

# Wonderful Flax

## BioFibre-Food for Northern Alberta Economy

### Flax and Industry Hemp

Jian Zhang MSc, PhD, PBio

# Outline

- Flax
- Northern Advantage
- As Material
- As Food, Functional Food
- Conclusion and future recommendation
- Acknowledgments

# Flax history



Fertile Crescent in red

By User:NormanEinstein - Own work This image was based on a similar map from the 1994 edition of the Encyclopedia Britannica., CC BY-SA 3.0, <https://commons.wikimedia.org/w/index.php?curid=471913>

*Linum usitatissimum*

30,000 years ago  
In Republic of Georgia

5000 yrs ago spread to  
Northern Europe and China



[Rosser 1954](#) Roger Griffith - Own work  
The Heckling Shop in Irvine where Robert Burns worked 1781-1782. North Ayrshire, Scotland.

Common names:

- flax (Source: World Econ Pl) - English
- linseed** (Source: Dict Rehm) - English
- kettan** (Source: F Egypt) - Arabic
- lin** (Source: Dict Rehm) - French
- Flachs** (Source: Zander ed16) - German
- Saatlein** (Source: Dict Rehm) - German
- lino** (Source: Mult Glossary Crops) - Italian
- linhaça** (Source: PROTA4U) - Portuguese
- linho** (Source: Dict Rehm) - Portuguese
- lino** (Source: Dict Rehm) - Spanish
- kitani** (Source: PROTA4U) - Swahili
- lin** (Source: Kulturvaxtdatabas) - Swedish
- ya ma** (Source: F ChinaEng) - Transcribed Chinese
- ama** (Source: Kulturpflanze) - Transcribed Korean

Economic Importance:

- Food additives:** gelling agent (fide PROTA4U)
- Food additives:** stabilizer (fide PROTA4U)
- Human food:** oil/fat (fide PROTA4U)
- Human food:** seeds (fide PROTA4U)
- Animal food:** fodder (seed cakes & chaff fide F USSR; PI Book)
- Materials:** fiber (fide Genet Res Crop Evol 42:263. 1994)
- Materials:** lipids (fide Genet Res Crop Evol 42:263. 1994)
- Medicines:** folklore (fide Dict Econ Pl; CRC MedHerbs ed2; Herbs Commerce ed2)
- Vertebrate poisons:** mammals (fide Kingsbury; Cooper & Johnson ed2)

<https://npgsweb.ars-grin.gov/gringlobal/taxonomydetail.aspx?22361>

Flax is grown for EITHER seeds or fibers

linseed

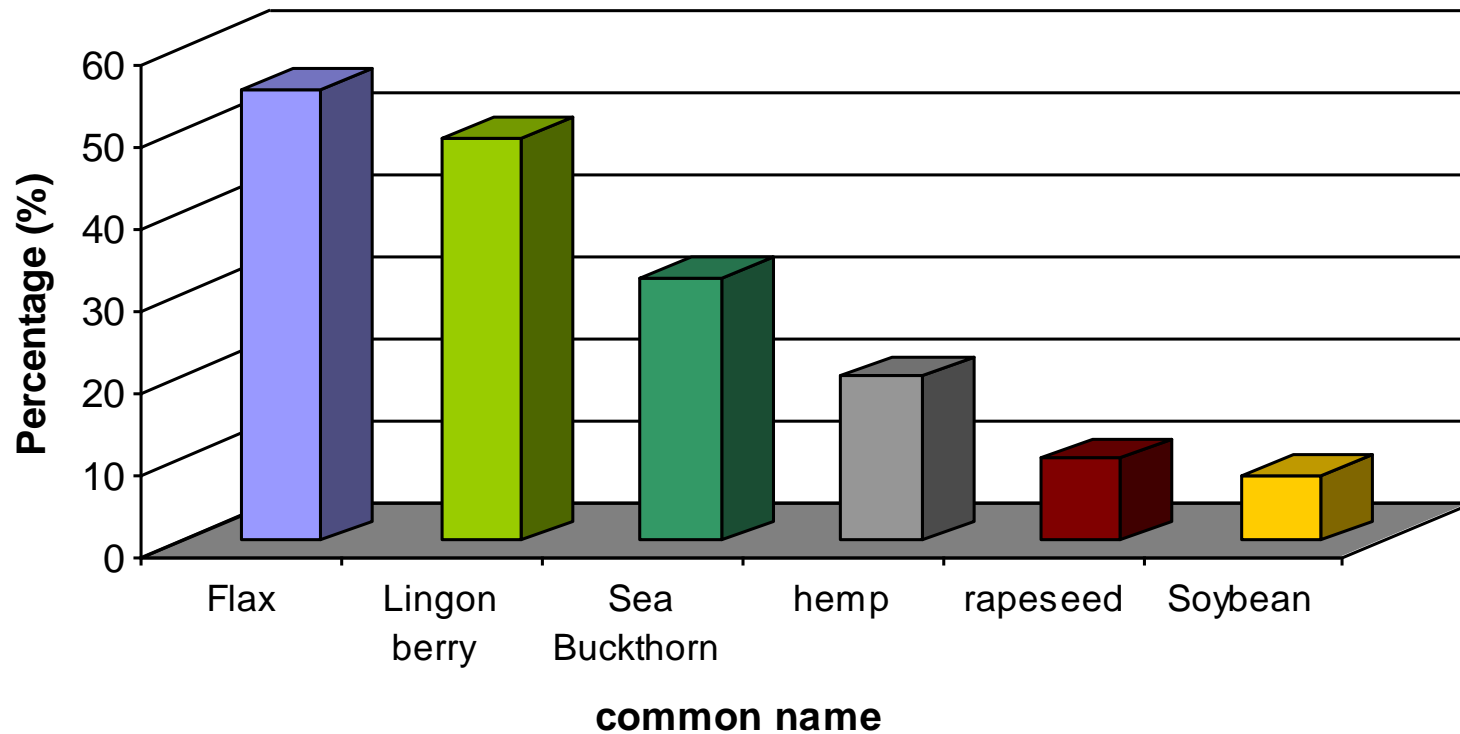


fiber flax



TradeKey.com

### ALA content in seed oil



### ALA in oil seed

# Northern Advantage

- During growth season, long daytime light, higher temperature difference between day and night.
- Fertile land
- Less industry impact

