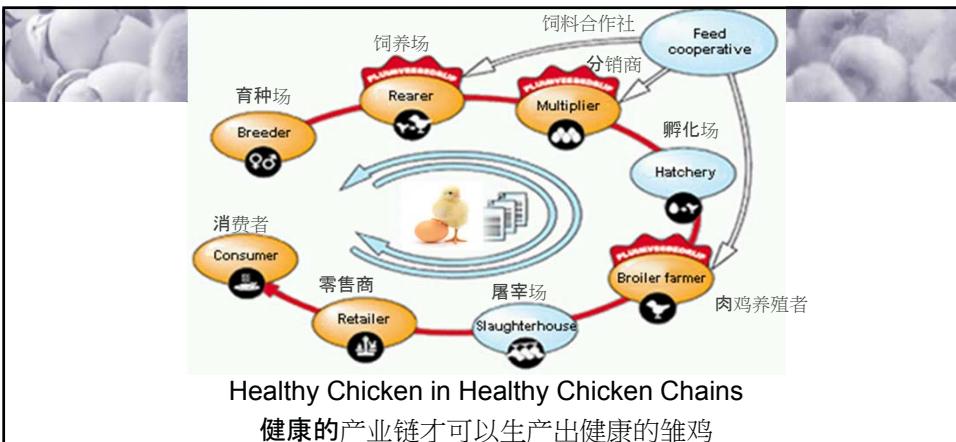


How to improve performance at all levels in the broiler chain? 如何提升肉鸡孵化链各个环节的水平?

Sander.lourens@wur.nl
www.hatchability.com



1. Good farming and management practice at all levels
各个环节的良好操作
1. Open information exchange 公开透明的信息交流
2. Upstream Quality Investments 上游质量控制的投入
3. Right incentives 适当的激励措施
4. Return on investments 投资回报





100% integrated broiler meat chain with top-down control

从上至下100%集约化管理的肉鸡产业链

- Central management and planning: quick introduction of new concepts is possible
- 集中管理和规划：可以快速引进新的理念
- Identical farm management
- 统一的农场管理
- Farmers do as told; creativity at low level
- 养殖人员依照既定的指示进行操作；自由创新比较受限
- Constant and average results; little variation between farms
- 确保产品的一致性和均一性，不同农场之间差异不大

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100% integrated broiler meat chain with top-down control

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Independent farmers per chain (Dutch situation)

产业链上各个养殖场独立运作（荷兰现状）

- Optimisation of own company results 养殖场根据自己的企业目标进行优化
- Specialised and innovative farmers 专业化和创新水平较高
- Good and poor production farms; more variation between farms
- 经营状况好坏不一，相互之间差异较大

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In both cases, all sectors depend on each other for good results
在上述两种情况下，产业链的各方必须彼此相互支持才能各取所需
Many factors influence the down stream technical and financial results
有很多因素都会影响到产业链下游的技术与经济结果
Upstream quality improvements can be lost due to down stream failures
如果下游控制不好，产业链上游的质量改进也会付之东流

- Breeder rearing and production management, hatching egg quality, storage quality and incubation process affect chick numbers, chick quality and technical performance
- 饲喂与生产控制、用来孵化的鸡蛋质量、储存条件和孵化过程都会影响雏鸡的孵化率、雏鸡质量及技术应用表现
- Additional, cumulative effects!
- 而这些都会产生额外的、长年累月的影响



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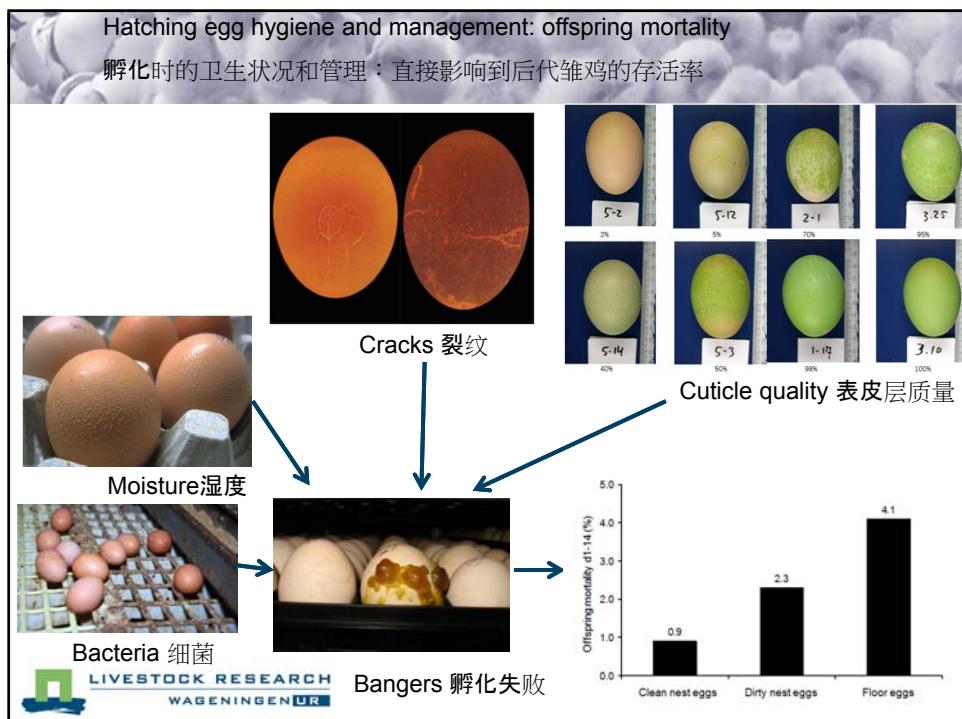
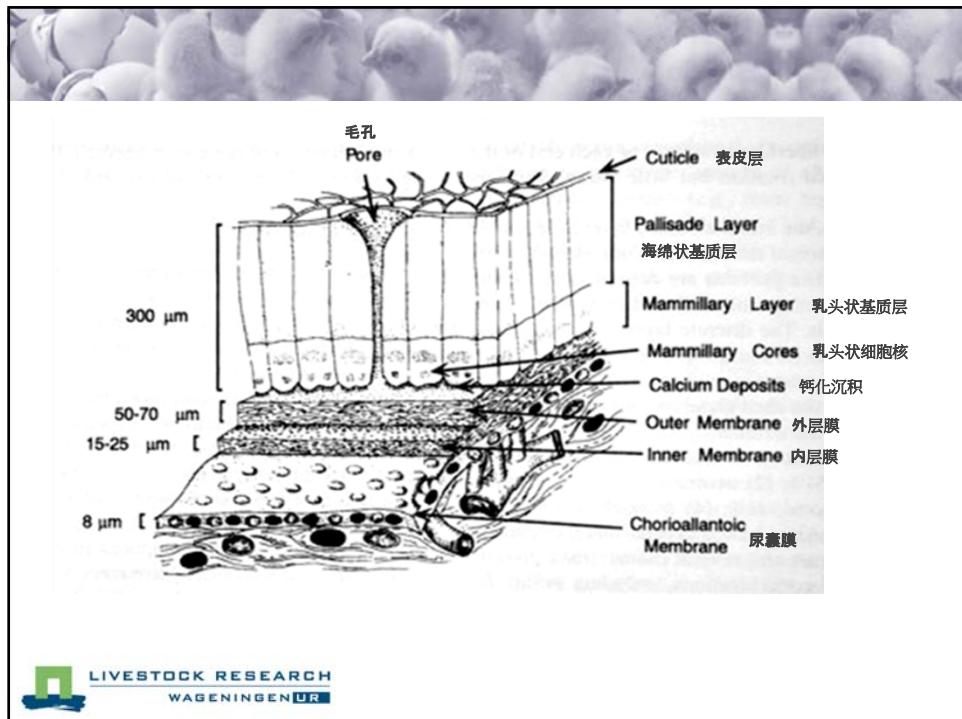


Large effect of broiler breeder management on offspring performance
肉种鸡的饲喂管理对后代雏鸡的性能表现影响很大

- Zootechnical factors
- Veterinary factors



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Most effective bacterial penetration across the eggshell:
蛋壳最容易被细菌侵入：

- Temperature gradient / egg content shrinks by cooling
- 温差/冷却导致内容物收缩
- Moisture (manure / washing / condensation)
- 湿度（粪污/清理/冷凝）
- First minute after lay when the cuticle is still soft
- 产蛋后的第一分钟：表皮层还是柔软的粘液状
- No cuticle
- 表皮层机械摩擦脱落
- Cracks! 破裂！



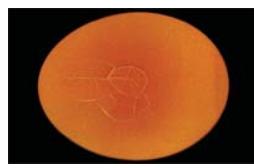
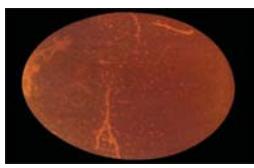
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表4：蛋壳破裂对受精失败、胚胎死亡和细菌感染的影响
Table 4. Effect of eggshell crack type on infertility, embryo mortality, and contamination.

Treatment 处理方法	受精失败率 Infertility (%)	Embryo mortality 胚胎死亡率					Contamination (%)
		1-8 days (%)	9-17 days (%)	18-19 days (%)	20-21 days (%)	Total embryo mortality (%)	
Normal 正常	2.22 ^c	10.55 ^c	0.55 ^b	0.55 ^b	1.66	13.32 ^c	2.77 ^c
Star cracks 星状裂纹	10.55 ^b	23.32 ^b	9.44 ^a	2.77 ^{ab}	1.1	36.65 ^b	6.66 ^b
Hairline cracks 发丝状裂纹	16.66 ^a	33.88 ^a	8.32 ^a	5.55 ^a	3.32	51.09 ^a	10.55 ^a
SEM 扫描电镜	1.88	2.93	1.68	1.28	0.81	3.14	1.242
P-value P-值	0.0006	0.0004	0.0055	0.0522	0.177	0.0001	0.003

*^{a,c}: Means within a column without a common superscript differ significantly ($P \leq 0.05$).



