



# Alkaloid analysis and reduction in lupins

## Problem

Lupins contain alkaloids, which are plant defence substances that can be toxic to humans and animals above a certain dose. Two crucial steps for authorising Lupin use in food production and increasing their economic value are: 1) determining alkaloid content in grain lots from both modern "sweet" varieties and traditional bitter landraces; and, 2) debittering lupins when needed.

## Solution

The alkaloid content should be determined after the first rough pre-cleaning of the harvest. It is important to take a representative sample.

Alkaloids in lupins can be effectively reduced during the cooking process and by soaking them for several days. Peeling or roasting, however, does not reduce the alkaloid content, as the alkaloids are located inside the lupin seeds and are not destroyed by dry heat.

## Benefits

Lupins, as many other grain legumes, have great potential as an alternative arable crop. Moreover, their protein content is higher than most other leguminous crops, ranging between 30 and 44 per cent of the dry grain mass.

As interest in legume value chain development is growing due to the mounting interest for plant-based diets, lupins are also receiving increased scientific and industrial attention with regards to their nutraceutical potential. Lupins' high levels of proteins, unsaturated fatty acids and bioactive components (e.g., the antioxidant tocopherol may be valued in bakery products (as a flour), hummus, vegi-burgers and others. In a dietary diversification perspective, lupins may contribute to reducing non-communicable diseases such as diabetes, cholesterolemia, hypertension.



Figure 1 White lupin grains

Credits: Christine Arncken, FiBL



Figure 2: Boiled and debittered white lupins

Credits: Andreas Basler, FiBL

## Applicability box

### Theme

Alkaloids in lupins: determination and reduction for food production

### Reference conditions

For home, artisanal and semi-industrial processing

### Application time

Before lupin use for food production

### Required time

A few days

### Period of impact

Debitting of lupins has long-lasting effect

### Equipment

Sample spear for random sampling; boiling recipient.

Laboratory for analytical determination of alkaloids

### Best in

Any food system

## Practical recommendation

Individual lupin seeds within a batch may vary in alkaloid content, implying that the latter is unevenly distributed. Multiple samples should be taken in order to obtain meaningful measured values. They consist of several samples from a batch and can therefore represent an average alkaloid content for the entire lupin batch.

The individual samples should not only be taken from the surface of the container (trolley, sack, big bag) but, if feasible, from all “layers” of the lupin batch. A bulk material collector or a sample spear is used for this purpose.

A wide-ranging alkaloid content may be the result of mixing harvests from different fields (batches).

Instead, batches should be stored separately (e.g. in big bags) until the analytical results are available. In this way, contamination of good batches with bitter batches can be avoided.

Approximately 200 grams of lupins are taken from this homogenised bulk sample and sent in as a laboratory sample.

If the alkaloid content exceeds the guideline value of 200 ppm (or mg/kg, or 0,02%) of dry matter, the lupins can either be used as animal feed (guideline value of 500 ppm) or debittered. If necessary, when the alkaloid content exceeds the guideline value in the first analysis, a further analysis is necessary after the debittering process.

A reference debittering method includes the following steps:

- Add six parts cold water to one part lupin grains and soak for 24 hours, drain and rinse;
- Add six parts water again to one part lupins and cook for about 10 minutes, drain and rinse;
- Soak again for several days until the lupins no longer taste bitter; change the water two to three times a day.

At low pH values (between 2.2 and 2.4) alkaloids are even more soluble in water. Citric acid can be added for this purpose. The addition of table salt (NaCl) also favours the leaching of alkaloids.

Depending on the initial alkaloid content, the soaking time and the number of water changes can be adjusted.

## Further information

### Further readings

- Ivrainna Brändle, Christine Arncken, Ursula Kretzschmar, Ludivine Nicod, Mariateresa Lazzaro (2024) Alkaloid analysis in lupins. Prerequisite for food production. Research Institute of Organic Agriculture FiBL; Fact sheet n. 1763; 10.5281/zenodo.10592310
- EFSA Panel on Contaminants in the Food Chain (CONTAM) (2019). Scientific opinion on the risks for animal and human health related to the presence of quinolizidine alkaloids in feed and food, in particular in lupins and lupin-derived products. EFSA Journal of 25 September 2019. DOI: [10.2903/j.efsa.2019.5860](https://doi.org/10.2903/j.efsa.2019.5860)

### Weblinks

- Divinfood's webpage on white lupin: <https://divinfood.eu/leg-it-switz-en/>

## About this practice abstract and DIVINFOOD

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FiBL and FIRAB

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**Permalink:** [10.5281/zenodo.13998499](https://zenodo.org/record/13998499)

This practice abstract is elaborated in the DIVINFOOD project, based on the EIP AGRI practice abstract format.

DIVINFOOD - Co-constructing interactive short and mid-tier food chains to value agrobioDiversity IN healthy plant-based FOOD, is running **from March 2022 to Feb 2027**.

**The overall goal** of DIVINFOOD (a multi-actor, participatory project) is to facilitate the use and increase the value of Neglected and Underutilised Crops (NUCs) in food chains to foster healthier diets and more sustainable food systems.

**Project website:** [www.divinfood.eu](http://www.divinfood.eu)

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