

IntelliGenWiki: An Intelligent Semantic Wiki for Life Sciences

Bahar Sateli Marie-Jean Meurs Greg Butler
Justin Powlowski Adrian Tsang René Witte

Concordia University, Montréal, QC, Canada



Semantic Software Lab



NETTAB 2012

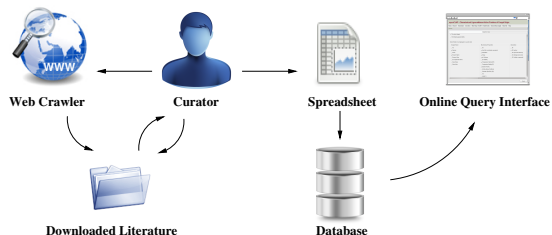
Nov. 15th, Como, Italy

Outline

- 1 Introduction
- 2 System Architecture
- 3 User Interface
- 4 Application
- 5 Evaluation
- 6 Conclusion

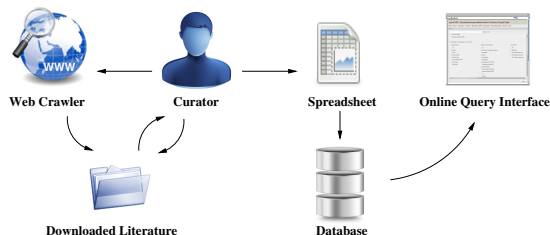
MOTIVATION: Curation of Biomedical Literature

- ▶ Finding and extracting relevant knowledge from the domain literature
- ▶ Manually refining and updating bioinformatics databases



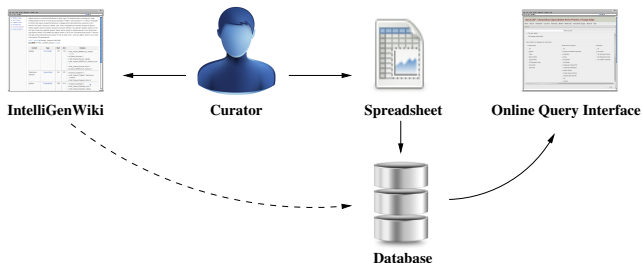
MOTIVATION: Curation of Biomedical Literature

- ▶ Finding and extracting relevant knowledge from the domain literature
- ▶ Manually refining and updating bioinformatics databases



- ▶ Manual literature curation is
 - ▶ **Expensive** → requires domain experts
 - ▶ **Labour-intensive** → ever growing amount of scientific publications
 - ▶ **Error-prone** → critical knowledge can be easily missed

APPROACH: IntelliGenWiki



Enhanced Literature Curation Workflow Using IntelliGenWiki

- ▶ Text mining techniques integrated within the wiki environment
- ▶ Novel Human-AI collaboration patterns
- ▶ Producing semantic metadata
- ▶ Transform text into knowledge base

APPROACH: IntelliGenWiki

- ▶ Adopts the “Wiki” paradigm
 - ▶ Accessible via a web browser
 - ▶ Simple syntax (markup)
 - ▶ Open collaboration
- ▶ Based on the MediaWiki engine
 - ▶ Open source
 - ▶ Highly scalable
 - ▶ Extensible: Semantic MediaWiki

The screenshot displays the IntelliGenWiki web interface within a Mozilla Firefox browser. The main content area shows a PubMed entry (19912637) for a thermotable GH5 mannan endo-1,4-beta-mannosidase from *Aspergillus niger* BkD1. Below the text, there is a table summarizing enzyme features.

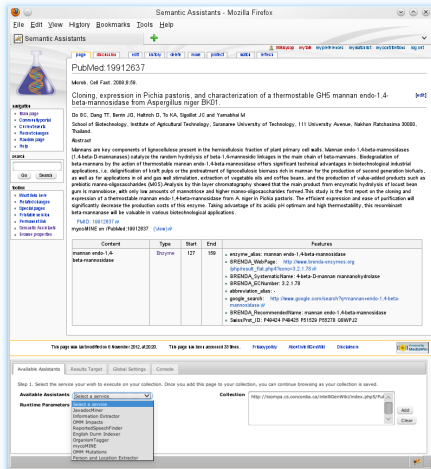
Content	Type	Start	End	Features
mannan-endo-1,4-beta-mannosidase	Enzyme	127	150	<ul style="list-style-type: none">• enzyme_name: mannan-endo-1,4-beta-mannosidase• BRENDA_WebPage: http://www.brenda-enzymes.org/brenindex.php?format=2.1.79• BRENDA_SystematicName: 4-beta-D-mannan mannanohydrolase• BRENDA_ECNumber: 3.2.1.79• abbreviation_abbrev: mannanase• google_search: http://www.google.com/search?q=mannanase&btnG=Search• BRENDA_RecommendedName: mannan-endo-1,4-beta-mannosidase• SwissProt_ID: P4424-P4424 P51523 P52775 Q9M7J2

At the bottom, the 'Available Assistants' section shows a list of services like 'Bioinformatics', 'Information Extractor', and 'Ontology Explorer'. A 'Collection' box on the right allows users to save their current view.

