第六屆肥豬國際研討會
The 6th Fatty Pig International Conference

Social-Cultural Value of Black Lanyu Pig Breed and Prospect of Biomedical Application of White Binlang Pig Breed

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Outline

Part One: Lanyu Pig Breed

Part Two: Social-Cultural Value

Part Three: Biomedical Application

Part One | Lanyu Pig Breed

Lanyu island introduction

Geography and Demographics

Philippine Sea Location	45 km² (volcanic island) Area
5,082 Population	6 & 4 Tribe & Villages
Tao, Han Ethnic groups	Fish, Taro, Sweet potatos and Millet Main meals
733 (2022) Total Pig Heads	196 (2022) Farms

Lanyu pig genetic background

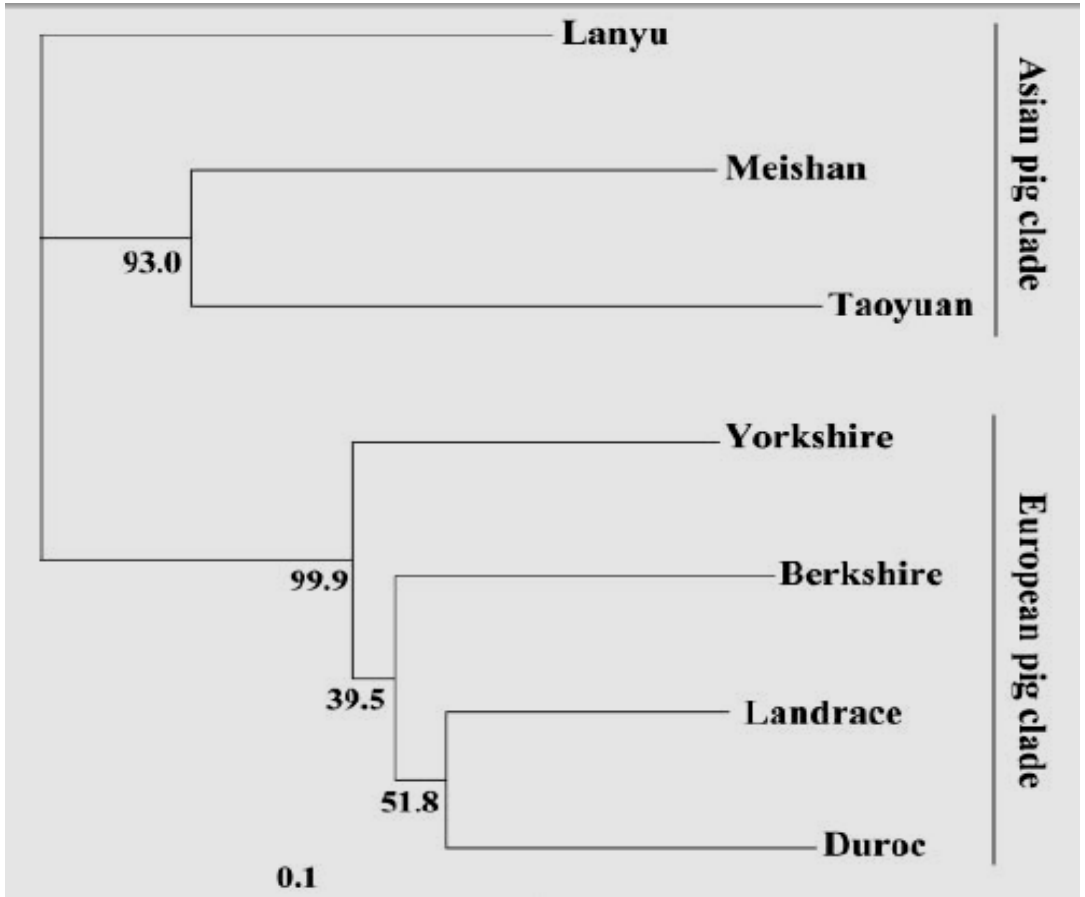


Figure 1. Neighbor-joining tree of Lanyu, Taoyuan, Meishan, Landrace, Yorkshire, Duroc, and Berkshire constructed from Cavalli-Sforza and Edward chord genetic distance by 19 microsatellite marker polymorphisms. The numbers at the branch nodes are the percentages of a group occurrence in 1,000 bootstrap replications of resampled loci.

The genetic distances for 19 microsatellite loci among 7 breeds were used to construct their neighbor-joining tree (Figure 1).

These results suggest that the Lanyu breed has a unique genetic lineage in its nuclear genome, and that it is long-distance from Asian and European-type breeds

Chang et al.,2009

Lanyu pig genetic background

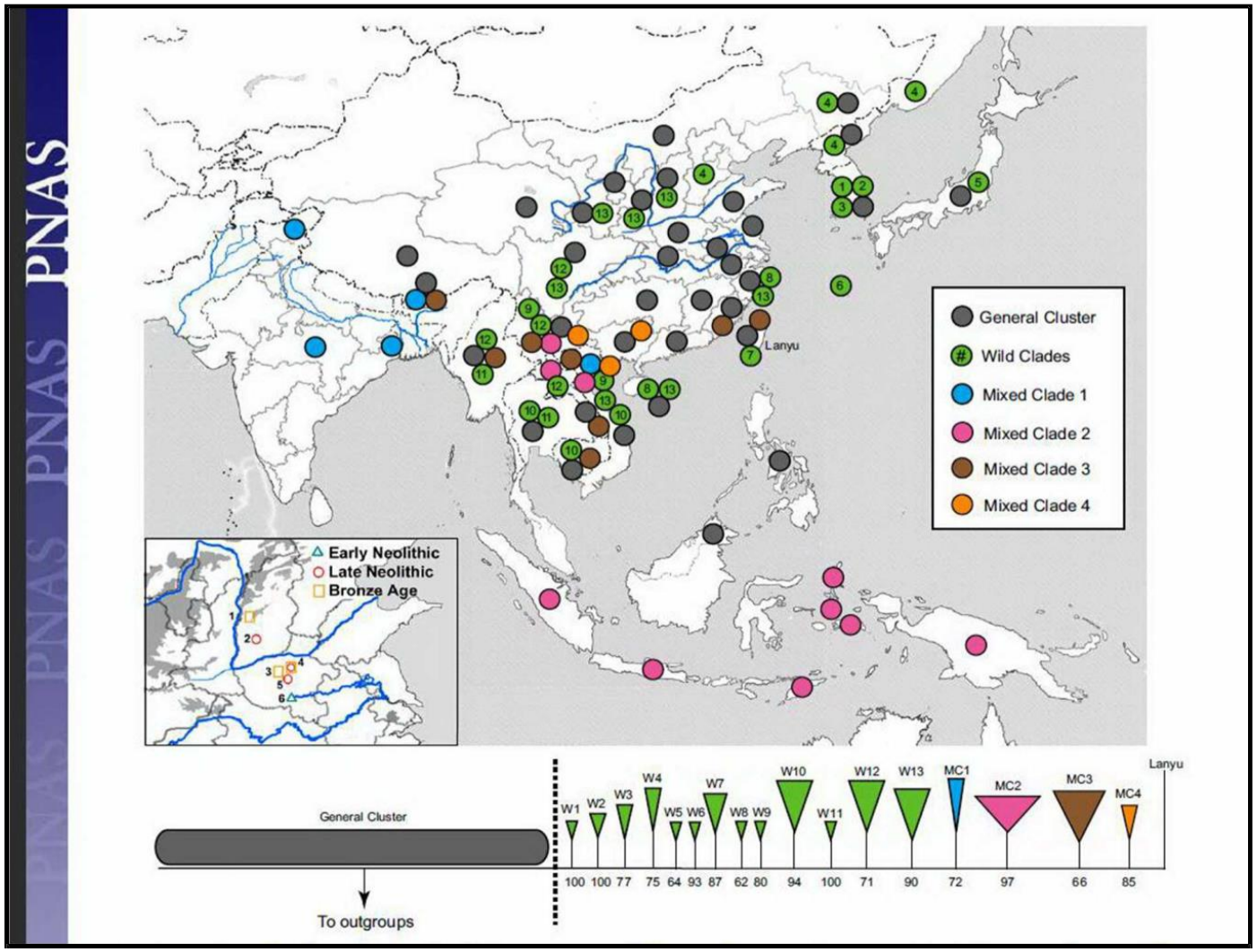


Fig. 1. A map of East Asia showing modern political and Chinese and Indian province boundaries, and a phylogenetic tree depicting the relationships between clades of wild and domestic pigs in the region.

