

Nutritional requirements of the high performing sow

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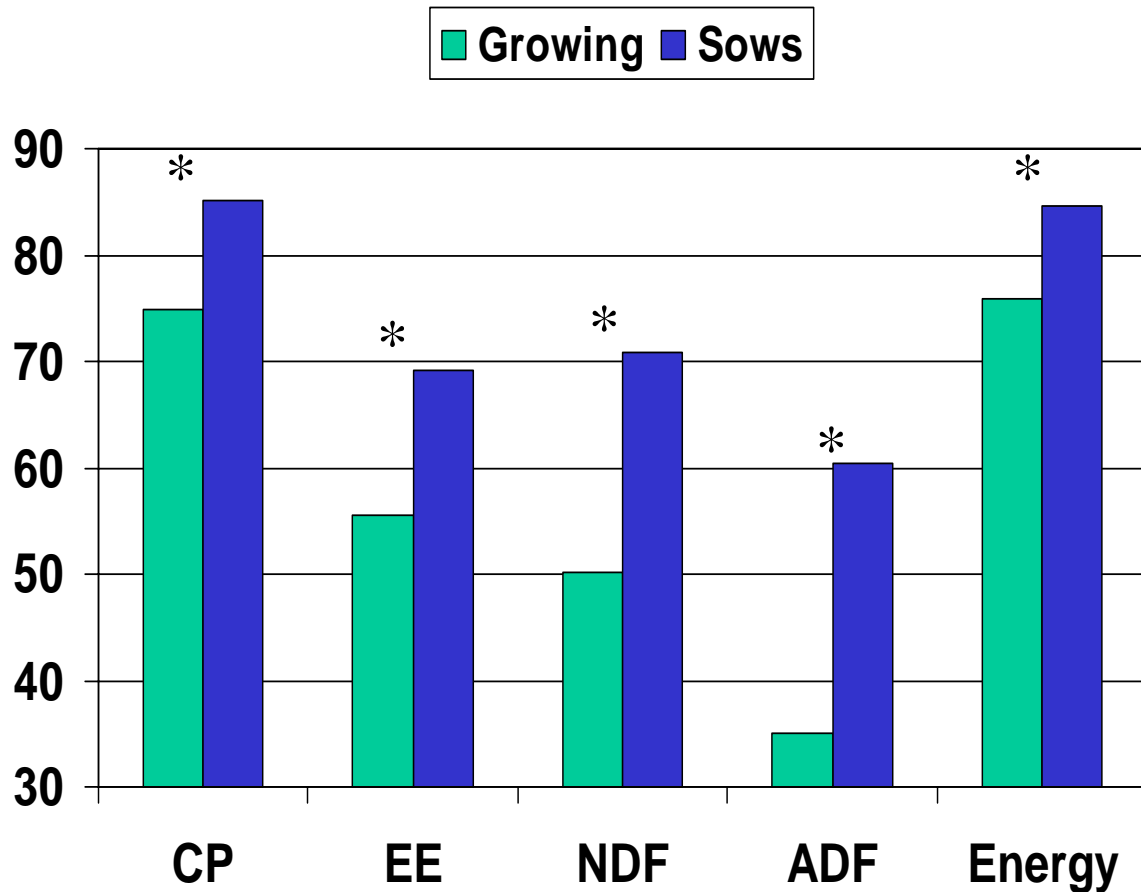
APPA 2008



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Comparing the sow to the growing pig

Nutrient digestibility in growing pigs fed ad lib and adult sows fed at maintenance



