



**GHENT
UNIVERSITY**

LUPINEX PROJECT

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OUTLINE

Introduction to the project

Aims & research questions

Introduction to lupins

Schematic overview of the project

Exposure assessment to PHOs en QAs

Q&A

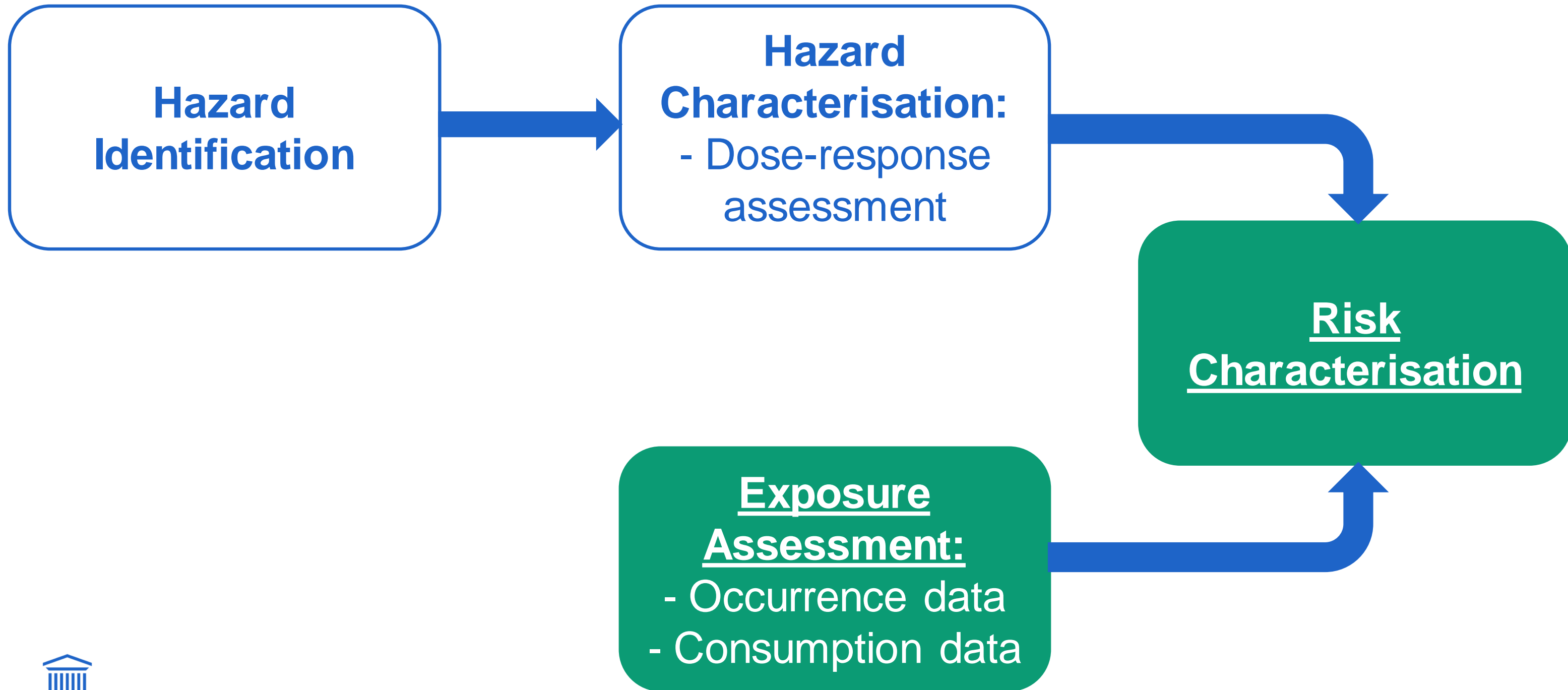
INTRODUCTION

“New consumption patterns and chemical
food safety risks”

AIMS AND RESEARCH QUESTIONS

The **overall research question** concerns the insight and quantification of **quinolizidine alkaloids** and **phomopsines** in **feed and food**, containing **lupin or lupin derivatives**, present on the **Belgian market**, as well as the **exposure and risk characterisation** for the **Belgian population**.

