

UNIVERSITY OF ILLINOIS
AT URBANA-CHAMPAIGN

纤维对25-50公斤生长母猪苏氨酸与赖氨酸最佳比值的影响

Effects of fiber on the optimum
threonine:lysine ratio for 25 to 50 kg
growing gilts

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Outline 概况

- **Background 背景**
- **Experiments 实验**
 - **Lys titration 赖氨酸梯度法**
 - **AA digestibility 氨基酸消化率**
 - **Thr titration 苏氨酸梯度法**
 - **2x N-balance 2倍氮平衡**
- **Overall Conclusions & Implications
综合结论&推论**



Background 背景

- Fibrous diets are becoming more common
纤维日粮日益普遍
 - DDGS, brans , canola meals
DDGS, 麦麸, 油菜籽粕
- Fiber's effects on nutrients? 纤维对营养的影响 ?
 - ↓ OM and E digestibility
↓ 有机物和能量消化率
 - ↑ & ↓ lipid digestibility
↑ & ↓ 脂质消化率
 - ↓ in CP and AA digestibility
↓ 蛋白质和氨基酸消化率



Background 背景

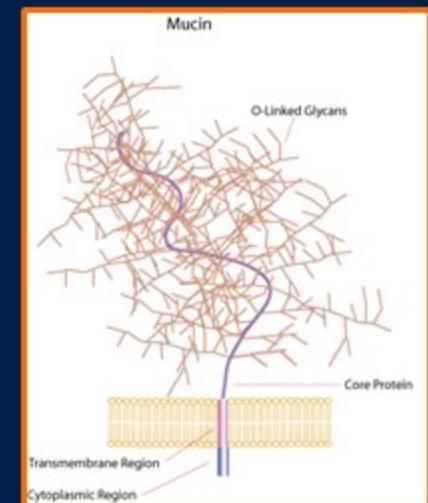
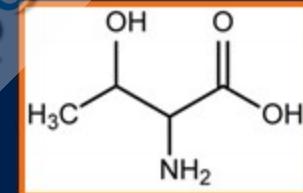
- Why decreases in N digestibility with fiber? 纤维为什么减少氮消化率?
 - Encapsulation of proteins and AA
蛋白质和氨基酸的包埋
 - Increasing secretion of endogenous proteins
增加了内源蛋白质的分泌
 - Increased intestinal mass 肠容积的增加
 - Increased endogenous losses
内源损失的增加
 - Epithelial cells, mucosa, and submucosa
上皮细胞、粘膜和粘膜下层



Background 背景

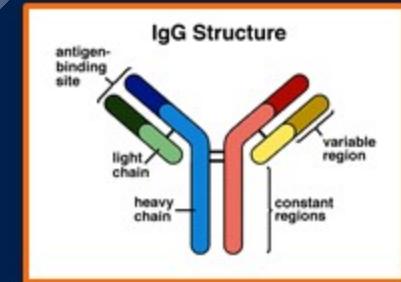
- **Mucins 黏蛋白**

- Secreted by goblet cells 杯形细胞分泌
 - Proteolytic barrier, barrier to pathogens, buffer
蛋白水解障碍、病原体屏障、缓冲区
- Composed of 3 parts polysaccharide to 1 part AA 由3部分多糖到1部分氨基酸组成
 - Most often Ser, Pro, or Thr
大多为丝氨酸、脯氨酸或苏氨酸
- Mucins do not get resorbed
- 黏蛋白不被再吸收
- Mucin production: multi-faceted 多面性
 - 黏蛋白产生: 多面性



Background 背景

- Fiber and Thr 纤维和苏氨酸
 - High concentration of Thr in mucins 黏蛋白中高浓度的苏氨酸
 - Higher endogenous losses 更高的内源损失
 - Increased Thr requirement for production 产品中苏氨酸需求量的增加
 - Possible immunological stimulation 可能的免疫刺激
- Does increased fiber in the diet increase the requirement of Thr for optimum protein synthesis? 日粮中纤维的增加会增加用于最佳蛋白质合成的苏氨酸的需求量吗?



Objective 目的

To determine the effects of fiber on the optimum SID Thr:Lys ratio in 25-50 kg growing gilts

确定纤维对25-50kg生长母猪中最佳SID苏氨酸:赖氨酸比值的影响



Experiment 1 实验1

Effects of fiber on the optimal Thr:Lys ratio
for 25 to 50 kg growing gilts

纤维对25-50kg生长母猪最佳苏氨酸与赖氨酸比
值的影响



Exp. 1 Thr Titration 苏氨酸梯度法

- By formulating diets with low SID Thr:Lys ratios and incrementally increasing the SID Thr:Lys ratio in successive diets the optimal ratio can be determined using simple regression analysis. 通过制定低的SID苏氨酸:赖氨酸比值的日粮，日粮中通过逐渐增加SID苏氨酸:赖氨酸比值，使用简单回归分析就能确定最佳比值。
- By creating identical diets with the exception of fiber level, the effect of fiber on the optimal SID Thr:Lys can be determined. 通过创建不同纤维水平的相同日粮，确定纤维对最佳SID苏氨酸:赖氨酸比值的影响。

2010
中国·上海



Exp. 1 Materials and Methods

材料与方法

- 28d growth assay 28天生长试验

- 192 growing gilts (Initial BW: 26.29 ± 4.64kg)