* $P < 0.05$

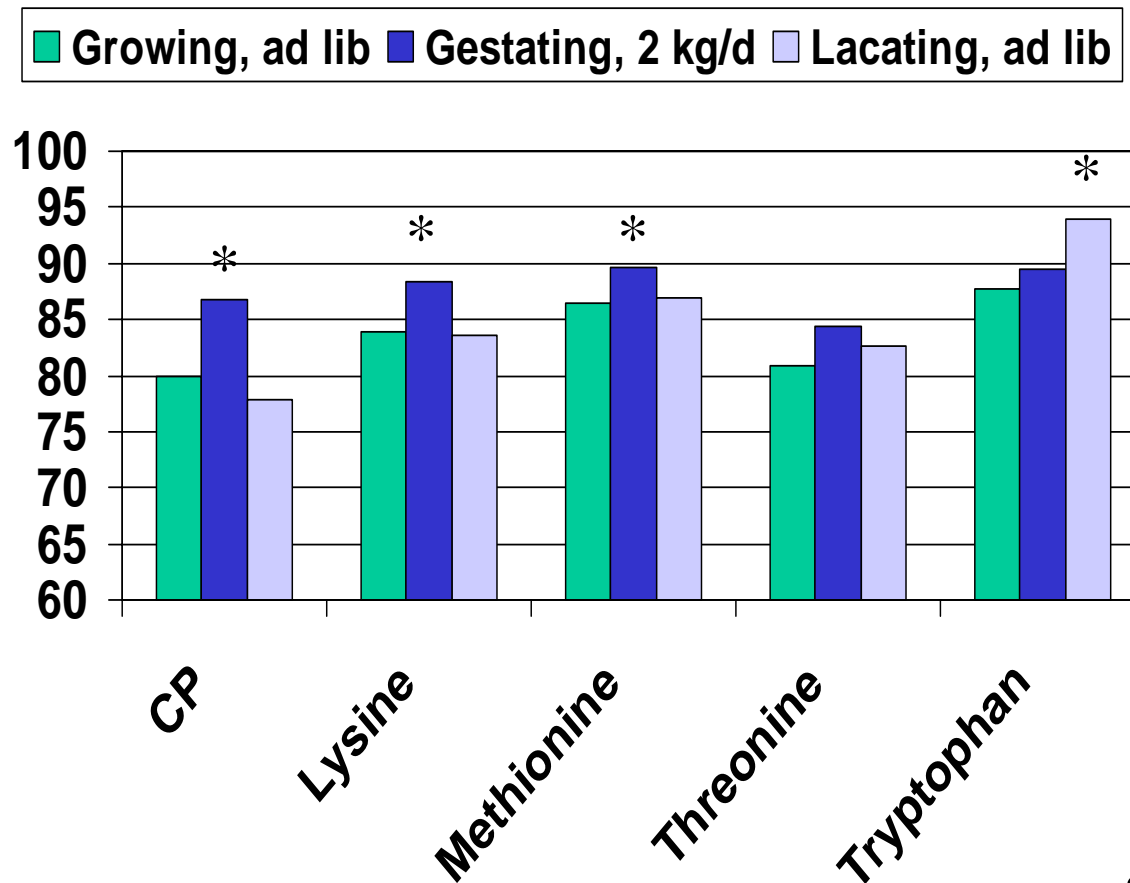
Noblet and Shi 1993



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Comparing the sow to the growing pig

Standardized ileal digestibility coefficients of CP and AA for corn, barley, wheat, SBM, canola meal and meat and bone meal



Comparing the sow to the growing pig

- Improved digestibility of **energy** and **fibre** in sows relative to growing pigs is due to differences in feed intake and the large hind-gut of the sow
- Improved ileal digestibility of **amino acids** in the gestating sow is probably due to the restricted feed intake



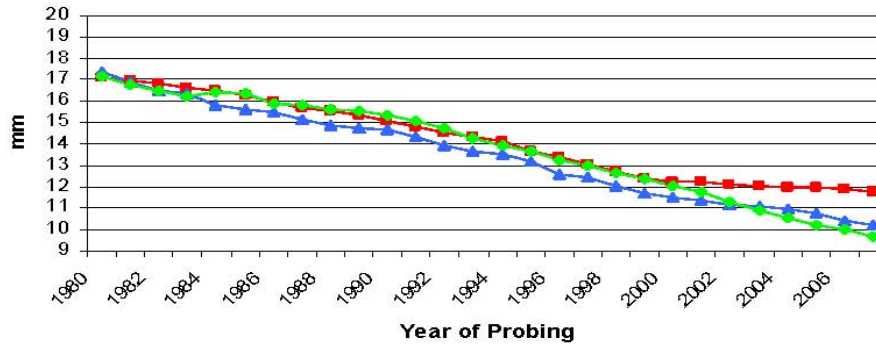
Nutrient requirements during gestation and lactation

- Current dietary recommendations are based on research conducted in the 1970's to early 1990's (ie. ARC 1981. NRC, 1998)

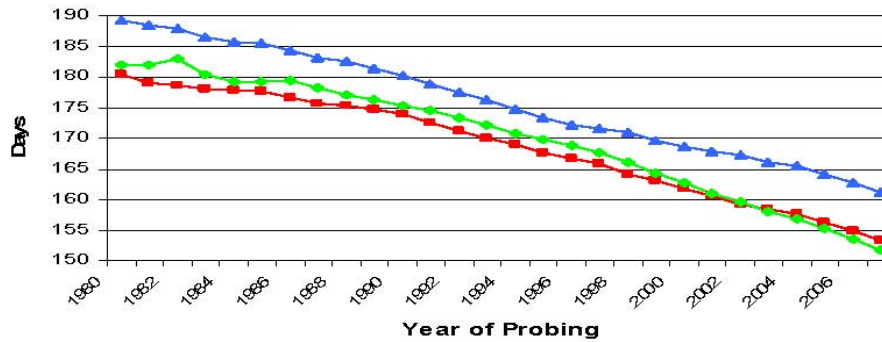
- But the sow has changed!



