

# Package ‘multiMiR’

April 16, 2024

**Title** Integration of multiple microRNA-target databases with their disease and drug associations

**Version** 1.24.0

**Description** A collection of microRNAs/targets from external resources, including validated microRNA-target databases (miRecords, miRTarBase and TarBase), predicted microRNA-target databases (DIANA-microT, EIMMO, MicroCosm, miRanda, miRDB, PicTar, PITA and TargetScan) and microRNA-disease/drug databases (miR2Disease, Pharmaco-miR VerSe and PhenomiR).

**URL** <https://github.com/KechrisLab/multiMiR>

**BugReports** <https://github.com/KechrisLab/multiMiR/issues>

**Depends** R (>= 3.4)

**Imports** stats, XML, RCurl, purrr (>= 0.2.2), tibble (>= 1.2), methods, BiocGenerics, AnnotationDbi, dplyr,

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**VignetteBuilder** knitr

**License** MIT + file LICENSE

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add.multimir.links      *Add External Database Link for Each of the multiMiR Result Entry*

---

**Description**

This is an internal multiMiR function that is not intended to be used directly. Please use `get_multimir`.

**Usage**

```
add.multimir.links(x, org)
```

**Arguments**

|     |   |
|-----|---|
| x   | table/dataset returned by multimir db     |
| org | Organism (see <code>get_multimir</code> ) |

**Value**

The input data frame x with a column added for the external database links.

---

all\_tables      *Functions defining the category each table belongs to.*

---

**Description**

One of three types: predicted, validated, or diseasedrug. Additionally two functions define characteristics of tables: those without a target column `tables_wo_target` and those with conserved target sites `conserved_tables`.

**Usage**

```
all_tables()
validated_tables()
predicted_tables()
diseasedrug_tables()
tables_wo_target()
conserved_tables()
reverse_table_lookup(.table)
table_types()
```

**Arguments**

.table            a table name

**Value**

Returns dataset that names that belong to the category of the function name (e.g. `validated_tables()` returns tables with validated miRNA-target interactions). `reverse_table_lookup()` does the opposite; it returns the category a given .table belongs to.

**Examples**

```
all_tables()
validated_tables()
predicted_tables()
diseasedrug_tables()
predicted_tables() %in% all_tables() # TRUE
table_types()
```

---

as.mmquery

*S3 constructor and methods for object returned by `get_multimir()`.*

---

**Description**

This package's primary user-facing object. Contains the SQL statement and the returned data query, as well as a summary table depending on specified option.

**Usage**

```
as.mmquery(a_list)

## S3 method for class 'mmquery'
print(x)
```

**Value**

An mmquery object.

---

|                      |   |
|----------------------|---|
| as_mmysql_components | <i>S3 Class constructors for objects defining SQL query components and a collection of these parts (mmysql_components).</i> |
|----------------------|---|

---

### Description

The collection object has a defined set of components that match the multiMiR database and defined options in `get_multimir()`. Conceptually this is split into two parts, the relatively straightforward SELECT, FROM, and ON portion of the query and the more complex filtering and sorting operations: WHERE and ORDER BY. The latter have their own classes, the former are resolved as strings (or character vectors) in the functions defining handling of each sql table (`sql_ prefix`).

### Usage

```
as_mmysql_components(.select = NULL, .from = NULL, .on = NULL,
  .where_list = NULL, .orderby = NULL, typeattr = NULL)
```

```
as_where_list(...)
```

```
as_where(.vars, .connect = NULL, .operator, .value = "%s")
```

```
is_where(x)
```

```
as_orderby(.vars, .order)
```

### Value

`as_mmysql_components`: A collection of components that make up a SQL query. `as_where_list`, `as_where`, `as_orderby`: Individual components of a SQL query.