IntelliGenWiki User Interface

APPROACH: IntelliGenWiki

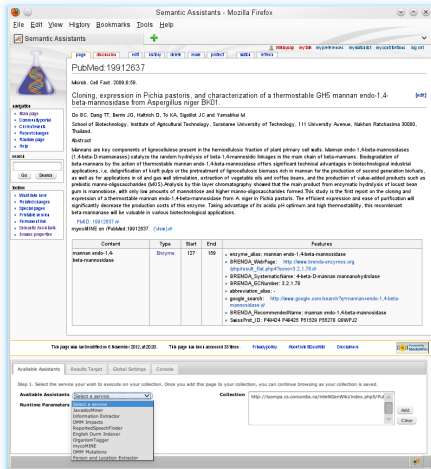
- Adopts the “Wiki” paradigm
 - Accessible via a web browser
 - Simple syntax (markup)
 - Open collaboration
- Based on the MediaWiki engine
 - Open source
 - Highly scalable
 - Extensible: Semantic MediaWiki
- Integrated Text Mining Assistants
- Provides semantic capabilities
 - Formalization of knowledge
 - Producing machine-readable content



IntelliGenWiki User Interface

APPROACH: IntelliGenWiki

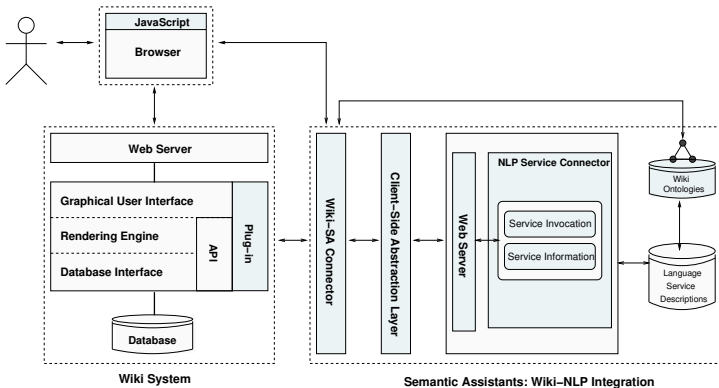
- ▶ Adopts the “Wiki” paradigm
 - ▶ Accessible via a web browser
 - ▶ Simple syntax (markup)
 - ▶ Open collaboration
- ▶ Based on the MediaWiki engine
 - ▶ Open source
 - ▶ Highly scalable
 - ▶ Extensible: Semantic MediaWiki
- ▶ Integrated Text Mining Assistants
- ▶ Provides semantic capabilities
 - ▶ Formalization of knowledge
 - ▶ Producing machine-readable content
- ▶ Open source software (AGPL3)



IntelliGenWiki User Interface

System Overview

- **Front-end:** Semantic MediaWiki
- **Back-end:** Wiki-NLP Integration [Sateli and Witte, 2012]
 - Comprehensive architecture based on the Semantic Assistants Framework [Witte and Gitzinger, 2008]
 - Seamless integration of various NLP capabilities *within* a wiki environment



IntelliGenWiki Pages

- ▶ Each wiki page corresponds to a literature instance, e.g., abstract of a paper
- ▶ Revision History
- ▶ Inquire text mining services via wiki toolbox

Wiki Toolbox

toolbox

- What links here
- Related changes
- Special pages
- Printable version
- Permanent link
- Semantic Assistants
- Browse properties

PubMed:20709852 - IntelliGenWiki - Mozilla Firefox

File Edit View History Bookmarks Tools Help

PubMed:20709852 - IntelliGenWiki

Wikisysop my talk my preferences my watchlist my contributions log out

page discussion edit history delete move protect watch refresh

PubMed:20709852

Title: Characterization of a cellobiohydrolase (MoCel6A) produced by *Magnaporthe oryzae*.

Authors: Takahashi M, Takahashi H, Nakano Y, Konishi T, Terauchi R, Takeda T.

Institute: Iwate Biotechnology Research Center, Kitakami, Iwate, Japan.

PMID: 20709852

Received on March 10, 2010. Accepted on July 30, 2010.

Full Text

[edit]

Abstract

Three GH-6 family cellobiohydrolases are expected in the genome of *Magnaporthe grisea* based on the complete genome sequence. Here, we demonstrate the properties, kinetics, and substrate specificities of a *Magnaporthe oryzae* GH-6 family cellobiohydrolase (MoCel6A). In addition, the effect of cellobiose on MoCel6A activity was also investigated. MoCel6A continuously fused to a histidine tag was overexpressed in *M. oryzae* and purified by affinity chromatography. MoCel6A showed higher hydrolytic activities on phosphoric acid-swollen cellulose (PSC), β -glucan, and cellobiosaccharide derivatives than on cellulose, of which the best substrates were cellobiosaccharides. A tandemly aligned cellulose binding domain (CBD) at the N terminus caused increased activity on cellulose and PSC, whereas deletion of the CBD (catalytic domain only) showed decreased activity on cellulose. MoCel6A hydrolysis of cellobiosaccharides and sulforhodamine-conjugated cellobiosaccharides was not inhibited by exogenously adding cellobiose up to 438 mM, which, rather, enhanced activity, whereas a GH-7 family cellobiohydrolase from *M. oryzae* (MoCel7A) was severely inhibited by more than 29 mM cellobiose. Furthermore, we assessed the effects of cellobiose on hydrolytic activities using MoCel6A and *Trichoderma reesei* cellobiohydrolase (TrCel6A), which were prepared in *Aspergillus oryzae*. MoCel6A showed increased hydrolysis of cellobioacetate used as a substrate in the presence of 292 mM cellobiose at pH 4.5 and pH 6.0, and enhanced activity disappeared at pH 9.0. In contrast, TrCel6A exhibited slightly increased hydrolysis at pH 4.5, and hydrolysis was severely inhibited at pH 9.0. These results suggest that enhancement or inhibition of hydrolytic activities by cellobiose is dependent on the reaction mixture pH.

