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CHEMICALS AND BIOTECHNOLOGY COMMITTEE****Consensus Document on Compositional Considerations for New Varieties of Faba Bean
(Vicia faba): Key Food and Feed Nutrients, Toxicants, Allergens, Anti-nutrients and
Other Plant Metabolites****Series on the Safety of Novel Foods and Feeds
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The Inter-Organisation Programme for the Sound Management of Chemicals (IOMC) was established in 1995 following recommendations made by the 1992 UN Conference on Environment and Development to strengthen co-operation and increase international co-ordination in the field of chemical safety. The Participating Organisations are FAO, ILO, UNDP, UNEP, UNIDO, UNITAR, WHO, World Bank, Basel, Rotterdam and Stockholm Conventions and OECD. The purpose of the IOMC is to promote co-ordination of the policies and activities pursued by the Participating Organisations, jointly or separately, to achieve the sound management of chemicals in relation to human health and the environment.

Foreword

The OECD Working Party on the Safety on the Novel Foods and Feeds decided at its first session, in 1999, to focus its work on the development of science-based consensus documents, which are mutually acceptable among member countries. These consensus documents contain information for use during the regulatory assessment of a particular food/feed product.

In the area of food and feed safety, consensus documents are being published on the nutrients, anti-nutrients or toxicants, information of its use as a food/feed and other relevant information. This document addresses compositional considerations for new varieties of faba bean by identifying the key food and feed nutrients, anti-nutrients, and other constituents. A general description of these components is provided. In addition, there is background material on the cultivation of faba bean species, production, consumption, processing and uses of faba bean, and considerations to be taken into account when assessing new varieties of this crop. Constituents to be analysed, related to food use and feed use, are suggested.

The Netherlands served as the lead country in the preparation for the document, and the draft has been revised on a number of occasions based on the input from other member countries and stakeholders. This consensus document was drafted by an Ad-hoc drafting group consisting of experts from the Netherlands (lead country; Gijs A. Kleter, Lianne M.S. Bouwman, Joyce E. Van Santen, Gijs W. Spaans, Ruud D. Timmer, Chris De Visser), AFSI (Bhavneet Bajaj), and Germany (Sharline Nikolay). The drafting was supported by the OECD secretariat (Ryoko Machida, Satoshi Nakano and Jane Richardson).

The WP-SNFF has endorsed this document.

Table of contents

Foreword	4
1 Background	6
General description of the faba bean (<i>Vicia faba</i>)	6
Production	7
Processing	9
Applications/Uses	13
Breeding characteristics	16
2 Nutrients	17
Composition of faba bean – General points	17
Constituents of faba bean	17
3 Other constituents: anti-nutrients, toxicants, allergens, other plant metabolites	30
Anti-nutrients	30
Toxins	33
Allergens	35
Other constituents	35
Impact of processing	36
4 Suggested constituents to be analysed related to food use	37
Key products consumed by humans	37
Suggested analysis for food use of new varieties	37
5 Suggested analysis for feed use of new varieties	39
Key products consumed by animals	39
Suggested analysis for feed use of new varieties	39
6 References	41

1 Background

General description of the faba bean (*Vicia faba*)

The bean *Vicia faba* L. is part of the Fabaceae (Leguminosea) family and is grown worldwide for its beans and used for human consumption and as animal feed. The beans of the legume *V. faba* comprise (when dried) high levels of protein.

Faba beans have been cultivated worldwide for thousands of years for both human consumption and for animal feed for pigs, poultry, and cattle. The beans are also processed into flour and protein concentrate which can be used as an addition to various food products. They also serve as a raw material for the production of meat substitutes.

The origin of *V. faba* is unclear, as varietal diversity linked to geographical dispersion has not been demonstrated (Serradilla, De Mora and Moreno, 1993).

Common names of *V. faba* are faba bean, broad bean, fava bean, field bean, horse bean, and many more. Several botanical types exist, of which *Vicia faba* var. *major* is the most common and known as broad bean. It has large seeds (up to 2 g/seed) and is used for human consumption in fresh and dried form. Fresh broad beans are harvested while still immature (Figure 1A), while dry broad beans (Figure 1B) are harvested in a matured stage. *Vicia faba* var. *equina* is known as horse bean having medium-sized seeds (between 0.6 and 1.1 g/seed) and used for animal feed as well as for human consumption. *Vicia faba* var. *minor*, known as field bean, has small seeds (up to 0.6 g/seed) and is mainly used for animal feed. Horse- and field beans are harvested when matured and dried in their pod (Figure 1C).

V. faba beans are harvested in an immature (unripe) or mature (ripe) stage. Immature beans are also named “green”, “fresh”, or “immature”. Other names for beans in the ripe stage are “dry” or “matured”.

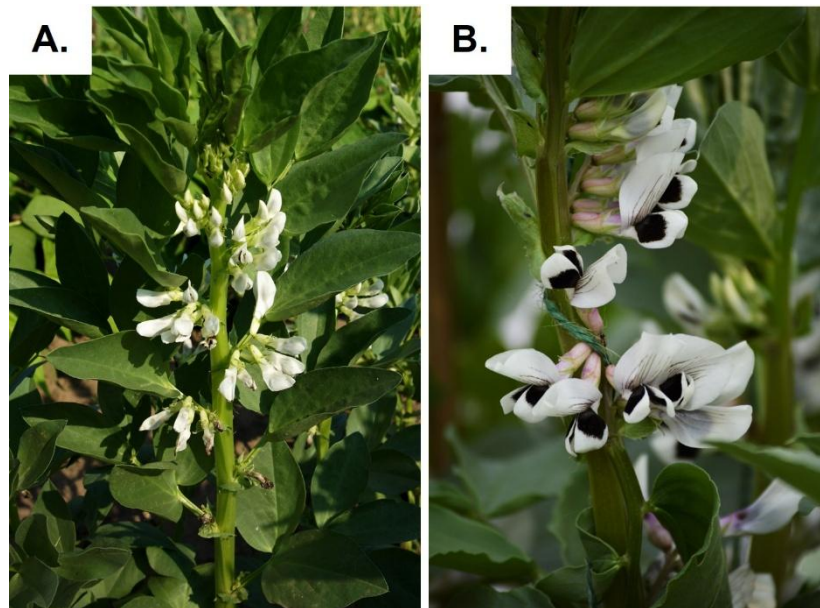
Figure 1. Immature faba beans (A), mature faba beans (B); ripe pods (C).



Source: Shutterstock

V. faba exhibits a large variation for flower colour, with flower colour being used as a morphological indicator of tannin content, an antinutritional factor (Hughes, Khazaei & Vandenberg, 2020). White flowering varieties (Figure 2A) contain low levels of tannin, while coloured-flowered faba beans (Figure 2B) contain high levels of tannin (Hughes, Khazaei & Vandenberg, 2020; Cabrera, López Medina and Martin, 1991).

Figure 2. White flowering variety (A) and coloured flowering variety (B).

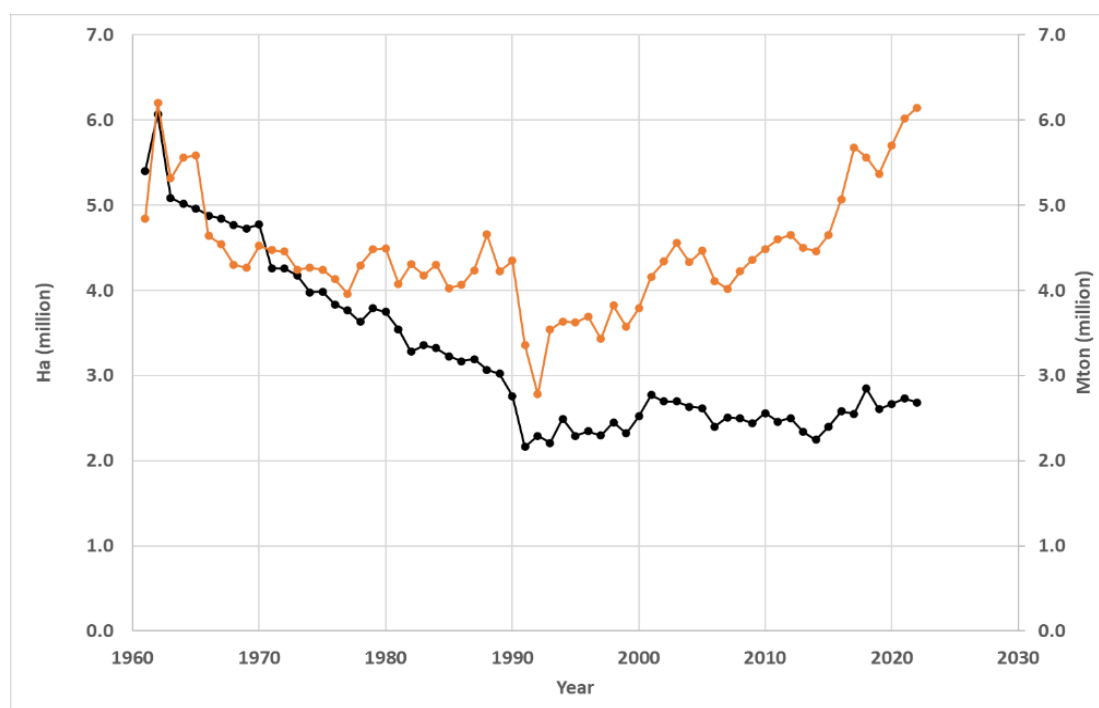


Source: Shutterstock

Production

For the last several decades, the acreage of *V. faba* has reached almost 3 million hectares (Mha) (Figure 3, black line). The area of cultivation decreased until the '90s and remained fairly stable from there. Nevertheless, the production of faba beans in tonnes has expanded (Figure 3, orange line). The world's largest faba bean producer over the period 2020-2022 is China, followed by Ethiopia as a second largest producer and Australia on third place (Table 1). Other important producers can be found in Africa and Europe. The main production is from field beans, with a small portion of broad beans.

Figure 3. Worldwide acreage (left y-axis, black line) and production (right y-axis, orange line) of faba beans, over the period 1961-2021



Source: FAOSTAT (2024), data include broad beans and field beans, dry and green.

Table 1. List of most important faba bean producing countries worldwide (acreage and production); average 2020-2022 ¹.