192头生长母猪(初始重: 26.29 ± 4.64kg)

- G-Performer x Fertilis 25

- 2 pigs per pen 每栏两头猪

- *Ad libitum feeding* 自由采食



Exp. 1 Materials and Methods

材料与方法

- RCBD随机分组设计
 - 12 treatments with 8 replications per diet
12个处理，每种日粮8个重复
- 6 low fiber diets with 15% corn starch
6种含15%玉米淀粉的低纤维日粮
- 6 high fiber diets with 15% soybean hulls
6种含15%大豆皮的高纤维日粮
 - Within each level of fiber: 每个纤维水平内
 - Basal diet with SID Thr:Lys ratio of 0.45
SID苏氨酸:赖氨酸为0.45的基础日粮
 - Subsequent diets with SID Thr:Lys ratios of 0.54, 0.63, 0.72, 0.81, and 0.90, respectively.
SID苏氨酸:赖氨酸分别为0.54、0.63、0.72、0.81和0.90的相应日粮



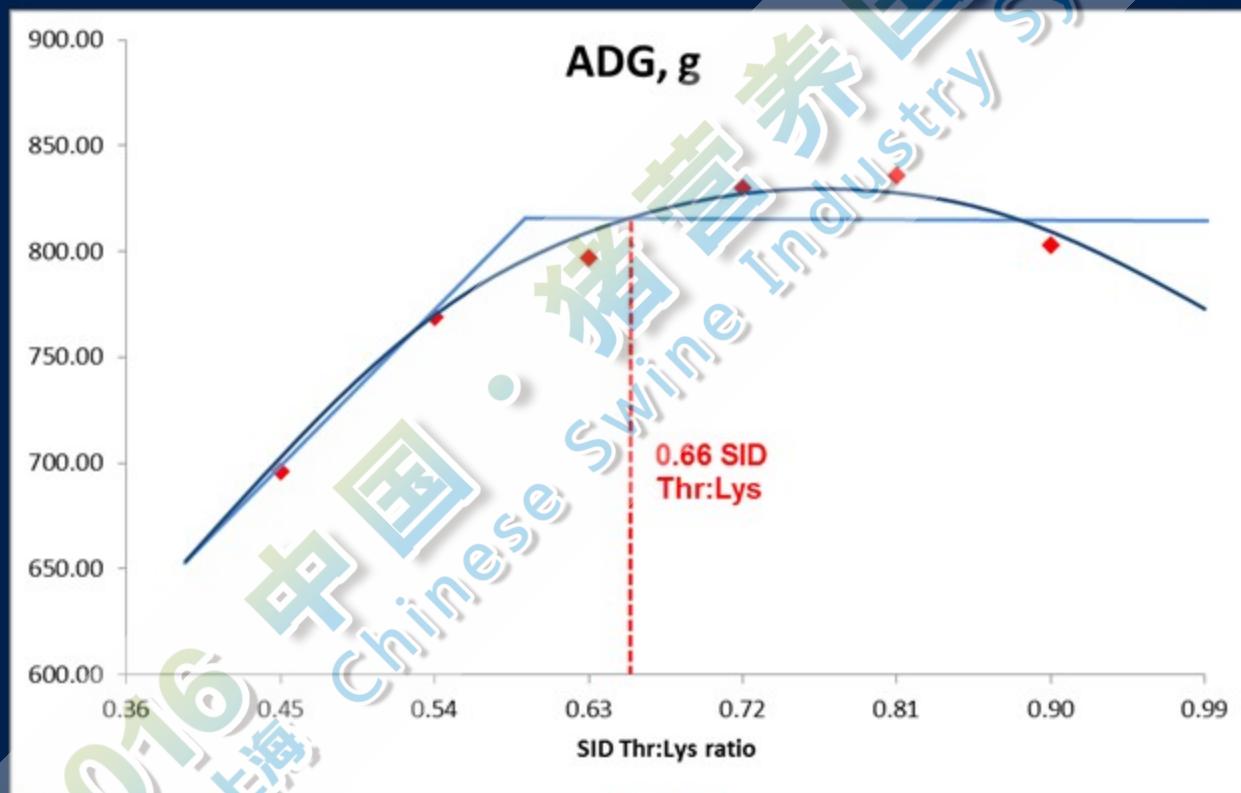
Exp. 1 Results 结果

Low fiber diets 低纤维日粮

Linear 线性: $P < 0.05$

Quadratic: $P < 0.05$

二次曲线

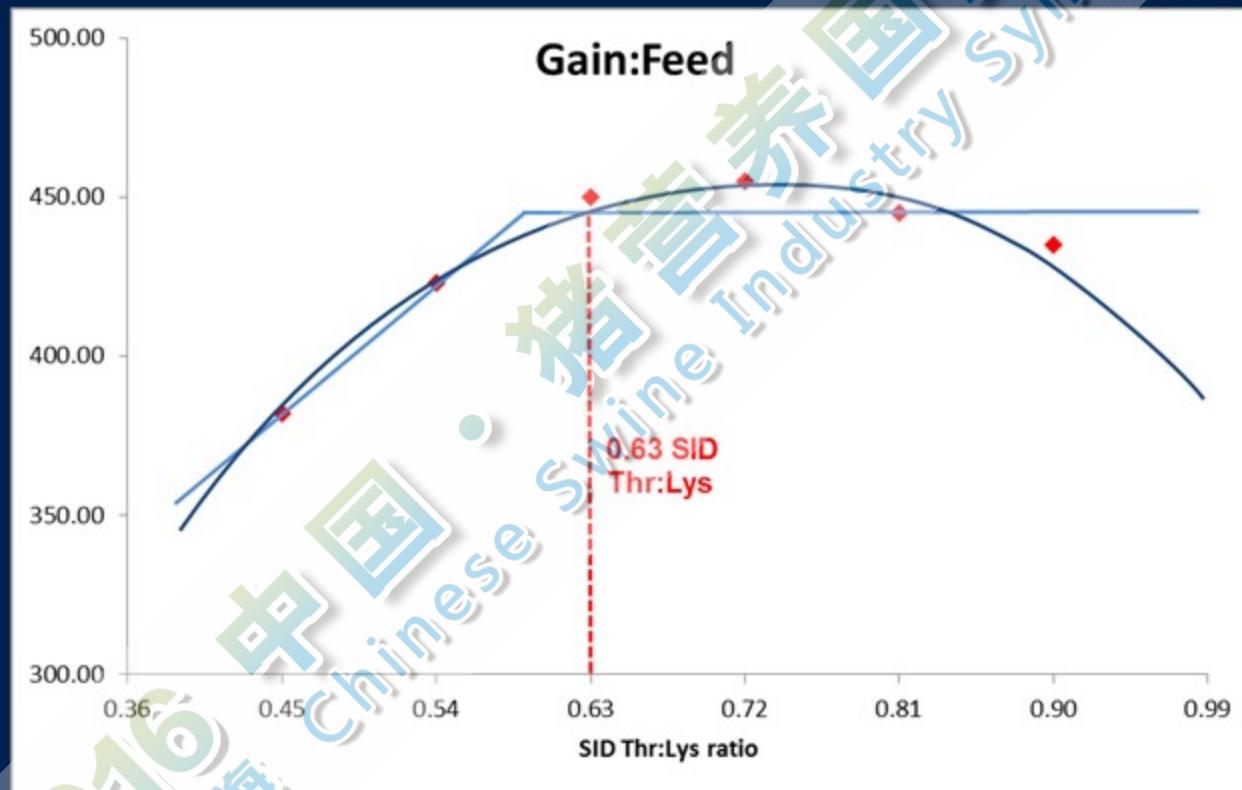


Exp. 1 Results 结果

Low fiber diets 低纤维日粮

Linear: $P < 0.05$

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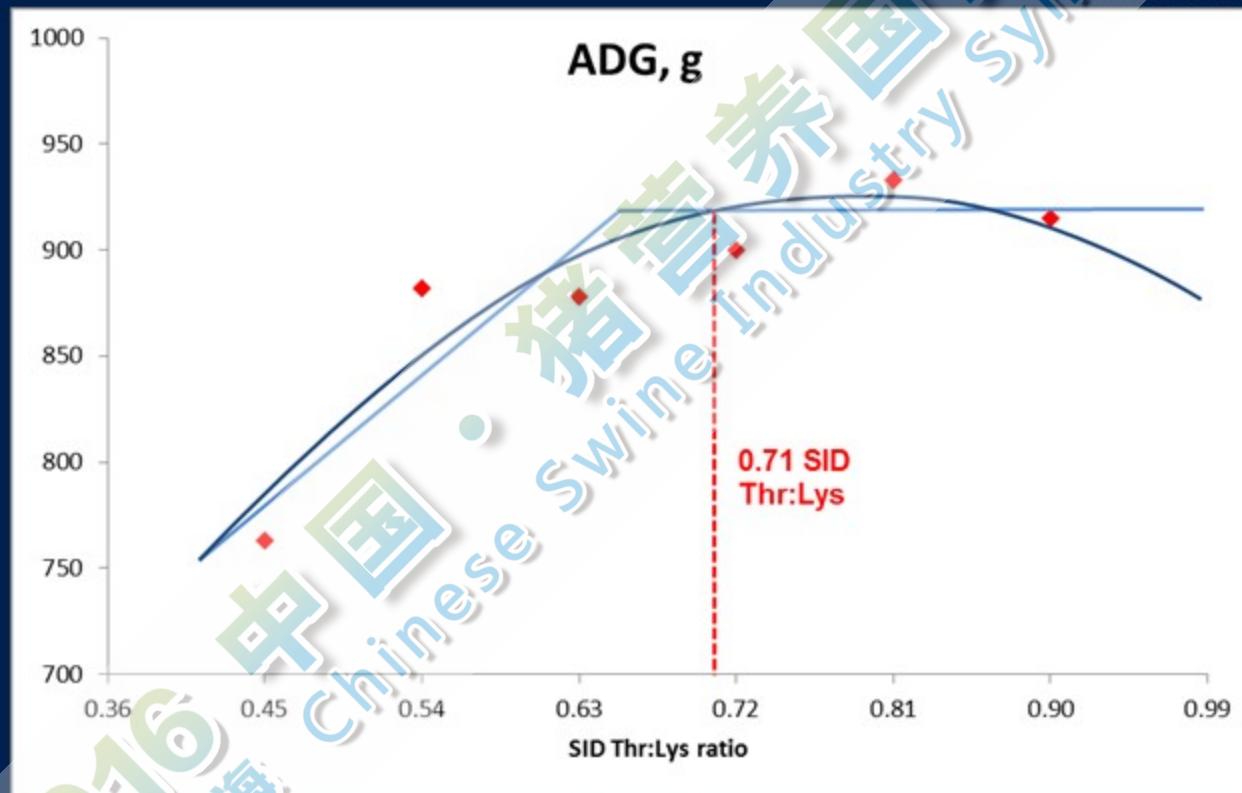


