# Feeding Value of Western Canadian Oilseed and Biodiesel Co-products

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# Introduction

- Preliminary results
- Collaborative work
- Mostly canola coproducts
  - Canola contributes $14B
  - $5.6B in farm cash receipts
- Why not flax?
- Camelina

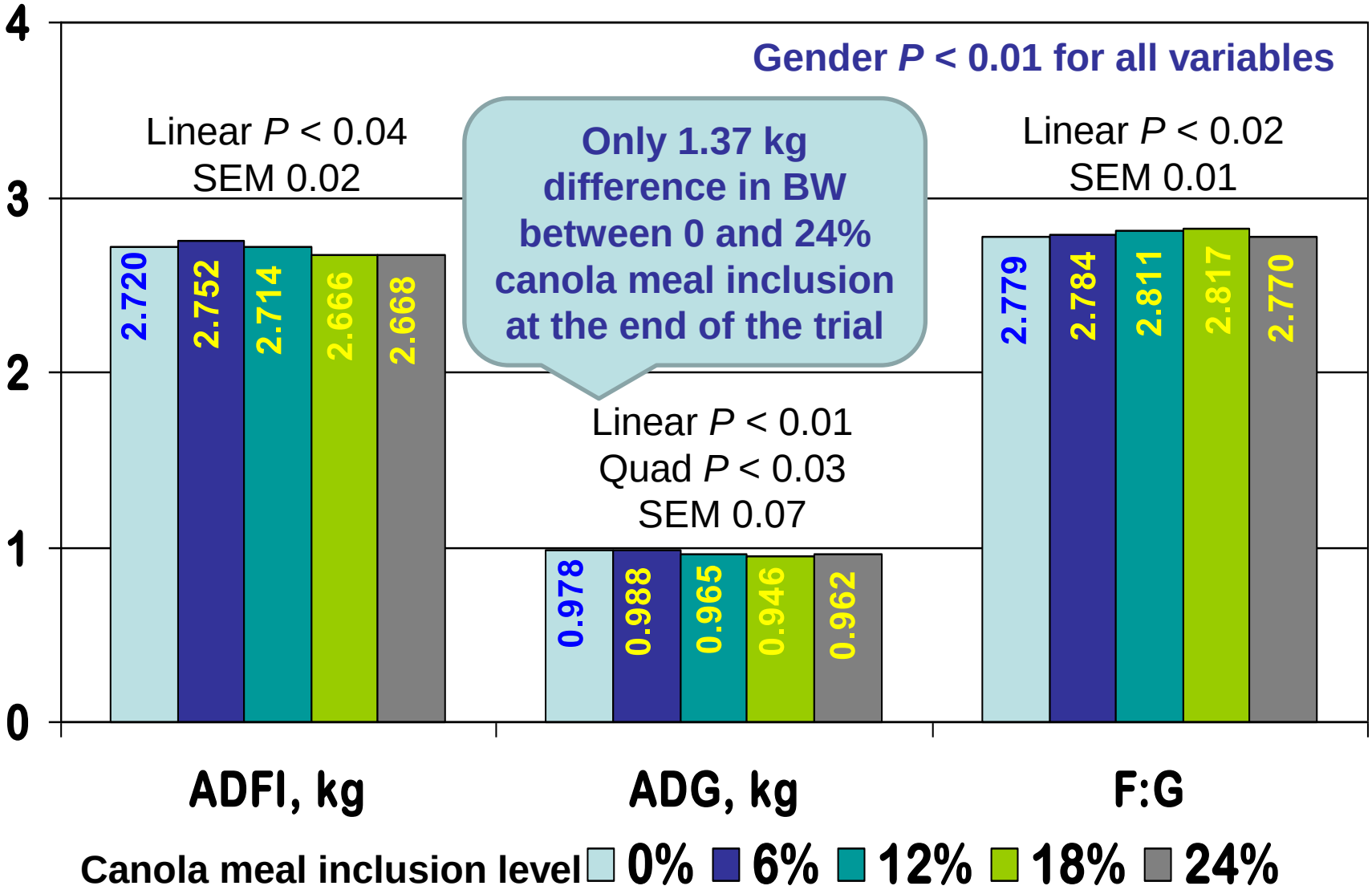
# Feeding Canola Co-products

- Solvent-extracted canola meal
- Expeller-pressed
- Extruded + pressed
- Screw-pressed cake
- Green canola seed
- Crude glycerol

