Raising Pigs but Producing Pork
高品质猪肉的生产而不仅仅是养猪

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What is quality?
什么是质量

Being on target with less variation
符合目标特性并且质量更稳定

The attributes that make pork products a desirable wholesome consumer ready product.

这些特性使猪肉制品成为消费者满意的、有益健康的产品

Pork Quality 猪肉质量

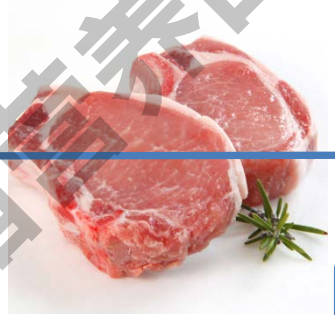
Genetics
基因

Barrow/Gilt/Boar
阉猪/种母猪/公猪

Environment
环境

Farm
养殖场

Transportation
运输



Diet 日粮

Abattoir
屠宰场

Lairage
待宰时长

Carcass weight
胴体重量

Carcass chilling
胴体冷却

Immobilization
致昏方法

Pork Quality 猪肉质量

- Consumers make purchasing decisions based on color and marbling
  消费者根据颜色和大理石花纹作出购买决定
- Consumers make *repeat* purchases based on tenderness and flavor
  消费者根据嫩度和味道决定是否重复购买
  - Flavor 味道
  - Price 价格
  - Appeal 外观

Genetic Variability in Meat Quality
基因差异对猪肉质量的影响

- **Lean Focus vs Quality Focus 关注瘦肉 vs 关注质量**
  - Consumer demand has created an opportunity for producers and packers to direct selection and management for more specific parameters

    消费者的需求为生产者和猪肉加工厂提供了机会，可指导选育和管理以达到更具体的参数要求
  - **Lean Focus** provides packers with larger loins and an overall greater percentage of fat free lean

    关注瘦肉会要求提供给猪肉加工厂更大块的里脊肉和比例更高的无脂瘦肉
  - **Quality Focus** results in loins with an increase in intramuscular fat and may be darker in visual color

    关注质量会导致腰肉的肌间脂肪增加并且外表颜色可能会更偏暗

Production Focus (Lean vs Quality) 生产目标（瘦肉 vs 质量）

Selection and management matters!
选育与管理很重要！

Item 项目		Production focus 生产目标 Lean 瘦肉	Quality 质量	SEM 标准误	*P* - value *P*-值
Visual color, 1 d	目测颜色，第1天	2.88	3.29	0.10	0.19
Visual marbling, 1 d	目测大理石花纹，第1天	1.65	2.60	0.25	**<0.0001**
Visual color, 20 d	目测颜色，第20天	3.08	3.20	0.07	0.20
Visual marbling, 20 d	目测大理石花纹，第20天	1.47	1.72	0.11	**<0.0001**
Purge loss, %, 20 d	贮藏损失，%，第20天	1.10	0.71	0.22	**0.03**
Predicted SSF tenderness, kg	预计嫩度剪切力，kg	17.96	16.56	0.42	**0.04**
Slice shear force, kg	剪切力（切片），kg	15.85	13.23	2.40	0.11

* Purge loss is water lost during storage in the packaging 猪屠宰在加工贮藏过程中失水量

Loins from the Quality Focus group were more marbled, had better water-holding capacity, and were predicted to be more tender

关注质量试验组腰肉的大理石花纹更多，持水能力更强，并且嫩度预计会更好

Arkfeld, E.K. PhD Dissertation, University of Illinois, 2016

Pietrain vs. Duroc 皮特兰猪 vs.杜洛克猪

Pietrain-sire pigs were leaner and had greater cutability, but were less marbled than Duroc sired-pigs

皮特兰父系猪瘦肉率和产肉率更高，但与杜洛克父系猪相比大理石纹理偏少

Item 项目		Pietrain 皮特兰猪	Duroc 洛克猪	SEM 标准误	*P*-value *P*-值
HCW, kg	热胴体重，kg	103.07	103.66	0.87	0.50
Loin muscle area, cm^2	眼肌面积，cm^2	55.58	55.40	0.96	0.85
10th rib fat thickness, cm	第10根肋排脂肪厚度，cm	1.60	1.92	0.07	< 0.001
Boneless cutting yield, %	无骨肉产率，%	52.44	51.59	0.23	0.01
Ultimate pH	最终pH值	5.53	5.57	0.01	< 0.001
Visual color	目测颜色	3.43	3.44	0.09	0.87
Visual marbling	目测大理石花纹	1.76	2.15	0.12	< 0.01
WB shear force, kg	沃-布式剪切力，kg	2.25	2.40	0.06	0.02
Cook loss, %	烹饪损失，%	20.08	20.73	0.34	0.06

Lowell et al., J. Anim. Sci. doi: 10.1093/jas/sky315

Health Beneficial Omega 3 Fatty Acids
健康有益的 ω3脂肪酸

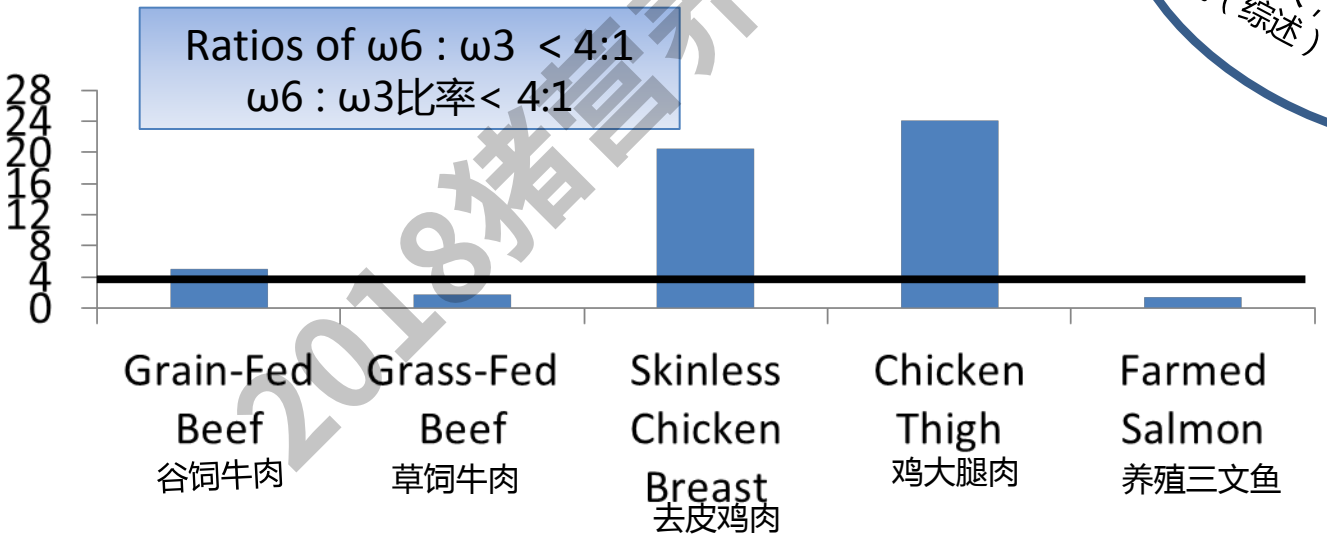
Reduces blood triglyceride levels and blood pressure 降低血液甘油三酯水平和血压

