Nutrient and phytochemical profile

The information provided is based on samples prepared under laboratory conditions where relatively pure fractions of the Australian Lupin Bean hull and kernel are prepared for chemical analysis. Commercial processing can result in less complete separation of the hull and kernel influencing the proximate analysis of these fractions.

There is minor variation in nutrient profile between varieties of the Australian Sweet Lupin and with the soil-type and seasonal conditions under which the crop is grown. Where possible, the data is collated from on a large number of samples grown over multiple seasons under Australian conditions.

Australian Lupin Bean

Whole seed

Kernel

Proximate Analysis

	Whole Seed (g/100g)	Kernel (g/100g)	Hull (g/100g)
Protein (N x 6.25)	31	41	4
Oil	5.5	7.0	0.5
Cellulosic polysaccharide	24	2	80
Pectin-like polysaccharide	22	25	2
Oligosaccharides	5.5	7.5	0.4
Starch	0.5	0.6	0.4
Sucrose	3.0	3.3	0.4
Lignin	0.5	0.5	1.0
Ash (Minerals)	2.5	2.5	4.0
Water	9	10	8

Compiled from:

Petterson DS, Sipsas S, Mackintosh JB (Eds) (1997). 'The chemical composition and nutritional value of Australian pulses.' (Grains Research & Development Corporation: Canberra).

Kim JC, Pluske JR & Mullan BP (2007). Lupins as a protein source in pig diets:CAB Reviews: Perspectives in Agriculture, Veterinary Science, Nutrition and Natural Resources 2, No. 003.

Evans AJ, Cheung PC, & Cheetham, NW (1993). The carbohydrate composition of cotyledons and hulls of cultivars of *Lupinus angustifolius* from Western Australia. Journal of the Science of Food and Agriculture, 61: 189-194.

Mazumder, K, Biswas, B, Kerr, PG Blanchard C, *et al*. (2021). Comparative assessment of nutritional, thermal, rheological and functional properties of nine Australian lupin cultivars. Science Reporter 11, 21515. https://doi.org/10.1038/s41598-021-00838-x

Protein and amino acid profile

The majority of the Australian Lupin Bean protein is made up of α conglutin (a legumin-like 11S globulin) and β conglutin (a vicilin-like 7S globulin). The next most abundant protein, δ conglutin, is a sulphur rich 2S albumin analogous to conglycinin from soybean. A fourth and unique protein to lupin, γ conglutin, is a basic 7S globulin. It is not a typical storage protein, but a bioactive protein that resides in the cell walls. γ-conglutin hydrolysed peptides are insulin mimetic providing potential blood glucose regulating applications.

The digestibility and bioavailability of Australian Lupin Bean protein and the content of sulphur containing amino acids is comparable to soybean protein.

The lysine content of lupin protein is higher than wheat and other cereal protein. It is notable that lupin is a rich source of arginine, a known vasodilator, which may explain why lupin has been shown to reduce hypertension.

AMINO ACID	Whole Seed (g/100g)	Kernel (g/100g)	% of protein
Alanine	1.04	1.4	3.4
Arginine	3.59	4.8	11.7
Aspartic acid	2.99	4	9.8
Cysteine	0.42	0.6	1.5
Glutamic acid	6.63	8.8	21.5
Glycine	1.29	1.7	4.1
Histidine	0.79	1.1	2.7
Isoleucine	1.22	1.6	3.9
Leucine	2.12	2.8	6.8
Lysine	1.46	1.9	4.6
Methionine	0.2	0.3	0.7
Phenylalanine	1.18	1.6	3.9
Proline	1.26	1.7	4.1
Serine	1.59	2.1	5.1
Threonine	1.09	1.5	3.7
Tryptophan	0.31	0.4	1.0
Tyrosine	1.13	1.5	3.7
Valine	1.17	1.6	3.9
Cysteine + Methionine	0.62	0.8	2.0
Tyrosine + Phenylalanine	2.33	3.1	7.6

Compiled from:

Petterson DS, Sipsas S, Mackintosh JB (Eds) (1997). 'The chemical composition and nutritional value of Australian pulses.' (Grains Research & Development Corporation: Canberra).

Kim JC, Pluske JR and Mullan BP (2007). Lupins as a protein source in pig diets. CAB Reviews: Perspectives in Agriculture, Veterinary Science, Nutrition and Natural Resources 2007 2, No. 003.

