Research Update
Alternative Feedstuffs: DDGS

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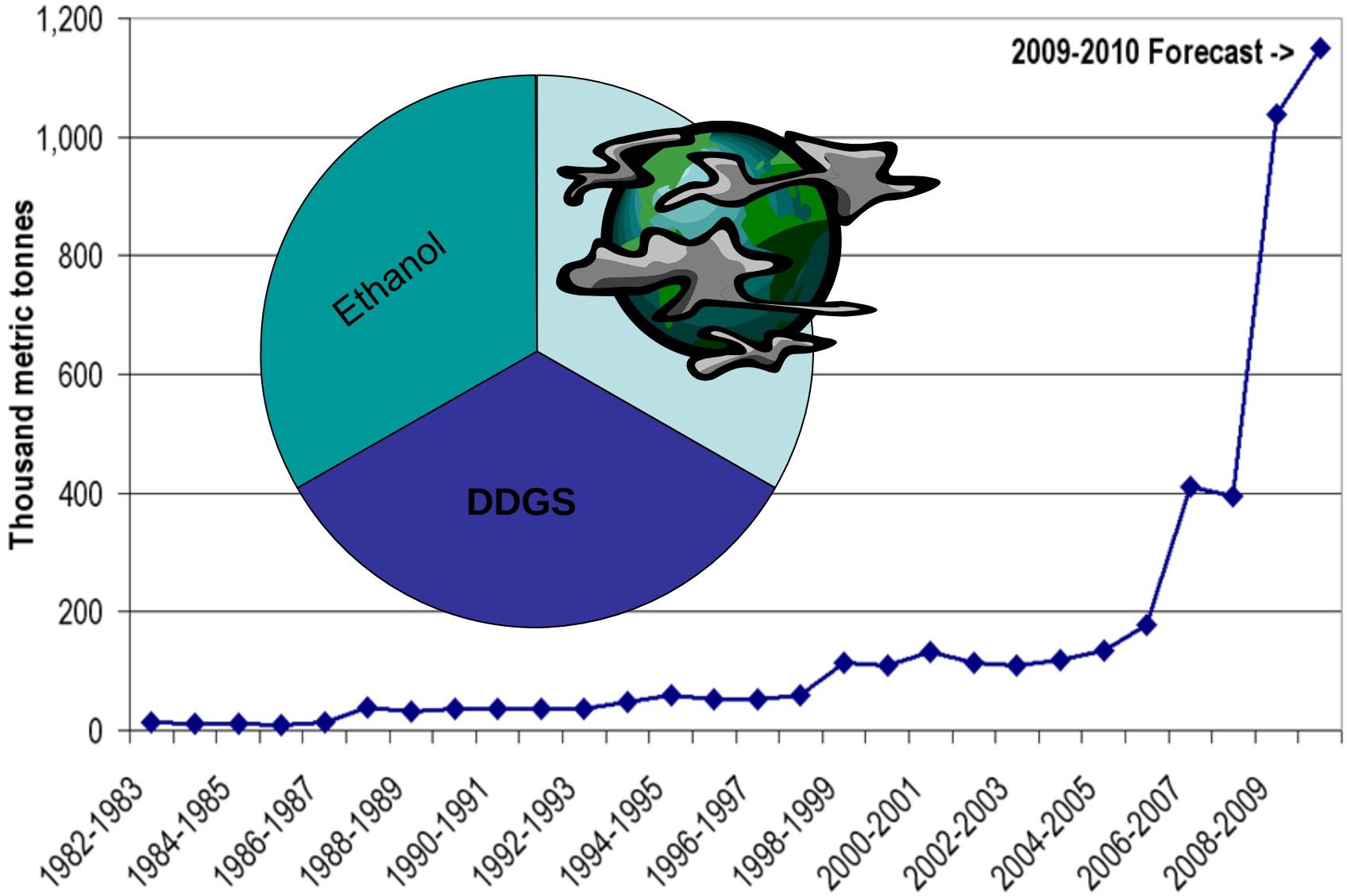
Agriculture et Agroalimentaire Canada

CDN Feedstuffs Outlook

	Production	Supply	Exports	Issues
Wheat (ex durum)	21Mt, **↓9%** -abandonment -lower yields	26Mt, **↓3%**	14Mt, **↓4%** -↓ world trade - ↓ CDN supply	-**industrial use is record high**
Barley	9.5Mt, **↓19%** -abandonment -lower yields	12.5Mt, **↓7.5%**	2.3Mt, **↓40%** vs. 2y ago	-lower livestock -large world supply of feed
Canola	12Mt, **↓6%** -abandonment -lower yields	13.5Mt, **↓4%**	6Mt, **↓25%**	**-more crushing** **-salmonella** **-clubroot**
Peas	3.4Mt, **↓5%** -abandonment -lower yields	3.8Mt, no change	2.7Mt, **↓4%** -lower global demand -green peas ↑	-yellow and feed pea prices ↓

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

Industrial Use of Wheat



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

Distillers Dried Grains & Solubles (DDGS)

- What market signals?
- Ample supply of DDGS
- … Feed more?
- DDGS, not perfect
- Feed is the highest cost of production

Talk Outline

- 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

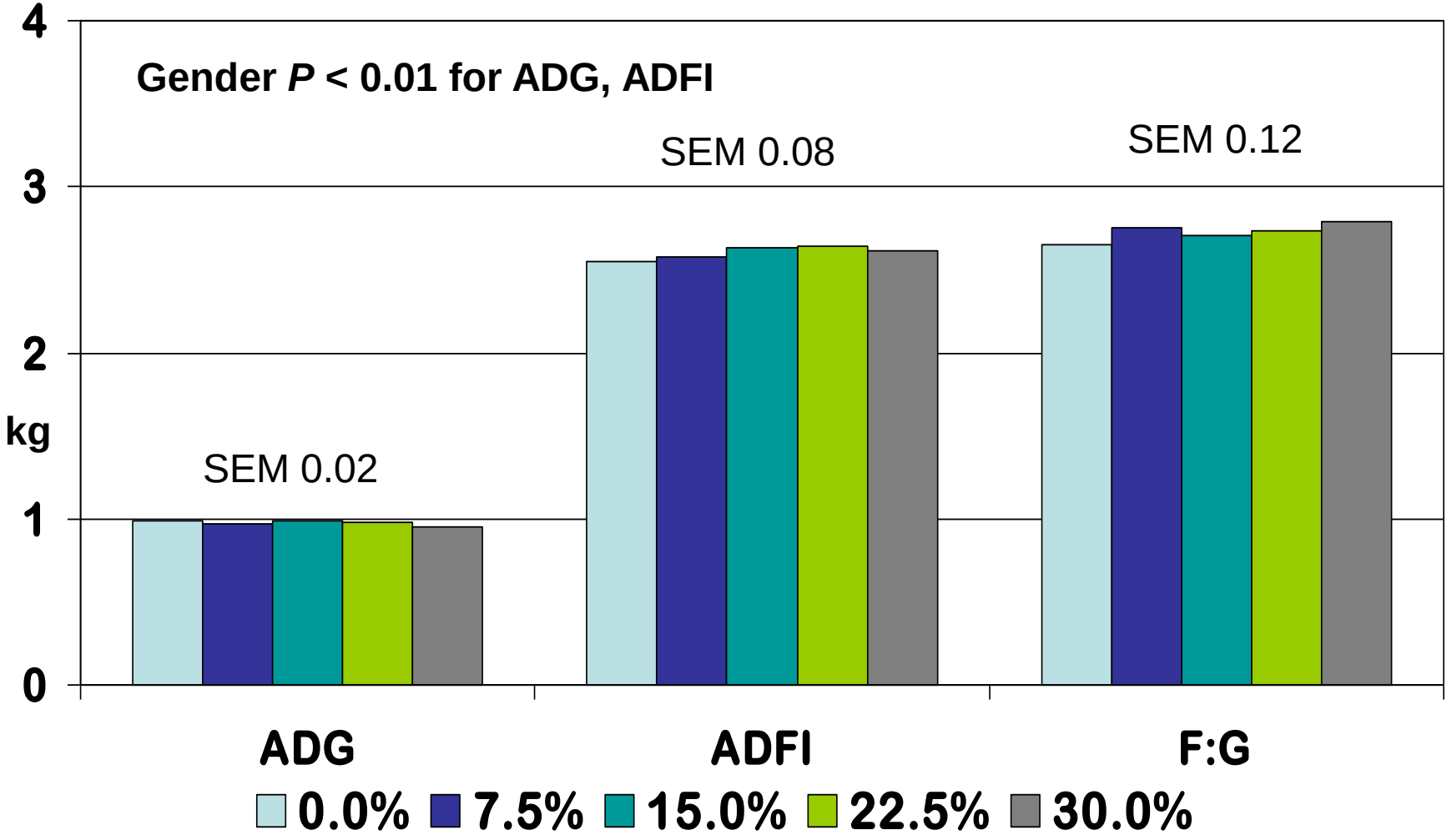

FEEDER
Crystal Spring
Crystal Spring

Finisher Diets

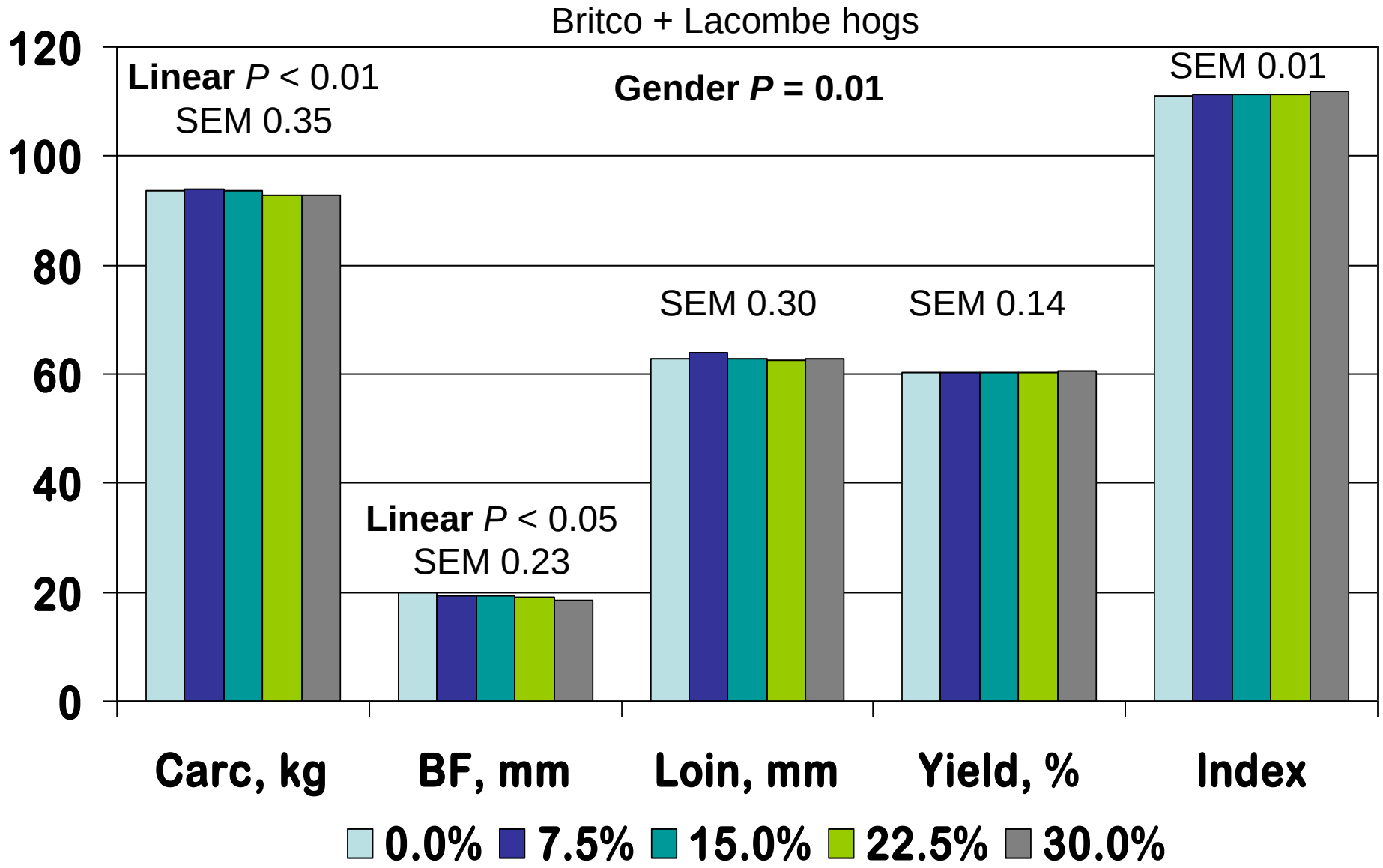
	Finisher 1					Finisher 2				
	0%	**7.5%**	**15%**	**22.5%**	**30%**	**0%**	**7.5%**	**15%**	**22.5%**	**30%**
Wheat	47.98	41.11	36.83	32.45	28.15	33.85	27.55	22.93	18.66	14.16
Barley	32.59	33.78	30.64	27.60	24.40	49.48	48.97	46.21	43.00	40.00
Terra DDGS	**0.00**	**7.50**	**15.00**	**22.50**	**30.00**	**0.00**	**7.50**	**15.00**	**22.50**	**30.00**
Peas	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00	10.00
SBM	1.79	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Canola	5.00	5.00	5.00	5.00	5.00	4.60	4.00	4.00	4.00	4.00
Limestone	1.07	1.13	1.20	1.28	1.38	1.10	1.14	1.19	1.29	1.37
Tallow	0.50	0.50	0.50	0.50	0.50	0.00	0.00	0.00	0.00	0.00

		G1	**G2**	**G3**	**F1**	**F2**
NE GF	Mcal	2.4	2.4	2.35	2.35	2.3
SID lys:NE	g/Mcal	4.04	3.71	3.32	3.06	2.83

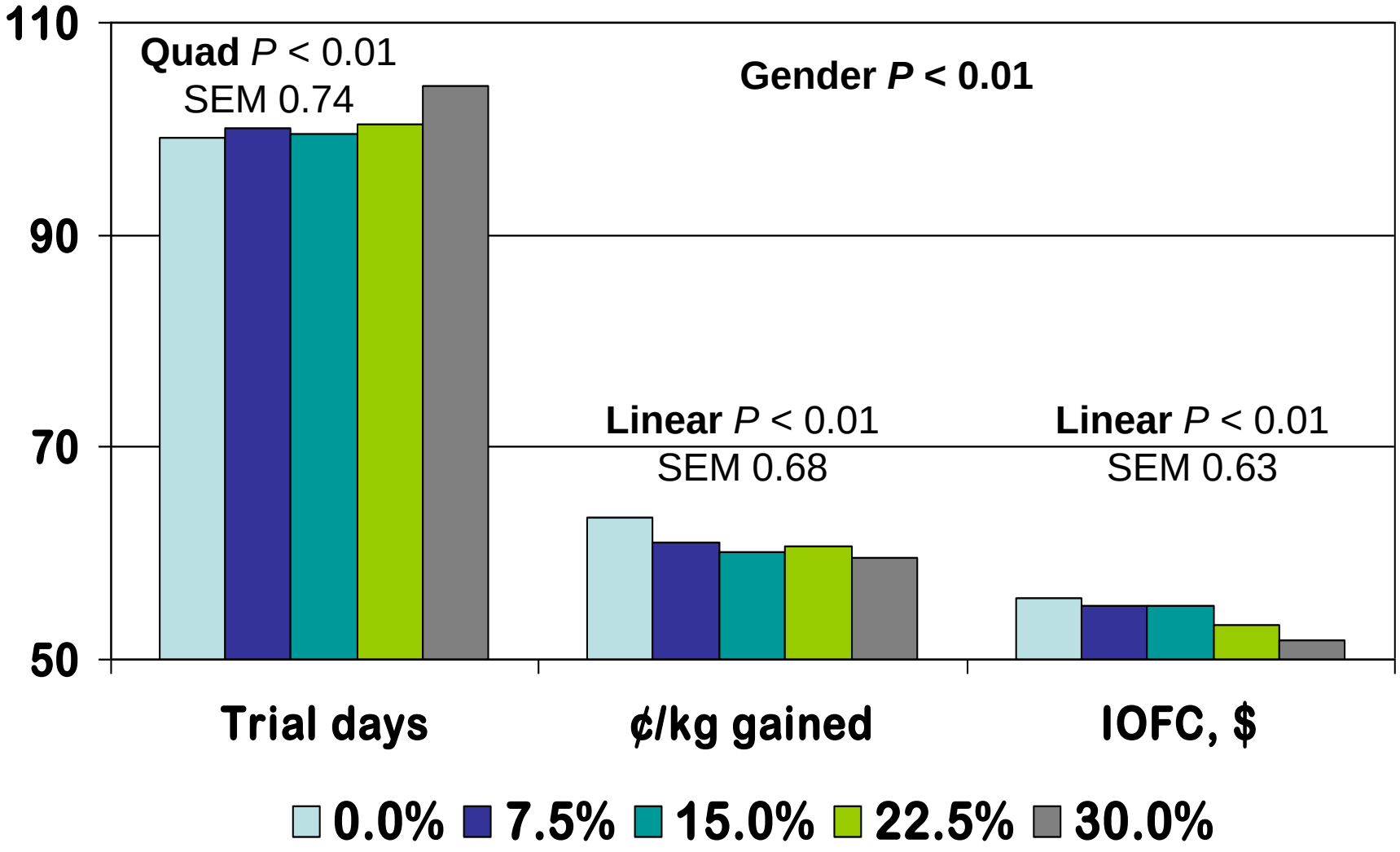
Wheat DDGS Level on Hog Growth Performance 0 – 75d



