Effect of Pulse Consumption on Gastrointestinal Response, Intestinal Microbiota, and Serum Lipids in Healthy Adults

pulse Food Symposium

Pulse Food Symposium
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University of Guelph

Presentation Outline

- Study Background and Rationale
- Study Purpose and Objectives
- Research Team
- Study Design and Methods
- Results
- Summary
- Value of Study Results

Pulses are Nutritious

- Edible seeds of legumes; includes many different types:
  - Beans, peas, chickpeas, lentils
- Superior nutritional attributes:
  - Low in fat
  - Low glycemic index
  - High in dietary fibre
  - High in protein
  - High in vitamins and minerals
- Part of national dietary recommendations

Pulse Consumption is Low

- Numerous potential reasons
  - Ignorance of health benefits
  - Lack of knowledge on how to prepare
  - Perception of negative side effects
- Opportunity to conduct and showcase research that investigates pulses in terms of:
  - Strategies to address consumption barriers
  - Effects related to human health

Pulses contain PREBIOTICS

- Increasing scientific and consumer interest in prebiotics in relation to human health
  - Non-digestible substances not hydrolyzed in the upper gastrointestinal tract
  - Modulate growth of beneficial bacteria (probiotics)
  - Exert biological effects related to human health
- Oligosaccharides, dietary fibre
- Research needed to explore the **prebiotic potential** of pulses in relation to human health

Pulses May Modulate Fecal Enzymes

- Reflect prebiotic-related changes in intestinal bacteria
- Changes associated with human health
  - Activities of specific fecal enzymes are associated with the production of carcinogens
- Pulse consumption may reduce cancer risk through reduction in specific fecal enzyme activities

Pulses May Reduce Short Chain Fatty Acids

- Produced by intestinal bacteria
- Can influence various biological processes relevant to human health
- Relevant to cancer
  - Gene expression, cell differentiation
- Relevant to cardiovascular disease (CVD)
  - Serum lipids
- Pulse consumption may reduce cancer and CVD risk through modulation of SCFA levels

Study Rationale

- Pulses are nutritious and warrant research into their links with human health
- A major reason for low pulse consumption is perceived negative side effects
  - Research needed to explore perceived effects and adaptation
- Pulses contain prebiotics which have great potential to influence human health
  - Prebiotic effects of pulses have not been widely studied

Study Purpose and Objectives

- To evaluate how a diet containing pulses is accepted and can influence prebiotic-related endpoints related to human health
- To determine the effect of pulse consumption on:
  - Gastrointestinal response, bowel habits
  - Intestinal bacterial enzymes
  - Serum lipids

Multi-Disciplinary Research Team

- University of Guelph
  - Amanda Wright, Alison Duncan
    - Candice Cryne, Branden Deschambault, Jesse Veenstra
- AAFC in St. Hyacinthe, Quebec
  - Ted Farnworth, Joyce Boye
    - Isabelle Mainville, Barbara Bisakowski, Sophie Roy
- AAFC in Guelph
  - Susan Tosh
    - Yolanda Brummer

Uniqueness of Study

- Multi-disciplinary research team
- Two-fold exploration of
  - Issues related to feasibility of increasing consumption
  - Health effects
- Multiple pulse types
  - Chickpeas, peas, lentils
  - Spray-dried powder

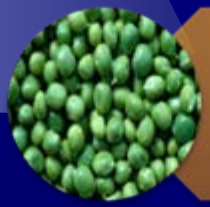
Study Design

- Randomized, crossover double-blinded
- n=21 healthy males
- Four 28-day treatment periods
  - separated by 28-day washout periods
- Three pulses and control
- Approved by University of Guelph Human Research Ethics Board
- All subjects provided written informed consent

Study Treatment Soups


Control Potato Soup


Chickpea Soup


Pea Soup


Lentil Soup

- 0.5 cup (100g) dry pulse/day
- spray-dried powder
- daily serving containers
- consumed various ways

Pulse Soups: Production and Analysis

- AAFC in St. Hyacinthe
  - Soup production
  - Spray dried powder
  - Microbiological testing of pulse soups at an independent lab
- AAFC in Guelph
  - Detailed proximate analysis
    - Including sugars, oligosaccharides, fibre fractions

