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

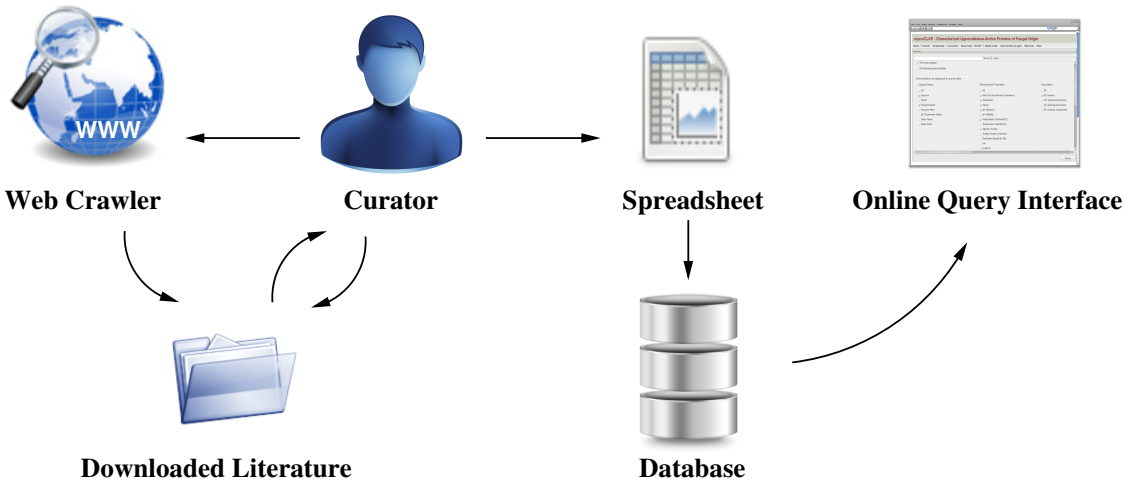
Semantic Software Lab

NETTAB 2012 Nov. 15th, Como, Italy

Outline

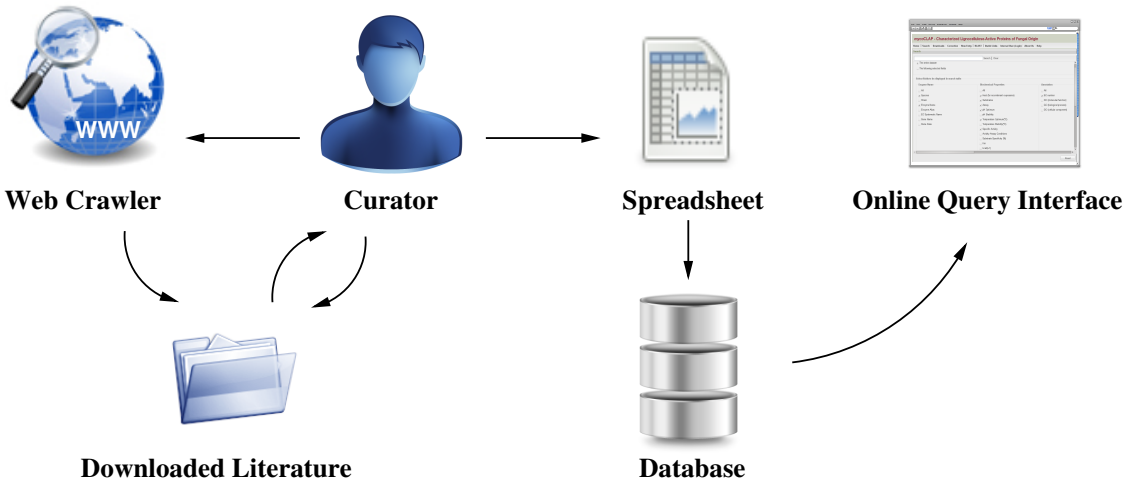
MOTIVATION: **Curation of Biomedical Literature**

