

# MycoCosm KEGG Browser

KEGG stands for Kyoto Encyclopedia of Genes and Genomes at <http://www.genome.jp/kegg/>, which maintains a curated set of EC-annotated enzymes and their pathways. Each portal's KEGG Browser facilitates display and discovery of MycoCosm's KEGG-annotated genes.

**Scenario:** You have plated a variety of yeasts on a variety of carbon sources, and discovered that some members of the Pichiaceae grow on galactose (e.g. *Dekkera bruxellensis*) and some do not (e.g. *Pichia membranifaciens*). Use MycoCosm to find genes that could explain this metabolic difference.

- 1) Go to the MycoCosm Pichiaceae PhyloGroup at [genome.jgi.doe.gov/Pichiaceae](http://genome.jgi.doe.gov/Pichiaceae) :

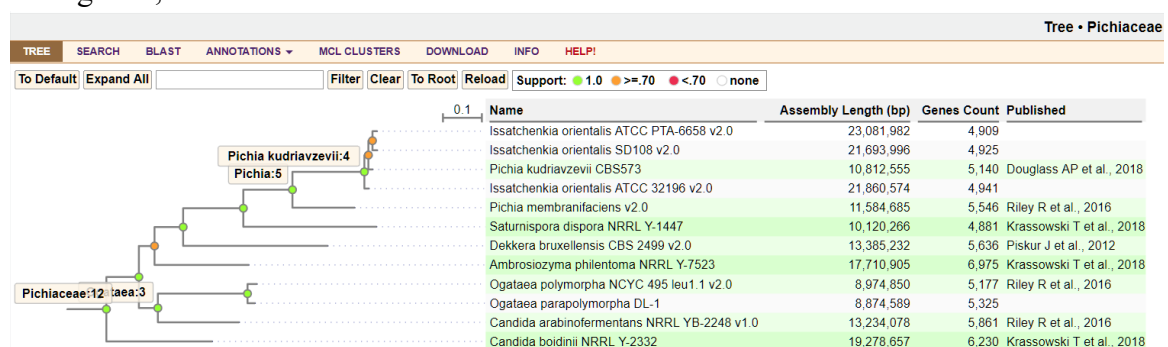
Info • Pichiaceae

TREE SEARCH BLAST ANNOTATIONS MCL CLUSTERS DOWNLOAD INFO **HELP!**

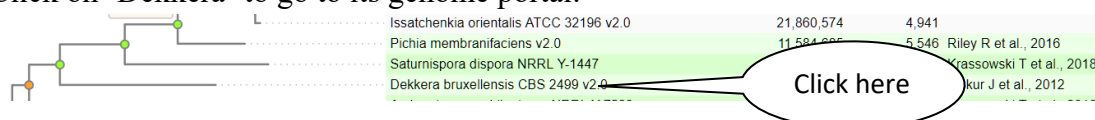
Group Name: Pichiaceae

##	Name	Assembly Length	# Genes	Published
1	<a href="#">Candida arabinoferrmentans NRRL YB-2248 v1.0</a>	13,234,078	5,861	<a href="#">Riley R et al., 2016</a>
2	<a href="#">Candida boidinii NRRL Y-2332</a>	19,278,657	6,230	<a href="#">Krassowski T et al., 2018</a>
3	<a href="#">Dekkera bruxellensis CBS 2499 v2.0</a>	13,385,232	5,636	<a href="#">Piskur J et al., 2012</a>
4	<a href="#">Issatchenkia orientalis ATCC 32196 v2.0</a>	21,860,574	4,941	
5	<a href="#">Issatchenkia orientalis ATCC PTA-6658 v2.0</a>	23,081,982	4,909	
6	<a href="#">Issatchenkia orientalis SD108 v2.0</a>	21,693,996	4,925	
7	<a href="#">Nakazawaea wickerhamii NRRL Y-2563</a>	10,857,285	5,490	<a href="#">Krassowski T et al., 2018</a>
8	<a href="#">Ogataea parapolyomorpha DL-1</a>	8,874,589	5,325	
9	<a href="#">Ogataea polymorpha NCYC 495 leu1.1 v2.0</a>	8,974,850	5,177	<a href="#">Riley R et al., 2016</a>
10	<a href="#">Pichia kudriavzevii CBS573</a>	10,812,555	5,140	<a href="#">Douglass AP et al., 2018</a>
11	<a href="#">Pichia membranifaciens v2.0</a>	11,584,685	5,546	<a href="#">Riley R et al., 2016</a>
12	<a href="#">Saturnispora dispora NRRL Y-1447</a>	10,120,266	4,881	<a href="#">Krassowski T et al., 2018</a>

- 2) To verify that *Dekkera* (which grows on galactose) and *Pichia* (which does not) are sibling taxa, click on 'TREE':



- 3) Click on 'Dekkera' to go to its genome portal:



- 4) Click on “ANNOTATIONS => KEGG” to go to the portal’s KEGG browser:

KEGG • Dekkera bruxellensis CBS 2499 v2.0

SEARCH BLAST BROWSE ANNOTATIONS MCL CLUSTERS SYNTENY DOWNLOAD INFO HOME STATUS HELP!

