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An update on flax seed and meal for use in dairy cow diets

AnSc 494.6 Undergraduate Thesis

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Eighth Annual Dairy Info Day
January 24, 2019

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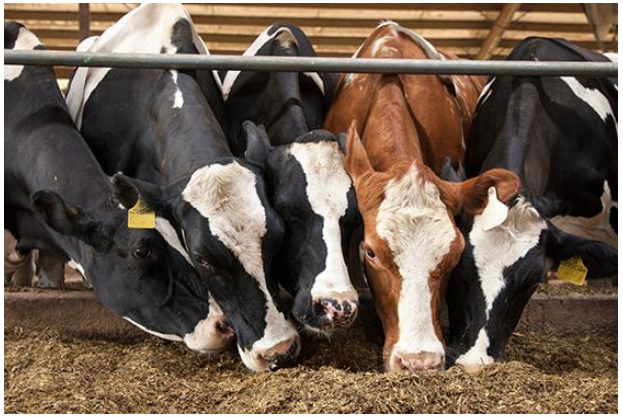
Outline

- Why flaxseed?
- General nutrients
- Special bioactive compounds
- Animal health benefits
- Transition cow management
- Value added products
- Adding flaxseed meal to the dairy cow diet
- Resources for further information



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Why Flaxseed?

- Readily available, highly nutritious crop grown in Saskatchewan
- Contains numerous bioactive compounds that can improve
  - Overall animal health
  - Reproductive performance
  - Immune function
- Transition cow management
- Opportunity for value added products

- Palatable and easy to incorporate into diet

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General Nutritional Properties of Flaxseed meal

Dry matter	90.82
Crude protein, % DM	40.03
ADF, % DM	10.74
NDF, % DM	18.33
Starch, % DM	0.65
Fat, % DM	10.44
TDN, %	87.08

Unpublished data

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Amino Acids

Essential Amino Acids in Flaxseed Meal

% of CP	Flaxseed meal[1]	Canola meal[2]	Soybean meal[3]
Methionine	1.84	2.06	1.40
Lysine	3.98	5.56	6.10
Arginine	9.08	5.78	7.40
Histidine	2.09	3.11	2.60
Isoleucine	4.31	4.33	4.60
Leucine	5.72	2.54	7.50
Phenylalanine	4.60	3.83	5.00
Threonine	3.54	4.39	3.90
Tryptophan	1.29	1.33	1.30
Valine	5.08	5.47	4.80
Total CP, % DM	35.68	36.00	51.80

[1] Unpublished data
[2] Canola Council – Canola Guide
[3] Feedipedia – Soybean Meal

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Bioactive Compounds

Omega- 3 Fatty Acids

Flaxseed is one of the richest sources of the essential fatty acid **alpha-linolenic acid (ALA)** (C18:3n-3):

- Precursor to DHA (22:6n-3) and EPA (20:5n-3)

Health Benefits:

- Cardioprotective and anti-inflammatory effects
- Positive impacts on central nervous system (development and function)
- Prevention and treatment of disorders (ie. attention deficit disorder) and autoimmune diseases (ie. Lupus)
- Anti-cancer effects (act as cytotoxin to initiate cell death in cancer cells)

Stark et al. 2008; Chikara et al. 2017; Morris 2007; D'Eliseo et al. 2016

Bioactive Compounds

Lignans

- Class of phytoestrogens (estrogen-like compounds produced in plants)
- **Secoisolariciresinol diglucoside (SDG)**
  - Flaxseed is the richest source of SDG (1-26mg/g)
    - Converted to mammalian lignans enterodiol and enterolactone in the human colon
  - Antioxidant
  - Reduce atherosclerosis (both humans and other mammals)
  - Anti-cancer, chemopreventive, chemotherapeutic effects (anti-proliferative effects seen in lung, breast, colon, ovarian, and prostate cancers)

Morris 2007; Herchi et al. 2014; Shim et al. 2014; Chikara et al. 2017

Animal Health

Reproduction

- Earlier post-partum estrus due to enhanced uterine involution and cyclic actively
  - Uterine involution 100% complete within 30 days for cows fed flax, compared to 61.5% for control group
  - Increased first service conception rate (flax fed: 87.5% vs control group: 50%)
  - Reduced time to rebreeding

Immune status

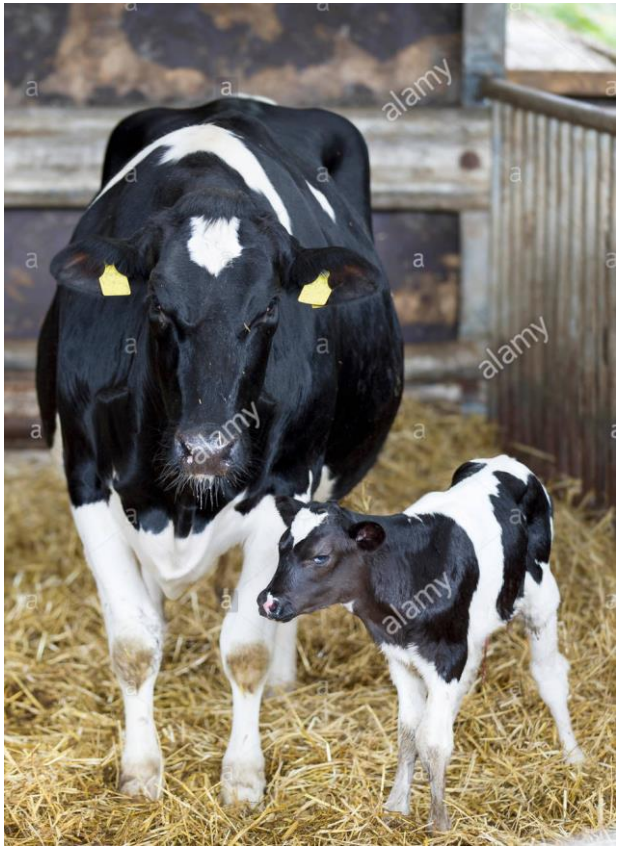
- Flaxseed supplemented to steers resulted in lower rectal temperatures and higher blood haptoglobin than those fed tallow
  - Indicative of an effect on immune response

