Faba bean seeds as a home-grown bypass protein source for lactating dairy cows

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Presentation Outline

- Background Information
  - Faba bean Adaptation and Characteristics.
  - Advantages for Growing Faba Beans.
  - Market Varieties.

- Faba Bean Research
  - Study 1. Nutrient Profiles, rumen degradation, and modelling data.
  - Study 2. Feeding trial in lactating dairy cows.

Background Information

Table 1. Common protein and energy sources fed to cattle.

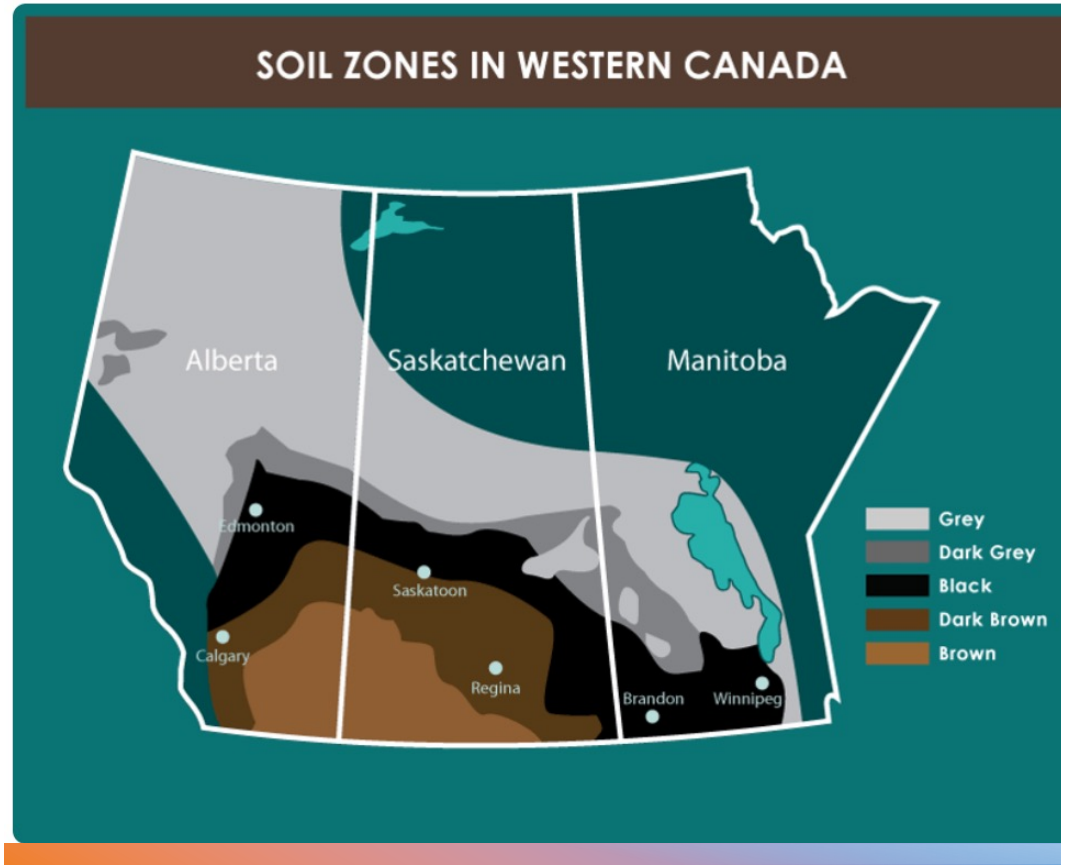
	Soybean meal	Canola meal	Wheat DDG's	Faba beans	Barley grain	Corn grain
Protein, %DM	48	41	39	29	14	9
Starch, %DM	2	4	3	40	55	74
NDF, %DM	15	28	32	17	12	9

Notes: DM, dry matter; NDF, neutral detergent fiber.

(NDS library, 2024)

Faba Bean Adaptation

- Faba bean is an annual legume crop.
- Later maturing- matures in 110 to 130 days.
- Well adapted to moist/cool areas in western Canada.



