

Laboratory Pig Breeds

實驗豬種品種

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朱賢斌



Taitung Animal Propagation Station (TAPS LRI)

畜產試驗所 台東種畜繁殖場

Introduction 4 ♂, 16 ♀ TAPS LRI 1980

1980年畜產試驗所引種 蘭嶼豬 4 ♂, 16 ♀

Introduction policy making

Developing experimental minipigs

Germplasm Introduction
4 ♂ 16 ♀, TAPS, 1980

Introduction Policy, 1979

Made by Dr. Jong and Dr. Hwang

Suggested by experts from NIH USA



Dr. Jong



Dr. Hwang



Dep. Animal Industry

Council for Agricultural Planning and Development (CAPD, 1979)

鍾博 博士

黃輝煌 博士

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Origin



<http://www.beha.tcu.edu.tw/lanyu/>



Lanyu Island
蘭嶼島



Adapting characteristics:

- heat tolerance 耐濕熱環境
- disease-resistance 抗病性強
- roughage tolerance 耐粗飼
- early maturity 性早熟
- similar to human physiologically and anatomically 生物特性接近人類



■ Missions of minipig in TAPS, LRI

工作目標

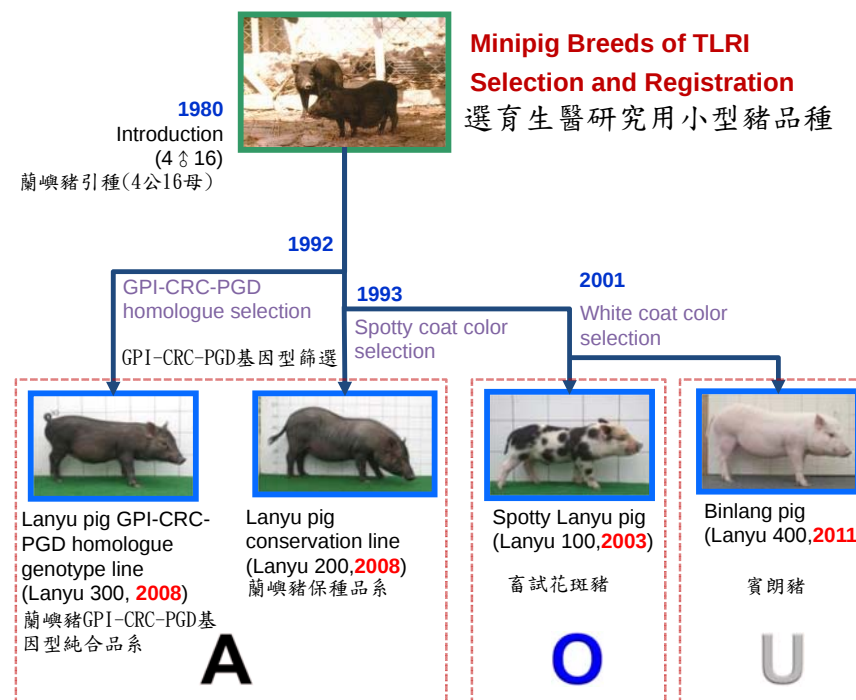
Germplasm Conservation

- Preserve agricultural biodiversity
- Maintain genetic diversity

Developing Niche Usage

- Selection
 - Extension
- For biomedical research

1. 守護珍貴本土小型豬種原
2. 選育生醫研究用小型豬品種
3. 生醫用途之生產供應



Breed	Basic information
 Lanyu pig GPI-CRC-PGD homologue genotype line 蘭嶼豬GCP品系	weight at birth : 0.6~0.8 kg 出生重
 Spotty Lanyu pig 畜試花斑豬	weight at sexual maturity : 20~25 kg 性成熟體重
 Binlang pig 賓朗豬	Sexual maturity : 4~5 months 性成熟月齡

豬種體型定義

Reproduction parameters of swine, and miniature swine with the adult weights of **Micropig** (微小型豬) and **Minipig** (小型豬).