Acreage	ha	Production	Mton
China, mainland	811.177	China, mainland	1.707.394
Ethiopia	498.771	Ethiopia	1.097.917
Australia	257.131	UK	627.739
UK	193.542	Australia	489.662
Morocco	97.599	Germany	240.400
France	74.147	Lithuania	188.663
Lithuania, Germany, Italy	55-70.000	Sudan	174.277
Algeria, Sudan, Peru, Brazil, Poland, Tunisia	30-55.000	France	163.220
		Egypt, Italy, Poland, Denmark, Latvia, Peru	80-120.000

Note:

¹ FAOSTAT item designation "Broad beans and horse beans, dry", "Broad beans and horse beans, dry"

Source: FAOSTAT (2024), data include broad beans and field beans, mature and immature

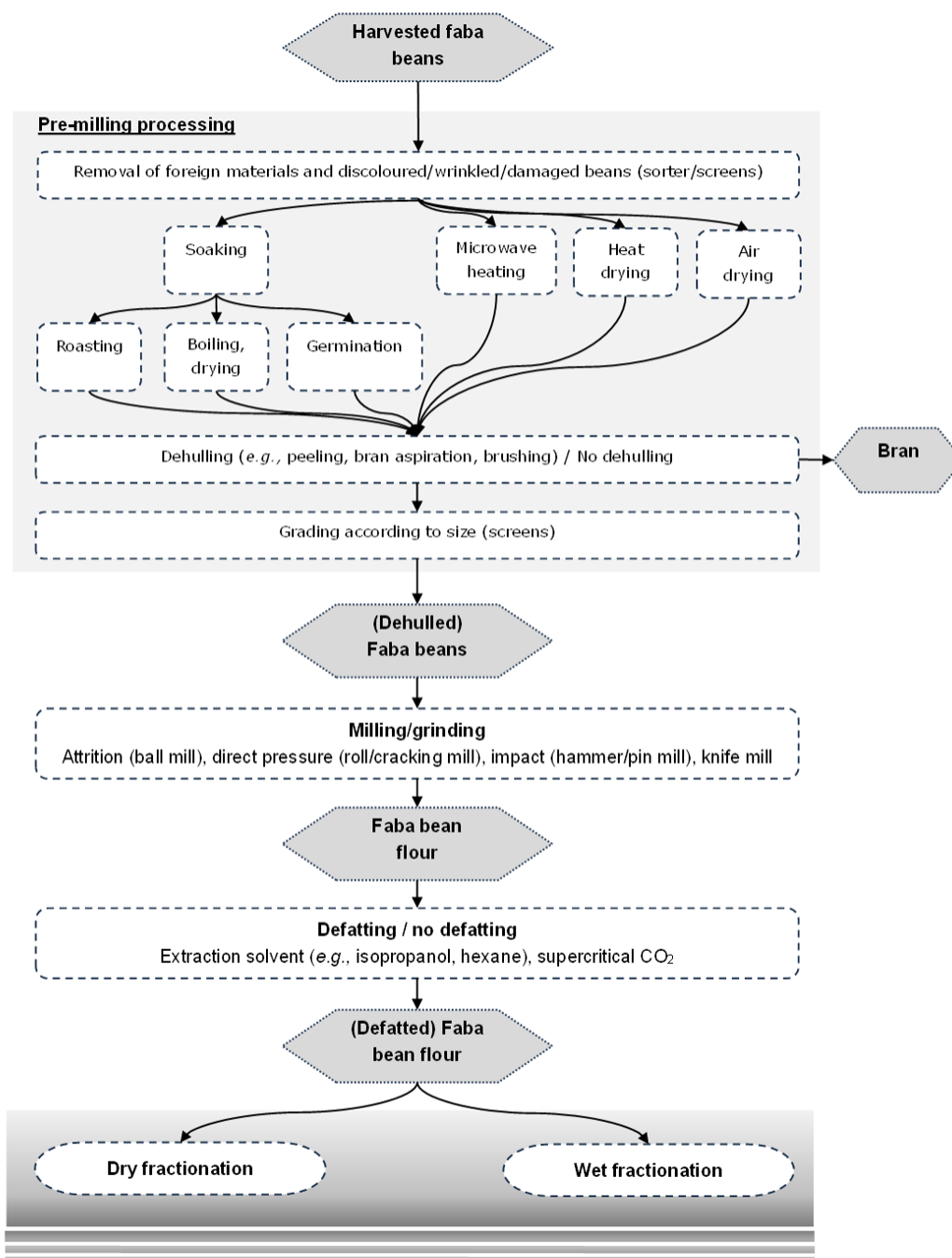
Processing

Several processing methods are described below which can be used for both human consumption and animal feed. For food use, both industrial and domestic processing can be applied to process faba beans into enriched fractions used as food ingredients.

The main food ingredients derived from industrial faba bean processing include flour as well as protein-rich concentrates and isolates (Dangi et al., 2022, Stone et al., 2024). Figures 4-6 summarize the preparation of faba bean flour from faba beans and the subsequent dry and wet fractionation processes delivering protein and starch fractions for food purposes.

Figure 4. Schematic representation of the industrial processing of faba beans into flour, which can be a food ingredient as such or further processed into protein- and starch-enriched fractions through dry and wet fractionation.

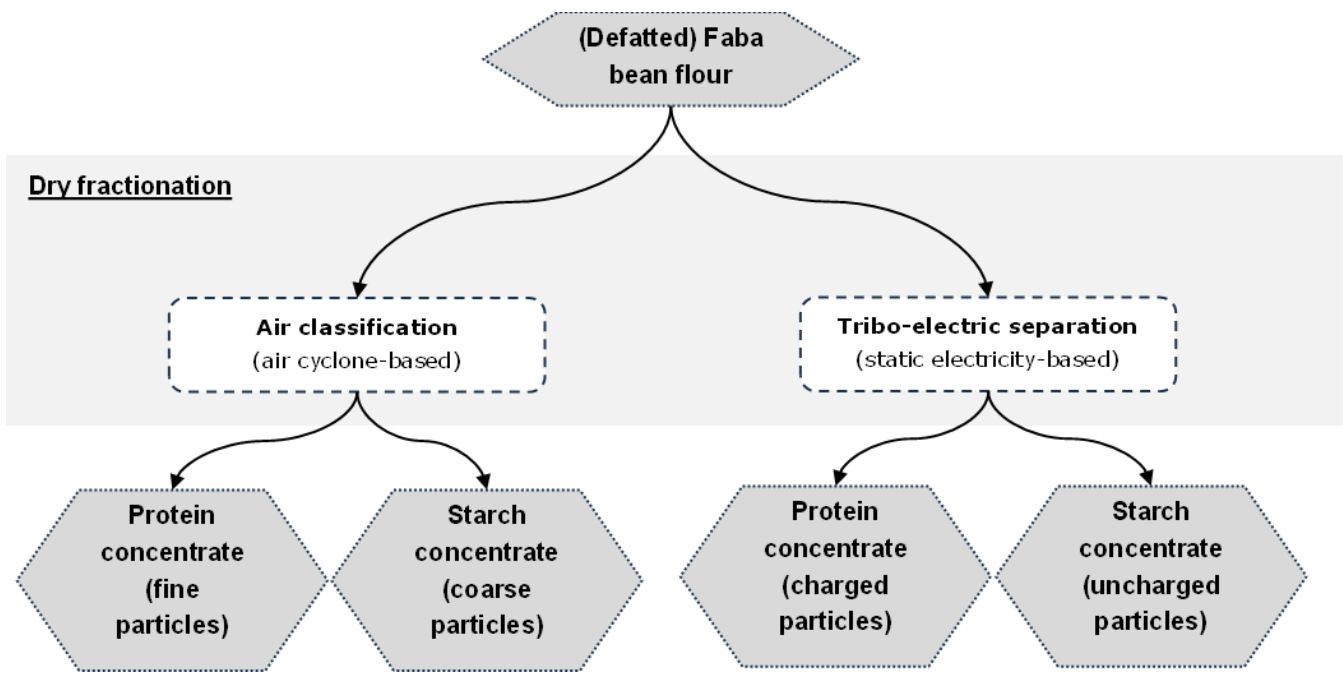
Both dry and wet forms of milling/grinding can be used. The dry process will result in a flour. Prior to wet milling/grinding, faba beans are soaked. Wet milling/grinding results in a slurry, which can be subject to wet fractionation. Alternatively, the slurry can be dried before being further processed, dry or wet.



Sources: Dangi et al., 2022; Sharan et al., 2021; Stone et al., 2024

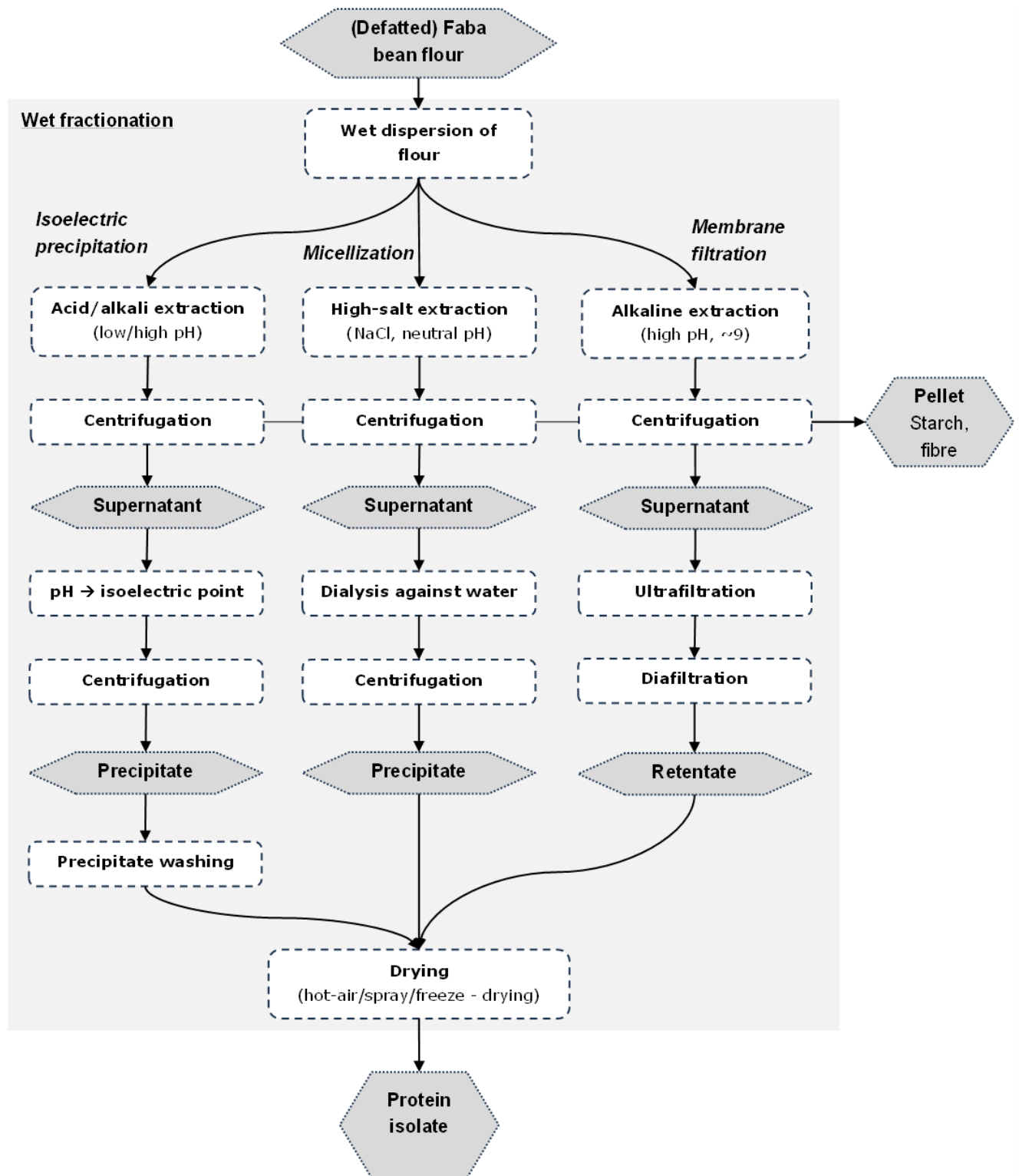
A number of methods have been used to produce high-protein ingredients from faba bean flour. Dry fractionated faba bean protein-rich concentrate is produced by separating faba bean flour particles based on their size and density or electrostatic interactions into protein-rich and starch-rich fractions (Figure 5). In addition, faba bean protein isolates are produced by wet fractionation through extraction with acid, alkaline, or high-salt solutions followed by isoelectric precipitation, dialysis (micellization), or ultra- and diafiltration (Figure 6). These high-protein ingredients (concentrate, isolate) from faba beans are used to provide alternatives to animal-based products (Boukid and Castellari, 2022; Vogelsang-O'Dwyer et al., 2020).

