PROCESSING SOLUTIONS FOR A NOVEL HIGH-PROTEIN FOOD INGREDIENT FROM VETCH

RESEARCH SUMMARY

UAD1123

FAST FACTS

PROBLEM
Natural toxins in common vetch make it unsuitable for consumption by humans or monogastric animals.

PROJECT
Develop an assay to measure toxin levels and investigate post-harvest processing methods to reduce toxins to safe levels.

PARTICIPANTS
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DATES
Start: 1 Jul 2023
Finish: 30 Jun 2024

Common vetch is widely grown to increase soil nitrogen in lower yielding regions. The plant and the grains can be eaten by ruminants but because the grain naturally contains high concentrations of two neurotoxins, β-cyanoalanine (BCA) and γ-glutamyl-β-cyano-alanine (ggBCA), it is unsuitable for consumption by humans and monogastric animals. Foods currently in the marketplace like almonds and cassava also contain toxic compounds with consumer safety managed through maximum toxin limits set by food regulatory bodies.

The core objective of the project was to identify, optimise and up-scale post-harvest processing treatments suitable for an up-to 99 per cent reduction of the toxins from vetch.

BACKGROUND

High market demand for pulse protein for human consumption has lifted the profile of most legumes but one legume crop, common vetch (Vicia sativa), has not featured in that trend for good reason. Despite the hulled split grain looking very similar to lentils, it is only ever used as feed for ruminants because it contains two compounds that are neurotoxic to monogastrics (humans, pigs and chickens) in high doses. Considerable long-term efforts to eliminate these neurotoxins, BCA and ggBCA from vetch using genetic strategies have so far been unsuccessful. We have known for some time that post-harvest processing methods like steeping can remove or reduce toxins, but this requires a large quantity of hot water, and unfortunately some of the toxin remains in the leaching water which creates concerns with its safe handling and disposal. This project investigated a variety of alternative processing methods, along with methods to accurately measure toxin levels.

Validation of a reliable and cost-effective method of removal of these toxins and an analytical methodology to ensure treated product is safe to consume could open up new market opportunities for this under-utilised grain legume, stimulate grower interest in vetch and add significant value to the crop. It would also create opportunities to breed and release vetch varieties specifically for grain production.

RESEARCH AIMS

The core objectives of the project were to:

- develop a robust assay to measure levels of toxins in vetch
- identify potential post-harvest processing methods to reduce the level of toxins in the grain.

IN THE FIELD

Project partners from the University of South Australia worked to develop an analytical method for detecting BCA and ggBCA at high sensitivity.

The SARDI project team investigated numerous methods for removing the toxins from vetch grain, including wet and dry fractionation to split flour into protein, starch and fibre components. Fermentation, microwave treatment and extrusion were also investigated. The results from these methods were compared to de-hulled vetch grain that had been steeped for four hours at 60°C with hourly water changes.

RESULTS

The University of South Australia established a liquid chromatography/ mass spectrometry method to analyse the two vetch toxins. The method was able to detect low levels of toxins – down to 25mg/kg ggBCA and 3mg/kg BCA.

Dry fractionation of vetch flour resulted in an increase in levels of both toxins in the protein-rich fraction compared to whole grain flour levels. Fermentation and extrusion significantly reduced ggBCA, but most treatments resulted in an increase in BCA suggesting a conversion from ggBCA to BCA.

Two processing approaches, wet fractionation and microwaving of intact grain followed by dehulling and a short period of steeping at room temperature, were found to be the best methods to reduce the toxin levels in the vetch flour. The microwaving method reduced toxin levels by 95 to 98 per cent compared to pre-processed grain. Microwaving warrants further investigation as it would be more energy and water efficient than steeping at high temperatures.

Macronutrient composition was not adversely affected by any processing method, but steeping reduced the level of some micronutrients.

VALUE FOR GROWERS

The project developed a robust and sensitive analytical method for measuring levels of ggBCA and BCA, the two neurotoxins in vetch. The project demonstrated that vetch flour could be processed to reduce the level of toxins to less than 5 per cent of the initial level. Additional work would be required to determine the level which would be considered suitable for human, pig or poultry consumption.

The vetch toxin assay can now be applied across vetch varieties and germplasm in the SARDI vetch breeding program to benchmark ggBCA and BCA levels.

MORE INFORMATION:

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