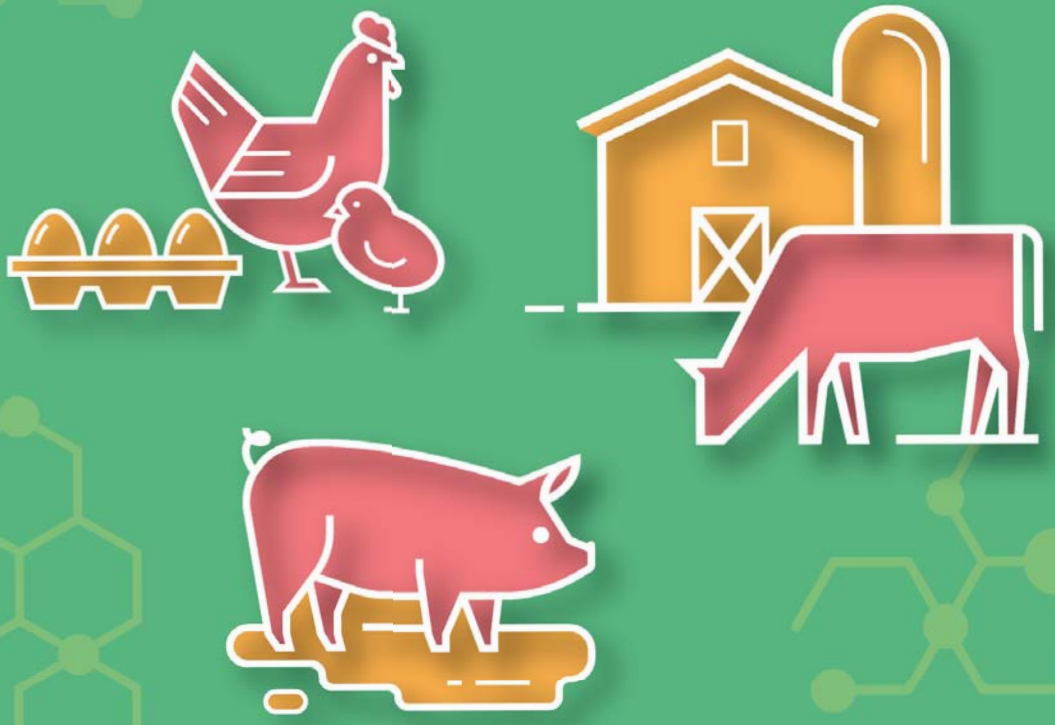
Livestock Research Institute
Council of Agriculture, Executive Yuan

Biennial Report
2018-2019



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Foreword

The Livestock Research Institute is an unique animal research and development unit under the Council of Agriculture, Executive Yuan. The institute is in charge of the establishment of animal resources, industry technology and practical study. A total of 149 research projects have been conducted in the year of 2018 and 2019. The Livestock Research Institute has made outstanding progress through these projects. Hence, the studied projects are fundamentals, animal industry upgrade, commercialization and sustainable management. The results of research projects categorize into six fields, including animal breeding and genetics, animal nutrition, animal physiology, forage crops, livestock management and processing of animal products. Achievements of these researches have been published and listed in the published papers. In addition, varieties of activities such as scientists sent abroad, training classes, seminars and symposia in the past two years are also shown in the biennial report. This biennial report is the summary results of the efforts completed in 2018 and 2019. This publication is dedicated to the support and hard work done by all the colleagues of our institute. We would highly appreciate your comments and suggestions.

Livestock Research Institute, Council of Agriculture, Executive Yuan
Director General

November, 2020

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Biennial Report 2018-2019

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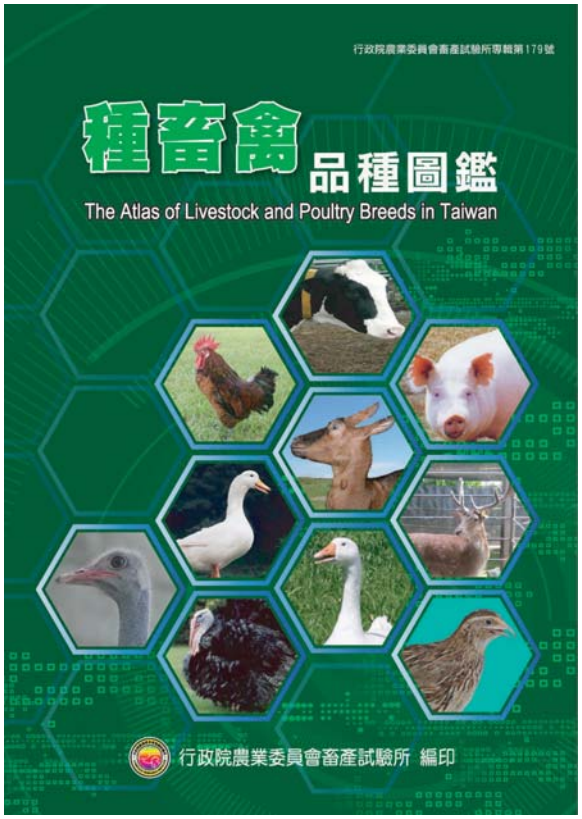
Research and Development

I The illustrated guide of livestock and poultry breeds

The variety of livestock and poultry breeds are prosperously increasing due to the commercial market demand following the human operation. It is difficult for us to realize the appearance of livestock and poultry according to the consequence. We composed the illustrated guide of livestock and poultry breeds with the characteristics to help the civil servants effectively clarify and identify the importation and exportation of animals. We have a list of animals including dairy, beef, swine, goat, deer, broiler, layer chicken, indigenous chicken, meat duck, layer duck, goose, turkey, Japanese quail, and ostrich. The characteristics of livestock and poultry divided into five sections, skin color, head, body, legs and identify characteristics. The photos about the livestock and poultry this book contained are collected by our researchers among livestock research institute and the branches in Taiwan. As the guide book has been printed, we also held the conference for the civil servants who work for the quarantine and in charge of the livestock investigation services around the island. In the beginning of the meeting, we introduced the guideline for screening application for letter of approval for the importation of breeding livestock and poultry and genetic resources. Secondly, the identified characteristics of livestock and poultry that we compiled in this book are presented by the author of each species. There are 73 persons taking part in the meeting and share their experience about the quarantine service and problems they met during their work. We want to provide the illustrated guide book for the public to step into the discovery of livestock and poultry breeds.

(C. T. Chu, N. T. Yen, D. Y. Lin, A. K. Su, H. C. Liu, M. C. Wu, A. Y. Shih and P. M. Chen)



The cover of the atlas of livestock and poultry breeds in Taiwan

Study on the factors affecting the purchase price of breeding pig

The purpose of this study was to examine whether the auction price of breeding pigs affected by the ranks of selection index, body type, and hoof evaluation. The rank of selection index body type and hoof evaluation datas collected from March 3, 2011 to May 22, 2019. We divided the ranking of each item into three grades. The analysis tool was Pearson simple correlation and t-test

analysis. The results were as follows: (1) The Pearson simple correlation coefficient values of Duroc and Landrace boar between the selection index, body type, hoof evaluation and the auction purchase price were -0.15 and -0.20, -0.39 and -0.32, and -0.21 and -0.148, respectively. (2) The auction purchase price of breeding pigs with the elite ranks of selection index was significantly higher than that of the sub-optimal and poor ranks. The results of this study showed that the auctioneers of the breeding pigs were willing to pay a high price for the Duroc and Landrace boars with good growth performance.

(N. T. Yen, H. R. Tsai, Y. Y. Lai, C. H. Chen, C. C. Chu, C. H. Lin, K. C. Liu and M. C. Wu)

Investigating the survival rate of different stages in pig farms with over 5,000 heads scale and its application strategy

According to the survey from the National Animal Industry Foundation in May 2018, there were 6,878 pig farms in Taiwan. In May of 2019, the pig farms with under 199 heads scale were counted 2,819 which occupied 41% of total pig farms and reared 3.09% of pigs in total pigs. Also, the pig farms with over 1,000 heads scale were counted 1,577 (22.93%) and reared 70.34% of pigs. Finally, the pig farms with over 5,000 heads scale were occupied 1.29% of total pig farms, however, they reared 22.87% of pigs in total pigs. This study was conducted to survey the reproduction performance and the survival rate in different stages of sows in the pig farms with over 5,000 heads scale. Totally 6 farms were surveyed in 7 months, and the results showed that the pregnancy rates of sows were 73.3 to 85.5%, total number of piglets born alive were 8.56 to 11.78, survival rates on weaning were 83.01 to 90.88%, survival rates on feeder were 84.15 to 89.37% and survival rates on finisher were 77.23 to 87.12%.

(C. H. Chen, C. J. Hsieh and M. C. Wu)

Counseling the pig farm

Application of flow cytometer to evaluate the sperm maturity in breeding pig of the pig performance testing station

The objective of this study is conducted to measure the sperm concentration and mitochondrial integrity by using flow cytometer to evaluate the semen productive ability and maturity of high feed efficiency young boar, and try to apply the elite young boar for the reproduction of breeding stock and the production of hog early. Finished test boars from 3 breeds (Duroc, Landrace and Yorkshire) in class 201807, 201809, 201810, 201811, 201901, 201903, 201904, and 201905 of the Pig Performance Testing Station of National Animal Industry Foundation were used at this project. We collected the semen 20 days before the auction and stored at 17°C. The collected semen were immediately analyzed the sperm concentration and mitochondrial integrity at least 5,000 sperm to assess the semen productive ability of each young boar. The results showed that the sperm concentration and mitochondrial integrity of the young boars from Duroc (n=358), Landrance (n=142) and Yorkshire (n=46) were 345 ± 112 (10^9/ml), 393 ± 115 (10^9/ml), 305 ± 127 (10^9/ml) and 47.2 ± 19.6 (%), 54.7 ± 22.27 (%), 51.05 ± 22.04 (%), respectively.

(C. C. Chu, S. R. Wang, H. L. Lin, C. J. Hsieh, T. Y. Kuo, C. T. Chu, and M. C. Wu)

The results of boars sperm testing analysis

Test results	Sperm concentration (10^9/mL)	Mitochondrial integrity (%)	Pass rate ofmitochondrial integrity (%)
Duroc (n=358)			
Mean ± SD	3.45 ± 1.12	47.2 ± 19.6	16.5 (59/358)
Min	0.65	6.28	
Max	6.66	98.71	
Landrance (n=142)			
Mean ± SD	3.93 ± 1.15	54.7 ± 22.27	25.4 (36/142)
Min	1.2	5.91	
Max	6.78	94.48	
Yorshire (n=46)			
Mean ± SD	3.05 ± 1.27	51.05 ± 22.04	23.9 (11/46)
Min	0.66	4.49	
Max	5.86	90.76	

The selection of black pig with HH6 haplotype of heart-type fatty acid binding protein gene

This project is for selecting the outstanding reproduction and the heart-type fatty acid binding protein (H-FABP) of HH6 genes (HHaadd) of black pig in Taiwan. The DK1 generation was crossed by female of Duroc (D) with HHaadd and male of KHAPS black pig (K) with estrogen

receptor locus (ESR) and then inbreeding. Through genetic screening technology, coat color and growth performance test, one generation was selected and expected after 5 generations of selecting, a new line of black pig with HHaadd and excellent reproductive performance would be selected. The descent of the new line was 25% for Meishan pig and 75% for Duroc. At present, the reproductive performance evaluation of the DK4 generation and the data of growth, body type traits and meat quality genotypes of the DK5 generation had been completed. The results showed that the proportion of black coat (full black and black gold spots) of the DK5 generation were 93.5%. There were 10.3 heads for the litter size at birth, 9.1 heads for litter size born alive and 90.6% for survival rate of 3 week-old in the sows of the DK4 generation. The piglet of the DK5 generation on body weight at birth and 3 week-old were 1.41 and 4.25 kg, respectively. The boar and gilt of the DK5 generation on body weight of 70 day-old were 20.7 kg and 22.4 kg, respectively; those on body weight, back fat, body length, chest width and hip width of 180 day-old were 108.2 kg, 2.09 cm, 121.8 cm, 33.5 cm and 30.7 cm and 91.5 kg, 2.04 cm, 116.9 cm, 32.3 cm and 30.0 cm, respectively. The CRC anti-stress genotype (AA), homozygous ESR prolific genotype (MM) and HL4, HL5 and HH6 genotype of H-FABP were 100%, 62.5% and 88%, respectively in the DK5 generation. In the future, the selection of ESR prolific genotype and H-FABP genotype will be the focus, and the identification of coat color gene will be carried out in order to accelerate the progress of excellent gene improvement and new line named.

(S. C. Chang, H. S. Wang, H. L. Lee, H. J. Huang, L. L. Peng and C. B. Hsu)

The appearance of black boar with heart-type fatty acid binding protein gene

Change of vulva size and its temperature before and after heat in sows

This study on the changes in vulva size and temperature of vulva of sows before and after heat help understanding those changes to develop the automated equipment and automatic warning system in the future. This experiment used 26 crossbreed sows (LY and YL), including gilts and sows. The temperature and surface area of the vulva were measured on 4 days before and after heat with an infrared thermometer and a vernier caliper at 08:00, 12:00, and 16:00 daily. The results showed that the length, width, and area of the vulva were having an increasing trend 4 days before and after heat. The length, width, and area of the vulva at the fourth day before heat were 4.86 ± 1.46 cm, 3.36 ± 0.71 cm, and 17.2 ± 10.1 cm^2. The length, width and area of the vulva of the sow at heat were 6.89 ± 2.82 cm, 4.05 ± 0.57 cm and 28.6 ± 11.9 cm^2, and the length, width and area at the fourth day after heat were 6.85 ± 1.74 cm, 4.05 ± 0.47 cm, and 28.2 ± 9.76 cm^2. The fourth hour before heat on vulva temperature has significantly than those of 4 hours after heat group (33.6°C vs. 33.1°C). In conclusion, the heat monitoring of sow using by swine vulvar swelling

and temperature, it could observe accurately to the heat of sows. This way could improve its mating rate in the sow.

(S. C. Chang, H. J. Huang, L. L. Peng, C. B. Hsu, Y. Y. Chen and S. Y. Peng)

Fifth day before heat | *Fourth day before heat* | *Third day before heat*

Second day before heat | *First day before heat* | *Heat*

Change of vulva size of before and after heat in sow

Optimization on health quality of core minipig breeding populations

Laboratory animals always play an important role in the development on medical research and biotechnical industry. The aim of this project is to supply high hygienic and genetic quality minimal disease mini-pigs as laboratory animals by upgrading feeding equipments and facilities, monitoring specific pathogen periodically, improving the standard operation procedures, and promoting animal welfare. 646 miniature pigs were produced in this year, and 269 of

them were provided to biomedical research. The pathogen monitoring was conducted quarterly. For upgrading equipments and facilities, buildings and facilities in the farm were fixed and renewed annually. Meanwhile SOP education and training were arranged once a month for improving biosecurity and occupational safety. Finally, Taitung Animal Propagation Station of Livestock Research Institute maintained AAALAC full accreditation in July 3, 2019.

(Y.L. Huang, H.S. Wang, Y.L. Chen, S.Y. Wu and C.C. Chang)

Collection of blood from minipig

Laboratory rearing and germplasm conservation of minipigs

The aim of this project is to maintain the genetic diversity of mininpig conservation herd and to promote the biomedical usage on the genetic resource. The breeding facilities for boars and sows are set up for the population management system according to the results of genetic monitoring. The purpose of this study was to investigate the polymorphisms of porcine calcium release channel (CRC) gene and estrogen receptor (ESR) gene in mininpigs (Lanyu, Spotty, Binlang and Mitsai). The results showed that the AA,(stress sensitive type) genotype frequencies of CRC genes was 100%. There have not stress sensitive gene existed in minipigs. the MM (prolific type), MN, NN (non prolific type) genotype frequencies of ESR genes were 41.1%, 50.7%, 8.2% vs. 0.0%, 25.0%, 75.0% vs. 8.3%, 58.3%, 33.3% vs. 14.3%, 57.1%, 28.6%. Suggesting were frequency for the M allele in this Lanyu pig.

(S. Y. Wu, C. C Chang, Y. L. Chen and Y. L. Huang)

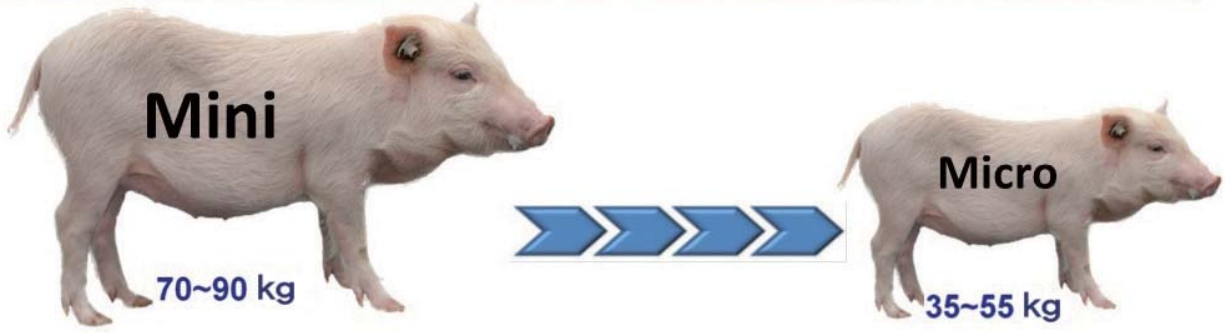
Lanyu pig was raised for use in biomedical research

Breeding of biomedical micropig

The aim of this project is to select micropig from Binlang breed (Lanyu 400) to meet the requirements of biomedical research and biotechnology industry. The individuals of G4 generation (registration litter numbers are #2092 for 2 males, #2165 for 4 females, #2224 for 1 male and 2 females, #2232 for 1 male and 2 females, and #2370 for 2 males and 3 females) have reached 2-year-old age and there are 17 litters in G5 generation. The average body weight at birth, six weeks, five months, and 1 year old of age are 0.08±0.09, 6.73±0.60, 25.94±1.26 , and 63.31±4.71 kg. The individuals of G5 generation (registration litter numbers are #2399 for 1 male and 1 females, #2346 for 1 male and 2 females, #2343 for 1 male and 2 females) have reached 2-year-old age and there are 8 litters in G6 generation. The body weight at birth, six weeks and five months of age are 0.51±0.08, 5.64±1.06, and 26.04±1.60 kg. The results provide a reference and further related micropig breeding of strategy planning.

(S. Y. Wu, C. C Chang, Y. L. Chen and Y. L. Huang)

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



Breeding of biomedical micropig

Using genetic testing to screen the genetic defects of Holstein cattle in Taiwan

Several inherited autosomal recessive defects of dairy cattle such as bovine leukocyte adhesion deficiency (BLAD), brachyspina (BS), complex vertebral malformation (CVM), deficiency of uridine monophosphate synthase (DUMPS), cholesterol deficiency (HCD) and mulefoot have been identified. The aim of this study was to investigate the carrier frequency in the

Holstein cattle in Taiwan. A total of 1,688 cows were genotyped from 31 dairy herds by using GeneSeek Prime 50K SNP chip. The results of genetic testing showed that 8, 86, 30, 59, 0 and 0 cows were BLAD, BS, CVM, HCD, DUMPS and mulefoot carrier, respectively. The carrier frequency was 0.53%, 5.1%, 1.77%, 3.49%, 0% and 0%, respectively. The results shown that there were still several inherited autosomal recessive defects in the Holstein cattle in Taiwan, and it is necessary to closely monitor them to prevent the spreading of any genetic defect allele.

(J. S. Chao, Y. M. Chen, I. H. Chen, K. H. Lee and J. W. Shiau)

Genetic analysis of Holstein dairy cattle by using 50K SNP chips

Dairy cattle genomic selection technique, the use of genomic information, is one of the global trends in dairy breeding technology. This single nucleotide polymorphism (SNPs) is a powerful genome selection tool that is a new generation of molecular marker selection. The purpose of this study is to establish a Taiwanese dairy cattle genome evaluation system. The study was conducted by genomic testing of 135 black and white Holstein cattle using the GeneSeek Prime 50K SNP chip. Genetic assessment mainly included (1) health-yield-fertility traits, (2) type traits, (3) genetic conditions and (4) parental identification. The genome reliability of animals were between 68-75%.The average net merit value, an estimate of the lifetime profit of the animal, was 114.27. Top ten net merits were from of 359 to 491. The worst 10 net merits were from -131 to -273. The average milk production was 240.16. The top ten milk productions were from 956 to 1588. The worst 10 milk productions were from -512 to -781. The results show that estimated economic values of individuals were very diverse and the cows need to be mated with suitable bull to increase the uniformity and the number of elite descendants.

(J. S. Chao, Y. M. Chen, I. H. Chen, K. H. Lee and J. W. Shiau)

Comparison of carcass and beef characteristics between Taiwan Yellow Cattle and its crossbreds

In Taiwan's beef consumption market, domestic beef accounted for less than 6% of the proportion, of which most of the meat from dairy cattle. However, most of the common beef cattle are hybrids with unknown beef blood sources. Therefore, in the absence of a well-established beef cattle production system and a properly adapted feeding and management model, the domestic beef industry standards and the quality of domestic beef can not be effectively improved. Taiwan Yellow Cattle (TY) have long existed in Taiwan and are well adapted to the climatic conditions. Although the growth rate is relatively slow, the cattle have the advantages of being resistant to roughage, heat and disease, good temperament, especially the carcass performance and meaty flavor features. It is a fast and effective way to take the advantage of the hybridization to improve domestic beef cattle's body size, growth, feed efficiency, carcass performance and meat quality by crossbreeding excellent beef cattle breeds with Taiwan Yellow Cattle. The objective

of this project is to develop the environment adapted and local consuming demand superior beef breed with different functional property exotic beef breed that crossbred with indigenous Taiwan Yellow Cattle (TY). Breeds that used to crossbred with TY were Limousin (LM), Charolais (CH), Gelbvieh (GV), Angus (AN) and Wagyu (WA). During the nursing period, LMxTY, CHxTY and GVxTY crossbreds performed better than straightbred Taiwan Yellow in average daily gain (ADG) at 3 months of age.

(J.S. Shiu, G.F. Li and J. H. Wu)

TY × AN calf

TY × LM calf

TY × CH calf

TY × WA calf

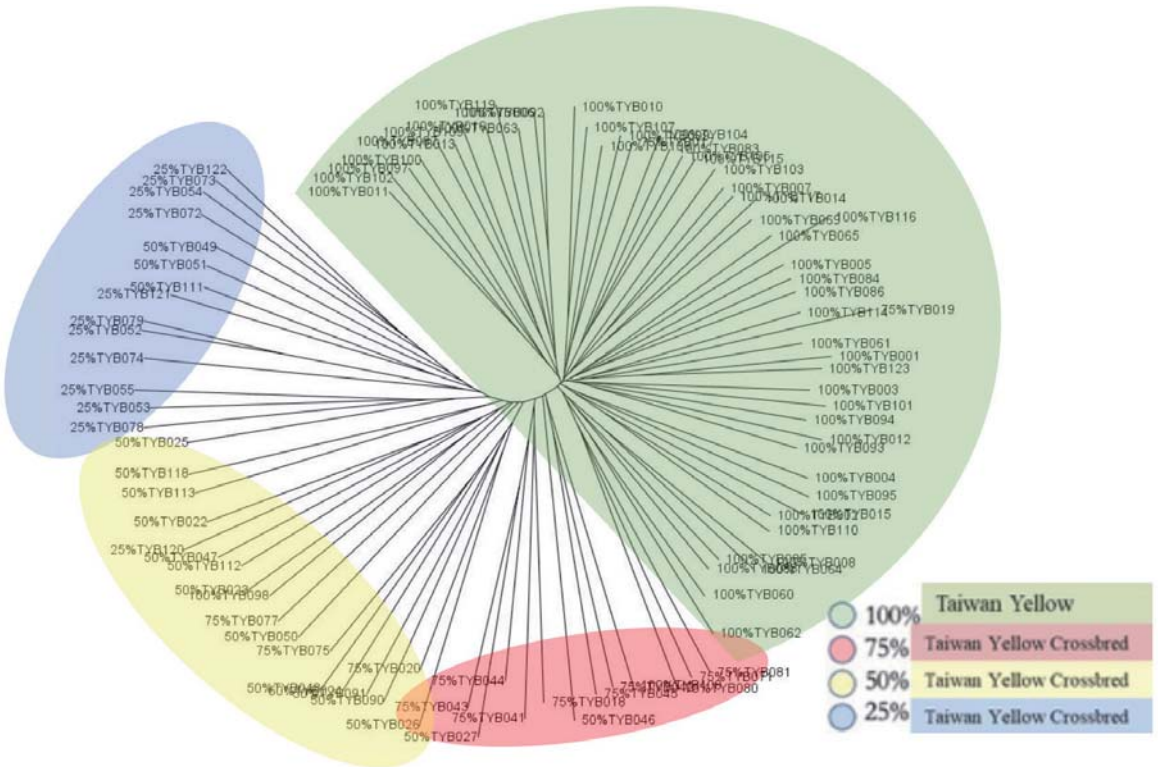
TY × GV calf

Taiwan Yellow (TY) calf

Taiwan Yellow Cattle ex situ conservation and construction of gene database

The purpose of preservation and utilization of Taiwan Yellow Cattle is to continually preserve live animals and their genetic materials with typical breed characteristics, and maintain the genetic diversities of the population. Back-flow of conserved animals to private farms to disperse the risk of genetic resource loss is another main work. Besides that, application of new livestock breeds that derive from indigenous and exotic genetic resources for future utilization is another long-term project. By the end of 2019, about 633 Taiwan Yellow Cattle were raised in the Taiwan and Penghu area, of which 340 were raised in 13 off-farm breeding sites. The total number of raising heads has been increasing year by year from 2012-2019, with an average growth rate of 7.8%. The Taiwan Yellow Cattle was under rare and endangered condition at the beginning when implementing the pilot conservation project of indigenous livestock since 1987. Over 30 years of persistent germplasm program to stick to basic population and actively promoted the animals to folk farms to establish decentralized seed stocks, the situation of Taiwan Yellow Cattle has been improved from endangered to endangered-maintained, which protecting the rare domestic animal genetic resources from the risk of loss. The high-density 60K mononucleotide polymorphic microarray chip was used to monitor the genetic composition ratio of purebred and crossbred with different proportions of Taiwan Yellow Cattle blood, which can effectively distinguish 100, 75, 50 and 25% individuals of Taiwan Yellow Cattle. In the future, it can be used to mark the blood sources of different individuals between breeds and within breed, for the purpose of assisting the identification of various species of adulteration or breed certification, registration, and identification of beef in the consumer market.

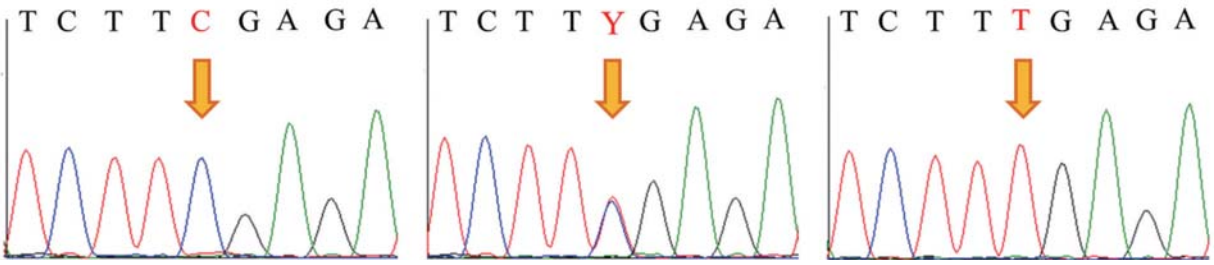
(G.F. Li, P. A. Tu and J.S. Shiu)



Analysis and monitoring of genetic diversity for Taiwan Water Buffalo

The reports showed that there are numerous major genes related to the growth performances in Mammalian. Insulin-like growth factor I receptor (IGF-IR) concerns the expression of IGF-I which could stimulate the synthesis of skeletal muscle and increase the protein content of myogenic cells, and then regulates the growth performance of animals indirectly. Myogenic determination factor (MyoD) and Myogenin (MyoG) are two important myogenic regulatory factors that regulate myogenic determination and terminal differentiation. In order to understand the relations between the polymorphisms of target genes and the growth performance of water buffalo, we assembled and aligned the partial of IGF-IR, MyoD and MyoG gene sequences from 68 heads of water buffaloes. Meanwhile, we also collected the data of body weight (BW), body height (BH), body length (BL) and chest girth (CG) of 25 water buffalo calves from 6 to 15 months-old. The results showed that there are 8 SNPs located in IGF-IR, MyoD and MyoG partial genes. According to the results of statistical analysis, it demonstrated that IGF-IR Exon 2 g.266C>T, IGF-IR Intron17 g.21G>A, MyoD Intron2 g.65C>T and MyoD Exon3 g.215A>G SNPs are associated with the growth performance of water buffalo. This preliminary report showed that there are candidate markers for growth performance selection could be used in the breeding of Taiwan Water Buffalo.