Further reading:

Blagrove RJ and Gillespie JM (1975). Isolation, purification and characterisation of the seed globulins of *Lupinus angustifolius*. Australian Journal of Plant Physiology 2: 13-27.

Lilley GG (1986). The sub-unit structure and stability of conglutin delta, a sulfur ricj seed protein of *Lupinus angustifolius* L. Journal of the Science of Food and Agriculture 37: 895-907.

Chukwuejima S, Utioh A, Choic TD, and Alukoa RE (2023). Lupin Seed Proteins: A Comprehensive Review of Composition, Extraction Technologies, Food Functionality, and Health Benefits. Food Reviews International. doi.org/10.1080/87559129.2023.2191701

Lipids

Whilst the lipid content of the Australian Lupin Bean is relatively low, the composition of the oil is of good nutritional profile and is stable from oxidation.

LIPID	% of oil
Triglycerides	71
saturated	20
polyunsaturated	46
monounsaturated	34
omega 3	5.3
omega 6	37
omega 9	34
Phospholipids	15
Free sterols	5.0
Glycolipids	3.5
Sterol and wax esters	0.5
Unidentified waxy material	4

Fatty acid profile		% of oil
Myristic	C14:0	0.15
Palmitic	C16:0	10.98
Palmitoleic	C16:1	0.11
Stearic	C18:0	3.75
Elaidic	C18:1(9)t	3.97
Oleic	C18:1(9)c	33.5
Vaccenic	C18:1(7)	0.71
Linoleic	C18:2 (Omega 6)	37.1
Linolenic	C18:3 (Omega 3)	5.29
Arachidic	C20:0	0.90
Eicosenoic	C20:1(9)	0.29
Gadoleic	C20:1(11)	0.30
Arachidonic	C20:4	0.01
Behenic	C22:0	1.9
Erucic	C 22:1	<0.01
Lignoceric	C24:0	0.39

Compiled from:

Petterson DS, Sipsas S, Mackintosh JB (Eds) (1997). 'The chemical composition and nutritional value of Australian pulses.' (Grains Research & Development Corporation: Canberra).

Hansen RP, Czochanska Z (1974). Composition of the lipids of lupin seed (*Lupinus angustifolius* L. var. "Uniwhite"). The Journal of the Science of Food and Agriculture 25: 409-415.

Food Standards Australia New Zealand (FSANZ). Australian Sweet Lupin. Available online: https://www.foodstandards.gov.au/science/monitoringnutrients/afcd/Documents/Industry%20Report%20-%20Australian%20Sweet%20Lupin.pdf (accessed on 22 April 2023)

Carbohydrates

The seed coat (testa or hull) and the kernel (cotyledons) of the Australian Lupin Bean contain distinctly different types of carbohydrate.

Seed coat

The seed coat comprises 22 - 25% of the total seed weight, noticeably higher than other legumes.

The seed coat is predominantly composed of cell wall material - structural polysaccharides (cellulose and hemicellulose with some pectin) and only small amounts of lipid, and protein.

Nutritionally, the seed coat fibre is primarily an insoluble fibre.

Hull carbohydrate	% dry weight
Cellulose	46 - 52
Hemicellulose	13 - 14
Pectins	16 - 28
Lignin	0.3 - 2.1
Oligosaccharides	0.4
Sucrose	0.7 - 1.4
Starch	0.4 - 0.9
Dietary Fibre	
Insoluble	84 - 87
Soluble	3.1 - 3.8

Compiled from:

Zhonga L, Zhongxiang F, Wahlqvist ML, Wua G, Hodgson JM and Johnson SK (2018). Seed coats of pulses as a food ingredient: Characterization, processing, and applications. Trends in Food Science & Technology 80: 35–42

Evans AJ, Cheung PCK and Cheetham NWH (1993). The carbohydrate composition of cotyledons and hulls of cultivars of *Lupinus angustifolius* from Western Australia. Journal of the Science of Food and Agriculture 61: 189-194.

Kernel

The Australian Lupin Bean kernel contain far higher dietary fibre levels than traditional pulses and soybean on account of their highly thickened mesophyll cell walls. Unlike pulses it is characterised by having negligible starch resulting in a very low glycemic load. In contrast to the hull, the kernel fibre contains more soluble non-starch polysaccharides which is more pectin-like (long-chain galactans with highly branched arabinans, linked to rhamnogalacturonan backbone) than cellulosic.

