



Federal Office of
Consumer Protection
and Food Safety

Implementation of AI-based support systems in the risk assessment of microorganisms - KAPRi

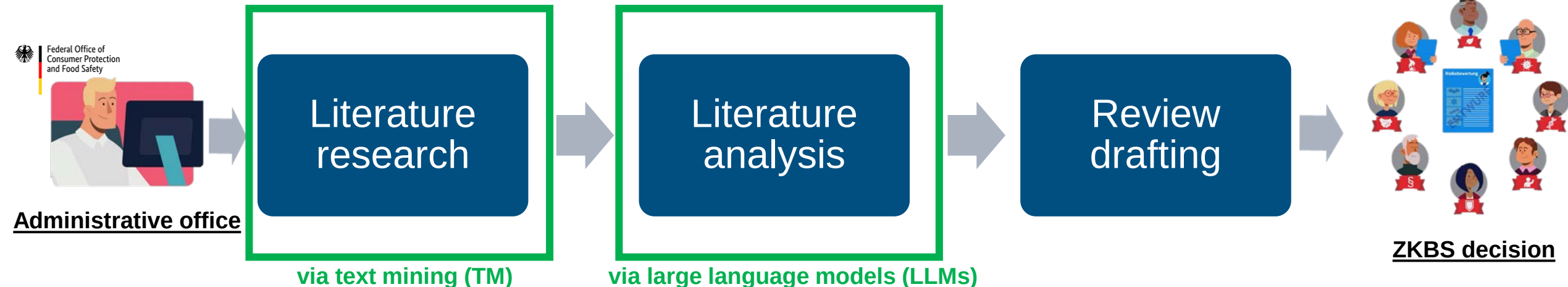
29.10.2026

Background: Risk assessment of microorganisms



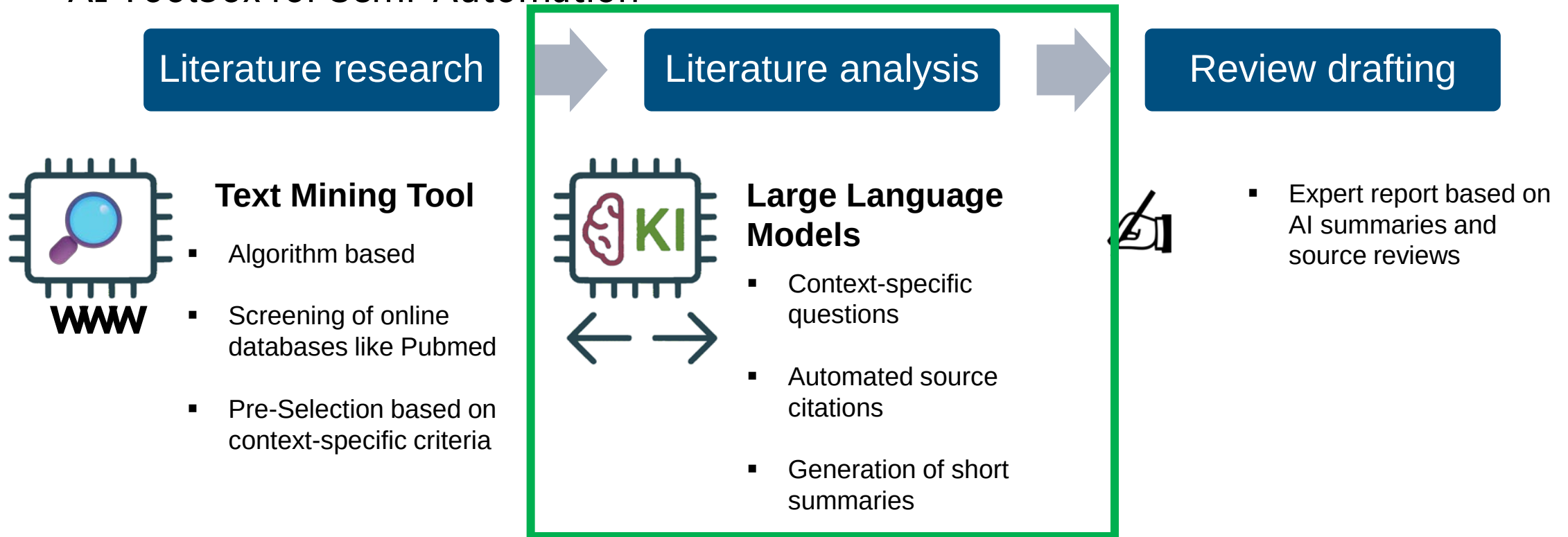
- Microorganisms must be assigned to one of four **risk groups** before being used as donor or recipient organisms in genetic engineering operations.
- Risk assessment is carried out by the Central Commission on Biological Safety (ZKBS) based on legal criteria (German Genetic engineering Act - GenTG).
- Position statements have the character of scientific reviews.

