nature portfolio

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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	Absorbance and chemiluminescence data - SoftMax Pro v7.x. QPCR data - QuantStudio Real-Time PCR Software 1.7.2. Plasma HBsAg, HBeAg, and HBsAb - Alinity ci-series 3.6.0 and Maccura I3000 Analyzer 1.0.11.240227. Plasma HBV DNA - SLAN Analysis Software 8.2.2. Plasma ALT - Immunoassay Operating Software 10.00.36.043193 and Hitachi 008AS Operating Software 1-32. Elispot - Mabtech IRIS 9.15.x. Clinical chemistry parameters - Hitachi 7180-7186079-06. Urinalysis - CLINITEK Novus software S003785 1.3.6.0. Plasma cytokines - xPONENT 4.3.1. Flow Cytometry - SAS 9.4. Histopathology Figures - NDP. scan 3.1.
Data analysis	GraphPad Prism 10.0.0. Microsoft Excel version 2019.

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

All data supporting the findings of this study are provided in the Source Data file.

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	we don't have related issues.
Reporting on race, ethnicity, or other socially relevant groupings	we don't have related issues.
Population characteristics	we don't have related issues.
Recruitment	we don't have related issues.
Ethics oversight	we don't have related issues.

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

Life sciences study design

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

Sample size	Sample size was chosen to ensure reproducibility of the experiments in accordance with the replacement, reduction and refinement principles of animal ethics regulation. At least three samples were included in each experiment.
Data exclusions	No data was excluded in this study.
Replication	All experimental findings were reliably reproduced. At least three independent samples were performed for each experiment.
Randomization	Random sampling was strictly executed in the whole study. Throughout the whole experiment, all the samples and the animals were randomly assigned.
Blinding	The investigators were no blinded to group allocation during data collection and analysis. All data collected was quantifiable, blind method does not change the data collected by any bias.

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

Antibodies

Antibodies used

APC-Cy™7 Mouse anti-rat CD45 (BD, Cat. No: 561586, Clone name: OX-1, Lot. No:3258955 , Dilution: 1:50)
FITC Mouse Anti-Rat CD3 (BD, Cat. No: 554832, Clone name: G4.18, Lot. No:3114240 , Dilution: 1:50)
PE-Cy™7 Mouse Anti-Rat CD4 (BD, Cat. No: 561578, Clone name: OX-35, Lot. No:4024523 , Dilution: 1:20)
PerCP Mouse Anti-Rat CD8a (BD, Cat. No: 558824, Clone name: OX-8, Lot. No:4015835 , Dilution: 1:50)
NHP CD45 Horizon V500 (BD, Cat. No: 561489, Clone name: D058-1283, Lot. No:3160468 , Dilution: 1:50)
Hu/NHP CD3 PerCP-Cy5.5 (BD, Cat. No: 552852, Clone name: SP34-2, Lot. No:4003828 , Dilution: 2:50)
Hu/NHP CD4 APC-H7 (BD, Cat. No: 560837, Clone name: L200, Lot. No:2059633 , Dilution: 1:50)
Hu CD8 PE (BD , Cat. No: 555367, Clone name: RPA-T8, Lot. No: 1116651, Dilution: 2:50)

Validation

All antibodies are commercially available and have been validated by suppliers. Validation data can be found by searching the manufacturer's websites using the provided catalog numbers.

Eukaryotic cell lines

Policy information about cell lines and Sex and Gender in Research

Cell line source(s)

HepG2 (HB-8065) cell line was purchased from American Type Culture Collection (ATCC). Primary human hepatocytes (LGI) was purchased from BioIVT. HepG2.2.15 cell line was a gift from other laboratory.

Authentication

The identification of the cell line was carried out through STR genotype testing.

Mycoplasma contamination

All cell lines were tested negative for mycoplasma contamination.

Commonly misidentified lines
(See ICLAC register)

No commonly misidentified cell lines were used in the study.

Animals and other research organisms

Policy information about studies involving animals; ARRIVE guidelines recommended for reporting animal research, and Sex and Gender in Research

Laboratory animals

Male C57BL/6 mice (6 weeks old)
Male and female C57BL/6N-Tg(1.28HBV)/Vst mice (8-10 weeks old)
Male and female Sprague Dawley (SD) rats (5-8 weeks old)
Male and female cynomolgus monkey (3-4 years old)

Wild animals

This study didn't involve wild animals.

Reporting on sex

Male and female mice, rats and monkeys were used in this study.

Field-collected samples

This study didn't involve samples collected from the field.

Ethics oversight

All animal studies were performed in compliance with relevant local regulations and approved by the respective Institutional Animal Care and Use Committee (IACUC) of Jennio Biotech Co. Ltd. (Guangzhou, China, Approved Numbers: JENNIO-IACUC-2024-A005, JENNIO-IACUC-2024-A014, JENNIO-IACUC-2025-A002, JENNIO-IACUC-2025-A003), Vitalstar Biotechnology Co. Ltd. (Beijing, China, Approved Numbers: VST-SY-24062701, VST-SY-25022401), WuXi AppTec (Chengdu, China, Approved Number: CD20240731-Rats), and Pharmaron (Beijing) TSP (Beijing, China, Approved Numbers: 25-023, 24-471).

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

Plants

Seed stocks	we don't have related issues.
Novel plant genotypes	we don't have related issues.
Authentication	we don't have related issues.

Flow Cytometry

Plots

Confirm that:

☒ The axis labels state the marker and fluorochrome used (e.g. CD4-FITC).

☒ The axis scales are clearly visible. Include numbers along axes only for bottom left plot of group (a 'group' is an analysis of identical markers).

☒ All plots are contour plots with outliers or pseudocolor plots.

☒ A numerical value for number of cells or percentage (with statistics) is provided.

Methodology

Sample preparation	Blood samples were harvested from rats or monkeys and washed with DPBS and subsequently incubated with pre-mixed antibody for 30 min at room temperature on an orbital shaker. FACS Lysing Solution (diluted 1:10 using deionized water) was added to each sample and incubated for additional 10 min. The samples were subsequently washed with DPBS and resuspended in DPBS for analysis on flow cytometer.
Instrument	FACSCanto ? flow cytometer (BD Biosciences).
Software	SAS 9.4 for Windows
Cell population abundance	11000 cells were collected for subsequent analysis
Gating strategy	Lymphocytes were identified based on CD45 positivity and side scatter (SSC). Approximately 11,000 events were collected within this gate. Total T cells were then defined as CD45+ CD3+ events, listed in the lower right quadrant (Q4) gate of the 2-parameter (CD3 vs. SSC) dot plot gated on lymphocytes. Helper T cells were defined as CD45+ CD3+ CD4+ CD8- events, listed in the lower right quadrant (Q4) gate of the 2-parameter (CD4 vs. CD8) dot plot gated on CD45+ CD3+ cells. Cytotoxic T cells were defined as CD45+ CD3+ CD4+ CD8+ events, listed in the upper left quadrant (Q4) gate of the 2- parameter (CD4 vs. CD8) dot plot gated on CD45+ CD3+ cells.

☒ Tick this box to confirm that a figure exemplifying the gating strategy is provided in the Supplementary Information.