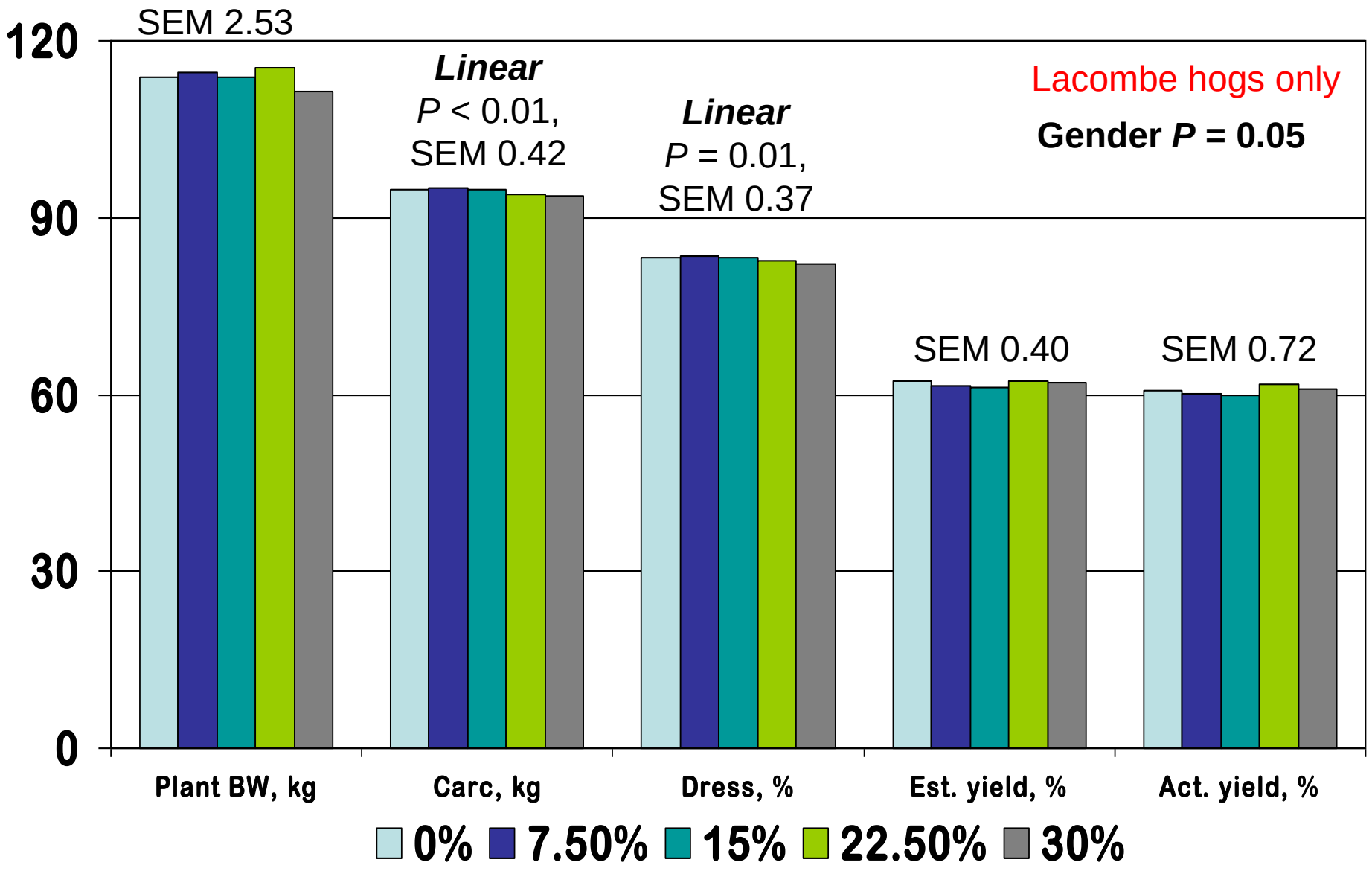
Wheat DDGS Level on Carcass Traits



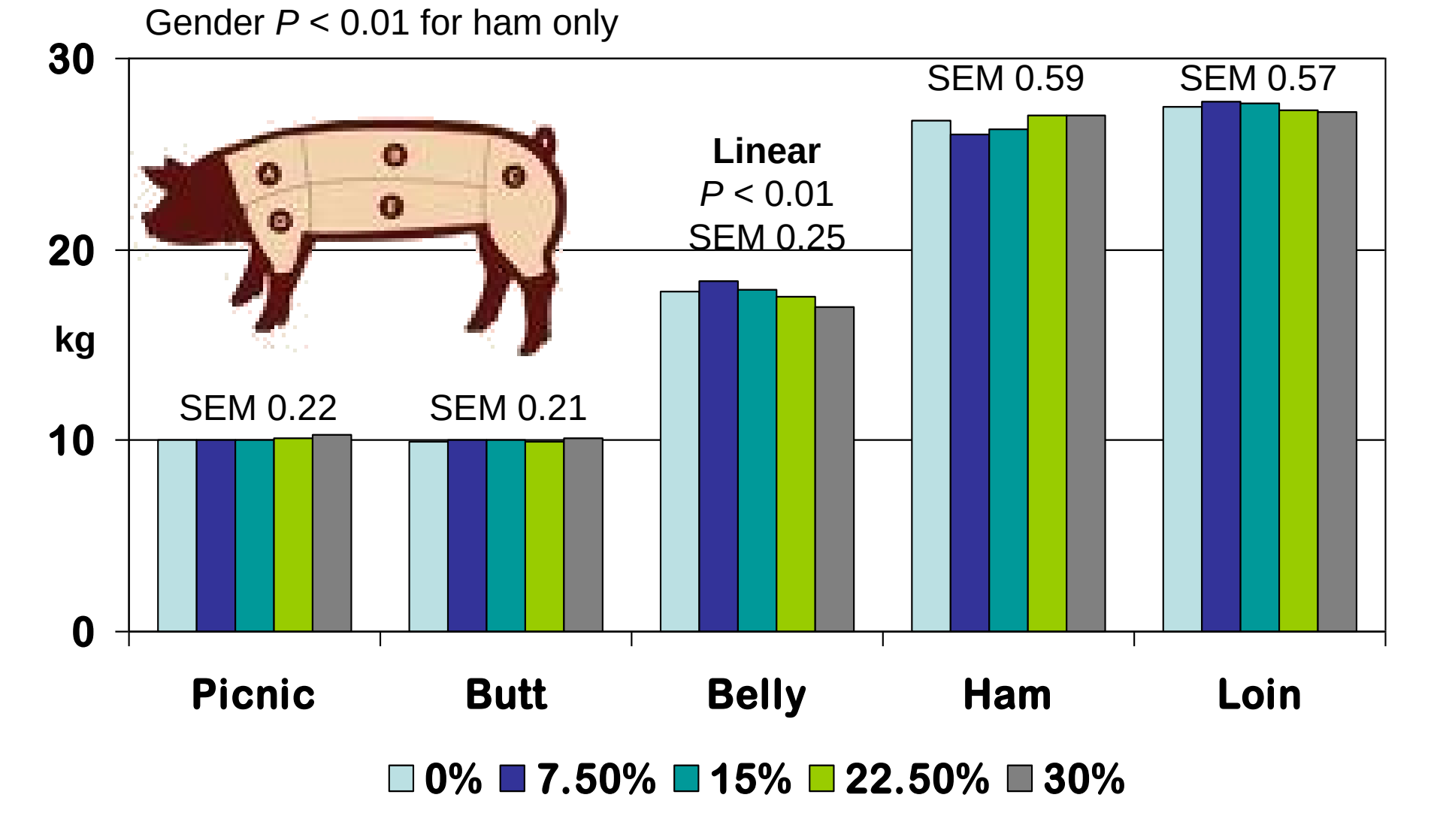
Wheat DDGS Level on Cost Variables



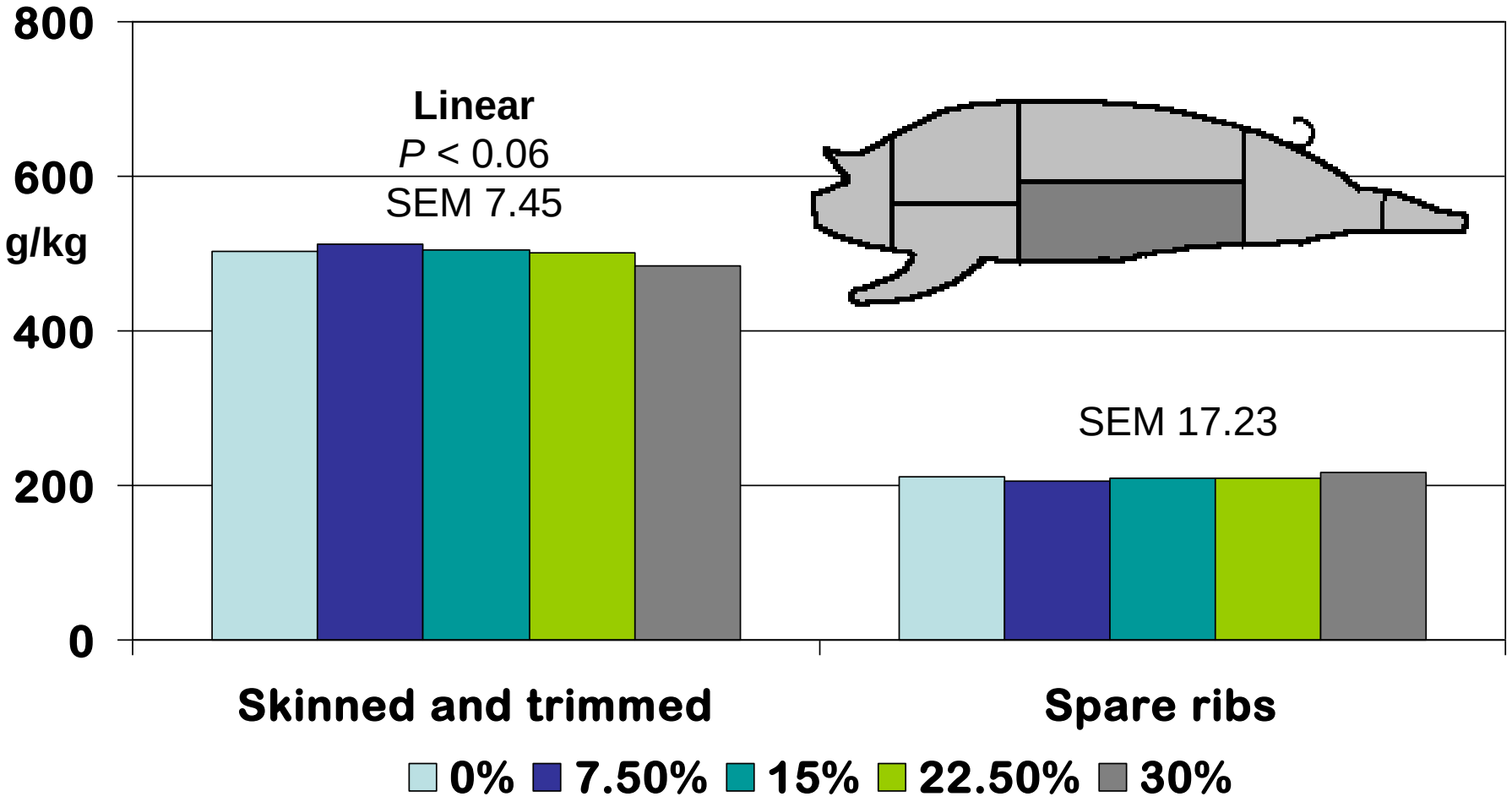
Wheat DDGS Level on Carcass Traits



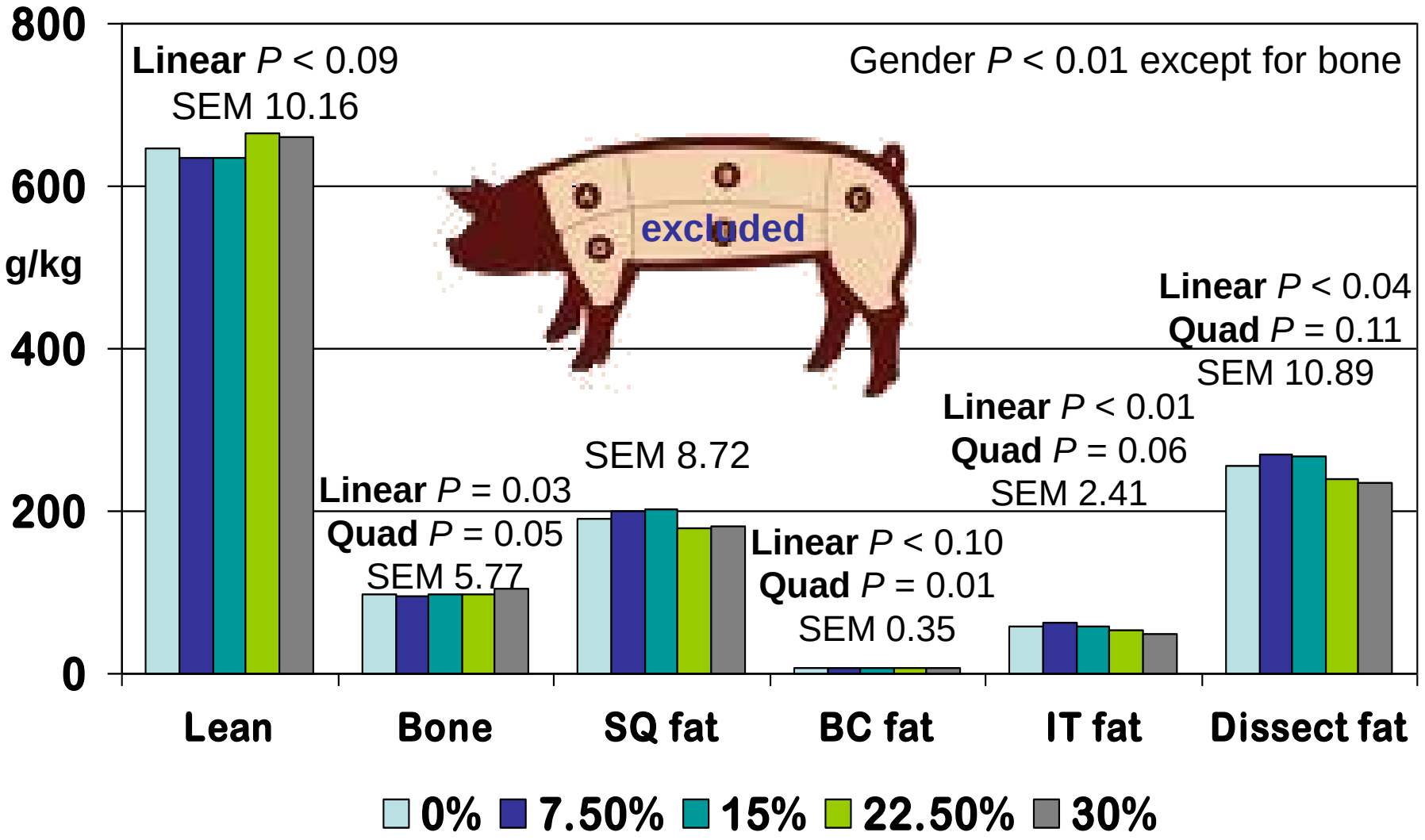
Wheat DDGS Level on Primal Cuts Weights



Wheat DDGS Level on BELLY Tissue Composition

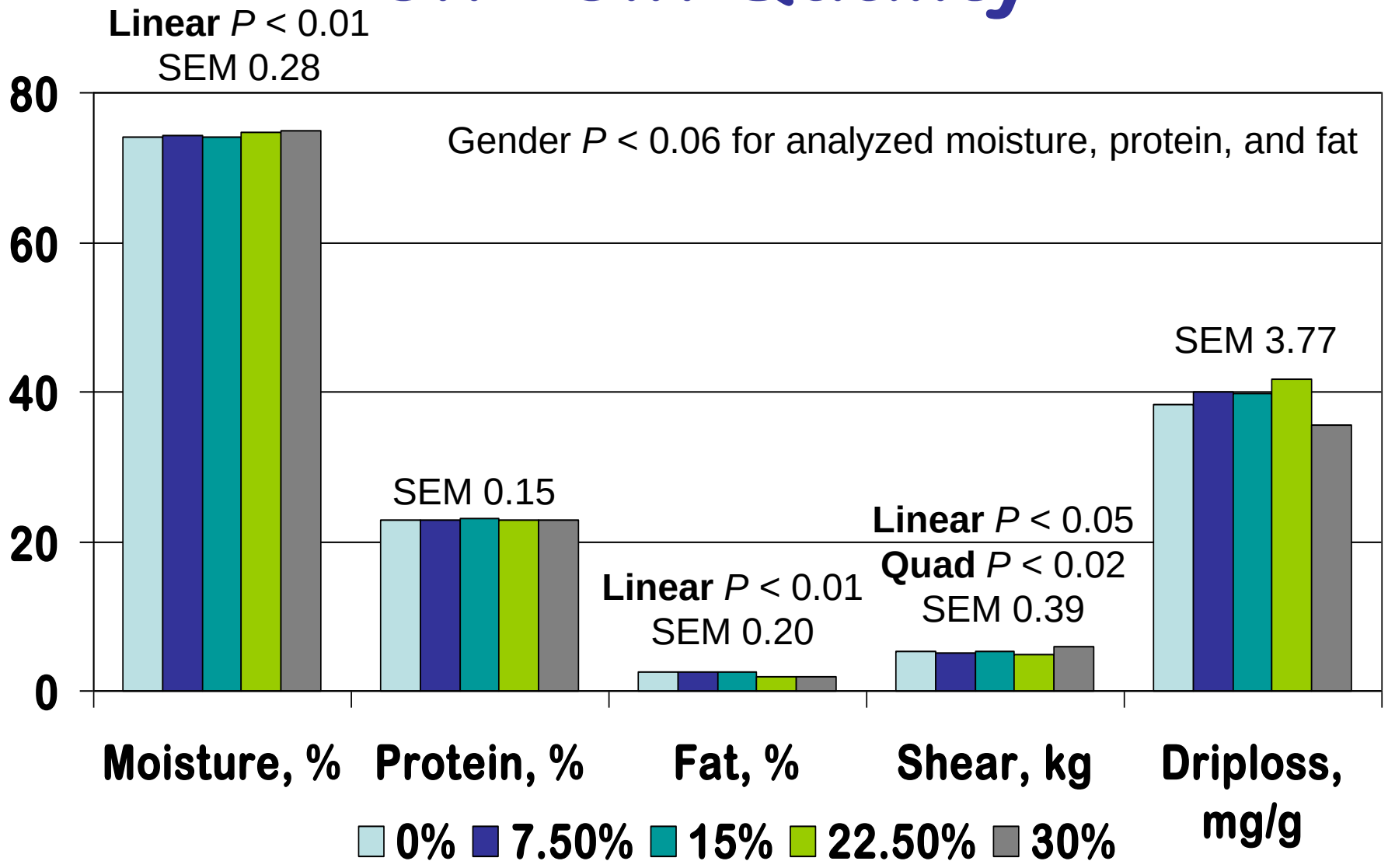


Wheat DDGS Level on Lean Cuts Tissue Composition

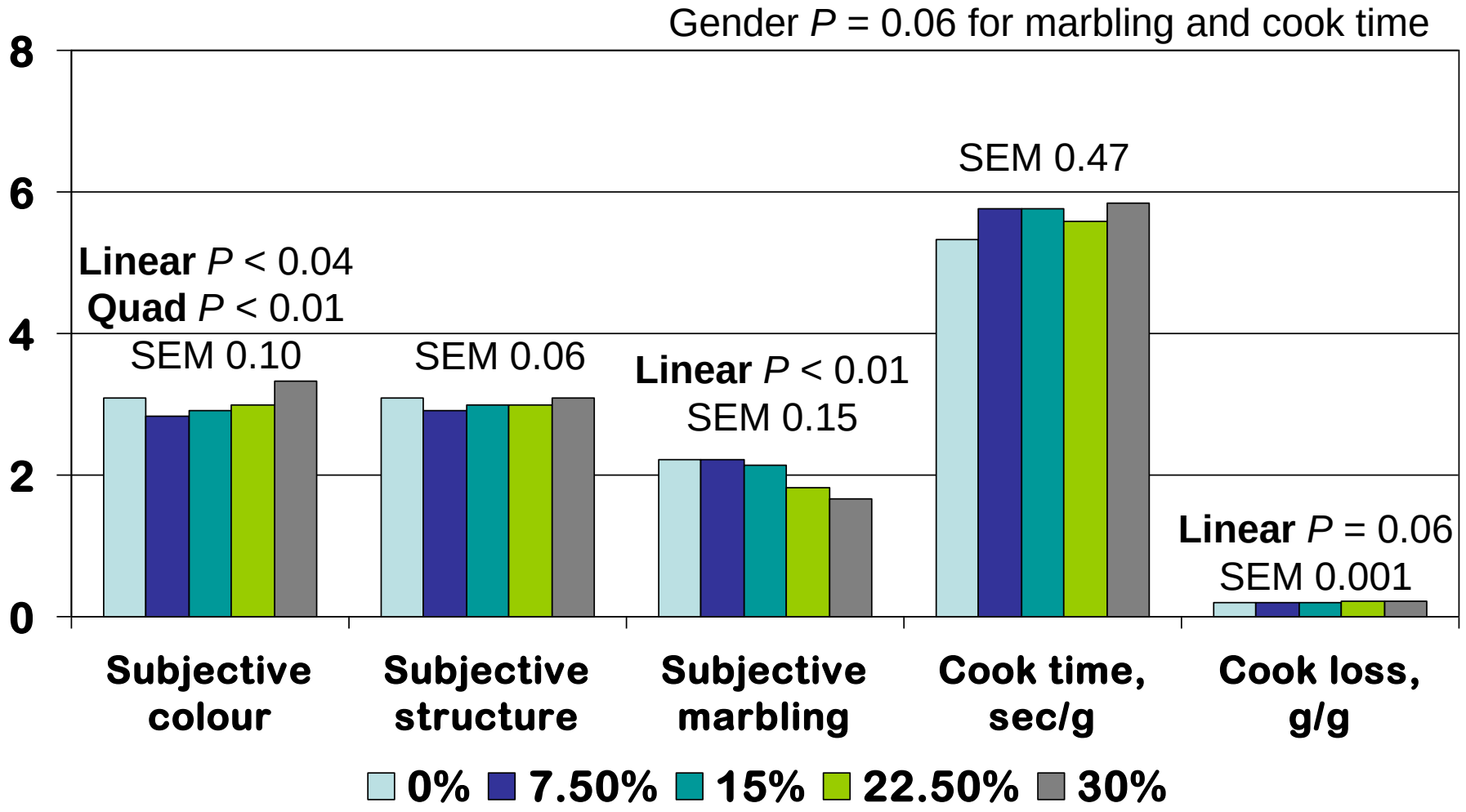


Loin Quality

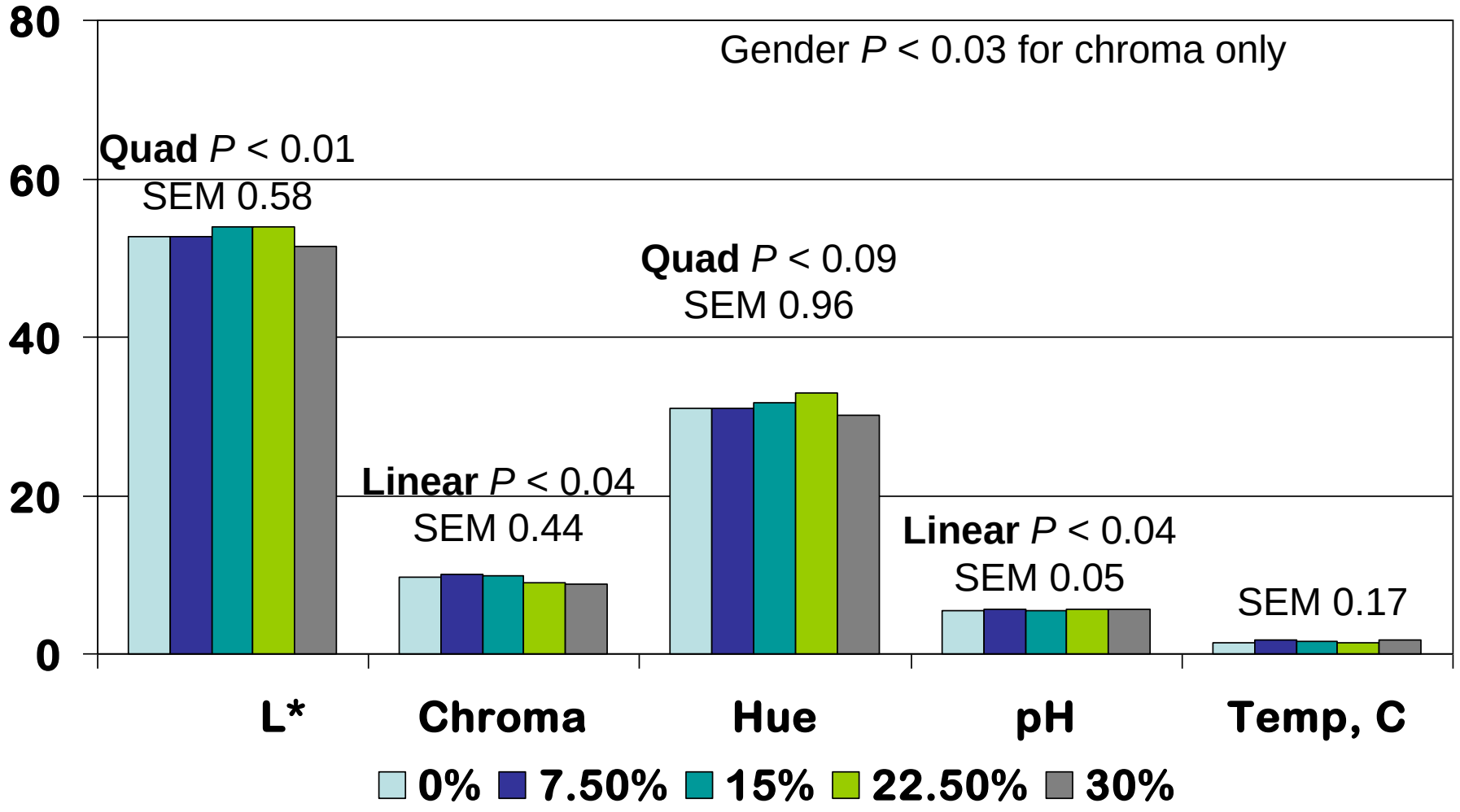
Wheat DDGS Level on Loin Quality



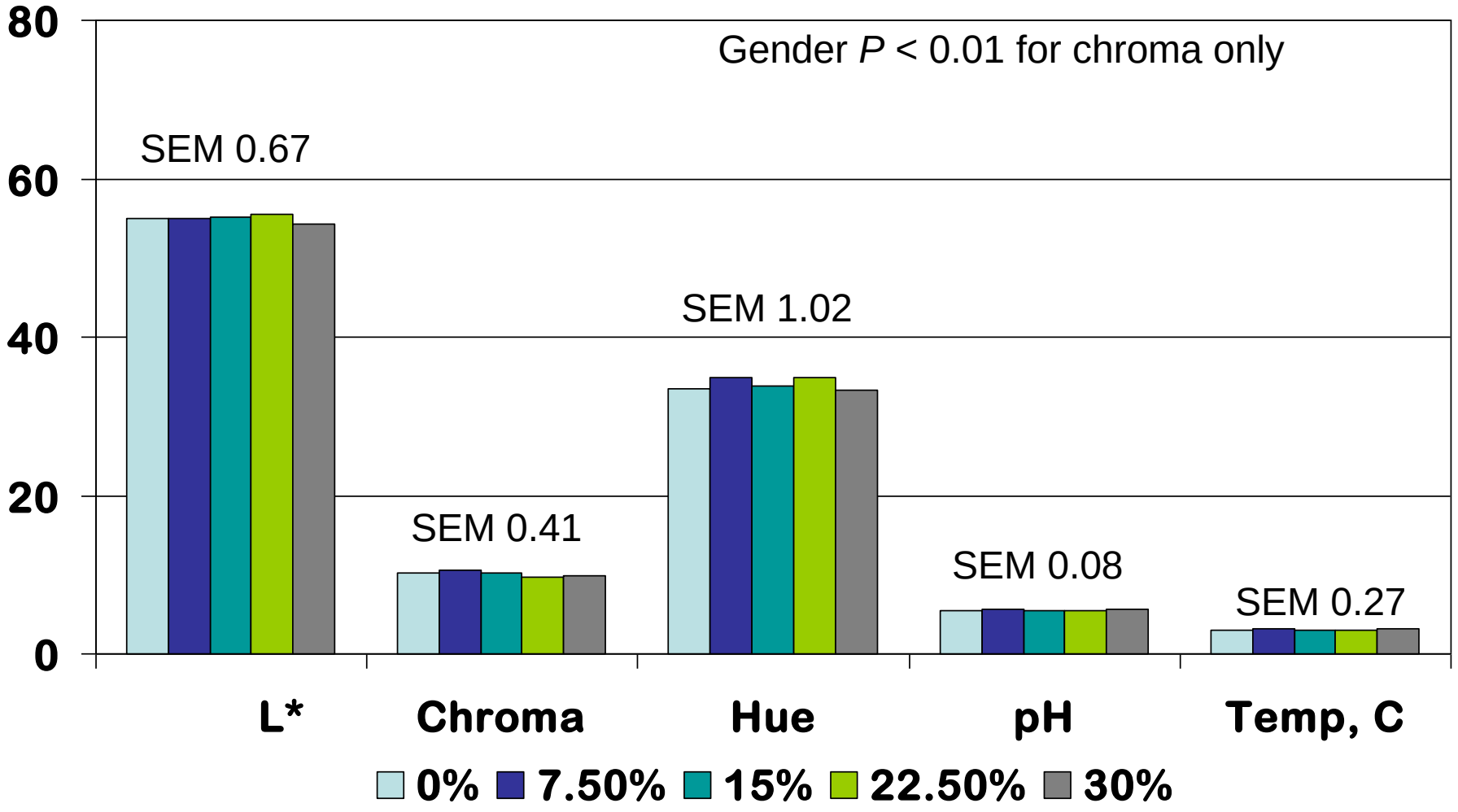
