Oilseed Co-products as Alternative Ingredients

Eduardo Beltranena and Ruurd T. Zijlstra

Government of Alberta

Alberta
Freedom To Create. Spirit To Achieve.

UNIVERSITY OF ALBERTA
QUAECUMQUE VERA

Alberta Agriculture and Rural Development ©

Introduction

- Talk mostly about canola coproducts
  - Canola contributes $14B
  - $5.6B in farm cash receipts
- Canola meal, a traditional protein source
- Residual oil, novel dietary energy source
- Cereals, field pea are currently expensive
- Flax
- Camelina

Alberta Agriculture and Rural Development ©

Feeding Canola Co-products

- Solvent extracted canola meal
  - Yellow- vs. dark-seeded
- Expeller pressed
- Extruded + pressed
- Screw pressed cake
- Green canola seed

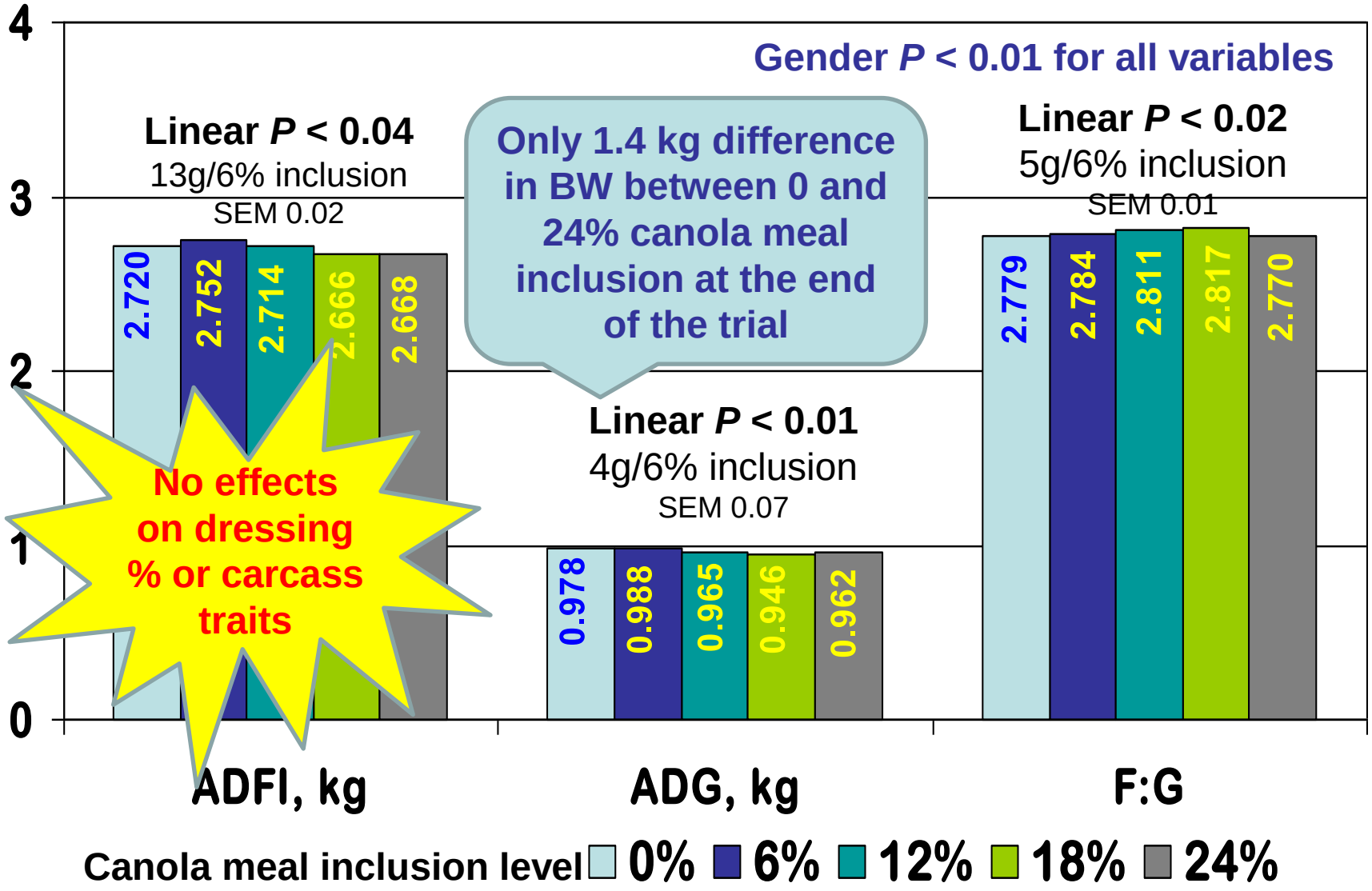
Alberta Agriculture and Rural Development ©

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

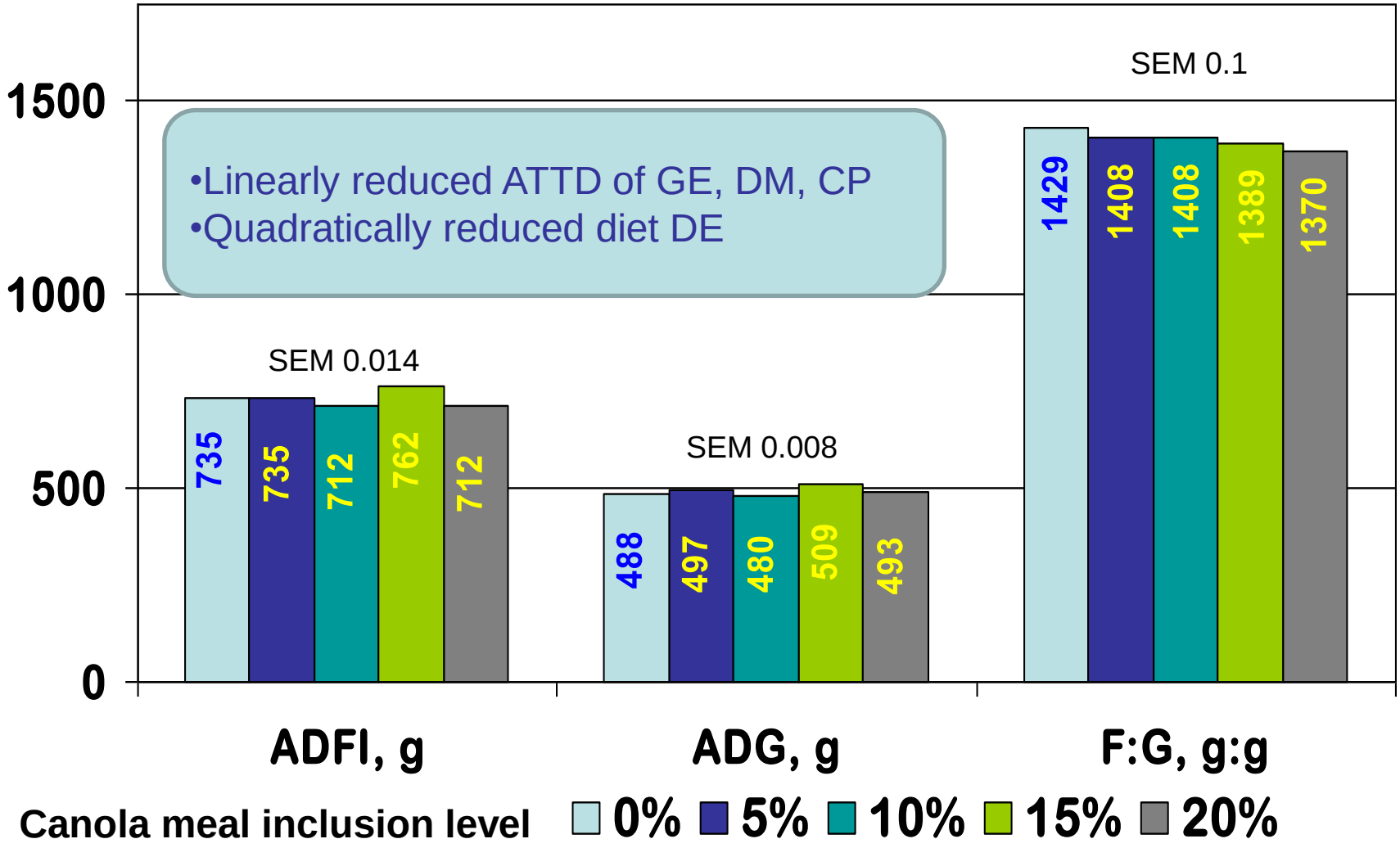
Alberta Agriculture and Rural Development ©