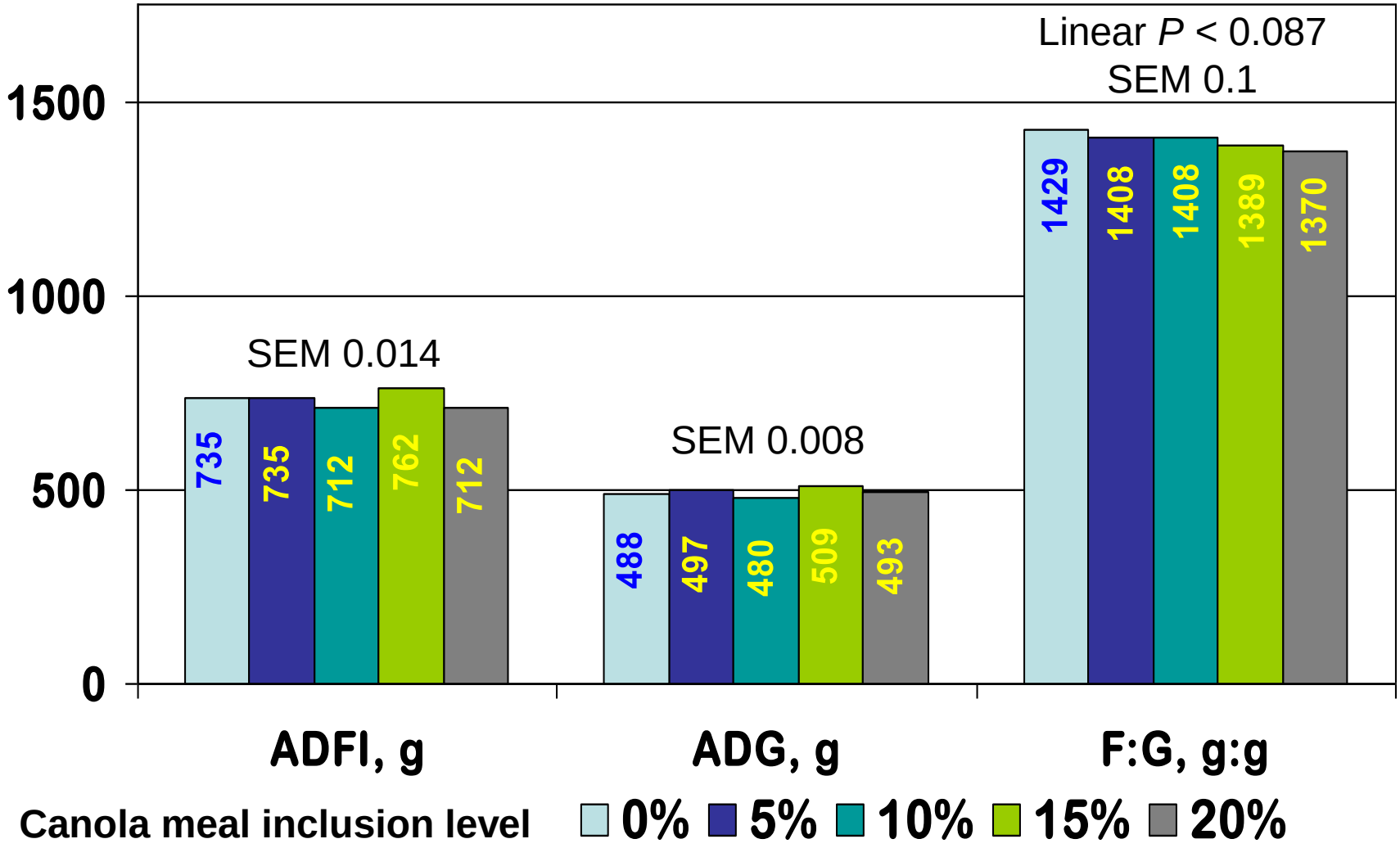
# Pushing the Limits Feeding SE CM

- Fed for ~35y, so what's new?
- Fed at conservative levels:
  - Palatability => glucosinolates
  - Fibre limits dietary energy => NE
- Recent pork crisis
- Increased local meal availability

# Increasing Canola Meal Levels in Hog Diets with 15% DDGS



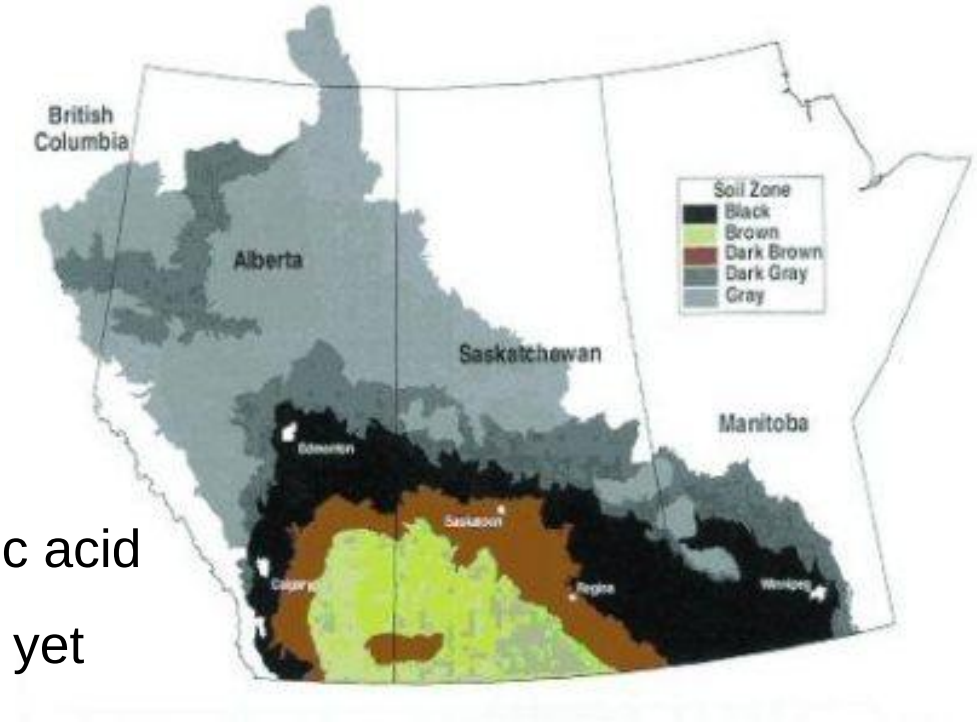
# Increasing SE Canola Meal Levels in Nursery Diets for Weaned Pigs




Landero et al. 2011

# *B. napus* (dark), *B. juncea* (yellow)

- *B. Juncea* is better adapted to grow in the southern Prairies
  - Brown soils *"One crop could add 2M acres of production"* CCC
  - Drought tolerant
  - Thermotolerant
  - Grows more upright
  - Lesser tendency to lodge
  - Pods do not shatter
  - Better for straight combining
  - Slightly more oleic, less linoleic acid
  - No herbicide tolerant varieties yet



# *B. napus* (dark), *B. juncea* (yellow)

- *B. Juncea* canola meal potentially has a higher energy value
  - Yellow, more attractive meal
  - Lower meal fibre content due to thinner seed coat
  - Higher glucosinolates in meal (~10 vs. 3.5 µmol/g)
  - Lower antinutritional factors (phytate, sinapine)

| | ***B. Napus*** **'dark CM'** | ***B. Juncea*** **'yellow CM'** |
|---|---|---|
| Crude protein, % | 38.9 | 39.1 |
| ADF, % | 18.2 | 13.4 |
| NDF, % | 27.2 | 19.8 |
| Avail. lysine | 1.82 | 1.85 |

# *B. napus* (dark), *B. juncea* (yellow) Digestible Nutrients

| | *B. juncea*[1] | *B. napus*[1] |
|---|---|---|
| ATTD of GE | 64.60 | 60.31 |
| DE, Mcal/kg DM | 3.05 | 2.88 |
| NE, Mcal/kg DM | 2.10 | 1.98 |
| SID Lys | 84.68 | 82.87 |
| SID Met | 90.24 | 90.75 |
| SID Thr | 81.50 | 82.23 |
| SID Trp | 83.86 | 84.44 |

[1]Mean of digestibility coefficients determined at 25 and 50% inclusion of each meal in test diets; Buchet et al. 2011

