精液生产的生物安全问题及猪人工授精的最新研究进展

BIO-SECURITY PROTOCOL & TECHNIQUES DURING SEMEN PRODUCTION

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Objectives of this presentation – introduce
报告主题

- Concept of producing high integrity bio-secure semen
  生产高生物安全完整性的精液理念
- Pre-requisite Specific Pathogen Free AI Centre; bio-secure location (1,000 point score)
  无特定病原体的人工授精中心是首要条件；生物安全的位置（评分 1000分）
- Pre-requisite pressure ventilated and clean filtered air
  有压力通风且干净的过滤空气是首要条件
- Measured, diagnostically tested drinking / washing water supply; water quality assessment, potage standard, free from contamination
  有基于标准的、按照诊断检测饮水/ 供应洗涤用水；水质评定、液体标准，无污染
- Water in lab Type 1 18.2 meg ohm quality, continual bacterial scan / conductivity measurement plus storage under UV
  实验室I级用水 18.2Ω，持续细菌检测/ 导电性检测加紫外光储存
- All inputs measured, recorded, monitored to ensure high integrity, audited and regulated consumables supply chain
  吸入性检测、记录、监控来保证高安全性、可监控以及耗材供应量管理
- All vectors measured, recorded, monitored to ensure minimal bacterial, viral contamination
  所有的细节都能被检测、记录和监控，从而最大程度上细菌、病毒的污染
- Pre-entry genomic selection of boars to ensure minimal dissemination inherited genetic defects through production chain
  种公猪的基因组选择预报清单能够保证在生产链过程中，遗传给后代的遗传缺陷最小。

BIOSECURITY (OIE Definition)　　生物安全（OIE 定义）

A set of management and physical measures designed to reduce the risk of introduction, establishment and spread of animal diseases, infections or infestations to, from and within an animal population

一系列管理和物理检测旨在降低动物疾病引入、确立和传播的风险，以及动物群体内或群体间感染和侵扰的风险。

Biosecurity is 生物安全是:

1) Plan (HACCP)
   计划（HACCP）
2）Traceability (Identify / Trace all semen dose including delivery)
   可追溯性（定义/追溯所有精液包括运输过程中的）
3）Surveillance (Monitor plan at all times)
   监督（随时的管控计划）
4）Diagnostic (Quick and reliable)
   诊断（快速可靠）
5）Documentation (Boar and semen dose production)
   文件记录（公猪和精液生产）
6）Emergency response (contingence planning)
   紧急情况反映（意外事件的计划）
7） Supervision and control (Who can decide: competence and authority)
   监督和控制（决策者：能力和权威）

风险评估

Assessing risks

决定必要的
生物安全测定

Determine essential biosecurity measures

实施生物安全测定

Implementing biosecurity measures

风险监控和测定

Monitoring risks and measures

经常改变评估

Always assess change

调整计划

Adjusting program

Cryogenic Technology to maximize the bio-security of elite genetics
通过使用冷冻技术能够最大程度上保证优秀遗传基因的生物安全性

- Cryogenic technology will enable gametes from elite sires / dams to be stored indefinitely
  冷冻技术能够无限期保存公母畜的配子

- Fertility cryogenically stored semen acceptable for dissemination elite genetics
  冷冻储存精液，能够将优秀的基因遗传给后代

- Bio-security enhanced, serum samples stored from donor and frozen with gamete
  生物安全性的提高，能够将供体的血清样本随配子一同进行冷冻保存

- Gametes from Genetic Nucleus can be stored in complete isolation, optimal bio-security
  胚胎的遗传基因的和物质能够通过冷冻储存的方式进行完全的分离，使生物安全性最佳

- Genomic testing of gametes and viral / bacteriological diagnostics in event of disease outbreak
  针对疾病的爆发，可以通过配子的基因组检测，病毒/细菌学诊断避免

Veterinary Bio-Banking
动物医学生物样本库

What is Biobanking? 什么是生物样本库

- Collection of biological materials and associated data
  生物材料和相关数据的收集

- Different types of Biobanks 生物样本库的不同类型
  - Human, microorganisms, animals, plants 人类，微生物，动物，植物
  - Biomedical research 生物医学研究
  - Medical archives 医学档案
  - Therapy 治疗方法
    - Blood banks | Bone marrow | Cord blood | Stem cells | Organs
      血库丨骨髓丨脐带血丨干细胞丨器官
  - Forensic 法医
  - Museum 博物馆

- Different Biobank formats 不同的生物样本库形式
  - Population-based 基于群体的
    - Random cohorts 随机分组
    - Twin-registries 双生子登记
    - Population isolates 人群结构
  - Disease-oriented 疾病主导
  - Disease-specific cohorts 特殊疾病的人群队列
  - Tissue banks 组织样本库

Biobanking and genetic potential preservation 生物样本库和遗传潜力保存

- Packaging and sample management solutions for preservation and storage of biological samples at variable low temperatures:

