Feeding Western Canadian Co-Products to Monogastrics

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Government of Alberta

Alberta

Freedom To Create. Spirit To Achieve.


Feed is the highest
cost of production

Western Canadian Feedstuffs 2012 August Estimates

	Production	Supply	Exports	Issues
Wheat 3 tonnes/ha $305 - 335	22Mt, ↑**4%** -seeding 22%↑wnt8%↑spg	26.8Mt, ↓**3%**	14.5Mt, ↑**5%** - US drought - ↓ world supply	**-industrial use is record high** **-lower feed use**
Barley 3.25 tonnes/ha $205 - 235	8.6Mt, ↑**10%** -abandonment -lower yields	9.3Mt, ↑**1.0%**	1.8Mt, ↓**1%** Larger world malt supply	-flat livestock production -US drought
Canola 1.86 tonnes/ha $630 - 670	15.7Mt, ↑**13%** **-record seeding** -lower yields	13.5Mt, ↑**3%**	9Mt, ↑**1%** **Record exports** **Strong world demand**	**-more crushing** **-carry-out stocks tight**
Peas 2.23 tonnes/ha $265 - 295	3.0Mt, ↑**45%** -abandonment -lower yields	3.2Mt, ↑20%	2.4Mt, ↑**14%** -China, Indian subcontinent	-yellow and feed pea prices ↓

www.agr.gc.ca/gaod-dco/

Oilseeds

- Canola
  - Canola contributes >$15B
  - $6B in farm cash receipts
- Flax
- Camelina

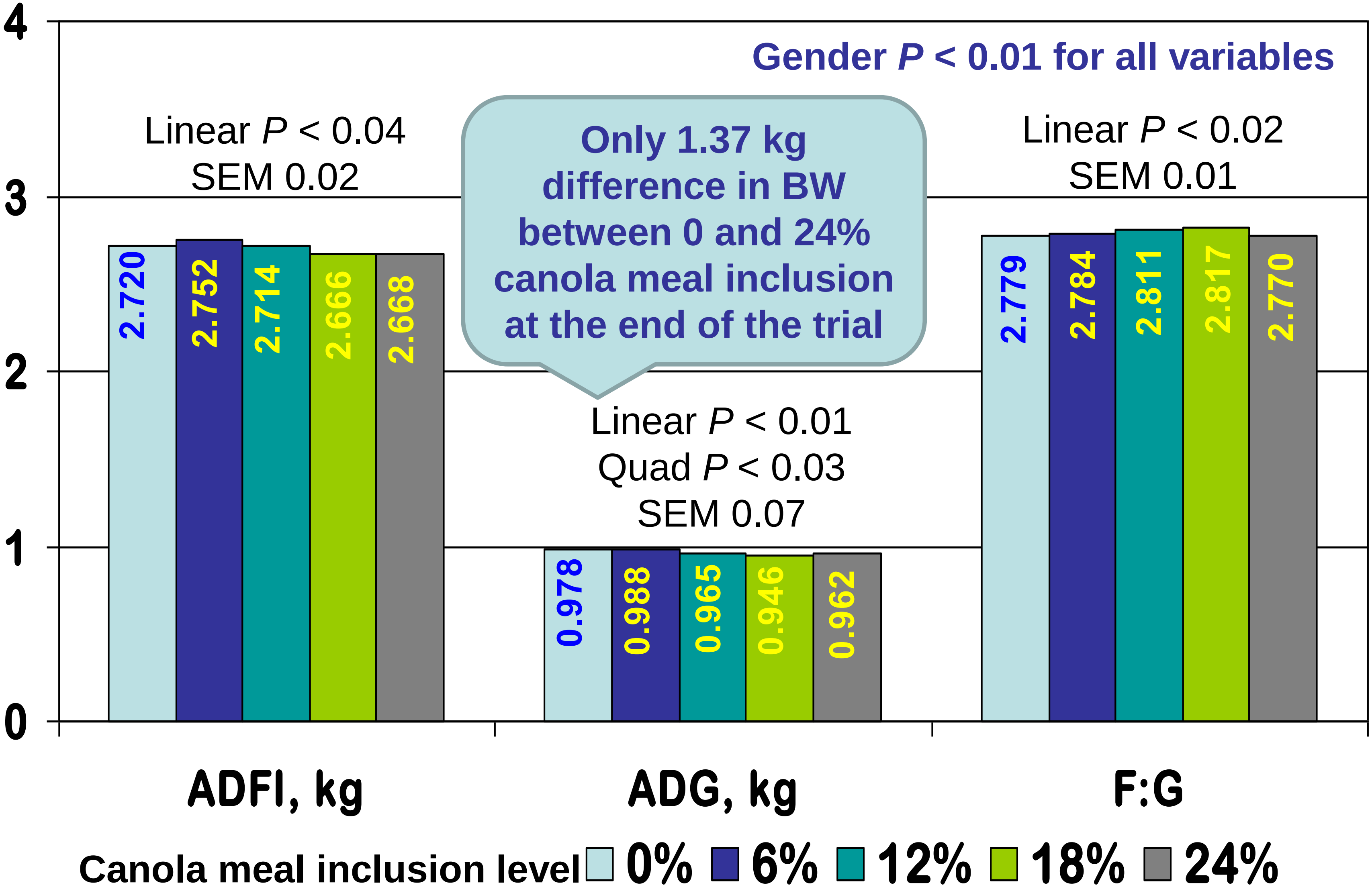
Feeding Canola Co-products

- Solvent-extracted canola meal
- Expeller-pressed
- Extruded + pressed
- Crude glycerol

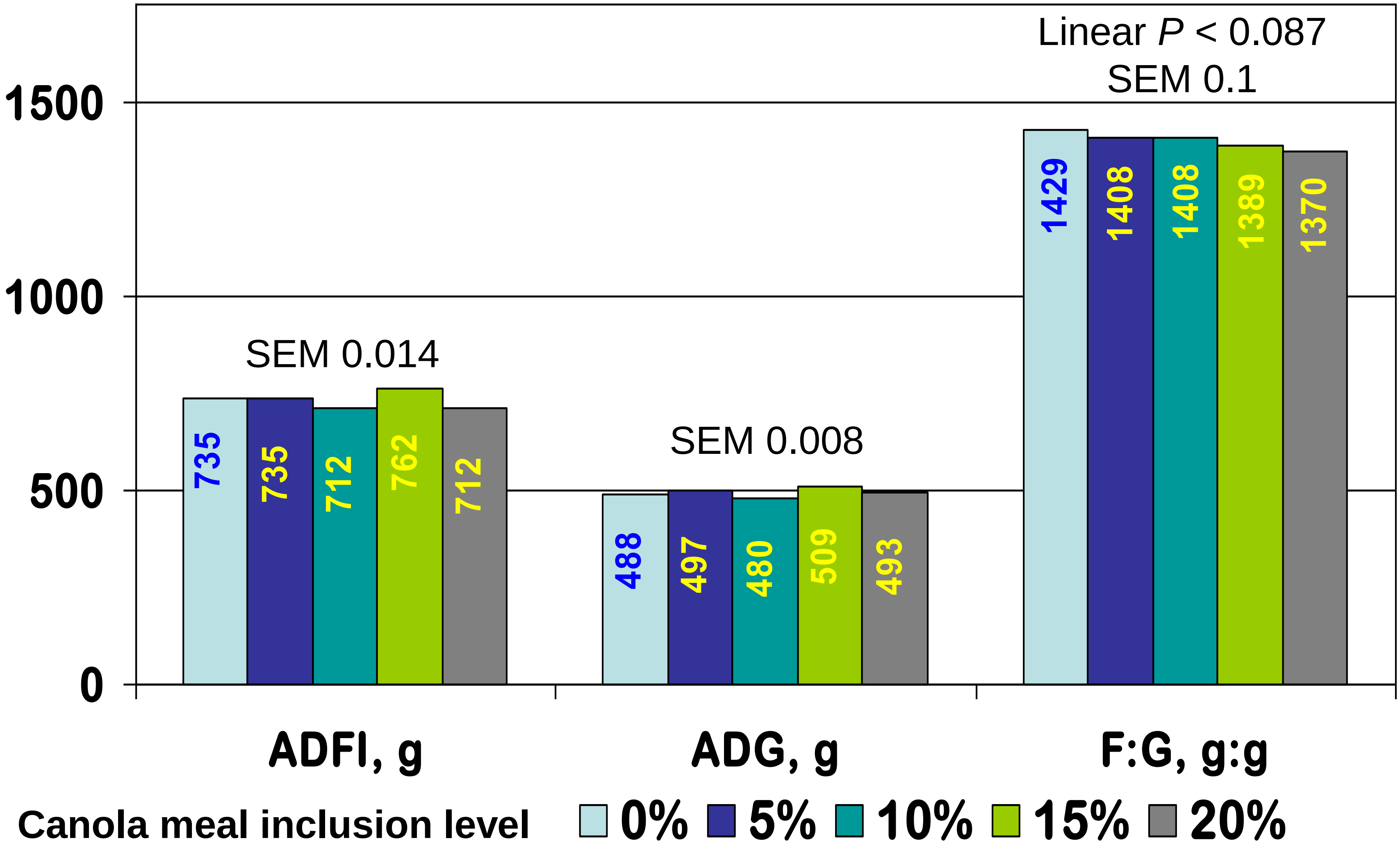
Pushing the Limits Feeding SE CM

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

Increasing Canola Meal Levels in Hog Diets



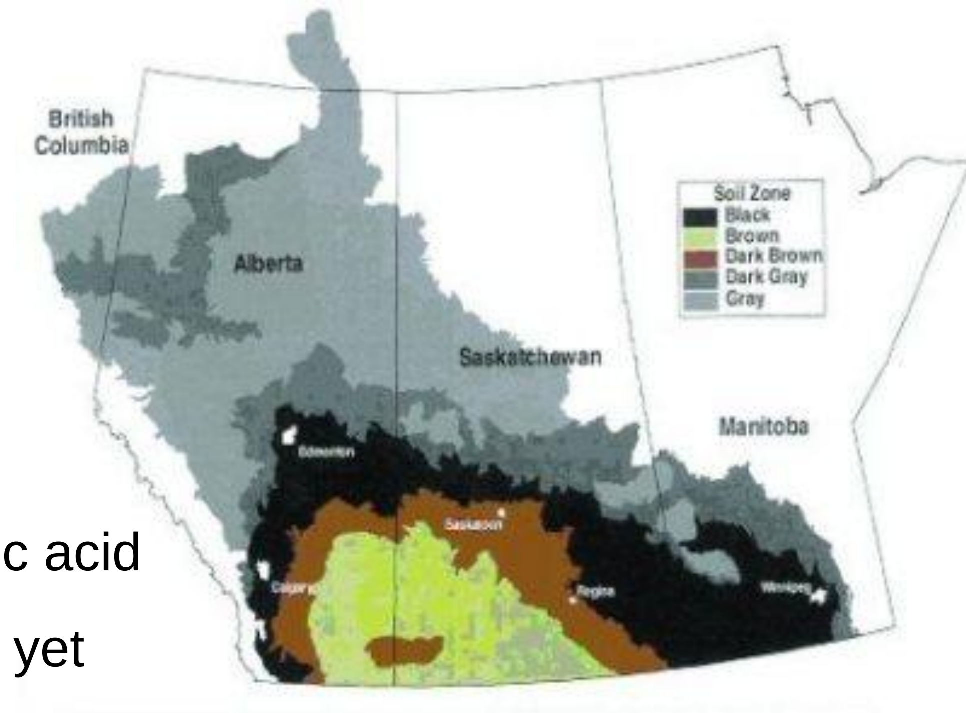
Increasing SE Canola Meal Levels in Nursery Diets for Weaned Pigs