Lardy at al. 2016; Ulfina et al. 2015; Petit et al. 2002

Transition Cow Management

Flaxseed of great interest due to:

- Immune support
  - Reduced inflammatory response
- Increased energy balance
  - Increased DM intake post-partum
- Reproductive support
  - Ovarian activity resumes sooner



Fetter 2017; Zachut et al. 2010

Value - Added Products

- When ingested by the cow, bioactive compounds found in flaxseed transfer into the milk
- There is room in the human food market for milk enriched in these compounds (ie. Omega-3 or lignan enriched)
- Further research is being conducted to determine the extent at which these bioactive compounds accumulate in the milk

Addition of Flaxseed Meal to the Diet

- Recommended inclusion rate: **up to 2 kg DM/cow/day**
  - High PUFA in the diet can cause milk fat depression
  - At this inclusion rate milk fat depression is not expected

- Excellent source of:
  - Protein
  - Fat
  - Structural and non structural carbohydrates
  - Minerals

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Example Flaxseed Meal Diet

Feedstuff	As fed kg	DM kg	%DMI
Alfalfa Hay	6.11	5.50	20.75
Barley Silage	28.84	7.81	29.46
Energy Booster 100®	0.40	0.39	1.46
Ground Barley	6.09	5.36	20.22
Ground Corn	2.52	2.22	8.38
Canola Meal	1.07	0.96	3.64
Soybean meal	1.18	1.06	4.00
Flaxseed meal	2.19	2.00	7.55
Corn gluten meal (60%)	0.27	0.25	0.94
U of S Premix	0.34	0.34	1.28
Molasses Cane	0.21	0.15	0.57
Biotin	0.01	0.01	0.04
R-Choline	0.06	0.06	0.22
PotMagSulfate	0.02	0.02	0.09
Sodium Bicarbonate	0.15	0.15	0.55
Limestone Ground	0.16	0.15	0.58
Niacin 6 g	0.01	0.01	0.02
Santoquin	0.003	0.003	0.01
Salt White	0.06	0.06	0.24
Water	5.00	0.01	0.02

Formulated for:

Lactation: 3rd

Days in milk: 120

Milk production: 40 kg/day

Milk fat: 3.88%

Diet specs:

As fed total: 54.7 kg

Total dry matter intake: 26.5 kg

Metabolizable energy: 106.8%

Metabolizable protein: 101.0%

Example Milled Flaxseed Diet

Feedstuff	As fed kg	DM kg	%DMI
Alfalfa Hay	6.11	5.50	20.75
Barley Silage	28.84	7.81	29.47
Energy Booster 100®	0.21	0.20	0.75
Ground Barley	5.68	5.00	18.87
Ground Corn	2.52	2.22	8.38
Peas	1.06	0.96	3.64
Canola Meal	1.07	0.96	3.64
Soybean Meal	1.18	1.06	4.00
Corn Gluten Meal (60%)	0.27	0.25	0.94
Flax Seed	1.07	1.00	3.77
Corn Distillers	0.64	0.58	2.19
U of S premix	0.34	0.34	1.28
Molasses Cane	0.21	0.15	0.57
Biotin	0.01	0.01	0.04
R-Choline	0.06	0.06	0.22
PotMagSulfate	0.02	0.02	0.09
Sodium Bicarb	0.15	0.15	0.55
Limestone Ground	0.16	0.15	0.58
Niacin 6 g	0.01	0.01	0.02
Santoquin	0.003	0.003	0.01
Salt White	0.06	0.06	0.24
Water	5.00	0.01	0.02

Formulated for:

Lactation: 3rd

Days in milk: 120

Milk production: 40 kg/day

Milk fat: 3.88%

Diet specs:

As fed total: 54.7 kg

Total dry matter intake: 26.5 kg

Metabolizable energy: 107.0%

Metabolizable protein: 100.8%

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Additional Resources

SaskFlax: https://www.saskflax.com/

Feedipedia:

Flaxseed: https://www.feedipedia.org/node/36

Flaxseed meal: https://www.feedipedia.org/node/735

Conclusions

- Flaxseed is an excellent source of omega-3 fatty acids and lignans, two important bioactive compounds
- As a feedstuff, it provides essential amino acids, high protein, fat, and fibre
- Can help to improve reproductive and immune function in cattle
- Easily incorporated into the dairy cow diet as milled flaxseed or flaxseed meal
- Room in the food market for value-added products such as milk fortified with lignans and omega-3 fatty acids

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References and Sources

Pictures:

Slide 1:https://static.wixstatic.com/media/af29f8_b2ffa1b202c14c95a9183434bebb0083~mv2.jpg
Slide 2:https://www.alltech.com/sites/default/files/styles/featured_article/public/2017-12/Alltech.com-dairy-homepage.png?itok=B1bpbwqu
Slide 3:https://ak2.picdn.net/shutterstock/videos/10567352/thumb/1.jpg
Slide 9:https://c8.alamy.com/comp/HT50PP/small-calf-standing-next-to-the-mother-cow-in-the-barn-holstein-cattle-HT50PP.jpg

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