Possibilities for automation:



General concept

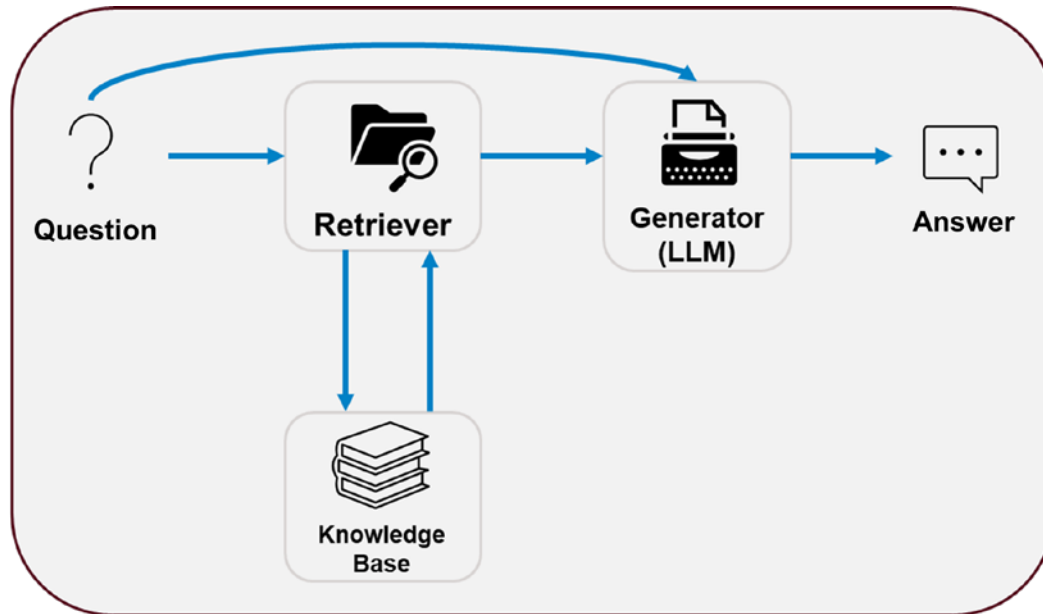
AI Toolbox for Semi-Automation



Halving research and evaluation time

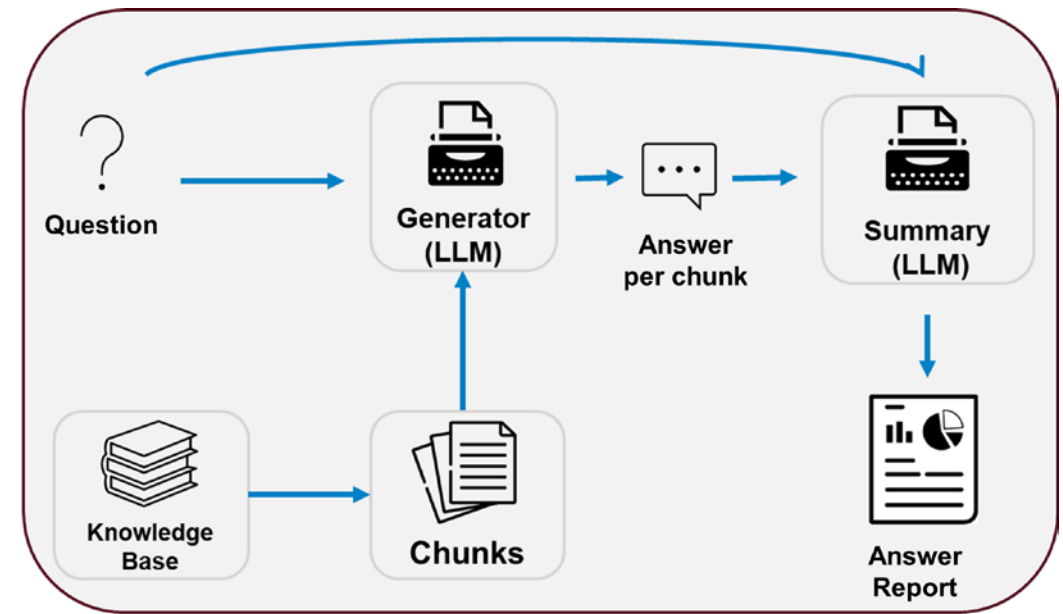
LLM concepts for literature analysis

Retrieval-Augmented Generation (RAG)