## Alberta's vast natural resources: land, forest and energy

The shield of Alberta represents the beauty of the province and natural resources:

- The Rocky Mountains
- Forests
- Grasses of the prairies
- Cultivated fertile fields



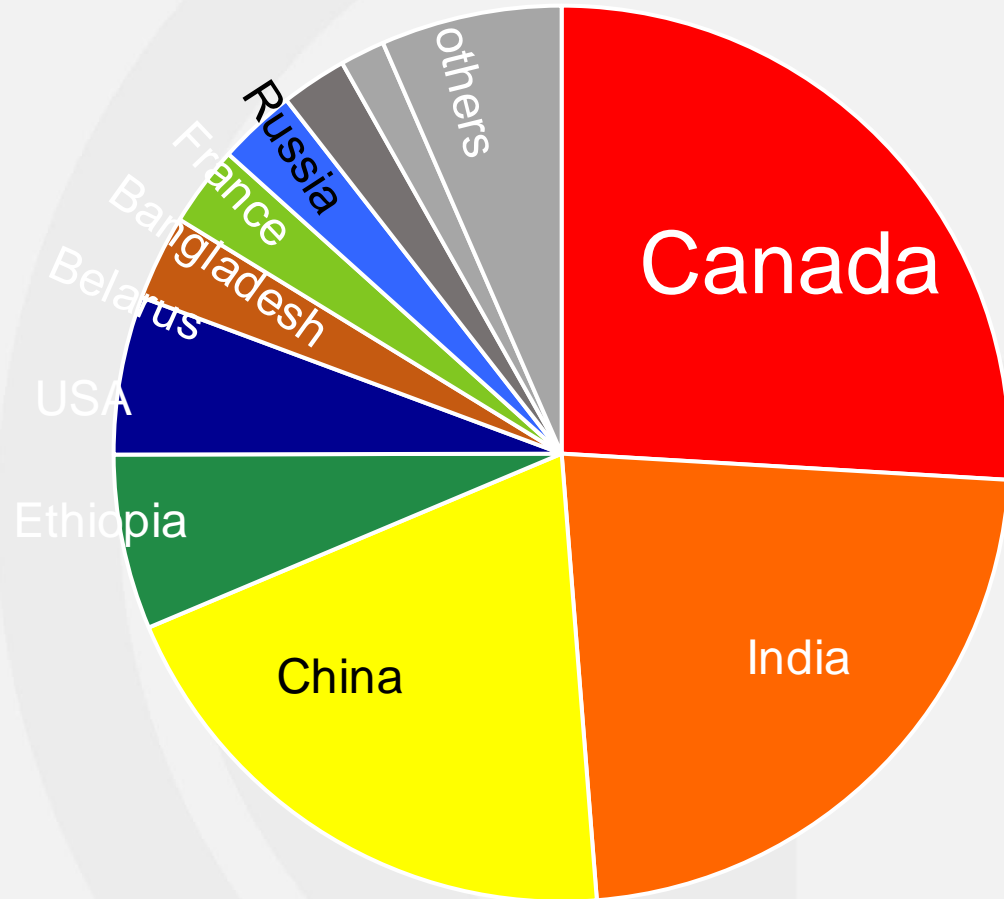


## Bioeconomy: Agricultural sustainability

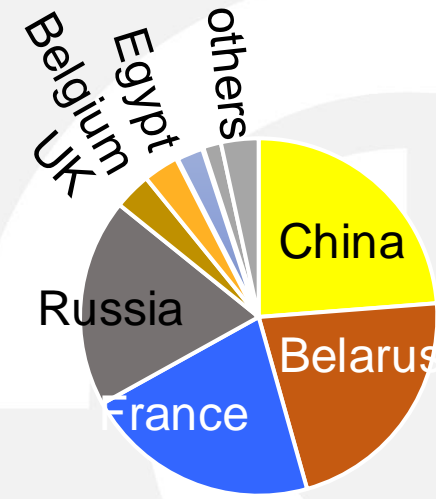
- **Diversification** of agricultural production for the benefits of land fertility and farmers' revenue
- Conversion of abundant agricultural biomass into **value-added bioproducts**
- **Fully realize** the value of our agriculture commodities