RISK ASSESSMENT

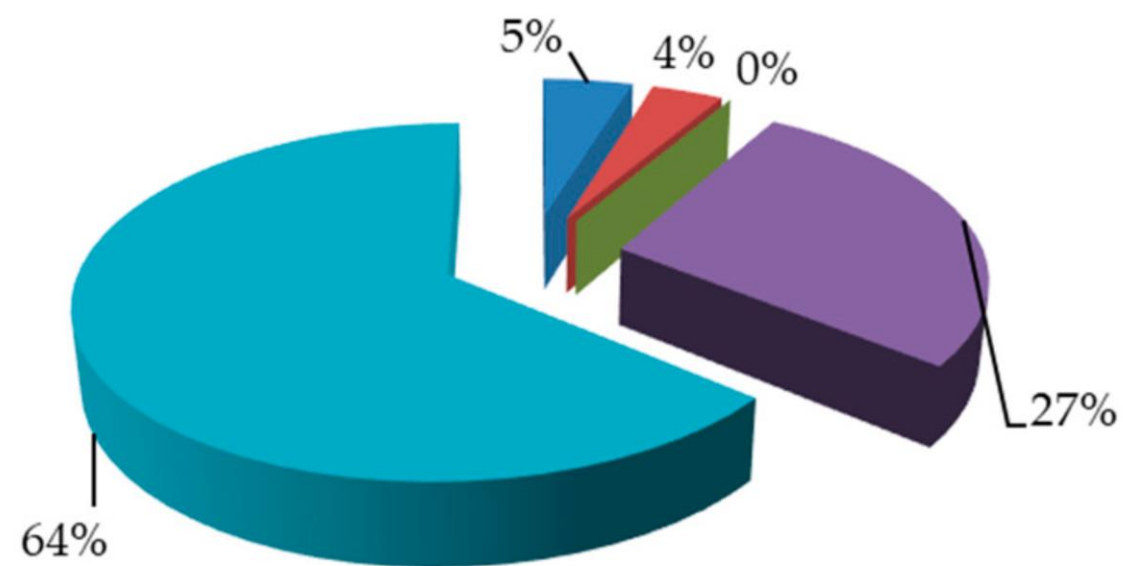


INTRODUCTION: *LUPINUS* SPP.

Fabaceae

- ✓ *Lupinus luteus* (yellow lupin)
- ✓ *Lupinus albus* (white lupin)
- ✓ *Lupinus angustifolius* (blue lupin)
- ✓ *Lupinus mutabilis* (Andean lupin)

(a) ■ Africa ■ America ■ Asia ■ Europe ■ Oceania



Worldwide production of lupin (FAOSTAT, 2018)



Lupinus luteus (Wikipedia, 2021)