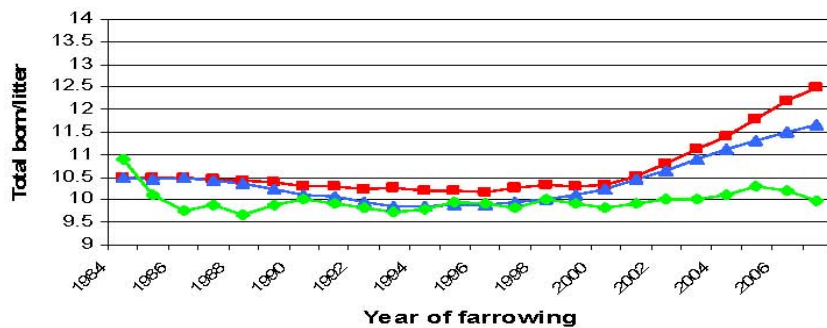
Genetic Trends for Backfat at 100kg



Genetic Trends for Age at 100kg



Genetic Trends for Litter Size



Genetic improvements in Canadian SOWS



Phase feeding of the sow

- **Gestation**
 - Early (first 3 weeks), - embryo development
 - Early to mid, - improve body condition of sows
 - Mid to late gestation, - mammary gland development
 - Late gestation, - high fetal weight gain
- **Lactation**
 - Day 1-2 post farrowing
 - Day 3-7
 - Day 8 - weaning
- **Weaning to breeding**



Overall objectives of the gestation feeding program

Adequate energy and protein intake to maintain body condition at “3” to “4” at 4 to 5 weeks of gestation (14 to 16 mm of backfat) in 85 to 90 % of the sows



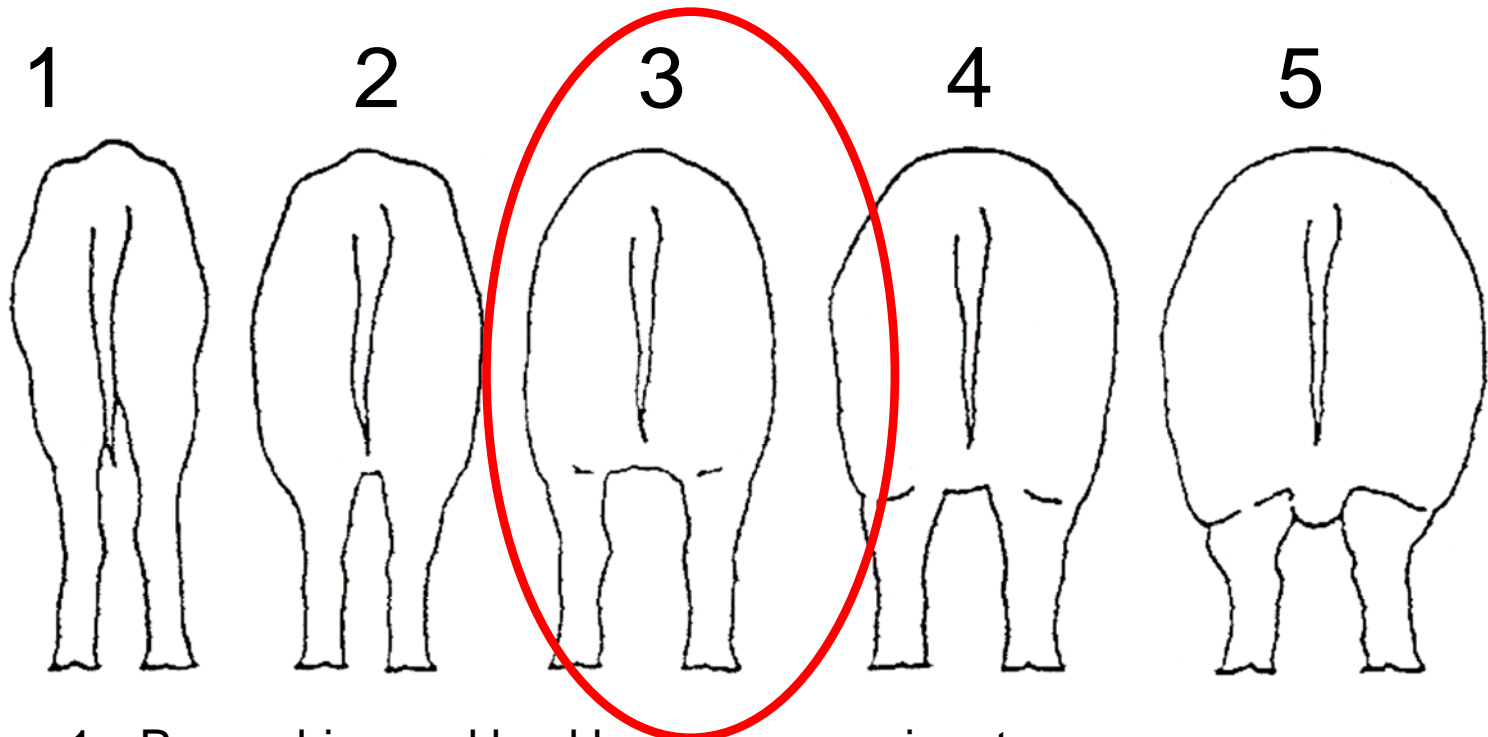
General recommendations

Gestation phase	Feeding Level (kg/d)
Wean – breed	Ad lib
Breed – d 21	1.8 – 2.0
d 21 – d 75	1.8 – 3.6 (to condition)
d 75 – d 90	1.8 – 2.3
d 90 – d 115	2 – 2.7

Excessive feed intake in early gestation negatively impacts embryo survival. Between days 21 to 75 sows should be fed to a targeted body condition. If feed intake is excessive in late gestation, reduces mammary development and feed intake during early lactation