## linseed 2.4 Mha

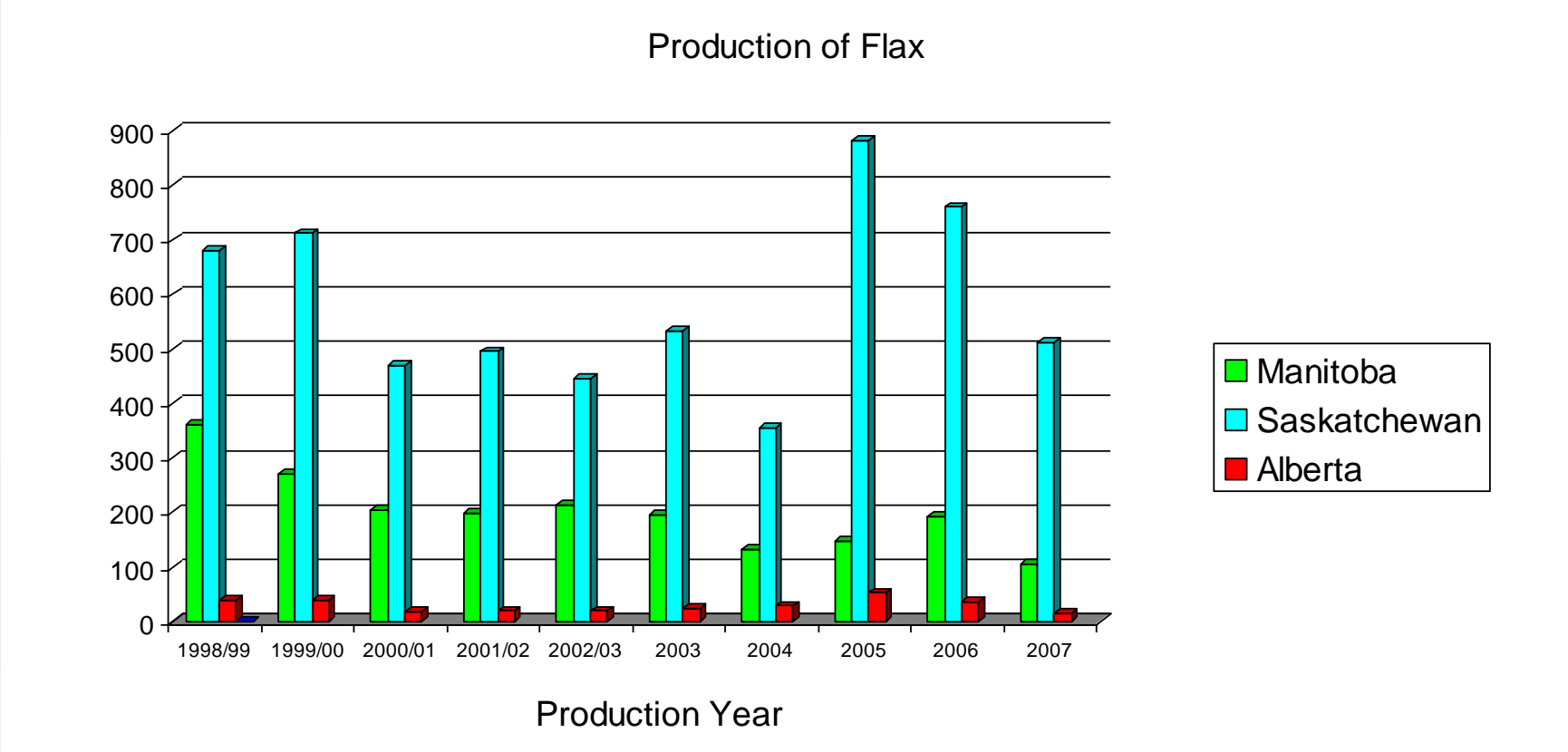


## fiber flax 0.4 Mha



Crop area harvested (Mha, FAO 2008)

# Flax production area in western Canada



# Flax Researches

- Started with Peace Country Flax
- Accumulate scientific data to characterize Peace Country Flax
- Integrate different expertise (AITF/ARC, AAFC, NADC, Flax growers etc) to cope with challenges facing flax industry, such as flax leftover utilization, better breeding lines for NA etc.
- Work together with international partners (China, Japan) to promote Peace Country Flax, by conducting Joint-projects to verify health benefits etc.

# Flax studies and utilizations

- Peace Country Flax Characterization
- Biochemistry and genetic
- Development of early matured flax lines
- Flax utilizations