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Khabisi et al., 2012



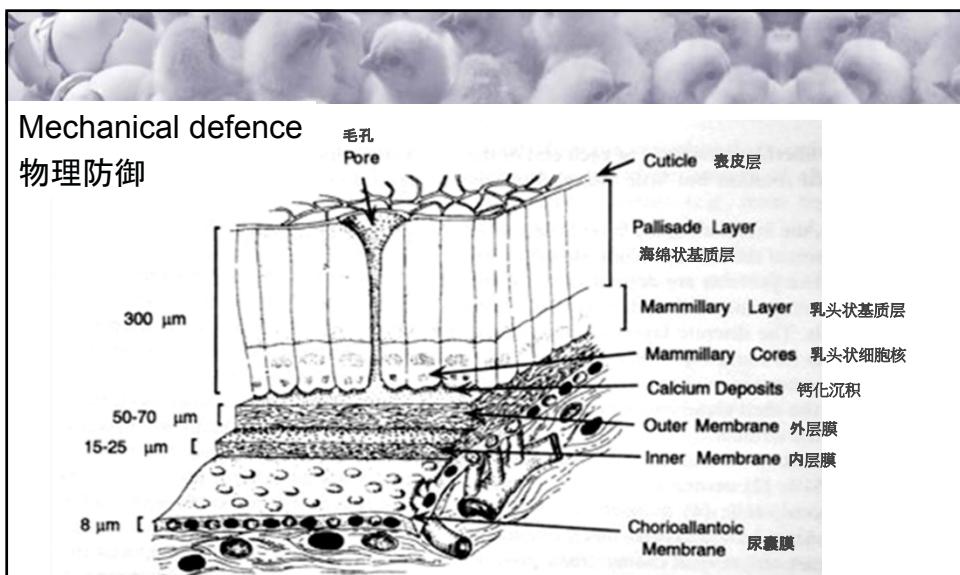
表1, 比较研究: 蛋壳表面存在微生物菌丛 V.S. 内部被微生物感染的鸡蛋

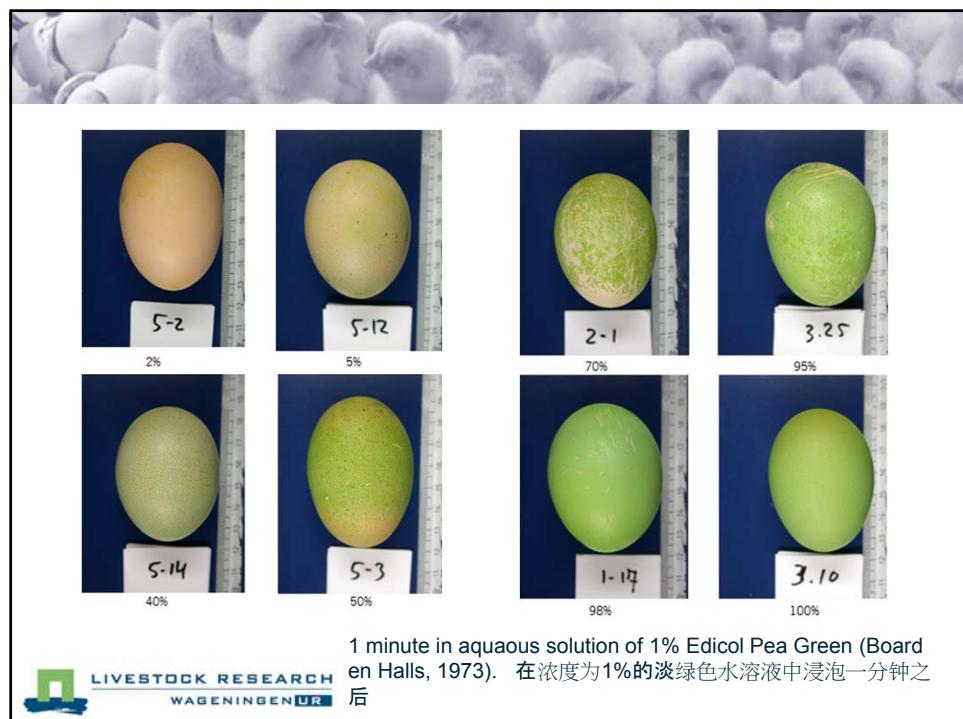
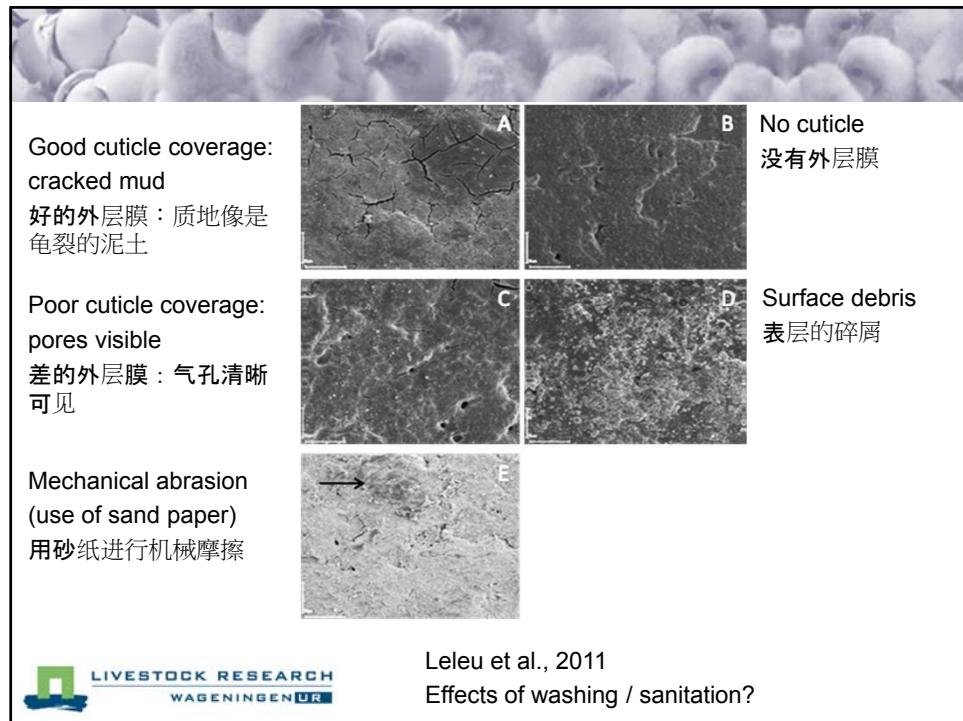
Table 1 Comparison of the microflora on the surface of the egg and within spoiled eggs (Mayes and Takeballi, 1983).

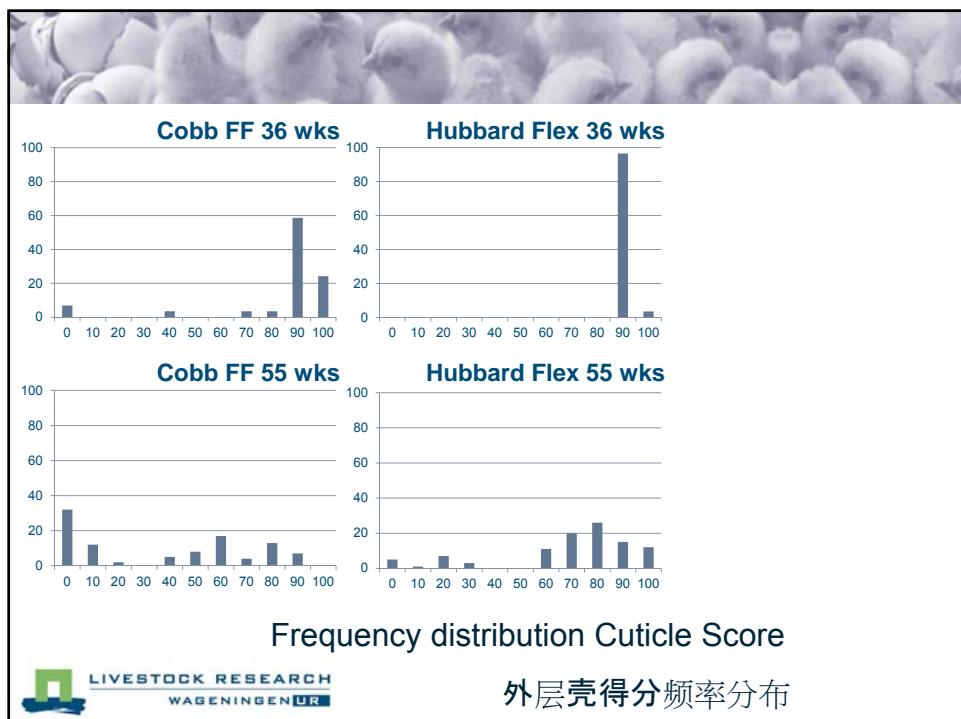
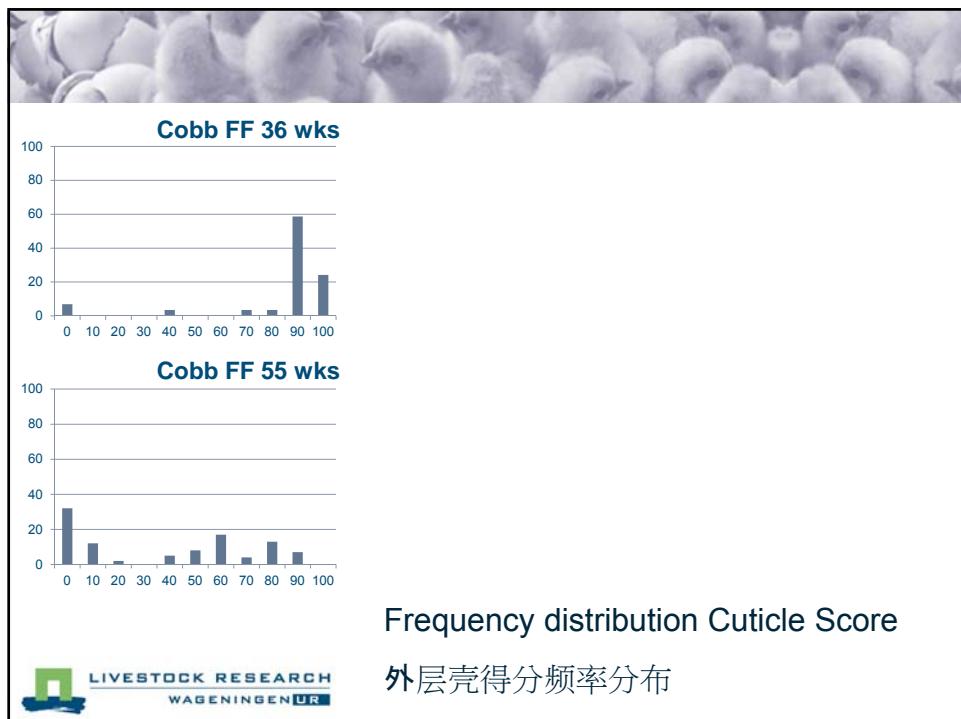
Type of organism 微生物菌丛类型	Frequency of occurrence ^a 感染频率	
	On the shell 蛋壳外部被感染	In rotten eggs 坏坏的鸡蛋
<i>Micrococcus</i> 小球菌	+++	+
<i>Achromobacter</i> 无色杆菌	++	+
<i>Aerobacter</i> 气杆菌	++	-
<i>Alcaligenes</i> 产碱杆菌	++	+++
<i>Arthrobacter</i> 节杆菌	++	+
<i>Bacillus</i> 芽孢杆菌	++	+
<i>Cytophaga</i> 萍纤维菌	++	+
<i>Escherichia</i> 埃希氏杆菌	++	+++
<i>Flavobacterium</i> 黄杆菌	++	+
<i>Pseudomonas</i> 假单胞菌	++	+++
<i>Staphylococcus</i> 葡萄球菌	++	-
<i>Aeromonas</i> 气单胞菌	+	++
<i>Proteus</i> 变形杆菌	+	+++
<i>Sarcina</i> 八叠球菌	+	-
<i>Serratia</i> 沙雷菌	+	-
<i>Streptococcus</i> 链球菌	+	+