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



Alberta Agriculture and Rural Development ©

Increasing SE Canola Meal Levels in Nursery Diets for Weaned Pigs

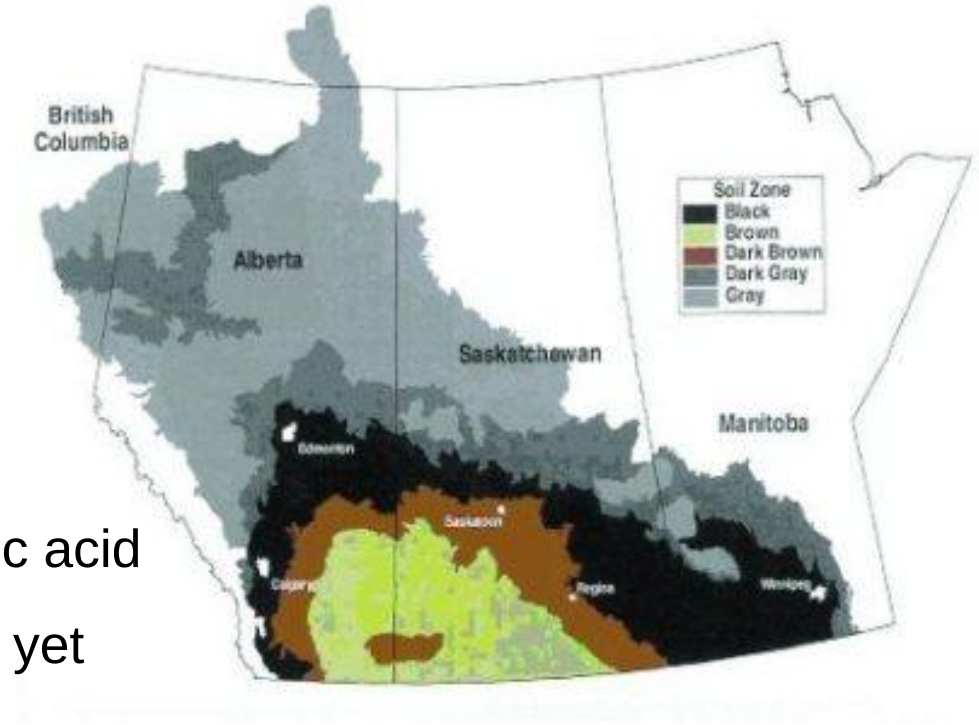


Landero et al. 2011. Anim. Feed Sci. Technol. 170:136-140

Alberta Agriculture and Rural Development ©

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



Alberta Agriculture and Rural Development ©

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

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

Alberta Agriculture and Rural Development ©

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

Alberta Agriculture and Rural Development ©

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

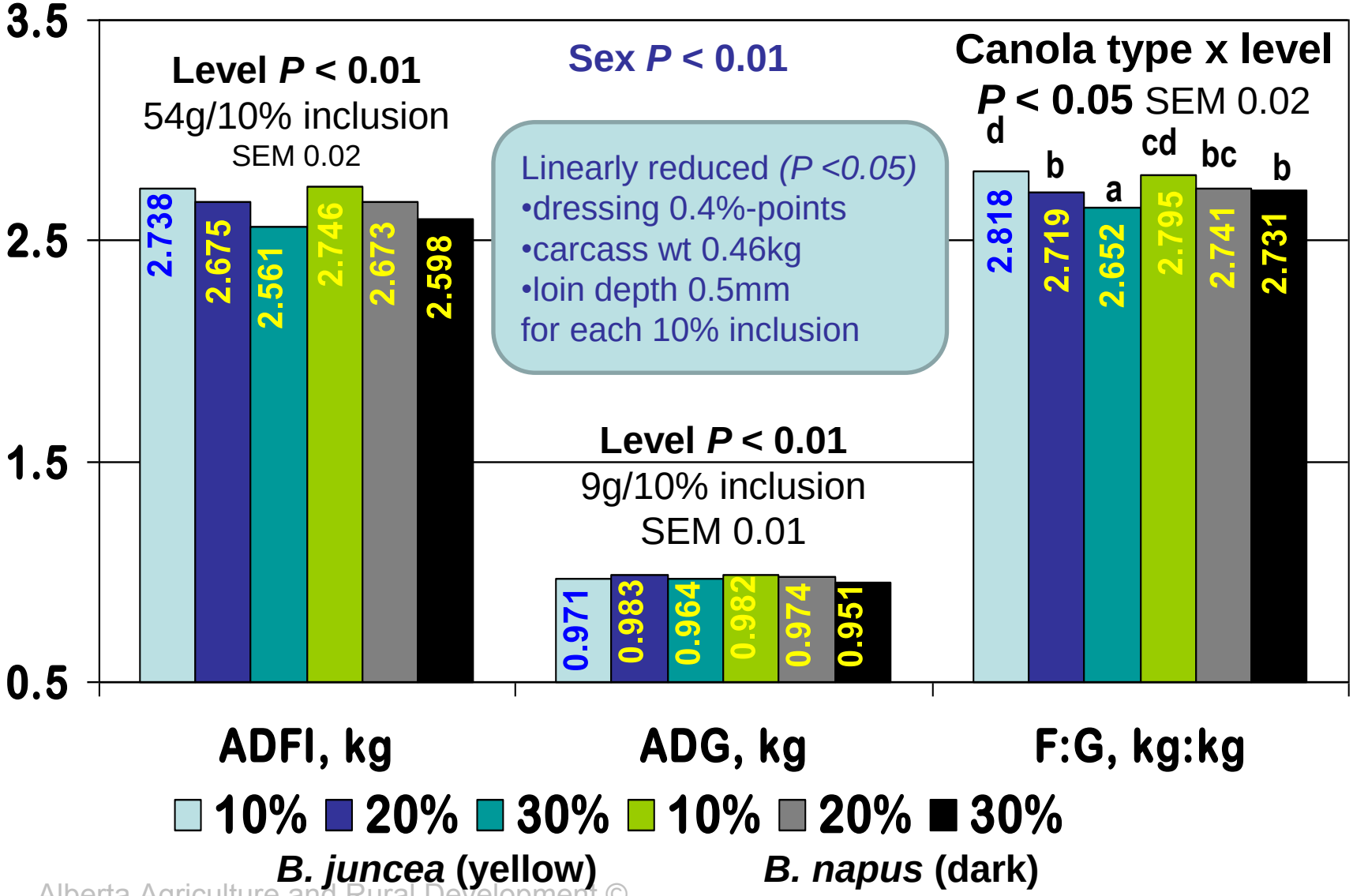
Preference expressed as disappearance of a diet over total amount fed

