猪的饲料配方、能量和氨基酸

Swine Feed

Formulation

Energy

Amino Acids

全世界食物和饲料的能量资源 Energy Sources of Food/Feed Worldwide

90%人类植物性食品供应来自以下作物,按重要性排序Ninety percent of human plant food supply is derived from the following crops in order of importance:

1. 小麦Wheat
2. 大米Rice
3. 玉米corn
4. 马铃薯potato
5. 大麦barley
6. 甘薯sweet potato
7. 木薯cassava
8. 大豆soybean
9. 燕麦oat
10. 高粱sorghum
11. 黍子millet
12.黑麦rye
13. 花生peanut
14. 蚕豆field bean
15. 豌豆pea
16. 香蕉banana
17. 可可豆coconut

其中一半是8种粮食谷物Half of those crops are the 8 major cereal grains.

小麦wheat
大米rice
玉米corn
大麦barley
燕麦oats
黑麦rye
高粱sorghum
黍子millet

全世界谷物总产量中小麦、大米和玉米占75%Wheat, rice, corn make up 75 % of total world grain product

这3种谷物的各自的副产品都超过大麦（第4种重要谷物）总产量Each of the byproducts from wheat, ric and corn exceed the total quantity of 4th most important grain, barley.

农业副产品是饲料工业的重要资源By-Products of agriculture are important to the feed industry.

能量是生命的动力 **Energy the driving force for life**

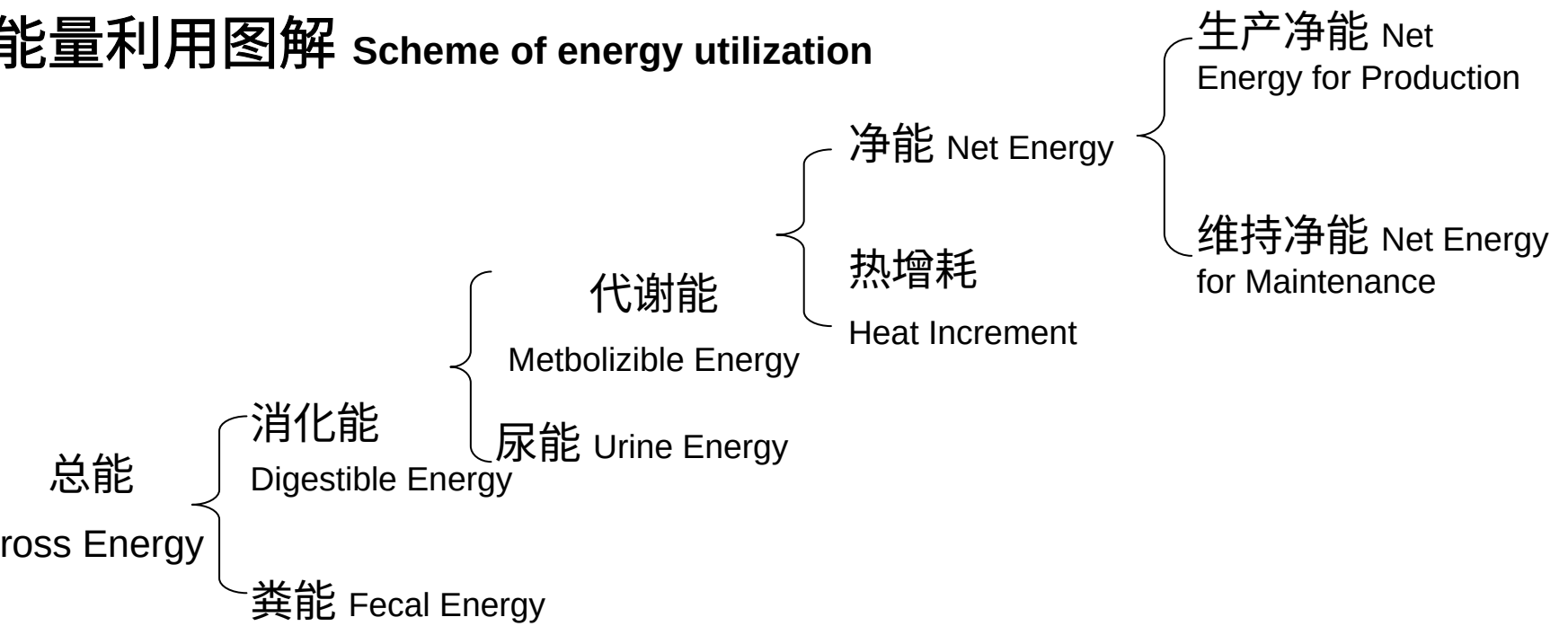
未得到人们的足够认识 **Receives less than proper consideration**

能量值的范围从稻壳到玉米油**Energy values range from rice hulls to corn oil**

维持和泌乳都需能量的支持**Needed to support activities from maintenance to ctation**

经常受到忽视 **Most often overlooked component**

能量利用图解 **Scheme of energy utilization**



碳水化合物提供3.7kcal/克葡萄糖-4.2kcal/淀粉
蛋白质提供5.6kcal/克
脂肪提供9.4kcal/克

2. 消化能
GE已经对粪中物质的燃烧热进行校正
可消化能是评定饲料原料主要指

3. 代谢能
消化能减去尿和肠道中产生气体的燃烧能 尿能损失不大，一般与含氮代谢物的排泄有关
气体能损失一般约为总能进食量的

ME经常按DE的96%计算
4. 净能
在营养物消化、代谢和发酵(热增耗)过程中所消耗的热
热增耗有时对动物很有利，有时则有害
环境温度高
动物开支大

环境温度低
动物有利
净能可用于维持和生产(脂肪、蛋白质、胎儿发育和产奶)

D. 影响能量利用的因素 Factors affecting Energy Utilization

1. 饲料成分 Feed Composition

a. 超过蛋白质合成所需的氨基酸进行脱氨 Excess amino acids (in excess of demands for protein syntheses) are deaminated.

- 氮以尿素形式排泄 Nitrogen is excreted as urea
- 碳架代谢产生能量 Carbon skeleton is metabolized to yield energy
- 每克尿素含2.52千卡（每克氮含5.45千卡） Urea contains 2.52 kcal/g (5.45 kcal/g of nitrogen)

蛋白质氨基酸比例不合适的日粮，其利用率低于氨基酸比例合适的日粮 Diets with protein or improper ratios of amino acids are utilized less efficiently than diets with adequate amounts and balance of amino acids.

b.日粮中添加脂肪可提高能量浓度，可能影响采食量（下降） Addition of fat to the diet increases energy density and may influence fed intake (reduce).

但是在采食量下降之前ME很可能已经增加 However ME is most always increased before intake is reduced.

C. 纤维 Fiber

- 采食量可能增加，以维持ME进食量 Feed intake may increase to sustain ME intake.
- 消化道可能增大，以增加容量 Digestive tract may enlarge to increase capacity
- 食糜通过率可能加快（可能降低营养素消化率） Rate of passage may increase (may reduce digestibility of nutrients)

纤维不能消化，进入盲肠和大肠 **Fiber is indigestible and passes to cecum and large intestine**

- 盲肠和大肠内有微生物，像瘤胃 Cecum and large intestine have microbial flora similar to rumen
- 纤维发酵，产生各种VFS Fiber is fermented with the production of VFA's
- VFA估计可提供维持所需能量的30% Estimate that VFA's may provide as much as 30% of maintenance energy requirement (Rerat, et al., 1997).
- 大肠发酵所产生能量的利用率低于小肠消化所得的能量 Energy derived from fermentation in the large intestine is utilized with lower efficiency than energy digested in small intestine, 52 versus 76% (Noblet et al., 1994).

各种原料能量浓度的比较Comparison of Ingredients by Energy Concentration (kcal/kg)

	GE	DE	ME	NE
玉米Corn	3945	3525	3420	2395
米糠Rice Bran	4320	3100	2850	2040
麦麸Wheat Bran	4020	2420	2275	1400
豆粕Soybean Meal层	4220	3490	3180	1935
花生粕Peanut Meal	4505	3415	3245	2170
猪油Lard	9320	8285	7950	5100
牛油Tallow	9360	8290	7955	4925
豆油Soybean Oil	9395	8750	8400	5300

- 有效能的差别大多是由于消化力Digestibility can account for much of the difference in available energy
- 纤维含量有影响Reflects fiber content
- 脂肪能量的差异反映脂肪酸构成不同和脂肪酸中双键的多少Differences in energy among fat sources reflects fatty acid profile and double bonds within the fatty acids

高能日粮的优点Advantages of High Energy Diet

e. 代谢能和脂肪水平对性能的影响Effect of level of ME and fat on performance

生长肥育猪日粮中添加动物脂肪的作用

Effect of Adding Animal Fat to Growing-Finishing Swine Diets

生长肥育猪日粮中添加动物脂肪的作用 Effect of Adding Animal Fat to Growing-Finishing Swine Diets						
	代谢能(kcal/kg)和脂肪添加量Metabolizable Energy and Fat Addition					
代谢能ME (kcal/kg)	2240	3357	3472	3586	3705	3817
加脂肪Fat ad, %	0	2.6	5.2	7.9	10.5	13.0
日增重Daily gain, kg	.72	.74	.75	.76	.77	.74
日采食Daily feed, kg	2.6	2.5	2.4	2.3	2.2	2.12
饲料Feed/增重Gain	3.6	3.4	3.2	3.0	2.8	2.9
背膘Backfat, cm	3.6	3.4	3.5	3.6	3.6	3.8
腰腿肉Ham-loin,						
热胴体% % of hot carcass	41.80	42.00	42.40	41.40	41.60	41.10

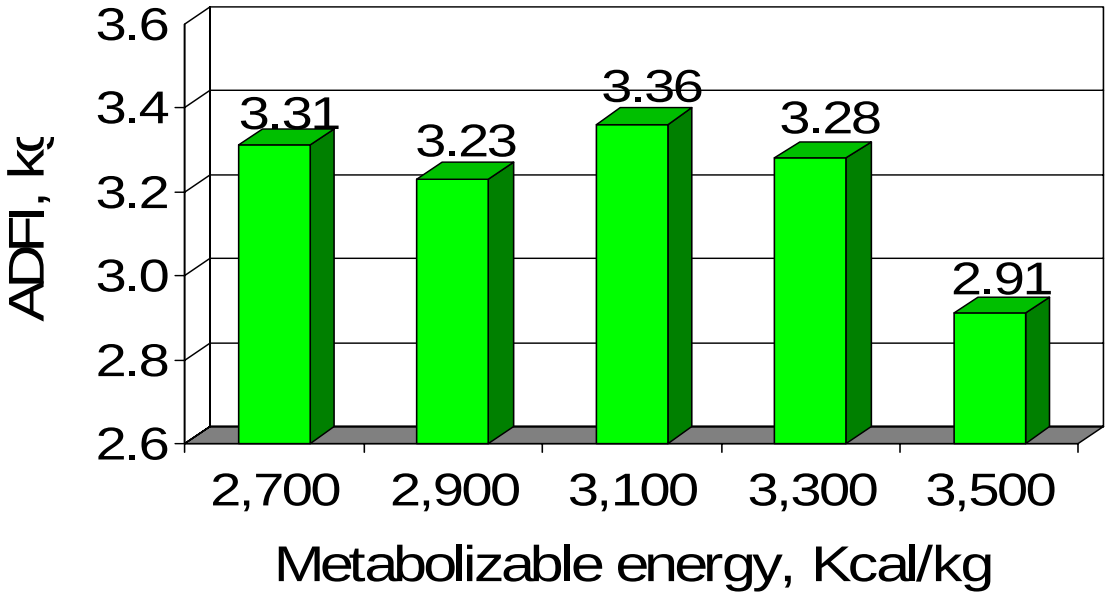
Moser

- 从很低能量的日粮开始Starting with a very low energy diet (2240 kcal/kg)
- 饲料效率(料/重) 和日增重线性改善直至添加10.5%脂肪或3700 kcal/kg

Linear improvement in feed efficiency (F/G) and daily gain through 10.5% added fat or 3700 kcal/kg

日粮能量水平对肥育猪性能的影响

Influence of dietary energy level on finishing pig performance



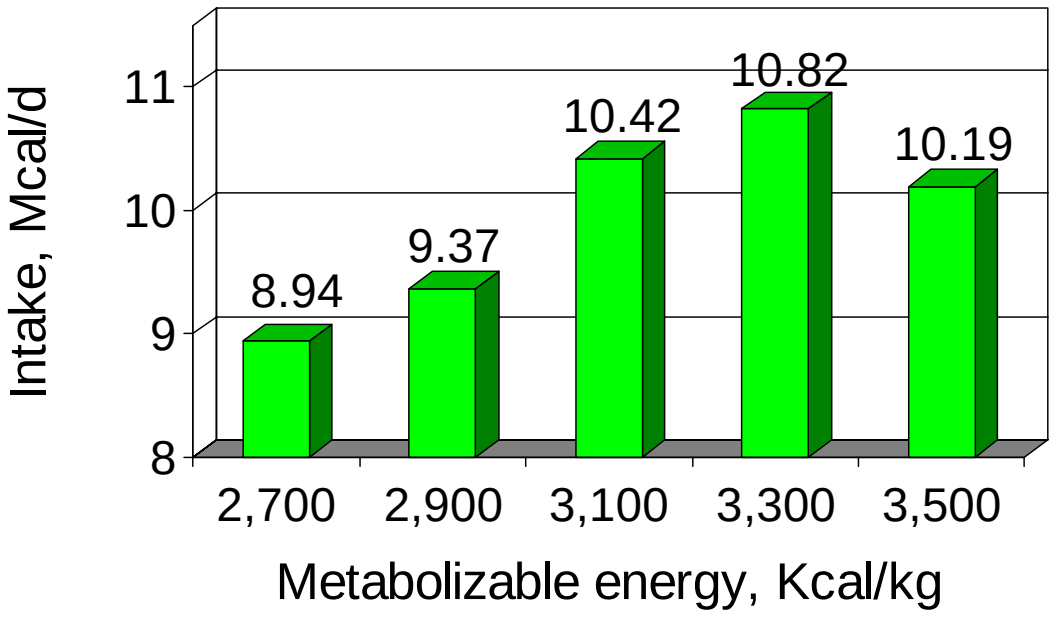
Stein and Easter, 1996

a,b P<0.05

- **每日饲料量一直稳定至最高代谢能水平3500 k cal/kg** **Daily feed was constant until the highest level of ME, 3500 k cal/kg**
- **能量进食量最高时饲料采食量最低** **Feed intake was reduced at highest level of energy intake**
- **应指出,对于该能量水平来说氨基酸是不足的,这引起了采食量下降** **Could indicate that amino acid intake was insufficient for that level of energy, and this caused reduction in feed intake**

日粮能量水平对肥育猪性能的影响

Influence of dietary energy level on finishing pig performance



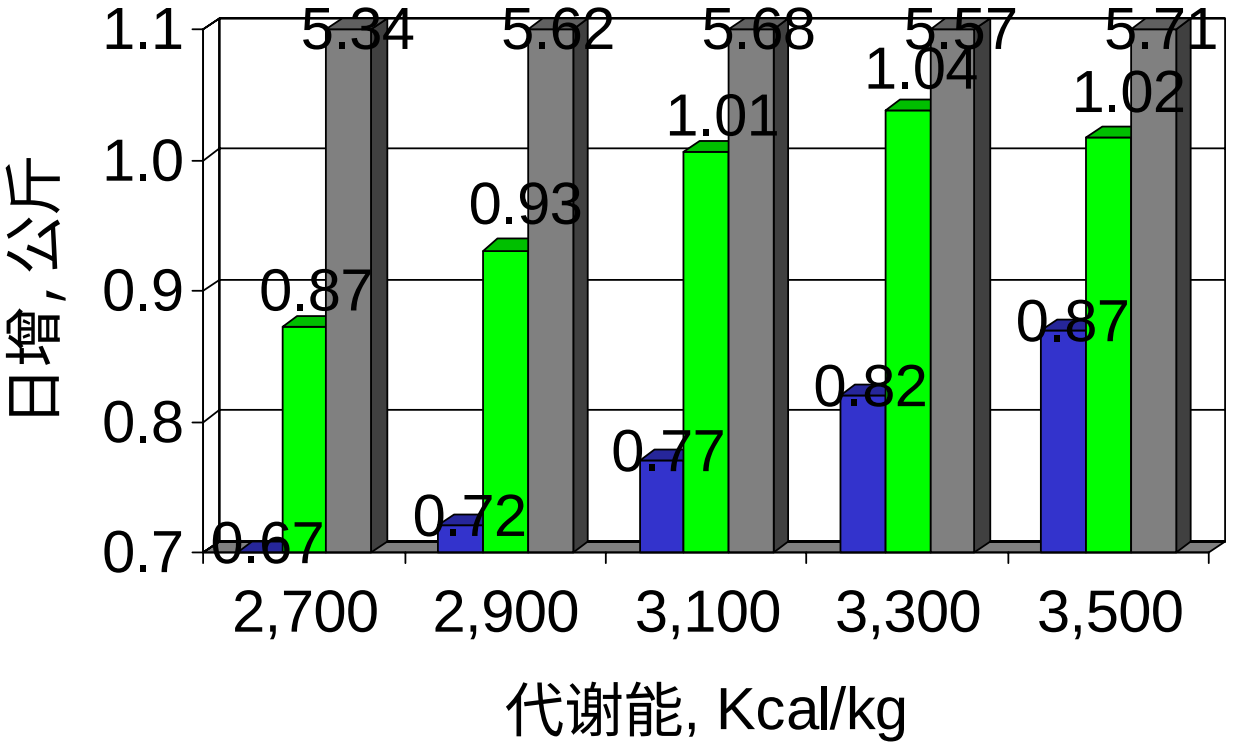
Stein and Easter, 1996

在达到最高能量水平前，能量进食量随能量浓度提高而增加

Energy intake increased linearly because of energy concentration until the highest level was reached