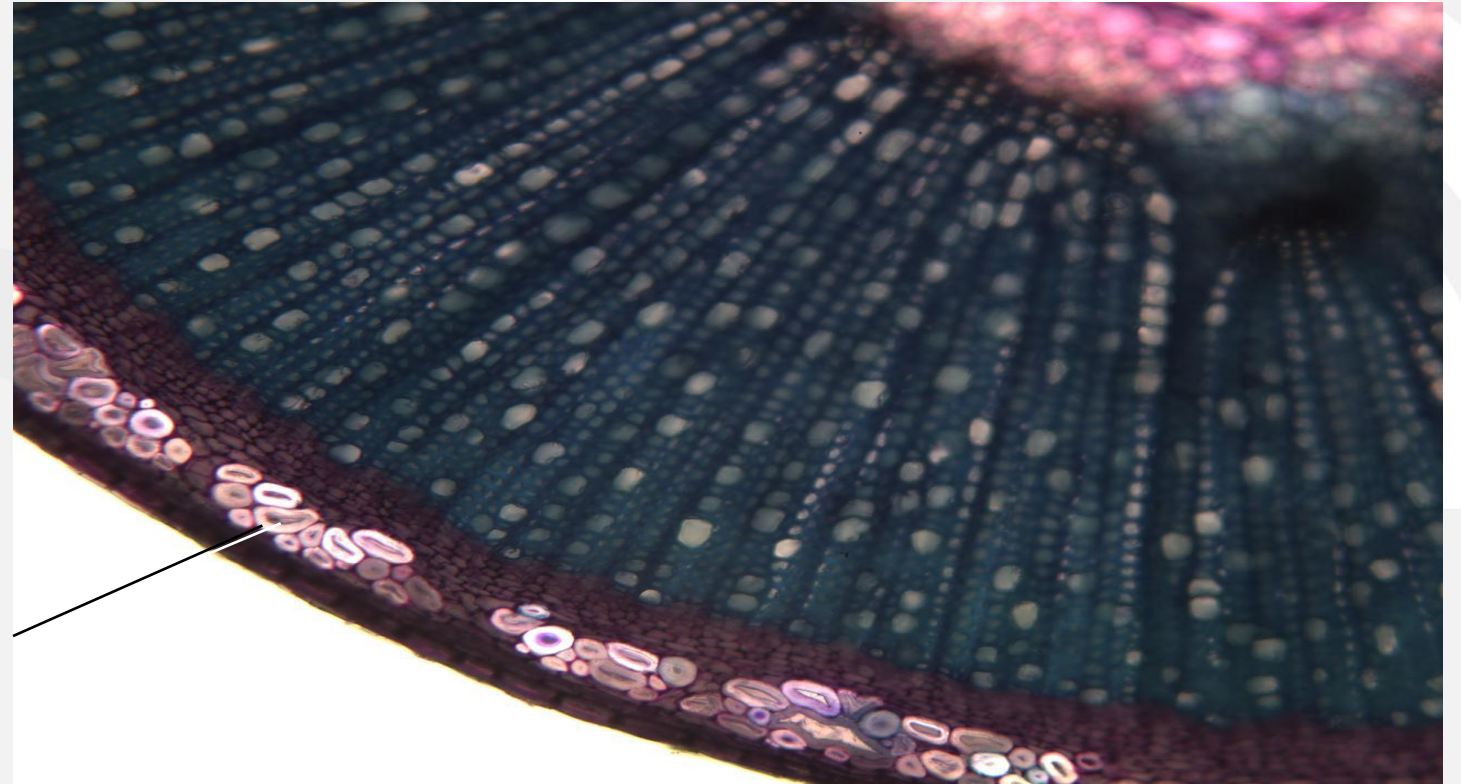


# Bast (phloem) fiber development



xylem

phloem (bast)  
fibers



# Flax is grown for EITHER seeds or fibers

## linseed



paints & finishes, linoleum

paints & finishes, linoleum, **health products**

ALA (omega-3 = 18:3 =  $\alpha$ -linolenic acid)