- 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. 2012 unpublished

Alberta Agriculture and Rural Development ©

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



Alberta Agriculture and Rural Development ©

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

Alberta Agriculture and Rural Development ©

Vibro-Sieving of SE *B. juncea*

	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

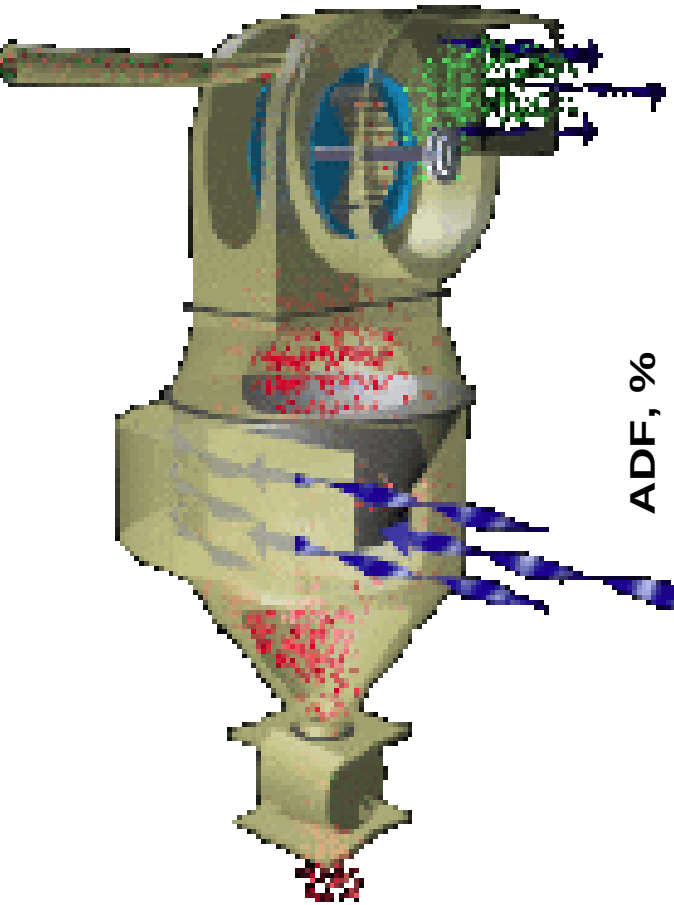
DM basis

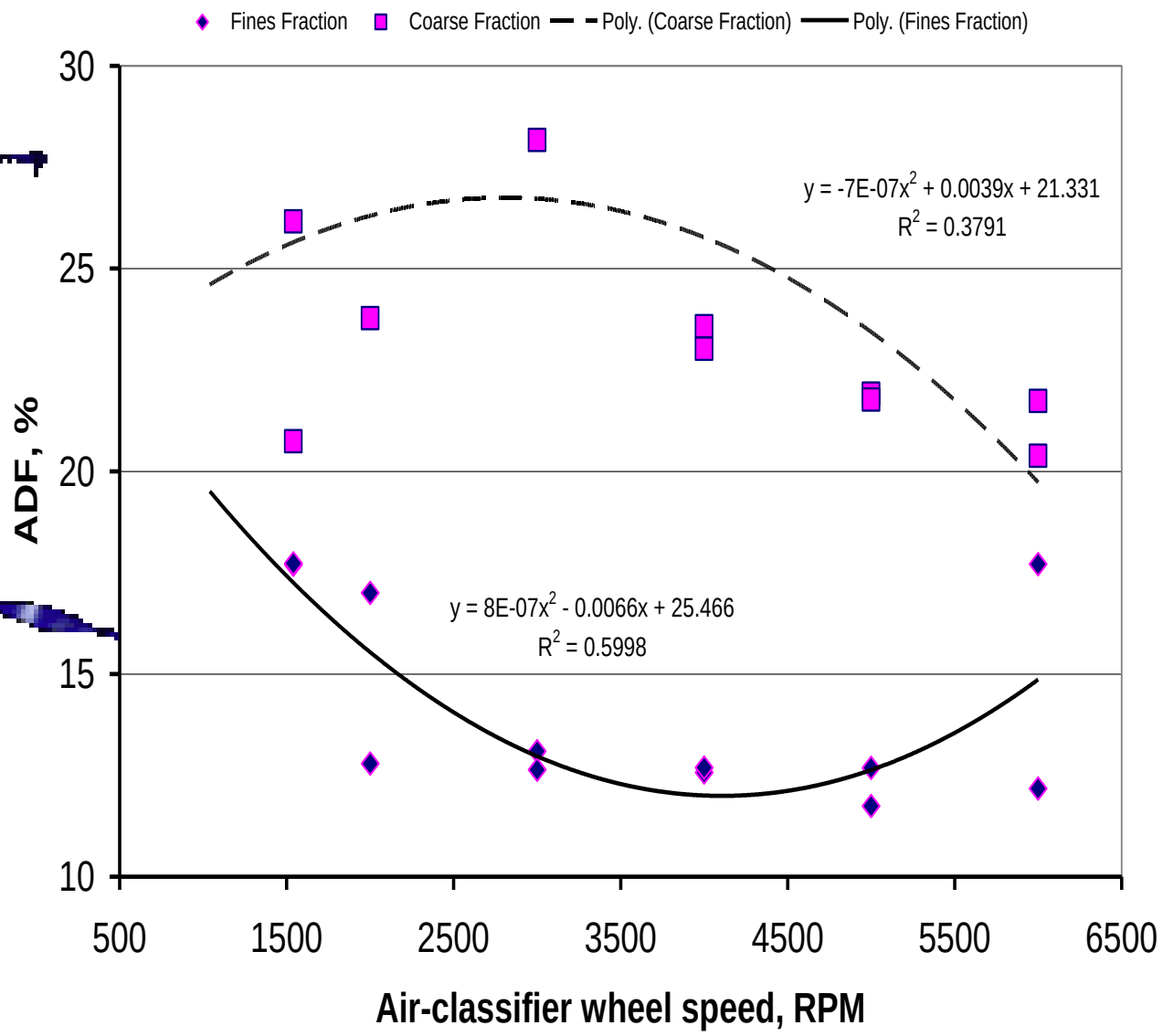
	Yield, %	Protein, %	ADF, %	NDF, %
> 600 µm	66.80	41.48	14.60	22.26
< 600 µm	10.80	43.67	12.77	19.06
< 425 µm	12.20	46.65	8.11	13.02
< 250 µm	8.20	47.68	7.23	11.43