Wheat DDGS Level on Loin Quality



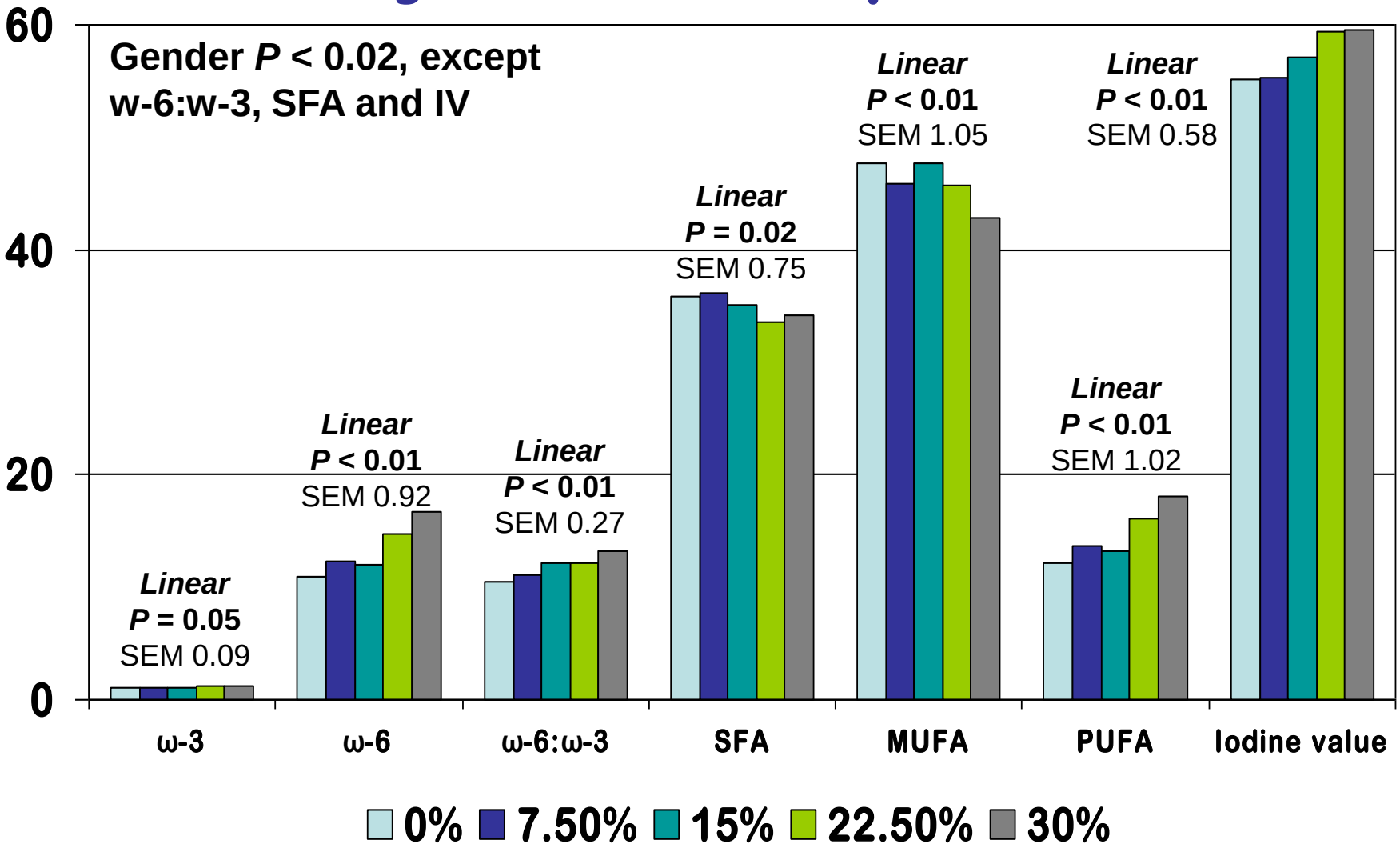
Wheat DDGS Level on Loin Quality 24h PM Measurements



Wheat DDGS Level on Loin Quality 72h PM Measurements



Wheat DDGS Level on Loin Fatty Acid Composition



Taste 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

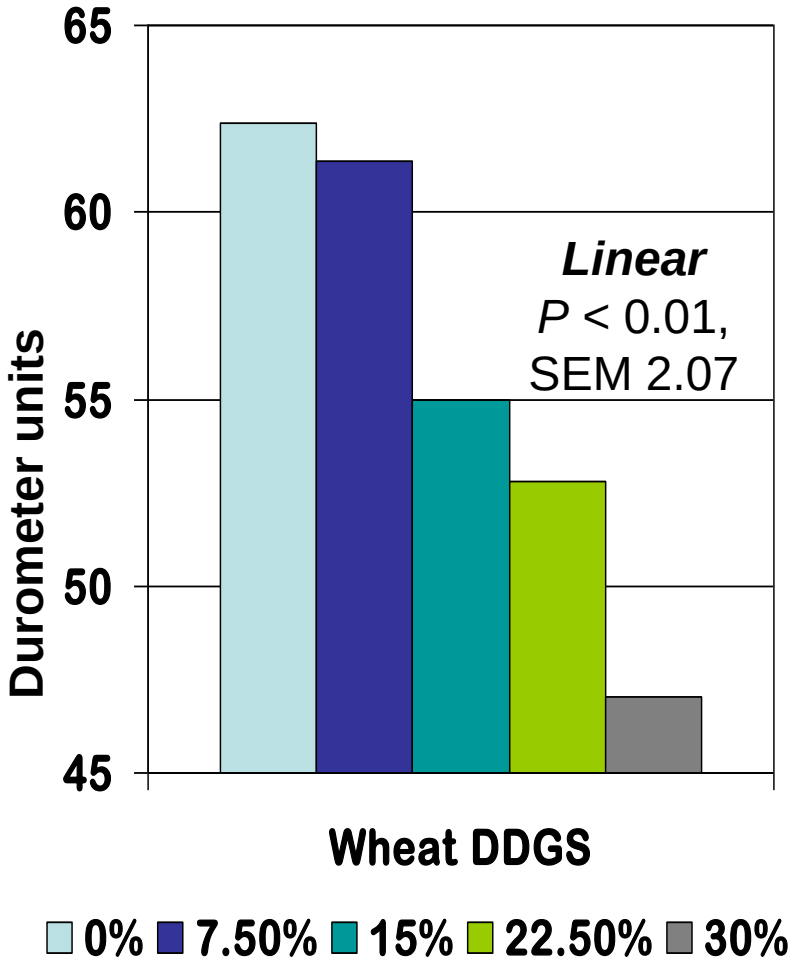
	0%	7.5%	15%	22.5%	30%	SEM
Metallic	1.04	0.00	0.00	0.00	0.00	0.47
Off sour	14.61	19.69	15.63	16.62	16.79	4.20
Barny	5.21	7.29	3.13	2.08	4.17	2.40
Stale	1.08	0.03	1.05	0.98	0.04	0.84
Rancid	1.08	0.03	1.05	0.98	0.04	0.84
Other	2.08	1.04	2.08	0.00	0.00	1.04
Unidentified	33.33	23.96	33.33	32.29	31.25	4.57