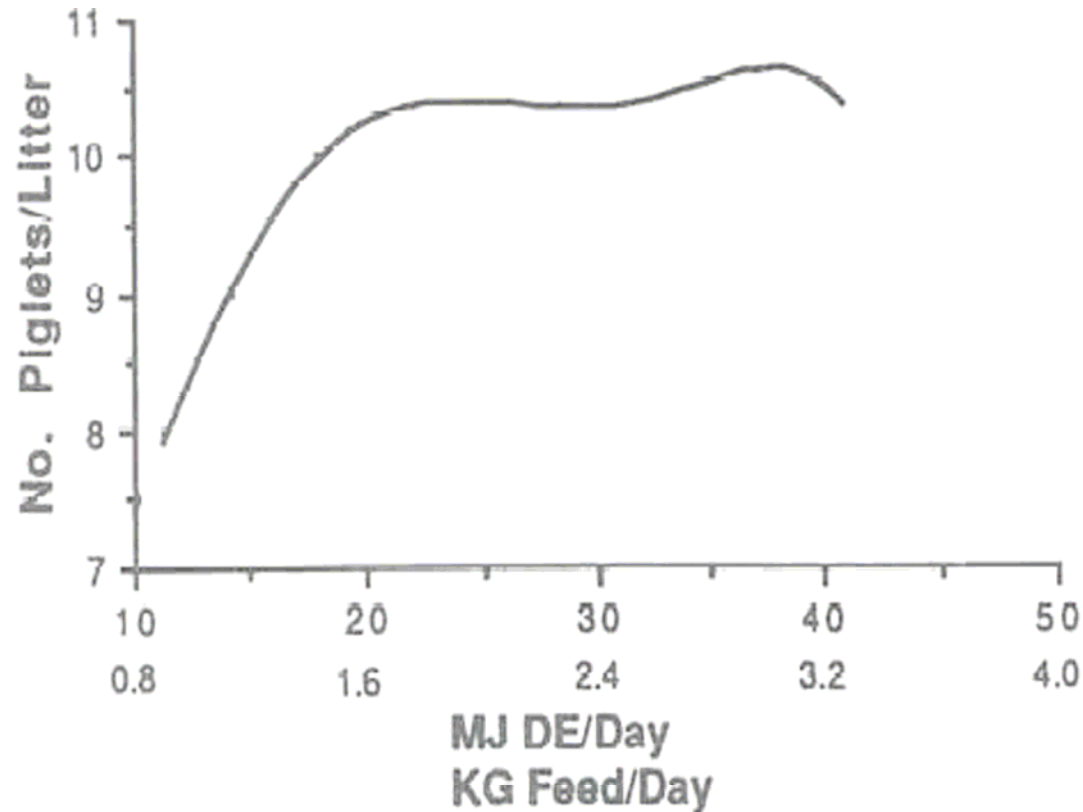
Sow condition scores



1. Poor, - hips and backbone are prominent
2. Moderate, - hips and backbone are easily felt
3. Ideal, - Hips and backbone are felt only after applying firm pressure
4. Moderately fat, - Hips and backbone can't be felt
5. Fat, - Hips and backbone are heavily covered



Effects of feed intake during pregnancy on sow productivity



Swine Nutrition Guide, 1995



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Objectives of the feeding program during **lactation**

- **Feed intake!!**
- She requires feed for maintenance, milk production and possibly growth
- Milk production is normally sufficient for litter growth rate if weaning 21 days or less
- Creep feeding required if weaning > 21 days



Parturition body size and protein loss during lactation

Parturition mass	Standard		High		P value	
	High	Medium	High	Medium	P	L
Lactation loss						
d 0 to 5	1.42	1.37	1.72	1.82	0.01	0.86
d 5 to 10	2.18	2.67	2.41	2.47	0.89	0.03
d 10 to 15	2.27	2.41	2.37	2.56	0.22	0.10
d 15 to 20	2.11	2.41	2.35	2.66	0.04	0.01
d 20 to 26	1.76	2.21	1.83	2.37	0.49	0.01

Litter performance was higher in high body mass sows and sows that loss the least protein in lactation

