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CATALYSE

Catalysing scientific innovation into food safety action

D3.2 – Creation of a collaborative space of high quality innovative works and solutions in food safety

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Executive Summary

The CATALYSE Project aims to establish a comprehensive network in the field of food safety, fostering connections and increasing interactions among key stakeholders -including innovators, researchers, industry professionals, and regulatory bodies- to facilitate the implementation of innovative solutions across the food sector.

Work Package 3 (WP3) is responsible for developing a database of knowledge and innovative solutions for food safety. Its main goal is to collect and select recent scientific knowledge and emerging innovations related to food safety. In addition, WP3 seeks to build a collaborative "online space" developed to improve access to relevant information and innovative solutions about food safety, and to promote their engagement through a Community of Practice (CoP) that supports knowledge exchange and practical application.

Delivery D3.2 describes the work carried out on the initial design of the CATALYSE database, considering the advancements made within the stakeholder engagement strategy (WP2). The database has been designed to offer an expanded range of resources covering various specific topics related to food safety, to facilitate knowledge transfer across all actors in the food system. This approach supports the dissemination and adoption of food safety knowledge and innovation (WP4 and WP5) and the expansion of the CATALYSE-CoP.

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LIST OF ABBREVIATIONS

AI	Artificial Intelligence
CoP	Community of Practice
LLM	Large Language Model
WP	Work Package

1. Introduction

1.1 Scope

The goal of the CATALYSE Project is to foster continuous innovation within the European food system and to promote its adoption by end users, thereby accelerating and improving the uptake of knowledge and innovative solutions that enhance food safety across the Farm-to-Fork chain.

The ambition of CATALYSE is to support the creation of a more resilient, sustainable, and equitable community – both online and in practice – that meets the needs of all stakeholders with the shared objective of ensuring food safety. By connecting diverse actors and encouraging the exchange of practices and experiences across scientific and professional domains, CATALYSE seeks to strengthen collaboration, stimulate the exchange of ideas, and enable the broader application of innovation in the food sector.

To achieve these goals, the CATALYSE Project is developing an interactive online platform and a Community of Practice (CoP) dedicated to food safety innovation. The platform serves as a collaborative digital space where stakeholders can access, share, and exchange scientific knowledge, innovative solutions, and best practices. Complementarily, the CATALYSE-CoP functions as a dynamic network that fosters discussion and collaboration among researchers, industry representatives, policymakers, and other key actors. Together, these tools aim to bridge the gap between innovation and implementation, enhancing knowledge transfer and supporting the practical adoption of innovative approaches throughout the food safety sector.

As part of the platform and as was detailed in deliverable D3.1- *Methodology for data collection*, a Database of Knowledge is currently under development and already includes a growing collection of practice-oriented knowledge and innovative solutions in food safety. The database integrates information from diverse sources such as scientific publications, patents, protocols, guidelines, and grey literature. It is designed to support the main actors driving innovation in the food system by providing relevant and easily accessible information. Preliminary results demonstrate significant progress in compiling and organizing relevant resources, offering users updated knowledge. As it continues to expand, the database is expected to strengthen collaboration among stakeholders, promote the exchange of best practices, and accelerate the implementation of innovative solutions within the food safety community.

In this deliverable, we describe the methodology defined to collect and select relevant and feasible knowledge, including a pilot study on the topic “novel microbial detection methods”. Furthermore, we provide an overview of how this information has been organized and classified within the CATALYSE platform to facilitate users access, as well as the main potential challenges identified and the future steps for the improvement of the database of knowledge.

Context: Definition of Topics (WP2 activity)

Work Package 2 (WP2) of the CATALYSE Project, aimed at engaging key actors across the European food system to understand their needs, priorities, and barriers related to food safety innovation. The main objective was to collect information to guide the development of the CATALYSE knowledge database, thematic chapters of the platform, and the Community of Practice (CoP). The Deliverable D2.2 – *Stakeholder Engagement Report* provides a comprehensive overview of the activities conducted and the results obtained.

A multi-method strategy was implemented, combining online surveys, 113 responses, and 85 one-to-one interviews with stakeholders representing different parts of the food value chain: researchers, innovators, industry professionals, policymakers, and regulators. The process was supported by all partners of the CATALYSE consortium, ensuring a diverse representation of expertise and perspectives across Europe.

These activities helped us to identify the main thematic areas regarding food safety innovation. Based on the analysis of survey and interview data, five priority topics emerged as the most relevant for the food sector (Figure 1).

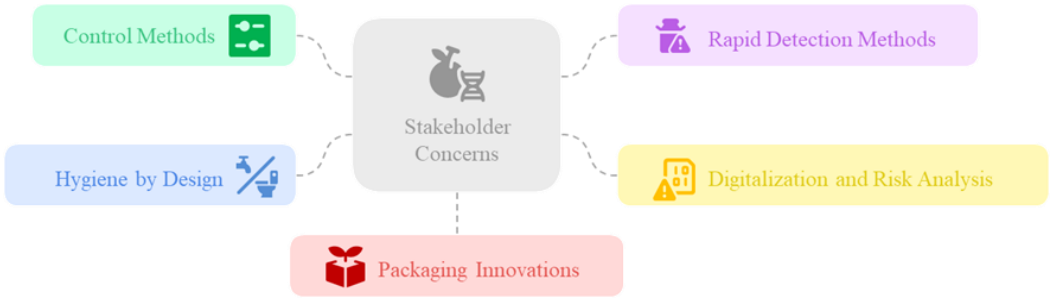

Figure 1. Five major concerns highlighted with the stakeholder engagement strategy. (The figure is extracted from D4.2 *CATALYSE CoP digital Platform*).

