Advantages of Lupinus mutabilis

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Lupinus mutabilis is an oil crop from the Andean with an oil content of ca. 20% (13-24%) and protein content ca. 45% (32-53%). L. mutabilis has virtually no starch as carbohydrate resource, but has instead prebiotic “soluble” fibre and oligosaccharides, mainly stachyose and raffinose.

composition lupin seeds and other major protein-oil crops								
material	unit	L.albus	L.angustifolius	L.luteus	L.mutabilis	G.max		
		white lupin	bleu lupin	yellow lupin	Andean lupin	Soy bean	Sunflower	Rapeseed
moisture	g /100 g fw	8.6	9.0	9.4	8.1	8.54	4.73	9.4
metabolic energy	kJ/ 100 g dw	2078	2032	2164	2307	2040	2565	1920
crude protein	g/100 g dw	38.2	33.9	42.2	43.3	39.9	21.8	35.8
crude lipids	g/100 g dw	11.2	6.3	5.5	18.9	21.8	54.0	1.4
fiber	g/100 g dw	8.9	16.0	15.8	8.2	10.2	9.0	16.0
ash	g/100 g dw	3.4	3.0	3.8	3.9	5.3	2.8	7.1
carbohydrates	g/100 g dw	39.3	41.0	38.8	32.9	33.0	21.0	48.0

Sources

F. E. Carvajal-Larenas, et al, Critical Reviews in Food Science and Nutrition Vol. 56 , Iss. 9,2016
https://ndb.nal.usda.gov/ndb/foods/show/4845?fgcd=&manu=&lfacet=&format=Full&count=&max=35&offset=&sort=&qlookup=16108
https://cereals.ahdb.org.uk/media/457271/rr80.pdf
https://ndb.nal.usda.gov/ndb/foods/show/3626?manu=&fgcd=&ds=Standard%20Reference

The nutritional value of Andean lupin can be compared with soy bean. Some Andean lupin varieties are even higher in lipid and oil content then soybean. Andean lupin has bitter (high in alkaloids 3-4%) and sweet varieties with low to very low alkaloid contents. (<.02% and <.001% respectively). Lupin can be successfully incorporated into several feed strategies for pig, poultry and cattle, making feed independent from soy imports.

The Andean lupin originates from the same agro-ecological zone as the potato. In fact Andean lupin is used in traditional Andean farming systems as trap crop for potato cyst nematodes. This makes the Andean lupin a good alternative for an oil and protein crop in the EU.

Preliminary agronomic evaluation of Andean lupin in Germany showed experimental yields between 4 and 7 tons/ha for 2 seed lines in 2 cropping seasons. Recent research in Poland showed cropping yields between 1.5 and 2.7 tons/ha for 2 seed lines in 2 years at different plant densities [1].

Scenario studies performed by WUR (Wageningen University - Dutch Agricultural Economics Institute) for possible Andean lupin cropping in the Netherlands, Germany, France, Poland and Romania demonstrated economically viable cropping possibilities comparable with winter wheat revenues when Andean lupin crop yields were at least 3.7; 3.3; 2.4; 1.9 and 1.1 tons/ha respectively. They compared the nett revenues of winter wheat cropping compared with hypothetical Andean lupin crops. The market value of Andean lupin was determined by its oil and protein content and the world market value for these commodities. The hypothetical price of Andean Lupin is estimated to be about 480€/ton compared with 350€/ton for bleu lupines (for years 2011-2013). As result, Andean lupin can already be cropped profitably in Polish and Romanian areas. The oil and protein productivity of the Andean lupin is one of the highest amongst other oil protein crops. This makes Andean Lupin a possible very interesting crop for European farmers.

Table below shows estimation of productivity from different crops for vegetable oil and protein production.

	Oil seed rape (UK)	Sun-flower	Soybean	Andean lupin L.mutabilis (JKI pre-breeding field study years 2010-2014)
Oil production ton/ha/year	1,3-1,6	0,8	0,3-0,6	1,0-1,4
Protein production ton/ha/year	0,6-0,8	0,6-0,9	0,6-1,2	1,7-2,8

Andean Lupin has also great potential for biogas production or green silage. Above ground biomass production in two year field trials on 3 sites in Northern and Southern Germany is between 7 and 16 tons DM/ha (35-80 tons fresh weight).

Lupines are beneficial to soils because of their production of nitrogen as fertilizer by symbiotic N2 fixation. Blue lupin can produce up to 200 kg N/ha symbiotically. Lupines are also known for mobilizing phosphates from soil and make this bioavailable for other crops. Lupines can grow on poor soils and increase organic matter content and bioavailable nutrients. Lupines are known to produce deep tap roots of more than 1 meter in poor and acidic/neutral soils.

Andean lupin offers new possibilities for food and non-food applications because of its high protein and lipid content with good functional characteristics for high added value applications. Examples of such applications are food products, animal feed, biobased coatings and bioplastics and natural cosmetics with skin caring and anti-aging effects.

The agronomic, economic, ecological benefits and the high added value applications make the Andean lupin a very promising new protein-oil crop for the EU.

[1] Pszczółkowska A., et al. 2016, Incidence of seed-borne fungi on Lupinus mutabilis depending on a plant morphotype, sowing date and plant density. J. Elem., 21(2): 501-512.
DOI: 10.5601/jelem.2015.20.3.888