# Weaned Pig Preference

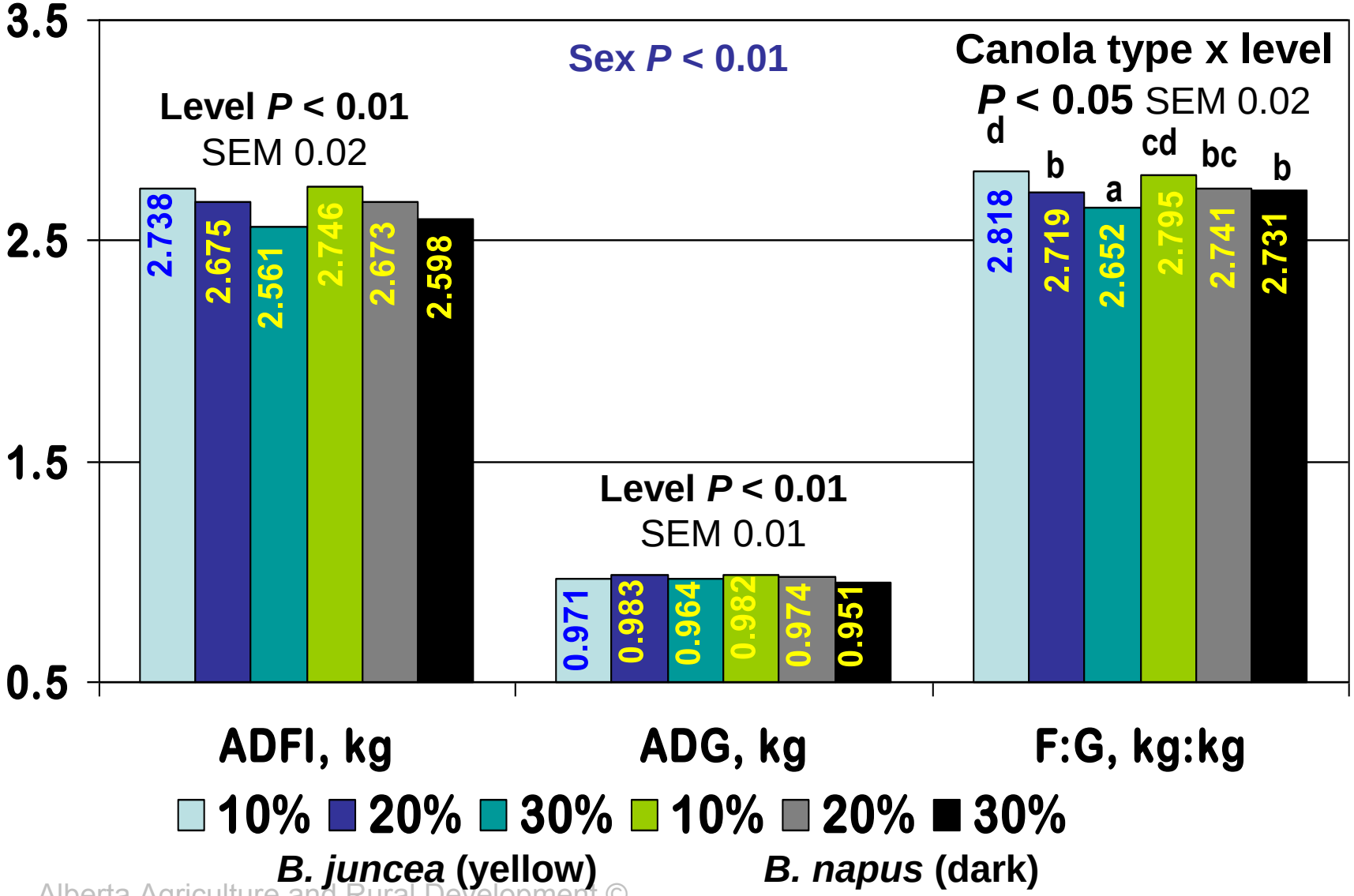
| Day 0 to 4 | Dark-seed *B. napus* or SBM | | Yellow-seed *B. juncea* or SBM | | Yellow-seed *B. juncea* or Dark-seed *B. napus* | |
|---|---|---|---|---|---|---|
| Exp. 1 | .16 | .84 | .10 | .90 | .36 | .64 |
| Exp. 2 | .14 | .86 | .12 | .88 | .23 | .77 |

**Preference expressed as disappearance of a diet over total amount fed**

- 216 pigs, 9.4kg at 34d of age
- 8 (Exp. 1) or 4 (Exp. 2) pigs per pen
- 3 consecutive 7d feeding periods
- Each period 3d adaptation, 4d choice
- Test ingredients included at 20%
- Mash wheat-based diets
- 2.4 Mcal NE/kg, 4.5g SID lys/Mcal NE

Landero et al. 2011

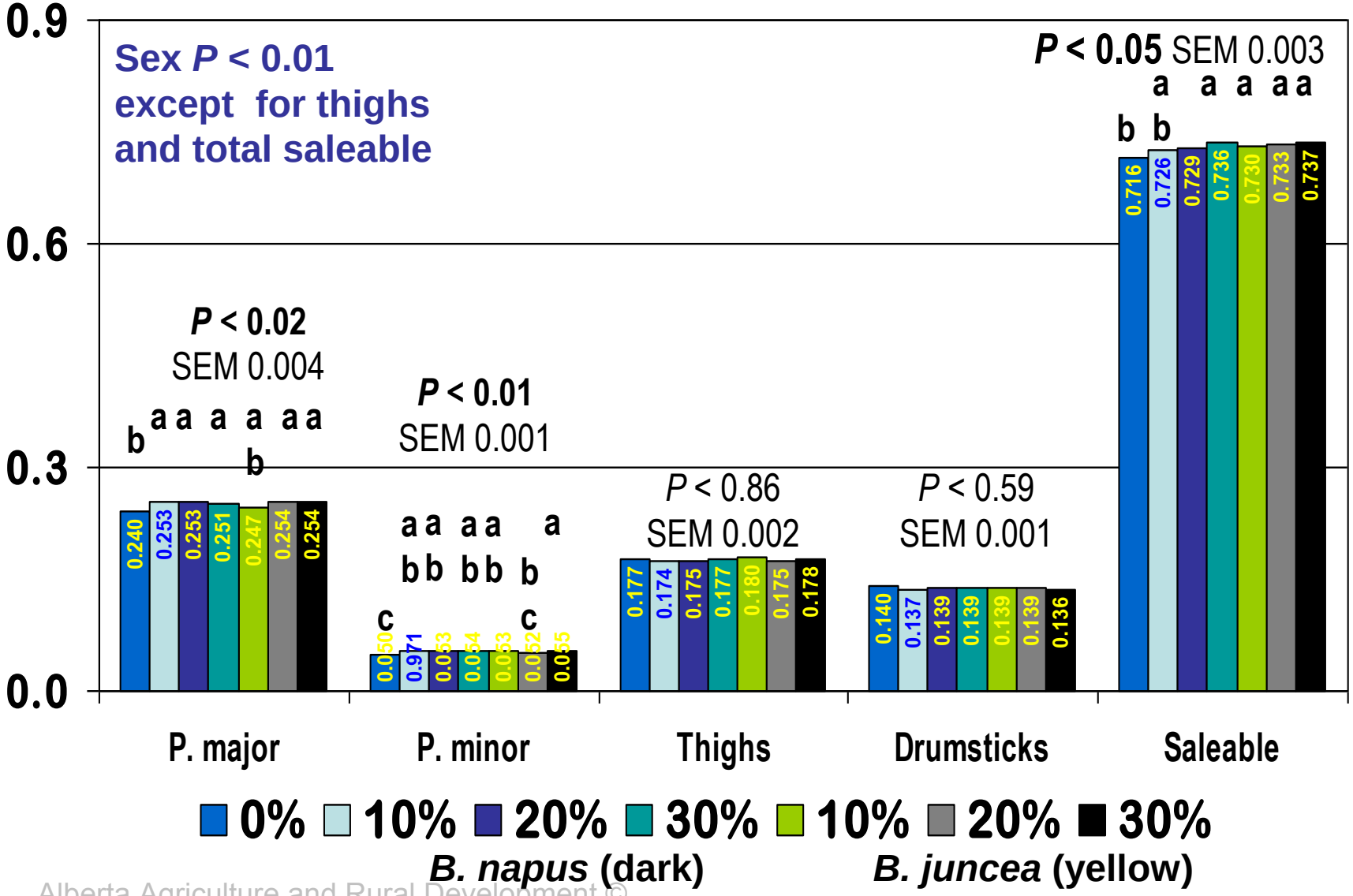
# Feeding Yellow vs. Dark SE Canola Meal at Increasing Levels to 1100 Hogs