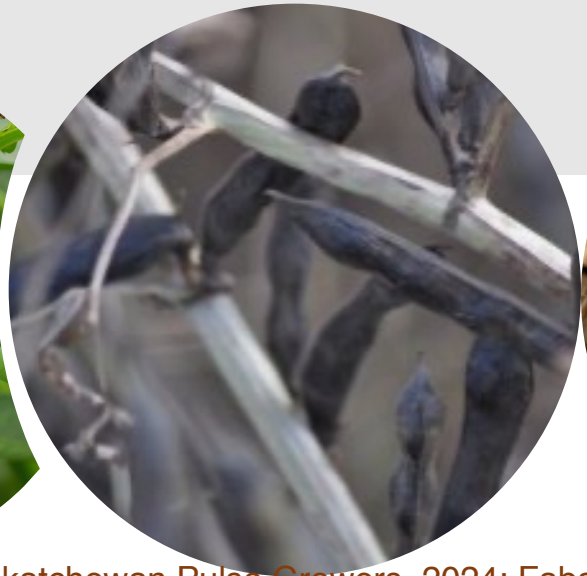
(Saskatchewan Pulse Growers, 2024).

Source: Faba Canada Ltd.

Faba Bean Characteristics

- High protein, high starch, low oil legume.
- Plant types: High and low tannin.

"Approximately 60% of the faba beans grown in Saskatchewan are low-tannin types" (Saskatchewan Pulse Growers, 2024).

(Source: Saskatchewan Pulse Growers, 2024; Faba Canada Ltd., 2024; Alberta Pulse Growers, 2024)

Advantages of Growing Faba Bean:

Crop rotation (black soil zones):

- Fusarium in cereals
- Root rot in peas

High nitrogen-fixing ability.

Non-GMO.

Source: Saskatchewan Pulse Growers

New varieties:

- Lower vicine-convicine
- Higher yields
- Smaller seeds

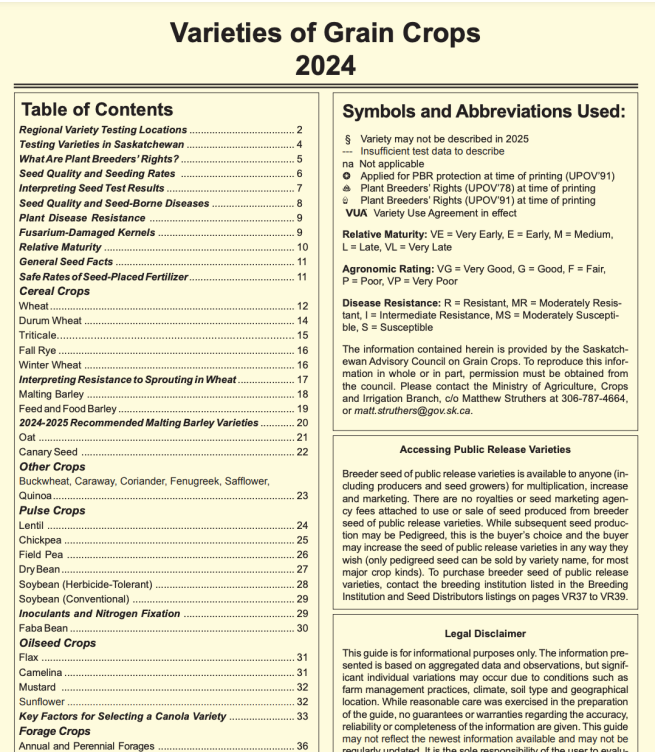
! **High cross-pollination by several bee species**

(Saskatchewan Pulse Growers, 2024; Faba Canada Ltd., 2024)

Information about Market Varieties:

Description & Adaptation ↓ | Varieties ↓ | Seeding ↓ | Inoculation & Fertility ↓

Market Class	Variety	Years Tested	Low Vicine/Convicine	Yield (% CDC Fatima)	Height (cm)	Lodging[1] (1-9)	Maturity (Days)
Coloured Flower (normal tannin) – new	Fabelled	8	Yes	100	104	2.4	105
	FB9-4	9	No	87	95	3.7	104
	CDC SSNS-1	10	No	86	109	3.4	105
	Taboar	5	No	91	110	3.7	107
	Vertigo	4	No	105	107	3	106
	186S-11	6	No	101	105	3.1	106
	247-13	4	No	102	103	3.4	106
White Flower (zero tannin)	Imposa	4	No	105	99	2.4	107
	Snowbird	14	No	100	95	3	104
	CDC Snowdrop	9	No	89	97	2.8	104
	Tabasco	5	No	96	93	1.9	106
	DL Tesoro	3	No	111	90	3.8	110