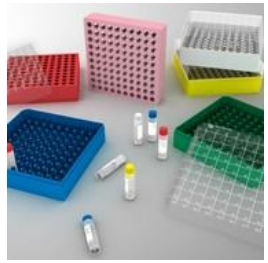
  不同低温设定下生物样本的保存，以及对保存样品的灌装和管理的解决方案。

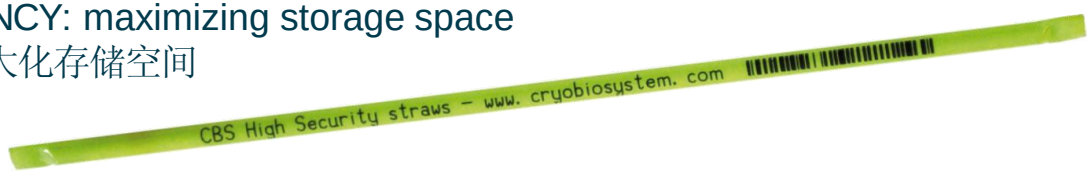
  - Liquid nitrogen phase (-196°C)
    液氮保存阶段（-196℃）
  - Liquid vapor phase nitrogen (~-132°C)
    液氮熏蒸阶段（-132℃）
  - Ultra-low temperature electrical freezers (-80°C)
    超低温冷冻仪

- To preserve valuable biological samples and viable cells for future use, ensuring maximum sample viability by assuring the:

  为了最大程度上保证今后保存多样的生物样本及细胞的活力，需要满足以下条件：

  - QUALITY: preserving and maintaining a sample's initial quality
    质量：保存和维持样本最初的质量
  - SAFETY: ensuring the safety of the stored product , the patient/donor, the user
    安全：确保所存储产品的安全性，病人/供体，使用者
  - TRACEABILITY: enhancing traceability with tamperproof barcoding
    可追溯性：使用防止篡改的条形码增强可追溯性
  - EFFICIENCY: maximizing storage space
    效率：最大化存储空间





Assisted reproductive techniques to maximize boar semen production
使用辅助繁殖技术使公猪精液产量最大化

- Significant improvement harvested sperm cells per ejaculate; utilisation ultrasound to evaluate boar reproductive tract
  显著提高射精后的采精量，使用B超来评估公猪的生殖道

- Semen qualitative assessment; improved microscopy technique, CASA technology, ffluorescent staining
  精液质量评定，提高显微镜检查技术，CASA技术，荧光染色

- Water purification technology Type I, II
  水质纯化，I级或II级用水

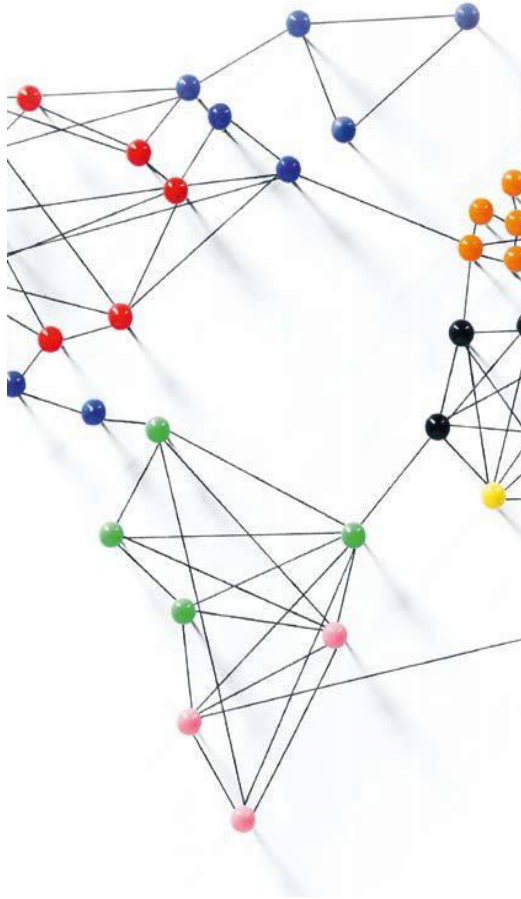
- Photometric sperm cell concentration
  密度仪检测精子细胞的密度

- Improved anti-biotic KTK, increased shelf-life of semen by using enriched preservation media
  提高KTK抗体，使用丰富成分的稀释液进行精子膜结构的保护

Reducing bacterial load, identifying viral problems, maximising efficacy of bio- logical media to reduce transfer of pathogens

降低细菌含量，识别病毒性影响，通过使用生物成分的稀释剂来最大程度上降低病原体的转移

- Automatic semen collection
  全自动精液采集系统
- Rectal temperature; monitor for elevated core body temperature indicative of potential infection
  直肠温度：检测躯体某些部位温度提高来说明可能的感染
- Bacterial swab preputial fluid; analysis
  细菌棉签检测包皮液
- Routine blood tests for specific pathogens through ELISA / PCR technology
  通过常规血液检测，进行特定病原体ELISA/PCR技术检测
- High efficacy anti-biotic in-media
  稀释剂中的高效抗生素
- Bacterial charge monitoring on semen doses as a part of the QC process
  质量控制中细菌检测监控精液品质
- Implementation of Hazard Analysis and Critical Control Points Systems (HACCP) and Good Processing Practices (GPP)
  危害分析与关键控制点系统（HACCP）和优良加工实践（GPP）