日粮能量水平对肥育猪性能的影响

Influence of dietary energy level on finishing pig performance

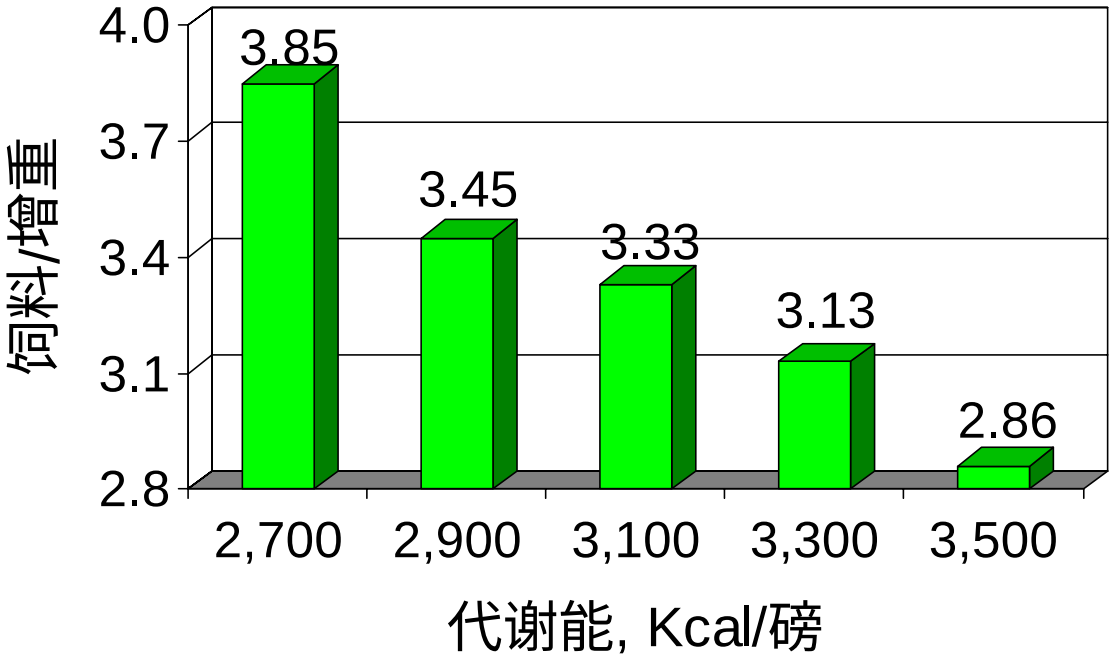


在3500千卡ME之前，日增重随能量水平而提高

Linear increase in daily gain until the 3500 kcal of ME

日粮能量水平对肥育猪性能的影响

Influence of dietary energy level on finishing pig performance



每单位增重的饲料消化率随能量水平提高而下降

Linear decrease in feed to produce a unit of gain

能量水平最高的日粮，其饲料消化率比对照日粮低26%

Highest energy diet had 26% lower feed to gain ratio than did control diet

脂肪水平对生长肥育猪的影响

Growing Finishing Hogs on Different Fat Levels

	%脂肪Fat					
	0	1	2	3	4	5
日增重公斤Daily Gain, kg	.792	.820	.823	.866	.828	.837
日采食公斤Daily Feed, kg	2.59	2.56	2.52	2.67	2.44	2.42
增重/饲料Gain/Feed	.310	.321	.326	.323	.339	.346

Allee et al., 1988

h. 玉米豆粕日粮中每添加1%脂肪后代谢能的增长情况

Calculation showing increase in ME with 1% increments to a corn soybean meal diet

添加脂肪%%Supplement Fat	代谢能 kcal/kg
0 典型的玉米豆粕日粮(Typical Corn Soy Diet)	3270
1	3320
2	3370
3	3420
4	3470
5	3520
6	3570
7	3620

生长肥育期中高能日粮的作用

Effect of High Energy Diets in Growing-Finishing Compared toFinishing Period

高能日粮High Energy Diets --生长肥育猪Growing-Finishing Swine

ME (kcal/kg)	3410	3586
生长猪Grower:		
日增Daily Gain, kg	.74	.75
日食Daily Feed, kg	2.00	1.78
重Gain/料Feed	.370	.420 (13.5%)x
肥育猪Finisher:		
日增Daily Gain, kg	.94	.92
日食Daily Feed, kg	3.12	2.81
重Gain/料Feed	.301	.327 (8.6%)x

Ralston Purina

x由于添加能量而改善的百分比Percentage improvement due to added energy

- 生长期(25-55 kg)对高能日粮的反应大于肥育期(55-100 kg

Response to high energy diet greater in growing period (25-55 kg) than in finisher period (55-100 kg)

- 能量增加5%,效率改善13.5 和 8.6% 5% increase in energy gave 13.5 and 8.6% improvement in efficiency

季节和日粮添加脂肪对猪性能的影响

Relationship of Season of the Year And Diet on Swine Performance

季节Season	冬季Winter		夏季Summer	
月份Month	11月至3月Nov- March		5月至9月May – Sept	
平均日高温^{0}C Avg. Da. Max. Temp: ° C	2-13		21-33	
牛油% Tallow (%)	0	5	0	5
日增重公斤ADG, kg	.78	.79	.79	.86
增重/饲料 G/F	.282	.309 (9.5%)	.341	.384 (12.6%)
背膘厘米 Backfat, cm	2.8	2.9	2.48	2.47

Stahly et al.

总结添加脂肪的反应

Summary of responses to supplemental fat (Pettigrew and Moser, 1991)

	正结果 Positive (increased)	负结果 Negative reduced)	反应 Response
日增重(公斤) ADG, kg	72	10	0.04
日采食(公斤) ADFI, kg	15	75	-0.10
增重/饲料 Gain/feed	.87	0	0.04
背膘(毫米) Backfat, mm	61	16	1.7

总的概念 Generalization

日粮代谢能每提高100千卡，饲料效率大约改进0.034个单位

For every increase of 100 kcal/kg in dietary ME, there is approximately .034 events improvement in feed efficiency

举例 Example:

脂肪添加量从3%增到5%，ME从3420提高到3520千卡/公斤

Going from 3% to 5% fat increased ME from 3420 to 3520 kcal/kg.

饲料效率应提高0.034个单位，即大约改进10%

Efficiency should increase by .034 units or about 10%.

举例 Example:

(.333 G/F + .034 = .367) or .034/.333 x 100 = 10.2%

建议添加4－6%脂肪，达到3450至3550千卡/公斤

Recommended high fat diets to about 3450 to 3550 ME kcal/kg or about 4-6%

有些猪场添加1%脂肪，只是为了控制粉尘

Some producers add 1% fat simply to control dust.

早期断奶仔猪的能量水平

Energy Level for Early Weaned Pigs

项目ITEM		能量水平 Energy level, kcal/kg			
		3,100	3,300	3,520	3,740
实验1 EXP	增重/饲料	221 .595	254 .595	263 .684	242 .735
实验2EXP	增重/饲料	303. 574	338 .578	366 .690	327 .709

McConnell et al. (1982). 实验1：91头猪，3-6周　实验2：42头猪，3-8周

- 全世界典型的加脂研究 Typical of fat-added studies around the world
- 随代谢能的提高，饲料效率是线性增长，直到3740kcal/kg Linear improvement in feed efficiency with increase in metabolizeable energy through 3740 kcal/kg
- 日增重线性增加，直至能量达3520kcal/kg Daily gain increased linearly through 3520 kcal/kg
- 典型的不加脂保育猪日粮的能量水平接近3200kcal/kg A typical nursery diet without added fat would be close to the 3200 kcal/kg

j. 日龄和脂肪水平对消化率的影响 Effect of Age and Level of Fat on Digestibility

日龄 Age, days	添加猪油 Added lard，% 0 %	5 %	10 %
23	43.3	66.7	67.4
37	69.9	86.7	87.8
58	71.2	85.0	90.9

Leibbrandt et al. (1975). 80头猪，初重4.6公斤，玉米豆粕日粮，日龄和脂肪水平的作用显著， p< .01

The 80 pigs initially weighed 4.6 kg; corn-soybean meal diets. Age and fat level effects significant, p< .01.

- 脂肪消化率随日龄而提高Fat digestibility increases with age, increasing in pigs from 23 to 58 days of age
- 添加脂肪提高了整个日粮的消化率Increasing fat in the diet increased digestion of total diet
- 加入脂肪的消化率大大高于其它日粮脂肪的消化率Data demonstrates that digestibility of added fat is much greater than the remainder of the dietary fat

高能日粮的优点 Advantages of High Energy Diet

1. 提高能量浓度，改进饲料转化率 Increases energy density and improves gain and feed efficiency
2. 高脂肪日粮产生的消化能低（SDA，特殊动力作用）
   High fat diets have lower heat of digestion, called SDA (Specific Dynamic Action)

a) 在大肠中的微生物消化和发酵过程中，纤维和难消化的碳水化合物和蛋白质产生热量

a) Fiber and poorly digested carbohydrate and proteins generate heat in the process of microbial digestion/
- fermentation in the large intestine

b) 纤维素和半纤维素 b) Cellulose and hemicelluloses

   1. 消化率很低 Very low digestibility
   2. 在大肠中产生VFA Generates volatile fatty acids in large intestine
   3. 产生发酵热 Generates heat from fermentation

c) 脂肪能降低消化产生的热量，因为多数脂肪是由酶消化的

c) Fat reduces the heat of digestion as most all fat is digested by enzymedigestion

d) 脂肪其实起冷却作用，因为可降低消化过程中的产热量

d) Fat actually cools and reduces heat generated in the process of digestion

e) 在中至高温下，大肠中微生物作用会产生热量，猪必须花费能量来排热（降低效率）

e) At neutral or higher temperature the microbial action in the large intestine generates heat and the pig must expend energy to dissipate heat. (Reduces efficiency)

f) 相反，在很低温度下，微生物发酵纤维和复合碳水化合物所产生热量节省了身体保温所需的能量（改进效率）

f) Conversely at very low temperatures the microbial action in fermenting fiber and complex carbohydrates will reduce energy needed to produce body warming heat (Improves efficiency)

g) 添加脂肪能够降低发酵和产热量

g) Adding fat to increase energy has the effect of lowering fermentation and heat generation

各种原料的特殊动力作用（SDA）

SDA of Various Ingredients

	总能Gross Energy	代谢能Metabolizable Energy
	kcal/kg	kcal/kg
SDA高的原料Ingredients with high SDA		
米糠Rice bran	4320	2850
麦麸Wheat bran	4020	1400
SDA中等的原料Ingredients with moderate SDA		
玉米Corn	3945	3380
碎大米Rice, broken	3830	3350
小麦3965 Wheat 3965	3305	
SDA低的原料Ingredients with low SDA		
猪油Swine fat	9320	7950
牛油Beef fat	9360	7955
豆油Soybean oil	9395	8400

1. 季节条件对猪对添加脂肪的反应的影响

Response of Pigs to Fat Supplementation as Influenced by Seasonal Conditions

	冬季Winte	夏季Summer
最高周气温Weekly Max Air Temp	4°C	29°C

添加5%脂肪引起的差异百分数Percent Response due to Addition of 5% Fat

增重Weight Gain	+0.9	+8.3
饲料效率Feed Efficiency	+8.5	+11.3
ME进食量ME Intake	-1.3	+2.7
增重Gain/ ME进食量ME Intake	+2.2	+5.1
背膘Backfat	-2.1	+2.9

Stahly, 1981

- 高温时提高日粮的能量最有好处
  Greatest benefits to added dietary energy occurs at highest temperature
- 实际应用中应根据季节对脂肪水平作某些修改
  Practical application some change fat level on seasonal basis
- 在南方，高能日粮全年有益；在北方，冬季以低脂肪日粮较为有利 **In Southern climate, the benefit from high energy diets occur throughout the year. Northern climates may benefit from lowering fat in winter.**
- 米糠既有利也有敝 **Rice bran offers problems as well as benefits**
  - 纤维和脂肪含量高 **high in fiber and fat**
  - 是价值极高的副产品 **Extremely valuable by-product**
  - 夏天最好少用米糠 **May want to restrict rice bran more in summer**
  - 在华中和华南的冬季可提高米糠用量 **Middle and northern climates use higher levels of rice bran in winter**

按季节选用原料的其它事例 Another examples of ingredient selection by season

- 带壳或去壳豆粕 **Dehulled vs. hulled soybean meal**
- 在华南用去壳豆粕 **In Southern climates use dehulled soybean meal**
- 在华北的冬季用常规豆粕 **In Northern climates use regular soybean meal in winter**
- 幼龄猪例外－应使用常规豆粕 **Exception would be in young pigs- use regular soybean meal**

m. 温度影响脂肪在室温下的物理状态（液态或固态）

豆油（很贵）Soybean oil- very expensive	液态 Liquid
鸡油 Poultry fat	有些液态 Some Liquid
饭店废油 Restaurant grease	液态 Liquid
猪油 Pork fat	固态 Solid
牛油 Tallow	固态 Solid

- 混合前是否需加热融化，视脂肪种类而定
  Fat source determines whether it is necessary to heat fat to melt for mixing
- 高脂日粮一般适口性较好 High Fat diets usually enhance palatability

n. 日粮中能量水平和氨基酸浓度的关系

1) 高能日粮可提高增重和单位饲料的脂肪沉积
2) 生长需要氨基酸
3) 氨基酸缺乏时，脂肪沉积增加，需利用额外的能量
4) 配制高能日粮往往是为了提高限制性氨基酸浓度
5) 与胴体组成的关系：高能日粮若不相应提高氨基酸水平会使胴体瘦肉少而脂肪较多

生长肥育猪日粮中使用脂肪的第二个重要原因

Second important reason for using fat in growing finishing diets

配制特定的能量水平Formulating To specific Energy Levels

日粮Diet	原料能量 kcal/kg		最终 ME
不加脂肪No added fat	-----		3270
加5%脂肪5% added fat	7950		3520
加10%木薯10% added cassava	3330	15%	3100
加15%米糠15% added rice bran	2850		3184

用脂肪维持日粮的能量水平Using Fat to Sustain Dietary Energy Levels.

日粮Diet	最终ME Final ME
玉米豆粕Corn Soybean Meal	3270
加20%小麦麸20% added Wheat Midds	3180
加2%脂肪2% added Fat	3360
玉米豆粕加20%小麦麸加2%脂肪C-SBM + 20% Wheat Midds + 2% added fat	3275

两种氨基酸水平下的加脂作用

Effect of Added Energy at Two Levels of Amino Acids

	日增重 Daily Gain g	增重/饲料 Gain/Feed	腰腿肌面积 Loin Eye Area cm2
高梁-大豆高营养浓度日粮 Milo-Soy High Nutrient Density			
0%脂肪 0%Fat	690	.273	29.1
3%脂肪 3%Fat	749	.303	29.7
6%脂肪 6%Fat	731	314	32.1
9%脂肪 9%Fat	780	342	33.2
高梁-大豆基础日粮 Milo-Soy Basal Diet (NRC)			
9%脂肪 9%Fat	717	.302	29.6

- 高梁-大豆粕高营养浓度日基础日粮会有较高水平的关键氨基酸 The milo-saybean meal high nutrient densely basal diet contained added levels of critical amino acids
- 增重、饲料效率和眼肌面积随加脂量达9%而线性增长 When fat was added to the diet there was a linear increase in gain, feed efficiency, and loin eye size up through 9% added fat
- 氨基酸含量刚好达标的日粮中加9%脂肪对以上指标好处不大 When the same+% fat was added to a diet just meeting amino acid standards there was little benefit in any criteria

能量蛋白比 Calorie Protein Ratio

加脂% Added Fat	能量蛋白比 Cal/P Ratio	日增重 Daily Gain, g	增重/饲料 G/F
0	19：1	672	.402
6	19：1	681	.476
6	21.5：1	640	.446
99	19：1	690	.529
99	22.6：1	617	.457
12	19：1	690	.532
12	23.6：1	599	.444

Allee 1979.

随日粮代谢能的提高而调节氨基酸

Amino acid adjustment with increases in metabolizable energy within the diets

- 氨基酸推荐用量是针对相当于玉米豆粕型日粮的能量而设计的Amino acid recommendations are made on the assumption that the dietary energy is comparable to a corn soybean meal type diet
- 提高代谢能可改进增重和效率 When matabolizable energy is increased the gain and efficiency are increased
- 能量水平提高后，氨基酸可能不足，使胴体组成和性能受损 At the point in the elevated level of energy, amino acids become limiting and carcass composition and performance can be compromised
- 为维持好的性能，必须提高氨基酸水平 To sustain improved performance, amino acid levels must be increased
- 可以按下面做法 One method to do this is as follows:
  - » 在3200 kcal/kg 以上，代谢能每增加10%，赖氨酸水平应提高7%。其它刚好符合需要量的氨基酸也应相应提高 For each 10% increase in metabolizable energy above 3200 kcal/kg the level of lysene should be increased by 7%. Other amino acids just meeting the requirement should be increased a comparable percentage

H 脂肪来源 Fat Sources of Energy

1. 植物脂肪

室温下趋于液态
双键较多
一般比动物脂肪贵
ME值略高于动物脂肪，这是双键数量的反映 植物脂肪可引起软胴体

2. 动物脂肪

室温下为固态
移动时(如：加入混和机)需加温
会较多饱和脂肪酸
一般为动物没炼制生产的非食用脂肪 一般比植物脂肪便宜得多(在美国，其价格为植物油的1/2)
½ price
禽
猪
牛
鱼油

3. 混合脂肪

饭店废油
酸化皂脚
游离脂肪酸含量高
极为经济

4. 质量控制

使用抗氧化剂
水份

不溶的 I – Insolubles
不可皂化的 U - Unsaponifiables

5.高脂日粮的优点 Advantages of high rations

- 可以配制比谷物日粮的能值更高的日粮 Opportunity to feed diets at energy level higher than grain diets
- 高温环境下高脂日粮更好 In higher temperature environment the advantages to high fat diets are greater
- 高脂日粮消化时产热较少，因此在高温下其优越性更大 High fat diets are cooler to digest, therefor the advantages are greater at high temperatures
- 猪产生很好的饲料效率，一般增重较高 Pigs respond with superior feed efficiency and usually with greater gain

6.缺点 Disadvantages

- 高脂日粮可能增加脂肪沉积 The higher fat diet may increase fat deposition
- 植物脂肪多的日粮可能引起软脂肪，其碘值下降 High plant fat diet may create a softer fat with lower iodine numbers

氨基酸和氨基来源

Amino Acids and Amino Sources

1. 进食的氨基酸未出现于消化物或排泄物中的部分即为表观消化率

   Apparent digestibility is the percent of amino acid intake that does not appear in the digesta or excreta

   - 表观粪消化率＝进食的氨基酸量－粪中排出的氨基酸量，以百分数表示 Apparent fecal digestibility compares the quantity of amino acids consumed by the animal with what is excreted in the feces
   - 表观回肠消化率＝进食的氨基酸－（进食的氨基酸－回肠末端的氨基酸），以百分数表示 Apparent ideal digestibility is the percentage of intake amino acids that does not appear at the terminal ileum

真消化率目的在于考虑内源损失 True digestibility attempts to account for endogenous losses

内源氨基酸来源：脱落的肠道细胞、酶、激素和其它分泌物 Sources of endogenous amino acids are: sloughed intestinal cells, enzymes, hormones, and other secretions

真实的内源损失难以测定 Actual endogenous losses are difficult to determine

饲喂无蛋白日粮，改变胰腺分泌 Feed a protein free diet, changes pancreatic secretions,

饲料消费量下降，趋于低估内源损失 feed consumption is reduced, and tends to over estimate endogenous losses

在得到更好的真消化率之前，用表观回肠消化率可以较准确地反映氨基酸可利用性 Apparent ileal digestibilities are the preferred accuracy of amino acid availability until better “true” digestibilities can be obtained

回肠消化率比粪消化率准确 Ileal digestibility is more accurate than fecal.