---

|              |  |
|--------------|--|
| build_mmysql | <i>Constructors for parts of SQL queries Expand_query converts a mmyquery object to a SQL query string</i> |
|--------------|--|

---

### Description

Constructors for parts of SQL queries `Expand_query` converts a `mmyquery` object to a SQL query string

### Usage

```
build_mmysql(.table, org, mirna = NULL, target = NULL, disease.drug = NULL,
  predicted.site = NULL, predicted.cutoff.type = NULL,
  predicted.cutoff = NULL, limit = NULL)
```

expand\_query(x)  
 expand\_select(x)  
 expand\_from(x)  
 expand\_on(x)  
 expand\_where\_list(x)  
 expand\_where(x)  
 expand\_orderby(x)  
 expand\_limit(x)  
 merge\_order(.list)

**Value**

A complete SQL statement and related information.

---

|                |  |
|----------------|--|
| default_cutoff | <i>If null, set default predicted.cutoff</i> |
|----------------|--|

---

**Description**

If null, set default predicted.cutoff

**Usage**

default\_cutoff(predicted.cutoff.type, predicted.cutoff)

**Value**

The default cutoff value.

---

|               |   |
|---------------|---|
| deprecate_arg | <i>Internal function for sending deprecation messages</i> |
|---------------|---|

---

**Description**

Internal function for sending deprecation messages

**Usage**

deprecate\_arg(name = c("url", "schema.file", "db.tables", "cutoff.file"))

**Arguments**

name                    Name of a deprecated function argument.

**Value**

A message indicating deprecated arg and new version.

---

|                 |  |
|-----------------|--|
| extract_mmquery | <i>Creates all objects needed for the legacy S3 return object and the new S4 object.</i> |
|-----------------|--|

---

**Description**

Creates all objects needed for the legacy S3 return object and the new S4 object.

**Usage**

```
extract_mmquery(outlist, org, .args, summary = FALSE, use.tibble = FALSE)
```

**Value**

A list of data queried, summary of results, and related input parameters.  
a list for packaging by `as.mmquery` and `as.mmquery_bioc`

---

|                                   |   |
|-----------------------------------|---|
| <code>get.multimir.cutoffs</code> | <i>Load Pre-calculated Prediction Score Cutoffs in the multiMiR Package</i> |
|-----------------------------------|---|

---

**Description**

This is an internal multiMiR function that is not intended to be used directly. Please set prediction score cutoff in `get_multimir`.

**Usage**

```
get.multimir.cutoffs(name = NULL, cutoff.file = NULL)
```

**Arguments**

cutoff.file            Deprecated. Set path to cutoffs file with the global option `multimir.cutoffs`.

**Value**

Cutoff values object from remote database.

---

 get\_multimir

*Get microRNA-target Interactions from the multiMiR Package*


---

## Description

The main function to retrieve predicted and validated miRNA-target interactions and their disease and drug associations from the multiMiR package.

## Usage

```
get_multimir(url = NULL, org = "hsa", mirna = NULL, target = NULL,
  disease.drug = NULL, table = "validated", predicted.cutoff = NULL,
  predicted.cutoff.type = "p", predicted.site = "conserved",
  summary = FALSE, add.link = FALSE, use.tibble = FALSE, limit = NULL,
  legacy.out = FALSE)
```

```
get.multimir(url = NULL, org = "hsa", mirna = NULL, target = NULL,
  disease.drug = NULL, table = "validated", predicted.cutoff = NULL,
  predicted.cutoff.type = "p", predicted.site = "conserved",
  summary = FALSE, add.link = FALSE, use.tibble = FALSE, limit = NULL)
```