Beltranena 2010, unpublished

Alberta Agriculture and Rural Development ©

Air-Classification of SE *B. napus*

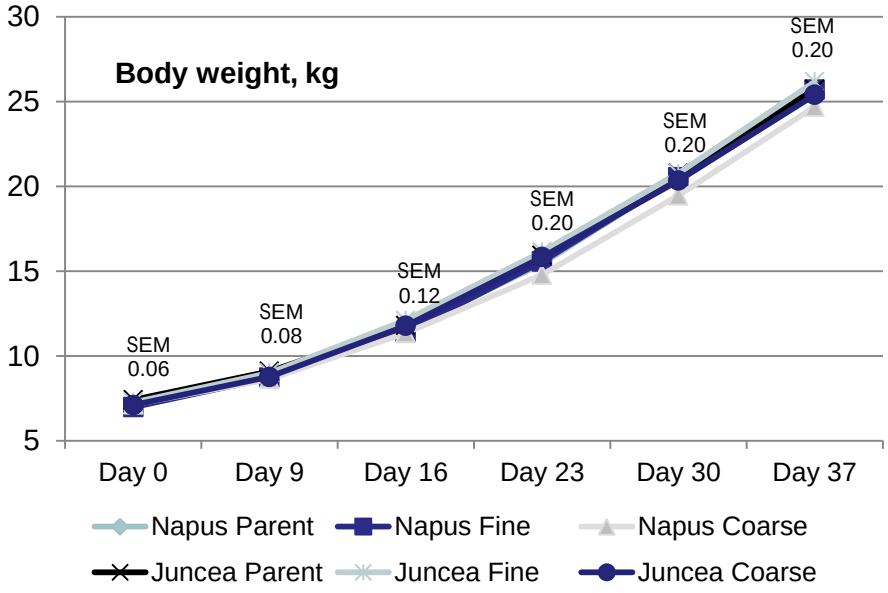


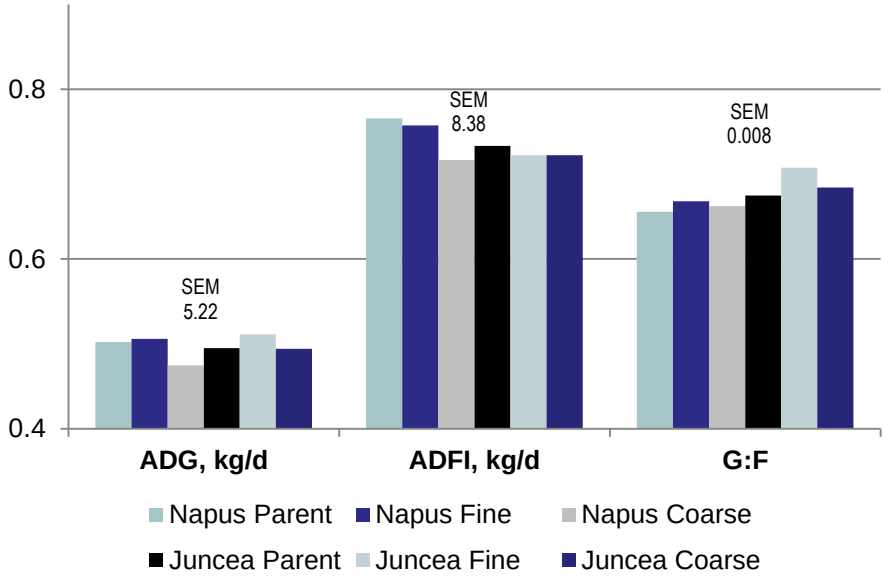


Alberta Agriculture and Rural Development ©

Feeding Air-Classified Fractions to Weaned Pigs

%, as is	*B. napus* parent stock	*B. napus* fine fraction	*B. napus* coarse fraction	*B. juncea* parent stock	*B. juncea* fine fraction	*B. juncea* coarse fraction
Crude protein	39.21	41.92	37.33	38.39	40.99	37.20
Crude fat	2.20	4.10	2.07	1.81	3.18	1.71
Crude fiber	9.72	0.26	8.73	6.81	0.37	8.35
ADF	**20.12**	**13.13**	**25.58**	**12.88**	**8.58**	**16.52**
NDF	**27.22**	**20.60**	**31.52**	**20.36**	**13.64**	**23.48**
Av. lysine	**1.81**	**2.22**	**1.94**	**1.83**	**1.92**	**1.67**
Glucosinolates, umol/g	6.39	4.71	3.92	11.69	9.83	8.97