Figure 5. Schematic representation of the industrial dry fractionation of faba beans into protein and starch concentrates



Sources: Dangi et al., 2022; Sharan et al., 2021; Stone et al., 2024

Figure 6. Schematic representation of the industrial wet fractionation of faba beans into protein and starch isolates



Sources: Dangi et al., 2022; Ehsani et al., 2024; Hadnadev et al., 2017; Sharan et al., 2021; Stone et al., 2024

At-home cooking of faba beans consists of gently boiling dried beans. The boiling time can be reduced by pre-soaking the dried broad beans in water for rehydration. Instead of cooking, other methods can be used, such as steaming or microwaving. Germinating plus boiling is a processing method for certain traditional meals. The beans are soaked in water for 12 hours and then germinated for three days, followed by an hour of boiling (Askar, 1986). Broad beans can also be fermented (Rahate, Madhumita and Prabhakar, 2021).

Roasting is another processing method for dried faba beans. Traditionally, this is performed at home and used for the production of flour for further utilization (Dhull et al., 2022).

Fresh beans can be preserved by freezing or canning. Freezing allows the preservation of fresh green broad beans for an extended period. Before freezing and bagging, the beans are first blanched and then cooled. Canned beans are made by blanching fresh or frozen beans, placing them in cans with water and salt, sealing, and processing at high temperatures under steam pressure. The European canned bean market is expected to show a steady growth of 5.9% through 2024, driven by the growing demand among European consumers for vegetable sources of protein to replace meat (CBI, 2022).

Faba beans can be dehulled, toasted, grounded, or milled for animal feed and have the potential to be a substitute for soybeans in animal feed (Meng et al., 2021). Toasting of field beans involves cracking the beans and heating them up to 130°C, after which they are processed into smaller particles through grinding and milling.

Klik of tik om tekst in te voeren. Faba beans are rich in protein in their dried form, yet they also contain various antinutritional factors (ANFs) including vicine, convicine, tannins, phytic acid, saponins, phenols, lectins, and trypsin inhibitors. These ANFs contribute to decreased digestibility and palatability. Several processing methods can be applied to increase both digestibility and palatability as discussed in more detail in Section 3.

Applications/Uses

Faba beans are a source of starch and protein, and the uses are diverse. Beans can be eaten as a whole seed in a meal or dehulled, toasted, grounded and/or milled and used for different food applications (Table 2 and Figure 7). However, they are primarily used in animal feed.

A small part of the total production is also used for human consumption all over the world (Table 2). In some cultures, the consumption of faba beans carries a spiritual, religious or traditional connotation and serves various culinary purposes. Throughout the world the large sized beans, broad beans, are mainly eaten as a whole bean in an immature and mature stage (Figure 1). When consumed in an immature green state, the beans can be consumed either fresh (Figure 7A) or in a preserved form. Broad beans can also be roasted or fried and are served as a snack in many cultures (Figure 7B). The smaller sized faba beans such as horse bean and field bean are often used as a base ingredient for falafel (Figure 7C) and hummus (Figure 7D) together with chickpeas. Faba beans are also ground into flour and can be used for bakery products, soup powders, ice cream etc. Faba beans are a staple food in many African, Asian, and Arab countries and are consumed in various ways (Table 2). The use of faba bean as a protein isolate in the food industry as a basic ingredient for plant-based meat is gaining popularity (Figure 7E).

The largest part of the worldwide acreage and production is filled in with smaller sized faba beans, field beans, which are mainly used for animal feed. These beans are harvested as mature, dry beans stored in warehouses and used as a protein rich (25-30%) ingredient for livestock diets. Faba beans have the potential to be a substitute for soybeans in animal feed of ruminants, poultry, and monogastrics. The level of lysine is relatively high. Besides protein, the main components are starch and dietary fibres. The proportion of faba beans in livestock feeds differ between animal groups and depends on the content of antinutritional factors (tannins, vicine/convicine and others) in the beans. For monogastrics, the amount of

beans in the feed is therefore limited. For ruminants, faba beans are a very nutritious and healthy feed component (Meng et al., 2021).

Sometimes, the whole crop is harvested, shredded, and used as silage to feed ruminant livestock. Also, crop residues after bean harvest can be used as forage in the form of straw. However, these applications are minor. Faba bean flour is also used in aquaculture, as a fish feed ingredient in aquaculture of tilapia (Li et al., 2023) and salmon (Berwick and Riesen, 2022).

Table 2. A selection of culinary dishes made with broad beans all over the world

Name of dish	Origin of cuisine	Description
Roasted broad beans	All cuisines	Snack all over the world
Bissara	Egypt and Marocco	Creamy dip
Dobara	Algeria	Spicy vegetarian soup
Egyptian-style falafel	Egypt	Falafel
Ful medames	Egypt	Stew of cooked faba beans, breakfast dish, national dish of Egypt and other Arab countries.
Shiro wot	Ethiopia	Stew widely used in Ethiopian dishes, also commonly made with chickpeas
Hilibet	Ethiopia	Thin white paste of broad bean flour
Siljo	Ethiopia	Thin yellow, spicy, fermented past of broad bean flour
Härkis	Finland	Vegetable protein product
Baghalee polo	Iran	Rice with broad beans
Tishreeb Bagilla	Iraq	Breakfast dish with bread, ghee and egg
Maccu	Italy	Sicilian soup with vannel
Ikarimame	Japan	Roasted or fried beans as snack
Judd mat Gaardebounen	Luxembourg	National dish of Luxembourg, smoked collar of pork with broad beans
Kusksu	Malta	Soup
Favas guisadas à Portuguesa	Portugal	Stew with faba beans and pork
Bobove pihtije	Serbia	Pureed and set in a mould, winter dish

Note: list is not complete

Figure 7. Faba beans can be eaten as an unripe whole seed, cooked in a dish (A), or roasted as a snack (B). Ripe grounded beans are used for falafel (C) and hummus (D); dehulled and milled, they form a basis for plant-based meat substitutes (E)



Source: Shutterstock

Breeding characteristics

V. faba is partially allogamous, which means that flowers can be self-pollinated and outcrossed, making breeding challenging. However, classical breeding efforts are ongoing worldwide.

Current characteristics of interest to faba bean breeders and farmers include: yield stability, drought tolerance, frost tolerance, heat tolerance (including pollen viability), resistance to the parasitic plants *Orobancha* and *Phelipanche* (also known as broomrape), nematode resistance, and resistance to diseases such as rust, *Ascochyta* blight, chocolate spot, *Cercospora* leaf spot, downy mildew, and the foot rot complex.

V. faba beans contain the toxic compounds vicine and convicine. There are differences between varieties, and there remains a breeding interest in lowering the levels of these compounds (Khamassi et al., 2013). While some improvements have already been achieved, the most commonly cultivated varieties still have high levels of vicine and convicine.

2 Nutrients

Composition of faba bean – General points

In this section, the nutrient composition in whole faba bean (seeds) is described. Faba beans are rich in nutrients, containing abundant protein, including essential amino acids, complex carbohydrates, and dietary fibre as well as considerable levels of important micronutrients, such as minerals and vitamins. Since faba beans are commonly harvested and utilized at both mature and immature stages of growth, composition data of both raw mature and immature faba bean seeds are reported.

Constituents of faba bean

Proximate composition

The proximate and fibre composition of mature and immature faba beans are given in Tables 3 and 4. Table 3 contains data from scientific literature and on both immature and mature faba beans, while Table 4 contains information from food composition databases, which are limited to mature *V. faba* beans. The most significant difference between mature and immature faba beans in proximate composition is the moisture content, ranging from 60 – 80 g/100g fresh weight (FW) when immature (Dhull et al., 2022; Salvador-Reyes et al., 2023), while ranging from 10 – 12 g/100g FW when seed maturity has been reached (Dhull et al. 2022; Salvador-Reyes et al., 2023; Meng et al., 2021; Millar et al., 2019).

Carbohydrates

Total carbohydrates in mature faba beans ranges from 40 – 70 g/100g dry matter (DM) (Dhull et al. 2022; Salvador-Reyes et al. 2023; Meng et al. 2021). These carbohydrates are primarily comprised of polysaccharides of which starch is the main component, of which the content ranges from 28 – 48 g/100g DM. The predominant starch in mature faba bean seeds is amylose (19 – 44 g/100g DM). Mature faba beans contain small amounts of disaccharides (0.4 – 3.8 g/100g DM) and monosaccharides (4.0 – 4.6 g/100g DM) (Table 3; Martineau-Côté et al., 2022; Meng et al., 2021). Limited data are available regarding mono-, di-, and polysaccharide composition in faba beans harvested at an immature stage.

Protein

The protein content in faba beans ranges from 20.6 – 39.9 g/100g DM for mature seeds and from 28.7 – 29.5 g/100g DM for immature seeds (Table 3 and 4). The amino acid composition in both mature and immature faba bean seeds, including information on the essential amino acids such as isoleucine, leucine, lysine, methionine, phenylalanine, valine, and histidine is provided in Table 5 and 6. The predominant amino acids are the non-essential amino acids glutamic acid, aspartic acid, and arginine (Table 5 and 6). The composition of different amino acids, expressed in g/100g protein, is rather similar between faba beans of different maturities as well as between different varieties (Dhull et al., 2022; Martineau-Côté et al., 2022; Salvador-Reyes et al., 2023; Meng et al., 2021).

Lipids/Fatty acids

Faba beans contain 0.7 – 4.7 g/100g DM of total lipids when mature and 2.0 – 3.2 g/100g DM of total lipids when immature (Tables 3 and 4). The percentages of total fats consisting of saturated, monounsaturated, and polyunsaturated fatty acids ranges from 14.6 – 19.1%, 24.9 – 36.5%, and 48.8 – 61.7%, respectively (Ritter, Gastl and Becker, 2022) This was probably from mature seeds but not confirmed in the article. The unsaturated fatty acids present in faba beans mainly constitute oleic acid (monounsaturated) and linoleic acid (polyunsaturated), while the most dominant saturated fatty acid is stearic acid (Choi et al., 2024). The fatty acid composition of mature faba beans is given in Table 7.

Vitamins

The available information on the vitamin content in mature and immature faba beans on a dry matter basis, is provided in Table 8. Most vitamins are more abundant on a dry matter basis in immature seeds than in mature seeds, except for riboflavin (Vitamin B2), with contents of 0.13 and 0.34 mg/100g DM, respectively (Salvador-Reyes et al., 2023). Mature and immature faba beans mostly contain vitamin A (immature: 59.5 IU/100g DM, mature: 1842.1 IU/100g) and vitamin C (immature: 72.3-173.7 mg/100g DM, mature: 1.6-9.7mg/100g), while also containing significant amounts of vitamin B3 (immature: 4.5-7.9 mg/100g DM, mature: 3.2-3.6mg/100g) and folate (immature: 505 ug/100g DM, mature: 475 ug/100g) (Dhull et al., 2022; Salvador-Reyes et al., 2023).