Aids in brain function 辅助脑功能

May reduce inflammation 可减轻炎症

Western diets are ~ 15:1 西方国家日粮中比例约为15:1

Daley et al. 2010 Nutr. Journal (Review)
Daley等人，2010，营养期刊（综述）



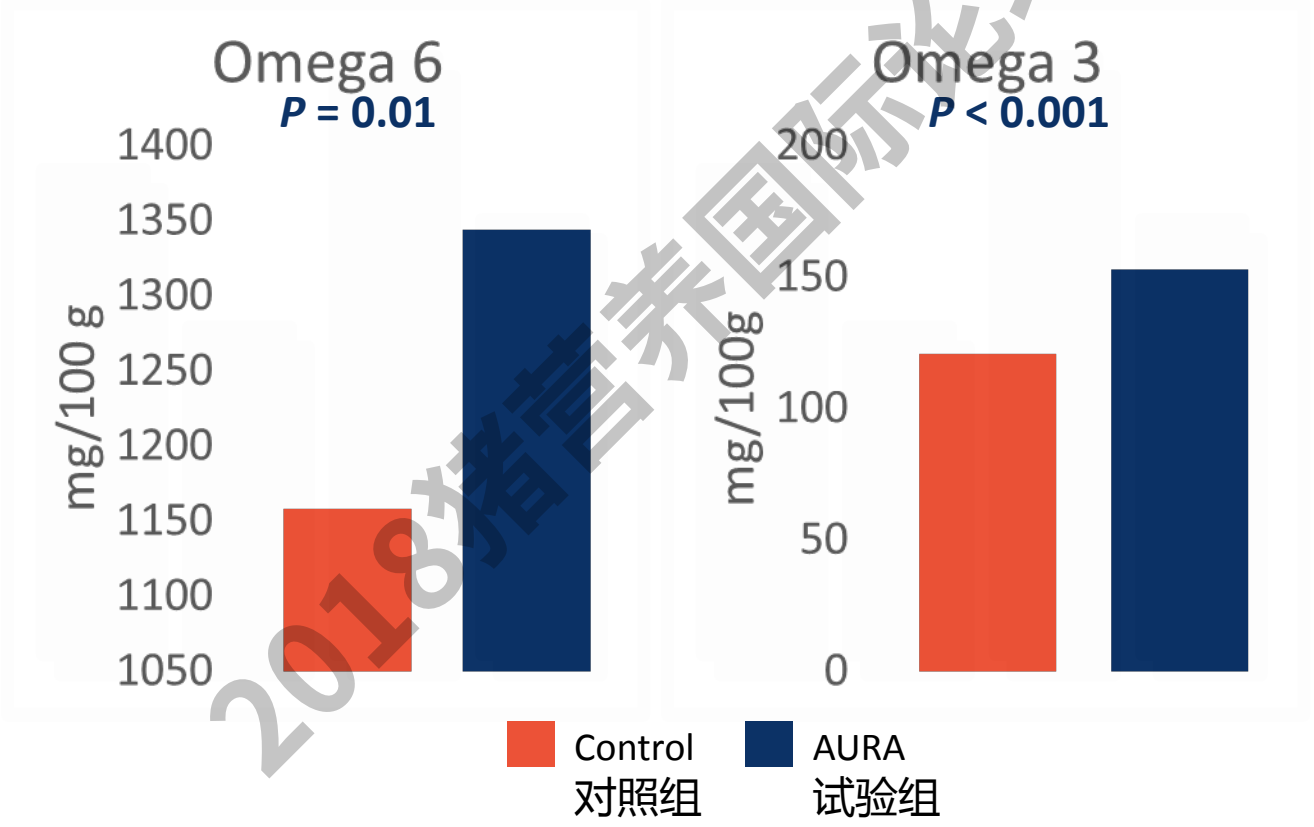
Feeding Diets Rich in DHA
饲喂富含DHA的日粮

- 144 barrows and gilts
  144头阉猪和种母猪
- Fed 0% or 1% AURA
  饲喂0%或1%裂殖壶菌
  - **Aurantiochytrium limacinum microalgae**
    裂殖壶菌微藻
  - AURA contained 18% DHA DM
    裂殖壶菌含有18%的DHA干物质
- n = 12 pens / replicate　每个重复12栏
- Experimental diets fed for the last 31 d prior to slaughter　屠宰前最后31天饲喂试验日粮

- No effects on: 不影响：
  - ADG (*P* = 0.82)　平均日增重
  - ADFI (*P* = 0.51)　平均日采食量
  - Water intake (*P* = 0.34)　摄水量
  - Feed efficiency (*P* = 0.74) 饲料转化效率
  - Fat thickness (*P* = 0.99)　脂肪厚度
  - Carcass yield (*P* = 0.59)　屠宰率
  - Estimated lean (*P* = 0.89) 预估瘦肉率

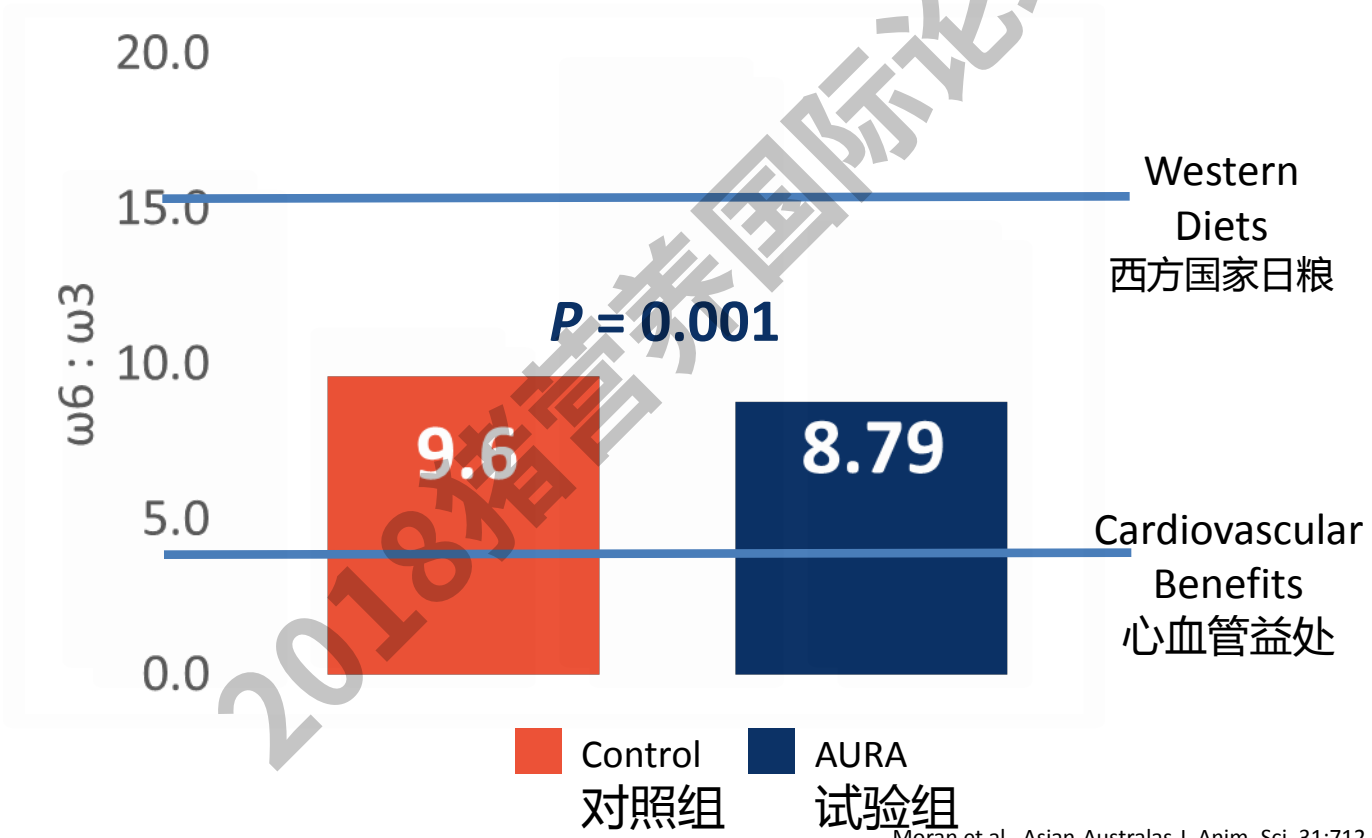
Moran et al., Asian-Australas J. Anim. Sci. 31:712