(Y. T. Chen, P. H. Chuang, and A. K. Su)



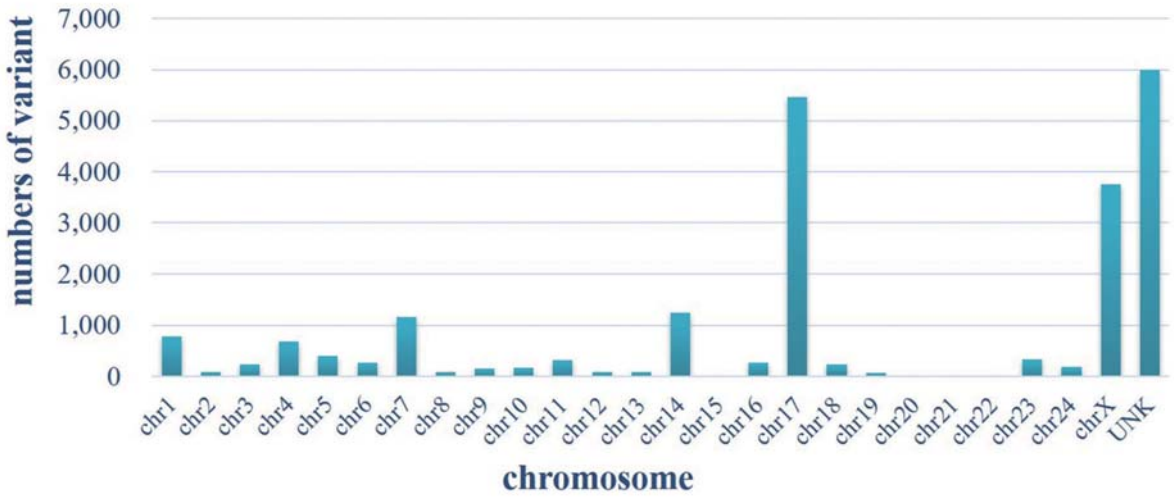
The pattern of single nucleotide polymorphism (resulted from sequencing of IGF-IR Exon2 g.266C>T)

The genomic diversity analysis of Taiwan Water Buffalo

The aim of this study was to construct a database of genomic DNA diversity by using genomic DNA resequencing method and to establish a database of the growth performance of Taiwan Water Buffalo. According to the genealogical data of water buffalo from Hualien propagation station, three independent individuals of water buffalo in different sub-groups were chosen to establish a genetic diversity database of buffalo. Mapping the reads with the reference sequence showed that there were 22,027 variants and mostly in 17th and sex chromosomes. The results of growth performance showed that the correlation coefficients between body length, body height and girth of chest with body weight were 0.64, 0.83 and 0.90, respectively. Moreover, it showed

that the birth weight of calves from primiparous buffalo cows was significantly lower than those of from multiparous buffalo cows (32.5 vs. 39.2 kg) ($P < 0.0001$). The database of water buffalo genomic DNA was constructed in this study. This database could apply to not only the management of water buffalo on the field, but also the analysis of genetic diversity of them.

(Y. T. Chen, P. H. Chuang, and A. K. Su)



Distribution of 22,027 variants in chromosomes of Taiwan Water Buffalo. UNK means the variants that unmatched to chromosome

Frequency of mucopolysaccharidosis IIID genotypes of registered breeding goat in Taiwan

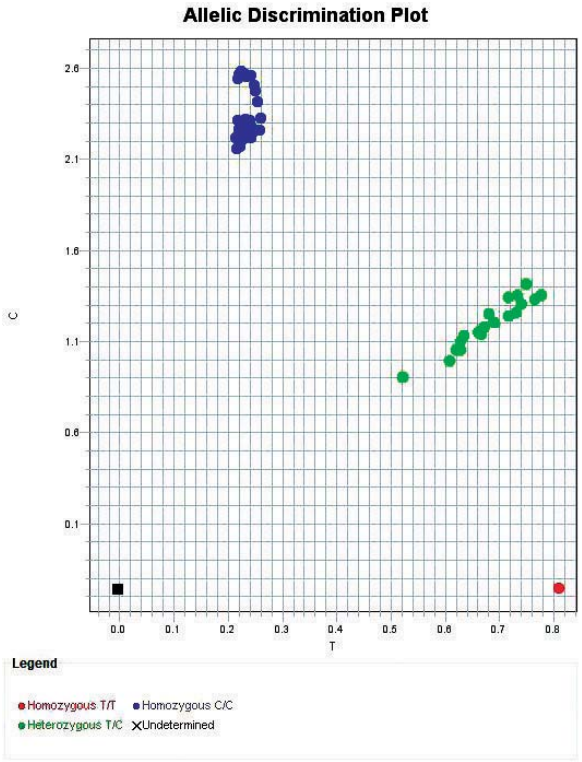
Caprine mucopolysaccharidosis IIID, or N-acetylglucosamine 6-sulfatase deficiency (G6S), is a recessive inherited disorder of goat. There were 982 goat DNA samples tested from 8 herds of 303 Nubians, 494 Alpines, 89 Saanens, 4 Boers, 44 Taiwan Black Goats, 32 Ji-An goats and 16 Kenting Goats. The result showed that except for Alpine goat, there are 7 female goats in the G6S AB heterozygous type, the other goats are all G6S AA normal type. Goats with heterozygous type have been advised to consider elimination. The frequency of abnormal G6S genotypes in this experiment was much lower than reported by Lin et al. in 2008 (0.7 % vs 5.9 %), indicating that the goat industry has applied this gene selection technique for breeding goat in the past ten years to improve the efficiency of overall production system in Taiwan.

(N. T. Yen, D.Y. Lin, J. C. Chen, S. T. Chen, G. J. Fan, P. H. Chuang, X. H. Liu and M. C. Wu)

Breed	N	G6S AA	G6S AB	G6S BB	Frequency of normal G6S genotype, %	Frequency of abnormal G6S genotype, %
Nubian	303	303	0	0	100	0
Alpine	506	499	**7**	0	98.62	1.38
Saanen	89	89	0	0	100	0
Boer	4	4	0	0	100	0
Taiwan Black Goat	44	44	0	0	100	0
Ji-An goat	32	32	0	0	100	0
Kenting goat	16	16	0	0	100	0
Total	994	987	7	0	99.30	0.70

Diagnosis of Caprine mucopolysaccharidosis type IIID by the application of real-time PCR platform

Mucopolysaccharidosis refers to a group of inherited conditions in which the body is unable to properly breakdown mucopolysaccharides. As a result, these sugars buildup in cells and connective tissue, leading to a variety of health problems. Besides the Mucopolysaccharidosis found in human, there were plenty of cases found in different animals. The mucopolysaccharidosis type IIID disorders are lysosomal storage diseases. In Nubian goat MPS IIID, the G6S deficiency is associated with a single mutation, changing a C to T in the 322 nucleotide of the G6S cDNA sequence. The consequent lack of G6S activity in goats leads to the primary accumulation of uncatabolized HS-GAGs in lysosomes . The critical technique to improve genetic progress is making use of simple marker assay to cull the genetic defect, which might affect the growth performance in animals. This study is to apply Kompetitive Allele-Specific PCR (KASP) for the identification of homozygote and heterozygote in Caprine MPS IIID.



The analysis result of the G6S genotypes utilized the KASP genotyping platform

Kompetitive Allele-Specific PCR (KASP) is a detection method that can type SNPs and InDels at specific sites. With respect to genotyping, KASP is based on terminal fluorescence reading, similar to the basis of TaqMan probe detection. Each method uses two-color fluorescence to detect individual samples of different genotypes at a single site; different fluorescent products reflect different DNA templates. For KASP tests, a SNP- or Indel-specific KASP assay mixture (specific primer mixture), KASP Master Mix (general mixture) and DNA samples are mixed together for thermal cycling, after which the fluorescence is read by laser scanning at the end point. KASP-SNP markers are highly accurate, inexpensive and highly flexible, and they have a high conversion rate and a wide range of applications. In the preliminary results of this study, the KASP genotyping platform can clearly and effectively identify the different genotypes, homozygote and heterozygote, in Nubian goat MPS IIID.

(C. T. Chu, D. Y. Lin, Y. Y. Lai, J. C. Chen, M. C. Wu and H. L. Chang)

Investigating calpastatin gene polymorphism of goat populations in Taiwan

Calpastatin is a calpain inhibitor and plays an important role in the myogenesis and the tenderness of the meat. Previous studies verified that the calpastatin gene (CAST) shows the polymorphism in the 620 bp length region between the exon 1C and exon 1D in goats. This study was conducted to the analysis the CAST polymorphism of Taiwan goat populations by PCR-RFLP and the populations included Taiwan Black Goat-Hualien line, Taiwan Black Goat-Hengchun line, Ji-An goat, Kenting Goat, Nubian goat, Alpine goat, and Sanna goat. The result indicated that 100% of goats were MM type in Taiwan. To figure out whether the Taiwan goat population-specific polymorphism in this region, DNA sequencing was applied. The results showed that variants located on 190 bp, 362 bp, 397 bp and 475 bp in the Nubian and Alpine populations, however, there no altered in indigenous and Sanna populations. The clarification of CAST polymorphism could be the reference of goat genetic breeding in the future.

(C. J. Hsieh, R. J. Chen, M. C. Wu)

Genotype and gene frequency at the bp 190 variant

Breed	Genotype Frequencies						Allele Frequencies	
	GG		GA		AA		G	A
	No.	Freq.	No.	Freq.	No.	Freq.	Freq.	Freq.
Nubian	30	81.1%	6	16.2%	1	2.7%	89.2%	10.8%
Sanna	22	100.0%	0	0.0%	0	0.0%	100.0%	0.0%
Alpine	8	36.4%	12	54.5%	2	9.1%	63.6%	36.4%

Genotype and gene frequency at the bp 326 variant

Breed	Genotype Frequencies						Allele Frequencies	
	GG		GA		AA		G	A
	No.	Freq.	No.	Freq.	No.	Freq.	Freq.	Freq.
Nubian	27	73.0%	9	24.3%	1	2.7%	85.1%	14.9%
Sanna	22	100.0%	0	0.0%	0	0.0%	100.0%	0.0%
Alpine	22	100.0%	0	0.0%	0	0.0%	100.0%	0.0%

Genotype and gene frequency at the bp 397 variant

Breed	Genotype Frequencies						Allele Frequencies	
	GG		GA		AA		G	A
	No.	Freq.	No.	Freq.	No.	Freq.	Freq.	Freq.
Nubian	30	81.1%	6	16.2%	1	2.7%	89.2%	10.8%
Sanna	22	100.0%	0	0.0%	0	0.0%	100.0%	0.0%
Alpine	8	36.4%	12	54.5%	2	9.1%	63.6%	36.4%

Genotype and gene frequency at the bp 475 variant

Breed	Genotype Frequencies						Allele Frequencies	
	GG		GA		AA		G	A
	No.	Freq.	No.	Freq.	No.	Freq.	Freq.	Freq.
Nubian	30	81.1%	6	16.2%	1	2.7%	89.2%	10.8%
Sanna	22	100.0%	0	0.0%	0	0.0%	100.0%	0.0%
Alpine	8	36.4%	12	54.5%	2	9.1%	63.6%	36.4%

Selection of heat-resistant goat breed

The Hengchun Branch of LRI located at the southernmost Taiwan with tropical climate, where provides an ideal environment to raise and select heat-resistant goat breed by evaluating their performances on milk yield, growth rate, and other economic traits. Alpine and Nubian goats were chosen to implement this breeding project. In this study, the average daily milk yield during 250-day lactating period of Alpine was 2.60 ± 0.30 kg, which indicating good milking ability, and subsequent average milk yield could be expected to increase by selecting high producing individuals. The kidding rate of Nubian was 178% (25/14), and the average body weight of the three-month-old male and female kids was 20.8 ± 3.3 kg vs. 17.3 ± 2.6 kg, respectively. The kidding rate of Boer goat is 145% (29/20), and the average body weight of the six-month-old male and female kids was 28.7 ± 5.2 kg and 24.4 ± 3.9 kg, respectively. After years of selection, the growth performance of all stages of Nubian herd has been improved, and the project will apply the same selecting mechanism to improve heat-resistant ability on Nubian and Boer population. Data collection of related characteristics will proceed in the future to establish the mating system of commercial crossbred meat goats.

(K. F. Tseng and T. C. Kang)

Nubian buck at Hengchun Branch, LRI

Boer buck at Hengchun Branch, LRI

Study on polymorphism of leptin gene and its association with growth performance in goats

In mammals, the leptin (LEP) gene affects body weight, energy balance, and food intake, and is an important hormone in animal growth. This study was to establish polymorphism data of LEP gen in domestic goat breeds and to expand the breeding database. Exploration of the associations between body weight, body length, body height, chest girth and LEP gene polymorphism was conducted in domestic goat populations (Boer goat, Nubian goat, Kenting Goat, and Taiwan Black Goat) from birth to 9 months of age. This experiment was to detect the g.117C> T polymorphism in the exon 1 region of the LEP gene. The wild-type homozygote can be recognized by the endonuclease NmuCI and named as the TT genotype (218 and 194bp), CC

genotype (412 bp), and heterozygotes named TC genotype (412, 218, and 194 bp). The frequencies of TT, TC, and CC of the black Boer goat were 0.16, 0.51, and 0.33, and the gene frequencies T and C were 0.42 and 0.59. The genotype TT and TC frequencies in Kenting Goat were 0.94 and 0.06, and the gene frequencies T and C were 0.97 and 0.03, respectively. The genotypes in Taiwan Black Goat are all TT with a frequency of 1.00, and the gene frequencies of T is 1.00. The TT and TC frequencies of Nubian goat were 0.96 and 0.04, and the gene frequencies T and C were 0.98 and 0.02 respectively. It can be seen that the genotype frequency of the LEP gene are significantly differences among breeds. In the 9-month-old, the TC genotype was significant better than the CC genotype. In terms of weight performance, the TT genotype was more important than the TC and CC genotypes from birth to 6 months of age.

(C. C. Pan, M. C. Chen, T. C. Kang and K. F. Tseng)

The measurement of body length (BL) in goat

The measurement of weither height (WH) in goat

Correlating deletion in 5'UTR of myostatin gene with weight and conformation traits of meat goat before nine-month-old

This study aimed to assess the association of SNP in MSTN gene (5' UTR-TTTTA deletion) with weight and conformation of meat goat before 9-month-old in four meat goat breeds, Boer, Kenting, Taiwan Black Goat (native goat), and Nubian. A total of 205 goats was genotyped and measured every three months for weight, body length (BL), wither height (WH), and chest girth (CG) from birth to 9-month-old. The SNP was screened using PCR-RFLP based analysis and the effects of genotypes was estimated. Significant breed effects were observed as expected, except for WH at 6-month-old. Gender effects were significant, except for conformation traits at birth. After taking into account the effects of breed and gender, significant association between the SNP and traits was found only at 9-month-old, which heterozygous (AB) animals had heavier and larger conformation (BL, WH, and CG) than homozygotes of mutant (AA) and wild type (BB). Additionally, significant dominance effects were also shown at same age.

(C. C. Pan, M. C. Chen, T. C. Kang, K. F. Tseng and H. L. Chang)

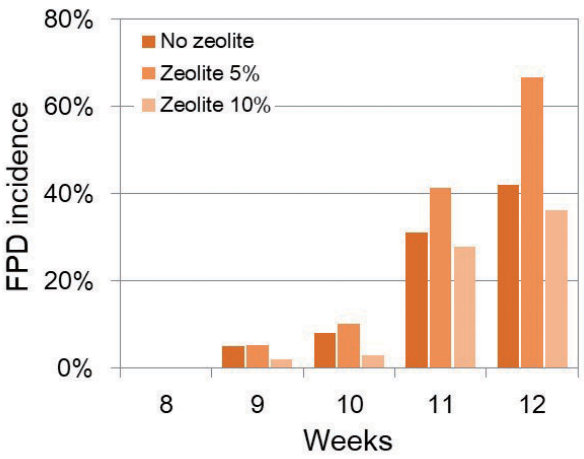
Taiwan black goat

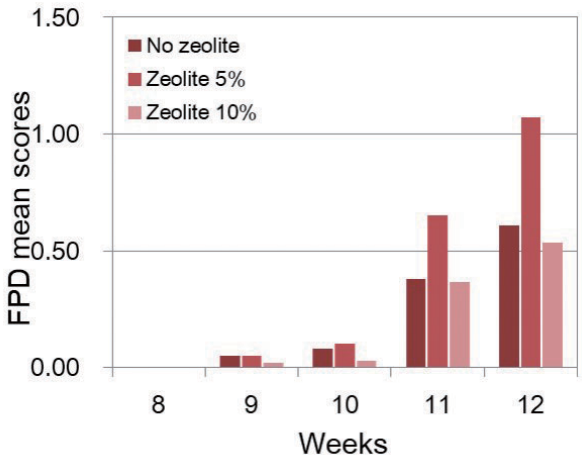
The measurement of chest girth (CG) in goat

The association between the litter quality and contact footpad dermatitis in floor-housed native chickens--The effects on FPD under different ratio of zeolite in the litters

This study was conducted to understand the influence on the chicken footpad under the different ratio of zeolite in the litters. Crossbreed chickens from TLRI K12 and K9 were reared on the litters contained 0%, 5% and 10% of zeolite respectively. Moreover, the extra water was added to the litters for inducing the footpad dermatitis (FPD) of chickens. The results showed that the moisture reached 54.91%, 57.76% and 52.46%in the no zeolite, 5% zeolite and 10% zeolite groups in 12 th week eventually. Consequently, the incidences of FPD were 42%, 67% and 36% were corresponded to the level of the litter moistures. Finally, the 10% zeolite group indicated not only the lowest FPD mean score as 0.54 but also the least chickens about 18% got the score 2. Obviously, the zeolite can help to decline the incidence of FPD and palliate the severity level of FPD.

(C. J. Hsieh, Y. L. Li, A. K. Su)





The FPD incidence and mean score from each group

Avian leucosis J-virus monitoring in the selection population of LRI native inbreeding lines

Avian leucosis is caused by avian leucosis viruses (ALVs) are prevalent in the poultry industry worldwide and cause severe economic losses. The subgroup J of ALV (ALV-J) has emerged as an important pathogen of meat-type chickens since 1989 and causes serious economic losses in poultry industry. In order to monitor ALV-J disease in the selection population of LRI native inbreeding lines, we collected blood samples of candidate breeder chicken by the blood collection device with anticoagulant EDTA-K3 in 2019. The DNAs of blood samples were extracted with nucleic acid extraction reagent and the primer kits (H5/H7) was used for ALV-J PCR detection. Four inbreeding lines of LRI native chicken were monitored in this program. Totally 868 blood samples of candidate breeder chickens including 263 Line 7, 202 Line 9, 212 Line11 and 191 L12. All of the samples were ALV-J negative. It shows that the selection population of LRI native inbreeding lines is an avian leukemia J virus free population.

(D. Y. Lin, S. J. Tzeng, C. M. Hung, M. Y. Tsai, Y. Y. Lai, C. T. Chu and M. C. Wu)

Chicken blood sample collection

Analysis of SNP genotypes on Z chromosome and laying performance in LRI-L9 hens

To study the relationship between SNP genotypes on the Z chromosome of hens and their laying performance. In this experiment, 131 SNP primers on chicken Z chromosome were used to detect the individual DNA of 92 hens in the LRI-L9 selection flock, and the detected SNP genotypes were analyzed the correlation with laying performance of hens. Among them, 82 SNP primer kits detected genotypes in all tested individuals were single type, and other 49 primer kits detected different genotypes. Differences in hens' SNP genotypes and their laying performance were analyzed. We found that it was significant differences in the age at first egg of hens with different genotypes in 3 SNP primer kits ($P<0.05$),

LRI-L9 hen

and different genotypes in 3 and 5 SNP primer kits were significant difference in the body weight and egg weight at 1st egg of hens, respectively (P<0.05). Different genotypes of hens detected by two SNP primer kits were significant difference in number of eggs laid up to 40 weeks of age. It was found different genotypes in each 3 SNP primer kits were significant difference in the body weight and egg weight at 40 weeks of age of hens, respectively (P<0.05). while the hens with different genotypes detected by 4 SNP primer kits had significant differences in broody days up to 40 weeks of age (P<0.05). This result provides molecular information on candidate genetic markers for this selection flock.

(D. Y. Lin, S. J. Tzeng, Y. Y. Lai, H. L. Lin, C. M. Hung and M. C. Wu)

Polymorphism analysis of Kai Shing silkie chicken by microsatellite markers

In order to evaluate genetic variation of Kai Shing silkie chicken flock. We use a set of 24 microsatellite markers recommended by FAO to analyze 64 candidate bred chickens from this flock. Except MCW0103, all the microsatellites were polymorphic with average allelic number 4.1, ranged from 0 to 7 per locus. The expected heterozygosity ranged from 0 to 0.798, and the average expected heterozygosity was 0.548. The observed heterozygosity of the population ranged from 0 to 0.641, and the average observed heterozygosity was 0.400. The estimated average polymorphic information content (PIC) was 0.491. In 24 markers, 13 markers were highly informative with polymorphism information content (PIC ≥ 0.50), nine markers were reasonably informative (0.5 > PIC ≥ 0.25) and the other two markers were slightly informative (PIC < 0.25). These results could be provided basic molecular information for the research on the germplasm characteristics of the population.

(D. Y. Lin, S. J. Tzeng, H. C. Teng, Y. Y. Lai, H. L. Liu and M. C. Wu)

Kai Shing silkie chicken

Analysis of nutrient contents of blue shell silky chicken eggs and brown eggs

The experiment was to determine the nutrient contents of blue shell silky chicken eggs and brown eggs for the reference of nutritional value. Four birds from blue shell silky hens and brown egg hens at 40 weeks of age and fed the same diets for 21 days were taken eggs for determination of eggs content including moisture, crude protein, crude fat, crude ash, calcium, zinc, iron, potassium and lecithin. The results indicated that the contents of blue shell silky chicken eggs and brown eggs were moisture 71.5 vs. 76.1%, crude protein 12.8 vs. 13.2%, crude fat 12.9 vs. 8.6%, crude ash 1.5 vs. 0.88%, calcium 507 vs. 230 ppm, zinc 20.3 vs. 10.3 ppm, iron 24.6 vs. 18.2 ppm, potassium 15.8 vs. 13.5 ppm, selenium 0.27 vs. 0.90 ppm and lecithin 3,823 vs. 2,643 mg/100 g, respectively. Silky chicken eggs had higher crude fat, crude ash, calcium, zinc, iron, potassium, selenium and lecithin. Brown eggs had higher moisture, crude protein and selenium. There were significant differences.

(M. Y. Tsai and H. L. Liu)

Blue shell silky chicken eggs

Brown eggs

Egg production performance and egg shell color of blue shell silky chicken selection at the second generation

The experiment was to select blue egg shell silky chicken from the LRI white silky chicken for the production of blue silky chicken eggs. The chicks of pedigree selection of the second generation were tagged with wing number individually. Feeds were provided ad libitum. After breed characteristics were selected and PD was screened at 16 weeks of age, hens of silky chicken were caged. Average age, egg weight and body weight at the first egg, egg shell color at 30 weeks of age; egg number, egg weight and body weight at 40 weeks of age were recorded. The results of 85 females indicated that average age, egg weight and body weight at the first egg were 164 ± 12.9 days, 30.8 ± 6.3 g and 1,373 ± 172 g, respectively. Body weight, egg weight and egg number at 40

weeks of age were 1,486 ± 224 g, 41.1 ± 3.5 g and 59 ± 22, respectively. The egg color at 30 weeks of age in L, a and b values were 77.6 ± 4.07, 1.59 ± 6.43 and 17.9 ± 4.23, respectively. Hens with bluer egg shell were selected and mated for the next generation for further experiment.

(H. L. Liu, C. Y. Lin, M. Y. Tsai, C. M. Hung, and Y. S. Chen)

Blue shell silky chicken selection at the second generation

Investigation of duration of fertility of LRI white silky chicken

The experiment was to investigate the duration of fertility of LRI white silky chicken. One hundred hens were inseminated with pooled semen of 10 cockerels at 56 weeks of age. Each hen was inseminated with 0.01 - 0.02 ml semen. Fifty hens were inseminated at one batch and breeder eggs were collected for 14 days (incubation at 7 days of collection). Each hen's relative characteristics were recorded after hatch. The results indicated that insemination rate of once of artificial insemination at 2 to 15 days was 25%, 82%, 62%, 38%, 33%, 37%, 0%, 25%, 25%, 15%, 25%, 0%, 8% and 0%, respectively. Hatch rate of incubation eggs were 25%, 73%, 54%, 38%, 22%, 11%, 0%, 25%, 25%, 15%, 17%, 0%, 8% and 0%, respectively. Number of incubation eggs, fertilized eggs, death embryo, hatched chicks, maximum duration days and fertility days were 7.7 ± 1.6, 2.0 ± 1.7, 0.3 ± 0.6, 1.7 ± 1.5, 6.0 ± 4.6 and 1.0 ± 0.7, respectively.

(C. M. Hung, H. L. Liu, M. Y. Tsai, H. C. Huang, W. S. Chen and Y. F. Lin)

LRI white silky chickens were inseminated with pooled semen

Selection of the pure cockfighting breed

The purpose of this experiment was to investigate the performance of cockfighting offspring which breed from G0 pure cockfighting at the station. One hundred and eighty G0 chicks, at the 8 weeks age, were divided into two groups by gender. The performance of body weight and feed efficiency on the G0 chicks at 0, 8, 16, 20 and 22 weeks were investigated. Meanwhile, the performance of egg production, primiparous age, primiparous weight, primiparous egg weight, 45-week-old body weight, egg weight, egg production rate of the G0 female cockfighting hen were also investigated. The results showed that the rate of fertilization and the hatching rate (accounting for the number of fertilized eggs) of G0 cockfighting hen were 54.6% and 75.2%, respectively. In terms of growth performance, the starting weight, the body weight of 20 weeks old, the average daily gain of 0-20 weeks old, the average daily feed intake and the average feed efficiency rate of cockfighting chicks were 37.7g, 3124g, 22.05g, 77.48g, and 3.51 respectively. In terms of egg production performance at 45 weeks of age, the primiparous weight, primiparous days, and initial egg weight of the cockfighting hens were 3126.3g, 173 days, 41.1g, respectively. At 45 weeks age, the G0 generation had laying 82 eggs, average daily egg weight was 50g and laying eggs rate was 58%.

(Y. L. Lee, S. S. Yan, and A. K. Su)

The feathers characteristic of the male cockfighting

Selection a hybrid native chicken from TLRI Kaohsiung native chicken No.9 with Kaohsiung native chicken No.12

The commercial brand of game hen is mated by male gamecock with large sized of Taiwan country female chickens, which leads to uneven growth of their offspring. Therefore, the farmers could not raise their chicken by batch management. It is in danger of raising chicken without batch management due to executing the poultry house disinfection difficultly. The purpose of this experiment was to investigate the reciprocal mating between Kaohsiung No. 9 (L9) chicken with Kaohsiung No. 12 (L12) chicken. This experiment carried out the gene fixation and appearance selection work on the hybrid offspring, which were the female side of game hen on their meat production. The experiment was divided into two groups. Group A was L12♂×L9♀ and

group B was L9♂×L12♀. All hens were mated by artificial insemination for reproductive traits and their chick were fed for growth traits. The results showed that the insemination rate and hatching rate of the two groups were 72.2%, 65.1% vs. 78.0 %, 64.3%, respectively. On the growth performance, the birth weight, 20-week-old body weight, average daily gain, average daily feed intake, and feed conversion ratio of the chick were 25.2g, 2301.0g, 16.2g, 88.8g, 5.83 vs. 25.1g, 2323.6g, 16.2g, 89.7g and 5.93, respectively. There were no significant differences between the two groups. Meanwhile, the average number of eggs laid at the age of 45 weeks, the average egg production rate and the average egg weight were 96.0, 51.9% and 40.8g vs. 85.4, 47.9%, and 40.8g, respectively. There were no significant differences between two groups. However, it seemed that the group A has better egg production performance than that of in group B.

(S. S. Yan, X. Y. Chen,Y.L.Lee and A. K. Su)

Growth performance survey

Hybrid native chicken selection from TLRI Kaohsiung native chicken No.9 with Kaohsiung native chicken No.12

Game hen is mated by male gamecock with Taiwan country female chickens, which leads to uneven growth of their offspring and managing them by batch method difficulty. The batch management on chicken raising can execute farm disinfection easely. The purpose of this experiment was to investigate the reciprocal mating of chicken between TLRI-L9 with TLRI-L12 for selecting the even appearance of feather color, growth and egg production, expand breeding number or accumulate breeding data of this flock. The results showed that the insemination and hatching rate of the 1th generation were 89.3 and 76.8%, respectively. The birth weight, 20-week-old weight, average daily gain and feed conversion rate of chick were 30.2, 2252.4, 15.9g and 4.5, respectively. The average number of eggs laid, the average egg production rate and the average egg weight of hens at 45 weeks were 113, 59.9%, and 40.8 g, respectively.