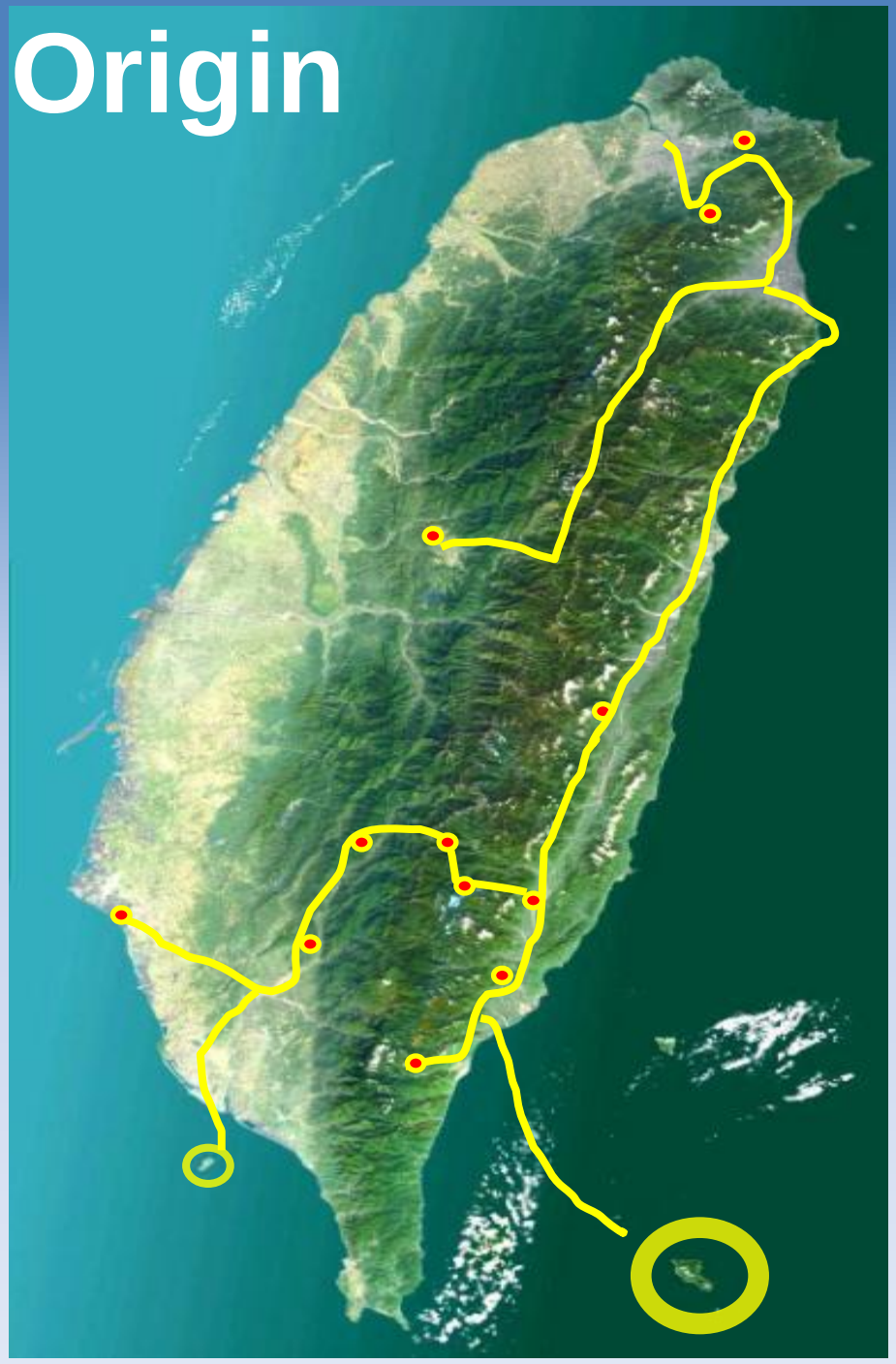
Larson team collect genetic specimens of domestic pigs and wild boars all over the world. (a total of 1500 living and 18 ancient DNA sequences samples)

In the relationship tree analyzed, Lanyu pig is far from the Eurasian wild boar and formed an independent group.

Larson wrote that Taiwan may also be one of the domestication centers of Eurasian wild boar. (Wu et al., 2007; Larson et al., 2010).

Larson et al.,2010

Origin



Investigation on small-ear miniature pig, 1975

Explore Team : part of faculty and students NTU

(Dep. Animal Husbandry Taiwan University)

Suggested by experts from NIH USA 1970

Lanyu Island

Lanyu minipig introduction

Introduction policy making → Developing experimental minipigs → Germplasm Introduction 4♂16♀, TAPS, 1980

Introduction Policy, 1979

Made by Dr. Jong and Dr. Hwang

Dr. Jong

Dr. Hwang

Dep. Animal Industry
Council for Agricultural Planning and Development (CAPD, 1979)

Conservation and sustainable use of biological resources




Boar training & semen collection

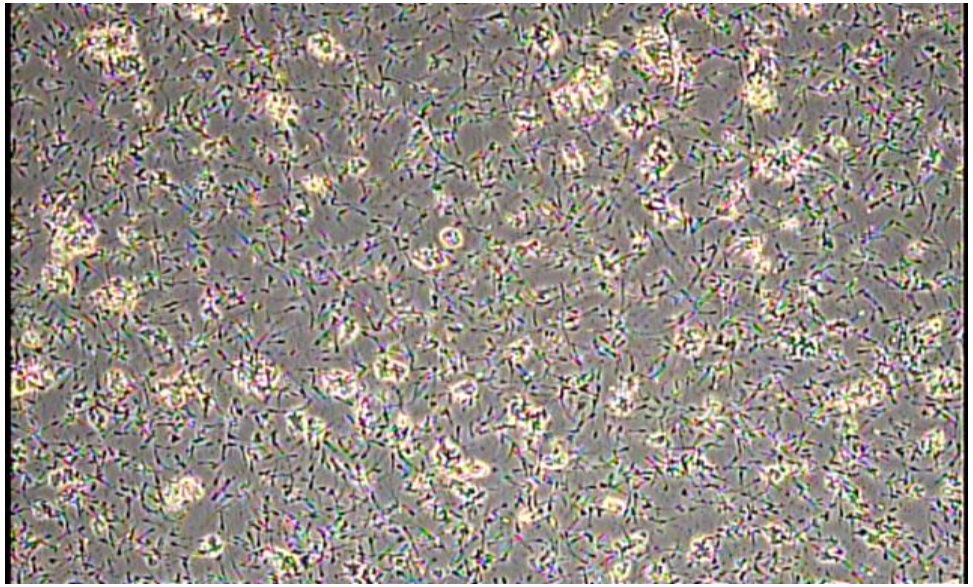
Semen cryopreservation



Taiwan Animal Germplasm Center, LRI

ex situ backup

Make sure the validity of 15-year frozen semen

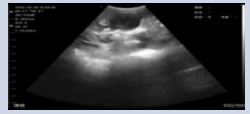
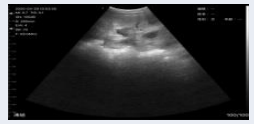
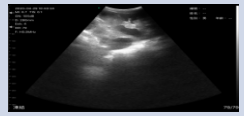


Lanyu pig semen thawed under a microscope

Evaluation of frozen semen

Semen No	Dose (5ml)	Frozen time	Thaw time	Total motility (%)	Progressive motility (%)
0226-01	3	2005/11/24(1) 2005/12/22(1) 2005/12/28(1)	2020/3/18	84.4± 2.3	73.3± 6.4

This demonstrates the viability of long-term frozen semen

Sow no	Last farrowing day	No of piglets	AI date	Pregnancy diagnosis after AI (45 days)		Birth date	Total born
2082-04	2020/2/7	4	2020/3/18	O		2020/7/14	5 (3♂2♀)
1933-04	2020/2/7	6	2020/3/18	O		2020/7/12	5 (3♂2♀)
0588-07	2020/2/7	6	2020/3/18	O		2020/7/10	4 (3♂1♀)

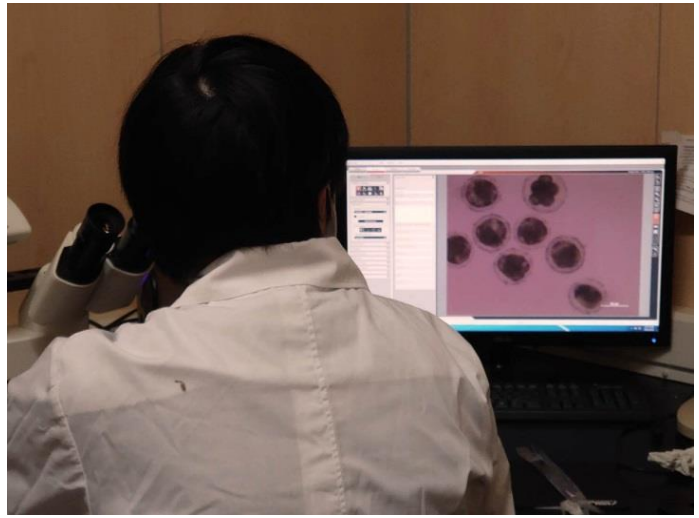
Establish minipig embryo recovery and cryopreservation

Embryos for this study were produced from natural.