# Feeding Yellow vs. Dark Seeded SE Canola Meal at Increasing Levels to Broilers

| | Canola meal | | | Dietary inclusion | | | | | *P* value | |
|---|---|---|---|---|---|---|---|---|---|---|
| | *B. juncea* | *B. napus* | SEM | 0% | 10% | 20% | 30% | SEM | CM | Level |
| d35, kg | 2.29 | 2.27 | 0.01 | 2.28 | 2.27 | 2.30 | 2.27 | 0.01 | 0.24 | 0.54 |
| | | | | | | | | | | |
| **0–35d** | | | | | | | | | | |
| ADFI, g | 107.7 | 106.9 | 0.6 | 106.8 | 107.3 | 107.3 | 107.8 | 0.7 | 0.248 | 0.857 |
| ADG, g | 62.2 | 61.6 | 0.5 | 61.9 | 61.6 | 62.4 | 61.6 | 0.6 | 0.408 | 0.806 |
| G:F, g:g | 0.614 | 0.615 | 0.005 | 0.613 | 0.614 | 0.619 | 0.612 | 0.006 | 0.841 | 0.871 |

# Feeding Yellow vs. Dark Seeded SE Canola Meal at Increasing Levels to Broilers



# Fractionation of SE Canola Meal

- Fibre has a functional role in the gut, but …
  - Dilutes nutrient content
  - Reduces nutrient digestibility

- CCC's goal of 10% or 2000 kcal (poultry) increase in meal energy value by 2015

ATP 200 classifying wheel

# Vibro-Sieving of SE *B. juncea* meal

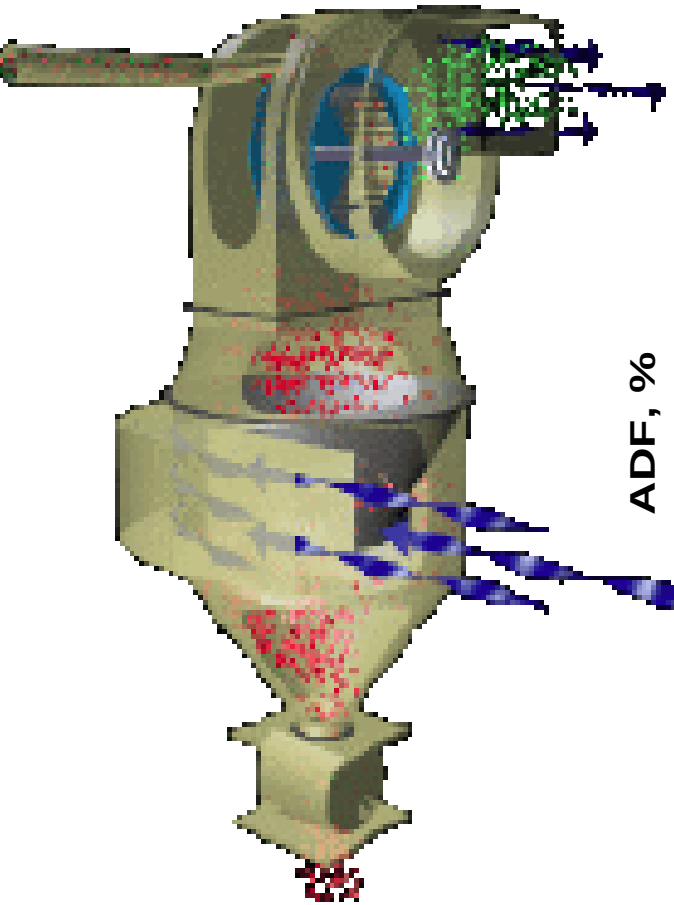
| | Yield, % | Protein, % | ADF, % | NDF, % |
|---|---|---|---|---|
| > 850 µm | 33.4 | 41.5 | 15.0 | 22.8 |
| < 850 µm | 20.1 | 40.6 | 14.9 | 23.6 |
| < 600 µm | 19.0 | 42.9 | 12.0 | 18.6 |
| < 425 µm | 23.9 | 47.0 | 7.6 | 11.8 |