PMID: 20709852 [PubMed - indexed for MEDLINE] PMID: PMC2950481 Free PMC Article

This page was last modified on 6 November 2012, at 23:21. [IntelliGenWiki](#) [Disclaimers](#) [Privacy policy](#) [About](#)

Done

Paper
Information

Paper
Content

The NLP Interface

- ▶ The IntelliGenWiki NLP user interface offers various text mining services
- ▶ Customizing services at runtime
- ▶ Dynamically-generated interface

Text Mining Assistants inside the wiki

The screenshot displays the IntelliGenWiki NLP user interface. At the top, there is a navigation menu with links: page, discussion, add, history, delete, more, protect, watch, refresh, and log out. Below the menu is a sidebar with a navigation tree containing: Main page, Community portal, Current events, Recent changes, Random page, and Help. The main content area shows a PubMed entry for 'PubMed:20709852' with the title 'Characterization of a cellobiohydrolase (MoCel6A) produced by Magnaporthe oryzae'. Below the title, it lists authors (Takahashi M., Takahashi H., Nakano Y., Konishi T., Terauchi R., Takeda T.), the institute (Iwate Biotechnology Research Center, Kitakami, Iwate, Japan), the PMID (20709852), and the date received (March 10, 2010). The 'Full Text' link is visible, along with an 'Abstract' section. On the right side, there is a snippet of text from the full text, mentioning 'complete genome', 'oryzae GH-5 family', 'end, MoCel6A', 'aphy, MoCel6A', 'saccharide', 'ed cellulose', 'on of the CBD', 'ides and', 'p to 430 mM', 'd severely inhibited', 'as using MoCel6A', '6A showed', '4.5 and pH 6.0, and', 'pH 4.5, and', 'olytic activities by'.

Below the main content area, there is a dialog box titled 'Available Assistants' with tabs for 'Available Assistants', 'Results Target', 'Global Settings', and 'Console'. The 'Available Assistants' tab is selected, showing a list of services: 'mycoMINE', 'IR Information Extractor', 'Information Extractor', and 'OrganismTagger'. The 'Collection' input field is empty, and the 'Add' button is visible. A purple arrow points from the 'Available Assistants' dialog box to the 'Collection' input field.

Below the dialog box, there is a footer section with the text: 'This page was last modified on 6 November 2012, at 23:21. This page has been accessed 4 times. Privacy policy About IntelliGenWiki Discussion'.

NLP Interface features

► Multi-document Analysis

Available Assistants Results Target Global Settings Console

Step 1. Select the service your wish to execute on your collection.
Once you add this page to your collection, you can continue browsing as your collection is saved.

Available Assistants Select a service

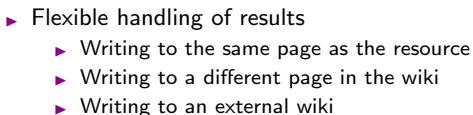
Runtime Parameters Select a service

mycoMINE
IR Information Extractor
Information Extractor
OrganismTagger

Collection <http://loompa.cs.concordia.ca/.../PubMed:19912637>
<http://loompa.cs.concordia.ca/.../PubMed:2186187>

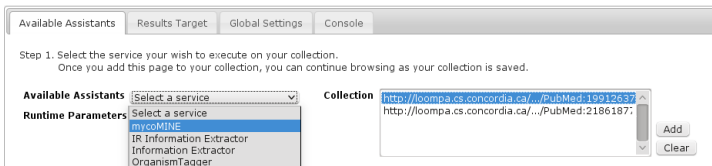
Add
Clear

- ▶ Multi-document Analysis



NLP Interface features

► Multi-document Analysis



► Flexible handling of results

- Writing to the same page as the resource
- Writing to a different page in the wiki
- Writing to an external wiki

► Dynamic discovery of NLP services



Information Extraction

- ▶ Automatically extracting knowledge from text
- ▶ Various IE services
 - ▶ mycoMINE
 - ▶ OrganismTagger
 - ▶ Open Mutation Miner
 - ▶ ...
- ▶ Enrichment of literature content with semantic markup

Example:

`[[hasType::Enzyme|cellobiohydrolase]]`

severely inhibited at pH 9.0. These results suggest that enhancement or inhibition of hydrolytic activities by cellobiose is dependent on the reaction mixture pH.

PMID: 20709852 [\[PubMed - indexed for MEDLINE\]](#) PMCID: PMC2950481 [Free PMC Article](#)

mycoMINE on PMID: 20709852 - Abstract [\(View\)](#)

Content	Type	Start	End	Features
cellobiohydrolase	Enzyme	103	120	<ul style="list-style-type: none"> enzyme_alias: cellobiohydrolase BRENDA_SystematicName: oligoxyloglucan reducing-end cellobiohydrolase BRENDA_EcNumber: 3.2.1.150 abbreviation_alias: - google_search: http://www.google.com/search?q=cellobiohydrolase BRENDA_RecommendedName: oligoxyloglucan reducing-end-specific cellobiohydrolase SwissProt_ID: - BRENDA's page: http://www.brenda-enzymes.org/php/result_flat.php4?ecno=3.2.1.150
Magnaporthe oryzae	Organism	143	161	<ul style="list-style-type: none"> NCBI_Taxonomy_WebPage: http://www.ncbi.nlm.nih.gov/Taxonomy/Browser/wwwtax.cgi?id=318829&mode=info organism_scientific_name: Magnaporthe oryzae organism_alias: Magnaporthe oryzae google_search: http://www.google.com/search?q=Magnaporthe+oryzae NCBI_Taxonomy_ID: 318829

Found Entity

Entity Type

Entity Location

NLP-Provided Additional Information

Semantic Entity Retrieval

- ▶ Unadorned wikis offer only keyword-based search
- ▶ What if we want to *discover* what's contained in the wiki?
 - ▶ e.g., *"Which papers in this wiki mention an enzyme entity in their text?"*