较好地估计动物对氨基酸的利用能力，可排除后肠发酵引起的变化（粪消化率有此问题） Provides a better estimate of the true animal availability of the amino acids and removes the changes due to hind gut fermentation that would be present in fecal digestibilities.

表观回肠消化率能较真实地反映加工方法对原料中案基酸可利用性的影响 Apparent Ileal digestibility provides a truer indication of the amino acid availability between feedstuffs and processing methods

生豆片的回肠消化率和粪消化率之间的差异高达50%，热处理豆片的这个差异最多仅15% There is as much as a 50% difference between ileal and fecal digestibility in raw soy flakes but only a maximum of 15% difference between ileal and fecal digestibilities in heated/processed soy flakes.

生大豆和热处理大豆的表观回肠和粪氨基酸消化率

Apparent ileal and fecal amino acid digestibilities in raw and heated soy flakes

Digestibility

氨基酸Amino Acid	Fecal 生Raw	Fecal 热处Heated	Ileal 生Raw	Ileal 热处Heat	Difference 生Raw	Difference 热处Heated
赖氨酸Lysine	72	87	44	85	28	2
苏氨酸Threonine	65	83	32	72	33	11
色氨酸Tryptophan	75	87	25	72	50	15
蛋氨酸Methionine	61	83	47	82	14	1
异亮氨酸Isoleucine	68	84	43	78	25	6

Vandergrift et al., 1983

结果表明,饲料越差,用回肠消化率来配制日粮越是重要,优于根据总成分或甚至粪消化率来配制日粮**This demonstrates the more marginal the feedstuff the more important the use of ileal digestibilities for diet formulation compared to total composition or even fecal digestibilities.**

理想蛋白质和氨基酸比例 Ideal Protein and Amino Acid Ratios

理想蛋白质的定义 Definition of ideal protein

- 是满足猪需要的完美的氨基酸平衡 Perfect balance of amino acids to meet needs of pigs
- 问题是一生中氨基酸需要量的比例是有变化的 Problem is the ratio of amino acids requirements change throughout life
- 以研究测定的赖氨酸需要量为100%，其它氨基酸以赖氨酸的百分比来表示 Determine by setting lysine requirement at 100% of research determined requirement and then expressing other amino acid as a percentage of lysine

c. 个别氨基酸不能过多Concerns for uncontrolled excesses of individual amino acids.

1.研究表明,与别的氨基酸接近的个别氨基酸过多可降低与其类似氨基酸的吸收Research shows that excesses of certain amino acids that are closely related to other amino acids may reduce the absorption of the similar amino acids.

2.有两种氨基酸组合不当会有损于生产性能there are 2 amino acid combinations where the impairment or reduced performance can be shown.

3.这种情况在饲料中常见Excesses occur with a very common diet.

a. 赖氨酸和精氨酸Lysine and arginine

- 两者结构相似Structures of the two amino acids are similar.
- 在简单的玉米豆粕型日粮中赖氨酸是最缺乏的,精氨酸是最过多的In a simple corn-soybean meal diet lysine is most limiting and arginine is most excessive.
- 精氨酸会干扰赖氨酸的利用Arginine has been shown to interfere with lysine utilization.
- 它们会争夺肠中的吸收位点May compete for absorptive sites in the intestine.

生长猪使用的玉米豆粕日粮 Corn-Soybean Meal for Growing Pigs

		C-SBM		C-SBM*	
Amino Acid	Req't	1st Limit	% Req't	2nd Limit	%Req't
赖氨酸Lysine	.74	.74	100	.74	100
蛋,胱氨酸Methionine/Cystine	.50	.56	112	.50	100
苏氨酸Threonine	.45	.65	144	.56	124
异亮氨酸Isoleucine	.52	.77	148	.64	123
缬氨酸Valine	.50	.75	150	.69	138
色氨酸Tryptophan	.12	.21	175	.15	125
组氨酸Histidine	.22	.39	177	.34	154
苯丙,酪氨酸Phenylalanine/Tyrosine	.70	1.41	201	1.23	175
亮氨酸Leucine	.60	1.53	255	1.43	238
精氨酸Arginine	.20	1.05	525	.91	455
豆粕%SBM	17.6		13.3		

*加合成赖氨酸Plus Synthetic Lysine

动物蛋白的赖氨酸,精氨酸之比较为合适,即赖氨酸含量高于精氨酸

Animal protein products tend to have a more favorable ratio of lysine to arginine, that is the lysine is higher than arginine level.

植物和动物产品中的赖氨酸和精氨酸含量

Lysine and Arginine in Plant and Animal Products

动物性产品 Animal Sources			植物性产品 Plant Sources		
	赖氨酸 Lys	精氨酸 Arg		赖氨酸 Lys	精氨酸 Arg
血粉 Blood Meal	6.9	2.4	玉米 Corn	.22	.52
肉粉 Meat Meal	3.0	3.7	小麦 Wheat	.40	.60
肉骨粉 Meat & Bone	2.6	3.4	高粱 Milo	.27	.40
鱼粉 Menh Fish Meal	4.7	3.2	普通豆粕 Reg SBM	2.9	3.4
脱脂粉 Skim Milk	2.6	1.1	去皮豆粕 Deh SBM	3.2	3.8
乳清 Whey	1.1	0.4	麸皮 Midds	.60	1.0
园酵母 T. Yeast	3.8	2.6	棉籽粕 Cot Sd meal	1.7	4.6
喷雾干燥 鸡蛋 Spray Dried Egg	3.2	3.0	向日葵籽粕 Sun Fl Meal	1.7	3.5

血粉是高赖氨酸、低精氨酸的好来源泉 Blood meal is an excellent source of high lysine and low arginine

氨基酸平衡对猪性能的影响 Influence of Amino Acid Balance on Swine Performance

	初期料 Starter		生长料 Grower		肥育料 Finisher	
	C/SBM	C/SBM/ BM	C/SBM	C/SBM/ BM	C/SBM	C/SBM/ BM
精氨酸 Arginine	1.12	.92	.84	.68	.74	.56
赖氨酸 Lysin	1.01	1.01	.75	.78	.64	.66
精/赖 A/L	1.11	.90	1.12	.84	1.15	.85
ADG, kg	.38	.46	.76	.84	1.90	1.94
F/G	2.33	2.08	2.32	1.90	3.42	3.29

C=玉米; SBM=豆粕　BM＝血粉

1.另一种比例，即缬氨酸、亮氨酸和异亮氨酸三者的配合比，也可能降低猪的性能 Another such ratio that can reduce performance is the 3-way combination of valine, leucine and isoleucine.

a. 三者之一或之二能降低其余一种的可利用性 Any one or two of the three can reduce the availability of the other

b. 这三种氨基酸的化学结构相似 Each of these three amino acids have chemical similarities

c. 这很可能是由日粮中亮氨酸水平高所引起，谷物的亮氨酸含量高。玉米豆粕型日粮的亮氨酸含量可能是需要量的两倍 This is more likely to result from high levels of leucine that is high in cereal grains. In a corn-soybean meal diet, the leucine may be twice as high

过多亮氨酸对异亮氨酸和缬氨酸利用率的影响 Effect of Excess Leucine on Use of Isoleucine & Valine

	血浆中的值 Blood Plasma Values uM/100mL		
亮氨酸% Leucine%	亮氨酸 Leu	异亮氨酸 Iso	缬氨酸 Val
0.73 (NRC Req't)	11.8	40.0	78.6
0.83	17.5	49.3	41.0
0.93	17.6	37.6	32.5
1.03	27.2	23.3	21.7
1.13	40.0	21.4	21.4
1.23b	a		14.8

a – 样品丢失

b 玉米豆粕型日粮含1.53%亮氨酸 A conr-soybean meal diet contains 1.53% leucine

d.避免亮氨酸过多可降低粪中氨和其它含氮成分的含量，从而减少粪便的臭气　Avoiding theas excesses will reduce the ammonia and other nitrogen compounds in the manure. This in turn will reduce the offensive odor from manure.

e. 用计算机配制日粮时在设置最低水平时对某个氨基酸设最高值

With computer formulation a maximum can be placed on an amino acid just as minimum levels are set

f. 使用多种原料就有较多的机会经济地降低某些氨基酸的过量问题

Use of multiple ingredients increases the chances of economically lowering the excesses

繁殖群在热应激时的饲养管理

Feeding And Management Of Breeding Herd In Heat STRESS

- 生长肥育猪在各季节的热应激Thermal stress in growing finishing swine on a seasonal basis
- 生长肥育猪对增加脂肪的反应预示母猪的反应Response in growing-finishing swine to increased fat is indicative of response by sows

季节和日粮对猪性能的关系

Relationship of Season of the Year and Diet on Swine Performance

季节 Season	冬季 Winter		夏季 Summer	
月份 Month	11-3月份 Nov.-March		5-9月份 May-Sept.	
平均日最高温 Avg. Da. Max. Temp: ℃	2-13		21-33	
牛油 Tallow(%)	0	5	0	5
平均日增重 ADG, kg	.78	.79	.79	.86
增重/饲料 G/F	.282	.309	.341	.384
		(9.5%)		(12.6%)
背膘 Backfat, cm	2.8	2.9	2.48	2.74

Stahly et al.

高温环境下对加脂的反应最大。 Response to added fat is greatest at hign environmental temperatures.

本研究用生长育肥猪在可控制室温下进行Study with growing finishing swine with controlled room temperatures

饲养在冷、温和热环境中的猪对补饲脂肪的反应

Relative Response of Pigs Housed in a Cold, Warm or Hot Environment to Fat Supplementation

5%脂肪 Fat	10℃			23 ℃			35 ℃		
	-	+	% 变化change	-	+	% 变化change	-	+	% 变化change
增重 Weight Gain	99	98	-1	100	109	+9	66	75	+14
饲料效率 Feed Eff	89	92	+3	100	114	+14	88	100	+14
代谢能进食量ME Intake	114	112	-2	100	103	+3	72	77	+7
增重/代谢量 Gain/ME Intake	86	86	0	100	106	+6	88	94	+7
背膘Backfat	93	97	+4	100	106	+6	85	92	+8

Stahl, Cromwell, 1979.

以23 ℃下饲喂基础料的猪的性能为100%

The performance of pigs fed the basal diet at 23 ℃ was considered 100%

泌乳母猪的热应激 Heat Stress in Lactating Sows

环境温度对泌乳母猪及其仔猪的影响

Effect of Environmental Temperature on Lactating Sows and Their Litters

	干球温度 Dry Bulb(℃)		
	16	27	
母猪头日采食量 Sow F/H/D(kg)	5.6	4.2	(-25%)
母猪体重变化 Sow Wt. Change (kg): (110天断奶) (110days weaning)	-13.0	-22.0	(+69%)
4周龄仔猪重 Pig 4-wk. Wt. (kg)	7.3	6.4	(-12.3%)

Lynch, 1978.

温度对泌乳性能的作用

Effect of Temperature on Lactation performance

温度 Temp. C	18	25	30
平均日采食 ADFI, kg	6.5	6.1	4.2
母猪体重变化 Sow BWC, kg	-3.1	-7.9	-24.5
仔猪断奶重 Pig weaning Wt., kg	7.8	6.9	6.4

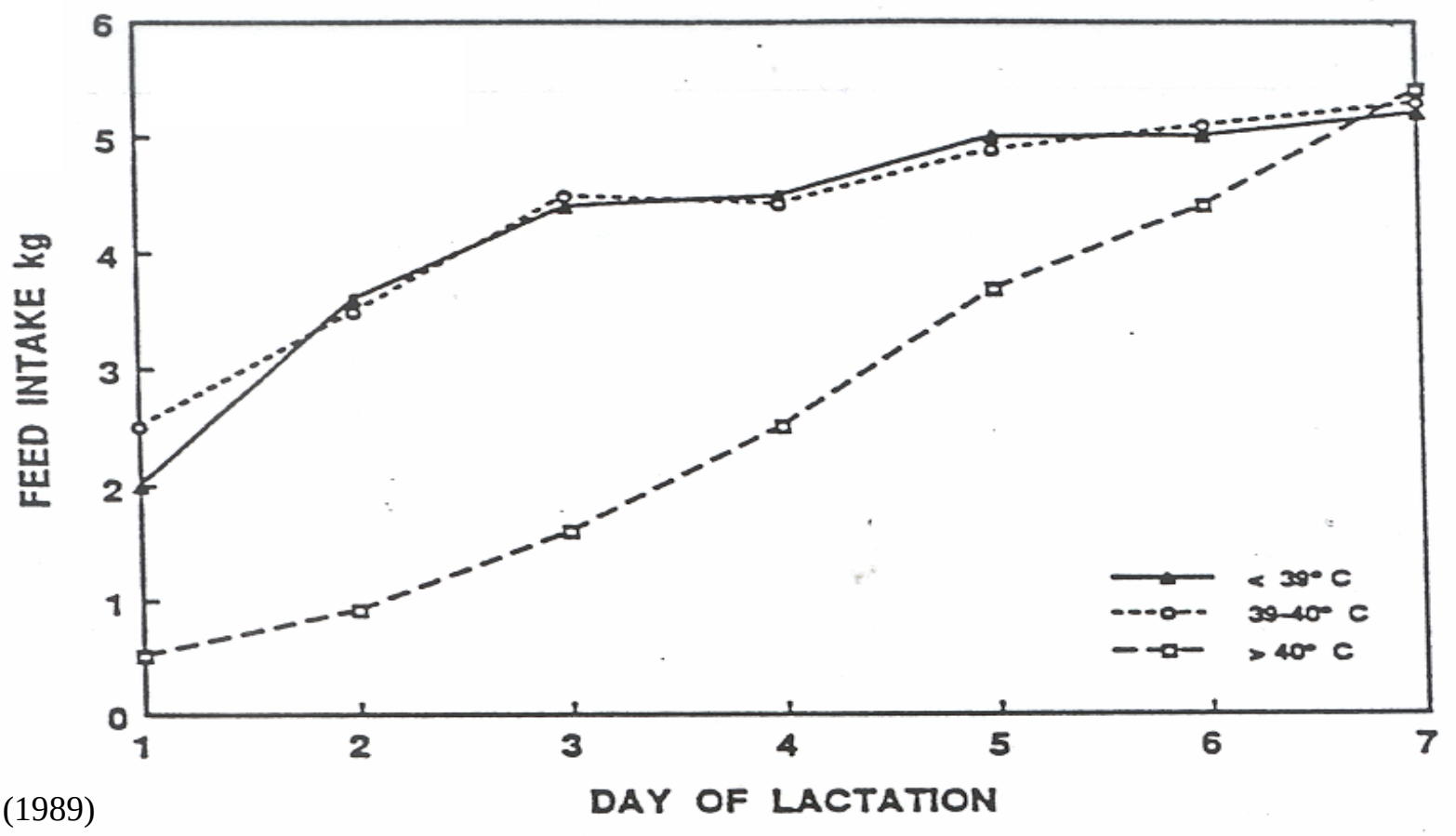
Stansbury et.al., 1987

温度对采食量的作用
Temperature Effects on Feed Intake

- 一般规律General Rule
- 18 °C 以上每提高5 °C ,采食量下降.7 kg for every 5 °C above 18 °C = .7 kg decrease in Feed Intake
- 采食量约减少15% About a 15% decrease in Feed Intake

直肠温度与泌乳母猪采食量的关系

Relationship of Rectal Temperature to Lactation Feed Intake of Sows[a]



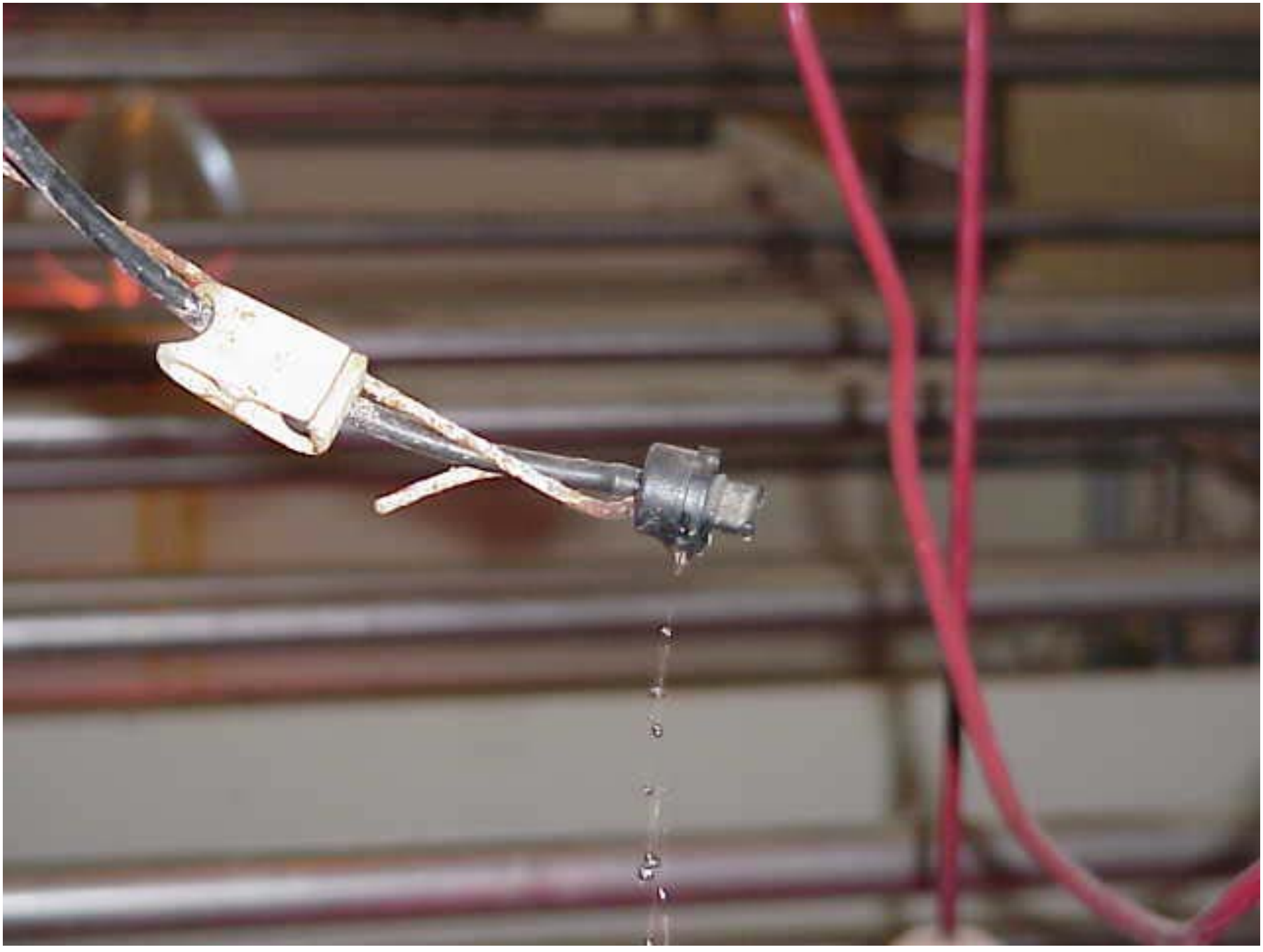
[a]Matzat (1989)