Zhou, et al 2012 –Group 1 and 2 preliminary data

Alberta Agriculture and Rural Development ©

Expeller-Pressed Canola Meal

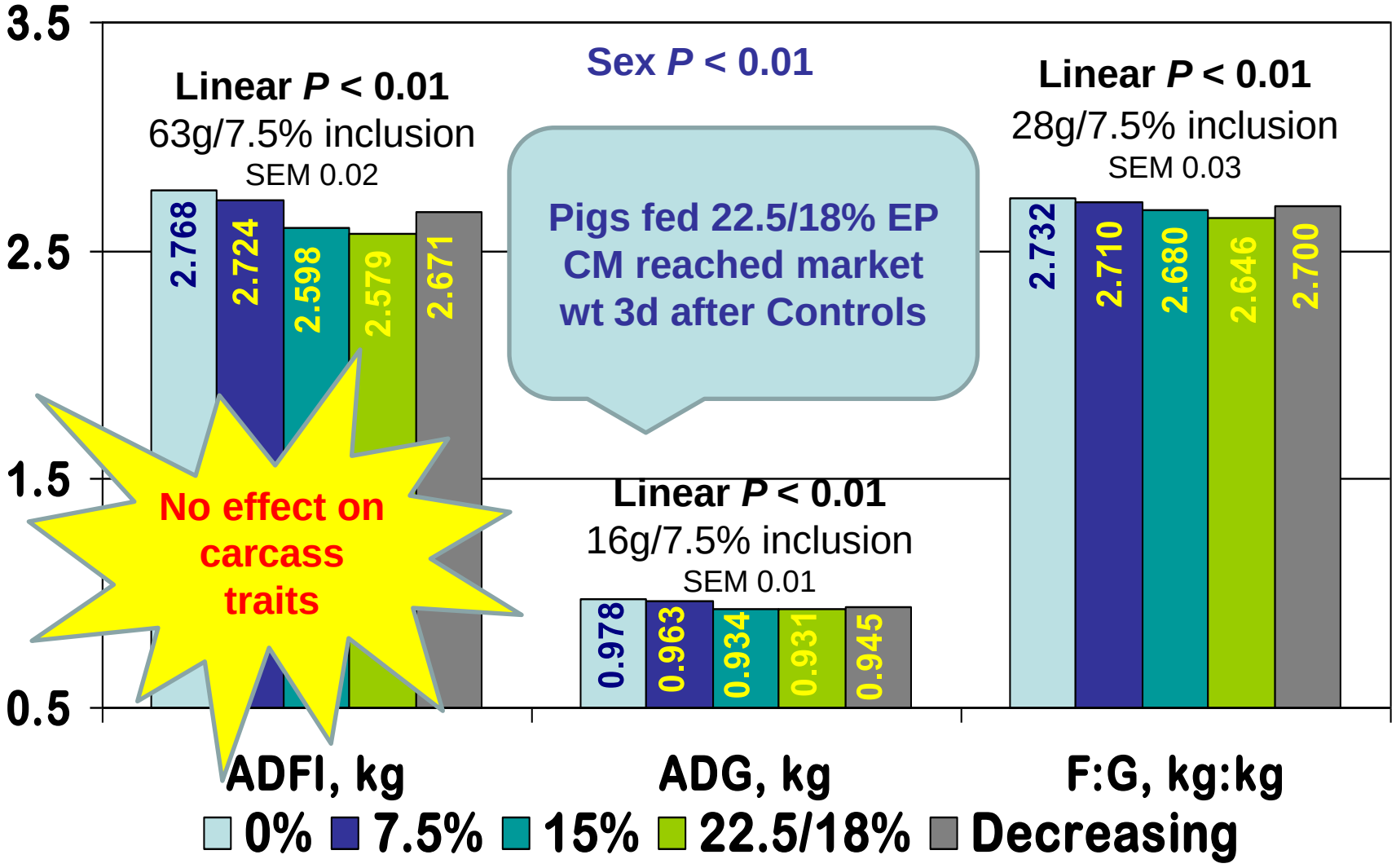
93.5% DM	Expeller-pressed[1]
Crude protein	35.27
Ether extract	**12.63**
Ash	6.55
ADF	15.93
NDF	19.98
Calcium	0.59
Phosphorus	1.03
Amino acids:	
Lysine	2.09
Avail. lysine	1.95
Methionine	0.68
Cysteine	0.85
Threonine	1.51
Tryptophan	0.52

Viterra, Ste. Agathe, MB

- Pre-heated
- 2x pressed

Alberta Agriculture and Rural Development ©

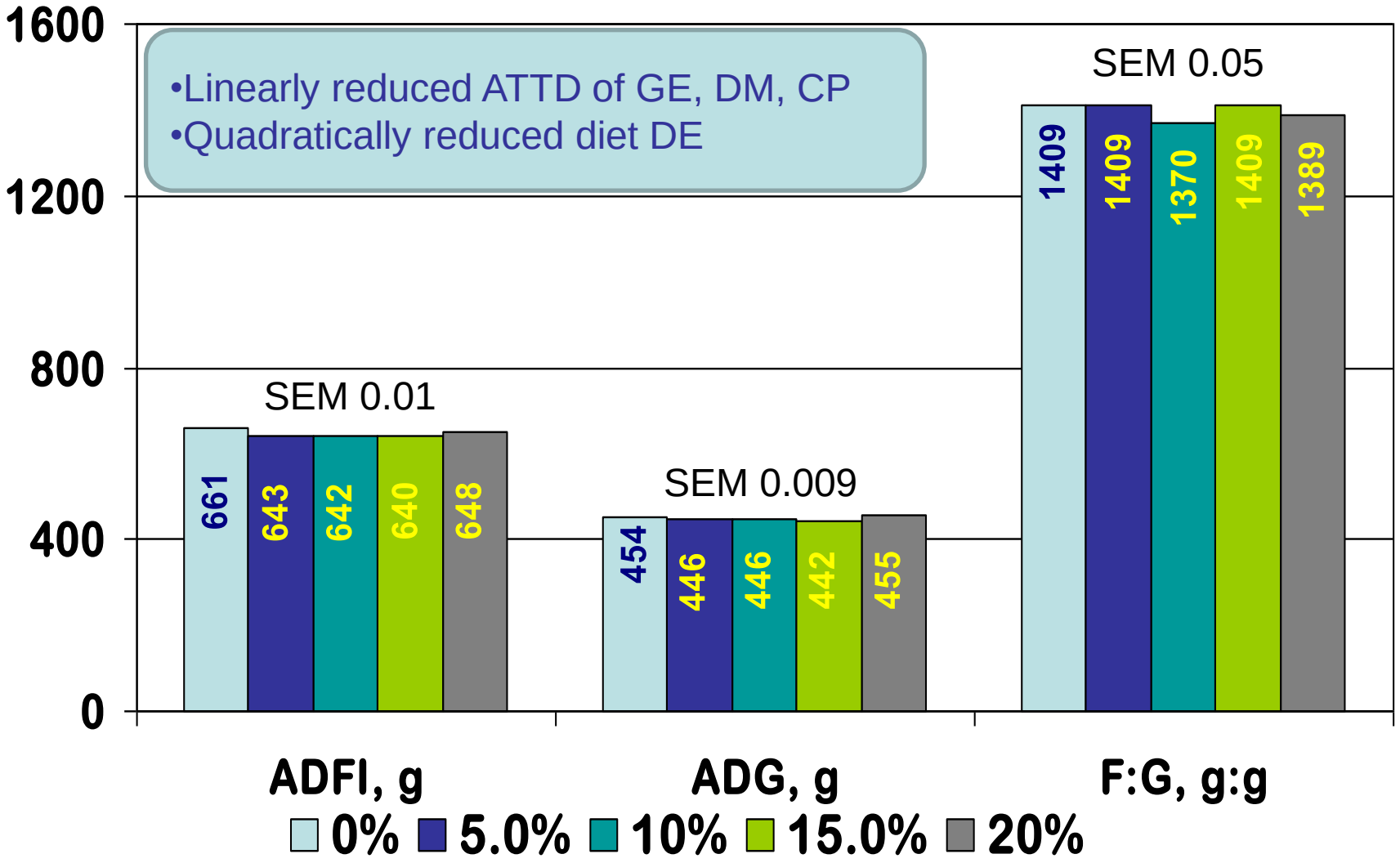
Feeding Expeller-Pressed Canola Meal at Increasing/Decreasing Levels to 1100 Hogs