^a The more plus signs, the more frequent the occurrence

+越多, 感染概率越大

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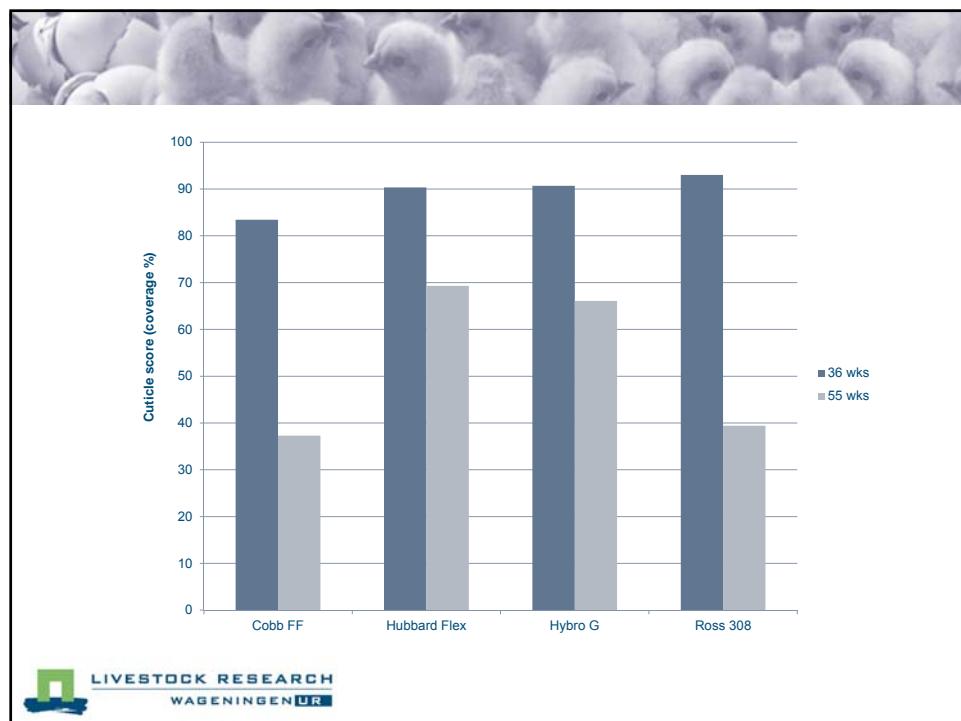
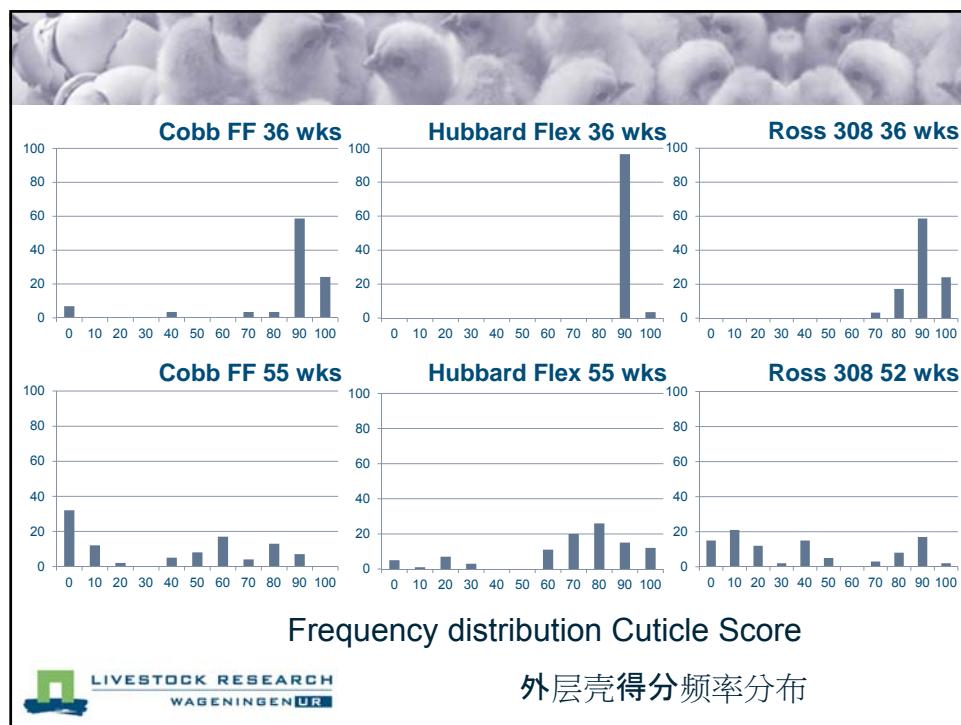




表1——外层壳对鸡蛋感染铜绿假单胞菌而变质的影响

Table 1—Effect of cuticle on spoilage of eggs after infection with Pseudomonas aeruginosa

Treatment	Trial	Spoilage time, days								
		3	5	7	9	11	15	20	25	30
<i>Percentage of spoilage</i>										
Normally laid 普通放置	1	—	—	—	—	7	28	57	80	93
	2	—	—	3	8	22	37	71	91	100
Eggs from uterus 刚出生的鸡蛋	1	8	35	41	47	64	98			
	2	43	61	74	89	100				
	3	38	50	68	86	91	100			
Shell-less eggs 不完全卵	1	100								
	2	100								
EDTA Treated eggs 用乙二胺四醋酸法 处理过的鸡蛋	1	—	12	28	45	62	82	100		
	2	—	18	32	51	70	86	100		

Vadhera et al., 1970

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**Eggs will 'sweat' if the relative humidity (% RH) outside the storage room is higher than:
如果储藏室外空气的相对湿度过高，蛋就会『冒汗』**

Temperature of storage room ¹ 储藏室内的温度	Temperature outside the storage room 储藏室外的温度			
	15 °C	18 °C	21 °C	24 °C
21 °C	> 85 % RH
18 °C	> 83 % RH	> 71 % RH
16 °C	...	> 89 % RH	> 74 % RH	> 60 % RH
11 °C	> 74 % RH	> 64 % RH	> 53 % RH	> 44 % RH

¹ Assuming that the temperature of the eggs equals the temperature of the egg storage room.
假设条件为：鸡蛋的温度=储藏室内的温度



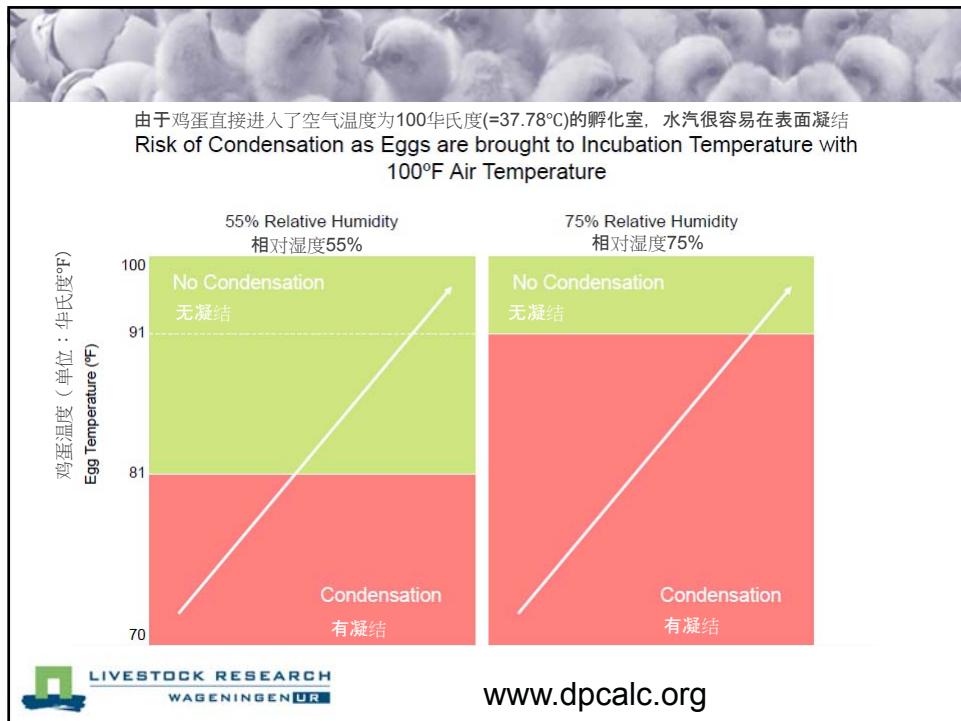




表1. 肉鸡孵化实验结果对照：正常蛋壳、未处理过的带有发丝裂纹的蛋壳、经覆盖处理的带有发丝裂纹的蛋壳
Table 1. Hatchability results of broiler breeder hatching eggs with normal intact shell, untreated hairline-cracked shell and covered hairline-cracked shell

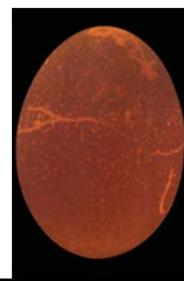
蛋壳类型 Properties	Fertility (n/100 eggs set)	受精程度(n/100) (chicks / 100 eggs set)	Hatchability (n/100个样本鸡蛋) (chicks / 100 eggs set)	Hatchability (n/100个已受精的样本鸡蛋) (chicks/100 fertile eggs)	孵化率 (n/100个已受精的样本鸡蛋)
Intact shell egg 正常	93.50±0.7 ^a		86.16±1.0 ^a		92.14±0.6 ^a
Hairline cracked-egg 带有发丝裂纹	85.15±1.5 ^b		25.84±2.4 ^c		30.17±2.3 ^c
Covered egg 覆盖处理	87.16±1.0 ^b		64.67±1.5 ^b		74.24±2.0 ^b
Significance (P) 显著性(P值)	**		***		***

**: P<0.01, **: P<0.001, *: Mean values with different superscripts within a line differ significantly.

Mean ± S.E.