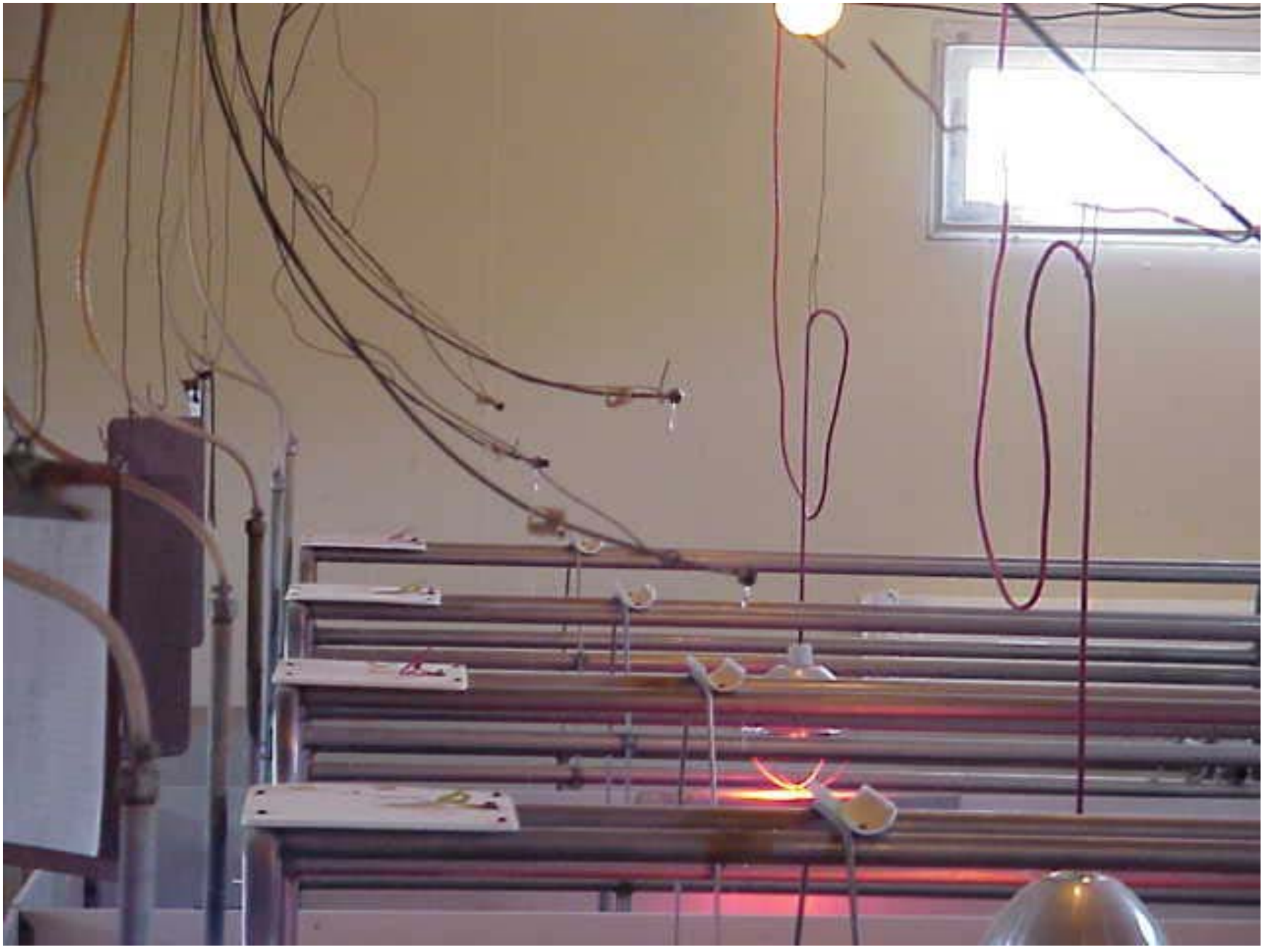
冷却母猪的方法

Methods of Cooling Sows

指标 Variable	无降温 No cooling	鼻部降温 Snout cooling	滴水降温 Drip cooling
日采食,公斤 Feed intake, kg/d	3.5	4.8	5.6
泌乳期失重,Lactation wt. loss, kg	21.2	16.8	14.2

McGlone et al. (1988)






STATUS
Temp Monitor
Shower Cycle
Interval Cycle
MICRO-COOL
78°F
FUNCTION
Room Temp
Actuation Temp
Shower Time
Interval Time
INCREASE SETTING
FUNCTION SELECT
DECREASE SETTING
2
YEAR WARRANTY

脂肪对减轻泌乳期母猪热应激的作用

Value of fat in alleviating heat stress in sows during lactation

猪舍室温和脂肪对泌乳期母猪的作用 Effects on Ambient Temperature and Fat on Lactating Sows

	对归组 Control	添加10%油脂 10% Added Fat
仔猪存活到断奶 Pig Surivval to Weaning (%)		
20°C	91.0	93.8
32°C	85.5	94.9
仔猪断姐体重 Pig Weaning Wt, (kg):		
20°C	5.4	6.0
32°C	4.9	5.3
返情 (天) Return to Estrus (days)		
20°C	7.0	4.1
32°C	5.4	4.8
呼吸率(次数/分钟) Respiration Rate (breaths/min):		
20°C	26.9	25.6
32°C	100.1	104.9
哺乳期饲料采食量		
20°C	5.9	5.3
32°C	3.4	3.5
哺乳母猪体重变化 Femal Lact. Wt, Change (kg)		
20°C	-2.6	-2.0
32°C	-15.8	-16.3

Schoenherr et al

猪舍室温和脂肪对泌乳期母猪的作用

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20°C	7.0	4.1
32°C	5.4	4.8
呼吸率(次数/分钟) Respiration Rate (breaths/min):		
20°C	26.9	25.6
32°C	100.1	104.9
哺乳期饲料采食量		
20°C	5.9	5.3
32°C	3.4	3.5
哺乳母猪体重变化 Femal Lact. Wt, Change (kg)		
20°C	-2.6	-2.0
32°C	-15.8	-16.3

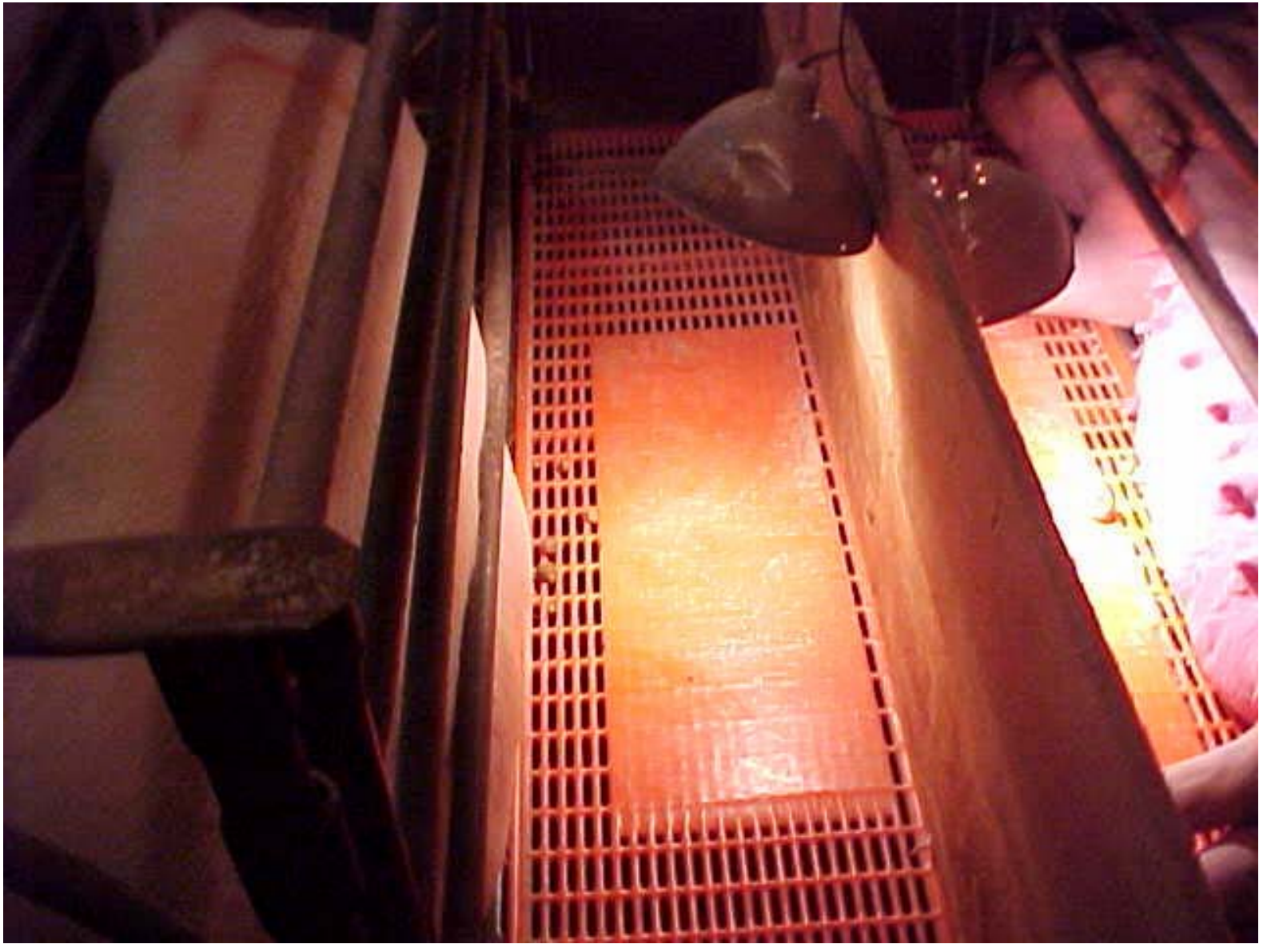
在产仔栏中使用热垫

Use of Heat Pads in Farrowing Crate

使用热垫可维持较低的室温,并使仔猪感到舒服

The use of heat pads allows maintaining lower room temperature and yet comfort for pigs

母猪的热应激Sow Heat Stress



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NCR-89 Committee (1991)

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繁殖群在热应激时的饲养管理

Feeding And Management Of Breeding Herd In Heat STRESS

- 生长肥育猪在各季节的热应激Thermal stress in growing finishing swine on a seasonal basis
- 生长肥育猪对增加脂肪的反应预示母猪的反应Response in growing-finishing swine to increased fat is indicative of response by sows

季节和日粮对猪性能的关系

Relationship of Season of the Year and Diet on Swine Performance

季节 Season	冬季 Winter		夏季 Summer	
月份 Month	11-3月份 Nov.-March		5-9月份 May-Sept.	
平均日最高温 Avg. Da. Max. Temp: ℃	2-13		21-33	
牛油 Tallow(%)	0	5	0	5
平均日增重 ADG, kg	.78	.79	.79	.86
增重/饲料 G/F	.282	.309	.341	.384
		(9.5%)		(12.6%)
背膘 Backfat, cm	2.8	2.9	2.48	2.74

Stahly et al.

高温环境下对加脂的反应最大。 Response to added fat is greatest at hign environmental temperatures.

本研究用生长育肥猪在可控制室温下进行Study with growing finishing swine with controlled room temperatures

饲养在冷、温和热环境中的猪对补饲脂肪的反应

Relative Response of Pigs Housed in a Cold, Warm or Hot Environment to Fat Supplementation

5%脂肪 Fat	10℃			23 ℃			35 ℃		
	-	+	% 变化change	-	+	% 变化change	-	+	% 变化change
增重 Weight Gain	99	98	-1	100	109	+9	66	75	+14
饲料效率 Feed Eff	89	92	+3	100	114	+14	88	100	+14
代谢能进食量ME Intake	114	112	-2	100	103	+3	72	77	+7
增重/代谢量 Gain/ME Intake	86	86	0	100	106	+6	88	94	+7
背膘Backfat	93	97	+4	100	106	+6	85	92	+8

Stahl, Cromwell, 1979.

以23 ℃下饲喂基础料的猪的性能为100%

The performance of pigs fed the basal diet at 23 ℃ was considered 100%

泌乳母猪的热应激 Heat Stress in Lactating Sows

环境温度对泌乳母猪及其仔猪的影响

Effect of Environmental Temperature on Lactating Sows and Their Litters

	干球温度 Dry Bulb(℃)		
	16	27	
母猪头日采食量 Sow F/H/D(kg)	5.6	4.2	(-25%)
母猪体重变化 Sow Wt. Change (kg): (110天断奶) (110days weaning)	-13.0	-22.0	(+69%)
4周龄仔猪重 Pig 4-wk. Wt. (kg)	7.3	6.4	(-12.3%)

Lynch, 1978.

温度对泌乳性能的作用

Effect of Temperature on Lactation performance

温度 Temp. C	18	25	30
平均日采食 ADFI, kg	6.5	6.1	4.2
母猪体重变化 Sow BWC, kg	-3.1	-7.9	-24.5
仔猪断奶重 Pig weaning Wt., kg	7.8	6.9	6.4

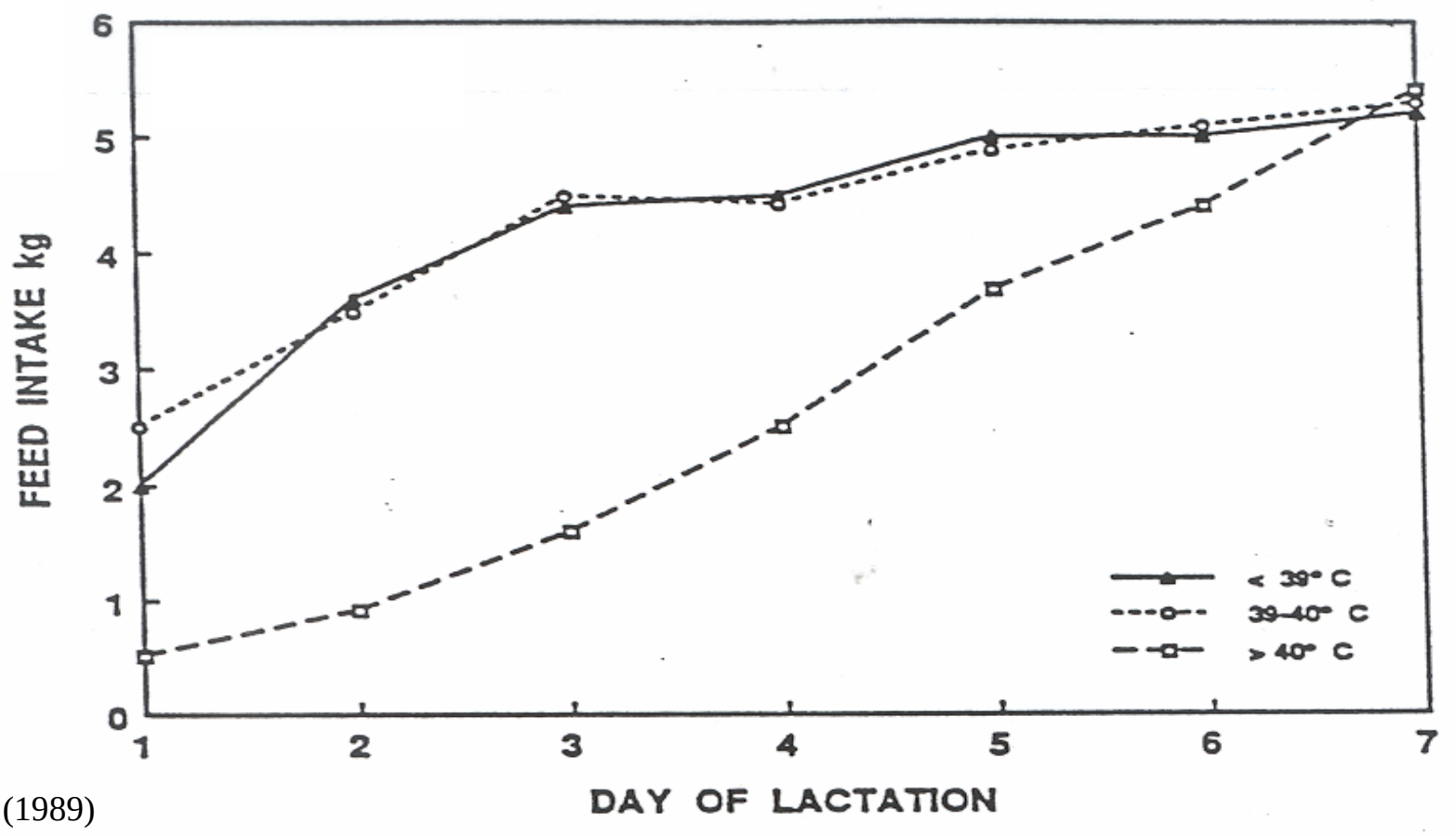
Stansbury et.al., 1987

温度对采食量的作用
Temperature Effects on Feed Intake

- 一般规律General Rule
- 18 °C 以上每提高5 °C ,采食量下降.7 kg for every 5 °C above 18 °C = .7 kg decrease in Feed Intake
- 采食量约减少15% About a 15% decrease in Feed Intake

直肠温度与泌乳母猪采食量的关系

Relationship of Rectal Temperature to Lactation Feed Intake of Sows[a]