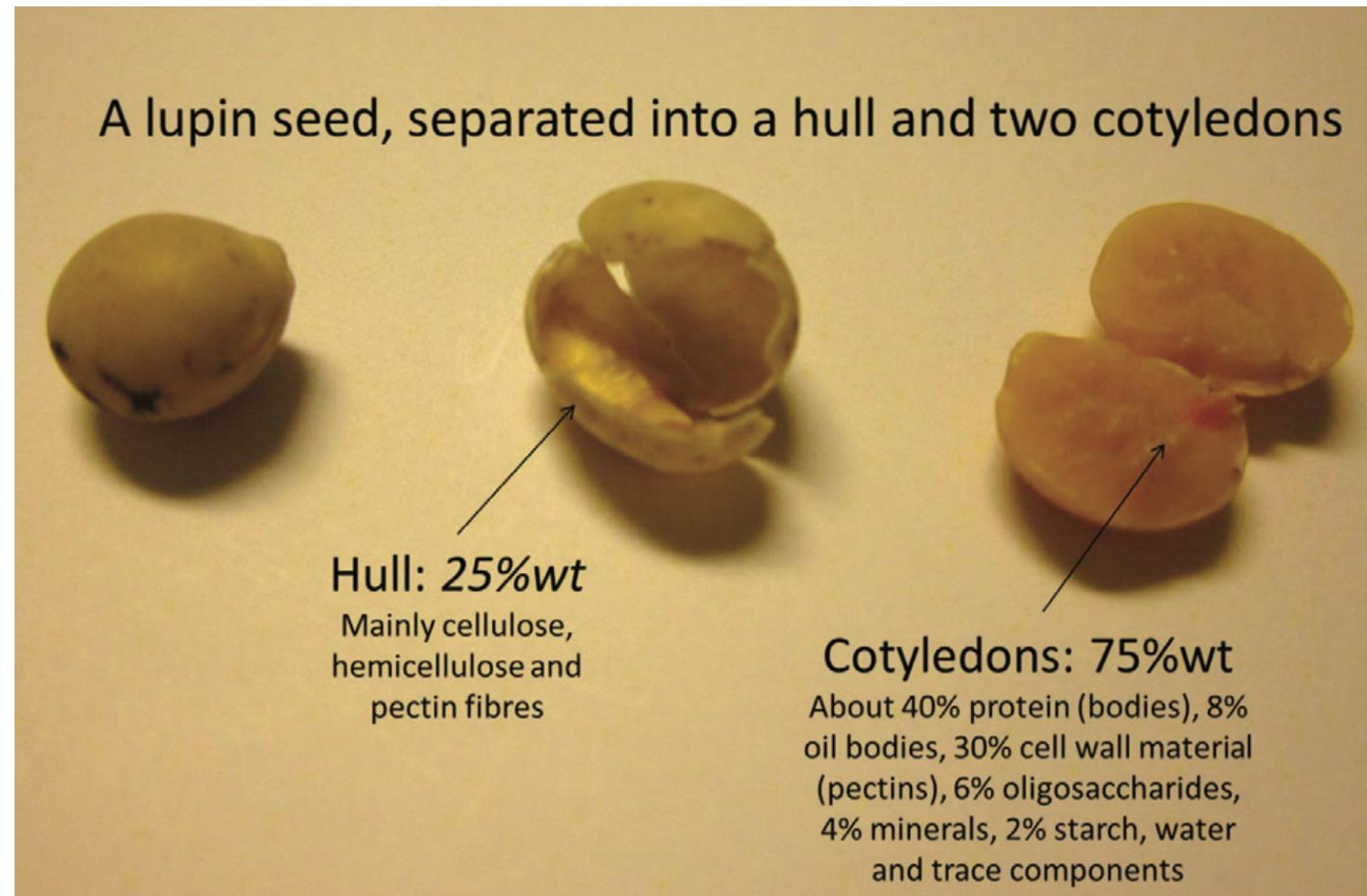
INTERESTING ALTERNATIVE TO SOY?



Field of white lupins (Shutterstock, 2021)

- ✓ Plant proteins in the EU
- ✓ Non-GM feed
- ✓ Nitrogen fixation

INTERESTING ALTERNATIVE TO SOY?



- ✓ Outstanding health benefits
- ✓ High value protein source
- ✓ High in dietary fiber
- ✓ Virtually no starch

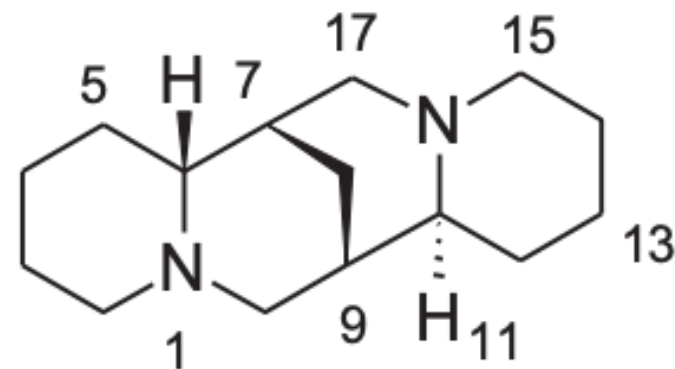
DRAWBACKS OF LUPINS

- ✓ Allergen
 - (EC) No 1169/2011
- ✓ Antinutritional factors:
 - (Chymo)trypsin inhibitors, tannins, phytic acids, lectins & saponins (trace)
- ✓ Yields are unpredictable

EXPOSURE ASSESSMENT OF QAs & PHOs

Quinolizidine alkaloids (QAs):