## Arguments

|              |   |
|--------------|---|
| url          | Deprecated. The URL for queries is now defined by the package options <code>multimir.url</code> and <code>multimir.queries</code> .   |
| org          | a character string for the organism. Three organisms are supported so far: human ("hsa" (default), "human", or "Homo Sapiens"), mouse ("mmu", "mouse", or "Mus musculus"), and rat ("rno", "rat", or "Rattus norvegicus"). The organism is case insensitive.  |
| mirna        | 'NULL' (default) or a character string or character vector for the mature miRNA(s). It can be the mature miRNA accession number (i.e. "MIMAT0000072"), mature miRNA ID (i.e. "hsa-miR-199a-3p"), or a combination of both (i.e. c("MIMAT0000065", "hsa-miR-30a-5p")). The character is case insensitive. *See note about the length of list supported.  |
| target       | 'NULL' (default) or a character string or character vector for the target gene(s). It can be the gene symbol (i.e. c("TP53", "KRAS")), Entrez gene ID (i.e. c(578, 3845)), Ensembl gene ID (i.e. "ENSG00000171791"), or a combination of any of these identifiers (i.e. c("TP53", 3845, "ENSG00000171791")). The character is case insensitive. *See note about the length of list supported. |
| disease.drug | 'NULL' (default) or a character string or character vector for the disease(s) and/or drug(s) (i.e. c("bladder cancer", "cisplatin")). The character is case insensitive.  |
| table        | a character string indicating which table(s) in multiMiR to search. Each table contains data from an external database. Options include "validated" (default, to search all validated tables "mirecords", "mirtarbase", and "tarbase"), "predicted" (to search all predicted tables "diana_microt", "elmmo", "microcosm",   |



|                       |  |
|-----------------------|--|
|                       | "miranda", "mirdb", "pictar", "pita", and "targetscan"), "disease.drug" (to search all disease/drug tables "mir2disease", "pharmacology_mir", and "phenomir"), "all" (to search all of the tables above), or an individual table from above.   |
| predicted.cutoff      | 'NULL' (default) or an integer giving a prediction score cutoff. By default ('NULL'), the cutoff is '20' (search the top 20% if predicted.cutoff.type="p") or '300000' (search the top 300000 (or all records if total < 300000) if predicted.cutoff.type="n").  |
| predicted.cutoff.type | a character indicating the type of prediction score cutoff. This must be either "p" (default, percentage cutoff) or "n" (number cutoff).   |
| predicted.site        | a character string indicating the type of predicted target sites to search. This can be one of the strings "conserved", "nonconserved", or "all", and can be abbreviated. This only applies to three of the predicted tables ("miranda", "pita", and "targetscan") that have conservation information of the target sites. |
| summary               | logical. Whether to summarize the result (default = FALSE).  |
| add.link              | logical. Whether to add link to external database for each result entry.   |
| use.tibble            | logical. Whether to use the data_frame class from the tibble package for returned dataframes. The key benefit for large datasets is more restrictive printing to the console (first 10 rows and only the number of columns that will fit getOption('width')). See ?tibble::data_frame for more information.                |
| limit                 | a positive integer. Limits the number of records returned from each table. Useful in testing potentially large queries.  |
| legacy.out            | logical. Whether to return the Bioconductor compatible S4 object or the legacy S3 object (default=FALSE).  |

## Details

get.multimir() has been deprecated and replaced with the get\_multimir() version.

get\_multimir is the main and recommended function to retrieve information from the multiMiR package. Input to the function must contain at least one of the followings: miRNA(s), target gene(s), and disease and drug term(s).

The setting of predicted.site is applicable to three ("miranda", "pita", and "targetscan") of the eight predicted tables. If predicted.site is "conserved", the function will search conserved target sites annotated by TargetScan, target sites with conservation scores greater than or equal to 0.57 (in human and rat; or 0.566 in mouse) in miRanda, and/or sites with conservation scores greater than or equal to 0.9 in PITA.

Although the summary (if summary=TRUE) can be used to find results that are recorded by combinations of different databases, please note that for predicted interactions a combination approach may not be as effective as a single algorithm because of age or quality of the tool.

Note: The length of the list supported has been increased from version 1.0.1. The size is now limited to 20MB which should accommodate most requests. There is a possibility for technical reasons that the query could fail even if the list is under this limit. If this occurs it is recommended that you break up the list into smaller batches and submit them sequentially.

**Value**

get\_multimir returns an S4 object (see ?mmquery\_bioc-class containing the queried data and associated metadata. With legacy.out=FALSE (default), the data is a single dataset with association/interaction type defined by the type variable. With legacy.out=TRUE the original S3 object with 3 separate data frames ('predicted', 'validated', and 'disease\_drug') is returned.