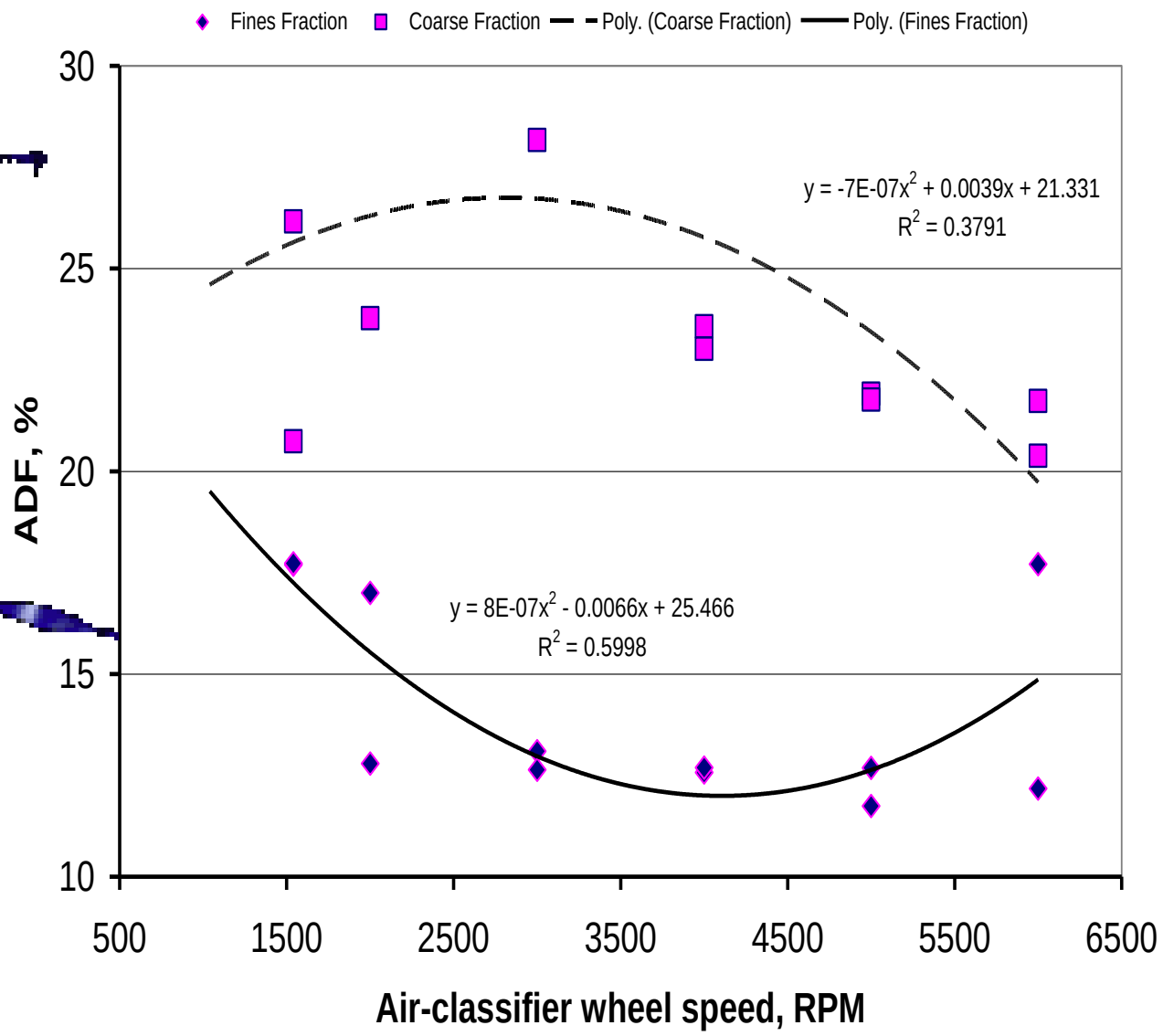
DM basis

| | Yield, % | Protein, % | ADF, % | NDF, % |
|---|---|---|---|---|
| > 600 µm | 66.80 | 41.48 | 14.60 | 22.26 |
| < 600 µm | 10.80 | 43.67 | 12.77 | 19.06 |
| < 425 µm | 12.20 | 46.65 | 8.11 | 13.02 |
| < 250 µm | 8.20 | 47.68 | 7.23 | 11.43 |

Beltranena 2010, unpublished

# Air-Classification of SE *B. napus*





# Digestibility of SE CM Fractions

| **Trout Diet ATTD, %** | Solvent-extracted | **Fine-**particle fraction | **Coarse-**particle fraction | SEM |
|---|---|---|---|---|
| DM | 82.80c | 83.59b | 80.58d | 0.61 |
| CP | 93.46a | 93.11a | 91.61b | 0.45 |
| Lys | 95.68a | 95.33ab | 94.73b | 0.40 |
| Thr | 93.23b | 93.10bc | 92.32c | 0.38 |
| Met | 95.69ab | 95.56ab | 95.13b | 0.40 |

ARD set up at Lethbridge College

PRC, UofA

| **Broilers Ingr. AID%** | Solvent-extracted | **Fine-**particle fraction | **Coarse-**particle fraction |
|---|---|---|---|
| DM | 72.7 | 53.0 | 50.5 |
| CP | 101.4 | 91.6 | 96.3 |
| Lys | 88.7 | 85.9 | 87.4 |
| Thr | 82.7 | 74.4 | 79.1 |
| Met | 98.3 | 92.5 | 95.5 |