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



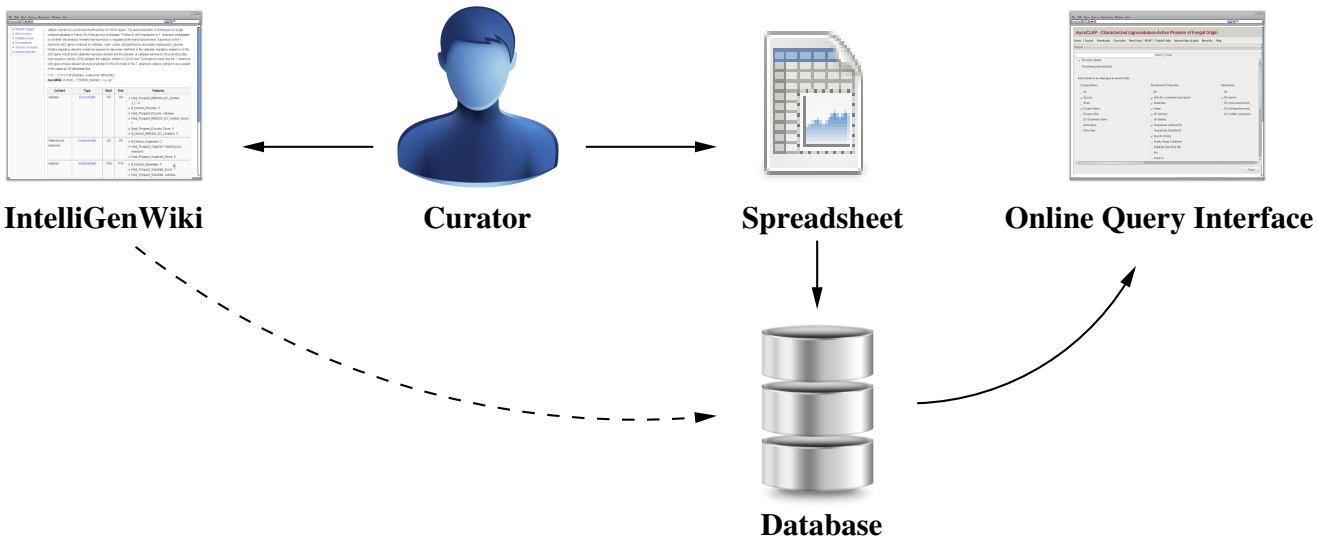
MOTIVATION: **Curation of Biomedical Literature**

