Fat&Muscle DB

A database to understand tissue growth processes contributing to body or muscle composition

Jérémy Tournayre, Isabelle Cassar-Malek, Matthieu Reichstadt, Brigitte Picard, Nicolas Kaspric and Muriel Bonnet

JOBIM

Journées Ouvertes en Biologie, Informatique & Mathématique

7th of July, 2015

INRA SCIENCE & IMPACT

VetAgro Sup

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Context

Fat&Muscle DB

Genomics generates a huge amount of data

NCBI

GEO Gene Expression Omnibus

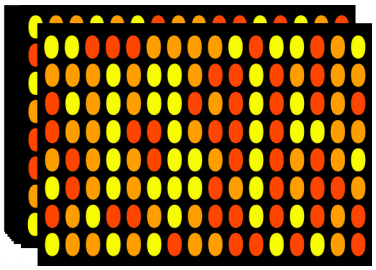
PubMed

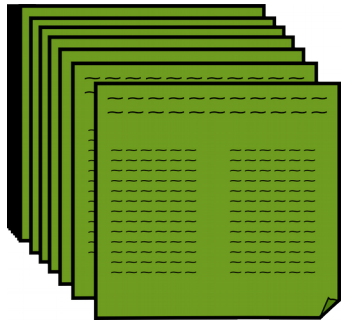
WEB OF SCIENCE™

52,000

1,000,000

430,000





- Oncomine: biomarkers of cancer
  ONCOMINE: A Cancer Microarray Database and Integrated Data-Mining Platform (*Daniel R Rhodes, 2004*)
- EURRECA (EURopean micronutrients RECommendations Aligned):
  Assessing potential biomarkers of micronutrient status by using a systematic review methodology: methods (*Lee Hooper et al., 2009*)

Context

Fat&MuscleDB

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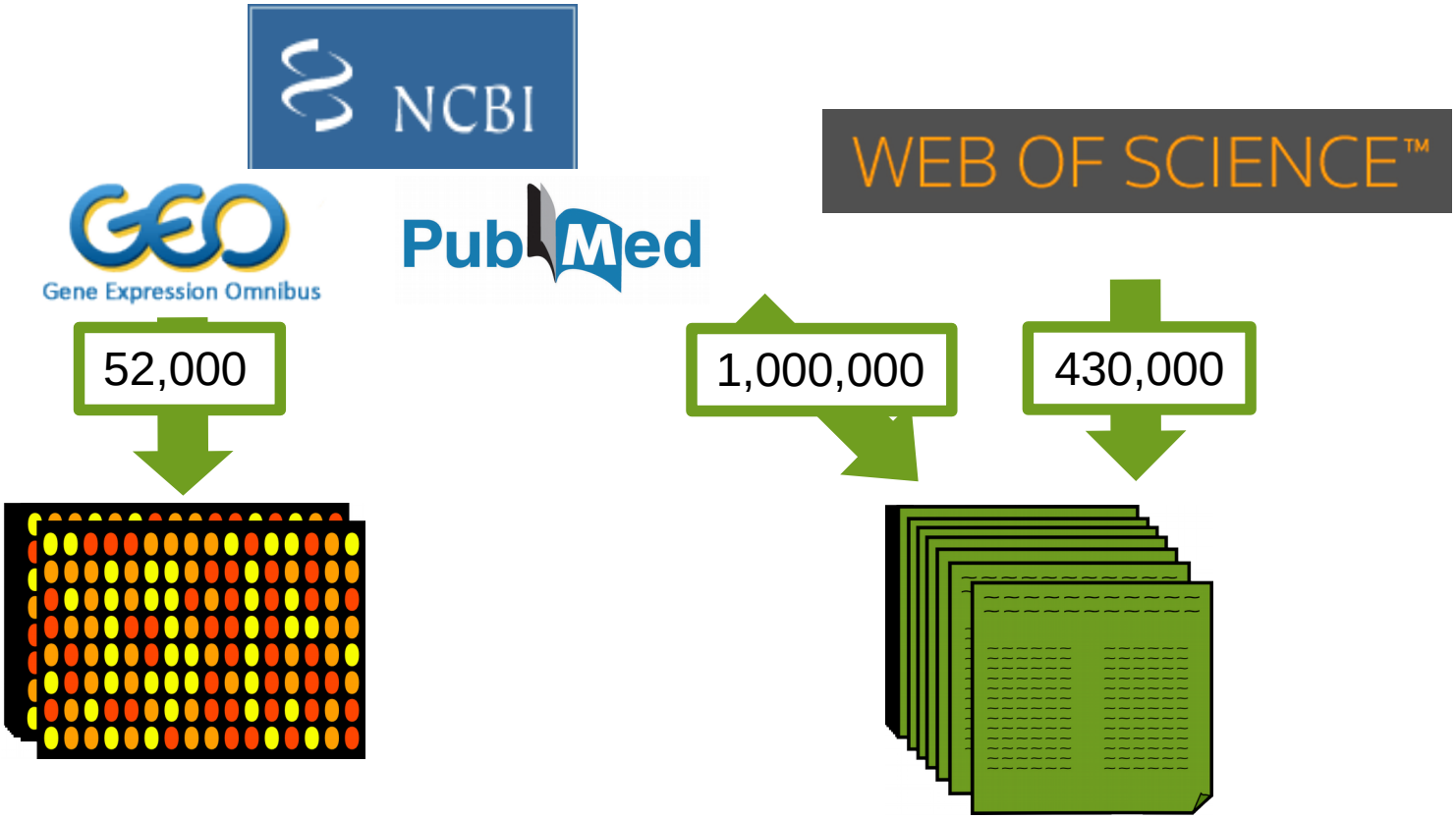