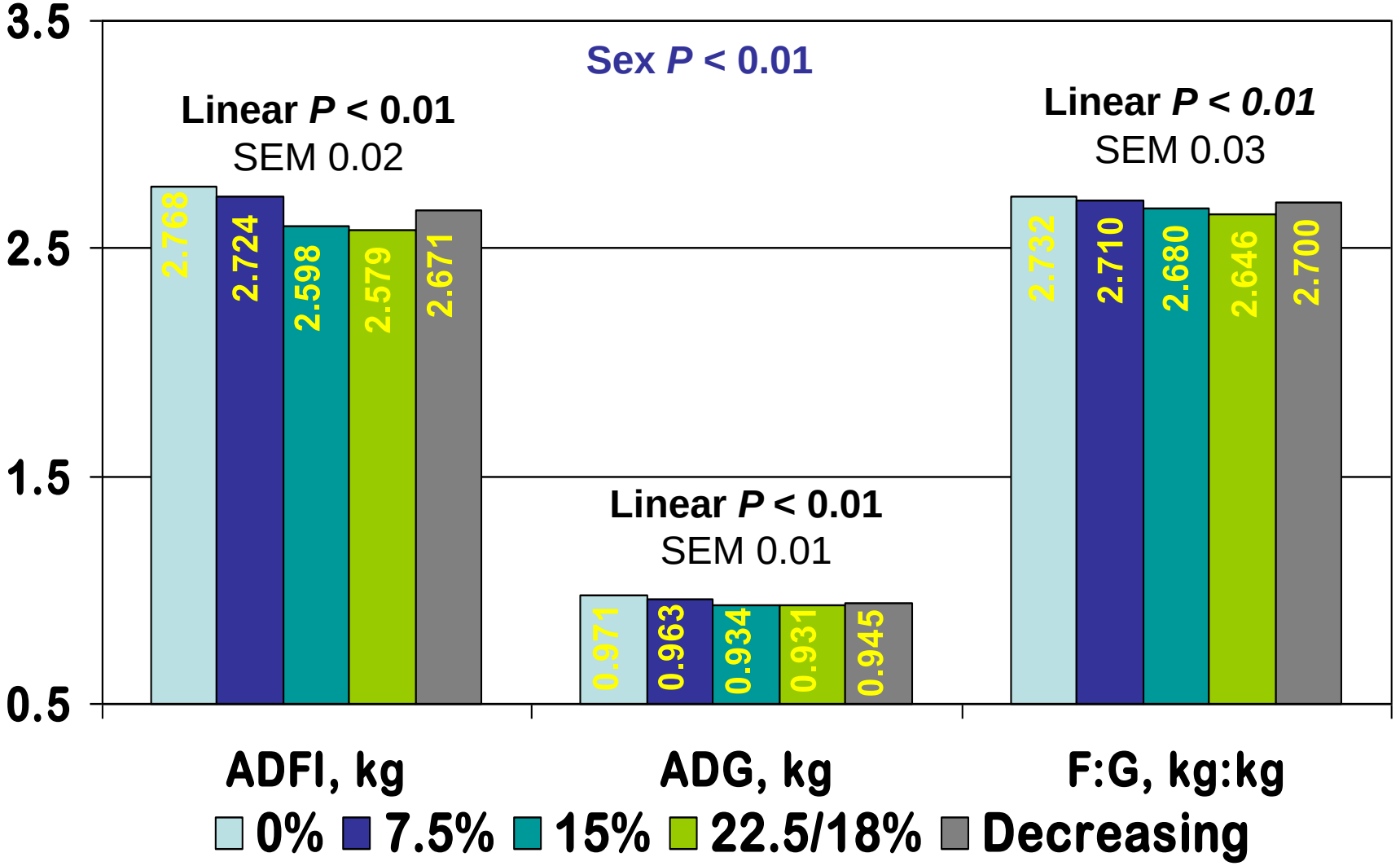
# Expeller-Pressed Canola Meal

| 93.5% DM | Expeller-pressed[1] |
|---|---|
| Crude protein | 35.27 |
| **Ether extract** | **12.63** |
| Ash | 6.55 |
| ADF | 15.93 |
| NDF | 19.98 |
| Calcium | 0.59 |
| Phosphorus | 1.03 |
| Amino acids: | |
| Lysine | 2.09 |
| Avail. lysine | 1.95 |
| Methionine | 0.68 |
| Cysteine | 0.85 |
| Threonine | 1.51 |
| Tryptophan | 0.52 |

- Pre-heated
- 2x pressed

Viterra, Ste. Agathe, MB

# Feeding Expeller-Pressed Canola Meal at Increasing/Decreasing Levels to 1100 Hogs




Seneviratne et al. 2010

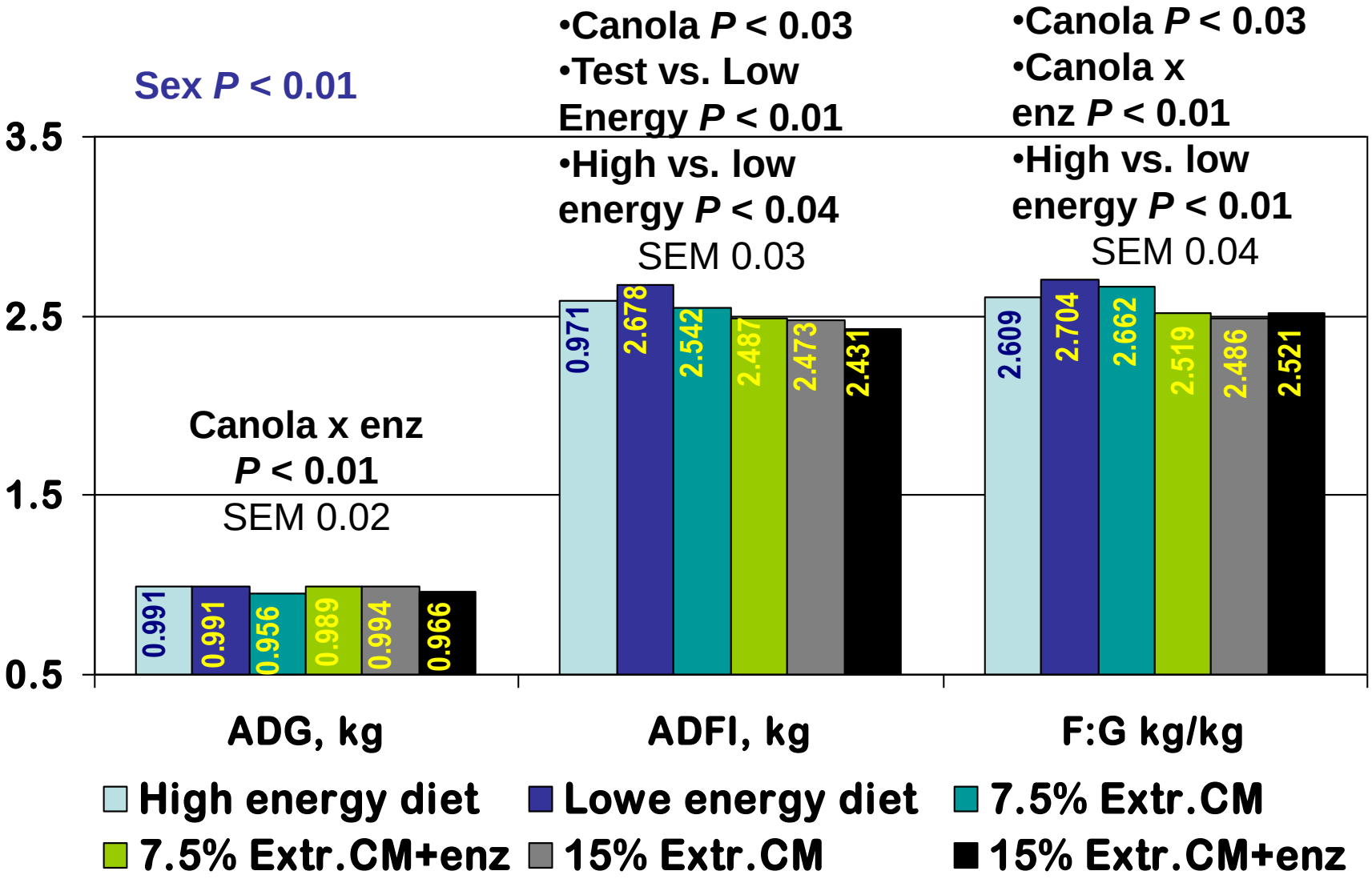
# Extruded + Pressed Canola Meal

| 93.5% DM | Expeller-pressed[1] | **Extruded +pressed[2]** |
|---|---|---|
| Crude protein | 35.27 | 29.86 |
| **Ether extract** | **12.63** | **17.31** |
| Ash | 6.55 | 7.22 |
| ADF | 15.93 | 22.58 |
| NDF | 19.98 | 28.09 |
| Calcium | 0.59 | 0.60 |
| Phosphorus | 1.03 | 0.82 |
| Amino acids: | | |
| Lysine | 2.09 | 1.21 |
| Avail. lysine | 1.95 | 1.04 |
| Methionine | 0.68 | 0.55 |
| Cysteine | 0.85 | 0.71 |
| Threonine | 1.51 | 1.17 |
| Tryptophan | 0.52 | 0.39 |

[1]Viterra, Ste. Agathe, MB

[2]Cansource Bioproducts, Mayerthorpe, AB

# Feeding Extruded + Pressed Canola Meal and Enzyme to 1100 Hogs




Young et al. 2010

# Screw-Pressed Canola Cake

| 93% DM | **Screw-pressed**[1] | Expeller-pressed[2] |
|---|---|---|
| Crude protein | 39.43 | 35.71 |
| **Ether extract** | **13.30** | **12.83** |
| ADF | 16.09 | 17.21 |
| NDF | 33.85 | 20.46 |
| Ash | 7.13 | 6.44 |
| Calcium | 0.84 | 0.54 |
| Phosphorus | 1.37 | 1.04 |
| Amino acids: | 0.00 | 0.00 |
| Lysine | 1.24 | 1.53 |
| Avail. lysine | 1.00 | 1.40 |
| Methionine | 0.54 | 0.52 |
| Cysteine | 1.01 | 1.00 |
| Threonine | 1.27 | 1.16 |