- 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**

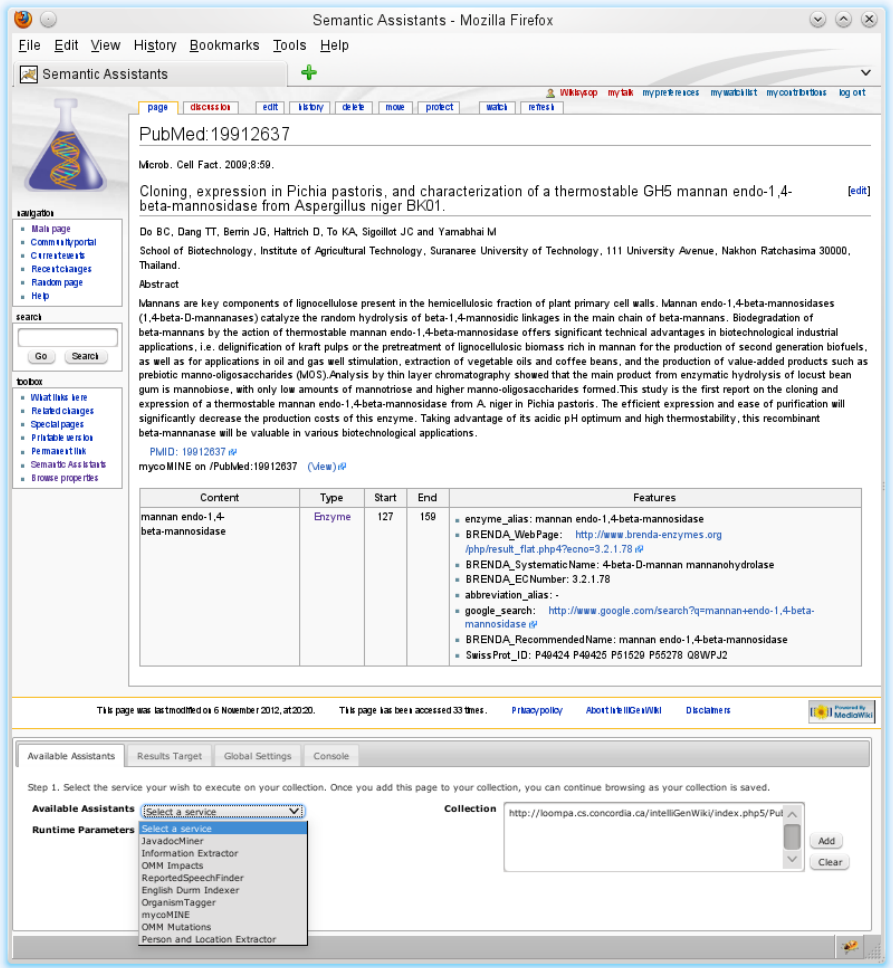


Enhanced Literature Curation Workflow Using IntelliGenWiki

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

Approach: **IntelliGenWiki**

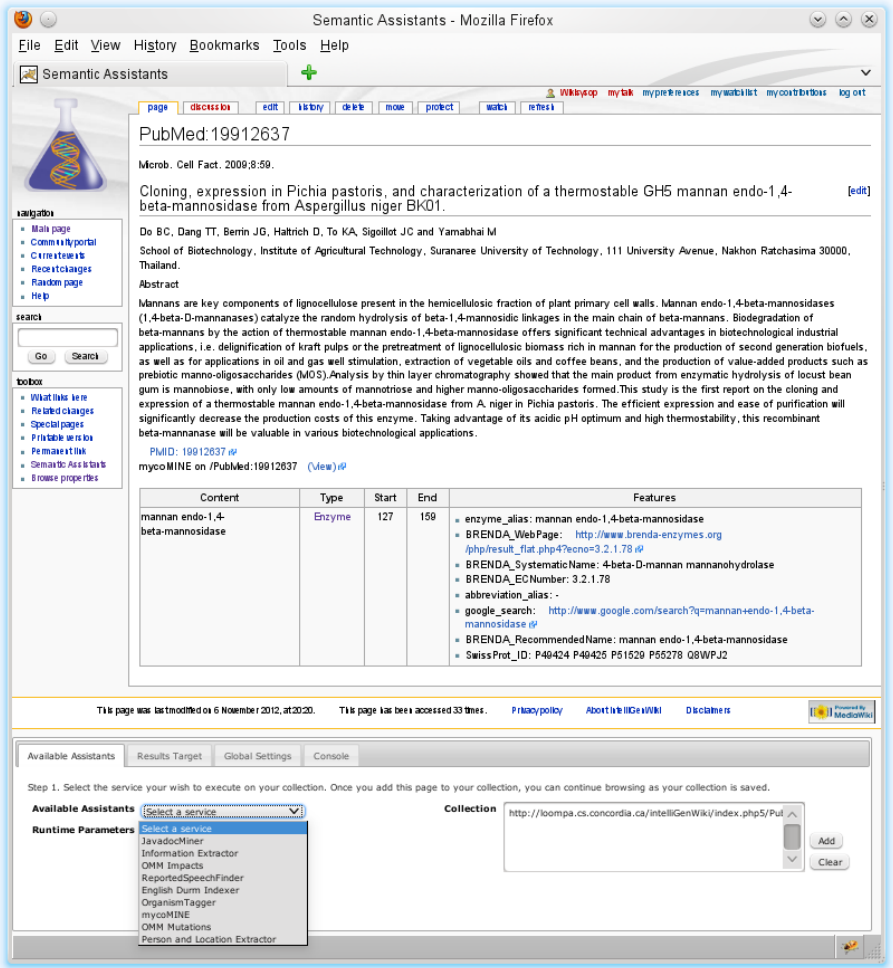
- Adopts the "Wiki" paradigm
  - Accessible via a web browser
  - Simple syntax (markup)
  - Open collaboration
- Based on the MediaWiki engine
  - Open source
  - Highly scalable
