

Package ‘microbiomeDataSets’

June 13, 2024

Title Experiment Hub based microbiome datasets

Version 1.12.0

Description microbiomeDataSets is a collection of microbiome datasets loaded from Bioconductor'S ExperimentHub infrastructure. The datasets serve as reference for workflows and vignettes published adjacent to the microbiome analysis tools on Bioconductor. Additional datasets can be added overtime and additions from authors are welcome.

License CC0

Encoding UTF-8

biocViews ExperimentHub, ExperimentData, MicrobiomeData, SequencingData

Depends R (>= 4.1), SummarizedExperiment, TreeSummarizedExperiment, MultiAssayExperiment

Imports methods, utils, BiocGenerics, ExperimentHub, Biostrings, ape

Suggests knitr, rmarkdown, BiocStyle, SingleCellExperiment, testthat

Roxygen list(markdown = TRUE)

RoxygenNote 7.1.1

VignetteBuilder knitr

git_url <https://git.bioconductor.org/packages/microbiomeDataSets>

git_branch RELEASE_3_19

git_last_commit 2b01999

git_last_commit_date 2024-04-30

Repository Bioconductor 3.19

Date/Publication 2024-06-13

Author Leo Lahti [cre, aut] (<<https://orcid.org/0000-0001-5537-637X>>),
Felix G.M. Ernst [aut] (<<https://orcid.org/0000-0001-5064-0928>>),
Sudarshan Shetty [aut] (<<https://orcid.org/0000-0001-7280-9915>>),
Chouaib Benchakra [ctb] (<<https://orcid.org/0000-0002-1167-7848>>),
Yagmur Simsek [ctb]

Maintainer Leo Lahti <leo.lahti@iki.fi>

Contents

microbiomeDataSets-package	2
availableDataSets	2
GrieneisenTSData	3
HintikkaXOData	5
LahtiMLData	6
LahtiWADData	7
OKeefeDSData	8
SilvermanAGutData	9
SongQADData	10
SprockettTHData	11
Index	13

microbiomeDataSets-package
Microbiome data sets

Description

microbiomeDataSets is a collation of data from microbiome and associated studies, which are publically available.

Details

The data is made available through the ExperimentHub resources of the Bioconductor project. It is loaded as TreeSummarizedExperiment object or a MultiAssayExperiment objects.

availableDataSets *Load available microbiome data sets*

Description

To list the available datasets in microbiomeDataSets, run availableDataSets.

Usage

```
availableDataSets()
```

Details

For information visit the individual man pages.

Value

A data.frame containing the following columns:

- Dataset: the name of the function to load a dataset

Examples

```
availableDataSets()
```

GrieneisenTSData	<i>Retrieve GrieneisenTS data</i>
------------------	-----------------------------------

Description

Obtain longitudinal gut microbiome data in wild baboons from Grieneisen et al. (2021).

Usage

```
GrieneisenTSData()
```

```
baboongut()
```

Details

The GrieneisenTS dataset contains 16,234 16S rRNA gene sequencing-based microbiome profiles from 585 baboon samples collected over 14 years to determine the heritability of the gut microbiome on various environmental factors such as diet, age, season. Each baboon had an average of 28 samples collected over 4.5 years. The data set can be used to investigate significance of longitudinal sampling at large sample sizes.

This data set contains the 613 most prevalent taxa with a phylogenetic tree.

Column metadata includes the following fields:

- sample: Sample ID (character)
- baboon_id: Baboon ID (factor)
- collection_date: Sample collection date (date ; YYYY-MM-DD)
- sex: Sex (factor; F/M)
- age: Age (numeric)
- social_group: Social group ID (factor)
- group_size: Social group size (integer)
- rain_month_mm: Rain per month(mm) (numeric)
- season: Season (factor; dry/wet)
- hydro_year: Hydro year (integer)
- month: Month (integer)
- readcount: Read count (numeric)
- plate: Plate (factor)
- post_pcr_dna_ng: Post PCR DNA(ng) (numeric)
- diet_PC1: Diet Principal coordinate 1 (numeric)
- diet_PC2: Diet Principal coordinate 2 (numeric)