Wheat DDGS Level on Texture of Loin Chops

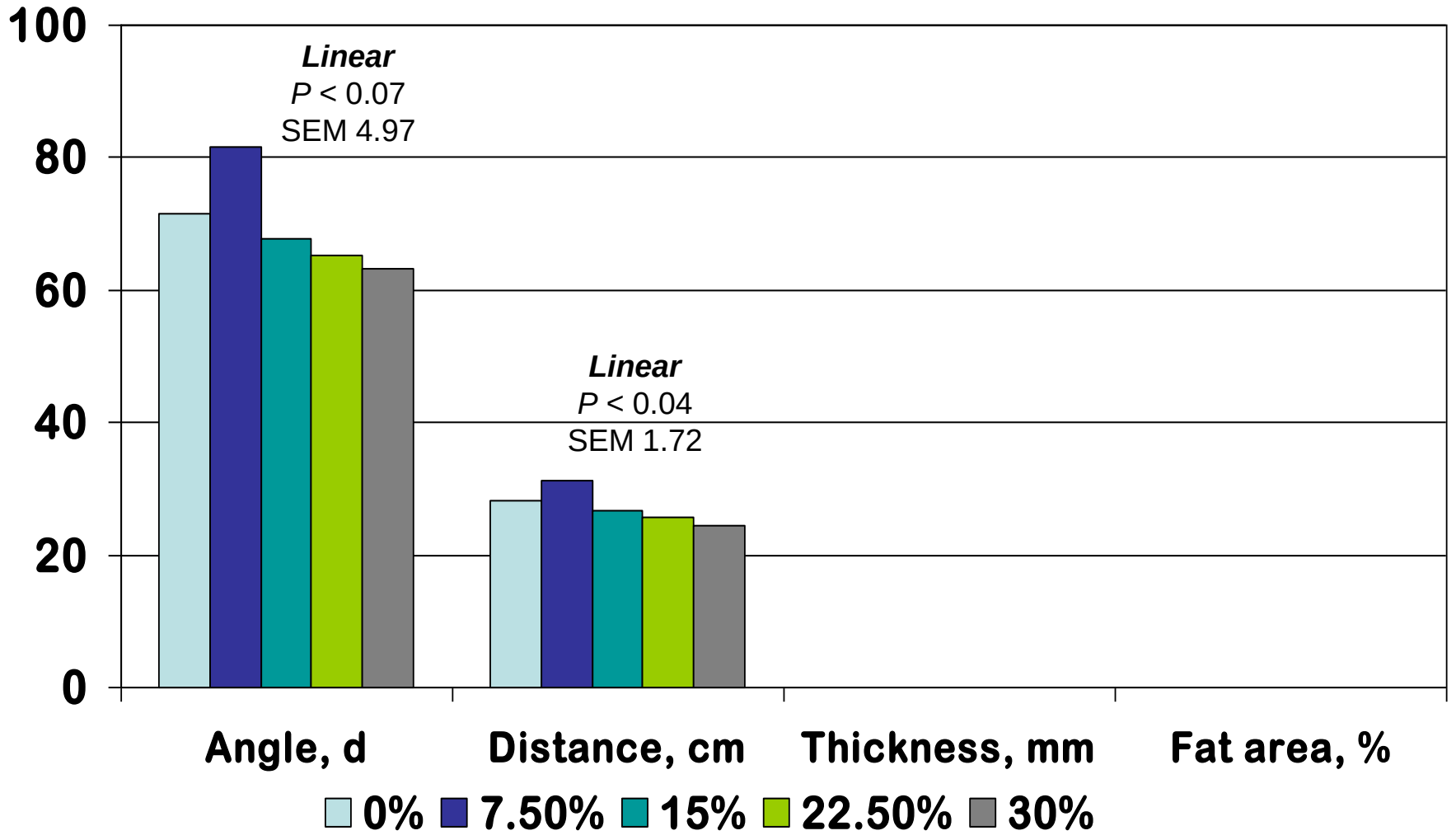
	0%	7.5%	15%	22.5%	30%	SEM
Typical pork	72.85	73.06	79.05	69.61	81.47	5.60
Mushy	1.04	8.33	4.17	2.08	4.17	3.71
Mealy	15.63	11.45	12.51	23.96	8.33	3.31
Rubbery	4.17	6.25	4.17	2.08	5.21	2.17
Spongy	6.11	1.14	0.09	2.18	0.89	1.86

Backfat and Belly Quality

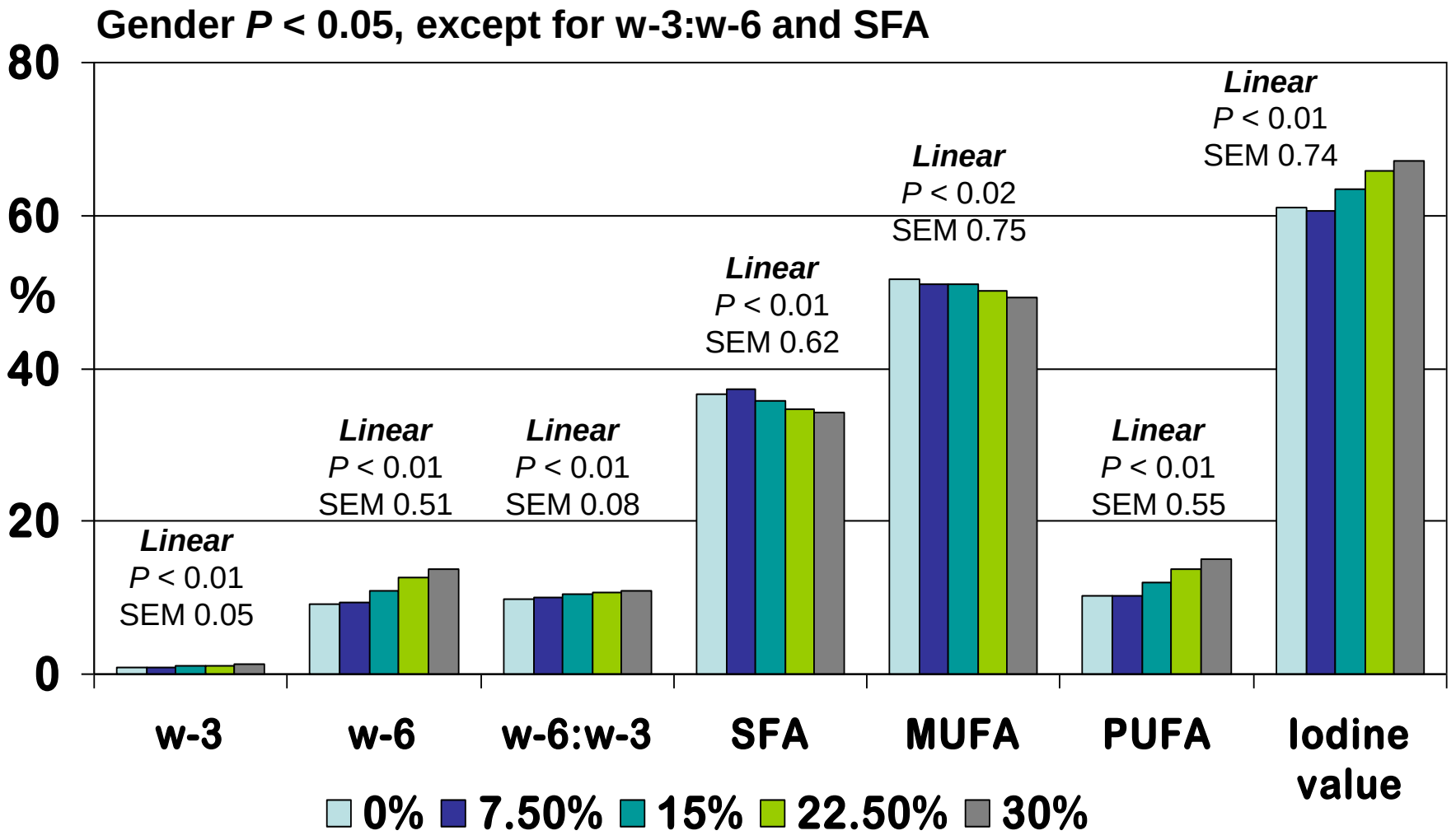
Wheat DDGS Level on Backfat Hardness



Wheat DDGS Level on Belly Measurements



Wheat DDGS Level on Belly Fatty Acid Composition



Wheat DDGS Summary

1. Feed intake of hogs increased to 22.5% wheat DDGS, weight gain increased to 15% DDGS and then declined

2. Dressing % decreased 0.45%-unit and BF decreased 0.23 mm for each 7.5% increase in wheat DDGS inclusion

3. Increasing wheat DDGS level reduced the weight of the belly, and the belly squared and trimmed

4. Increasing wheat DDGS level increased separable lean and reduced dissected fat in primal cuts

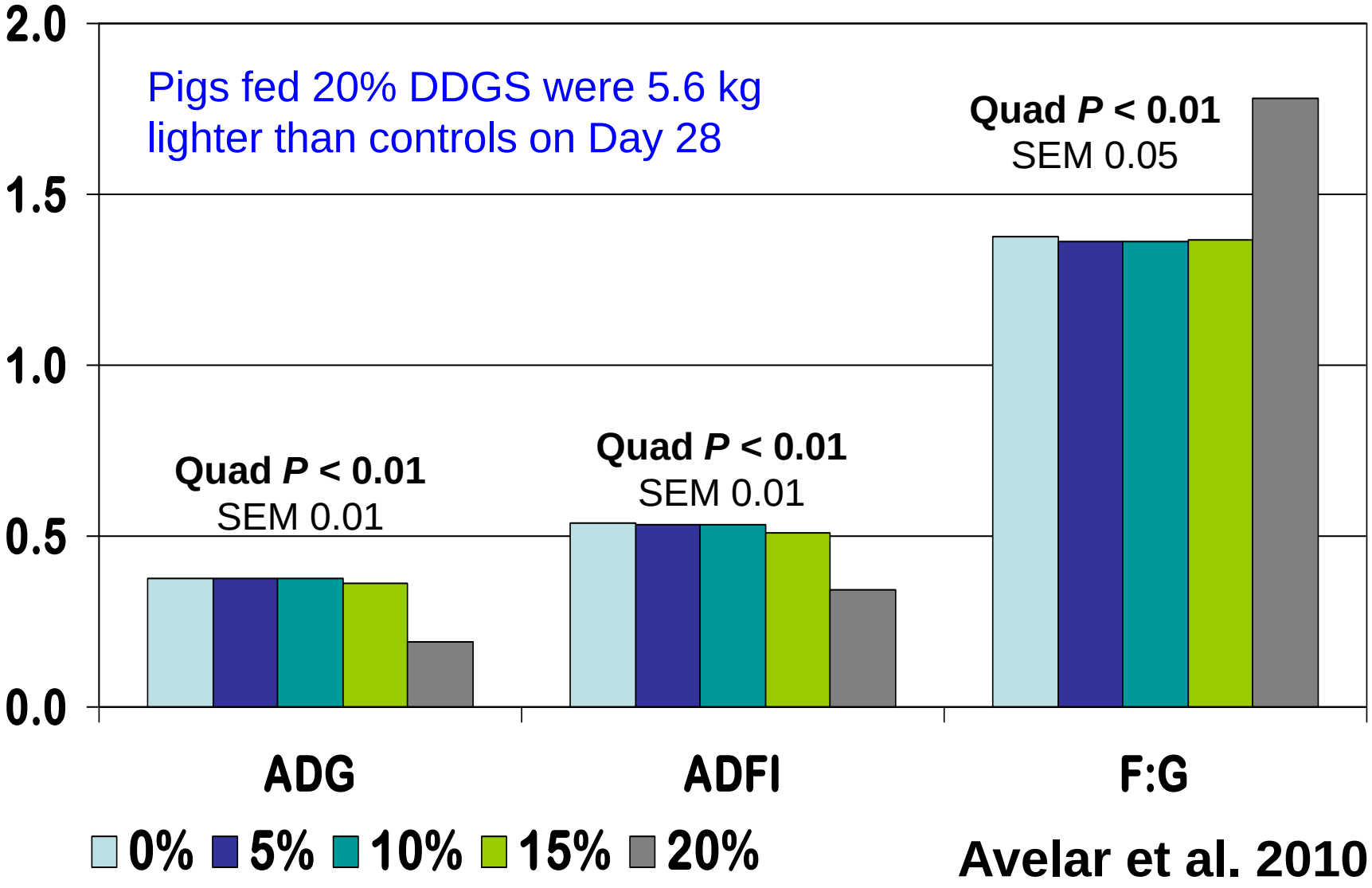
5. Increasing wheat DDGS level increased shear force, subjective color, but reduced analyzed fat and marbling in loin

6. Increasing wheat DDGS level reduced backfat hardness, SFA and MUFA, but increased PUFA, w-3, w-6, w-6:w-3, and iodine value in loin and belly

Wheat DDGS Conclusions

1. Overestimated NE value of wheat DDGS
2. Amino acid availability of wheat DDGS was mostly right
3. Performance less predictable at high wheat DDGS inclusion rates
4. Underformulate vs. proper specs
5. Current focus is not DDGS quality

Wheat DDGS Level for Weaners



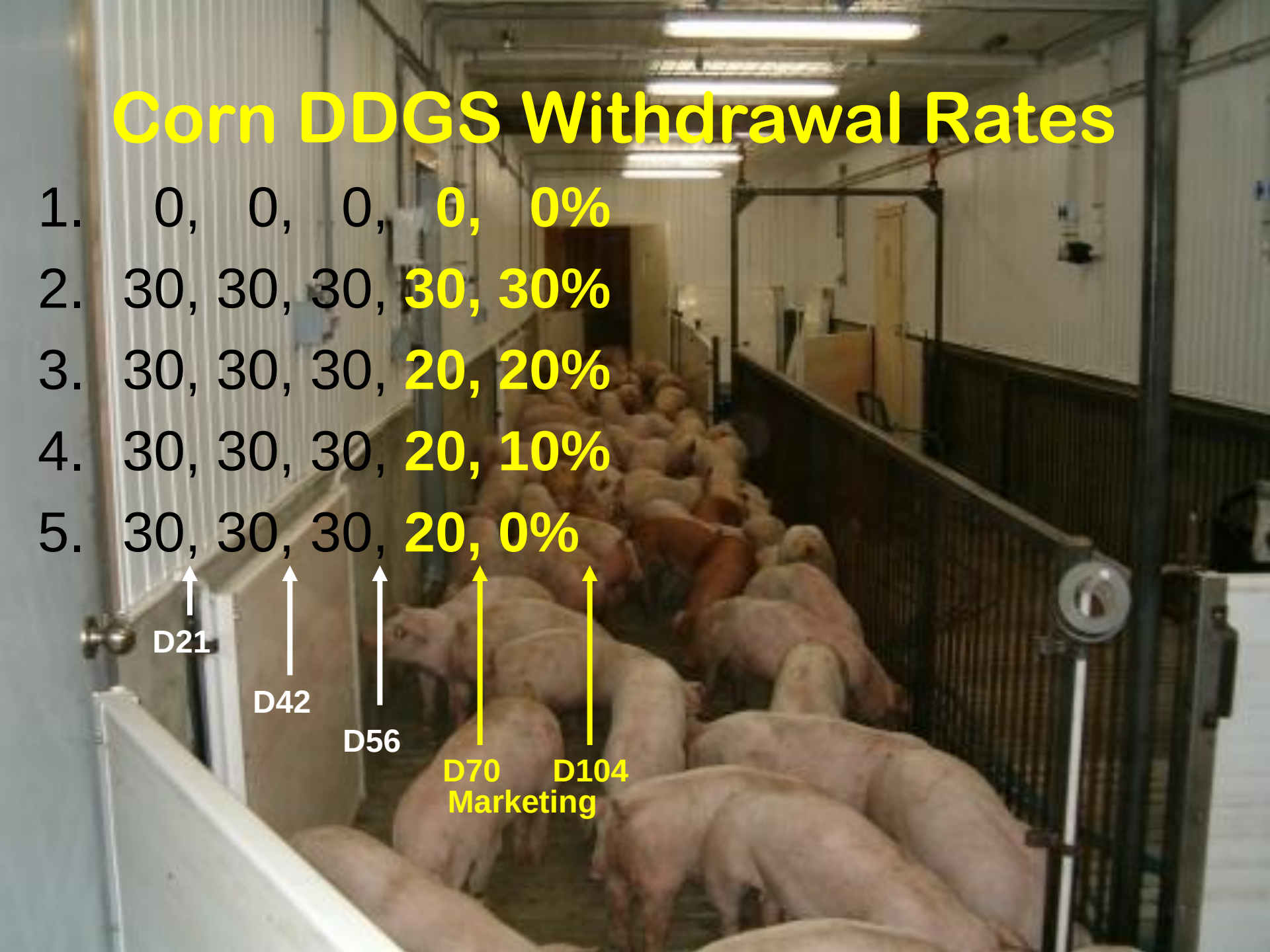
Avelar et al. 2010

Corn DDGS

- High in unsaturated linoleic acid
- Feeding DDGS may soften pork fat
- Canada is a large pork exporter
- Packers concerns:
  - Loin firmness
  - Bacon slices may stick and gel together
  - Sausage may appear oily, runny
  - Reduced pork shelf life
- Genotype and gender exacerbate the problem

Trial Objectives

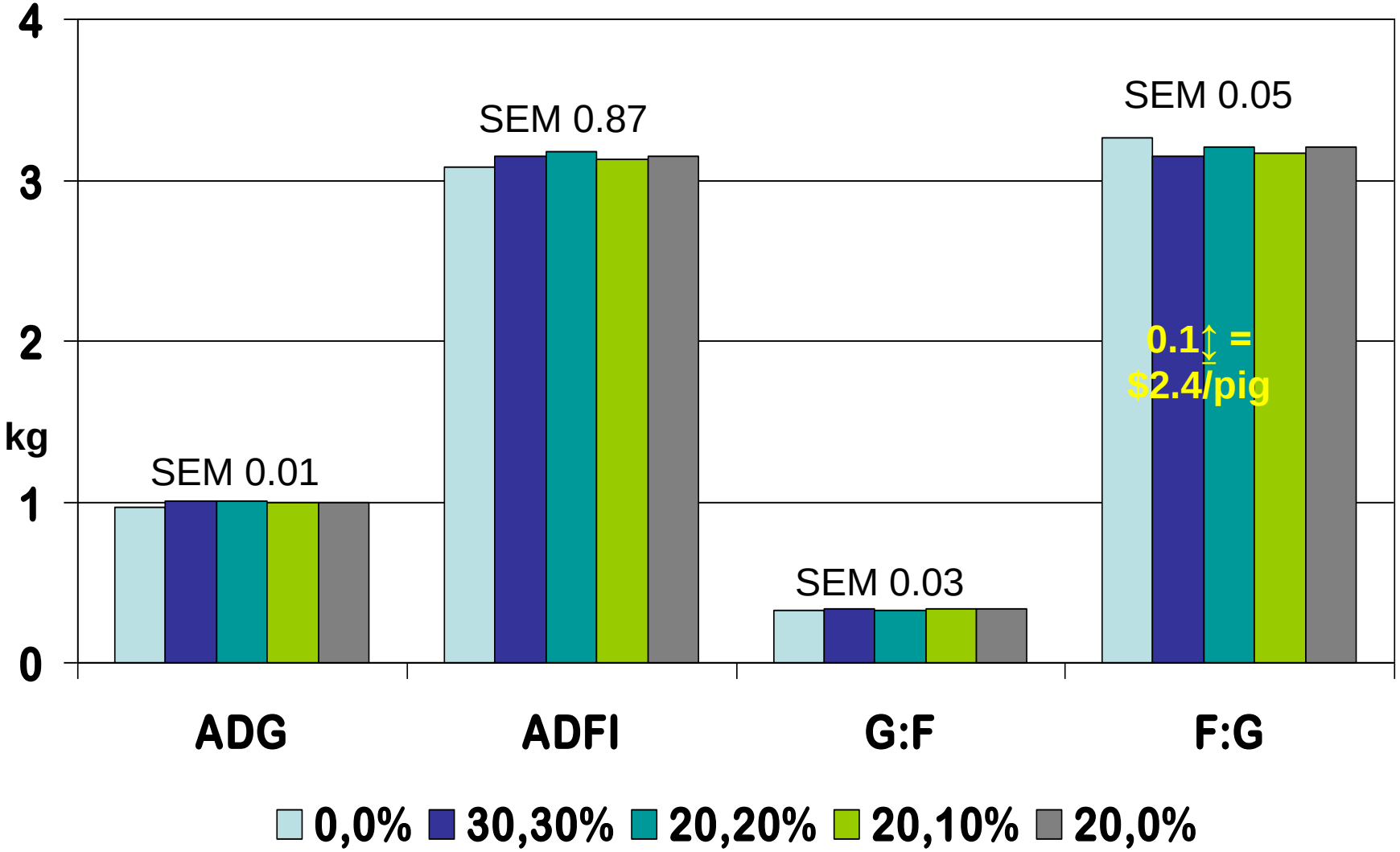
- **How much can we feed to minimize feed cost and not affect growth performance?**
- **How fast should we withdraw corn DDGS out of the diet in order to not impact pork quality?**