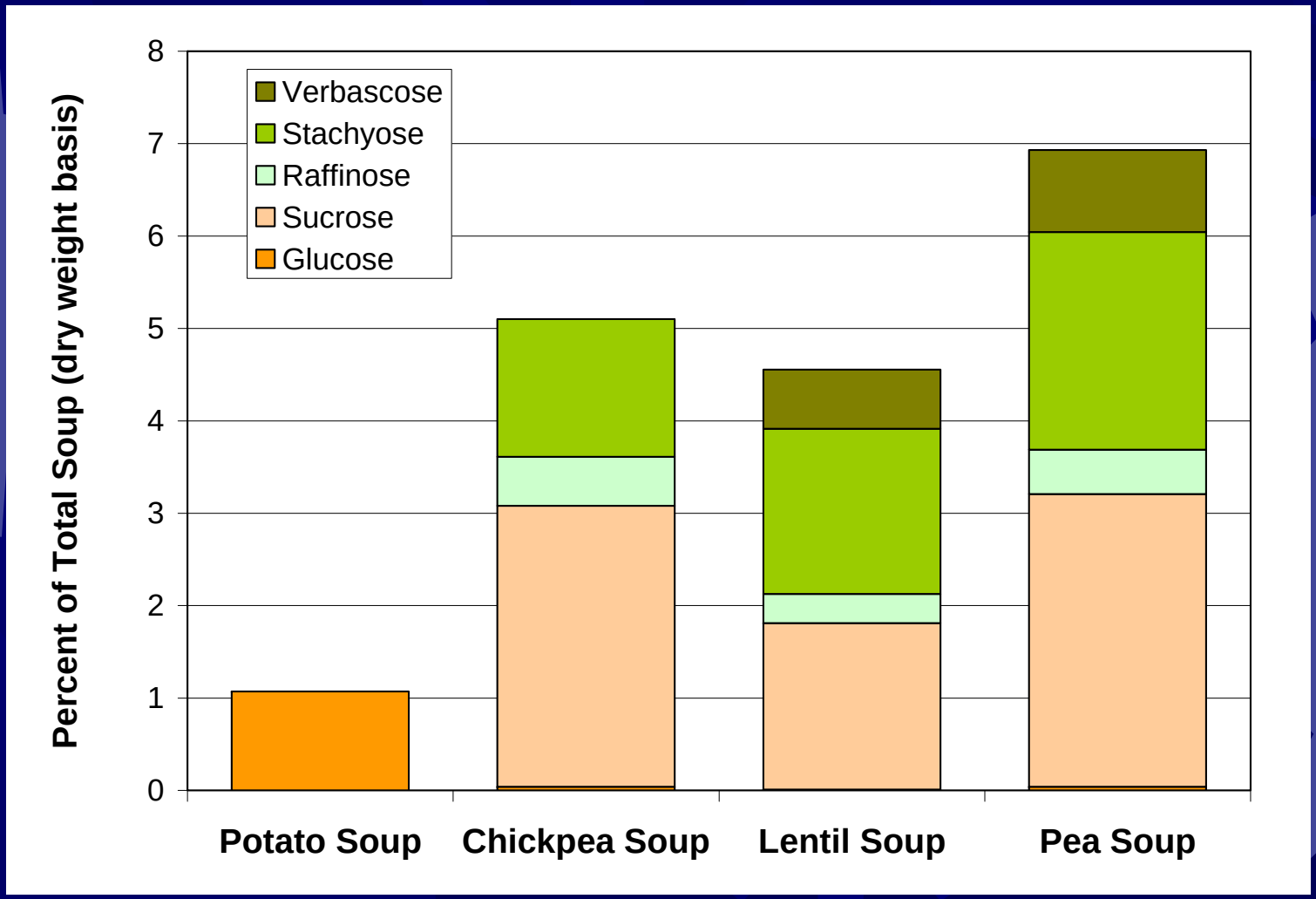
Nutrient Composition of Study Treatments

Table 1. Nutrient and proximate composition of study treatments (mean ± SD)[1]

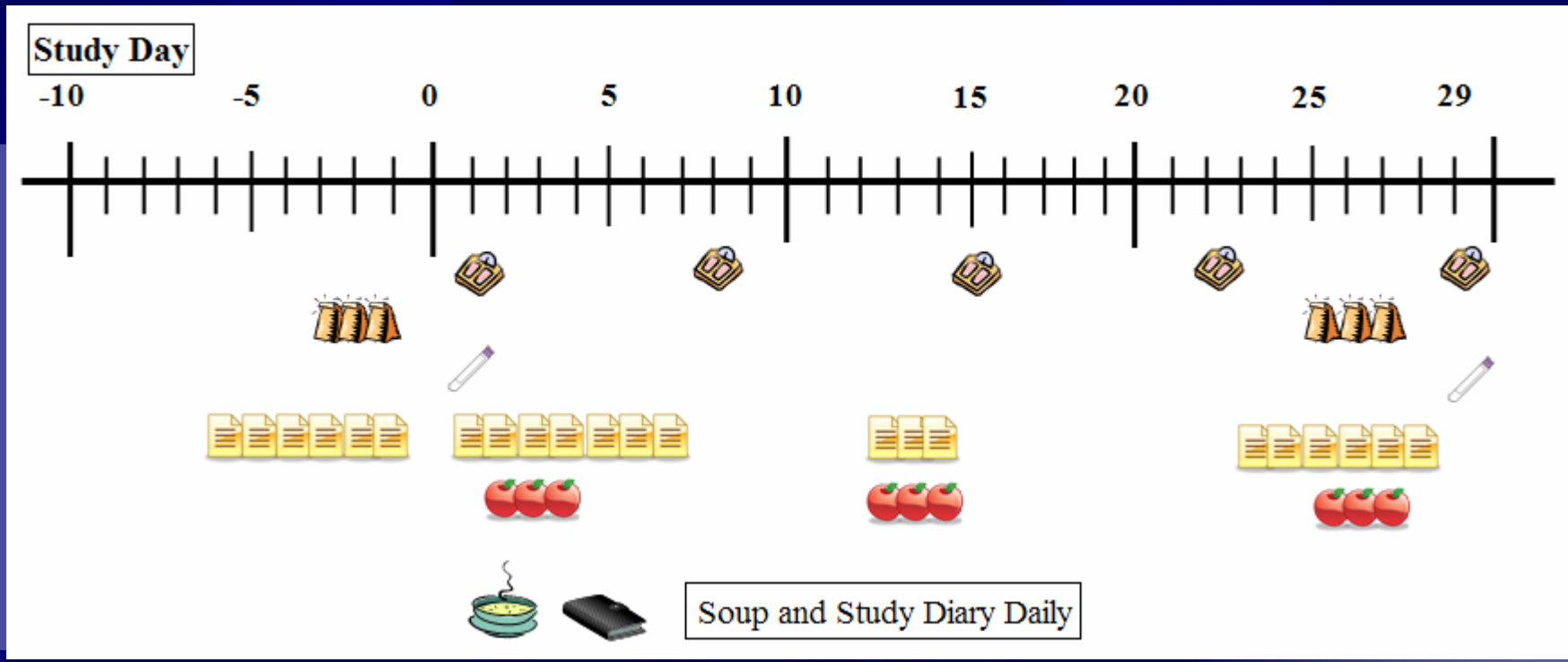
	Potato	Chickpea	Lentil	Pea
Energy (kilocalories/100g)	299.80	282.74	263.69	245.20
Moisture (%)	7.89	7.03	5.66	6.30
Protein (%)	5.41 ± 0.18	18.29 ± 0.33	22.67 ± 0.18	21.27 ± 0.49
Lipids (%)	0.24 ± 0.06	4.97 ± 0.23	0.70 ± 0.08	0.60 ± 0.08
Ash (%)	3.76 ± 0.15	2.79 ± 0.07	2.62 ± 0.06	2.74 ± 0.23
Digestible Starch (%)	68.02 ±1.27	40.22 ± 1.15	42.57 ± 099	39.17 ± 1.28
Sugars (%)	0.99 ± 0.00	2.86 ± 0.56	1.71 ± 0.04	3.00 ± 0.36
Total Dietary Fibre	7.75 ± 0.60	26.24 ± 2.74	21.94 ± 1.35	27.08 ± 1.63
Resistant Starch (%)	0.78 ± 0.02	4.44 ± 0.16	4.75 ± 0.14	5.17 ± 0.07
Dietary Fibre (%)	6.96 ± 0.58	19.91 ± 2.49	14.59 ± 1.14	18.42 ± 0.97
Oligosaccharide (%)[2]	ND	1.88 ± 0.09	2.59 ± 0.07	3.49 ± 0.59