Varieties of Grain Crops 2024

Table of Contents

Symbols and Abbreviations Used:

§ Variety may not be described in 2025
--- Insufficient test data to describe
na Not applicable
Ⓟ Applied for PBR protection at time of printing (UPOV'91)
Ⓑ Plant Breeders' Rights (UPOV'78) at time of printing
Ⓑ Plant Breeders' Rights (UPOV'91) at time of printing
VUA Variety Use Agreement in effect

Relative Maturity: VE = Very Early, E = Early, M = Medium, L = Late, VL = Very Late

Agronomic Rating: VG = Very Good, G = Good, F = Fair, P = Poor, VP = Very Poor

Disease Resistance: R = Resistant, MR = Moderately Resistant, I = Intermediate Resistance, MS = Moderately Susceptible, S = Susceptible

Accessing Public Release Varieties

Breeder seed of public release varieties is available to anyone (including producers and seed growers) for multiplication, increase and marketing. There are no royalties or seed marketing agency fees attached to use or sale of seed produced from breeder seed of public release varieties. While subsequent seed production may be Pedigreed, this is the buyer's choice and the buyer may increase the seed of public release varieties in any way they wish (only pedigreed seed can be sold by variety name, for most major crop kinds). To purchase breeder seed of public release varieties, contact the breeding institution listed in the Breeding Institution and Seed Distributors listings on pages VR37 to VR39.

Legal Disclaimer

This guide is for informational purposes only. The information presented is based on aggregated data and observations, but significant individual variations may occur due to conditions such as farm management practices, climate, soil type and geographical location. While reasonable care was exercised in the preparation of the guide, no guarantees or warranties regarding the accuracy, reliability or completeness of the information are given. This guide may not reflect the newest information available and may not be regularly updated. It is the sole responsibility of the user to evalu-

Saskatchewan Pulse growers: https://saskpulse.com/growing-pulses/faba-beans

Varieties of Grain Crops 2024: https://saskseed.ca/wp-content/uploads/2020/12/2024-Varieties-of-Grain-Crops.pdf

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FABA BEAN RESEARCH

Heat Processing Evaluation

Study 1. Nutrient Profiles, rumen degradation, and modelling data.

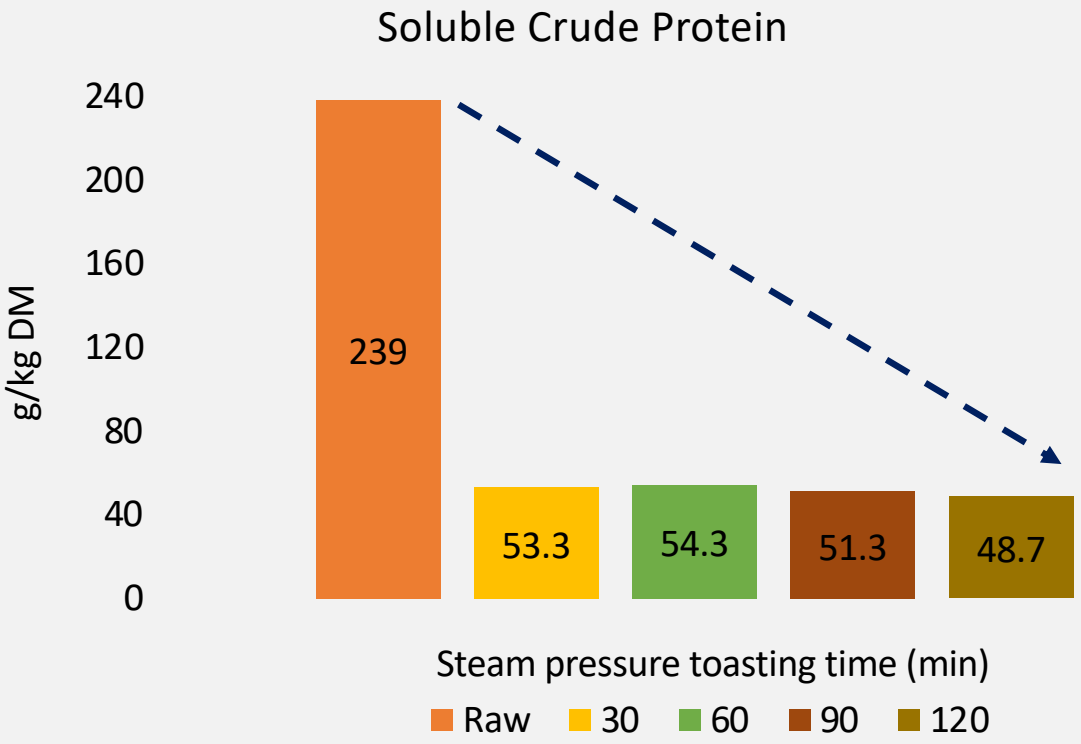
Study 2. Feeding trial in lactating dairy cows.

