

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 (<i>n</i>) 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 <i>Only common tests should be described solely by name; describe more complex techniques in the Methods section.</i>
☒	☐ 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. <i>F</i> , <i>t</i> , <i>r</i>) with confidence intervals, effect sizes, degrees of freedom and <i>P</i> value noted <i>Give P values as exact values whenever suitable.</i>
☒	☐ 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 <i>d</i> , Pearson's <i>r</i>), 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	Collection of Compound X-ray data: Bruker SC-XRD; Collection of Protein X-ray data: Shanghai Synchrotron Radiation Facility (SSRF) beamline BL18U1 and BL19U1; Collection of LC-MS data: SHIMADZU LC-MS 2020 system; Collection of Compound high-resolution MS (HRMS) data: Thermo Fisher Scientific Orbitrap Exploris 120; Collection of NMR data: Bruker DRX-500 or DRX-600 NMR spectrometers (Bruker Co. L.td., Germany); Protein modeling: AlphaFold 3; Docking: SwissDock ; Molecular Dynamics (MD): GROMACS 2022.4. Genome or gene data:NCBI Datasets Construction of a Local Genomic Database: BioEdit (version 7.0.9.0)
Data analysis	XDS, Aimless, REFMAC 5 and Phenix for crystal data of CYP204A3; Pymol 3.1 was used for preparing enzyme structure figures; MestReNova (version 14.0.0) was used for analysis of NMR data; Ortep3 (version 2023.1) was used to visualize the X-ray crystal structures of products; Microsoft Excel (version 2010) and Origin 2024 were employed for statistical analysis; Microsoft Power Point (version 2010) was used to prepare and combine figures; MEGA 11 was used for building the phylogenetic tree; Interactive Tree of Life (iTOL) v7 were used to visualize and annotate the phylogenetic tree;

WebLogo 3 was used for creating the graphic of an amino acid multiple sequence alignment.
ChemDraw (version 19.0.0.22) was used to visualize the chemical structures in figures;

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](#)

The structure of substrate-free CYP204A3 have been deposited in the Protein Data Bank (PDB) under ID numbers, 9WAT57 (<https://www.rcsb.org/structure/unreleased/9WAT>). The structure of mammalian CYP11A1-cholesterol complex is available in PDB database 3N9Y (<https://www.rcsb.org/structure/3N9Y>). The crystallographic data for 22S-HCO, 20S-HC and 22R-HC have been deposited at the Cambridge Crystallographic Data Center with deposition numbers CCDC 2414994 (22S-HCO), CCDC 2415099 (20S-HC) and CCDC 2414991 (22R-HC)58, these data can be obtained free of charge from The Cambridge Crystallographic Data Centre via <https://www.ccdc.cam.ac.uk/structures>. The MD simulation parameters files are available as a Supplementary Data item and update text references accordingly. The other characterization data generated in this study are provided in the Supplementary Information or Source Data file. Source data are provided as a Source Data 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

Reporting on race, ethnicity, or other socially relevant groupings

Population characteristics

Recruitment

Ethics oversight

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

Data exclusions

Replication

Randomization

Blinding

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

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

Methods

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

Plants

Seed stocks

Report on the source of all seed stocks or other plant material used. If applicable, state the seed stock centre and catalogue number. If plant specimens were collected from the field, describe the collection location, date and sampling procedures.

Novel plant genotypes

Describe the methods by which all novel plant genotypes were produced. This includes those generated by transgenic approaches, gene editing, chemical/radiation-based mutagenesis and hybridization. For transgenic lines, describe the transformation method, the number of independent lines analyzed and the generation upon which experiments were performed. For gene-edited lines, describe the editor used, the endogenous sequence targeted for editing, the targeting guide RNA sequence (if applicable) and how the editor was applied.

Authentication

Describe any authentication procedures for each seed stock used or novel genotype generated. Describe any experiments used to assess the effect of a mutation and, where applicable, how potential secondary effects (e.g. second site T-DNA insertions, mosaicism, off-target gene editing) were examined.