ND, not detectable.
[1]Based on 100g serving of dry powdered study treatment.
[2]Oligosaccharides include stachyose, verbascose, and raffinose.

Sugar and Oligosaccharide Content of Study Treatments



Data Collection Timeline



Body Weight Measured (Days 1, 8, 15, 22, 29)

Fecal Sample (Days -3 to -1 & 25 to 27)

Blood Sample & Body Composition (Days 1 & 29)

GIQ Questionnaire (Days -6 to -1, 1-7, 12-14, 23-28)

3 Day Food Record (Days 2-4, 12-14, 25-27)

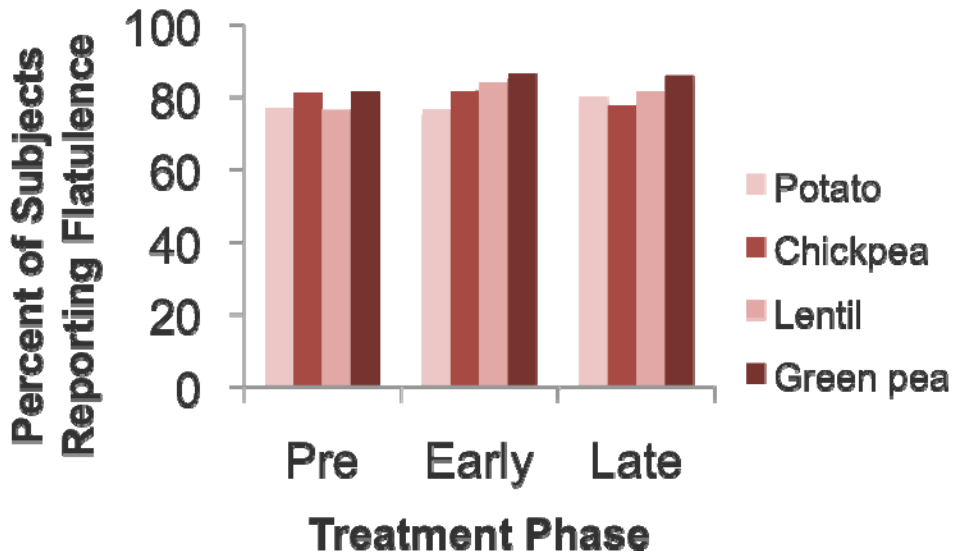
Study Community Efforts

- The “Soup and Poop Newsletter”
- Study contests
  - Newsletter name
  - Pea counting contest
  - Random draw prizes
- Responding to subject feedback and questions
- Prioritizing subject rapport