Corn DDGS Withdrawal Rates
1. 0, 0, 0, 0, 0%
2. 30, 30, 30, 30, 30%
3. 30, 30, 30, 20, 20%
4. 30, 30, 30, 20, 10%
5. 30, 30, 30, 20, 0%
D21
D42
D56
D70
D104
Marketing

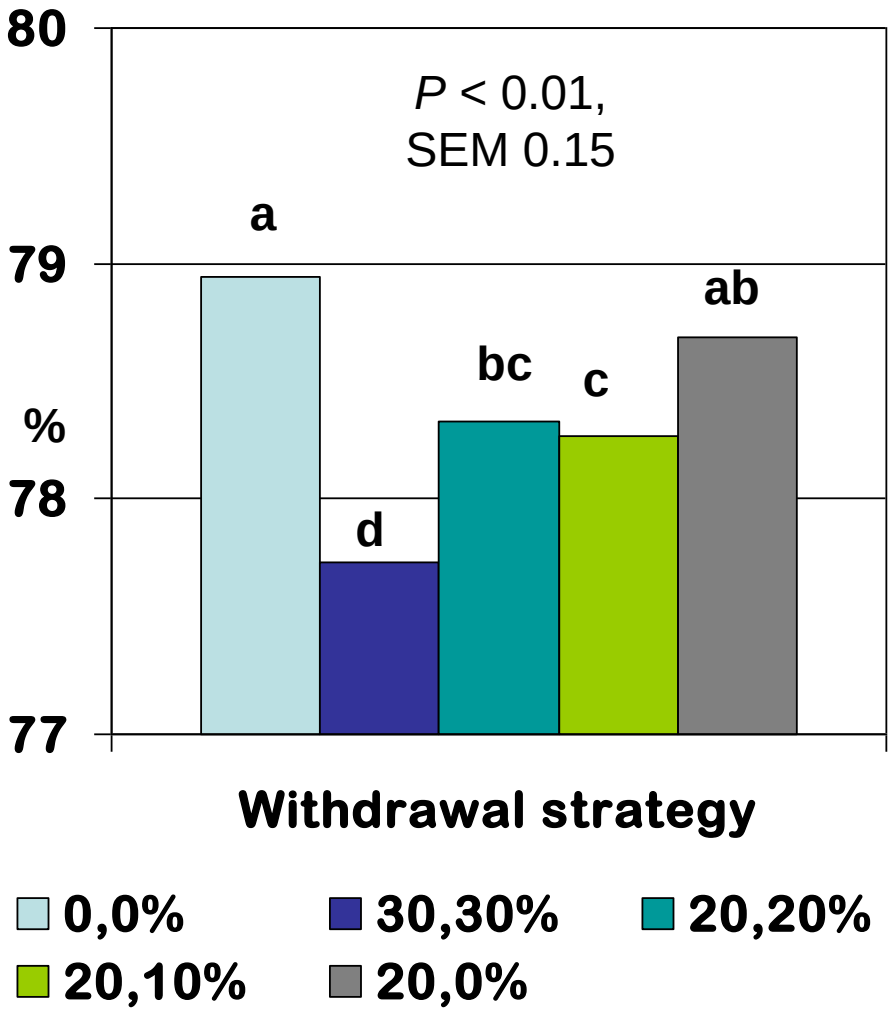
GROWER DIETS	Grow 1	Grow 1	Grow 2	Grow 2	Grow 3	Grow 3
Ingredient, %	**Control**	**30%DDGS**	**Control**	**30%DDGS**	**Control**	**30%DDGS**
Wheat 14%CP	74.12	45.79	79.75	51.47	73.48	53.82
Barley 11.4%CP	0.00	0.00	0.00	0.00	12.20	5.64
Corn DDGS 29.0%CP	0.00	30.00	0.00	30.00	0.00	30.00
Canola meal 37%CP	8.00	8.00	8.00	8.00	8.00	8.00
Soybean meal 46%CP	12.90	10.19	8.73	6.01	3.78	0.00
Tallow	2.64	3.59	1.21	2.13	0.30	0.30
Limestone	1.32	1.48	1.21	1.45	1.18	1.37
Salt	0.47	0.45	0.52	0.45	0.51	0.42
L-lysine	0.35	0.35	0.35	0.35	0.35	0.35
Feeder premix	0.10	0.10	0.10	0.10	0.10	0.10
L-threonine	0.05	0.00	0.09	0.00	0.10	0.01
Copper sulfate 25%Cu	0.04	0.04	0.04	0.04	0.00	0.00
Phyzyme XP	0.01	0.00	0.01	0.00	0.01	0.00
NE, Mcal	***2.45***	***2.45***	***2.40***	***2.40***	***2.35***	***2.35***
Std ID LYS, %	***0.98***	***0.98***	***0.89***	***0.89***	***0.78***	***0.78***
g Std ID LYS/Mcal NE	***4.00***	***4.00***	***3.71***	***3.71***	***3.32***	***3.32***

FINISHER DIETS	**Fin 1**	**Fin 1**	**Fin 1**	**Fin 2**	**Fin 2**	**Fin 2**	**Fin 2**
Ingredient, %	**Control**	**20%DDGS**	**30%DDGS**	**Control**	**10%DDGS**	**20%DDGS**	**30%DDGS**
Wheat 14%CP	80.90	68.49	57.98	55.15	49.90	44.90	39.45
Barley 11.4%CP	6.85	0.00	0.00	35.76	31.03	26.00	21.44
Corn DDGS 29%CP	0.00	20.00	30.00	0.00	10.00	20.00	30.00
Canola meal 37%CP	10.00	9.35	9.50	7.00	7.00	7.00	7.00
Tallow	0.00	0.00	0.32	0.00	0.00	0.00	0.00
Limestone	1.20	1.33	1.44	1.16	1.25	1.37	1.45
Salt	0.51	0.45	0.42	0.49	0.46	0.43	0.41
L-lysine	0.35	0.28	0.24	0.31	0.27	0.23	0.20
Feeder premix	0.10	0.10	0.10	0.06	0.06	0.06	0.06
L-threonine	0.08	0.00	0.00	0.07	0.02	0.00	0.00
Phyzyme XP	0.01	0.00	0.00	0.01	0.00	0.00	0.00
NE, Mcal	***2.35***	***2.35***	***2.35***	***2.30***	***2.30***	***2.30***	***2.30***
Std ID Lys, %	***0.72***	***0.72***	***0.72***	***0.65***	***0.65***	***0.65***	***0.65***
g Std ID Lys/Mcal NE	***3.06***	***3.06***	***3.06***	***2.83***	***2.83***	***2.83***	***2.83***

Corn DDGS Withdrawal Rates on Hog Growth Performance

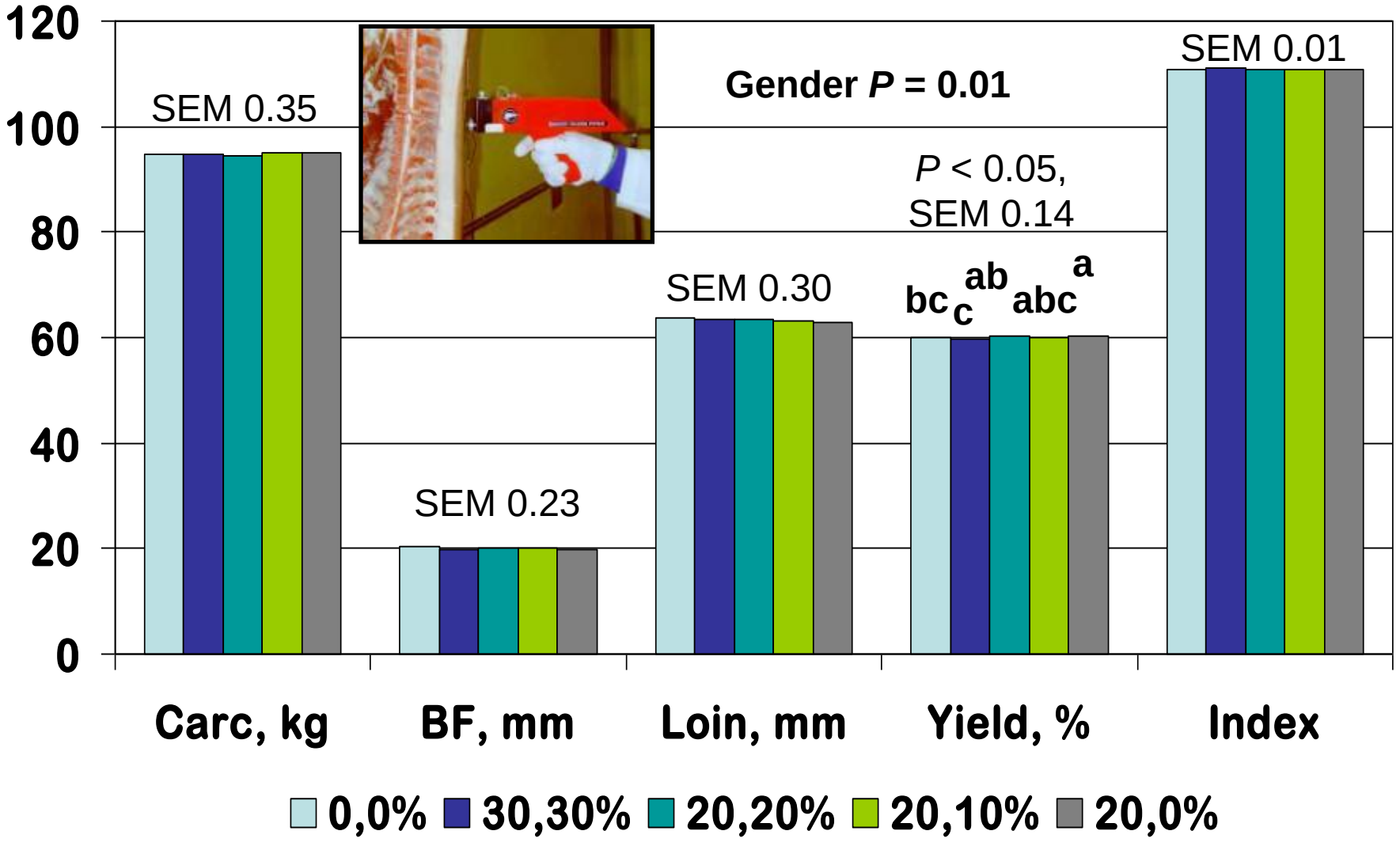


Corn DDGS Withdrawal on Dressing

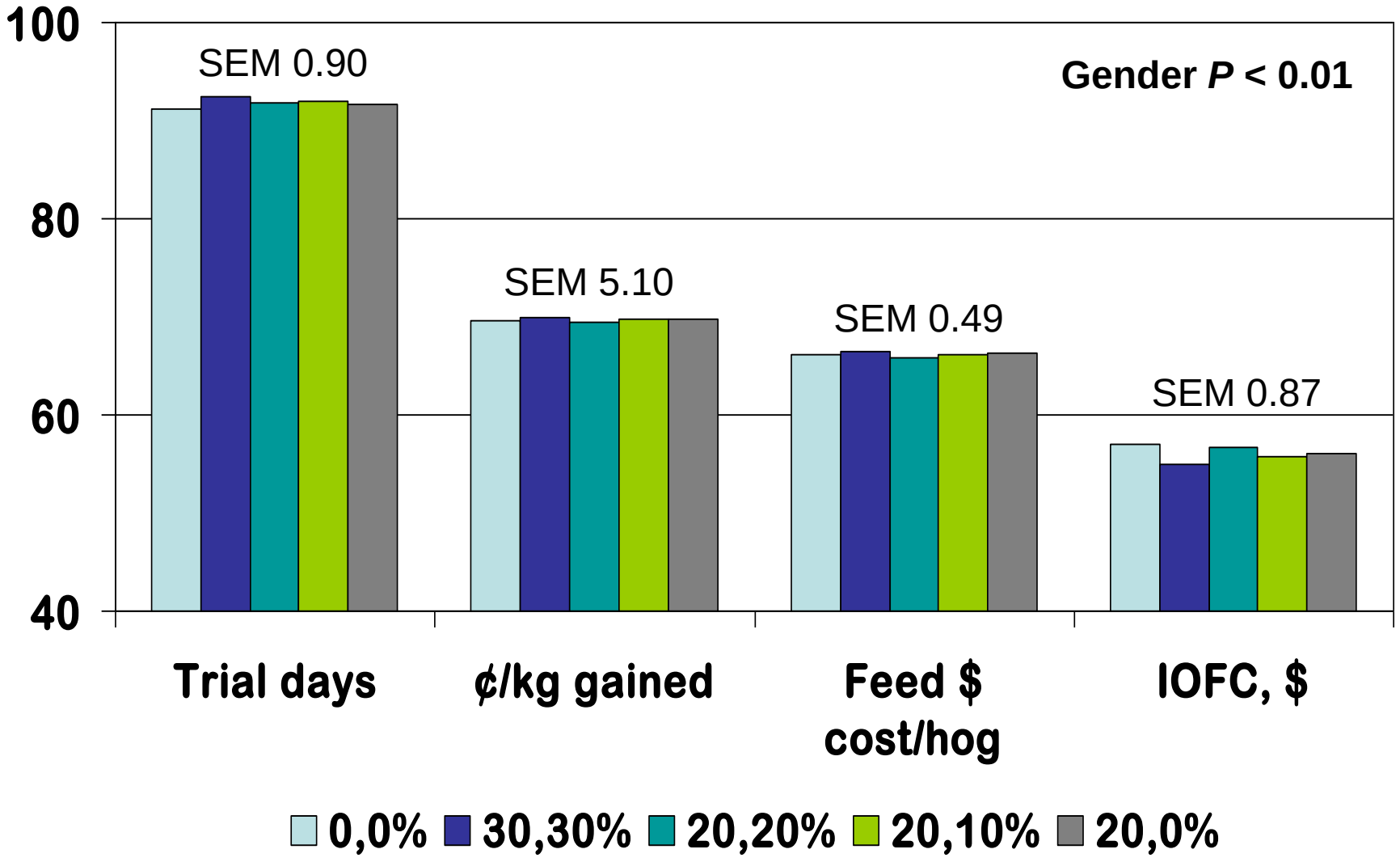


- For each 10% DDGS dressing declined 0.4%
- **Withdrawal strategies mitigated the problem**

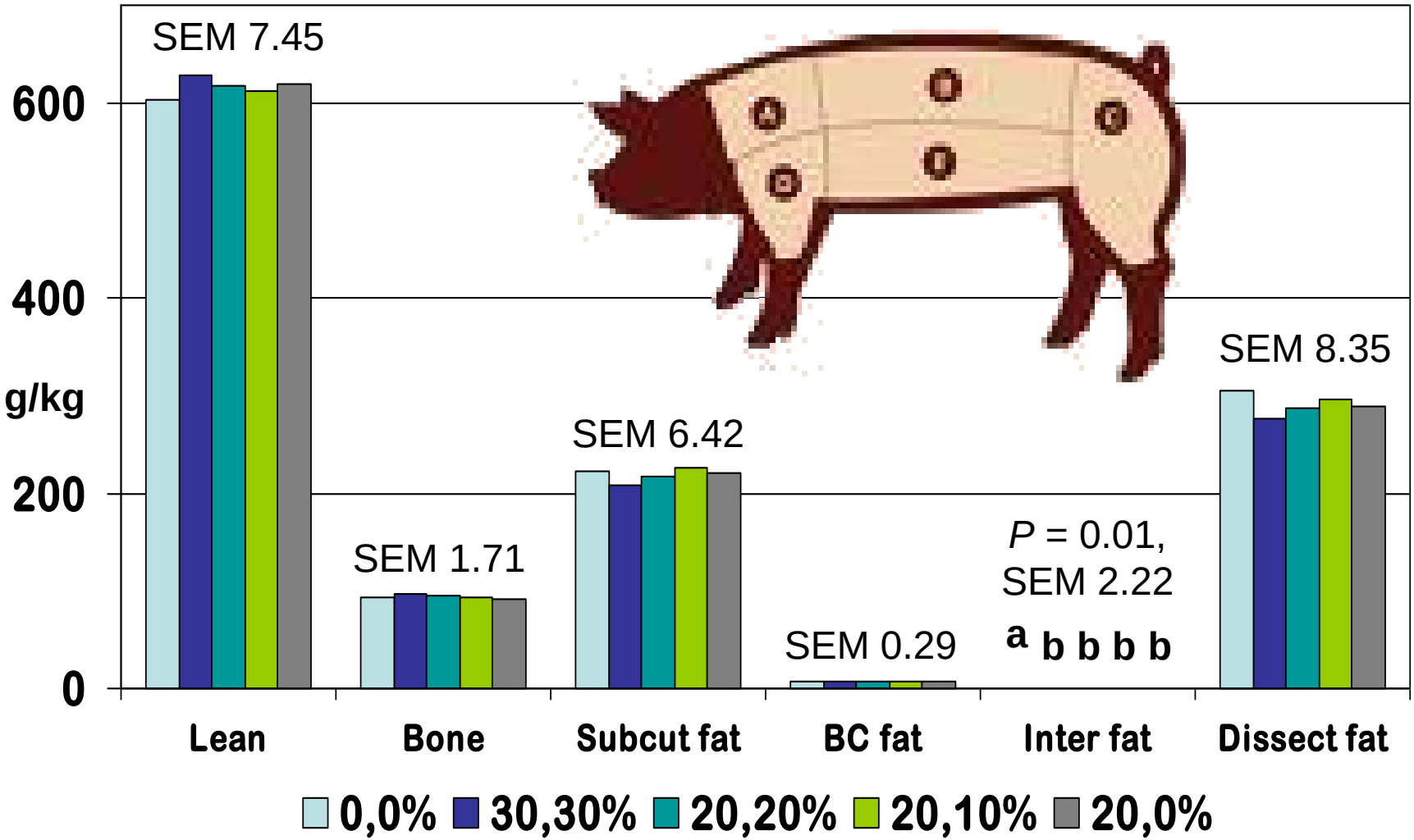
Corn DDGS Withdrawal Rates on Carcass Traits