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

Weaned Pig Preference

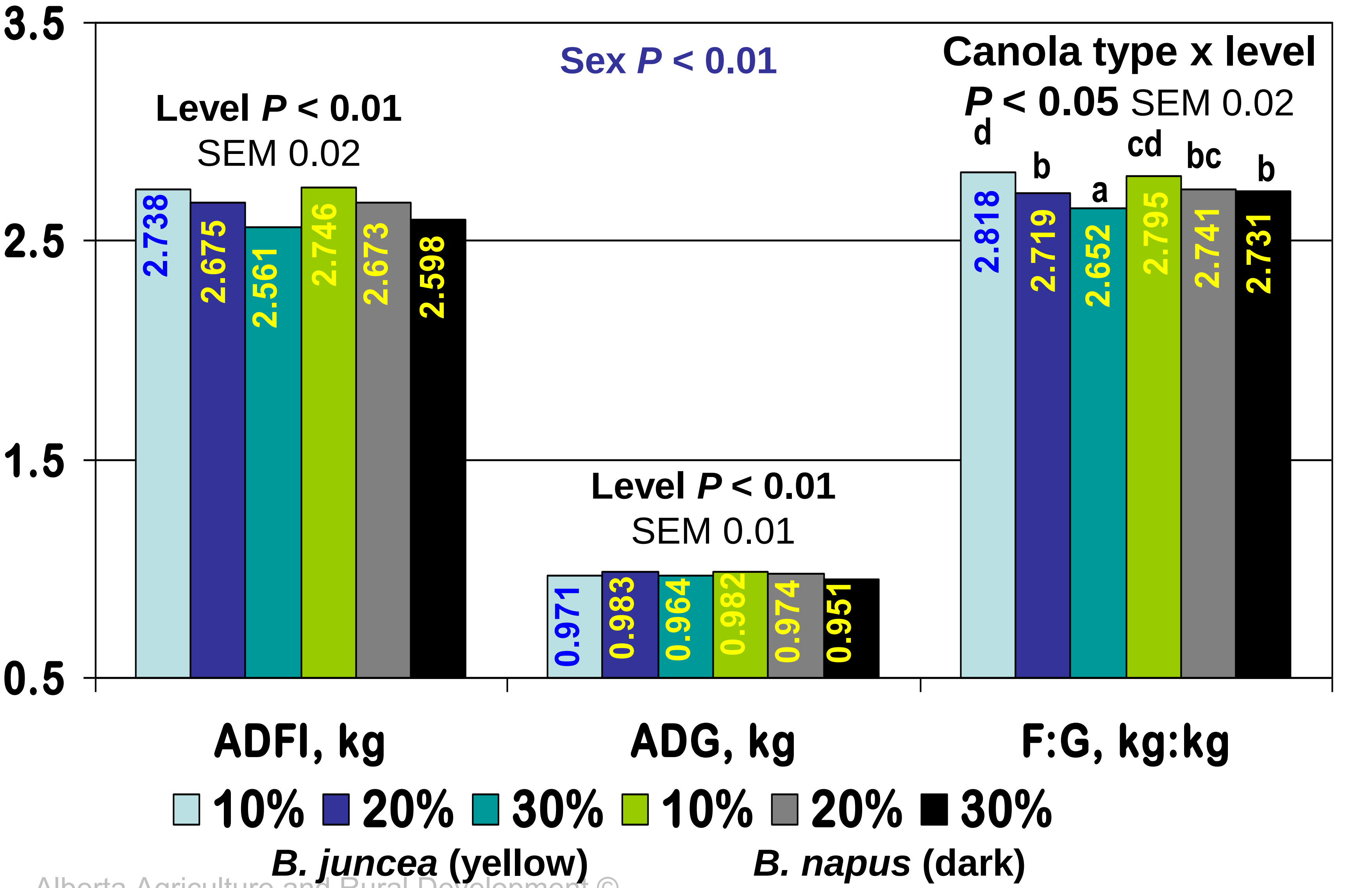
Day 0 to 4	Dark-seed *B. napus* or SBM		Yellow-seed *B. juncea* or SBM		Yellow-seed *B. juncea* or Dark-seed *B. napus*	
Exp. 1	.16	.84	.10	.90	.36	.64
Exp. 2	.14	.86	.12	.88	.23	.77

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

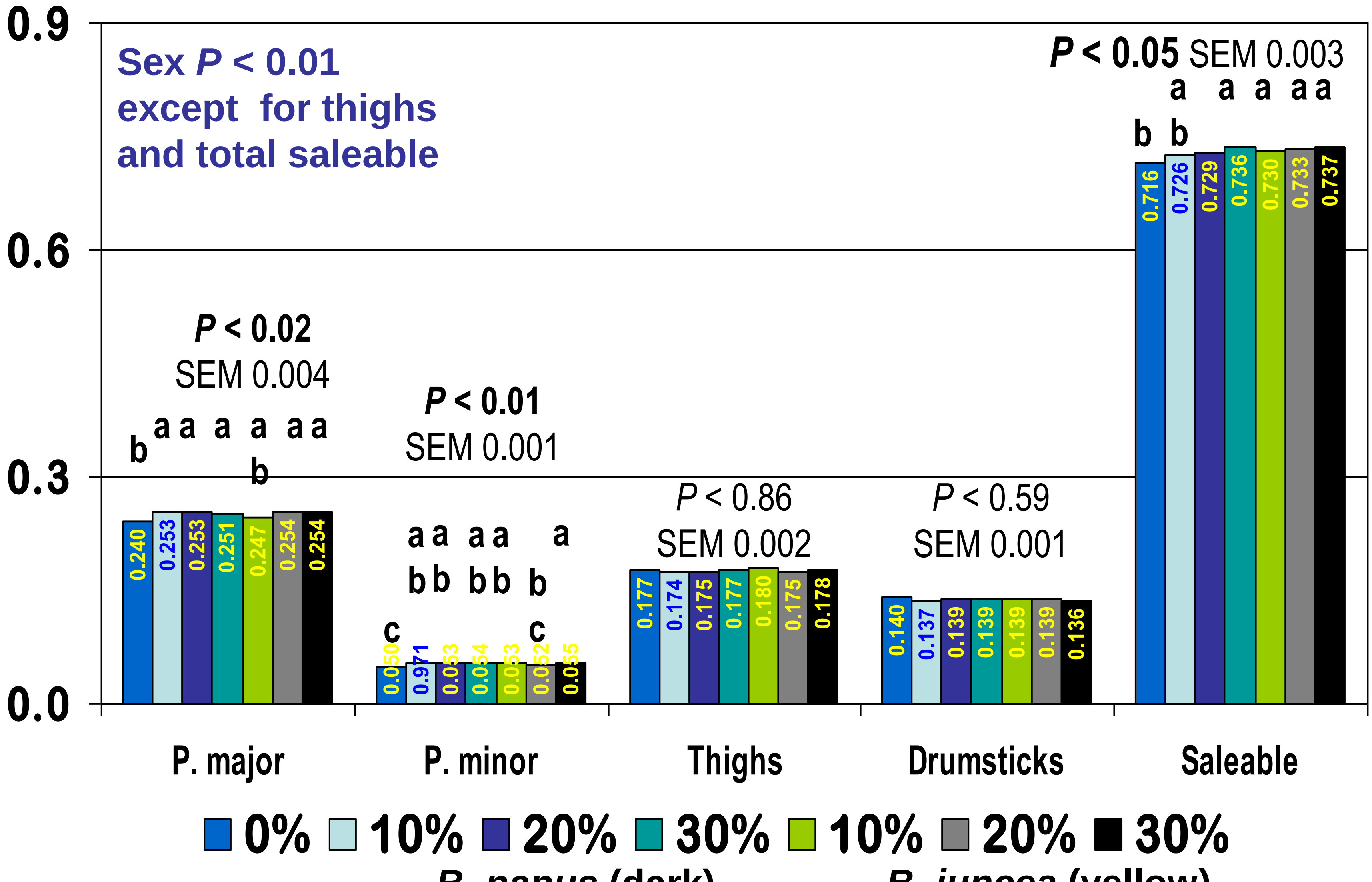
Feeding Yellow vs. Dark SE Canola Meal at Increasing Levels to 1100 Hogs



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*

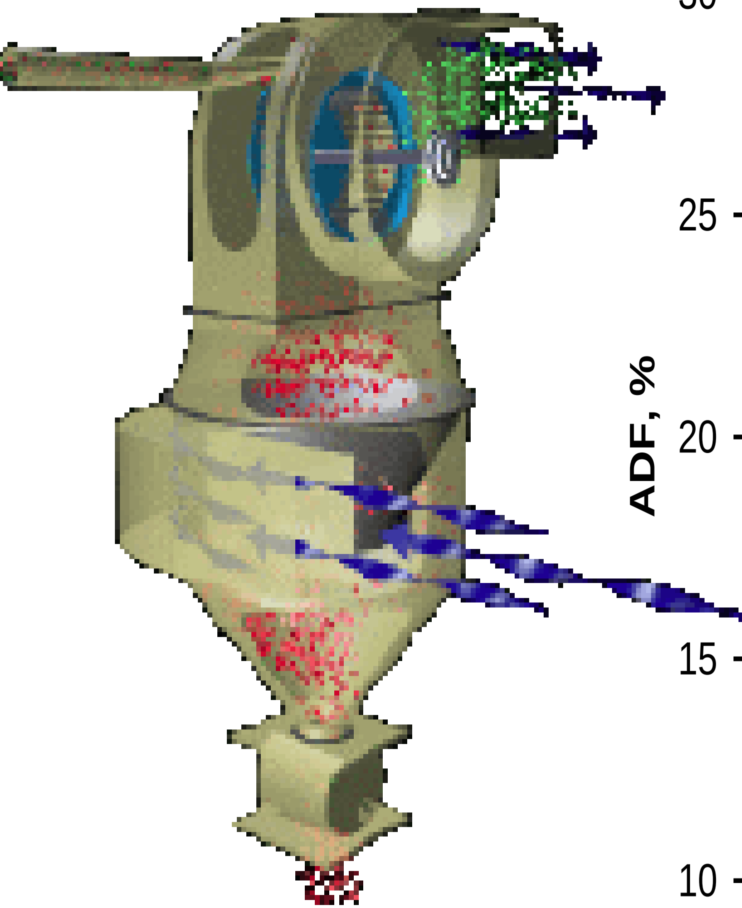
	Yield, %	Protein, %	ADF, %	NDF, %
> 850 µm	33.4	41.5	15.0	22.8
< 850 µm	20.1	40.6	14.9	23.6
< 600 µm	19.0	42.9	12.0	18.6
< 425 µm	23.9	47.0	7.6	11.8