Gastrointestinal Questionnaire

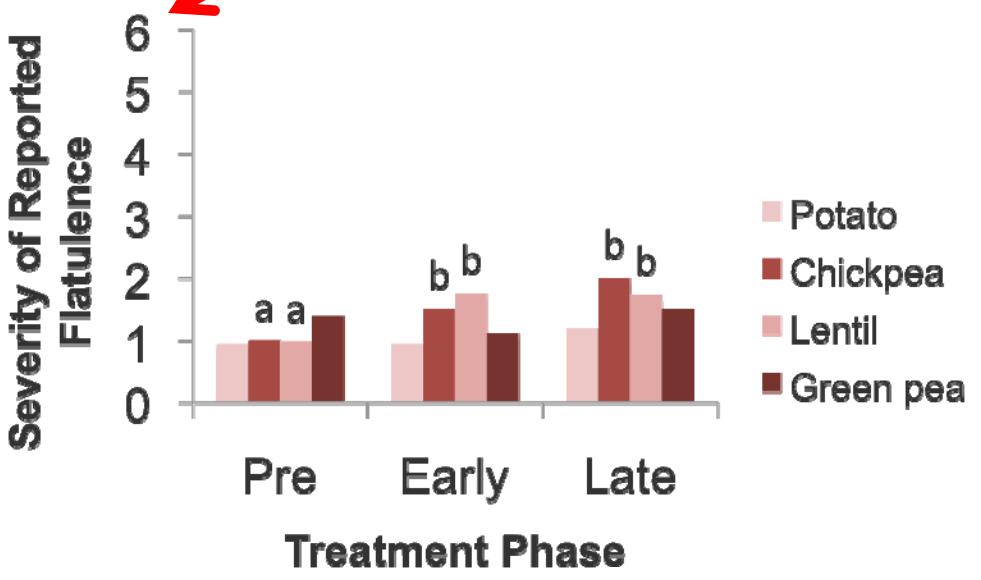
- Completed at 3 treatment phases
  - PRE (d-6 to -1); EARLY (d 1-7), LATE (d 23-28)
- Questions related to GI function
  - Flatulence, bloating, cramping, abdominal comfort, bowel movements
- Incidence and severity
- Severity ranked on 6-inch VAS
  - 0=none
  - 6=worst possible

Flatulence (n=21)

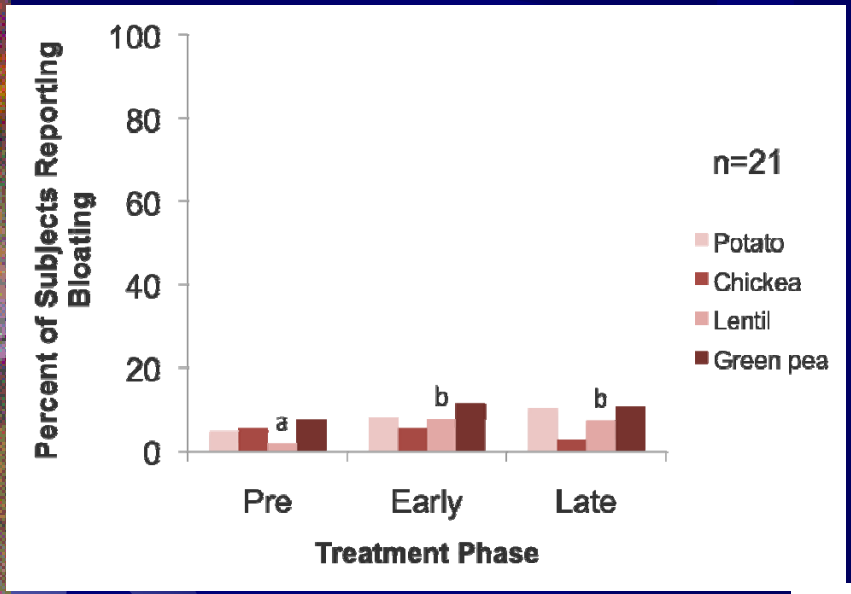


- Flatulence incidence was HIGH during all treatments
- Did not differ between treatments or phases

- Flatulence severity was LOW during all treatments
- increased between phases during Chick Pea and Lentil

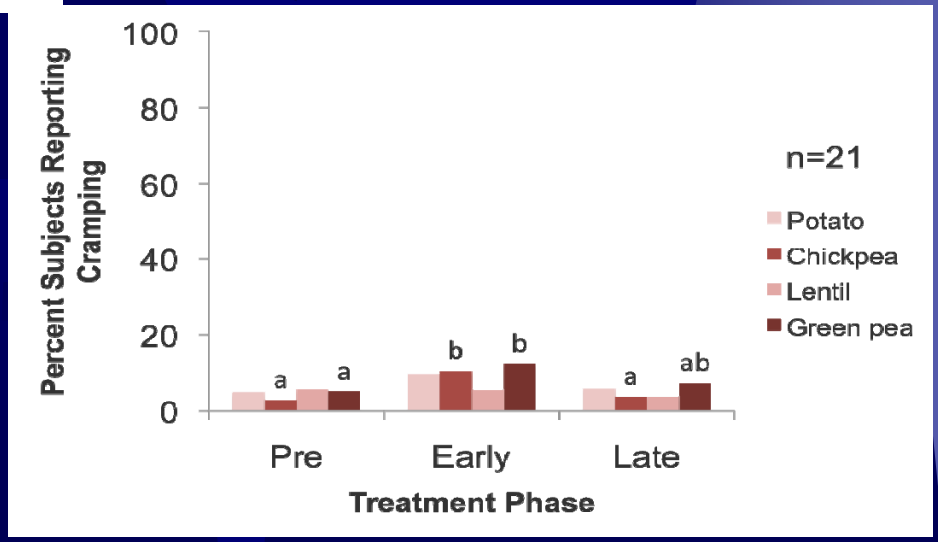


Bloating and Cramping (n=21)



- Bloating was LOW during all treatments
- Increased from PRE to EARLY with LENTILS