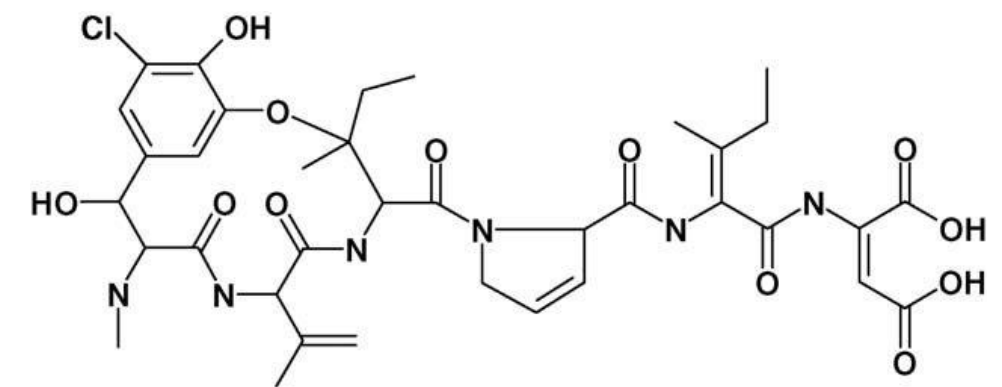
- ✓ Alkaloids = plant inherent toxins
- ✓ Tropane alkaloids, pyrrolizidine alkaloids, ..



(-)-Sparteine

Phomopsins (PHOs):

- ✓ Mycotoxins = toxic secondary metabolites of fungi
- ✓ Patulin, aflatoxins, fumonisins, ...