Exp. 1 Results 结果

High fiber diets 高纤维日粮

Linear: $P < 0.05$

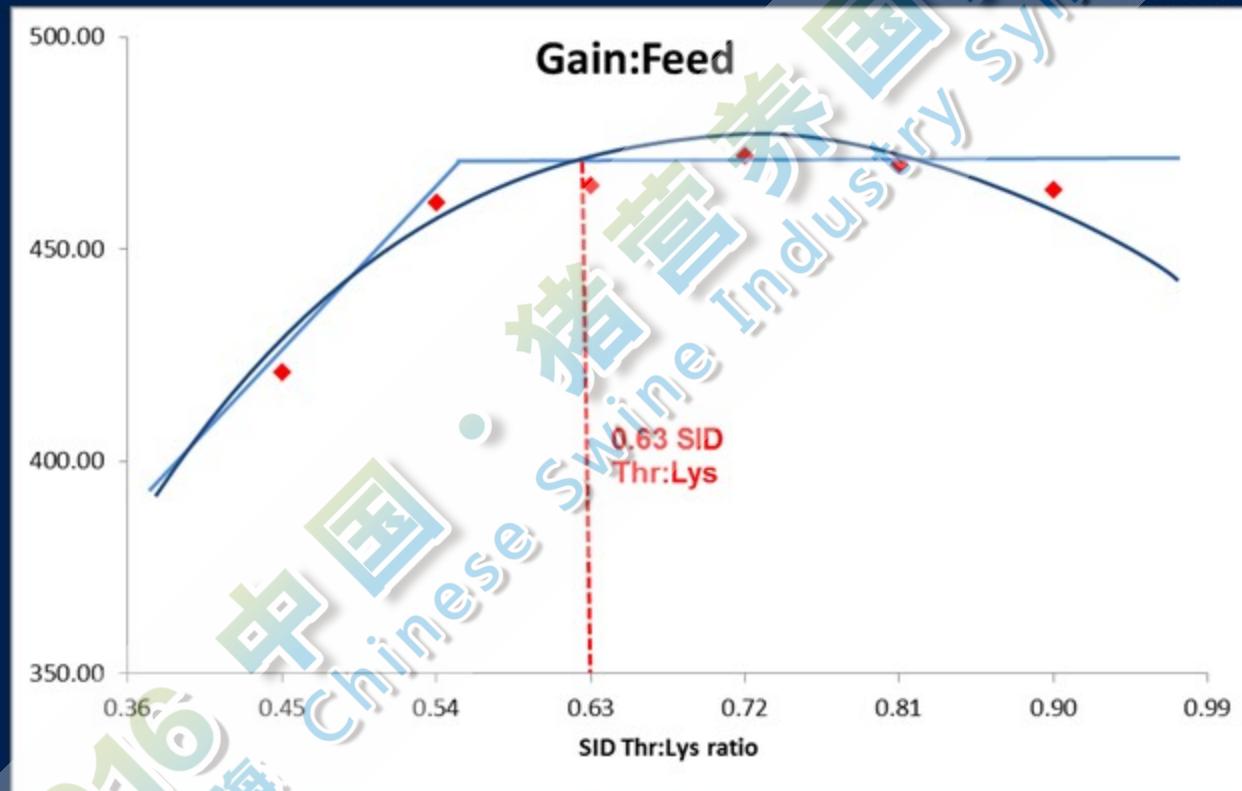
Quadratic: $P < 0.05$



Exp. 1 Results 结果

High fiber diets 高纤维日粮

Linear: $P < 0.05$
Quadratic: $P < 0.05$



Exp. 1 Conclusions 结论

	Low fiber diets 低纤维日粮	High fiber diets 高纤维日粮
Optimal Thr:Lys ratio 最佳比值		
ADG 日增重	0.66	0.71
G:F 料肉比	0.63	0.63

- However, the estimated SID Thr:Lys ratio for optimizing ADG did increase by 5 percentage units when fiber was included in the diet
当日粮中含有纤维时, 为获得最佳日增重, SID苏氨酸 : 赖氨酸比值增加5%
- Evidence that fiber in the diet may increase the optimal SID Thr:Lys ratio for growth
表明日粮中纤维可增加利于生长的最佳SID苏氨酸 : 赖氨酸比值



Experiment 2 实验2

Effects of fiber level on N balance of growing
pigs fed diets that are very deficient or
marginally deficient in Thr

纤维水平对饲喂非常缺乏或稍微缺乏苏氨酸
日粮的生长猪的氮平衡的影响



Exp 2. N-balance 氮平衡

- A method to determine the effects of fiber on Thr using response parameters other than growth performance:

使用响应参数而不是生长性能来确定纤维对苏氨酸的影响的方法

- Fecal and urine excretion of N
粪便和尿液中氮的排泄
- ATTD of N 氮的表观总肠道消化率
- Retention of N 氮的沉积