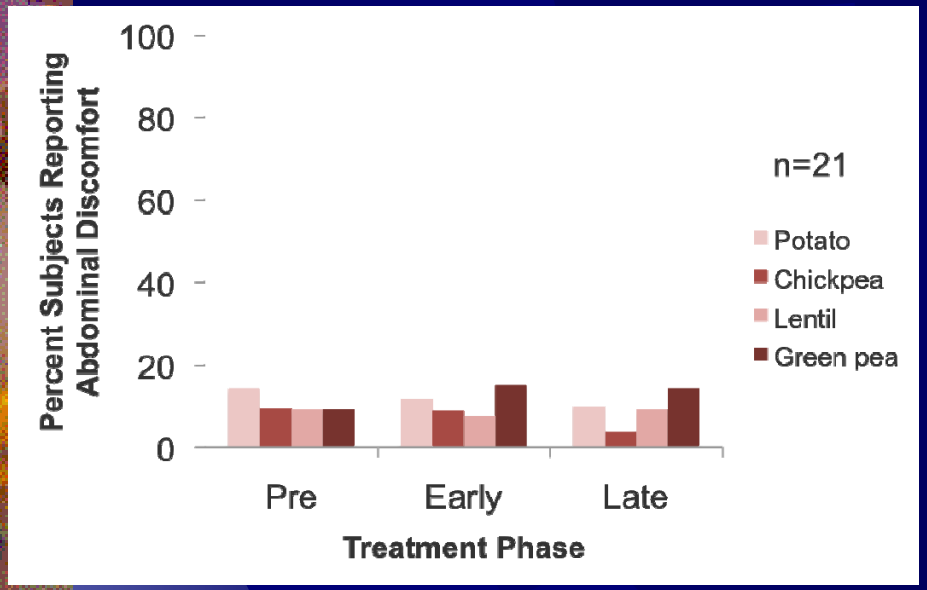
- Cramping was LOW during all treatments
- Increased then decreased during Chickpea and Pea
- Indicative of adaptation



Bowel Habits (n=21)

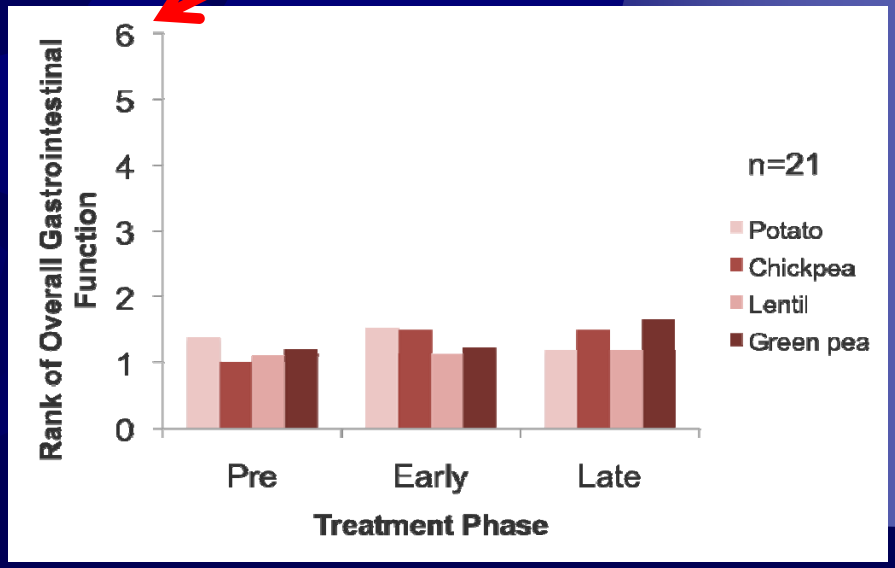
- no significant differences between phases or treatments in:
  - Number of bowel movements
  - Consistency of bowel movements
  - Urgency of bowel movements
  - Problems with defecation

Abdominal Discomfort and Overall GI Function (n=21)



•ABDOMINAL DISCOMFORT was LOW and did not differ between treatments or phases

•OVERALL GI FUNCTION severity was LOW and did not differ between treatments or phases



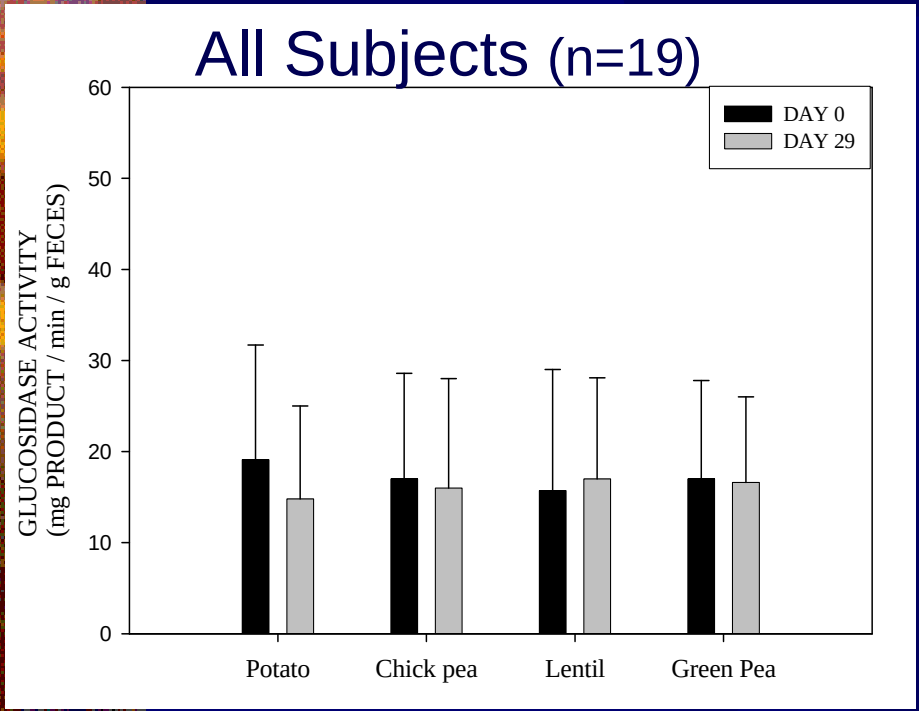
GIQ Results SUMMARY

- Negligible perceived side effects
  - Increased flatulence severity
  - Short term bloating and cramping
- Incidence and severity did not differ
  - between phases (over time)
  - Between treatments
- Evidence to support feasibility of introducing pulses into the diet