Morulae and blastocysts were collected on day 6 of the estrous cycle (D0: onset of estrus).
Embryos were collected by washing the tip of each uterine horn

Vitrofication Technology was patented in 2010
Frozen purebred alpine goat embryo transfer crossbred goat successfully give birth.

All embryos graded as excellent or good for developmental stage and morphological appearance were vitrified.



Part Two | Social-Cultural Value

To the Tao, the economic value of livestock is much lower than its sociocultural value.

academia sinica institute of ethnology
research fellow Yu GH.

The role of Lanyu pigs in Lanyu

1. Meat rituals
2. Edible
3. Medicinal
4. Moisturizing
5. Sacrificial offering
6. Praying

By Lanyu Cultural Worker Xie YQ

Pigs on the Lanyu have been introgressed with exotic breeds

Why do Lanyu pigs return to their hometown after 40 years?

- **According to the Convention on Biological Diversity**

  1.The conservation of biological diversity

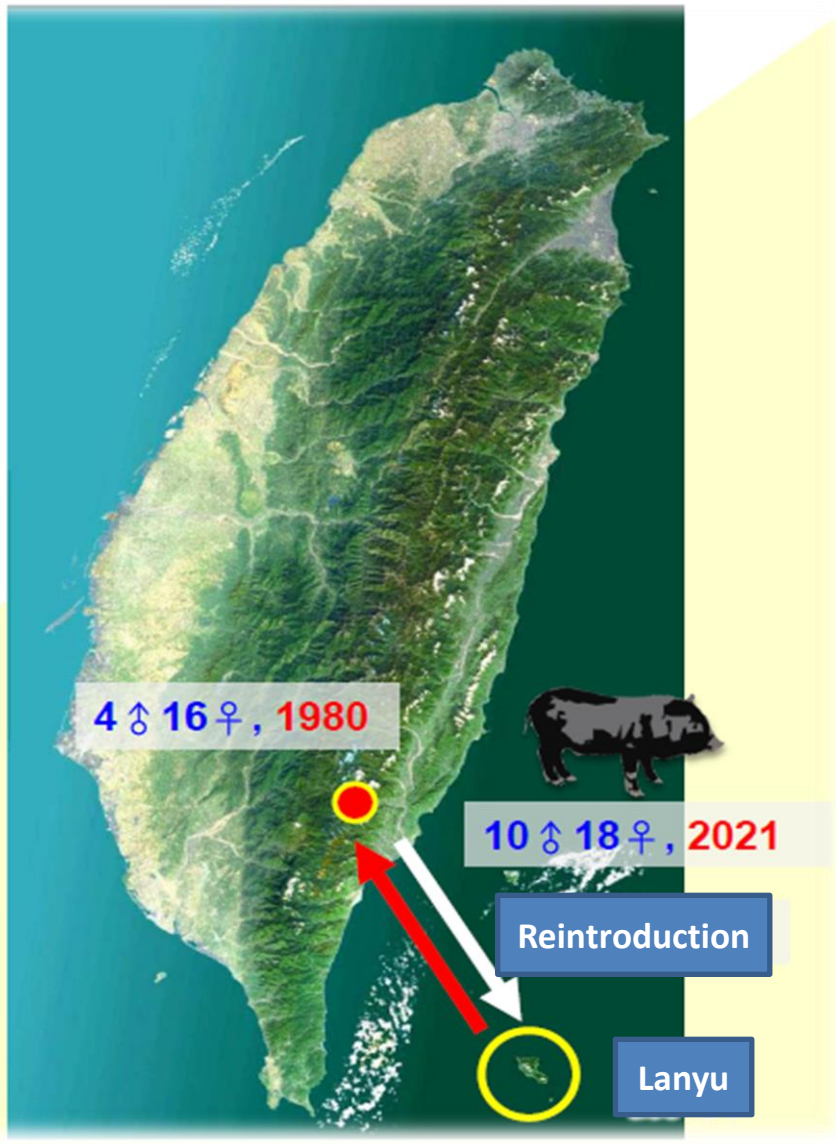
  2.The sustainable use of the components of biological diversity

  3.The fair and equitable sharing of the benefits arising out of the utilization of genetic resources

- **Cultural Heritage**
- **Risk Diversification:**

  African Swine Fever: A Global Epidemic

- **Lanyu pigs are the important gene pool**: climate change, strong environmental adaptability



The return of native species is a world value for conservation

Welcome back 28 conserved Lanyu pigs to the island to preserve pure genetics

On February 20, 2020, Lanyu Township Office: The villagers wish to raise pure-bred Lanyu pigs. , and counted a total of 148 pigs (64 males and 84 females)

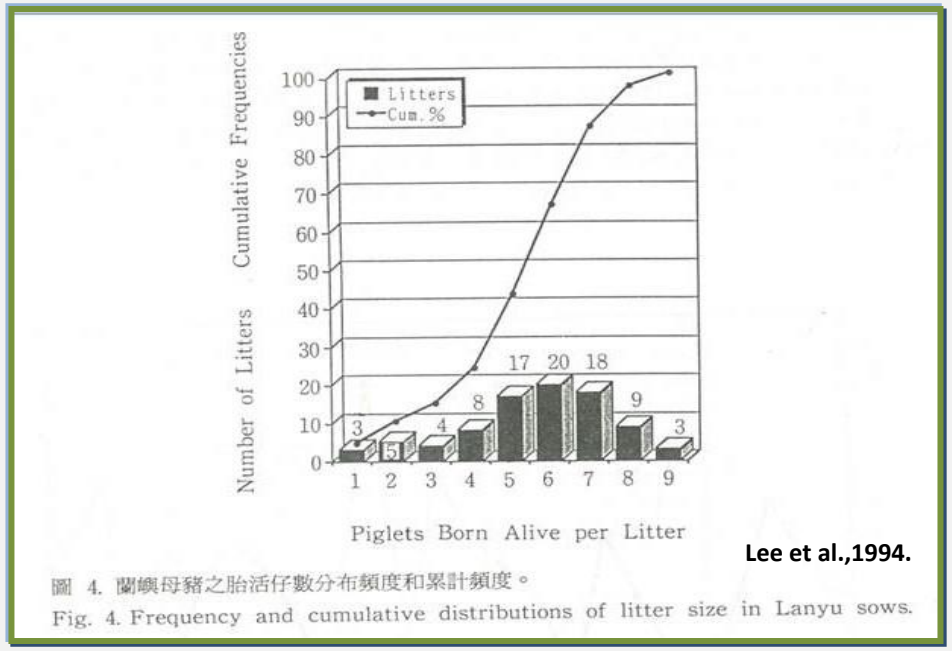
First reintroduction confirmation

1. The first generation of Purebred Lanyu pigs has successfully bred under different environmental conditions.

2. To avoid competitive pressure with crossbred pigs, it is recommended that purebred Lanyu pigs must be bred separately.

3. The purpose of the villagers raising purebred Lanyu pigs is to inherit the culture and life heritage

4. Purebred Lanyu sows are transferred to Lanyu for breeding. In this way, Purebred Lanyu boar's semen is cryopreservation. it has been confirmed that germplasm is a security backup to avoid epidemic outbreaks in Taiwan.

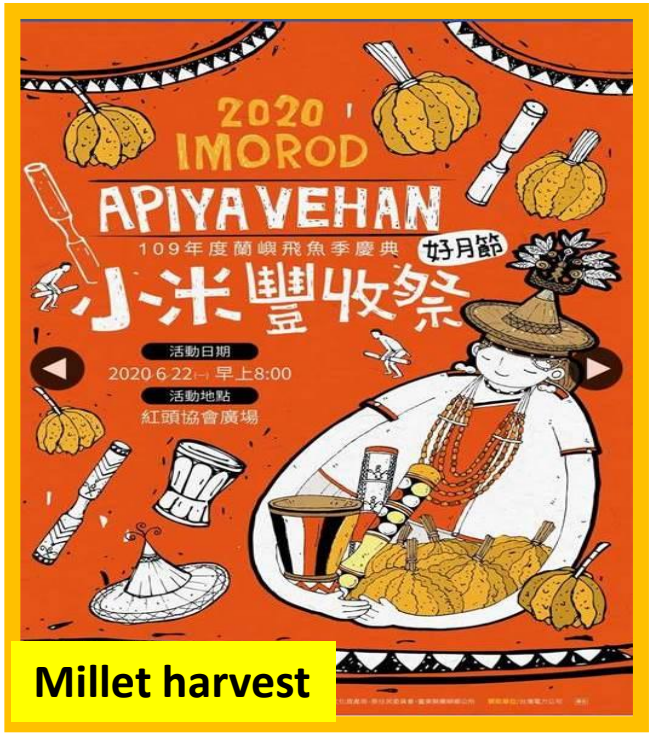


Lee et al.,1994.