Phomopsin A

QUINOLIZIDINE ALKALOIDS

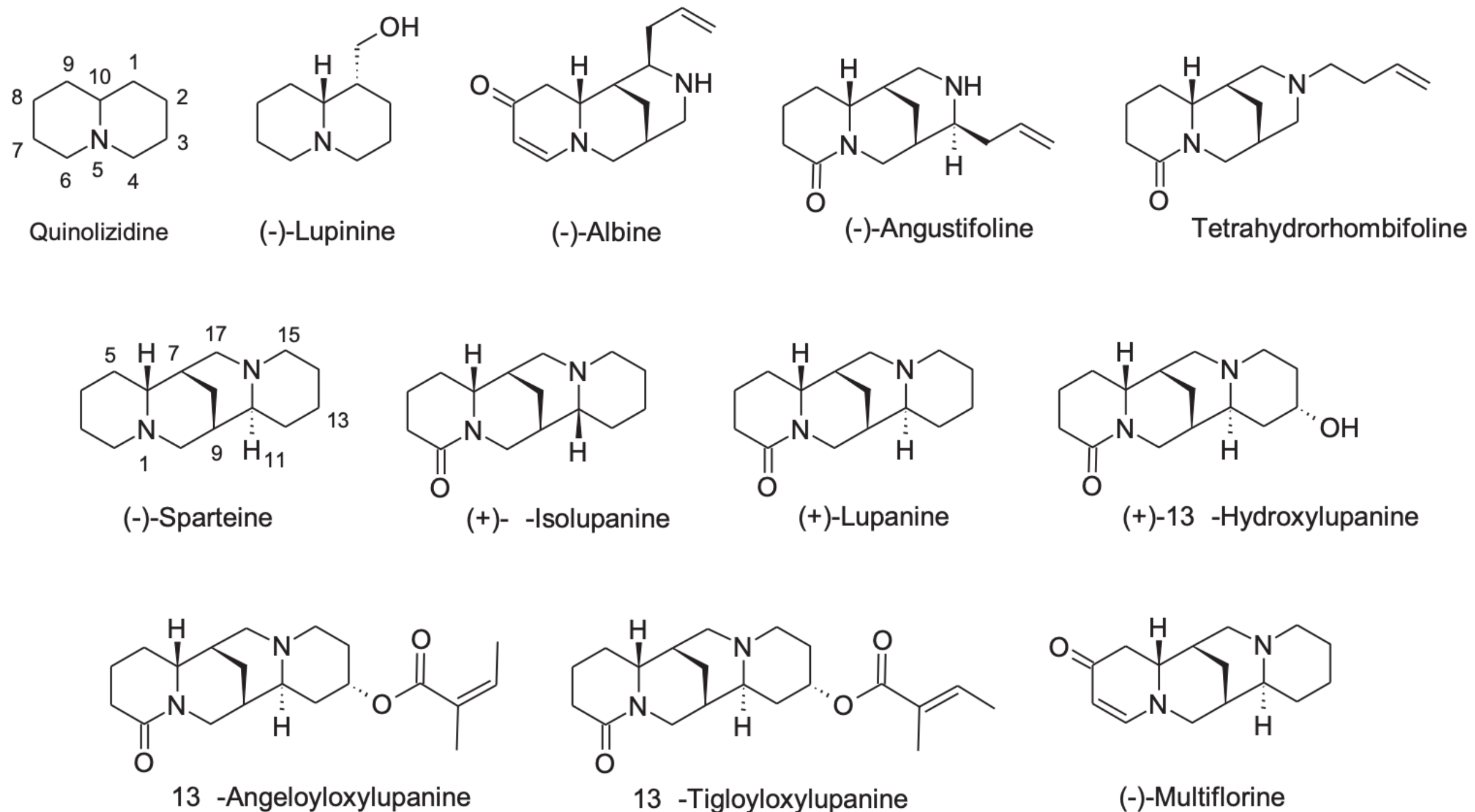


Figure 1: Quinolizidine core structure and the most relevant quinolizidine alkaloids for human and animal consumption in Europe found in *Lupinus* species

QA CONCENTRATIONS

- ✓ **'Bitter lupins'**: high alkaloid content
- ✓ **Debittering**: soaking and washing with water for multiple days
- ✓ **Poisoning**: insufficient debittering of bitter lupin seeds by consumers!
- ✓ **'Sweet lupins'**: < 200 mg alkaloids/kg seeds

HAZARD CHARACTERISATION OF QAs

- ✓ **Human data** from cases of poisoning ⇔ findings of **experiments with animals** on acute and longer-term toxicity
 - ✓ **Humans react more sensitively** to QAs than laboratory rodents do

TOXICOLOGICAL REFERENCE VALUES

Sparteine has a higher potency than other QAs

0.20 mg sparteine/kg bw was regarded as the threshold dose for **acute exposure** (BfR, 2017)

The **lowest single oral active dose of 0.16 mg sparteine/kg bw** (EFSA, 2019)

No toxicological reference value for long-term exposure

TOXICOLOGICAL REFERENCE VALUES OF PHOs

- ✓ **No NOAEL** for animals due to insufficient toxicological data
- ✓ No data on the potential toxicity to humans
- ✓ **No TDI for humans!**

→ Human exposure should be kept as low as reasonably achievable

PREVIOUS RISK ASSESSMENTS

ANZFA (2001) & EFSA (2012):

- ✓ Lack of of food consumption data (exposure)
- ✓ Lack of data on contamination levels (exposure)
- ✓ Lack of dose-response relationships

EXPOSURE & RISK assessment for PHO was not possible

WP0 & WP1 Farm to fork approach to **identify lupins and derivatives** in food and feed

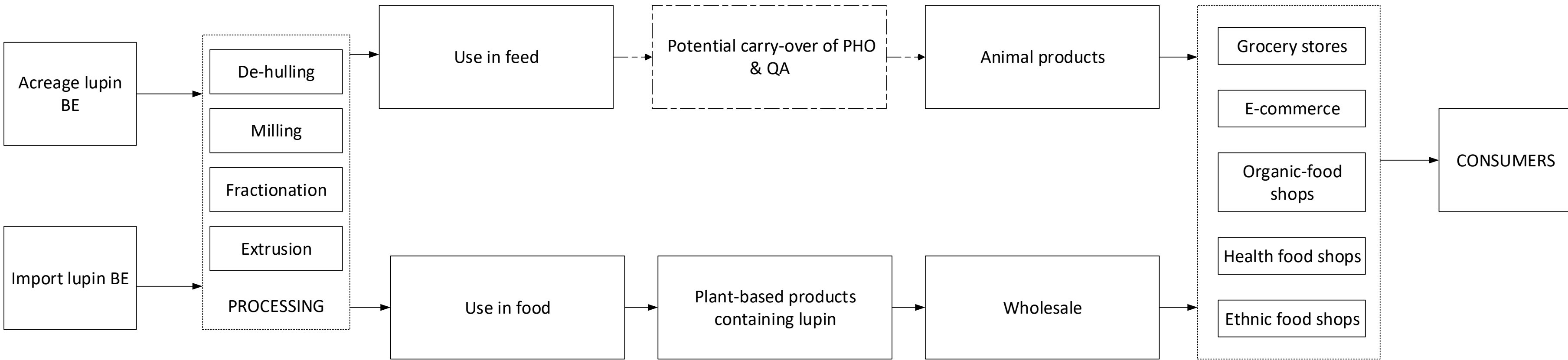
WP2 Development & optimisation of multi-analysis method