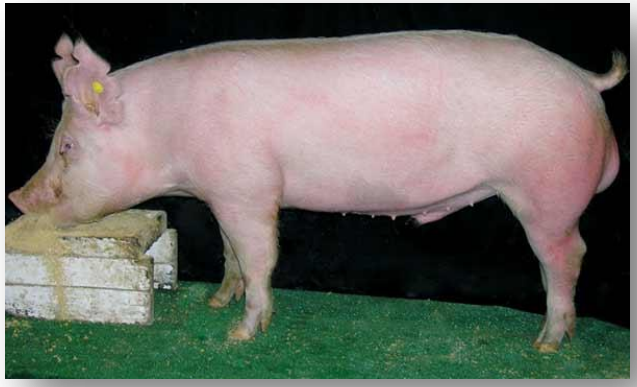


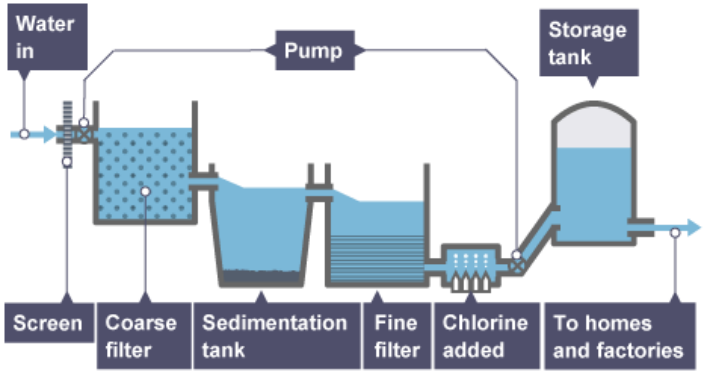
Contamination sources during processing of swine semen
猪精液处理过程中的污染源

Animal origin 动物源性	Non-animal origin 非动物源性
Fecal 粪便	Tap water 自来水
Preputial cavity fluids 包皮液	Purified water (e.g., water lines or holding tanks) 纯净水（供水线或控制箱）
Skin/hair 皮肤、毛发	Plant matter (i.e., feed, bedding) 植物因素（饲料、垫草）
Respiratory secretions 呼吸道分泌物	Air/ventilation system 空气/通风系统
Human (e.g., skin, hair, respiratory secretions)	Sinks/drains 水槽/排水

人（皮肤、发毛、呼吸道分泌物）

Althouse and Lu 2005

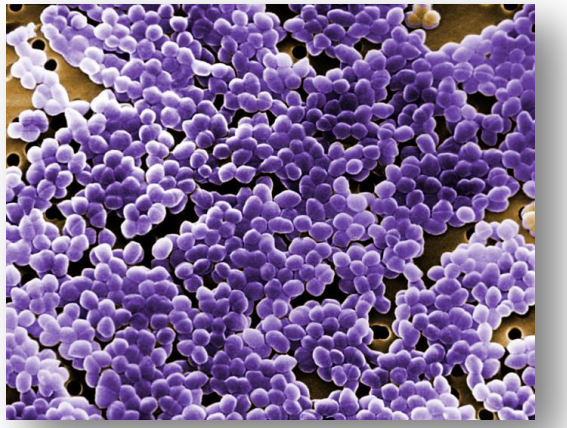




Principal bacteria involved in semen contamination
精液污染中涉及的主要细菌

Bacterial contaminants isolated from submitted samples to the reference Andrology Laboratory at the University of Pennsylvania from 13 August 2002 through 15 August 2003 ($n = 78$)

Bacterial isolate	Frequency of isolation (no.)
Enterococcus spp.	16
S. maltophilia	12
A. xylosoxidans	8
S. marcescens	8
A. lwoffi	6
E. coli	5
Pseudomonas spp.	5
Comamonas testosteroni	4
Klebsiella spp.	3
Providencia rettgeri	3
B. cepacia	2
E. cloacae	2
Corynebacterium spp.	1
Pasteurella multocida	1
P. mirabilis	1
Streptococcus suis	1



Enterobacteria
肠道菌
Staphylococcus
葡萄球菌
Streptococcus
链球菌

Althouse and Lu 2005

Boar semen bacterial contamination origin
公猪精液的细菌污染源

Bacteria contamination sources
细菌污染源

Mammalian origin *(Althouse, 2008)*
哺乳动物来源

- Preputial fluids 包皮液
- Urogenital system 泌尿生殖系统
- Skin 皮肤
- Hair 毛发
- Respiratory secretions 呼吸分泌物
- Feces 粪便
- Poor hygiene conditions较差的卫生条件
- Personnel contamination 人员污染

Environmental origin *(Althouse and Lu, 2005; Althouse et al., 1998)* 环境来源

- Contaminated water 水污染
- Feed 饲料
- Bedding 垫料
- Equipment 设备
- Air ventilation systems 通风系统

Impact on semen quality 精液质量的影响

- Competition for nutrients 养分竞争
- Sperm damage (by bacterial waste products or direct interaction)
  精子损伤（通过细菌废弃产物或直接）
  Decrease in sperm motility and viability
  Premature acrosome reaction 精子活力和存活性能下降，过早的顶体反应
  Sperm agglutination 精子聚集
- Resistance development 抗性发展

(Dagmar Waberski et al./ Morrell JM/ Althouse et al., 2008/ Engblom et al., 2007)

Impact on reproduction results繁殖结果的影响

- Genital infection 生殖器感染
- Loss of fertility 繁殖力损失
- Reduces conception rate and litter size at birth 窝产仔数和受胎率下降
- General disease in sows 母猪常见病

(Dagmar Waberski et al./ Morrell JM/ Althouse et al., 2008/ Engblom et al., 2007)