Exp. 2 Materials and Methods 材料和方法

- 36 growing gilts (Initial BW: $29.0 \pm 0.74\text{kg}$)
36头生长母猪(初始重:
 $29 \pm 0.74\text{kg}$)
- G-Performer x Fertilis 25
- Metabolism cages 代谢笼
 - 7 d adaptation followed by 5 d of fecal and urine collection 适应7天后，收集5天的粪便和尿液
 - Marker to marker 标记



Exp. 2 Materials and Methods 材料和方法

- RCBD随机分组设计
 - 4 treatments with 9 replications per diet
4个处理, 每种日粮9个重复
- Diets prepared in a 2×2 factorial arrangement
拟定 2×2 因素组合的日粮
 - 2 low fiber diets with 15% corn starch
2种含有15%玉米淀粉的低纤维日粮
 - 2 high fiber diets with 15% soybean hulls
2种含有15%大豆皮的高纤维日粮
 - Within each level of fiber: 在每个纤维水平内
 - SID Thr:Lys ratio of 0.45
 - SID Thr:Lys ratio of 0.60

Pigs fed at 90% of *ad libitum* intake 饲喂猪其自由采食量的90%



Exp. 2 Materials and Methods 材料和方法

- 2 hypotheses: 2个假设

- Increasing the SID Thr:Lys ratio in the diet will increase the N retention in the diets.

增加日粮中SID苏氨酸：赖氨酸比值将会增加日粮中沉积氮。

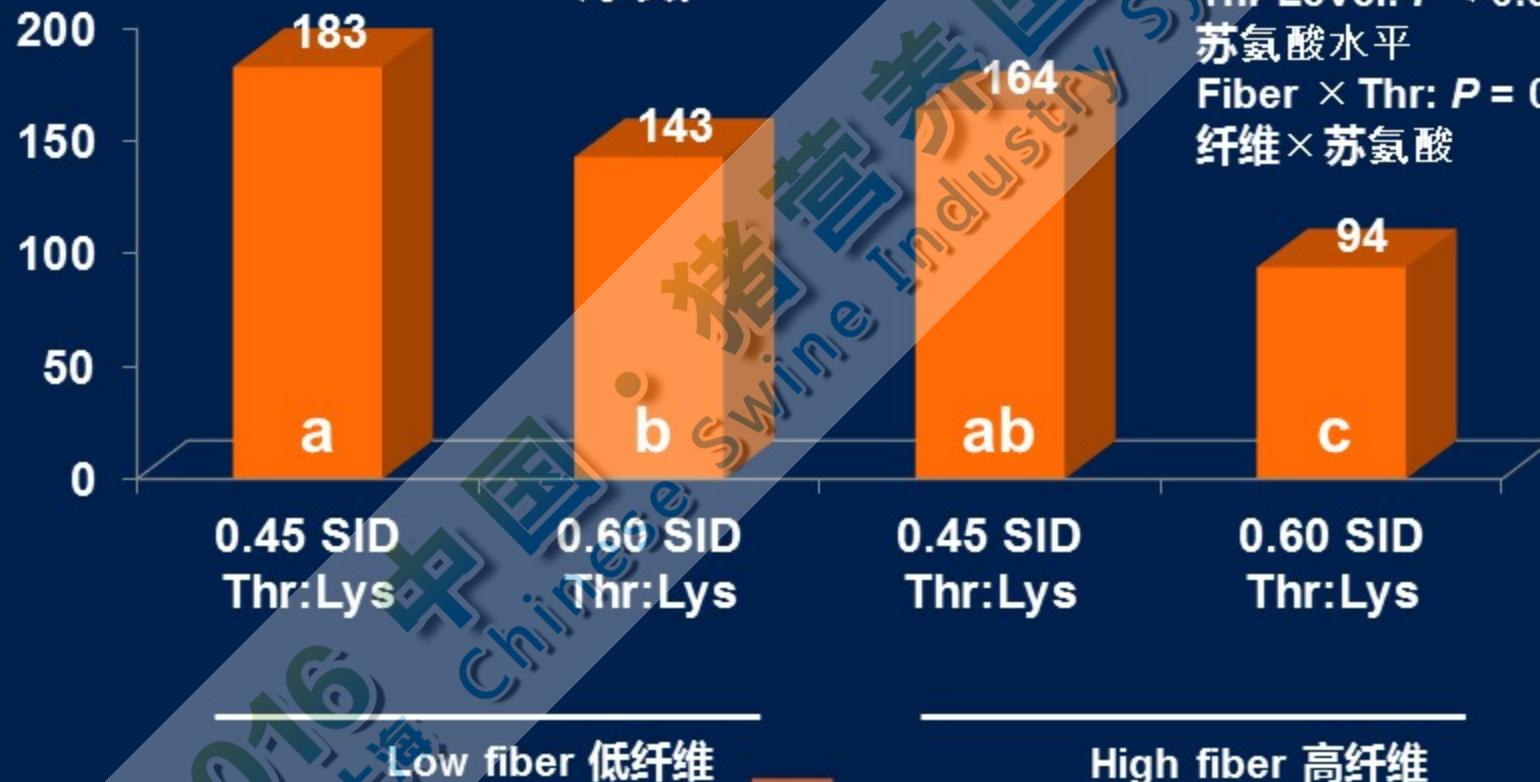
- Fiber in the diet will reduce N retention in the animals
日粮中的纤维将会减少动物中氮的沉积