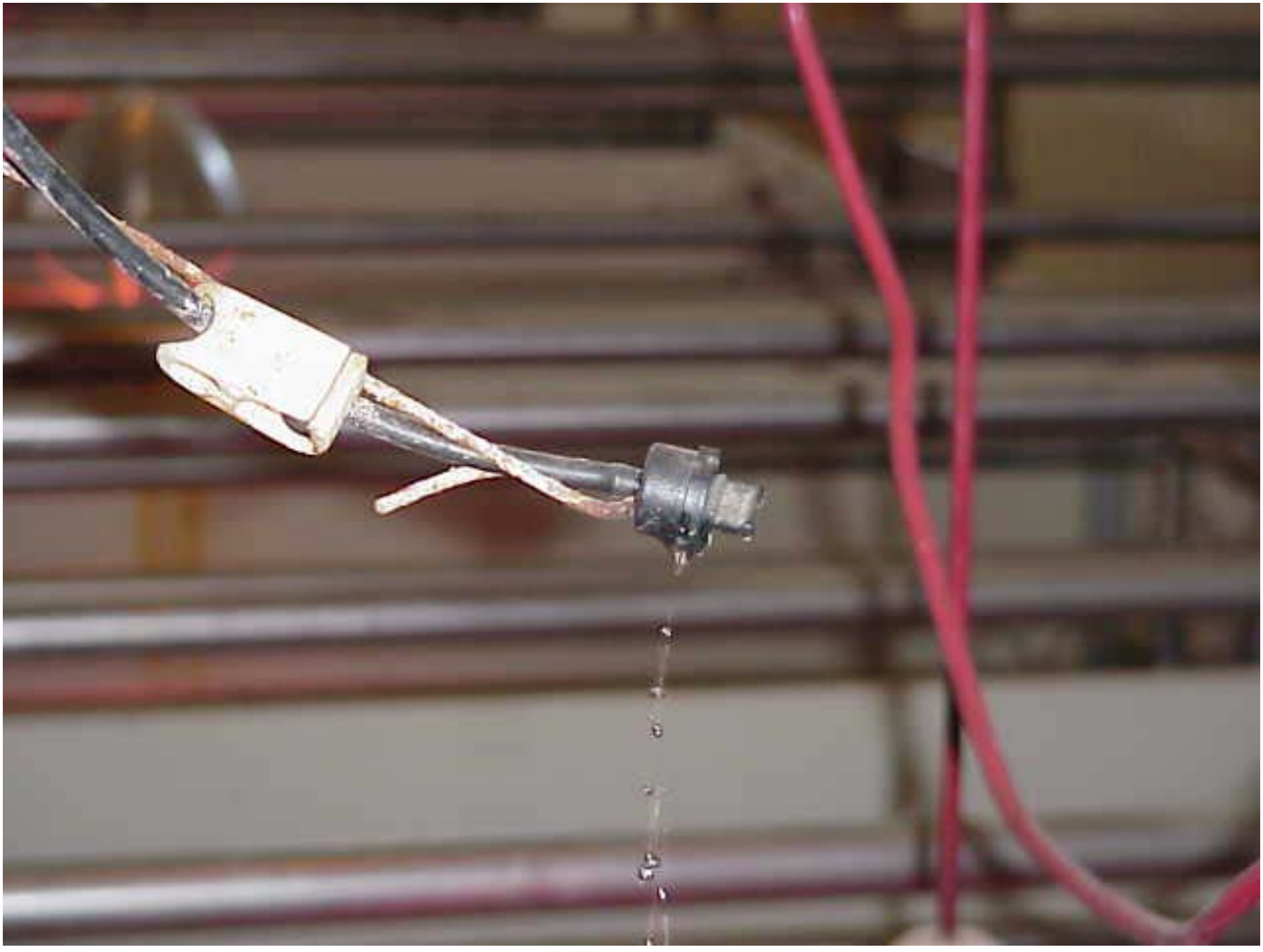
[a]Matzat (1989)

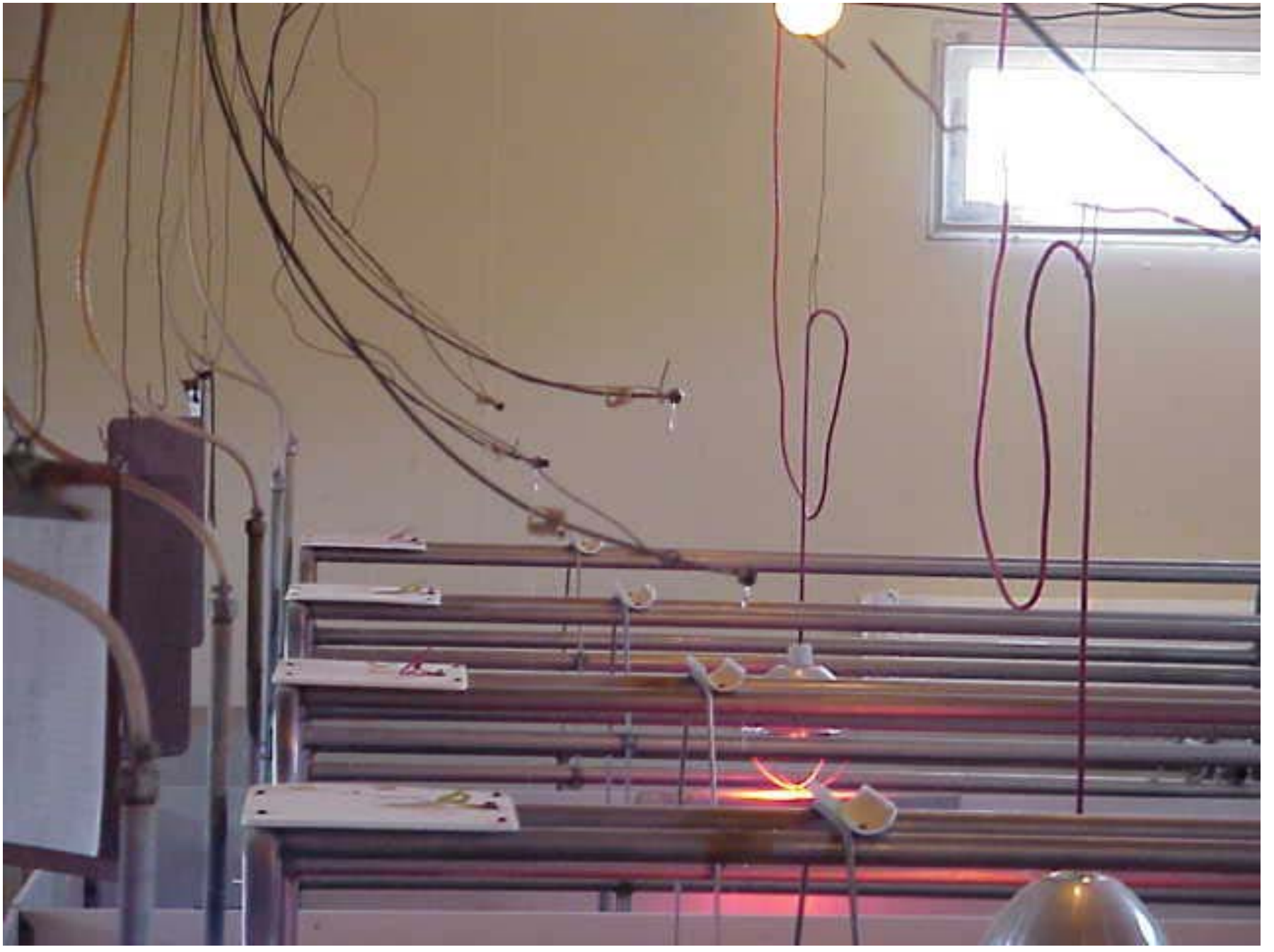
冷却母猪的方法

Methods of Cooling Sows

指标 Variable	无降温 No cooling	鼻部降温 Snout cooling	滴水降温 Drip cooling
日采食,公斤 Feed intake, kg/d	3.5	4.8	5.6
泌乳期失重,Lactation wt. loss, kg	21.2	16.8	14.2

McGlone et al. (1988)






STATUS
Temp Monitor
Shower Cycle
Interval Cycle
MICRO-COOL
78°F
FUNCTION
Room Temp
Actuation Temp
Shower Time
Interval Time
INCREASE SETTING
FUNCTION SELECT
DECREASE SETTING
2
YEAR WARRANTY

脂肪对减轻泌乳期母猪热应激的作用

Value of fat in alleviating heat stress in sows during lactation

猪舍室温和脂肪对泌乳期母猪的作用 Effects on Ambient Temperature and Fat on Lactating Sows

	对归组 Control	添加10%油脂 10% Added Fat
仔猪存活到断奶 Pig Surivval to Weaning (%)		
20°C	91.0	93.8
32°C	85.5	94.9
仔猪断姐体重 Pig Weaning Wt, (kg):		
20°C	5.4	6.0
32°C	4.9	5.3
返情 (天) Return to Estrus (days)		
20°C	7.0	4.1
32°C	5.4	4.8
呼吸率(次数/分钟) Respiration Rate (breaths/min):		
20°C	26.9	25.6
32°C	100.1	104.9
哺乳期饲料采食量		
20°C	5.9	5.3
32°C	3.4	3.5
哺乳母猪体重变化 Femal Lact. Wt, Change (kg)		
20°C	-2.6	-2.0
32°C	-15.8	-16.3

Schoenherr et al

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在产仔栏中使用热垫

Use of Heat Pads in Farrowing Crate

使用热垫可维持较低的室温,并使仔猪感到舒服

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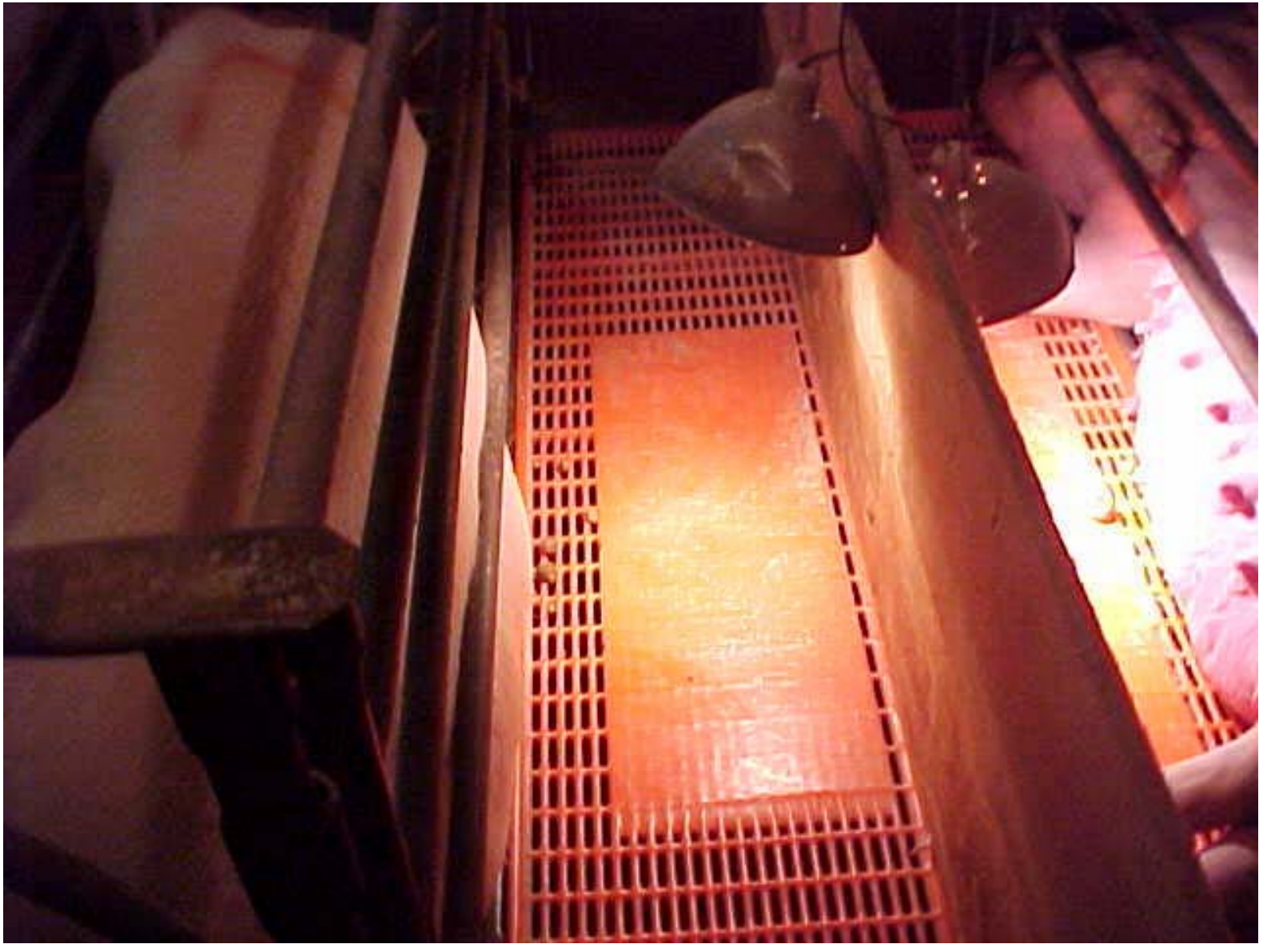

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保育猪和种猪的饲养方案

Feeding Programs

For

Nursery

And

Breeding

Herd

青年猪和种猪的饲料配方 Feed Formulation for Young Pig and Breeding Herd

1. 保育阶段的饲养方案 Nursery Stage Feeding Program

a) 在养500头以上母猪的美国农场，92%的猪在20日龄或之前断奶 Weaning age on US farms with 500 or more sows 92% of pigs are weaned at 20 days or less

仅8%的猪在20日龄以后断奶 Only 8% are weaned after 20 days of age
美国70%的猪由这些大型猪场生产 These larger farms account for 70% of all swine produced in US

b) 常规断奶日龄21－28天 Conventional 21-28 days

c) 早期隔离断奶在14－20日龄断奶 Segregated Early Weaning SEW, 14-20 days of age

强调满足早期断奶猪（少于20天）的需要 Emphasis on meeting needs of early weaned pigs (less than 20 days)

早期隔离断奶（SEW）的特殊需要

Special Needs of Segregated Early Weaning (SEW)

b. 早期隔离断奶的特殊需要 Special Needs of Segregated Early Weaning (SEW)

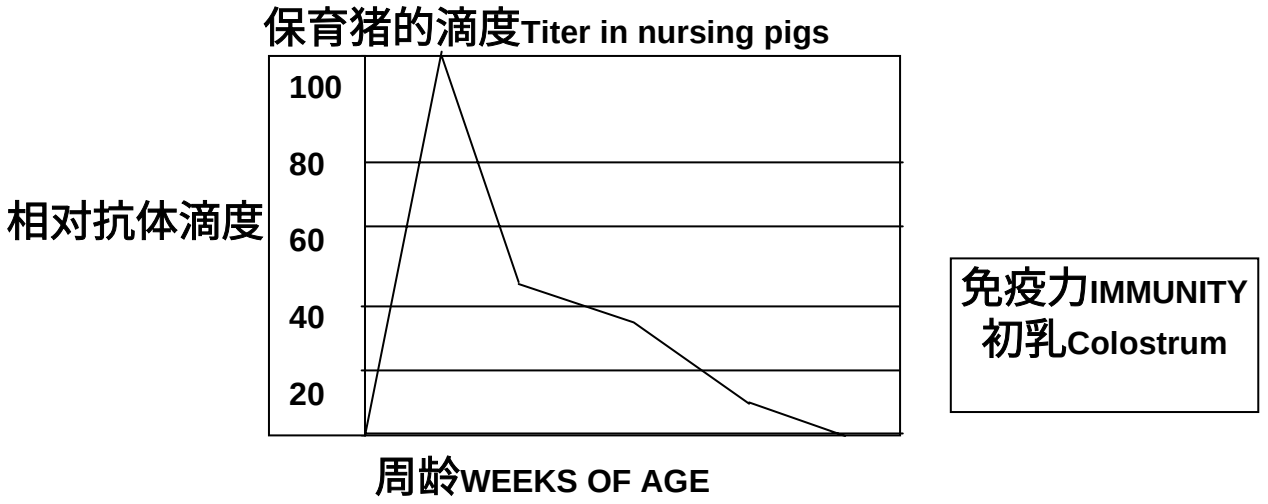
1) 隔离是SEW的成功关键 Isolation is critical to success of SEW program

- **是多点生产的组成部分 part of multisite production**
- **地域上的隔离 physical isolation**
- **管理－人员的管理 management-people isolation**

2)免疫力 Immunity

- **断奶仔猪依赖从初乳获得的被动免疫力weaned pig dependent on passively acquired immunity acquired from colostrum**

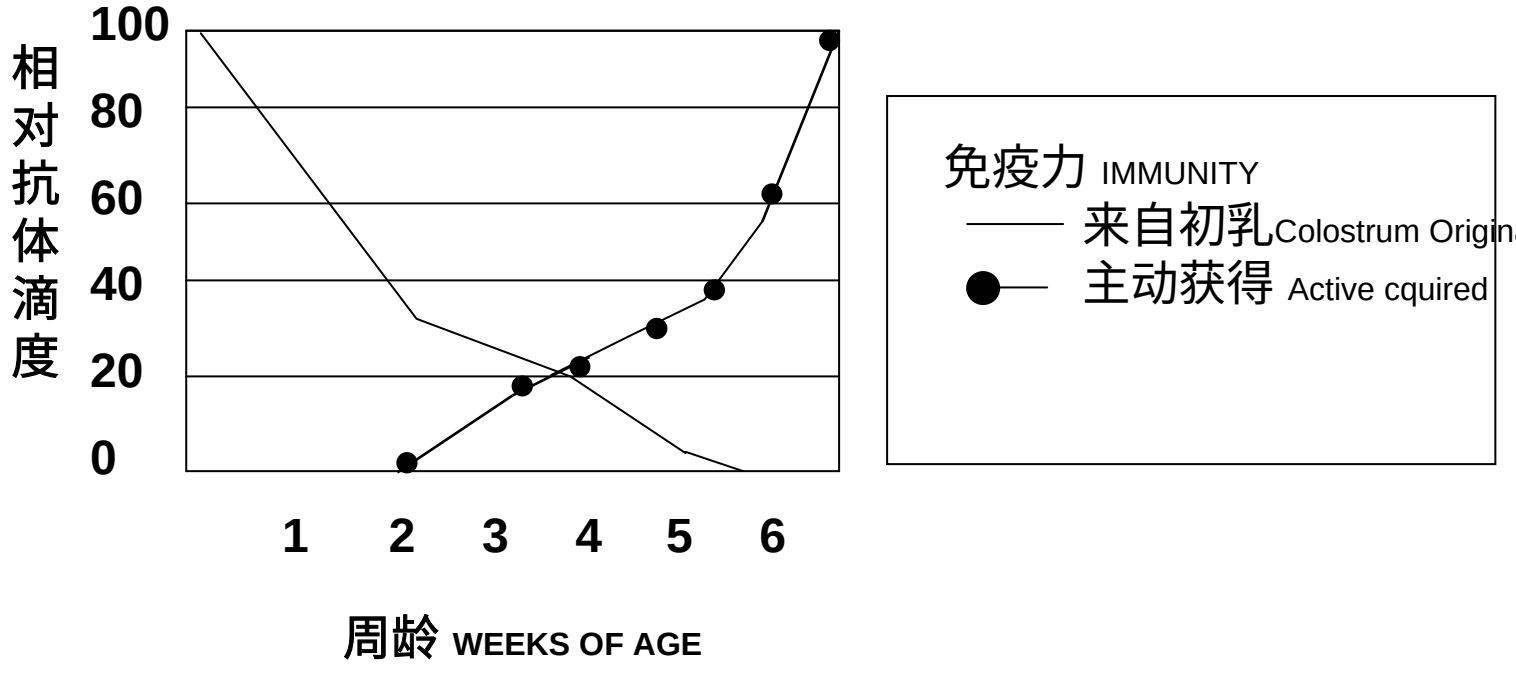
仔猪 Baby Pig
免疫力的建立 Immune Development



- 出生后仅30小时以内能够从初乳吸收伽马球蛋白或免疫球蛋白 gamma globulin or immune globulin absorption occurs only in first 30 hours of life from colostrum milk
- 肠道关闭被动吸收－胞饮作用 closure of intestine to passive absorption – pinocytosis
- 幼猪的被动免疫力的半衰期约为9天。免疫球蛋白在体内缓慢分解 the passively acquired immunity in young pig has a half-life of about 9 days. the immune globulin proteins are slowly broken down in the body