ω6 : ω3 In Pork Loin
猪眼肌中ω6 : ω3



Moran et al., Asian-Australas J. Anim. Sci. 31:712

ω6 : ω3 In Pork Loin 猪腰肉中ω6 : ω3



Moran et al., Asian-Australas J. Anim. Sci. 31:712

Pelleting Swine Diets 猪日粮制粒

- IMPROVES GROWTH PERFORMANCE AND EFFICIENCY[1]
  提高生长性能和效率[1]
  - 3% increase in ADG 平均日增重增加3%
  - 6% increase in G:F 肉料比提高6%
- Increases stomach lesions and esophagosastric ulcers[2]
  增加胃损伤和食管溃疡[2]
- Increases belly fat Iodine Value (IV) 2-3 units[1]
  增加腹部脂肪碘值(IV)2-3个单位[1]
  - Increases linoleic acid by 10.2% 亚油酸增加10.2%
  - Increases linolenic by 7.8% 亚麻油酸增加7.8%

[1]Nemechek et al., J. Anim. Sci. 93:4486
[2]Wondra et al., J. Anim. Sci. 73:757

Drop Value 副产品损失价值

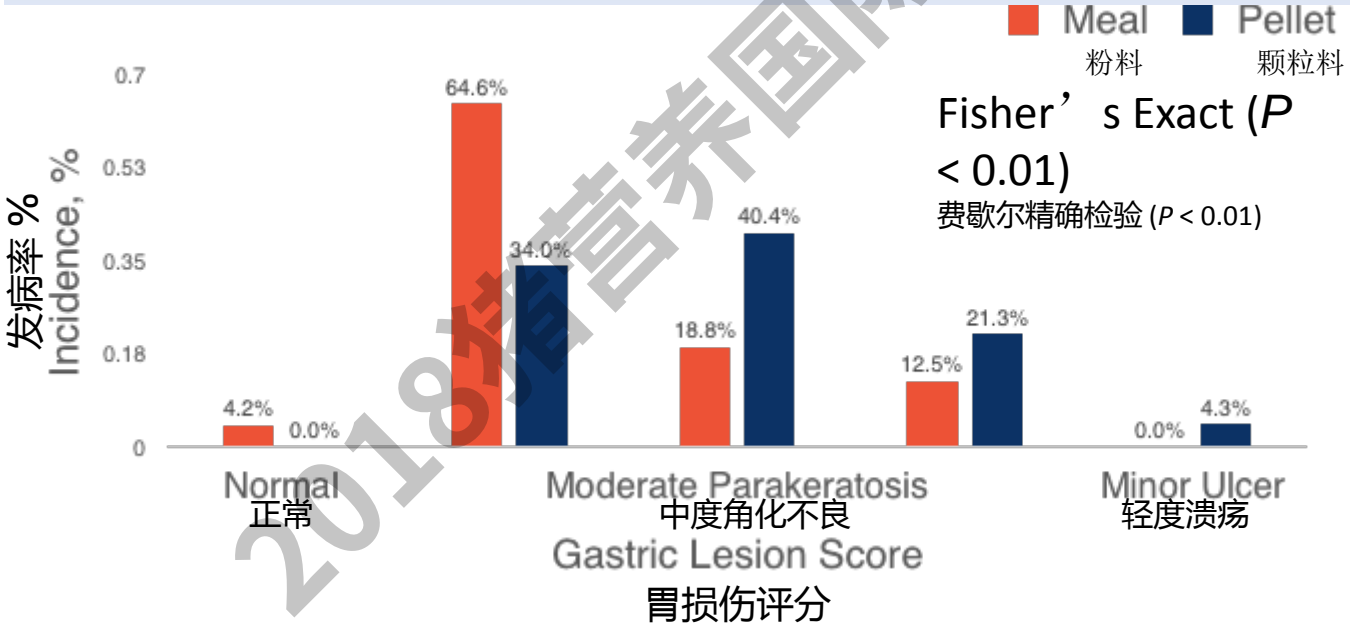
- [1]Current drop value is $3.65/cwt live (Week ending 1 Sept. 2018)[1] 当前每头猪副产品损失价值为3.65美元/每100磅（2018年9月1日周末）
  - Assumes 270 lb ELW 假设猪活体重预估为270磅
  - 74% carcass yield 屠宰率为74%
- Total drop value is between $10 and $11/pig
  每头猪副产品损失价值为10-11美元
- [2]Stomach weighs ~ 0.63 kg (1.4 lbs)
  [2]胃重量约为0.63kg (1.4 lbs)
- Stomach value is ~$1.47
  胃价值约为1.47美金
  - Represents ~ 15% of total drop value
    约为副产品损失总价值的15%

[1]USDA AMS National Weekly Carlot Report
[2]Boler et al. J. Anim. Sci. 91:359

Stomach Morphology Scores 胃形态学评分

Feeding a pelleted diet shifted the distribution of gastric lesion scores compared with feeding a meal diet

与饲喂粉状料相比，饲喂颗粒料改变了胃损伤评分的分布



Overholt et al., J. Anim. Sci. 94:2172

Stomach Morphology Scores 胃形态学评分

Normal (0)
正常

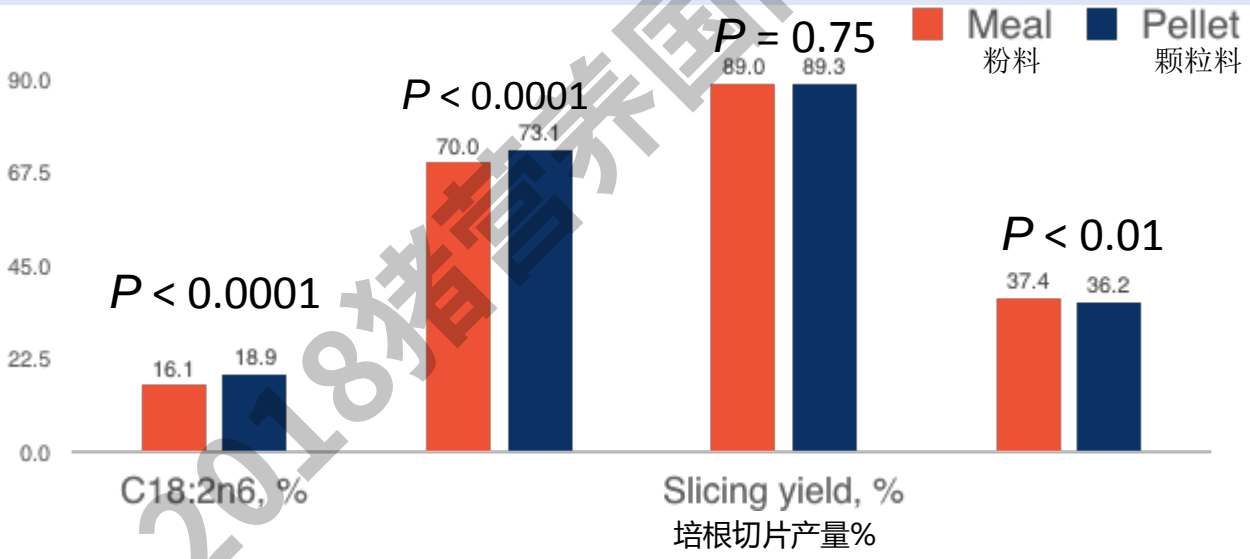
Minor Ulceration (4)
轻度溃疡

Gastric lesion scores were rated on 10 point scale where 0 represents a normal stomach (no evidence of ulceration) and 10 represents severe ulceration
胃病变评分按10分等级评定，0代表正常胃（无溃疡迹象），10代表严重溃疡。

Fat Quality 脂肪质量

Feeding a pelleted diet increased calculated iodine value by ~4.5% but did not decrease bacon slicing yields

饲喂颗粒料，其碘值增加约4.5%，但培根切片产量不会降低



Overholt et al., J. Anim. Sci. 94:2172

Immunological Castration
免疫去势

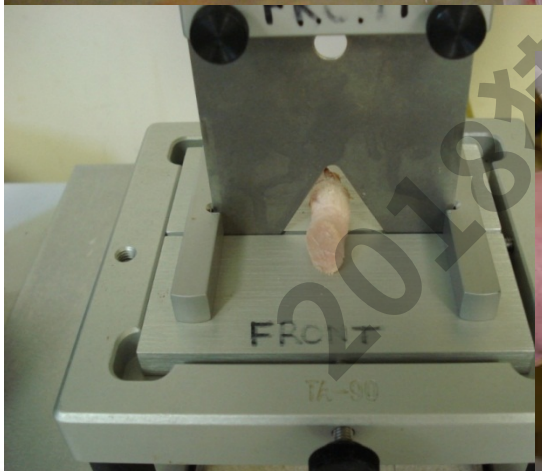
- Causes the pig to produce antibodies that neutralize GnRF
  促使猪产生可中和促性腺激素释放因子(GnRF)的抗体