Boar semen bacterial contamination 公猪精液细菌污染

Enterobacteriaceae family (Gram+): highest contamir

肠杆菌科家族（Gram+）：最高污染

- ***Escherichia coli* 大肠杆菌**
- ***Pseudomonas*绿脓杆菌**
- ***Proteus spp* 变形杆菌**

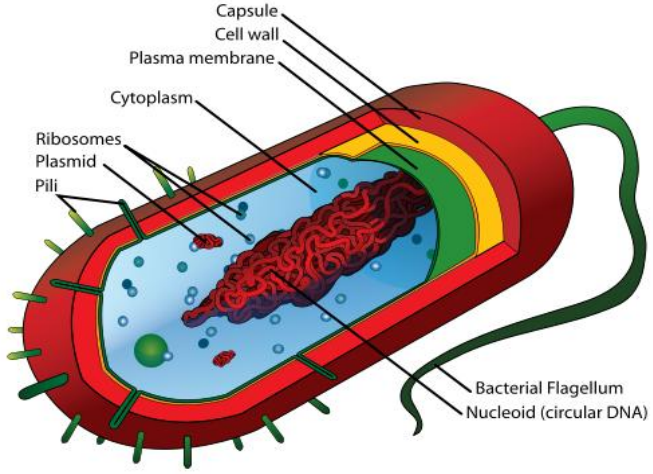


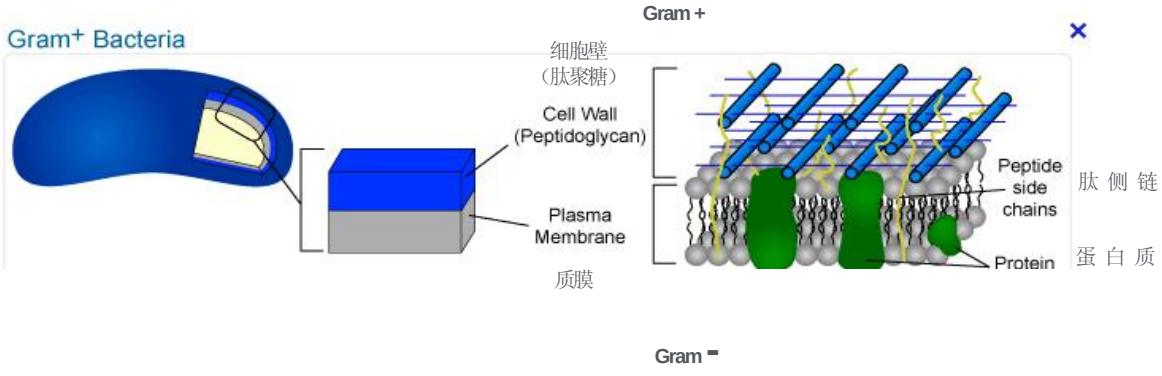
Table 1
Common bacterial flora isolated from the neat boar ejaculate

Tamuli et al. [7]	Danowski [3]	Dagnall [2]	Sone et al. [5]
E. coli	*Staphylococcus* spp.	*Citrobacter* spp.	*Pseudomonas* spp.
Pseudomonas spp.	*Pseudomonas* spp.	*Pseudomonas* spp.	*Micrococcus* spp.
Bacillus spp.	*E. coli*	*Corynebacterium* spp.	*Staphylococcus* spp.
Staphylococcus spp.	*Citrobacter* spp.	*Streptococcus* spp.	*Klebsiella* spp.
Klebsiella spp.	*Providencia* spp	*E. coli*	*E. coli*
Proteus spp.	*Neisseria* spp.	*Actinomyces*-like spp.	*Citrobacter* spp.
Enterobacter spp.	*Proteus* spp.	*Bacteroides* spp.	*Proteus* spp.
Pasteurella spp.		*Lactobacillus* spp.	*Actinomyces* spp.
Citrobacter spp.		*Acinetobacter* spp.	*Serratia* spp.
		Bacillus spp.	*Enterobacter* spp.
		Actinobacillus spp.	*Bacillus* spp.
		Staphylococcus spp.	*Streptococcus* spp.
		Flavobacterium spp.	
		Klebsiella spp.	
		Micrococcus spp.	
		Proteus spp.	

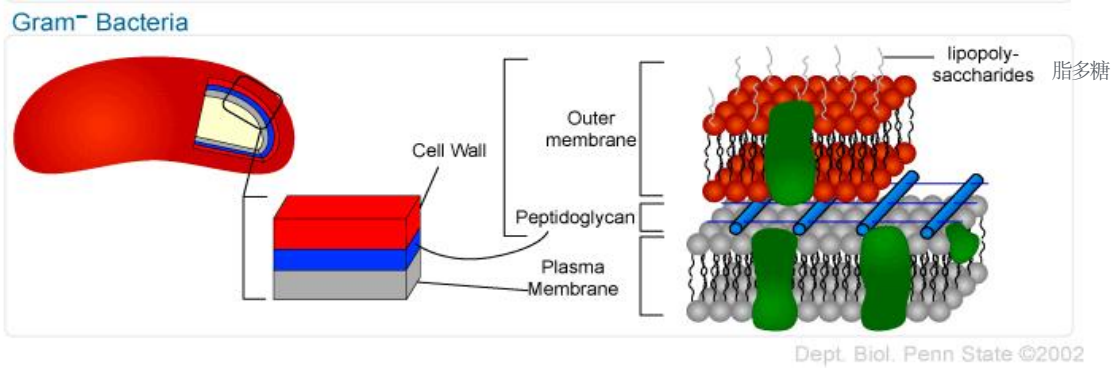
Althouse et al, 2004

Boar semen bacterial contamination resistance 公猪精液抗细菌污染性

“Drug resistance has been observed among isolates from boar semen against antibiotics commonly used as preservative antimicrobials in commercial porcine semen extenders” ***(Althouse and Lu, 2005).***
通常使用的商业化的公猪精液稀释液中的抗菌剂的抗体会是的公猪精液产生抗药性。



Due to impenetrable cell wall, Gram-negative bacteria are more resistant against antibiotics.
因为不可穿透的细胞壁，革兰氏阴性菌抗药性更强