** : P<0.01, *** : P<0.001, a-c : 肩标小写字母不同表示差异显著。

存在标准误差。



Simsek, 2009



表2. 肉鸡孵化实验结果对照：正常蛋壳、未处理过的带有发丝裂纹的蛋壳、经覆盖处理的带有发丝裂纹的蛋壳
Table 2. Hatching performance of broiler breeder hatching eggs with normal intact shell, untreated hairline-cracked shell and covered hairline-cracked shell

蛋壳类型 Properties	胚胎死亡率 (n/100个已受精的鸡蛋)	Embryonic mortalities (n/100 fertile eggs)		受感染率 (n/100个样本鸡蛋) Contaminated egg rate (n/100 eggs set)	Egg weight loss (% of fresh egg weight)	Cull chicks rate (n/100 of living chicks)	鸡蛋失水率(与新鲜鸡蛋相比的%) 雏鸡不合格率 (n/100个已孵化的雏鸡)
		Early (0-18 d)	Late (18-21 d)				
Intact shell egg 正常	2.32±0.6 ^b	5.53±0.7 ^c	0.50±0.1 ^b	10.63±1.2 ^c	3.16±1.4		
Hairline cracked-egg 带有发丝裂纹	19.66±2.9 ^a	50.15±2.3 ^a	2.84±0.7 ^a	21.28±2.0 ^a	8.77±3.1		
Covered egg 覆盖处理	7.77±1.4 ^b	17.98±1.8 ^b	1.22±0.5 ^b	14.41±1.7 ^b	2.88±0.6		
Significance (P) 显著性(P值)	***	***	*		**	NS	

NS: P>0.05, *: P<0.05, **: P<0.01, ***: P<0.001, *: Mean values with different superscripts within a line differ significantly.

Mean ± S.E.

NS : P>0.05, * : P<0.05, ** : P<0.01, ***P<0.001, a-c : 肩标小写字母不同表示差异显著。

存在标准误差。

Simsek, 2009

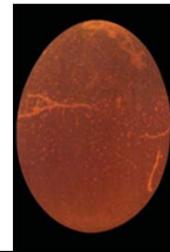




Table 4. Effect of eggshell crack type on infertility, embryo mortality, and contamination.

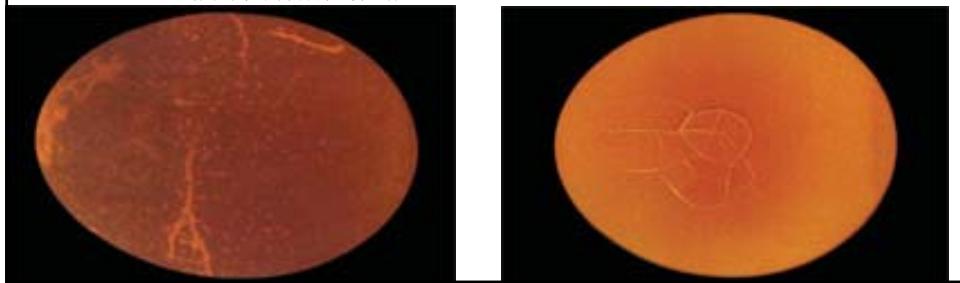
表4. 蛋壳裂纹的类型对受精率、胚胎死亡率和受感染率的影响

蛋壳类型 Treatment	受精率(%) Infertility (%)	Embryo mortality 胚胎死亡率					Contamination 受感染率 (%)
		1-8 days (%)	9-17 days (%)	18-19 days (%)	20-21 days (%)	Total embryo mortality (%)	
Normal 正常	2.22 ^c	10.55 ^c	0.55 ^b	0.55 ^b	1.66	13.32 ^c	2.77 ^c
Star cracks 星状裂纹	10.55 ^b	23.32 ^b	9.44 ^a	2.77 ^{ab}	1.1	36.65 ^b	6.66 ^b
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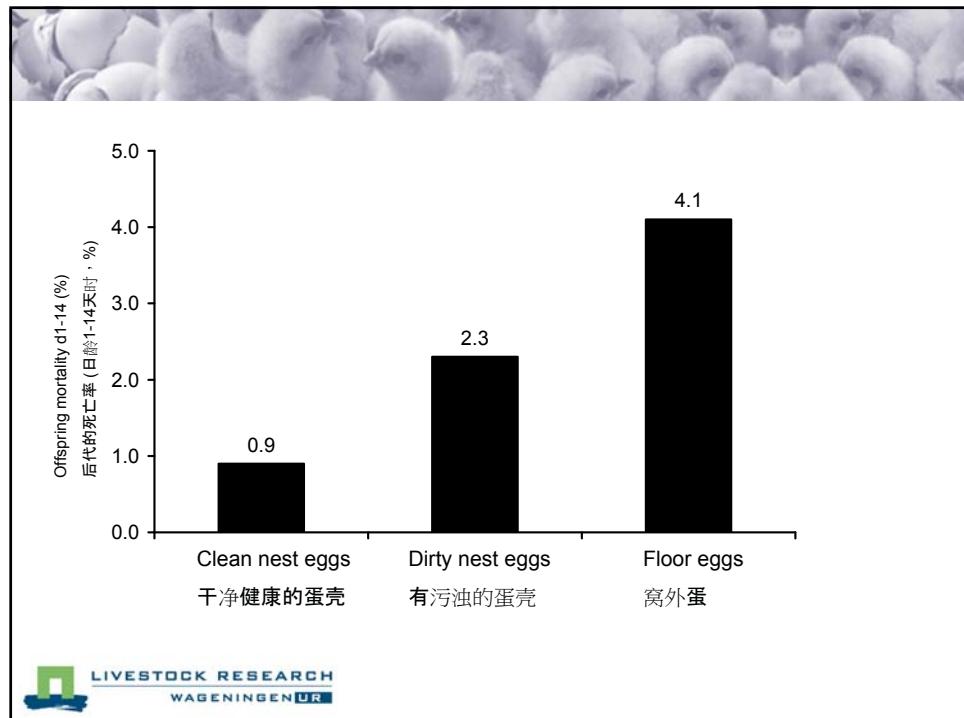
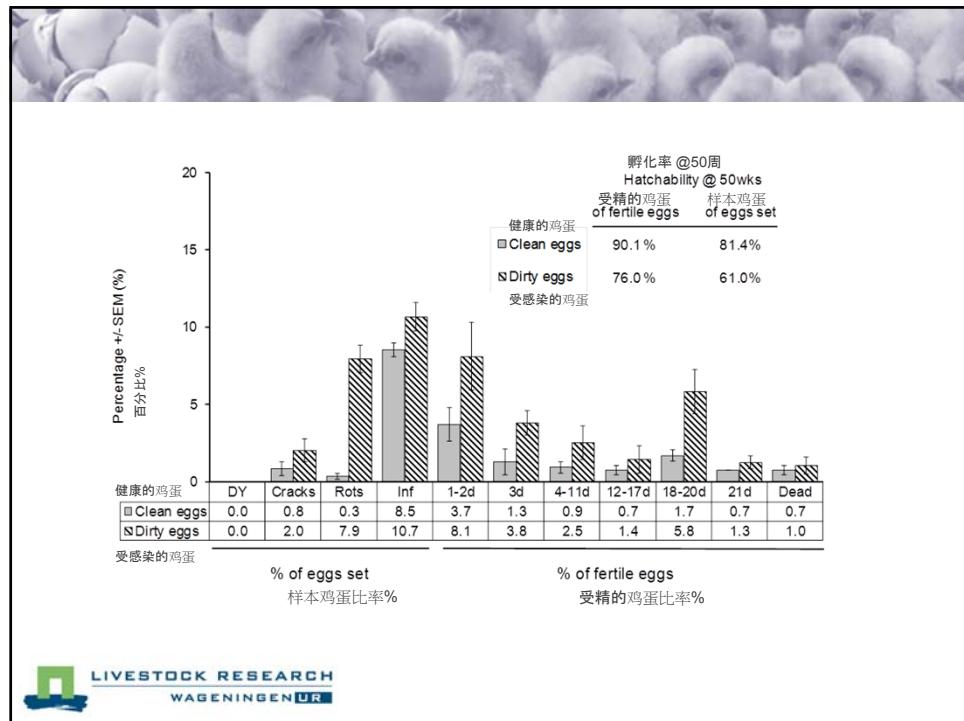
Khabisi et al., 2012



	Good quality eggs 高质量的鸡蛋	Hairline-cracked eggs 蛋壳有发丝状裂纹	
Hatchability (%) 孵化率(%)			显著性 (P值)
- Eggs set 样本鸡蛋	74.4	50.5	Significant ($P < 0.05$)
- Fertile eggs 受精的鸡蛋	80.9	56.4	Significant ($P < 0.05$)
Chick weight 雏鸡重量			
- Weight (g) 体重(克)	45.0	43.5	Significant ($P < 0.05$)
- Relative weight (% of eggs set) 相对体重(克)	69.9	67.5	Significant ($P < 0.05$)
Growth performance 生长表现			
- D14 body weight 日龄14天时的体重	293.5	298.9	Not significant
- Mortality 死亡率	2	7.5	Significant ($P < 0.05$)
Egg weight loss in the setter (%) 样本鸡蛋的失水率(%)	13.4	17.02	Significant ($P < 0.05$)
Embryonic mortality (%) 胚胎死亡率(%)			
- Early (1 - 7d) 早期(%)	7.9	13.9	Not significant
- Mid (8 - 14d) 中期(%)	0.0	2.9	Significant ($P < 0.05$)
- Late (15 - 21d) 晚期(%)	4.6	15.5	Significant ($P < 0.05$)
- Cull 淘汰	5.3	6.2	Not significant
Contaminated or broken (%) 被感染或坏掉的鸡蛋	1.2	5.2	Significant ($P < 0.05$)

Reference: Barnet et al. (2004). Hatchability and Early Chick Growth: potential of broiler breeder eggs with - hairline cracks. J. Appl. Poult Res. 13: 65 - 70.