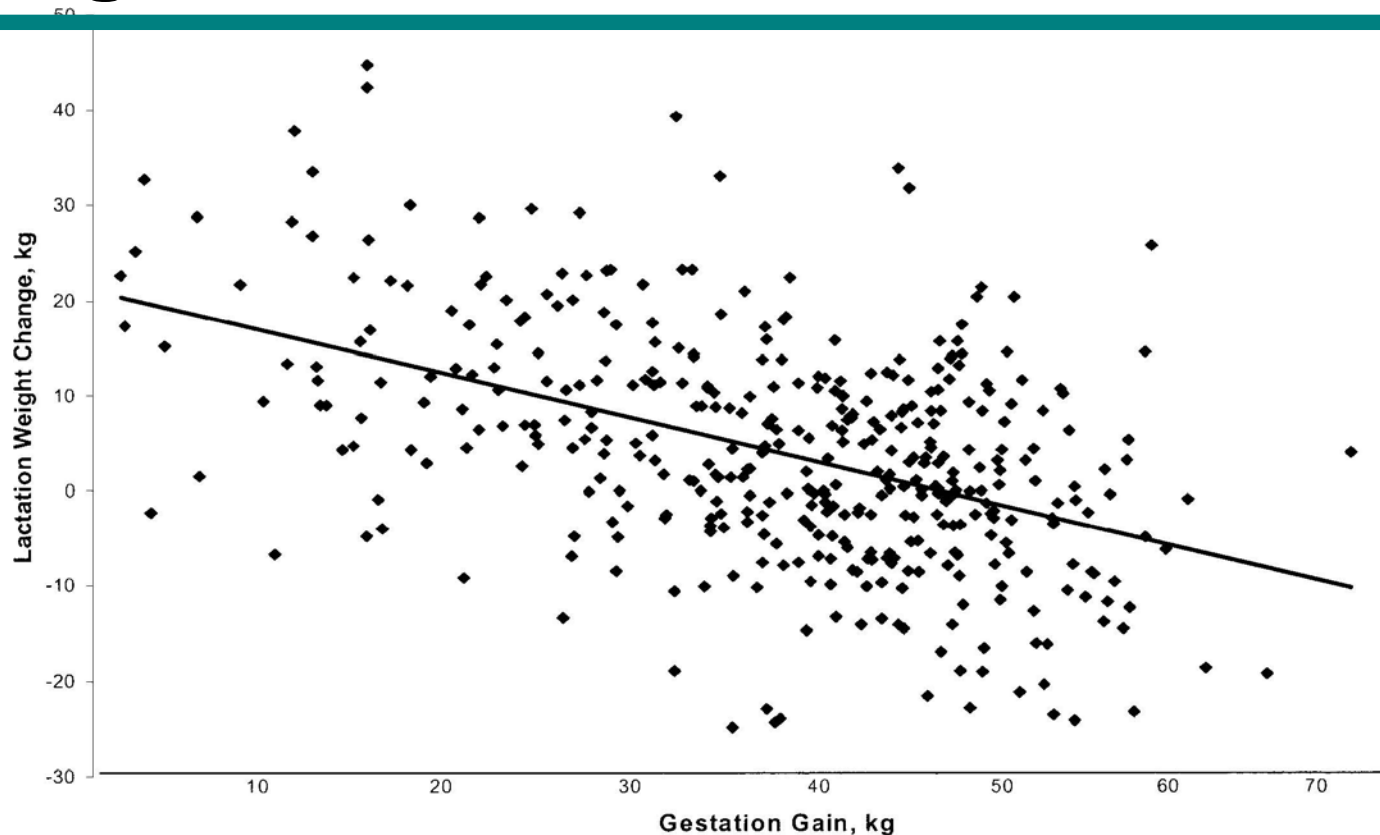


Energy intakes in **gestation** impacts lactation

- Total piglets born alive increased with increasing BW gain in gestation (Cooper et al. 2001)
- This resulted in increased BW losses during lactation
- **BW gain during gestation impacts losses during lactation!! How much is normal?**



High producing sows will lose some BW during lactation (Cooper et al. 2001)



In this experiment increased gain in gestation was correlated with increased number and weight of piglets born and BW losses during lactation



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How much BW should a sow lose during lactation???

The loss in *protein mass* is important

Clowes et al. (2003) :

Sows were fed diets varying in AA intake, resulting in different amounts of body protein loss in lactation

Body protein (kg) calculated as:

$$-2.3 + (0.19 \times \text{live weight, kg}) - [0.22 \times \text{backfat, mm}]$$



Sows were fed to attain low, moderate or high protein losses during lactation

Protein loss in lactation

	Low	Moderate	High	<i>P</i> value
Sow lactation intake				
Feed, kg/d	4.49	4.33	4.03	0.103
ME, MJ/d	63.7	61.0	56.9	0.089
CP, g/d	878	647	491	0.001
Lysine, g/d	50.2	34.6	24.2	0.001
Weight, kg				
Farrow	195	197	200	0.516
Loss in lactation	12.9	16.9	28.4	0.001
Backfat, mm				
Farrow	15.4	15.0	16.3	0.712
Loss in lactation	0.89	1.45	1.57	0.340