Following internal discussions within the CATALYSE consortium, two additional cross-cutting topics were added to ensure a more holistic coverage of the food safety scene: Traceability and Food Fraud. In summary, the selected topics for CATALYSE CoP platform are:

1. Control Measures
2. Detection Methods
3. Packaging Innovation
4. Hygiene by Design
5. Digitalization and Risk Analysis
6. Traceability
7. Food Fraud

These seven topics now serve to WP3 as the core framework for structuring the CATALYSE knowledge Database and the thematic chapters of the platform. This alignment guarantees that the

information and resources collected with our methodology directly respond to stakeholders' needs and contributes to bridging the gap between innovation and implementation in the food sector.

2. Methodology

2.1 Data collection process (recap of D3.1)

As described in Deliverable D3.1 *Methodologies for data collection on recent knowledge and innovation in food safety*, a workflow for collecting and selecting relevant and reliable knowledge resources and innovative solutions was developed (Figure 2).

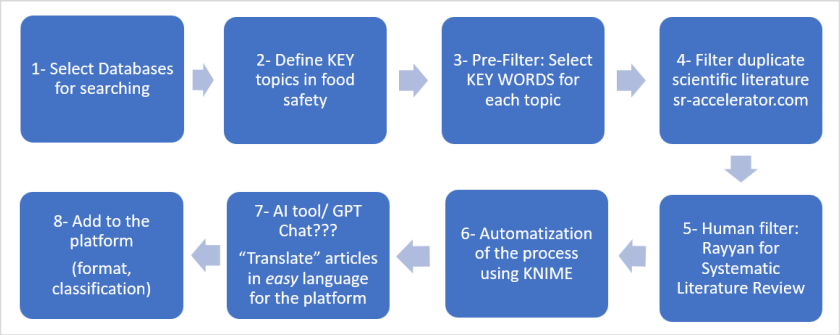

Figure 2. First schema of data collection workflow to be implemented.

For the first step, the data sources were selected considering how broad and detailed each database is, the accessibility, and the relevance of the content for CATALYSE purposes.

The second step of the methodology was based on the most relevant Food Safety Topics defined with the stakeholder engagement strategy, these are being used for the selection of innovative solution resources and, considered to classify them into the platform for the Knowledge Database.

As described in D3.1, after selecting the databases and the thematic topics, the third step of the workflow was identifying and refining the keywords used to guide the search and selection of relevant knowledge resources. For this reason, a pilot with one of the "trending" topics in food safety was chosen: "*novel microbiological detection methods*". In this phase, a set of primary keywords – such as *"food," "safety,"* and *"innovation"* – were combined with topic-specific terms using logical operators (AND, OR, NOT) and the asterisk (*) as a wildcard to capture variations of each word. The number and combination of keywords were adjusted according to the characteristics of each database to optimize the research of relevant and high-quality information.

In addition, topic-specific terms and a complete set of keywords were developed for each of the seven thematic areas defined according to the needs and priorities identified (the full list of keywords is provided in the Annex I for reference).

It is important to note that for the topic of Digitalization and Risk Analysis, the search terms were divided into individual components to facilitate a more effective keyword-based search. Additional filters were applied during the pilot phase and are also being used for the other topics. Specifically, the year of publication was limited to 2020 onward to ensure the inclusion of recent and relevant innovations. Preference was given to open-access literature to promote accessibility and

transparency. Furthermore, review articles were excluded in order to avoid opinion-based content and to focus exclusively on original research (other specific criteria of each topic are detailed in Annex I). This approach aims to prioritize studies that provide concrete data and propose innovative solutions in the field of food safety.

Thereafter, to avoid duplicated information, the Systematic Review Accelerator (SRA) software was used, (more details about it in D3.1).

For the review stage, expert participation incorporated relevance screening and critical evaluation of the publications and other information sources compiled to ensure that the database was grounded in high-quality and domain-relevant knowledge. For this step, a list of evaluation criteria was established (included in D3.1) to provide clear definitions and guidance, enabling systematic and consistent assessment by reviewers. To manage the review process, the Rayyan tool was used, allowing reviewers to classify documents as "included" or "excluded," add comments or justifications, and maintain an organized record of decisions. In addition, each article was reviewed by two independent experts; if both agreed on inclusion or exclusion, the decision was implemented accordingly. In cases of disagreement, a senior reviewer was assigned to make the final decision, ensuring fairness and consistency across the review process.

In the concluding stage of the process, the relevant information was gathered from the selected materials. Data extraction was carried out using a custom GPT model developed specifically for this use case. The model was developed on the basis of the data-extraction template (Annex II), which specified all information intended for upload to the platform. Throughout the process, every material and its extracted data were independently cross-checked by a human reviewer.

The selected knowledge resources were uploaded to the CATALYSE platform following a standardized format: including simplified information about each article with user-friendly vocabulary, to ensure understandable content for the CATALYSE-CoP.

To streamline and accelerate future processes, the pilot phase also tested and validated a workflow (Figure 3) in which the traditionally manual and time-consuming human screening step was automated using a large language model (LLM).

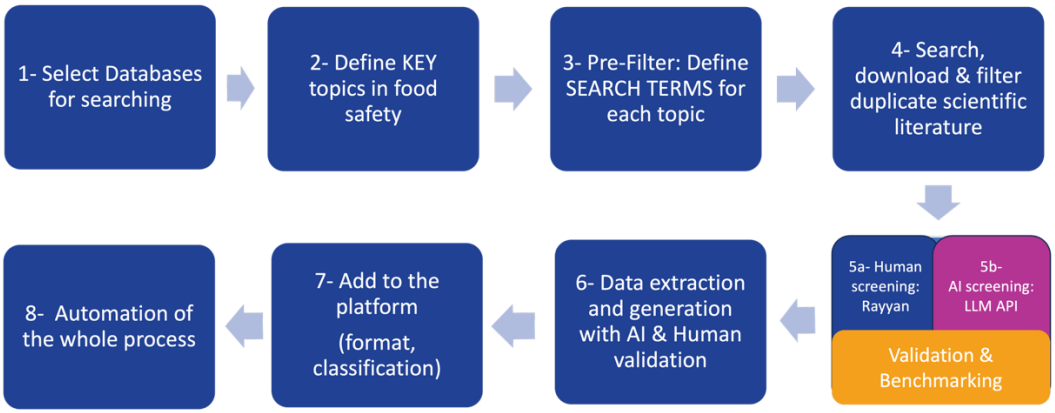

Figure 3. Database workflow for the first pilot on "novel microbial detection methods".