Objective: In the context of carcass and meat qualities we hypothesised that aggregating data could help to understand mechanisms underlying fat and muscle hypertrophy and hyperplasia → Fat&MuscleDB

Workflow of the development of Fat&MuscleDB

To target publications and data

Fat&Muscle DB

Select → Extract → Classify → Visualise → Aggregate

Keywords

Cellular and tissular traits linked to muscle and adipose tissue growth (86)
e.g. Adipose tissue, muscle, marbling, double-muscled, carcasses, meat qualities...

Species and cell lines (26)
e.g. Bovine, 3T3-L1, C2C12...

Methods (12)
e.g. Transcriptome, proteome...

Keywords to exclude
e.g. Diseases, carcinoma...

NCBI GEO Gene Expression Omnibus PubMed WEB OF SCIENCE™

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~28,000 combinations

Number of references:

~18,000 publications

PubMed WEB OF SCIENCE™

~2,500 transcriptomic data

GEO Gene Expression Omnibus

To target publications and data

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e.g. Diseases, carcinoma...

Number of references:

~18,000 publications (PubMed, WEB OF SCIENCE™)

~2,500 transcriptomic data (GEO Gene Expression Omnibus)

Curators

~410 Publications

~170 Transcriptomics data

Data extraction from publications

Fat&Muscle DB

Select | **Extract** | Classify | Visualise | Aggregate

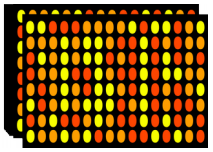
Target genes of myostatin loss-of-function in muscles of late bovine fetuses.
Isabelle Cassar-Malek et al., 2007

Examples of up-regulated genes in DM *semitendinosus*

Gene symbol	Gene name	Fold change	Homology
2610103N14Rik	Slc16a10 Solute carrier family 16	2.76	53%
2410044K02Rik	Thoc3 THO complex 3	2.64	96%
SURF1	Surfeit 1	2.54	88%
LOC58504	Hypothetical protein from clones 23549 and 23762	2.52	86%
Slc26a4	Solute carrier family 26, member 4	2.48	ND
FLJ13855	Hypothetical protein FLJ13855	2.36	94%

Semi-automatic extraction with these tools: Tabula, Pdf2text

Data extraction from GEO

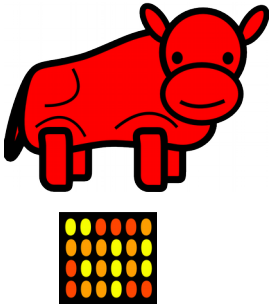


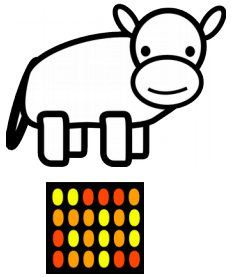
Fat&Muscle DB

Select | **Extract** | Classify | Visualise | Aggregate

What are the transcripts differentially expressed between two conditions ?