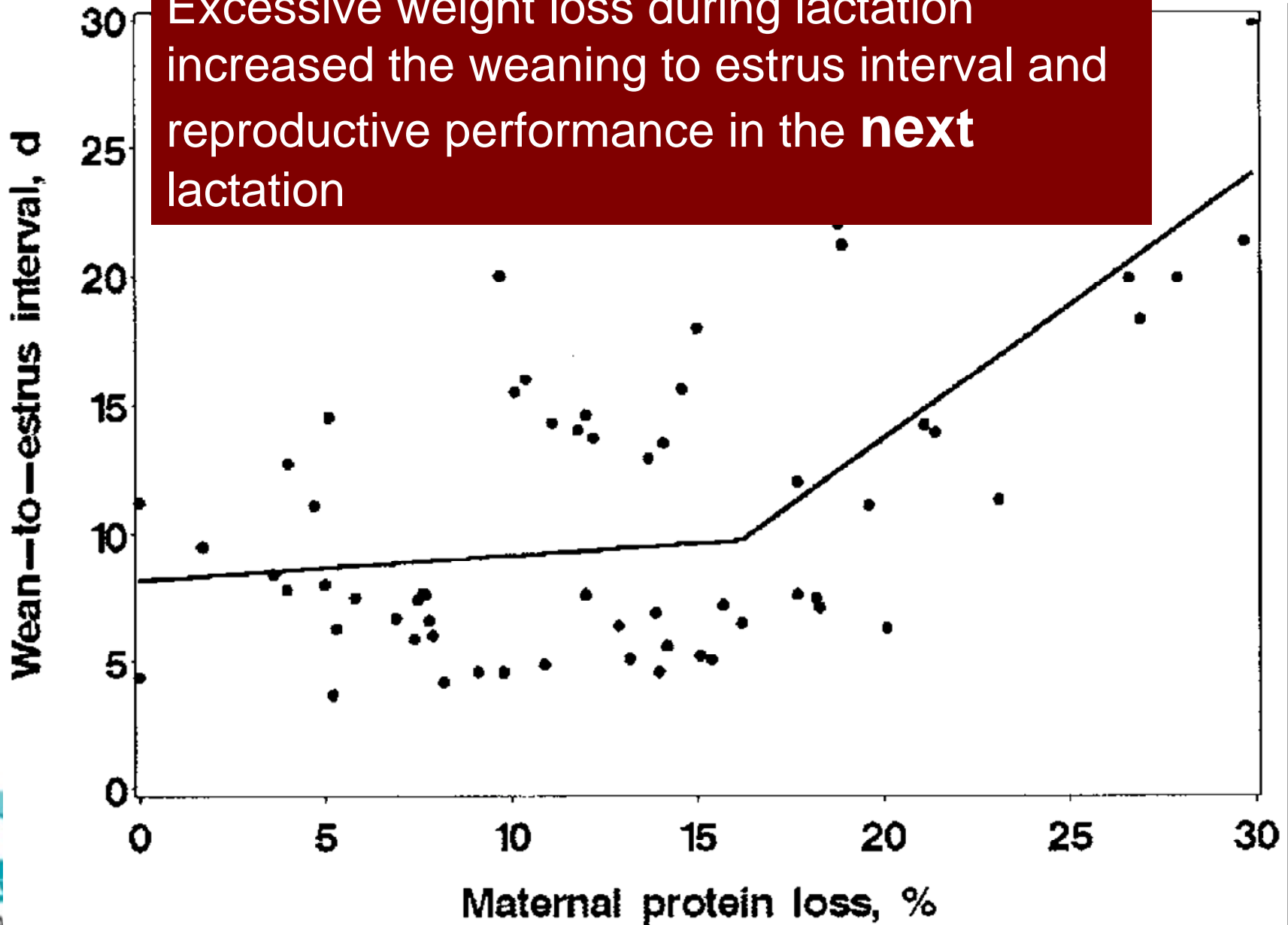
Clowes et al 2003a



Protein loss during lactation, impacted pig growth rate in late lactation

	Protein loss in lactation		
	Low	Moderate	High
Litter size, d 0	9.4	9.5	9.3
Litter size, d 23	9.1	9.0	9.0
Pig birth weight, kg	1.65	1.37	1.63
Pig wean weight, kg	6.04	5.42	5.90
Pig growth rate, g/d			
d 0 to 20	251	244	261
d 20 to 23	287	259	228

Excessive weight loss during lactation increased the weaning to estrus interval and reproductive performance in the **next** lactation



Conclusions

- Sows, including first parity sows can maintain milk production and reproductive function during lactation, even when they lose maternal tissue
- However, mobilizing too much protein (in this experiment 9 to 12 % of protein mass) resulted in a decrease in litter growth in late lactation and impaired ovarian function



- Estimated DE requirements of the lactating sow:

- 6.8 Mcal DE/kg BW litter gain
- 5.8 Mcal DE/day for maintenance

Daily feed level (kg/d) to achieve 85 % energy balance

# pigs nursed	Interval in lactation, d		
	1-7	8-14	14-19
9	4.45	5.68	6.27
10	4.82	6.10	6.77
11	5.14	6.55	7.36

Assuming 3.5 Mcal DE/kg. First litter, 160 kg BW

Pigs growing 156, 230, 265 g/d for weeks 1,2,3

Amino acids requirements of the lactating sow

- Amino acids are required for:
 - Output in the milk
 - Milk synthesis
 - Tissue growth
 - Tissue retention