(S. S. Yan, X. Y. Chen,Y.L.Lee and A. K. Su)

Laying egg performance survey

Developing a productive commercial cross breeding model system for laying ducks for export

This study evaluated the growth and egg production performance of commercial layer ducks produced from crossing breeding the Wuchieh White duck and Brown Tsaiya duck LRI No.3. The experimental hatched duckling body weights were 38.2 and 38.1 for males and females, respectively. The experimental duck body weights also increased from 50 g at first week of age to 1,544 g at 9 weeks of age. This was close to the female Wuchieh White duck body weight and significantly greater than that of the Brown Tsaiya duck. The duckling livability rate at first weeks was only 90.6%. Survivability was over 95% after 2 weeks of age. The accumulated livability rate at 70 weeks of age was only 77%. Experimental duck feed consumption increased from 4 g/d average at first week of age to 102 g per day at 22 weeks of age. Feed consumption continually increased to 150 g per day at 70 weeks of age. This was close to that of the mature Brown Tsaiya duck. The average first egg was observed at 22 weeks of age. The egg production rate increased with age increased and reached 68% after 7 weeks from the first egg. The egg production performance did not meet expectations, even after forced molting. This may be due to the lack of proper feed restriction during the experimental duck growth period

(H. C. Liu and J. S. Chang)

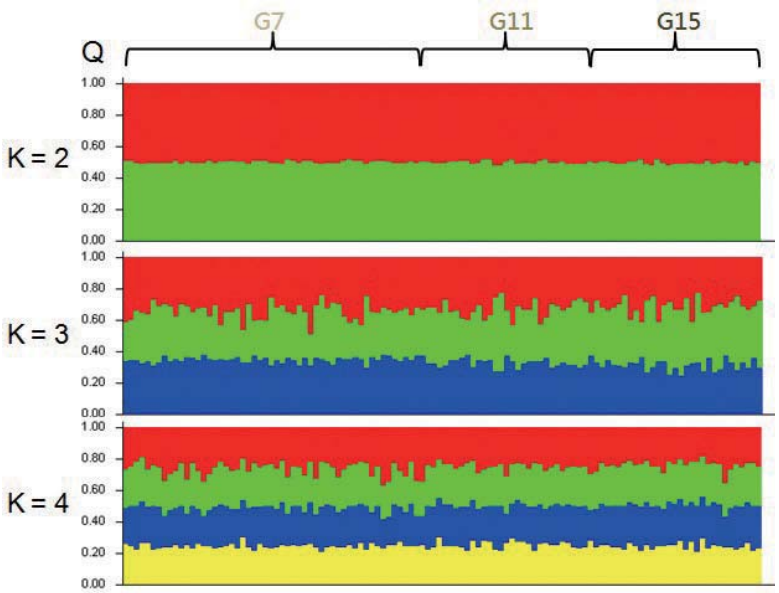
The experimental ducks kept in Ilan Branch, Livestock Research Institute

Study on the effect of rotational mating system on the genetic structure in germplasm-preserved White Tsaiya duck

Germplasm-preserved project chose the random mating line of Ilan White Tsaiya TLRI NO.1 as the germplasm-preserved White Tsaiya duck population, and for the preservation of

the characteristics of White Tsaiya duck, the population has been kept by random mating with long-term phenotype monitoring. Furthermore, for the maintenance of genetic heteozygosities, a rotational mating system was applied to population reproduction since G8. This study aimed to evaluate the effect of the rotational mating system on the genetic structure in germplasm-preserved White Tsaiya duck genetic structure. A total of 114 germplasm-preserved White Tsaiya ducks were used as experimental animals, including before (G7) and after (G11 and G15) rotational mating system was applied. The 11 microsatellite markers derived from Tsaiya ducks were chosen to conduct the genetic analysis; including measuring genetic variation, conducting principal component analysis (PCA), STRUCTURE software analysis and evaluating the index of population genetic differentiation (F_{ST}). The results showed a slight decrease from G11 to G15 in genetic variations, which may result from an interruption in the rotational mating system at G12. As for the principal component analysis and STRUCTURE software analysis results, G7, G11, and G15 were about the same in genetic structure. There was no significant decrease in diversity in all three generations. In addition, there was almost no differentiation observed between two of the three generations (F_{ST}=0.0069-0.0272). In summary, more samples are needed from other generations before and after the rotational mating system to further evaluate the rotational mating system effect on genetic structure maintainence in germplasm-preserved White Tsaiya ducks. In the future, genetic information in different generations should be studied and monitored to conserve the endemic duck genetic resources.

(Y. Y. Chang, W. P. Chang, L. Y. Wei, J. Y. Chen and H. C. Liu)



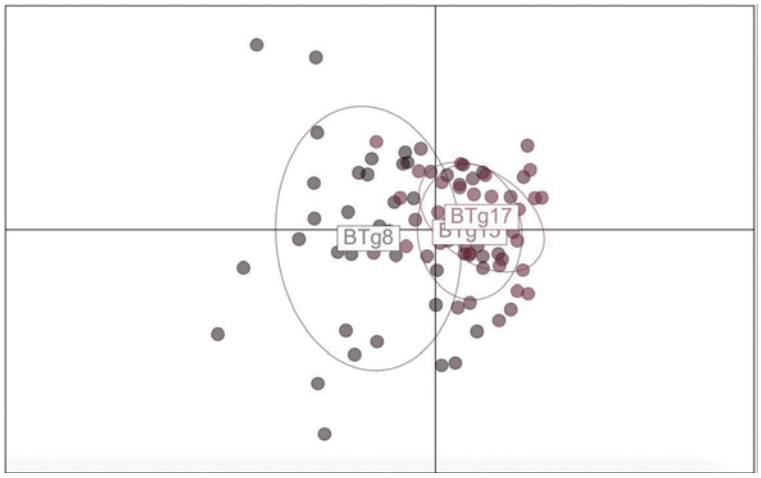
STRUCTURE analysis of three germplasm-preserved White Tsaiya duck subpopulations based on 11 Tsaiya microsatellite markers

Study on the effect of rotational mating system on the genetic structure in germplasm-preserved Brown Tsaiya duck

Germplasm-preserved project constructed a germplasm-preserved Brown Tsaiya duck population by introducing ducks from industrial farm, and for the preservation of the characteristics of Brown Tsaiya duck, the population has been kept by random mating with long-term phenotype monitoring. Furthermore, for the maintenance of genetic heteozygosities, rotational mating system was applied to reproduction of the population since G10. This study aimed to evaluate the

effect of the rotational mating system on the genetic structure in germplasm-preserved Brown Tsaiya duck. A total of 96 germplasm-preserved Brown Tsaiya ducks were used as experimental animals, including before (G8) and after (G15 and G17) rotational mating system applied, and the 11 microsatellite markers derived from Tsaiya duck were chosen to conduct the genetic analysis, including measuring genetic variation, conducting principal component analysis (PCA), and evaluating the index of population genetic differentiation (F_{ST}). The results showed a decreasing trend from before and after rotational mating system applied in genetic variations, while the trend didn't show in the generations after rotational mating system applied. As for the result of PCA, there was a change in genetic structures and decrease in diversities from G8 to G15 and G17, however, the genetic structure of G15 was about the same as G17. In addition, the differentiation level was higher between G8 to the other generations (F_{ST} =0.0473-0.0715) than the one between G15 and G17 (F_{ST}=0.0006). In summary, after rotational mating system applied, there was almost no decrease in genetic variations and diversities, also change in generations. It revealed that rotational mating system is an effective way to maintain the heterozygosity and to decelerate the differentiation of the population.

(Y. Y. Chang, W. P. Chang, L. Y. Wei, J. Y. Chen and H. C. Liu)



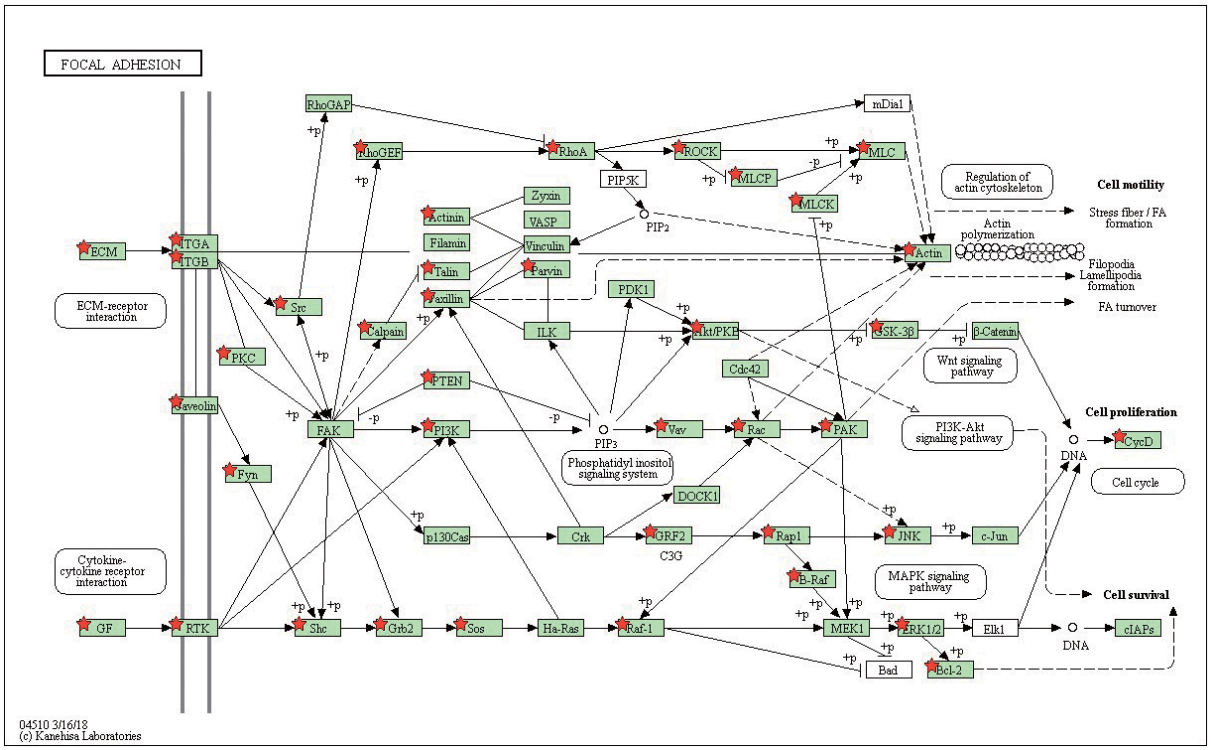
PCA plot of three germplasm-preserved Brown Tsaiya ducks subpopulations based on 11 Tsaiya microsatellite markers

SNP discovery through whole-genome resequencing in Brown Tsaiya LRI3

Brown Tsaiya LRI 3, selected from the ancestor of Brown Tsaiya LRI 1 and was nomenclatured in 2009, with good performance on egg production and uniform blue-shelled eggs. To screen out candidate markers for marker assisted selection and preliminary investigate the mechanism of blue-shelled eggs in duck, we conducted a whole-genome resequencing in Brown Tsaiya LRI3 and compare to the posterity of Brown Tsaiya LRI1 to discover the single nucleotide polymorphisms (SNPs) potentially associated with blue-shelled eggs and eggshell quality. A total of 10 ducks in the 15th generation of Brown Tsaiya LRI3 had been chosen on the basis of pedigree and phenotypic value of a* in L*a*b* system to obtain representative individuals. Then these ducks' DNA were used to conduct whole-genome resequencing separately. The 10-individual sequencing data were pooled and analyzed by CLC Genomics Workbench 11.0.1 to call SNPs which should present in all of the 10 seqeunced individuals. Then the common SNPs between Brown Tsaiya LRI3 and Brown Tsaiya LRI1 we obtained previously would be deducted from

all the SNPs called in LRI3 to select out Brown Tsaiya LRI3-specific SNPs. The general functions and gene annotations for the genes containg the SNPs in genic region was compiled using information from the Database for Annotation, Visualization and Integrated Discovery (DAVID). The average sequencing depth was 54.53X, and the coverage of the reference genome was 97.34%. As for Brown Tsaiya LRI3-specific SNPs, the results showed that there was a total of 460,429 SNPs, while 153,245 SNPs were located in the genic region. These line-specific SNPs will be considered as candidate variants associated with blue-shelled eggs. The results of DAVID showed that the genes which Brown Tsaiya LRI3-specific SNPs are located in may be related to the pathway of focal adhesion, MAPK signaling pathway, and Regulation of actin cytoskeleton. In the future, population studies will be carried on for further investigation of the availability in genomic selection for blue-shelled eggs to enhance the selection efficiency.

(Y. Y. Chang, L. Y. Wei, and H. C. Liu)



STRUCTURE analysis of three germplasm-preserved White Tsaiya duck subpopulations based on 11 Tsaiya microsatellite markers

Study on change in genetic structure of Better Feed Efficiency Brown Tsaiya selected line and its control line using microsatellite markers

Better Feed Efficiency Brown Tsaiya (BFEBT) were selected for low residual feed consumption (RFC) from Brown Tsaiya LRI1 to improve feed conversion ratio and reduce cost of feed. And the Brown Tsaiya LRI1 has also been the control line of BFEBT from G0 to evaluate selection

response. To avoid severe inbreeding depression caused by long-term selection, we conduct this study to evaluate the effect of RFC selection on the population genetic structure. There were 50 and 46 individuals in the G6 generation of BFEBT (S) and its control line (C) investigated by 11 Tsaiya microsatellite markers, and an across-generation comparison was also conducted with the previous G2, G4, G5 and G6 generations. The genetic analysis included measuring genetic variation, using FreeNA software to detect null allele and evaluating the index of population genetic differentiation (F_{ST}) by FSTAT software. The results showed that there was no obvious difference between the G6 generation of BFEBT and its control line in genetic variances. The F_{IS} (Wright's fixation index) values showed a large variation in 11 markers (-0.104-0.669, avg=0.177), however, it was much greater in APT001 (0.625) and APT033 (0.669) than the other markers. And the result of FreeNA indicated that the null allele frequency in the two markers was over and near 0.2, after removing the two markers, The F_{IS} value decrease to 0.052. It reveals that the populations were still not faced with severe inbreeding. On the other hand, the results also showed that there was no differentiation between different generations within the S and C line, while there was significant differentiation between S and C line in the G4 and G5 generations ($P < 0.05$). Overall, the F_{ST} values showed a increased trend with generations of selection from the G2 to G5 generation. In order to promote the sustainable management of these duck lines, the cross-generational genetic monitoring will be carried on continuously.

(Y. Y. Chang, W. P. Chang, L. Y. Wei, and H. C. Liu)

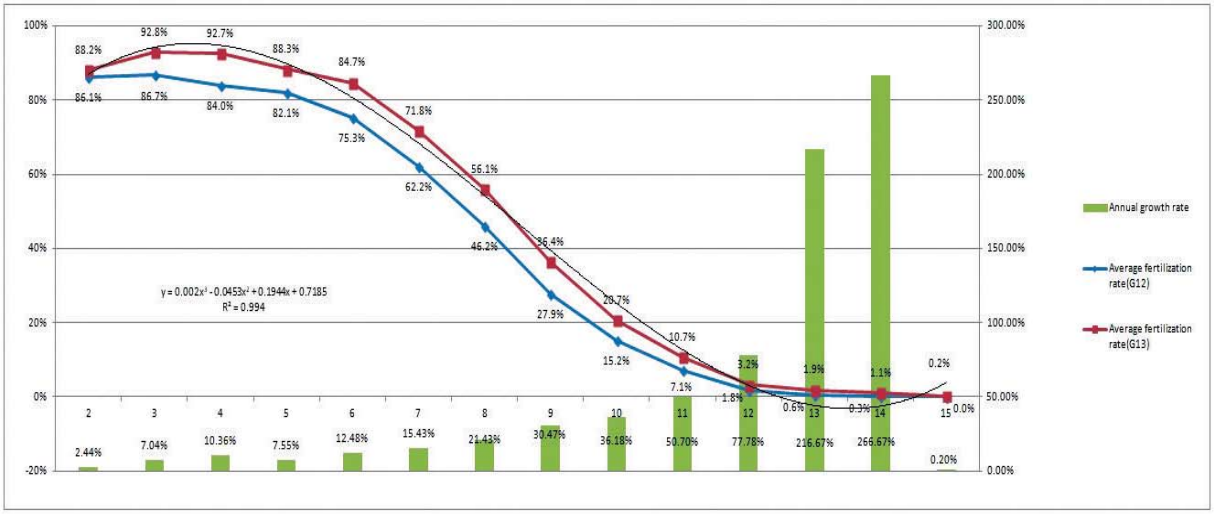
Better Feed Efficiency Brown Tsaiya drake (left) and duck (right)

Pekin Ducks selected for longer fertility duration

This experiment extended the fertility duration in Pekin Ducks using the genetic selection method. This would reduce the cost of artificial insemination when the mule duck was produced. A 13-generation selection experiment has been conducted since 2006 to increase the number of fertile eggs laid by Pekin Ducks after a single artificial insemination (AI) with pooled Muscovy semen. At 29, 32, and 35 weeks of age, the ducks were artificially inseminated with 0.05 mL of

pooled semen from 10 to 15 Muscovy drakes of line 302 from Ilan Branch, LRI. After a single AI, eggs were collected for a period of 14 days for incubation. The results showed the number of fertile eggs (F), the maximum duration of fertility from 2nd day after AI up to the day of the last fertile egg (Dm) and the duration of effective fertilization (De) were 5.59 ± 2.35 eggs, 6.99 ± 2.55 days and 5.84 ± 2.46 days (Mean ± SD), respectively. The fertility rate (above 89.35%) was high 2-6 days after a single artificial insemination. However, the fertility was 7.9% higher than the same period at last year. The fertility was extended from day 12 to day 14, showing that the fertility and duration were stable. The Pekin Duck from F, Dm and De fertility exceeded day 6 were 57.14%, 77.34% and 61.47%, respectively. Those were more 0.72%, 4.95% and 30.36%, respectively than the same period last year. The selection criterion was the breeding values of the BLUP animal model for the number of fertile eggs at candling (F) at 7th day of incubation. After 12 generations selection, fertilized egg at candling was 4.05, 3.44, 4.03, 4.14, 4.79, 4.05, 4.95, 5.52, 5.20, 5.43, 5.13, 5.55 and 5.94 eggs, respectively. The breeding values of fertilized eggs from G1 to G11 was -0.05, -0.04, 0.13, 0.14, 0.25, 0.69, 1.04, 1.42, 1.79, 2.10, 2.57 2.90 and 3.24, respectively. So, a correlated response on increasing duration of effective fertilization is expected when selecting breeding values for fertilized eggs.

(L. Y. Wei, J. Y. Chen, J. C. Chiu, Y.Y. Chang and H. C. Liu)



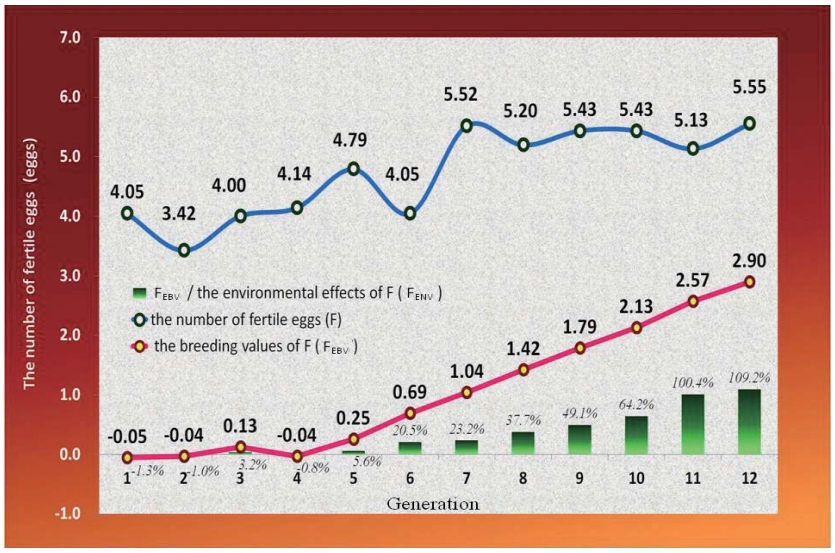
The variances in fertilization rate in Pekin Ducks (L201 G13) from 2nd to 15th day after a single artificial insemination

Selection for the duration of fertility in Pekin Duck

A 12-generation selection experiment has been conducted since 2006 with the aim of increasing the number of fertile eggs laid by the Pekin Duck after a single artificial insemination (AI) with pooled Muscovy semen. At 29, 32, and 35 weeks of age, the ducks were artificially inseminated with 0.05 mL of pooled semen from 10 to 15 Muscovy drakes of line 302 from Ilan Branch, LRI. After a single AI, eggs were collected for a period of 14 days for incubation. Pedigree hatching was conducted in each generation and an individual recording system was used. The

selection criterion was the breeding values of the BLUP animal model for the number of fertile eggs at candling (F) at 7th day of incubation. After 12 generations selection, fertilized egg at candling was 4.05, 3.44, 4.03, 4.14, 4.79, 4.05, 4.95, 5.52, 5.20, 5.43, 5.13 and 5.55 eggs, respectively. The average duration of effective fertilization from G1 to G11 was 3.36, 3.79, 3.26, 3.58, 4.02, 3.83, 4.18, 4.90, 4.55, 4.90, 4.21 and 4.48 days, respectively. The breeding values of fertilized eggs from G1 to G12 was -0.05, -0.04, 0.13, 0.14, 0.25, 0.69, 1.04, 1.42, 1.79, 2.10, 2.57 and 2.90, respectively. So, a correlated response on increasing duration of effective fertilization is expected when selecting on breeding values of fertilized eggs.

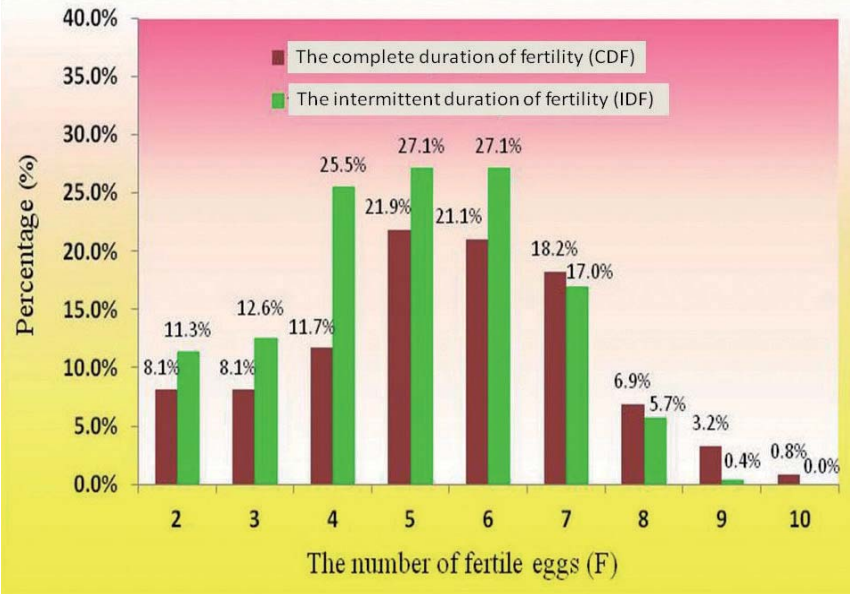
(J. Y. Chen, H. C. Liu, L. Y. Wei, W. P. Chang, Y. Y. Chang and Y. S. Cheng)



The genetic improvement of duration of fertility in Pekin Ducks

The analysis of pattern of fertility for the number of fertile eggs in Pekin Duck selection line

The aim of this project was to study the consecutive pattern of fertilized eggs from Pekin Duck selection line (L201) for understanding the complete duration of fertility (CDF), intermittent duration of fertility (IDF) in the fertile eggs (F) and the ratio of dead embryos and unfertilized eggs in the IDF. The verification data was from 11th generation Pekin Duck line selected for long egg fertility



The frequency and trend of CDF and IDF in different the number of fertility eggs (F)

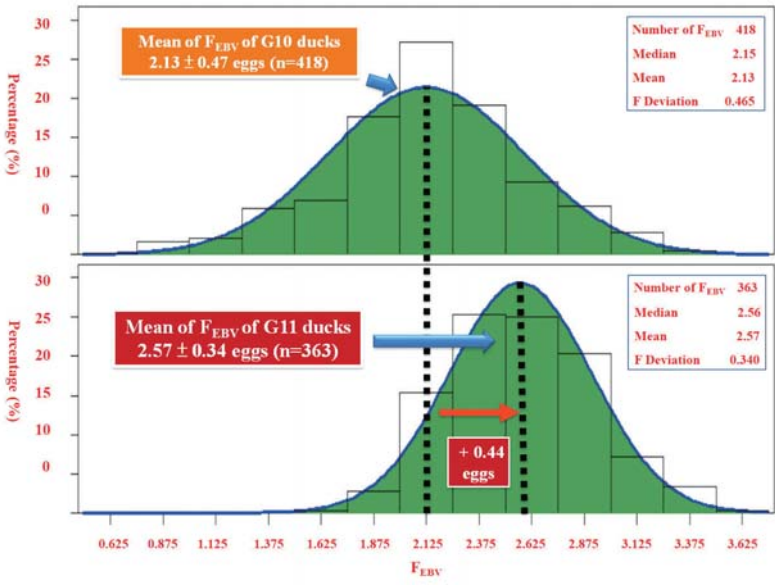
duration. Each female Pekin Ducks was artificial inseminated with 0.05 mL pooled semen collected from 10 to 15 LRI1 white Muscovy drakes at 29, 32 and 35 weeks of age. After a single artificial insemination, 14 days. The results showed the ratio between CDF and IDF was 44.1 : 55.9%, when the F was lower 6, the IDF was higher than CDF 8 to 34%, when the F was 7 to 10, the CDF was higher than IDF 2 to 7%. If the broken points was dead embryos egg in IDF, the dead embryos egg ratio was initial increased from 35.7 to 55.6% when the F ratio was increased from 2 to 4 pies, and subsequently the dead embryos egg ratio was reduced from 55.6 to 28.6% when the F ratio was increased from 4 to 7 pies. If the broken points was unfertilized egg in IDF, the unfertilized egg ratio was reduced from 57.1 to 85.7% when the F ratio was increased from 2 to 8 pies. However, the ducks of longer duration of fertility (F was exceed 6 pies) were more unfertilized egg in the broken points of IDF, the ducks of duration of fertility (F was 4 to 5 pies) were more dead embryos egg in the broken points of IDF.

(J. Y. Chen, H. C. Liu, L. Y. Wei, W. P. Chang, Y. Y. Chang and Y. S. Cheng)

The selection differential of breeding value between G10 and G11 selected parents of Pekin Duck population after eleven generations of selection for increased fertile eggs

The aim of this study was to evaluate the selection effect by investigating the selection differential of breeding value between G10 and G11 after 11 generations of selection for increased fertilized eggs (F). At 29, 32 and 35 weeks of age, eggs were collected for a period of 14 days after Pekin Ducks were single artificially inseminated with pooled Muscovy semen, and the F value was calculated for the number of fertile eggs at candling at the 7th day of incubation. The breeding values of the BLUP animal model for the number of fertile eggs were estimated. The results showed that F of G11 base population was 5.13 eggs and FEBV was 2.57 eggs. The FEBV of selected drakes was 2.86 eggs, 0.28 eggs higher than G10, FEBV of selected ducks was 3.02 eggs, 0.45 eggs higher than G10. The FEBV of G11 selected population was 2.98 eggs, 0.45 eggs higher than G10. The G11 selection differential was 0.41 higher than G10, is consisted with the breeding goal of genetic improvement with F value.

(J. Y. Chen, H. C. Liu, L. Y. Wei, W. P. Chang, Y. Y. Chang and Y. S. Cheng)

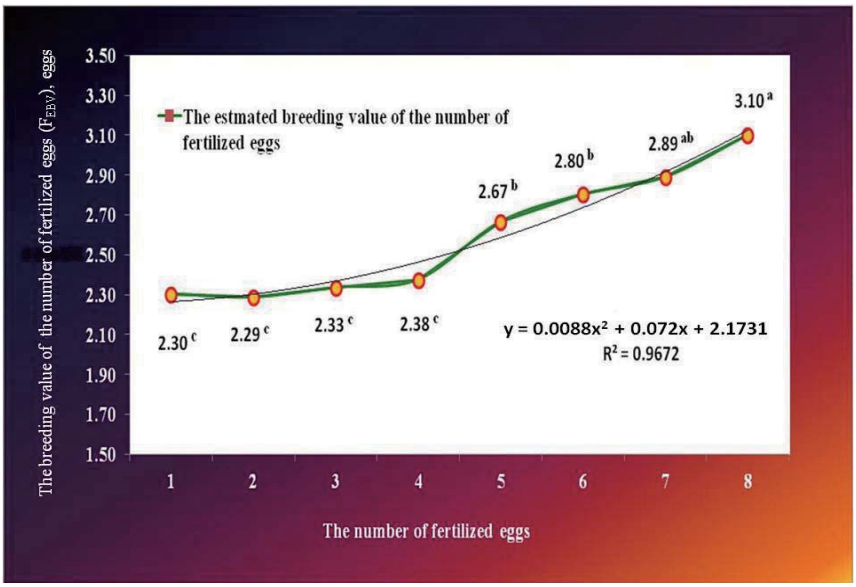


The difference of FEBV selected for Pekin Duckes (L201) in G10 and G11

Relationship investigation between the phenotype and breeding value for the number of fertilized eggs in Pekin Ducks after 11 generations of selection

The purpose of this study was to evaluate the genetic express of select traits by investigating the relationship between the number of fertilized eggs (F) and it's breeding value (F_{EBV}) of the Pekin Ducks after 11 generations selection of F. At 29, 32 and 35 weeks of age, eggs were collected for a period of 14 days after Pekin Ducks were single artificially inseminated with pooled Muscovy semen, and the F value was calculated for the number of fertile eggs at candling at the 7th day of incubation. The breeding value of the BLUP animal model for the number of fertile eggs was estimated. The results indicated that F_{EBV} increased linearly with F value and followed with polynomial y = 0.0088x2 + 0.072x + 2.1731 (y: F_{EBV}, x: F), R2 = 0.97, the correlation between F and F_{EBV} was 0.55. The frequency of F was more than or equal to 5 that was 87.5%, and F_{EBV} of G11 selected ducks was 2.97. In summary, the higher F_{EBV} ducks accompanied with higher F and more likely be selected as parent.