Danish hatchery: “canalisation” of trouble eggs
Danish 孵化场：有问题的鸡蛋进行统一处理
Candled DIS to determine fertility
用蜡烛亮光检查(鸡蛋的)好坏
Transferred all eggs to hatching baskets
把所有鸡蛋转移到孵化篮中
In a cork screw basket tipper all chicks were covered in dirt...
把所有外表脏污的鸡蛋放置在软木钉孵化篮自卸车中
First week mortality > 2%
第一周，死亡率>2%
Removal of DIS → 1.5 %
拿掉蜡烛DIS → 1.5%
Rejection dirty eggs → < 1.0 %
移除外壳脏污的鸡蛋 → <1.0%

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German Integration (hatching >100 million chicks per year)
德国式集约化孵蛋（每年孵化>1亿只雏鸡）
Stopped using dirty - and floor eggs ($\pm 1.0 \%$)
不使用蛋壳脏污的鸡蛋及窝外蛋 ($\pm 1.0\%$)
Increased overall hatchability by 0.8 %
整体孵化率提高0.8%
Decreased first week mortality by 0.6%
第一周的死亡率降低0.6%
Decreased antibiotics use by 50%!
抗生素的使用量降低50% !

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Deficiencies in feed 饲料不足

Requirements and allowances do not match

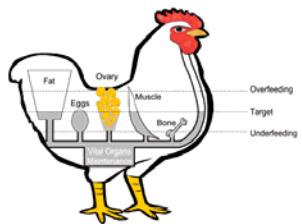
需求与供给不匹配

- Age PS 父母代鸡群的周龄
- Feather conditions 羽毛状态
- Parasites (worms, red mites) 寄生虫（蠕虫、红螨）
- Temperature 体温
- Diseases 疾病
- Stress 压力
-

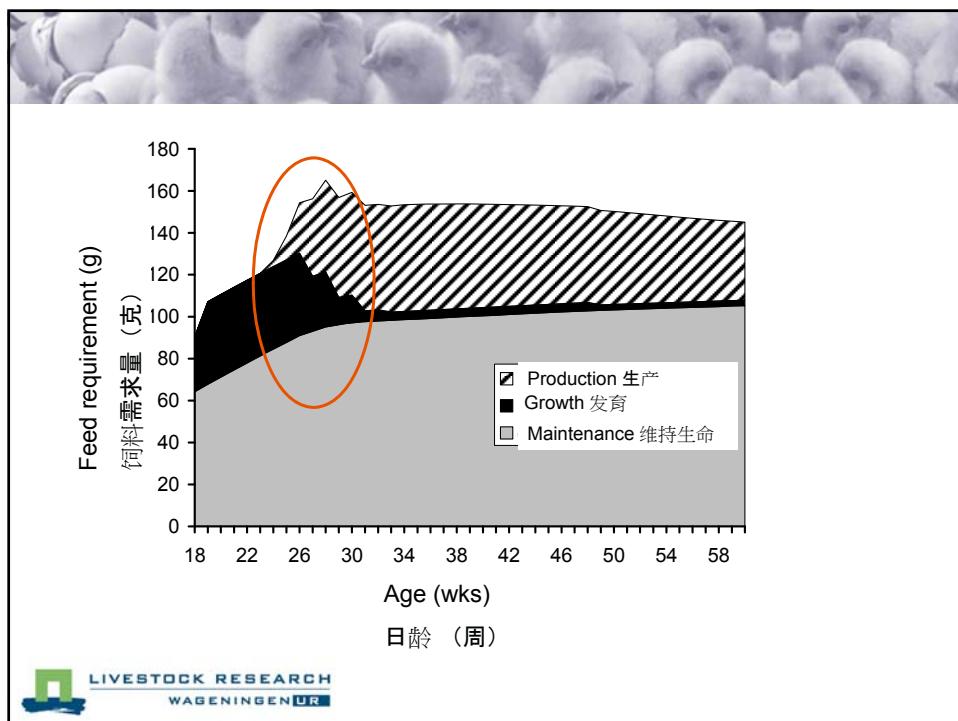
Incomplete transmission of essential nutrients

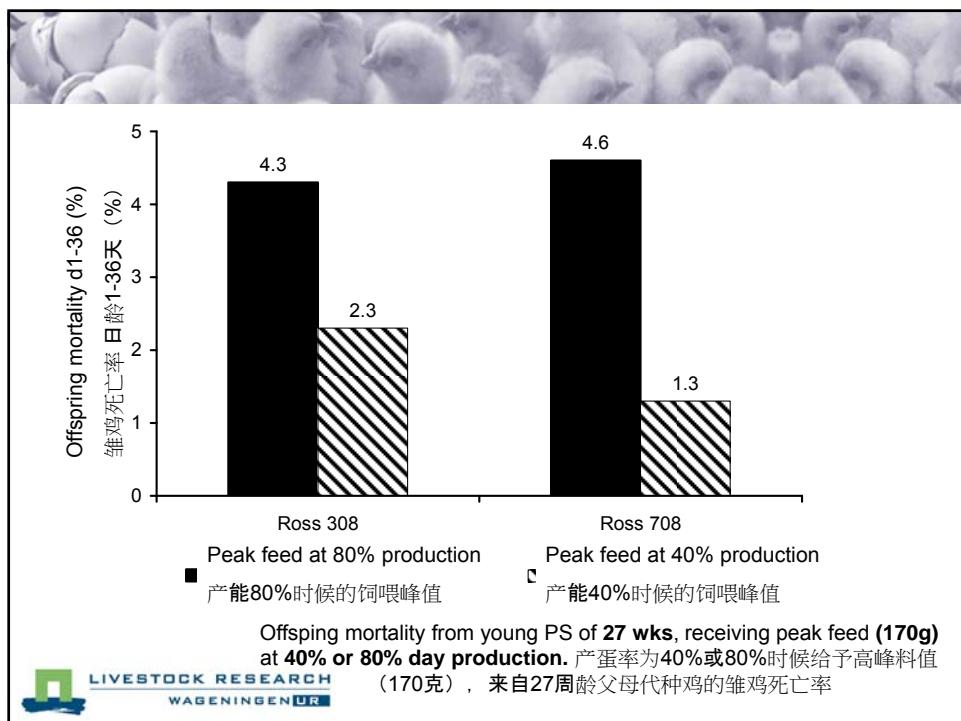
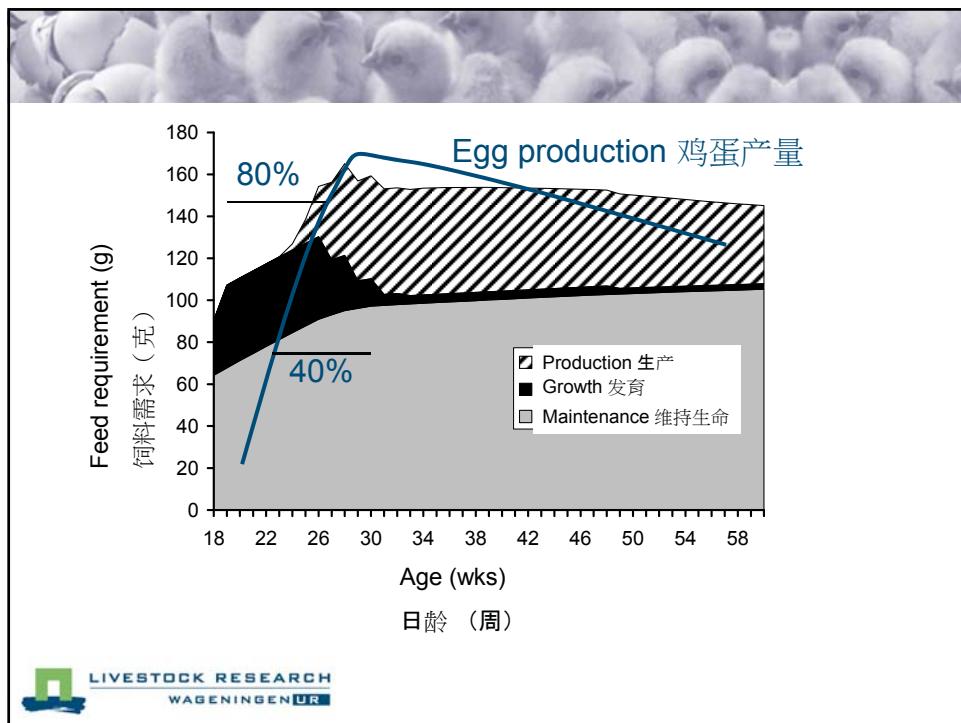
必需营养元素的不完全摄入