**Examples**

```
## search 'hsa-miR-18a-3p' in validated interactions in human
example1 <- get_multimir(mirna='hsa-miR-18a-3p', summary=TRUE)
columns(example1)
## target genes that are validated by Luciferase assay
lucif <- select(example1, keytype = "type", keys = "validated",
                columns = columns(example1))
lucif[grep("Luciferase", lucif$experiment), ]
example1@summary[example1@summary[, "target_symbol"] == "KRAS", ]

## search 'cisplatin' in disease and drug tables in human
example2 <- get_multimir(disease.drug='cisplatin', table='disease.drug')
nrow(example2@data)
head(example2@data)
```

---

list\_multimir

*List microRNAs, Genes, Drugs Or Diseases in the multiMiR Package*


---

**Description**

list\_multimir lists all the unique microRNAs, target genes, drugs, or diseases in the web server of the multiMiR package.

**Usage**

```
list_multimir(x = c("mirna", "gene", "drug", "disease"), limit = NULL,
              url = NULL)
```

```
list.multimir(x = c("mirna", "gene", "drug", "disease"), limit = NULL,
              url = NULL)
```

**Arguments**

|       |   |
|-------|---|
| x     | a character string indicating what to list. This must be one of the strings "mirna" (default), "gene", "drug", or "disease". This can be abbreviated and is case insensitive. |
| limit | a positive integer. Limits the number of records returned from each table. Useful in testing potentially large queries.   |
| url   | Deprecated. Use global option multimir.url instead.   |

**Details**

list.multimir() has been deprecated and replaced with the list\_multimir() version.

**Value**

list\_multimir returns a data frame with information of microRNAs (microRNA unique ID, organism, mature microRNA accession number, and mature microRNA ID), target genes (gene unique ID, organism, gene symbol, Entrez gene ID, and Ensembl gene ID), drugs (drug names), and diseases (disease name).

**Author(s)**

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**Examples**

```
mirnas <- list_multimir("mirna", limit = 10)
genes <- list_multimir("gene", limit = 10)
drugs <- list_multimir("drug", limit = 10)
diseases <- list_multimir("disease", limit = 10)
```

---

mmquery\_bioc-class      *S4 constructor and methods for object returned by get\_multimir().*

---

**Description**

This package's primary user-facing object. Contains the SQL statement and the returned data query, as well as a summary table depending on specified option. Note that the returned data is now contained in a single dataframe. To filter to a specific type of association or interaction, select on the type variable.

**Usage**

```
as.mmquery_bioc(.list)

## S4 method for signature 'mmquery_bioc'
columns(x)

## S4 method for signature 'mmquery_bioc'
keys(x, keytype, ...)

## S4 method for signature 'mmquery_bioc'
keytypes(x)

## S4 method for signature 'mmquery_bioc'
select(x, keys, columns, keytype, ...)

## S4 method for signature 'mmquery_bioc'
show(object)
```

**Arguments**

|                        |  |
|------------------------|--|
| <code>.list</code>     | a list of returned dataframes, summary   |
| <code>x, object</code> | An <code>mmquery_bioc</code> object.   |
| <code>keytype</code>   | allows the user to discover which keytypes can be passes in to select or keys and the <code>keytype</code> argument  |
| <code>...</code>       | additional arguments   |
| <code>keys</code>      | A result of the <code>keys()</code> function. For the <code>mmquery_bioc</code> class this is a character vector of microRNA's in the returned <code>mmquery_bioc</code> object. |
| <code>columns</code>   | lists the columns that can be returned for the <code>mmquery_bioc</code> object.   |

**Value**

an `s4` object of class `mmquery_bioc`. Contains queried data, a summary dataset, and associated input parameters.