- 2 injection program
  2针注射计划
  - The pig performs like a boar until the 2nd dose
    猪具备公猪特性直至第二针注射

- After the 2nd dose, the pig transitions from a boar to a barrow and thereby allows the liver to reduce boar odor compounds
  第二针注射后猪从公猪转变为阉猪，从而使肝脏能够减少公猪异味化合物

- Carcass composition and meat quality are functions of the timing of the 2nd dose and carcass weight
  胴体组分和肉品质量受到第二针注射时间安排和胴体重量的影响

Fresh Loin Quality Evaluation 新鲜里脊肉质量评估



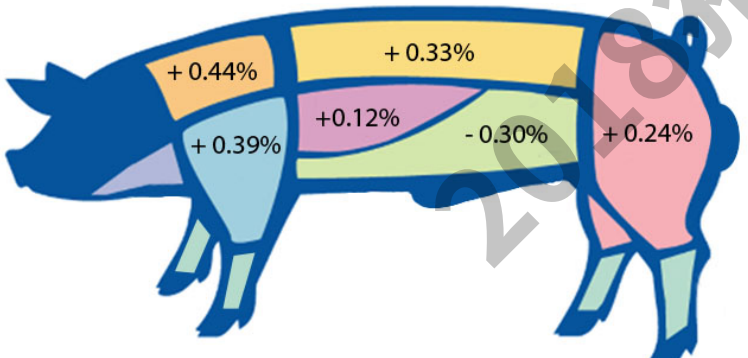
Immunological Castration and Pork Quality
免疫去势和猪肉质量

Item 项目	IC 免疫去势	Gilt 雌猪	PC 手术去势	Effect IC - PC IC-PC效应	SED	*P*-value *P*-值
Ultimate pH 最终pH值	5.59	5.55	5.60	-0.01	0.05	0.60
Instrumental color 仪器检测颜色						
Lightness, L* 亮度	48.52	48.03	48.25	0.27	0.90	0.69
Redness, a* 红色	6.89	6.75	7.13	-0.24	0.46	0.31
Yellowness, b* 黄色	3.67	3.59	3.79	-0.12	0.45	0.72
Visual color 目测颜色	2.83	2.93	3.01	-0.18	0.25	0.24
Visual marbling 目测大理石纹理	1.74[a]	1.59[a]	2.07[b]	-0.33	0.22	<0.01
Loin composition 里脊肉组成						
Moisture, % 水分	74.61[a]	74.33[ab]	74.12[b]	0.49	0.50	0.02
Extractable lipid, % 脂肪	2.01[a]	2.08[ab]	2.39[b]	-0.38	0.31	0.03
Drip loss, % 滴水损失	2.78[ab]	3.14[b]	2.56[a]	0.22	0.28	0.04
Cook loss, % 烹饪损失	21.04	21.11	20.73	0.31	1.36	0.83
WB Shear force, kg 沃-布式剪切力	2.92	--	2.91	0.01	0.08	0.82

Harsh et al., Transl. Anim. Sci. 1:77

Immunological Castration
免疫去势

	Effect IC - PC IC-PC效应	SED	*P*-value *P值*
Boston butt, % chilled side wt. 肩胛肉，%冷却后重量	0.44	0.12	< 0.001
Picnic, % chilled side wt. 前腿肉，%冷却后重量	0.39	0.12	< 0.01
Trimmed loin, % chilled side wt. 里脊肉，%冷却后重量	0.33	0.22	0.13
Spareribs, % chilled side wt. 排骨，%冷却后重量	0.12	0.06	0.06
Natural fall belly, % chilled side wt. 腹肉，%冷却后重量	-0.30	0.15	0.05
Whole ham, % chilled side wt. 全后腿肉，%冷却后重量	0.24	0.23	0.30

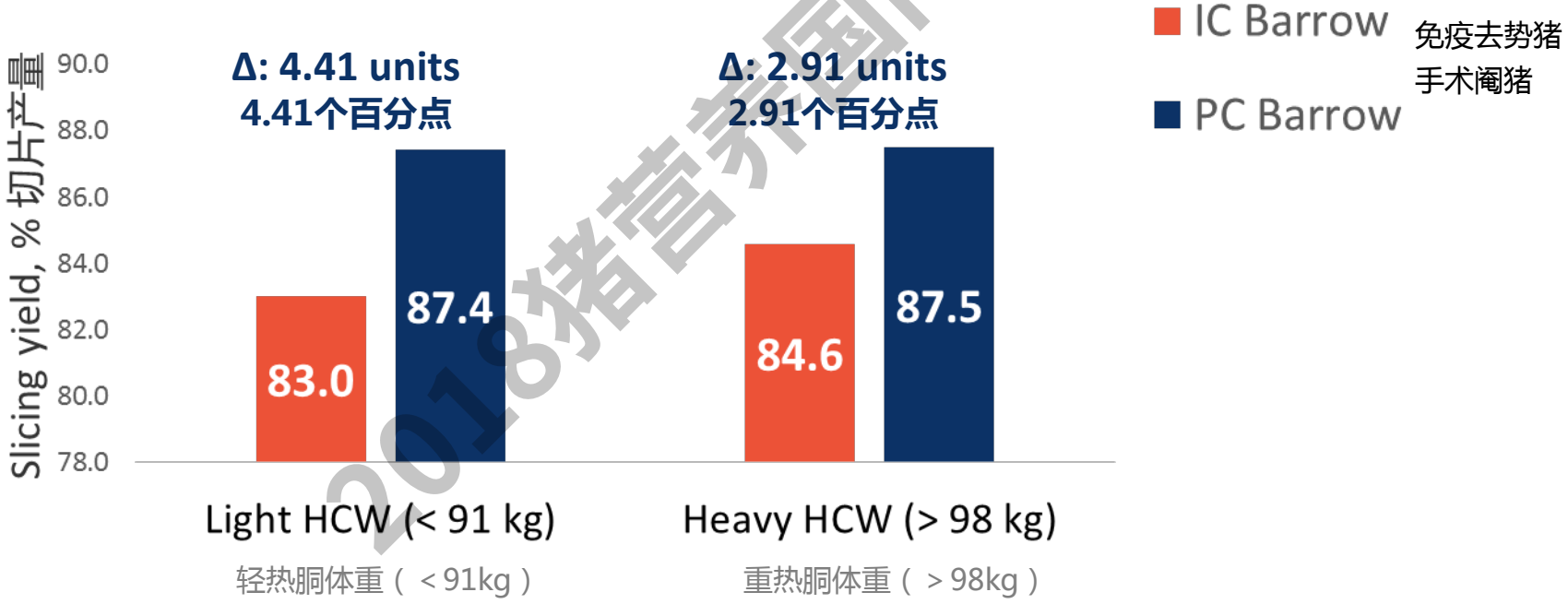


IC barrows + 1.23% unit advantage
免疫去势猪的总优势为1.23%

Harsh et al., Transl. Anim. Sci. 1:77

Bacon Slicing Yields
培根切片产量

Bacon slicing yields are less in IC barrows compared with PC barrows but increasing HCW mitigates some of the effects
与手术阉猪相比，免疫去势猪的培根切片产量较低，但热胴体重的增加降低了部分负面影响



Harsh et al., Transl. Anim. Sci. 1:77

Bacon Slicing Yields 培根切片产量

Weight of bacon slices after slicing and sorting as a percentage of raw belly (green) weight