**SDG (lignan, secoisolariciresinol diglucoside)**

## fiber flax



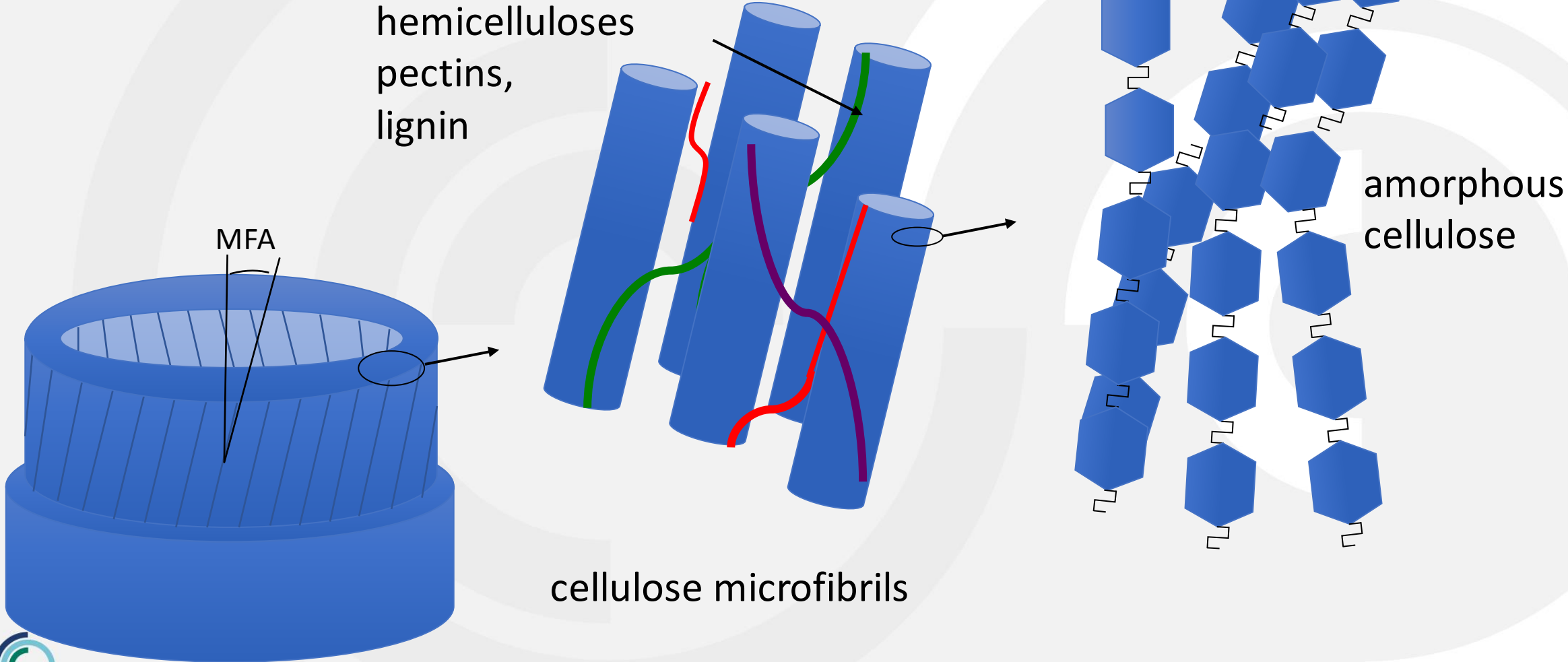
textiles, **composites**

long, strong fibers

highly crystalline cellulose, low lignin



# Cell wall structure





# Extractability limits fiber utilization



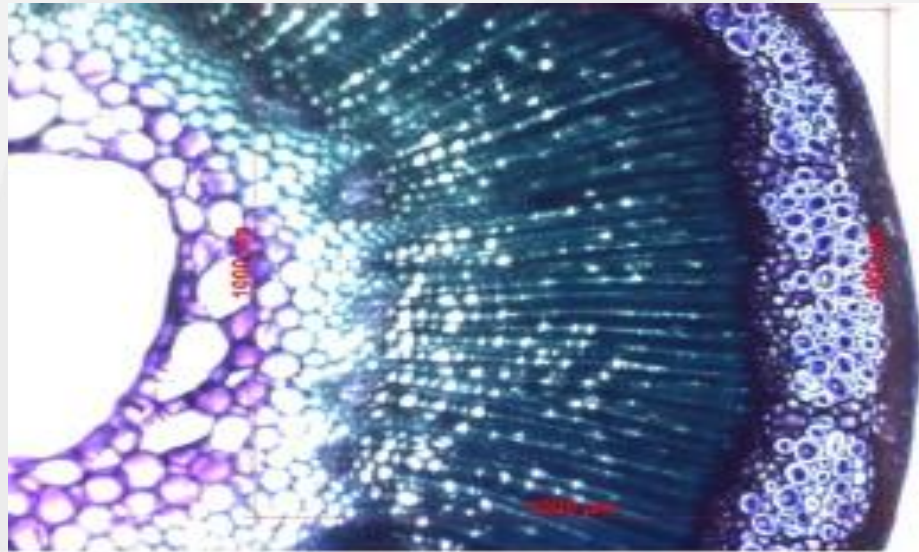
Saskatoon, October 2009  
photo: Ken Jackle



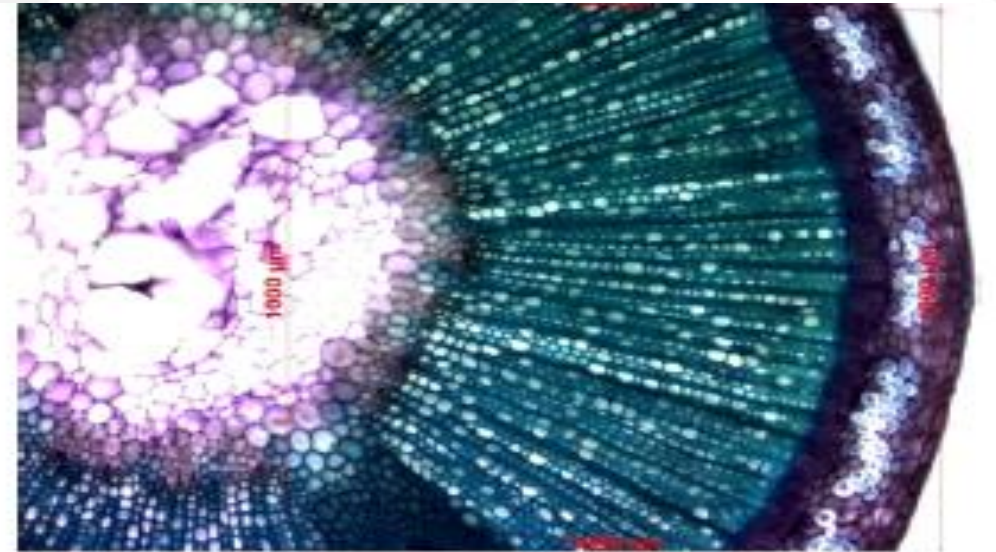
France, July 2009  
warm, moist conditions allow retting:  
microbial degradation of pectins

# Yield limits linseed fiber utilization

fiber flax



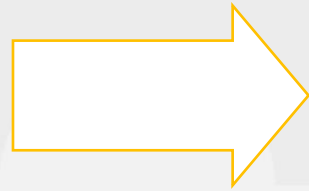
linseed



photos: Sushmita Nandy & Gordon Rowland

Fibers currently have negative value in linseed?

tractor fire caused by  
linseed straw



# Objectives: flax research at genetic and genomics

- short term
  - develop genetic/genomic resources for flax
  - increase understanding of fiber development
  - decrease fiber content in linseed
- long term
  - increase fiber quantity & quality in linseed
  - Improve for better healthy food

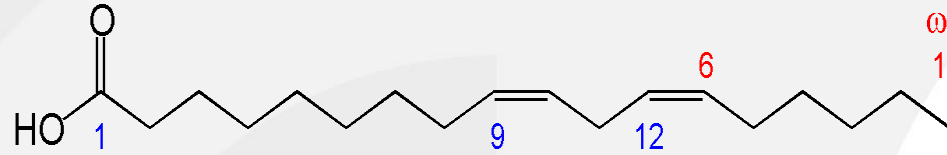
# Flax as Canadian Health-Enhancing food



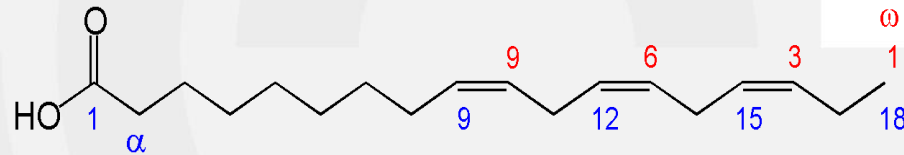
## Research partnership

1. Verify Peace Country Flax nutrient quality, ALA, LignanBiochemical Analysis
2. Collect scientific evidences for Peace Country agricultural commodity's unique quality started with Flax