- diet_PC3: Diet Principal coordinate 3 (numeric)
- diet_PC4: Diet Principal coordinate 4 (numeric)
- diet_PC5: Diet Principal coordinate 5 (numeric)
- diet_PC6: Diet Principal coordinate 6 (numeric)
- diet_PC7: Diet Principal coordinate 7 (numeric)
- diet_PC8: Diet Principal coordinate 8 (numeric)
- diet_PC9: Diet Principal coordinate 9 (numeric)
- diet_PC10: Diet Principal coordinate 10 (numeric)
- diet_PC11: Diet Principal coordinate 11 (numeric)
- diet_PC12: Diet Principal coordinate 12 (numeric)
- diet_PC13: Diet Principal coordinate 13 (numeric)
- diet_shannon_h: Dietary Shannon's H index (numeric)
- asv_richness: Amplicon sequence variant (ASV) richness (integer)
- asv_shannon_h: ASV Shannon's H index (numeric)
- pc1_bc: Principal coordinate 1 Bray-Curtis dissimilarity (numeric)
- pc2_bc: Principal coordinate 2 Bray-Curtis dissimilarity (numeric)
- pc3_bc: Principal coordinate 3 Bray-Curtis dissimilarity (numeric)
- pc4_bc: Principal coordinate 4 Bray-Curtis dissimilarity (numeric)
- pc5_bc: Principal coordinate 5 Bray-Curtis dissimilarity (numeric)

Row metadata of the microbiome data contains taxonomic information on the Domain, Phylum, Class, Order, Family, Genus, and ASV levels.

The row tree consists of a phylogenetic tree build using sequence information of 613 taxa.

As reference sequences the ASV are provided.

Value

A [TreeSummarizedExperiment](#) object.

Author(s)

Yagmur Simsek and Leo Lahti

References

Grieneisen et al. (2021): Gut microbiome heritability is nearly universal but environmentally contingent *Science* 373:6551 <https://science.sciencemag.org/content/373/6551/181.full>

Examples

```
tse <- GrieneisenTSData()
```

HintikkaXOData	<i>Retrieve HintikkaXO data</i>
----------------	---------------------------------

Description

Obtain microbiota, metabolite and biomarker data from Hintikka et al. (2021).

Usage

```
HintikkaXOData()
```

Details

The HintikkaXO dataset contains high-throughput profiling data from 40 rat samples, including 39 biomarkers, 38 metabolites (NMR), and 12706 OTUs from 318 species, measured from Cecum. This is diet comparison study with High/Low fat diet and xylo-oligosaccharide supplementation.

Column metadata is common for all experiments (microbiota, metabolites, biomarkers) and includes the following fields:

- Sample: Sample ID (character)
- Rat: Rat ID (factor)
- Site: Site of measurement ("Cecum"); single value
- Diet: Diet group (factor; combination of the Fat and XOS fields)
- Fat: Fat in Diet (factor; Low/High)
- XOS: XOS Diet Supplement (numeric; 0/1)

Row metadata of the microbiota data contains taxonomic information on the Phylum, Class, Order, Family, Genus, Species, and OTU levels.

Biomarker data contains 39 biomarkers.

Metabolite data contains 38 NMR metabolites.

All data are downloaded from ExperimentHub and cached for local re-use.

Value

for HintikkaXOData a [MultiAssayExperiment](#) is provided.

Author(s)

Leo Lahti

References

Hintikka L et al. (2021): Xylo-oligosaccharides in prevention of hepatic steatosis and adipose tissue inflammation: associating taxonomic and metabolomic patterns in fecal microbiotas with bi-clustering. *International Journal of Environmental Research and Public Health* 18(8):4049 <https://doi.org/10.3390/ijerph18084049>

Examples

```
# Retrieve the MAE data
mae <- HintikkaXOData()

# List the experiments in this MultiAssayExperiment object
print(experiments(mae))

# colData for this MAE data object (print first few rows)
print(head(colData(mae)))

# metabolite assay data
nmr <- assays(mae[["metabolites"]])$nmr

# biomarker assay data
bm <- assays(mae[["biomarkers"]])$signals
# microbiota assay counts
counts <- assays(mae[["microbiota"]])$counts

# microbiota rowData
taxtab <- rowData(mae[["microbiota"]])
```

LahtiMLData

Obtain the Lahti Microbiome and Lipid data

Description

Obtain the microbiome and lipid data from Lahti et al. (2013).

Usage

```
LahtiMLData()
```

```
LahtiMData()
```

```
peerj32()
```

Details

The LahtiML dataset contains high-throughput profiling data from 389 human blood serum lipids and 130 intestinal genus-level bacteria from 44 samples (22 subjects from 2 time points; before and after probiotic/placebo intervention). The data set can be used to investigate associations between intestinal bacteria and host lipid metabolism

This data set is based on the Human Intestinal Tract (HIT)Chip phylogenetic 16S microarray (Rajilic-Stojanovic *et al.* 2009). This profiling technology differs from the more widely used 16S rRNA amplicon sequencing.

Column metadata includes the time points, sex, subject identifier, sample identifier and treatment group.

Row metadata of the microbiome data contains taxonomic information on the Phylum, Family and Genus level.

All data are downloaded from ExperimentHub and cached for local re-use.