切片和分类后培根的重量占原腹部肉总量比

Economics
经济分析

Primal 部位	Three price scenarios: 三种价格情况								
	5 Yr. avg. value (2011-2015) 5年平均价值（2011-2015）			Best case value (2014) 最佳情况价值（2014）			Worst case value (2015) 最差情况价值（2015）		
	IC 免疫去势	PC 手术去势	Effect 效应	IC 免疫去势	PC 手术去势	Effect 效应	IC 免疫去势	PC 手术去势	Effect 效应
Chilled side wt, lbs 冷却后重量，磅	101.68	101.68	--	101.68	101.68	--	101.68	101.68	--
Bone in Boston 带骨肩胛肉	$18.47	$17.60	**$0.87**	$23.58	$22.46	**$1.13**	$15.86	$15.11	**$0.75**
Bone in picnic 带骨前腿肉	$15.21	$14.67	**$0.54**	$20.07	$19.36	**$0.71**	$11.21	$10.82	**$0.40**
Whole ham 全后腿肉	$39.07	$38.69	**$0.38**	$51.88	$51.38	**$0.50**	$30.27	$29.98	**$0.29**
Trimmed loin 里脊肉	$47.11	$46.30	**$0.81**	$54.54	$53.60	**$0.93**	$40.10	$39.41	**$0.69**
Natural fall belly 腹肉	$42.40	$43.04	**$(0.64)**	$44.53	$45.20	**$(0.67)**	$37.54	$38.10	**$(0.57)**
Spareribs 排骨	$11.32	$10.83	**$0.49**	$12.21	$11.68	**$0.53**	$12.11	$11.58	**$0.53**
Total added value from primals 猪肉部位总增加价值			**$2.44**			**$3.13**			**$2.08**

Harsh et al., Transl. Anim. Sci. 1:77

TRANSITION FOR THE FARM TO THE ABATTOIR

养殖场到屠宰场的运输

Lairage 待宰

Increasing feed withdrawal time from 8 h to 36 h increased loin ultimate pH
休饲期从8小时延长至36小时增加了里脊肉的最终pH值

Item 项目	Feed withdrawal, h 休饲期，小时				SED	Linear线性
	8	12	24	36		
Loin pH 里脊肉pH值						
45 min 45分钟	6.57	6.65	6.71	6.59	0.060	0.78
3 h 3小时	6.50	6.52	6.56	6.50	0.054	0.85
21 h 21小时	5.85	5.90	5.89	5.93	0.039	0.08
Ultimate 最终	**5.84**	**5.92**	**5.89**	**5.99**	**0.051**	**0.01**
Visual color score 目测颜色评分	3.63	3.71	3.80	3.56	.0239	0.80
Visual marbling score 目测大理石花纹评分	1.77	1.99	2.26	1.90	0.216	0.51
10 d purge loss, % 10天后加工贮藏失水，%	1.53	1.58	1.51	1.29	0.195	0.16

Frobose et al. J. Anim. Sci 92: 3693

Relationship Between pH and Pork Quality
pH值和猪肉质量之间的关系

	Color 颜色	Marbling 大理石花纹	Purge Loss 贮藏失水	Lightness L* 亮度	Cook Loss 烹饪损失	WB Shear Force 沃布式剪切力
pH, 24 h	0.50*	0.25*	-0.43*	-0.53*	-0.42*	-0.28*
Color 颜色		0.29*	-0.25*	-0.51*	-0.31*	-0.16*
Marbling 大理石花纹			-0.06	-0.12*	-0.11*	-0.32*
Purge loss贮藏失水				0.27*	0.25*	0.18*
L* 亮度					0.29*	0.11*
Cook loss 烹饪损失						0.27*

Ultimate pH has the strongest correlation with other pork quality traits
最终pH值与其他猪肉质量特性呈最强相关性

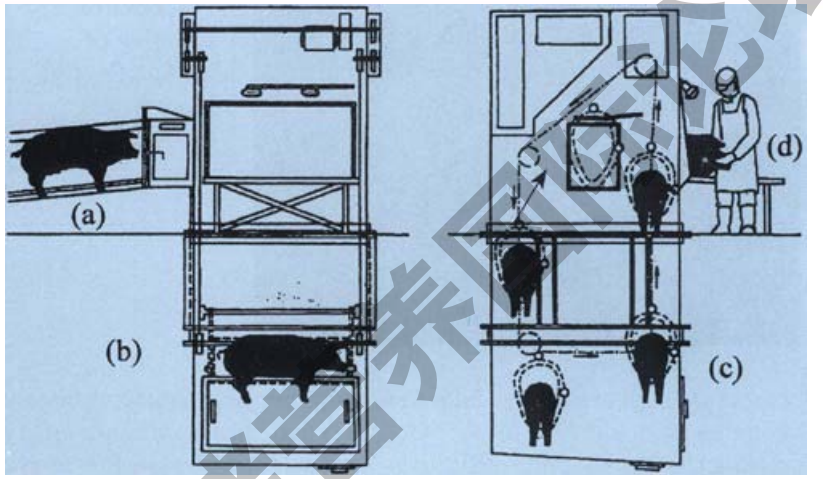
Boler et al., J. Muscle Foods 21: 119

CO_2 Immobilization & Pork Quality
二氧化碳窒昏 & 猪肉质量

- Using CO_2 to immobilize pigs in large production systems decreases pre-slaughter stress and increases overall carcass quality
  在大型生产系统中使用二氧化碳窒昏猪只可降低宰前应激并提高整体胴体质量
  - When moved in groups, pigs are less likely to resist forward motion
    当进行群体转移时，猪只不前进的可能性更小
  - CO_2 immobilization reduces loin drip loss and incidence of PSE compared with electrical immobilization 与电击致昏相比，二氧化碳窒昏可降低里脊肉滴水损失和PSE肉发生率
  - CO_2 stunned pigs are also less likely to have bone fractures or bruising compared with electrically immobilized pigs 与电击致昏猪只相比，二氧化碳致昏猪只也不太可能有骨折或瘀伤
  - CO_2 immobilized pigs had darker longissimus dorsi color and a greater water holding capacity compared with electorally immobilized pigs 与电击致昏猪只相比，二氧化碳致昏猪只背最长肌肉色偏暗且持水能力更强

Channon et al. Pork CRC 3A-103 1112 ; Shackelford et al. J. Anim. Sci 90: 2842

CO_2 vs Electrical Immobilization
二氧化碳 VS 电击



CO_2 Immobilization & Pork Quality
二氧化碳窒昏 & 猪肉质量

Plant 工厂		Immobilization method 致昏方法			SEM 标准误
		§CO_2 CO_2致昏§	*CO_2 CO_2致昏*	*Electrical 电昏*	
Pigs, n	猪数量	200	197	200	
Ultimate pH	最终pH值	5.74[a]	5.72[a]	5.65[b]	0.07
Instrumental color	仪器检测颜色				
L*	亮度	51.0[b]	51.4[b]	53.4[a]	0.50
Visual color[1]	目测颜色	2.94[a]	2.91[a]	2.71[b]	0.23
Cook loss, %	烹饪损失	16.7[b]	16.4[b]	17.6[a]	0.60
Purge loss, %	贮藏损失	0.48[c]	0.64[b]	0.78[a]	0.12

§ Carcasses were spray chilled; *carcasses were blast chilled
§胴体采用喷雾冷却；*胴体采用急速冷却

Means, within a row, not sharing a superscript differ ($P < 0.05$)
同一栏具有不同肩标的平均值间存在差异($P < 0.05$)

1 = pale, pinkish gray; 6 = dark purplish red
1=灰白，粉灰色；6=深紫色红

Shackelford et al. J. Anim. Sci 90: 2842

Effects of pH on Sensory Traits
pH值对感官特性的影响

Loin chops with a pH >5.95 were more tender than loin chops with a pH < 5.95
pH >5.95的里脊肉块比pH < 5.95的里脊肉块更嫩