  - Extensible: Semantic MediaWiki



IntelliGenWiki User Interface

Approach: **IntelliGenWiki**

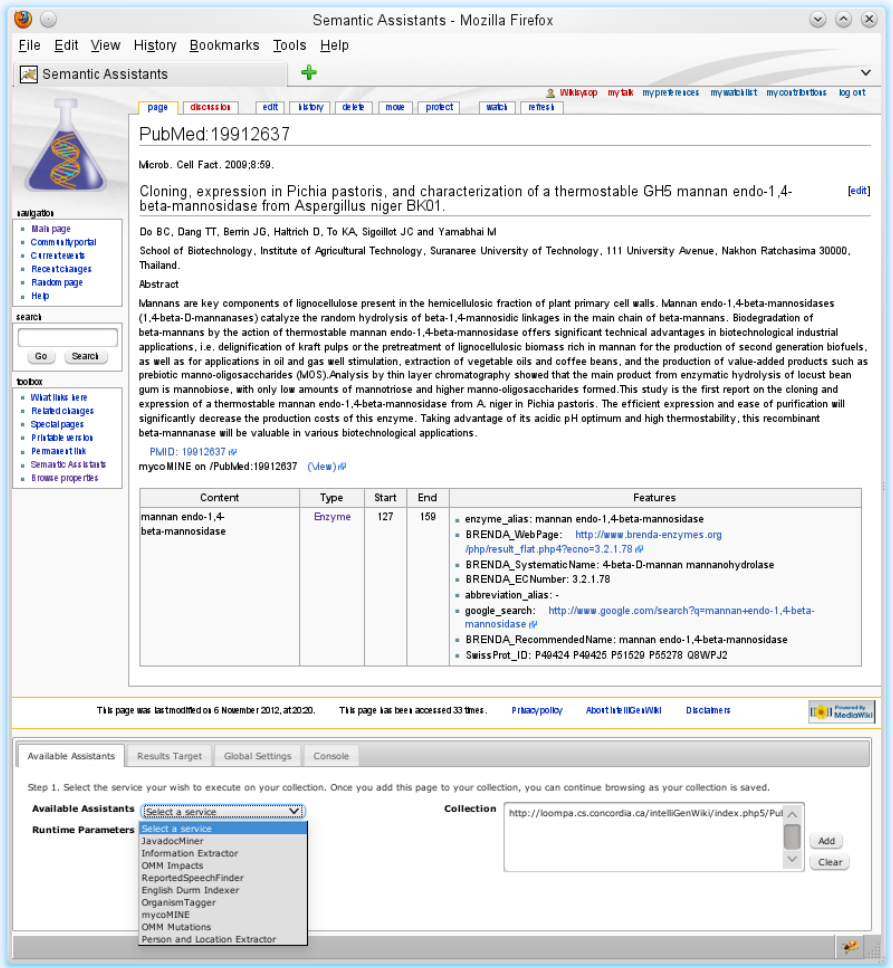
- Adopts the "Wiki" paradigm
  - Accessible via a web browser
  - Simple syntax (markup)
  - Open collaboration
- Based on the MediaWiki engine
  - Open source
  - Highly scalable
  - Extensible: Semantic MediaWiki
- Integrated Text Mining *Assistants*
- Provides semantic capabilities
  - Formalization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