**Slots**

|                                    |  |
|------------------------------------|--|
| <code>data</code>                  | A dataframe containing validated and predicted microRNA-target interactions and disease/drug associations found. |
| <code>queries</code>               | A list of queries submitted to the multiMiR SQL server.  |
| <code>summary</code>               | A summary dataframe of the returned microRNA dataframes  |
| <code>tables</code>                | A character vector of the microRNA relationship types returned (validated, predicted, disease.drug, or all).     |
| <code>org</code>                   | The selected organism (hsa/human, mmu/mouse, rno/rat).   |
| <code>predicted.cutoff</code>      | An integer giving a prediction score cutoff.   |
| <code>predicted.cutoff.type</code> | A character indicating the type of prediction score cutoff (p = percentage, n = number, character() = none)      |
| <code>predicted.site</code>        | A character string indicating the type of predicted target sites to searched.                                    |

---

multiMiR

---

*MultiMiR: R package for accessing the multiMiR database*


---

**Description**

This package provides an interface to the multiMiR database of microRNA-target interactions, and disease and drug associations. See <http://multimir.org> and the vignette ('multiMiR') for more details.

**References**

[Add reference here]

---

|                  |  |
|------------------|--|
| multimir.summary | <i>Summarize microRNA/target Information from the multiMiR Package</i> |
|------------------|--|

---

**Description**

This is an internal multiMiR function that is not intended to be used directly. Please use `get_multimir`.

**Usage**

```
multimir.summary(result, pair.index = 2:6, order.by = "all.sum")
```

**Arguments**

|            |             |
|------------|-------------|
| result     | PLACEHOLDER |
| pair.index | PLACEHOLDER |
| order.by   | PLACEHOLDER |

**Value**

Summary of objects queries from databse

---

|                 |   |
|-----------------|---|
| multimir_dbInfo | <i>Collect Information About the Web Server And Database of the multi-MiR Package</i> |
|-----------------|---|

---

**Description**

Functions for collecting and displaying information about the web server and database of the multiMiR package.

**Usage**

```
multimir_dbInfo(url = NULL)

multimir_dbInfoVersions(url = NULL)

multimir_dbSchema(schema.file = NULL)

multimir_dbTables(url = NULL)

multimir_dbCount(url = NULL)
```

**Arguments**

|                          |  |
|--------------------------|--|
| <code>url</code>         | Deprecated. Use global option <code>multimir.url</code> instead.                                       |
| <code>schema.file</code> | Deprecated. Option exists as <code>multimir.schema</code> , but it should not need to be set directly. |

**Details**

`multimir.url` is a global option containing the URL of the multiMiR web server. Set using `options("multimir.url" = ...)`

`multimir_dbCount` returns counts of records in the tables in the multiMiR database. Each table contains data from an external miRNA/target database.

`multimir_dbInfo` returns other information about the multiMiR database. This includes information of external miRNA/target databases in multiMiR.

`multimir_dbInfoVersions` returns other information about the multiMiR database versions available. This provides a list of available options if switching to previous version is desired.

`multimir_dbSchema` prints the schema definition of the multiMiR database.

`multimir_dbTables` returns the vector of tables in the multiMiR database and saves it to the global option `multimir.tables.list`. This function is automatically run when `get_multimir` is called if the `multimir.tables.list` is `NULL`.

**Value**

`multimir_dbCount`: a data frame with the count of records in each of the tables in the multiMiR database.

`multimir_dbInfo`: a data frame with information about the multiMiR database.

`multimir_dbInfoVersions`: a data frame with information about the multiMiR database versions.

`multimir_dbSchema`: none (invisible `NULL`).

`multimir_dbTables`: a data frame with table names in the multiMiR database.

**Examples**

```
this_url <- getOption("multimir.url")
this_url
options(multimir.url = this_url)

db_ver <- multimir_dbInfoVersions()

db_count <- multimir_dbCount()

db_info <- multimir_dbInfo()

multimir_dbSchema()

db_tables <- multimir_dbTables()
```

---

`multimir_switchDBVersion`*Manage Database Version to use*

---

**Description**

Functions for managing the database version used to complete requests on the web server.

**Usage**

```
multimir_switchDBVersion(db_version, url = NULL)
```

**Arguments**

|                         |   |
|-------------------------|---|
| <code>db_version</code> | A character string containing the full version number for the database version to use for for all package functions. The default will be the most recent version. |
| <code>url</code>        | Deprecated. Use global option <code>multimir.url</code> instead.  |

**Details**

`url` is a character string containing the URL of the multiMiR web server. Optional as it is set when the package is loaded.