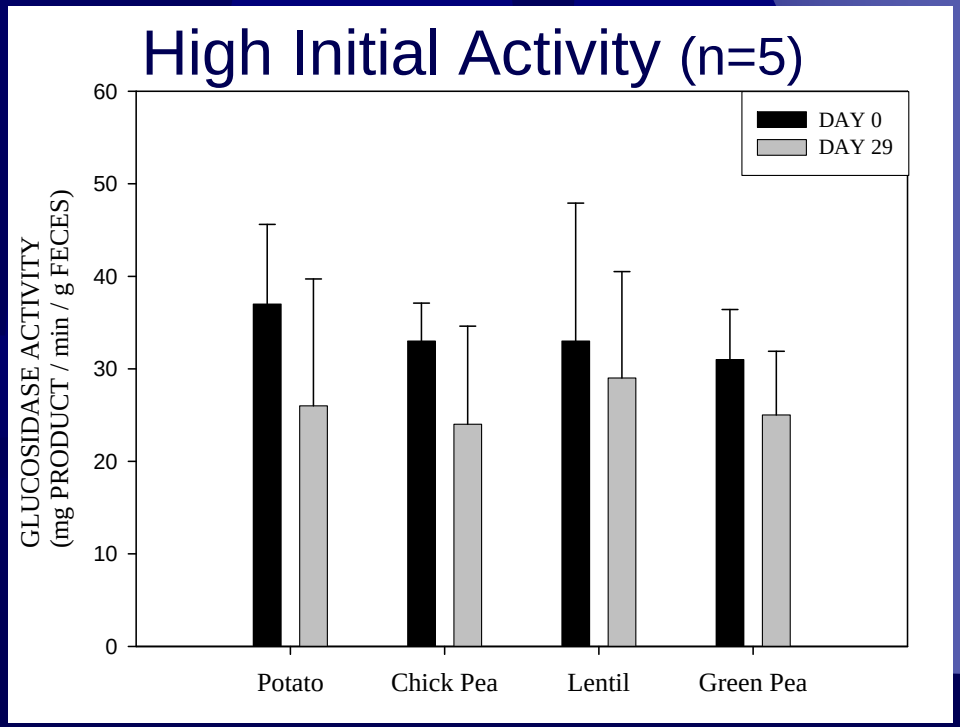
Fecal Samples

- 3-day collection at start and end of each treatment
- 1 sample collected, refrigerated and returned within 18 hours
- Immediately processed and sent to AAFC in St. Hyacinthe
- Analyzed for bacterial enzymes, short chain fatty acids and pH