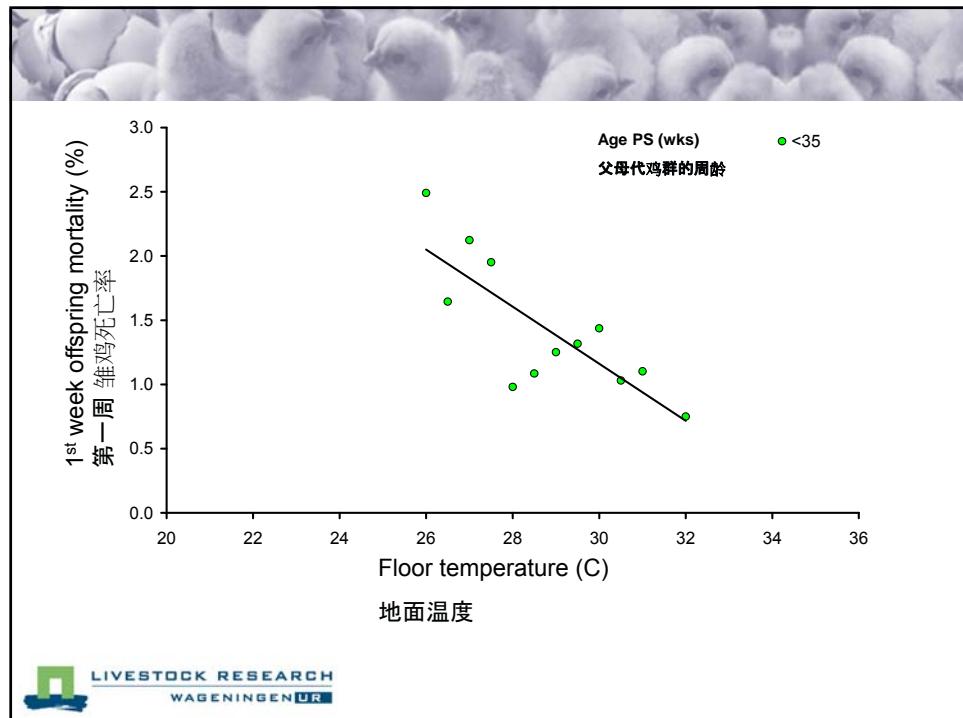
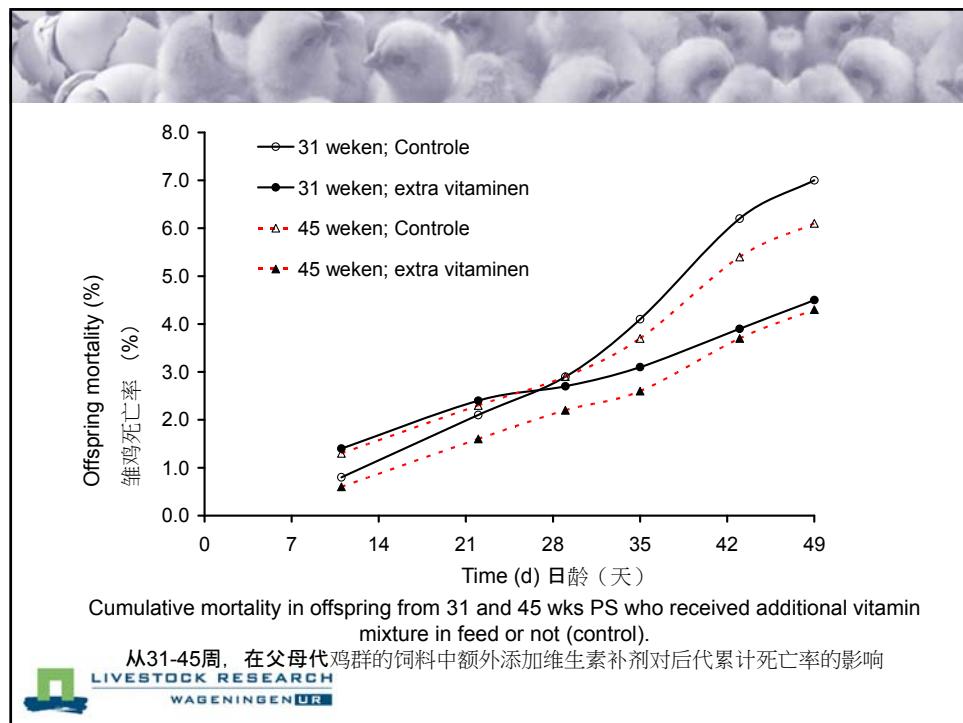
- Young PS: limited fatty acid metabolism of the embryo's -> temperature
- 父母代幼龄雏鸡：胚胎的脂肪酸代谢有限 → 体温
- Incubation conditions (large residual yolk sac)
- 孵化室的条件（大的卵黄囊残余）

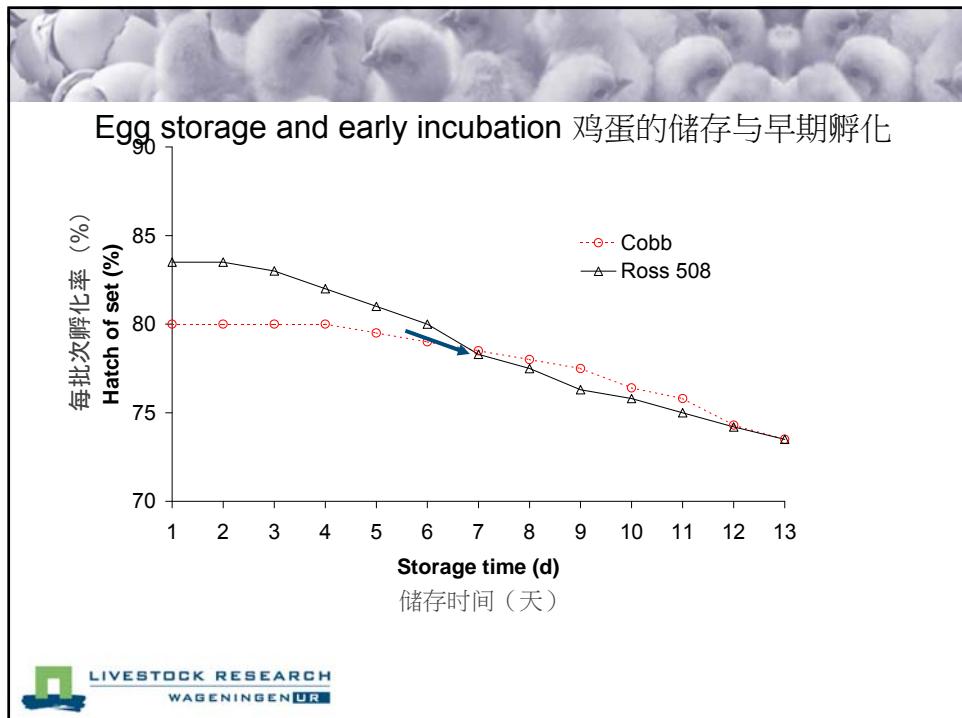
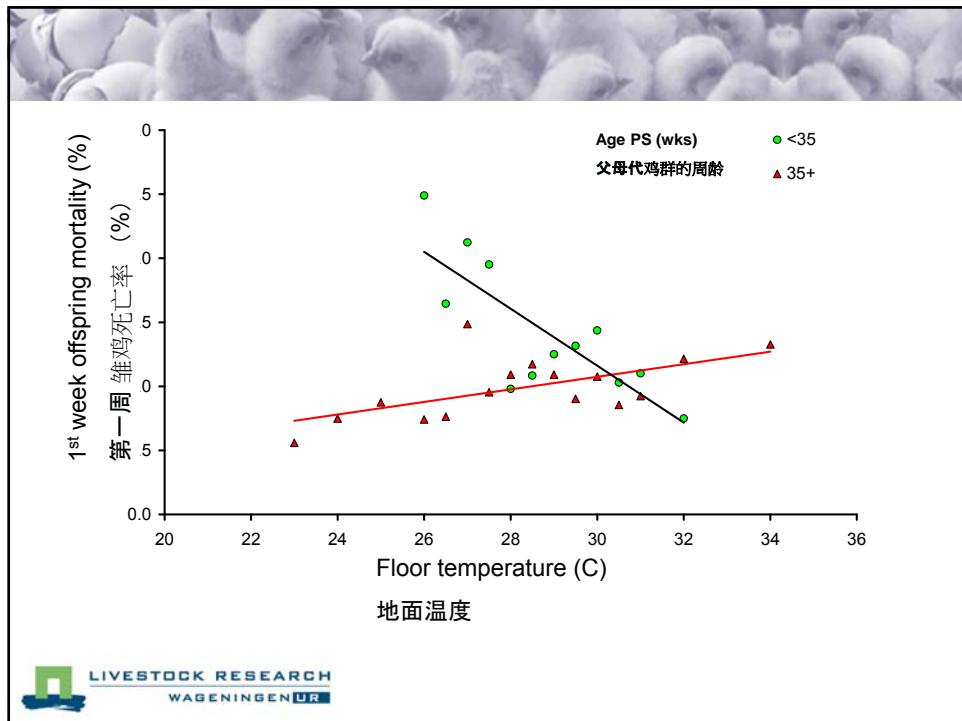