WP3 Investigation of potential **carry-over** of QAs & PHOs to animal products

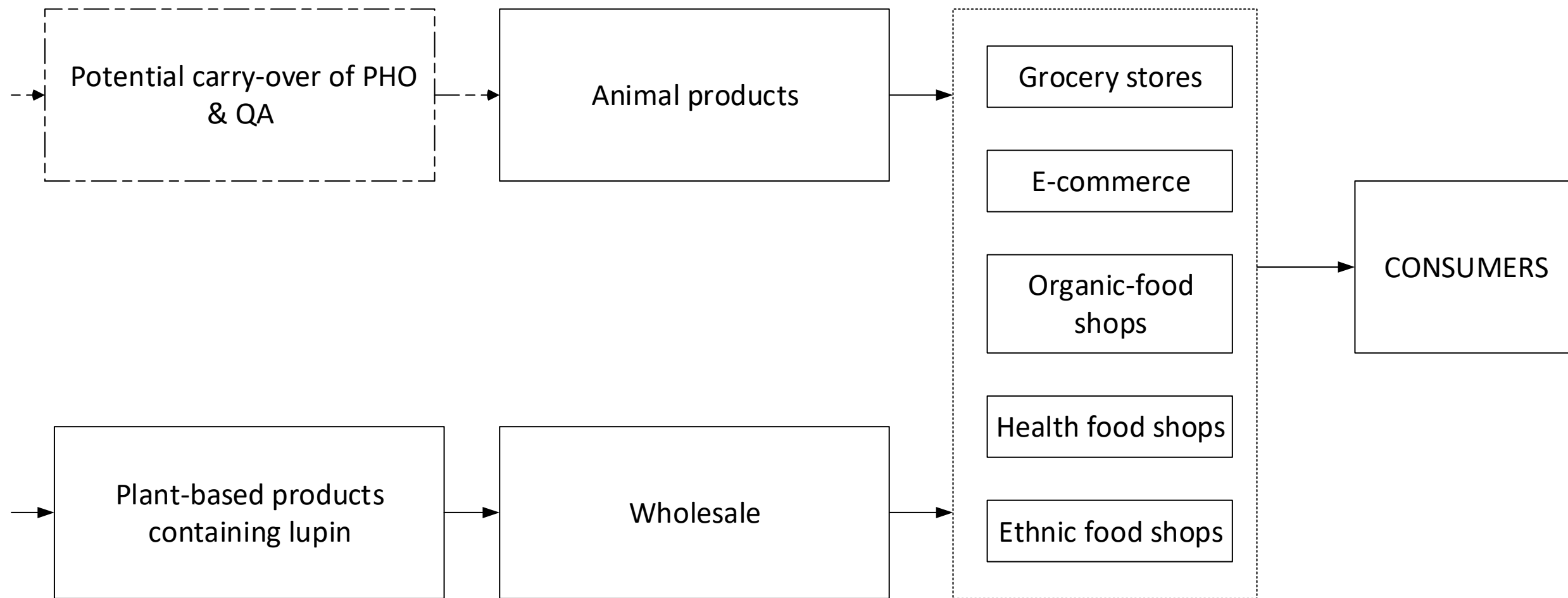
WP4 Screening of food and feed present in the Belgian agri-food chain : collection of **quantitative data** on the prevalence and concentration of QAs & PHOs in relevant samples

WP5 Exposure assessment and risk characterisation of the Belgian population to quinolizidine alkaloids and phomopsins