`multimir_dbInfoVersions` returns other information about the multiMiR database versions available. This provides a list of available options if switching to previous version is desired.

`multimir_switchDBVersion` returns other information about the multiMiR database versions available. This provides a list of available options if switching to previous version is desired.

**Value**

`multimir_dbInfoVersions`: a data frame with information about the multiMiR database versions.  
`multimir_switchDBVersion`: none (invisible NULL).

**Examples**

```
multimir_dbInfoVersions()  
multimir_switchDBVersion(db_version="2.0.0")
```

---

|            |  |
|------------|--|
| null_to_df | <i>Replace nulls with an empty object of each type</i> |
|------------|--|

---

**Description**

Replace nulls with an empty object of each type

**Usage**

null\_to\_df(x)

null\_to\_num(x)

null\_to\_char(x)

**Arguments**

x                   input object

**Value**

an empty data.frame, numeric, or character vector.

---

|     |  |
|-----|--|
| pad | <i>Pad single space on each side of an input</i> |
|-----|--|

---

**Description**

Pad single space on each side of an input

**Usage**

pad(x)

**Value**

Input value wrapped in single spaces.



---

|              |   |
|--------------|---|
| parens_quote | <i>Prep certain names for use in SQL query by adding parens</i> |
|--------------|---|

---

**Description**

Prep certain names for use in SQL query by adding parens

**Usage**

parens\_quote(x)

**Value**

The input value wrapped in quotes and then parentheses.

---

|             |   |
|-------------|---|
| parens_wrap | <i>Collapse a vector to a single comma-separated string and wrap in parentheses</i> |
|-------------|---|

---

**Description**

Collapse a vector to a single comma-separated string and wrap in parentheses

**Usage**

parens\_wrap(x)

**Value**

The input vector converted to a comma-separated string wrapped in parentheses.

---

|            |  |
|------------|--|
| parse_orgs | <i>Each org can be specified in one of 3 ways – this standardizes the argument into the 3 char abbreviation.</i> |
|------------|--|

---

**Description**

Each org can be specified in one of 3 ways – this standardizes the argument into the 3 char abbreviation.

**Usage**

parse\_orgs(org)

**Value**

A standardized, abbreviated form of the input org.

---

|                |   |
|----------------|---|
| parse_response | <i>Parse the Result Returned by the multiMiR Web Server</i> |
|----------------|---|

---

**Description**

This is an internal multiMiR function that is not intended to be used directly. Please use `get_multimir`.

**Usage**

```
parse_response(HTML . response)
```

**Value**

The queried table portion of the HTML response.

---

|                |  |
|----------------|--|
| query_multimir | <i>Wrapper for search_multimir for adding feature (printing notification to console)</i> |
|----------------|--|

---

**Description**

Wrapper for `search_multimir` for adding feature (printing notification to console)

**Usage**

```
query_multimir(x, org, add.link, use.tibble)
```

**Value**

The queried multimir data with the addition of a requested feature.

---

|            |   |
|------------|---|
| quote_wrap | <i>Internal function for adding single quotes around a string</i> |
|------------|---|

---

**Description**

Internal function for adding single quotes around a string

**Usage**

```
quote_wrap(x)
```

**Arguments**

`x` a string to be wrapped in single quotes.

**Value**

The input wrapped in single quotes.

---

remove\_empty\_strings    *Remove empty strings from character vector.*

---

**Description**

The WHERE clauses for target and mirna use allow for multiple arguments always separated by 'OR' and several columns are checked for each value (mirna id, acc; target symbol, entrez, ensemble). If empty strings "" are present in the get\_multimir arguments, Targets and miRNA with empty values in one of these columns will be incorrectly returned. – thus purge empty strings first.

**Usage**

```
remove_empty_strings(x)
```

**Arguments**

x                    A character vector

**Value**

A character vector with empty strings removed

---

remove\_table            *Remove tables x from a vector of table names.*

---

**Description**

Typically used when a set of arguments don't apply to a table or would return an error/empty response

**Usage**

```
remove_table(tables, x)
```

**Arguments**

tables                A character vector.  
x                      A second character vector to remove from the first (tables).