Minerals

An overview of the mineral content in mature and immature faba beans on dry matter basis is given in Table 10. Faba bean has high potassium concentrations, ranging from 924 – 1316 mg/100g DM in immature seeds and ranging from 976 – 1220 mg/100g DM in mature seeds, respectively (Dhull et al., 2022; Salvador-Reyes et al., 2023; Meng et al., 2021; Millar et al., 2019). Phosphorus in faba beans (immature: 348 – 500 mg/100g DM, mature: 374 – 473 mg/100g DM) is primarily present in the form of phytate, or phytic acid, which is an unavailable form of phosphorus (Dhull et al., 2022). Phytate is further elaborated on in section 3.1.3. Sodium content seems to be highly variable in faba beans, with contents ranging from 15.2 – 263.2 mg/100g DM (immature) and from 14.6 – 71.2 (mature) (Table 6; Dhull et al., 2022; Salvador-Reyes et al., 2023; Meng et al., 2021). Mineral content in faba beans as reported in food composition databases can be found in Table 11.

Table 3. Proximate, fibre, fatty acid, and carbohydrate composition of mature and immature faba beans - mean and ranges reported in scientific literature

Substance	Dhull et al., 2022 ¹		Salvador-Reyes et al., 2023 ²		Martineau-Côté et al., 2022 ³	Meng et al., 2021 ³	Ritter, Gastl and Becker, 2022 ³	Millar et al., 2019 ⁴
Description	Mature	Immature	Dry beans (with peel) (mature)	Fresh/ Green beans (immature)	Mature	Mature	Mature	Mature
Moisture (g/100g FW)	10.98	81.00	11.50	60.60	-	10.6 (4.0-14.1)		12.30
Protein (g/100g DM)	29.34	29.47	26.89	28.68	27.6 (22.7-34.7)	28.2 (21.0-34.1)	- (20.6-39.9)	27.99
Lipids (g/100g DM)	1.72	3.16	1.69	2.03	1.4 (0.7-3.2)	3.87	- (1.0-4.7)	1.57
Saturated fatty acids (g/100g DM)	-	-	-	-	-	-	- (14.6-19.1)	-
Mono unsaturated fatty acids (g/100g DM)	-	-	-	-	-	-	- (24.9-36.5)	-
Poly unsaturated fatty acids (g/100g DM)	-	-	-	-	-	-	- (48.8-61.7)	-
Carbohydrates (g/100g DM)	65.48	61.58	39.67	55.08	66 (55.2-71.4)	56.5 (45.7-70.1)	-	-
Starch (g/100g DM)	-	-	-	-	40 (28.1-47.5)	36.0 (30.1-41.7)	-	-
Amylose (g/100g DM)	-	-	-	-	34 (18.6-44.4)	-	-	-
Sucrose (g/100g DM)	-	-	-	-	-	-	- (0.37-3.80)	-

Sugar (g/100g DM)	-	-	-	-	-	4.3 (4.0-4.6)	-	-
Total dietary fibre (g/100g DM)	28.08	22.11	28.25	10.66	12.9 (6.4-34.9)	-	- (11.4-24.7)	13.80
Insoluble dietary fibre (g/100g DM)	-	-	-	-	15.1 (10.7- 30.3)	-	-	9.07
Soluble dietary fibre (g/100g DM)	-	-	-	-	1.4 (0.6-7.6)	-	-	4.74
Ash (g/100g DM)	3.46	5.79	3.50	3.55	3.4 (2.6-4.4)	4.1 (2.9-7.3)	-	3.40

Notes:

- ¹ Data based on USDA database accessed in 2021 with data from 2005 and 2007
- ² Data based on MINSa database from 2009
- ³ Data based on various studies from literature review
- ⁴ Data based on triplicate analysis from experimental study on faba bean

Table 4. Proximate, starch, sugar, and dietary fibre composition of faba beans (raw, dried) as reported by food composition databases

Nutrient	ASEAN 2014 ¹	Australia 2025 ²	Finland 2019 ³	UK 2021 ⁴	USA 2019 ⁵
	Mean value, g/100 g fresh weight				
Water	11.9	10.6	-	11.0	11.0
	Mean value, g/100 g dry matter ⁶				
Protein	25.1	27.2	32.1	29.3	29.3
Fat	1.7	2.3	2.1	2.4	1.7
Carbohydrate					
total ⁷	70.1	62.2	62.8	67.5	65.5
available ⁸	-	41.4	47.5	36.5	37.4
Starch	-	38.4	41.6	27.4	-
Sugars	-	3.0	6.0	6.6	6.4
Dietary fibre	-	20.8	15.3	31.0	28.1
Ash	3.1	3.1		-	3.5

Notes:

¹ Concise ASEAN Food Composition Tables (Institute of Nutrition, Mahidol University, 2014), "Broad bean seed, dried, raw".

² Australian Food Composition Database (FSANZ, 2025), "Bean, broad, dried; tag: fava bean".

³ Finnish Food Composition Database FINELI (THL, 2019), "Bean, broad bean, fava bean, dry, broad bean groats, Vicia faba".

⁴ Public Health England (2021), "Beans, broad, dried, raw".

⁵ USDA Food Composition Databases (USDA, 2019), "Broadbeans (fava beans), mature seeds, raw" (Nutrient Database Number (NDB No.) 16052).

⁶ Mean values based on dry matter were calculated from a fresh weight basis (wet weight) using the mean moisture level reported from each source. For data from the Finnish food composition database, for which moisture was lacking, the average moisture content for raw dried faba beans from the four other databases was taken (11.1%).

⁷ Carbohydrate total calculated by difference = 100 – protein – fat – ash (dry weight), Values for Finland (2019) and UK (2021), for which ash values are lacking, are based on the following equation: Carbohydrate (total) = available carbohydrates + dietary fibre.

⁸ Carbohydrates available = Carbohydrates total - dietary fibre.

Table 5. Amino acid content of faba bean seeds in g/100g protein - mean and ranges reported in scientific literature

Substance	Dhull et al., 2022 ¹		Salvador-Reyes et al., 2023 ²		Martineau-Côté et al., 2022 ³		Meng et al., 2021 ⁴
	Mature	Immature	Mature	Immature	Bobas (cv. high tannin)	Kasztelan (cv. low tannin)	Mature
Tryptophan	0.95	1.00	0.82	-			-
Threonine	3.55	3.71	5.08	-			3.1 (1.3-3.8)
Isoleucine ⁵	4.03	4.48	8.2	-	3.94	3.91	3.3 (1.4-3.4)
Leucine ⁵	7.52	7.72	7.54	-	7.47	7.01	6.2 (2.6-7.5)
Lysine ⁵	6.40	6.54	9.13	-	7.08	6.71	5.4 (2.5-6.1)
Methionine ⁵	0.82	0.77	-	-	0.87	1.06	0.7 (0.3-0.9)
Cysteine	1.28	1.38	-	-	1.33	0.85	0.9 (0.4-1.2)
Methionine ⁵ + Cysteine	-	-	1.34	-	-	-	-
Phenylalanine ⁵	4.22	4.07	-	-	4.19	4.12	3.5 (1.5-3.7)
Tyrosine	3.17	3.50	-	-	2.78	2.59	2.7 (1.1-2.9)
Phenylalanine ⁵ + Tyrosine	-	-	7.05	-	-	-	-
Valine ⁵	4.45	4.89	4.26	-	4.31	4.12	3.7 (1.6-4.0)
Arginine	9.23	8.27	8.56	-	9.46	9.04	7.5 (3.6-8.2)
Histidine ⁵	2.54	2.39	2.45	-	2.41	2.29	2.4 (1.0-2.6)
Alanine	4.10	4.07	-	-	4.15	4.03	3.6 (1.4-4.4)
Aspartic acid	11.16	11.27	-	-	10.74	10.40	8.9 (3.7-11.3)
Glutamic acid	16.99	15.27	-	-	16.51	16.26	14.2 (5.5-16.9)
Glycine	4.19	4.11	-	-	4.73	4.25	3.6 (1.5-4.3)
Proline	4.21	4.11	-	-	3.94	3.86	3.9 (1.5-5.5)

Serine	4.58	4.39	-	-	4.69	4.76	4.1 (1.6-5.4)
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Notes:

- ¹ Data based on USDA database accessed in 2021 with data from 1986, calculated to g/100g protein
- ² Data based on MINSA database from 1996 and MIDAGRI database from 2004
- ³ Data based on experimental study referred to in article (Malgorzata et al. 2018: The effect of feeding native faba bean seeds (*Vicia faba* L.) to sows and supplemented with enzymes to piglets and growing pigs)
- ⁴ Data calculated to g/100g protein from data in literature review derived from 7 different references
- ⁵ Essential amino acid

Table 6. Amino acid profile of faba beans (raw, dried, mg/100 g dry matter) reported by food composition databases

Amino acid	Total amino acids	
	Australia, 2025 ¹	USA, 2019 ²
Alanine	1,361	1,202
Arginine	2,658	2,708
Aspartic Acid/Asparagine ³	2,983	3,281
Cystine/Cysteine	256	375
Glutamic Acid/Glutamine ³	3,518	4,989
Glycine	940	1,236
Histidine	569	746
Isoleucine	1,078	1,180
Leucine	1,762	2,202
Lysine	1,583	1,876
Methionine	213	239
Phenylalanine	852	1,236
Proline	996	1,236
Serine	1,157	1,348
Threonine	800	1,043
Tryptophan	274	278
Tyrosine	666	929
Valine	1,244	1,303

Notes:

¹ Australian Food Composition Database (FSANZ, 2025), "Bean. broad, dried; tag: fava bean".

² USDA Food Composition Databases (USDA, 2019), "Broadbeans (fava beans), mature seeds, raw" (Nutrient Database Number (NDB No.) 16052).

³ For asparagine and glutamine, no separate values are available as they are converted to aspartic and glutamic acids, respectively, by acid hydrolysis prior to amino acid analysis

Table 7. Fatty acid composition of faba beans (raw, dried, g/100 g dry matter) as reported by food composition databases¹

Nutrient	Australia 2025 ²	Finland 2019 ³	UK 2021 ⁴	USA 2019 ⁵
Fatty acids, total saturated	0.36	0.34	0.34	0.29
Palmitic acid (C16:0)				0.23
Stearic acid (C18:0)				0.03
Fatty acids, total monounsaturated	0.45	0.45	0.34	0.34
Oleic acid (C18:1)				0.33
Fatty acids, total polyunsaturated	1.07	0.90	1.24	0.70
Linoleic acid (C18:2)	1.00	0.87		0.65
Linolenic acid (C18:3)	0.08	0.03		0.05

Notes:

- ¹ Mean values based on dry matter were calculated from a fresh weight basis (wet weight) using the mean moisture level reported from each source. For data from the Finnish food composition database, for which moisture was lacking, the average moisture content for dried raw faba beans from four other databases was taken (11.1%).
- ² Australian Food Composition Database (FSANZ, 2025), "Bean, broad, dried; tag: fava bean"
- ³ Finnish Food Composition Database FINELI (THL, 2019), "Bean, broad bean, fava bean, dry, broad bean groats, Vicia faba".
- ⁴ Public Health England (2021), "Beans, broad, dried, raw".
- ⁵ USDA Food Composition Databases (USDA, 2019), "Broadbeans (fava beans), mature seeds, raw" [Nutrient Database Number (NDB No.) 16052].