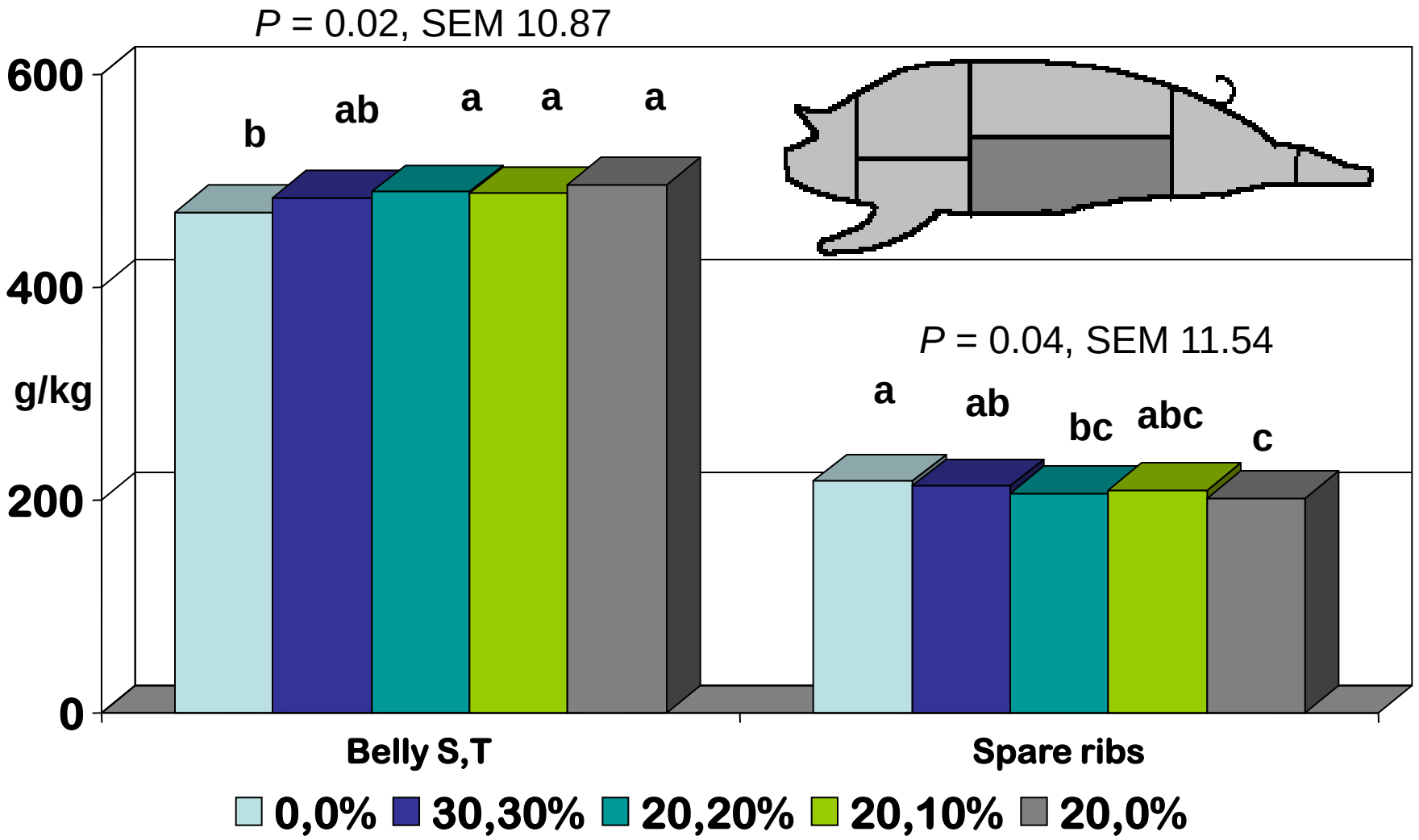
Corn DDGS Withdrawal Rates on Days on Trial, ¢/kg Gained, Feed Cost, IOFC



Corn DDGS Withdrawal Rates on Lean Cuts Tissue Composition

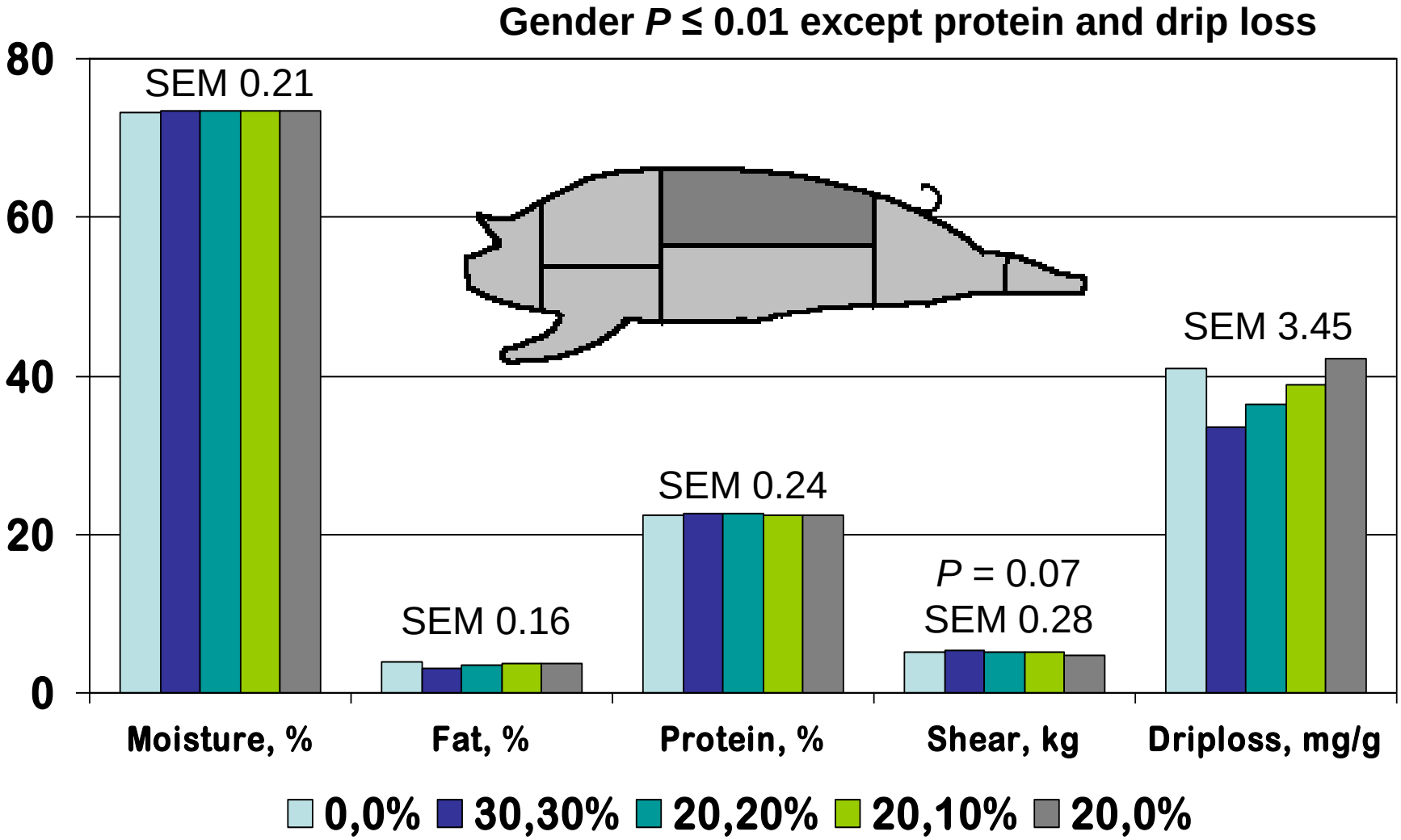


Corn DDGS Withdrawal Rates on BELLY Tissue Composition

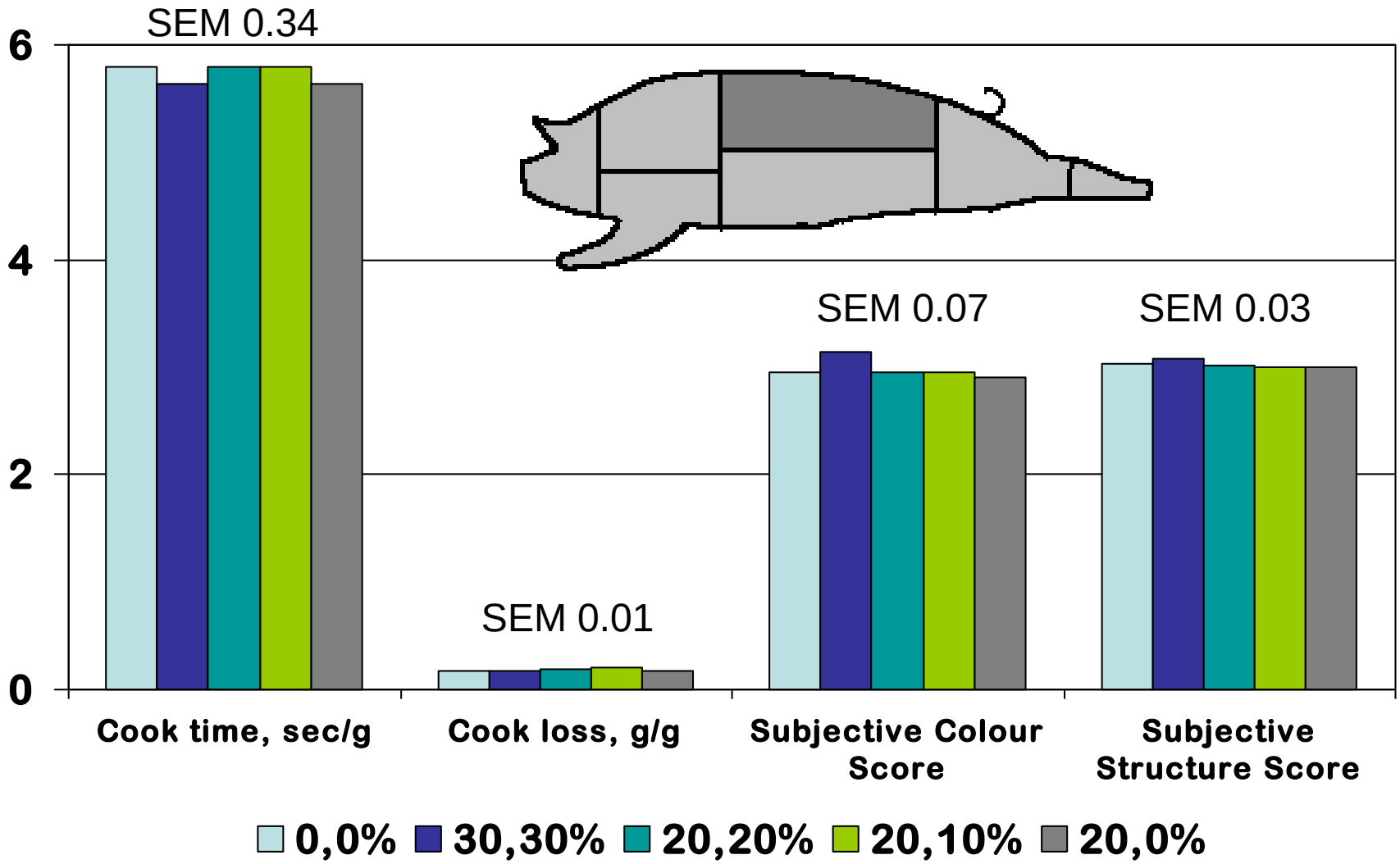


Loin Quality

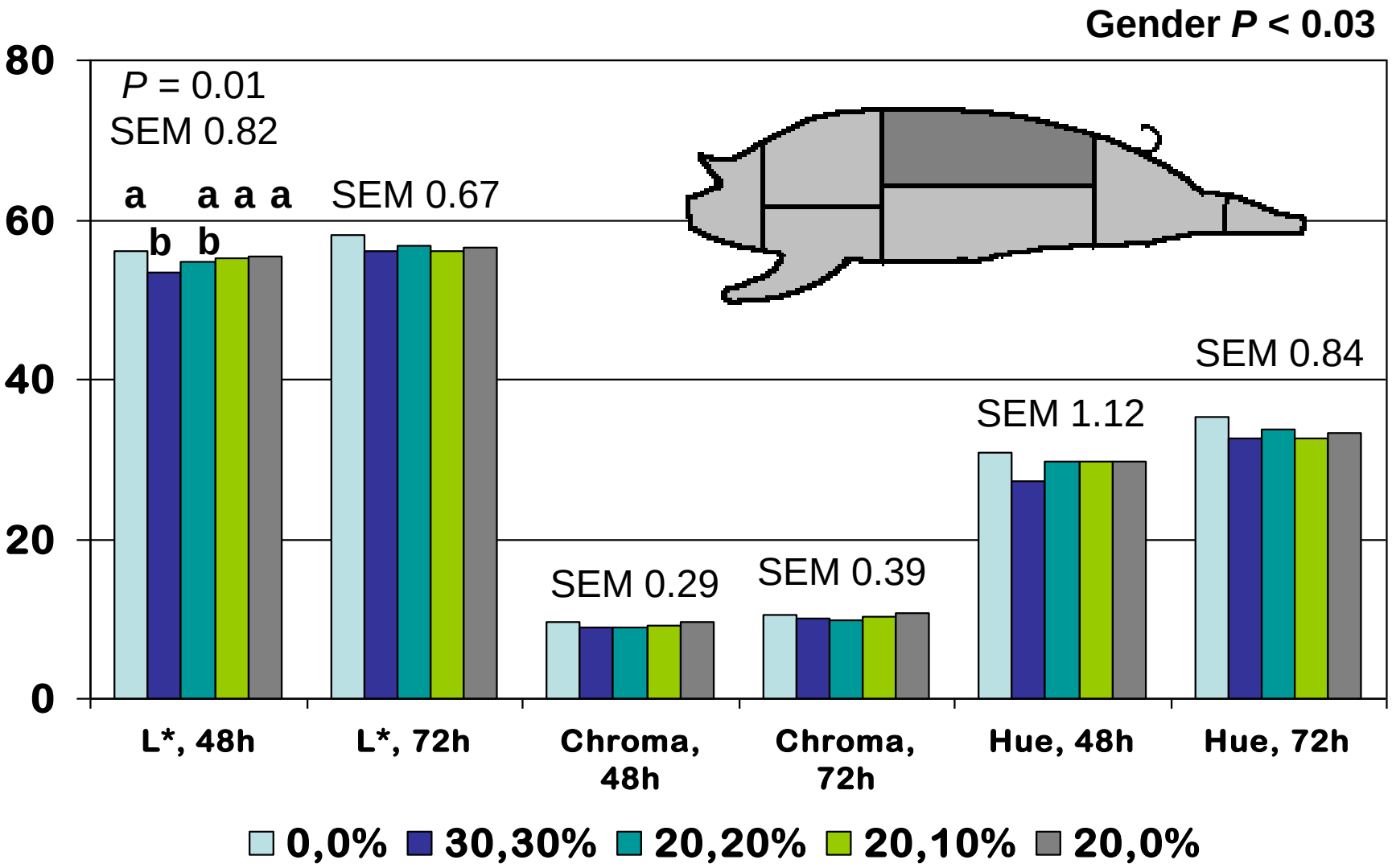
Corn DDGS Withdrawal Rates on Uncooked Loin Quality