This adjustment aimed to evaluate whether artificial intelligence (AI) could efficiently support the relevance screening of documents while maintaining accuracy. An automated pipeline was developed using KNIME, a free and open-source data analytics platform, to ensure continuous information retrieval and processing. The aim was to create an AI model that can reach conclusions as close as possible to human decisions.

The LLM screening method involved no human interaction, preparing the process for automation. It used a zero-shot approach, meaning no previous training is provided (we did not show "good" and "bad" papers). The Llama-3.3-70B-Instruct model was prompted through the DeepInfra API. Every title/abstract was prompted individually, with no learning from previous results. For prompting, we applied the same inclusion and exclusion criteria used in the human screening method, supplemented by the additional insights gained during the manually performed pilot screening phase.

The process was optimised for inclusion: some non-relevant papers may be included, but no (or very few) relevant ones should be excluded.

3. Results

3.1 Data extracted from the pilot

As part of the development of the CATALYSE knowledge platform, the first pilot about *novel microbial detection methods* was conducted. The objective of this pilot was not only to collect and curate relevant literature, but also to test, refine, and validate the overall data collection workflow—in particular the combination of human expertise and automated tools for screening and classification.
The comparative assessment had two approaches for screening and selecting relevant literature: (1) the traditional human review process, and (2) an AI-assisted workflow using a LLM integrated into KNIME (Figure 4). This comparison aimed to evaluate whether AI tools could support or partially automate the most time-consuming steps of the workflow without compromising quality.

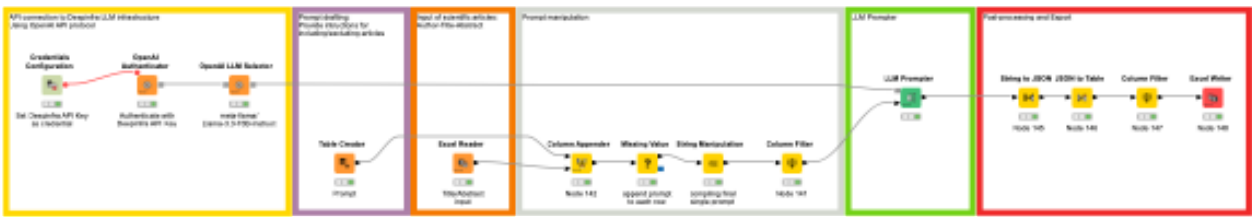

Figure 4. Illustrative image of KNIME workflow.

On one hand, the human reviewers screened a total of 5622 documents, and through this systematic evaluation, a total of 346 articles (6%) were selected for inclusion and uploaded to the CATALYSE platform, while 5,276 were excluded during the screening process (Table 1). Each document was

evaluated independently by two reviewers, with a third reviewer resolving cases of disagreement. The selected articles were systematically classified according to both the food sector (Meat & Poultry; Fish & Seafood; Dairy & Cheese; Grains & Cereals; Fresh Fruit & Vegetables; Plant-Based & Alternative Proteins; Processed & Packaged Food; Beverages) and the pre-defined thematic areas. This structured classification would allow CATALYSE users to navigate the database efficiently and access information to their specific professional interests and research needs.

On the other hand, to explore the potential of automation, the same dataset (5622) was processed using an AI model (Llama 3.3). Before running the model, a carefully designed prompt considering the inclusion and exclusion criteria were defined to prepare the model to ensure the accuracy of the results. The AI workflow performed the relevance screening automatically, producing a classification output that could be directly compared with the human reviewers' decisions. This approach identified 695 articles for inclusion (12%) and excluded 4927 (Table 1).

Table 1. Comparison of Human Reviewers vs. AI screening capacity.

	REVIEWERS		
AI	INCLUDED	EXCLUDED	SUM
INCLUDED	328	367	**695**
EXCLUDED	18	4909	**4927**
SUM	**346**	**5276**	

The results show a high level of agreement between the human reviewers and the LLM. The AI model achieved 93.2% accuracy in identifying relevant and not relevant publications. The model achieved 99.6% precision in predicting non-relevant papers, and 93% recall in finding all instances of non-relevant papers. The F1 score of the model (combining recall and precision in a single metric) was 96.2%. As prompted, in case of uncertain papers the model tended to be slightly more inclusive than human reviewers.

The pilot testing showed certain areas of confusion for both the human and AI review, demonstrating that human oversight during data extraction remains essential to ensure accuracy and consistency, suggesting that combining structured human curation with AI-assisted screening can enhance efficiency in literature review while maintaining high-quality selection standards.

Overall, the pilot demonstrated that with proper preparation – well-defined criteria, fit-for-purpose prompting, and iterative refinement – AI can significantly support the review process. Even if the

model may include slightly more papers than human reviewers, it does not omit important content, demonstrating its suitability for relevance screening in CATALYSE project, and much faster.

3.2 Platform organization – Resources section (data extracted for WP4/5)

The selected articles were systematically added to an Excel template that had been previously defined in collaboration with the WP4 and WP5 Leader (UCP). This template was designed to capture all information necessary for sharing on the CATALYSE platform and to ensure consistency and completeness across entries. Each entry also contains information on how to classify the document within the platform, indicating the relevant food sector and field of application (Figure 5), to better organize all the information and literature in the CoP-platform.

Table 2. Categorization and classification of the innovative resources within the CATALYSE platform, by food sector and field of application.