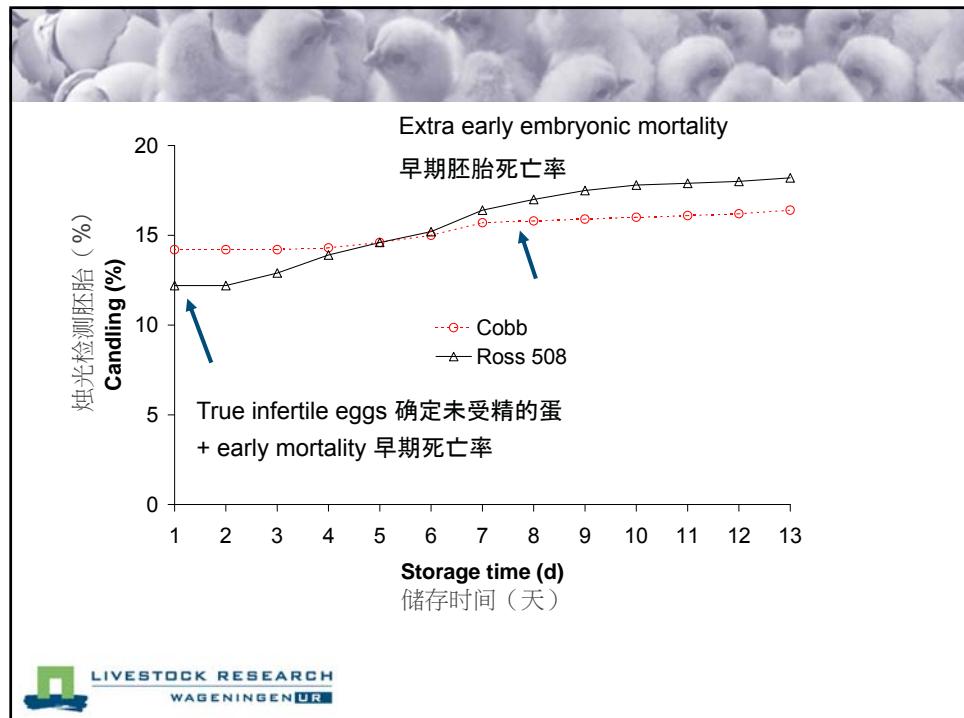
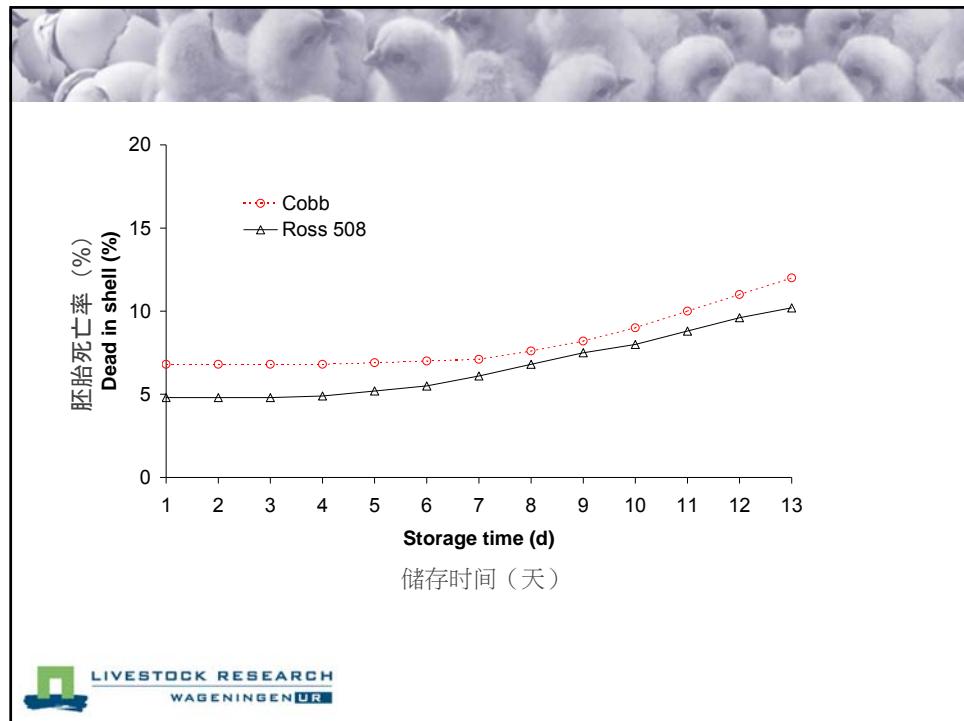
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Pre-heating of hatching eggs 孵化用蛋的预热处理

Bar chart showing body weight at 36 days post-hatch (BW at 36d) in grams for Hennen (female chickens) under different pre-heating and storage conditions.

Pre-heating:	Storage:	BW at 36d (g)	Significance
no	short 短	~2120	a
yes	short 短	~2100	a
no	long 长	~2050	b
yes	long 长	~2120	a

+80g



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Conclusions 结论:

- pre-heating technique prevented production loss due to increased storage
预热处理技术可以预防由于存储期延长而导致的产量损失
- not harmful when applied at 3d storage
3d储存条件下应用，无负面影响

But 然而:

- system needs to be monkey proof!!! 本系统需要扎实的例证
- no use in times when demand for hatching eggs is high...
当孵化量很大时并没有实际效果
- Who will pay for it?? 费用由谁来承担？

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Veterinary factors 兽医数据

Virus diseases at PS level and progeny mortality.
父母代鸡群感染病毒性疾病概率与子代死亡率

Virus diseases 病毒性疾病	Primary mortality 早期死亡率	Vertical Transmission 垂直传播	Transmission via eggshell 通过蛋壳传播	Disease possible by insufficient maternal protection 外界保护不充分时容易患病	Immuno-Suppression 免疫抑制

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Veterinary factors 兽医数据

Virus diseases at PS level and progeny mortality.
雏鸡感染病毒性疾病概率与子代死亡率

Virus diseases 病毒性疾病	Primary mortality 早期死亡率	Vertical Transmission 垂直传播	Transmission via eggshell 通过蛋壳传播	Disease possible by insufficient maternal protection 外界保护不充分时容易患病	Immuno-Suppression 免疫抑制
NCD	X	??	??		
IB (Infectious Bronchitis)	X			X	
IBD (Gumboro)	X			X	X
CAV (Chicken Anaemia Virus)	X	X		X	X
IBH (Inclusion Body Hepatitis)	X	X		X	
AE	X	X		X	
Reo tenosynovitis (+ MAS)	X	X		X	X
TRT/ART (Rhinotracheitis)	X	X			
Marek	X				X
Aviaire Leucosis	X	X			x (ALV-J)

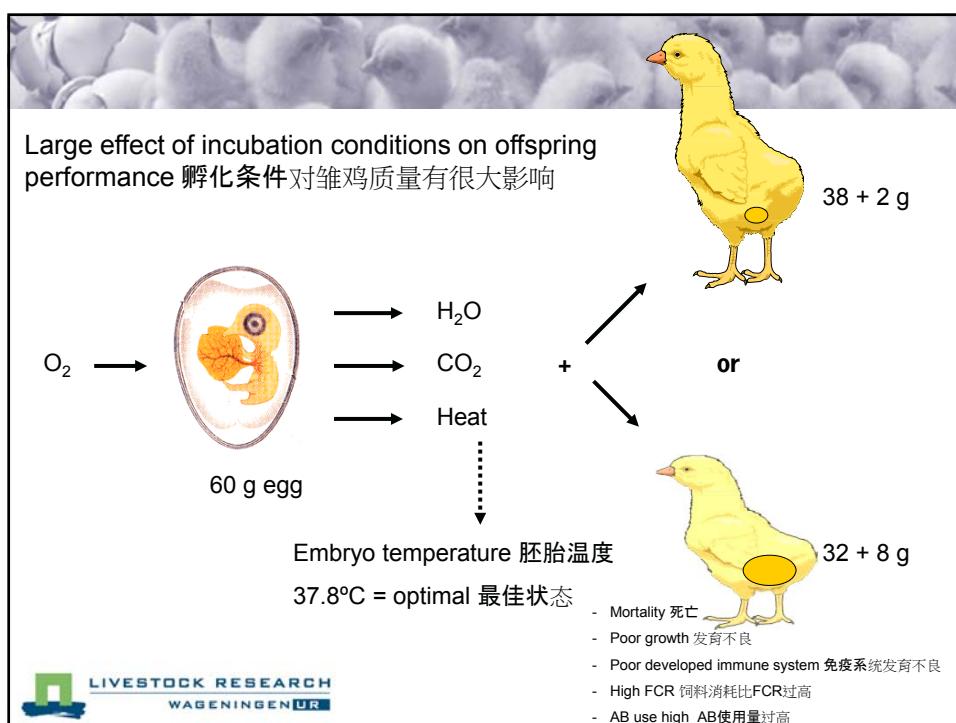
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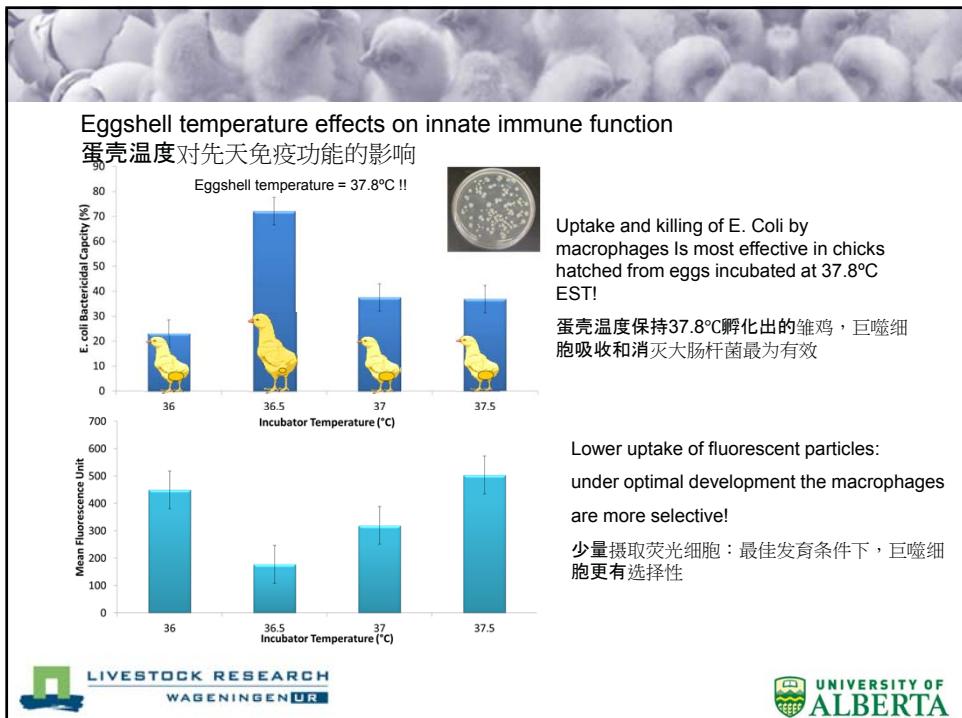
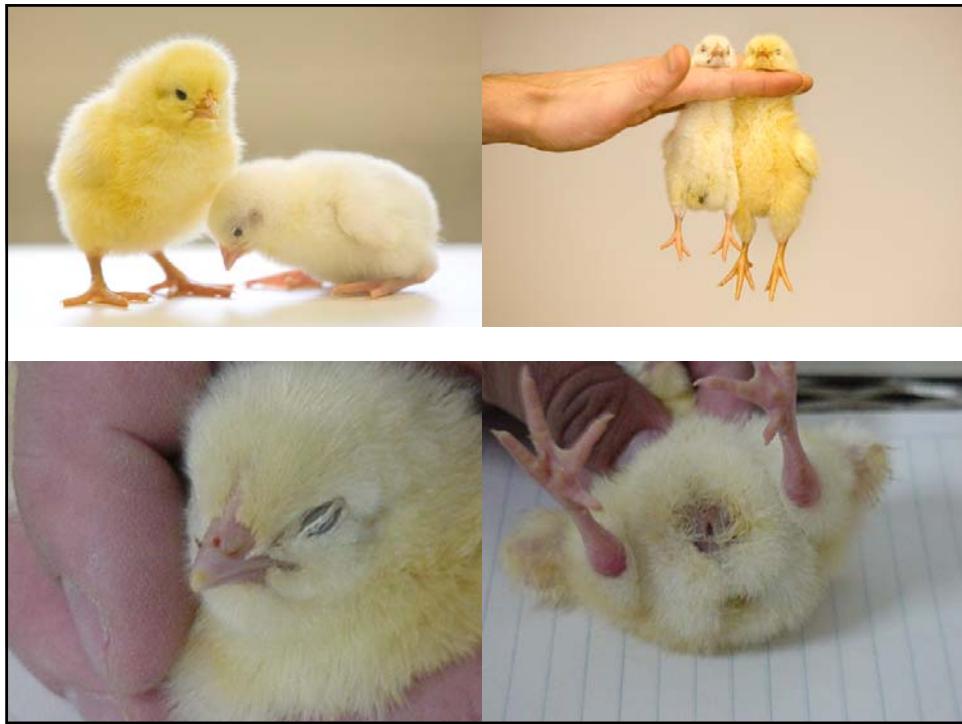
Veterinary factors 兽医数据