Corn DDGS Withdrawal Rates on Cooked Loin Quality

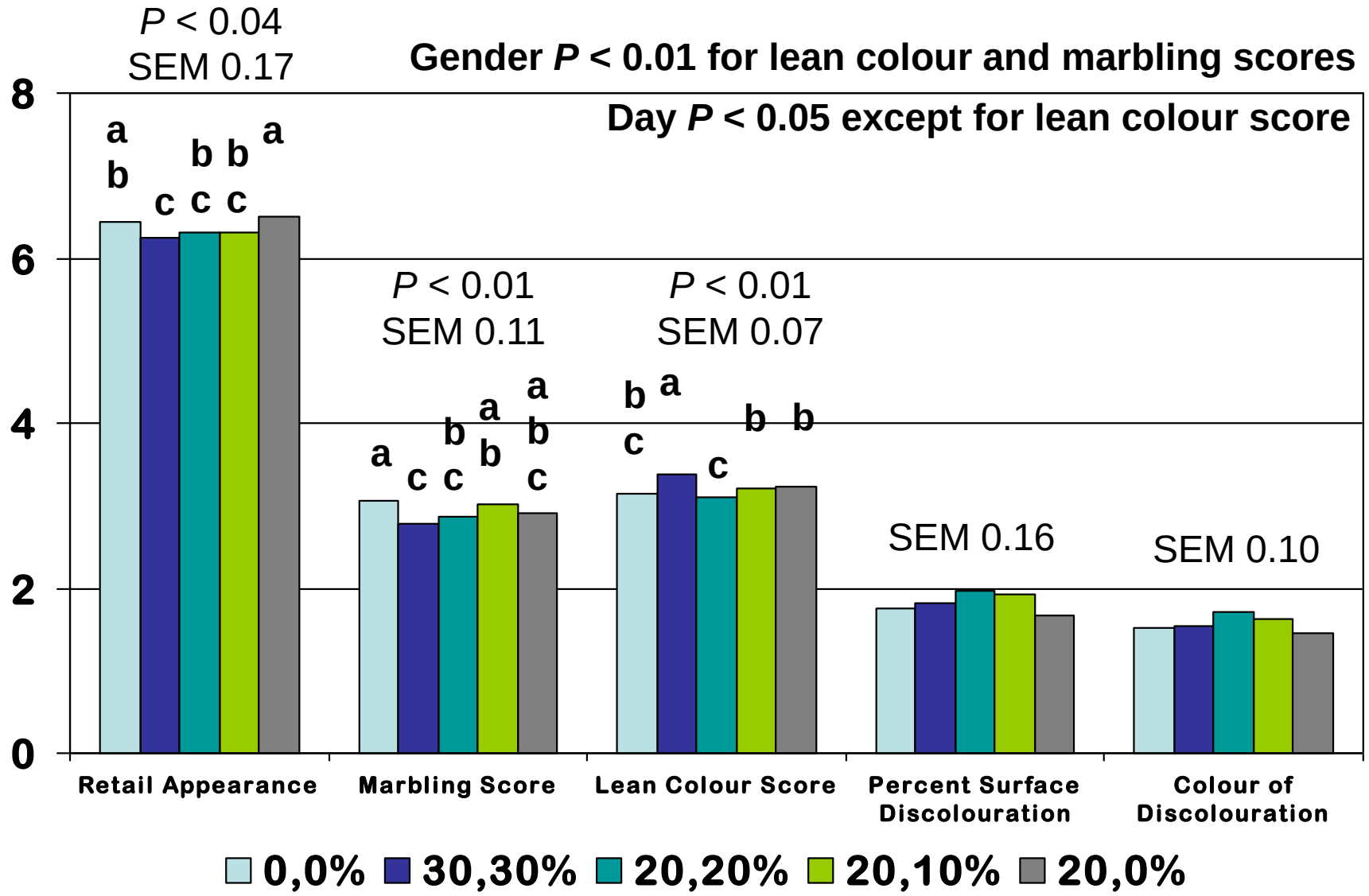


Corn DDGS Withdrawal Rates on Uncooked Loin Quality

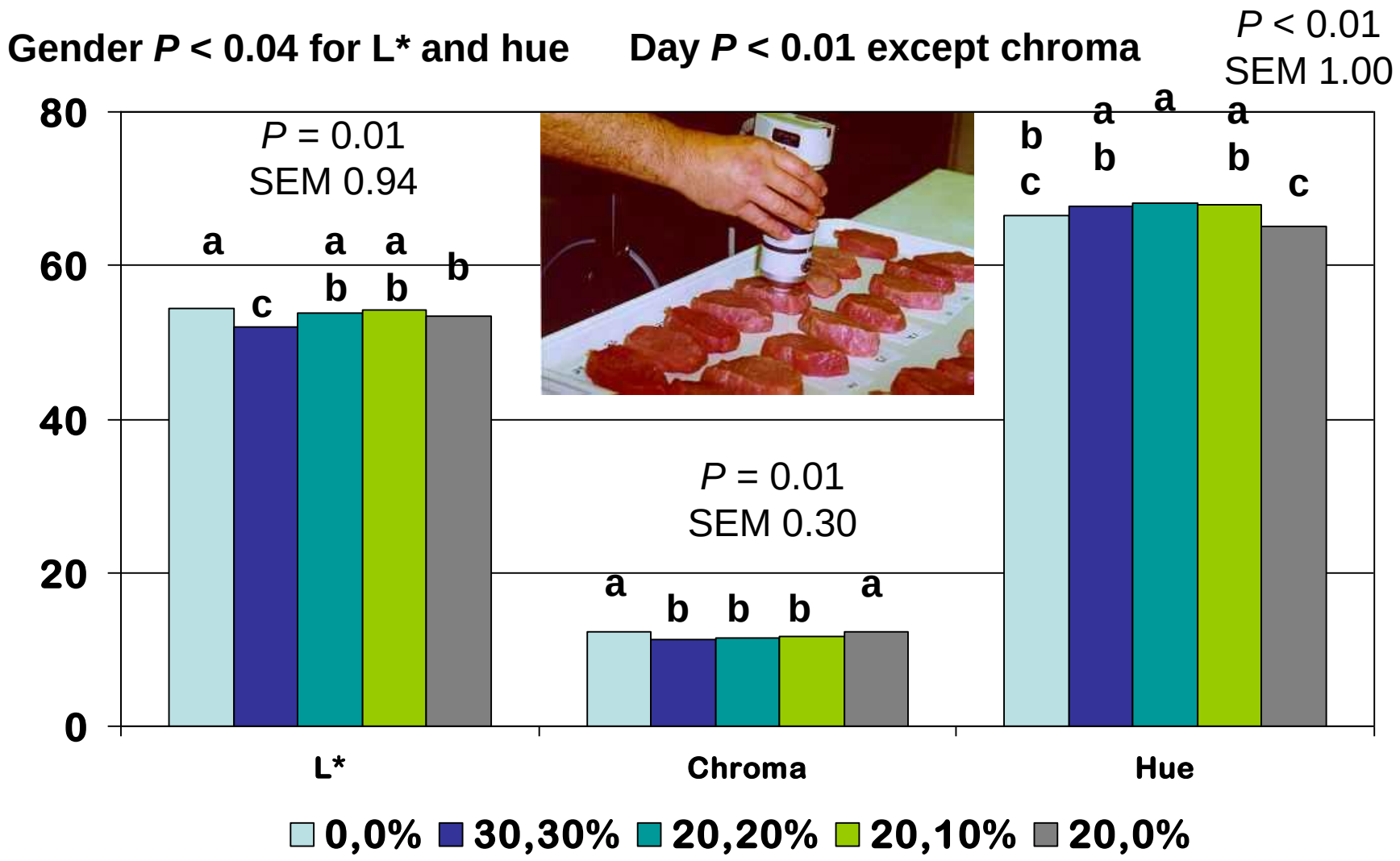


Retail Appearance

Corn DDGS Withdrawal Rates on *Subjective* Loin Retail Appearance over 3 days



Corn DDGS Withdrawal Rates on *Objective* Loin Retail Appearance over 3 days



Taste Panel

Corn DDGS Withdrawal Rates on Taste of Burger Patties

	0,0%	30,30%	20,20%	20,10%	20,0%	SEM
						***P* < 0.03**
Initial Tenderness	7.73**b**	7.82**a**	7.86**a**	7.83**a**	7.80**ab**	0.06
Initial Juiciness	5.42	5.38	5.46	5.31	5.35	0.18
Flavour Desirability	5.21	5.28	5.19	5.18	5.16	0.11
Pork Flavour Intensity	5.19	5.15	5.20	5.07	5.12	0.11
Off Flavour Intensity	7.23	7.30	7.18	7.33	7.20	0.14
Sustainable Juiciness	7.73	7.84	7.85	7.82	7.78	0.06
Overall Tenderness	5.48	5.57	5.60	5.48	5.45	0.17
Overall Palatability	4.82	4.78	4.81	4.70	4.69	0.15

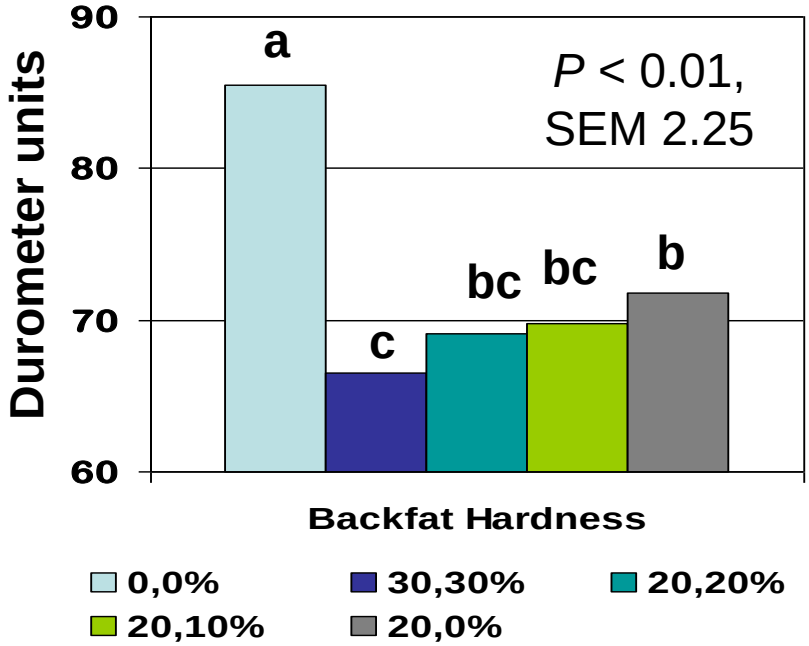
Corn DDGS Withdrawal Rates on Flavour of Burger Patties

	0,0%	30,30%	20,20%	20,10%	20,0%	SEM
Metallic	0.63	0.63	1.86	0.71	1.96	0.86
Off sour	51.79	37.68	39.09	39.29	39.64	5.24
Barny	6.43	6.34	8.24	6.43	6.34	3.17
Stale	4.64	7.41	5.50	6.52	3.99	2.00
Rancid	0.00	2.14	1.73	1.25	0.76	1.09
Other	3.21	5.36	6.25	5.00	1.96	2.04
Unidentified	11.87	15.45	13.80	12.59	18.12	2.71

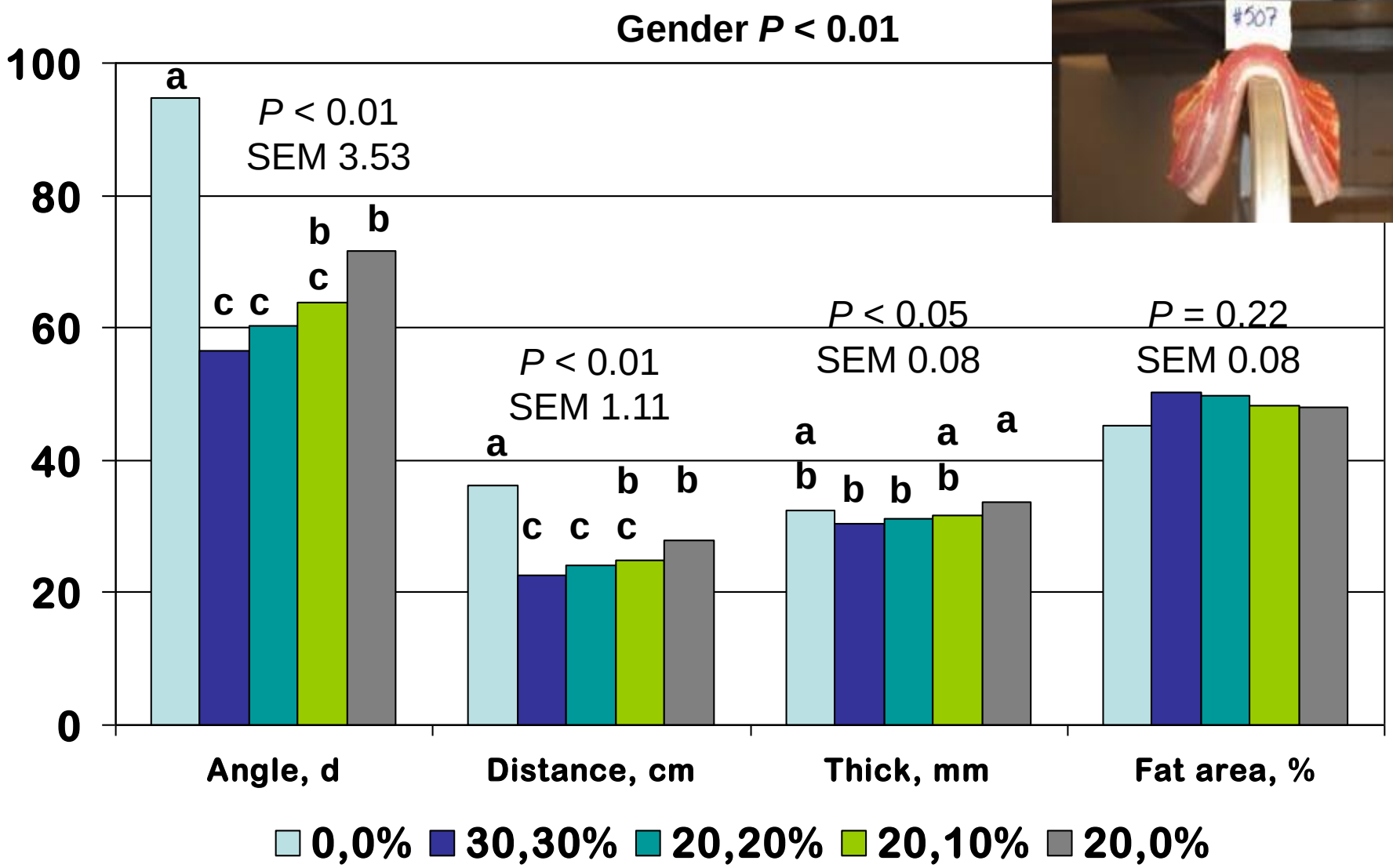
Corn DDGS Withdrawal Rates on Texture of Burger Patties

	0,0%	30,30%	20,20%	20,10%	20,0%	SEM
Typical Pork	21.43	25.00	23.99	28.21	27.27	3.50
Mushy	73.48	69.29	71.92	64.91	65.71	5.21
Mealy	4.64	8.48	7.95	10.71	9.00	2.19
Spongy	21.87	22.23	20.30	24.37	25.27	4.87
Rubbery	0.00	0.00	0.00	0.00	0.00	0.00

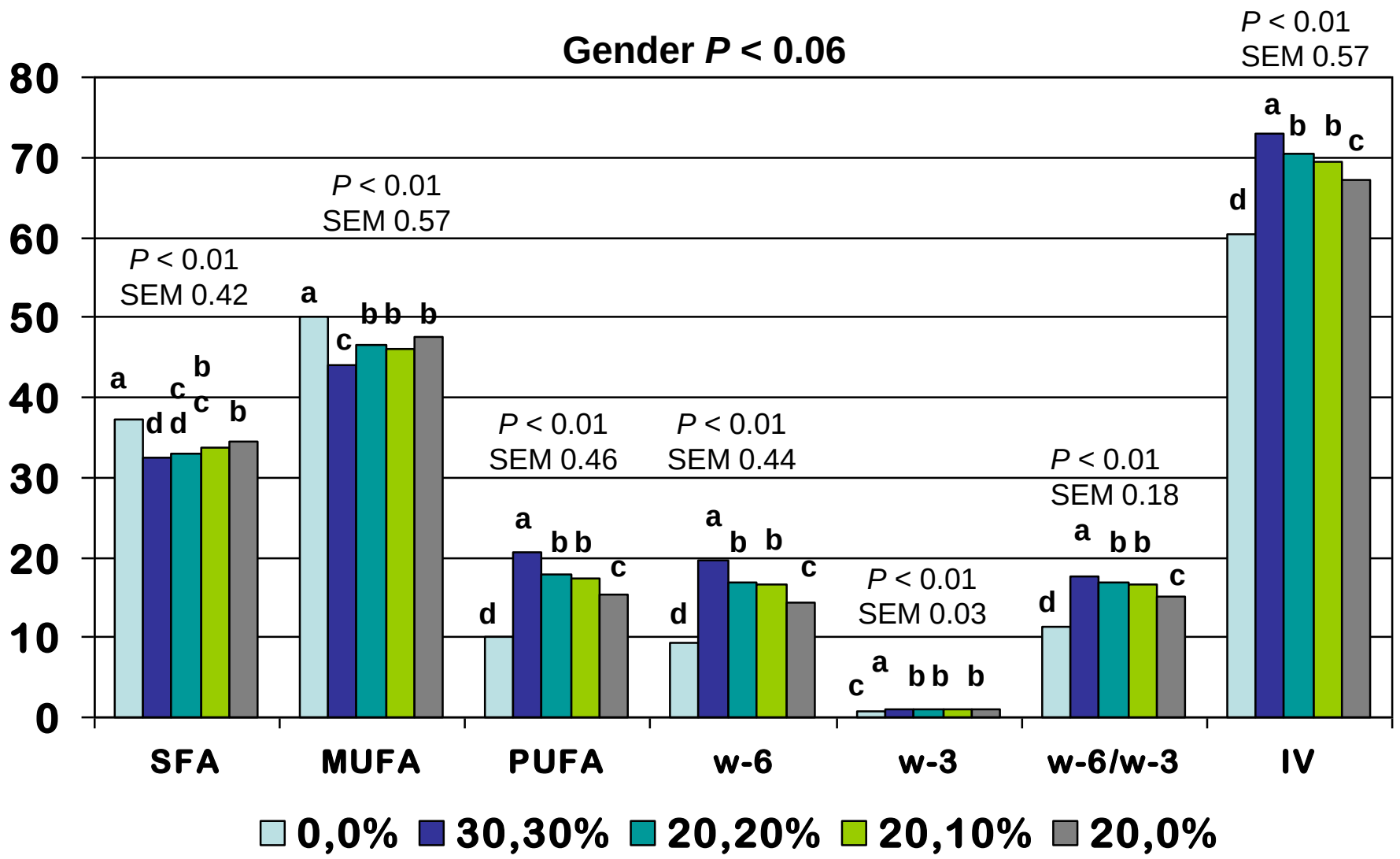
Corn DDGS Withdrawal Rates on Backfat Hardness



Corn DDGS Withdrawal on Belly Measurements



Corn DDGS Withdrawal Rates on % Belly Fatty Acid Composition



Corn DDGS Conclusions

1. Maximize inclusion of corn DDGS in grower diets

2. If bellies are the MOST important cut to packers,
   - withdraw for 4 wks if hogs previously fed ≥30% corn DDGS
   - withdraw for 2 wks if hogs previously fed ≤20% corn DDGS

3. Withdrawal strategies tested improved fat hardness, but not even the most aggressive (20, 0%) restored fat hardness

4. Is there a need to reach ‘zero’ impact on fat hardness when withdrawing corn DDGS?

5. Packers should consider paying producers an incentive to withdraw corn DDGS in the finisher diet(s) when prices are low

6. Effects of feeding corn DDGS were more pronounced in gilts compared to barrows

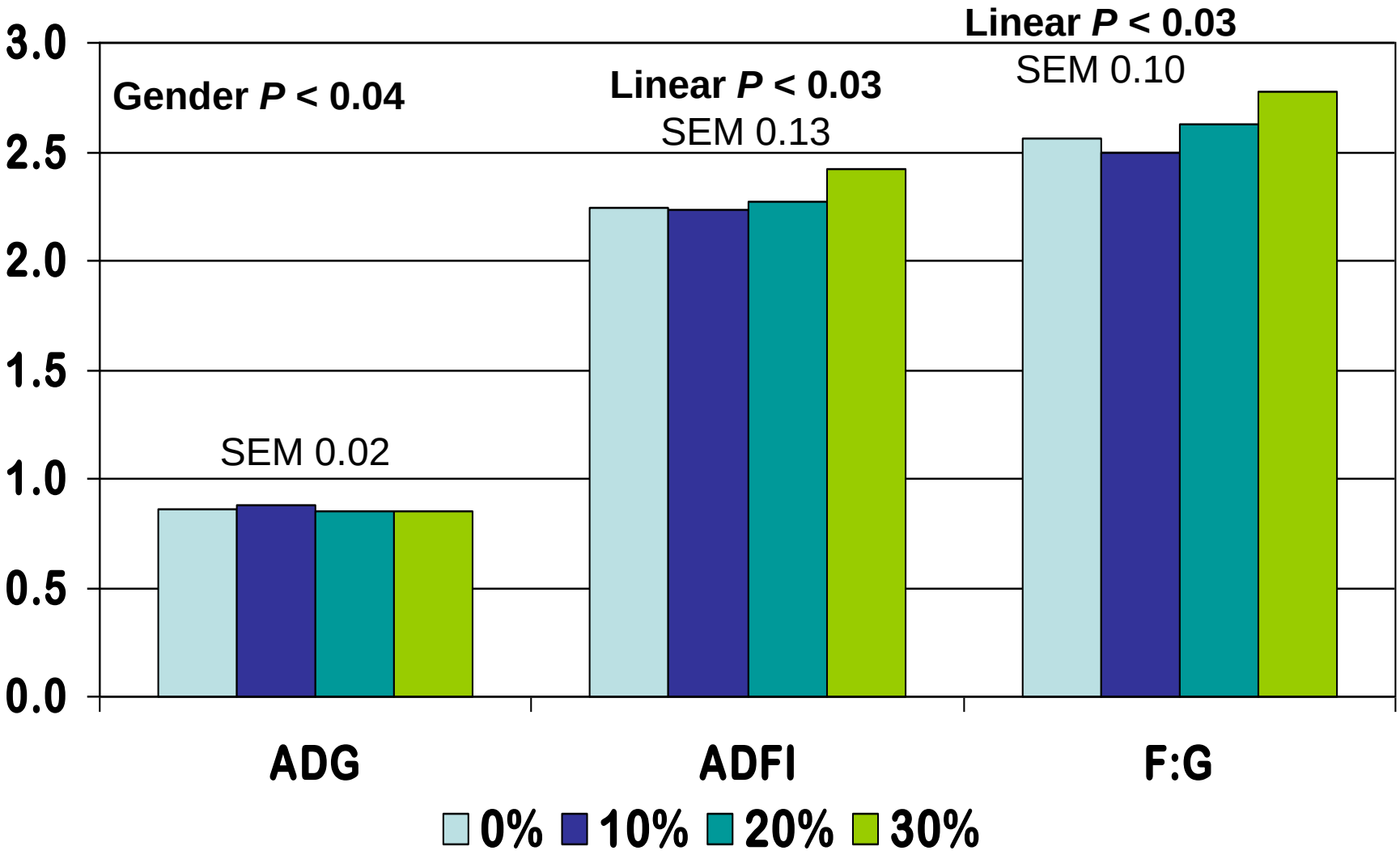
Triticale DDGS

- Why triticale?
  - 5 to 20% more grain yield than wheat
  - 14% lower crop inputs than wheat
  - Similar ethanol yield