IDENTIFICATION OF LUPINS IN THE AGRI-FOOD CHAIN

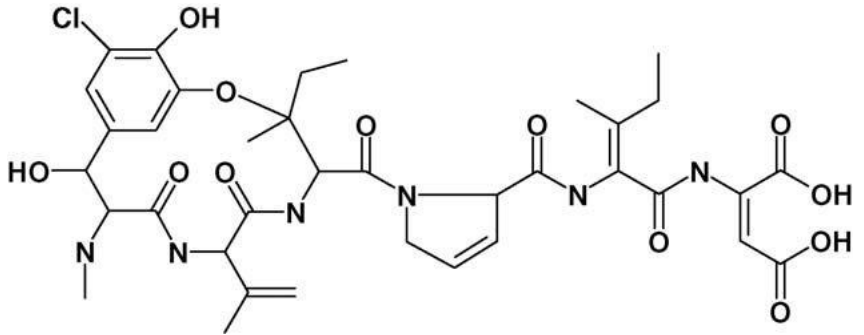
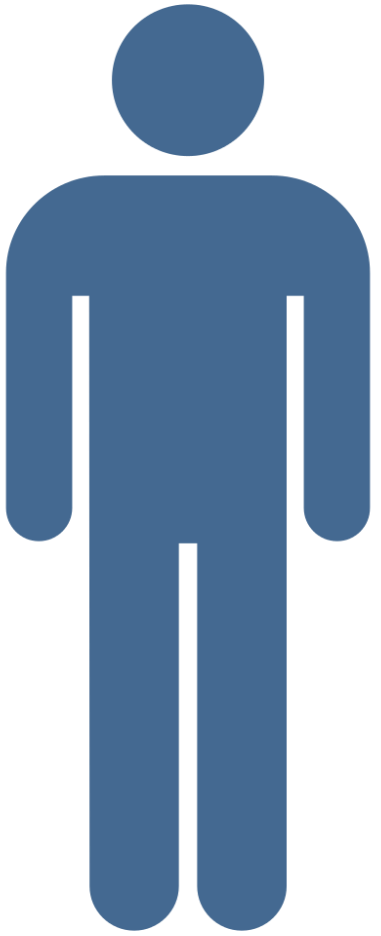
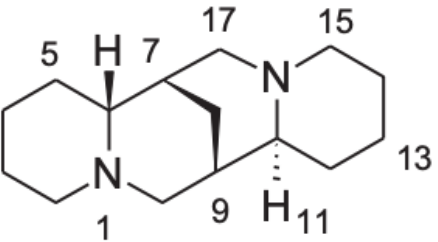


LUPINS IN FOOD





QAs



PHOs

FOOD INTAKE STUDY

- ✓ IDENTIFIED FOODS SPECIFIC
- ✓ FOCUS ON SUB-POPULATIONS (VEGETARIANS & VEGANS)



BFR (2017): FFOQ

Table 1: Food categories in which foods with lupin seeds are consumed and frequency of consumption of foods containing lupin seeds in the individual categories

Food Category	n (% of 2,022)	Frequencies in %				
		Several times a week	Once a week	Once a fortnight	Roughly once a month	Less often than once a month but at least once in the last year
Lupini beans as a snack	51 (2.5)	9.8	3.9	7.8	13.7	64.7
Confectionery	28 (1.4)	3.4	6.9	0.0	20.7	69.0
Patties/meat substitutes	51 (2.5)	0.0	12.0	4.0	22.0	62.0
Muesli/breakfast cereals	23 (1.1)	16.0	24.0	8.0	16.0	36.0
Biscuits	42 (2.1)	0.0	16.7	7.1	9.5	66.7
Cakes	42 (2.1)	0.0	16.7	7.1	9.5	66.7
Bread	61 (3.0)	6.6	14.8	6.6	19.7	52.5
Spreads	21 (1.0)	4.5	9.1	4.5	18.2	63.6
Smoothies/shakes	15 (0.7)	0.0	14.3	7.1	14.3	64.3
Ice-cream/dessert on a lupin basis	21 (1.0)	9.5	9.5	0.0	19.0	61.9
Dietary supplements (DS)	22 (1.1)	13.0	8.7	21.7	26.1	30.4

n – Number of respondents who have eaten foods with lupin seeds in this category at least once in the last 12 months

EXPOSURE ASSESSMENT AND
RISK CHARACTERISATION OF
THE BELGIAN POPULATION TO
QUINOLIZIDINE ALKALOIDS AND
PHOMOPSINS

EXPOSURE ASSESSMENT & RISK CHARACTERISATION ?

- ✓ Probabilistic methods (@Risk)
- ✓ Focus on acute exposure
- ✓ Non-average consumers: special dietary patterns
- ✓ BfR: MOS
- ✓ EFSA:
 - ✓ Scenarios
 - ✓ MOE
- ✓ Cumulative risk assessment or aggregated risk assessment?

QUESTIONS & REMARKS?

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