IntelliGenWiki User Interface

Approach: **IntelliGenWiki**

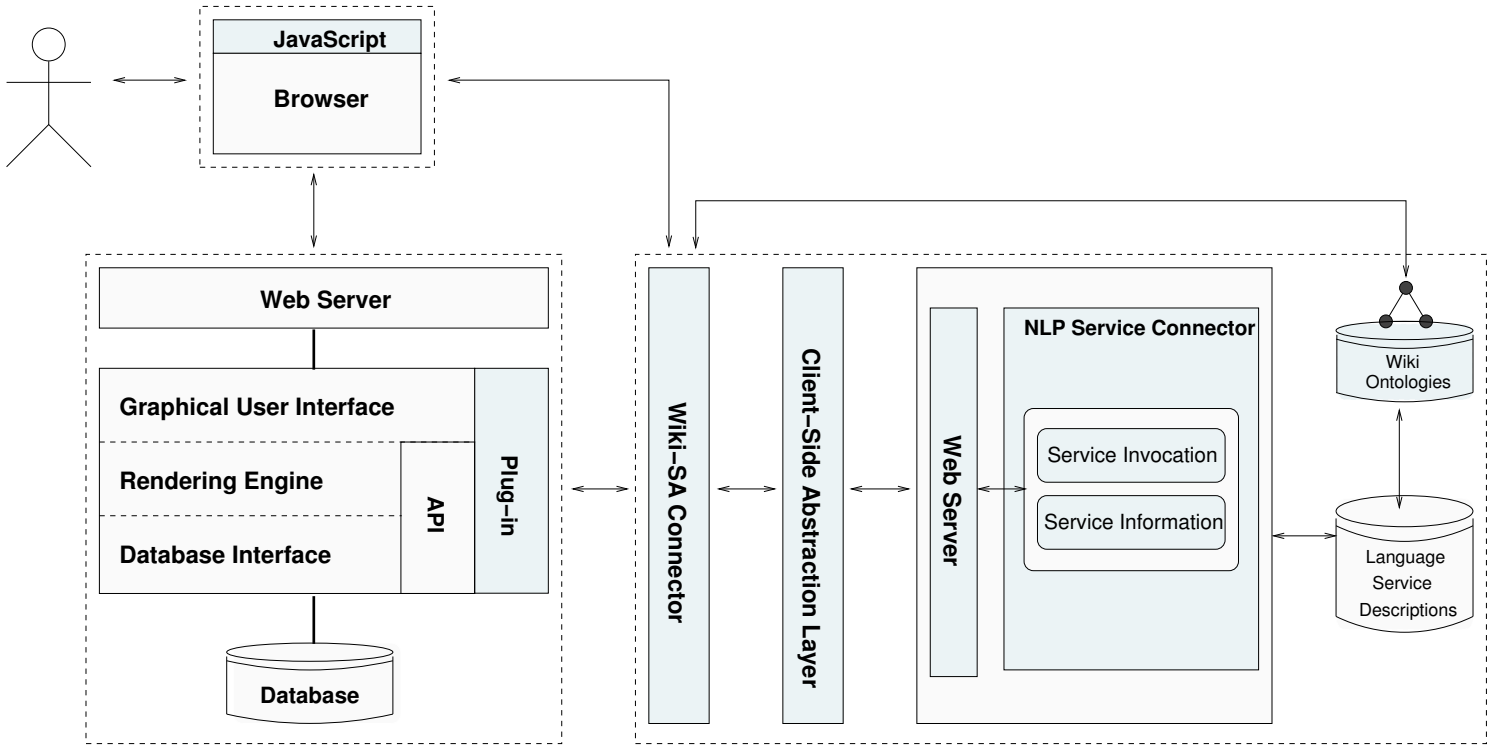
- Adopts the "Wiki" paradigm
  - Accessible via a web browser
  - Simple syntax (markup)
  - Open collaboration
- Based on the MediaWiki engine
  - Open source
  - Highly scalable
  - Extensible: Semantic MediaWiki
- Integrated Text Mining *Assistants*
- Provides semantic capabilities
  - Formalization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