圖 4. 關嶼母豬之胎活仔數分布頻度和累計頻度。
Fig. 4. Frequency and cumulative distributions of litter size in Lanyu sows.

The pregnancy and kidding rate is 81.2% and litter size is 4 (3-8).

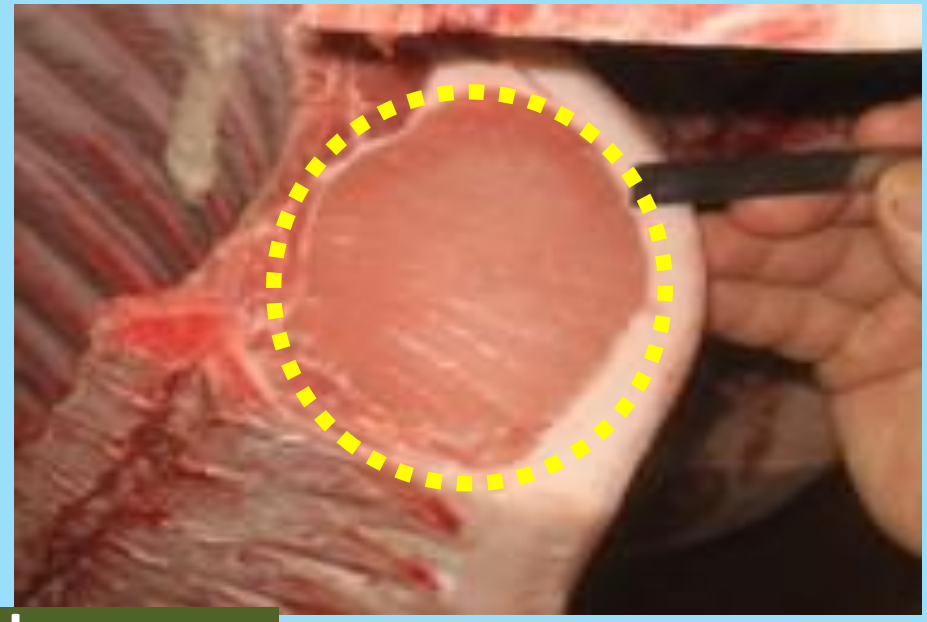
Participate Lanyu township events in traditional cultural practices (7 sessions)



Millet harvest


New canoe launchin

Development and application



(Lean meat ratio of the same part, different size)

Innovations and practices and encourage the utilization

Cooperated with the Catering Department of Lanyu High School to develop special ingredients

Food is cultural cuisine, and it must be valuable. Every dish has its story……

Innovations and practices and encourage the utilization

Traditional Lanyu Cured Meats.

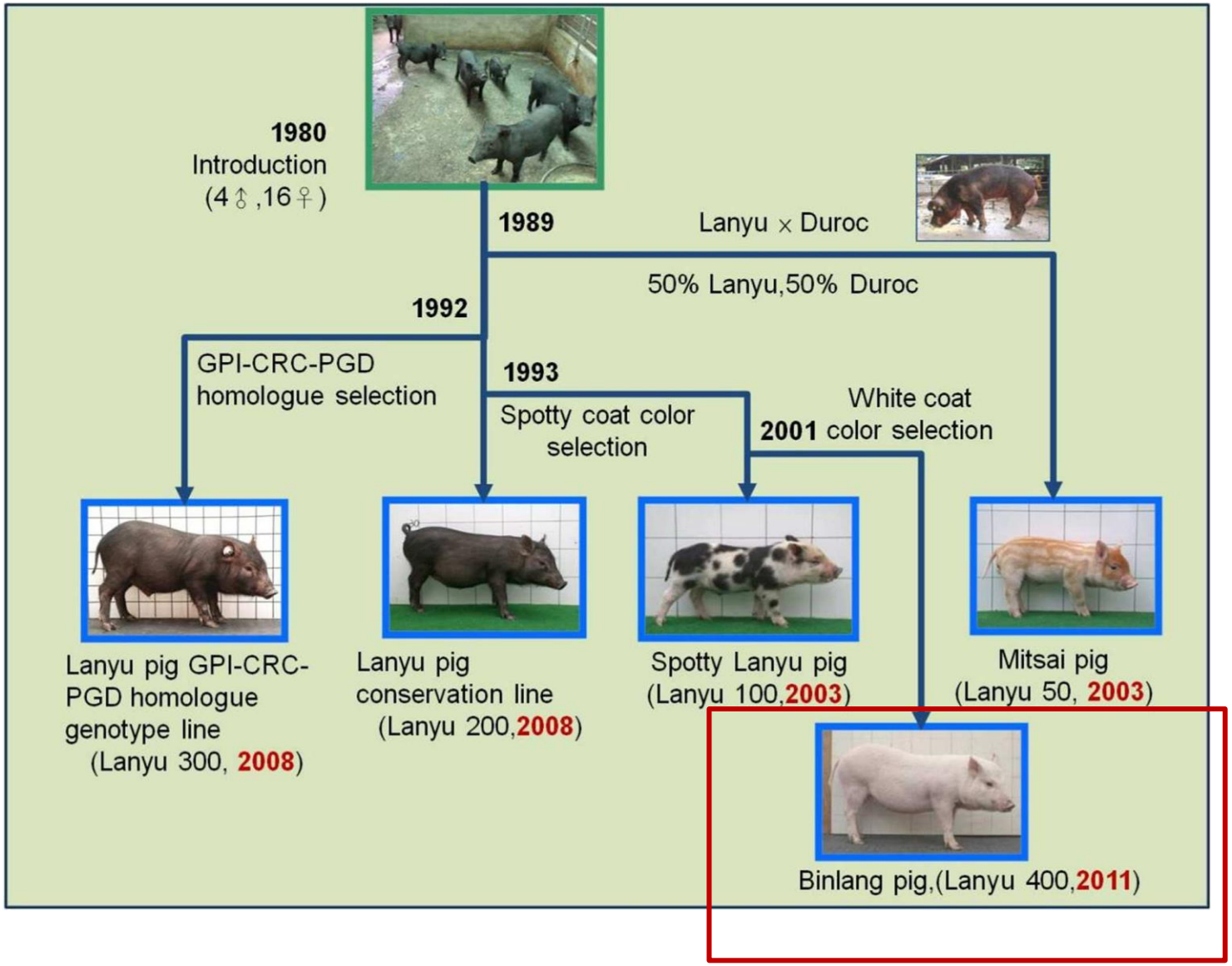
166,000 tourists in 2020

資料來源:臺東縣第六期(112-115年)離島綜合建設實施方案(草案)

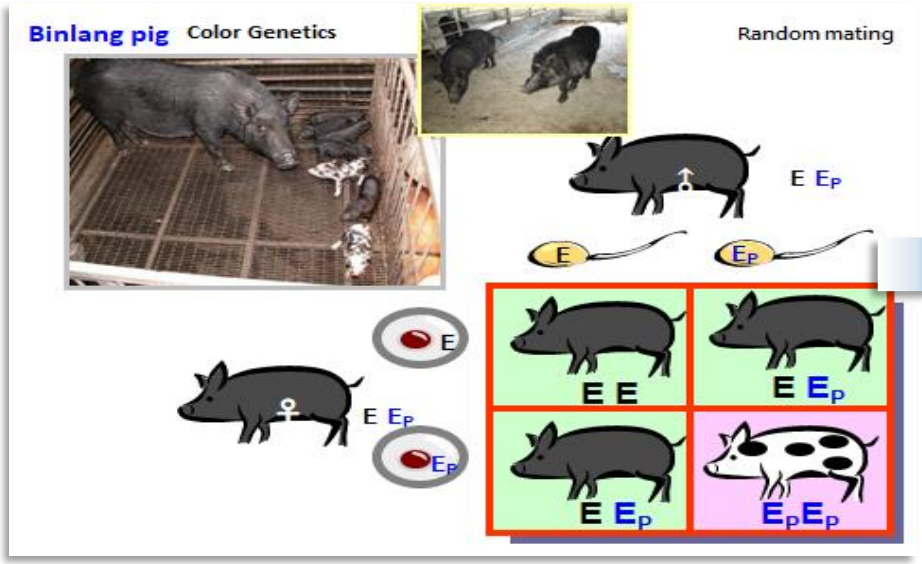
Introducing in-depth tourism experience to promote the sustainable local breeds