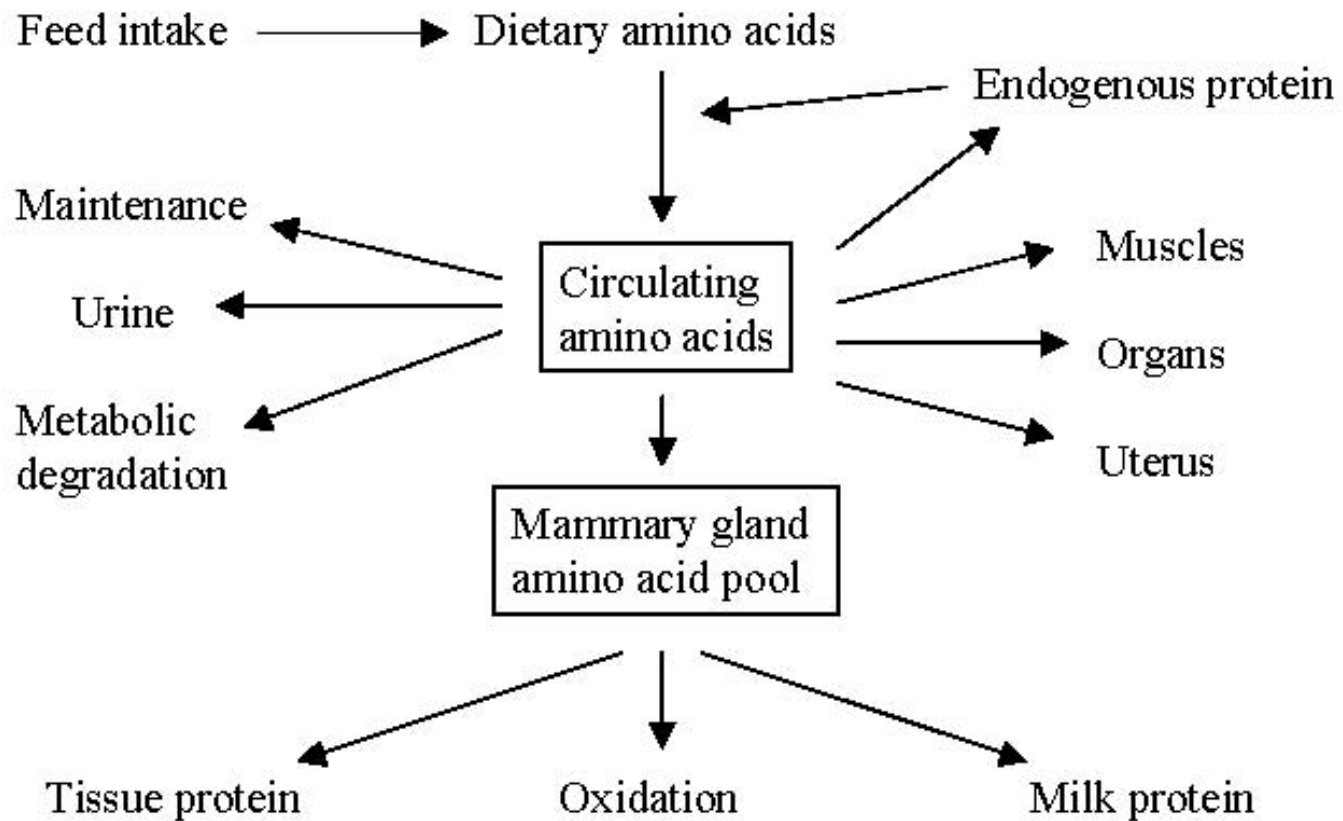


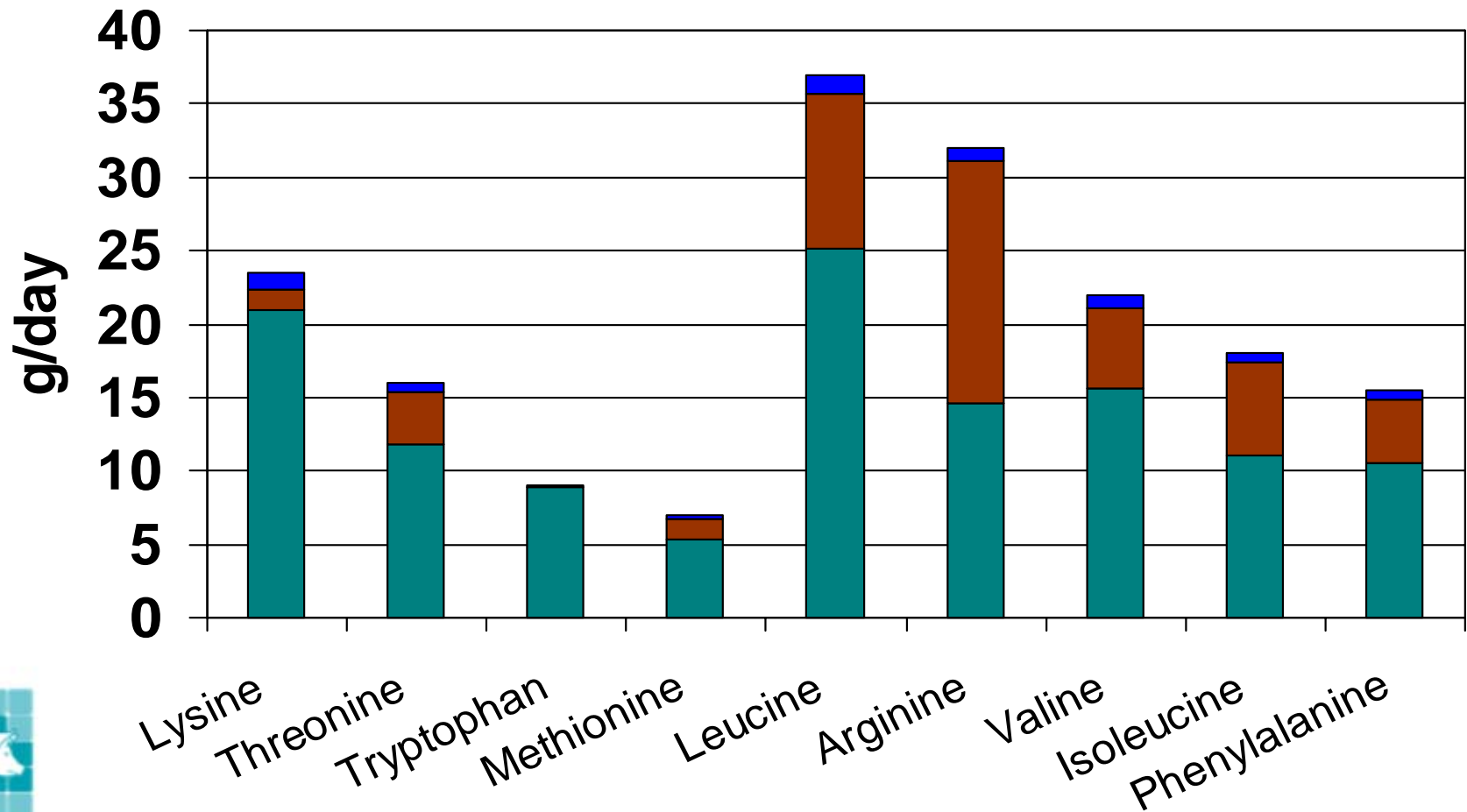
Figure 1. Amino acid flow in lactating sows