Field of application	**Food sector**
Control measures	Dairy
Detection methods	Meats
Hygienic by design	Fish&Seafood
Packaging innovation	Grain&Cereals
Food fraud	Fruits&Vegetables
Traceability	Plant-based & alternative proteins
Digitalization & AI	Processed & packaged food
Others	Beverages

3.3 Technical Resource Organization inside CATALYSE Platform

As explained in Deliverable D4.2 *CATALYSE CoP digital Platform*, registering to the platform is free and open for every stakeholder interested in food safety innovation. There is a short registration form to be complete and then, users receive login credentials to fully access the CoP. Even if it is still under development, the platform offers an intuitive and user-friendly opportunity to access different features (educational materials, innovative resources, networking opportunities, events, news, etc.).

As part of the *Resources* section on the CATALYSE CoP platform, the *Science Hub* sub-section (Figure 6) offers a dedicated repository of knowledge focused on food safety innovations. This repository is being designed to support users in accessing a wide range of relevant information in a structured and user-friendly manner. It contains curated materials and grey literature, including scientific articles, regulatory guidelines, industry reports, magazines, and other relevant documents (Figure 7).

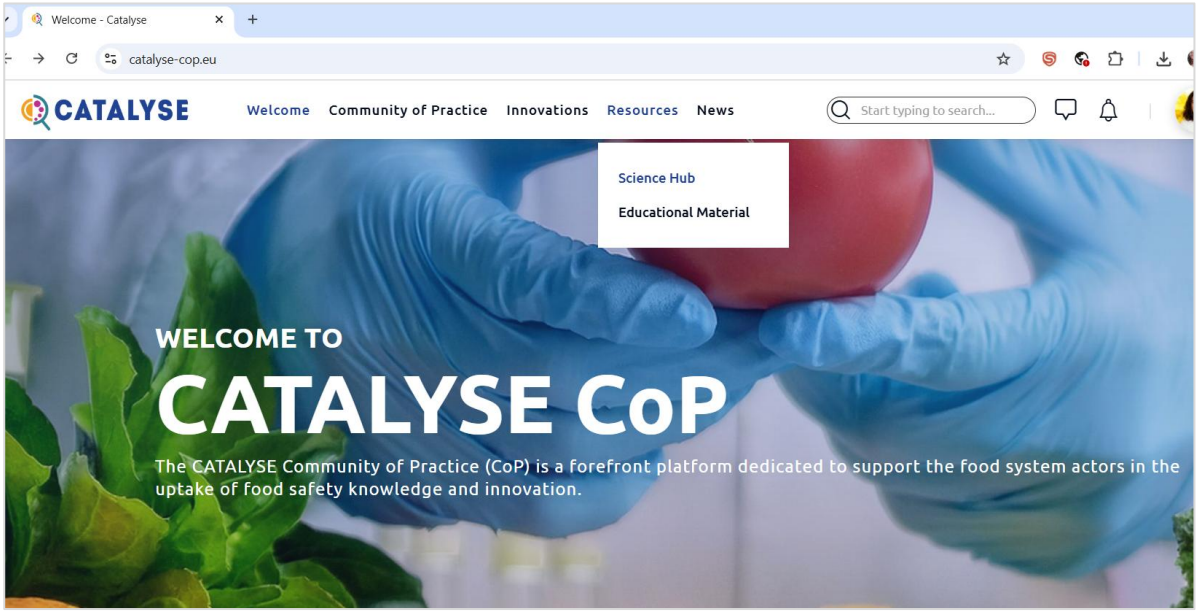

Figure 6. CATALYSE CoP platform main page, highlighting the *Resources* section and the *Science Hub* subsection, where the repository of data is available for being explored by all the users.

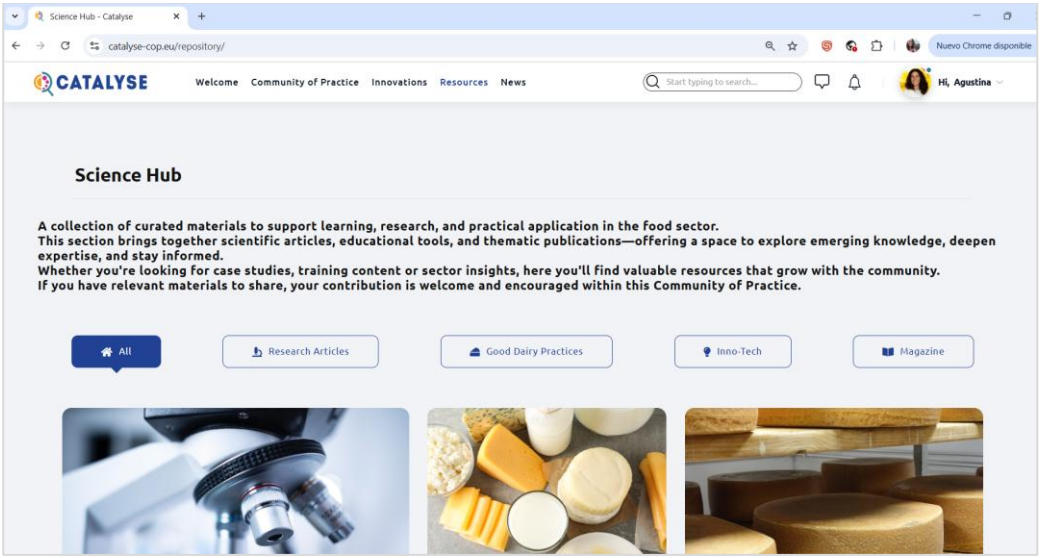

Figure 7. Overview inside the *Science Hub* sub-section in the CATALYSE CoP platform.

For each article in the repository, key information is systematically presented to facilitate user engagement and comprehension. This includes the title, authors, year of publication, journal, and a direct link to the full publication. In addition, each entry is accompanied by an illustrative image and a concise summary, written in clear and accessible language (Figure 8). This approach ensures

that the content is both visually appealing and easily understandable, making the repository useful for a broad spectrum of users, including researchers, practitioners, policymakers, and other stakeholders in the food safety community.