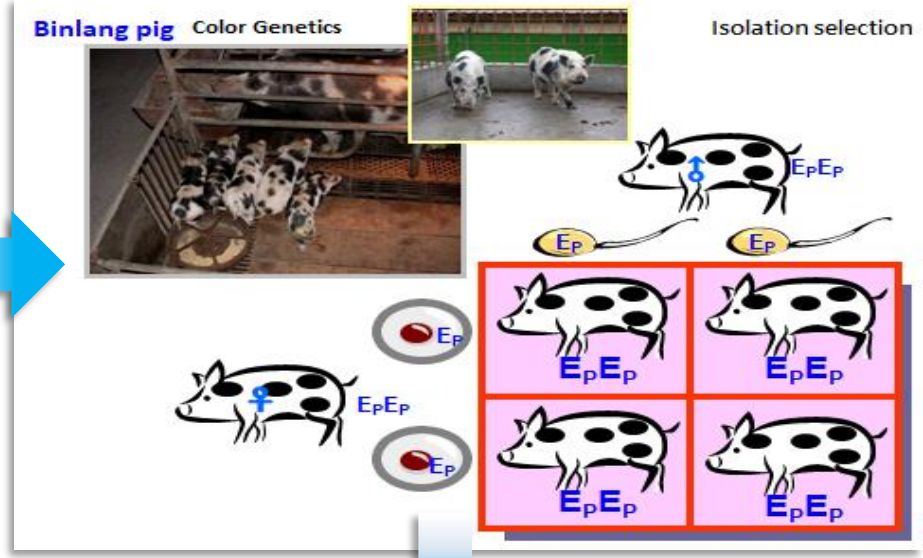
Part Three | Biomedical Application

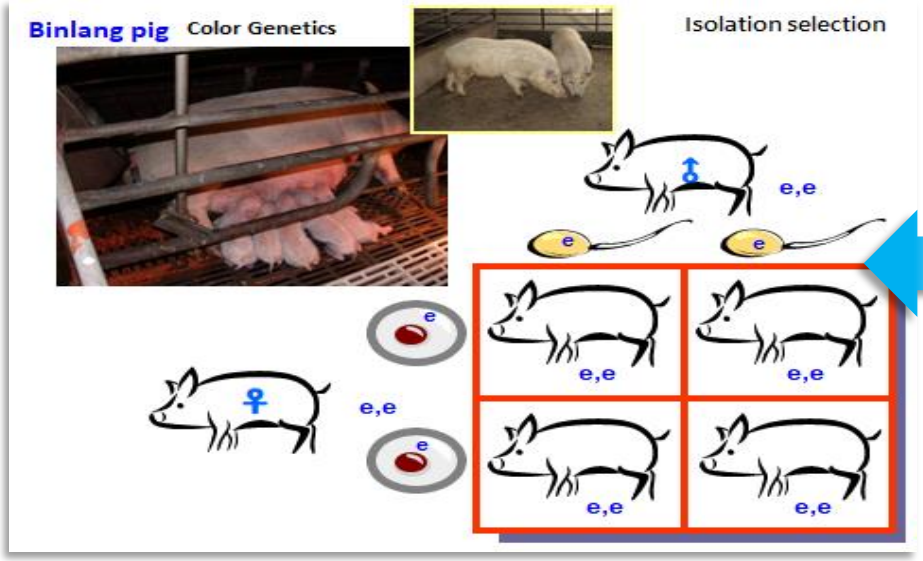
Breeds of minipig in TAPS

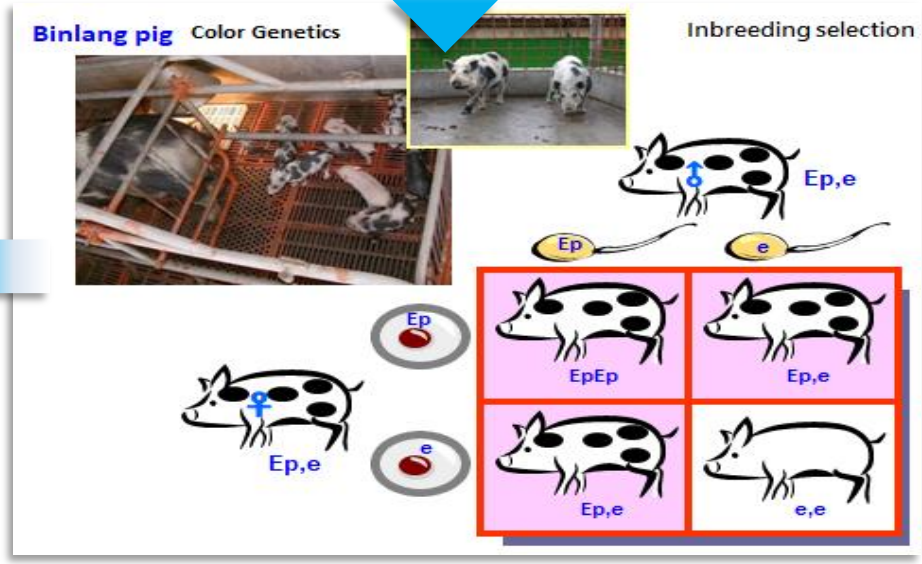


Binlang pig breeding process

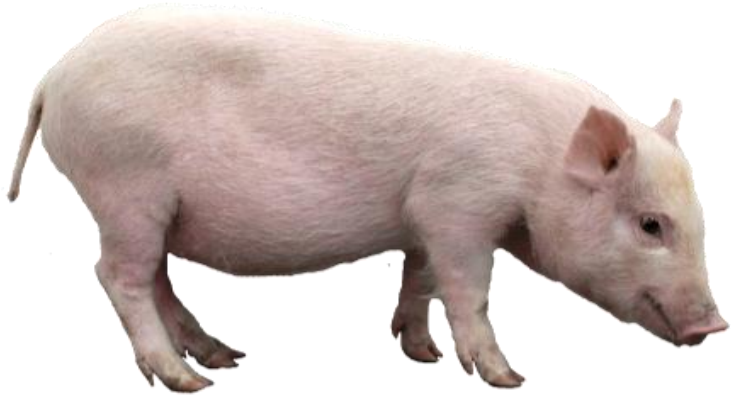








Binlang pig (Lanyu 400)



The name is based on TAPS locate at **Binlang** Village

Generation	Period	Breeding method
G0	1999	Full-sib mating of Spotty Lanyu
G1	2001	1 male white offspring appeared
G2~G3	2003~2004	Collect more white piglets (white boar x Spotty sows)
G4~G5	2005~2008	Full-sib selection
Registered as a new breed in 2011		

The Binlang minipig breed, was selected as laboratory animal for biomedical research.

The white coat color of Binlang pig was not dominant white in KIT gene sequencing.

The white appearance is especially useful for animal model experiments related to plastic and transplant surgery and clinical testing.

Challenges: Not Good at Sales

表 2.　生醫用小型豬推廣品種

Table 2.　Sales on the breeds of biomedical minipig

Breeds	Year					
	2011	2012	2013	2014	2015	2016
Lanyu pig	363 (72.6%)	291 (77.4%)	283 (75.5%)	314 (77.0%)	337 (90%)	284 (86.9%)
Spotty Lanyu pig	74 (14.8%)	55 (14.6%)	48 (12.8%)	76 (18.6%)	30 (8.0%)	36 (11%)
Mitsai pig	2 (0.4%)	9 (2.4%)	4 (1.1%)	14 (3.4%)	6 (2.0%)	5 (1.5%)
Binlang pig	61 (12.2%)	21 (5.6%)	40 (10.6%)	4 (1.0%)	0 (0.0%)	2 (0.6%)