Adapted from Kim and Easter, 2000



Amino acids taken up by mammary glands, retained or used for tissue growth during lactation in sows*

■ Uptake ■ Retention ■ Tissue



* nursing 10 pigs

adapted from Kim and Easter, 2000



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Amino acids

- Very few recent estimates of individual AA requirements
- Lysine is usually first limiting, valine, threonine?
- Depends on feed composition, consumption and tissue mobilization



The effect of dietary lysine on sow* and litter performance

	Digestible lysine, %			
	0.67	0.86	1.06	1.25
	-----First lactation-----			
Sow BW change, kg ^a	-14.8	-11.1	-7.1	-9.6
Litter growth, kg/d	2.03	2.05	1.98	2.05
	-----Second Lactation-----			
Total born ^a	12.2	12.1	11.0	10.5
Born alive ^a	11.2	10.8	9.7	9.6

No effect of lysine on litter size, pigs weaned, or piglet growth rate

^alinear effect of lysine, $P < 0.05$

•*Primiparous sows

•The NRC (1998) requirement is 0.79 % TID lysine to support 2 kg/d of litter growth

Threonine requirements

- Requirement to minimize sow tissue mobilization and maximize litter performance
 - 28, 30, 30 g/TID threonine/day for parities 1, 2 and 3+
 - Equals 11.8 g d threonine per kg of litter gain
 - Supports the NRC (1998) requirement

(Cooper et al. 2001)



But, - some recent information:

- Samuel et al. (2008) estimated the dietary lysine requirement for maintenance as $49 \text{ mg/kg}^{0.75}$,
 - 30 % higher than the 1998 NRC recommendation
- Heat production and the respiratory quotient were lowest at this level of dietary lysine, indicating that energy metabolism was most efficient at this intake
- If we assume that the ideal protein ratio is correct, - the requirement for other AA's is under-estimated by 30 – 40 %



No production data to support this, - yet

Conclusions

- Extensive protein mobilization decreases litter performance during lactation and ovarian follicular development at weaning
- Careful feeding of replacement gilts in their first gestation may abolish these problems
- Sows with large protein reserves at parturition cope better with poor lactation nutrition
- NRC requirements for AA's are adequate ?



Mineral requirements of the sow

- Limited research!
- Calcium
 - 0.75 % calcium in gestation and lactation (NRC 1998) appears appropriate
- Phosphorus
 - Environmental issues



Influence of reducing phosphorus levels during gestation on piglet performance

	Treatment			
	Low	Low +	Med	High
Total P, %	4.2	4.2	5.1	6.8
Ca, %	8.7	8.7	8.7	8.7
Phytase, FTU/kg	534	1203	766	738
Intake, g P/day	9.5	9.8	11.9	15.5
Sow BW and BW changes		NS		
# of live-born piglets	13.4	13.6	12.6	12.4
Piglet ADG, g/d*	250	257	249	258
Serum P, mmol/l				
Sow	1.98	2.00	2.06	1.93
Piglet	3.16	3.06	3.09	3.12

No effect of reduced P on sow or piglet performance

Two reproductive cycles studied

* weaned at 34 days of age

Lyberg et al. 2006



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Other nutrients

- **Vitamins**
 - Effects on embryo development
 - Folic acid and Vitamin B12 levels in the diet are being reevaluated
- **Carnitine**
 - Milk production and piglet growth



Take-home Message

- Monitor gestation feed intake and body condition
- Encourage feed intake during lactation





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