Fecal Glucosidase Activity

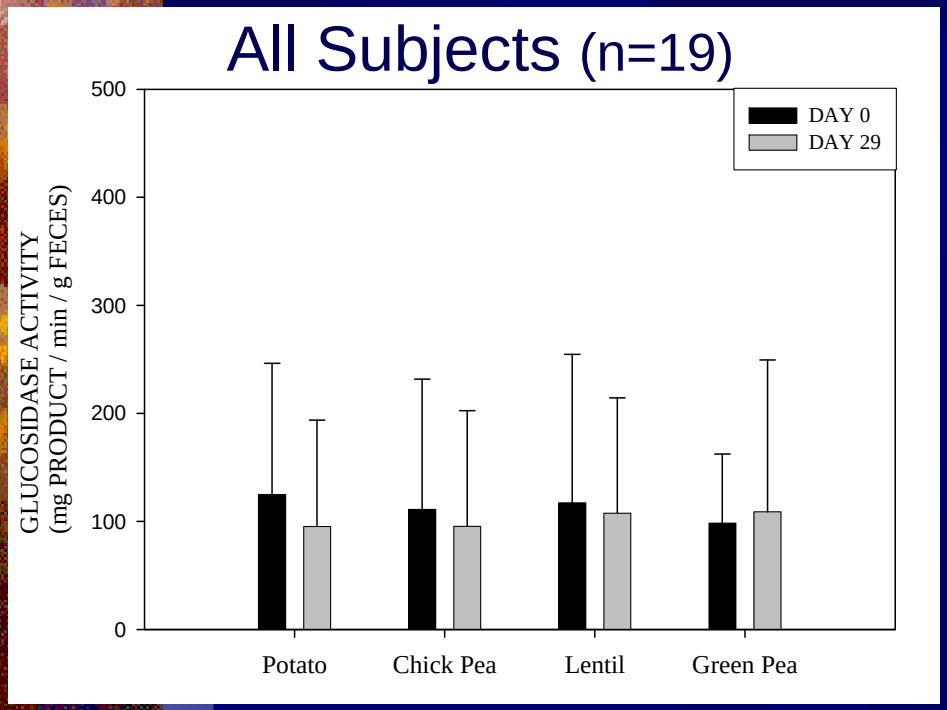


Fecal glucosidase did not differ between treatments

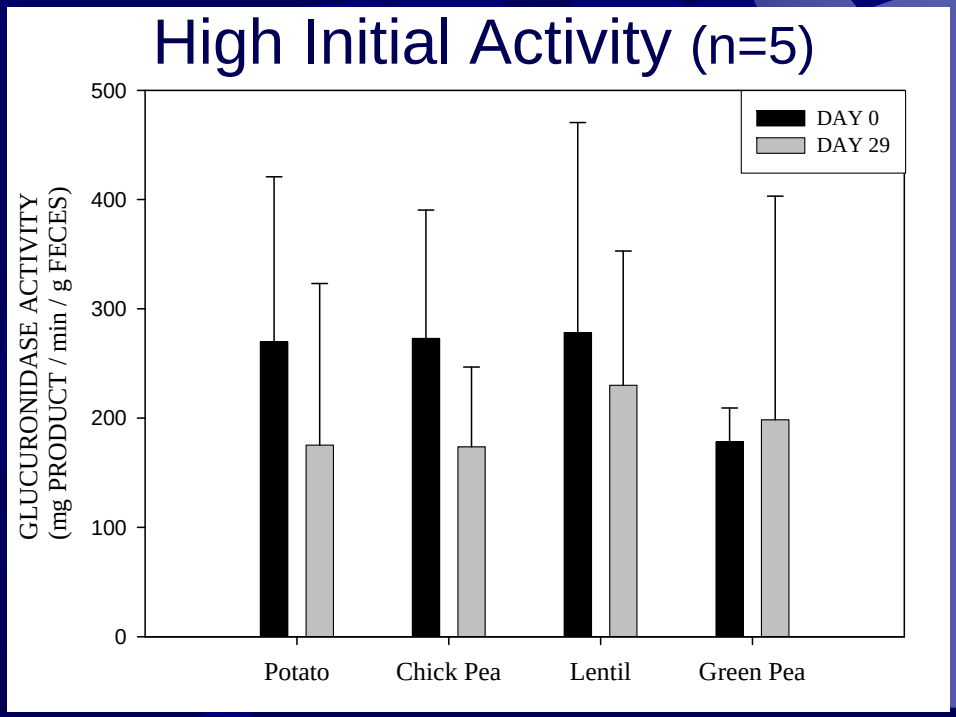


- Subjects in upper quartile of activity tended to have a decrease in activity

Fecal Glucuronidase Activity

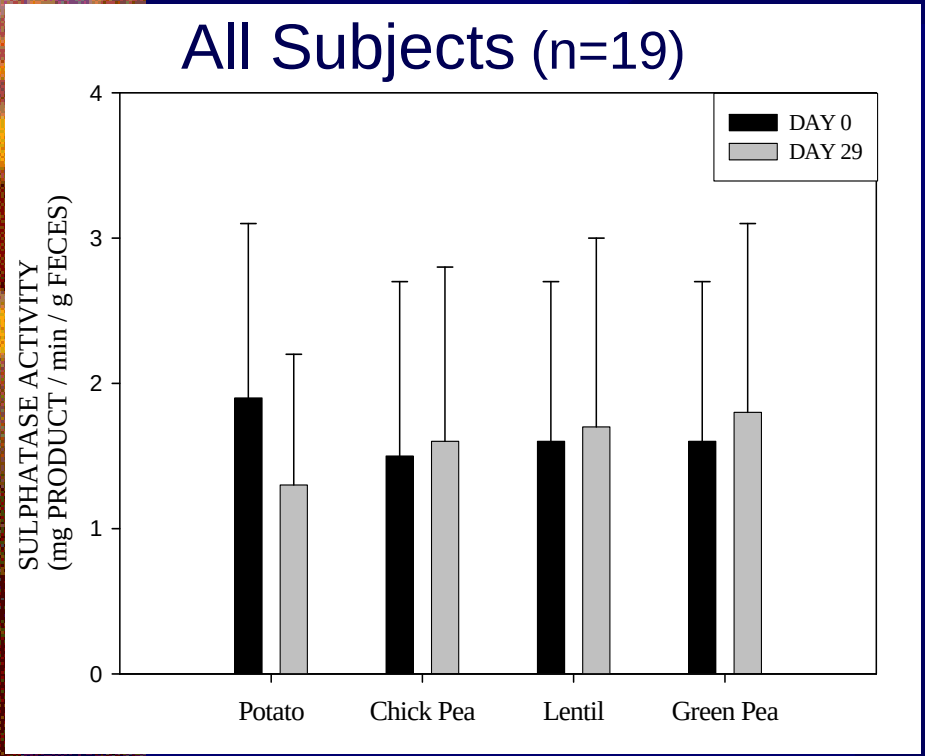


Fecal glucuronidase did not differ between treatments

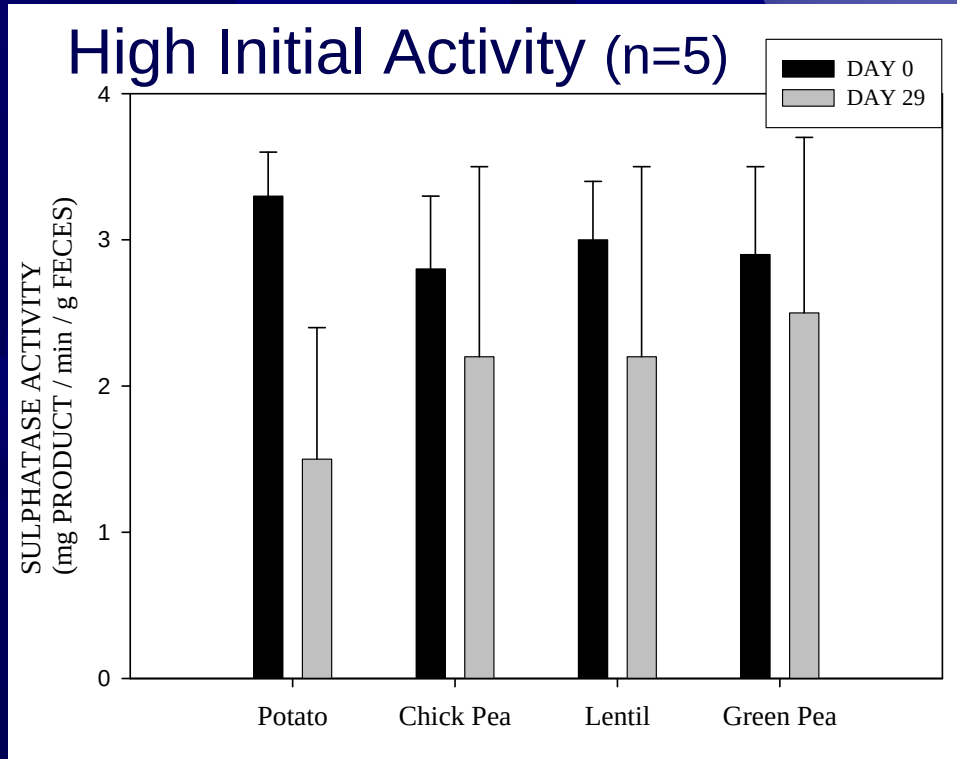


- Subjects in upper quartile of activity tended to have a decrease in activity

Fecal Sulphatase Activity



Fecal sulphatase did not differ between treatments



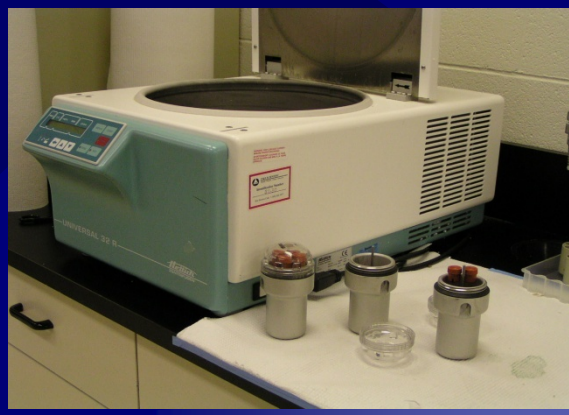
- Subjects in upper quartile of activity tended to have a decrease in activity

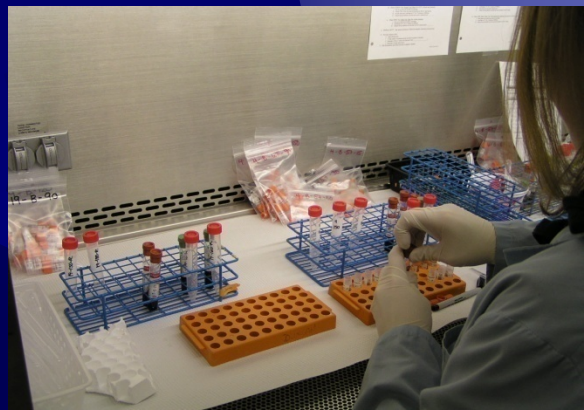
Fecal Results SUMMARY

- Adds to a limited literature showing effects of pulses on gastrointestinal bacterial enzyme activity
- Effects were not significant
  - Glucosidase
  - Glucuronidase
  - Sulfphatase
  - Urease
  - Nitroreductase
  - Short chain fatty acids, ph
- Trend toward beneficial effects in higher-risk individuals

Blood Samples

- Before and after each treatment
- Serum separated and frozen at -80C
- Lipids
  - Total-cholesterol
  - HDL-cholesterol
  - Triglycerides
  - Calculation of LDL-cholesterol
  - Calculation of lipid ratios
  - Apolipoproteins





Serum Lipids

- No differences between treatments