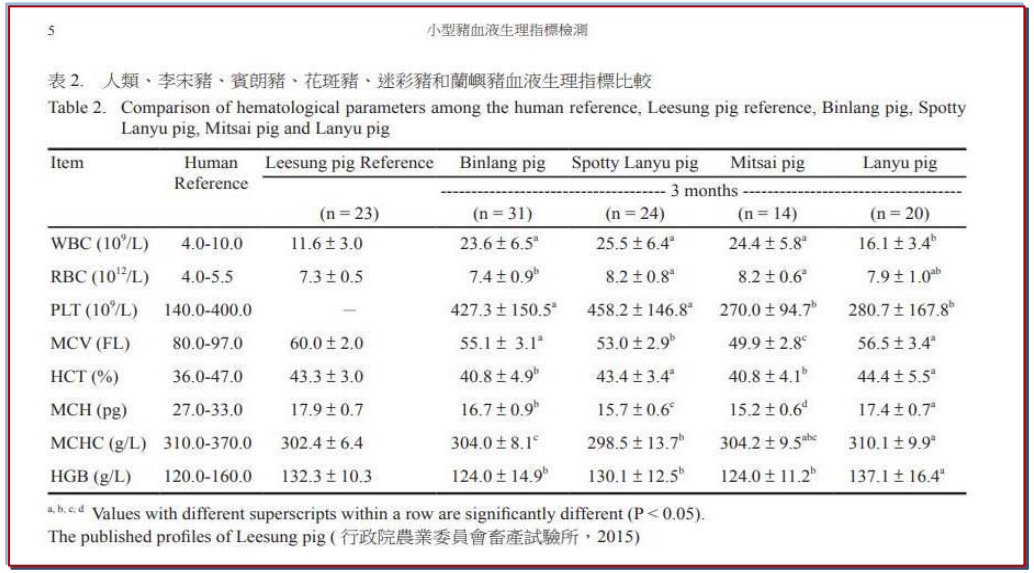
表 3.　生醫用小型豬公、母推廣數

Table 3.　Sales on the sexuality of biomedical minipig

Sexuality	Year					
	100	101	102	103	104	105
Male	283 (57%)	174 (46%)	210 (56%)	217 (53%)	193 (52%)	164 (50%)
Female	217 (43%)	202 (52%)	165 (44%)	191 (47%)	178 (48%)	163(50%)

(Wu et al., 2017)

Research: Provide the blood reference values



5 小型豬血液生理指標檢測

表 2. 人類、李宋豬、賓朗豬、花斑豬、迷彩豬和蘭嶼豬血液生理指標比較

Table 2. Comparison of hematological parameters among the human reference, Leesung pig reference, Binlang pig, Spotty Lanyu pig, Mitsai pig and Lanyu pig

Item	Human Reference	Leesung pig Reference	Binlang pig	Spotty Lanyu pig	Mitsai pig	Lanyu pig
			3 months			
		(n = 23)	(n = 31)	(n = 24)	(n = 14)	(n = 20)
WBC (10^9/L)	4.0-10.0	11.6 ± 3.0	23.6 ± 6.5[a]	25.5 ± 6.4[a]	24.4 ± 5.8[a]	16.1 ± 3.4[b]
RBC (10^{12}/L)	4.0-5.5	7.3 ± 0.5	7.4 ± 0.9[b]	8.2 ± 0.8[a]	8.2 ± 0.6[a]	7.9 ± 1.0[ab]
PLT (10^9/L)	140.0-400.0	—	427.3 ± 150.5[a]	458.2 ± 146.8[a]	270.0 ± 94.7[b]	280.7 ± 167.8[b]
MCV (FL)	80.0-97.0	60.0 ± 2.0	55.1 ± 3.1[a]	53.0 ± 2.9[b]	49.9 ± 2.8[c]	56.5 ± 3.4[a]
HCT (%)	36.0-47.0	43.3 ± 3.0	40.8 ± 4.9[b]	43.4 ± 3.4[a]	40.8 ± 4.1[b]	44.4 ± 5.5[a]
MCH (pg)	27.0-33.0	17.9 ± 0.7	16.7 ± 0.9[b]	15.7 ± 0.6[c]	15.2 ± 0.6[d]	17.4 ± 0.7[a]
MCHC (g/L)	310.0-370.0	302.4 ± 6.4	304.0 ± 8.1[c]	298.5 ± 13.7[b]	304.2 ± 9.5[abc]	310.1 ± 9.9[a]
HGB (g/L)	120.0-160.0	132.3 ± 10.3	124.0 ± 14.9[b]	130.1 ± 12.5[b]	124.0 ± 11.2[b]	137.1 ± 16.4[a]

[a, b, c, d] Values with different superscripts within a row are significantly different ($P < 0.05$).

The published profiles of Leesung pig (行政院農業委員會畜產試驗所，2015)

Wu S.Y. and C.C. Chang. 2018.

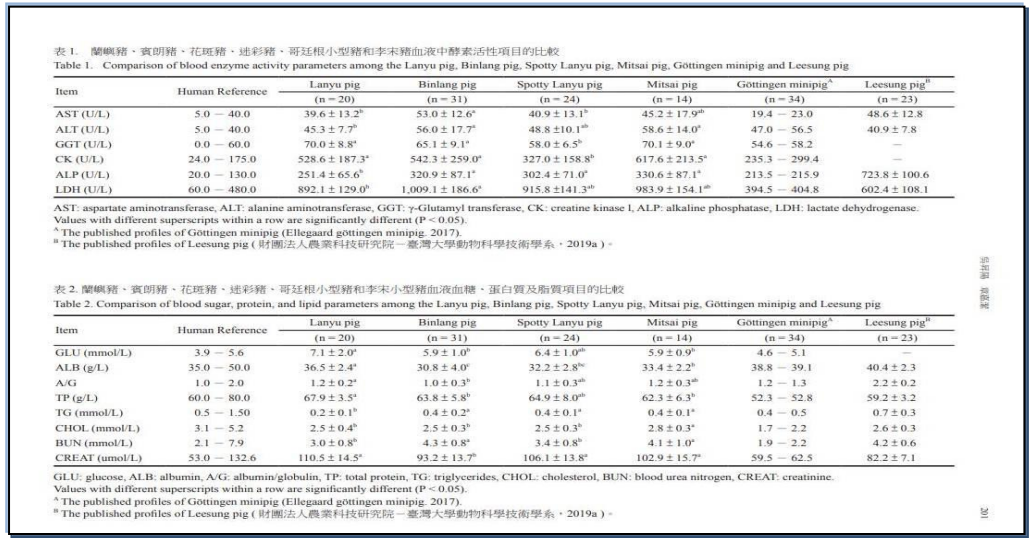


表 1. 蘭嶼豬、賓朗豬、花斑豬、迷彩豬、哥廷根小型豬和李宋豬血液中酵素活性項目的比較

Table 1. Comparison of blood enzyme activity parameters among the Lanyu pig, Binlang pig, Spotty Lanyu pig, Mitsai pig, Göttingen minipig and Leesung pig

Item	Human Reference	Lanyu pig (n = 20)	Binlang pig (n = 31)	Spotty Lanyu pig (n = 24)	Mitsai pig (n = 14)	Göttingen minipig[A] (n = 34)	Leesung pig[B] (n = 23)
AST (U/L)	5.0 — 40.0	39.6 ± 13.2[b]	53.0 ± 12.6[a]	40.9 ± 13.1[b]	45.2 ± 17.9[ab]	19.4 — 23.0	48.6 ± 12.8
ALT (U/L)	5.0 — 40.0	45.3 ± 7.7[b]	56.0 ± 17.7[a]	48.8 ±10.1[ab]	58.6 ± 14.0[a]	47.0 — 56.5	40.9 ± 7.8
GGT (U/L)	0.0 — 60.0	70.0 ± 8.8[a]	65.1 ± 9.1[a]	58.0 ± 6.5[b]	70.1 ± 9.0[a]	54.6 — 58.2	—
CK (U/L)	24.0 — 175.0	528.6 ± 187.3[a]	542.3 ± 259.0[a]	327.0 ± 158.8[b]	617.6 ± 213.5[a]	235.3 — 299.4	—
ALP (U/L)	20.0 — 130.0	251.4 ± 65.6[b]	320.9 ± 87.1[a]	302.4 ± 71.0[a]	330.6 ± 87.1[a]	213.5 — 215.9	723.8 ± 100.6
LDH (U/L)	60.0 — 480.0	892.1 ± 129.0[b]	1,009.1 ± 186.6[a]	915.8 ±141.3[ab]	983.9 ± 154.1[ab]	394.5 — 404.8	602.4 ± 108.1

AST: aspartate aminotransferase, ALT: alanine aminotransferase, GGT: γ-Glutamyl transferase, CK: creatine kinase I, ALP: alkaline phosphatase, LDH: lactate dehydrogenase.
Values with different superscripts within a row are significantly different ($P < 0.05$).
[A] The published profiles of Göttingen minipig (Ellegaard göttingen minipig. 2017).
[B] The published profiles of Leesung pig (財團法人農業科技研究院－臺灣大學動物科學技術學系，2019a) .