Mechanisms of resistance development
抗性发展机制

- **Reduction in the binding of the antibiotic by modification of the lipopolysaccharide**
- 通过修饰脂多糖减少抗菌素的结合
- **Generation of outer membrane vesicles that minimize the effective amount of the antibiotic per cell**
- 外膜泡的形成以降低每个细胞中的有效抗菌素数量
- **Modifications in the number or type of porins required for penetration of antibiotics**
- 孔蛋白类型或数量的修饰需要抗菌素的侵入
- **Expression of efflux pumps to eliminate antibiotics present in the cytoplasm**
- 外排泵表达以消除细胞质中存在的抗菌素
- **Some bacteria can also produce antibiotic-inactivating enzymes**
- 一些细菌能产生抗菌灭活酶

(Corona and al, 2013; Reguera et al, 1988, 1991; Martinez et al, 1989)

Bacterial contamination 1 - reduction 2.5 to 3.3 pigs/litter

细菌污染 1 – 减少2.3到3.3个仔猪/窝

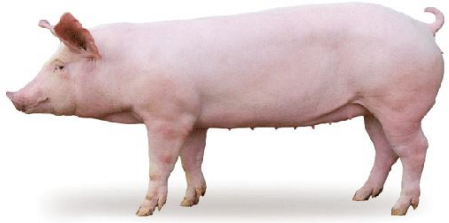
Bacterial contamination of boar semen affects the litter size

公猪精液细菌污染影响窝产仔数

Luis O. Maroto Martína, et al., 2010

Experimental design
实验设计

42 boars
(39 boars contaminated)
42头公猪
（39头污染）



9 sows per boar
每头公猪配9头母猪

Results
结果

If E coli > 3.5 10^3 CFU/ml,
Reduction in litter size :
2.53 to 3.35 pigs/litter
如果大肠杆菌＞3.5 10^3 CFU/ml，
窝产仔数降低：2.53-3.35只/窝

Bacterial contamination effect 2 - conception rates reduction
细菌污染影响2- 受胎率下降

The impact of bacteriospermia on boar sperm storage and reproductive performance
含菌精液对精液保存和繁殖表现的影响

C.E. Kuster a,, G.C. Althouse b, 2015*

Experimental design
实验设计

Number of boars : 160
Number of sows : 21 000
公猪数量：160
母猪数量：21 000

Results
结果

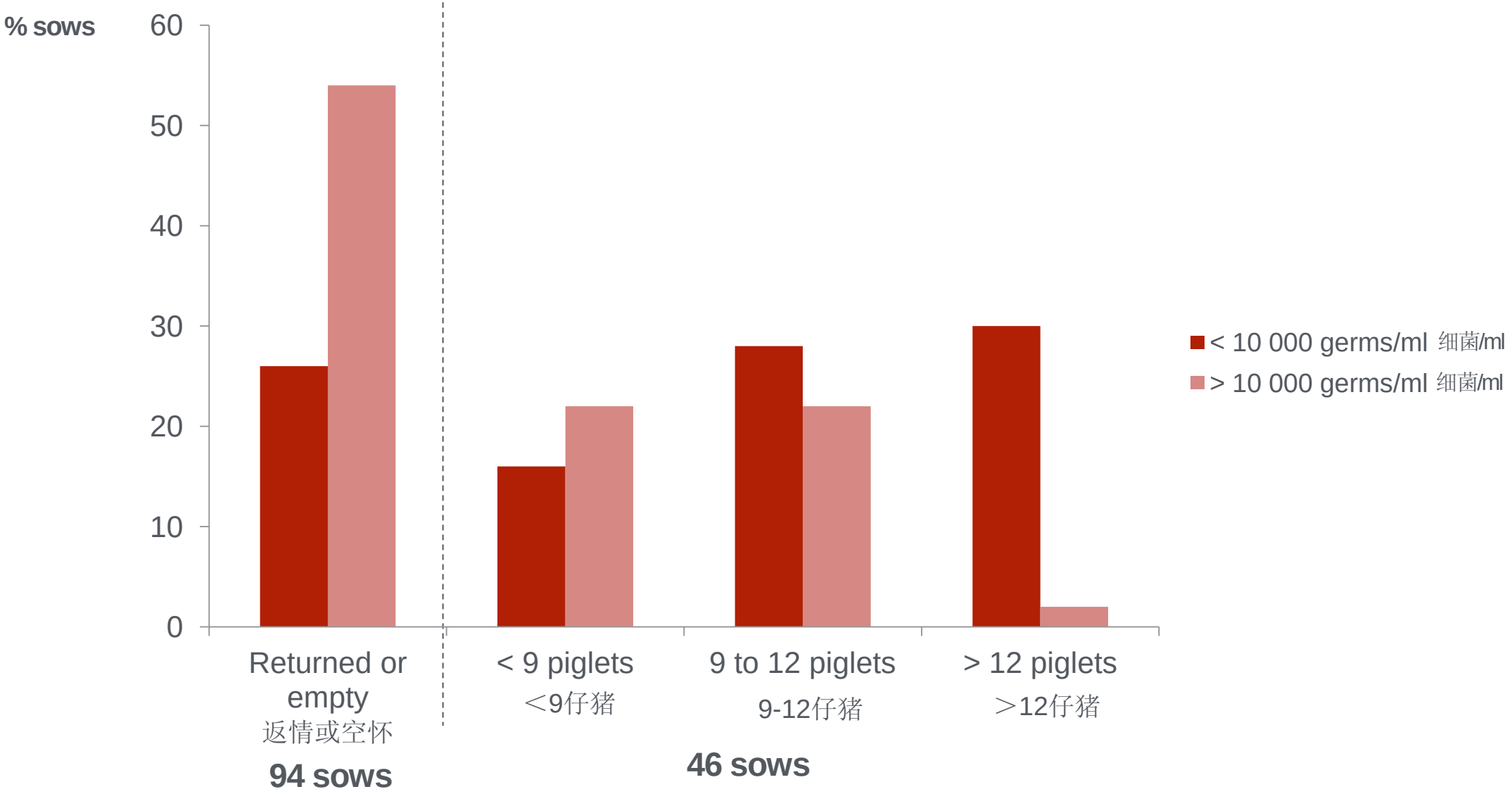
- Vulva discharge : 8 to 15%
- 阴户流出：8-15%