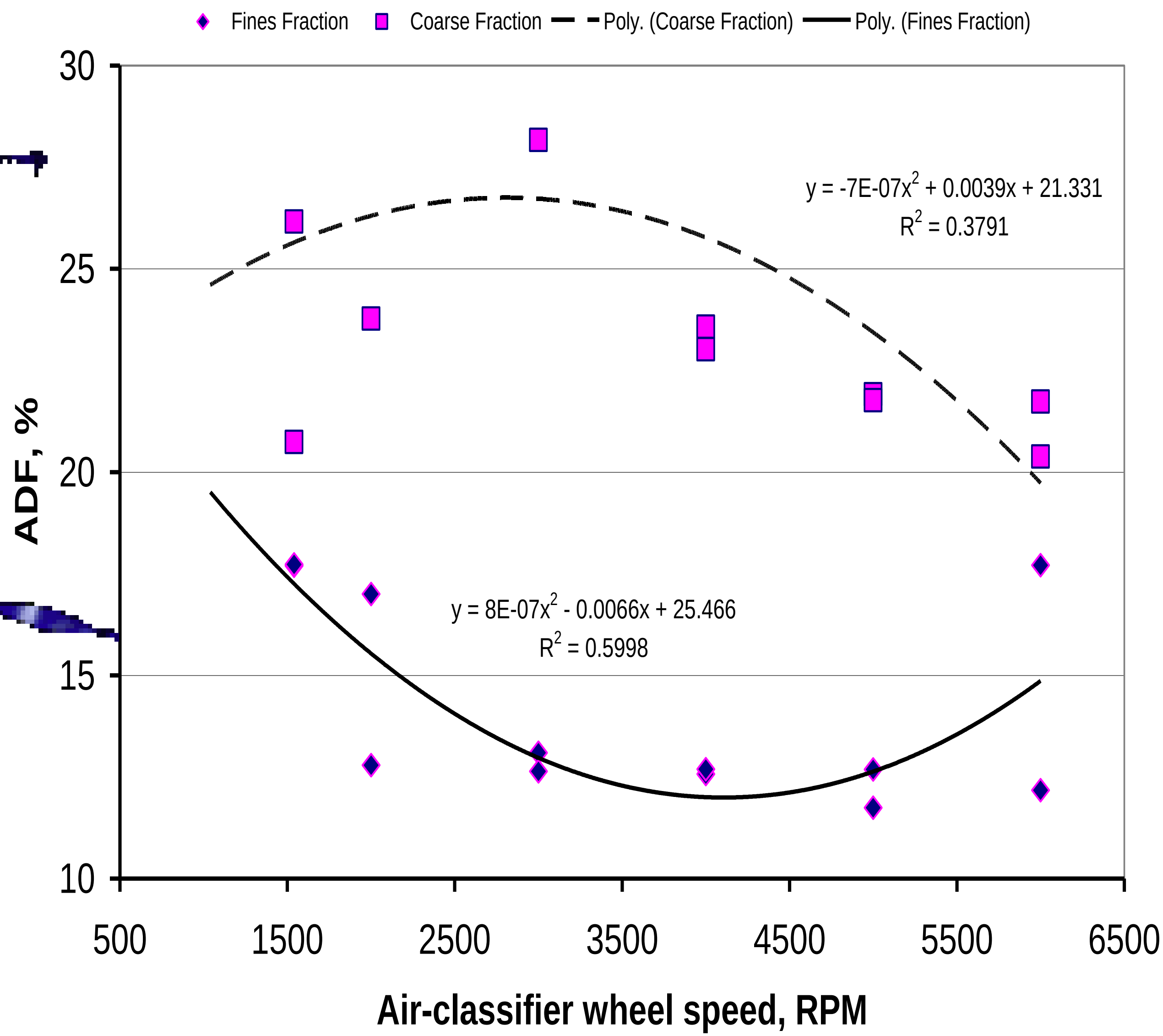
DM basis

	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

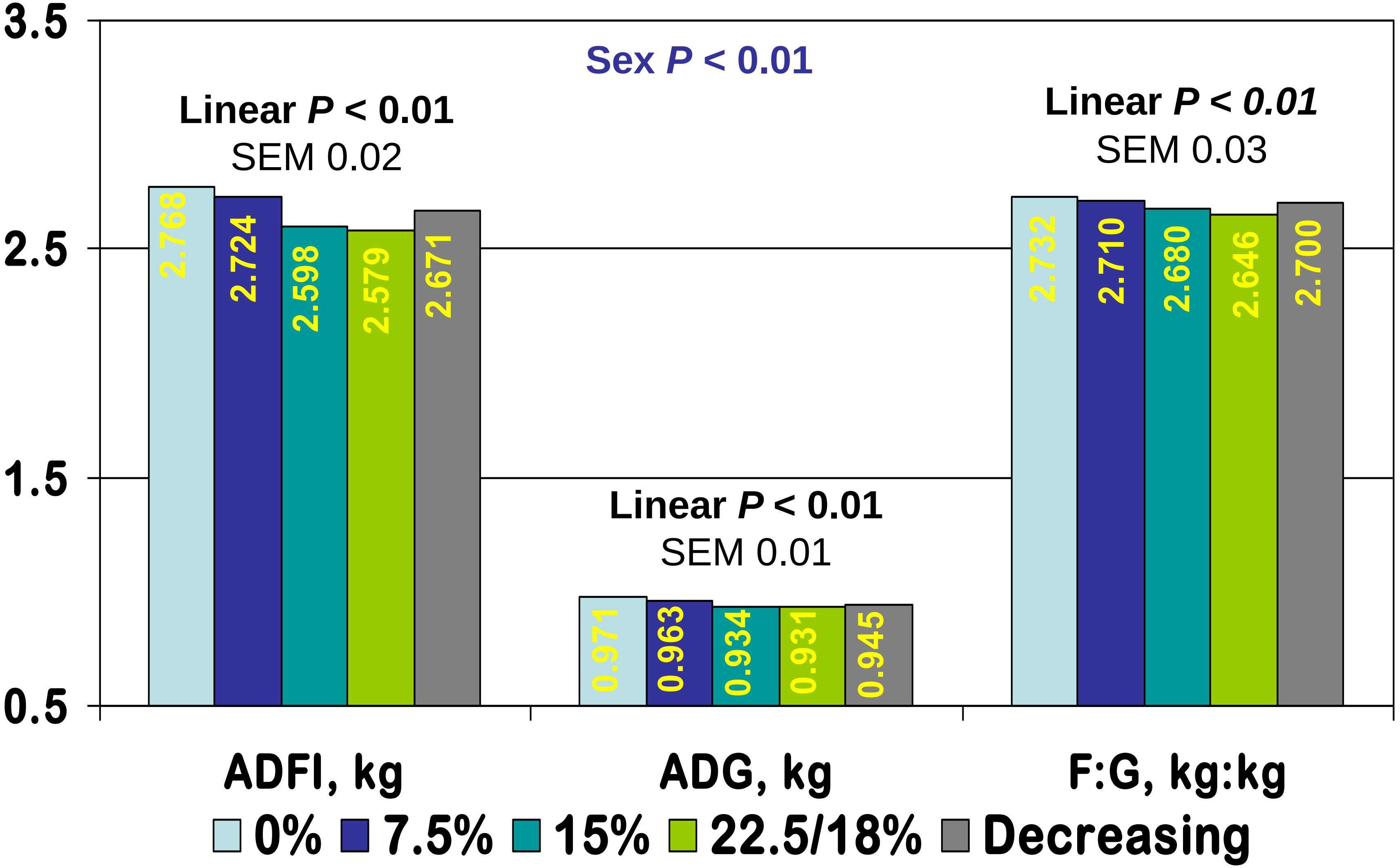
Broilers Ingr. AID%	Solvent-extracted	Fine-particle fraction	Coarse-particle fraction
DM	72.7	53.0	50.5
CP	101.4	91.6	96.3
Lys	88.7	85.9	87.4
Thr	82.7	74.4	79.1
Met	98.3	92.5	95.5