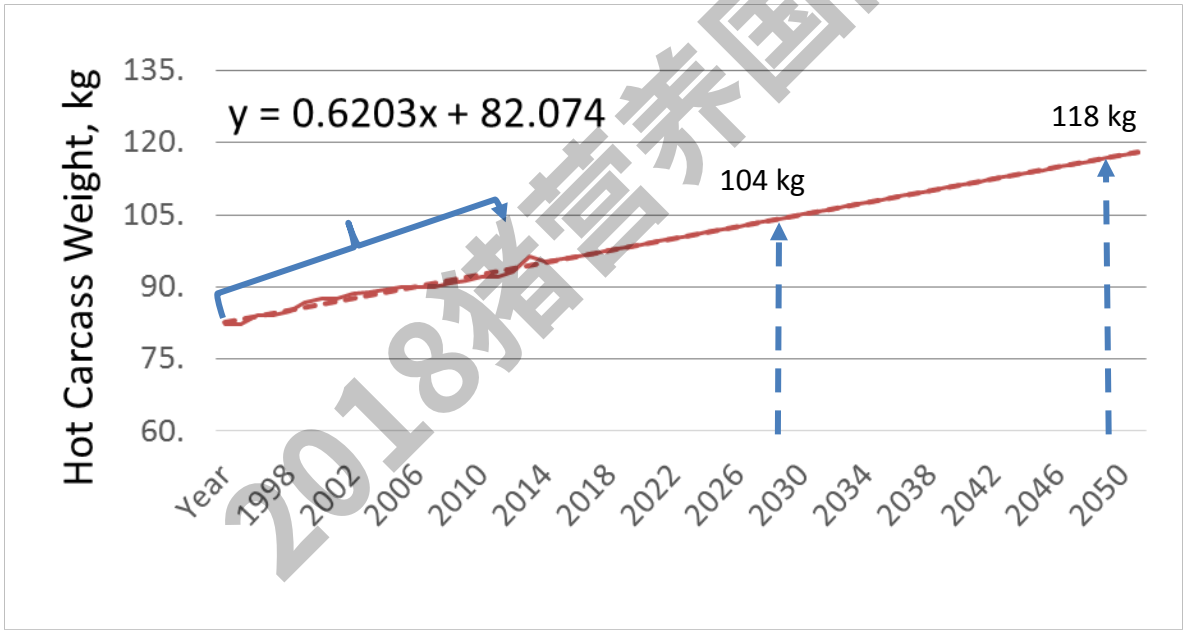
Item 项目		pH category[1] pH分类[1] >5.95	5.80 to 5.95	5.65 to 5.80	5.50 to 5.65	<5.50	SEM 标准误	*P*-value *P*-值
Loins, n	里脊肉，重复数	22	75	102	91	6		
Sensory tenderness	感官嫩度	10.59[a]	9.67[b]	9.51[b]	9.46[b]	9.47[b]	0.29	< 0.01
Sensory juiciness[2]	感官多汁性[2]	9.29	9.15	9.02	9.03	8.74	0.23	0.18
Sensory flavor[2]	感官风味[2]	2.30	2.35	2.44	2.44	2.27	0.13	0.12
Cook loss, %[3]	烹饪损失，%[3]	16.14	18.09	18.54	18.58	18.87	1.13	0.08
WB shear force, kg[4]	沃-布式剪切力kg[4]	2.87	2.78	2.82	2.67	2.84	0.19	0.09

Richardson et al. J. Anim. Sci 96: 3768

Hot Carcass Weight 热胴体重

Since 1995, the average HCW of U.S. pork carcasses has increased from 82 to 95 kg

自1995年来，美国猪肉胴体的平均热胴体重已从82kg增加至95kg

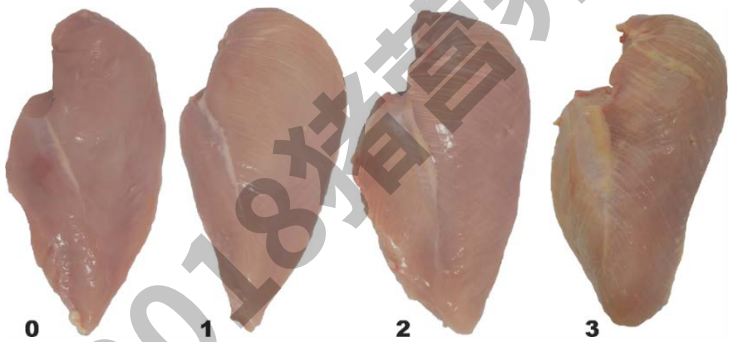


36% increase
增加了36%

USDA, 2018

Poultry - Myopathies
家禽-鸡肉疾病

- **Average HCW of broilers increased from 1.1 kg in 1925 to 2.8 kg in 2017 (National Chicken Council, 2017)**
  肉鸡的平均热胴体重从1925年的1.1kg增加至2017年的2.8kg（美国鸡肉协会，2017）
- **White Striping (WS) 白纹**
  - **White lines of intramuscular connective tissue deposits in raw meat, parallel to muscle fibers in breasts, tenders, and thigh muscles**
    肌肉内结缔组织白纹在生肉中积淀，类似于鸡胸肉、鸡里脊和大腿肌肉中的肌肉纤维

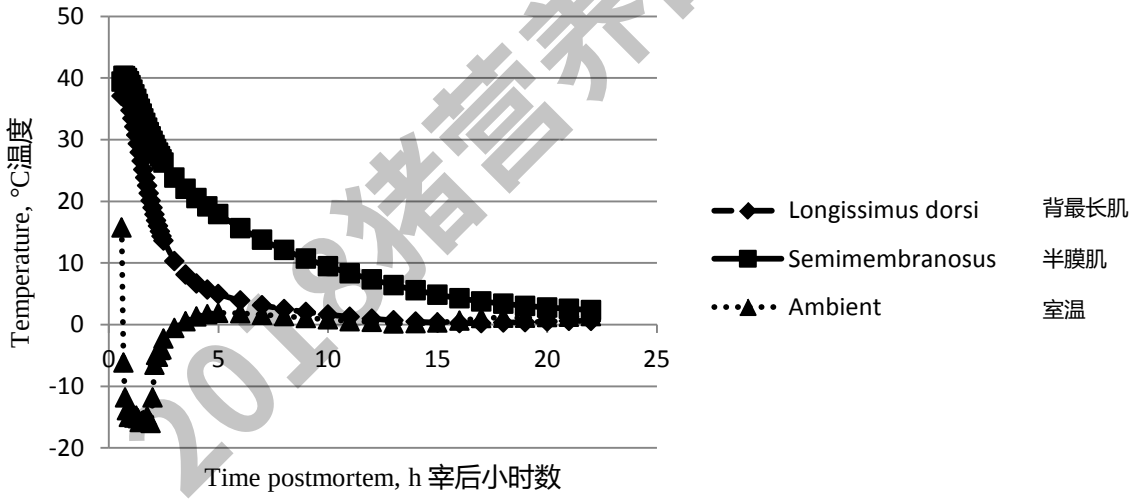


155% increase
增加了155%

White striping and woody breast myopathies in the modern poultry industry: a review
现代家禽行业中白纹和木质胸肉鸡肉疾病：综述
Poult Sci. 2016;95(11):2724-2733. doi:10.3382/ps/pew216

Chilling Rate (Ham vs Loin)
冷却速率（后腿肉 vs 腰肉）

- Hams chill at a slower rate than loins 后腿肉的冷却速率低于里脊肉
  - Loins reached ambient temperature 14h postmortem after going through blast chill system
    腰肉在通过急速冷却系统后宰后14小时达到目标温度
  - Hams on the same carcasses did not reach ambient temperature prior to carcass fabrication at 22h postmortem
    在宰后22小时胴体加工之前，胴体的后腿肉未达到目标温度



