [human participants or human data](#). See also policy information about [sex, gender \(identity/presentation\), and sexual orientation](#) and [race, ethnicity and racism](#).

Reporting on sex and gender	N/A
Reporting on race, ethnicity, or other socially relevant groupings	N/A
Population characteristics	N/A
Recruitment	N/A
Ethics oversight	N/A

Note that full information on the approval of the study protocol must also be provided in the manuscript.

Field-specific reporting

Please select the one below that is the best fit for your research. If you are not sure, read the appropriate sections before making your selection.

☒ Life sciences ☐ Behavioural & social sciences ☐ Ecological, evolutionary & environmental sciences

For a reference copy of the document with all sections, see [nature.com/documents/nr-reporting-summary-flat.pdf](https://www.nature.com/documents/nr-reporting-summary-flat.pdf)

Life sciences study design

All studies must disclose on these points even when the disclosure is negative.

Sample size	The sample size of N=3 biological replicates was chosen according to the standard of the field to ensure reproducibility while minimizing cost.
Data exclusions	No data were excluded.
Replication	Each experiment was replicated several times independently and all attempts at replication were successful.
Randomization	Randomization was irrelevant because our study did not involve assigning samples to experimental groups.
Blinding	The group allocation was not involved in our study. So investigators were not blind to the group allocation. Investigators were not blind during acquisition and analysis as well. Because the collected data was the result of quantitative data detected by instruments and was generally not affected by subjective factors.

Reporting for specific materials, systems and methods

We require information from authors about some types of materials, experimental systems and methods used in many studies. Here, indicate whether each material, system or method listed is relevant to your study. If you are not sure if a list item applies to your research, read the appropriate section before selecting a response.

Materials & experimental systems

Methods

n/a	Involved in the study
☐	☒ Antibodies
☒	☐ Eukaryotic cell lines
☒	☐ Palaeontology and archaeology
☒	☐ Animals and other organisms
☒	☐ Clinical data
☒	☐ Dual use research of concern
☒	☐ Plants

n/a	Involved in the study
☒	☐ ChIP-seq
☒	☐ Flow cytometry
☒	☐ MRI-based neuroimaging

Antibodies

Antibodies used	Anti-6xHisTag mouse monoclonal antibody (catalog number D191001, Sangon Biotechnology, Shanghai, China); FITC-conjugated Donkey anti-Mouse IgG (catalog number D110068, Sangon Biotechnology, Shanghai, China); Goat anti-mouse IRDye 800CW fluorescent secondary antibody (catalog number 926-32210, LI-COR, Inc., Lincoln, NE).
Validation	https://store.sangon.com/productDetail?productInfo.code=D191001 ; https://store.sangon.com/productDetail?productInfo.code=D110068 ; https://www.gene-mart.cn/search.aspx?keyword=926-32210 .

Plants

Seed stocks	Corn cob was obtained from Corn Research Center of Qingdao Agriculture University.
Novel plant genotypes	No.
Authentication	No.