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

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

[2]Cansource Bioproducts, Mayerthorpe, AB

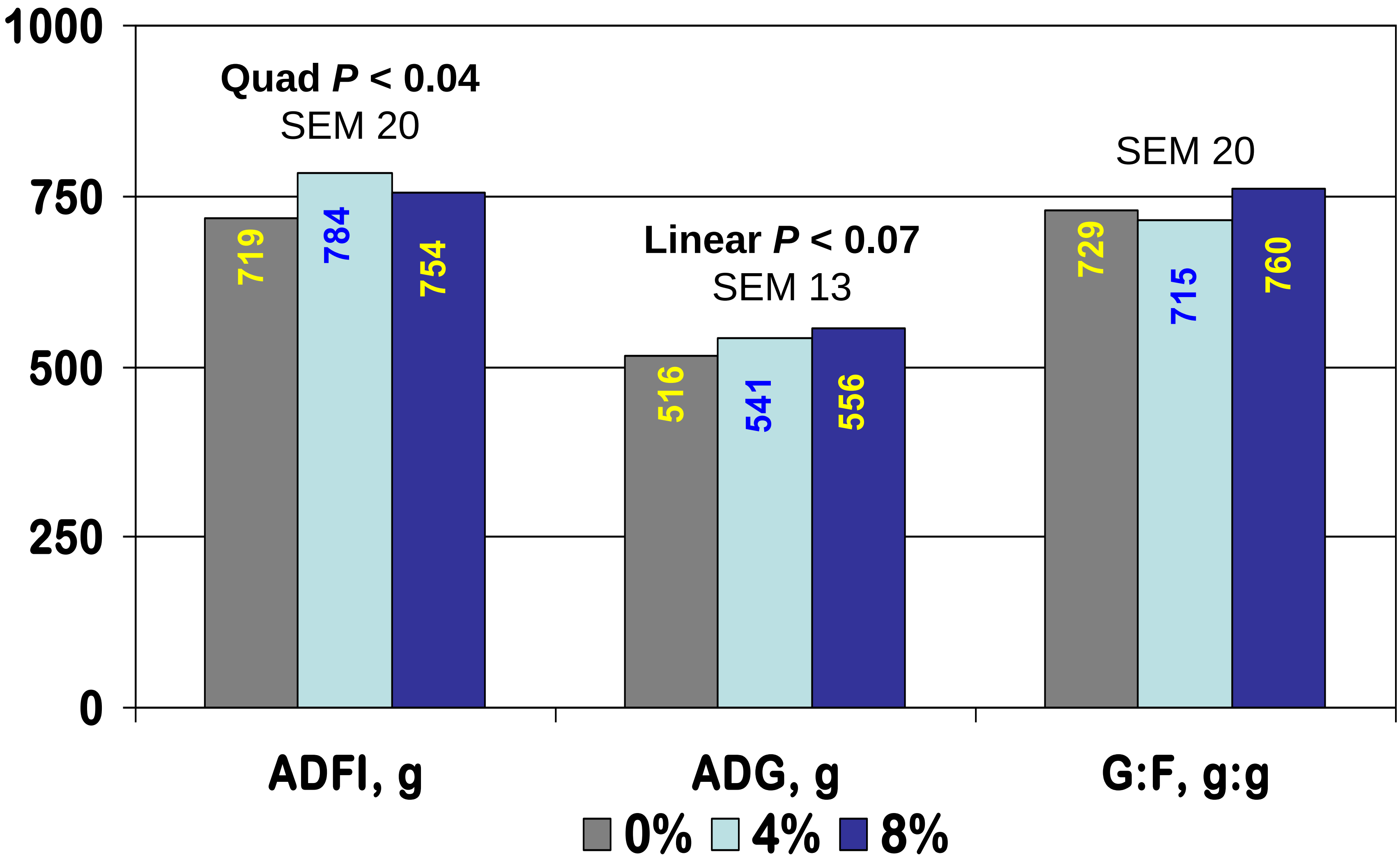
[1]Viterra, Ste. Agathe, MB

Feeding Crude Glycerol

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

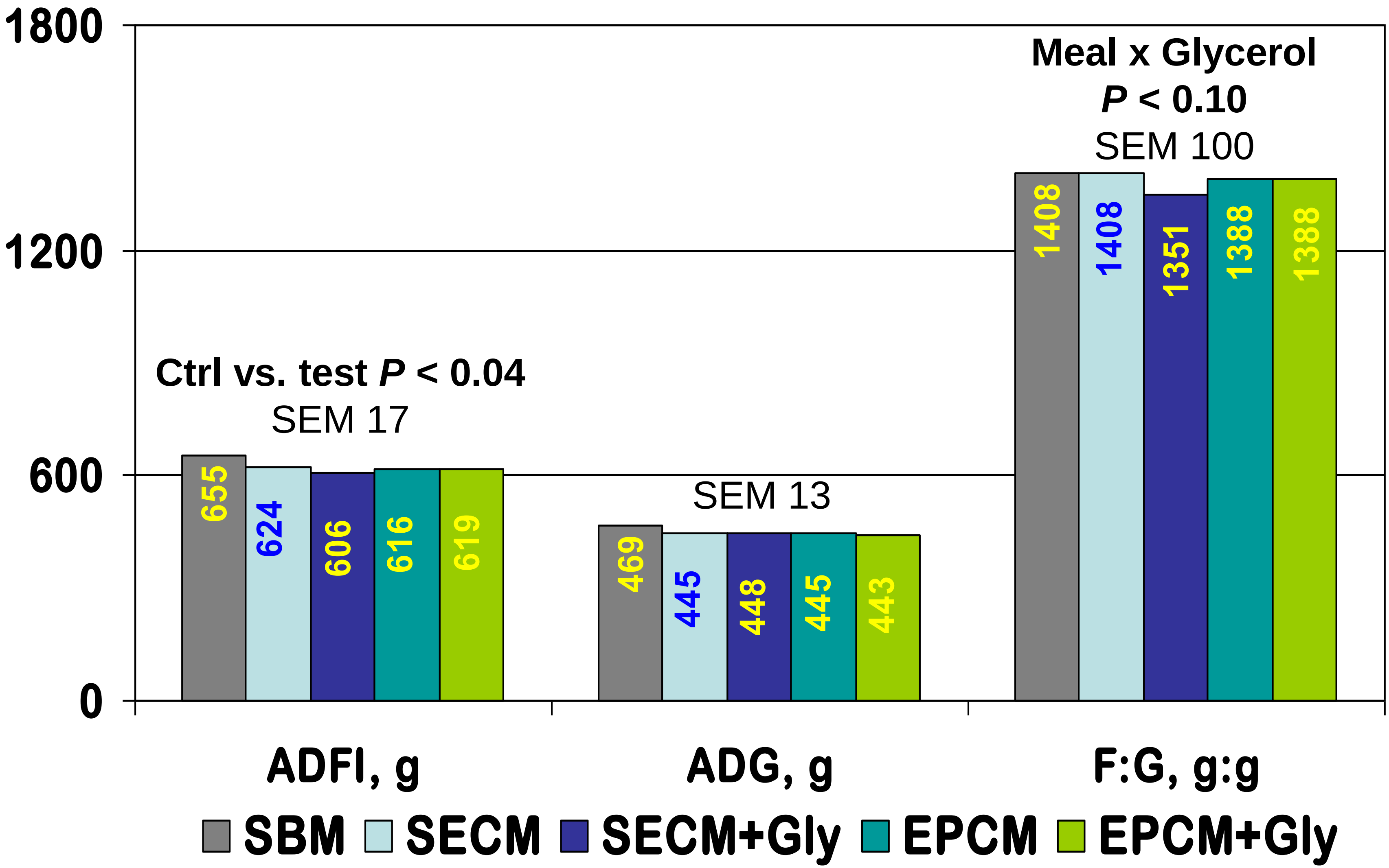
Crude glycerol	
Moist, %	15.2
EE, %	49.6
Ash, %	10.8
Methanol, %	0.02

Feeding Increasing Levels of Crude Glycerol to Weaned Pigs



Zijlstra et al. 2009

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 ?

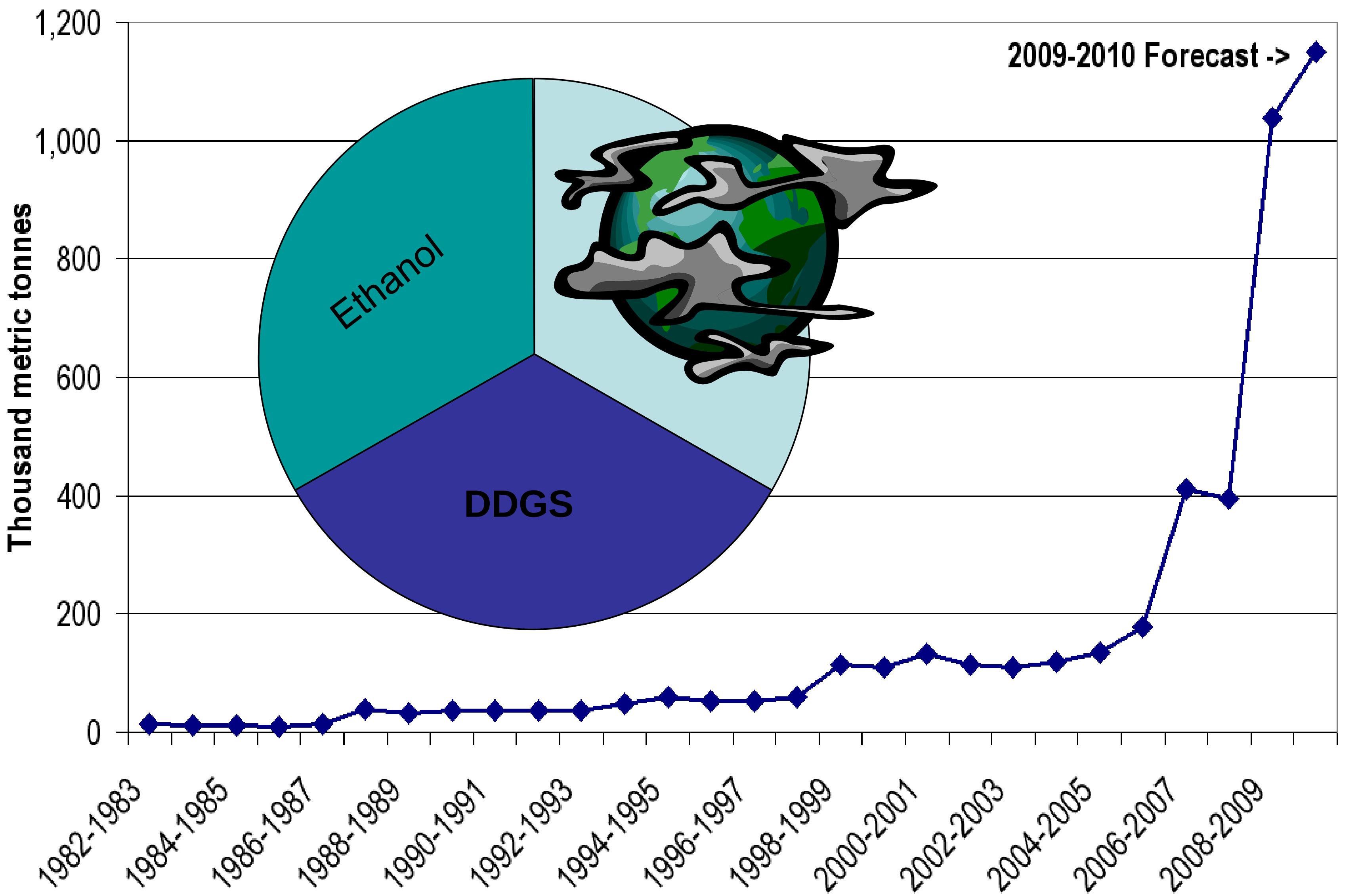
Conclusions

- 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

Distillers Dried Grains & Solubles (DDGS)