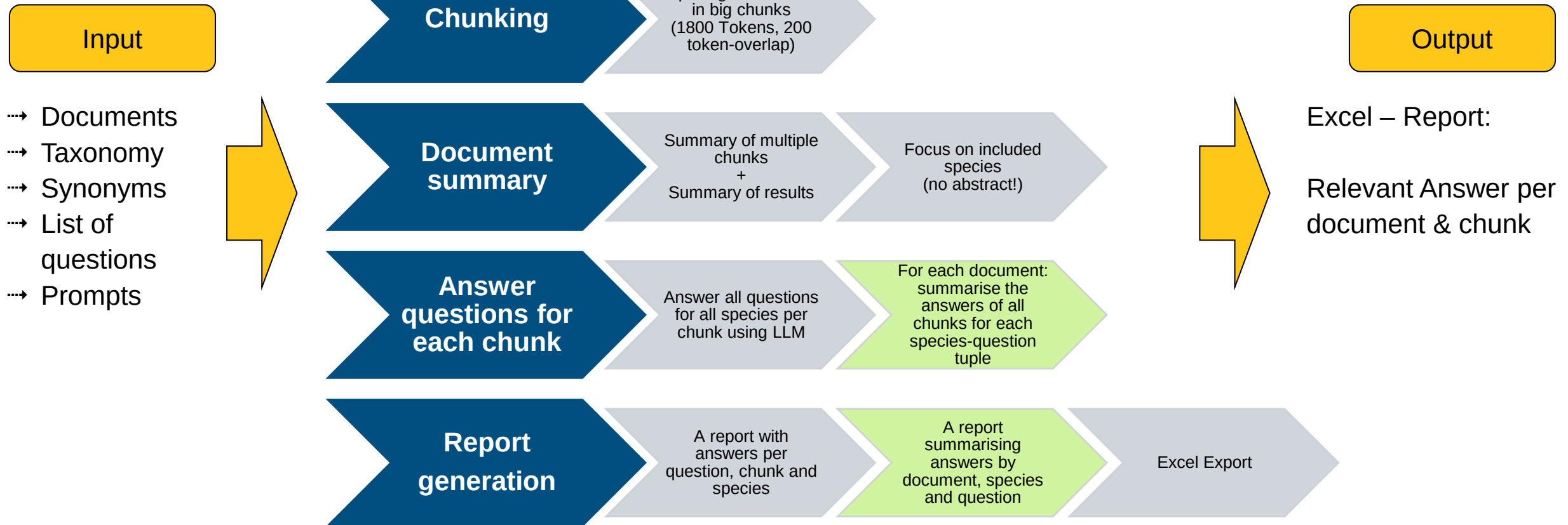
- **Fast approach**
- **Limited & missing citations**
- **Vague answers**