Parameter	Swine	Miniature swine	
		Micropig	Minipig
Weight at birth (Kg)	1.30	0.45~0.60	0.60~1.00
Weight at sexual maturity (Kg)	90~120	15~18	25~30
Weight at body maturity (Kg)	200~300	35~55	70~90
Sexual maturity (month)	6	4~5	6
Length of pregnancy (day)	114	114	114
Litter size	10~14	5~8	5~8
Age at weaning (day)	28~35	28~35	28~35

^aYucatan micropig, Gottingen and Sinclair minipig

^bYucatan and Hanford minipig

Lanyu minipig breeds

The Laboratory Swine,

2000 by Peter Bollen PJA; AK Hansen & HJ Rasmussen. CRC Press.

A Lanyu pig GPI-CRC-PGD homologues genotype line (Lanyu 300)



蘭嶼豬GCP品系

GPI – B B
CRC- C C
PGD- A A

G0	1992	Gene Screening 基因型篩選
G1~G2	1993 ~ 1998	Half-sib selection 半同胞選育
G 3~G5	1999 ~ 2004	Full-sib selection 全同胞選育
Registered as a new line in 2008 命名登記		

A Lanyu pig GPI-CRC-PGD homologues genotype line (Lanyu 300)

蘭嶼豬GCP品系

Gene	Chromosome	Genotype	Function
GPI	6th	BB	Glucose phosphate isomerase
CRC	6th	CC	Calcium Release Channel
PGD	6th	AA	6-Phosphogluconate dehydrogenase



CRC-CC Type (Normal type)
free of **stress-shock syndrome**

GPI (葡萄糖磷酸基異構酵素)
CRC (鈣離子釋放管道) CC正常型・去緊迫。
PGD (六磷酸鹽葡萄糖去氫酵素)

registered as a new line in 2008.

O Spotty Lanyu pig (Lanyu 100)



畜試花斑豬

G0	1993	Separating spotty offspring 隔離
G1~G5	1994 ~ 1998	Half-sib selection 半同胞選育
G 6~G8	2000 ~ 2002	Full-sib selection 全同胞選育
Registered as a new breed in 2003 命名登記		

O Spotty Lanyu pig Breeding Process

畜試花斑豬



Spotty offspring were observed from black herd from 1993.

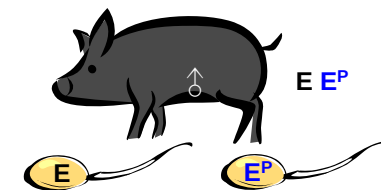
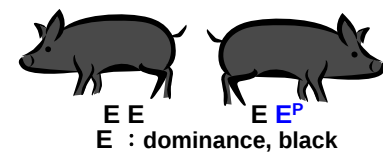
Spotty Lanyu pig Breeding Process

畜試花斑豬

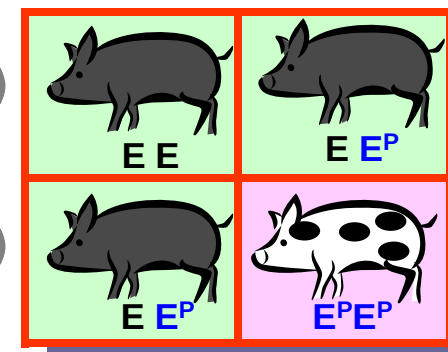
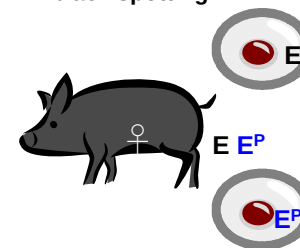