(J. Y. Chen, H. C. Liu, L. Y. Wei, W. P. Chang, Y. Y. Chang and Y. S. Cheng)



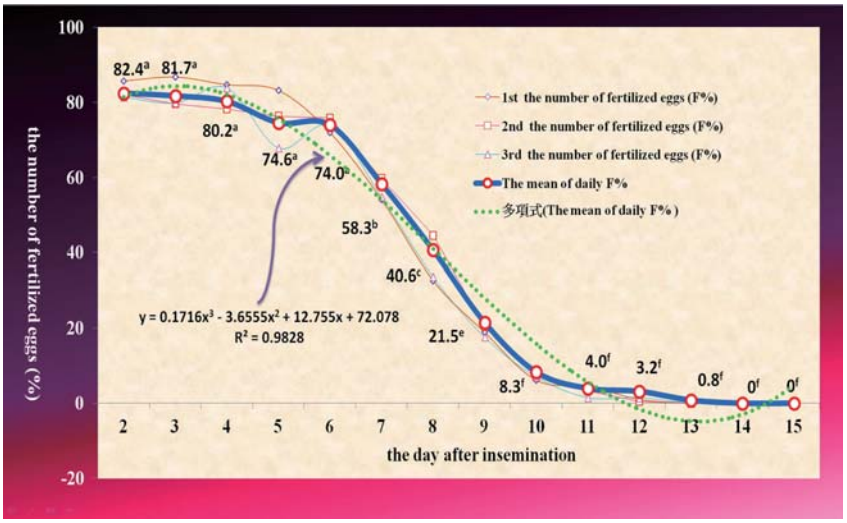
Relationship between the phenotype and breeding value for the number of fertilized eggs of L201 Pekin Ducks in G11

Trends and differences in the number of fertilized eggs of Pekin Ducks after single artificially inseminated with pooled semen from white Muscovy ducks

The purpose of this study was to investigate the trend and difference in daily fertilization rate (F%) of tested Pekin Ducks, after 11 generations of selection with breeding value (F_{EBV}) as criterion, during the test period. These experimental ducks, at 29, 32 and 35 weeks of age, were single artificially inseminated with pooled 10-15 Muscovy semen, and eggs were candled at the 7th day of incubation to determine the F and F%. The results indicated that F was

5.13 ± 1.78, F% was 39.05 ± 13.2%, and F% decreased linearly with day after insemination and followed with polynomial y=0.1716x3-3.6555x2+12.755x+72.078 (y: F, x: day, R2 = 0.98). The daily F% decreased from 81.5% of the 2nd day to 74% of the 6th day after insemination and there were no significant differences. Then decreased from 58.3% to 8.3% ($P < 0.05$) on the 7th to 10th day, and there was no fertile eggs been collected on the 14th and 15th day.

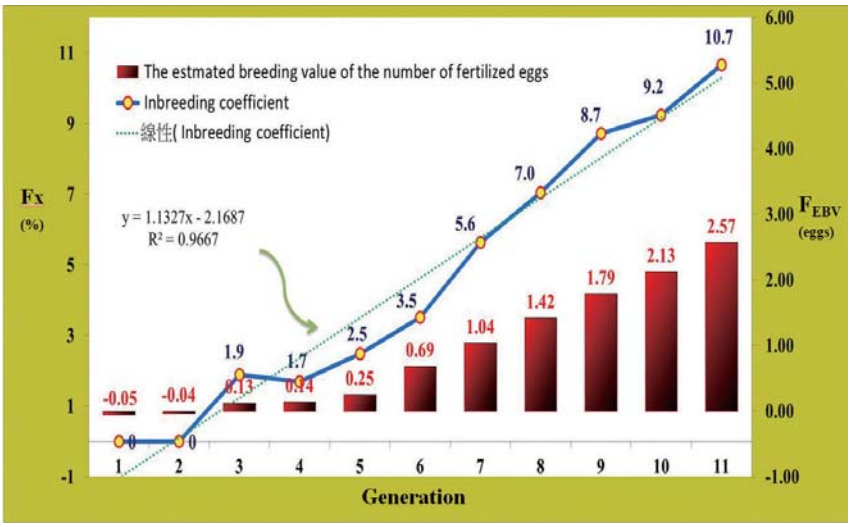
(J. Y. Chen, H. C. Liu, L. Y. Wei, W. P. Chang, Y. Y. Chang and Y. S. Cheng)



The variety of daily fertility percentage from 2 to 15 days after one artificial insemination at G11 in Pekin Duck of L201

The investigation and trend of inbreeding of Pekin Duck population after 11 generations of selection for the number of fertilized eggs

The purpose of this study was to investigate the trend of inbreeding coefficient (FX) of Pekin Duck population, after 11 generations of selection with breeding value (F_{EBV}) as criterion, and the relationship between inbreeding and the number of fertilized eggs (F) of G11. The results indicated FX increased linearly from 1.9% of G3 to 10.7% of G11 and followed with polynomial y = 1.1327x – 2.1687. (y: FX, x: G, R2 = 0.97). The FX was increased with generations of selection, 25.2% per generation, which also increased risk of inbreeding depression. The



The variety trend between the FX and F_{EBV} in Pekin Ducks from G1 to G11

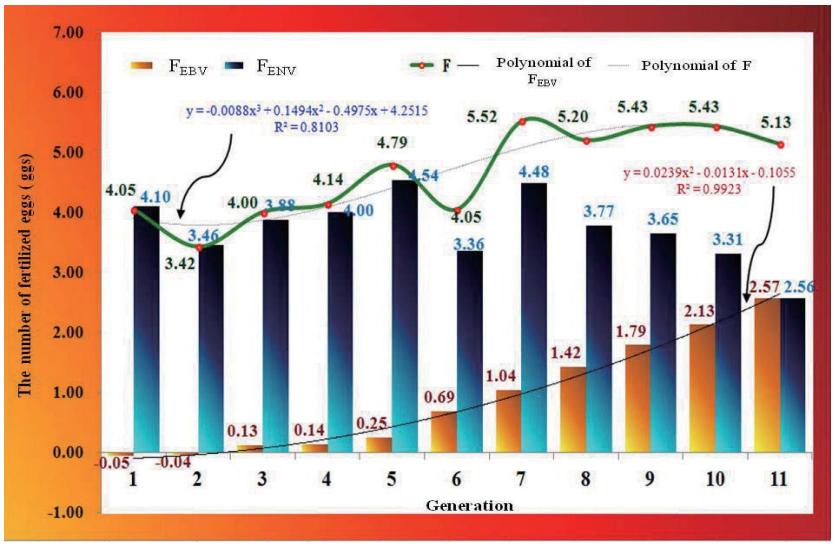
FX of the G11 ducks ranged between 6.4% and 19.8%, and no significant relationship was found between FX and F (r= -0.09 ± 0.20). The increase in FX is mainly due to the number of ducks in this closed population is small, resulting in an increased probability of mating between relative individuals occurred

(J. Y. Chen, H. C. Liu, L. Y. Wei, W. P. Chang, Y. Y. Chang and Y. S. Cheng)

Genetic trends between phenotype, breeding values and environmental effects of number of fertilized eggs in Pekin Ducks

The purpose of this study was to estimate the breeding values (F_{EBV}) of the BLUP animal model for the number of fertile eggs (F) of Pekin Duck Line 201, which been selected for 11 generations to increased fertilized eggs, and to evaluate the genetic trends between F, F_{EBV} and environmental effects of F (F_{EBV}). The results indicated that F increased from 4.05 of G1 to 5.13 of G11, and followed with polynomial y = -0.0088x3 + 0.1494x2 - 0.4975x + 4.2515 (y: F, x: generation, R2= 0.81). The F_{EBV} increased from -0.05 of G1 to 2.57 of G11, and followed with polynomial y = 0.0239x2 - 0.0131x - 0.1055 (y: F_{EBV}, x: generation, R2 = 0.99). The genetic effect (F_{EBV} /F) increased from -1.33 of G1 to 50.11% of G11. In summary, the increase in F is small but the variation is large. The increase of F_{EBV} is large, stable and variation is small, which is consistent with the genetic trend of using F as selection criterion.

(J. Y. Chen, H. C. Liu, L. Y. Wei, W. P. Chang, Y. Y. Chang and Y. S. Cheng)



Genetic trends between the number of fertility eggs (F), F_{EBV} and F_{ENV} of number of fertilized eggs in Pekin Ducks

The investigation of the reproductive performances of Chinese geese and blood characteristics of black swan in indoor raising

The aim of current study was to investigate the reproductive performances in Chinese geese and blood characteristics in black swan. The 19th generation of 73 mature White Chinese geese and

the 12th generation of 68 Brown Chinese geese were used in this study. During breeding season, the experimental geese were recorded for the numbers of laying eggs. Then, the fertilization rate of hatching eggs and the hatchability of fertilized eggs were calculated. The results showed that the annual egg numbers, fertilization rate and hatchability in White and Brown Chinese geese were 20.5 and 24.1 eggs, 43.8% and 58.1%, 70.2% and 78.9%, respectively. The fertilization rate of hatching eggs and the hatchability of fertilized eggs of Brown Chinese geese were better than White Chinese geese ($P < 0.05$). Another purpose of present study was to investigate the numbers of white blood cells, erythrocyte and values of blood biochemistry in cobs and pens in mature black swan. The twelve cobs and fifteen pens were used in the study, feed and water were supplied ad libitum. Blood samples were taken from superficial planter metatarsal vein for analyzing the haematological parameters. The results showed that the number of white blood cell, erythrocyte (numbers of red blood cell, concentration of hemoglobin, volume of packed cell, average volume of corpuscular, average value of corpuscular hemoglobin, average concentration of corpuscular hemoglobin, and platelet), and the values of blood biochemistry (total protein, albumin, globulin, glutamic oxaloacetic transaminase, glutamic pyruvic transaminase, creatinine, uric acid, cholesterol, triglyceride, and glucose) were not significant differences for both sexes.

(C. C. Hsiao, S. D. Wang and C. Y. Lien)

Feeding of Brown Chinese geese

Feeding of White Chinese geese

Feeding of cygnets

Reproduction of black swan

II

Effect of supplementation of Cordyceps militaris culture to diet on growth performances of weaned Alpine kids

To evaluate the health-enhancing benefit of Cordyceps militaris culture (CMC), containing Cordycepin to boost immune capacity and clean free radicals, CMC was added into diet for weaned Alpine kids. A total of 80 kids, avg. 87.5 days of age and 15.9 kg BW, were assigned into four groups and sub-group fed for 12 weeks. Diet for control group included 80% of grain concentrate, 10% of pangolagrass hay and 10% of alfalfa pellet. Three treatment diets were supplemented 1, 2, or 3% of CMC. Results showed diet treatments did not influence the feed intake and diarrhea index of kids. Daily dry matter intakes of control, 1, 2 and 3% CMC groups reached 0.68, 0.66, 0.63 and 0.63 kg per head ($P > 0.05$). Daily BW gains were 160, 142, 136 and 140 g, respectively. Kids fed control diet had higher BW gain than those fed 2% CMC diet ($P < 0.05$). In conclusion, diet supplemented with CMC 1 to 3% to weaned Alphine kids could neither improve growth performances nor reduce the diarrhea occurrence.

(G. J. Fan, B. L. Shih, T. Y. Li, M. H. Chen, C. F. Lee)

Cordyceps militaris culture test on weaned Alphine kids

Safety risk assessment of genetically modified feed on alpine goat health and milk

Most of the livestock feed is formulated from imported genetically modified (GM) corn and soybean. To assess its safety, this experiment was conducted on Alpine goats by checking their milking performance, health, and GM event residues. A total of 16 goats were assigned into two treatments fed diet containing 50% forage and 50% concentrate for 10 wks. Forages came from local non-GM corn silage and pangolagrass hay. Concentrate of non-GM group was formulated from local corn and soybean, and GM group was from imported. By PCR procedures, 4 to 5 GM events (Nos-T, EPSPS-CP4, FMV 35S-P, and Pat,

Milking performance test of alpine goats

and extra CaMV 35S-P in corn) were detected in the imported corn and soybean. No GM event detected from local feed. Results showed milk yield, milk compositions, and blood GOP and GPT were all similar between two groups. There was no residue of GM events detected in both milk and feces samples. It is suggested the feeding of GM corn and soybean for lactating goats is safe from this study.

(G. J. Fan, B. L. Shih, J. R. Chen, H. J. Chang, C. F. Lee)

Effect of feeding diet with regrow-rice plant on milking performance of alpine goats

Rice plant will regrow after first harvest, however its low rice quality results in problem in barn storage. The regrow-rice plant was ensiled into haylage (RH) and evaluated as forage for dairy goat. A total of 15 Alpine goats were assigned into three treatments in repeat feeding trials with 28-d each. Control diets included corn silage, alfalfa, pangolagrass hay (PG, 9.7% of diet dry matter), grain and by-products. By substituting the PG hay, RH was added into diets at 7.5% or 9.7%. Results showed that the dry matter intakes, milk yield, milk fat and milk protein concentrations of goats were all similar among groups. The whole average values for each trait in the trial were 2.32 kg, 2.36 kg, 4.07% and 3.16%, respectively. In conclusion, utilization of regrow-rice plant as fibrous forage resource for lactating goats is feasible and 10% in diet dry matter is acceptable. The determining point is decided by its quantity, mechanical harvest, and competitive price.

(G. J. Fan, C. T. Chang, S. R. Chang, T. F. Shioa, C. F. Lee)

Effects of dietary supplementation of pineapple pulp and wheat bran silage on milking performance of dairy goats

Pineapple pulp rich in water soluble carbohydrates and fiber is the by-product from pineapple cake or juice processing. To explore the local by-product feed resources and also hope to stimulate the milk composition synthesis, this study investigated the proper ensiling ratio of pineapple pulp and wheat bran (PWS) and their proper addition ratio in diet for lactating dairy goats. The PWS was constituted at 6:1 fresh weight ratio and ensiled in pails. A total of 21 head individually fed lactating Alpine goats with daily milk yield above 2.2 kg were assigned into two 28-d feeding trials. Diet

Pineapple pulp and wheat bran

included corn silage, alfalfa hay, pangolagrass hay, grain mixture, wet brewers' grains, and soybean hull pellet. Control diet had 8% of wheat bran, and by substituting the wheat bran, PWS was added into trial diets at 4 or 8% diet dry matter separately. Results showed that the supplement of PWS would not affect the goats' dry matter intake (DMI), milk yield, and milk compositions. DMI for PWS 0, 4 and 8% three groups were 2.00, 2, 09 and 2.14 kg; milk yield were 2.59, 2.69 and 2.70 kg; milk specific gravity were 1.0306, 1.0306 and 1.0303; milk fat were 3.65, 3.64 and 3.71%; and milk protein were 3.33, 3.29, and 3.27%, respectively. In conclusion, although the addition of PWS does not effectively promote the milk compositions in summer, PWS itself is a good alternative feed resource for lactating dairy goats and a diet with 8% PWS is recommended.

(G. J. Fan, C. T. Chang, T. F. Shiao, and C. F. Lee)

Establishment of mini-pig nutrition requirements and their feed supply system

Two experiments were carried out to establish the feed formula for mini pigs, which maintains the growth and health and avoid over fatty of pigs. In Experiment 1, the purpose was to determine the effect of low protein diet and conjugated linoleic acid (CLA) addition on growth and backfat thickness of minipig. A total of 36 Lanyu pigs, 9 kg body weight (BW), were allocated into 3 groups and provided the diets containing 1.0% lysine. Dietary crude protein of second group was reduced 2% compared to control group. For the third group, 0.65% CLA were added to diet of control group. Pigs were raised until BW reach 25 kg. The purpose of the second Experiment was to study the body fat reduction effect on Lanyu pig by dietary fiber content. A total of 24 piglets, about 10 kg BW, were selected and assigned to three treatment diets. Basal diet is formulated by the United States miniature pig formula (USDA 1160) containing 5% alfalfa and wheat bran was applied as crude fiber source and the adding amount was 10% or 10%, respectively. Experiment was conducted until pigs reach at 25 kg of BW. Feed intake, body weight, and back fat thickness were measured. Results in experiment showed that feed intake and daily weight gain were not different among treatment while pigs fed with diet added with CLA had higher feed efficiency significantly ($P < 0.05$). Furthermore pigs fed with diet added with CLA had lowest increase of backfat thickness during the testing period that indicated CLA had the effect of reducing the body fat. Results in experiment 2 showed there were not different of growth performance in terms of feed intake, daily weight gain and feed efficiency and the change the backfat thickness among treatments. As the price of wheat bran is lower than the price of alfalfa, which indicated wheat bran might be a fiber source of ingredient for minipigs.

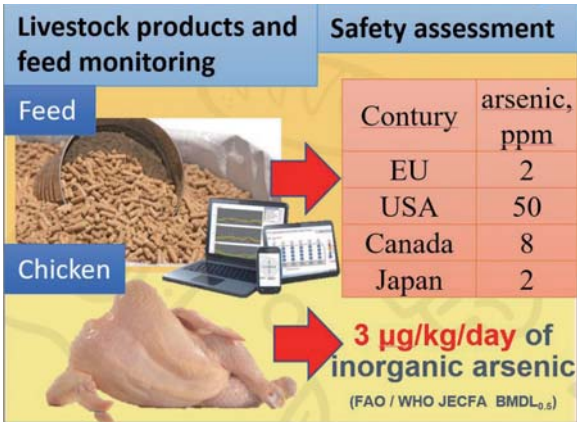
(H. F. Lee, C. W. Liao, T. C. Yang and F. C. Liu)

Lanyu pigs in experiment

The risk assessment of arsenic exposure in chicken

The chemical and biological toxicity of arsenic is dependent on its forms. This study investigated the arsenic species and content in chicken meat and evaluates the risk of arsenic exposure. Analysis of 30 samples from commercial and campus lunch suppliers showed that the average total arsenic content was about 179 μg/kg (dry matter). The main arsenic species are arsenobetaine (AsB), dimethlarsinic acid (DMA), and arsenite (AsIII). Among them, AsB is the highest with 92.72% (1.28-670.68 μg/kg) of total arsenic content, followed by DMA and AsIII. The ratio of organic arsenic to total arsenic was 92.22% containing 176.38 μg/kg. Inorganic arsenic (AsIII and AsV) was only 3.19 μg/kg in average accounting for 1.78% of total arsenic. A risk assessment of the inorganic arsenic content of chicken showed that if one serving of meat (60 g) was taken daily, the exposure levels of inorganic arsenic to 6 and 15 year-old childrens were 0.001 and 0.003 μg/kg/day, respectively. The results were lower than 3.0 μg/kg body weight per day, which were Benchmark Dose Lower Confidence Limit (BMDL0.5) as set by the Joint FAO/WHO JECFA that resulted in a 0.5% increase in lung cancer.

(C. C. Hung, Y. P. Tai)



The risk assessment of arsenic exposure

Construction of the platform for feed additives pilot production to improve livestock health

The global consumption of livestock product is continued increasing along with the growth of human population. Based on the higher demand of quality and safety of livestock product from consumer, there is a strong trend for anti-biotic free feeding model of livestock. Therefore the innovation of healthy feed additive for livestock animal becomes an important issue of the industry. Health feed additive includes probiotics, phytogenics, fungi and micro peptide. In order to elevate the competitive of livestock industry, the aim of this project was to construct a pilot production platform for feed additives. So far the fermentation system and extraction system and the equipments for production and analysis

300 L Liquid fermentation system

have been set up for the platform. In the future the probiotics and phytogenics produced will be supplied for animal test and also addressed for the connection bridge prior to commercial production. It is expected that the platform could accelerate the commercialization of the research results.
(H. F. Lee, Y. C. Lin, B. S. Lin, T. Y. Lee, G. J. Fan, B. L. Shih, F. C. Liu and C. F. Lee)

Extended construction of the platform for feed additives pilot production to improve livestock health

The global consumption of livestock product is continued increasing along with the growth of human population. Based on the higher demand of quality and safety of livestock product from consumer, there is a strong trend for anti-biotic free feeding model of livestock. Therefore the innovation of healthy feed additive for livestock animal becomes an important issue of the industry. Health feed additive includes probiotics, phytogenics, fungi and micro peptide. In order to elevate the competitive of livestock industry, the aim of this project was to expand the equipments such as solid fermentation, spray dryer, ultra filtration, vacuum packaging machine and centrifugal mill followed the construct of pilot production platform for feed additives in 2019. In the future the probiotics and phytogenics produced will be supplied for animal test and also addressed for the connection bridge prior to commercial production. It is expected that the platform could accelerate the commercialization of the research results.
(H. F. Lee, Y. C. Lin, B. S. Lin, T. Y. Lee, and C. F. Lee)

300 L Solid fermentation system

Effects of adding waster medium of Cordyceps militaris and stalk residue of mushrooms on growth performance and carcass traits of native chickens

The waster medium of *Cordyceps militaris* (CMWM) and stalk residue of mushrooms could be a new source of animal additives. It was aimed to study the effects of adding CMWM and mushroom stalk residues to diet for native chickens on growth performance and carcass traits. A total of 330 day-old native chickens, half male half female, were randomly assigned into five groups, 22 chickens in a pen and three pens for each treatment and raised during the 0 to 16-wk-old. A corn-soybean meal basal diet was offered as control group. Other treatments were included CMWM only or CMWM mixed with stalk residue of *Pleurotus eryngii or P. sajor-*

caju. Fifty ppm of tylosin was added as positive control during the 0 -12 wks-old feeding period. Feed and water were offered ad libitum. Results showed that addition of CMWM+*P. eryngii* increased weight gain ($P < 0.05$) during the 0-4 wks-old period. However, weight gain and feed conversion ratio were improved ($P < 0.05$) when chickens fed with the CMWM only or CMWM mixed with stalk residue of *P. eryngii* groups during the 8-12 wks-old period. Totally feeding period, supplementation CMWM or CMWM mixed with stalk residue of *P. eryngii* groups were increased gain, moreover, CMWM mixed with stalk residue of *P. eryngii* group had better feed conversion ratio ($P < 0.05$). Dressing percentages, weight of edible organs, lightness, red and yellow color of breast meat and skin were not affected by diets. In conclusion, supplementation of CMWM in diets could effectively improve the growth of native chickens. Meanwhile, due to the stronger improvement response, mixture of CMWM and *P. eryngii* showed the synergistic effect.

(B. L. Shih, G. J. Fan, T. Y. Lee, M. H. Chen and C. F. Lee)

Eggshell strength testing

The effects of dietary energy on egg laying performance and egg quality of enriched cage-feeding hens

This experiment was to investigate different dietary energy on laying performance and egg quality of enriched cage-feeding hens in hot season. Day-old ISA hens were used. Hens were caged at 12 weeks of age and randomly divided into four groups at 24 weeks of age. The control group had 30 birds in 30 battery cages with dietary ME 2,750 kcal/kg. Three treatment groups were enriched caged with ME 2,750, 2,900 and 3,050 kcal/kg, respectively. Each group had 60 birds in three enriched cages; each cage had 20 birds. Egg laying performance and egg quality were determined. The results showed that battery caged birds had higher daily feed intake. There was no significant difference in egg laying performance and egg quality among ME contents of enriched cages. ME of 3,050 kcal/kg of enriched cage tended to decrease feed intake and had obvious high egg yolk weight. High energy (ME 2,900 and 3,050 kcal/kg) had significantly higher egg yolk lightness and lower yellowness

Enriched cage-feeding hens

($P < 0.05$). Enriched cages with 2,900 and 3,050 kcal/kg ME had significant feather damage. In summary, enriched cage-feeding with 2,750 kcal/kg can meet the need for egg laying performance without affecting egg quality.

(B. L. Shih, G. J. Fan, T. Y. Lee, and Y. F. Lin)

Development of novel metabolic molecules producing Lactobacilli as an anti-stress feed additive for animal health care

Stress in piglet is a complex state particularly caused by environment, which contributes to reduction of pig health. Chronic or acute stress-related illnesses, including immunity depression and bacterial infections can lead to decrease agricultural productivity and growth efficiency in animal production. Thus, the control and prevention of stress and its related illnesses are important key factors affecting the profitability of the livestock industry. Recently, a growing interest of feeding animals with innovative feed additive, particularly by using functional probiotics which provide potential health promoting benefit to animals. In our previous studies, a novel metabolic molecule exhibited anti-inflammatory properties expression as a cytoguardin that suppressed COX-2 expression in cancer cells and quiescent fibroblasts was discovered by comparative metabolomics as an innate as an innate vasoprotective factor. To extend the findings in application of feed additive, one potential probiotics Lactobacillus strain Y310, originally isolated from raw milk, have been demonstrated highly produced with this novel metabolic molecule. First, to test intestinal protective ability of the selective strain, we carried out to determine the protective effect of this selected strain on against of lipopolysaccharide (LPS) induced endotoxemia and immune stress by using Lan-yu minipigs. Otherwise, dietary supplementation on growth performance, gut microbial composition, and immune function in cross-bred-Landrace×Duroc (LD) piglets were also investigated. In our test, the result indicated that animal fed a basal diet supplemented with Y310 showed the similar trend on suppression of lipopolysaccharide-induced damages as compared with intraperitoneal injection of this metabolic molecule. Dietary supplementation with Y310 suppressed the amount of LPS-induced bronchoalveolar lavage fluid and proinflammatory cytokine production as well as endotoxemic lung tissues. In addition, a better beneficial effect of selected potential probiotics on growth performance and feed efficiency was noted after addition of the probiotic in commercial LD piglets. Overall, We conclude that this novel metabolic molecules systemic inflammatory responses. Our data indicated that the selected probiotics with high production of novel metabolic molecule has potential on animal health promoting. This bacterium also showed a great industrial potential to pig industry with inexpensive alternative feed ingredients while contributing to the agricultural economy.

(Y. C. Lin, C. C. Kuo and Y. P. Chen)

LPS-induced inflammatory model of LD piglet

Evaluation of health care on economic animals with purpureal napiergrass grass

The purpose of this research is to establish the field cultivation and production technology of Purpurael napiergrass, and at the same time to carry out the development, testing and application evaluation of related animal products and product design, and industrial application. The results showed that plants with a regeneration period of 4 - 8 weeks of Purpurael napiergrass had increased anthocyanins and total phenol contents per unit weight of leaves, but their total leaves and area decreased. Therefore, it is recommended to pay attention to water supply to the 6th week of regeneration after harvesting the Purpurael napiergrass to maintain agronomic characteristics and anthocyanin performance. The 8-week-old live weight of each treatment group of Peking duck was in the range of 2,103 - 2,234 g, but the live weight of the group added 3% Purpurael napiergrass powder to the diet was 2,234 g, which was significantly higher than that of the 6% Purpurael napiergrass powder group. 2,103 g is heavy ($P < 0.05$). In terms of weight gain, the weight gain of 3-8 weeks of age in each treatment group was in the range of 1,497 - 1,610 g, but the weight gain of the group added 3% Purpurael napiergrass powder to the diet was 1,610, which was significantly higher than that of 6% Purpurael napiergrass. The powder group gained weight by 1,497 g ($P < 0.05$). The increase of dietary Purpurael napiergrass powder to 9% can effectively reduce the triglyceride concentration in the blood of goose. With the increase in the amount of Purpurael napiergrass powder in the diet, the glutamate pyruvate transaminase in the plasma of 5 - 12 week-old growing goose had a reducing effect.

(J. B. Lin, J. H. Lin, T. R. Li, Y. C. Liu, S M. Liu, H. L. Lee and H. W. Hung)

Adding different percentage of purpureal napiergrass grass in feeds

Effects of decreasing dietary crude protein and balanceing amino acid on growth performances, fecal nitrogen and phosphorus concentrations of grower and finisher pigs

The experiment was to evaluate the effects of crude protein levels decreased by 2 or 4% and synthetic amino acid blended in regular diet on growth performance, fecal nitrogen and phosphorus contents of grower pigs (bodyweight from 30 to 60kg) and finisher pigs (bodyweight from 60 to 110 kg). A total of 24 hd LD hybrid pigs (half male and half female) at approximately 30 kg and 60 kg bodyweight were respectively adopted, and they were to raise up in individual pens and to end up at 60 kg and 110 kg of pigs' bodyweight. The crude protein and digestible energy in regular diet were respectively 16% and 3,250 kcal/kg for grower pigs and 14% and

3,250 kcal/kg for finisher pigs. Both of trial diets crude protein levels were reduced by 2 or 4% and synthetic L-lysine, L-threonine and L-tryptophan added to match the aforementioned amino acids profile. The results showed that in grower pigs fed with crude protein decreased by 2% or 4% diet, which did not affect on their growth performance. The fecal nitrogen content also decreased by following crude protein levels were reduced in diet. Grower pigs fed with 16% crude protein diet were significantly higher in the fecal nitrogen (dry basis) and urinary nitrogen (dry basis) than fed with 12% crude protein diet, and finisher pigs fed with 14% crude protein diet were also significantly higher in the fecal nitrogen (dry basis) and urinary nitrogen (dry basis) than fed with 10% crude protein diet, but there was no significant difference of fecal phosphorus (dry basis) and urinary phosphorus (dry basis) among diets. Therefore, crude protein reduced by 2 - 4% and synthetic amino acid added in regular diet of diet strategy did not affect their growth performance of grower and finisher pigs, and the nitrogen content of the excreta could reduce at the same time.

(F. C. Liu, C. M. Wang, and C. Y. Chen)

Collecting of manure and urine of pigs

Effects of increasing dietary selenium and vitamin E concentration on growth performance of the piglets

The purpose of this study was to evaluate the effect of dietary selenium and vitamin E concentration on growth performance of piglets. Total of 32 piglets (5-wk-old, TLRI Black Pig No.1) were divided into control and treatment groups by the body weight and sexes. The treatment group, selenium and vitamin E concentration in the diet was 6 times of recommended by NRC (2012). The selenium detected values of the control and treatment group were 0.33 and 1.81 mg/kg, respectively, and the vitamin E detected values were 51.4 and 103.2 IU/kg, respectively. The data of study period was divided into pre-stage between 5 and 7 weeks of age, post-stage between 7 and 9 weeks of age and whole period between 5 and 9 weeks of age by vaccination time. The results showed that there was no significant difference in growth performance between the two groups

TLRI Black Pig No.1

at the pre-stage, and the feed efficiency of the treatment group was significantly better than that of the control group at the post-stage ($P < 0.05$). In whole period, the piglets of treatment group fed a higher selenium and vitamin E concentration diet had a tendency to reduce feed intake ($P = 0.09$). In the blood cells count, neutrophil/lymphocytes value (N/L = 0.59) of the treatment group piglets fed with higher selenium and vitamin E concentration diet, which was significantly lower than the control group (N/L = 0.67, $P < 0.05$). It seems that increasing dietary selenium and vitamin E concentration can reduce the stress response of the piglets. In conclusion that increasing the dietary selenium and vitamin E concentration might reduce the stress response of the piglets and the negative effect of the vaccination on the body weight gain and feed efficiency of the piglets.