Seneviratne et al. 2010 JAS 88:2073-2083

Alberta Agriculture and Rural Development ©

Feeding Expeller-Pressed Canola Meal at Increasing Levels to Weaned Pigs



Landero et al. 2012 Anim. Feed Sci. Technol. 171:240-245

Alberta Agriculture and Rural Development ©

Extruded + Pressed Canola Meal

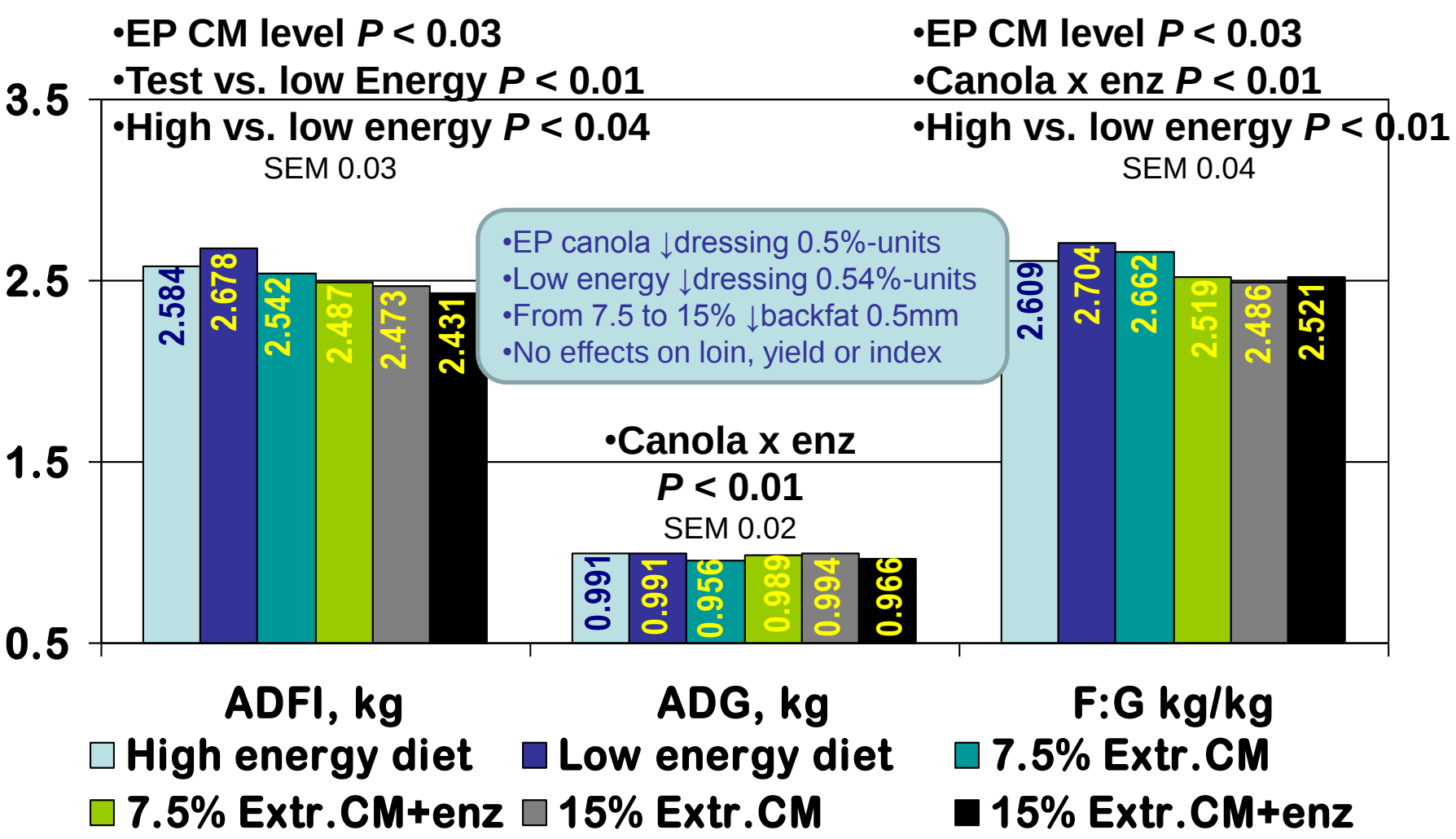
93.5% DM	Expeller-pressed[1]	**Extruded +pressed[2]**
Crude protein	35.27	29.86
Ether extract	**12.63**	**17.31**
Ash	6.55	7.22
ADF	15.93	22.58
NDF	19.98	28.09
Calcium	0.59	0.60
Phosphorus	1.03	0.82
Amino acids:		
Lysine	2.09	1.21
Avail. lysine	1.95	1.04
Methionine	0.68	0.55
Cysteine	0.85	0.71
Threonine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