Kernel carbohydrate	**% dry weight**
Non-starch polysaccharide (NSP)	
Pectin-like	29 - 31
Cellulose	0.8 - 1.7
Oligosaccharides (Raffinose family)	7.7
Sucrose	0.4
Lignin	0.9
Starch	0.6
Monosaccharides	**% of NSP**
Arabinose	13.0
Galactose	67.0
Glucose	4.6
Mannose	0.7
Rhamnose	2.6
Uronic acids	9.9
Xylose	2.3

Compiled from:

Cheetham NW, Cheung PCK, and Evans AJ (1993). Structure of the principal non-starch polysaccharide from the cotyledons of *Lupinus angustifolius* (cultivar Gungurru). Carbohydrate. Polymers 22: 37–47.

Malekipoor R, Johnson SK and Bhattarai RR (2017). Lupin kernel fibre: nutritional composition, processing methods, physicochemical properties, consumer acceptability and health effects of its enriched products. Nutrients 14: 2845. https://doi.org/10.3390/nu14142845

Minerals and Vitamins

The mineral content of the Australian Lupin Bean varies to some extent with soil-type. The values presented are based on Australian Lupin Beans grown in Western Australia.

Kernel mineral content	per 100g
Calcium	81mg
Sodium	30mg
Potassium	715mg
Iron	4.0mg
Magnesium	188mg
Selenium	8.2µg
Iodine	0.4µg
Phosphorus	410mg
Zinc	3.5mg

Kernel vitamin content		per 100g
Vitamin B-1	Thiamine	0.64mg
Vitamin B-2	Riboflavin	0.02mg
Vitamin B-3	Niacin	2.2mg
Vitamin B-6	Pyridoxine	0.1mg
Vitamin C		2.0mg
Vitamin E	Alpha tocopherol	0.5mg
Gamma tocopherol		20.3mg
Folate		350µg

Compiled from:

Kouris-Blazos, A and Belski R (2016). Health benefits of legumes and pulses with a focus on Australian sweet lupins. Asia Pacific Journal of Clinical Nutrition 25: 1-17.

Grains & Legumes Nutrition Council. https://glnc.org.au/resource/lupins

Bioactives

Legumes are known to have a range of antinutritional factors.

The Australian Lupin Bean has a very low content of protease inhibitors and thus does not require heat treatment to inactivate them.

Lectins have not been detected and isoflavone, phytate and saponin levels are relatively low.

Carotenoid levels are higher than many grains and contribute to the bright yellow colour of the kernel.

Quinolizidine alkaloids, made up of mainly lupanine, 13-hydroxylupanine and angustifoline, are closely monitored in the Australian Lupin Bean to remain under the food industry standard of 200mg/kg.

Bioactives	per 100g
Alkaloids	< 20 mg
Trypsin inhibitor	13 mg
Condensed tannins	7.7 mg
Isoflavone (genistein)	0.7 mg
Phytate	580 mg
Saponins	57 mg
Lutein	154 µg
Zeaxanthin	134 µg
Beta carotene	200 µg

Compiled from

Petterson D, 1998. Composition and food uses of lupins. In: Gladstones JS, Atkins C, Hamblin J (eds.). Lupins as Crop Plants; Biology, Production and Utilization. CAB International, Wallingford, UK. 353–384.

Chandra-Hioe MV, Elvira J & Arcot J (2019). Ascorbic Acid Effectively Improved Lutein Extraction Yield from Australian Sweet Lupin Flour. Plant Foods for Human Nutrition 74: 34–39

Lemus-Conejo A. Rivero-Pino F, Montserrat-de la Paz S, Millan-Linares MC. (2023). Nutritional composition and biological activity of narrow-leafed lupins (*Lupinus angustifolius* L.) hydrolysates and seeds. Food Chemistry 420 https://doi.org/10.1016/j.foodchem.2023.136104

Andor B, Danciu C, Alexa E, Zupko I, Hogea E, Cioca A, Coricovac D, Pinzaru I, Pătrașcu JM, Mioc M, Cristina RT, Soica C et al. (2016). Germinated and ungerminated seeds extract from two Lupinus species: biological compounds characterization and in vitro and in vivo evaluations. Evidence-based Complementary and Alternative Medicine 2016: https://doi.org/10.1155/2016/7638542