(C. M. Wang, Y. J. Lin, C. Y. Chen, F. C. Liu)

Effects of added Bacillus coagulans on growth performance of the piglets

The purpose of this study was to evaluate the effect of added Bacillus coagulans on the growth performance of weaned piglets. Thirty-two 4-week-old LD (Landrace × Duroc) weaned piglets were used. They were divided into two groups according to the body weight and sexes, which were control group and treatment group. The treatment group added Bacillus coagulans to the diet, the concentration in the diet was 108 CFU/kg. Feed intake and body weight gain were measured during the study period. The results showed that the feed intake of piglets in the two groups was 0.866 and 0.863 kg/piglet/day, respectively, and the body weight gain was 0.249 and 0.262 kg/piglet/day, respectively. They were no significant difference. The feed conversion rate was 0.286 and 0.305 (body weight gain/feed intake), respectively, and the added Bacillus coagulans group had a better tendency on feed conversion rate ($P = 0.10$). In terms of blood biochemical values, the ratio of neutrophil to lymphocytes (N/L) was not significantly different between the two groups. It indicated that the added Bacillus coagulans to the diet had no significant effect on reducing stress of weaned piglets or that piglets were in low stress environment. It concluded that added Bacillus coagulans in diet was no significant effect on feed intake and body weight gain of the weaned piglets in this study, but had a better tendency on feed conversion rate.

(C. M. Wang, Y. J. Lin, C. Y. Chen, F. C. Liu)

The experimental piglets

Research on the development of mimic food waste diet

The objective of this study was to open up a diet which nutritional components similar food waste, and compared it with regular diet (grower phase diet) on growth performance and carcass traits of bodyweight around 75 and 90 kg of TLRI No. black pigs respective 12 hd (half male and half female). They were randomly allotted to low nutrition concentration diet (as mimic food waste containing 10% crude protein, 8% crude fiber and 2,676 kcal/kg metabolizable energy) and to regular diet (containing 14.4% crude protein, 3% crude fiber and 3,180 kcal/kg metabolizable energy) by trial pigs' bodyweight and gnder to end up at 130 kg of pigs' bodyweight. The resulted showed that fed with mimic food waste diet would become slow in growth score and would prolong 21 days in sale weight at 130 kg. The feed cost of mimic food waste diet would be higher 255 NT dollars/hd than those of feeding with regular diet, but pigs' body shape would be improved. There were no significantly different in slaughter rate, muscle color, free-type amino acid profile and fatty acid contents, panel test, and the score of NPPC's marbling and muscle fitness and carcass grade. However, the carcass lean percent, muscle protein content, and muscle hardness and toughness were significantly lower than those of feeding with regular diet, but the percentage of carcass fat and muscle fat contents were significantly higher than fed with mimic waste diet.

(C. Y. Lin, F. C. Liu, C. M. Wang, C. Y. Chen, T. Y. Li and H. F. Lee)

Eating regular diet diet of pigs

Eating mimic food waste diet of pigs

Establishment of the effect of feeding native herbal extracts on growth performance and immunity of postweaning pigs

In this plan was to survey the effects of 4 kinds of native herbal powders on growth performance and immunity of postweaning pigs. Two trials were conducted to determine the appropriate amount of addition of native herbal powders for postweaning pigs. A total of 48 hd postweaning pigs at the age of 4 weeks were adopted in trial I and trail II. The trial pigs were weaned by similar

body weight and breed, and were assigned to 5 treatment groups in trial I and 6 treatment groups in trail II depending on body weight and sexes at random, and each trial had 4 - repeation and 2 - piglet per pen. The trial diets in trial I were as follows: control (not added), 0.5% *Plectranthus amboinicus*, 0.5% *Ophiopogon* japonicas, 0.5% *Astragalus propinquus* or 0.5% *Coptis chinensis* group for 6 weeks experimental period, and in trial II were as follows: control (not added), 0.5% *Astragalus propinquus*,1.0% *Plectranthus amboinicus*, 1.0% *Ophiopogon japonicas*, 1.0% *Astragalus propinquus* or 1.0% *Coptis chinensis* group for 6 weeks experimental period. Trial pigs' body weight, weight gain, feed intake, feed conversion ratio, blood cell count, plasma biochemistry, immunoglobulin and Interleukin (IL) concentration were used as parameters for determining the herbal powders added amount for postweaning pigs. The results indicated that after weaning pigs fed with extra added 0.5% *Astragalus propinquus* diet on growth performance had improved and plasma IL-1β, IL-6, IL-10 and IL-12 concentration were also decreased. Therefore, feeding 0.5% *Astragalus propinquus* added diet could improve growth performance and immunity of postweaning pigs. *(C. Y. Lin, C. Y. Chen,F. C. Liu, and C. M. Wang)*

Trial pigs usually take a nap after eating

Effect of dietary supplementation of probiotics on growth performance and blood traits of broilers

The purpose of this experiment was to screen the probiotics with immune adjustment ability and to investigate their effects on growth performance and blood characteristics. Three hundred and twenty day-old broiler chicks were divided into group A (corn-soybean diets), group B (diets added with *Lactobacillus plantarum* G1), group C (added with *Lactobacillus reuteri* G3), group D (added with G1+G3) and group E (added with tylosin 50 ppm during 1 - 3 weeks of age). The amount of probiotics was 5×10^8 CFU/kg feed. There were four replicates. Each replicate has

The broiler rearing situation

8 males and 8 females. Feed and water were provided ad libitum. Body weight and feed intake were recorded every week. Plasma of two males of each replicated was collected at 35 days of age. The results indicated that feed intake of D group was significantly higher than that of A group ($P < 0.05$) and feed conversion ratio of D group was significantly higher than that of E group ($P < 0.05$). There was no significant difference in the other growth performance. In conclusion, broiler diets added with 5×10^8 CFU/kg *Lactobacillus plantarum* G1 and *Lactobacillus reuteri* G3 had no adverse effect on growth performance and blood characteristics.

(M. Y. Tsai, H. L. Liu, Y. F. Lin, C. M. Hung, R. H. Yeh, and Y. C. Lin)

Effect of dietary supplementation of phytogenics on serum antibody titer and blood traits of silky chickens

The purpose of this experiment was to investigate the effect of dietary supplementation of phytogenics on serum antibody titer and blood characteristics of silky chickens. Three hundred and twenty day-old black male silky chicks were divided into group A (corn-soybean diets), group B (added with 2% *Artemisia argyi*), group C (added with 2% *Plectranthus amboinicus*), group D (added with 1% *Artemisia argyi* and 2% *Plectranthus amboinicus*) and group E (added with tylosin 50 ppm during 1-14 weeks of age). Each treatment had 4 replicates and each replicate had 12 birds. Feed and water were provided ad libitum. In blood characteristics, white blood cell of group B was significantly higher than group E and D ($P < 0.05$). Heterophil of group C was significantly higher than group A and D ($P < 0.05$). The others had no significant difference.

(M. Y. Tsai, H. L. Liu, C. M. Hung, C. Y. Lin, K. H. Hung and Y.R. Huang)

The silky chickens rearing situation

Different floor material effects on Mule duck growth performance

This experiment investigated different floor material effects on Mule duck growth performance to evaluate Mule duck indoor production model feasibility. Two hundred forty three-way crossbred Mule ducks were raised in a brooding house and hatched to 3 weeks of age. After 3 weeks of age, the Mule ducks were divided into 4 treatment groups, stainless steel mesh floor, plastic floor, wooden slats floor and rubber anti-slip floor, with three replicates per treatment, with 20 ducks per replicate. An isocaloric and isonitrogenous diet was given for each group. The

individual body weight and feed consumption of each group were determined to calculate the growth performance such as feed intake, body weight gain, feed conversion ratio and main feather length development, footpad damage were also determined when ducks were 3, 7, 10 and 12 weeks of age. The results showed that the body weight of each treatment ranged from 2,663-2,875 g at 12 weeks of age, but the wood slat floor and stainless steel mesh floor treatment results were 2,875 g and 2,862 g were significantly higher than 2,663 g of the rubber anti-slip floor treatment ($P < 0.05$). In terms of feed conversion ratio, the feed conversion ratio of each treatment ranged from 3.45 to 3.78 at 3-12 weeks of age and there was no significant difference between the groups, but the feed conversion ratio of the wood slat floor group was 3.45 showed a better trend than the other three groups. In terms of the length of the 8th primary feather at 12 weeks of age, the length of the main feathers of each treatment group ranged from 19.0 to 21.1 cm. No significant difference was found between the treatments. The footpad damage score indicated that stainless steel mesh floor treatment was 1.80 and significantly better than plastic floor (3.25), wooden slats floor (2.67) and rubber anti-slip floor (3.58) treatments at 12 weeks of age ($P < 0.05$). According to the results from this experiment, it is recommended that stainless steel mesh floors be used for indoor duck houses if the ducks body weight, feed conversion rate and footpad damage are taken simultaneously into concern.

(J. H. Lin, C. H. Su, Y. A. Lin, T. F. Tseng, C. H. Cheng and H. C. Liu)

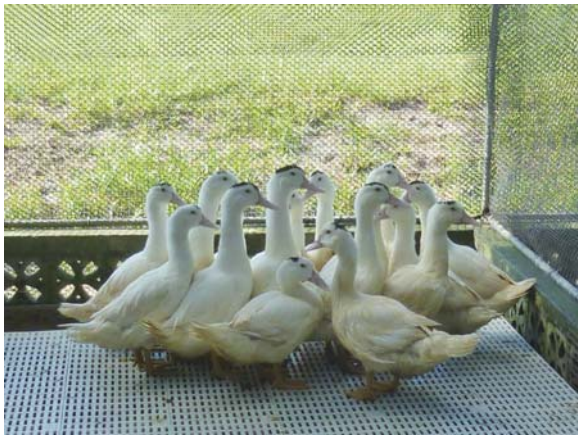
Mule duck appearance bred on stainless steel mesh floor at 10 weeks of age

Different purpureal Napier grass ratio diet supplementation effects on Mule duck growth performance

This experiment investigated different purpurael Napier grass supplementation ratio effects on Mule duck growth performance. Two hundred forty two-way crossbred Mule ducks were randomly allocated to four groups after three weeks of age including control (diets without purpurael Napier grass), 2, 4 and 6% purpurael Napier grass added. Each group had three replicates and each replicate had 20 mule ducks. The growth traits were determined when the ducks were 3, 7 and 10 weeks old. The carcass traits were determined at 10 weeks of age. The results showed that the body weight of four groups ranged from 2,813 to 2,847 g at 10 weeks of age ith no significant difference found between the groups. The body weight gain of all groups ranged from 2,364-2,408 g from 3 to 12 weeks of age and there were no significant differences between the groups. The average daily feed intake ranged from 148 to 152 g with no significant differences between the groups. The feed conversion ratio from 3 to 10 weeks of age ranged from 3.08 to 3.13 between groups with no significant differences between the groups. The

primary feather length results were between 15.9 to 17.0 cm and diets contained purpurael Napier grass groups were significantly higher than the control group ($P < 0.05$). The results from this experiment indicated that if body weight, feed conversion ratio and primary feather length are taken into consideration simultaneously, it is recommended that 6% purpurael Napier grass be added into the diet.

(J. H. Lin, J. B. Lin, T. R. Li , C. H. Su, C. H. Cheng and H. C. Liu)



Mule duck appearance fed diet supplemented with 6% purpureal Napier grass at 10 weeks of age

The effects of different composite floors on Mule duck growth performance

This study investigated the composite floor effects on Mule duck growth traits to evaluate the feasibility of rearing Mule ducks in raised floor duck houses. Two-way crossbred Mule ducklings were bred in a brooding house until three weeks of age. Ducklings were then allocated randomly into 4 treatment groups (half stainless mesh floor with half rice hull litter, half stainless mesh floor with half plastic floor, half stainless mesh floor with half wooden slats floor, or half stainless mesh floor with half non-slip rubber floor), with three replicates per treatment, and 20 ducks per replicate. All treatments were given isonitrogenous and isocaloric diets. Individual body weight and feed consumption were determined for calculating feed intake, body weight gain, feed conversion ratio, 8th primary feather length and footpad damage scores at 3, 7, 10 and 12 weeks of age. The results showed that the body weight at 12 weeks of age in each treatment was in the 3, 105-3, 283g range, but the body weight of the half stainless steel mesh floor with half non-slip rubber floor group was 3,150 g and significantly lighter than the other three groups ($P < 0.05$). The feed conversion ratio from 3 to 12 weeks of age in each treatment was in the 3.73-4.01 range, and there were no significant differences between groups. The feed conversion ratio of the half stainless steel mesh floor with half plastic floor group was 3.73, and there was a trend to be better than the other three groups ($P > 0.05$). The primarily feather length was in the 20.8-22.6 cm range. The primary feather length of the half stainless mesh floor with half non-slip rubber floor group was 20.8 cm and significantly shorter than the other three groups ($P < 0.05$).

Mule duck appearance bred on half stainless mesh floor with half plastic floor at 10 weeks of age

The footpad damage condition at 12 weeks of age in the half stainless mesh floor with half rice hull litter treatment was 0.4, significantly better than the other three groups ($P < 0.05$). According to the experimental results, it is recommended that half stainless mesh floor with half plastic floor be applied in the duck house if the duck live body weight, feed conversion ratio and primary feather length are simultaneously taken into consideration. The half stainless mesh floor with half rice hull litter is recommended if duck foot pad damage is a concern.

(J. H. Lin, C. H. Su, Y. A. Lin, T. F. Tseng, C. H. Cheng and H. C. Liu)

Different ratios of purpureal Napier grass supplementation effects on Pekin duck growth performance

This experiment investigated different ratios of purpureal Napier grass supplementation effects on growth performance, carcass and blood traits of Pekin ducks. Ducks were reared in a brooding house from hatching to 3 weeks of age and then randomly allocated into control group (diets without purpureal Napier grass), 3, 6 and 9% purpureal Napier grass supplemented diet groups. Each group had three replicates with 20 Pekin ducks. A total of 240 ducks (half male and female) were used in these experiments. Isocaloric and isonitrogenous diet contained 16% crude protein and 3,000 kcal/kg ME was given from 3 to 8 weeks of age. Duck individual body weight and feed intake were determined at 3, 5 and 8 weeks of age for calculating duck body weight gain and feed conversion ratio. The results showed that the body weight of four groups ranged from 2,103 to 2,234 g at 8 weeks of age and the body weight of diets supplemented 3% purpureal Napier grass group significantly heavier than diets supplemented 6% group purpureal Napier grass (2,234 g vs 2,103 g)($P < 0.05$). The body weight gain of four groups ranged from 1,497 to 1,610 g and the body weight gain of diets supplemented 3% was 1,610 g significantly higher than 1,497 g of supplemented 6% group ($P < 0.05\%$). The average daily feed intake for four groups from 3 to 8 weeks of age ranged from 150 to 157 g with no significant difference between the groups. The feed conversion ratio of four groups from 3 to 8 weeks of age ranged from 3.29 to 3.67 g and no significant difference between the groups. However, the feed conversion ratio of supplemented 3% purpureal Napier grass group was 3.29 had a trend that was better than the other three groups ($P > 0.05$). The primary feather lengths of four groups ranged from 12.4 to 12.9 cm at 8 weeks of age and no significant differences were found between groups. It is recommended that 3% purpureal Napier grass be supplemented in the diet when the duck body weight, feed conversion ratio, primary feather length and breast meat weight were taken simultaneously into consideration.

(J. H. Lin, J. B. Lin, T. R. Li , C. H. Su, C. H. Cheng and H. C. Liu)

Pekin duck appearance fed diet supplemented with 3% purpureal Napier grass at 8 weeks of age

Effect of application of black fungus discarded cultivation medium during feed restriction period on laying performance of Tsaiya duck

This experiment evaluated the effect of feeding black fungus discarded cultivation medium on Brown Tsaiya duck laying performance during the breeding period to establish a reference for saving feed costs in the laying duck limited feeding period. Ducklings were reared in the brooding house at 0-4 weeks of age, and feed with brooding feed containing CP and ME of 19.5% and 2,900 kcal/kg, respectively. During the 4-8 weeks of age period, ducklings were raised in the breeding house, and the CP and ME feeds were 13.5% and 2,650 kcal/kg, respectively. After that, they were distributed into the test duck house. The test was divided into 4 groups, namely corn group (control), corn group replaced by 10, 20 and 30% discarded cultivation medium, respectively (DCM-10, DCM-20 and DCM-30 group). Each treatment group had 3 repetition pens, 13 in each repetition pen, with a total of 156 ducks kept. When the ducks had an egg production rate of 5%, we increased the feed, which contained CP and ME of 19% and 2,750 kcal/kg, respectively. Both feeds and water were available ad libitum during the test period. The body weight, feed consumption, egg production rate, and egg weight were collected. The results showed there was no significant difference in feed consumption between the groups during the limited feeding period and the laying period. The ducks weighed between 821 to 864 g at 21 weeks of age. The egg production rate of the DCM-20 group was higher than that of the other groups during the 26-29 week old period, followed by the DCM-30 group. The average egg production rates for each group at 24-34 weeks of age were 88%, 89%, 95% and 90%, respectively. In terms of egg weight, there were no significant differences between the groups at 28, 31 and 34 weeks of age, and the egg weights were between 56.6-57.1 g, 57.6-58.6 g and 58.6-59.7 g, respectively. The results showed that the black fungus discarded cultivation medium can be used as a feed ingredient for the laying duck limited feeding period to replace corn by 30%.

(C. H. Cheng, H. Y. Hsu, C. H. Su, J. H. Lin and H. C. Liu)

Black fungus discarded cultivation medium

Black fungus crude extract as a feed additive for duck

This project studied black fungus as a duck feeding supplement. The black fungus nutrient information and its availability in the feed crop industry was collected and the processing conditions for black fungus by-product raw materials from washing, fine crushing, separation, rough extraction and drying were established. We evaluated the effects of different black fungus powder and extracts proportions, and polysaccharides on the Brown Tsaiya duck laying

period. In this experiment the test feed was started at 22 weeks of age. The ducks were divided into six groups, namely control group, 1 and 3% black fungus group (F1 and F3), 1 and 3% black fungus extract group (FCE-1 and FCE-3), and 120 ppm black fungus polysaccharide group (FE). All feeds contained CP and ME of 19% and 2,750 kcal/kg, respectively. Each group had 12 Brown Tsaiya ducks. Both feed and water were provided ad libitum. The results showed: the FCE-3 group had the highest total feed consumption at 22-41 weeks of age (3,459 g). The cumulative number of eggs in the FP group at 22-41 weeks of age was higher (120±15 eggs/duck). The FP group had a higher egg weight trend. The results showed that adding black fungus extract and polysaccharide into the diet had potential to improve the laying performance and egg quality.

(C. H. Cheng, H. Y. Hsu, C. H. Su, J. H. Lin and H. C. Liu)

Black fungus crude extract appearance

Effect of domestic swan oat hay feeding on dry matter intake, body weight, milk yield and milk quality of Holstein lactating cows

The objectives of this study were to investigate the effects of applying domestic swan oat hay to replace the imported oat hay in the diets for lactating cows on dry matter intake (DMI), body weight(BW), milk yield (MY), milk protein (MP), milk fat (MF), milk lactose (ML), milk solid non-fat (MSNF), milk total solid (MTS), somatic cell counts (SCC), milk urea nitrogen (MUN) and milk citric acid (MCA). Two repeated trials with total of 8 Holstein dairy cows were randomly allocated into two groups according to their body weight, milk yield, parity and days in milk. Each group has 4 cows. The results showed that there were no differences between the control and domestic swan oat hay feeding group on DMI (19.3 kg vs. 18.3 kg), BW (558.5 kg vs. 565.1 kg), MY (20.9 kg vs. 23.7 kg), MP (3.43% vs. 3.52%), MF (3.96% vs. 3.55%), ML (4.93% vs. 4.98%), MSNF (9.06% vs. 9.34%), MTS (13% vs. 12.2%), SCC (10×10^4 cells/mL vs. 18.1×10^4 cells/mL), MUN (13.1 mg/dL vs. 13.5 mg/dL) and MCA(175 mg/dL vs. 171 mg/dL). The domestic swan oat hay could be used as a new feedstuff choice, particular in northern Taiwan.

(S. H. Wang, Y. M. Shy, C. T. Chang, and J. W. Shiau)

The experiment of domestic swan oat hay for Holstein lactating cows

Evaluation of black soldier fly (Hermetiaillucens L.) prepupa powder as a fish meal substitute

The aim of this study was to use drying black solider fly (BSF) prepupa powder to replace fish meal to feed piglets. Before the experiment, the BSF prepupa was dried and crushed into powder and the nutrient components was analyzed and compared with related reference literature. In an animal experiment, the diets were adjusted for equal protein content, fifty-four piglet (half female and half male) were distributed using randomized complete block design into 3 treatment groups of both genders. Control diet was formulated with 5% fish meal, whereas fish meal in the treatment groups was replaced with 0, 50, and 100% drying BSF prepupa powder, respectively. The feeding period was about 4 weeks. The results showed that: (1) Different feeding matrix and larva age produced different nutrient-contents. (2) There was no significant difference in average daily gain (ADG), average daily feed intake (ADFI), feed conversion ratio (FCR), diarrhea index, and survival rate for piglets fed with different diets. Although there was no significant difference between drying BSF prepupa powder treatment groups and control group in survival rate, the treatment groups performed had a better tendency in survival rate than the control group. However, considering the cost of drying, refrigeration, water and electricity bill, and labor, the production of drying BSF prepupa powder was much more expensive than fish meal. Automation and large scale production might be a direction to lower cost and increased the potential of industry utilization.

(M. K. Yang, C. X. Lee, Y. H. Yeh, S. H. Wang, J. W. Shiau, S. H. Liang, T. Y. Lee, S. J. Liao, and P. A. Tu)

Using black soldier fly powder to feed piglets

The study on the colostrum quality at different parities of Holstein cows and the weekly change of body weight and blood parameters of the calf

The purpose of this study was to investigate the colostrum quality at different parities of cow's lactation and the calves' birth weight and blood parameters. There was no difference on the colostrum quality between the first to third milking time and the number of cow's parity. The Brix value of colostrum from the first to fourth parities cows were 18, 17, 14 and 19% respectively. Regardless of the number of lactation, colostrum quality at the first milking was the best, and significantly ($P < 0.05$) higher than the second and third milking. The average birth weight of calves from the first to the fourth lactation was 33.3, 33.7, 40.9 and 38.2 kg, respectively. The claves of the first lactation cow have the lowest birth weight. While the month of calving had no effect on the birth weight of the calves. Blood glucose and urea

nitrogen concentration were affected ($P < 0.05$) by calf's age. No effect on blood ketone and TG concentration, GOT and GPT. In conclusion, the colostrum quality at the first milking at the dam is higher than other milking. The birth weight of calves from multiparous cows were heavier than these from primiparous cow. There was difference on the blood glucose and urea nitrogen concentration among the age of calves, but not for blood ketone, GOT, GPT, TG, etc.
(S. H. Wang, C. T. Chang, and J. W. Shiau)

Colostrum quality test

The promotion for productive efficiency of breeding geese in the environmental control house

The change of light regime not only is able to manipulate the initiation of egg laying, but also affects egg production of geese and its fertilization rate. The influence on promotion for laying performance of geese has been well studied and the study of promotion for fertility of geese is less. The commercial geese breeders raised geese in the environmental control house (ECH) with varying elements, such as the feeding management and dietary calcium content. After the investigation of evaluating the effects of calcium content in diet during laying season and feeding management during resting season on the fertility and reproductive performances of breeder flock in ECH, the aim of this study is to evaluate the effects of feed weight during laying season on the productive efficiency of breeder flock in ECH. This study was to investigate the effect of treatments of laying diet on the productive efficiency of White Roman breeder geese in environmental control house. There were 36 ganders and 144 geese randomly assigned into 9 pens, each with 4 ganders and 16 geese. The 9 pens were randomly allotted into 3 treatments of laying diet ad libitum (AD), 85% of laying diet ad libitum (85%AD) and the amount of laying diet adjusted with egg production (AEP). The results showed that during laying period the body

The feeding of breeding geese in the environmental control house

weight at beginning and at peak of production of the 3 treatments (AD, 85%AD and AEP) were 5.74 and 6.21 kg, 5.64 and 6.02 kg, 5.53 and 5.92 kg, respectively; the egg production of the 3 treatments during early egg production were 28.4, 28.1 and 27.4 eggs/bird, respectively. The geese of AEP during early egg production had tend to higher egg fertility in comparison with the other treatments (73.2 vs. 60.1 and 51.7%, $P < 0.10$).
(M. J. Lin, S. M. Liou, C. C. Hsiao, S. H. Chuang, C. Y. Lien and S. D. Wang).

Effects of Lycium chinense Miller on growth performance and blood traits in White Roman geese

The aim of this program was to investigate the effects of fresh and dry Lycium chinense Miller (LCM) on growth performance and blood traits in White Roman geese. The first stage, sixty females were randomly divided into control group and 3 treatments (5 geese per pen). The percentage of 0, 5, 10, and 15 of fresh LCM were added in daily feed, respectively. The results showed that there were no significant differences between each treatment for total feed intake (FI), body weight gain (BWG), and feed conversion (FC). Moreover, the levels of creatinine (CREA), glutamic-oxaloacetic transaminase (GOT), glutamic-pyruvic transaminase (GPT), triglyceride (TG), and cholesterol (CHOL) were no significant differences between each group. The second stage, a total of sixty males were randomly divided into control group and 3 treatments. The percentage of 0, 1, 3, and 5 of dry LCM powder were added in daily feed, whereas 3 replicates (5 geese per pen) were set up in current study at 3 to 12 weeks of age. The results showed that there were no significant differences between each treatment for FI, BWG, and FC. For the blood traits, the levels of CREA, GOT, GPT, TG, and CHOL were no significant differences between each group at 12 weeks of age. In summary, there were no adverse effects on the growth performance and blood traits by feeding 15% fresh or 5% dry powder of LCM in geese. LCM could be used as a source of crude fiber to reduce feed costs in meat-type geese.
(S. Y. Shen, J. S. Wang, P. A. Tu, S. C. Liao, C. Y. Lien and S. D. Wang)

Animal experiment by freshly fed of Lycium chinense Miller in White Roman geese

Study on growth trait uniformity of littermate boars under swine purebred performance test

The area of waste farmland in Peng-Hu area is about 6,400 hectares, of which up to 84% of the agricultural land is mostly occupied by *Leucaena leucocephala*, and continues to expand. *Leucaena* was widely used for afforestation in Peng-Hu during the Japanese occupation period.

Unexpectedly, the northeast monsoon in Peng-Hu caused a lot of defoliation. Instead of achieving windproof effect, it invaded and replaced other tree species distribution areas, causing ecological problem. There are few crops for goat farmers in Peng-Hu area. Most of the wild weeds growing from fallow fields and Pennisetum planted by farmers themselves rarely buy imported crops. The reason is that the Peng-Hu goat farms are small. Purchasing crops have preservation problems and raises feeding costs.In order to reduce the cost of raising goat in the Peng-Hu area, this experiment compared the effects of grazing in areas rich in grass and lack of grass on the growth of goat. The 3-month-old black goats are divided into two groups: grazing and exercise group. The grazing group grazes in areas rich in grass, and the exercise group grazes in areas lacking grass. The starting average weight of female goats is 8.7 kg; the average body weight of 6-month-old body replay is 18.1 kg in the pasture group and 17.7 kg in the exercise group.In the future, we will continue to observe growth traits. Some goats will be raised to slaughter weight, and compare carcass traits and meat quality.The other goats will only be bred, and the effect of the two feeding methods on reproductive performance will be observed. This experiment is expected to increase the use of ground ruminants to reduce the cost of raising goat and provide good quality lamb.

(T. T. Chen, H. H. Liao)

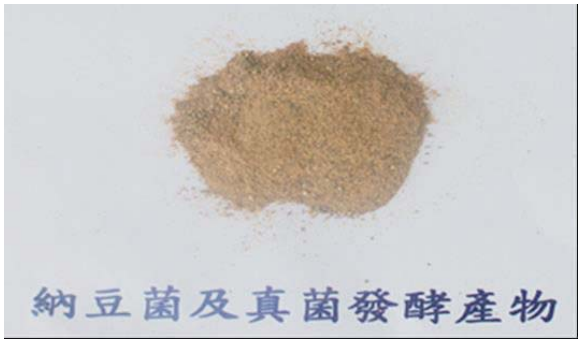
Grazing goat

Fermented protein and different proportions of combinatory products fermented by Bacillus natto with fungus supplementation improvement on the growth performance and immune trait of suckling piglet

The study will conducted to determine the effects of fermented feedstuff and various ration of products fermented by *Bacillus natto* with fungus (CPFBF) feed on growth performance and immunity trait of suckling pigs. Piglet were randomly divided into seven groups. These included control group (5% fish meal), 5% fish meal+0.14% antibiotic group, 5% commercial high protein group, 5% fermented protein group, 5% fermented protein+0.1% CPFBF group, 5% fermented protein+0.2% CPFBF group and 5% fermented soybean meal+0.3% CPFBF group. Growth performance result of weaning piglets showed that the Percentage survival (%) of 5% fermented protein+0.3% CPFBF group were significantly higher ($p<0.05$) than 5% fermented protein group. The daily weight gain of 5% fish meal+0.14% antibiotic group, 5% fermented protein+0.2% CPFBF group and 5% fermented protein + 0.3% CPFBF group were significantly higher ($p < 0.05$) than 5% fish meal group, 5% commercial high protein group and 5% fermented protein group. The results of serum immune response indicated that the interferon-γ of serum

in 5% fermented protein + 0.2% CPFBF group and 5% fermented protein + 0.3% CPFBF group were significantly increased ($p < 0.05$) than 5% fish meal and 5% commercial high protein group. Taken together, The growth performance and immune response could be improved by adding 5% fermented protein + 0.3% CPFBF supplementation to replace the 5% fish meal + 0.14% commercial antibiotic product in suckling piglets diet.