  - does not rule out potential effects in those at higher risk of CVD
    - Older
    - Elevated baseline lipids
    - Diabetes, obesity
  - does not rule out potential effects over a longer time period
- Rationale for pulses to improve CVD risk is solid and warrants further study

Summary Notes

- Study involved 28 days of 3 pulse types in healthy men
- Spray-dried pulse powders contained oligosaccharides
- Pulses were well tolerated, minimal GI effects
- Gastrointestinal bacterial enzymes
  - not significant
  - trends toward beneficial effects in higher-risk individuals
- Serum lipids, no effects

Value of Study Results

- Information about spray-dried pulses
  - Hydrated easily
  - Consumed a variety of ways
  - Contains oligosaccharides
- Evidence to encourage pulse consumption
- Information on gastrointestinal bacterial enzyme levels following pulse consumption
- Adds to growing literature on health effects of pulses

Acknowledgements

- Pulse Innovation Project
  - Pulse Canada
  - Saskatchewan Pulse Growers
  - Agriculture and Agri-Food Canada
- Pulse Food Symposium
- Research Team Collaborators
  - Amanda Wright, Ted Farnworth, Susan Tosh, Joyce Boye
- Students and Staff
  - Candice Cryne, Branden Deschambault, Jesse Veenstra, Isabelle Mainville, Barbara Bisakowski, Sophie Roy, Yolanda Brummer
- Study Participants