IntelliGenWiki User Interface

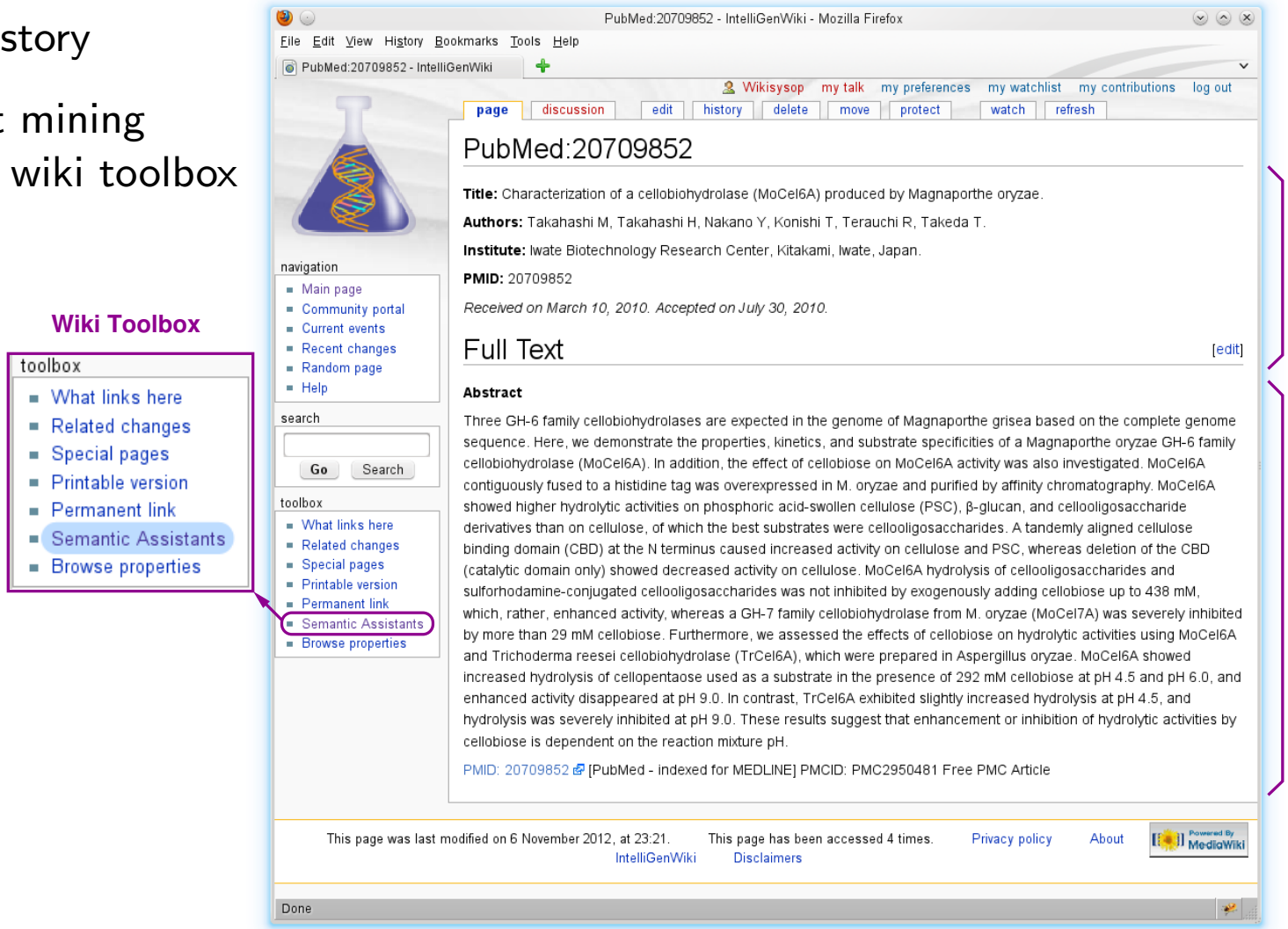
System Overview

- **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

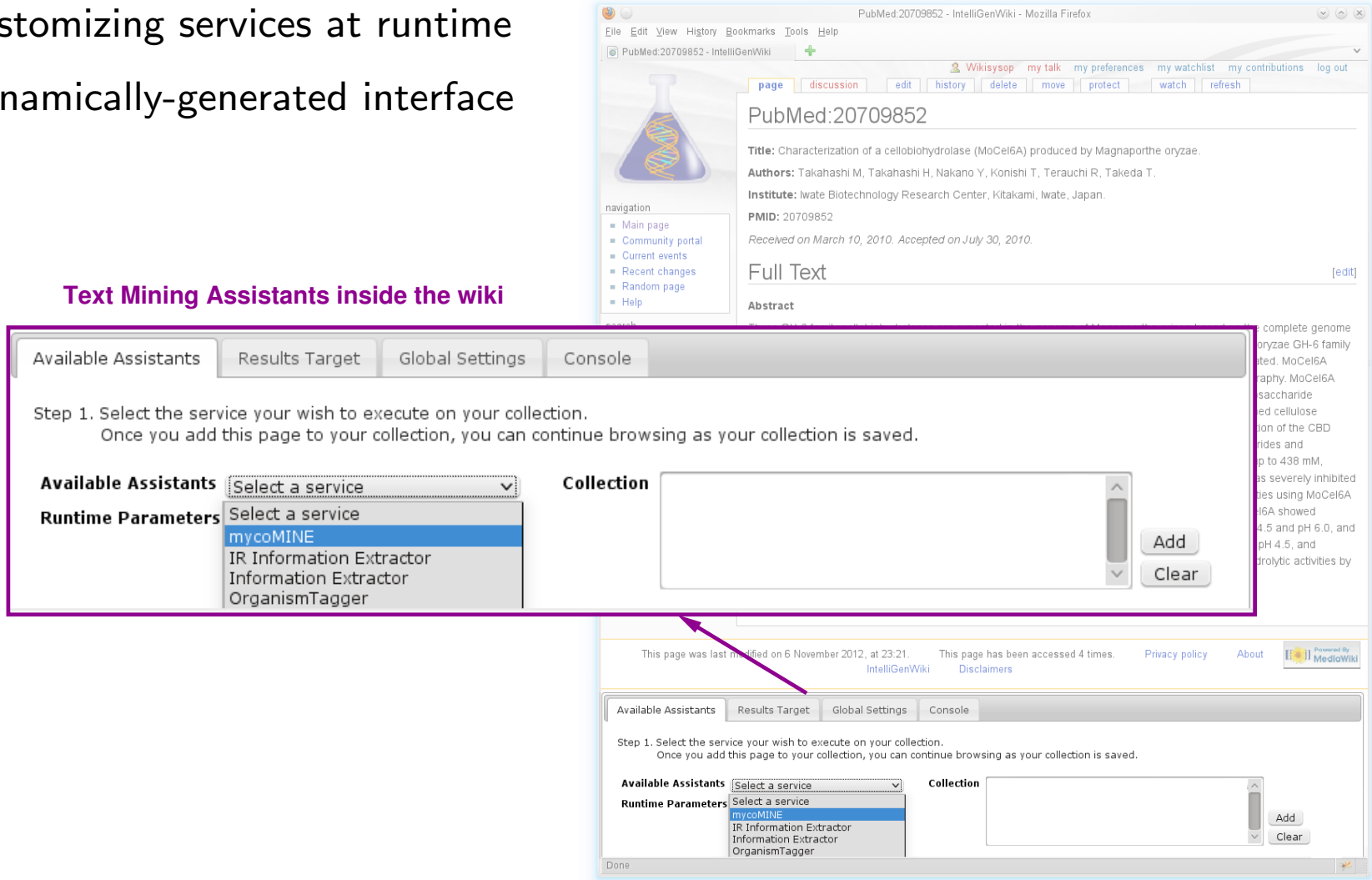
- Each wiki page corresponds to a literature instance, e.g., abstract of a paper