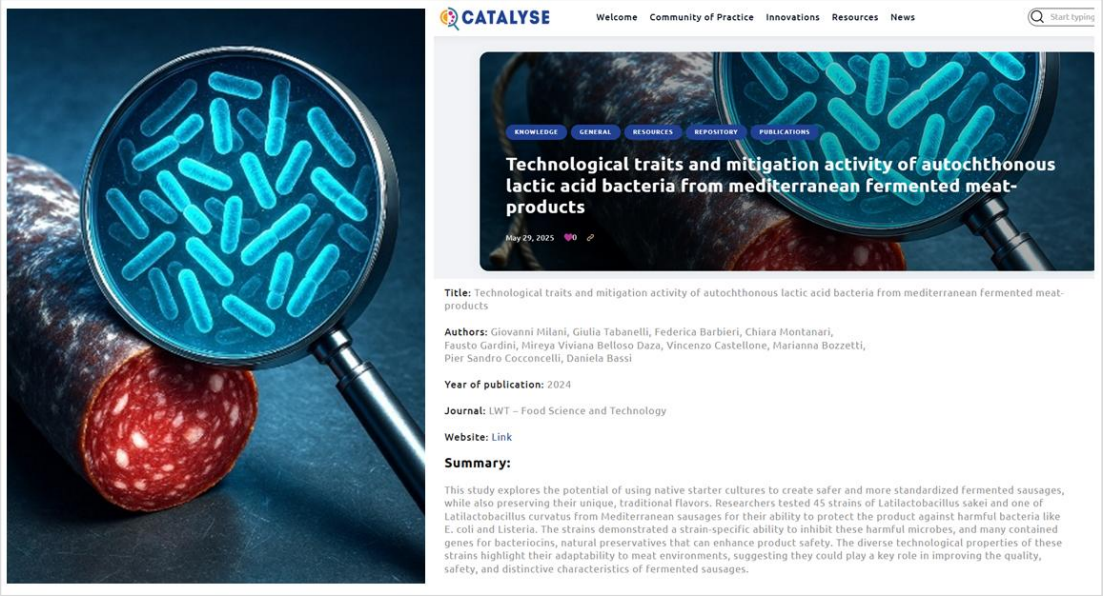

Figure 8. Illustrative example of how the information is presented in the CATALYSE CoP platform. The essential information is shared in an attractive format combining structured metadata with accessible summaries, facilitating efficient knowledge acquisition, and promoting the practical application of scientific findings.

Finally, it is worth noting that most of the collected content has been selected with our methodology, to ensure quality, relevance, and reliability. Users can explore the *Science Hub* at their convenience, navigating the materials according to their specific interests and needs. By providing centralized access to diverse sources of information, this section of the platform helps foster innovation, collaboration, and the practical application of scientific knowledge in food safety.

4. Future Activities

4.1 Next Thematic Areas and Resource Planning

The results of the first pilot clearly demonstrate that integrating LLM-based screening substantially accelerates the literature review process while maintaining a high degree of precision. Building on these results, the automated workflow developed in KNIME is now being applied to additional topics identified through the stakeholder engagement strategy. By 2026, the knowledge database is expected to be fully populated with the most relevant literature and innovative solutions in the field of food safety.

Between May and December 2026, the project will focus on the dissemination of the methodology. Scientific articles are being prepared and will be submitted, providing a detailed description of the

workflow and its application, allowing the broader scientific community to benefit from the insights gained.

In parallel, the automated workflow will undergo continuous refinement. The process will be optimized, potential issues addressed, and improvements implemented to ensure its efficiency, reliability, and adaptability across the selected topics.

Finally, a system will be implemented to keep the repository up to date. This will allow the continuous integration of new knowledge and emerging innovations, ensuring that the CATALYSE CoP platform remains a dynamic, high-quality resource for researchers, practitioners, and other stakeholders in the food safety ecosystem.

This combined approach guarantees that the final repository of the *Science Hub* section meets the rigorous accuracy and quality standards established by the CATALYSE project.

5. Conclusions

The results demonstrated that, when preceded by an appropriate human preparation phase—such as pilot screening and precise prompt design, the model achieved an accuracy rate, showing strong potential for complementing expert review.

This pilot confirmed that integrating AI-assisted screening with expert validation offers an effective and efficient approach for extracting and organizing relevant knowledge. Despite the automation, human oversight remains essential to verify the quality, accuracy, and relevance of the content integrated into the database.

The deliverable D3.2 *Creation of a collaborative space for high-quality innovative works and solutions in food safety*, has been successfully achieved. Its outcomes and results are reflected in the active CATALYSE-CoP Platform, which currently acts as a dynamic space for collaboration and knowledge exchange between food safety actors.

HISTORY OF CHANGES		
Version	**Publication date**	**Change**
1.0	30.12.2025	▪ Initial version

Annex I

Search terms for the thematic topics

1. Analytical detection methods

FOOD	ANALYTICS	DETECTION	VALIDATION
food	chemical	detect*	validat*
	contamina*	identif*	"performance criteria"
	toxin	analys*	
	pollut*	method*	
	substance	confirm*	
	material	criterion	
		limit	

2. Control measures

FOOD	PRODUCTION	CONTROL	SAFETY
food	process*	measur*	safety
	industr*	sensor	precaution
	supply chain	track*	protection
	manufactur*	monitoring	assurance
	facilit*	testing	safeguard*
	production	remote sensing	hygiene
	ccp	authority	
	haccp	assurance	
	ifs	control	
	brc	sampling	
	FSCC		
	GFSI		
	GLOBALG.A.P.		
	PrP		

3. Hygiene by design

FOOD	TOOLS	HYGIENE BY DESIGN
food	method	"hygiene by design"
	technique	"hygienic design"
	process	"facility design"
	intervention	"construction design"
	approach	"sanitary design"
		"hygienic zoning"
		EHEDG
		"3-A"

4. Packaging innovations

FOOD	PACKAGING	NEW
food	coating	sustainable
	label	biodegradable
	"food contact material"	edible