[1]Viterra, Ste. Agathe, MB

[2]Cansource Bioproducts, Mayerthorpe, AB

Alberta Agriculture and Rural Development ©

Feeding Extruded + Pressed Canola Meal and Enzyme to 1100 Hogs



Young et al. 2011

Alberta Agriculture and Rural Development ©

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

Alberta Agriculture and Rural Development ©

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

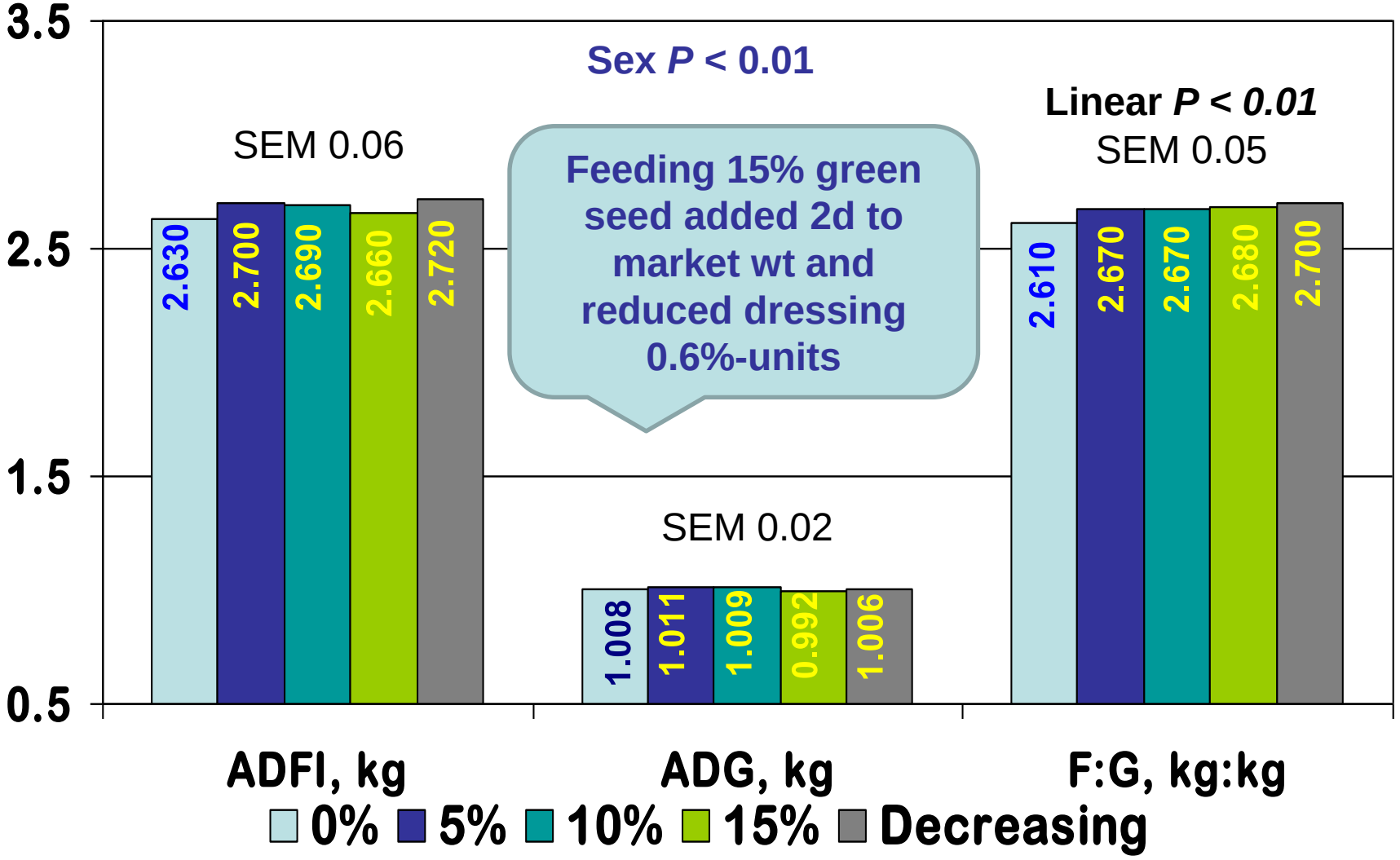
Alberta Agriculture and Rural Development ©

Green Canola Seed

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

Alberta Agriculture and Rural Development ©

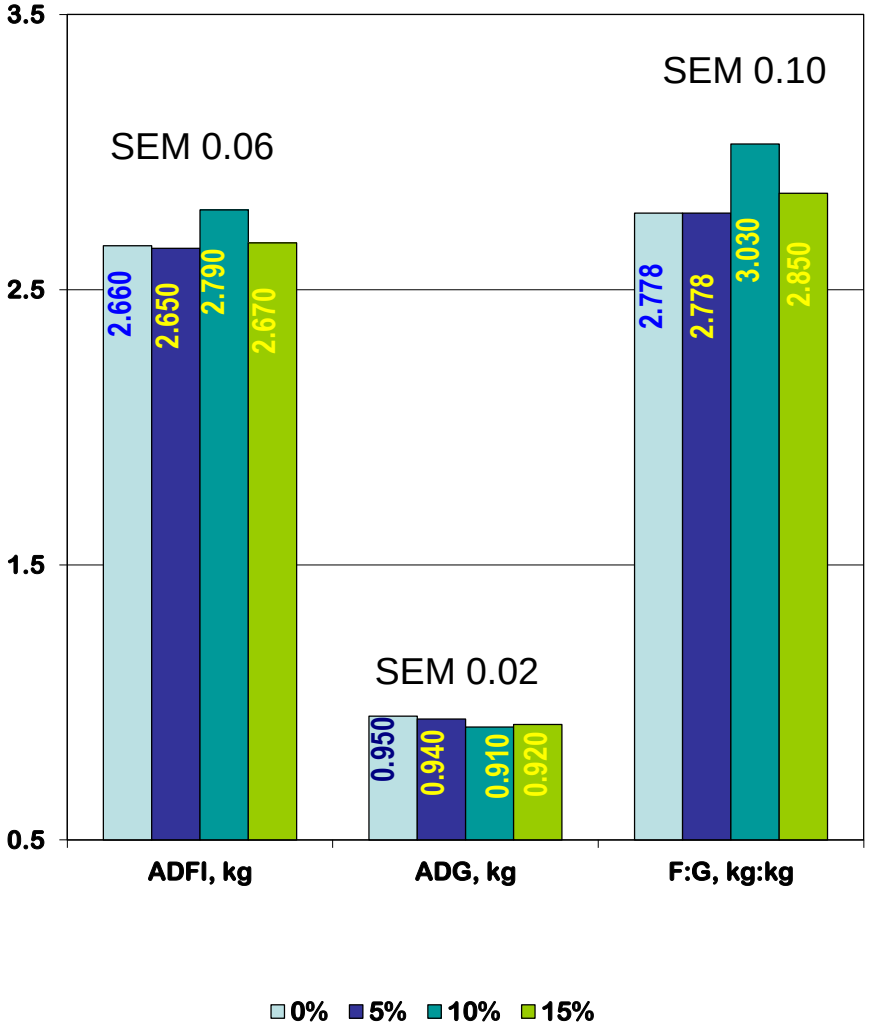
Feeding Green Canola Seed at Increasing/Decreasing Levels to 1100 Hogs