(H. J. Huang, H. L. Lee , S.C. Chang ,C. B. Hsu, and K. L. Chen)



The combinatory products fermented by bacillus natto with Fungus supplementation can promote the growth performance and had better immunocompetence than control group

Duroc x KHAPS hybrid pigs (dwarf with 75% Duroc pigs, 25% Meishan pigs) of experimental pigs

Supplementation of fermented protein and combinatory products fermented by *Bacillus natto* with fungus on the growth performance and immune trait in nursing pig

The study will conducted to determine the effects of fermented feedstuff and various ration of combinatory products fermented by *Bacillus natto* with fungus (CPFBF) feed on growth performance, immunity trait, diarrhea incidence and blood biochemistry of nursing pigs. Piglet were randomly divided into six groups. These included control group (5% soybean meal), 5% fish meal, 5% fermented protein group, 5% fish meal+0.1% antibiotic group, 5% fermented protein + 0.1% CPFBF group and 5% fermented protein+ 0.2% CPFBF group. Per day was provided ad libitum during piglets diet and water. Growth performance result of nursing piglets showed that the 0-1 week average daily feed intake of 5% fish meal+0.1% antibiotic group and 5% fermented protein + 0.2% CPFBF group were significantly higher ($p<0.05$) than 5% control group. The 0-1 week average daily weight gain of 5% fish meal+0.1% antibiotic group, 5% fermented protein+0.1% and 0.2% CPFBF group were significantly higher ($p<0.05$) than 5% control group. The 0-5 week average daily feed intake and average daily weight gain of 5% fish meal+0.1% antibiotic group, 5% fermented protein+0.1% and 0.2% CPFBF group were significantly higher ($p<0.05$) than 5% control group. The results of serum immune response indicated that the IgA of serum in 5% fermented protein+0.1% and 0.2% CPFBF group were significantly increased ($p<0.05$) than 5% control group.There were no significant difference in the

percentage survival (%), blood biochemical value, diarrhea incidence indicated and E. coli counts of fecal among treatments (P>0.05) .Taken together, The growth performance and immune response could be improved by adding 5% fermented protein + 0.2% CPFBF supplementation to replace the 5% fish meal+0.1% commercial antibiotic product in nursing pigs diet.

(H. J. Huang, H. L. Lee , S.C. Chang ,C. B. Hsu, and K. L. Chen)

Nursing pig fed with CPFBF

Benefit evaluation of Hirami lemon application in field test of growing pigs

The study intended to develop the commercial potential phytogenic product- Hirami lemon (*Citrus depressa* Hayata) for the commercial feed additives of livestock. Forty-eight LD growing pigs were randomly allotted to three dietary treatments, including Treatment 1: the basal diet (CP 17%, ME 3200 kcal/kg) based on corn-soybean meal; Treatment 2: basal diet supplementing 0.15% Hirami lemon powder; Treatment 3: basal diet supplementing 0.3% Hirami lemon powder. Each pen had 4 pigs (half of male and female), and each group had 4 replicates. Each Pigs were fed 2 kg/day from 43 to 100 kg (end). Results showed that there was no significant difference in daily gain (ADG) and feed efficiency (G/F) among treatments, but the ADG in groups supplementing HL increased by 8.8~16%, G/F increased by 8~13.7% compared with the control group. In benefit, each pig from groups supplementing HL increased approximately by 248-440 NT dollars. It shows that Hirami lemon powder has a positive effect and commercial application value.

(C. B. Hsu, H. L. Lee, H. J. Huang, S. C. Chang and H. S. Wang)

1. The fruit of Hirami lemon (Citrus depressa Hayata)

2. The feeding trail of growing pigs

Evaluation of the growth benefit of Hirami lemon application in starter piglets

The study intended to develop the potential phytogenic product- Hirami lemon (Citrus *depressa* Hayata) for the commercial *feed* additives of livestock. Forty-eight starter piglets, 5 weeks of age were randomly allotted to three dietary treatments, including Treatment 1: the basal diet (CP 18%, ME 3200 kcal/kg) based on corn-soybean meal; Treatment 2: basal diet supplementing 0.2% Hirami lemon powder; Treatment 3: basal diet supplementing 0.4% Hirami lemon powder. Each pen had 4 pigs (half of male and female), and each group had 4 replicates. Pigs were fed *ad libitum* for 42 days. Results showed that the average daily gain in Treatment 2 increased by 7.5% (0.57 vs. 0.53 kg/d), the feed intake decreased by 4.3% (1.10 vs. 1.15 kg/d), and the feed efficiency (G/F) increased by 13% (0.52 vs. 0.46) compared with the control group. It shows that Hirami lemon powder has a positive effect and commercial application value. *(C. B. Hsu, H. L. Lee, H. J. Huang, S. C. Chang and H. S. Wang)*

1. The fruit of Hirami lemon (Citrus depressa Hayata)

2. Hirami lemon powder

Effects of domestic gramineae-legume mixture forage on daily feed intake and digestibility in Nubian goats

The main component of the cost structure in goat industry is feed cost. Because the goat industry in Taiwan is highly dependent on imported forage, it is difficult to reduce the cost of feeding. The gramineae-legume mixture can increase nutrient value of gramineae. The purposes of this study was to evaluate the feeding values of silage of corn with soybean intercropping (SCS) and silage of pangola grass with alfalfa intercropping (SPA) for goat. Six 10-month-old Nubian goats with body weight of 30.6 ± 1.9 kg were randomly allotted into 3 treatments with two replicates. The

3 treatments were: Bermuda hay, SCS and SPA. The experiment period was 21 days including 14 days for ration adaptation, and 7 days for sample collection. The results showed that the SCS and SPA can increased crude protein concentration of dietary silage of forage maize and pangola grass. SPA resulted in the highest (P<0.05) daily dry matter intake (635g/d). There were no significant differences among the treatments for digestibility of dry matter, crude protein, crude fat and neutral detergent fiber. Total digestible nutrients of SCS and SPA groups reached 77.5% ± 3.0 and 67.2 ± 2.1%. In conclusion, SCS and SPA were good forage for dairy and meat goats which could be replacing Bermuda hay.

(M. C. Cheng, M. H. Chu, T. H. Yu, H. H. Liu, C. C. Pan, H. Q. Ke and Z. H. Wu)

Pangola glass filed

Application of Phytogenic Products in Lanyu Pigs

This study was conducted to evaluate the effect of diets supplemented with phytogenics (*Citrus depressa* Hayata) powder on the growth performance, serum biochemical parameters and diarrhea index of Lanyu pigs in nursing period. Trials used Pigs with 5.1 kg of weight and were assigned to one of the dietary treatments including control (CP 16%, ME 2,800 kcal/kg), 0.2% (control diets supplemented with 0.2% *Citrus depressa* Hayata byproduct powder, w/w), 0.4% (control diets supplemented with 0.4% *Citrus depressa* Hayata byproduct powder, w/w). The results showed that average body weight, average daily gain (ADG), average daily feed intake (ADFI), feed conversion ratio (F/G) of 0-4 weeks were not significant difference in treatments. In 4-6 weeks, the ADG of control was higher than 0.4% significantly (P < 0.05) and the other traits were not significant difference in treatments. In overall period, the ADG, ADFI, F/G and cost of feeds per head were not significant difference in treatments and the ADG and ADFI were better in 0.2%, the F/G and cost of feed per head were better in control. The blood urea nitrogen, cholesterol and triacylglycerol were not

The Citrus depressa Hayata powder

significant difference in treatments. The diarrhea index was better in control and 0.2% group. In conclusion, diets supplemented with 0.2% *Citrus depressa* Hayata by product powder increased 3% BW and 4.5% ADG than control. However, the serum cholesterol, triacylglycerol and diarrhea index did not improve by supplement with *Citrus depressa* Hayata byproduct powder. In future, we could supplement with higher levels or extend the experimental period to evaluate the effects.

(H. S. Wang, Y. C. Chen, Y. L. Chen, S. Y. Wu, C. C. Chang,and C. B. Hsu)

Effects of different feed program on growth performance of Duroc x KHAPS black pig crossbred growing pigs

After Kaohsiung Animal Propagation Station black pigs (KHAPS black pigs) were approved certification of new breed, we promoted as a well prolific maternal line. However, they still had some questions such as higher fat percentage, lower lean percentage and loin eye area, etc. Therefore, we tried to improve the weakness by crossbred between Duroc (D) and KHAPS black pigs (K). This study was conducted to investigate the effect of feed restriction and subsequent refeeding on growth performance and plasma biochemical parameters of Duroc x KHAPS black pig crossbred grower. Sixty growers with the age of 120 d were used to investigate the effects of different feed program (R for restricted feeding from 0 to 28 d and then *ad libitum* for 84 d, AL for ad libitum access to feed) and sex on growth performance and plasma biochemical parameters of Duroc x KHAPS black pig crossbred growers. In 0-28 d, the results showed that average body weight, average daily gain (ADG), average daily feed intake (ADFI), backfat thickness and blood urea nitrogen in AL and barrows (B) were higher than R and gilts (G) significantly ($P < 0.05$). Feed conversion ratio (F/G), loin area increase percentage (LA) and creatinine in AL were better and higher than R significantly ($P < 0.05$). In overall period, ADG and F/G of feed program and sex were not significant difference and ADFI and LA in B were higher than G significantly ($P < 0.05$). In conclusion, the growth performance of Duroc x KHAPS black pig crossbred growers didn't affect by different feed program during growing phase.

(H. S. Wang, H. L. Li, H. J. Huang, C. B. Hsu ,C. H. Wang, S. C. Chang and C. Y. Lin)

The loin fillet of DK black pigs

Studies on the appropriate nutritional requirement of weaned Lanyu Pigs

This study was conducted to investigate the effect of different lysine and metabolizable energy levels on the growth performance and blood biochemical parameters. Trials used thirty-two Lanyu pigs with 6.2 kg of weight and were assigned to one of the dietary treatments in a 2 x 2 factorial design. In the overall period, the results showed that the average daily feed intake and increment of backfat thickness of lysine and metabolizable energy were not significant difference. The average daily gain (ADG) in high lysine group was higher than low lysine group significantly ($P < 0.05$) and the feed conversion ratio (F/G) in high metabolizable energy group was higher than low metabolizable energy group significantly ($P < 0.05$). In blood biochemical parameters, the urea nitrogen, creatinine, triacylglycerol and cholesterol of 6 weeks were not significant difference in treatments. At the end of experiment, the creatinine, triacylglycerol and cholesterol were not significant difference in treatments but urea nitrogen in low metabolizable energy group was higher than high metabolic energy group significantly ($P < 0.05$), the urea nitrogen in low lysine high metabolizable energy group was lower than low lysine low metabolizable energy group and high lysine high metabolizable energy group significantly ($P < 0.05$). In conclusion, high lysine level increased ADG significantly and high metabolizable energy increased F/G significantly. But the Lanyu pigs mainly promoted to biomedical research, we have to maintain normal physical status and lower down body fat deposition. Therefore, in this study the low lysine and low metabolizable level was acceptable for Lanyu pig grower.

(H. S. Wang, Y. C. Chen, M. F. Wu, Y. L. Chen, Y. L. Huang, S. Y. Wu and C. C. Chang)

The experimental Lanyu pigs and diets

Effects of dietary supplementation of Scutellaria baicalensis Georgi herbal complex on the diarrhea and blood traits in calves

The study was conducted to investigate the effects of *Scutellaria baicalensis* Georgi herbal complex (SB) on the diarrhea and blood traits in calves. Twelve healthy calves were randomly assigned to two groups and fed a diet without (control group, n = 6) or with (treatment group, n = 6, 5g SB powder per head per day) SB supplementation for 12 weeks. At start and end of the experiment, the average of diarrhea score, blood hematological parameters and blood biochemical parameters were measured. The results showed that calves fed with SB powder had a significantly lower ($P < 0.05$) diarrhea score than the control group. However, the white blood cell, red blood cell, platelet cell, asparatate aminotransferase (AST) and blood urea nitrogen (BUN) were no significant difference between control group and treatment group. Based on these results, SB could be suggested as a potential feed additive of calf diets to decrease the rate of diarrhea.

(K. H. Lee, Y. M. Chen, H. S. Chen, J. S. Chao, Y. H. Yeh, S. Y. Hou and J. W. Shiau)

Calves fed a diet with SB supplementation

Effects of phytogenics on the dairy udder health

The study was conducted to investigate the effects of phytogenics complex A on udder health of the dairy cattle. Twelve lactating cows, with high somatic cell count (SCC, > 50×10^4 cells / mL), were randomly assigned to two groups and fed a diet without (control group, n = 6) or with (treatment group, n = 6, 100g phytogenics complex A powder per head per day) phytogenics complex A supplementation for 28 days. At start and end of the experiment, the fat, protein, lactose and SCC in the raw milk, and the blood hematological parameters and the blood biochemical parameters were measured. The results showed that cows fed with phytogenics complex A powder (from 228.5 ± 227.2 to 81.6 ± 44.5 $\times10^4$ cells/mL) had a significantly ($P <$

0.05) reduced SCC compared to the control group (from 247.6 ± 150.4 to 320.4 ± 122.2 $\times 10^4$ cells/mL). However, the fat, protein, lactose, white blood cell, red blood cell, platelet cell, aspartate aminotransferase (AST) and blood urea nitrogen (BUN) were no significant difference between control group and treatment group. In conclusion, the effects of phytogenics complex A were associated with down-regulation of SCC of dairy cow.

(K. H. Lee, Y. H. Yeh, Y. M. Chen, H. S. Chen, J. S. Chao, S. Y. Hou and J. W. Shiau)

Cows fed a diet with phytogenics complex A supplementation

Nutritional strategies to improve udder health and transition reproduction in dairy cows

To improve the reproduction during transition period and the udder health of lactating cows during the hot season, the study will be reduced incidence of metabolic disorders and somatic cell counts by using nutrition strategy to enhance dairy cows' health and well-being. Therefore, the effects of different combinations and supplementation of Zn, Cu, Mn or vitamin E and Se on milk production and reproduction, reduced somatic cell counts dairy cows will be evaluated during the trial period. In transition cattle experiment, the placenta retention rate of control, experiment 1 (supplementation of Se, vitamin E) , and experiment 2 (supplementation of Zn, Cu, Mn) were 25% (2/8), 0% (0/8), and 12.5% (1/8), respectively. The count of white blood cell (10,632 ± 510 vs 13,281 ± 524 μL) and red blood cell (RBC) (5.39 ± 0.11 vs 5.71 ± 0.12 10^6 /μL) in control were significantly lower than experiment 1 ($P < 0.05$). Besides, the neutrophil (39.8 ± 2.0 vs 33.3 ± 2.0 %) and lymphocytes rate (50.3 ± 2.0 vs 57.2 ± 2.1 %) of control have a lower trend than

the value in experiment 1 (P < 0.1). In hot season experiment, the results of showed that dietary supplementation of Zn, Cu, Mn, and vitamin E and Se could help increase 3% and 6% milk yield. But there was no significant difference between the treatments of other milk compositions. There was a trendy of decrease with vitamin E and Se supplementation in blood GOT. From the above results, it could be concluded that adding vitamin E and Se to the diet of transition period or hot season had a tendency to improve immune function and decrease somatic cell score due to improve liver function.

(Y. H. Chen, C. T. Chang, Y. M. Chen, K. H. Lee and P. A. Tu)

Experimental cow eating hay

Effects of propylene glycol and rumen-protected choline supplements in the transition period dietary on dairy cattle

The period of 3 weeks (wk) pre-calving until 3 wk post-calving is called transition period. During this time, dry matter intake of dairy cows even decreases to 32.2%. This stage is a stressful period for the dairy cows in particular to lead to negative energy balance (NEB). If NEB is worse, the incidence of disease in transition cows is higher. A total of 30 transition dairy cows were randomly assigned into three groups according to their parity. All of groups received the same basal diet accorded by NRC (2001). The cows fed the diets containing 0 (control) and 300 g mixture of propylene glycol and glycerin (experiment 1) and 80 g rumen-protected choline (experiment 2) each day. Treatments were applied from 3 wk before until 3 wk after calving. Milk was sampled each day to record milk yield, and milk composition were analyzed at each post-calving week. The results showed that 305-2X-ME of control, experiment 1 and experiment 2 were 7,278.7 kg, 7,724.2 kg and 7,673.7 kg (P = 0.83). The milk fat rate of control, experiment 1 and experiment 2 were 3.6%, 3.7% and 3.6% (P = 0.26), and milk protein rate were 3.2%, 3.3% and 3.3% (P = 0.88) in whole lactation. Results from this study suggest that experiment 1 (mixture of propylene glycol and glycerin) had better milk yield and milk fat rate even though there were no significant differences.

(Y. H. Chen, Y. M. Chen, Y. H. Yeh and K. H. Lee)

A development on production traceability of chitin production process of black soldier flies

This project uses distiller's grains to be the material for black soldier fly feed. Effective processes for converting distiller's grains into feed ingredients or feed additive materials by establish good agricultural practices. This can effectively produce regional high-quality animal protein, animal fat and feed additive chitosan, which is used as raw material for animal health application or pet feed raw material for downstream industry applications. After crushing the black water clam shell, the chitin is extracted by microbiological method and chemical method. The results showed that the crude protein and ash content of the black water clam shell powder were 62.1% and 8.21%, respectively. After microbial and chemical extraction, the microbial deproteinized (DP%) and deashed (DM%) were 87.9% and 97.2%, respectively, while the chemical methods of DP% and DM% were 88.5% and 96.6%. The two extraction methods showed a significant decrease in DP% and DM%. The chitosan is a product of chitin after deacetylation. Generally, the degree of deacetylation is 70–90%. The degree of acetylation affects the physiology effect. The results showed that the degree of deacetylation by microbial and chemical methods was 81.5% and 53.9%, respectively. The microbial method has a higher degree of deacetylation.

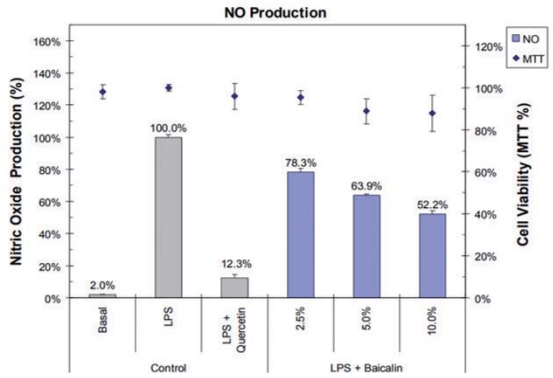
(S. H. Liang, S. H. Wang and J. W. Shiau)

The fly shell, chitin, and chitosan of black soldier flies

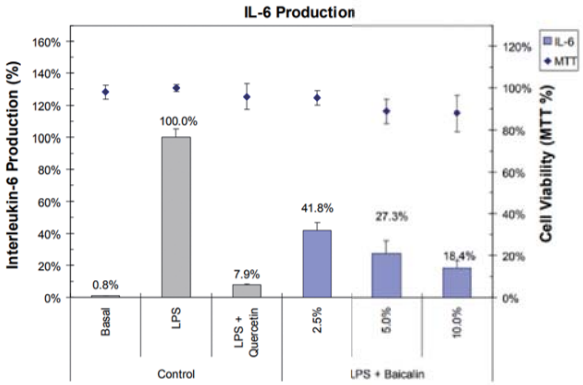
The effects of Scutellaria baicalin feed supplement on the lipopolysaccharide -induced mouse BALB/c macrophage RAW 264.7

Development of herbal feed supplements that modulate inflammatory mediators in activated macrophages may be a useful strategy for calf diarrhea. We investigated the anti-inflammatory effect of Scutellaria baicalin extract (SBE) on lipopolysaccharide (LPS) -induced responses in the mouse BALB/c macrophage RAW 264.7. The macrophage cells were pretreated with various concentrations of SBE (0, 2.5, 5, 10%) and subsequently incubated with LPS (10 μg/mL). The level of nitric oxide (NO) was determined by using Griess reagent assay. The levels of pro-inflammatory cytokines including interleukin (IL) -6 and tumor necrosis factor-α (TNF-α) were analyzed by enzyme-linked immunosorbent assays. The results showed no significant decrease TNF-α levels on the macrophage cells with SBE treatment. Treatment of SBE (10%) significantly reduced 47.8% of NO and 81.6% of IL-6 production in LPS-stimulated macrophage cells ($P < 0.01$).

(K. H. Lee, Y. H. Yeh, H. S. Chen, Y. M. Chen, J. Y. Chen, J. S. Chao and J. W. Shiau)



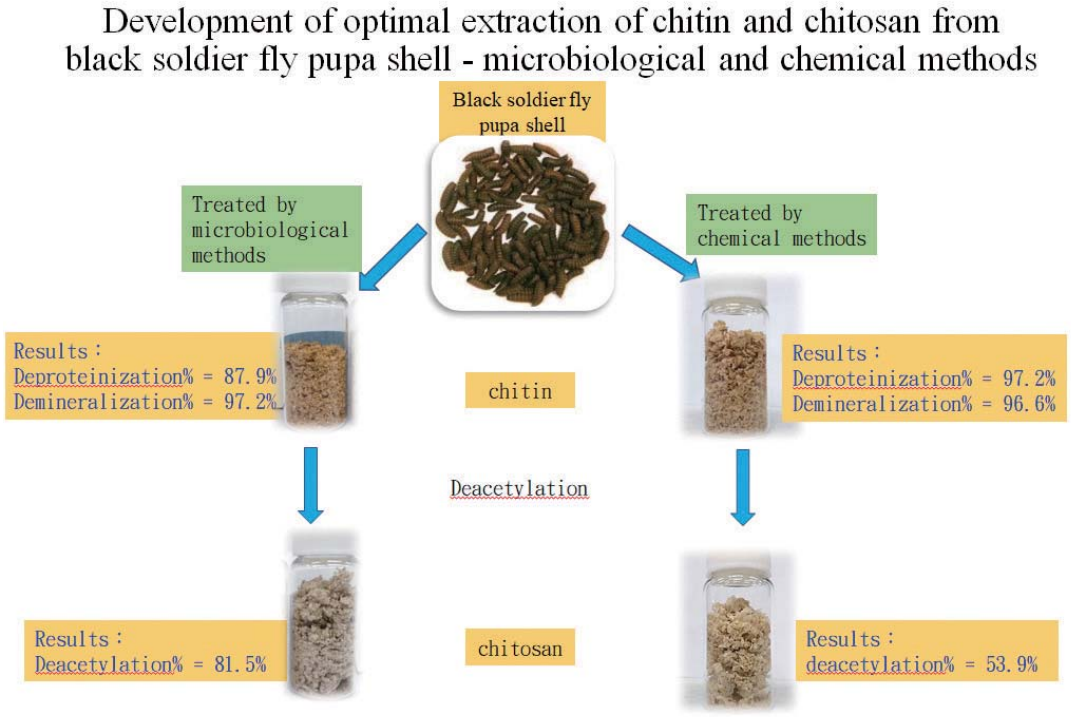
Treatment of SBE (10%) significantly reduced 47.8% of NO production in LPS-stimulated macrophage cells



Treatment of SBE (10%) significantly reduced 81.6% of IL-6 production in LPS-stimulated macrophage cells

The chitin of traceable black soldier flies as a feed additive product process development

The black soldier fly (*Hermetia illucens*) was a recommended insect application by the FAO that can convert agricultural by-products into biomass and develop it for as insect oil, insect



The extraction and development of chitin and chitosan of pupae shell of black soldier flies

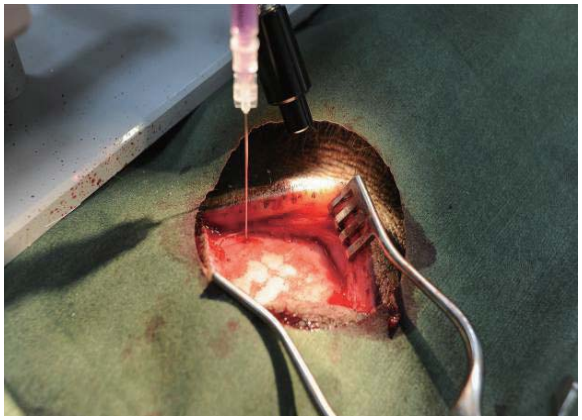
protein or chitosan. Chitin and chitosan are a group of macro-molecular compound with high nutritional and health value, usually extracted from shrimp and crab shells. However, because of the instability of raw materials from shrimp and crab shells, the quality of chitosan are affected, and costs are increased. In nature, insects are one of the three major sources of chitin. Therefore, there is a great demand for the development of chitin and chitosan derived from insects in the short supply of chitin. At the same time, the uses of black soldier flies in value-added waste management systems are new environmental technologies that make our world more environmental friendly. This project will develop the method of microbial fermentation to remove the proteins and minerals from the pupa shell of the black soldier flies, change the original high-volume acid-base treatment method, establish a green extraction process and establish the quality control system of chitosan products.

(S. H. Liang, S. H. Wang and J. W. Shiau)

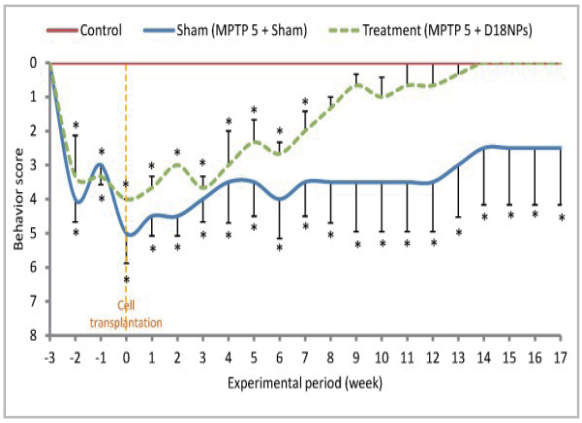
III

Study the therapy of porcine induced pluripotent stem cells in Parkinson's disease model of Lanyu pigs

This study was attempted to induced Parkinson's disease in Lanyu pigs by injecting 1-methyl-4-phenyl-1,2,3,6-tetrahydropyridine (MPTP) and to treat them by transplanting porcine induced pluripotent stem cells (piPSCs). The results showed that after induction of Parkinson's disease by MPTP 5 mg/kg injection, the behavioral score (0 = normal, 8 = abnormal) in the group treated with piPSCs-derived neural cells can recover to 0.0 ± 0.0, and the result can retain in the end of 20-week-experimental period. The results in the treatment group also bettered than that in the sham group. The present study established the criteria and analysis methods for behavioral score in Lanyu pig model of Parkinson's disease. The technique can be the reference for the study of human clinical trial, stem cell therapy, and translational medicine in the future. *(J. R. Yang, Y. J. Liao)*



The piPSC transplantation into the coordinates of DV = -3.5 and -3.0

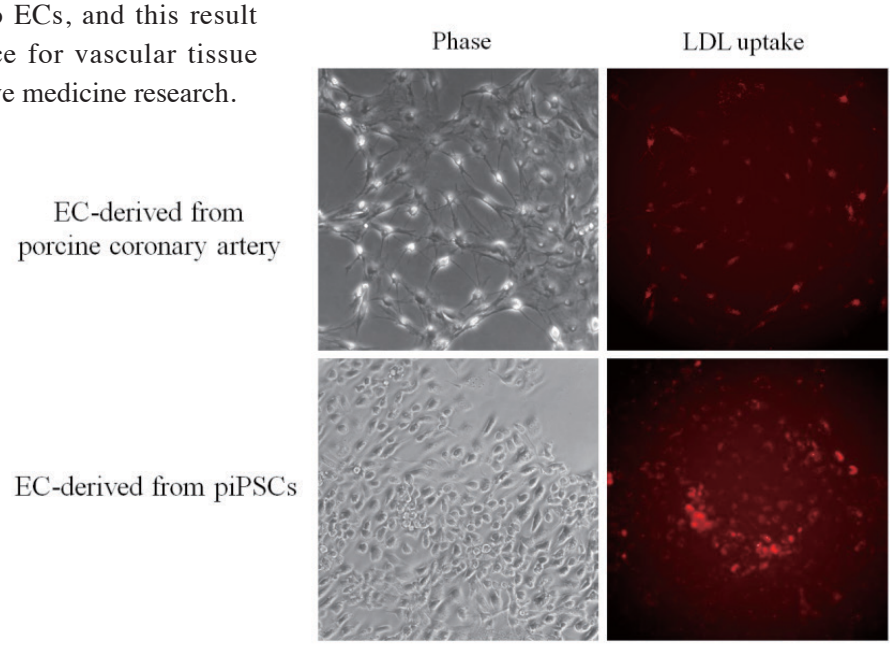


The improvement of behavior score in the piPSC treatment group

Differentiation of porcine induced pluripotent stem cells to vascular endothelial cells

Cardiovascular disease is the second leading cause of death in Taiwan, so research on cardiovascular disease can greatly help improve people's health. Endothelial cells (ECs) and perivascular cells (PCs) can establish a complete vascular network through vascularization, providing cellular stable oxygen and nutrients. In this study, porcine induced pluripotent stem cells (piPSCs) were induced to differentiate into ECs using a two-stage approach. In the first stage, piPSCs were treated with a differentiation solution containing CHIR99021 for 2 days, and then treated with bone morphogenetic protein 4 (BMP4), vascular endothelial growth factor (VEGF), and basic fibroblast growth factor (bFGF) for 2 days. In the second stage, differentiated cells were cultured in endothelial cell growth medium containing VEGF for 4 weeks to form ECs. Differentiated ECs can express CD31, VE-cadherin, and vWF antigens. They also have the ability to phagocytize low-density lipoprotein (LDL) and form tubular structures. Therefore, this study successfully

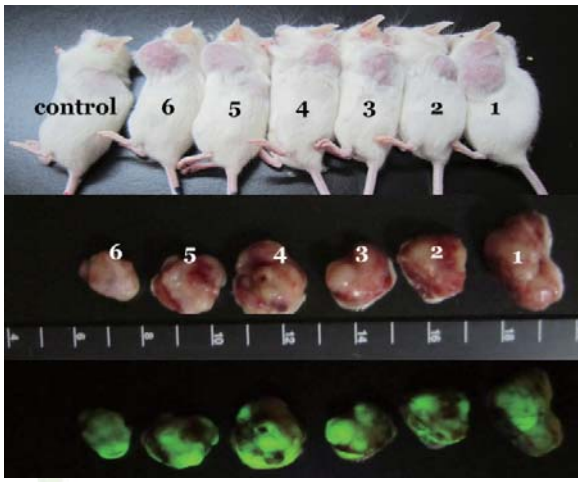
differentiated piPSCs into ECs, and this result can be used as a reference for vascular tissue engineering and regenerative medicine research. *(J. R. Yang, Y. J. Liao)*



The EC-derived from porcine coronary artery and EC-derived from piPSCs have LDL uptake expression

Establishment of GFP-expressing induced pluripotent stem cell lines in chicken

The purpose of this study was to establish the GFP expressing iPSC in chicken and to study the celluar characters includind pluripotency. The results showed that the GFP expressing of ciPSC/GFP$^+$ transformed 24-39 hours after being infected with lentiviral vector-based GFP. The transformed cells were maintained in vitro for more than 25 passages, thereafter, which continuously and steadily expressed GFP signal and continuously expressed pluripotent markers of stem cells including Oct-4, AP, and PAS antigens. The EB formation derived from ciPSC/GFP$^+$ cells by hanging drop culture also maintained GFP expression, induced and spontaneous differentiated into cells and tissues of the three germ layers. Furthermore, the teratomas were found in the NOD-SCID mice after ciPSC/GFP$^+$ cells transplantation. The GFP expression of the teratomas could be detected by fluorescence microscope. The results demonstrated that the ciPSC/GFP$^+$ cells established in this study were pluripotent. *(J. F. Liou, Y. S. Chen, F. H. Chu and L. R. Chen)*

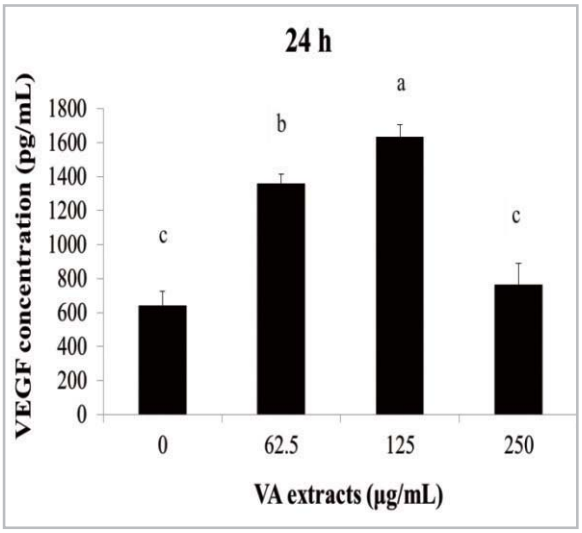


Tetratomas derived from injected SBciPSCs in NOD-SCID mice

Application of velvet antler products in wound repair

Velvet antler (VA) is one of the most famous and valuable Chinese traditional medicines. Several studies indicated that the VA comprises certain growth factors related to its regeneration annually. These growth factors might provide positive effects on wound repairs. Thus, the purpose of this study was to evaluate the wound healing effects of Formosan sambar deer VA (SVA) extract. The results revealed that SVA extracts exhibited wound healing activity in Caco-2 cells. SVA cold water and hot water extracts could stimulate keratinocyte proliferation in a dosage-dependent manner. In the animal experiment of wound healing, the test results showed that the VA extract was better for the healing of mice skin wounds. The skin wound model of Lanyu pig showed that velvet gel can promote wound healing and slow the pain of wound contraction in the later stage of wound healing. This experiment proves that antler preparation is feasible in medical treatment of human diseases.