Spotty Lanyu pig Color Genetics 畜試花斑豬 毛色遺傳

Under random mating system

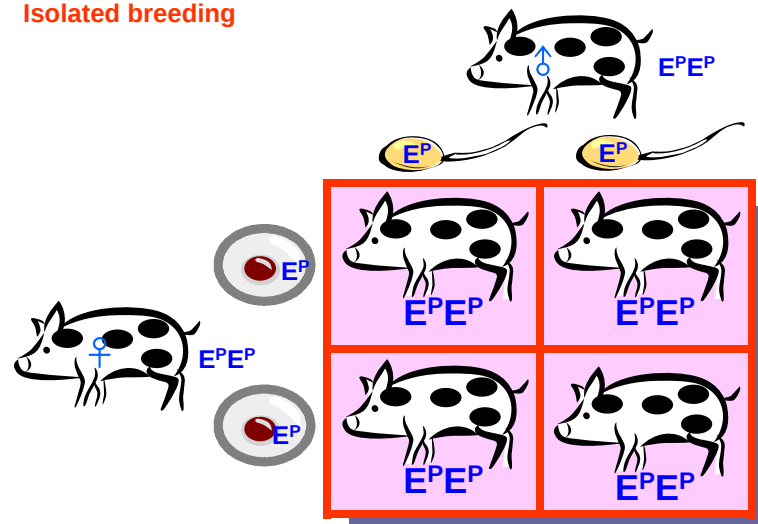


E^P : black spotting



Spotty Lanyu pig Color Genetics 畜試花斑豬 毛色遺傳

Isolated breeding



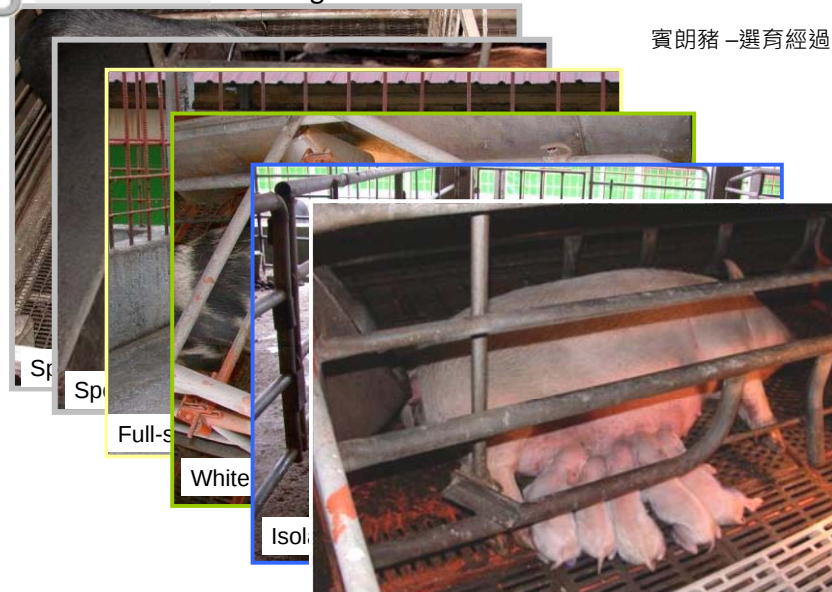
Binlang pig (Lanyu 400)

TAPS locate at Binlang Village 賓朗豬



G0	1999	Full-sib mating of Spotty Lanyu	源自花斑豬
G1	2001	1 male white offspring appeared	白色後裔隔離
G2~G3	2003~2004	Collect more white piglets (the white boar x Spotty sows)	白色後裔隔離 & 回交增殖
G4~G5	2005~2008	Full-sib selection	全同胞選育
Registered as a new breed in 2011 命名登記			

Binlang pig Breeding Process



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KIT exon and intron 17 of Binlang pig

賓朗豬 毛色遺傳

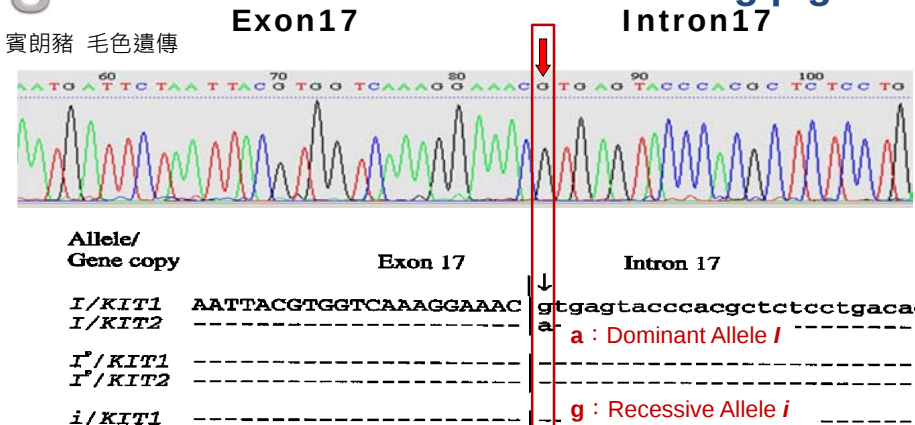
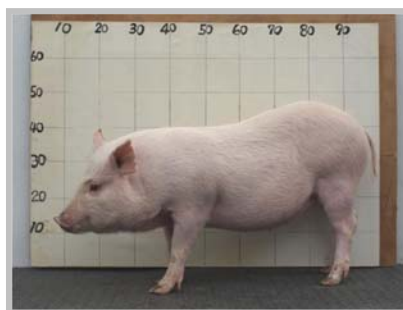