Exp. 2 Results 结果

N in urine, g/5 d

尿氮



Fiber level: $P < 0.05$

纤维水平

Thr Level: $P < 0.05$

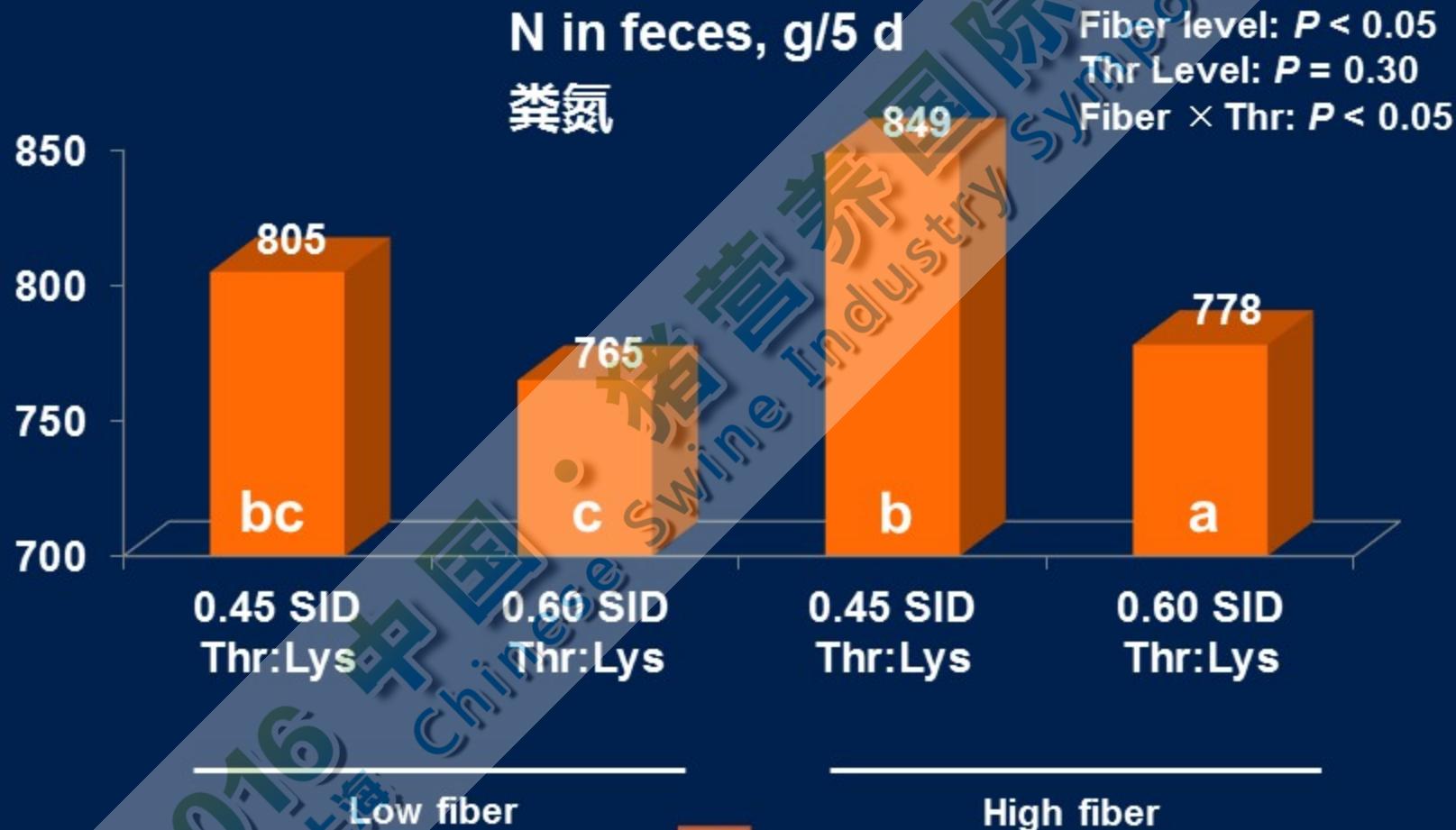
苏氨酸水平

Fiber \times Thr: $P = 0.22$

纤维 \times 苏氨酸



Exp. 2 Results 结果



Exp. 2 Results 结果



Exp. 2 Conclusions-结论

- Fiber increases total N output, while simultaneously shifting N excretion from urine to feces. 纤维增加了总氮的排放，同时氮排泄由尿液转到粪便。
- Fiber reduces the ATTD of N (data not shown). 纤维减少了氮的总消化道消化率(数据未标明)



Exp. 2 Conclusions-结论

- The increase in N retention in pigs fed higher-Thrdiets indicates that these diets were closer to the requirement. 饲喂高苏氨酸日粮的猪中氮沉积的增加表明这些日粮较为接近需求。
- The difference between N retention in pigs fed the high Thr diets indicates that the animals on the high-fiber, higher-Thr diets were not receiving enough Thr. 饲喂高苏氨酸日粮猪的氮沉积之间的差异表明饲喂高纤维、高苏氨酸日粮的动物并没有获得足够的苏氨酸。
- Fiber in the diet may require a greater inclusion level of Thr. 日粮中的纤维可能要求更高含量的苏氨酸



Experiment 3 实验3

Effects of various fiber levels on N balance
of growing pigs fed Thr-limited diets