(C. Y. Kuo, T. Y. Kuo, S. H. Lin, S. R. Kang, C. H. Wang and M. J. Chen)



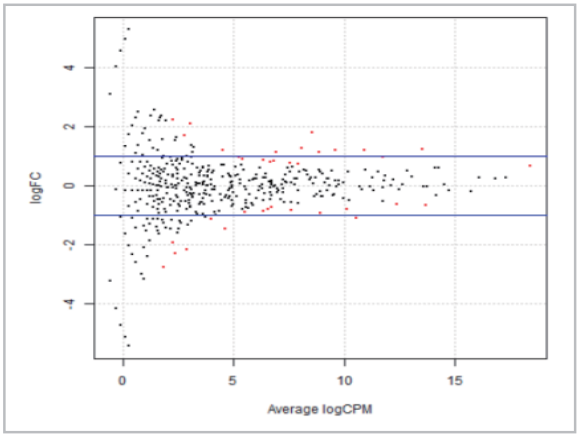
The concentration of VEGF was increasing significantly when the addition amount of SVA extract was 125 μg/mL

Lanyu pig experiment of wound healing treatment

The microRNA expression in early chicken embryos

The purpose of this study was to analyze the expression of sex-differentiated miRNAs in early chicken embryos, to understand the possible functions and regulatory pathways of specific miRNAs in the early chicken embryonic stage. Stage X chicken embryos RNA were extracted and separated into the male and female groups. Library construction and sequencing were performed following next generation sequencing manufacturer protocols. The results showed that there were a total of 683 miRNAs detected in male chicken embryos, of which 101 were male-specific miRNAs, and a total of 664 miRNAs were found in female chicken embryos, of which

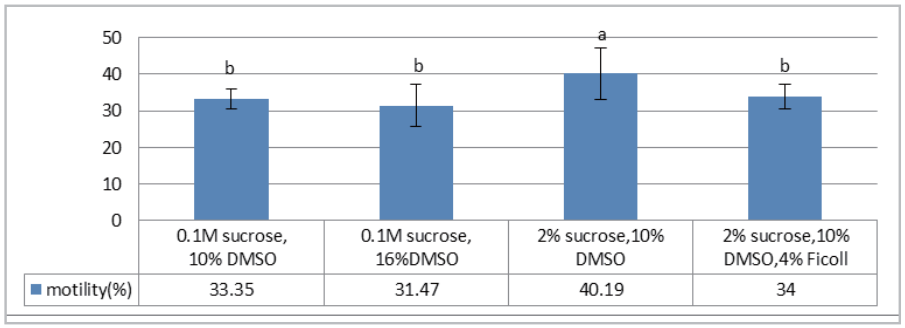
82 were female-specific miRNAs. There are 582 miRNAs performed in both male and female chicken embryos. Among them, 23 miRNAs in male embryos showed significantly higher performance than in female embryos, and 21 miRNAs in female embryos showed significantly higher performance than in male embryos. Subsequent by, the differential and specific expression of miRNAs will be verified by qPCR and the results can be used as a reference to future study the connections and the genetic pathways of miRNAs-mRNAs interactions networks potentially involved during early chicken embryonic stage. *(H. Y. Kuo, Y. R. Chou, C. H. Yang and L. R. Chen)*

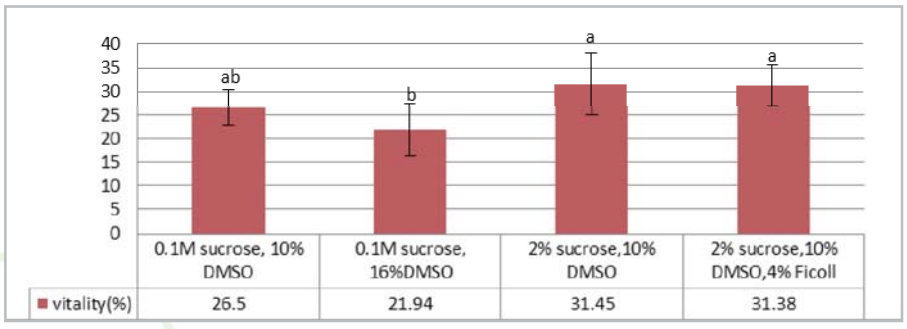


The miRNA expression in female and male chicken embryos

Comparing the effects of different cryoprotectants in rabbit semen traits

The low survival rate of sperm after freezing is a major drawback for the widespread use of frozen semen in artificial insemination programs for livestock animals such as the rabbit, in which sperm cryopreservation has only been used for experimental purposes. The aim of this study was designed to identify a suitable freezing protocol for rabbit semen by comparing the effects of different operation procedure. In our study, after cooling down at 5 °C, pool semen were diluted to



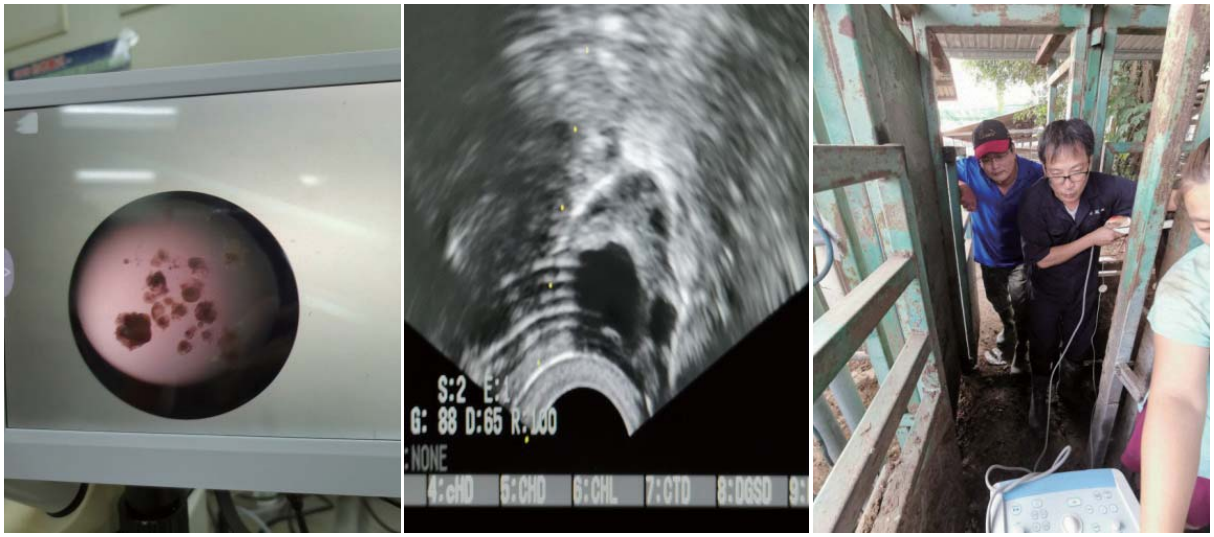


The motility and vitality difference between different semen diluted ingredient after freezing and thawing

a ratio 1:1 or 1:4 (v : v) , with a freezing medium composed of Tris-citrate-glucose containing 6, 10, or 16% DMSO, 4% Ficoll 70 or 10% LDL(combined with 0.5% or 0.1M BSA and 2% sucrose). The different semen was load in 0.25ml plastic straws and equilibrated for 45 minutes at 5°C before freezing in liquid nitrogen vapor (5 cm above the liquid nitrogen surface). The variable assessed after thawing were sperm motility, vitality and progressive percentage. Marked effects on these variables were shown by the CPAs (cryoprotectant agents) concentration and dilution ratio. In conclusion, the best results obtained using 10% DMSO or 10% DMSO combined with 4% Ficoll 70 and diluted to a ratio 1:1 (v:v), result in good motility (40.19 ± 7.65%), vitality (31.45 ± 6.6%). *(P. C. Tsai, M.C. Lin)*

Ovum Pick-Up (OPU) and sexing embryo production of dairy cattle

Ovum Pick-Up (OPU) is a technique that uses ultrasound to guide a probe to suck eggs through the vagina to the ovarian follicles. It is a non-surgical invasive method that can recover oocytes from live animals. OPU is considered to be the most effective way to increase the excellent genetic spread from embryos produced by female donor eggs, and has been implemented in industrial applications in advanced animal breeding technology countries. The use of sexing sperm of dairy cattle to produce sex control embryos in vitro. The oocytes collected in the slaughterhouse and harvested in vivo were compared, and the oocytes were maturated in vitro, fertilized and cultured to blastocysts for cryopreservation, and the developmental ability of each stage was evaluated. A total of 9 cow ovaries were collected from the Slaughterhouse. The follicular fluid was aspirated from the ovaries and the oocytes were collected. After maturation, 215 mature oocytes were obtained. After in vitro fertilization with sexing sperm, the percentage of cleavage (44.2%). A total of 26 fertilized eggs developed in vitro to the blastocyst stage. In the OPU of collecting oocytes, the technical proficiency of the operators is improved. After



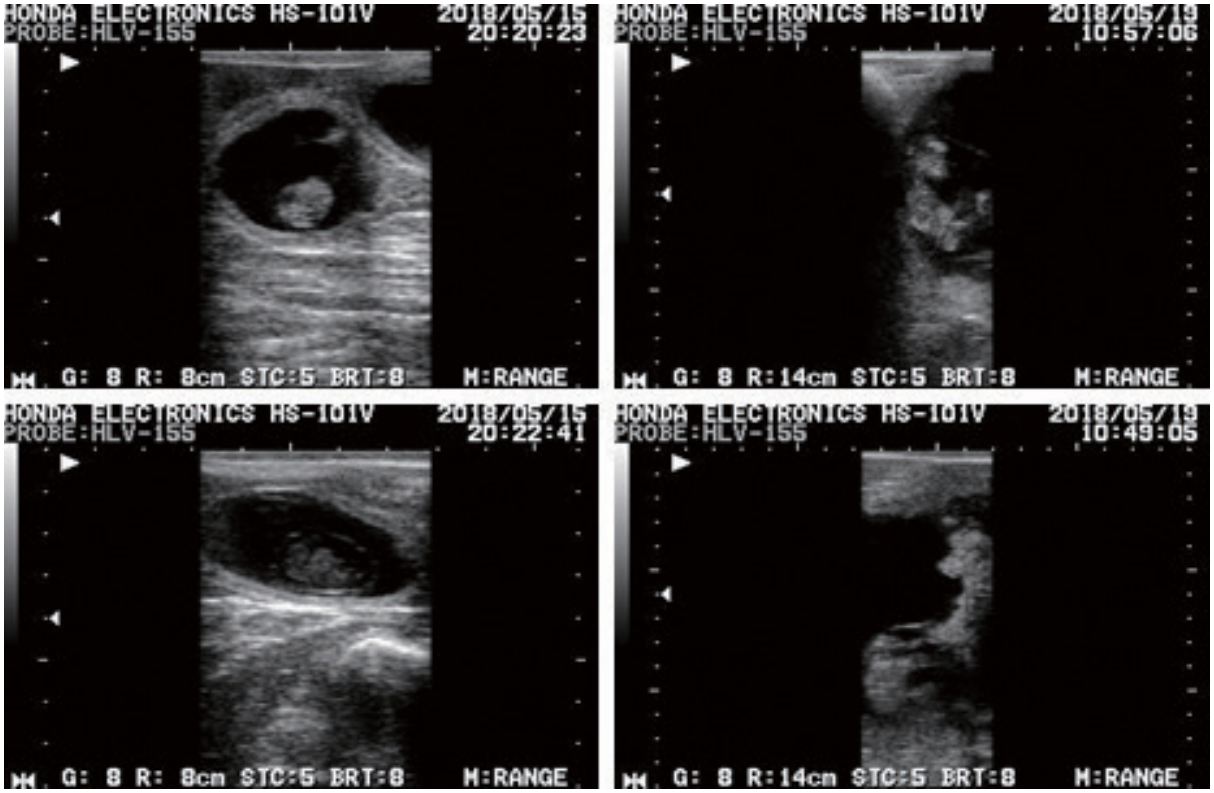
Oocytes collected from Ovum Pick-Up of dairy cattle

the upgrade and construction of the relevant equipment is completed, the skills of using the newly purchased equipment are practiced, and the recovery rate of oocytes can reach 60%. Dairy cattles used for OPU need to be carefully selected. In addition to rectal palpation, ultrasound scanning equipment should be used to evaluate their ovarian health and super ovulation effect, and individuals with poor response should be removed before embryo recovery. A total of 33 oocytes were collected from OPU, and then fertilized with sexing sperm. The percentage of cleavage (39.4%). A total of 5 embryos developed to blastocyst stage after in vitro culture. *(F. H. Chu, Y. H. Chen, J. F. Liou and L. R. Chen)*

Effect of different semen diluents on the quality of frozen-thawed semen of Holstein bull

This experiment continued the 2017 project,and the quality traits of frozen-thawed Holstein bull semen with different cryo-extender was analyzed.. Three different extender formulas was selected in this experiment and Bioxcell (base containing soy extract) and OptiXcell (base containing plant phospholipid) and TCF-8% LDL + 0.5 mM GSH (base extract of egg yolk) to carry out mating of cow by artificial insemination. The effects of different cryo-extenders on the pregnancy rate of cows by artificial insemination was investigated. The results demonstrated that OptiXcell (matrix containing plant phospholipids) had better sperm progressive motility, VCL and ALH ($P < 0.05$); Bioxcell (matrix containing soy extract) had better LIN, STR and BCF ($P < 0.05$), allthough the performance of the overall sperm movement parameters in the group of LDL extender were between the groups of OptiXcell and Bioxcell. The conception rate in group of LDL extender (62.96%) who better than OptiXcell (55.56%) and Bioxcell (40.74%), but there was no significant differences among three extenders. In conclusion, the traditional role of the egg yolk using as a cryoprotectant in Holstein bull semen cryopreservation extender could be substituted by LDL. In addition, compared with the plant-based extenders, the cryopreservation extender containing 8% LDL and 0.5 mM GSH can achieve the best cryopreservation effect, and maintain a better conception rate on the Holstein bull semen. *(C. X. Lee, M. K. Yang, Y. H. Yeh, S. H. Wang and J. W. Shiau)*

Collection of bull semen



Diagnosis of pregnancy by ultrasound on the female Holsteins cow 43-55 days after artificial insemination. The two panels on the left and right sides are overhead and side views of fetus, respectively

Ketone body concentration in milk determined by Fourier transform infrared spectroscopy and its value for the detection of subclinical hyperketonemia in dairy cows

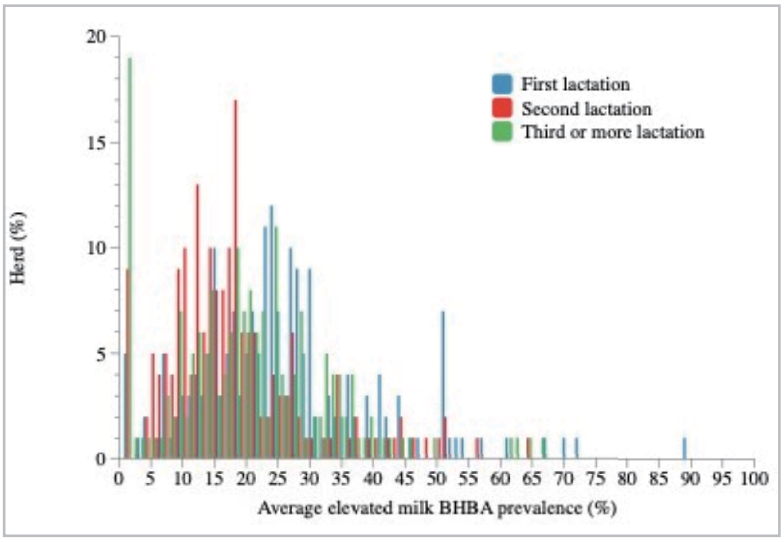
The purpose of this study was to illustrate the prevalence and effect of elevated milk β–hydroxybutyrate (BHBA) as detected by routine Fourier–transform infrared analysis in Dairy Herd Improvement (DHI) milk samples. Data collected over 3 yr included cow information as well as milk yield and composition from 39,026 samples from postparturient Holstein cows (5–35 d in milk) from 192 herds. The following thresholds were used to classify cows based on their early lactation milk BHB concentration: < 84 μmol/L = negative; ≥ 84 μmol/L = positive. Overall prevalence was 20.3% which was higher for older cows (24.1, 16.8, and 21.4%, for cows in their first, second, and third or greater lactation, respectively). Distribution with regards to days in milk was different among parity groups, with first–lactation cows having highest prevalence (46%) in the 3rd day at the first week after calving; cows in their second and third and greater parity had the highest prevalence in the 4–5th day of the first week after calving, at 30.0 and 35.0%, respectively. Season of calving affected the prevalence of elevated milk BHBA, with cows calving in late spring to early summer (March to May) seasons showing higher prevalence. Distribution among herds was highly variable, as 66.3% of herds had a prevalence of 20% or less, 31.1% of herds had a prevalence between 21 and 40%, 1.6% of herds had a prevalence between

Using Fourier transform infrared (FTIR) spectrometry to measure milk ketone bodies to detect subclinical hyperketonemic cows

41 and 50%, and 1% of herds had a prevalence of 51% or more. Positive cows had lower milk yield, protein, lactose, solids-not-fat (SNF), casein, milk urea nitrogen (MUN) concentration and yield than negative cows, but also higher in fat concentration and yield, energy corrected milk (ECM), free fatty acid, F:P ratio, as well as higher somatic cell counts (SCC) and score (SCS) than negative cows. The present analysis highlights the importance of elevated milk BHBA monitoring at the herd level through routine BHBA testing in DHI milk samples. *(Y. H. Yeh and P. A. Tu)*

Prevalence of subclinical ketosis of different parities and their association with milk components in dairy cows

The purpose of this study was to illustrate the prevalence and effect of elevated milk β–hydroxybutyrate (BHBA) as detected by routine Fourier–transform infrared analysis in Dairy Herd Improvement (DHI) milk samples. Data collected over 3 yr included cow information as well as milk yield and composition from 39,026 samples from postparturient Holstein cows (5–35 d in milk) from 192 herds. The following thresholds were used to classify cows based on their early lactation milk BHB concentration: < 84 μmol/L = negative; ≥ 84 μmol/L = positive. Overall prevalence was 20.3% which was higher for older cows (24.1, 16.8, and 21.4%, for cows in their first, second, and third or greater lactation, respectively). Distribution with regards to days in milk was different among parity groups, with first–lactation cows having highest prevalence (46%) in the 3rd day at the first week after calving; cows in their second and third and greater parity had the highest prevalence in the 4–5th day of the first week after calving, at 30.0 and 35.0%, respectively. Season



Distribution of elevated milk BHBA prevalence among herds. Prevalence includes cows with milk BHBA concentrations ≥ 84 μmol/L. Only herds with more than 20 cows tested between 1 and 35 DIM over the experimental period are reported (n = 192)

of calving affected the prevalence of elevated milk BHBA, with cows calving in late spring to early summer (March to May) seasons showing higher prevalence. Distribution among herds was highly variable, as 66.3% of herds had a prevalence of 20% or less, 31.1% of herds had a prevalence between 21 and 40%, 1.6% of herds had a prevalence between 41 and 50%, and 1% of herds had a prevalence of 51% or more. Positive cows had lower milk yield, protein, lactose, solids-not-fat (SNF), casein, milk urea nitrogen (MUN) concentration and yield than negative cows, but also higher in fat concentration and yield, energy corrected milk (ECM), free fatty acid, F:P ratio, as well as higher somatic cell counts (SCC) and score (SCS) than negative cows. The present analysis highlights the importance of elevated milk BHBA monitoring at the herd level through routine BHBA testing in DHI milk samples. *(Y. H. Yeh and P. A. Tu)*

Flock expansion in minimal diseases geese and maintenance of genetic resources in another place

This study was to expand the population of minimal diseases (MD) geese with 1 male to 3 to 5 female geese, and regularly collected 30 throat swabs and anal swabs to screen the specific pathogens: including goose parvovirus, circovirus, goose hemorrhagic polyomavirus, riemerella anatipestifer, fowl cholera and avian reoviruses were monitored per season and all results were negative. In addition, our physiological unit supported us to culture the embryonic fibroblasts and the pluripotent stem cell from goose eggs for retaining the goose species in different places. The embryonic fibroblasts were completed 34 tubes, included MD level of White Roman geese of high laying eggs line (×4), Beidou White geese (×4), Brown Chinese geese (×4), clean level of White Roman geese (×8), and White Chinese geese (×14). And the pluripotent stem cell were completed 20 tubes, which form White Roman geese. As well as, for better transportation of goose eggs, we organize their length and width to make a carton (length 37 × width 23 × height 15 cm^3) of expanded polyethylene for single transport. By the way, total of 509 MD goslings and 930 MD eggs were provided for other experimental research. *(S. H. Chuang, M. J. Lin, T. Y. Lin and S. D. Wang)*

The embryonic fibroblasts and the pluripotent stem cell of goose

Set up a business production model for biomedical geese

This study was to establish a system for minimal diseases (MD) geese production, which includes the environment of feeding, facilities planning and standard operating procedures etc. In order to maintain the production quality of the MD geese, the ISO 9001:2015 quality management system was verified. The contents of this revision include internal and external communication management procedures, quality policy objectives and implementation program management procedures, process performance and continuous improvement management, risk and opportunity management procedures, organization knowledge management procedures and the company situation and demand expectations management procedures, etc. According to the guideline of ISO 9001:2015 for operation and document management, we applied and passed the ISO 9001:2015 quality management system certification, the certificate registration number is 17QMA31071.

We already set up a clean geese production technology that can reduce the risk of disease. This technology includes the environment and facilities planning, entrance buffer zone planning and standard operating procedures, counseling to establish environmental testing and goose group health monitoring and other technologies can be transferred to provide industrial construction of goose clean products. In addition, we also set up the information of MD geese on internet to expand the multiple use for biomedical geese. *(S. H. Chuang, M. J. Lin, T. Y. Lin and S. D. Wang)*

Certificate of Registration

This is to certify that the
QUALITY MANAGEMENT SYSTEM
of
Changhwa Animal Propagation Station, TLRI., COA., Executive Yuan
No. 80, Tuo-Nong Road. Beidou Township, Changhua County. TAIWAN. R.O.C.
for
Production and Sales of The Minimal Diseases Goose Products
has been assessed and registered against the provisions of
ISO 9001:2015
International Standard with

Registration Number: 17QMA31071
Registration Date : 26 Sep., 2017
Issue Date : 26 Sep., 2017
Expiration Date : 25 Sep., 2020
Certification Approved :

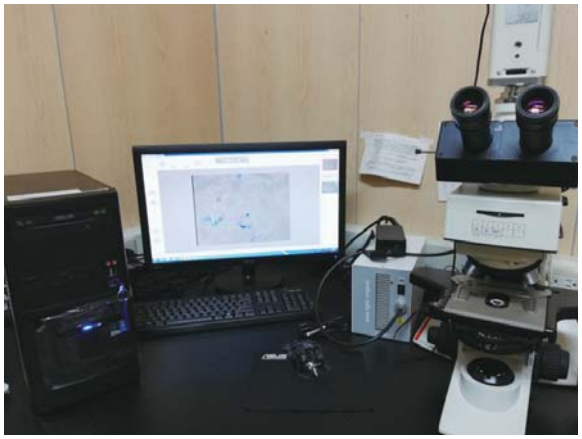
UCS UNIVERSAL CERTIFICATION SERVICE CO., LTD.