# Essential fatty acids



Linoleic acid:  $\text{CH}_3(\text{CH}_2)_4\text{CH}=\text{CHCH}_2\text{CH}=\text{CH}(\text{CH}_2)_7\text{COOH}$  18:2 OMEGA-6

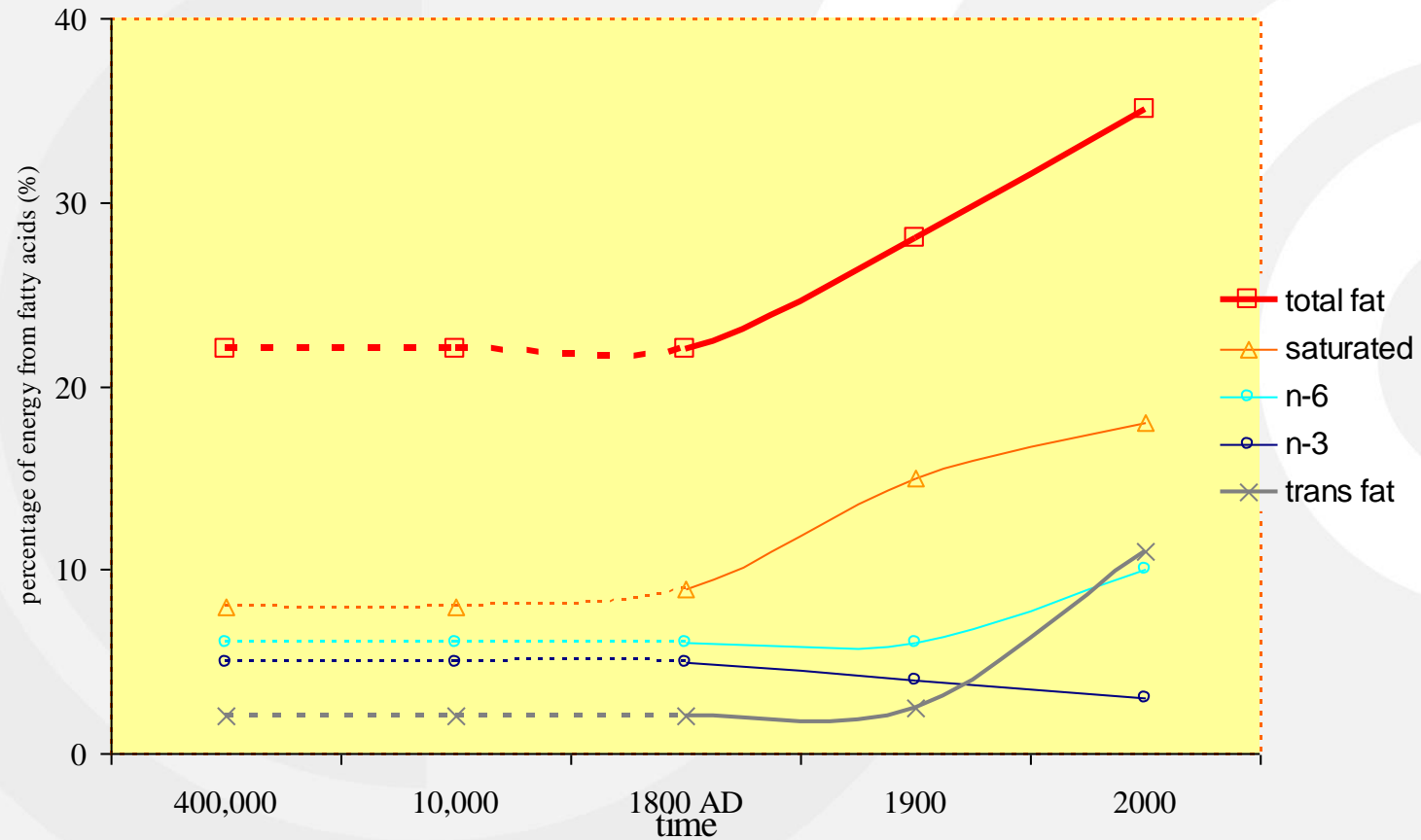


Alpha-linolenic acid (ALA-linolenic acid):