- Revision History
- Inquire text mining services via wiki toolbox



The NLP Interface

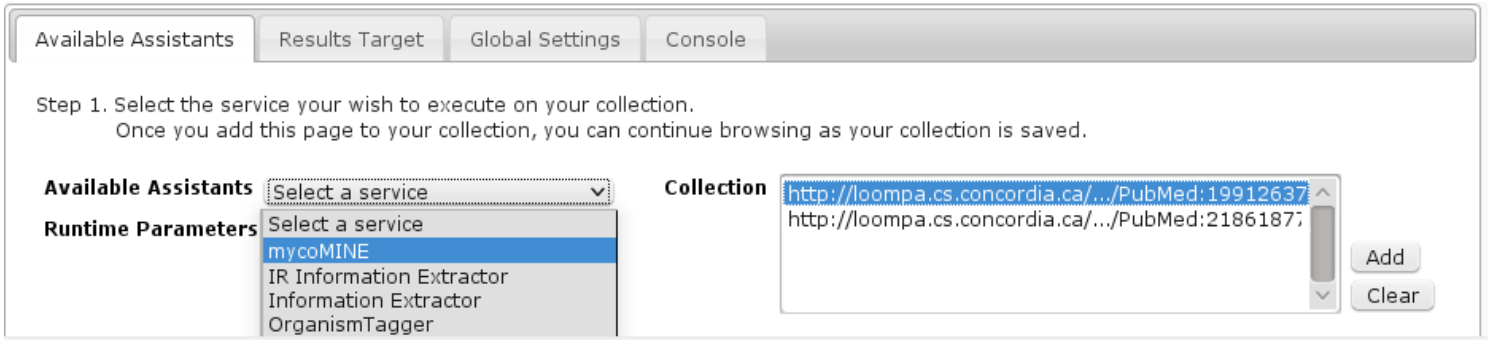
- The IntelliGenWiki NLP user interface offers various text mining services
- Customizing services at runtime
- Dynamically-generated interface