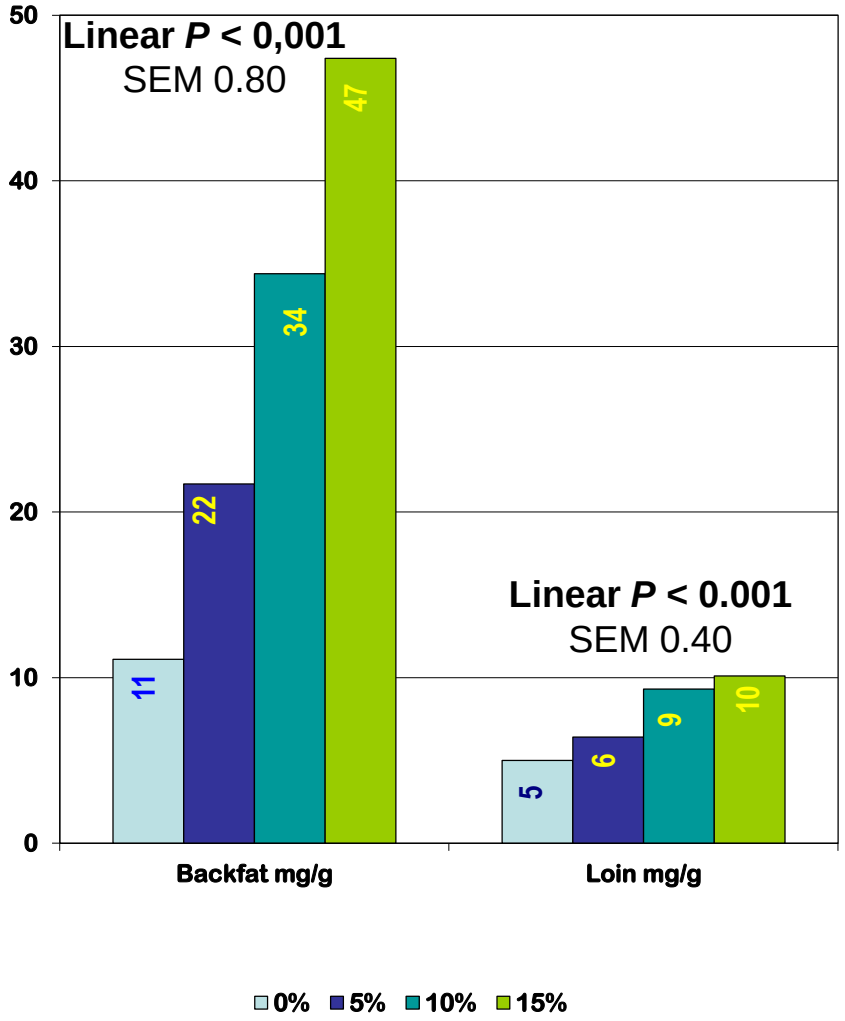


Young et al. 2011

Alberta Agriculture and Rural Development ©

Feeding Flax Meal at Increasing Levels to Hogs –Performance, ALA





Eastwood and Beaulieu, Centre on Swine Spring 2010

Alberta Agriculture and Rural Development ©

Feeding Coextruded Flaxseed and Field Pea on Sensory Attributes

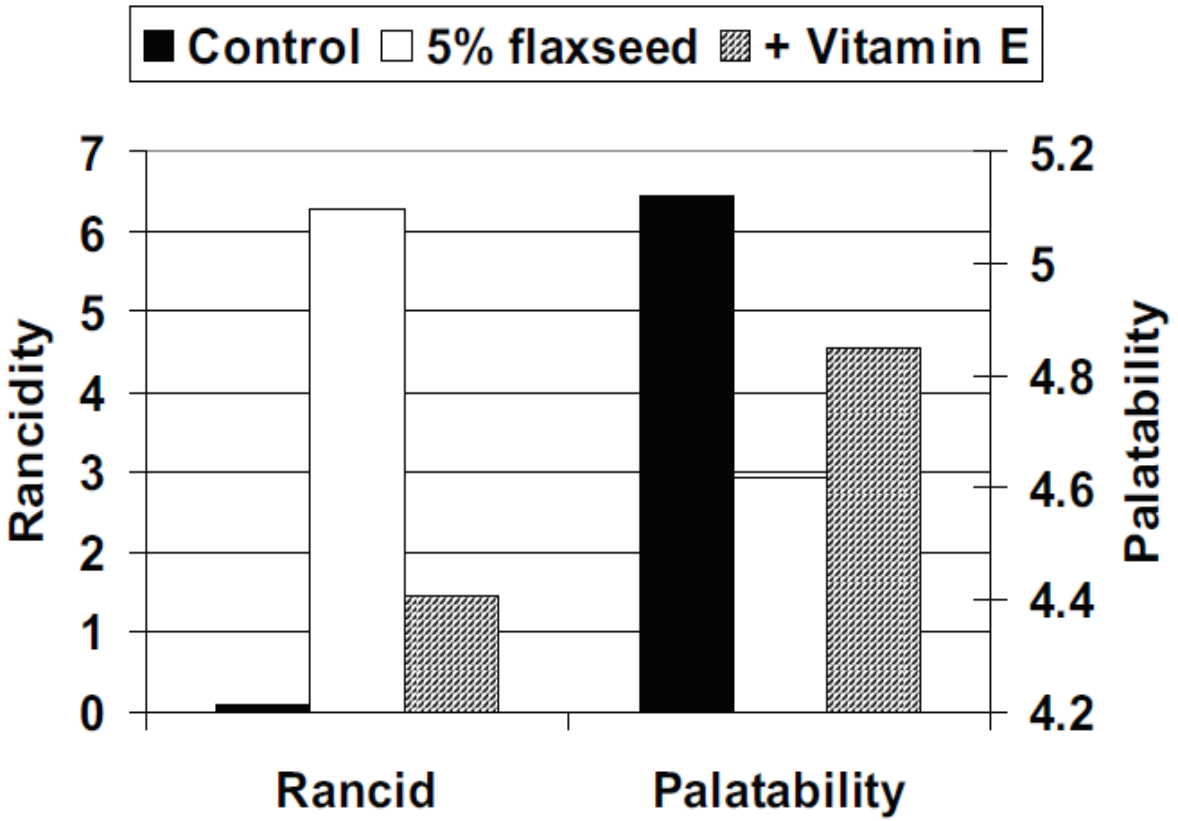


Figure 1. Sensory analysis of burgers. Rancidity is reported as the percentage of panelists reporting meat with this attribute. Palatability is measured on a 9-point scale where 1 = extremely undesirable and 9 = extremely desirable (a, b. $P < 0.05$)

Beaulieu, D., M.E.R. Dugan, M. Juarez. 2009 PSCI Annual Report

Alberta Agriculture and Rural Development ©

Camelina

- Omega-3 fatty acids
- Oil is rich in 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

Alberta Agriculture and Rural Development ©

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 ?
  - Antinutritional factors - Consistent product ?

Alberta Agriculture and Rural Development ©

Conclusions

- **$/Mcal NE of residual oil**
- Payback > energy dependent phase
- Dietary inclusion to increase IOFC
- Co-product variability issues
- Soft fat issues vs. fatty acid enrichment
- Withdrawal fibrous feedstuffs from finisher
- Proper fasting prior to slaughter

Alberta Agriculture and Rural Development ©

Acknowledgments

- Matt Oryschak
- Malachy Young
- Neil Campbell
- Gregorio Lanz
- Rex Newkirk
- Ruwani Seneviratne
- Jose Luis Landero
- Arnoud Buchet
- Xun Zhou

Alberta Agriculture and Rural Development ©