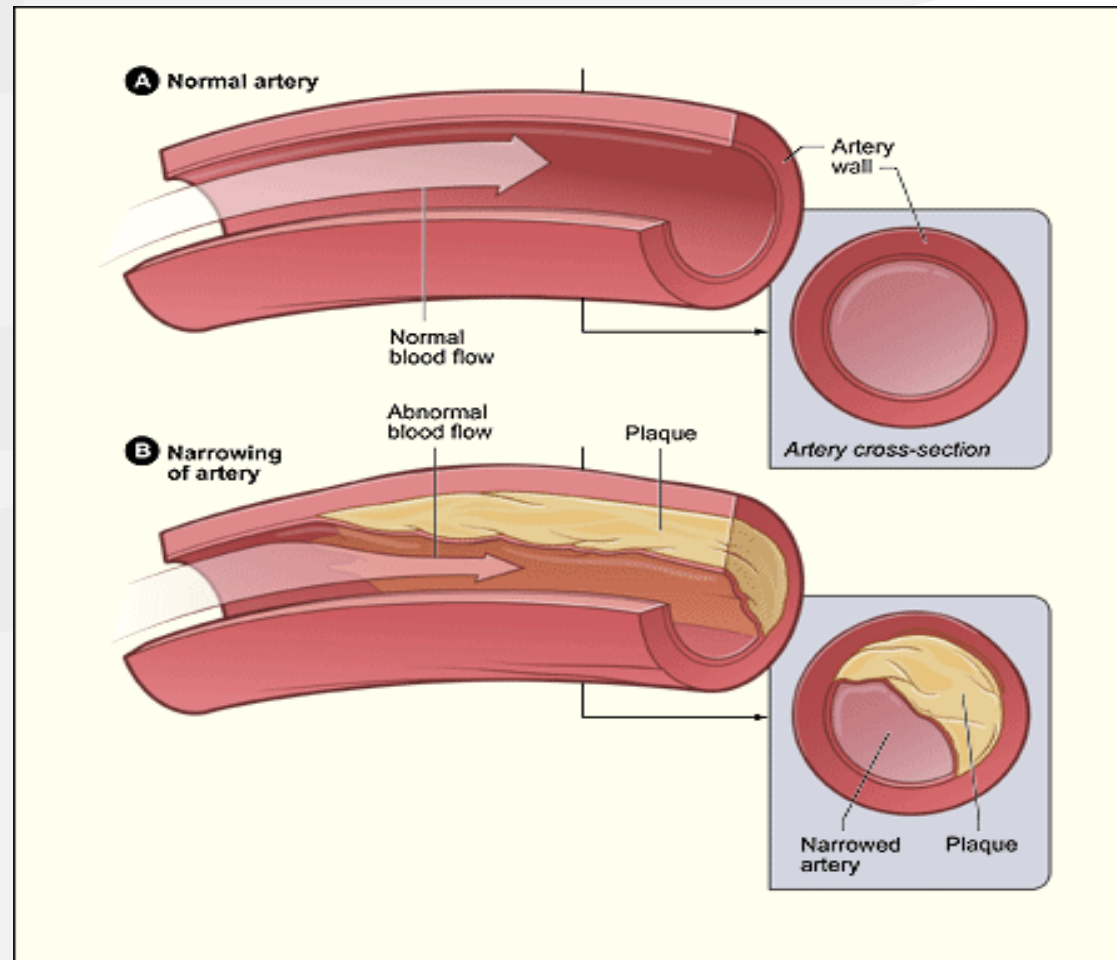
$\text{CH}_3\text{CH}_2\text{CH}=\text{CHCH}_2\text{CH}=\text{CHCH}_2\text{CH}=\text{CH}(\text{CH}_2)_7\text{COOH}$  18:3 OMEGA-3