- **Conception rates reduction : by 6% to 12%**
- **受胎率下降：6-12%**

Bacterial contamination effect 3 – Performances reduction
细菌污染影响 3- 性能下降

Influence of semen contamination on reproductive performances精液污染对繁殖性能的影响

Madec and Vannier 1989



BACTIBAG, a new solution against bacteria growth
BACTIBAG，抵抗细菌生长的新的解决方案

1

- Bacterial contamination 细菌污染/ economical impact 经济影响

2

- BactiBag : new solution against bacterial growth抵抗细菌生长的新的解决方案

3

- BactiBag : in vitro and in vivo results 体外或体内结果

Which solution to prevent bacteria in semen
哪种方案可以阻止精液中的细菌？

75% boar studs: 75%公猪站

Challenge to control bacteria contamination in semen doses 向控制每份精液中的细菌污染挑战

How to decrease bacteria contamination in semen doses?

如何降低每份精液中的细菌污染？

Hygienic process
卫生条件

- Decrease bacteria in ejaculate during collection (Collectis, disposable products, hygienic process disinfection…)
- 采精过程中降低细菌污染（Collectis，一次性产品，卫生消毒过程）

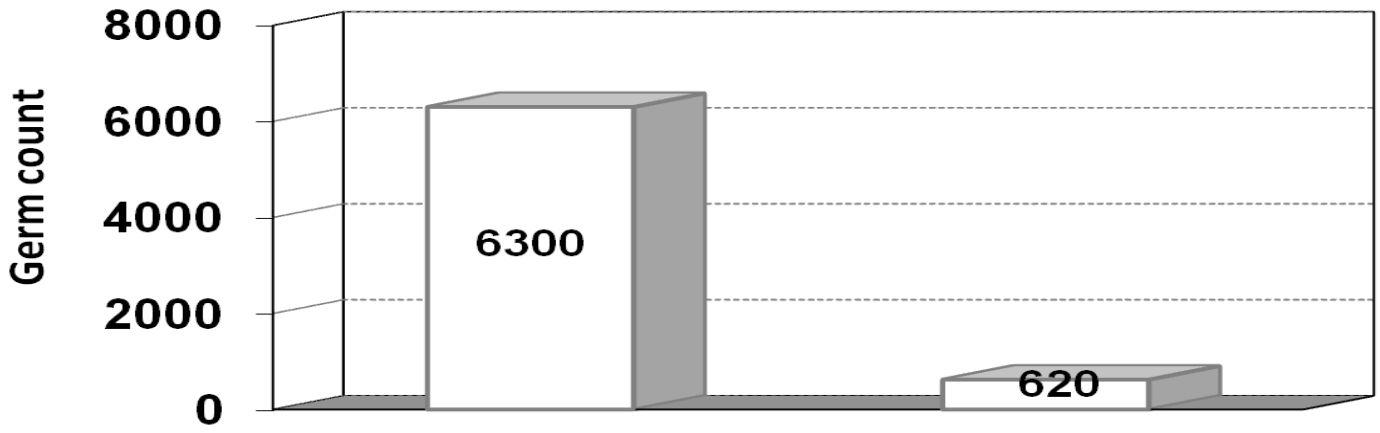
Additional antibiotics
其他的抗菌素

- Add a new antibiotic to the antibiotics combination (compatibility problem between antibiotics and risk of toxicity)
- 加入新的抗菌素（抗菌素和毒性风险的相容性问题）

BactiBag

- New agent, BactiGuard, contained in the plastic
- 新的介质，塑料中含有BactiGuard

Automated semen collection 全自动采精系统



Over 12,000 boars collected weekly in more than 65 centres, 20 countries
平均每周全球20个国家，65个授精中心，超过12,000头公猪通过此系统采精
18 million doses produced per year
每年生产1800万剂精液

- **Reduce by over 10 times bacterial content of ejaculates (Lellbach *et al*, 2008)**
  采集的精液细菌含量缩减了10倍
- **Increasing productivity (Aneasa *et al*, 2008)**
  增加生产力

Semen dose packing and smart plastics
精液袋包装和优良的塑料

- **Plastic bags for packing boar semen results in a practical alternative compatible with inseminations programs world wide.**
  公猪精液灌装的塑料袋要求与全球的方法相匹配

- **Smart plastics allow for extra protection of semen doses during storage, delivering and insemination.**
  在精液袋存储、运输和输精过程中，优质的精液袋能够提供额外的保护

- **Bacteriostatic effect of the packing bag improves semen quality at AI by stopping bacterial growth.**
  此款精液袋的抑制细菌的效果将会提高AI过程中的精液质量，同时抑制细菌的生长

- **This technology envisages the reduction or complete elimination of antibiotics in boar semen.**
  这款设计理念降低或完全消除了公猪精液中的抗体