Select Model Set(s) to View:

Dekkera bruxellensis CBS 2499 v2.0  
Pichia membranifaciens v2.0/FilteredModels1  
Ogataea polymorpha NCYC 495 leu1 v2.0/FilteredModels2  
Candida arabinofimentans NRRL YB-2248 v1.0/FilteredModels1

apply

Other Functions  
View KEGG Metabolic Pathways  
View KEGG Regulatory Pathways  
Search KEGG  
Enzyme Commission Numbers

KEGG Metabolic Pathway

Amino Acid Metabolism

Pathway	models in Dekkera bruxellensis CBS 2499 v2.0 FilteredModels1 (ver 1)
Amino sugar and nucleotide sugar metabolism	206
Alanine, aspartate and glutamate metabolism	27
Arginine and proline metabolism	45

- 5) Scroll down to the ‘Carbohydrate Metabolism’ section, and find the subsection ‘Galactose metabolism’. Dekkera has 24 genes annotated to this metabolic pathway:

<b>Carbohydrate Metabolism</b>	<b>332</b>
<a href="#">Amino sugar and nucleotide sugar metabolism</a>	68
<a href="#">Ascorbate and aldarate metabolism</a>	21
<a href="#">Butanoate metabolism</a>	34
<a href="#">C5-Branched dibasic acid metabolism</a>	2
<a href="#">Citrate cycle (TCA cycle)</a>	28
<a href="#">Fructose and mannose metabolism</a>	46
<a href="#">Galactose metabolism</a>	24
<a href="#">Glycolysis / Gluconeogenesis</a>	47
<a href="#">Glyoxylate and dicarboxylate metabolism</a>	10
<a href="#">Inositol phosphate metabolism</a>	27

- 6) Click on ‘Galactose metabolism’ to drill down into the KEGG hierarchy and list the EC numbers of that pathway.
- 7) Go to the ‘Select Model Set(s) to View’ list box and select *Dekkera* and *Pichia* and click the ‘apply’ button. The *Dekkera* and *Pichia* galactose metabolism gene counts are side-by-side and may be directly compared. Galactokinase (EC = 2.7.1.6) and UDPglucose--hexose-1-phosphate uridylyltransferase (2.7.7.12) are each present in *Dekkera* but not in *Pichia*:

KEGG • Dekkera bruxellensis CBS 2499 v2.0

SEARCH BLAST BROWSE ANNOTATIONS MCL CLUSTERS SYNTENY DOWNLOAD INFO HOME STATUS HELP!

Select Model Set(s) to View:

Dekkera bruxellensis CBS 2499 v2.0/FilteredModels1 (ver 1)  
Pichia membranifaciens v2.0/FilteredModels1 (ver 1)  
Ogataea polymorpha NCYC 495 leu1 v2.0/FilteredModels2 (ver 1)  
Candida arabinofimentans NRRL YB-2248 v1.0/FilteredModels1 (ver 1)