Table 8. Vitamin composition (per 100g dry matter) in faba beans – means reported in scientific literature

Substance Description	Unit	Dhull et al., 2022 ¹		Salvador-Reyes et al., 2023 ²	
		Mature	Immature	Mature	Immature
Total ascorbic acid (vitamin C)	mg	1.57	173.68	9.72	72.34
Thiamine (vitamin B1)	mg	<1.12	<5.26	0.44	0.76
Riboflavin (vitamin B2)	mg	<1.12	<5.26	0.34	0.13
Niacin (vitamin B3)	mg	3.18	7.89	3.55	4.52

Pantothenic acid (vitamin B5)	mg	<1.12	<5.26	-	-
Pyridoxine (Vitamin B6)	mg	<1.12	<5.26	-	-
Folate	µg	475.17	505.26	-	-
Pro-vitamin A	IU	59.54	1842.11	-	-
Vitamin K1 (phylloquinone)	µg	10.11	-	-	-

Notes:

¹ Data based on USDA database accessed in 2021 with data from 2005

² Data based on MINSA database from 2009

Table 9. Vitamin composition of faba beans (raw, dried per 100 g dry matter) as reported in food composition databases ¹

Nutrient	Unit	Australia 2025 ²	USA 2019 ³
Vitamin C (ascorbic acid)	mg	1.1	1.6
Vitamin B1 (thiamin)	mg	0.82	0.62
Vitamin B2 (riboflavin)	mg	0.08	0.37
Vitamin B3 (niacin)	mg	2.0	3.2
Vitamin B5 (pantothenic acid)	mg		1.1
Vitamin B6 (pyridoxine)	mg	0.22	0.41
Vitamin B9 (folate)	µg	473	475
Vitamin E	mg	0.06	1.34
Vitamin K1 (phylloquinone)	µg		10
β-carotene (provitamin A)	µg	36	36
Pro-vitamin A, RAE ⁴	mg	5.6	3.4

Notes:

¹ Mean values based on dry matter were calculated from a wet-weight basis, using the mean moisture level reported from each source

² Australian Food Composition Database (FSANZ, 2025), "Bean. broad, dried; tag: fava bean"

³ USDA Food Composition Databases (USDA, 2019), "Broadbeans (fava beans), mature seeds, raw" (Nutrient Database Number (NDB No.) 16052).

⁴ Retinol activity equivalents, µg/100g.

Table 10. Mineral composition (per 100g dry matter) in faba beans – mean and ranges reported in scientific literature

Reference	Unit	Dhull et al. 2022 ¹		Salvador-Reyes et al. 2023 ²		Meng et al. 2021 ³	Millar et al. 2019 ⁴
Description		Mature	Immature	Mature	Immature	Mature	Mature
Calcium	mg	116	116	223	79	224 (37-190)	172.65
Iron	mg	7.5	10.0	14.7	5.1	11.67 (8.15-15.18)	5.48
Magnesium	mg	216	200	-	-	93 (8-140)	101.55
Phosphorus	mg	473	500	467	348	374 (69-562)	-
Potassium	mg	1193	1316	1219	924	976 (753-1200)	1220.45
Sodium	mg	14.6	263.2	71.2	15.2	50 (50-50)	-
Zinc	mg	3.53	3.05	-	1.47	5.2 (4.0-6.4)	4.18

Notes:

¹ Data based on USDA database accessed in 2021 with data from 2005² Data based on MINSa database from 2009³ Data based on various studies from literature review⁴ Data based on triplicate analysis from experimental study on faba bean

Table 11. Mineral composition of faba beans (raw, dried, per 100 g dry matter) as reported by food composition databases ¹

Nutrient	Unit	Australia 2022 ²	UK 2015 ³	USA 2019 ⁴
Calcium, Ca	mg	121	112	116
Chloride, Cl	mg		91	
Copper, Cu	mg		0.92	0.93
Iron, Fe	mg	4.1	6.2	7.5
Magnesium, Mg	mg	157	213	216
Manganese, Mn	mg		1.80	1.83
Phosphorus, P	mg	405	663	473
Potassium, K	mg	1188	1225	1191
Sodium, Na	mg	23	12	15
Zinc, Zn	mg	2.7	3.5	3.5

Notes:

¹ Mean values based on dry matter were calculated from a wet-weight basis, using the mean moisture level reported from each source

² Australian Food Composition Database (FSANZ, 2022), "Bean. broad, dried; tag: faba bean"

³ Public Health England (2021), "Beans, broad, dried, raw".

⁴ USDA Food Composition Databases (USDA, 2019), "Broad beans (faba beans), mature seeds, raw" (Nutrient Database Number (NDB No.) 16052)

3

Other constituents: anti-nutrients, toxicants, allergens, other plant metabolites

Anti-nutrients

Faba beans contain certain constituents with anti-nutritional properties, including lectins, oligosaccharides, phytic acid, tannins, and trypsin inhibitors.

Lectins

Lectins (phytohemagglutinins) are proteins with low molecular weight, consisting of an alpha and beta chain, which are linked by carbohydrate moieties (Sharan et al., 2021). They bind in a reversible manner to sugars and proteins present on the gut wall, thereby hindering digestion and absorption of nutrients (Sharan et al., 2021; Salvador-Reyes et al., 2023). Lectins might also promote the development of food allergies (Sharan et al., 2021; Salvador-Reyes et al., 2023). Levels of 7-28 haemagglutinin units/mg were reported for bean flour (Lu et al., 2024).

Additionally, lectins also bind erythrocytes, forming aggregates. This property is used in the determination of lectin levels in so-called hemagglutinin assays (Mayer-Labba, Frøkiær and Sandberg, 2021). Lectin levels are expressed in hemagglutinin units.

Foodborne illness related to the consumption of raw beans is ascribed to the presence of lectins. Heating processes, such as cooking, are believed to eliminate lectins (Martineau-Côté et al., 2022, Dhull et al., 2022), although some reports suggest that certain lectins are partially heat stable (Sharan et al., 2021).

Oligosaccharides

Faba beans contain oligosaccharides such as verbascose, stachyose, and raffinose, which belong to part of the raffinose family oligosaccharides (RFOs) (Dhull et al., 2022, Ritter, Gastl and Becker, 2022). RFOs can cause abdominal discomfort due to flatulence (Mayer-Labba, Frøkiær and Sandberg, 2021).

Levels of RFOs depend on growing conditions, the genotype or cultivar, agronomic practices, and seed maturity (Meng et al., 2021). Levels of raffinose, stachyose, and verbascose are lower in immature than in mature seeds (Landry, Fuchs and Hu, 2016). Levels of RFOs in mature faba beans are given in Table 12.

Table 12. Levels of the oligosaccharides raffinose, stachyose and verbascose in mature faba beans, in g/ kg DW.

	Duc et al., 1999	Mayer-Labba, Frøkiær and Sandberg, 2021	Landry, Fuchs and Hu, 2016
Raffinose	0.6 - 14.5	1.1-3.9	2.7-13.7
Stachyose	2.7 - 14.9	4.4-13.7	9.0-25.0
Verbascose	8.3 - 42.4	8.0 - 15.0	6.7 - 50.3

Phytic acid

Phytic acid, or myo-inositol hexaphosphate (IP6), is the most important reserve of phosphorus in faba beans, predominantly found in the cotyledons (Martineau-Côté et al., 2022). When the faba bean germinates, naturally present phytases in the plant are activated, which leads to facilitating the release of phosphate for the seedling (Zehring et al., 2022).

Phytic acid binds minerals, proteins and starches, thereby forming insoluble, indigestible complexes in the gut (Sharan et al., 2021; Mayer-Labba, Frøkiær and Sandberg, 2021). These complexes lead to lower bioavailability of the nutrients. Calcium, iron, magnesium and zinc have all been reported to have a lower bioavailability due to phytic acid (Salvador-Reyes et al., 2023), whereby particularly the availability of iron and zinc are of concern in *V. faba* (Mayer-Labba, Frøkiær and Sandberg, 2021). Phytic acid-protein interactions can lead to the inhibition of digestive enzymes (Zehring et al., 2022). Ruminants have microbiota that are able to break down phytic acid complexes, thereby making the phosphate available. For monogastric animals, phytase is often added to the feed, thereby making more phosphate bioavailable in the feed, and potentially reducing phosphate excretion (Zehring et al., 2022).

A wide range of phytic acid levels has been reported in literature. Factors that are thought to influence the phytic acid levels in the plant include cultivar, climate conditions, soil composition, seed maturity and agronomic practices (Meng et al., 2021; Mayer-Labba, Frøkiær and Sandberg, 2021). The phytic acid levels in beans from the cultivar Fanfare, grown in different parts of Germany vary between 5.5 to 13.5 mg/g (Zehring et al., 2022). The concentrations of phytic acids in various cultivars are given in Table 13, determined either by high-performance ion chromatography (Mayer-Labba, Frøkiær and Sandberg, 2021), or by colorimetric methods (Abusin, Hassan and Babiker, 2009; Oomah et al., 2011; Zehring et al., 2022).

Treatments that affect the phytic acid levels include dehulling, roasting, heating, autoclaving (Dhull et al., 2022; Sharan et al., 2021; Salvador-Reyes et al., 2023), although the reduction levels vary widely with the conditions of the treatments (Martineau-Côté et al., 2022). Treatment with phytase does reduce the phytic acid content to a large extent (Dhull et al., 2022; Martineau-Côté et al., 2022).

Table 13. Ranges of phytate or phytic acid in mature faba bean seeds in g/ kg dry matter.

Mayer-Labba et al., 2021	Oomah et al., 2011	Abusin, Hassan and Babiker, 2009	Zehring et al., 2022
1.12-12.81	4.93-21.38 ¹	1.534 & 1.837	5.5 - 16.1

Note:

¹ Phytate**Tannins**

The seed coats of *V. faba* contain condensed tannins, predominantly consisting of proanthocyanidins (Sharan et al., 2021). They have a bitter flavour (Ritter, Gastl and Becker, 2022) and darken in colour when they are oxidized (Sharan et al., 2021). Faba beans also contain hydrolysable tannins, but at levels that are negligible (Martineau-Côté et al., 2022). An overview of tannin levels in mature *V. faba* beans is given in Table 14.

Tannins are considered anti-nutritional factors because they bind proteins, thereby forming insoluble complexes. Tannins have this effect across a range of pH levels (Martineau-Côté et al., 2022). As this occurs in the digestive tract, tannins decrease protein digestibility as well as the bioavailability of proteins and minerals (Khazaei and Vandenberg, 2020). Tannins bind and inhibit digestive proteins, increase the excretion of digestive enzymes and can cause damage to intestinal cells (Salvador-Reyes et al., 2023).

Ruminants can adapt to tannin intake, whereby changes in ruminal microbes and condensed-tannin-binding salivary proteins can counteract the anti-nutritional effects of tannins. In addition, tannins may have positive effects, including nitrogen retention and increased availability of essential amino acids to the ruminant because the complexes formed protect the amino acids from microbial degradation (Naumann et al., 2017).

Table 14. Ranges of tannins in mature faba bean seeds in g/ kg dry matter.

	Duc et al., 1999	Oomah et al., 2011	Abusin, Hassan and Babiker, 2009 ¹	Siegert et al., 2022	Ivarsson and Neil, 2018 ²
Regular varieties	4.5-10.4	4.33 -5.42	0.7 ; 11.2	10.6 - 18.5	3.62 - 7.92
Low-tannin varieties	0.1 - 0.2	0.50 - 0.76	-	-	0.03 - 0.72

Notes:

¹ Authors did not indicate whether these were regular or low-tannin varieties.² Authors did not indicate whether they analysed regular or low-tannin varieties, but they did make a distinction between colour flowered, known to be high in tannins, and white flowered varieties, known to be low in tannins.**Trypsin inhibitors**

Trypsin inhibitors are proteins that inhibit the pancreatic enzymes trypsin and chymotrypsin which are important for protein digestion. As a result, the protein availability decreases (Ritter, Gastl and Becker, 2022; Salvador-Reyes et al., 2023). In addition, consumption of trypsin inhibitors can lead to an increase in pancreatic hyperplasia (Mayer-Labba, Frøkiær and Sandberg, 2021; Dhull et al., 2022).