Bacti BAG

Monitoring of bacterial load in AI doses as part of the QC process
质量控制过程中的一个重要部分就是监控AI精液中的细菌含量

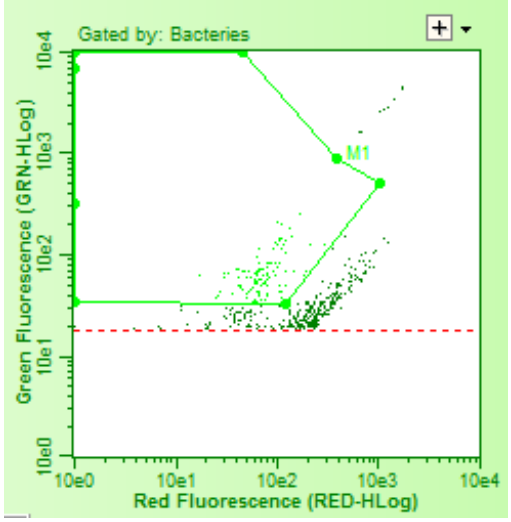
- Flow cytometry technology offers a precise estimation of the bacterial load of sperm doses.
  流式细胞技术为精液中的细菌含量检测提供了一个精确的方法

- Discrimination of dead and alive bacterial and yield of a total bacterial count.
  区分死或活的细菌，计算总细菌数

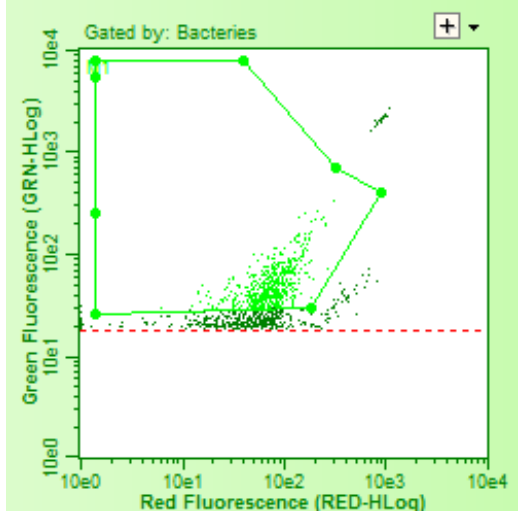
- Fast preparation of samples for analysis (10-20 minutes)
  样本分析的快速制备（10-20分钟）

- Screening of single boars for bacterial load of ejaculates maximises traceability and avoids contamination of semen pools during preparation of AI doses.
  筛查每次采精的单一公猪的细菌含量，并未AI精液的准备过程提供最佳化的可追徐性，同时避免整体精液库的污染

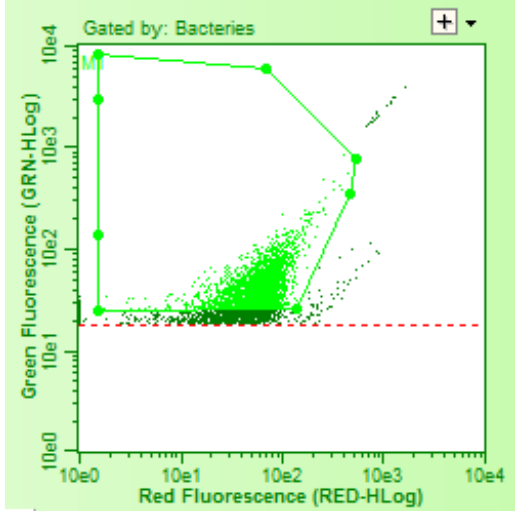
轻度污染
Low concentration



中度污染
Median concentration



高度污染
High concentration



Hazard analysis and critical points (HACCP)
危害分析和关键控制点

Principles	Planning	Implementation
Hazard's identification	Review of the nature and causes of reduction in the viability of samples. Identification and characterization of tangible hazards	Assess the nature and severity of the identified hazards. Identify hazards present in the SPC
Risk and severity of hazards	Evaluation of the relative severity of hazards according to the literature	Identify the risk and severity of hazards according to their frequency
Identification of critical control points	Priority for actions to correct the occurrence of a hazard that cannot be controlled in subsequent steps	Identify steps of the processing incurring in potential damage for the viability of the samples
Identification of monitoring procedures	Establishment of protocols to monitor the identified hazards	Use procedures to check volumes and temperatures
Establishment of corrective actions	Establishment of actions for immediate correction of deviations	Identify corrective actions for each hazard
Verification procedures	Review and validation of procedures	Periodical monitoring to evaluate the system, introducing changes when necessary

Goularte et al. 2015

Pork Industry Biosecurity Code 猪业生物安全准则

Piggery Audit Checklist 猪圈审计清单

Audit date: 审计时间	Audit done by: 审计人	Property name: 牧场名

1.0	DOCUMENTATION and TRAINING 文档和培训	PARAGRAPH REF.参考	YES	NO	N/A	CORRECTIVE ACTION 矫正措施
1.2	Have staff been given instruction in the relevant parts of the Code? 员工是否给予过相应准侧的指导方法？	1.2				
1.3	Is a record kept of all relevant training received by employees? 是否有记录表明所有员工都收到过相应培训	1.2				
1.4	Is a pig mortality register being maintained?死亡率是否登记注册？	4.4.1				
1.5	Is an appropriate pig movement register being maintained?猪是否有适当的运动记录？	4.4.2				
Notes						