apply

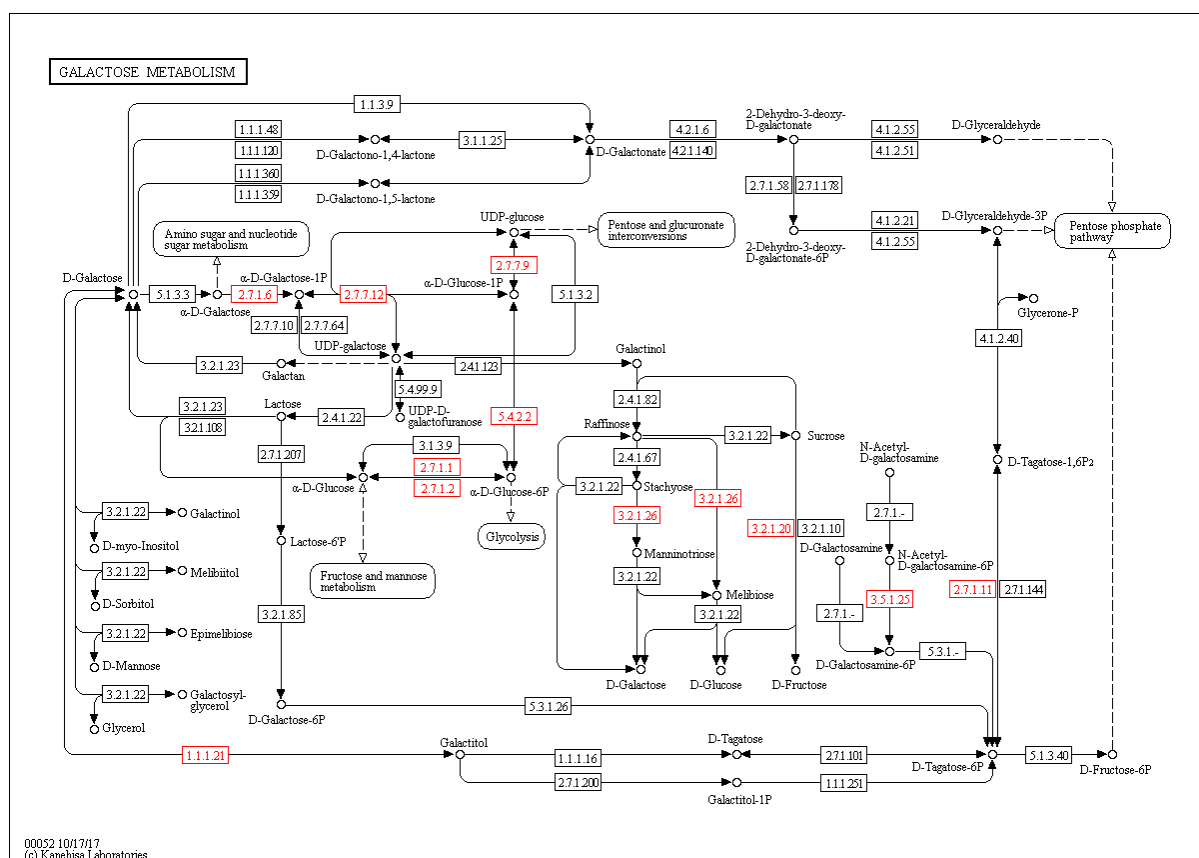
Other Functions  
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View KEGG Regulatory Pathways  
Search KEGG

**MAP00052: Galactose metabolism**

Summary View | Model View | View KEGG Map

EC Number	Description	models in Dekkera bruxellensis CBS 2499 v2.0 FilteredModels1 (ver 1)	models in Pichia membranifaciens v2.0 FilteredModels1 (ver 1)	models in all selected model sets
1.1.1.120	galactose 1-dehydrogenase (NADP+)	0	0	0
1.1.1.16	galactitol 2-dehydrogenase	0	0	0
2.7.1.58	2-dehydro-3-deoxygalactonokinase	0	0	0
2.7.1.6	galactokinase	1	0	1
2.7.1.69	protein-Npi-phosphohistidine--sugar phosphotransferase	0	0	0
2.7.7.10	UTP--hexose-1-phosphate uridylyltransferase	0	0	0
2.7.7.12	UDP-glucose--hexose-1-phosphate uridylyltransferase	1	0	1
2.7.7.9	UTP--glucose-1-phosphate uridylyltransferase	2	2	4
3.1.1.25	1,4-lactonase	0	0	0
3.1.3.9	glucose-6-phosphatase	0	0	0
3.2.1.108	lactase	0	0	0
3.2.1.20	alpha-glucosidase	6	2	8
3.2.1.22	alpha-galactosidase	0	0	0

- 8) Scroll back up to the now-familiar 'Select Model Set(s) to View' list box and select *Dekkera* only. Click 'apply' to show the *Dekkera* counts only.
- 9) Click 'View KEGG Map' to see a graphical display of the pathway. Only those enzyme boxes colored red are annotated as such in *Dekkera*. These include both 2.7.1.6(Galactokinase) and 2.7.7.12 (UDPglucose--hexose-1-phosphate uridylyltransferase):



- 10) Use the web browser back button return to the now-familiar *Dekkera* galactose metabolism page and select *Pichia* only. Click ‘apply’ to show the *Pichia* counts only.

KEGG • Dekkera bruxellensis CBS 2499 v2.0

<a href="#">SEARCH</a>	<a href="#">BLAST</a>	<a href="#">BROWSE</a>	<a href="#">ANNOTATIONS ▾</a>	<a href="#">MCL CLUSTERS</a>	<a href="#">SYNTENY</a>	<a href="#">DOWNLOAD</a>	<a href="#">INFO</a>	<a href="#">HOME</a>	<a href="#">STATUS</a>	<a href="#">HELP!</a>
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**Select Model Set(s) to View:**

Dekkera bruxellensis CBS 2499 v2.0/FilteredModels1 (ver 1)

Pichia membranifaciens v2.0/FilteredModels1 (ver 1)

Ogataea polymorpha NCYC 495 leu1.1 v2.0/FilteredModels2 (ver 1)

Candida arabinofementans NRRL YB-2248 v1.0/FilteredModels1 (ver 1)

[Other Functions](#)  
[View KEGG Metabolic Pathways](#)  
[View KEGG Regulatory Pathways](#)  
[Search KEGG](#)

apply