Figure 1. DNA sequence comprising 48 bp of the exon17/intron 17 border in *KIT1* and *KIT2* associated with the *I*, *I^p*, and *i* alleles. The position of the exon/intron border is marked with a vertical line, the splice mutation (nt1^G → A) with a vertical arrow, and sequence identity to the master sequence with a dash. (Marklund *et al.*, 1998)

Binlang pig



賓朗豬 - 毛色外觀



Oncoming Project : Micropig Selection

For all fields of biomedical research, especially *pharmacology* and *toxicology* studies.

Animal resource : Binlang pig

微小型豬 選育計畫

Reproduction parameters of swine, and miniature swine with the adult weights of Micropig and Minipig.

Parameter	Swine	Miniature swine	
		Micropig	Minipig
Weight at birth (Kg)	1.30	0.45-0.60	0.60-1.00
Weight at sexual maturity (Kg)	90-120	15-18	25-30
Weight at body maturity (Kg)	200-300	35-55	70-90
Sexual maturity (month)	6	4-5	6
Estrus cycle (day)	14	14	14
Length of estrus (day)	3	3	3
Length of pregnancy (day)	114	114	114
Size	10-14	5-8	5-8
	35	28-35	28-35



Lanyu minipig breeds



Oncoming Project : **Micropig Selection** 微小型豬 選育計畫

Sire & Dam determination

Sire : The **smallest body-size** Binlang boar

G0

G1

G2

Dam : The daughters of the Binlang boar who **has the most offspring**

Also consider the lighter skin selection

Small body size selection

Boar	BW(kg)	BL(cm)	BH(cm)	RW(cm)	CG(cm)	Age(month)	offspring
722-3	112	112	74	37	132	36	28
731-2	86	104	49	34	121	36	18
639-1	132	103	67	42	138	42	31
549-3	132	123	69	38	135	50	23
530-1	149	122	72	42	142	51	32
729-2	135	113	72	45	135	36	4
717-4	107	118	68	36	125	37	52
389-1	121	127	72	37	126	62	36
717-2	101	117	69	34	122	37	54
791-1	112	118	72	38	129	31	19
730-2	123	116	70	39	134	36	45
626-1	132	125	68	40	135	43	39



實驗用小型豬 生產供應體系 建立



■ Utilization of minipigs for biomedical research from 2011 to 2013

Category	No.	Item	User*
Surgery	653	Medical device Urological technology Laparoscope Stem cell technology New Drug Development Allotransplantation Regeneration Teaching test Cardiology research Operation technology	實驗用小型豬 供應情形 NCKUH, MMH, NTUCM, TVGM, FEMH, CGMH, KMH, TSGH, MMH, CSMUH, NDMC
Dentistry	56	Regeneration	NTUVM, TMUH, TVGM
Emergency	78	Training Operation test	FAST, NTUVM, NTUCM
Internal Medicine	251	Cardiac vascular check diabetes therapy Cancer therapy Cardio cell regeneration New Drug Development	CGMH, NTUCM, NCKUH, CGMH, NTUVM
Anesthesiology	96	Teaching test	MMH, CMMC, NDM
Orthopedics	82	Allotransplantation Regeneration	CGMH, CMUH, NTUVM
Radiology	35	Medical image	NHRI
Pharmacology	10	Teaching test	YCHM
Total	1261	82 projects	24 users

- **Application** — 2012/7/24(提出申請)
- **Site visit** — 2012/11/6(現場查驗)
- **Full Accreditation** — 2013/2/25(獲取認證)



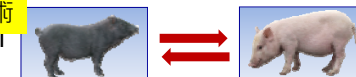
Swine hemi-facial composite tissue allotransplantation: A model to study immune rejection. 實驗用小型豬 醫學應用實績

發展臉部組織異體移植技術

Kaohsiung Chang-Gung Memorial Hospital

Team : Yur-Ren Kuo, M.D. Ph.D. et al.