STUDY 1

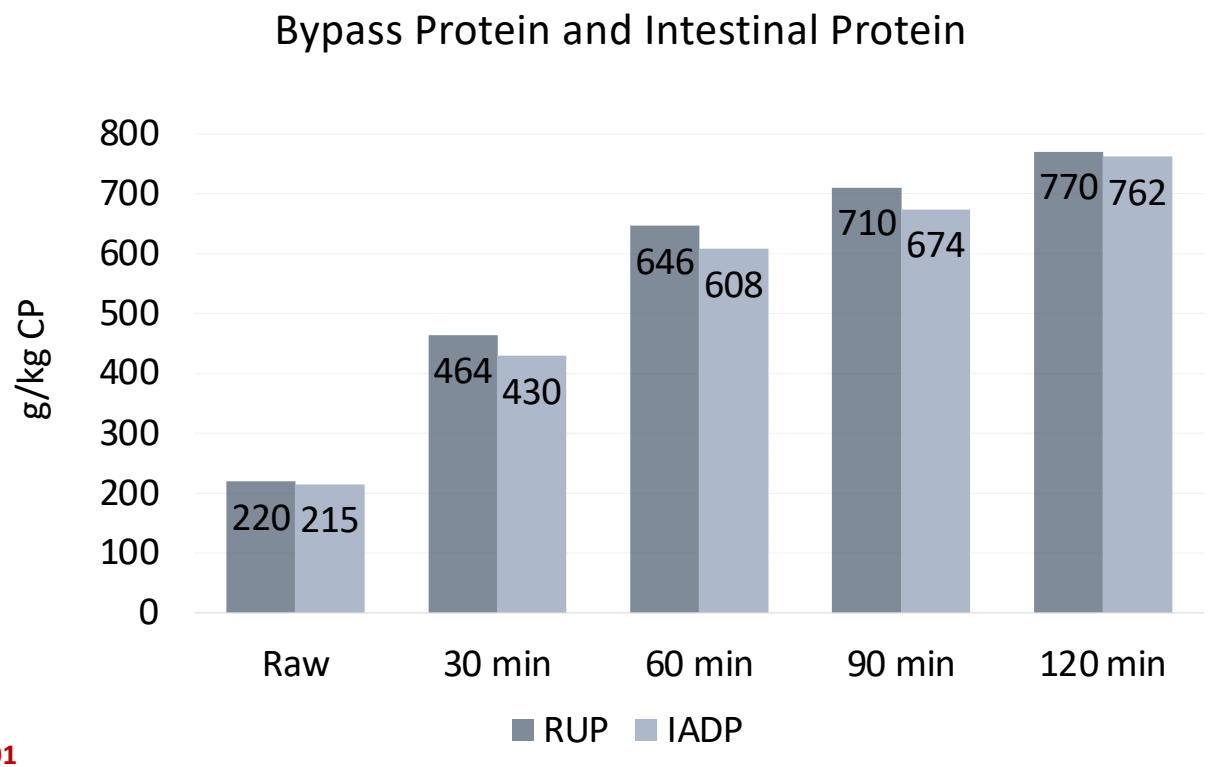
Processing time (min):
0
30
60
90
120

- Whole FBS seeds (CDC)
- Snowbird variety
- Autoclaving at 121°C

Results:



SEM= 3.53 Quadratic: P<0.01



Quadratic: P<0.01

RUP: rumen undegradable protein (SEM= 8.3)

IADP: intestinal digestible crude protein (SEM= 21.2)

Animal Feed Science and Technology
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Impact of steam pressure toasting time on the alpha helix to beta sheet ratios, nutritional value, protein and carbohydrate subfractions, and rumen fermentation parameters of Faba bean seeds for dairy cattle

https://doi.org/10.1016/j.anifeedsci.2024.115885

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STUDY 2

Steam Pressure Toasting Trial

- Snowbird variety Faba bean seeds (FabaCanada Ltd.).
- Heat-processed with pressurized steam in a hydrothermal reactor (InnoTech, Vegreville, AB).
- Dried in a commercial scale belt dryer (BELTOMATIC) at a max. temperature of 100°C.