Text Mining Assistants inside the wiki



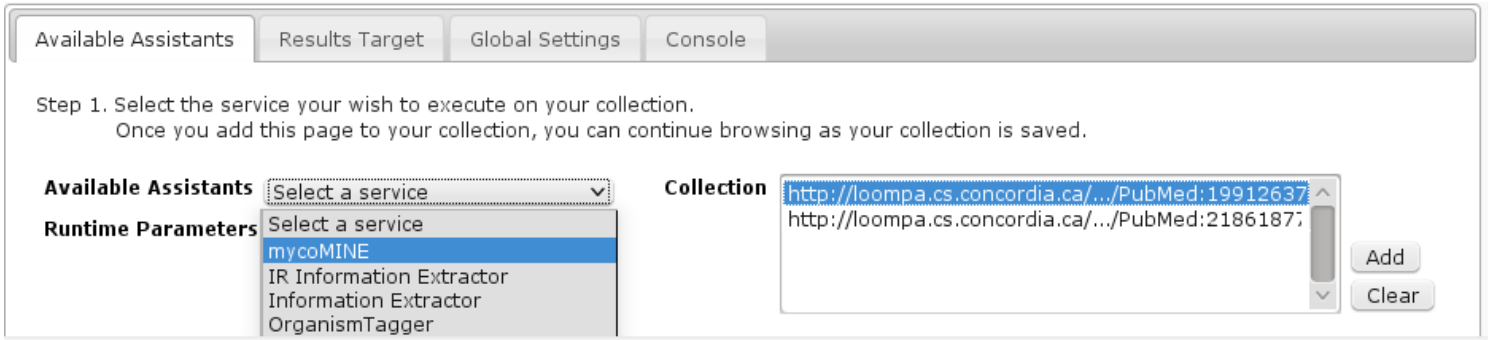
NLP Interface features

- Multi-document Analysis



NLP Interface features

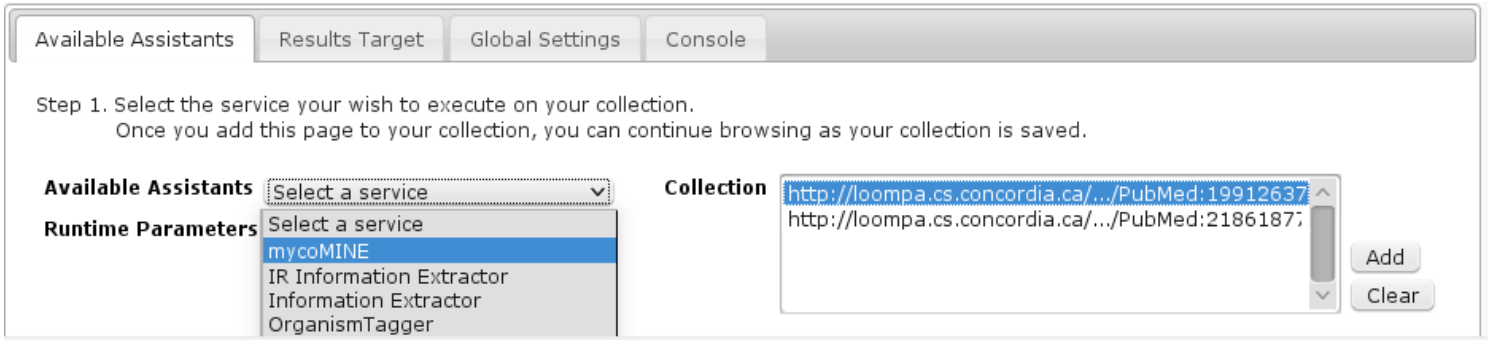
- Multi-document Analysis



- 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

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

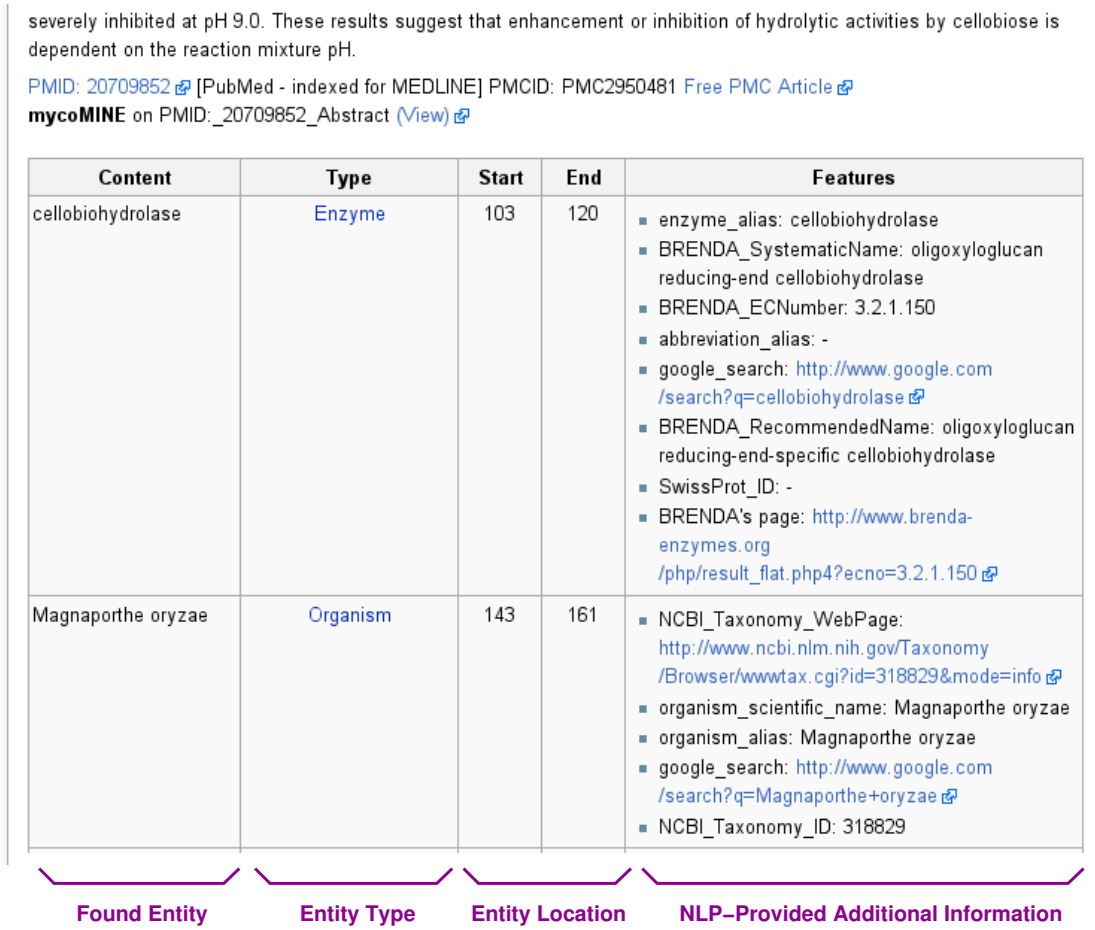
- Dynamic discovery of NLP services

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	▪ 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	▪ 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
- Results:

Average Curation Time

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
- Results:

Average Curation Time

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

Wikisysop my talk my preferences my watchlist my contributions log out

page discussion edit history delete move protect watch refresh

Main Page

*Intelli*GenWiki is a semantic wiki-based biomedical literature curation environment.

Sample pages:

- PubMed:19912637
- PubMed:21861877

navigation

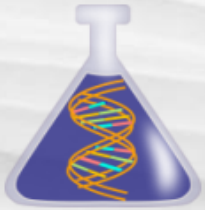
- Main page
- Community portal
- Current events
- Recent changes
- Random page
- Help

search

Go Search

toolbox

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



navigation

- Main page
- Community portal
- Current events
- Recent changes
- Random page
- Help

search

Go 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, Sigoillot 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

navigation

- Main page
- Community portal
- Current events
- Recent changes
- Random page
- Help

search

Go 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, Sigoillot 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

navigation

- Main page
- Community portal
- Current events
- Recent changes
- Random page
- Help

search

Go 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, Sigoillot 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

navigation

- Main page
- Community portal
- Current events
- Recent changes
- Random page
- Help

search

Go 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, Sigoillot 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

navigation
- Main page
- Community portal
- Current events
- Recent changes
- Random page
- Help

search
Go 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, Sigoillot 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

mycoMINE on /PubMed:19912637 (View)

Content	Type	Start	End	Features
mannanases	EnzymeStats	588	598	▪ 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	▪ 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

Go 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, …