Direct approach

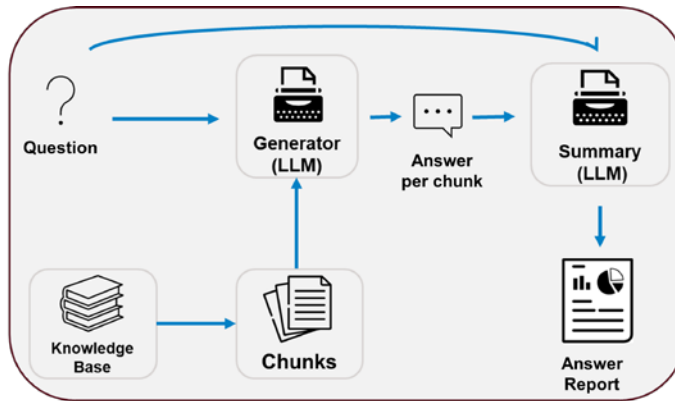


- **Slow approach**
- **Guaranteed & verified citations**
- **Precise answers**

Direct approach - concept

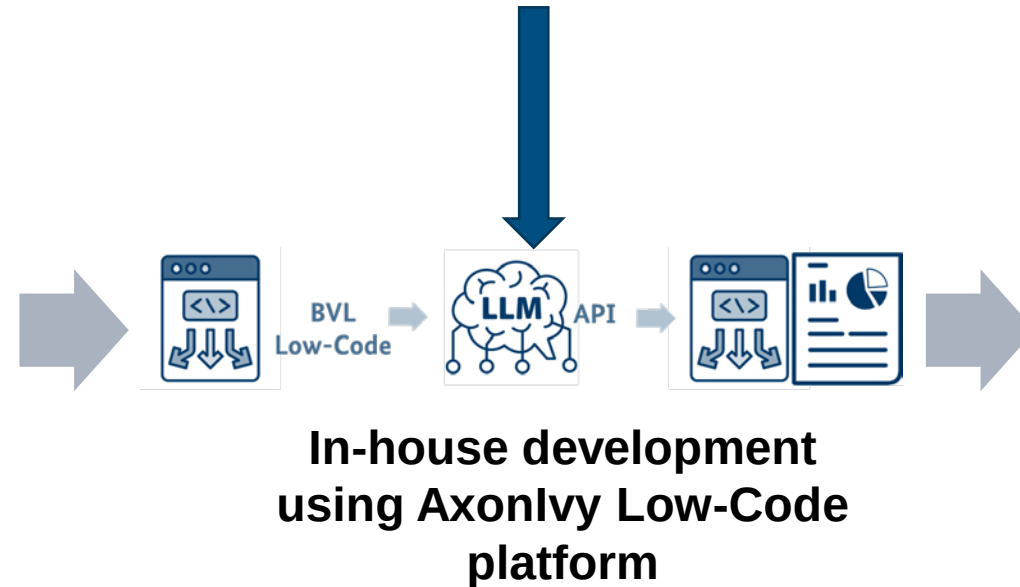


Recent developments



KAPRi – direct approach (based on SVA prototype)

LLM via API
(e. g. KIPITZ)

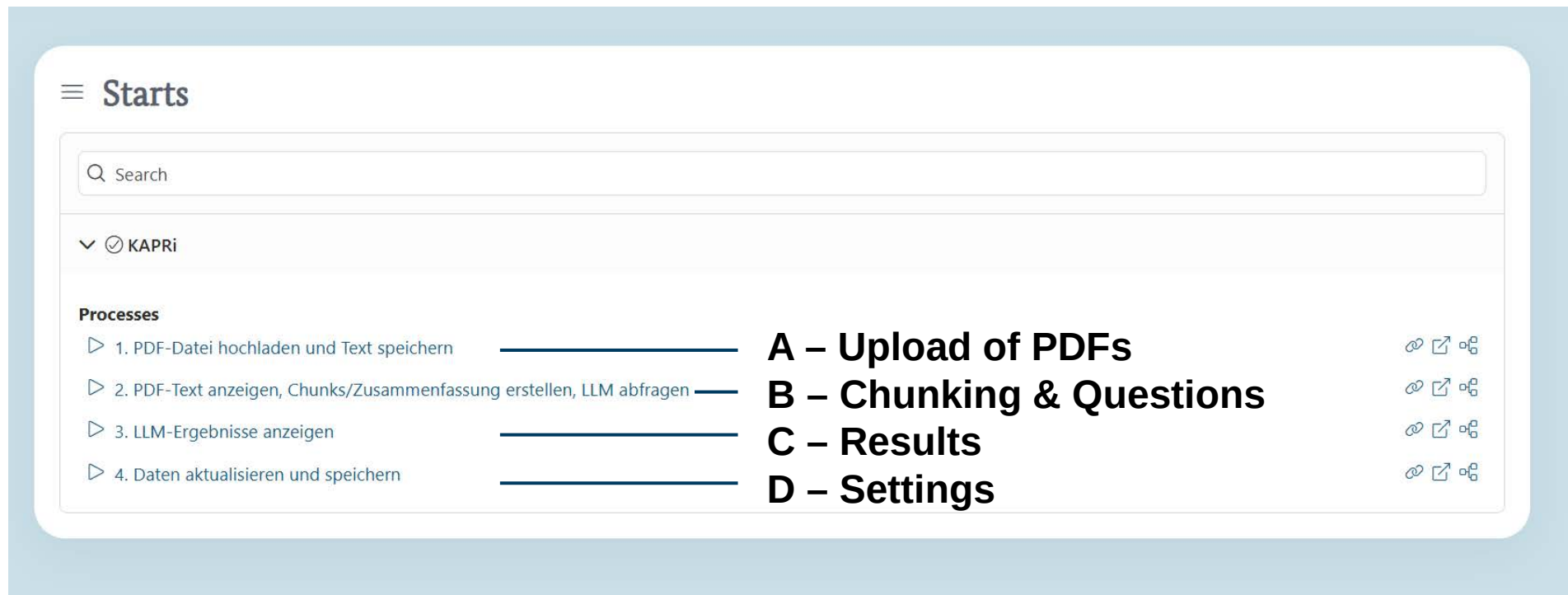


**In-house development
using Axonivy Low-Code
platform**



Low-Code Application

- Interchangeable use cases (Including GUI)
- Rights and roles management
- Continuous operation