[1]Heated barrel, fast speed (Seneviratne et al. 2011c)
[2]Viterra, Ste. Agathe, MB

# Processing Affects the Digestibility of Screw-Pressed Canola Cake

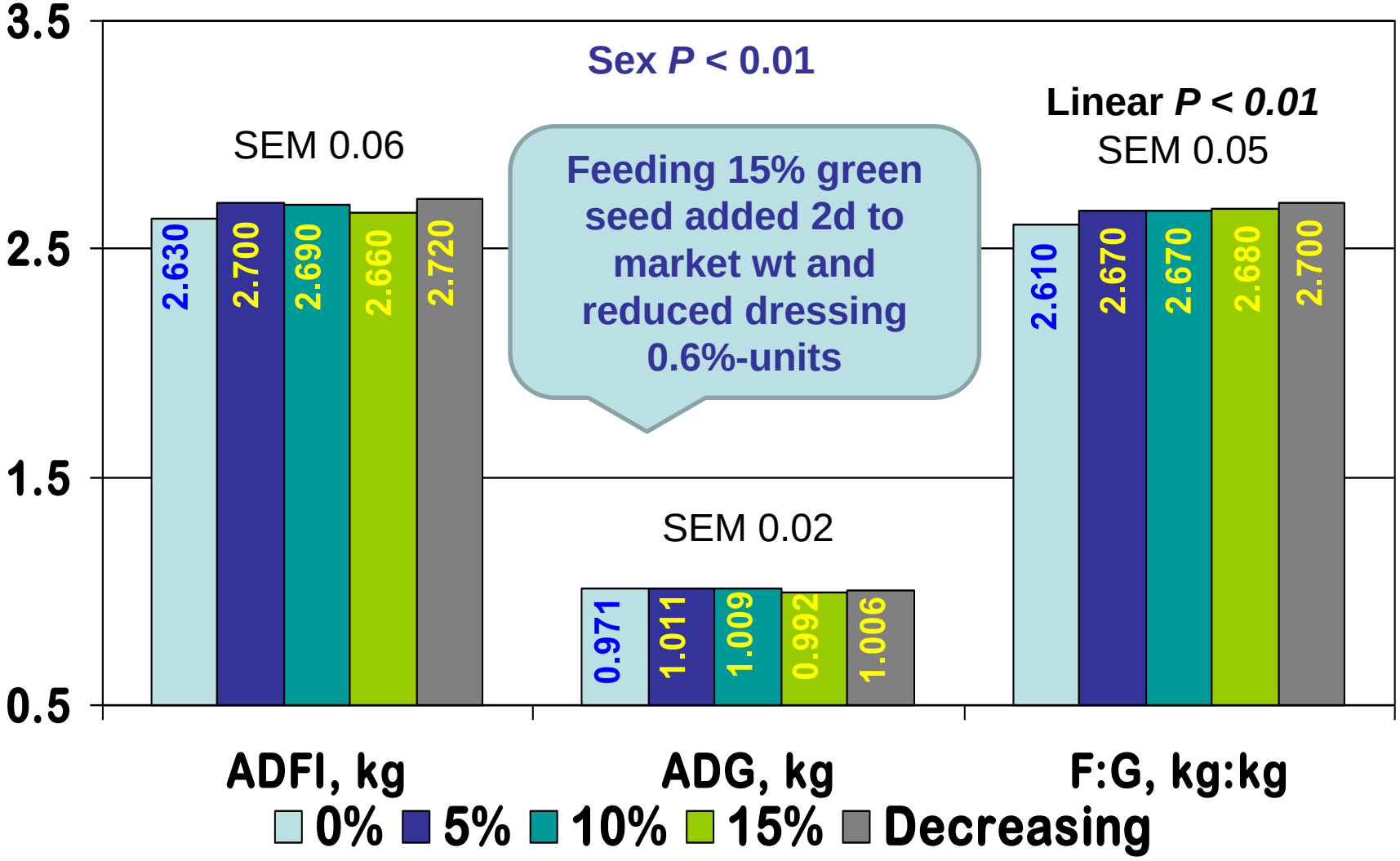
| | Non-heated | | | Heated | | | Heat x |
|---|---|---|---|---|---|---|---|
| | Slow | Fast | | Slow | Fast | SEM | speed |
| ATTD of GE, % | 60.7 | 68.1 | | 85.5 | 89.6 | 5.6 | 0.468 |
| DE, Mcal/kg | 3.15 | 3.76 | | 5.08 | 4.68 | 0.20 | 0.001 |
| NE, Mcal/kg | 2.06 | 2.56 | | 3.55 | 3.19 | 0.14 | 0.002 |
| SID Lys, % | 41.4 | 50.0 | | 80.7 | 83.0 | 1.2 | 0.040 |
| SID Thr, % | 50.9 | 50.3 | | 88.7 | 82.0 | 2.4 | 0.249 |
| SID Met, % | 82.1 | 76.8 | | 82.1 | 91.9 | 1.4 | 0.001 |
| SID Cys, % | 67.9 | 71.3 | | 89.3 | 90.0 | 1.1 | 0.179 |

Seneviratne et al. 2010

# Green Canola Seed

- Greenly, darker colour to the oil
- Discounting factor
- Alternative markets
- Reduce feed cost
- VARIABILITY

