Enhancing Lupin Seed Quality for Food Market: Integrated Multi-Omics and Genetics Approaches

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Current projections indicate that the global population, expected to reach 9.8 billion by 2050, will require approximately 70% more food. Plant-based protein is poised to fulfill over half of this protein demand. Narrow-leafed lupin (NLL) stands out as a prime candidate due to its high protein content (35-40%). Not only is it a valuable source of animal feed, but it's also gaining traction as a premium plant-based protein for human consumption. Lupins boast high fibre, low starch, low fat, and a low glycemic index, holding promise in addressing prevalent health concerns like diabetes, cardiovascular diseases, and obesity. However, current lupin varieties harbor undesirable traits such as thick seed coats, grain alkaloids, a beany flavor, and specific seed storage proteins that can trigger food allergies in some individuals.

CSIRO’s research endeavors to enhance seed quality by exploiting the intricate programming of seed development and composition in NLL. Toward this end, we have re-sequenced a diverse panel of wild and domesticated NLL germplasm, established large transcriptome and proteome datasets for lupin grain development, along with a reverse genetic (TILLING) platform. This integrated genetic and multi-omics approach enables us to delve into crucial developmental and biosynthetic pathways in seed biology, pinpointing targets for precision genome engineering to expedite future breeding efforts aimed at redesigning seed composition in lupins. It paves the way for the discovery of novel genes to remove or mitigate undesirable traits, thereby enhancing the suitability of lupins for plant-based protein food production.