Semantic Entity Retrieval

- ▶ Unadorned wikis offer only keyword-based search
- ▶ What if we want to *discover* what's contained in the wiki?
 - ▶ e.g., “Which papers in this wiki mention an enzyme entity in their text?”
- ▶ **Solution:** Querying the semantic metadata in the wiki
 - ▶ Search the wiki by semantic properties, e.g., entity *type*, generated by NLP services
 - ▶ Using special Semantic MediaWiki markup, called *inline queries*

```
{{#ask: [[hasType::Enzyme]]
| ?Enzyme = Enzyme Entities Found
| format = table
| headers = plain
| default = No pages found!
| mainlabel = Page Name
}}
```

Semantic Entity Retrieval

- ▶ Unadorned wikis offer only keyword-based search
- ▶ What if we want to *discover* what's contained in the wiki?
 - ▶ e.g., “Which papers in this wiki mention an enzyme entity in their text?”
- ▶ **Solution:** Querying the semantic metadata in the wiki
 - ▶ Search the wiki by semantic properties, e.g., entity *type*, generated by NLP services
 - ▶ Using special Semantic MediaWiki markup, called *inline queries*

```
{{#ask: [[hasType::Enzyme]]
|?Enzyme = Enzyme Entities Found
|format = table
|headers = plain
|default = No pages found!
|mainlabel = Page Name
}}
```

Property:Enzyme

Page Name	Enzyme Entities Found
PMID: 20709852	Cellobiohydrolase Cellulases endoglucanases β-glucosidases Invitrogen DNA polymerase

User Study

- Is the integration of text mining assistants in a wiki environment actually effective?

User Study

- ▶ Is the integration of text mining assistants in a wiki environment actually effective?
- ▶ User study within the Genozymes project context (www.fungalgenomics.ca)
 - ▶ **Goal:** Identifying and characterizing fungal enzymes
 - ▶ **Dataset:** 30 documents
 - ▶ **Users:** 2 expert biocurators
 - ▶ **NLP Service:** mycoMINE [Meurs et al, 2012]
 - ▶ **Measure:** Time spent on curation
 - ▶ **Method:** Comparison against time spent on manual curation

User Study

- ▶ Is the integration of text mining assistants in a wiki environment actually effective?
- ▶ User study within the Genozymes project context (www.fungalgenomics.ca)
 - ▶ **Goal:** Identifying and characterizing fungal enzymes
 - ▶ **Dataset:** 30 documents
 - ▶ **Users:** 2 expert biocurators
 - ▶ **NLP Service:** mycoMINE [Meurs et al, 2012]
 - ▶ **Measure:** Time spent on curation
 - ▶ **Method:** Comparison against time spent on manual curation

Average Curation Time

- ▶ Results:

Abstract Selection		Full Paper Curation	
no support	IntelliGenWiki	no support	IntelliGenWiki
1 min.	0.3 min.	37.5 min.	30.6 min.

User Study

- ▶ Is the integration of text mining assistants in a wiki environment actually effective?
- ▶ User study within the Genozymes project context (www.fungalgenomics.ca)
 - ▶ **Goal:** Identifying and characterizing fungal enzymes
 - ▶ **Dataset:** 30 documents
 - ▶ **Users:** 2 expert biocurators
 - ▶ **NLP Service:** mycoMINE [Meurs et al, 2012]
 - ▶ **Measure:** Time spent on curation
 - ▶ **Method:** Comparison against time spent on manual curation

Average Curation Time

- ▶ Results:

Abstract Selection		Full Paper Curation	
no support	IntelliGenWiki	no support	IntelliGenWiki
1 min.	0.3 min.	37.5 min.	30.6 min.

- ▶ **Conclusion:** IntelliGenWiki was indeed efficient and reduced the paper selection and curation time by almost **70%** and **20%**, respectively.

Conclusion

What you can do now

- ▷ Install MediaWiki and Semantic MediaWiki extension
- ▷ Download and deploy the Wiki-NLP integration
- ▷ Use the existing text mining services in our public server
- ▷ Alternatively, setup your own Semantic Assistants services developed based on the GATE framework

What is next

- ▷ Cover other tasks, e.g.,
 - ▶ Quality assessment
 - ▶ Paper recommendation
 - ▶ Personalization
- ▷ Develop services for automatic import of literature, e.g., from PubMed
- ▷ Query the RDF in wiki from external applications

More Information

<http://www.semanticsoftware.info/intelligenwiki>

Acknowledgment

- ▶ Funding for this work was provided by NSERC, Genome Canada and Génome Québec.
- ▶ Caitlin Murphy and Sherry Wu, biocurators at the Centre for Structural and Functional Genomics (CSFG) at Concordia University, are acknowledged for their participation in the evaluation task.

Demo



navigation

- [Main page](#)
- [Community portal](#)
- [Current events](#)
- [Recent changes](#)
- [Random page](#)
- [Help](#)

search

toolbox

- [What links here](#)
- [Related changes](#)
- [Special pages](#)
- [Printable version](#)
- [Permanent link](#)
- [Semantic Assistants](#)
- [Browse properties](#)

 [Wikisysop](#) [my talk](#) [my preferences](#) [my watchlist](#) [my contributions](#) [log out](#)

[page](#)[discussion](#)[edit](#)[history](#)[delete](#)[move](#)[protect](#)[watch](#)[refresh](#)

Main Page

IntelliGenWiki is a semantic wiki-based biomedical literature curation environment.

Sample pages:

- [PubMed:19912637](#)
- [PubMed:21861877](#)

This page was last modified on 27 August 2012, at 11:09.

This page has been accessed 59 times.

[Privacy policy](#)

[About IntelliGenWiki](#)

[Disclaimers](#)





navigation

- [Main page](#)
- [Community portal](#)
- [Current events](#)
- [Recent changes](#)
- [Random page](#)
- [Help](#)

search

toolbox

- [What links here](#)
- [Related changes](#)
- [Special pages](#)
- [Printable version](#)
- [Permanent link](#)
- [Semantic Assistants](#)
- [Browse properties](#)

PubMed:19912637

Microb. Cell Fact. 2009;8:59.