Double-muscled Charolais (260 days post coitum)





Control Charolais (260 days post coitum)

(source on GEO: GSE5456)

Muscular hypertrophy from genetic origin

Variance mixture from Anapuce (R library) (J. Aubert)
(http://cran.r-project.org/web/packages/anapuce/index.html)

Lists of:
- up-regulated genes
- down-regulated genes
- stable genes

Classification

Select → Extract → **Classify** → Visualise → Aggregate

Criteria

Muscle or adipose tissue growth from both in vivo and in vitro experiments
e.g. Muscular hypertrophy from genetic origin, 3T3-L1 differentiating into adipocytes...

Physiological traits
e.g. Double-muscled, high marbled, obese...

Cell lines
e.g. C2C12, 3T3-L1, C3H/10T1/2...

Tissues
e.g. Semitendinosus muscle, white adipose tissue...

Breeds
e.g. Charolais, holstein, piedmontese...

Data source
Publication name, chip(s), author(s)

Classification

Fat&Muscle DB

Select | Extract | **Classify** | Visualise | Aggregate

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Data source

Publication name, chip(s), author(s)

First condition	Second condition	State	Species	Breed	Tissue	Cell	Reference	Authors
Muscular hypertrophy from genetic origin	Reference	Double-muscled VS Control	Bovine	Charolais (260 Days)	Semitendinosus muscle	NA	Target genes of myostatin loss-of-function in muscles of late bovine fetuses. Link DOI Link Pubmed	Cassar-Malek I ; Passelaigue F ; Bernard C ; Léger J ; Hocquette JF

Data visualisation

Fat&MuscleDB

Select → Extract → **Classify** → Visualise → Aggregate

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Transcripts - Increased abundance | **Transcripts - Decreased abundance**

Analysed by Fat&MuscleDB	Uniprot conversion	Gene Symbol	Gene name	Fold
No	Q3U9N9	2610103N14Rik	Slc16a10 Solute carrier family 16	2.76
No	Q29RH4	2410044K02Rik	Thoc3 THO complex 3	2.64
No	F1N6P2	SURF1	surfeit 1	2.54
No	NA	LOC58504	Hypothetical protein from clones 23549 and 23762	2.52
No	E1BMB2	SLC26A4	solute carrier family 26, member 4	2.48
No	I7G9K3	FLJ13855	hypothetical protein FLJ13855	2.36
No	Q9Y236	C8orf1	Chromosome 8 open reading frame 1	2.27
No	G3X6W9	MYBPH	myosin binding protein H	2.27
No	Q13495	CXorf6	chromosome X open reading frame 6	2.19
No	A7MB74	ACCN2	amiloride-sensitive cation channel 2, neuronal	2.17