表 2. 蘭嶼豬、賓朗豬、花斑豬、迷彩豬、哥廷根小型豬和李宋小型豬血液血糖、蛋白質及脂質項目的比較

Table 2. Comparison of blood sugar, protein, and lipid parameters among the Lanyu pig, Binlang pig, Spotty Lanyu pig, Mitsai pig, Göttingen minipig and Leesung pig

Item	Human Reference	Lanyu pig (n = 20)	Binlang pig (n = 31)	Spotty Lanyu pig (n = 24)	Mitsai pig (n = 14)	Göttingen minipig[A] (n = 34)	Leesung pig[B] (n = 23)
GLU (mmol/L)	3.9 — 5.6	7.1 ± 2.0[a]	5.9 ± 1.0[b]	6.4 ± 1.0[ab]	5.9 ± 0.9[b]	4.6 — 5.1	—
ALB (g/L)	35.0 — 50.0	36.5 ± 2.4[a]	30.8 ± 4.0[c]	32.2 ± 2.8[bc]	33.4 ± 2.2[b]	38.8 — 39.1	40.4 ± 2.3
A/G	1.0 — 2.0	1.2 ± 0.2[a]	1.0 ± 0.3[b]	1.1 ± 0.3[ab]	1.2 ± 0.3[ab]	1.2 — 1.3	2.2 ± 0.2
TP (g/L)	60.0 — 80.0	67.9 ± 3.5[a]	63.8 ± 5.8[b]	64.9 ± 8.0[ab]	62.3 ± 6.3[b]	52.3 — 52.8	59.2 ± 3.2
TG (mmol/L)	0.5 — 1.50	0.2 ± 0.1[b]	0.4 ± 0.2[a]	0.4 ± 0.1[a]	0.4 ± 0.1[a]	0.4 — 0.5	0.7 ± 0.3
CHOL (mmol/L)	3.1 — 5.2	2.5 ± 0.4[b]	2.5 ± 0.3[b]	2.5 ± 0.3[b]	2.8 ± 0.3[a]	1.7 — 2.2	2.6 ± 0.3
BUN (mmol/L)	2.1 — 7.9	3.0 ± 0.8[b]	4.3 ± 0.8[a]	3.4 ± 0.8[b]	4.1 ± 1.0[a]	1.9 — 2.2	4.2 ± 0.6
CREAT (umol/L)	53.0 — 132.6	110.5 ± 14.5[a]	93.2 ± 13.7[b]	106.1 ± 13.8[a]	102.9 ± 15.7[a]	59.5 — 62.5	82.2 ± 7.1

GLU: glucose, ALB: albumin, A/G: albumin/globulin, TP: total protein, TG: triglycerides, CHOL: cholesterol, BUN: blood urea nitrogen, CREAT: creatinine.
Values with different superscripts within a row are significantly different ($P < 0.05$).
[A] The published profiles of Göttingen minipig (Ellegaard göttingen minipig. 2017).
[B] The published profiles of Leesung pig (財團法人農業科技研究院－臺灣大學動物科學技術學系，2019a) .

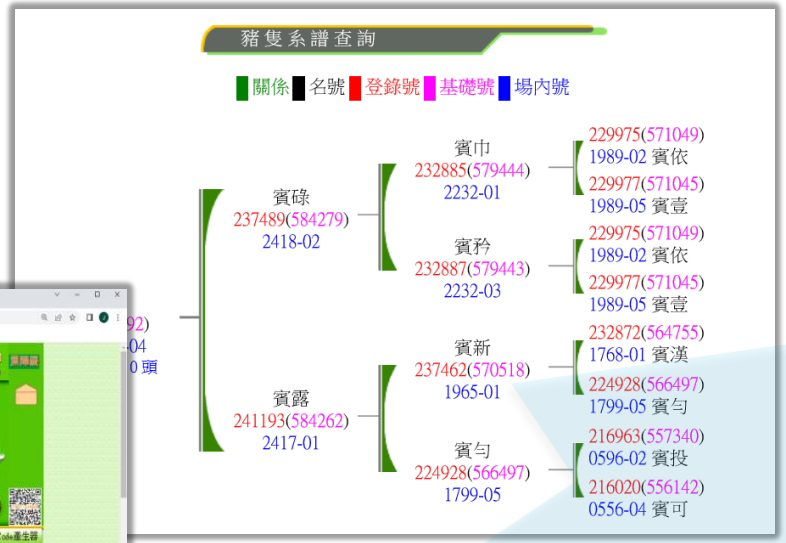
Wu S.Y. and C.C.Chang. 2019.

Provide the blood reference values and help the use of miniature pigs in medical science research.

The comparison among the different types of miniature pig breeds (Gottingen minipigs, Chinese experimental minipigs, Binlang pigs, Spotty Lanyu pigs, and Mitsai pigs) and the human reference values.

Breed Pedigree and Traceability

Taiwan animal genetic resources information network



https://www.angrin.tlri.gov.tw/

Traceability System of Biomedical Purpose Miniature Pigs

Supplier：Taitung Aminal Propagation Station, Livestock Research Institute, COA

CHINESE

Breed：	Binlang			
Gender：	♀			
Ear Notch：	2630-04			
Birth Date：	2021.6.28	Birth Weight：	0.52	Kg
Weaning Date：	2021.8.5	Weaning Weight：	5.01	Kg
Sold Date：	2021.11.18	Sold Weight：	26	Kg

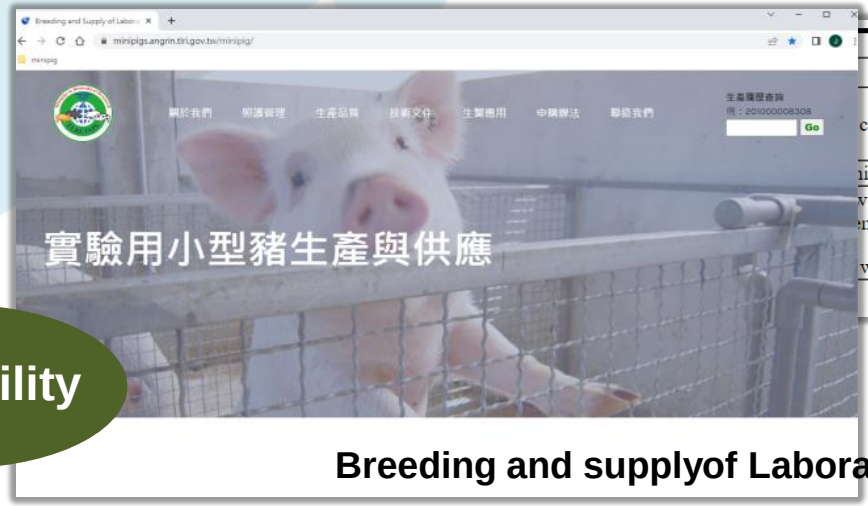
vaccination Record：

Vaccines	IRON	AR	HC	LEP	FMD	PR	EXC	OTC	SEP
Injection Date	2021.6.30	2021.7.8 2021.7.15	2021.8.26 2021.9.16			2021.9.30 2021.10.14			2021.7.8 2021.7.15

AR : Atrophic Rhinitis **HC** : Hog Cholera **FMD** : Foot-and-Mouth Disease
PR : Pseudorabies **OTC** :Oxytetracycline **SEP** : Mycoplasma hyoplasma bacterin
EXC : Excede **LEP** : Lepicom **IRON** : Iron dextran

Pedigree

Traceability



Breed Code : Lanyu 400

color	Body weight in sexual maturity (4-5 month old)	Breed Registration
ite	25~30 kg	2011 registered

were observed during the inbreeding selection of Spotty
n were kept as the founders of this new breed.

was verified to be a recessive homozygote.