- What market signals?
- Ample supply of DDGS
- … Feed more?
- DDGS not perfect

Industrial Use of Wheat



www.agr.gc.ca/gaod-dco/

DDGS Research

- Wheat DDGS
- Corn DDGS
- Triticale DDGS
- Processing to enhance DDGS

Terra Grain Fuels

Wheat DDGS Levels of Inclusion

- 0%
- 7.5%
- 15%
- 22.5%
- 30%

to market weight

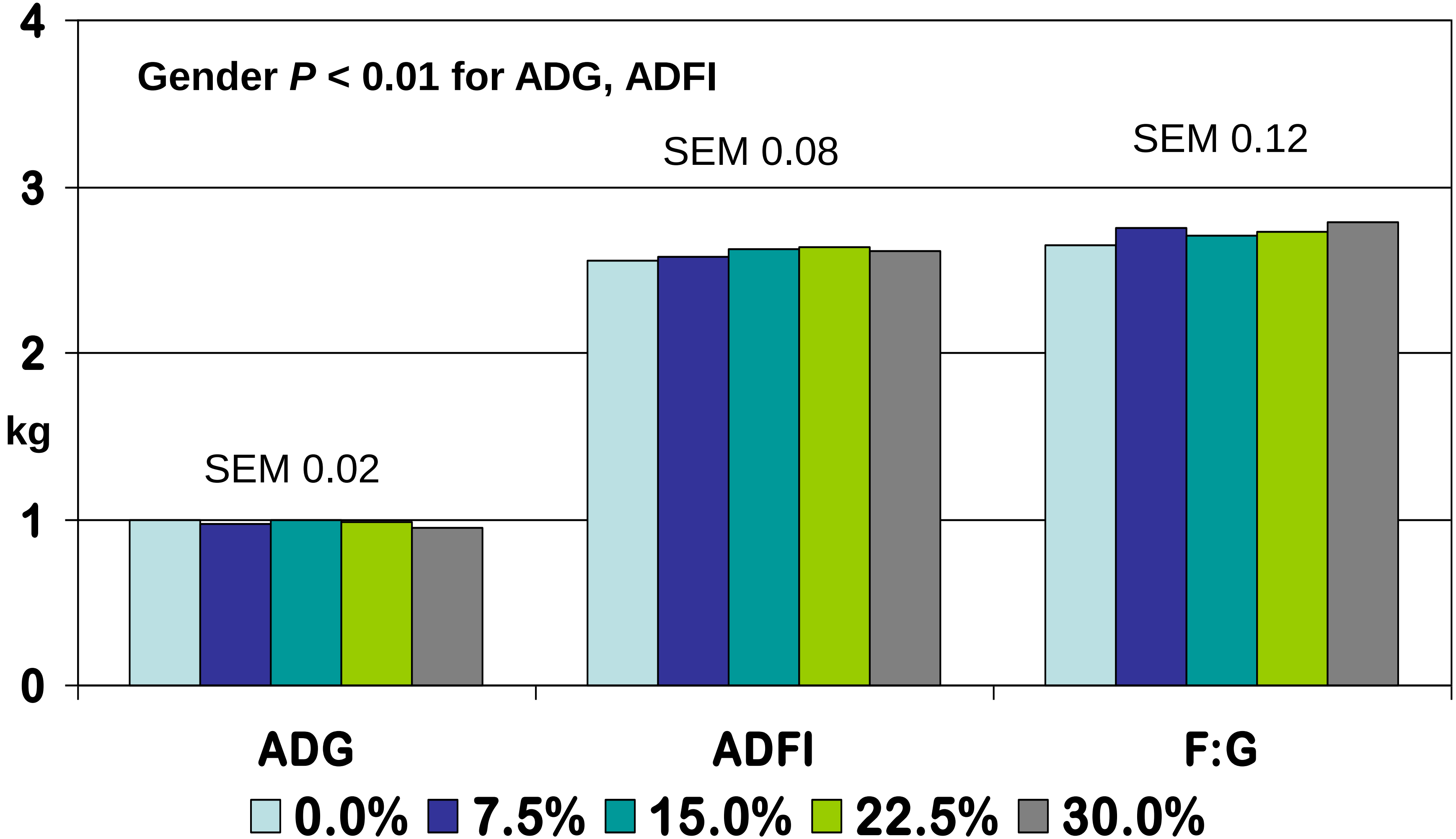
Drumloche Barn at Lougheed, AB

50 pens,
-25 per side

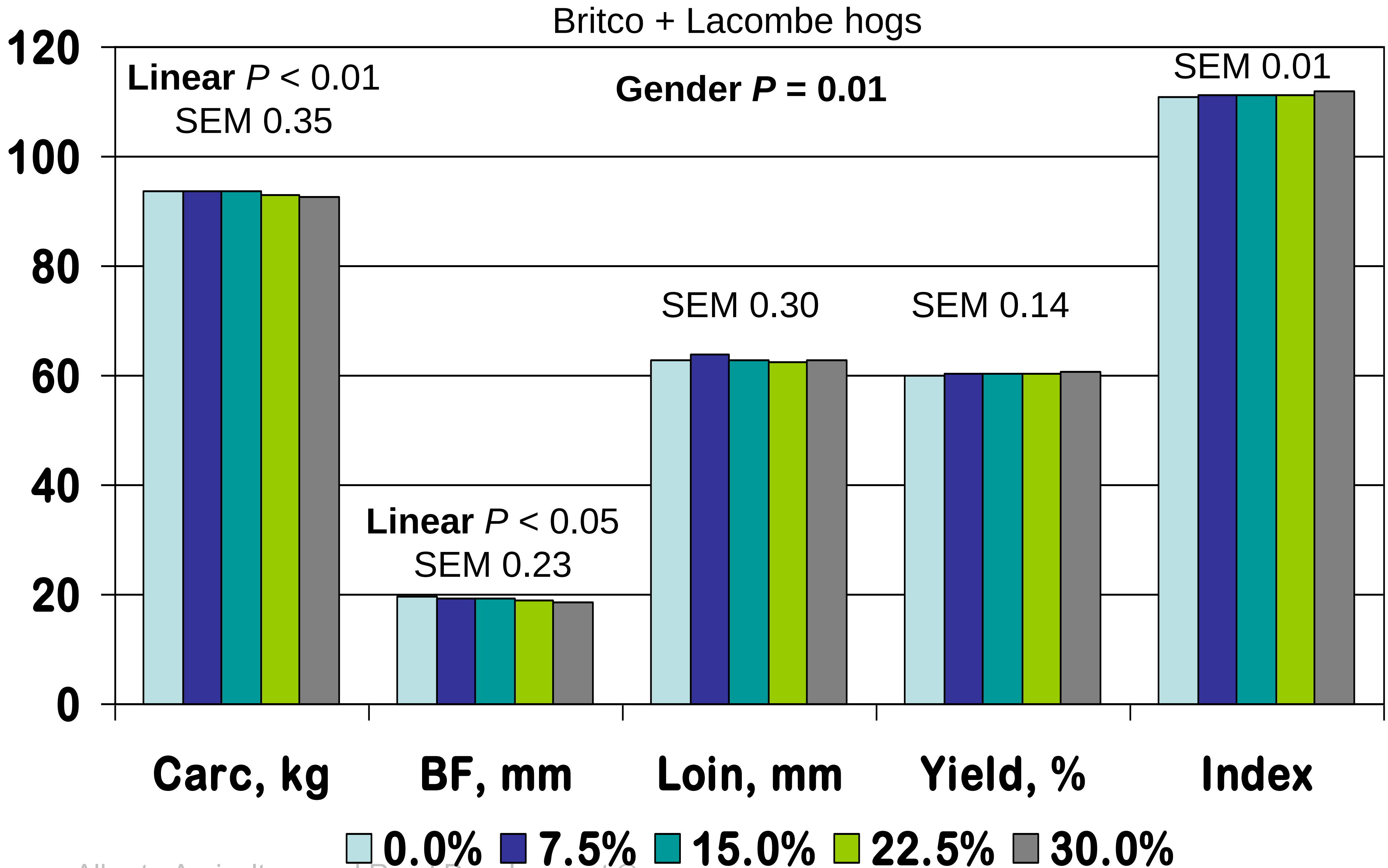
Pens housed 22 gilts or barrows


Crystal Spring
Crystal Spring

Wheat DDGS Level on Hog Growth Performance 0 – 75d



Wheat DDGS Level on Carcass Traits



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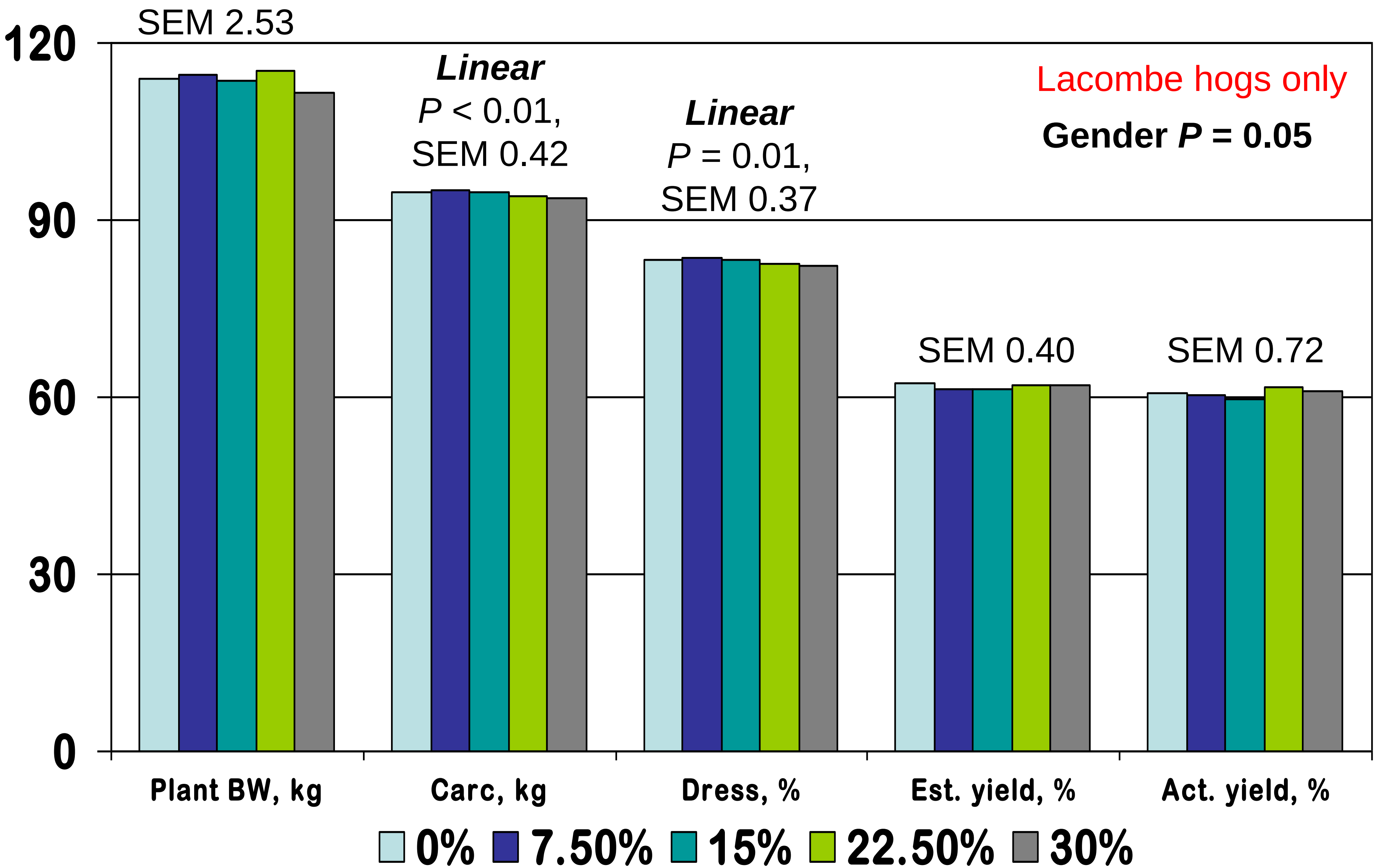
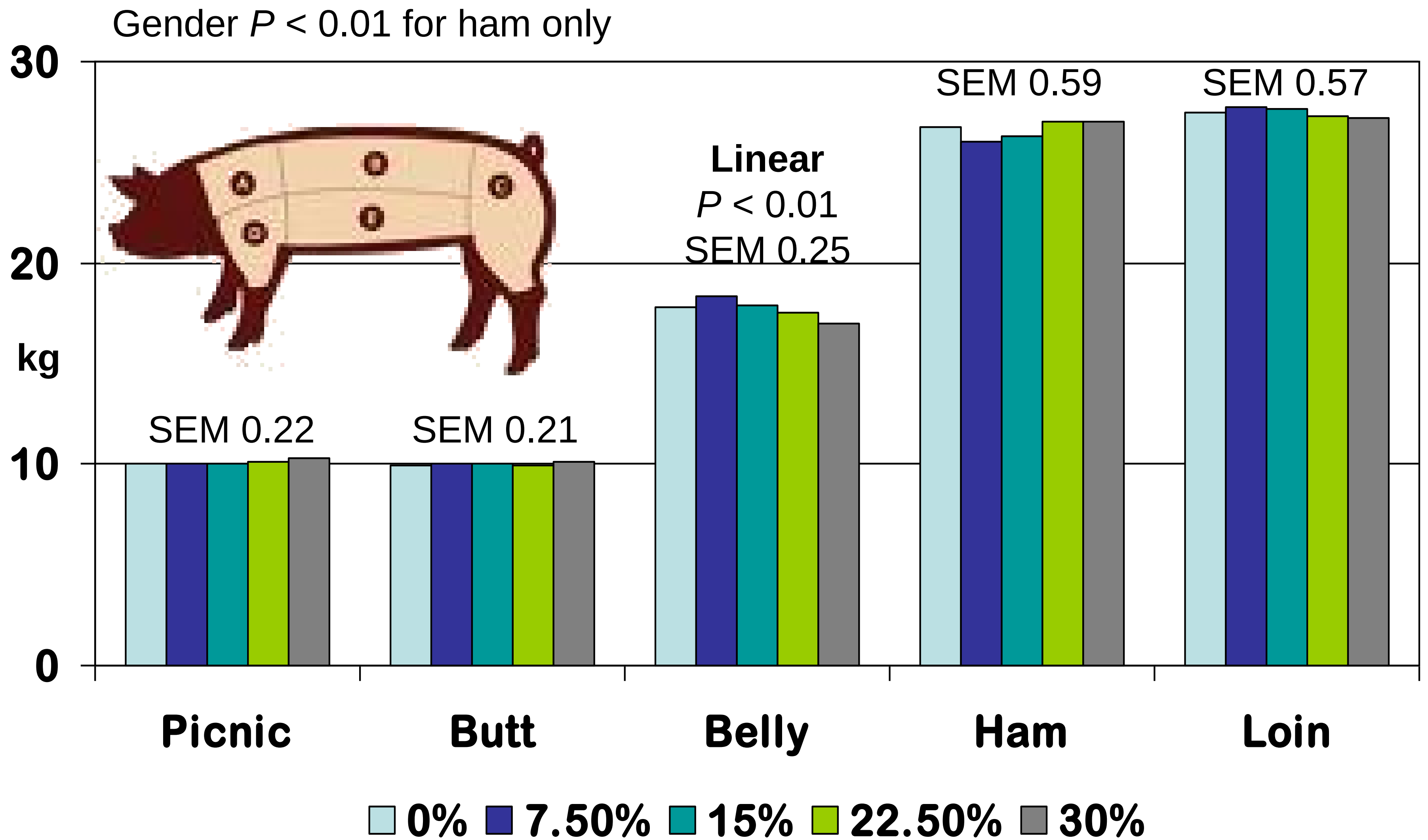
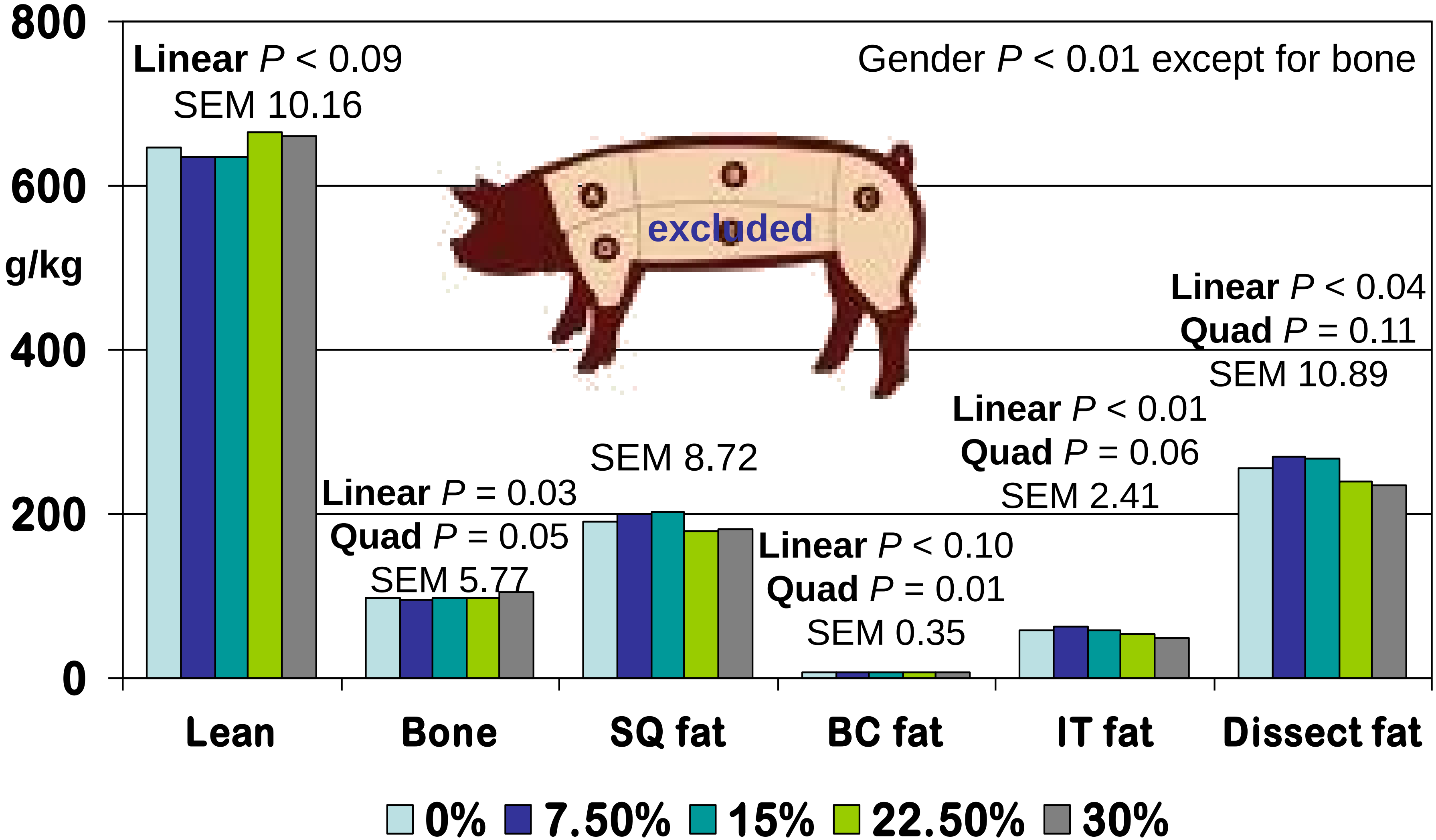