121°C.
Processing time (min):
0
7.5
15
30

Table 2. Chemical composition of raw and heat-processed Faba bean seeds.

Item	Raw	7.5 min	15 min	30 min
Dry matter, %	89.0	89.1	92.3	88.2
Ether extract, %DM	2.10	1.96	1.68	1.76
Crude protein, %DM	28.2	29.1	28.3	29.0
Soluble protein, %CP	**76.0**	**72.1**	**68.1**	**50.9**
ADICP, %CP	1.30	1.00	1.00	2.30
NDICP, %CP	1.40	1.40	1.60	2.70
aNDF, %DM	16.6	14.3	15.6	27.5
Starch, %DM	41.7	42.1	43.0	32.3

Notes: DM, dry matter; CP, crude protein; ADICP, acid detergent insoluble CP; NDICP, neutral detergent insoluble CP; aNDF, neutral detergent fiber determined with alpha amylase.

Table 3. Ingredient composition of the total mixed rations.

Item	Steam pressure toasting time (min)			
Ingredient, %DM	TMR_0	TMR_7.5	TMR_15	TMR_30
Barley Silage	46.5	46.5	46.5	46.5
Straw	0.98	0.98	0.98	0.98
Canola meal expeller 36%	13.8	13.8	13.8	13.8
Palmit 98	0.65	0.65	0.65	0.65
Barley/corn grain mix	23.4	23.4	23.4	23.4
Barley steam flaked	16.6	16.6	16.6	16.6
Corn steam rolled 38lb	6.80	6.80	6.80	6.80
Lactation supplement*	4.63	4.63	4.63	4.63
Faba bean rolled	10.0	10.0	10.0	10.0
Water	0.01	0.01	0.01	0.01
Chemical composition, %DM*				
Dry matter, %	52.9	52.5	52.9	51.5
Crude protein	16.0	16.1	16.1	16.3
Soluble crude protein	7.32	7.53	7.40	7.23
Soluble crude protein, %CP	45.9	47.0	46.0	44.3
Starch	23.2	22.9	23.5	23.9
aNDF	35.7	35.4	36.6	36.2
ADF	23.0	22.9	22.5	21.7

Concentrate mix prepared at the Canadian Feed Research Centre (CFRC, University of Saskatchewan)

Results:

Table 4. Milk Production of lactating dairy cows fed Faba beans.

Item	Steam pressure time (min)					Polynomial Contrast		
	TMR_0	TMR_7.5	TMR_15	TMR_30	SEM	Linear	Quadratic	Cubic
Milk production								
Milk yield, kg/cow/day	39.07	39.86	39.46	39.27	1.216	0.98	0.62	0.50

39.40 kg/cow/day was the total averaged milk yield.

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Milk Components Yield:

1.56 kg/cow/day was the averaged fat yield.

1.16 kg/cow/day was the averaged protein yield.

Efficiency:

Fat corrected milk averaged **43 kg/cow/day.**

The cows in this trial had a feed efficiency of at least **1.50.**
(ECM/DMI; FCM/DMI).

Canadian Journal of
Animal Science

Article

The effects of raw and steam-pressure toasted faba bean seeds on the production performance in high-lactating dairy cows

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Abstract

Introducing new feeds for feeding options requires reliable information to prove beneficial impacts on animal productivity. The objective of the study was to evaluate the effects of 10% inclusion of raw faba bean seeds (R-FBS) and steam-pressure toasted FBS (SP-FBS) on dairy production performance and metabolism. Snowbird FBS were processed by steam-pressure toasting at 121 °C for 0, 7.5, 15, and 30 min. Total mixed rations (TMRs) were prepared using R-FBS (FBS0) and SP-FBS (FBS7.5, FBS15, and FBS30). The TMRs were fed to cows (second and third lactation, 69 ± 15 days in milk, and 720 kg mean BW) for 120 days (November 2020 to February 2021). Data were analyzed using a repeated 4 × 4 Latin square design model with treatment as the fixed effect and cows as the random effect. Feed efficiency was linearly decreased as processing times increased ($P = 0.02$) from 1.63 with FBS0 to 1.52 with FBS30. Milk urea nitrogen decreased from 12.18 mg/dL with FBS0 to 11.10 mg/dL with FBS30 (linear $P < 0.01$). Heating FBS for 7.5 min could be suitable for increasing milk fat and feed efficiency in dairy cows. We believe that high-lactating dairy cows can be fed locally grown faba beans to support their production performance.