2.0	FACILITY STANDARDS 设施标准	PARAGRAPH REF.参考	YES	NO	N/A	CORRECTIVE ACTION 矫正措施
2.1	Does the production area have a perimeter fence and can access routes be closed off to prevent vehicle entry? 生产区是否有牢固的围栏，且有路线设计能避免车辆进入？	2.1 2.5				
2.2	Is there a sketch, map or photo	2.4				

	clearly defining the production area and the property, including all access roads and gates? 是否有地图清晰指明生产区域，标的物，以及通道和大门？					
2.3	Is there adequate signage to inform visitors of the Biosecure Area and what action they should take?是否有适当的标识告知参观者生物安全区域以及他们应该如何处理？	2.5				
2.4	Is there an off-site parking area for visitors?参观者是否有站外停车位？	2.6				
2.6	Is a separate pair of boots available and used for each pig shed enclosure? 是否每个猪圈围栏都有单独可使用的靴子？	2.7				
2.8	Is the area around the sheds neat and tidy, e.g. mown grass? 围栏区域周边是否干净整洁，比如 割下的草？	2.10				
2.9	Are hand sanitisers or washing facilities available and used at all entrances which allow personnel access to sheds?是否所有的通道都有洗手消毒剂和清洗设施，以便所有人都能进入围栏？	3.6.2				
2.10	Are other livestock excluded from the production area or effectively restricted to areas so that their faeces cannot come in contact with pigs either directly or indirectly, e.g. water draining into pig areas/sheds?是否排除生产区域的其他动物，或者通过有效的温岚设施避免它们与猪的直接或间接接触，比如 向猪圈内排水	2.2 2.15				
2.11	Are the sheds bird proof as far as practical? 实际中这些围栏能否防止鸟类进入	2.9				
2.12		2.15				
2.13	Are feed and bedding stores as bird and vermin proof as	2.17 2.18				

	practically possible? 饲料和垫草能否防鸟和害虫					
2.14	Is the pig effluent disposed of according to recommended protocols?猪排出的废水能够根据推荐的方法处理？	2.19				
Notes 备注						

3.0	**PERSONNEL STANDARDS 员工标准**	**PARAGRAPH REF. 参考**	**YES**	**NO**	**N/A**	**CORRECTIVE ACTION 矫正措施**
3.1	Is there a signed Personnel Biosecurity Declaration for each employee? 每个员工是否有签名的生物安全宣言？	3.1.1				
3.2	Is there a Visitors' Log and are all production area visitors required to enter their details in the Log?是否对于进入生产区域的参观者有详细的记录？	3.4.2				
3.3	Are the conditions of entry to the production area prominently displayed near the Visitors' Log?生产区域是否与参观者通道很近？	3.4.1				
Notes						

4.0	**WATER QUALITY, FEED & BEDDING 水质，饲料和垫料**	**PARAGRAPH REF. 参考**	**YES**	**NO**	**N/A**	**CORRECTIVE ACTION 矫正措施**
4.1	Does the pig drinking water meet recommended livestock water quality standards? 猪的饮水是否符合推荐的动物饮水质量标准？	2.1.14 4.1.1				
4.2	If water treatment is used, is the treatment method effectively monitored? 如水进行处理，是否对处理措施进行有效监控？	4.1 4.1.2, 4.1.3				

4.3	Does all the feed and bedding provided for pigs come with vendor declarations of its suitability for purpose and freedom from contaminants? 针对所有提供给猪的饲料和垫料是否保证杜绝污染？	4.1.7				
4.4	Does the feed provided comply with swill feeding regulations? 所有提供的饲料是否符合残羹饲养规律？	4.1.8				
Notes						

5.0	**VERMIN CONTROL PROGRAM AND RODENT BAITING PROGRAM** 害虫控制计划和啮齿类下诱计划	**PARAGRAPH REF.参考**	**YES**	**NO**	**N/A**	**CORRECTIVE ACTION 矫正措施**
5.1	Is there an appropriate pest and vermin control plan documented? 是否有良好的害虫和寄生虫控制计划？	2.12				
5.2	Is there a rodent baiting program in place in the production area? 生产区域是否有啮齿类动物下诱计划？	2.13				
5.3	Is there a plan showing the location of bait stations? 是否有表明诱饵位置的计划？	2.13.1				
5.4	Are the baits regularly checked for activity and replaced; and is there a record of this process? 定期检查诱饵的活性和位置，并对此进行记录？	2.13 4.2				
Notes 备注						

6.0	**CLEANING AND GROUND MAINTENANCE 清洁和地面保障**	**PARAGRAPH REF. 参考**	**YES**	**NO**	**N/A**	**CORRECTIVE ACTION 矫正措施**
6.1	Has spilt feed been cleaned up around silos? 从粮仓溢出的饲料是否进行清洁？	2.18 4.3				
6.2	Is the feed system closed to	2.18				

	prevent contamination of feed by rodents and birds? 这个饲喂系统能够防止啮齿类和鸟类对饲料的污染吗？					
6.3	Is there adequate drainage of the production area and in particular the area around the sheds? 生产区域和猪圈周围有适当的排水系统吗？	2.11 4.3.4				
Notes 备注						

7.0	**DEAD PIG DISPOSAL死猪处理**	**PARAGRAPH REF. 参考**	**YES**	**NO**	**N/A**	**CORRECTIVE ACTION 矫正措施**
7.1	Is there an appropriate procedure in place for the disposal of dead pigs?针对死猪处理是否有适当的程序？	2.8				
7.2	Is the procedure both environmentally sound and biosecure? 这个流程是否对于环境无害且有生物安全性？	2.8				
Notes 备注						

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Thank you

for your attention

谢 谢 聆 听