Value

for LahtiMLData a [MultiAssayExperiment](#) object with [TreeSummarizedExperiment](#) and a [SummarizedExperiment](#), for LahtiMData a [TreeSummarizedExperiment](#)

Author(s)

Felix G.M. Ernst and Leo Lahti

References

Lahti L et al. (2013): Associations between the human intestinal microbiota, *Lactobacillus rhamnosus* GG and serum lipids indicated by integrated analysis of high-throughput profiling data. *PeerJ* 1:e32 <https://doi.org/10.7717/peerj.32>

Rajilic-Stojanovic M, Heilig HG, Molenaar D, Kajander K, Surakka A, Smidt H, de Vos WM (2009). Development and application of the human intestinal tract chip, a phylogenetic microarray: analysis of universally conserved phlotypes in the abundant microbiota of young and elderly adults. *Environ Microbiol.* 11(7):1736-51 <https://doi.org/10.1111/j.1462-2920.2009.01900.x>

Examples

```
mae <- LahtiMLData()  
tse <- LahtiMData()
```

LahtiWAData

Obtain the Lahti Western Adult microbiome data

Description

Obtain the microbiome data from Lahti et al. (2014).

Usage

```
LahtiWAData()  
  
atlas1006()
```

Details

The LahtiWA dataset contains high-throughput genus-level microbiota profiling with HITChip for 1006 western adults with no reported health complications, reported in Lahti et al. (2014).

This data set is based on the Human Intestinal Tract (HIT)Chip phylogenetic 16S microarray (Rajilic-Stojanovic *et al.* 2009). This profiling technology differs from the more widely used 16S rRNA amplicon sequencing.

Column metadata includes the age, sex, nationality, DNA extraction method, project identifier, precomputed diversity measurement, BMI group, subject identifier, time information and sample identifier.

Row metadata contains taxonomic information on the Phylum, Family and Genus level.

All data are downloaded from ExperimentHub and cached for local re-use.

Value

a [TreeSummarizedExperiment](#)

Author(s)

Felix G.M. Ernst and Leo Lahti

References

Lahti L et al. (2014): Tipping elements in the human intestinal ecosystem. *Nature Communications* 5:4344 (2014) <https://doi.org/10.1038/ncomms5344>

Rajilic-Stojanovic M, Heilig HG, Molenaar D, Kajander K, Surakka A, Smidt H, de Vos WM (2009). Development and application of the human intestinal tract chip, a phylogenetic microarray: analysis of universally conserved phylotypes in the abundant microbiota of young and elderly adults. *Environ Microbiol.* 11(7):1736-51 <https://doi.org/10.1111/j.1462-2920.2009.01900.x>

Examples

```
tse <- LahtiWAData()
```

OKeefeDSData

Obtain the O'Keefe diet swap microbiome data

Description

Obtain the microbiome data from O'Keefe et al. (2015).

Usage

```
OKeefeDSData()
```

```
dietswap()
```


Details

The OKeefeDS dataset contains microbiome data from a study with African and African American groups undergoing a two-week diet swap.

This data set is based on the Human Intestinal Tract (HIT)Chip phylogenetic 16S microarray (Rajilic-Stojanovic *et al.* 2009). This profiling technology differs from the more widely used 16S rRNA amplicon sequencing.

Column metadata includes the subject identifier, sex, nationality, group information, sample identifier, time point information, time point information within group and BMI group.

Row metadata contains taxonomic information on the Phylum, Family and Genus level.

All data are downloaded from ExperimentHub and cached for local re-use.

Value

a [TreeSummarizedExperiment](#)

Author(s)

Felix G.M. Ernst and Leo Lahti

References

O'Keefe S et al. (2015): Fat, fibre and cancer risk in African Americans and rural Africans. *Nature Communications* 6:6342 (2015) <https://dx.doi.org/10.1038/ncomms7342>

Rajilic-Stojanovic M, Heilig HG, Molenaar D, Kajander K, Surakka A, Smidt H, de Vos WM (2009). Development and application of the human intestinal tract chip, a phylogenetic microarray: analysis of universally conserved phylotypes in the abundant microbiota of young and elderly adults. *Environ Microbiol.* 11(7):1736-51 <https://doi.org/10.1111/j.1462-2920.2009.01900.x>

Examples

```
tse <- OKeefeDSData()
```

SilvermanAGutData

Obtain the Silverman Artificial Gut data

Description

Obtain the microbiome data from Silverman et al. (2018).

Usage

```
SilvermanAGutData()
```

```
artificialgut()
```

Details

The SilvermanAGutData dataset contains 16S rRNA gene based high-throughput profiling of 4 in vitro artificial gut models. The sampling was done hourly and daily to capture sub-daily dynamics of microbial community originating from human feces. The data consists of 413 taxa from 639 samples. The data set can be used to investigate longitudinal dynamics of microbial community in a controlled environment.