Key words: dairy cows, faba beans, steam-pressure toasting, production performance

https://doi-org.cyber.usask.ca/10.1139/cjas-2023-0087

Supporting Research:

Author	Cow's breed	Research aim	Processing	Experimental treatments	Outcome	Country
Goelema et al. (1998)	In-situ Holstein cross Friesian	To measure the effect of pressure toasting on the rumen protein and starch degradability and the intestinal protein digestibility.	Toasting Time: 3 min Temperature: 132°C Equipment: laboratory scale pressurised toaster Dried: 35°C for 15 h.	• Unheated seeds. vs. • Whole or broken heated seeds.	• Reduced protein degradability without affecting the total tract protein digestibility. • Effects enhanced with broken seeds.	The Netherlands
Volpelli et al. (2017)	In-vivo Reggiana cows	To evaluate the partial replacement of soybean meal with flaked faba beans.	Steam cooking. Time: 30 min Temperature: 95–100°C Steam pressure: 1.2 Bar) Rolled at 1 mm, 20 Bar Dried at 150°C	• Control: 12% soybean meal • Treatment: 7.5% soybean meal and 10% whole flaked faba beans	• No difference in milk yield and milk composition. • Reduced urea concentration in blood and milk.	Italy
Hansen et al. (2021)	In-vivo Holstein cows	To evaluate the replacement of soybean meal or rapeseed meal + wheat with toasted faba beans. To evaluate the effect of replacing untoasted with toasted faba beans in milk production.	Toasting. Temperature: 124°C Equipment: Bulldog Toaster (Mecmar S.p.A.)	• 100% untoasted seeds • 100% toasted seeds • Partial replacement with soybean meal • Partial replacement with rapeseed meal	• "Toasted faba beans can substitute isonitrogenous mixtures of soybean meal+wheat or rapeseed meal+wheat in diets for dairy cows with regard to ECM yield." • Reduced milk protein yield when substituting with toasted faba beans.	Denmark
Wang et al. (2022)	In-vivo Danish Holstein dairy cows	To investigate the effects of toasting, grinding, and rolling.	Toasting. Time: 3 min Temperature: 125°C Equipment: flame tumble toaster (Dantoaster, Cimbria)	• Ground untoasted • Ground toasted • Rolled untoasted + Different forage source	• No effect of toasting on MP supply or digestibility.	Denmark
Pitkänen et al. (2023)	In-vivo Nordic Red cows	To investigate processed fava bean as a protein feed for dairy cows.	Faba bean meal. Dehulled Flaked Heat treated for 90 min at 95°C.	• Control: no protein supplementation. • Rapeseed meal. • Heated faba beans. • Heated faba beans+RP Met.	• Minor production differences between the experimental diets. • "Processed faba bean is a suitable alternative for rapeseed meal in lactating dairy cow diets."	Finland

Take Home Message

- Faba bean seeds (Snowbird var.) can support the production of lactating dairy cows when added in well-balanced rations.

Implications for Faba bean use:

1. Available feed ingredients for diet formulation.
2. Feed prices.
3. Heat processing?
   - Finding and applying suitable heating methods based on production goals.

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- Faba Canada Ltd.

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- Dr. David Christensen
- Dr. Yongfeng Ai
- Rex Newkirk
- Denise Beaulieu

Project Supervisor:
- Dr. Peiqiang Yu

More information at:

- Saskatchewan Pulse growers: https://saskpulse.com/growing-pulses/faba-beans
- Varieties of Grain Crops 2024: https://saskseed.ca/wp-content/uploads/2020/12/2024-Varieties-of-Grain-Crops.pdf
- Faba Canada Ltd: https://fabacanada.com/why-faba-beans/
- Government of Manitoba: https://gov.mb.ca/agriculture/markets-and-statistics/crop-statistics/pubs/fava-bean-sector-profile.pdf
- Alberta Pulse Growers: https://albertapulse.com/growing-faba-beans/

THANK YOU

https://www.quora.com/Why-do-cows-consistently-face-north-or-south-when-eating-or-resting