	FCM	eco-friendly
	packag*	functional
	"food wrap"	antimicrobial
		smart
		"plastic-free"
		"plant-based plastic*"
		"PLA bioplastic*"
		active
		"time-temperature indicators"
		bioplastic*

5. Digitalization and AI

FOOD	DIGITALIZATION	SAFETY
food	AI	safety
	IoT	precaution
	Internet of things	protection
	smart	assurance
	blockchain	safeguard*
	digitalization	hygiene
	large language model	
	LLM	
	Artificial Intelligence	
	Computer Heuristics	
	Expert Systems	
	Fuzzy Logic	
	Generative Artificial Intelligence	
	Intelligent Systems	
	Knowledge Bases	
	Biological Ontologies	
	Machine Learning	
	Deep Learning	
	Dimensionality Reduction	
	Ensemble Learning	
	Federated Learning	
	Reinforcement Machine Learning	
	Representation Machine Learning	
	Supervised Machine Learning	
	Transfer Machine Learning	
	Unsupervised Machine Learning	
	Natural Language Processing	
	Neural Networks	
	Cellular Neural Networks	
	Convolutional Neural Networks	
	Feedforward Neural Networks	
	Graph Neural Networks	
	Radial Basis Function Networks	
	Recurrent Neural Networks	
	Particle Swarm Optimization	

	Pattern Analysis	
	Prediction Methods	
	Predictive Learning Models	
	Robotics	
	Autonomous Robots	
	Sentiment Analysis	

6. Risk assessment

FOOD	RISK ASSESSMENT (NEW)
food	hazard predict*
	hazard modelling
	hazard modeling
	hazard assess*
	hazard evaluat*
	hazard analys*
	hazard characteris*
	decision-support
	risk decision-support
	risk predict*
	risk modelling
	risk modeling
	risk assess*
	risk evaluat*
	risk analys*
	risk characteris*
	exposure predict*
	exposure modelling
	exposure modeling
	exposure assess*
	exposure evaluat*
	exposure analys*
	exposure characteris*
	intake predict*
	intake modelling
	intake modeling
	intake assess*
	intake evaluat*
	intake analys*
	intake characteris*
	hazard identif*

7. Food fraud

FOOD	FRAUD	METHODS
food	adulteration	detect*
	authenticity	prevent*
	mislabel*	mitigat*
	fraud	control*
		manage*

		identif*
		trac*

8. Traceability

FOOD	TRACEABILITY	SAFETY
food	track	safety
	trace	precaution
	traceability	protection
	provenance	assurance
		safeguard*
		hygiene

Inclusion/exclusion criteria for screening

1. Analytical detection methods

	Eligibility criteria	
Domain	**Inclusion**	**Exclusion**
Study focus	Development, optimization, or validation of analytical laboratory methods for detecting or quantifying chemical hazards in food.	In-silico, computational, or purely data-analytical detection methods without a laboratory component. Application-only studies using established methods without new development or validation.
Innovation	Novel or innovative methods (e.g., biosensors, nanotechnology-based assays, novel spectroscopy, portable/rapid lab-based methods).	Established reference methods already widely applied, unless modified in a novel way.
Hazard type	Chemical hazards only (contaminants, toxins, residues, pollutants, undesirable chemical substances, allergens).	Biological hazards (pathogens, viruses). Food quality/authenticity/fraud/freshness studies not directly related to safety.
Domain	Studies in the food safety context (food/feed and related materials).	Studies outside food safety (e.g., environmental, clinical, pharmaceutical), unless the method is tested/applied to food safety.
Study design	Primary research reporting laboratory-based method development or validation.	Reviews, meta-analyses, commentaries, opinion papers, editorials. Non-peer-reviewed sources (reports, theses, conference abstracts).
Evidence type	Description of the analytical detection method (principle, procedure, or application in food matrices).	Studies without sufficient description of the method.
	Both experimental and theoretical method development studies (analytical laboratory context).	Non-laboratory studies or conceptual papers without connection to analytical methods.

2. Control measures

Domain	**Eligibility criteria**	
	Inclusion	**Exclusion**
Study focus	Technological or innovative control measures in food production, processing, manufacturing, supply chain, or monitoring (e.g., sensors, blockchain, IoT, automation, remote sensing, digital monitoring, advanced hygiene/sampling systems). Includes significant improvements of existing systems.	Managerial/organizational control measures only (e.g., new HACCP documentation, training, management frameworks). Policy/regulatory frameworks (e.g., GLOBALG.A.P., GFSI, BRC, IFS) unless directly linked to novel technological implementation.
Innovation	Novel or emerging approaches, or innovative adaptations of existing systems (e.g., automation of HACCP, AI-enhanced monitoring).	Traditional, widely established control measures with no innovative component.

Hazard type	Both chemical and biological food safety hazards (contaminants, pathogens, toxins, allergens, residues, pollutants).	Measures addressing only food quality, authenticity, fraud, or productivity, not directly related to food safety.
Domain	Measures applied in the food safety context (food/feed production, processing, manufacturing, or supply chain).	Measures outside the food safety domain (environmental monitoring, clinical, pharmaceutical) unless explicitly applied to food safety.
Study design	Primary research reporting development, validation, or empirical implementation (including pilot projects, case studies, industrial trials). Theoretical/conceptual proposals for innovative technological measures may also be included.	Reviews, commentaries, editorials, or opinion pieces without primary research. Non-peer-reviewed literature (e.g., reports, theses, conference abstracts).
Evidence type	At minimum, a description of the control measure (principle, application, or system).	Studies without any description of the technological/innovative control measure.