Data visualisation

Fat&Muscle DB

Select → Extract → Classify → **Visualise** → Aggregate

Search accessions

ADIPOQ

Presence

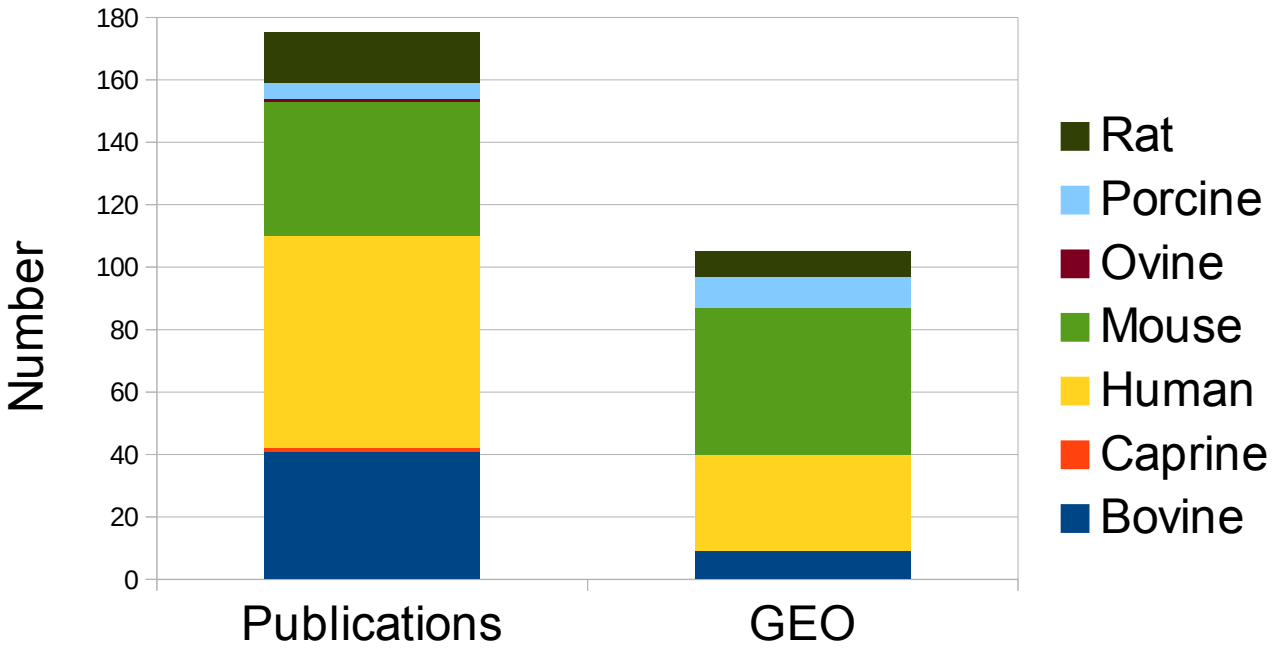
First condition	Second condition	Molecule	State	Species	Breed (age)	Biological sample	Reference	Authors
Proteins secreted by adipose tissues	Proteins secreted by adipose tissues	Proteins	[NA]	Rat	Sprague-Dawley Male (5 Weeks)	Gonadal adipose tissue	Secretome analysis of rat adipose tissues shows location-specific roles	Roca-Rivada, Arturo ; Alonso, Jana ; Al-Massadi, Omar ; Castelao, Cecilia ; Ramon Peinado, Juar Maria Seoane. Luisa
Proteins secreted by adipose tissues	Proteins secreted by adipose tissues	Proteins	Undergoing laparotomy to remove an intramural myoma	Human	(39 Years)	Omental	Comparison of isotope-labeled amino acid incorporation rates	Roelofsen H ; Dijkstra M ; Weening D ; de Vries MP ; Hoek A ; Vonk RJ

Current contents Fat&MuscleDB

~170 Publications

To be implemented

~100 Gene Expression Omnibus series



The number of publications and GEO relative to species

Aggregation

Select | Extract | Classify | Visualise | **Aggregate**

What are the transcripts and proteins involved in muscular hypertrophy from genetic origin ?

Condition	In Vivo In Vitro Muscular hypertrophy from genetic origin
Analysed by Fat&MuscleDB	All (All / Yes / No)
Species/Breeds	All
Tissue	All
Cell	All

Submit

- Muscular hypertrophy from genetic origin
- Muscular hypertrophy from myostatin mutation
- Muscular hypertrophy induced by a gene modification (except myostatin)
- Muscular hypertrophy induced by diet
- Muscular atrophy induced by diet
- Muscular hypertrophy linked to the growth physiology (age)
- Adipose hypertrophy from genetic origin
- Adipose hypertrophy induced by a gene modification
- Adipose hypertrophy induced by diet
- Adipose atrophy induced by diet
- Adipose hypertrophy linked to the growth physiology (age)
- Adipose hypertrophy linked to obesity
- Proteins secreted by muscles
- Proteins secreted by adipose tissues
- Adipose hypertrophy induced by gender
- Muscular hypertrophy induced by gender

Aggregation

Fat&MuscleDB

Select → Extract → Classify → Visualise → **Aggregate**

What are the transcripts and proteins involved in muscular hypertrophy from genetic origin ?