Breeding and supplyof Laboratory Minipigs

https://minipigs.angrin.tlri.gov.tw/minipig/

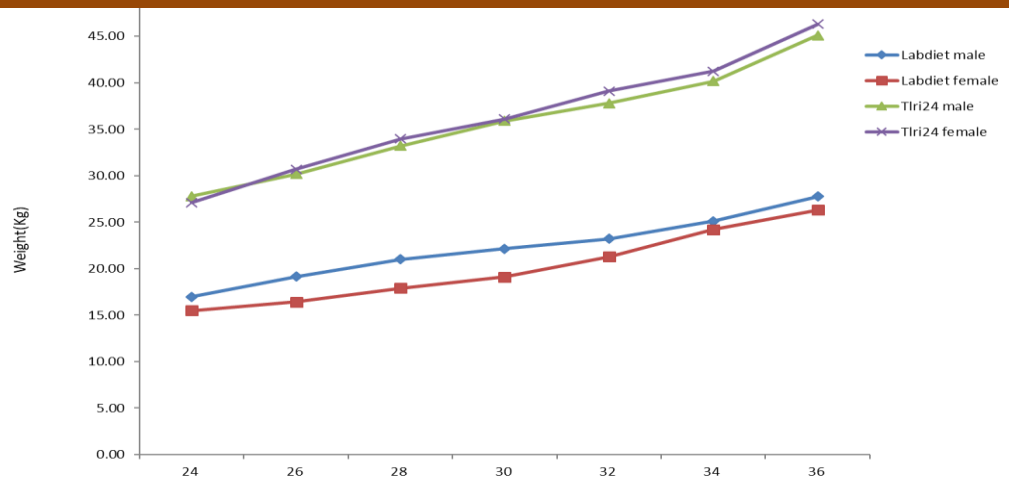
Research:

Effect of different dietary on biochemical and hematological parameters in Binlang pigs

C. C. Chang[(1)], S. Y. Wu[(1)], H. S. Wang[(1)], Y. L. Chen[(1)], S. H. Lee[(1)] and Y. L. Huang[(1)]

[(1)]Taitung Animal Propagation Station, COA-LRI

The study aimed to determine the effect of diet on hematological and biochemical blood parameters of Binlang pigs. These included 20 Binlang gilts after weaning. They divided into two groups of equal size randomly. One group received with Laboratory Minipig Grower Diet 5081, and the other group received the Tlri24 feed. Eight hematological parameters and twenty biochemical parameters were analyzed at 6 months of age. The 5081 diets significantly influenced the activity of white blood cells (WBC) and Platelet (PLT) in pigs (P <0.05). Assessment of blood biochemistry parameters, Pigs receiving the 5081 diets had significantly higher aspartate aminotransferase (AST), alkaline phosphatase (ALP), albumin/globulin (A/G), and Ca compared to pigs from the Tlri24 groups, there was a significant decrease in the plasma concentration of gamma-glutamyl transferase (GGT), lactate dehydrogenase (LDH), total protein (TP), and P decreased relative to the Tlri24 groups. The other biochemical and hematological parameters did not show any significant differences. The result could provide important information for further research and application.



Laboratory Mini-Pig Grower Diet 5081*
Laboratory Mini-Pig Grower Diet 3/8" 5L0U*

DESCRIPTION

Laboratory Mini-Pig Grower Diet is a Constant Nutrition® diet low in energy to restrict growth rate and animal size. The high fiber content allows animals to satisfy hunger on less feed.

Features and Benefits

- Constant Nutrition® composition minimizes nutritional variables
- Low in energy, high in fiber to restrict growth rate, yet satisfy hunger

Product Forms Available

- 5081: Pellet, 4 (5/32") mm x 6 (1/4") mm length
- 5L0U: Pellet, 10 (3/8") mm x 19 (3/4") mm length

GUARANTEED ANALYSIS

Crude fat not less than	2.5%
Crude fiber not more than	18.0%
Ash not more than	7.5%
Added minerals not more than	1.5%

INGREDIENTS

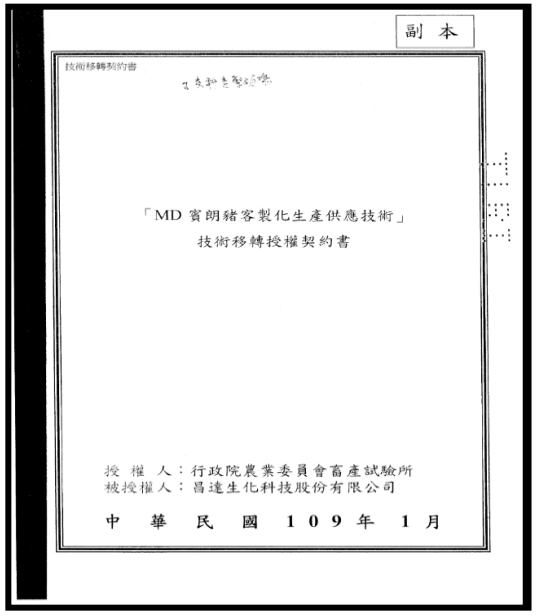
Ground oats, wheat middlings, dehydrated alfalfa meal, dehulled soybean meal, dried beet pulp, calcium carbonate, cane molasses, salt, DL-methionine, dicalcium phosphate, monocalcium

CHEMICAL COMPOSITION[1]

Nutrients[2]		Sulfur, %	.0.26
Protein, %	**14.0**	Sodium, %	.0.25
Arginine, %	.0.74	Chlorine, %	.0.43
Cystine, %	.0.21	Fluorine, ppm	.2.2
Glycine, %	.0.63	Iron, ppm	.280
Serine, %	.0.63	Vitamin K (as menadione),ppm	.2.1
Aspartic Acid, %	.1.28	Thiamin Hydrochloride, ppm	.11
Glutamic Acid, %	.3.12	Riboflavin, ppm	.10
Alanine, %	.0.59	Niacin, ppm	.74
Proline, %	.1.16	Pantothenic Acid, ppm	.25

Crude protein <14%
Crude fat <2.5%
Crude fiber <18%

New opportunities:


副 本

「MD 賓朗豬客製化生產供應技術」
技術移轉授權契約書

授 權 人：行政院農業委員會畜產試驗所
被授權人：昌達生化科技股份有限公司

中 華 民 國 109 年 1 月

License Agreement

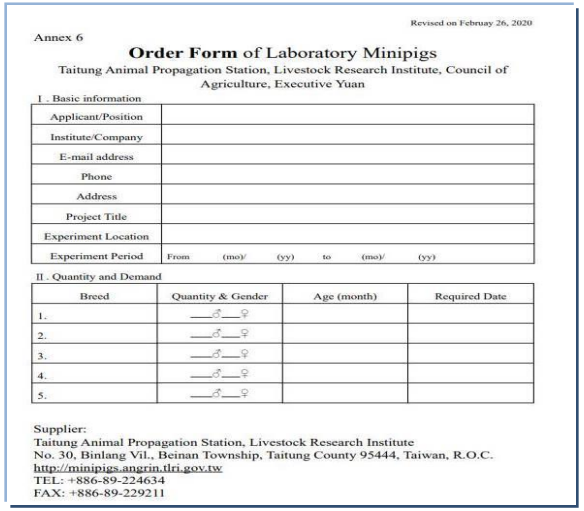
TAPS Technology Transfer QPS

Binlang pigs supply preclinical applications in the domestic biotechnology industry and develop suitable testing models.

Establishing the supply system of Binlang pigs ensures that the service entrusted by the industry is more conducive to the competitive advantage.

Customized production

Customer Information about the research project is required.



Revised on February 26, 2020

Annex 6

Order Form of Laboratory Minipigs

Taitung Animal Propagation Station, Livestock Research Institute, Council of Agriculture, Executive Yuan

I . Basic information

Applicant/Position	
Institute/Company	
E-mail address	
Phone	
Address	
Project Title	
Experiment Location	
Experiment Period	From (mo)/ (yy) to (mo)/ (yy)

II . Quantity and Demand

Breed	Quantity & Gender	Age (month)	Required Date
1.	___♂___♀		
2.	___♂___♀		
3.	___♂___♀		
4.	___♂___♀		
5.	___♂___♀		

Supplier:
Taitung Animal Propagation Station, Livestock Research Institute
No. 30, Binlang Vil., Beinan Township, Taitung County 95444, Taiwan, R.O.C.
http://minipigs.angrin.tlri.gov.tw
TEL: +886-89-224634
FAX: +886-89-229211

Planning for breeding& production with 3R policy (Replacement, Reduction, Refinement)

Pregnancy was confirmed at day 35 by ultrasound.

Protect the baby pigs after birth.

Make sure the sow has the nursing ability.

Our partnership approach

Establishing Preclinical Leadership in Asia with the Addition of Mini Pig Studies

August 19, 2019 By QPS

QPS team contract research organization (CRO) service providing:

1. Testing unit conforms :OECD GLP and US FDA GLP test report.
2. Develop skin routes of administration and establish animal models.
3. Efficacy test :wound healing and atopic dermatitis.

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–Mr. De-Sheng Huang
–Mr. Ying-Sheng Lin
–Mr. Ming-Feng Wu
–Mr. Qiang Xiao

Collaborators
–Dr. Lih-Ren Chen
–Dr. Mnig-Che Wu
–Dr. Jeng-Fang Huang
–Prof. Yu-Ten Ju
–Dr. Shu- Hui Lee
–Mr. Hsien-Pin Chu
–Ms. Hsiu-Chiao Wen
–Mr. Wen-Qian Lian


Thanks for your attention