3. Hygiene by design

Domain	**Eligibility criteria**	
	Inclusion	**Exclusion**
Study focus	Innovative hygiene-by-design approaches, including: – Technological/material innovations (e.g., antimicrobial coatings, self-cleaning materials). – Design/system innovations (e.g., hygienic facility layouts, zoning, airflow management).	General construction or engineering studies not linked to food hygiene.
Innovation	Novel or emerging hygiene-by-design concepts, or innovative adaptations of existing systems (e.g., redesigned equipment for cleanability, advanced zoning concepts, smart hygienic surfaces).	Traditional or widely established hygienic design measures without innovative components.
Hazard type	Measures addressing both chemical and biological hazards (e.g., residues, microbial contamination, cross-contamination prevention).	Studies focusing only on non-safety aspects (e.g., energy efficiency, productivity, cost reduction) without a hygiene-by-design element. Studies addressing only food quality, authenticity, fraud, or productivity without a safety focus.
Domain	Applied in the food/feed safety context (equipment, machinery, facility design, processing environments).	Studies outside food production facilities or unrelated to equipment design.
Level of application	Innovations at both equipment/machinery level (e.g., hygienic redesign of tools, lines) and facility-level (e.g., hygienic zoning, facility construction design).	Studies unrelated to food production facilities or equipment.

Study design	Primary research reporting development, validation, implementation, or pilot testing. Conceptual or design proposals for novel hygiene-by-design methods, even without implementation.	Reviews, commentaries, editorials, or opinion pieces without original research or design proposal. Non-peer-reviewed grey literature (e.g., reports, theses, conference abstracts). Policy/guideline/certification documents (e.g., EHEDG, 3-A) unless explicitly linked to novel applications or innovative research.
Evidence type	At minimum, a description of the hygiene-by-design method (material, technology, design principle, or system).	Studies without sufficient description of the hygiene-by-design method.

4. Packaging innovations

Domain	**Eligibility criteria**	
	Inclusion	**Exclusion**
Study focus	Packaging innovations in food safety, including: – Novel materials (e.g., bioplastics, edible films, coatings). – Functional, antimicrobial, active, and smart packaging (e.g., indicators, sensors, controlled release). – Significant improvements of existing packaging systems.	Studies on sustainability/environmental impact only (e.g., carbon footprint, recycling efficiency) without a food safety component.
Innovation	Novel or emerging packaging concepts, or innovative adaptations of existing systems (e.g., plastic-free or plant-based plastics with enhanced safety functions, smart time–temperature indicators, antimicrobial surfaces).	Conventional/established packaging without innovative elements.
Hazard type	Packaging addressing both chemical and biological food safety hazards (e.g., migration of substances, prevention of microbial contamination, inhibition of pathogen growth).	Packaging innovations addressing only non-safety aspects (e.g., shelf-life extension for freshness, marketing/branding, product quality only).
Domain	Applied in the food/feed safety context, including direct food contact materials (FCM), food wraps, coatings, and container systems.	Packaging studies unrelated to food or food contact.
Study design	Primary research reporting development, validation, laboratory testing, industrial trials, or pilot implementations. Conceptual proposals for innovative packaging designs, even without testing.	Reviews, commentaries, editorials, or opinion pieces without original research/design. Grey literature (reports, theses, conference abstracts). Policy/regulatory/certification documents unless explicitly linked to novel applications or innovative research.
Evidence type	At minimum, a description of the packaging innovation (material, technology, function, or system).	Studies without sufficient description of the packaging innovation.

5. Digitalization and AI

Domain	Eligibility criteria	
	Inclusion	**Exclusion**
Study focus	Digitalization and AI applications in food safety, including: – Digital tools (IoT, blockchain, robotics, big data systems, smart monitoring). – AI methods (machine learning, deep learning, NLP, generative AI, expert systems, ontologies, predictive models).	Studies outside food safety (e.g., healthcare, environmental monitoring) unless explicitly applied to food safety.
Innovation	Novel or emerging digital/AI applications, as well as significant improvements of existing systems.	Conventional digital tools without innovative adaptation.
Hazard type	Applications addressing both chemical and biological hazards (e.g., contaminants, toxins, pathogens, allergens).	Applications focused on food quality, authenticity, fraud detection, or productivity without a safety component.
Domain	Applied in the food/feed safety context, including production, processing, manufacturing, monitoring, or supply chain.	Applications unrelated to food safety or not clearly linked to food safety domains.
Study design	Primary research reporting method development, validation, proof-of-concept, pilot projects, case studies, or industrial trials. Conceptual/theoretical proposals for innovative digital or AI applications, even without validation.	Reviews, commentaries, editorials, or opinion pieces without original research or proposal. Grey literature (reports, theses, conference abstracts). Policy/regulatory/certification documents unless directly linked to innovative applications.
Evidence type	At minimum, a description of the digital/AI method (technology, system, application). Effectiveness/performance data welcome but not required.	Studies without sufficient description of the digital/AI method.

6. Risk assessment

Domain	Eligibility criteria	
	Inclusion	**Exclusion**
Study focus	Risk assessment methods for food safety, including: – Quantitative/mathematical/statistical/computational approaches (e.g., probabilistic models, Bayesian networks, AI-based modeling). – Qualitative/conceptual frameworks for hazard/exposure/risk assessment.	General risk management or decision-making studies not focused on risk assessment methodology.
Innovation	Novel or emerging approaches only, such as AI/ML-based risk models, dynamic/digital exposure modeling, innovative probabilistic/statistical frameworks, or new conceptual approaches.	Conventional/established methods or incremental refinements of standard techniques (e.g., standard Monte Carlo without novel adaptation).

Hazard type	Methods addressing both chemical and biological hazards in food safety.	Studies unrelated to safety hazards (e.g., food quality, authenticity, fraud, or productivity).
Domain	Applied in the food/feed safety risk assessment context (hazard identification, characterization, exposure, intake, overall risk estimation).	Risk assessment in non-food domains (environmental, clinical, occupational) unless directly linked to food safety.
Study design	Primary research reporting method development, validation, proof-of-concept, application studies. Conceptual/theoretical proposals for innovative risk assessment methods.	Reviews, commentaries, editorials, or opinion pieces without original methodological contribution. Policy, guideline, or regulatory framework papers (e.g., Codex, EFSA guidance), unless related to innovative risk assessment.
Evidence type	At minimum, a description of the innovative risk assessment method (model, framework, or computational approach).	Studies without sufficient description of a risk assessment method.