**Value**

Character vector tables excluding the strings matching those in x.

---

|                 |   |
|-----------------|---|
| search_multimir | <i>Search the multiMiR Database Given a MySQL Query</i> |
|-----------------|---|

---

### Description

This is a function for directly querying the multiMiR database with MySQL queries. Given a MySQL query, it searches and retrieves result from the multiMiR database on the multiMiR web server. To use search\_multimir directly, users will need to be familiar with MySQL and multiMiR table structures. Users are advised to use get\_multimir instead.

### Usage

```
search_multimir(query)
```

```
search.multimir(query)
```

### Arguments

query            a character string for the MySQL query.

### Details

search.multimir() has been deprecated and replaced with the search\_multimir() version.

### Value

search\_multimir returns a data frame containing results from the multiMiR web server.

### Examples

```
## show all tables in the multiMiR database
tables <- search_multimir(query="show tables")

## show the structure of table diana_microt
microt <- search_multimir(query="describe diana_microt")

## search for validated target genes of hsa-miR-18a-3p in miRecords
qry <- paste("SELECT m.mature_mirna_acc, m.mature_mirna_id,",
            "  t.target_symbol, t.target_entrez, t.target_ensembl,",
            "  i.experiment, i.support_type, i.pubmed_id",
            "FROM mirna AS m INNER JOIN mirecords AS i INNER JOIN target",
            "AS t ON (m.mature_mirna_uid=i.mature_mirna_uid AND",
            "  i.target_uid=t.target_uid)",
            "WHERE m.mature_mirna_id='hsa-miR-18a-3p'")
result <- search_multimir(query = qry)
```

---

|          |   |
|----------|---|
| split_by | <i>Split, order and sort lists by their components.</i> |
|----------|---|

---

**Description**

Copied from purrr:v0.2.2

**Usage**

```
split_by(.x, .f, ...)
```

**Arguments**

|     |  |
|-----|--|
| .x  | A list or atomic vector.               |
| .f  | A function, formula, or atomic vector. |
| ... | Additional arguments passed on to .f.  |

**Value**

A list split by .f

---

|         |  |
|---------|--|
| sql_org | <i>Functions defining the WHERE clauses.</i> |
|---------|--|

---

**Description**

Functions defining filtering by organism (org), disease/drug, conserved, and cutoff. Filtering by mirna and target are defined within their sql\_... functions.

**Usage**

```
sql_org(.table, org)

where_org(.table, org)

where_diseasedrug(.table, disease.drug)

where_conserved(.table, org, predicted.site)

where_cutoff(.table, score_var, score_cutoff)

create_cutoff_name(.table, org, predicted.site)

cutoff_to_score(.table, cutoff_name, predicted.cutoff.type, predicted.cutoff)
```

**Value**

The WHERE portion of a SQL query

---

|               |  |
|---------------|--|
| sql_validated | <i>Generate mmysql_components objects for each of the three types of tables, as well as the mirna and target tables.</i> |
|---------------|--|

---

**Description**

The three types of tables are predicted, validated, and diseasedrug (disease/drug). Additionally, mirna and target portions of the SQL statements are defined, including their filter clauses (WHERE).

**Usage**

```
sql_validated(.table)
```

```
sql_predicted(.table, org, predicted.site, predicted.cutoff.type,  
predicted.cutoff)
```

```
sql_diseasedrug(.table, disease.drug)
```

```
sql_mirna(mirna)
```

```
sql_target(.table, target)
```

**Value**

Components of a SQL query specific to each table type.

---

|                |  |
|----------------|--|
| submit_request | <i>General workhorse function for submitting and returning queries</i> |
|----------------|--|

---

**Description**

This is an internal multiMiR function that is not intended to be used directly. Please use `get_multimir`.

**Usage**

```
submit_request(url = full_url("multimir.queries"), query, ...)
```

**Value**

Table requested in query.

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