Wheat DDGS Level on Primal Cuts Weights

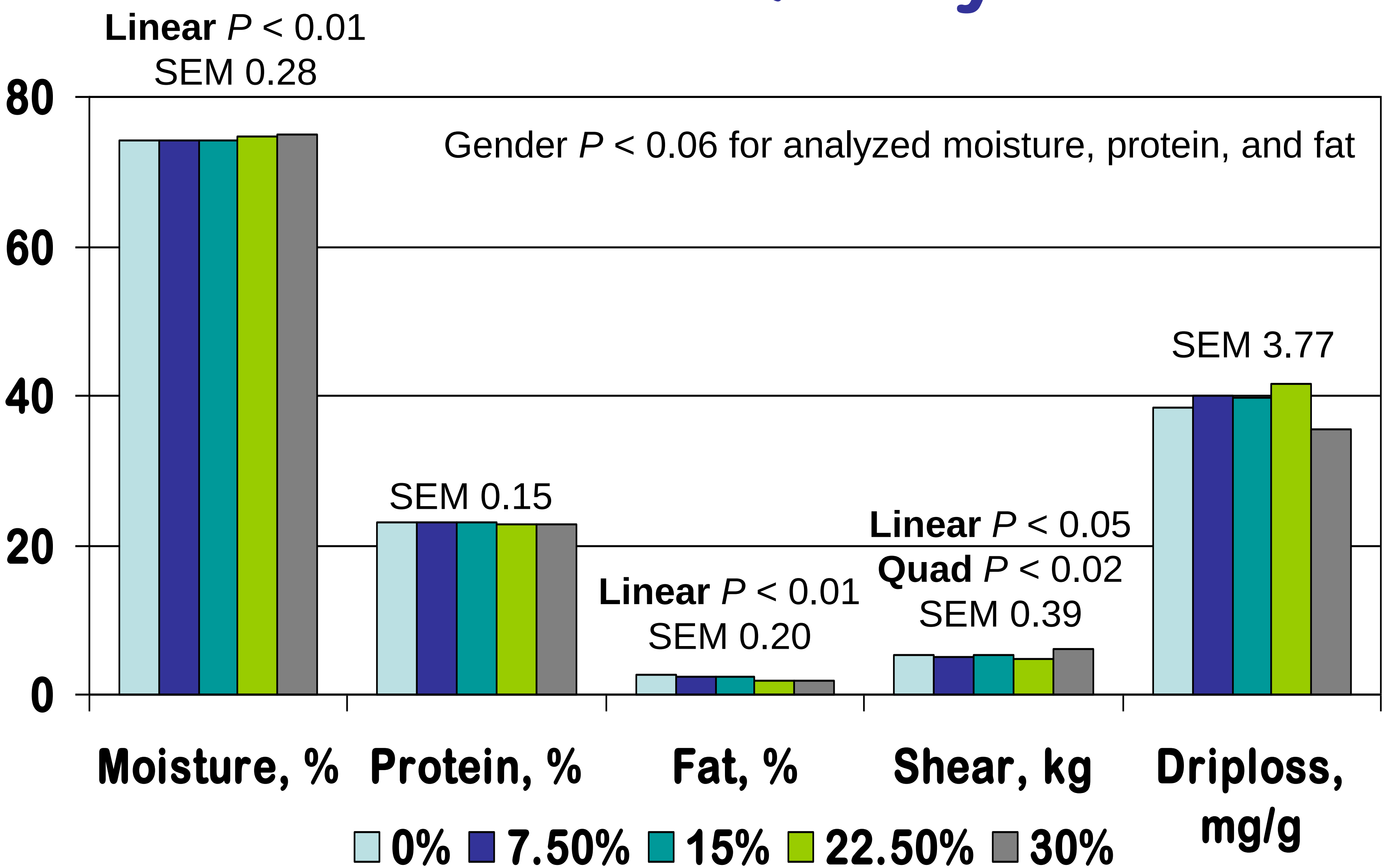


Wheat DDGS Level on Lean Cuts Tissue Composition

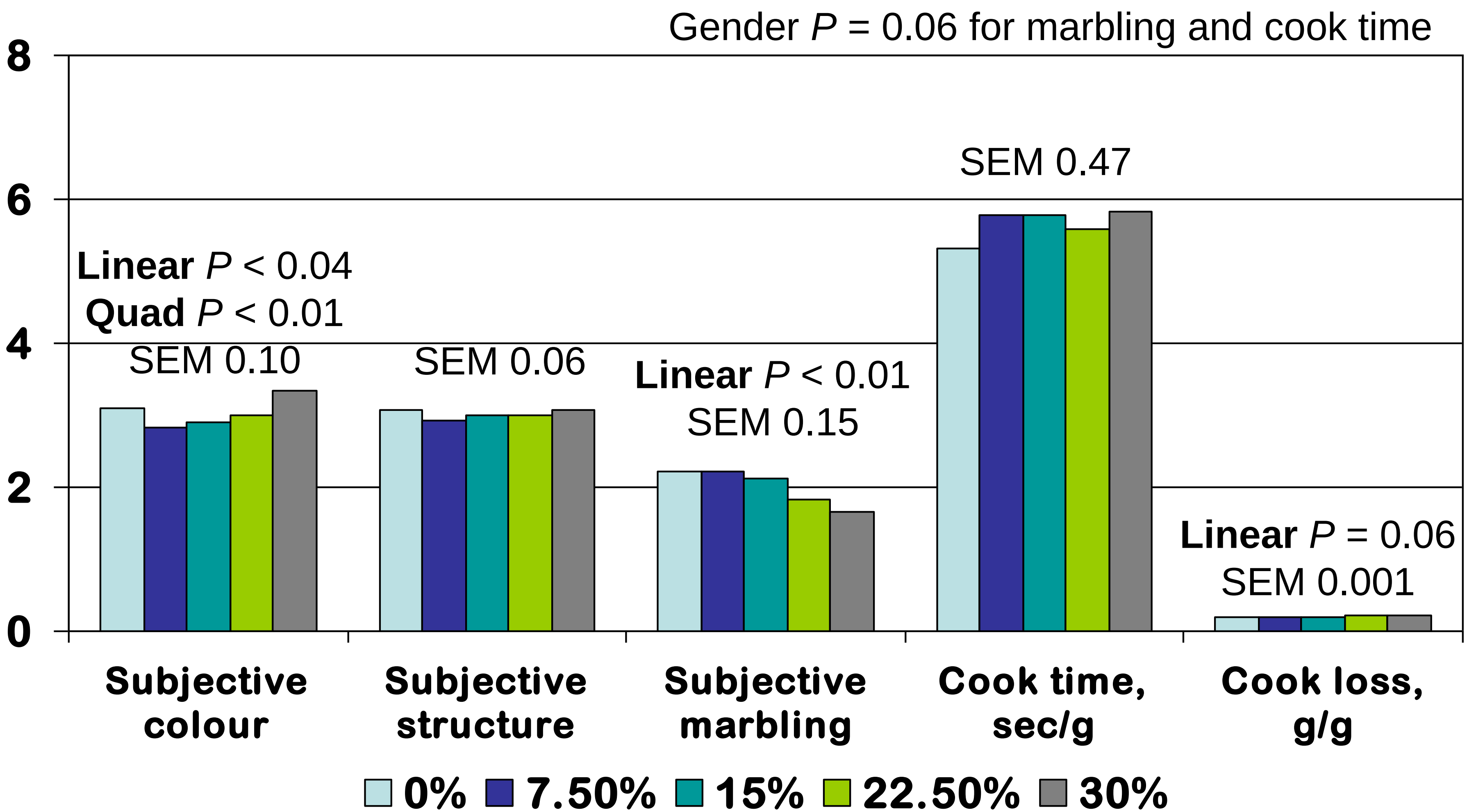


Loin Quality

Wheat DDGS Level on Loin Quality



Wheat DDGS Level on Loin Quality



Sensory Panel

Wheat DDGS Level on Taste of Loin Chops

	0%	7.5%	15%	22.5%	30%	SEM
Initial Tenderness	5.77	6.06	6.01	6.25	5.82	0.19
Initial Juiciness	5.35	5.58	5.59	5.64	5.83	0.16
Flavour Desirability	5.31	5.35	5.37	5.43	5.44	0.10
Pork Flavour Intensity	4.88	4.93	4.97	4.97	4.94	0.10
Off Flavour Intensity	7.97	8.00	7.94	8.04	7.94	0.12
Sustainable Juiciness	5.12	5.14	5.27	5.25	5.43	0.15
Overall Tenderness	6.06	6.13	6.20	6.31	5.99	0.17
Overall Palatability	4.88	4.91	4.99	5.11	5.00	0.13