Trypsin inhibitor levels are usually expressed in Trypsin Inhibition Units (TIU)/mg. Levels of trypsin inhibitors in faba beans are lower than in soybeans (Dhull et al., 2022; Martineau-Côté et al., 2022). Levels can vary significantly between cultivars (Table 15), ranging from 1.2 TIU/mg DW to 23.1 TIU/mg DW amongst 15 cultivars (Mayer-Labba, Frøkiær and Sandberg, 2021). For specific levels, see Table 15.

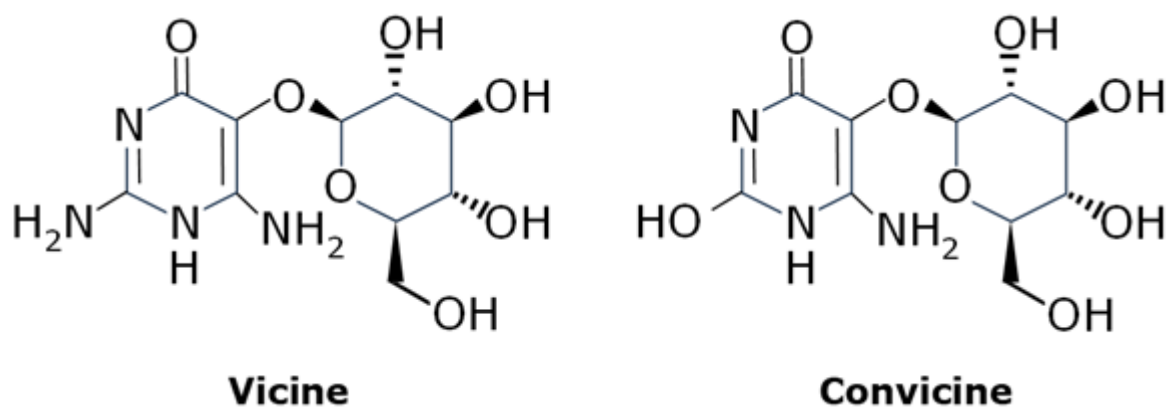
Table 15. Levels of trypsin inhibitors in mature faba beans in trypsin inhibition units (TIU) per mg DW.

Duc et al., 1999	Mayer-Labba, Frøkiær and Sandberg, 2021	Valdebouze et al., 1980
0.3-5.3 TIU/mg	1.9-23.1 TIU/mg	3.3-6.2 TIU/mg

Toxins

Vicine and convicine are pyrimidine glycosides, which are present in the cotyledon of fresh and dry *V. faba* beans (Figure 8). Low amounts are also present in the roots, stem, petiole and leaves (Khazaei et al., 2019).

Figure 8. Chemical structures of vicine and convicine



Vicine and convicine can cause a disease called “favism” in individuals with a deficiency in glucose-6-phosphate dehydrogenase (G6PD), an enzyme in the pentose monophosphate shunt pathway. It is essential for the production of nicotinamide adenine dinucleotide phosphate (NADPH) in red blood cells. NADPH is necessary for the reduction of glutathione. Vicine and convicine are metabolized into their aglycone derivatives divicine and isouramil in red blood cells, which can oxidize intracellular glutathione. Such metabolism also occurs in the gastrointestinal contents and microbiota but not in the host tissues of animal models for mammals and chick, for example (Frohlich and Marquardt, 1983; Hegazy and Marquardt, 1984; Rizzello et al., 2016). In individuals with G6PD deficiency, the consumption leads to oxidative damage and haemolysis (Dhull et al., 2022; Khazaei et al., 2019; Martineau-Côté et al., 2022). The resulting haemolytic anaemia can cause clinical symptoms such as fatigue, affected breathing, weak and rapid pulse, jaundice, and may even be fatal (Dhull et al., 2022; Sharan et al., 2021). The severity of the symptoms depends on the quantity of faba beans consumed and the concentration of vicine and

convicine in the faba beans (Ritter, Gastl and Becker, 2022). There is no cure for favism, hence avoidance of *V. faba* is the only way individuals can prevent symptoms (Khazaei et al., 2019). It is estimated that about 330 million people worldwide suffer from G6PD deficiency, which is prevalent in Sub-Saharan Africa, the Middle East, South-East Asia and the Mediterranean (Nkhoma et al., 2009). As G6PD deficiency is a recessive X-linked trait, it is more common and more severe in men (Khazaei et al., 2019, Martineau-Côté et al., 2022).

See table 16 for levels of vicine and convicine in a number of cultivars from around the world. There have been advances in breeding cultivars that are low in vicine and convicine, containing 10% of these compounds compared to “regular” varieties (Ritter, Gastl and Becker, 2022). Vicine and convicine also decrease during seed development, with immature seeds having higher concentrations than mature seeds (Khazaei et al., 2019).

Table 16. Levels of vicine and convicine in mature faba beans in g/kg DW.

	Duc et al., 1999	Khazei et al., 2019	Mayer-Labba, Frøkiær and Sandberg, 2021 ¹	Purves et al., 2017	Skylas et al., 2019
Vicine (regular cultivars)	3.4-10.4	4.64 & 5.64	0.40-7.01 ¹	3.21-10.80	4.5-7.4
Convicine (regular cultivars)	1.7-4.3	0.94 & 3.09	0.04-3.12 ¹	0.89-5.24	1.7-3.2
Vicine (low-vicine cultivars)	0.2-0.6	0.29	-	0.13-0.73	-
Convicine (low-vicine cultivars)	0.1-0.2	0.014	-	0.009-0.037	-

Note:

¹ Authors did not mention whether the analysed cultivars include low-vicine cultivars.

Allergens

Members of the legume family, a popular source of proteins from plant origin, are frequently consumed in high amounts in Asia, Africa, and the Mediterranean region. This includes faba beans which have traditionally been consumed in developing countries but recently have drawn an increased interest in the developed world for making protein-rich foods (Warsame, O'Sullivan and Tosi, 2018).

High protein foods draw concerns about allergenicity. However, reports on allergic reactions to *V. faba* in scientific literature are rare in comparison to other substantially consumed legumes (Martineau-Côté et al., 2022). Various incidental reports indicating possible sensitization against *V. faba* appeared as early as 1962 (Kantor, Pinkhas and Djaldetti et al., 1962). The first reported case of allergenicity to *V. faba* in 2007 was in a single patient with a history of allergenicity to other legumes (Mur Gimeno et al., 2007). In another instance, Campina Costa et al. (2007) confirmed a case of anaphylaxis upon ingestion of fresh faba beans by following up with a controlled oral challenge test. A later report by Rodríguez -Mazariego et al. (2016) hinted at a possible impact of bean processing on the allergic reactivity of *V. faba*. A patient who had suffered an allergic reaction from consuming a *V. faba*-containing snack reacted positively in a skin prick test but could still tolerate an oral challenge with cooked beans. The authors hypothesized that different ways of processing (e.g., cooking, frying) could induce the exposure of different epitopes that would account for such differences (Rodríguez-Mazariego et al., 2016).

Other constituents

Phenolics

Phenolics are a diverse range of compounds of varying complexity, including but not limited to the tannins discussed elsewhere in this document. These compounds interfere with the availability of proteins, carbohydrates, and essential minerals, whilst some also impart an astringent taste (Murphy et al., 2023). The phenolics present in faba bean can be divided into the hydroxybenzoic acids (e.g., protocatechuic acid, p-hydroxybenzoic acid, vanillic acid, syringic acid), and hydroxycinnamic acids (e.g., chlorogenic acid, p-coumaric acid, trans-ferulic acid). In addition, faba beans also contain flavonoids, including flavones and flavonols (catechin, quercetin, myricetin, apigenin), as well as precursors of hydrolysable tannins (gallic acid, ellagic acid) and condensed tannins/proanthocyanidins (flavan-3-ol, flavan-3,4-diol) (Baginsky et al.,

2013; Johnson et al., 2021). In 10 Australian varieties of *V. faba* grown in two locations, syringic acid and catechin were the most abundant phenolic compounds at 72-150 µg syringic acid/g and 191-297 µg catechin/g, respectively (Johnson et al., 2021). In immature beans of 10 *V. faba* varieties grown in Chile, myricetin was the most prominent phenol from the group of flavones and flavanols (range 19-119 µg/g), while (+)-catechin and (-)-epicatechin were the most prominent ones from the group of condensed tannins (proanthocyanidins; ranges 85-978 and 148-774 µg/g, respectively). Several other studies not further discussed here report the total contents of phenols and flavonoids in faba beans using, e.g., colorimetric methods.

Saponins

Saponins are compounds with high foaming and emulsifying properties. Whereas they do not contribute to the bitterness of faba beans (Karolkowski et al., 2023ab), they have been implicated as a probable cause of gastrointestinal problems in cultured fish (De Santis et al., 2016). The main saponins present in *V. faba* are B-type soyasaponins, which are triterpenoids covalently bound to a sugar (di-/tri-glycoside) group at C3. DDMP soyasaponins contain an additional DDMP (2,3-dihydro-2,5-dihydroxy-6-methyl-4H-pyranone) group at the C22 position in addition to the glycoside at C3. The bonds with these groups are prone to hydrolysis at higher temperature or low/high pH, producing the B soyasaponins without bound DDMP or the aglycone soyasapogenol B without both the glycoside and DDMP. Care should therefore be taken when processing samples for analysis to prevent hydrolysis (Stone et al., 2021).

The levels of the soyasaponin βG in whole beans are the highest, followed by soyasaponin αG and aglycones S1 and SV. Total saponins are lower in split beans than in whole beans, but increased after cooking (Stone et al., 2021). Soaking of *V. faba* in water and removal of the seed hull reduces the saponin content by 35%. Cooking of faba bean-containing bars through various means like microwave, steaming, frying, and baking reduces total saponin contents by 26%-36% (Barakat, Reim and Rohn, 2015).

Impact of processing

Adverse reactions caused by the consumption of faba beans can be prevented by processing, e.g., soaking, rinsing, and cooking the beans. These processing steps ensure that lectins, other ANFs and toxins, each in their own way, are removed, degraded or are no longer functional. At the same time, other proteins become more available for digestion. Cooking decreases trypsin inhibitory activity considerably, and germination also leads to lower trypsin inhibitory activity (Ritter, Gastl and Becker, 2022; Dhull et al., 2022). Dehulling of faba beans results in a major decrease in tannins, as most of the tannins can be found in the husk (Rahate, Madhumita and Prabhakar, 2021; Van der Poel, Gravendeel and Boer, 1991). On the other hand, dehulling increases the levels of phytic acid and trypsin inhibitor activity (Luo and Xie, 2013). Vicine and convicine levels are lowered more by aqueous processing (wet fractionation) than dry processing (Vogelsang-O'Dwyer et al., 2020). Fermentation was found to completely eliminate vicine and convicine (Rahate, Madhumita and Prabhakar, 2021). Germination decreases phytic acid, saponins, and tannins but not convicine/vicine (Chen et al., 2024).

4 Suggested constituents to be analysed related to food use

Key products consumed by humans

Faba beans are typically consumed as whole beans after cooking, as part of meals, salads, or after dehulling in, for example, hummus or falafel. The processed fraction of flours, concentrates or isolates can be incorporated into bakery products, meat analogues, dairy substitutes, and sports nutrition, amongst others. The technical functionalities of these fractions include protein enrichment, gelling, foaming, and emulsification (Augustin and Cole, 2022).