仔猪 BABY PIG

免疫力的建立（在保育猪中的滴度）IMMUNE DEVELOPMENT Titer in nursing pig



在20日龄或之前开始实行早期隔离断奶才有效 **SEW program effective when initiated at 20 days of age or less**

- 在来自初乳的免疫球蛋白损失2-1/2 半衰期之前 **before loss of 2-1/2 half-life's of immune globulins that were obtained from colostrum**

早期断奶猪的免疫应答 **Immune Response in Early Weaned Pigs**

3. 隔离 Isolation

- 关键是保护这些免疫力脆弱的仔猪免受微生物污染**critical to prevent microbial contamination of these immunological fragile young pigs**
- 保育舍在地域上完全离开母猪群和生长肥育猪舍**nurseries totally removed from physical location of sow herd or growing finishing animals**
- 避免人员往返于其它猪场**Avoid Human Traffic To and From Other Pigs**
- 灭鼠**Eliminate all rodents**
- 持续地使用消毒剂**Use continuous disinfectant**

原地或异地保育舍的表现

On-Site vs. Off-Site Nursery Performance*

出保育舍时的体重 **Final Weights * When Emptying Nursery**

	常规原地保育 on-site	异地保育 Off-site SEW
	kg	kg
地域A Area	22.4	29.4
地域B Area	27.2	31.2
平均值 Mean	24.8	30.4

- 始重相同。 所示为最终保育舍体重*
- 在保育舍中时间相同

4. 消除了潜在的疾病 Potential Diseases Removed

- 早期隔离断奶可打断许多疾病的周期，视断奶日龄而定

  Various disease cycles can be broken by SEW depending somewhat on age at weaning

为消除特定疾病所建议的断奶日龄 Weaning age to eliminate particular diseases

疾病/病原菌	日龄
肺炎放线菌 (APP)	15
猪支原体肺炎Myco pnemonia	21
蓝耳病，PRRS	21
猪霍乱沙门菌S.choleraesuis	21
传染性胃肠炎，TGE	21
伪狂犬病，PRV	21
细小病毒Parvovirous	21
支气管败血性博代氏病Bordetella bronchiseptica	10-12
多杀性巴氏杆菌病P.multocida	10-12
萎缩性鼻炎Atrophic rhinitis	10
钩端螺旋体病Leptospira	10
猪链球菌病II StreptococcussuisII	5

5)疾病的易感性 Disease susceptibility

- **早期隔离断奶仔猪如管理不当，将易感有些疾病，因被动免疫力已衰退而主动免疫力尚未建立 SEW pigs managed effectively will be more susceptible to different diseases because immunity has not been passively or actively acquired by the pigs**
- **当年龄较大时得病，受损害较小 Often diseases are less damaging when acquired at an older age**

- 关键原料 Critical Ingredients
  - •SEW方案中营养素和原料的需要更加关键
    nutrient and ingredient needs are more critical in SEW program
  - •各种情况下都可利用特种原料而受益 advantages to using specialized ingredients exist in all environments

1) 富含免疫球蛋白的原料 Ingredients rich in immune globulins

- •它们在被消化分解前会在消化道中提供免疫保护
  These provide immune protection in digestive tract until broken down (digested)
- •这些原料会包裹上消化道的上皮和内容物
  These ingredients bathe the lining and contents of upper digestive tract

猪血浆蛋白 Porcine plasma protein

- •从屠宰厂的猪血中分离，消毒灭菌 Isolated from pig blood at swine packing plants and sterilized to destroy microbial life
- •一般在断奶猪1号日粮中添加5－6% Normally included at 5-6% of first diet fed to weaned pigs
- •在欧洲和其它有些国家禁用 Forbidden in Europe and some other countries
- •约含蛋白质78% Analyzes about 78% protein
- •提高采食量，减少腹泻 Increases feed intake and reduces diarrhea
- •持续向胃和小肠提供免疫球蛋白源 Provides constant source of immune globulins in stomach and small intestine.

喷雾干燥血浆蛋白和抗菌剂对断奶仔猪性能的影响

Spray Dried Plasma Protein and Antimicrobials on Weanling Pig Performance

周Weeks	处理Treatment 血浆蛋白 Plasma Protein	-	+	-	+
	抗菌剂 Antimicrobial	-	-	+	+
日增重Daily gain, g					
	1 + 2	63	218	145	304
	3	368	318	377	232
	1,2,3+4	254	336	304	345
日采食Daily feed, g					
	1+2	218	359	277	450
	3	490	495	518	504
	1,2,3+4	422	527	463	554
增重Gain/饲料feed					
	1+2	.29	.61	.52	.68
	3	.75	.64	.73	.46
	1,2,3+4	.60	.63	.66	.62

第二个双周全部猪饲喂玉米豆粕＋10%乳清粉的日粮

Second two weeks all pigs were fed corn, soybean meal, 10% whey diet.

抗菌剂 Antimicrobials:

美卡多、金霉素、磺胺噻唑和青霉素 Mecadox, Aureomycin, Sulfathiazole and Penicillin

Rojas et al. 1994

- 提高第一个双周的采食量 Increased feed intake first 2 weeks
- 对抗生素有反应，但对猪血浆蛋白的反应更好 response to antibiotics but greater response to porcine plasma protein
- 对血浆蛋白＋抗生素的反应最好 Greatest response was to the combination of plasma protein and antibiotics

猪开食料中血浆源的影响Effect of Plasma Source in Starter Pig Diet Centers

		喷雾干燥蛋白源5%Spray Dried Plasma Source 5%		
	对照ontrol	牛Bovine	猪Porcine	母猪Sow
0-7天Day 0-7				
日增重克Daily gain, g	113.5	154.4	168.0	168.0
日采食克Daily feed, g	168.0	190.7	204.3	195.2
增重Gain/饲料Feed	.689	.800	.826	.862
7-14天Day 7-14				
日增重克Daily gain, g	263.3	263.3	295.1	300.6
日采食克Daily feed, g	340.5	336.0	340.5	336.0
增重Gain/饲料Feed	.773	.782	.867	.895
0-14天Day 0-14				
日增重克Daily gain, g	188.4	208.8	231.6	234.3
日采食克Daily feed, g	254.2	263.4	272.4	265.6
增重Gain/饲料Feed	.731	.791	.846	.879

416头猪(4.1 kg, 15 天) 416 pigs (4.1 kg, 15 days)
Smith et al., 1994

- 牛血浆和猪血浆都有益both sources (bovine and porcine) were beneficial
- 对猪血浆的反应最好 greater response to porcine
- 10－20天后，反应趋弱 response is diminished after 10-20 days
- 猪血浆贵，难推广 expense of porcine plasma limits the use

喷雾干燥蛋粉 **Spray Dried Egg:**

- 来自无菌的未受精的新鲜鸡蛋 Sterilized, unfertilized fresh eggs
- 一般在断奶猪1号日粮中添加4－6% Normally included at 4-6% of first diet fed to weaned pigs
- 全世界批准使用 Approved world Wide
- 提高采食量，减少腹泻 Increases feed intake and reduces diarrhea
- 持续向胃和小肠提供免疫球蛋白 Provides constant supply of immune globulins in stomach and small intestine

喷雾干燥蛋粉的免疫球蛋白含量 **Immune Globlin Content of Spray Dried Eggs**

- 一个鸡蛋至少含150 mg 的IgY An egg contains at least 150 mg of IgY
- 每毫升蛋黄含10毫克IgY Concentration of IgY in yolk is about 10 mg/ml of egg yolk (Akita & Nakai J Food Sci. (1992)
- 每个鸡蛋约含16克蛋黄 Each egg contains about 16 g of yolk
- 假设蛋黄密度约1g/ml Assume a density of egg yolk of about 1g/ml
- 则， 10 mg/ml x 16 ml (g) =每个蛋黄或鸡蛋含 160 mg Therefore 10 mg/ml x 16 ml (g) = 160 mg per yolk and per egg
- 每个鸡蛋去壳重约55克，干物质含量24.5%，即含干物质13.475克 The contents of an egg (minus shell) weighs about 55g, which is 24.5% solids, or 13.475 g of solids
- 蛋粉中IgY 的浓度约11,873 ppm Therefore the concentration of IgY in dried egg is about 11,873 ppm IgY (160 mg IgY/13.475 g = .01187 mg IgY/mg 蛋粉或 11,873 mg/kg (ppm))
- 喷雾干燥蛋粉的IgY含量约12,000 ppm

Spray dried egg contain about 12,000 ppm IgY

鸡蛋中免疫球蛋白比血浆高10倍

Immune globulin in egg is 4 times higher than in serum

- 向胃和肠道持续供应免疫球蛋白来源**Provides constant source of immune globulins in stomach and intestine**
- 富含蛋白质(48%)，赖氨酸(3.72%)，脂肪(28%) 和能量(4050 kcal/kg)

Rich source of Protein (48%), Lysine (3.72%), Fat (28%) and energy (4050 kcal/kg)

Rose et. al. 欧洲免疫学杂志1974

European Journal of Immunology 1974

Cambridge University and Houghton Poultry Research Station, Houghton, Huntingdon

	IgG 或or IgY Mg/ml
人血清Hen Serum	6
蛋黄Egg Yolk	25
蛋白Egg White	<.003

根据关于蛋黄中IgY 的计算，喷雾干燥蛋粉的 IgY 含量应为30,000 ppm **Using the calculation above the Rose data on concentration of IgY in yolk, the SDE feed ingredient would contain 30,000 ppm**

鸡蛋IgY对降低大肠杆菌的效力 Efficacy of IgY Obtained from eggs in reducing c

E. Coli

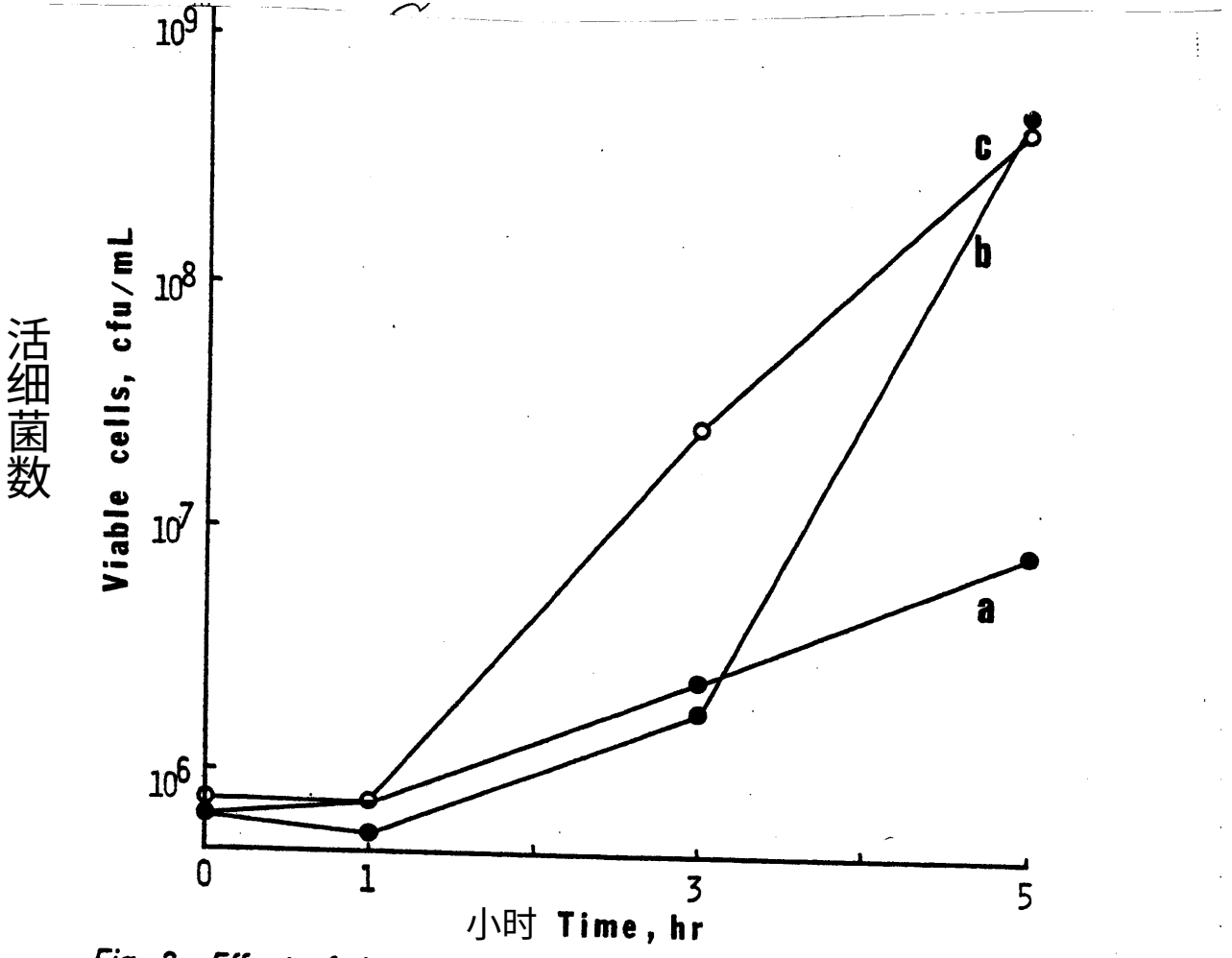


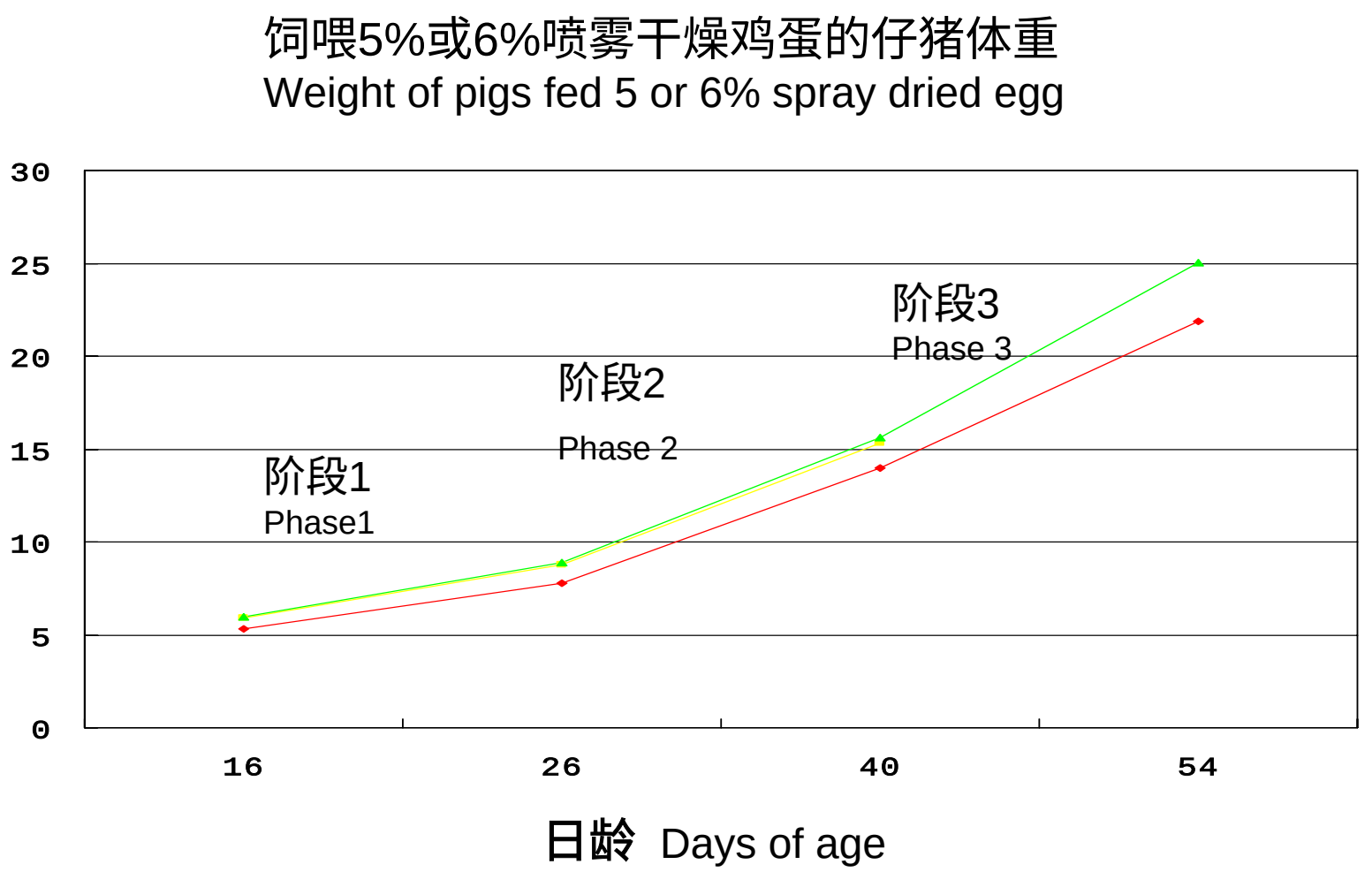
Fig. 3—Effect of the anti-E. coli antibody IgY on the growth of *E. coli*. (a) IgY, 10 mg/mL; (b) IgY, 2 mg/mL; (c) growth control.