Arkfeld et al. J. Anim. Sci 94: 5155

HCW and Chilling Rates
热胴体重和冷却速率

Time postmortem, h:min 宰后时间	Hot carcass weight class, kg 热胴体重等级 85	90	95	100	105	SEM标准误	*P* - value
	Observed loin temperatures (°C) 里脊肉观察温度						
1:00	34.1	34.0	33.9	35.3	35.9	1.4	0.53
5:00	2.5^{a}	4.1^{ab}	4.4^{b}	6.0^{c}	6.4^{c}	0.8	< 0.001
10:00	0.0^{a}	1.3^{b}	1.3^{b}	2.1^{c}	2.4^{c}	0.4	< 0.0001
15:00	-0.4^{a}	0.3^{bc}	0.1^{ab}	0.5^{c}	0.6^{c}	0.2	0.01
20:00	0.1	0.5	0.7	0.5	0.7	0.2	**0.23**
22:00	0.3	0.6	0.8	0.6	0.7	0.2	**0.52**
	Observed ham temperatures (°C) 后腿肉观察温度						
10:00	7.7^{a}	8.8^{a}	9.0^{a}	10.3^{b}	10.6^{b}	0.6	< 0.001
15:00	3.0^{a}	4.4^{b}	4.4^{b}	5.6^{c}	5.8^{c}	0.5	<.0001
20:00	1.5^{a}	2.4^{b}	2.6^{bc}	3.1^{c}	3.3^{c}	0.4	**< 0.01**
22:00	1.5^{a}	2.1^{ab}	2.3^{abc}	2.8^{bc}	2.9^{c}	0.4	**0.02**

Every 5 kg increase in HCW decreases the fractional rate constant of the ham by 2%
热胴体重每增加5kg，后腿肉冷却速率分数常数减少2%

Least squares means within a row lacking a common superscript are different ($P \leq 0.05$)
同一栏具有不同肩标的平均值间存在差异($P \leq 0.05$)

Overholt et al. Under Consideration

Correlation Between Loin Quality & Ham Quality (Pearson correlation coefficients)
腰肉质量和火腿质量之间相关性（皮尔逊相关系数）

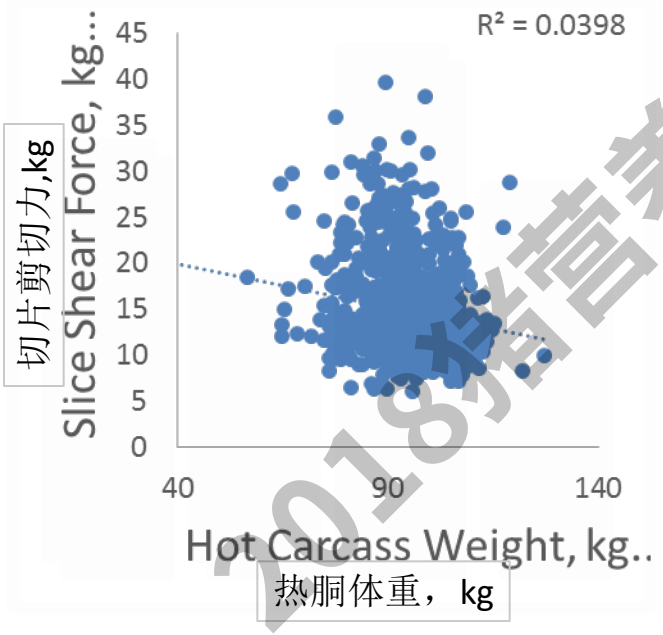
Loin quality is not correlated with fresh or cured ham quality
里脊肉质量与新鲜或腌制火腿质量没有相关性

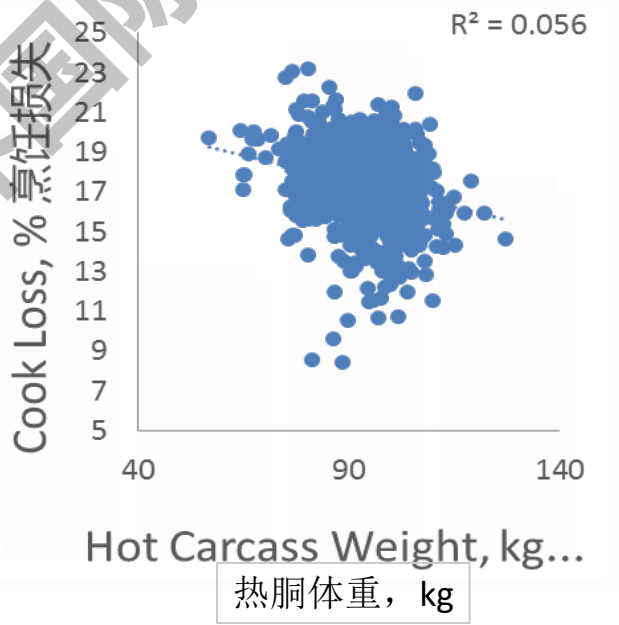
Variable 变量	**pH, 31 min** 31分钟pH值	**pH, 1 d** 第1天pH值	**Purge loss, 20 d** 第20天贮藏损失	**Cook loss, 21 d** 第21天烹饪损失	**Slice shear force** 切片剪切力
Gluteus medius 臀中肌					
L* 亮度	-0.03	-0.34	0.14	0.23	0.05
Semimembranosus 半膜肌					
L* 亮度	-0.05	-0.28	0.15	0.23	0.05
pH pH值	0.00	0.33	-0.30	-0.36	-0.22
Ham brine retention 火腿盐水保留	0.02	0.09	-0.11	-0.05	-0.01
Cured ham color 腌制火腿肉颜色					
L* 亮度	0.21	-0.22	0.18	0.20	0.16

Arkfeld et al. J. Anim. Sci 94: 5155

Hot Carcass Weight and Loin Quality
热胴体重和里脊肉质量

Increasing HCW to 130 kg did not negatively impact tenderness or cook loss
热胴体重增加至130kg不会对嫩度或烹饪损失带来负面影响





Harsh et al. J. Anim. Sci. 95:4958

Pork Eating Experience (Degree of Doneness)
猪肉食用体验（熟度）

In 2011, the USDA FSIS reduced the recommended cooking temperature of pork chops from 71℃ to 63℃

2011年美国食品安全监督服务局将猪排的推荐烹饪温度从71℃降至 63℃

- Pork will be more tender, juicy, and flavorful
  猪肉会更嫩、更多汁、更可口
- Just as safe as cooking it to 160°F
  如同烹饪至71℃一样安全

Medium-Rare 四分熟
63 – 66℃

Medium 五分熟
66 - 68℃

Medium-Well 七分熟
68 - 71℃

Well 全熟
71℃

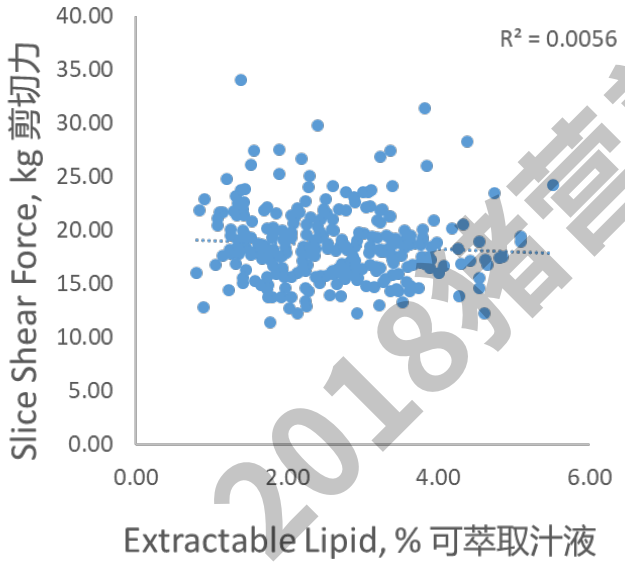
Sensory Evaluation 感官评价

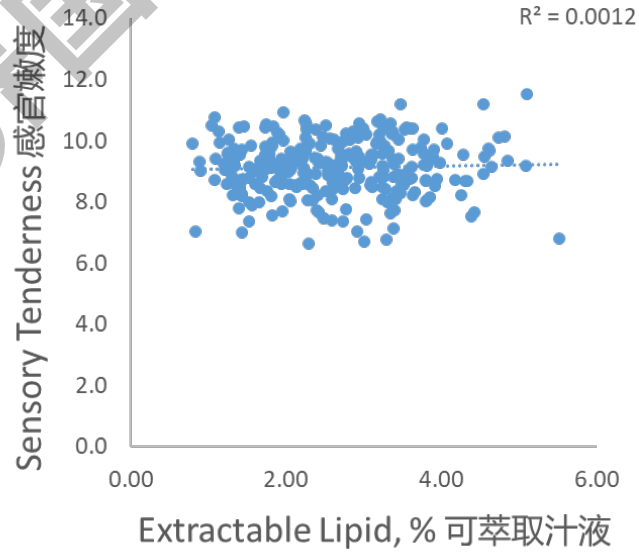
样品号

Sample # _____

Marbling and Tenderness
大理石花纹和嫩度

Marbling does not predict sensory tenderness of pork chops cooked to 63℃
大理石花纹并不能用于预测猪排烹饪至 63°C时的感官嫩度