# Feeding Green Canola Seed at Increasing/Decreasing Levels to 1100 Hogs



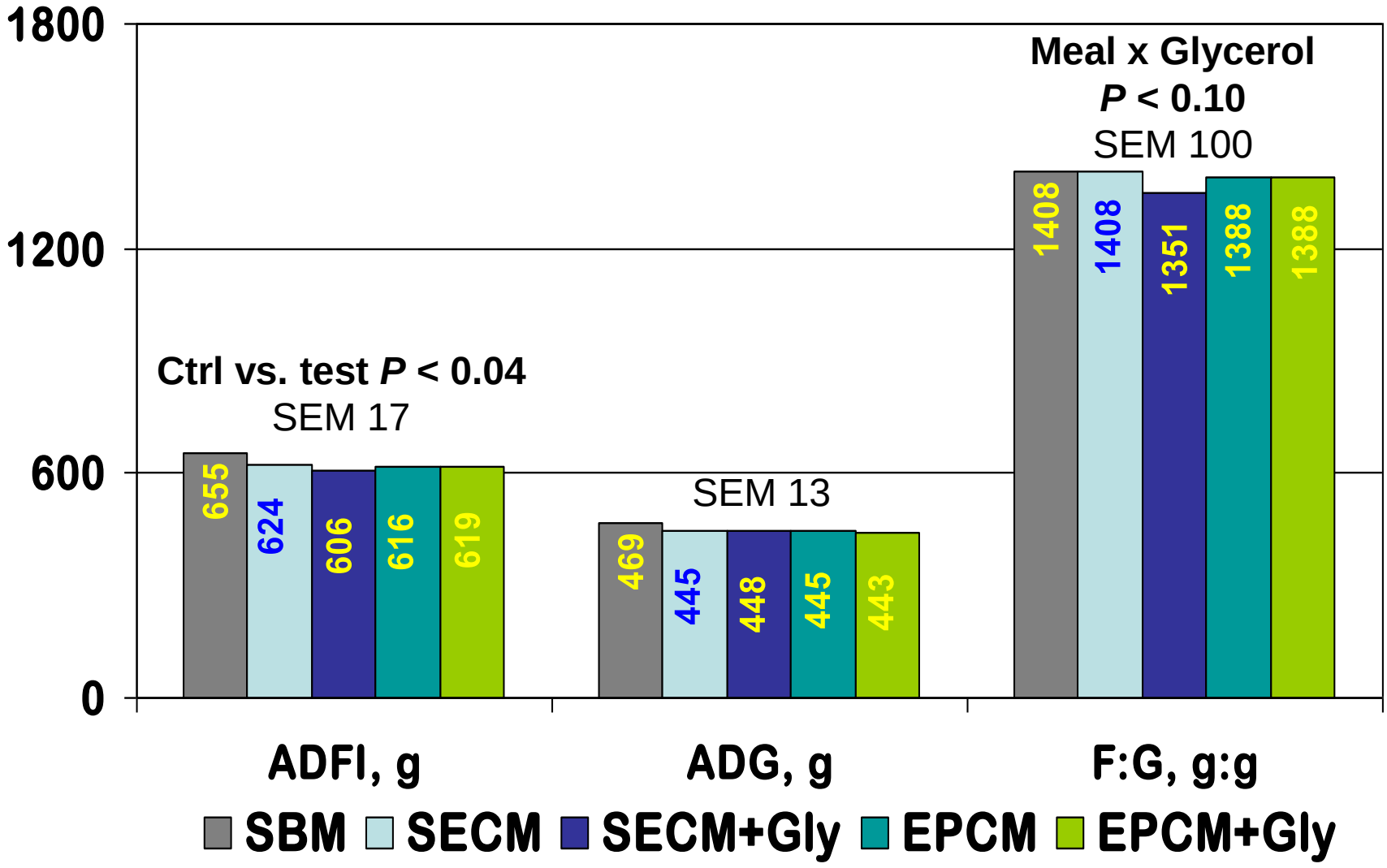

Young et al. 2010

# Feeding Crude Glycerol

- Coproduct of biodiesel
- Dietary energy source
- Pelleting power requirements
- Residual chemicals
- CFIA registration

| Crude glycerol | |
|---|---|
| Moist, % | 15.2 |
| EE, % | 49.6 |
| Ash, % | 10.8 |
| Methanol, % | 0.02 |

# Feeding SE or Expeller-Pressed Canola Meal +/- Crude Glycerol to Weaned Pigs




Seneviratne et al. 2011

# Camelina

- Omega-3 fatty acids
- Vitamin E
- Sch. IV, Feed Act
  - Safety, efficacy
  - Digestibility
  - Performance

| | Meal | Oil | Seed |
|---|---|---|---|
| Crude protein | 32.46 | | 21.11 |
| Crude fat | 19.06 | 90.12 | 43.68 |

| Meal amino acids, % | | | |
|---|---|---|---|
| Lysine | 1.59 | Methionine | 0.55 |
| Avail. lysine | 1.46 | Cysteine | 0.70 |
| Threonine | 1.31 | Tryptophan | 0.47 |

| Oil fatty acid, % | | | |
|---|---|---|---|
| Palmitic (16:0) | 5.25 | Arachidic (20:0) | 1.44 |
| Stearic (18:0) | 2.72 | (20:1n9) | 16.19 |
| Oleic (18:1n9) | 15.5 | (20:3 ω3) | 1.44 |
| Linoleic (18:2) | 17.57 | Docosanoic (22:0) | 0.3 |
| Linolenic (ω18:3) | 33.06 | Erucic (22:1n9) | 2.6 |

# Feeding Increasing Levels of Screw-Pressed Camelina Meal to Broiler Chickens

| **Day 0 to 42** | 0% Meal | 8% Meal | 16% Meal | 24% Meal |
|---|---|---|---|---|
| Total Gain/bird, g | 2180.8 | 2515.6 | 2690.3 | 2287.0 |
| ADG, g | 51.9 | 59.9 | 64.1 | 54.5 |
| ADFI, g | 86.8 | 89.1 | 89.1 | 88.4 |
| G:F | 0.599 | 0.674 | 0.719 | 0.616 |

| **Organ weight as % of BW** | 0% Meal | 8% Meal | 16% Meal | 24% Meal | SEM | Linear |
|---|---|---|---|---|---|---|
| Breast | | | | | | |
| Day 14 | 3.87 | 4.28 | 4.14 | 4.23 | 0.147 | 0.104 |
| Day 28 | $5.09^{b}$ | $4.96^{b}$ | $6.15^{a}$ | $6.10^{a}$ | 0.192 | 0.001 |
| Day 42 | $5.54^{b}$ | $5.53^{b}$ | $6.88^{a}$ | $6.82^{a}$ | 0.358 | 0.001 |
| Pancreas | | | | | | |
| Day 14 | $0.39^{b}$ | $0.46^{a}$ | $0.43^{ab}$ | $0.45^{a}$ | 0.019 | 0.091 |
| Day 28 | $0.22^{c}$ | $0.27^{c}$ | $0.33^{b}$ | $0.40^{a}$ | 0.019 | 0.001 |
| Day 42 | $0.17^{c}$ | $0.19^{c}$ | $0.24^{b}$ | $0.28^{a}$ | 0.010 | 0.001 |

# Differential Cost per Mcal NE

| | Solvent-extracted | Expeller-pressed | Extruded +pressed | Screw-pressed | Green seed | Canola oil |
|---|---|---|---|---|---|---|
| Expeller-pressed meal | 0.82 | | | | | |
| Extruded + pressed meal | 0.72 | 0.88 | | | | |
| Screw-pressed cake | 1.05 | 1.28 | 1.46 | | | |
| Green canola seed | 0.87 | 1.07 | 1.22 | 0.83 | | |
| Canola oil | 1.45 | 1.77 | 2.03 | 1.38 | 1.66 | |
| Tallow | 1.26 | 1.55 | 1.77 | 1.21 | 1.45 | 0.87 |

- Co-product variability issues
  - Seed quality - Quality control
  - Local processing - Antinutritional factors
  - Consistent product ?

# Conclusions

- Who can afford to feed fats?
- Cost per Mcal of residual oil
- Oilseed meals => protein or energy source
- Dietary inclusion to reduce feed cost
- Lower fibre solvent-extracted canola meal
- Co-product variability issues
- Soft fat issues vs. fatty acid enrichment

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