Wheat DDGS Level on Flavour of Loin Chops

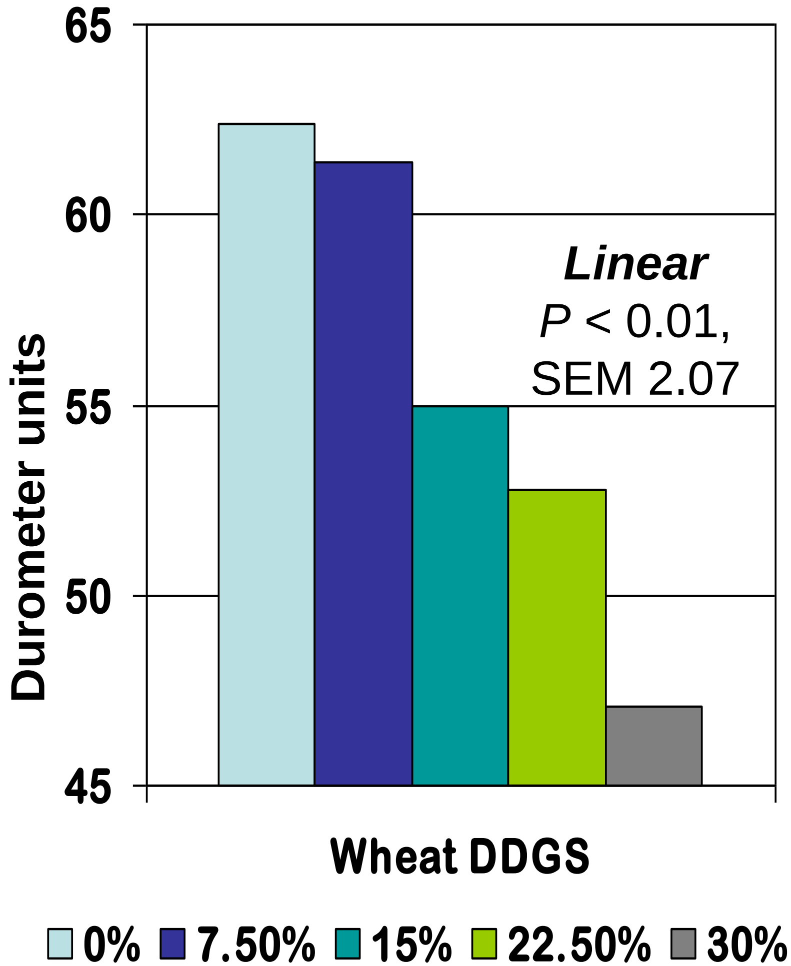
	0%	7.5%	15%	22.5%	30%	SEM
Metallic	1.04	0.00	0.00	0.00	0.00	0.47
Off sour	14.61	19.69	15.63	16.62	16.79	4.20
Barny	5.21	7.29	3.13	2.08	4.17	2.40
Stale	1.08	0.03	1.05	0.98	0.04	0.84
Rancid	1.08	0.03	1.05	0.98	0.04	0.84
Other	2.08	1.04	2.08	0.00	0.00	1.04
Unidentified	33.33	23.96	33.33	32.29	31.25	4.57

Wheat DDGS Level on Texture of Loin Chops

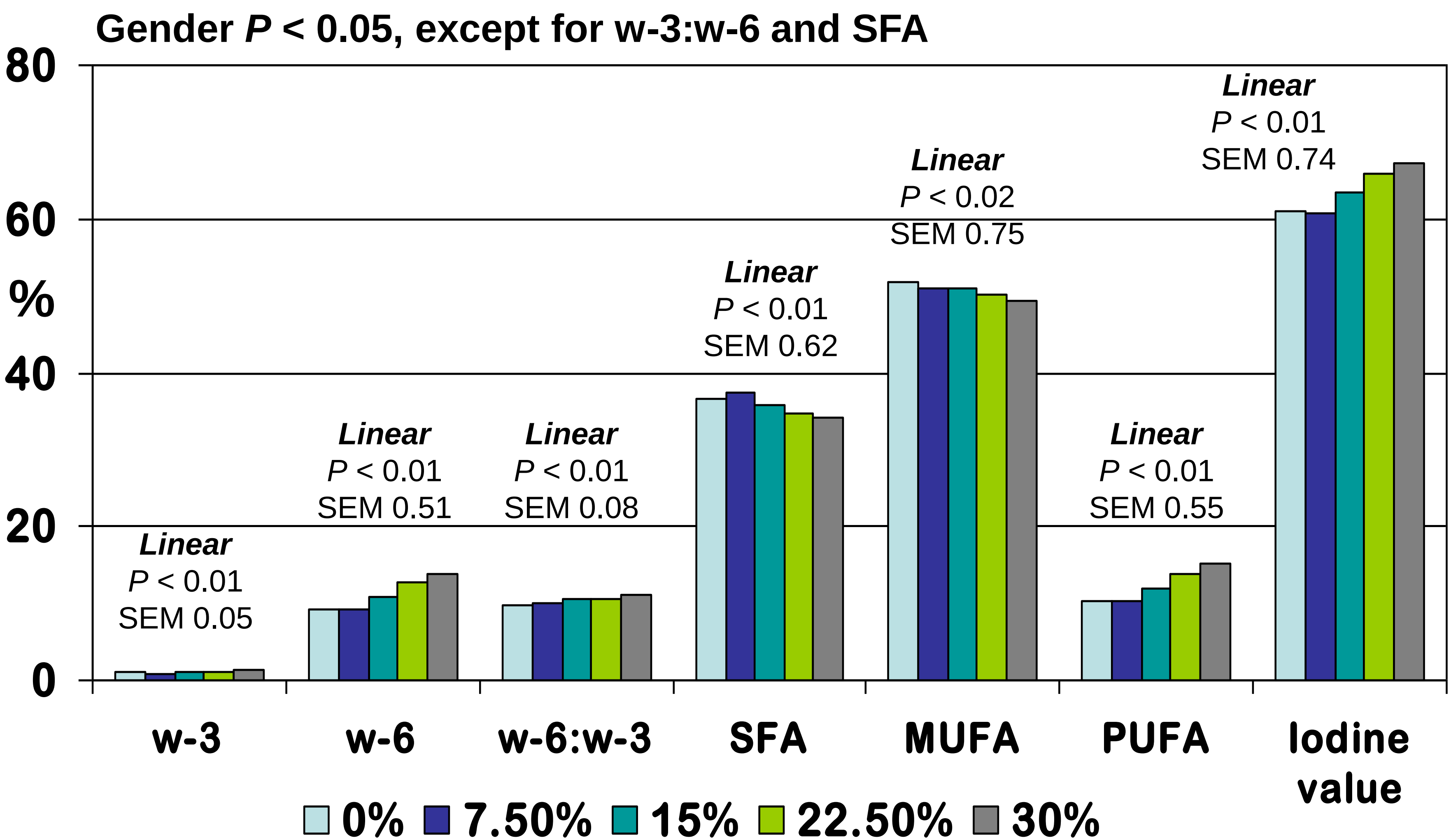
	0%	7.5%	15%	22.5%	30%	SEM
Typical pork	72.85	73.06	79.05	69.61	81.47	5.60
Mushy	1.04	8.33	4.17	2.08	4.17	3.71
Mealy	15.63	11.45	12.51	23.96	8.33	3.31
Rubbery	4.17	6.25	4.17	2.08	5.21	2.17
Spongy	6.11	1.14	0.09	2.18	0.89	1.86

Backfat and Belly Quality

Wheat DDGS Level on Backfat Hardness



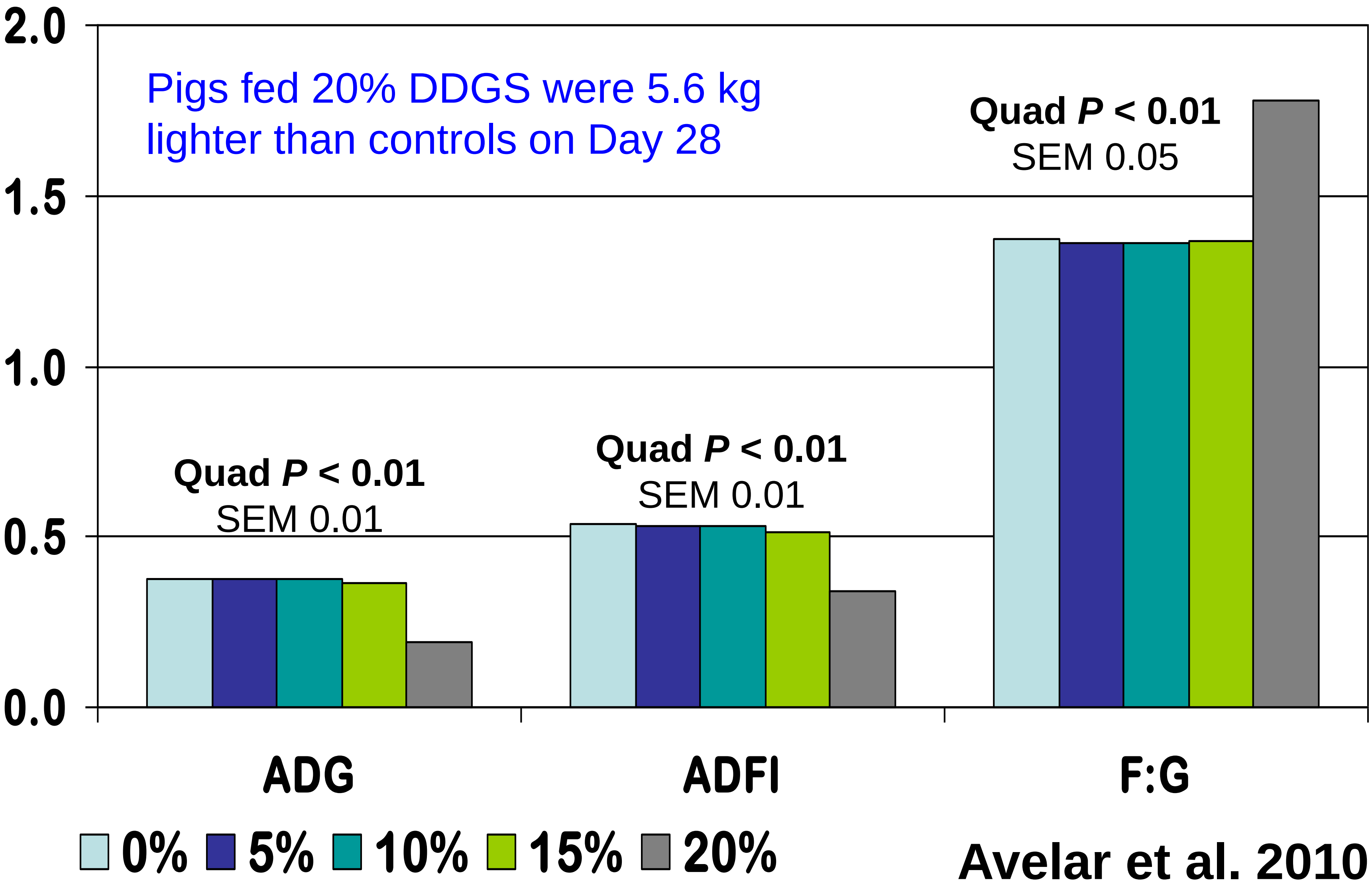
Wheat DDGS Level on Belly Fatty Acid Composition



Wheat DDGS Conclusions

1. NE value of wheat DDGS
2. Amino acid and phosphorus availability
3. Performance less predictable at high wheat DDGS inclusion rates
4. Underformulate vs. proper specs
5. Ethanol focus, not DDGS quality