Suggested analysis for food use of new varieties

Faba beans can provide protein, carbohydrates, dietary fibre, vitamins, and minerals. Faba beans also contain certain anti-nutrients, including phytic acid, trypsin inhibitors, lectins, oligosaccharides, and tannins as well as the toxic compounds vicine and convicine. These constituents are recommended for analysis in new *Vicia faba* varieties for food use (Table 17).

Table 17. Suggested nutritional and compositional parameters to be analysed in faba beans for human food use

Constituent	Immature bean	Mature bean
<i>Moisture</i>	X	X
<i>Protein</i> ¹	X	X
<i>Fat</i> ²	X	X
<i>Carbohydrates</i>	X	X
<i>Dietary fibre</i>	X	X
<i>Amino acids</i>	X	X
<i>Minerals (Fe, Mg, P, K, Zn)</i>	X ³	X
<i>Vitamins (pro-A, B1, B2, B3, B5, B6, B9, C)</i>	X ³	X
<i>Phytic acid</i>	X ³	X

<i>Trypsin inhibitors</i>	X ³	X
<i>Lectins</i>	X ³	X ³
<i>Vicine</i>	X ³	X
<i>Convicine</i>	X ³	X

Notes:

¹ Derived from proximate analysis (e.g., crude protein)

² Derived from proximate analysis (e.g., crude fat)

³ There is limited data on the contents of these parameters within the respective type (mature/immature) of faba bean

5 Suggested analysis for feed use of new varieties

Key products consumed by animals

Parts typically consumed by animals include both beans (as a source of protein, starch, and fibre) and the whole plant (e.g., forage, as a source of fibre and protein for ruminants). Beans from varieties with smaller seeds designated “horse beans” or “field beans” are typically fed to livestock, including ruminants, pigs, poultry, and fish. Beans can be consumed both raw and processed (e.g., germinated, dehulled, toasted). Besides beans, fractionation products, such as starch-rich flours or protein-rich concentrates, are typically used as feed. Processing can help reduce the content of anti-nutritional factors (Meng et al., 2021). Both forage and silage can be fed to ruminants (bovine, ovine, etc.), although the fermentation process during ensiling reduces both the protein and fiber (ADF, NDF) contents (Guevara Oquendo, Rodriguez Espinosa and Yu, 2022) .

Suggested analysis for feed use of new varieties

Besides being a source of the macronutrients protein, starch (energy), and fibre, faba beans also contain antinutrients and toxins that may impact on animal nutrition and health, such as tannins, vicine/convicine, phytic acid, and trypsin inhibitor. “Double zero” varieties developed by breeders contain low levels of both vicine/convicine and condensed tannins (Pulse Canada, 2021). Table 18 lists suggested parameters for the analysis of new varieties of faba bean destined for animal feed use.

Table 18. Suggested nutritional and compositional parameters to be analysed in faba beans for animal feed use

Constituent	Mature faba bean	Forage
<i>Proximates</i> ¹	X	X
<i>Moisture</i>	X	X
<i>Protein</i> ¹	X	X
<i>Fat</i> ²	X	X
<i>Carbohydrates</i>	X	X
<i>Fibre fractions (ADF, NDF)</i> ³	X	X

<i>Minerals (Ca, P)</i>	X	X
<i>Amino acids</i>	X	
<i>Phytic acid</i>	X	
<i>Trypsin inhibitors</i>	X	
<i>Tannins</i>	X	
<i>Vicine</i>	X	
<i>Convicine</i>	X	

Notes:

¹ Derived from proximate analysis (e.g., crude protein)² Derived from proximate analysis (e.g., crude fat)³ NDF – neutral detergent fibre; ADF – acid detergent fibre

6

References

- Abusin, S.A.E., A.B. Hassan and E.E. Babiker (2009), "Nutritional evaluation of cooked faba bean (*Vicia faba* L.) and white bean (*Phaseolus vulgaris* L.) cultivars", *Australian Journal of Basic and Applied Sciences*, Vol. 3, pp. 2484-2490. <https://www.ajbasweb.com/old/ajbas/2009/2484-2490.pdf>
- Askar, A. (1986), "Food science: Faba beans (*Vicia faba* L.) and their role in the human diet", *Food and Nutrition Bulletin*, Vol. 8 (3), pp. 1-11. <https://doi.org/10.1177/156482658600800309>
- Augustin, M.A. and M.B. Cole (2022), "Towards a sustainable food system by design using faba bean protein as an example", *Trends in Food Science & Technology*, Vol. 125, pp. 1-11. <https://doi.org/10.1016/j.tifs.2022.04.029>
- Baginsky, C., et al. (2013), "Phenolic compound composition in immature seeds of fava bean (*Vicia faba* L.) varieties cultivated in Chile", *Journal of Food Composition and Analysis*, Vol. 31, pp. 1-6. <https://doi.org/10.1016/j.jfca.2013.02.003>
- Barakat, H., V. Reim and S. Rohn (2015), "Stability of saponins from chickpea, soy and faba beans in vegetarian, broccoli-based bars subjected to different cooking techniques", *Food Research International*, Vol. 76, pp. 142-149. <https://doi.org/10.1016/j.foodres.2015.03.043>
- Berwick, M. and G. Riesen (2022), *Evaluation of Whole and Dehulled Field Beans, Vicia faba, as Feed Materials for Atlantic salmon, Salmo salar, in Seawater*, Mowi, Bergen. <https://mowi.com/wp-content/uploads/2022/12/GRI-Faba-Beans-For-Atlantic-Salmon.pdf>
- Boukid, F. and M. Castellari (2022), "How can processing technologies boost the application of faba bean (*Vicia faba* L.) proteins in food production?", *eFood*, Vol. 3, pp. e18. <https://doi.org/10.1002/efd2.18>
- Cabrera A., J. López Medina, and A. Martin (1991), "Antinutritional factors in faba bean. Tannin content in *Vicia faba*: possibilities for plant breeding", in Cubero, J.I. and M.C. Saxena (eds.), *Present Status and Future Prospects of Faba Bean Production and Improvement in the Mediterranean Countries (CIHEAM Options Méditerranéennes, Série A. Séminaires Méditerranéens, No. 10)*, pp. 105-110, International Centre for Advanced Mediterranean Agronomic Studies, Bari. <https://om.ciheam.org/ressources/om/pdf/a10/92605141.pdf>
- Campina Costa, S., et al. (2007), "Anafilaxia à fava (Fava bean anaphylaxis)", *Revista Portuguesa de Imunoalergologia*, Vol. 15, pp. 339-347. https://www.spaic.pt/client_files/rpia_artigos/anafilaxia-a-fava.pdf
- CBI (2022), *The European Market Potential for Canned Beans*, CBI, The Hague. <https://www.cbi.eu/market-information/processed-fruit-vegetables-edible-nuts/canned-beans/market-potential>
- Chen, M., et al. (2024), "Effects of diet containing germinated faba bean (*Vicia faba* L.) on the intestinal health and gut microbial communities of Nile tilapia (*Oreochromis niloticus*)", *Aquaculture Reports*, Vol. 36, pp. 102053. <https://doi.org/10.1016/j.aqrep.2024.102053>
- Choi, Y.M., et al. (2024), "Anti-nutrient factors, nutritional components, and antioxidant activities of faba beans (*Vicia faba* L.) as affected by genotype, seed traits, and their interactions", *Food Chemistry X*,

- 23, 101780. <https://doi.org/10.1016/j.fochx.2024.101780>
- Dangi, P., et al. (2022), "Faba bean proteins: Extraction methods, properties and applications", In Punia Bangar, S. and S.B. Dhull (eds.), *Faba Bean: Chemistry, Properties and Functionality*, pp. 245-273, Springer, Cham. https://doi.org/10.1007/978-3-031-14587-2_10
- De Santis, C., et al. (2016). Influence of dietary inclusion of a wet processed faba bean protein isolate on post-smolt Atlantic salmon (*Salmo salar*). *Aquaculture*, Vol. 465, pp. 124-133. <https://doi.org/10.1016/j.aquaculture.2016.09.008>
- Dhull, S.B., et al. (2022), "A review of nutritional profile and processing of faba bean (*Vicia faba* L.)", *Legume Science*, Vol. 4, pp. e129. <https://doi.org/10.1002/leg3.129>
- Duc, G., et al. (1999), "Genetic variability for feeding value of faba bean seeds (*Vicia faba*): Comparative chemical composition of isogenics involving zero-tannin and zero-vicine genes", *Journal of Agricultural Science*, Vol. 133, pp. 185-196. <https://doi.org/10.1017/S0021859699006905>
- Ehsani, M., et al. (2024), "Advancing faba bean protein purification using membrane technology: Current state and future perspectives", *Journal of Composites Science*, Vol. 8, pp. 15. <https://doi.org/10.3390/jcs8010015>
- FAOSTAT (2024) ,*Crops and Livestock Products*, Food and Agriculture Organisation of the United Nations, Rome. <https://www.fao.org/faostat/en/#data/QCL>
- Frohlich, A.A. and R.R. Marquardt (1983), "Turnover and hydrolysis of vicine and convicine in avian tissues and digesta", *Journal of the Science of Food and Agriculture*, Vol. 34, pp. 153-163. <https://doi.org/10.1002/jsfa.2740340207>
- FSANZ (2025), *Australian Food Composition Database – Release 2.0*, Food Standards Australia New Zealand, Canberra ACT. <https://www.foodstandards.gov.au/science/monitoringnutrients/afcd/Pages/default.aspx>.
- Guevara Oquendo, V.H., M.E. Rodriguez Espinosa and P. Yu (2021), "Research progress on faba bean and faba forage in food and feed types, physiochemical, nutritional, and molecular structural characteristics with molecular spectroscopy", *Critical Reviews in Food Science and Nutrition*, Vol. 62, pp. 8675-8685. <https://doi.org/10.1080/10408398.2021.1931805>
- Hadnadev, M.S., et al.. (2017), "Progress in vegetable proteins isolation techniques: A review", *Food and Feed Research*, Vol. 44, pp. 11-21. <https://doi.org/10.5937/FFR1701011H>
- Hegazy, M.I. and R.R. Marquardt (1984), "Metabolism of vicine and convicine in rat tissues: Absorption and excretion patterns and sites of hydrolysis", *Journal of the Science of Food and Agriculture*, Vol. 35, pp. 139-146. <https://doi.org/10.1002/jsfa.2740350204>
- Hughes, J., H. Khazaei and A. Vandenberg (2020), "The study of genetics of flower color in faba bean reveals generous diversity to be used in the horticulture industry", *HortScience*, Vol. 55, pp. 1584–1588. <https://doi.org/10.21273/HORTSCI15238-20>
- Institute of Nutrition, Mahidol University (2014), *ASEAN Food Composition Database, Electronic version 1, February 2014*, Institute of Nutrition, Mahidol University, Nakhon Pathom. http://www.inmu.mahidol.ac.th/aseanfoods/composition_data.html.
- Ivarsson, E. and M. Neil (2018), "Variations in nutritional and antinutritional contents among faba bean cultivars and effects on growth performance of weaner pigs", *Livestock Science*, Vol. 212, pp. 14-21. <https://doi.org/10.1016/j.livsci.2018.03.017>
- Johnson, J.B., et al. (2021), "Phenolic profiles of ten Australian faba bean varieties", *Molecules*, Vol. 26, pp. 4642. <https://doi.org/10.3390/molecules26154642>