各种纤维水平对饲喂苏氨酸限制性日粮的生长猪的
氮平衡的影响



Exp. 3 Materials and Methods 材料和方法

- 96 growing gilts (Initial BW: 28.98 ± 2.0 kg)

96头生长母猪(初始重: 28.98 ± 2.0 kg)

- G-Performer x Fertilis 25
- Metabolism cages 代谢笼
 - 7 d adaptation followed by 5 d of fecal and urine collection

适应7天后收集5天的粪便和尿液

- Marker to marker 标记



Exp. 3 Materials and Methods 材料和方法

- RCBD 随机分组设计
 - 12 treatments with 8 replications per diet
12个处理, 每种日粮8个重复
- Diets prepared in a 3×4 factorial arrangement
拟定 的 3×4 因素组合的不同日粮
 - 3 low fiber diets with no added fiber sources
3种无纤维来源的低纤维日粮
 - 3 medium fiber diets with 15% corn DDGS and wheat midds
3种含15%玉米DDGS和小麦的中纤维日粮
 - 3 high fiber diets with 30% corn DDGS and wheat midds
3种含30%玉米DDGS和小麦的高纤维日粮
 - Within each level of fiber: 在每个纤维水平内
 - SID Thr:Lys ratio of 0.45, 0.50, 0.55, 0.60
- Pigs fed at $3.2 \times$ maintenance requirement
饲喂试验猪其维持需求的3.2倍

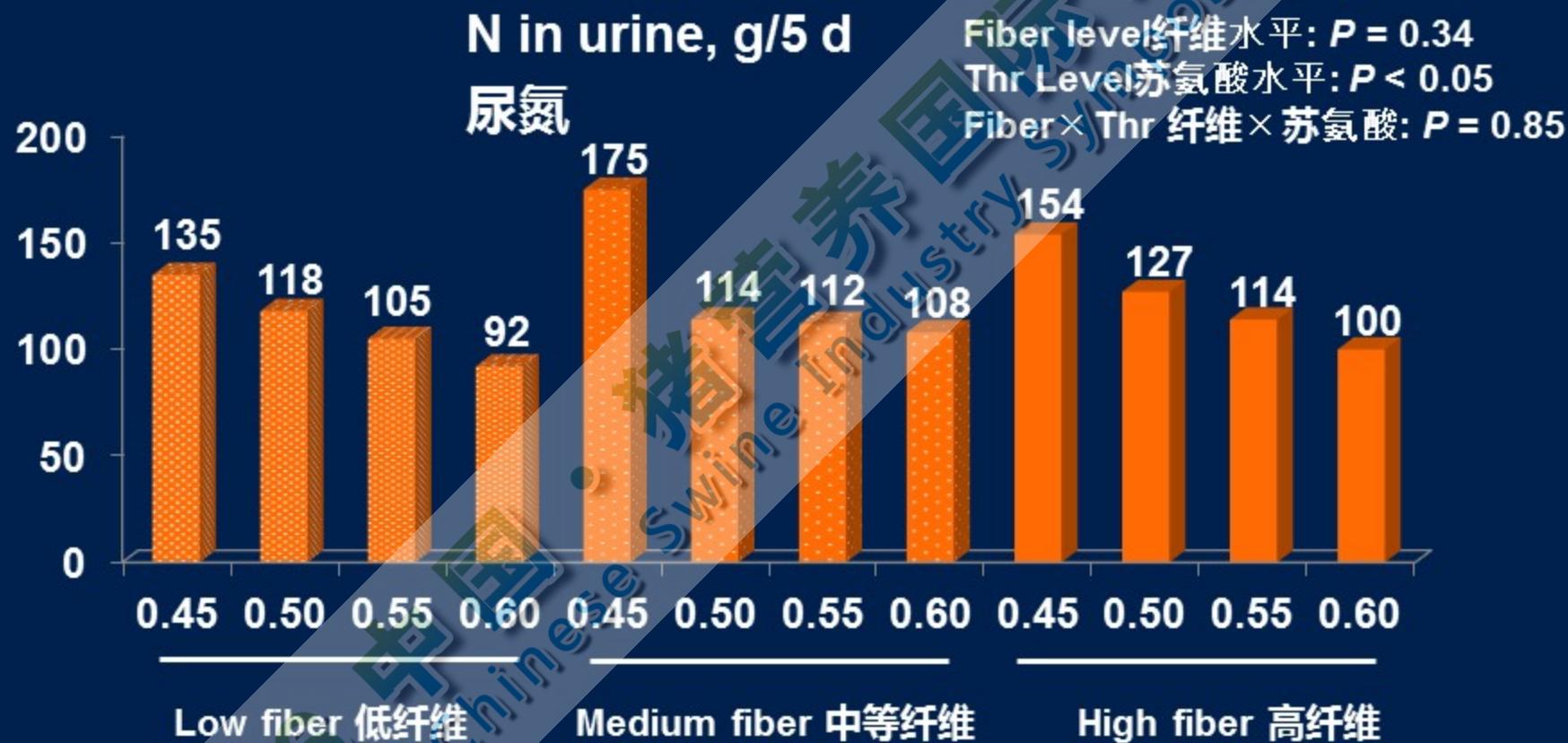


Exp. 3 Materials and Methods 材料和方法

- 2 objectives 目的:
 - Confirmation of results from experiment 3 under commercial settings.
商业背景下试验3结果的确认
 - Potential quantification of fiber's effects on the Thr requirement
纤维对苏氨酸需求影响的潜在量化