7. Food fraud

Domain	**Eligibility criteria**	
	Inclusion	**Exclusion**
Study focus	Food fraud detection and mitigation methods, including: – Analytical laboratory methods (e.g., spectroscopy, chromatography, DNA-based authenticity tests). – Digital/technological methods (e.g., AI, blockchain, IoT, smart sensors). – Supply chain traceability tools (digital ledgers, monitoring systems).	Purely economic or market analyses of fraud without methodological focus.
Innovation	Novel or emerging methods only, including innovative analytical techniques, AI-based detection, and advanced digital traceability solutions.	Conventional/established fraud detection methods without innovation.
Hazard type	All types of food and feed fraud (e.g., adulteration, mislabeling, counterfeiting, dilution, substitution).	Studies unrelated to food/feed fraud or addressing food quality/productivity without fraud dimension.
Domain	Applied in the food and feed fraud context across production, processing, and supply chains.	Fraud detection/mitigation in non-food domains (e.g., pharma, cosmetics) unless directly applied to food/feed.
Study design	Primary research reporting method development, validation, proof-of-concept, pilot projects, or application studies. Conceptual/theoretical proposals for novel fraud detection or mitigation methods.	Reviews, commentaries, editorials, or opinion pieces without original methodological contribution. Policy, guideline, certification, or management framework papers (e.g., anti-fraud regulations, management systems).
Evidence type	At minimum, a description of the fraud detection or mitigation method (laboratory, digital, or supply chain).	Studies without sufficient description of a fraud detection or mitigation method.

8. Traceability

Domain	Eligibility criteria	
	Inclusion	**Exclusion**
Study focus	Traceability applications in food and feed, including: – Digital/technological systems (e.g., blockchain, IoT, RFID, QR codes, big data provenance platforms). – Analytical/laboratory-based methods (e.g., isotopic fingerprinting, DNA barcoding for origin/authenticity).	General supply chain management or logistics studies without a food safety traceability component.
Innovation	Novel or emerging traceability approaches only, such as blockchain-enabled traceability, AI-enhanced provenance systems, advanced isotopic/DNA tracing.	Conventional or established traceability systems without innovative components.
Hazard type	Hazard-neutral: traceability systems addressing any food safety hazard (chemical, biological, physical).	Studies addressing non-safety aspects only (e.g., quality, marketing, consumer preference, productivity).
Domain	Restricted to food and feed traceability contexts across production, processing, distribution, and retail.	Traceability applications in non-food domains (e.g., pharmaceuticals, textiles, general logistics) unless directly applied to food/feed.
Study design	Primary research reporting method development, validation, proof-of-concept, implementation, pilot projects, or case studies. Conceptual/theoretical proposals for novel traceability frameworks or architectures.	Reviews, commentaries, opinion pieces without original methodological contribution. Policy, guideline, certification, or regulatory framework papers unless explicitly linked to innovative applications.
Evidence type	At minimum, a description of the traceability method or system (digital or analytical).	Studies without sufficient description of a traceability method.

Annex II

Data extraction template: This table is send to technicians of CATALYSE CoP Platform. All the information share in this template is published in the CoP. The first two columns are for classifying the material (to understand where should be include in the platform).

		Scientific Articles, Publications from your institution that can be add in the platform						
Food sector	**Field of innovation**	**Title**	**Key words**	**Authors**	**Year**	**Journal**	**URL/doi**	**Synopsis**
All/General	Detection methods	Multi-Probe Nano-Genomic Biosensor to Detect S. aureus from Magnetically-Extracted Food Samples	foodborne pathogens; foodborne illness; biosensing; food safety; gold nanoparticles; magnetic nanoparticles	Chelsie Boodoo, Emma Dester, Jeswin David, Vedi Patel, Rabin KC, Evangelyn C. Alocilja	2023	Biosensors	10.3390/bios13060608	This study developed a cost-effective and rapid biosensor combining glycan-coated magnetic nanoparticles (MNPs) and gold nanoparticles (GNPs) for the detection of Staphylococcus aureus in food samples. The MNPs were used to extract and concentrate the bacteria from various food matrices, while the GNP-based biosensor targeted the nuc gene of S. aureus without the need for DNA amplification. The biosensor demonstrated high specificity, distinguishing S. aureus from other bacteria such as E. coli, S. Enteritidis, and B. cereus, and a sensitivity capable of detecting as low as 2.5 ng/µL of DNA. The system provided visual colorimetric results observable by eye or spectrophotometry, showing potential for application in low-resource settings. Overall, this method offers a low-cost, portable, and user-friendly alternative to traditional detection methods for foodborne pathogens.
Meat & Poultry	Detection methods	Establishment and Comparison of In Situ Detection Models for Foodborne Pathogen Contamination on Mutton Based on SWIR-HSI	hyperspectral imaging; deep learning; machine learning; foodborne pathogens; mutton	Zongxiu Bai, Dongdong Du, Rongguang Zhu, Fukang Xing, Chenyi Yang, Jiufu Yan, Yixin Zhang, Lichao Kang	2024	Frontiers in Nutrition	10.3389/fnut.2024.1325934	This study developed detection models using short-wave infrared hyperspectral imaging (SWIR-HSI) combined with machine learning and deep learning to identify foodborne pathogens (E. coli, Staphylococcus aureus, and Salmonella typhimurium) on mutton. A 1D-Convolutional Neural Network (1D-CNN) was optimized and found to outperform traditional models like PLS-DA and SVM in detecting both contamination status and pathogen species. The study explored characteristic wavelength extraction to build simplified models, which reduced model complexity while maintaining acceptable accuracy. The 1D-CNN model based on original spectra without preprocessing achieved the highest accuracy, showing superior feature extraction capability. The results support the feasibility of using SWIR-HSI and deep learning for rapid, non-destructive, and accurate detection of pathogenic contamination in meat.