Journal of Surgical Research 153: 268-237, 2009 (SCI; IF=1.875, Surgery 49/148)



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Mesenchymal stem cells prolong composite tissue allotransplant survival in a swine model. 實驗用小型豬 醫學應用實績

Kaohsiung Chang-Gung Memorial Hospital 發展移植抗排斥技術

Team : Yur-Ren Kuo, M.D. Ph.D. et al.

Transplantation 87: 1769-1777, 2009. (SCI; IF=3.816, Surgery 10/148)



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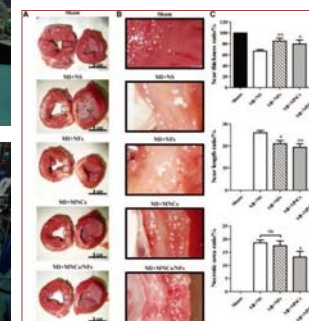
Intramyocardial Peptide Nanofiber Injection Improves Postinfarction Ventricular Remodeling and Efficacy of Bone Marrow Cell Therapy in Pigs 實驗用小型豬 醫學應用實績

National Cheng Kung University hospital, 幹細胞治療心肌梗塞

Team : Patrick C.H. Hsieh, MD, PhD et al.

Circulation 2010;122:S132-S141

Stem cell therapy on myocardial infarction



Stem Cells Tissue Regeneration --Tooth Regeneration

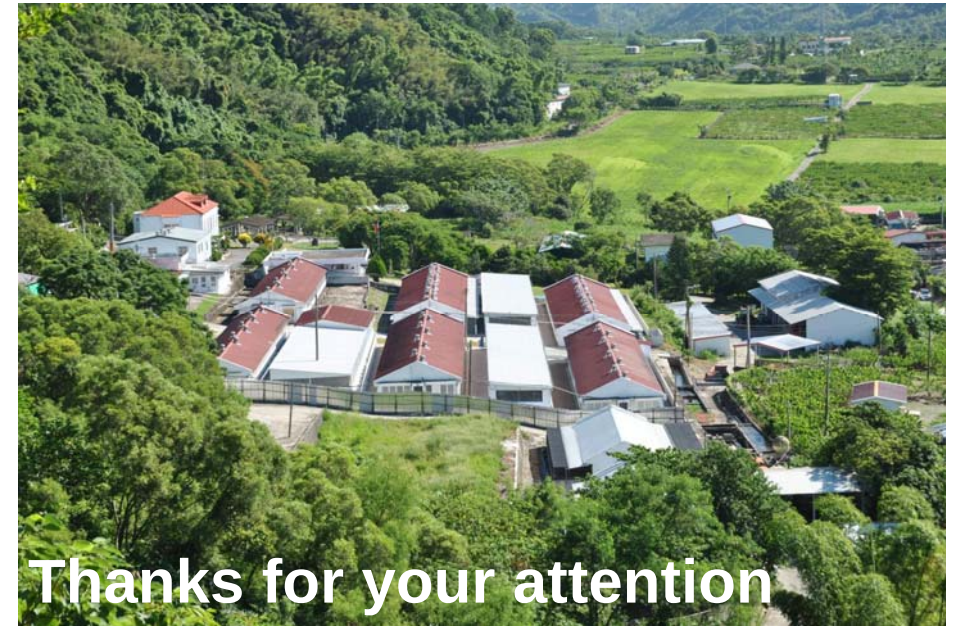
2010-11-25

Tooth Regeneration on Mini Pigs from Dental Stem Cells 牙髓幹細胞再生新齒

Eight mini pigs (about one and half month old in age) were used for study, six for experimental group and two for control group. In experimental group, **dental stem cells** were **isolated** from tooth buds by explant **outgrowth technique** and **transplanted** into alveolar bone of the original mini pig (autograft) for establishing tooth regeneration. After one year, **Well differentiated tooth crowns** were found to grow in mini pigs in the experimental group.



Fig. The tooth formed by dental stem cells transplanted



Thanks for your attention