Bacterial and fungal infections in PS on progeny mortality
感染细菌与真菌对雏鸡死亡率的影响

Bacterial and Fungal diseases 细菌真菌类疾病	Primary mortality 早期死亡率	Vertical Transmission 垂直传播	Transmission via eggshell 通过蛋壳传播	Disease possible by insufficient maternal protection 外界保护不充分时容易患病	Immuno-Suppression 免疫抑制
Salmonella	X	X	X		
Campylobacter		x (very low)	X		
Colibacillosis	X	??	X		
ORT	X	X	??		
M. gallisepticum	X	X	X		
M. synoviae		X	X		
Enterococci / Streptococci	X	??	X		
Aspergillosis	X	X	??		

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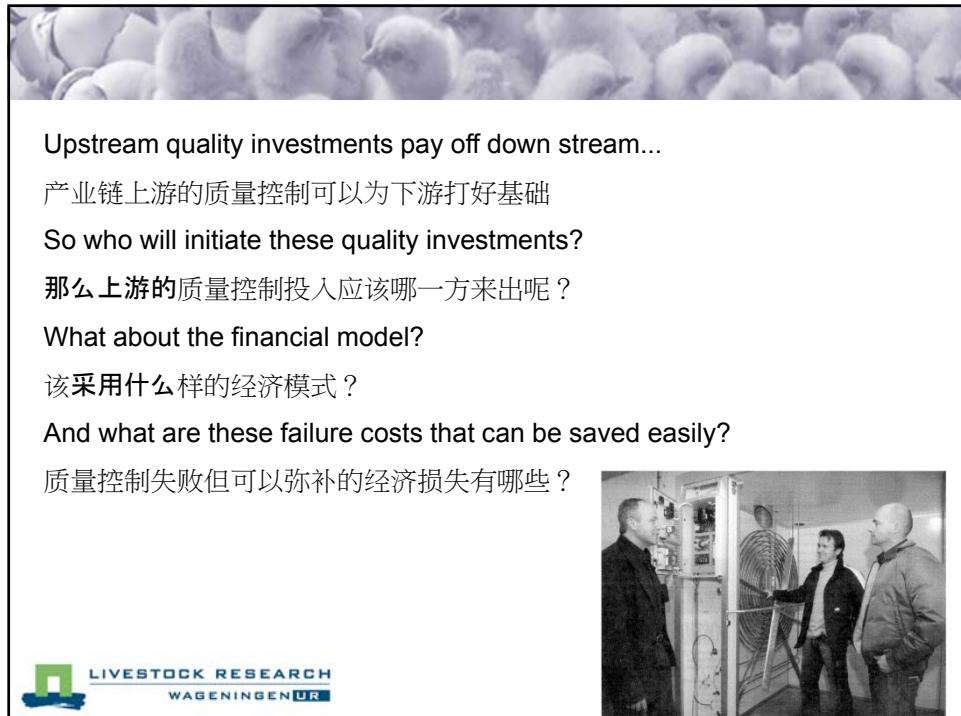


Day 16-21 temp (embryo) 日龄 16-21 天时的 胚胎温度	Bodyweight 体重	Fcr (2 kg) 饲料转化率
99	2.214 ^a	1.82 ^a
101	2.263 ^b	1.75 ^b
103	2.166 ^a	1.80 ^a

Experiment (Penn State, Gladys et al)



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Experiments and field results: 实验和实地数据结果：

- sign. differences in hatch, growth, feed conversion, mortality etc
- 对孵化、发育、饲料转化、死亡率等都有重大影响
- experiments: FCR effect 3-7 points
- 实验结果：对饲料转化率的影响有3-7个百分点
- field results Holland, 18 million broilers, 4.2 points FCR
- 荷兰的实地数据：1800万肉鸡，饲料转化率为4.2

Suppose difference is 2,5 points: 50 gram feed/2.0kg broiler

假设转化率的差异为2.5个百分点：50克饲料/2.0千克肉鸡

- machine 100.000 eggs, 17 eggs/egg place/year
- 孵化100000个鸡蛋，17个/地/年
- 80% hatch, 95% livability
- 80%用于孵化，95%的存活率

Profits 利润

- $100.000 \times 17 \times 80\% \times 95\% \times 0.05 = 64.600 \text{ kg feed / machine!!}$
- In Holland this relates to € 15.000 - € 20.000
- 在荷兰这相当于 15000-20000欧元



Example of the effect of improvements in technical results for an integration setting a million eggs per week. 案例：技术提升对于一个每周孵化100万鸡蛋的集约孵化场有何影响。Assumptions 假定：

Setting capacity 孵化能力	1.000	x 1.000 hatching eggs / week
Setter and hatcher costs 孵化室成本	0,50	€ / egg place
Interest rate 利息率	5	% / yr
Maintenance costs 维护成本	2	% / yr
Depreciation costs 折旧成本	10	% / yr
Hatching egg price 孵化用鸡蛋成本	0,18	€
DOC price	0,25	€
Days in setter 在孵化室的时间	18	d
Days in hatcher 在孵化器的时间	3,5	d
Feed costs 饲料成本	25,00	€ / 100 kg
Broiler meat price 肌肉价格	0,80	€ / kg
Filet price 鸡排价格	5,00	€ / kg
Broiler weight 肉鸡体重	2,0	kg
FCR	1,6	kg feed / kg growth
Mortality 死亡率	3,5	%
Filet yield 鸡排产量	20,0	%





Example of the effect of improvements in technical results for an integration setting a million eggs per week. 案例：技术提升对于一个每周孵化100万鸡蛋的集约孵化场有何影响。 **Extra income 额外收入:**

	Extra income 每年额外收入 (per year)	Unit 每个孵化间
Hatchability 孵化能力	€ 130.000	per %
Survival 存活率	€ 290.000	per %
Broiler slaughter weight 肉鸡屠宰体重	€ 180.000	per 10 g
FCR	€ 215.000	per point
Medicine use 用药量	?	Kg of ddd
Filet 鸡排	€ 223.000	per 0.1 %

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German integration (top down)
德国集约化孵化场

	Extra income 每年额外收入 (per year)
Hatchability 孵化能力 + 1,2 %	€ 156.000
Survival 存活率 +0.8 %	€ 232.000
Broiler slaughter weight 肉鸡屠宰体重 +40 g	€ 720.000
FCR -4 points	€ 430.000
Medicine use 用药量 Down by 50 %	?
Filet 鸡排 +0.3 %	€ 669.000
Totaal 合计	> € 2.207.000

Combination of factors 综合各种因素:

- Incubation at embryo temperature 在控制胚胎温度的条件下进行孵化
- All floor eggs discarded (1.0%) 去除所有的窝外蛋 (1.0%)
- Measuring and controlling chick temperature during the first week 在第一周测量和控制雏鸡的体温

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- Large effect of breeder and hatchery on offspring mortality!
- 育种与孵化对雏鸡死亡率影响很大
- What can you do as broiler farmer??
- 作为肉鸡饲养者，该怎么做？
 - Ask for the PS background (broiler passport?) 要求雏鸡的背景资料数据
 - Flock age? 鸡群日龄
 - Vaccination chart? 疫苗接种记录
 - First week mortality in foregoing flocks of the same breeder? 所在同一品种第一周的雏鸡死亡率？
 - How many PS farms and houses used to complete the batch? 达到既定存栏量需要从多少父母代鸡群饲养场和孵化场购买雏鸡？
 - Health status and medicine use? 健康状况与用药情况？
 - Farm egg storage time? Hatchery egg storage time? 在产蛋场的存储期是多长？在孵化场的存储期？
 - Floor eggs included? 有没有使用窝外蛋？
 - Selection for cracks and misshapen eggs? 有没有筛选有裂纹和形状不规则的蛋？
 - Measure chick temperatures daily! 每天都测量雏鸡的体温。

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As an integration 总而言之,

Make a plan, work together with breeder farms, hatchery and broiler farmers
 育种场、孵化场和肉鸡饲养场应该一起协作，制定计划

Share information and do not optimise each sector with their own specific goals
 相互之间共享信息，不是单纯考虑己方的利益最大化，而是整体利益最大化

Train farmers how to achieve and maintain good quality chicks
 培训农民，告诉他们怎么培育和饲喂高质量的雏鸡

Give broiler farmers the choice to pay more for good quality chicks
 培育更多高质量的雏鸡，让肉鸡饲养场有更多选择

Give other broiler farmers the choice to buy cheaper less quality chicks
 同时也可以生产一部分质量一般的雏鸡，供其他肉鸡饲养场自由选择

Introduce upstream quality investments:
 对产业链上游的质量控制进行投资：

- Feed + water quality 饲料质量+水源质量
- Automatic laying nests + good ventilation 自动产蛋窝+良好的通风
- Egg storage facility 鸡蛋储存设施
- Egg and chicken transport 鸡蛋与雏鸡的运输
- Equipment to preheat hatching eggs before storage 储存前对孵化用蛋的预热处理
- Incubator equipment, Hatchbrood, Hatchcare, X-treck 孵化器设备
- Etc. 等

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