Cloning, expression in *Pichia pastoris*, and characterization of a thermostable GH5 mannan endo-1,4-beta-mannosidase from *Aspergillus niger* BK01.

[\[edit\]](#)

Do BC, Dang TT, Berrin JG, Haltrich D, To KA, Sigolliot JC and Yamabhai M

School of Biotechnology, Institute of Agricultural Technology, Suranaree University of Technology, 111 University Avenue, Nakhon Ratchasima 30000, Thailand.

Abstract

Mannans are key components of lignocellulose present in the hemicellulosic fraction of plant primary cell walls. Mannan endo-1,4-beta-mannosidases (1,4-beta-D-mannanases) catalyze the random hydrolysis of beta-1,4-mannosidic linkages in the main chain of beta-mannans. Biodegradation of beta-mannans by the action of thermostable mannan endo-1,4-beta-mannosidase offers significant technical advantages in biotechnological industrial applications, i.e. delignification of kraft pulps or the pretreatment of lignocellulosic biomass rich in mannan for the production of second generation biofuels, as well as for applications in oil and gas well stimulation, extraction of vegetable oils and coffee beans, and the production of value-added products such as prebiotic manno-oligosaccharides (MOS). A gene encoding mannan endo-1,4-beta-mannosidase or 1,4-beta-D-mannan mannanohydrolase (E.C. 3.2.1.78), commonly termed beta-mannanase, from *Aspergillus niger* BK01, which belongs to glycosyl hydrolase family 5 (GH5), was cloned and successfully expressed heterologously (up to 243 microg of active recombinant protein per mL) in *Pichia pastoris*. The enzyme was secreted by *P. pastoris* and could be collected from the culture supernatant. The purified enzyme appeared glycosylated as a single band on SDS-PAGE with a molecular mass of approximately 53 kDa. The recombinant beta-mannanase is highly thermostable with a half-life time of approximately 56 h at 70 degrees C and pH 4.0. The optimal temperature (10-min assay) and pH value for activity are 80 degrees C and pH 4.5, respectively. The enzyme is not only active towards structurally different mannans but also exhibits low activity towards birchwood xylan. Apparent K_m values of the enzyme for konjac glucomannan (low viscosity), locust bean gum galactomannan, carob galactomannan (low viscosity), and 1,4-beta-D-mannan (from carob) are 0.6 mg mL⁻¹, 2.0 mg mL⁻¹, 2.2 mg mL⁻¹ and 1.5 mg mL⁻¹, respectively, while the k_{cat} values for these substrates are 215 s⁻¹, 330 s⁻¹, 292 s⁻¹ and 148 s⁻¹, respectively. Judged from the specificity constants k_{cat}/K_m , glucomannan is the preferred substrate of the A. niger beta-mannanase. Analysis by thin layer chromatography showed that the main product from enzymatic hydrolysis of locust bean gum is mannobiose, with only low amounts of mannotriose and higher manno-oligosaccharides formed. This study is the first report on the cloning and expression of a thermostable mannan endo-1,4-beta-mannosidase from A. niger in *Pichia pastoris*. The efficient expression and ease of purification will significantly decrease the production costs of this enzyme. Taking advantage of its acidic pH optimum and high thermostability, this recombinant beta-mannanase will be valuable in various biotechnological applications.

PMID: 19912637 [↗](#)



navigation

- [Main page](#)
- [Community portal](#)
- [Current events](#)
- [Recent changes](#)
- [Random page](#)
- [Help](#)

search

toolbox

- [What links here](#)
- [Related changes](#)
- [Special pages](#)
- [Printable version](#)
- [Permanent link](#)
- [Semantic Assistants](#)
- [Browse properties](#)

PubMed:19912637

Microb. Cell Fact. 2009;8:59.

Cloning, expression in *Pichia pastoris*, and characterization of a thermostable GH5 mannan endo-1,4-beta-mannosidase from *Aspergillus niger* BK01.

[\[edit\]](#)

Do BC, Dang TT, Berrin JG, Haltrich D, To KA, Sigolliot JC and Yamabhai M

School of Biotechnology, Institute of Agricultural Technology, Suranaree University of Technology, 111 University Avenue, Nakhon Ratchasima 30000, Thailand.