Wheat DDGS Level for Weaners



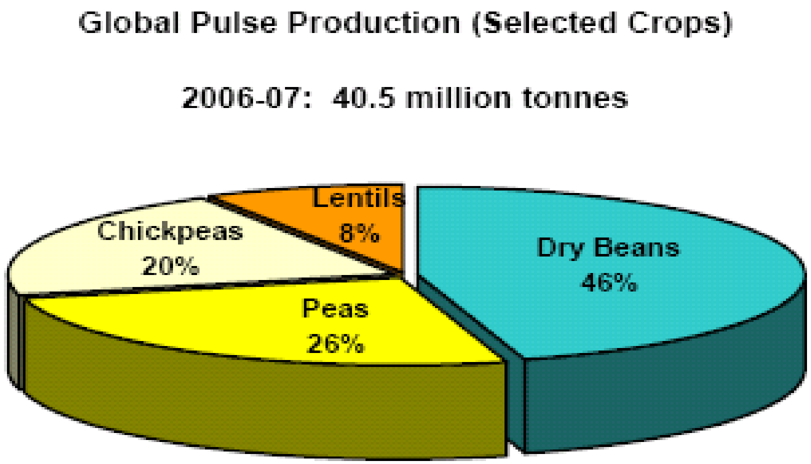
Avelar et al. 2010

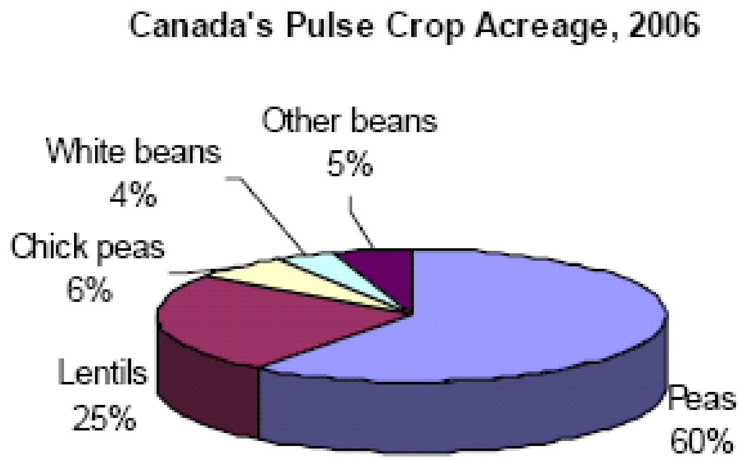
Air-Classified Zero Tannin Faba bean and Field Pea Fractions for Swine

Legumes –Global & Canadian Perspective

- Canada is the world's largest exporter of field pea and lentil

- In western Canada
  - Dry pea, lentil, dry bean, chickpea
  - Faba bean and lupin are emerging





Source: FAO; Pulse Canada, August 2007

Why Faba Bean?

- Crop yield
- Nitrogen fixation
- Vegetable protein
- Value-added processing

Air Classification

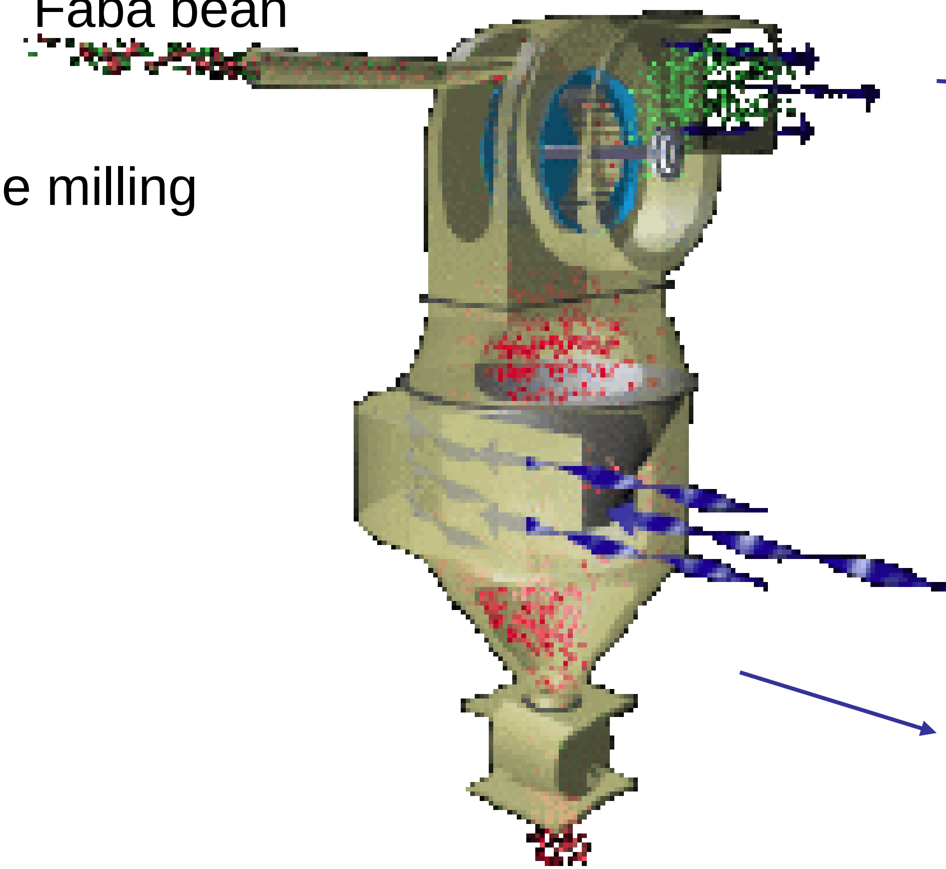
✓**Particle separation**
✓**Fractions concentration**

or

Zero tannin Faba bean

Field pea

Fine milling



Fine Fraction (Protein)

Ground flour

Coarse Fraction (starch)

Pulse Fractions
Nutrient Composition

	Faba bean			Field pea		
	Parent	Protein	Starch	Parent	Protein	Starch
CP, %	29.0	63.0	18.4	22.7	46.5	7.56
Starch, %	35.0	1.30	46.0	48.6	10.7	68.9

Gap in Knowledge

- Lack of digestibility values
- Lack of animal performance data
- $ Feasibility ??

Materials and Methods

- 8 barrows (25 kg) fitted with T-cannulae
- 5d adaptation, 3d fecal and 3d digesta collection
- 6 x 8 Youden square design
  - Soy protein concentrate-corn starch diet
  - Faba bean protein-corn starch diet
  - Pea protein-corn starch
  - Faba starch diet
  - Pea starch diet
  - Corn starch diet

Conclusions

- Faba bean and field pea **protein concentrates** had higher ATTD of DM, OM, and higher NE than soy protein concentrate

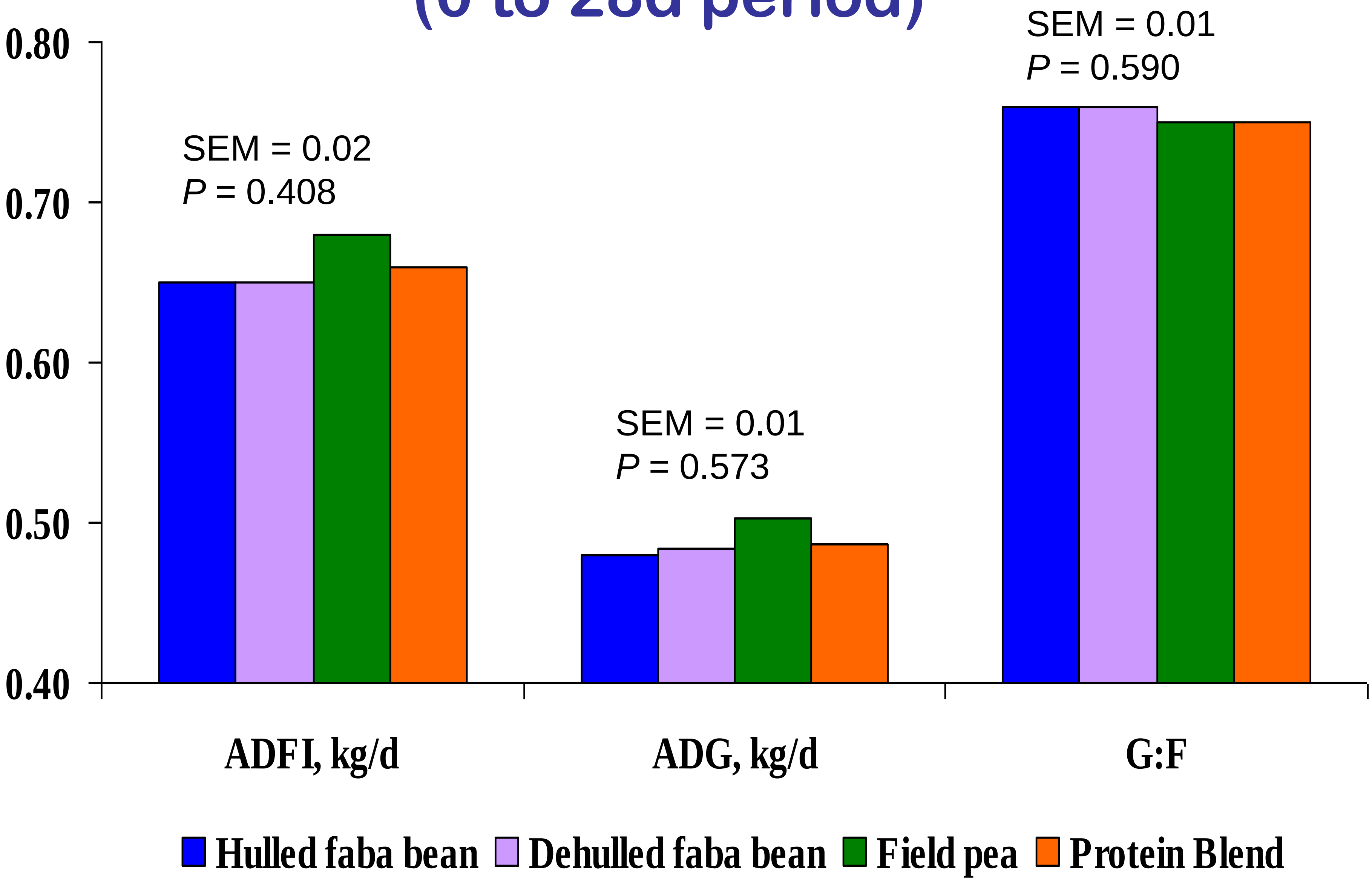
- Faba bean and field pea **protein concentrates** also had higher AID of CP and higher SID of Lys, Met, Thr

- The ATTD of faba bean **starch** was lower than corn starch; pea starch was as high as cornstarch

Materials and Methods

- 192 crossbred piglets (7.5 kg, 27d old)
- RCB design, 4 diets fed over 7 to 35 days post-weaning
- 2 barrows, 2 gilts/pen, 12 replicate pens/diet
- Individual pigs and feed added/leftover weighed weekly
- Faecal grabs collected Day 18 to 21
- Response variables:
  - Feed intake
  - Weight gain
  - Feed conversion
  - ATTD of diets

Feed Intake, Daily Gain and Feed Efficiency (0 to 28d period)



Implications

- Air-classified ZT faba bean and field pea protein concentrates are suitable replacements for specialty protein sources used in weaned pig diets.
- Pulse protein concentrates have good potential for inclusion in aquafeeds and young animal diets

Pulse Fractions …Tomorrow

- **PROTEIN** fractions
  - Feed:
    - AQUAQULTURE
    - Milk replacers
    - Young animal diets
  - Food industry:
    - Snacks
    - Breakfast bars
    - Meat replacers
  - Industrial:

- **STARCH** fractions
  - Food industry:
    - Baking
    - Snacks
    - Noodles
  - Pet food
  - Industrial:
    - Bio-degradable
    - Paper
    - Cosmetics
    - Paint

Food, Feed, Fuel, Bio-industrial Uses