# Essential fatty acids

## Fatty acids in human diat

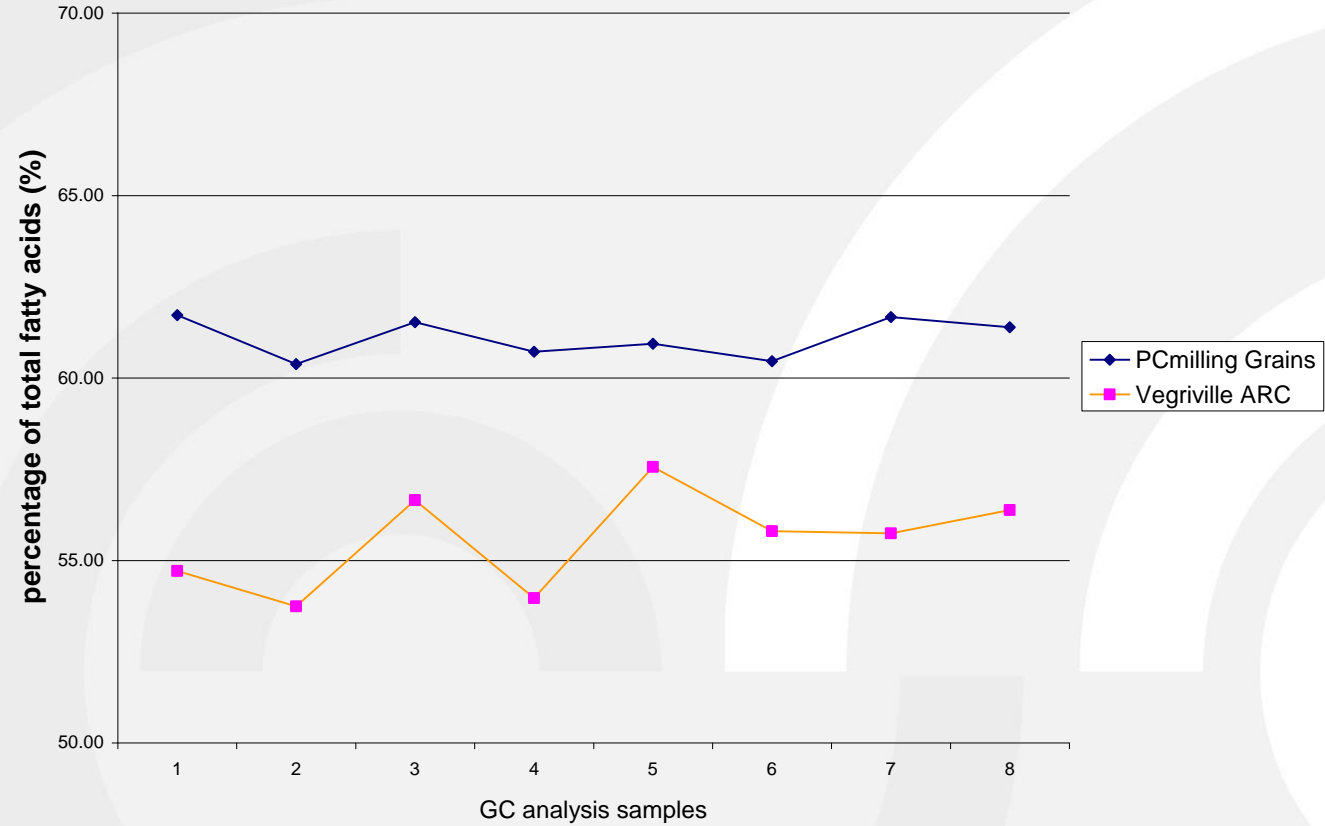


# Atherosclerosis



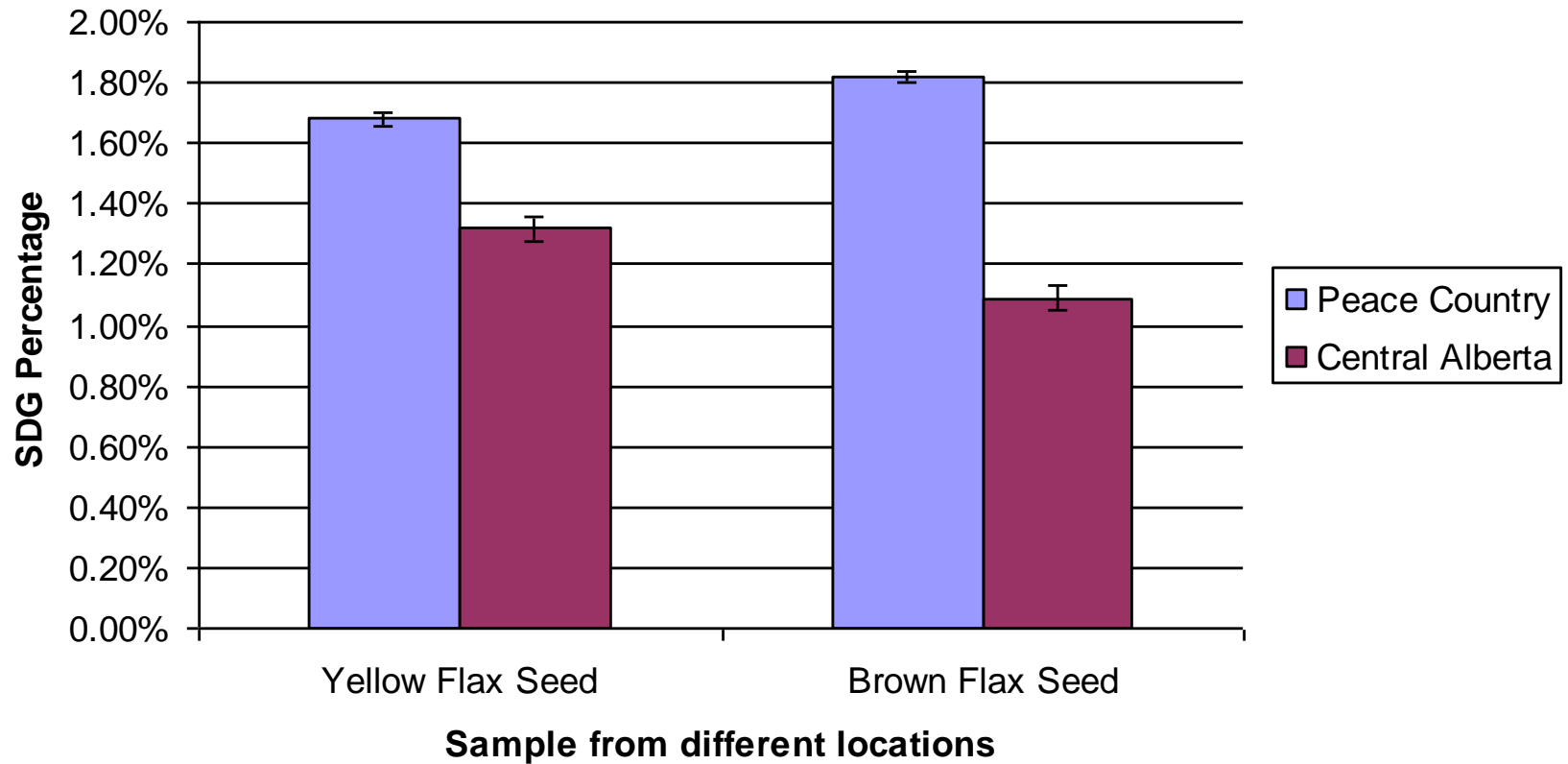
- Prevention measures have become the top priority for consumers and the public health systems
- Dietary consideration has been recognized and realized





18:3 fatty acid amount comparisons between Peace Country and centre Alberta flax

ALA content comparison between the flax collected from Vegreville, AB and Peace Country, AB



## SDG analysis between different locations

# Future Recommendations

- Collaboration between NA and InnoTech/AAFC, University, flax growers and municipal governments
- high-impact proposal for Developing Innovative Agri-Products
- Continuing working together industries especially Textile

# Acknowledgment

- Northern Alberta Development Council
- Branding Peace Country Canada
- University of Alberta
- University of British Columbia
- Agriculture and Agri-Food Canada
- Alberta Innovates - Technology Futures/InnoTech Alberta
- Genome Canada

Dr. Jan Slaski, Innotech

Prof. Mike Deyholos, UBC Kelowna

Dr. Rong Cao, AAFC Guelph

Prof. Xiao Qiu, U of S

# Very Flax Future



Rolling flax filed