Low-Code Application – GUI

A – Upload & Data organisation

Liste der gespeicherten Dateien

☐	Benutzer ↑↓	Organismus ↑↓	Name ↑↓	Upload-Zeit ↑↓	Bearbeitung
>	André				
>	Developer				
✓	Referat 402				
☐	Referat 402	Basidiobolus meristosporus	Coremans-Pelseneer 1973 - Isolation of Basidiobolus meristosporus.pdf	Jun 3, 2026, 1:40:54 PM	Zur Liste der Fragen

<< < 1 > >>

Low-Code Application – GUI

B – Questions & Chunking

Datei anzeigen

Name

Latheef, Keyburn et al. 2020 - Atypical Brucella sp in captive20.pdf

Zeit

27.11.2025 15:54

Organismus

Brucella Ceti

Chunks erstellen

Zusammenfassung erstellen

Alle Fragen an Chunks stellen

Eingelesener Text

Chunks

Zusammenfassung

CASE REPORT

Atypical Brucella sp in captive Australian green tree frogs (Litoria caerulea): clinical features, pathology, culture and molecular characterization

S Latheef, a A Keyburn, b I Broz, b A Bagnara, b C Bayley, a S Frith c and EC Dobson a *

Background Brucella spp. are globally important zoonotic bac- teria, which have historically been considered pathogens of warm-blooded species. More recently, new strains of Brucella have been cultured from a broader range of animals including terres- trial and marine mammals and amphibians. These new isolates are classi fi ed as '

Low-Code Application – GUI

C – Results → Filter in Low-Code or Excel export

Abfrage-Ergebnisse anzeigen

☒ nur nicht leere Antworten
 ☐ alle Antworten

Filtern

Spalten Exportdaten

<< < 1 > >>

Dokument ↑↓	Organismus ↑↓	Frage ↑↓	Antwort ↑↓	Zeit ↑↓	Chunk
Marker, Choi et al.pdf	Staphylococcus auricularis	Is Staphylococcus auricularis associated with infections in healthy humans, if so, what infections occur?	Yes. In the provided case data, **Staphylococcus auricularis** is linked to ear-related infections: - **Otorrhea** (persistent ear discharge) in	Jun 3, 2026, 1:31:25 PM	d. Otorrhea resolved 14 45-y-old female with a history of right canal wall up tympanomastoidectomy followed by radical mastoidectomy for cholesteatoma 7 y ago presenting for follow-up. She has intermittent right otorrhea once a month. Right mastoid cavity with a strip of mucosalization on the floor and overlying yellow-green otorrhea with crusting. Ciprofloxacin-dexamethasone otic drops switched to gentamicin otic drops after culture results Improved but continuing otorrhea Abbreviations: bid, twice a day; PE, pressure equalizing; TM, tympanic membrane. Table 2. (continued) Marker et al 7 Table 3. Summary of Antibiotic Sensitivity for Turicella otitidis (n = 3) and Staphylococcus auricularis (n = 1) From the Subset of Case Report Patients

Low-Code Application – GUI

D – Settings

Date

Prompts

Fragen

Organismus

Name ↑↓	Synonyms ↑↓	Bearbeitung	
Brucella ceti	Brucella maris, B. ceti		
Orthobornavirus bornaense	Borna disease virus, Mammalian 1 orthobornavirus, BoDV, BoDV-1		
Eubacterium limosum	E. limosum, Bacteroides limosus, Butyribacterium limosum, B. limosus, B. limosum		
Cyanidioschyzon merolae	C. merolae		
Akanthomyces muscarius	A. muscarius, Lecanicillium muscarium, Cephalosporium muscarium		
Staphylococcus auricularis	S. auricularis		

Evaluation of the Low-Code Application

Use cases: 4 × old ZKBS risk assessments (fungi, virus, bacteria, micro algae)
1 new risk assessment (fungi)
~ 50 peer-reviewed scientific Papers
10 risk assessment questions
Same system prompt / Same LLM

Evaluation: Target vs. Actual comparison

✓ - **expected answer**
± - **border cases**
X - **wrong answer**

	Species A		Species B	
	target	LLM answer	target	LLM answer
Question 1	[...]	✓	[...]	✓
Question 2	[...]	±	[...]	X