抗大肠杆菌抗体IgY对大肠杆菌生长的作用（对照）

Shimizu et al 1988

16日龄断奶后饲喂5-6%喷雾干燥蛋粉的猪的增重

Weight gain of pigs fed 5-6% sprayed dried egg in pigs weaned at 16days



3个分别的试验中饲喂 喷雾干燥鸡蛋的结果，16日龄断奶

Results from feeding SDE in 3separate trials. Pigs weaned at 16 days

中国试用喷雾干燥蛋粉的结果

Use of Sprayed Dried Egg in studies conducted in China

28日龄断奶并接受两种免疫球蛋白建议水平的仔猪的性能Performance of pigs weaned at 28 days of age containing recommended levels of the two immune globulin sources

	喷雾干燥蛋粉 Spray** Dried Egg	喷雾干燥血浆粉 Spray** Dried Plasma
莲塘猪场1号猪舍(10 天试验)[b] Swine Unit #1 Liantang Swine Farm (10 Day study)[b]		
日增重克 Daily gain, g	215	211
日采食克 Daily Feed, g	267	269
饲料Feed/增重 Gain	1.24	1328
莲塘猪场2号猪舍(7天试验)b Swine Unit #2 Liansheng Swine Farm (7 Day study)[b]		
日增重克 Daily gain, g	243	250
日采食克 Daily Feed, g	260	258
饲料Feed/增重 Gain	1.07	1.03

B每个处里20头猪Twenty pigs per treatment at each site

**8%喷雾干燥蛋粉或5%喷雾干燥血浆粉 8% spray dried egg or 5% spray dried plasma

选泽原料的原因是价格oice between porcine plasma and spray dried egg is mainly price

Purdue University,
B.G. Harmon and Li Qiang

普渡大学的试验 Studies Conducted at Purdue

断奶后1号料First Diet After Weaning*

喷雾干燥蛋粉 Sprayed Dried Eggs	0%	5%
日增重克 Daily Gain, g	204	243
日采食克 Daily Feed, g	204	236
饲料Feed/增重Gain**	1.00	.97

*16日龄断奶后在SEW环境中试验10天，每处理70头猪 Pigs raised in Segregated Early Weaning Environment 10-day study after weaning at 16 days, 70 pigs per treatment

Harmon, Oct 2001

**每单位增重所需饲料 Feed per unit of gain

断奶后1号料 First Diet After Weaning*

喷雾干燥蛋粉 Sprayed Dried Eggs	0%	5%
日增重 Daily Gain, g	181	204
日采食 Daily Feed, g	253	263
饲料Feed/增重Gain	1.40	1.29

*16日龄断奶后在SEW环境中饲养10天，每处理84头猪Pigs raised in Segregated Early Weaning Environment

10-day study after weaning at 16 days, 84 pigs/Treatment

Harmon, Nov 2001

- 喷雾干燥蛋粉 的比例按乳糖 Ratios of Spray Dried Egg go Lactose

在SEW猪日粮中使用稳定比例的乳糖和喷雾干燥鸡蛋

Use of a Constant ratio of Lactose and Spray Dried Eggs In Diets of SEW Pigs

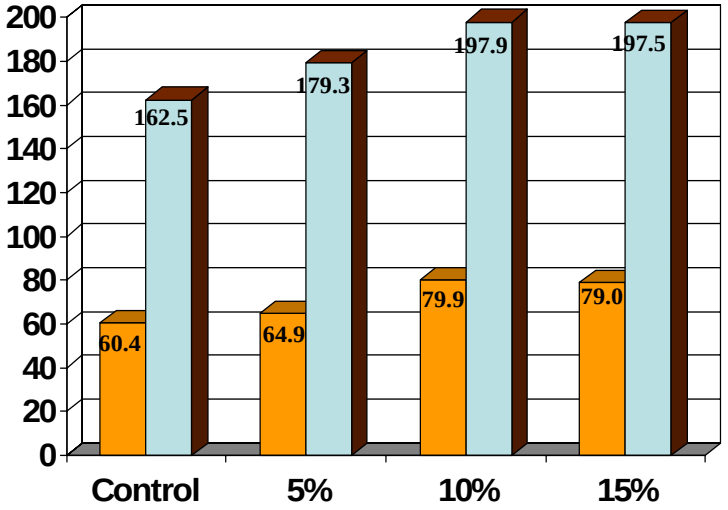
阶段1(0-10试验日) Phase 1 (0 to 10 days on test)				
乳糖/SDE水平 Level of Lactose/SDE, %	0	8	16	24
日增重 Daily Gain, g	41	68	85	73
日采量 Daily Feed Intake, g	114	136	136	145
增重/饲料 Gain/Feed	.360	.500	.625	.503
阶段2(10-24试验日) Phase 2 (10 to 20 days on test)				
乳糖/SDE水平 Daily Gain, g	0	8	16	24
日增重 Daily Gain, g	295	345	331	331
日采量 Daily Feed Intake, g	472	522	508	495
增重/饲料 Gain/Feed	.524	.661	.652	.668
合计(0-24试验日) Overrall (0 to 24 days on test)				
日增重 Daily Gain, g	191	227	227	222
日采量 Daily Feed Intake, g	322	363	354	350
增重/饲料 Gain/Feed	.593	.625	.641	.634

168头猪，每处理42头，7个重复，16日龄断奶，全部日粮含5% 普渡大学

168pigs, 42per treatment, 7 replications, pigs weaned at 16 days, all diets contained 5% dried whey Purdue University

不同比例和水平的SDE/乳糖对猪生长性能的影响（试验3,阶段1）

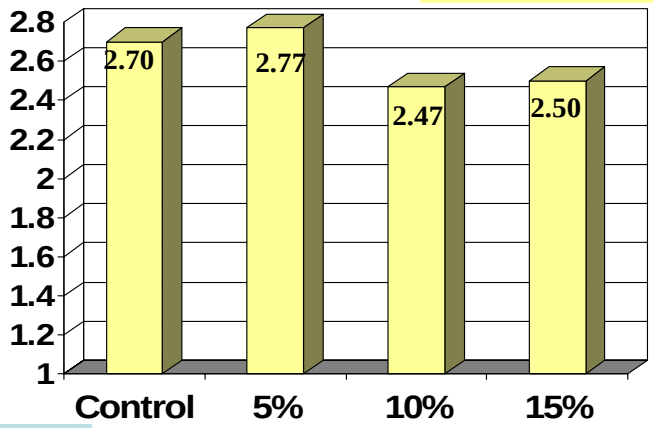
Effect of different levels of SDE/lactose on pig performance (trial 3, phase 1)



SEM=8.6

SEM=15.5

SEM=0.5

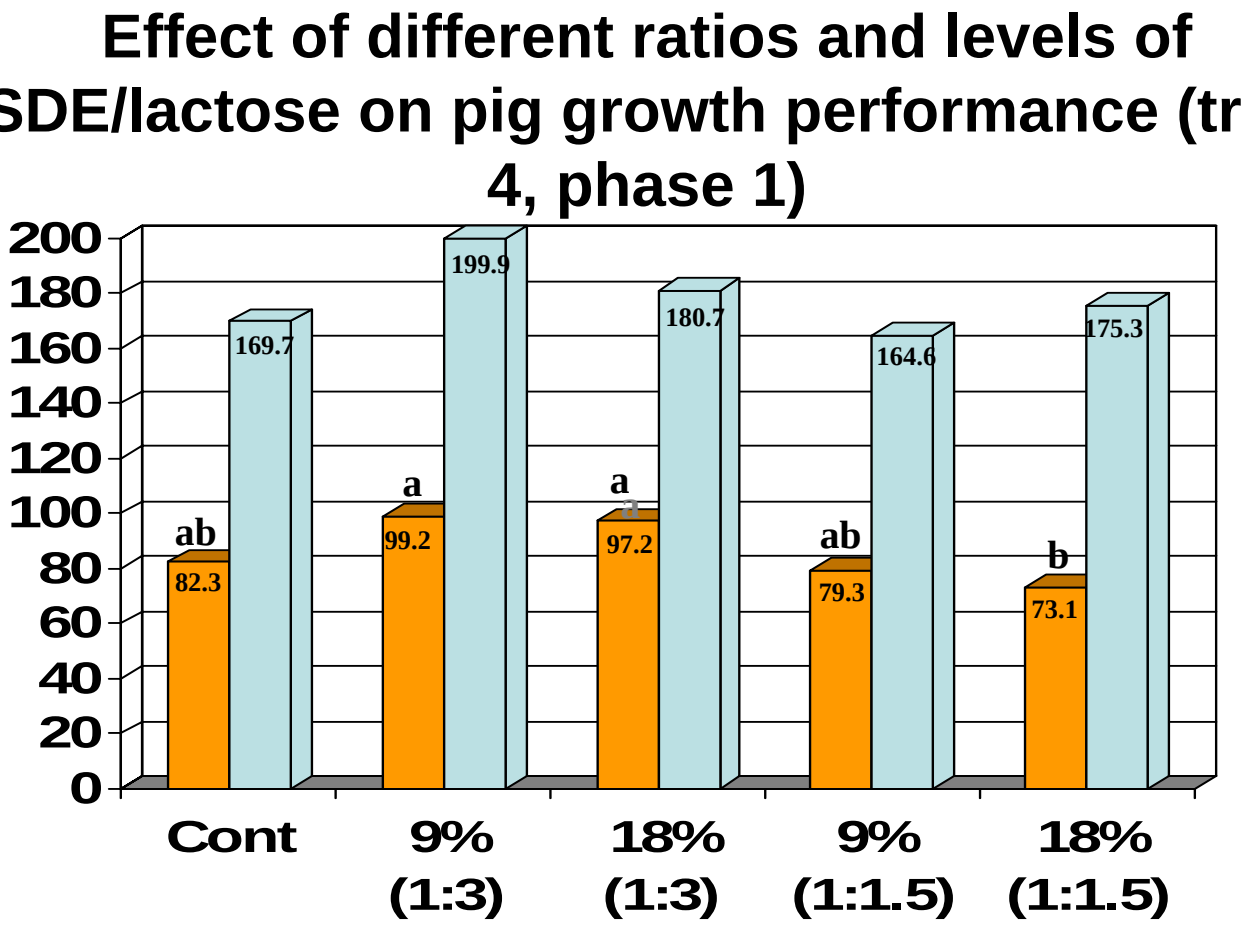


平均日增重（克） **ADG, g/day**

平均日采食（克） **Average Daily Feed Intake, g/day**

Feed/Gain 饲料/增重

不同比例和水平的SDE/乳糖对猪生长性能的影响（试验4,阶段1）



平均日增重（克） **ADG, g/day** SEM=8.3

平均日采食（克） **Average Daily Feed Intake, g/day** SEM=12.7

#3. 乳制品 Milk Products

a. 乳糖，99%纯乳糖 Lactose 99% pure lactose

- 保育猪日粮中极佳的增味剂 Excellent palatability agent in nursery diets
- 奶中的碳水化合物能源，ME = 3435 kcal/kg Carbohydrate energy source in milk; ME = 3435 kcal/kg
- 乳糖促进乳杆菌生长，乳杆菌能与大肠杆菌和沙门氏菌竞争，抑制它们，使保育猪少患腹泻 Carbohydrate of choice for Lactobacillus bacteria to increase growth of this species that competes and suppresses coliform an Salmonella bacteria which causes much of diarrhea in nursery pigs
- 乳糖发酵产生乳酸，降低大肠pH，进一步抑制大肠杆菌和沙门氏菌 Fermentative substrate to produce lactic acid that reduces large intestine pH, further helping restrict coliforms and Salmonella
- 在保育猪日粮中添加10－20% Include in nursery diets at 10-20% of diet

b.乳清粉（11%蛋白）、乳清蛋白精（34%蛋白）、乳清渗透料（3%蛋白）和脱脂奶粉（37%蛋白） **Dried Whey (11% protein), whey protein concentrate (34% protein), whey permeate (3% protein), and dried skim milk (37% protein)**

- **乳清粉是保育猪日粮的好原料** **Dried whey is a valuable ingredient in nursery diets**
- **优良的氨基酸来源** **Excellent source of amino acids**
- **含乳糖** **Contains lactose**：

(1) 能源 **energy source**

(2) 促进乳杆菌生长，抑制大肠杆菌，减少腹泻 **carbohydrate of choice for Lactobacillus bacteria to increase the growth of this species that competes against coliform bacteria (cause of much diarrhea)**

(3) 发酵产生乳酸，降低大肠pH，抑制大肠杆菌和沙门氏菌 **fermentive substrate to produce lactic acid that reduces large intestine pH, helping to restrict coliform and salmonella bacteria**

- **牛奶副产品中的蛋白质含有乳球蛋白，是某些抗体的来源** **protein in milk byproducts contains Lactoglobulins (source of some antibodies)**
- **保育猪日粮含15－30%乳清或10－20%脱脂奶粉** **nursery diets contain from 15 to 30% whey or 10 to 20% dried skim milk**

其它动物性副产品 Other Animal by-products

- 鱼粉、肉粉、血粉和禽粉都经常用于保育猪日粮
  fish meal, meat meal, blood meal and poultry meal often are included in nursery diets

- 动物蛋白是优良的氨基酸来源，过敏原含量极低（豆粕含有过敏原） animal proteins are excellent sources of amino acids and extremely low in allergens such as contained in soybean meal

- 对保育猪应限用豆粕，以减少对大豆蛋白的超敏反应以及由于大豆含有的高水平过敏原而引起的腹泻 in nursing pigs soybean meal is restricted to minimize hypersensitivity to soy protein and resultant diarrhea from high levels of soybean based allergens

- 动物副产品中免疫球蛋白含量较低 animal by-products tend to have low level of immune globulins

蛋白源对保育猪性能的影响

Protein Source on NurseryPig Performance

项目 Item	氨基酸 AA	鱼 Fish	喷雾干燥猪血浆 Spray Dried Porc Plasma	喷雾干燥血粉 Spray Dried Blood Meal	Soy Conc	挤压大豆精料 Extruded Soy Conc
7-14天 d 7-14						
日增重磅 ADG, lb	.45	.56	.67	.63	.47	.57
日采食磅 ADFI, lb	.83	.82	.98	.91	.87	.87
饲料F/增重G	2.00	1.64	1.55	1.59	2.14	1.67
7-28天 d 7-28						
日增重磅 ADG, lb	.87	.87	.94	.92	.87	.89
日采食磅 ADFI, lb	1.39	1.32	1.41	1.40	1.35	1.36
饲料F/增重G	1.61	1.52	1.51	1.53	1.56	1.53

432头猪0-7天喂普通料，试验料含5%鱼粉或其它产品的氨基酸当量 432 Pigs, fed common diet 0-7 days

Exp diets had 5% fish meal or Lysine equiv. Of other test products.

Tokash et. al. 1995

猪开食料中的酸化剂 Acidifying Products in Pig Starters

作者 Source	添加有机酸的改进% % Improvement With Addition of Organic Acids		
	增重 Gain	采食 Feed Intake	增重 Gain/采食 Feed
Kirchgessnger (1976)	**11.6**	**3.8**	**9.2**
Lewis (1981)	**9.5**	**6.9**	**3.9**
Giesting (1984)	**3.6**	**-3.4**	**13.8**
Falkowski (1984)	**6.0**	**-3.5**	**10.4**
平均 Average	**7.7**	**1.0**	**9.3**

- 据推测，有机酸可降低小肠和大肠的pH organic acids thought to lower pH of small and large intestine
- 研究证明，有机酸能降低大肠pH studies show organic acids lower pH in large intestine
- 低pH促进乳杆菌生长 lower pH encourages Lactobacillus species
- 低pH抑制大肠杆菌 lower pH discourages coliform bacteria
- 有机酸改进增重、采食和效率 organic acids improve gain, intake and efficiency
- 猪日粮中使用多种酸：延胡索酸、柠檬酸、苹果酸、乳酸、丙酸和adipic酸 various acids have been used in swine diets; fumaric acid, citric acid, malic acid, lactic acid, propionic acid, and adipic acid
- 经常首选延胡索酸 fumaric acid is most often the acid of choice
- 有机酸是能源 organic acids are an energy source
- 日粮中添加1－2%有机酸 organic acids are added at 1-2% of diet
- 对有机酸的反应在某种程度上取决于开食料中乳产品（乳清或乳糖）的用量 response to organic acids somewhat dependent on amount of milk products (whey or lactose) included in starter diets

氧化锌是保育猪料中的抗菌剂 Zinc Oxide as an antimicrobial feed additive in nursery diets

- 很多保育猪料添加2000- 3000 ppm锌以促进生长（2800－4200ppm氧化锌） Zinc oxide is added to many nursery diets at 2000- 3000 ppm zinc to improve pig growth rate (2800- 4200 ppm zinc oxide)
- 高剂量的氧化锌在消化道中起抗菌剂作用 Zinc oxide acts like an antibacterial at this high inclusion level, acting in the digestive tract
- 日粮中锌需要量约100ppm Dietary requirement for zinc is about 100 ppm
- 锌的形式为氧化锌 Form of zinc should be zinc oxide
- 饲喂氧化锌别超过5周或在保育舍期间 product should not be fed for more than five weeks or during the time in the nursery

开食料中锌水平的作用

Effect of Zinc Level in Starter Diet

0-14天 0-14 Days					
日增重Daily gain, kg	**. 16**	**. 17**	**. 18**	**. 19**	**. 21**
日采食Daily feed, kg	**. 21**	**. 22**	**. 23**	**. 24**	**. 25**
饲料Feed/增重Gain	**1.39**	**1.29**	**1.26**	**1.30**	**1.15**
14-28天 14-28 Days					
日增重Daily gain, kg	**. 33**	**. 35**	**. 39**	**. 37**	**. 36**
日采食Daily feed, kg	**. 60**	**. 62**	**. 65**	**. 72**	**. 69**
饲料Feed/增重Gain	**1.84**	**1.76**	**1.72**	**1.90**	**1.97**
0-28天 0-28 Days					
日增重Daily gain, kg	**. 25**	**. 26**	**. 28**	**. 28**	**. 29**
日采食Daily feed, kg	**. 41**	**. 42**	**. 44**	**. 47**	**. 46**
饲料Feed/增重Gain	**1.69**	**1.60**	**1.57**	**1.70**	**1.66**

Smith et. al. 1995. Pigs 12 days of age

全部料中添加阿拉伯霉素和Mecadax Apramycin and Mecadax provided antibiotic in all diets

- 增重和采食随日粮中氧化锌用量的提高而改善 **Linear improvement in gain and intake as zinc oxide was increased in the diet**

- 饲料效率的改善仅出现在最初14天
Improvement in feed efficiency occurred only during the first 14 days

保育猪的阶段饲养 Phase feeding of nursery pigs

1)从断奶至23公斤体重，使用3－4种日粮 programs include 3 to 4 diets going from weaning to 23 kg.