Exp. 3 Results 结果

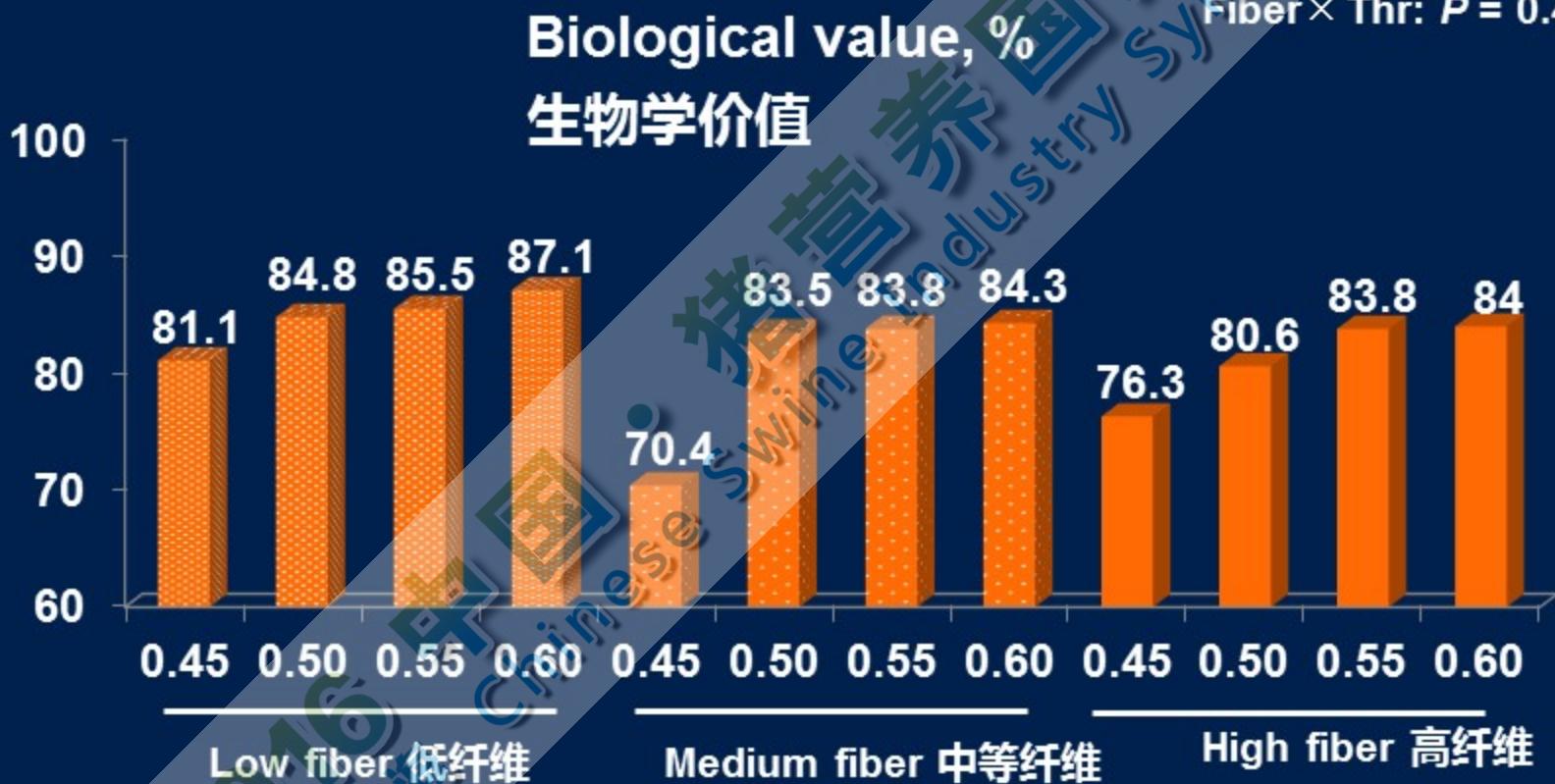


Exp. 3 Results 结果

Fiber level: $P < 0.05$
Thr Level: $P = 0.74$
Fiber \times Thr: $P = 0.34$



Exp. 3 Results 结果



Exp. 3 Conclusions-结论

- Urinary output of N decreased as SID Thr:Lys increased
SID苏氨酸:赖氨酸增加时, 尿氮的排放降低
- Fecal output of N increased as SID Thr:Lys increased
SID苏氨酸:赖氨酸增加时, 粪便中氮的排放增加
- Retention of N and biological value of protein increased as SID Thr:Lys increased within fiber levels
在纤维水平内SID苏氨酸:赖氨酸增加时, 氮沉积和蛋白质的生物学价值增加。



Overall Conclusions & Implications

综合结论&推论

- Combined, the results of these experiments indicate that the optimal SID Thr:Lys ratio is greater in pigs fed high-fiber diets than in pigs fed low fiber diets.

这些实验结果表明饲喂高纤维日粮猪的SID苏氨酸 : 赖氨酸比值比饲喂低纤维日粮的高。

- To maximize performance, the concentration of Thr should be increased when fiber level of the diet is increased.

为了使生长性能最大化, 当日粮中纤维水平增加时, 应该增加苏氨酸的含量。



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