+ quality check if cited paper really contains the answer

Evaluation of the Low-Code Application

Target vs. Actual comparison:

	<i>Parapoxvirus sealpox</i> (Virus)	<i>Paulinella chromatophora</i> (Algae)	<i>Basidiobolus meristosporus</i> (Fungi)	<i>Staphylococcus auricularis</i> (Bacteria)	<i>Fomes fomentarius</i> (Fungi)
Number of publications	10	8	12	9	8
✓	185 (99 %)	27 (67,5 %)	121 (93,8 %)	64 (96,9 %)	143 (99,3 %)
±	2 (1 %)	10 (25 %)	8 (6,2 %)	2 (3,1 %)	1 (0,7 %)
✗	0	3 (7,5 %)	0	0	0

Answer Quality:

- Mostly short and precise
- Synonyms included in search
- Basic understanding of taxonomy and microbiology (e. g. basidiospores = sexual reproduction)
- Interpretation of table data

Citation quality:

- Correct citations in every case

Low-Code Application – Examples

Expected answers

Table Data Interpretation

Q: What is the optimal growing condition (temperature & pH) for *Fomes fomentarius*?

A:

The chunk provides temperature-optimum estimates for five *Fomes fomentarius* isolates:

- 1FT_SF ≈ 27.9 °C
- 44FT_LG ≈ 25.5 °C
- 124FT_JM ≈ 27.6 °C
- 195FT_MM ≈ 27.5 °C
- 200FT_AK ≈ 25.9 °C

Thus, the species grows best at temperatures in the mid-20 °C range (≈ 25–28 °C).

No information on pH optimum is given in the provided text.

Paper:

TABLE I. Quadratic equations for the hyphal growth response of five isolates each of *Fomes fasciatus* and *Fomes fomentarius* to temperature

Day	Species	Isolate	Equations ^a			Estimated temperature optimum (°C)	Standard error
			Quadratic	Slope	Intercept		
3	<i>Fomes fasciatus</i>	10FA_FPL	-1.979E-03	0.155	-0.085	39.05	1.622
		11FA_FPL	-1.842E-03	0.146	-0.046	39.52	2.449
		52FA_JJRB	-3.138E-03	0.206	-0.424	32.89	0.395
		109FA_SMS	-1.929E-03	0.152	-0.007	39.37	1.752
		262FA_MM	-3.088E-03	0.204	-0.428	33.08	1.081
	<i>Fomes fomentarius</i>	1FT_SF	-1.858E-03	0.104	-0.578	27.95	0.514
		44FT_LG	-1.208E-03	0.062	-0.997	25.46	0.491
		124FT_JM	-2.730E-03	0.151	-0.100	27.56	0.424
		195FT_MM	-3.168E-03	0.174	-0.150	27.54	0.506
		200FT_AK	-3.502E-03	0.181	-0.191	25.86	0.222

Chunk:

[...] TABLE I. Quadratic equations for the hyphal growth response of five isolates each of *Fomes fasciatus* and *Fomes fomentarius* to temperature Equations a Estimated temperature optimum (°C) Standard error Day Species Isolate Quadratic Slope Intercept 3 *Fomes fasciatus* 10FA_FPL í 1.979E í 03 0.155 í 0.085 39.05 1.622 11FA_FPL í 1.842E í 03 0.146 í 0.046 39.52 2.449 52FA_JJRB í 3.138E í 03 0.206 í 0.424 32.89 0.395 109FA_SMS í 1.929E í 03 0.152 í 0.007 39.37 1.752 262FA_MM í 3.088E í 03 0.204 í 0.428 33.08 1.081 *Fomes fomentarius* 1FT_SF í 1.858E í 03 0.104 í 0.578 27.95 0.514 44FT_LG í 1.208E í 03 0.062 í 0.997 25.46 0.491 124FT_JM í 2.730E í 03 0.151 í 0.100 27.56 0.424 195FT_MM í 3.168E í 03 0.174 í 0.150 27.54 0.506 200FT_AK í 3.502E í 03 0.181 í 0.191 25.86 0.222 6 *Fomes fasciatus* 10FA_FPL í 4.241E í 03 0.285 í 1.208 33.63 0.404 11FA_FPL í 3.697E í 03 0.256 í 0.826 34.61 0.921 52FA_JJRB í 4.645E í 03 0.293 í 1.015 31.59 0.567 109FA_SMS í 3.596E í 03 0.260 í 0.891 36.20 0.854 262FA_MM í 4.472E í 03 0.282 í 0.821 31.51 0.557 [...]