Column metadata includes the days of sampling, vessel identifier, sampling frequency pre-post challenge with *Bacteroides ovatus*.

The row metadata of the microbiome data contains taxonomic information on the Kingdom, Phylum, Class, Order, Family and Genus and Species level.

The row tree consists of a phylogenetic tree build using sequence information of 413 taxa.

As reference sequences the ASV are provided.

All data are downloaded from ExperimentHub and cached for local re-use.

Value

a [TreeSummarizedExperiment](#)

Author(s)

Sudarshan A. Shetty and Felix G.M. Ernst

References

Silverman J.D et al. (2018): Dynamic linear models guide design and analysis of microbiota studies within artificial human guts. *Microbiome* 6:202 <https://doi.org/10.1186/s40168-018-0584-3>

Examples

```
tse <- SilvermanAGutData()
```

SongQAData

Obtain the Song quality assurance dataset

Description

Obtain the microbiome data from Song et al. (2016).

Usage

```
SongQAData()
```

```
qa10934()
```

Details

The SongQA dataset contains microbiome data from a study comparing different sample preparation methods focusing on temperature and DNA extraction methods mainly.

The dataset was generated by sequencing the variable region 4 of 16S rRNA genes via Illumina HiSeq or MiSeq.

Column metadata was reconstructed from sample names and includes information on the source, timepoint, extraction method, temperature conditions and other optional data.

Row metadata contains taxonomic information on the Phylum, Family and Genus level.

All data are downloaded from ExperimentHub and cached for local re-use.

Value

a [TreeSummarizedExperiment](#)

Author(s)

Felix G.M. Ernst

Source

<https://qiita.ucsd.edu/study/description/10394>

References

Preservation Methods Differ in Fecal Microbiome Stability, Affecting Suitability for Field Studies. Se Jin Song, Amnon Amir, Jessica L. Metcalf, Katherine R. Amato, Zhenjiang Zech Xu, Greg Humphrey, Rob Knight. *mSystems* May 2016, 1 (3) e00021-16; DOI: 10.1128/mSystems.00021-16

Examples

```
tse <- SongQAData()
```

SprockettTHData

Obtain the Sprockett Tsimane Horticulturalists data

Description

Obtain the microbiome data from Sprockett et al. (2020).

Usage

```
SprockettTHData()
```

Details

The SprockettTHData dataset contains 16S rRNA gene based high-throughput profiling of 1966 Feces, 120 Saliva samples from 319 participants from Bolivia, Finland and Bangladesh. These include samples from adults, children, and infants. Several participants have longitudinal samples. The data consists of 2319 taxa from 2086 samples. The data set can be used to investigate assembly, structure, and dynamics as well as associations between several host related parameters with microbiota.

Column metadata includes the sex, age, feeding status, delivery mode, country, and other information.

The row metadata of the microbiome data contains taxonomic information on the Kingdom, Phylum, Class, Order, Family and Genus, Species and lowest taxonomic rank.

The row tree consists of a phylogenetic tree build using sequence information of 2319 taxa.

As reference sequences the ASV are provided.

All data are downloaded from ExperimentHub and cached for local re-use.

Value

a [TreeSummarizedExperiment](#)

Author(s)

Sudarshan A. Shetty and Felix G.M. Ernst

References

Sprockett, D.D., Martin, M., Costello, E.K. et al. (2020) Microbiota assembly, structure, and dynamics among Tsimane horticulturalists of the Bolivian Amazon. *Nat Commun* 11, 3772 <https://doi.org/10.1038/s41467-020-17541-6>

Subramanian, S., Huq, S., Yatsunenko, T., et al. (2014) Persistent gut microbiota immaturity in malnourished Bangladeshi children. *Nature* 510, 417-421 <https://doi.org/10.1038/nature13421>

Vatanen, T., Kostic A.D., d’Hennezel E., et al. (2016) Variation in microbiome LPS immunogenicity contributes to autoimmunity in humans. *Cell* 165, 842-853 <https://doi.org/10.1016/j.cell.2016.04.007>

Examples

```
tse <- SprockettTHData()
```

Index

artificialgut (SilvermanAGutData), 9
atlas1006 (LahtiWAData), 7
availableDataSets, 2

baboongut (GrieneisenTSDData), 3

dietswap (OKeefeDSDData), 8

GrieneisenTSDData, 3

HintikkaXOData, 5

LahtiMData (LahtiMLData), 6
LahtiMLData, 6
LahtiWAData, 7

microbiomeDataSets-package, 2
MultiAssayExperiment, 5, 7

OKeefeDSDData, 8

peerj32 (LahtiMLData), 6

qa10934 (SongQAData), 10

SilvermanAGutData, 9
SongQAData, 10
SprocketTHData, 11
SummarizedExperiment, 7

TreeSummarizedExperiment, 4, 7–12