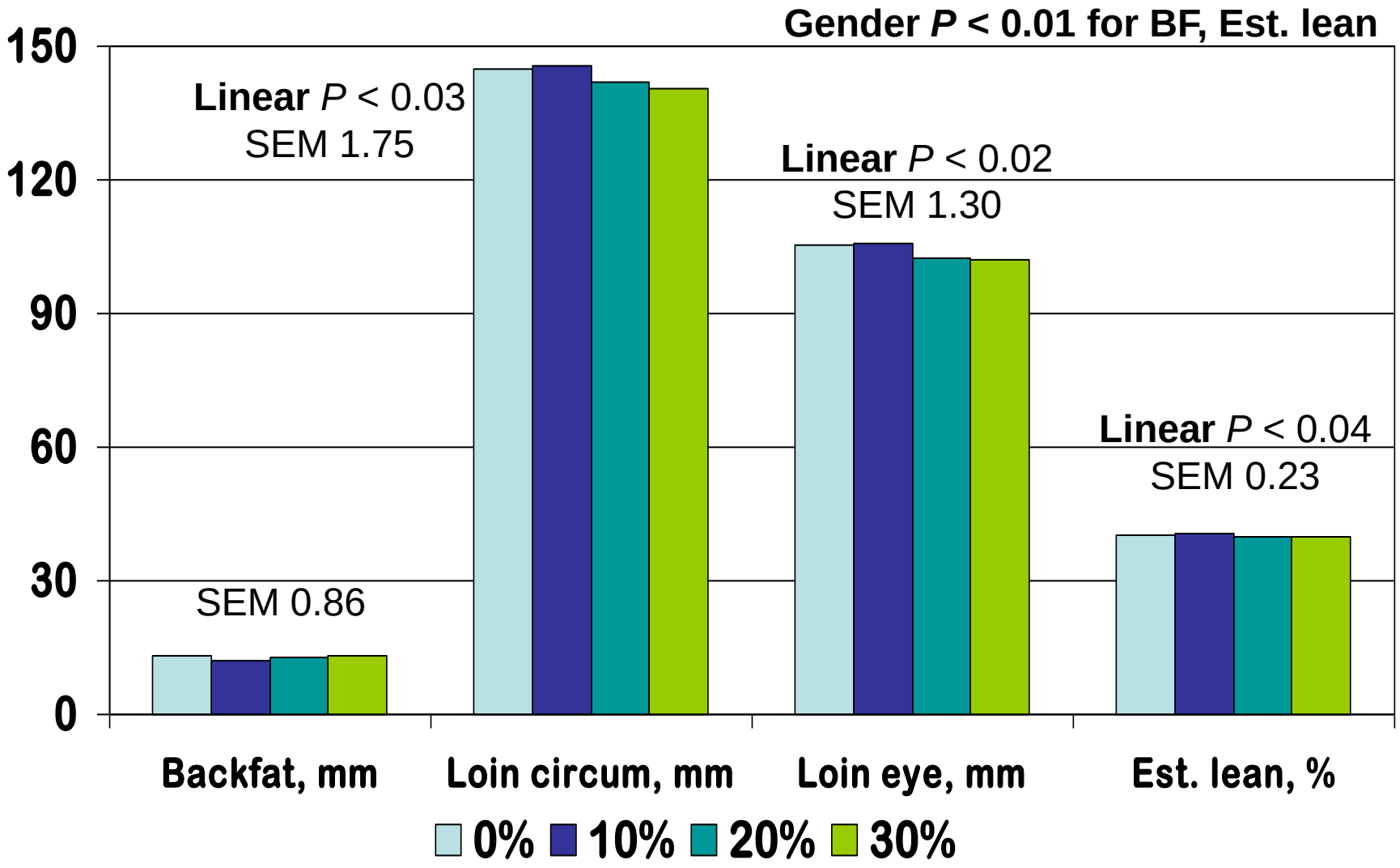
Objective:

Evaluate increasing dietary levels of triticale DDGS on hog growth performance and carcass characteristics

Increasing Triticale DDGS Levels on Hog Performance



Increasing Triticale DDGS Levels on Live RTU at 125kg

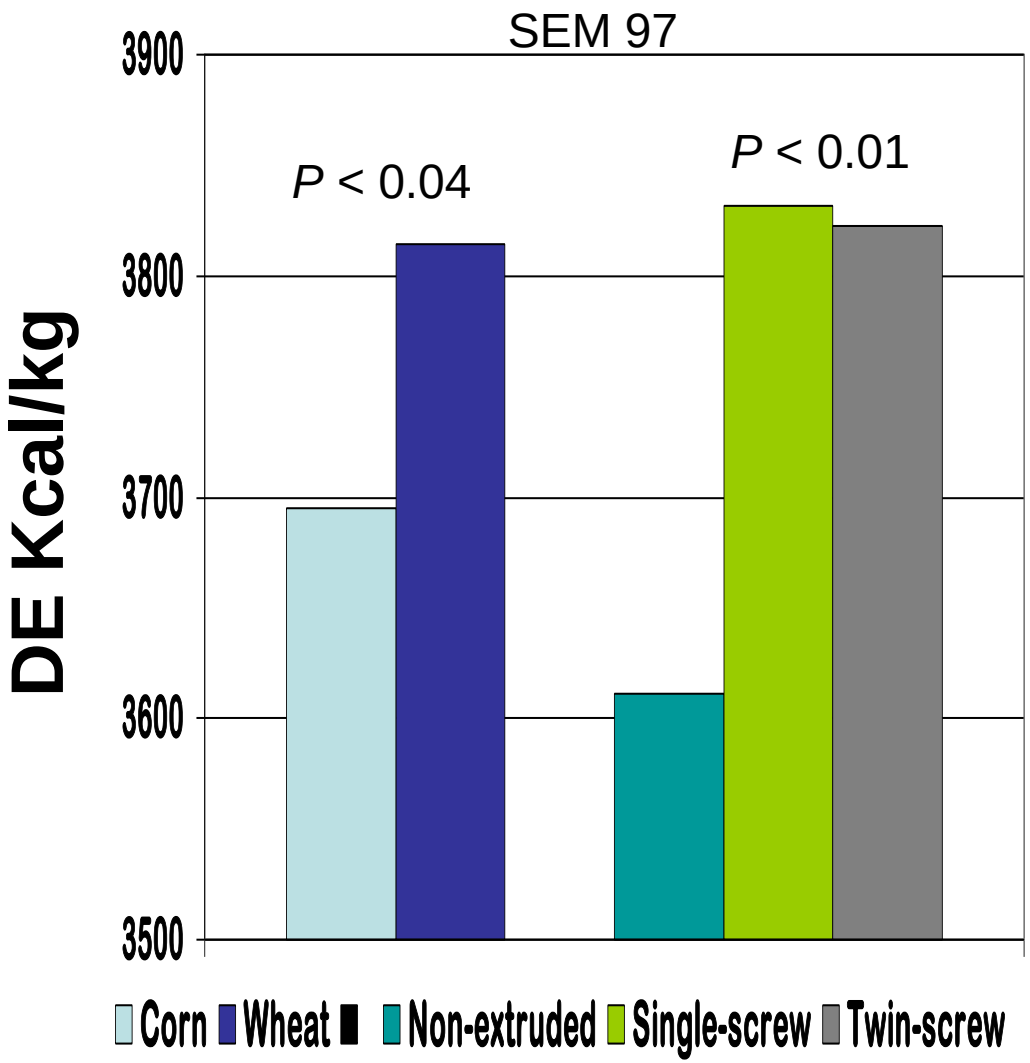


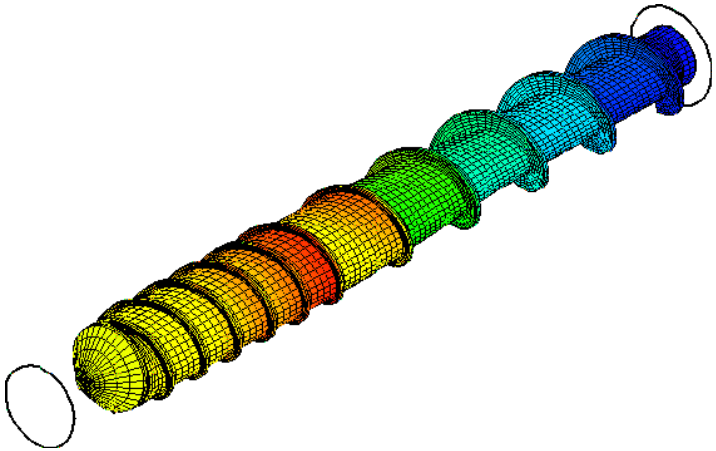
Triticale DDGS Conclusions

- Slightly higher intake and more feed per kg gained to maintain weight gain, suggest that the NE value of triticale DDGS was somewhat overestimated

- Small reductions in loin circumference, loin eye, and estimated yield also suggest a small overestimation on amino acid availability

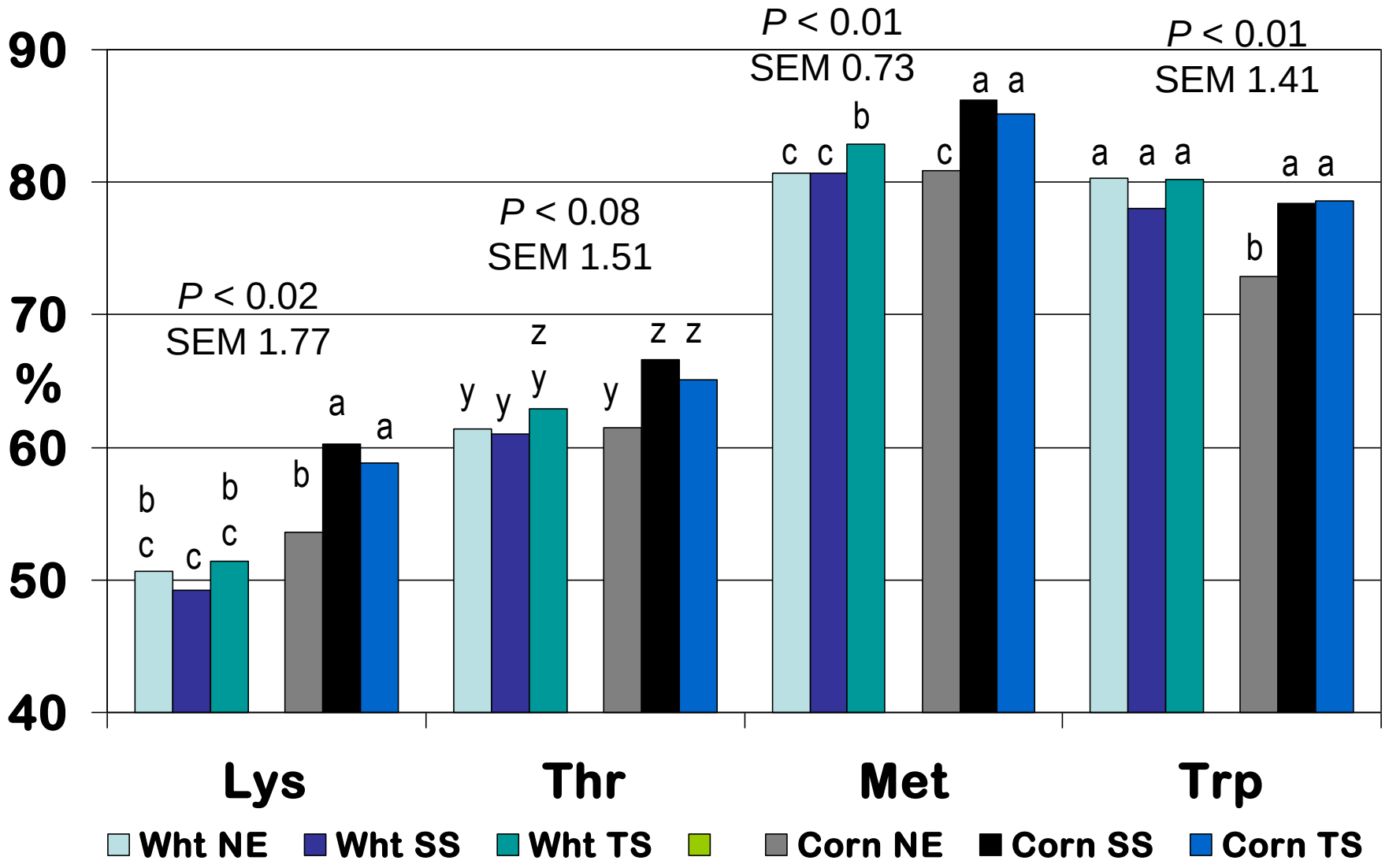
Extrusion of DDGS



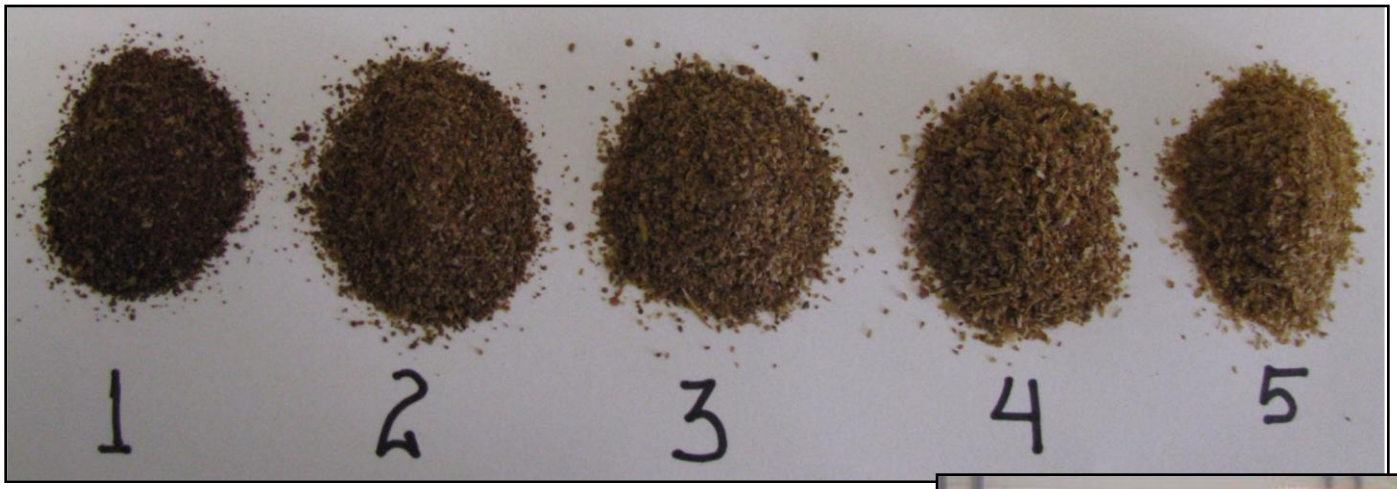


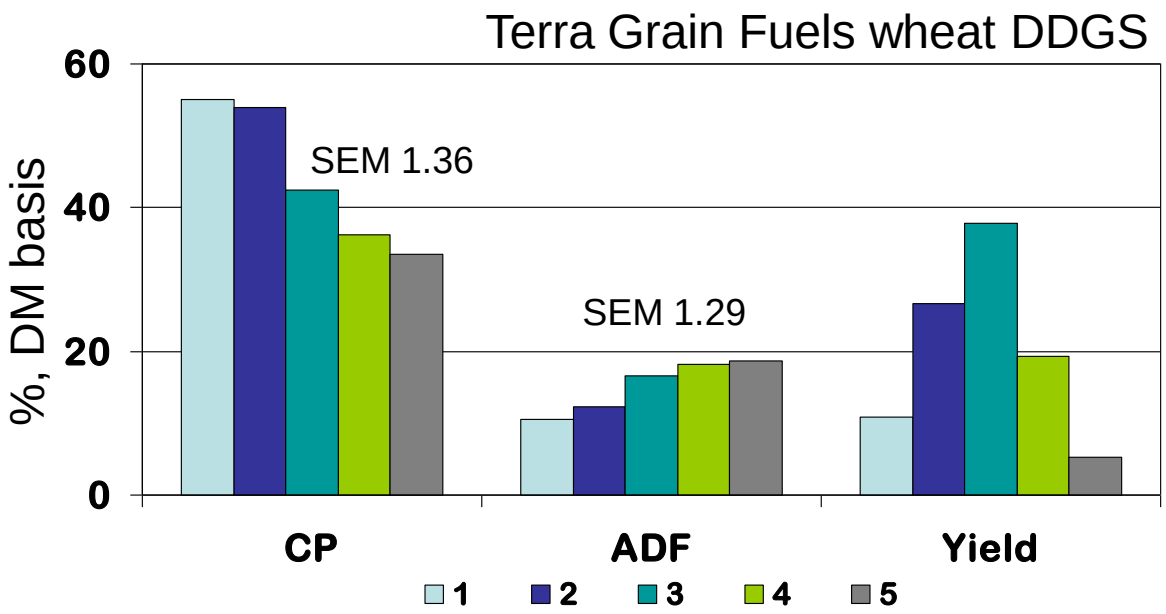
Insta-pro 2500

DDGS x Extrusion on SID% of AA



Fractionation of Wheat DDGS





Processing Conclusions

- Grain fractionation should preferable occur upfront
- Tail-end fractionation is possible. Scale-up?
  - ‘Ruminant DDGS’
  - ‘Monogastrics DDGS’
- Enhancing DDGS quality could be part of the ethanol production process
- Current focus is on ethanol production, not DDGS quality

Acknowledgements

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