Abstract

Mannans are key components of lignocellulose present in the hemicellulosic fraction of plant primary cell walls. Mannan endo-1,4-beta-mannosidases (1,4-beta-D-mannanases) catalyze the random hydrolysis of beta-1,4-mannosidic linkages in the main chain of beta-mannans. Biodegradation of beta-mannans by the action of thermostable mannan endo-1,4-beta-mannosidase offers significant technical advantages in biotechnological industrial applications, i.e. delignification of kraft pulps or the pretreatment of lignocellulosic biomass rich in mannan for the production of second generation biofuels, as well as for applications in oil and gas well stimulation, extraction of vegetable oils and coffee beans, and the production of value-added products such as prebiotic manno-oligosaccharides (MOS). A gene encoding mannan endo-1,4-beta-mannosidase or 1,4-beta-D-mannan mannanohydrolase (E.C. 3.2.1.78), commonly termed beta-mannanase, from *Aspergillus niger* BK01, which belongs to glycosyl hydrolase family 5 (GH5), was cloned and successfully expressed heterologously (up to 243 microg of active recombinant protein per mL) in *Pichia pastoris*. The enzyme was secreted by *P. pastoris* and could be collected from the culture supernatant. The purified enzyme appeared glycosylated as a single band on SDS-PAGE with a molecular mass of approximately 53 kDa. The recombinant beta-mannanase is highly thermostable with a half-life time of approximately 56 h at 70 degrees C and pH 4.0. The optimal temperature (10-min assay) and pH value for activity are 80 degrees C and pH 4.5, respectively. The enzyme is not only active towards structurally different mannans but also exhibits low activity towards birchwood xylan. Apparent Km values of the enzyme for konjac glucomannan (low viscosity), locust bean gum galactomannan, carob galactomannan (low viscosity), and 1,4-beta-D-mannan (from carob) are 0.6 mg mL⁻¹, 2.0 mg mL⁻¹, 2.2 mg mL⁻¹ and 1.5 mg mL⁻¹, respectively, while the kcat values for these substrates are 215 s⁻¹, 330 s⁻¹, 292 s⁻¹ and 148 s⁻¹, respectively. Judged from the specificity constants kcat/Km, glucomannan is the preferred substrate of the *A. niger* beta-mannanase. Analysis by thin layer chromatography showed that the main product from enzymatic hydrolysis of locust bean gum is mannobiose, with only low amounts of mannorose and higher manno-oligosaccharides formed. This study is the first report on the cloning and expression of a thermostable mannan endo-1,4-beta-mannosidase from *A. niger* in *Pichia pastoris*. The efficient expression and ease of purification will significantly decrease the production costs of this enzyme. Taking advantage of its acidic pH optimum and high thermostability, this recombinant beta-mannanase will be valuable in various biotechnological applications.

PMID: 19912637 [🔗](#)

This page was last modified on 11 November 2012, at 06:46.

This page has been accessed 47 times.

[Privacy policy](#)

[About IntelliGenWiki](#)

[Disclaimers](#)

Powered By MediaWiki

Available Assistants

Results Target

Global Settings

Console

Step 1. Select the service your wish to execute on your collection. Once you add this page to your collection, you can continue browsing as your collection is saved.

Available Assistants

Runtime Parameters

This service has no runtime parameter.

Collection



navigation

- [Main page](#)
- [Community portal](#)
- [Current events](#)
- [Recent changes](#)
- [Random page](#)
- [Help](#)

search

toolbox

- [What links here](#)
- [Related changes](#)
- [Special pages](#)
- [Printable version](#)
- [Permanent link](#)
- [Semantic Assistants](#)
- [Browse properties](#)

[page](#) [discussion](#) [edit](#) [history](#) [delete](#) [move](#) [protect](#) [watch](#) [refresh](#)

PubMed:19912637

Microb. Cell Fact. 2009;8:59.

Cloning, expression in *Pichia pastoris*, and characterization of a thermostable GH5 mannan endo-1,4-beta-mannosidase from *Aspergillus niger* BK01.

[\[edit\]](#)

Do BC, Dang TT, Berrin JG, Haltrich D, To KA, Sigolliot JC and Yamabhai M

School of Biotechnology, Institute of Agricultural Technology, Suranaree University of Technology, 111 University Avenue, Nakhon Ratchasima 30000, Thailand.

Abstract

Mannans are key components of lignocellulose present in the hemicellulosic fraction of plant primary cell walls. Mannan endo-1,4-beta-mannosidases (1,4-beta-D-mannanases) catalyze the random hydrolysis of beta-1,4-mannosidic linkages in the main chain of beta-mannans. Biodegradation of beta-mannans by the action of thermostable mannan endo-1,4-beta-mannosidase offers significant technical advantages in biotechnological industrial applications, i.e. delignification of kraft pulps or the pretreatment of lignocellulosic biomass rich in mannan for the production of second generation biofuels, as well as for applications in oil and gas well stimulation, extraction of vegetable oils and coffee beans, and the production of value-added products such as prebiotic manno-oligosaccharides (MOS). A gene encoding mannan endo-1,4-beta-mannosidase or 1,4-beta-D-mannan mannanohydrolase (E.C. 3.2.1.78), commonly termed beta-mannanase, from *Aspergillus niger* BK01, which belongs to glycosyl hydrolase family 5 (GH5), was cloned and successfully expressed heterologously (up to 243 microg of active recombinant protein per mL) in *Pichia pastoris*. The enzyme was secreted by *P. pastoris* and could be collected from the culture supernatant. The purified enzyme appeared glycosylated as a single band on SDS-PAGE with a molecular mass of approximately 53 kDa. The recombinant beta-mannanase is highly thermostable with a half-life time of approximately 56 h at 70 degrees C and pH 4.0. The optimal temperature (10-min assay) and pH value for activity are 80 degrees C and pH 4.5, respectively. The enzyme is not only active towards structurally different mannans but also exhibits low activity towards birchwood xylan. Apparent Km values of the enzyme for konjac glucomannan (low viscosity), locust bean gum galactomannan, carob galactomannan (low viscosity), and 1,4-beta-D-mannan (from carob) are 0.6 mg mL⁻¹, 2.0 mg mL⁻¹, 2.2 mg mL⁻¹ and 1.5 mg mL⁻¹, respectively, while the kcat values for these substrates are 215 s⁻¹, 330 s⁻¹, 292 s⁻¹ and 148 s⁻¹, respectively. Judged from the specificity constants kcat/Km, glucomannan is the preferred substrate of the A. niger beta-mannanase. Analysis by thin layer chromatography showed that the main product from enzymatic hydrolysis of locust bean gum is mannobiose, with only low amounts of mannorose and higher manno-oligosaccharides formed. This study is the first report on the cloning and expression of a thermostable mannan endo-1,4-beta-mannosidase from A. niger in *Pichia pastoris*. The efficient expression and ease of purification will significantly decrease the production costs of this enzyme. Taking advantage of its acidic pH optimum and high thermostability, this recombinant beta-mannanase will be valuable in various biotechnological applications.