Low-Code Application – Examples

Border cases

Context Misinterpretation

Q: What is the optimal growing condition (temperature & pH) for Staphylococcus auricularis?

A:

The strain was cultivated under the following conditions:

- ****pH:** 6.5 (used for enrichment broth)**
- ****Temperature:** 28 °C–30 °C (used for growth in glucose-yeast extract-peptone broth)**

>> Answer from Materials & Methods chunk - Not the answer in the context of the question

Non-optimized questions

Q: In which environment does Parapoxvirus sealpox exists?

A:

The chunk describes the virus only in the context of ****in-vitro cell culture****. After several blind passages, the virus produced a cytopathic effect in the cultured cells, and intracellular mature virions (IMV) were purified from lysates of these infected cells. Thus, within the information provided, Parapoxvirus sealpox is present in the environment of ****infected cell cultures (intracellularly within cultured host cells)****.

>> “Environment” can be interpreted too broadly. The question should be optimized or narrowed down

Low-Code Application – Examples

Wrong answers

Missing biological context

Q: In which environment does *Paulinella chromatophora* exist?

A:

Paulinella chromatophora resides inside its host cell, i.e., in a homogeneous intracellular environment.

>> **P. Chromatophora has an endosymbiotic organelle within the cell. Confusion between endosymbiotic organelle and organism.**

Q: Does Paulinella chromatophora express virulence factors or toxins?

A:

Yes. The study identified a class of short, nuclear-encoded proteins imported into the chromatophore that are “AMP-like” (antimicrobial peptide-like) proteins. These peptides act as effectors of innate immunity, killing bacteria by forming trans-membrane pores or disrupting membranes, and they may also have roles in controlling the endosymbiont. Thus, Paulinella chromatophora expresses AMP-like proteins that function as antimicrobial/toxic factors.

>> **Antimicrobial factors and “toxins” are not relevant. Confusion between general toxins and cytotoxic substances.**

Limitations of the LLM knowledge base

Future prospects



KAPri Low-Code Application

Short Term

- Integration of more use cases
- Optimized GUI and usability

Long Term

- Development of the literature research module
- Within an EFSA Tailor Made Activity Project



Federal Office of
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RAG approach using KIPITZ

- LLM platform of the ITZ-Bund
- Preassembled RAG-Application ‘Mit Wissensdatenbanken Chatten’
- Paper-PDFs converted to JSON
>> JSON knowledge base for the RAG-component
- Used LLM interchangeable
- System prompt customizable
- Overview about used sources (‘Zitat’)



Mit Wissensdatenbank chatten

Neu starten

Mistral Small 3.1 24B

Wissensdatenbanken
Brucella ✓ Offene Daten

UA Du

What is the Gram-status of Brucella vulpis?



Modell

Brucella vulpis is described as a **slow-growing, gram-negative, non-motile, and non-spore-forming** bacterium [1]. It consists of coccoid bacteria that are approximately 0.5–0.7 µm in diameter and 0.4–1.3 µm long [2].

These characteristics help differentiate Brucella vulpis from other species within the genus Brucella.

Zitat 1	Zitat 2	Zitat 3	Zitat 4	Zitat 5	Zitat 6
Zitat-Nummer: 1					
Zitat: Zitat anzeigen					
Dokument: Jiménez de Bagüés, Maria Pilar, Iturralde et al. 2014 - The New Strains Brucella inopinata_1.pdf					
Seite: 1					
Datenbank: Brucella					
Score: 1.0					

Evaluation of RAG and direct approach (SVA prototype):

Use case: 8 × *Brucella* sp. (Bacteria)
~ 100 peer-reviewed scientific Papers
10 risk assessment questions (e. g. Is *Brucella* sp. X a pathogen to humans or animals?)
Same system prompt

Evaluation: Target vs. Actual comparison

✓ - **expected answer**
± - **border cases**
X - **wrong answer**

	Species A		Species B	
	Target	LLM Answer	Target	LLM Answer
Question 1	[...]	✓	[...]	✓
Question 2	[...]	±	[...]	X

+ quality check if cited paper really contains the answer

Evaluation of RAG and direct approach (SVA prototype):

Target vs. Actual comparison:

RAG (KIPITZ)

✓	-	41,8 %
±	-	19,8 %
X	-	38,4 %

Citation quality:

- Accurate citations in only ~1/3 of cases
- Cited sources are mostly random

Answer Quality:

- Answers are frequently long, vague, or hallucinated
- Significant limitations with taxonomy, synonyms & technical terminology

Direct approach (Container-based)

✓	-	100 %
±	-	0 %*
X	-	0 %

Citation quality:

- Accurate citations in 100% of cases

Answer Quality:

- Answers are consistently short and precise
- Successful integration of synonyms and foundational taxonomy

Examples RAG

Taxonomic problems



Du

Is *Brucella anthropi* a pathogen to humans or animals?