30 pairwise comparisons

Selected	Muscular hypertrophy from genetic origin	Adipose hypertrophy from genetic origin	Proteins	Higher intramuscul fat developmer VS Lower intramuscul	Bovine	Korean (27 Months)	Longissimus dorsi	NA	Differentially expressed proteins during fat accumulation in bovine	Zhang Q ; Lee HG ; Han JA ; Kim EB ; Kang SK ; Yin J :
Selected	Muscular hypertrophy from genetic origin	Adipose hypertrophy from genetic origin	Transcripts	Control	Bovine	Piedmontese (3 Months) VS Wagyu (3 Months)	Longissimus dorsi	NA	GSE25554	Reverter A ; Hudson N

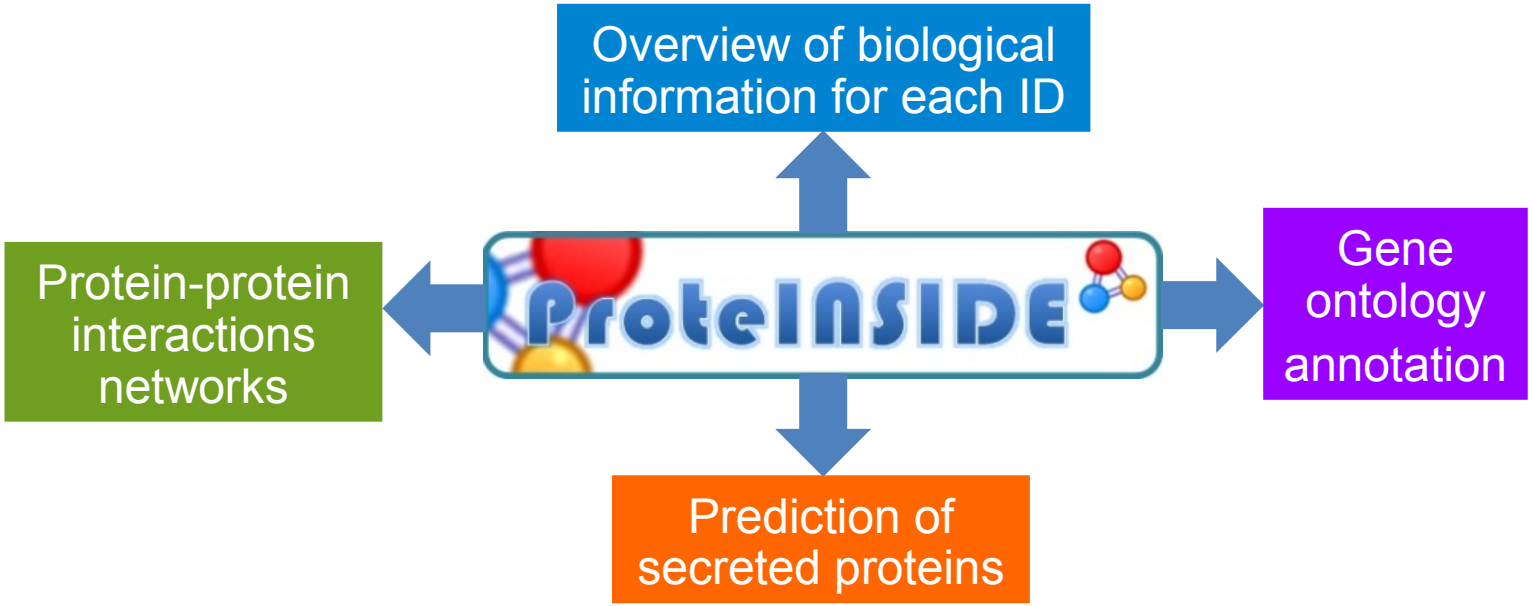
Decreased abundance | **Increased abundance** | **Stable abundance**

Analysed by Fat&MuscleDB	Uniprot	Entry Name	Reviewed	Count
No	Q0P571	MLRS_BOVIN	Yes	2
No	Q3SWW8	TSP4_BOVIN	Yes	2
No	A7MBI7	COMT_BOVIN	Yes	2
No	Q5KR47	TPM3_BOVIN	Yes	2

Analysis

(See: Demo-C1 | 14h30 by N. Kaspric)

Gene Names
CACNA1F
CCL18
COL4A2
CTBP1
DDAH1
FURIN
IL21R
ITGA3
LIMK1
LTA
LTB4R
MAMLD1
MGC159566
MRAS



ProteINSIDE to Easily Investigate Proteomics Data from Ruminants: Application to Mine Proteome of Adipose and Muscle Tissues in Bovine Foetuses (*Kaspric N et al. , 2015*)