PMID: 19912637

This page was last modified on 11 November 2012, at 06:46.

This page has been accessed 47 times.

[Privacy policy](#)

[About IntelliGenWiki](#)

[Disclaimers](#)



Available Assistants

Results Target

Global Settings

Console

Step 2. Please select the target for the service results from the following options:

Target

- ☒ Same page (results will be written in the same page as the resource) ☒ Body
- ☐ Another page (results will be written in the specified page) ☐ Talk
- ☐ Another wiki (results will be written in a separate wiki)



navigation

- [Main page](#)
- [Community portal](#)
- [Current events](#)
- [Recent changes](#)
- [Random page](#)
- [Help](#)

search

toolbox

- [What links here](#)
- [Related changes](#)
- [Special pages](#)
- [Printable version](#)
- [Permanent link](#)
- [Semantic Assistants](#)
- [Browse properties](#)

[page](#) [discussion](#) [edit](#) [history](#) [delete](#) [move](#) [protect](#) [watch](#) [refresh](#)

PubMed:19912637

Microb. Cell Fact. 2009;8:59.

Cloning, expression in *Pichia pastoris*, and characterization of a thermostable GH5 mannan endo-1,4-beta-mannosidase from *Aspergillus niger* BK01.

[\[edit\]](#)

Do BC, Dang TT, Berrin JG, Haltrich D, To KA, Sigolliot JC and Yamabhai M

School of Biotechnology, Institute of Agricultural Technology, Suranaree University of Technology, 111 University Avenue, Nakhon Ratchasima 30000, Thailand.

Abstract

Mannans are key components of lignocellulose present in the hemicellulosic fraction of plant primary cell walls. Mannan endo-1,4-beta-mannosidases (1,4-beta-D-mannanases) catalyze the random hydrolysis of beta-1,4-mannosidic linkages in the main chain of beta-mannans. Biodegradation of beta-mannans by the action of thermostable mannan endo-1,4-beta-mannosidase offers significant technical advantages in biotechnological industrial applications, i.e. delignification of kraft pulps or the pretreatment of lignocellulosic biomass rich in mannan for the production of second generation biofuels, as well as for applications in oil and gas well stimulation, extraction of vegetable oils and coffee beans, and the production of value-added products such as prebiotic manno-oligosaccharides (MOS). A gene encoding mannan endo-1,4-beta-mannosidase or 1,4-beta-D-mannan mannanohydrolase (E.C. 3.2.1.78), commonly termed beta-mannanase, from *Aspergillus niger* BK01, which belongs to glycosyl hydrolase family 5 (GH5), was cloned and successfully expressed heterologously (up to 243 microg of active recombinant protein per mL) in *Pichia pastoris*. The enzyme was secreted by *P. pastoris* and could be collected from the culture supernatant. The purified enzyme appeared glycosylated as a single band on SDS-PAGE with a molecular mass of approximately 53 kDa. The recombinant beta-mannanase is highly thermostable with a half-life time of approximately 56 h at 70 degrees C and pH 4.0. The optimal temperature (10-min assay) and pH value for activity are 80 degrees C and pH 4.5, respectively. The enzyme is not only active towards structurally different mannans but also exhibits low activity towards birchwood xylan. Apparent Km values of the enzyme for konjac glucomannan (low viscosity), locust bean gum galactomannan, carob galactomannan (low viscosity), and 1,4-beta-D-mannan (from carob) are 0.6 mg mL⁻¹, 2.0 mg mL⁻¹, 2.2 mg mL⁻¹ and 1.5 mg mL⁻¹, respectively, while the kcat values for these substrates are 215 s⁻¹, 330 s⁻¹, 292 s⁻¹ and 148 s⁻¹, respectively. Judged from the specificity constants kcat/Km, glucomannan is the preferred substrate of the *A. niger* beta-mannanase. Analysis by thin layer chromatography showed that the main product from enzymatic hydrolysis of locust bean gum is mannobiose, with only low amounts of mannotriose and higher manno-oligosaccharides formed. This study is the first report on the cloning and expression of a thermostable mannan endo-1,4-beta-mannosidase from *A. niger* in *Pichia pastoris*. The efficient expression and ease of purification will significantly decrease the production costs of this enzyme. Taking advantage of its acidic pH optimum and high thermostability, this recombinant beta-mannanase will be valuable in various biotechnological applications.

PMID: 19912637

This page was last modified on 11 November 2012, at 06:46.

This page has been accessed 47 times.

[Privacy policy](#)

[About IntelliGenWiki](#)

[Disclaimers](#)

Powered by MediaWiki

Available Assistants

Results Target

Global Settings

Console

```
[Nov 13,2012 07:37] Console is ready!
[Nov 13,2012 07:46] Number of documents to process: 1
[Nov 13,2012 07:46] Processing "http://loomp.cs.concordia.ca/intelliGenWiki/index.php5/PubMed:19912637"
[Nov 13,2012 07:46] Bot successfully logged into the wiki.
[Nov 13,2012 07:46] Retrieving page content...
[Nov 13,2012 07:46] Invoking "mycoMINE"
[Nov 13,2012 07:46] Service invocation finished. Writing the results...
[Nov 13,2012 07:46] Results will be written in the body of the same page as the resource.
[Nov 13,2012 07:46] Execution finished.
```



navigation

- [Main page](#)
- [Community portal](#)
- [Current events](#)
- [Recent changes](#)
- [Random page](#)
- [Help](#)

search

toolbox

- [What links here](#)
- [Related changes](#)
- [Special pages](#)
- [Printable version](#)
- [Permanent link](#)
- [Semantic Assistants](#)
- [Browse properties](#)

PubMed:19912637

Microb. Cell Fact. 2009;8:59.