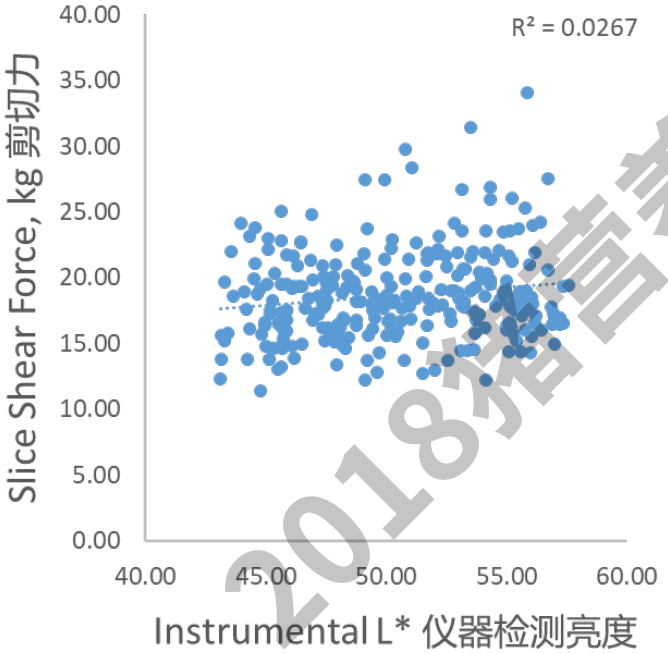


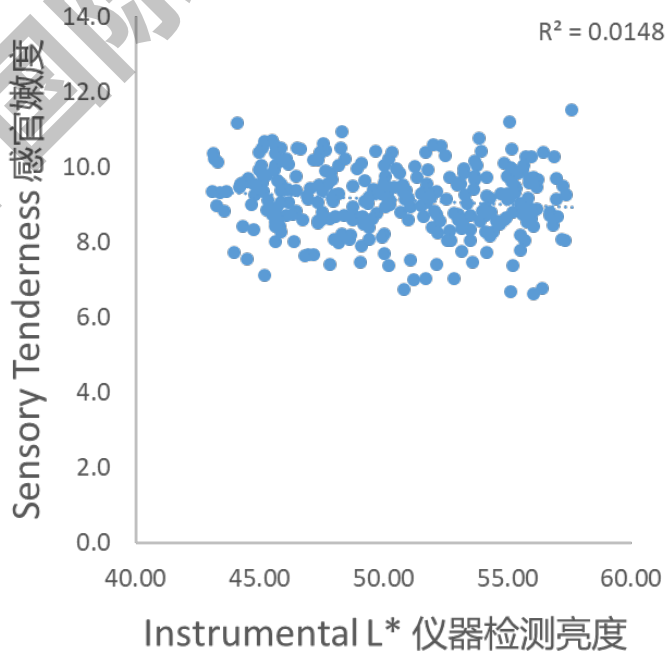


Wilson et al. J. Anim. Sci. 95:2052

Color and Tenderness
颜色和嫩度

Color does not predict sensory tenderness of pork chops cooked to 63°C
颜色并不能用于预测猪排烹煮至 63°C时的感官嫩度





Wilson et al. J. Anim. Sci. 95:2052

Degree of Doneness 熟度

	Final internal temperature, ° C 最终内部温度			
	62° C	71° C	80° C	SEM
Tenderness 嫩度	8.56[a]	7.76[b]	6.81[c]	0.11
Juiciness 多汁性	9.85[a]	8.51[b]	6.29[c]	0.08
Flavor 风味	4.66	4.75	4.56	0.07

Means within a row with different superscripts differ (P < 0.05)
同一栏具有不同肩标的平均值间存在差异(P < 0.05)

Sensory items were evaluated with a 15 cm line scale where 0 = extremely tough, dry, and no flavor; 15 = extremely tender, juicy, and intense flavor
感官特性通过采用15cm直线比例尺进行评估，其中0=非常硬、干且无味；15=非常嫩、多汁且味道浓郁

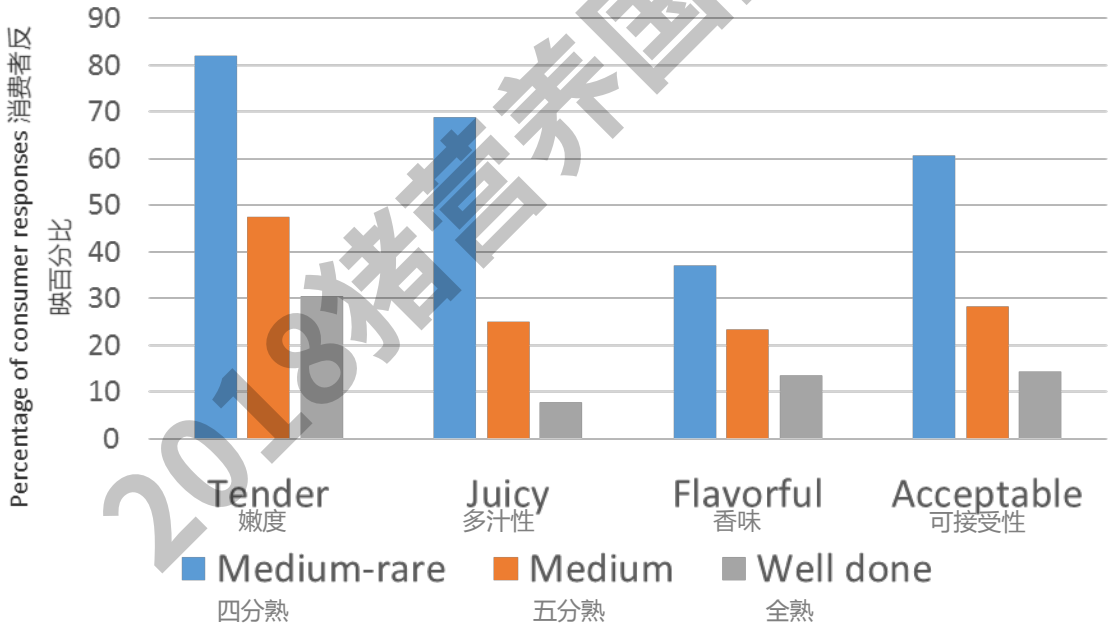
Trained panelists rated chops cooked to a lesser degree-of-doneness as more tender and juicy than chops cooked to a greater degree-of-doneness
经受过培训的技术专员评估得出，熟度较低的猪排相较于熟度较高的猪排更嫩更多汁

Rinker et al. J. Anim. Sci. 86: 730

Consumer Preference
消费者偏好

Consumers rated a greater percentage of chops as tender, juicy, flavorful, and overall more acceptable when cooked to a medium-rare degree of doneness

消费者对烹煮至四分熟的猪排在嫩度、多汁性、香味和整体更加可接受性方面给予更高的百分比评分



Honegger et al. In progress, 2018

- Many factors influence meat quality and carcass composition 肉品质量和胴体组分受诸多因数影响
  - Some of those occur at the farm 养殖场存在一些影响因素
  - Some occur during the slaughter process 屠宰过程中也存在一些影响因素
- Some production decisions made at the farm can impact product quality 养殖场的一些养殖决策会影响产品质量
- Product quality can be greatly impacted during the slaughter process 在屠宰过程中，产品质量会受到很大的影响
- The greatest impact on eating experience is Degree of Doneness 熟度对食用体验的影响程度最大

Thank You

谢谢