2) 举例：从4.5到23公斤的3阶段饲养方案 example three phase program from 4.5 to 23 kg

如果在15天后断奶，饲喂1号料至26日龄 If weaning beyond 15 days feed Phase 1 diet for short period up to 26 days at age

如果断奶较晚（如28日龄），则每只猪仅喂1－2公斤1号料

If weaning at older ages, such as 28 days, feed only 1-2 kg/pig of phase 1 diet

项目Item	阶段1 Phase 1	阶段2 Phase 2	阶段3 Phase 2
	预期Expected	表现Performance	反应 Responses
体重Body Weight, kg	4.5-7	7-12	12-23
日龄Days of Age	15-26	26-39	39-56
日增重Daily Gain, kg	.23	.38	.62
日采食Daily feed, kg	.27	.54	.82
饲养天数Feeding Duration, days	11	13	17
	建议营养水平Recommended Nutrient Levels		
总氨基酸Amino Acids (total)			
赖氨酸Lysine, %	1.60	1.38	1.25
色氨酸Tryptophan, %	.24	.21	.19
苏氨酸Threonine, %	.93	.81	.72
蛋/胱氨酸Methionine + Cystine, %	.82	.78	.68
常量元素Macro-minerals			
钙Calcium, %	1.00	0.90	0.90
总磷Phosphorus (total), %	0.80	0.70	0.70
有效磷Phosphorus (available), %	0.55	0.45	0.45
钠Sodium, %	0.25	0.20	0.15
氯Chloride, %	0.25	0.20	0.15

每公斤日粮含3420-3500 kcal Dietary Energy 3420-3500 kcal/kg in each diet.

添加维生素和微量元素 Plus vitamins and trace minerals.

微量元素和维生素以预混料形式添加，未列入表中 trace minerals and vitamins are provided in premixes to assure adequacy within the diets and not shown on the table

表中列出的4种氨基酸符合需要，其它氨基酸由主要饲料原料满足需要 other amino acid requirements are met by major feed ingredients when the four listed above are met

日粮举例Sample Diet

计算机配制最低成本日粮Computer Generated Least Cost Diet

1号开食料 Starter - Phase 1 - 3500 ME

原料Ingredient	%	成分Ingredient	%
玉米粉Corn, Ground	43.7	延胡索酸Fumaric Acid	1.50
豆粕Reg Soya Ml meal 44	15.3	盐Salt	.40
乳请粉Whey, Dehy	18.00	氧化锌Zinc Oxide	.25
喷雾干燥蛋粉Spray Dried Eggs	5.00	赖氨酸Lysine	.45
动物脂肪Fat, Animal	4.6	猪用维生素预混料Swine Vit Px	.25
肉骨粉Meat & Bn-50	5.00	猪用微量元素Swine Tr Min	.12
鱼粉Fish Meal	5.00	硒预混料Se Premix	.05
		蛋氨酸Methionine	.03
		Mecadox	.25
		苏氨酸Threonine	.07

营养组成 Nutrient Composition

名称Name	单位	最低Minimum	数量Amount
猪净能Met. Energy – Swine	kcal/kg	3,500	3,500
粗蛋白Crude Protein	% of Wt	21.00	22.00
赖氨酸Lysine	% of Wt	1.60	1.60
蛋+胱氨酸Meth + Cystine	% of Wt	.80	.80
苏氨酸Threonine	% of Wt	.93	.93
色氨酸Tryptophan	% of Wt	.24	.26
钙Calcium	% of Wt	.90	1.05
磷Phosphorus	% of Wt	.70	.80
有效磷Phosphorus - Avail.	% of Wt	.55	.60

生长－肥育猪和种猪群的营养标准和饲养方案

Nutrient Standards

And Feeding Programs For Growing/Finishing And Breeding Herd

猪的营养标准和饲养方案
Nutrient Standards and Feeding Program for Swine

生长－肥育猪Growing Finishing

- 25公斤至上市Feeding From 25 kg to Market Weight
- 增重23公斤时换料Switch at about 23 kg increments
- 分性别饲养Feed by sex
- 按生产性能饲养Feed by performance level

  -养猪业的平均水平industry average

  -瘦肉率高，健康好High lean Gain – High Health

不同瘦肉增长率和自由采食阉公猪和小母猪的氨基酸需要量 Amino Acid Requirements of Barrows and Gilts of Different Lean Growth Rates and Fed Ad Libitum (90% dry matter)

							体重 80-120kg Body Weight					
							300	300	325	325	350	350
							B	G	B	G	B	G
							3,265	3,265	3,265	3,265	3,265	3,265
代谢能进食	8,985	7,840	8,985	7,840	8,985	7,840	10,705	9,360	10,705	9,360	10,705	9,360
日采食，克	2,750	2,400	2,755	2,400	2,755	2,400	3,280	2,865	3,280	2,865	3,280	2,865
						真回肠消化率 True ileal digestible basis (%)						
精氨酸	.20	.23	.22	.26	.25	.28	.13	.15	.15	.17	.16	.19
组氨酸	.18	.21	.20	.23	.21	.24	.14	.16	.15	.18	.17	.19
异亮氨酸	.32	.36	.34	.39	.37	.42	.25	.29	.27	.31	.29	.33
亮氨酸	.58	.66	.62	.72	.67	.77	.45	.51	.48	.55	.52	.59
赖氨酸	.58	.66	.62	.71	.67	.76	.45	.51	.48	.55	.52	.59
蛋氨酸	.16	.18	.17	.19	.18	.21	.12	.14	.13	.15	.14	.16
蛋氨酸+胱氨酸	.34	.39	.36	.42	.39	.44	.27	.31	.29	.33	.31	.35
苯丙氨酸	.34	.39	.36	.42	.39	.44	.27	.31	.29	.33	.31	.35
苯丙氨酸+色氨酸	.54	.62	.59	.67	.63	.72	.43	.49	.46	.52	.49	.56
苏氨酸	.37	.43	.40	.46	.43	.49	.30	.34	.32	.37	.34	.39
色氨酸	.11	.12	.11	.13	.12	.14	.08	.10	.09	.10	.10	.11
缬氨酸	.39	.45	.42	.48	.45	.52	.30	.35	.33	.38	.35	.40
						总计 Total basis (%)						
精氨酸	.24	.27	.26	.29	.28	.32	.16	.18	.18	.20	.19	.22
组氨酸	.21	.24	.23	.26	.24	.28	.17	.18	.18	.20	.19	.22
异亮氨酸	.36	.41	.39	.45	.42	.48	.29	.33	.31	.35	.33	.37
亮氨酸	.61	.71	.67	.77	.72	.83	.46	.54	.50	.58	.54	.63
赖氨酸	.67	.76	.72	.82	.77	.88	.53	.60	.57	.64	.60	.69
蛋氨酸	.17	.20	.19	.21	.20	.23	.14	.15	.15	.17	.16	.18
蛋氨酸+胱氨酸	.38	.44	.41	.47	.44	.50	.31	.35	.33	.38	.35	.40
苯丙氨酸	.38	.44	.41	.47	.44	.51	.29	.34	.32	.36	.34	.39
苯丙氨酸+色氨酸	.61	70	.65	.75	.70	.80	.48	.54	.51	.59	.55	.63
苏氨酸	.44	.50	.47	.54	.51	.58	.36	.41	.38	.44	.41	.46
色氨酸	.12	.14	.13	.15	.14	.16	.10	.11	.10	.12	.11	.13
缬氨酸	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

普渡大学、密歇根大学和俄亥俄大学的猪营养指南 Purdue University, Michigan State, Ohio State University Swine Nutrition Guide

生长肥育猪的营养需要(行业平均) Nutrient Recommendations for Grower-Finisher Pigs(Industry Average)

	体重范围 Weight Range							
重量	23-45		45-68		68-90		90-上市	
性别	母	公	母	公	母	公	母	公
	预期性能反应 Expected Performance Response							
日增重	.5-.73	.5-.73	.64-.82	.64-.82	.68-.91	.68-.91	.73-.95	.73-.95
日采食	1.4-2.3	1.4-2.3	1.8-2.9	1.8-2.9	1.8-3.2	2-3.4	2-3.9	2.3-4.1
	日粮推荐量(实料中) Dietary Recommendations (As Fed Basis)							
蛋白质	178-20	15-18	16-19	14-17	15-18	13-16	13-15	12-14
氨基酸(总)	3270	3270	3270	3270	3270	3270	3270	3270
赖氨酸(总)	0.95	0.85	0.82	0.72	0.72	0.63	0.63	0.55
赖氨酸/天	15	14	17	16	18	17	17	16
色氨酸	0.17	0.16	0.15	0.13	0.13	0.11	0.11	0.10
苏氨酸	0.62	0.55	0.53	0.47	0.47	0.41	0.41	0.36
蛋氨酸+胱氨酸	0.57	0.51	0.49	0.43	0.43	0.38	0.38	0.33
钙	0.65	0.65	0.60	0.60	0.50	0.50	0.45	0.45
总磷	0.55	0.55	0.50	0.50	0.45	0.45	0.40	0.40
有效磷	0.28	0.28	0.23	0.23	0.20	0.20	0.15	0.15

日粮中加盐.25-.35% Add salt at .25-.35%

普渡大学、密歇根大学和俄亥俄大学的猪营养指南 Purdue University, Michigan State, Ohio State University Swine Nutrition Guide

生长肥育猪(高瘦肉增长、高健康)的营养推荐量 Nutrient Recommendations for Grower-Finisher Pigs(High Lean-Gain, High Health)

	体重范围 Weight Range							
体重	23-45		45-68		68-90		90-上市	
性别	母	公	母	公	母	公	母	公
	预期性能反应 Expected Performance Response							
日增重	.68-.82	.77-.91	.73-.91	.77-.91	.73-.95	.77-1.0	.73-.95	.73-1.1
日采食	1.4-1.8	1.6-2.0	1.8-2.3	2.0-2.5	1.8-2.7	2.0-3.2	2.0-3.2	2.3-3.6
	日粮推荐量(实料中) Dietary Recommendations (As Fed Basis)							
蛋白质	18-22	17-20	17-20	16-19	16-19	15-18	14-17	13-16
氨基酸(总)	3270	3270	3270	3270	3270	3270	3270	3270
赖氨酸(总)	1.10	0.92	1.00	0.85	0.90	0.75	0.75	0.60
赖氨酸/天	18	16	21	18	21	18	19	16
色氨酸	0.20	0.17	0.18	0.15	0.16	0.14	0.14	0.11
苏氨酸	0.72	0.62	0.65	0.55	0.58	0.49	0.49	0.39
蛋氨酸+胱氨酸	0.66	0.57	0.60	0.51	0.54	0.45	0.45	0.36
钙	0.72	0.72	0.72	0.72	0.58	0.58	0.58	0.58
总磷	0.60	0.60	0.60	0.60	0.48	0.48	0.48	0.48
有效磷	0.30	0.30	0.30	0.30	0.21	0.21	0.21	0.21

日粮中加盐 25- 35% Add salt at .25- 35%

如何选择营养水平
Decision to choose nutrient level

- 需要知道该品种的瘦肉沉积率和沉积模式以及饲料采食特性Need to know the rate and pattern of lean accretion and feed intake of that genetic level
- 根据胴体数据可以计算每天的瘦肉增长量
  When carcass measurements are available total lean gain (lean gain per day) can be calculated

瘦肉增重
LeanGain = .95x

7.231+0.437x 校正热胴体重，磅
7.231+0.437x adj warm carcass wt.lb

-18.746第10肋膘厚，英寸 -18.746 x10th rib fat depth, in

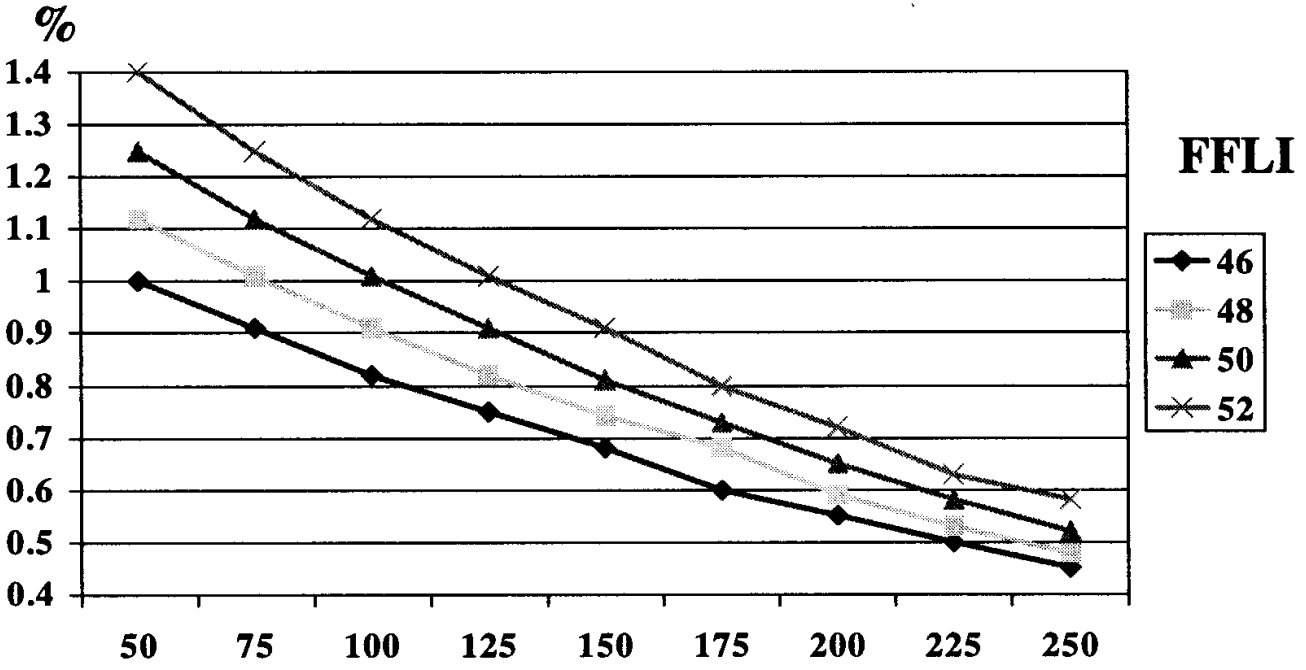
＋3.877第10肋腰肌面积，英寸^2 ＋3.877 x10th rib loin area, In

试验天数 Days on test

-[(0.418x livewt,lb)-3.65

日粮的赖氨酸总量（%）

Total Dietary Lysine as a Percent of the Diet



Kansas St. Univ., 1997

妊娠和泌乳的营养需要

Requirements for Gestation Lactation

妊娠和泌乳母猪的日粮氨基酸需要量(90%干物质) Dietary Amino Acid Requirements of Gestating and Lactating Sows(90% dry matter)

	妊娠 Gestation				泌乳 Lactation		
配种时体重Wt..at.Breeding	175	200	200	母猪 Sow(kg)	175	175	175
妊娠期增重Gestation Wt.Gain(kg)	40	35	30	l预期泌乳期体重变化 Anticp.Lactationa 日	-10	-10	-10
预期窝仔数Anticipated Pigs in Litter	12	12	12	增重Wt.Chf.(kg)	150	200	250
日粮ME ME of diet(kcal/kg)	3,265	3,265	3,265		3,265	3,265	3.265
ME进食 ME intake(kcal/day)	6,150	6,275	5,870		11,635	15,055	18,470
采食量 Feed intake	1.88	1.92	1.80				
				真回肠3消化基础 True ileal digestible basis			
精氨酸 Agrinine	0.00	0.00	0.00		0.35	.044	0.50
组氨酸 Histidine	0.15	0.14	0.14		0.30	0.34	0.36
异亮氨酸 Isoloucine	0.27	0.26	0.26		0.44	0.48	0.50
亮氨酸 Leucine	0.44	0.41	0.41		0.87	0.97	1.03
赖氨酸 Lysine	0.46	0.44	0.44		0.77	0.85	0.90
蛋氨酸 Methionine	0.13	0.12	0.12		0.20	0.22	0.23
蛋+胱氨酸 Methionine Cystine	0.32	0.31	0.32		0.39	0.42	0.43
苯丙氨酸 Pheny.alanine	0.27	0.25	0.25		0.42	0.46	0.49
苯丙氨酸+酪氨酸 Phenyl.alanine Tyrosine	0.46	0.44	0.44		0.88	0.97	1.02
苏氨酸 Threonine	0.37	0.36	0.37		0.50	0.53	0.56
色氨酸 ryptophan	0.09	0.09	0.09		0.15	0.16	0.17
缬氨酸 Valine	0.31	0.30	0.30		0.66	0.73	0.77
				总量 Total basis(%)			
精氨酸 Agrinine	0.00	0.00	0.00		0.39	0.49	0.55
组氨酸 Histidine	0.17	0.16	0.17		0.34	0.38	0.40
异亮氨酸 Isoloucine	0.31	0.30	0.30		0.50	0.54	0.57
亮氨酸Leucine	0.46	0.42	0.43		0.95	1.05	1.12
赖氨酸Methionine	0.54	0.52	0.52		0.89	0.97	1.03
蛋氨酸Methionine Cystine	0.14	0.13	0.13		0.22	0.24	0.26
蛋氨酸+胱氨酸Pheny.alanine	0.37	0.36	0.36		0.44	0.47	0.49
苯丙氨酸Phenyl.alanine Tyrosine	0.30	0.28	0.28		0.47	0.52	0.55
苯丙+酪氨酸Threonine Tryptophan	0.51	0.49	0.49		0.98	1.08	1.14
苏氨酸Threonine	0.44	0.43	0.44		0.58	0.63	0.65
色氨酸Tryptophan	0.11	0.10	0.10		0.17	0.18	0.19
缬氨酸Valine	0.363	0.34	0.34		0.76	0.83	0.88

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种猪群的营养推荐量 Nutrient Recommendations for Breeding Herd

项目 Item	妊娠 Gestation			泌乳 Lactation	
	行业平均 Industry Av.	高产水平 HighProducing		行业平均	高产水平
采食 Feed intake, kg	1.9-2.3	2.1-2.5	0-14天	4.8-5.4	5.2-6.4
产前2－3周采食 “”(2 to 3 wk prefarrow), kg	2.4-3.2	2.3-3.6	0-21天	5-6	5.7-7.4
妊娠增重 Gest. Gain (0-114d), kg	34-45	41-50	日进食赖氨酸	38	50
妊娠增重 (0-产仔), kg	23-36	27-41	泌乳期失重(产仔-断奶	5-8	5-10
进食 ME intake(kcal/day)	20-25	20-25	再配种间隔天数	4 to 7	4 to 7
	营养需要量（实料中） Nutrient Requirements (As-Fed Basis)				
能量 Energy, kcal ME	3200	3200		3300	3300
赖氨酸 Lysine, %	0.55	0.60		0.70	0.80
色氨酸 Tryptophan, %	0.08	0.09		0.13	0.15
苏氨酸 Threonine, %	0.31	0.36		0.47	0.53
蛋＋胱氨酸 Methionine/Cystine, %	0.32	0.35		0.40	0.45
缬氨酸 Valine, %	0.30	0.31		0.70	0.80
钙 Calcium	0.90	1.00		0.90	1.00
总磷 Phosphorus (total), %	0.70	0.80		0.70	0.80
有效磷 Phosphorus (available), %	0.42	0.45		0.50	0.50
盐 Salt, %	0.50	0.50		0.50	0.50