Analysis

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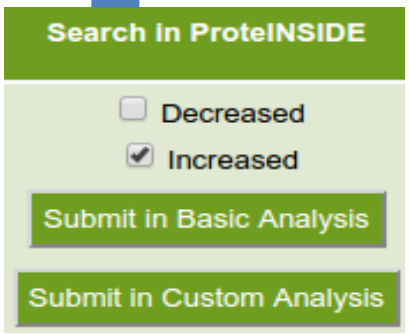
Gene Names
CACNA1F
CCL18
COL4A2
CTBP1
DDAH1
FURIN
IL21R
ITGA3
LIMK1
LTA
LTB4R
MAMLD1
MGC159566
MRAS

Overview of biological information for each ID

Protein-protein interactions networks

Gene ontology annotation

Prediction of secreted proteins



ProteINSIDE to Easily Investigate Proteomics Data from Ruminants: Application to Mine Proteome of Adipose and Muscle Tissues in Bovine Foetuses (*Kaspric N et al. , 2015*)

(Realised by A. Perot)

Conclusions

Perspectives

- Continue to feed Fat&MuscleDB
- Address research questions: e.g. what are the proteins involved in the cross-talk between adipose tissues and muscles (secretome)

Minimise unnecessary redundancy in research efforts by a better use of available data

Muriel Bonnet

Isabelle Cassar-Malek

Matthieu Reichstadt

Brigitte Picard

Nicolas Kaspric

Antoine Perot

Anne de la Foye

Thank you for your attention

To target publications and data

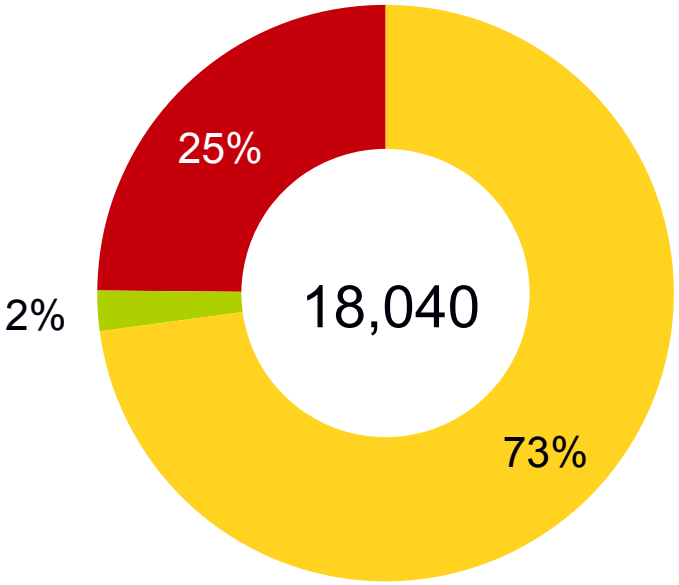
Fat&Muscle DB

Rejected

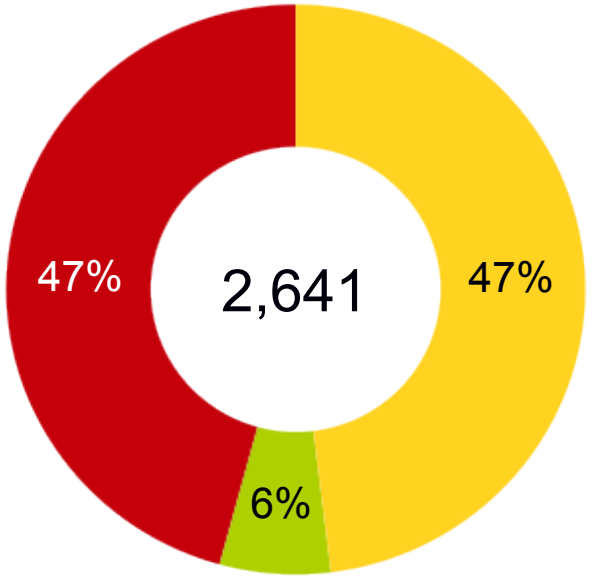
Not seen

Selected

Publications



Gene Expression Omnibus series



409 Publications

168 Gene Expression Omnibus series