The answer is not available in the provided context.

The excerpts discuss *Ochrobactrum anthropi*, which is related to the genus *Brucella* but **is not the same species**. There is no information provided about *Brucella anthropi* specifically. The excerpts mention *Ochrobactrum anthropi* as a pathogen to humans and animals, but this does not directly answer the question about *Brucella anthropi*.

Zitat 1	Zitat 2	Zitat 3	Zitat 4	Zitat 5	Zitat 6	Zitat 7
Zitat-Nummer: 1						
Zitat:	 Zitat anzeigen					
Dokument:	Lama, Chanakya et al. 2021 - Genomic analysis of a multidrug-resistant_1.pdf					
Seite:	1					
Datenbank:	Brucella					
Score:	1.0					

Wrong and too many citations

Not able to find the source / information

Q: What is the Gram-status of *Brucella inopinata*?

A: The answer is **not available** in the provided context. The document excerpts do not mention the Gram-status of *Brucella inopinata*.

Wrong answers / missinterpretation

Q: Is *Brucella vulpis* associated with infections in healthy animals? if so, which infections occur?

A: Yes, *Brucella vulpis* is associated with infections in healthy animals. The document excerpts mention that atypical *Brucella* isolates, including *B. vulpis*, have been found in apparently healthy individuals [Ja[∞], Girault et al. 2018 - Phenotypic and Molecular Characterization_1.pdf].

>> Paper disuses other Species and mentions *B. vulpis* only twice, not in pathogenic context

Examples Direct approach (SVA prototype)

Synonym understanding

Q: Is the species '*Brucella anthropi*' resistant to antibiotics? If yes, which ones?

A: The species referred to as **Brucella anthropi** (which is actually **Ochrobactrum anthropi**) shows resistance to several antibiotics. Specifically, it is resistant to: - Ampicillin - Co-amoxiclav - Temocillin - Cefazolin - Aztreonam. However, it is sensitive to: - Amikacin - Ofloxacin - Imipenem. Therefore, **Brucella anthropi** (or **Ochrobactrum anthropi**) is resistant to the antibiotics listed above.

Source: Ezzedine, Mourad et al. 1994 - An outbreak of *Ochrobactrum anthropi*.pdf

Taxonomic understanding

Q: What is the Gram-status of *Brucella inopinata*?

A: The provided information does not explicitly state whether *Brucella inopinata* is Gram-positive or Gram-negative. However, it is known that all species of the genus *Brucella* are Gram-negative. Therefore, *Brucella inopinata* is Gram-negative.

Technical terms understanding

Q: What virulence factors does the species '*Brucella ceti*' have?

A: **Brucella ceti** possesses several key virulence factors that contribute to its ability to infect and survive within host cells:

- 1. **Smooth Lipopolysaccharide (LPS)**:** All known isolates of **B. ceti** are smooth, indicating the presence of a complete O-polysaccharide (O-PS) side chain. The smooth LPS is crucial for the survival of **Brucella** in macrophages and plays a role in antigenic variation.
- 2. **Type IV Secretion System (T4SS)**:** **B. ceti** contains the type IV secretion system, which is essential for delivering effector proteins into host cells, facilitating intracellular survival and replication.
- 3. **Tra Genes**:** **B. ceti** harbors the tra genes, which are part of the IncP island (SAR 2-5). These genes are associated with the type IV secretion system and are likely involved in lateral gene transfer and virulence. [...]

Border Cases - Direct Approach (SVA prototype)

Problems:

- Interpretation of common, non explained abbreviations
- Interpretation of data tables
- Long and confusing sentences

> Example: Does the species '*Brucella inopinata*' infect foxes?

Answer: Yes, the species '*Brucella inopinata*' has been found in red foxes, as evidenced by the isolates F60 and F965.

Chunk: This phylogenetic tree shows **clustering** of BO3 **within** the group of **"atypical" Brucella**, together with **B. inopinata BO1** [7], *B. inopinata* (-like) BO2 [5], and isolates from Australian rodents (NF2653 and 83/13 [11]), **red foxes (F60 and F965 [12])**, a bluespotted ribbontail ray [10], and frogs (B13-0095, 09RB8910, 10RB9215, and 09RB8471 [6, 9]).

Expected answer: No