Cloning, expression in *Pichia pastoris*, and characterization of a thermostable GH5 mannan endo-1,4-beta-mannosidase from *Aspergillus niger* BK01.

[\[edit\]](#)

Do BC, Dang TT, Berrin JG, Haltrich D, To KA, Sigolliot JC and Yamabhai M

School of Biotechnology, Institute of Agricultural Technology, Suranaree University of Technology, 111 University Avenue, Nakhon Ratchasima 30000, Thailand.

Abstract

Mannans are key components of lignocellulose present in the hemicellulosic fraction of plant primary cell walls. Mannan endo-1,4-beta-mannosidases (1,4-beta-D-mannanases) catalyze the random hydrolysis of beta-1,4-mannosidic linkages in the main chain of beta-mannans. Biodegradation of beta-mannans by the action of thermostable mannan endo-1,4-beta-mannosidase offers significant technical advantages in biotechnological industrial applications, i.e. delignification of kraft pulps or the pretreatment of lignocellulosic biomass rich in mannan for the production of second generation biofuels, as well as for applications in oil and gas well stimulation, extraction of vegetable oils and coffee beans, and the production of value-added products such as prebiotic manno-oligosaccharides (MOS). A gene encoding mannan endo-1,4-beta-mannosidase or 1,4-beta-D-mannan mannanohydrolase (E.C. 3.2.1.78), commonly termed beta-mannanase, from *Aspergillus niger* BK01, which belongs to glycosyl hydrolase family 5 (GH5), was cloned and successfully expressed heterologously (up to 243 microg of active recombinant protein per mL) in *Pichia pastoris*. The enzyme was secreted by *P. pastoris* and could be collected from the culture supernatant. The purified enzyme appeared glycosylated as a single band on SDS-PAGE with a molecular mass of approximately 53 kDa. The recombinant beta-mannanase is highly thermostable with a half-life time of approximately 56 h at 70 degrees C and pH 4.0. The optimal temperature (10-min assay) and pH value for activity are 80 degrees C and pH 4.5, respectively. The enzyme is not only active towards structurally different mannans but also exhibits low activity towards birchwood xylan. Apparent Km values of the enzyme for konjac glucomannan (low viscosity), locust bean gum galactomannan, carob galactomannan (low viscosity), and 1,4-beta-D-mannan (from carob) are 0.6 mg mL⁻¹, 2.0 mg mL⁻¹, 2.2 mg mL⁻¹ and 1.5 mg mL⁻¹, respectively, while the kcat values for these substrates are 215 s⁻¹, 330 s⁻¹, 292 s⁻¹ and 148 s⁻¹, respectively. Judged from the specificity constants kcat/Km, glucomannan is the preferred substrate of the *A. niger* beta-mannanase. Analysis by thin layer chromatography showed that the main product from enzymatic hydrolysis of locust bean gum is mannobiose, with only low amounts of mannitriose and higher manno-oligosaccharides formed. This study is the first report on the cloning and expression of a thermostable mannan endo-1,4-beta-mannosidase from *A. niger* in *Pichia pastoris*. The efficient expression and ease of purification will significantly decrease the production costs of this enzyme. Taking advantage of its acidic pH optimum and high thermostability, this recombinant beta-mannanase will be valuable in various biotechnological applications.

PMID: 19912637 [⌕](#)

mycoMINE on PubMed:19912637 [\(View\)](#) [⌕](#)

Content	Type	Start	End	Features
mannanases	EnzymeStats	588	598	<ul style="list-style-type: none">■ Most_Frequent_BRENDA_EC_Number: 3.2.1.78■ #_Distinct_Enzymes: 8■ Most_Frequent_Enzyme: mannanase■ Most_Frequent_BRENDA_EC_Number_Score: 9■ Most_Frequent_Enzyme_Score: 6■ #_Distinct_BRENDA_EC_Numbers: 3
mannan endo-1,4-beta-mannosidase	Enzyme	127	159	<ul style="list-style-type: none">■ enzyme_alias: mannan endo-1,4-beta-mannosidase■ BRENDA_WebPage: http://www.brenda-enzymes.org/php/result_flat.php4?ecno=3.2.1.78 ⌕■ BRENDA_SystematicName: 4-beta-D-mannan mannanohydrolase■ BRENDA_ECNumber: 3.2.1.78■ abbreviation_alias: -■ google_search: http://www.google.com/search?q=mannan+endo-1,4-beta-mannosidase ⌕■ BRENDA_RecommendedName: mannan endo-1,4-beta-mannosidase■ SwissProt_ID: P49424 P49425 P51529 P55278 Q8WPJ2



navigation

- [Main page](#)
- [Community portal](#)
- [Current events](#)
- [Recent changes](#)
- [Random page](#)
- [Help](#)

search

toolbox

- [What links here](#)
- [Related changes](#)
- [Special pages](#)
- [Printable version](#)
- [Permanent link](#)
- [Semantic Assistants](#)
- [Browse properties](#)

Property:Enzyme

 Page Name	 Enzyme Entities Found
PubMed:19912637	mannan endo-1,4-beta-mannosidase BK01 endo-1,4-beta-mannosidases mannanases 1,4-beta-D-mannan mannanohydrolase beta-mannanase hydrolase mannanase
PubMed:21861877	β-glucosidase β-galactosidase cellobiohydrolases Cel7A/Cel6A endoglucanases Cel7B/Cel5A Cel7A Cel6A cellulase

Pages using the property "Enzyme"

Showing 2 pages using this property.

P

- [PubMed:19912637](#) + mannan endo-1,4-beta-mannosidase, BK01, endo-1,4-beta-mannosidases, ...
- [PubMed:21861877](#) + β-glucosidase, β-galactosidase, cellobiohydrolases, ...