- Kantor, S.Z., J. Pinkhas and M. Djaldetti (1962), "Immunologic studies in a case of favism", *Journal of Allergy*, Vol. 33, pp. 390-396. [https://doi.org/10.1016/0021-8707\(62\)90042-4](https://doi.org/10.1016/0021-8707(62)90042-4)
- Karolkowski, A., et al. (2023a), "Activation of bitter taste receptors by saponins and alkaloids identified in faba beans (*Vicia faba* L. minor)", *Food Chemistry*, Vol. 426, pp. 136548. <https://doi.org/10.1016/j.foodchem.2023.136548>
- Karolkowski, A., et al. (2023b), "Faba bean (*Vicia faba* L. minor) bitterness: An untargeted metabolomic approach to highlight the impact of the non-volatile fraction", *Metabolites*, Vol. 13, pp. 964. <https://doi.org/10.3390/metabo13080964>
- Khamassi, K., et al. (2013), "A baseline study of vicine-convicine levels in faba bean (*Vicia faba* L.) germplasm", *Plant Genetic Resources: Characterisation and Utilisation*, Vol. 11, pp. 250–257. <https://doi.org/10.1017/S1479262113000105>
- Khazaei, H., et al. (2019), "Eliminating vicine and convicine, the main anti-nutritional factors restricting faba bean usage", *Trends in Food Science & Technology*, Vol. 91, pp. 549-556. <https://doi.org/https://doi.org/10.1016/j.tifs.2019.07.051>
- Khazaei, H., and A. Vandenberg (2020), "Seed mineral composition and protein content of faba beans (*Vicia faba* L.) with contrasting tannin contents", *Agronomy*, Vol. 10, pp. 511. <https://www.mdpi.com/2073-4395/10/4/511>
- Landry, E.J., S.J. Fuchs and J. Hu (2016), "Carbohydrate composition of mature and immature faba bean seeds", *Journal of Food Composition and Analysis*, Vol. 50, pp. 55-60. <https://doi.org/https://doi.org/10.1016/j.jfca.2016.05.010>
- Li, Q., et al. (2023). Effects of faba beans (*Vicia faba* L.) on growth performance, textural quality and physiological indices of tilapia (*Oreochromis niloticus*), *Aquaculture*, Volume 574. <https://doi.org/10.1016/j.aquaculture.2023.739640>
- Lu, J., et al. (2024), "Minimizing anti-nutritional factors in wet protein extraction from Swedish faba beans through the application of response surface methodology", *Food Chemistry*, Vol. 460 (Pt.2), pp. 140700. <https://doi.org/10.1016/j.foodchem.2024.140700>
- Luo, Y.W. and W.H. Xie (2013), "Effect of different processing methods on certain antinutritional factors and protein digestibility in green and white faba bean (*Vicia faba* L.)", *CYTA - Journal of Food*, Vol. 11, pp. 43–49. <https://doi.org/10.1080/19476337.2012.681705>
- Martineau-Côté, D., et al. (2022), "Faba bean: An untapped source of quality plant proteins and bioactives", *Nutrients*, Vol. 14, pp. 1541. <https://www.mdpi.com/2072-6643/14/8/1541>
- Mayer-Labba, I.-C., H. Frøkiær and A.-S. Sandberg (2021), "Nutritional and antinutritional composition of fava bean (*Vicia faba* L., var. minor) cultivars", *Food Research International*, Vol. 140, pp. 110038. <https://doi.org/10.1016/j.foodres.2020.110038>
- Meng, Z., et al. (2021), "Nutritive value of faba bean (*Vicia faba* L.) as a feedstuff resource in livestock nutrition: A review", *Food Science and Nutrition*, Vol. 9, pp. 5244–5262. <https://doi.org/10.1002/fsn3.2342>
- Millar, K.A., et al. (2019), "Proximate composition and anti-nutritional factors of fava-bean (*Vicia faba*), green-pea and yellow-pea (*Pisum sativum*) flour", *Journal of Food Composition and Analysis*, Vol. 82, pp. 103233. <https://doi.org/10.1016/j.jfca.2019.103233>
- Mur Gimeno, P., et al. (2007), "Allergic reaction caused by a new hidden food, broad bean flour", *Allergy*, Vol. 62: pp. 1340-1341. <https://doi.org/10.1111/j.1398-9995.2007.01471.x>
- Murphy, R.M., et al. (2023), "Reduction of phenolics in faba bean meal using recombinantly produced and purified *Bacillus ligninophilus* catechol 2,3-dioxygenase", *Bioresources and Bioprocessing*,

- Vol. 10, pp. 13. <https://doi.org/10.1186/s40643-023-00633-8>
- Naumann, H.D., et al. (2017), "The role of condensed tannins in ruminant animal production: advances, limitations and future directions", *Revista Brasileira de Zootecnia*, Vol. 46, pp. 929-949. <https://doi.org/10.1590/S1806-92902017001200009>
- Nkhoma, E.T., et al. (2009), « The global prevalence of glucose-6-phosphate dehydrogenase deficiency: A systematic review and meta-analysis", *Blood Cells, Molecules, and Diseases*, Vol. 42, pp. 267-278. <https://doi.org/10.1016/j.bcmd.2008.12.005>
- Oomah, B.D., et al. (2011), "Phenolics, phytic acid, and phytase in Canadian-grown low-tannin faba bean (*Vicia faba* L.) genotypes", *Journal of Agricultural and Food Chemistry*, Vol. 59, pp. 3763-3771. <https://doi.org/10.1021/jf200338b>
- Public Health England (2021), *McCance and Widdowson's 'Composition of Foods Integrated Dataset' on the Nutrient Content of the UK Food Supply*, Public Health England, London, <https://www.gov.uk/government/publications/composition-of-foods-integrated-dataset-covid#history>.
- Pulse Canada (2021), *Canadian Faba Bean. A Guide for the Livestock and Aquaculture Industry (1st Edition)*, Pulse Canada, Winnipeg MB. <https://pulsecanada.com/uploads/resources/Pulse-Canada-Faba-Bean-Feed-Guide.pdf>
- Purves, R.W., et al. (2017), "Rapid analysis of medically relevant compounds in faba bean seeds using FAIMS and mass spectrometry", *International Journal for Ion Mobility Spectrometry*, Vol. 20, pp. 125-135. <https://doi.org/10.1007/s12127-017-0226-7>
- Rahate, K.A., M. Madhumita and P.K. Prabhakar (2021), "Nutritional composition, anti-nutritional factors, pretreatments-cum-processing impact and food formulation potential of faba bean (*Vicia faba* L.): A comprehensive review", *LWT - Food Science and Technology*, Vol. 138, pp. 110796. <https://doi.org/10.1016/j.lwt.2020.110796>
- Ritter, S.W., M.I. Gastl and T.M. Becker (2022), "The modification of volatile and nonvolatile compounds in lupines and faba beans by substrate modulation and lactic acid fermentation to facilitate their use for legume-based beverages—A review", *Comprehensive Reviews in Food Science and Food Safety*, Vol. 21, pp. 4018-4055. <https://doi.org/10.1111/1541-4337.13002>
- RIVM (2019), *NEVO Online, Version 2019/6.0*, National Institute for Public Health and the Environment (RIVM), Bilthoven. <https://nevo-online.rivm.nl/>.
- Rizzello, C., et al. (2016), "Degradation of vicine, convicine and their aglycones during fermentation of faba bean flour", *Science Reports*, Vol. 6, pp. 32452. <https://doi.org/10.1038/srep32452>
- Rodríguez-Mazariego, M.E., et al. (2016), Broad bean-induced anaphylaxis: A case report. *Journal of Investigational Allergology and Clinical Immunology*, Vol. 26, pp. 374-375. <https://doi.org/10.18176/jiaci.0096pulse>
- Salvador-Reyes, R., et al. (2023), "From ancient crop to modern superfood: Exploring the history, diversity, characteristics, technological applications, and culinary uses of Peruvian fava beans", *Food Research International*, Vol. 173, pp. 113394. <https://doi.org/10.1016/j.foodres.2023.113394>
- Serradilla, J.M., T. De Mora and Moreno (1993), "Geographic dispersion and varietal diversity in *Vicia faba* L.", *Genetic Resources and Crop Evolution*, Vol. 40, pp. 143-151. <https://doi.org/10.1007/BF00051119>
- Sharan, S., et al. (2021), "Fava bean (*Vicia faba* L.) for food applications: From seed to ingredient processing and its effect on functional properties, antinutritional factors, flavor, and color", *Comprehensive Reviews in Food Science and Food Safety*, Vol. 20, pp. 401-428. <https://doi.org/10.1111/1541-4337.12687>

- Siegert, W., et al. (2022), "Amino acid digestibility and metabolisable energy of spring and winter faba beans grown on two sites and effects of dehulling in caeectomised laying hens", *Journal of the Science of Food and Agriculture*, Vol. 102, pp. 920-930. <https://doi.org/10.1002/jsfa.11424>
- Skylas, D.J., et al. (2019), "Nutritional and anti-nutritional seed-quality traits of faba bean (*Vicia faba*) grown in South Australia", *Crop and Pasture Science*, Vol. 70, pp. 463-472. <https://doi.org/10.1071/CP19017>
- Stone, A., et al. (2021), "The levels of bioactive compounds found in raw and cooked Canadian pulses", *Food Science and Technology International*, Vol. 27, pp. 528-538. <https://doi.org/10.1177/1082013220973804>
- Stone, A.K., et al. (2024), "Current review of faba bean protein fractionation and its value-added utilization in foods", *Sustainable Food Proteins*, Vol. 2, pp. 101–124. <https://doi.org/10.1002/sfp2.1028>
- THL (2019), *National Food Composition Database FINELI, Release 20 (2019)*, Finnish Institute for Health and Welfare (THL), Helsinki. <https://fineli.fi/fineli/en/index>
- USDA (2019), *SR Legacy (April 2019)*, United States Department of Agriculture, Washington DC. <https://fdc.nal.usda.gov/>
- Valdebouze, P., et al. (1980), "Content and distribution of trypsin inhibitors and hemagglutinins in some legume seeds", *Canadian Journal of Plant Science*, Vol. 60, pp. 695-701. <https://doi.org/10.4141/cjps80-097>
- Van der Poel, A.F.B., S. Gravendeel and H. Boer (1991), "Effect of different processing methods on tannin content and in vitro protein digestibility of faba bean (*Vicia faba* L.)", *Animal Feed Science and Technology*, Vol. 33, pp. 49-58. [https://doi.org/10.1016/0377-8401\(91\)90045-T](https://doi.org/10.1016/0377-8401(91)90045-T)
- Vogelsang-O'Dwyer, M., et al. (2020), "Comparison of Faba bean protein ingredients produced using dry fractionation and isoelectric precipitation: Techno-functional, nutritional and environmental performance", *Foods*, Vol. 9, pp. 322. <https://doi.org/10.3390/foods9030322>
- Warsame, A.O., D.M. O'Sullivan and P. Tosi (2018), "Seed storage proteins of Faba bean (*Vicia faba* L): Current status and prospects for genetic improvement", *Journal of Agricultural and Food Chemistry*, Vol. 66, pp. 12617-12626. <https://doi.org/10.1021/acs.jafc.8b04992>
- Zehring, J., et al. (2022), "Phytic acid content of Faba beans (*Vicia faba*) - annual and varietal effects, and influence of organic cultivation practices. *Agronomy*, Vol. 12, pp. 889. <https://doi.org/10.3390/agronomy12040889>