ISO 9001:2015 certification

Effect of different agents added to thawing extender on the quality of cryopreserved boar semen

The aim of this study was to investigate the effect of different agents (alginate, vitamin B12, glycolic acid and α-ketoglutarate) were added to thawing extender on the quality of cryopreserved boar semen. Fresh semen was collected from five sexually mature boars, mostly between 1 and 2 years old, semen were diluted with lactose-egg yolk (LEY) extender, which it brought to 5×108 cell/mL in the final concentration. The effects of addition of 0.6/L alginate, 0.1mg/mL vitamin B12, 1mM glycolic acid, and 0.1 g/L α-ketoglutarate into thawing extender were

evaluated. The percentage of sperm motility, rapid progressive motility, motility kinetic variables parameters and acrosome integrity were recorded. The results showed that the percentage of rapid progressive motility in 1mM glycolic acid supplemented thawing extender group after thawing for 2 to 6 hrs were lower than 0.6/L alginate and 0.1 g/L α-ketoglutarate supplemented group. There were no significant differences in post-thaw sperm quality in terms of motility, rapid progressive motility between the 0.6/L alginate, 0.1mg/mL vitamin B12, 1mM glycolic acid, and 0.1 g/L α-ketoglutarate supplemented and control group regardless of the incubation time ($P > 0.05$). Acrosome integrity results demonstrated that the intact acrosome was significantly higher in the 0.6/L alginate or 0.1 g/L α-ketoglutarate group than in the 1mM glycolic acid ($P < 0.05$) group. The percentage of sperm motion parameters (VAP, VSL, VCL, ALH, BCF, STR and LIN) after 2 to 6 hrs of post-thaw incubation was evaluated. There is no significant difference between the different agents supplemented and control group ($P > 0.05$). Addition of different agents to the thawing extender hasn't improved motility kinetic variables parameters. In conclusion, the addition of 0.6/L alginate, 0.1mg/mL vitamin B12, 1mM glycolic acid, and 0.1 g/L α-ketoglutarate, to the thawing extender did not result in any improvement in sperm motility parameters. *(C.C. Chang and S. Y. Wu)*



Motility was objectively evaluated using a computer aided sperm analysis system

The effect of freezing programs on the sperm quality of boar frozen-thawed sperm

Programmable cryopreservation system controlled rate freezer

The objective of this study was to verify the effect of different freezing programs on quality of frozen-thawed semen in boars. Semen collected from five boars were diluted with Lactose-egg yolk (LEY) extender, which it brought to 5×10^8 cell/mL in the final concentration, and packaged into 0.5 mL plastic straws. Straws were further cooled at: (1) cooling rate 3°C/min from 5 to -5°C, 1 min holding at -5°C and then freezing rate of 20°C/min from -5 to -140°C, (2) cooling rate 3°C/min from 5 to -5°C, and then freezing rate of 40°C/min from -5 to -80°C, 30 sec holding at

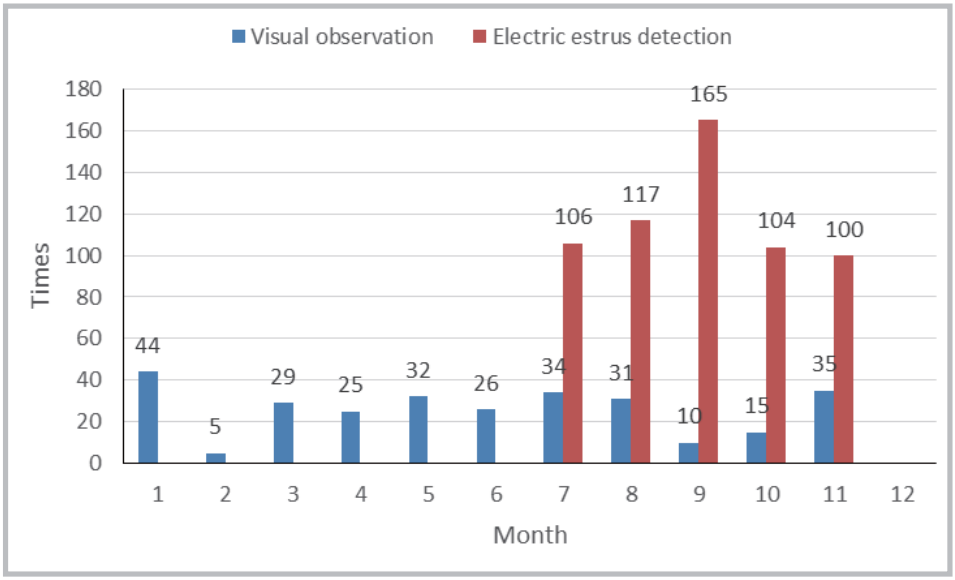
-80°C and then freezing rate of 60°C/min from -80 to -14°C, and (3) cooling rate 20°C/min from 5 to -8°C, and then freezing rate of 70°C/min from -8 to -140°C. They were then plunged into liquid nitrogen. Sperm quality was determined by assessing motility, rapid progressive motility, motility kinetic variables parameters motility and acrosome integrity (fluorescein isothiocyanate conjugated with peanut agglutinin) after thawing. The results showed that the percentage of total motility, rapid progressive motility, motility kinetic variables parameters and acrosome integrity (fluorescein isothiocyanate conjugated with peanut agglutinin) were not affected significantly from the freezing program ($P > 0.05$). In conclusion, the cooling rate had no influence on the sperm quality parameters. The semen was processed and frozen by cooling program 3 methods, which shortens the waiting time and reduces LN_2 consumption. It applied potential on the cryopreservation techniques of boar semen. *(C.C. Chang and S. Y. Wu)*

Effects of different oocyte sources and in vitro maturation medium compositions on production efficiencies of goat embryos in vitro production system

The aims of this study was to evaluate the effects of goat oocytes collected from slaughterhouses and surgical operations and cultured in different in vitro maturation media on the maturation rate of oocytes and resumption develop ability to blastocysts. Tissue culture media 199 (TCM199) was used as the control group. The treatment group was divided into three groups: EGF (epidermal growth factor) group was serum and hormone-free, FCS (fetal calf serum) group present serum and hormone and the MIX (mixture) group present both of above two components. The results showed the oocytes maturation rate from different origins was no significant difference between the treatment groups, evaluated with germinal vesicle (GV) stage and metaphase II (MII). However, there were significantly better than control group. In the in vitro fertilization, monospermic penetration and polyspermic penetration were observed. No matter which sources of oocytes, there was no significant difference between each treatment, but were significantly better than the control. The monospermic at all treatment groups were significantly better in surgical sources then those from slaughterhouse. There was no significantly different in polyspermic of all treatment groups. The results showed the oocytes colllected from surgery, the cleavage rate and total number of blastocysts were significantly higher in the MIX group than in the other treatment groups. EGF and FCS groups was no significant difference, but both were significantly better than the control group. The slaughterhouses sources oocytes also showed the blastocyst rate was significantly higher in the MIX group than in the other treatment groups, the cleavage rate and blastocysts rate were no significantly different. The same treatment but different oocytes sources, only FSC group have no significantly different but the EGF and FSC groups were significantly higher in surgical resources. The total cell number of blastocyst was no significantly different between each groups but was significantly in surgical resources. The comprehensive results showed that regardless of which sources of oocytes, the performance of MIX group was the best. The EGF and FCS groups perform equally. However, according to the balance of cost and efficiency, the EGF group should be more appropriate. *(T. C. Kang)*

Construction reproductive management modeling of dairy cattle under hot and humid environment

This study applied exogenous hormones to postpartum dairy cows under high temperature and humidity condition to control estrus time and reduce reproduction problems. In addition, electronic estrus detection equipment assisted the visual observation to improve the accuracy of heating. The experiment was divided into two parts. First, we will compare the reproduction effects of using hormones or not to dairy cows under different temperature and humidity index (THI). Dairy cows were divided into 4 groups with or without Oxytocin (OT) and Prostaglandin (PG). Second, we will use electric estrus detection equipment to identify which dairy cow needed artificial insemination (AI) and the optimal AI time. The results showed that the average monthly temperature in June was the highest, and the outdoor and the open stall were 28°C and 28.3°C, respectively. In tunnel-ventilation stall, the average THI were maintained at low heat stress, while the open stall were exposed to moderate heat stress for a long period of time. In comparison of different estrus detection methods, the numbers of estrus detection by electronic-detection equipment was much higher than visual observation. There were no significant differences in uterine horn diameter and endometrium thickness of in the groups by heat stress or by OT and PG treatment. In comparison of reproductive problems and conception rates in each group, There were 2 groups at moderate and mild heat stress environment may cause of the endometritis and follicular/lutein cysts relatively high. *(H. W. Ou, C. J. Lee, C. T. Chang and T. F. Shiao)*



Comparison of visual observation and electronic-detection of estrus

IV

Breeding of napiergrass (*Pennisetum purpureum*) new lines

Napiergrass is one of the commonly used forage crops in Taiwan. It can be fed to herbivores for green or silage. Line 2504 is one of the progeny of Taishigrass No. 2 (TS 2) and Taishigrass No. 3 (TS 3). It can produces 268 mt/ha/year fresh weight that is similar to Taishigrass No. 2, while it's forage quality is similar to Taishigrass No. 3. After evaluated entirely, line 2504 was named Napiergrass Taishigrass No. 8 on October 2018. There are three research objectives in the proceeding napiergrass varieties improvement program: first, to select a stress-tolerant line with good quality and high yield; second, to develop a new line with good palatability and functional ingredients, such as anthocyanin; third, to improve the genetic of both quality and yield for all type of napiergrass. The interspecific hybridization of napiergrass was conducted after parental selection, hybrid combination, single plant selection, three-level line comparison tests, animal tests, etc.. The major characters investigated and determined were as follows: the agronomic trait, forage yield, the contents of crude protein, fiber, lignin, and water-soluble carbohydrate, etc.. The results showed that the lines 1120, 2015 and the varieties TS 2, TS 3 and TS 8 had the worst agronomic traits in Hualien as compared to those of other four regions. The second-year investigation will be conducted. Based on the preliminary results, the recommended amount of fertilizers for consideration to both yield and economic benefits of the elite lines should be nitrogen 600 kg/ha, phosphorus 150 kg/ha, and potassium oxide 300 kg/ha. Besides, the survive plants of the hybrid descendants by TS 3 and TS 5 were 122, while the percentage of red-purple strains was only 8.2%. In order to accelerate the improvement of tall-type napiergrass, database of napiergrass breeding was thoroughly reviewed. It showed that 2102, 2112, 2201, and 2213 are potential line, and both 2112 and 2213 had been conducted integral regional survey in 2017 among them, which can be carried out large-area regional survey in recent year. It is planned to conduct the naming review process after animal trials in 2021.

(T. R. Li, J. B. Lin, S. R. Chang, C. H. Lu, S. F. Yan and Y. K. Cheng)

Napiergrass Taishigrass No. 8

Breeding of nilegrass (*Acroceras macrum*) elite lines

Nilegrass (*Acroceras macrum*) are a population full with polyploid strains, while tetraploid is most common. Polyploid plants have more genetic variation and are more helpful for adaptability to environmental stress. Results of polyploidization and mutagenesis by colchicine application showed that, root induction of nilegrass by colchicine was 25%, which was significantly better than that of bud induction (9%). In 4 different colchicine concentration treatment sections, the best colchicine concentration was 0.05%, for its induction rate of root and bud reached to 32% and 25%. As the colchicine concentration increased, the induction of root and bud showed a downward trend.

(P. Y. Chen)

Polyploid mutagenesis with colchicine

Short internodes of nilegrass mutagenic plants

Application of livestock manure biochar in production of forage crops and evaluation of the ability to improve environment of livestock farm

The biochars cracked at 500°C with pig, chicken and goat manure were applied to pangolagrass pasture with amounts of 5,000 kg per hectare. The results showed that biochar of livestock manure had no significant effect on the forage yield and quality of pangolagrass, but those could increase the content of soil pH, organic matter, available phosphorus, exchangeable K, Ca and Mg in pasture grassland. Isothermal adsorption experiments were carried out with different amounts of livestock manure biochar. The results show that chicken and pig manure biochar have higher absorption capacity than goat manure biochar under the low-concentration (<100 ppm) of NH_4^+. However, the goat nanure biochar was higher absorption capacity than those of the chicken and pig manure biochar under high-concentration (>100 ppm) of NH_4^+. The absorption modes were fitted to Freundlich (R^2>0.82) and Langmuir isothermal adsorption equations (R^2>0.98). The abilities of three types of livestock manure biochar to absorb NH_3 within 24 hours were determined by laboratory's evaluation platform. The results show that the absorption capacity of pig manure biochar, goat manure biochar and chicken manure biochar are 135±30 mg/kg, 120±26 mg/kg and 160±43 mg/kg, respectively. These experiments showed that biochar from livestock manure could improve soil physical and chemical properties, increase acid soil pH and soil organic matter. Livestock manure biochar could also be developed as a products those adsorb NH_3 to improve the environment of livestock farm.

(C. H. Lu and S. R. Chang)

Study of napiergrass cultivation under saline stress

The objectives of this study were conducted with soil-tank system and napiergrass Taishigrass No. 3 to evaluate the growth and forage quality of napiergrass grown under irrigation with saline drainage water or cattle wastewater. The irrigated water was salt solution synthetic drainage with

electrical conductivity of 15 to 100 mM. Forage yield and chemical components of forages were determined during harvesting. In addition, the physic and chemical properties of soil were determined. The results showed that the saline effect on growth and forage yield of napiergrass was very obvious as the [NaCl] of irrigated water increasing. Increased the salt concentration over 50 mM will delay the growth of napiergrass, even caused it impossible to be harvest. For example, high [NaCl] treatments, such as 50 and 100 mM, caused napiergrass to stop growing by decreasing the leaf number, plant height and tiller number, so the forage yield were significantly lower as compared to CK and 15 mM. On the other hand, the irrigation of cattle wastewater had no significant effect on the traits of growth and development of napiergrass, and its treatment effect was better than that of 15 mM salt irrigation water treatment. The dry matter yield was similar to that of control. The growth and development of napiergrass under 15 mM low-salinity irrigation water showed that napiergrass Taishigrass No. 3 could grow well without significant saline impact in the coastal areas with sufficient irrigation water, and could still be harvested and produced. In addition, the better effect revealed that cattle wastewater irrigation had significant benefits for the production of napiergrass Taishigrass No. 3.
(S. R. Chang and C. H. Lu)

Feasibility assessment for forage use of regional Featured crops

The objectives of this study were to investigate and analyze the forage characteristics of aboriginal specialty crops, in order to evaluate its feasibility as forage application. Results of the first year showed that both the line and the growth stage of foxtail millet significantly affected the performance of agronomic traits and dry matter yield. The growth stage also significantly affected the performance of plant chemical composition, while the line of foxtail millet showed no significant influence on plant chemical composition. There were significant differences observed on the agronomic traits, dry matter yield, and plant chemical composition of Formosan Beard Grass collected from different aboriginal tribes in Taiwan. This experiment will continue to investigate the other aboriginal specialty crops in the future two years. Crops with more forage potential will be selected to conduct research on their production and ensiling for application to establish and develop the aboriginal specialty livestock products.
(S. R. Chang and C. H. Lu)

Field growth of foxtail millet in the experimental farm of forage crops of LRI

Evaluation of the region-profit basis forage production modes

This study would assess the yield and quality of forage crops in three regions. The forage production models for different regions were conducted and evaluated, which were: Changhua (A. rice-sweet sorghum-oat saia. and B. soybean-sweet sorghum-oat swan), Tainan (C. sweet

sorghum-soybean-forage corn and D. soybean-sweet sorghum-oat swan), and Taitung (E. soybean-rice-oat saia and F. soybean-sweet sorghum-oat swan). There was no significant difference between the forage yield of sweet sorghum in Tainan and Changhua, which were 56,290 and 56,997 kg/ha, respectively. The forage yield of oat "swan" production in Tainan and Changhua was the highest by 9,213 and 9,221 kg/ha, respectively. The forage yield of oat "saia" in Changhua was 5,059 kg/ha, which was significantly higher than that of Taitung by 3,970 kg/ha. No significant differences on WSC, NDF, and ADF of the sweet sorghum were observed among three regions. The crude protein content of oat "swan" in Tainan (7.7%) was significantly lowest. The WSC content of oat "saia" in Taitung was significantly higher than that of Changhua (2.1%). Although the total forage yields of both Tainan and Changhua were higher than that of Taitung, the forage quality of Taitung was better than those of other two regions.

(P. Y. Chen, S. H. Liang and S. F. Yan)

Sweet sorghum is suitable for harvesting with forage corn harvester

Yield assessment of different oat varieties

The development of prompt forage drying technology for the companion animals

The objective of this study was to develop the prompt drying technology of napiergrass. Napiergrass, cv.TS3, cv.TS6 and cv.TS8 were harvested and dried at different temperature. The average drying time of cv.TS3, TS6 and TS8 at 65°C, 100°C, and 150°C were 71.0, 58.6 and 71.3 hours, respectively, while average drying time at 100°Cwere 15.8, 13.6 and 17.1 hours, respectively, and were 6.1, 5.3 and 6.5 hours at 150°C, respectively. The content of crude protein of cv.TS6 at 65°C, 100°C and 150°C was 8.57, 8.35 and 9.14%, respectively, which were higher than other two varieties and showed better nutritional content. The higher drying temperature (100°C and 150°C) did not change the forage composition, but did shorten the drying time. It should be more careful when napiergrass was dried at 150°C, for it was easy to catch fire and be dangerous. For the stem diameter of TS6 is much smaller than TS3 and TS8, the drying time of TS6 was much shorter than that of cv.TS3 and TS8.

(S. T. Chen, T. R. Li, S. R. Chang and C. H. Lu)

The planting experiment site of this study

Studies on functional products of the anthocyanin from napiergrass

Napiergrass *(Pennisetum purpureum)* is a popular forage crop in Taiwan. The purple-type variety, napiergrass Taishi No. 5, which contains high anthocyanin content in its leaves, was verified to possess high antioxidant capacity. The anthocyanin content of the new leaves increases as the regeneration week increases. It is recommended to pick new leaves every 2 weeks from the 6th week of regeneration to 12 weeks, and the anthocyanin content is the highest in the afternoon. The new leaves growing out in autumn have higher anthocyanin content than that in summer. It is suggested that the amount of leaves should be adjusted to stabilize the anthocyanin concentration of whole year. The dried leaves contain 4.0-4.7 mg/g anthocyanin. The leaves should be dried at low temperature before anthocyanin extraction, and a new extraction procedure has been developed which could produce higher anthocyanin concentration reaching to 480.9 mg/L. Adding juice or sugar could maintain the anthocyanin activity of the extract for at least 5 months. Morevoer, a new product made by micro-sugar fermentation technique has a flavor similar to cranberry juice, and their phenol concentration and color are similar. To store at 4°C could keep it stable for 6 months.

(T. R. Li, J. B. Lin and M. S. Wang)

Higher anthocyanin concentration of drink (right) made of napiergrass Taishigrass No. 5

Collection and preservation of forage germplasm-collection and evaluation of legume forages in Taiwan

The domestic forage supply is insufficient, owing to the rainy weather in Taiwan. In order to improve the production and utilization modes of domestic forages, it is necessary to develop alternative domestic forage legumes for livestock production. Four legumes from the forage germplasm resource pool were evaluated their forage characters. The results showed manure soybean Tainan No. 3 (TN3) and No. 4 (TN4) produced higher forage yield than alfalfa did at 60 and 90 days after planted (DAP). In addition, the soybean TN3 at DAP90 had higher pod proportion of whole plant thanTN4. At DAP120, soybeanTN3 produced higher forage yield and pod proportion as compared to soybean TN4 and perennial peanut. The crude protein content of soybean TN3 and alfalfa is equivalent at DAP60, and soybeanTN4 had the lowest crude protein content. As compared to soybean TN4 and perennial peanut, soybean TN3 had the highest crude protein content at DAP120. The content of neutral detergent fiber (NDF) and acid detergent fiber (ADF) of perennial peanut were the lowest at DAP90 and 120, while soybean TN4 had the highest NDF and ADF content. The mix-planting of pangolagrass with perennial legumes has also been conducted. No significant effects on forage growth and quality were observed at the first year.

(P. Chung and T. R. Li)

Study on degradation of pagolagrass biochar and its effect on carbon sequestration

The purpose of this study was to estimate the degradation of pangolagrass biochar produced by Hengchun Branch, Livestock Research Institute, and its effect on carbon sequestration. We set up a field experiment for two years, including four soil conditions (clay-surface, clay-underground 10 cm, sandy-surface and sandy-underground 10 cm) and two biochar particle size (biochar powder,£1 mm and slightly crushed biochar, >5 mm). Each kind of biochar particle sealed in a filter bag (pore size=25 mm) was deployed in four field conditions, and then it was taken to investigate the residuum of dry matter, carbon and nitrogen every three-months. Averagely, after incubated for 365 days, the residuum of dry matter, carbon and nitrogen were 89.8%, 86.1% and 71.6%, respectively. After incubated for 730 days, the residuum of dry matter, carbon and nitrogen were 90.7%, 83.6% and 70.8%, respectively. The degradation of biochar in the second years was less than those in the first year. The loss of dry matter, carbon and nitrogen of biochar powder were higher than those of slightly crushed biochar. The degradation of biochar on the soil surface was higher than those under soil and the effect of soil texture was not clear. From our results, the carbon losses of pangolagrass biochar in the soil were between 0~21.7%, the carbon contents of pangolagrass biochar was between 54~73%, which meant applying one kilogram pangolagrass biochar in the soil could produce carbon sequestrations between 421~730 g C and this was equal to a reduction of 1.4~2.4 kg CO2 emission.

(S. M. Wang, H. H. Liu, T. H. Yu, C. H. Lu and C. S. Chen)

Comparison of palatability by goat fed on domestic alfalfa processed by different conditions

The purpose of this study was to evaluate the applicability of medium-size film binding bale wrapper for domestic alfalfa and the effects of processing conditions on the preference of goats. There were three batches of preference tests in this study. The preference tests were conducted by four female Kenting goats in individual pen to compare the four alfalfa forages. In the first experiment, four process conditions confined were compared: control-am (wrapped immediately after harvest in the morning, with no inoculant), inoculation-am (wrapped immediately after harvest in the morning, with inoculant), control-pm (wrapped after wilting in the afternoon, with no inoculant), inoculation-pm (wrapped after wilting in the afternoon, with inoculant). The haylage bales (with diameter 90 cm height 90 cm) were ensiled in room temperature for two months. The results showed that the fermentation quality of haylage wrapped in the morning were poor with or without inoculation. The responses of preference test were consistent with fermentation quality of alfalfa haylage. In the second experiment, four materials for comparsion were alfalfa haylage-inoculation-pm, haylage-inoculation-am, dried haylage-inoculation-pm and dried haylage-inoculation-am. The results showed that the palatability of haylage were better than dried haylage. Two pet's grade domestic alfalfa hays: fresh prepared and stored were compared with two alfalfa haylages: inoculation-pm treated domestic alfalfa and imported alfalfa haylage

in the third experiment. The dry matter intake of fresh prepared pet's hay was higher than it of imported haylage on feeding 3 hours and there was no difference on both bouts and dry matter intakes among these four treatments before feeding 3 hours. The results showed that medium-size film binding bale wrapper was applicable for domestic alfalfa preparation and the moisture content of alfalfa was a key factor for determining the ensiling quality.

(S. M. Wang, H. H. Liu, T. H. Yu and C. S. Chen)

The effect of inoculation of alfalfa haylage on its palatability

The purpose of this study was to investigate: 1. the effect of inoculation on the palatability of alfalfa haylage, and 2. the comparison of palatability among alfalfa haylage, pangolagrass haylage, imported alfalfa hay and imported Bermuda hay. The alfalfa haylage in this study were harvested from Hengchun Branch station, LRI. The harvested materials were wilted one day on field and separated into three equal parts for three inoculation treatments, i.e. control, no inoculation; Lp, inoculated with a new strain of Lactobacillus plantarum; KT, inoculated with a commercial inoculant (L. plantarum and L. casei). The alfalfa haylage were stored for two months under room temperature before trial. The preference tests on four kinds of forages were conducted by four female Kenting goats in individual pens. Each preference test compare three different alfalfa haylage with imported alfalfa hay, pangolagrass haylage and Bermuda hay, respectively. The test period for each trial was 5 days. The results showed that three kinds of alfalfa haylage had better palatability than pangolagrass haylage and Bermuda hay. The palatability of alfalfa haylage was better than imported alfalfa hay. The best palatability of alfalfa haylage was Lp inoculation and the worst was haylage without inoculation. The results showed that inoculation could improve the fermentation quality and palatability of alfalfa haylage for goats.

(S. M. Wang, T. H. Yu and C. S. Chen)

The effect of aerobic exposure of pangolagrass haylages on palatability of goats

Due to the small scale of meat goat farm in Taiwan, it will take several days to completely consume a round balage when feeding with domestic pangolagrass haylage. In this study, wilted pangolagrass either inoculated with commercial inoculant (containing Lactobacillus plantarum and L. casei) or the non-inoculated one were wrapped into balage and used to investigate the palatability change after aerobic exposure for 0, 2, 4 and 6 days for goat. At 0 d., pH were 4.68, and 5.24 in the inoculated and the non-inoculated haylage, and butyric acid contents were 0.11% and 0.57%, respectively. It showed that inoculation significantly improved the fermentation quality of pangolagrass haylage. During 2-6 days of aerobic exposure, pH did not rise and did not show strong sign of deterioration in both treatments, while the content of butyric acid in the non-inoculated treatment decreased significantly. The preference tests were carried out by 4 head of 12-14 months old Nubian rams in individual railing. Results of inoculation set showed that the number of bouts in the first 6-10 minutes of was the highest at 0 d and the lowest at 6 d.. The dry matter intake (DMI)

of 0.5, 1 and 1.5 hr. was significantly lower at 6 d., and the difference was not significant after 2 hr. In the aspect of non-inoculation set, 2 d. had the lowest number of bouts in the first 5 minutes, and the difference in 6-10 minutes was not significant. The DMI of 6 d. in the first 0.5 hr. was significantly higher than that of 0, 2 and 4 d.. The DMI of 1 and 1.5 hr. of 6 d. and 4 d. were also higher than 0 d. and 2 d., and the DMI of 2 d. was still the lowest up to 2 and 3hr. of feeding. It can be inferred from the two sets of preference tests that balage inoculated with homo-fermentation lactic acid bacteria had better fermentation quality, but its palatability decreased during aerobic exposure. While in the case of balage without inoculation which fermented poorly, the palatability was relatively easy to maintain before deterioration as compare to 0 d., or even could be enhanced due to reduction of unfavorable ingredients.

(C. S. Chen, S. M. Wang and T. H. Yu)

The response of palatability of goat to forage with adding sugar, organic acids, changing the water soluble carbohydrate and ensiling

This report examined six batches of preference tests: 1. the responses of goats to hay with adding sucrose and organic acids, 2. changing of the water-soluble carbohydrate (WSC) content in hay by harvest conditioning to test whether the change is sufficient to cause palatability differences, and 3. the effect of silage fermentation. Tests 1 and 2 showed that the effect of adding 1% acetic acid on palatability is negative; while adding 1% lactic acid or 1% sucrose had the effect of improving preference and intake in early stage. The study further compared two varieties of oat hay with variation of watersoluble carbohydrate (WSC) contents by different mowing time and drying speed (Tests 3 and 4) . The WSC content varied from 2.5%-7.7% for Saia and 2.9-10.7% for Swan, while changes in WSC content also significantly affected the proportions of other components. The results of experiments 3 and 4 showed no impact on the palatability for goat under the range of variation of WSC content modulated in this study. As for the effects of silage fermentation, the results of tests 5 and 6 showed that: the goat showed a high and stable preference for pangola haylage, while dry haylage also showed higher palatability than imported Bermuda hay and pangola hay. The dry matter intake of dry haylage may be higher than haylage due to its higher dry matter content. Palatability of domestic pangola hay is not higher than imported Bermuda hay. Ensiling is an effective way to improve palatability, and has the same effect after drying.

(C. S. Chen, S. M. Wang and T. H. Yu)

The effect of grass species, dryness and processing method on palatability of goats

This report was based on four batches of goat preference tests to investigate three factors: 1. the test of digitgrass (Digitaria X umfolozi Hall), pangolagrass (Digitaria decumbens) and

bermudagrass (Cynodon dactylon) (the same test was operated twice by different batchs of materials), and 2. the palatability differences among different drying methods and dryness levels of pangolagrass, and 3. the test for hay, haylage, dried haylage of pangola, and bermudagrass. Preference test was conducted with 4 head of Nubian rams in individual feeding pens. The test period for each trial was 4 days. In experiment 1 and experiment 2, we compared two kinds of maturity of digitgrass which were harvested at 6 weeks old and 8 weeks old, respectively with pangolagrass and bermudagrass. Results showed that 6-week digitgrass had the best preference, while 8-week digitgrass was better than bermuda and pangolagrass. Results of these two batches of test were similar. In test 3, the pangolagrass was harvested from the same field on the same day and were divided into four treatments, which were mechanically dried to 24% and 14% water content, and sun cured to 23%, and 15% water content. The results showed that sun drying was better than artificial drying, and high moisture content was better than low moisture content, and the difference caused by dryness was greater than drying method. The results of test 4 showed that haylage had the best palatability, and dried haylage was the second, however, some of the intakes of dried haylage were not significantly different from those of two kinds of hays. In this paper, the relative palatability of each entry in our series of trials was estimated based on imported bermudagrass. It showed that the average bouts of pangola haylage was as high as 5 times as compared to bermudagrass. It was also higher in dried haylage than that of bermudagrass, but it was not as good as that of haylage. The average bouts of digitgrass was 3.2 times higher than bermudagrass. From the results we found that the palatability of pangolagrass was similar as bermudagrass, and proper processing could increase palatability of pangolagrass.

(C. S. Chen, S. M. Wang, T. H. Yu and C. Y. Lee)

Oat forage production and application during winter season in Taiwan

The objectives of this study were to develop the cultivated system and silage technology of oats growth in the northern part of Taiwan. The oat experiment about 1 hectare was carried out in Xinwu township on October 25, 2018. The fresh grass yield was 33.3 ton/ha on January 22, 2019.

Oat forage growth in large land

Appearance of oat forage after 180 day of ensiling

The dry weight was 6.38 ton/ha, the crude protein (CP) was 11.06%, the neutral fiber (NDF) was 63.39 %, and acid fiber (ADF) was 39.97%. The examination on February 12th showed that the yield of fresh weight was 40.3 ton/ha, the yield of dry weight was 9.77 ton/ha, the crude protein was 5.62%, the neutral fiber was 66.58%, and the acid fiber was 41.72%. Crude protein was significantly reduced from 11.06% to 5.62%, mainly due to the effect of oat maturity. In this study, large-scale of experimental planting and silage by film packing were carried out and to solve various problem in field operation. Total about 11 ton oat silage was prepared in field and storage about half a year, were analysis that the quality of Flieg's score was 62.8, pH 4.66 and appear gold yellow color. The quality of the silage was less than 80 points than expected, mainly due to the high moisture content of oats in the winter rainy season of the northern Taiwan. From those studies, oat cultivation and silage production were established and it was beneficially to improve the utility of cultivated land of Taiwan.

(Y. M. Shy)

The cultivation patterns of sweet sorghum crop rotation in northern Taiwan

The field experiment in this project was been carried out from the winter of 2017 to the end of 2018. The sweet oats Swan and Mount One varieties were planted in the experimental area of the branch to measure the yield per unit area. The sweet sorghum Tailive No. 1 was planted after sweet oat harvest yield per unit area. The statistical analysis of the experimental data showed that in the yield of hay per hectare of Swan and Mount one were about 5.86 and 4.90 mt, with significant difference. The sweet sorghum Tailive No. 1 hay production per hectare was about 15 tonnes at the harvest. As sweet oats are susceptible to early spring winds and rains when harvested, it is advisable to use them in the form of green, semi-dry silage or silage for farmers. Sweet sorghum plants have more drought-tolerance, better growth potential, resistant to strong winds and rain, more suitable for maize crop rotation planting in the northern region, which is the recommended crop rotation cultivation model.

(S. H. Liang, S. H. Wang and J. W. Shiau)

The sweet oats Swan and Mount One cultivation

The sweet sorghum Taiwan livestock No.1 cultivation

V The carbon footprint of goat production by life cycle assessment

The purposes of this study were evaluated the carbon footprint of goat production in goat farm, life cycle assessment software SimaPro was used to evaluate the goat farm with cradle-to-farm gate boundary. However, the management information, including herd size, feed intake, water, power and diesel fuel consumption, live body weight, were also collected and combined with emission factors in estimation of carbon footprint. Results indicated that the carbon footprint of live body weight evaluated by life cycle assessment were 12.11kg CO_2 equivalent from January to November in 2018. If slaughter rate of goat is estimated to be 55%, the estimate of carbon footprint for carcass weight via life cycle assessment was 22.01kg CO_2e. Also, GHG emissions proportion of goat production in life cycle, raw materials, manufacture, and disposal stage, which accounted for 43.10, 55.19, and 1.71% of total emission, respectively. CH_4 from enteric fermentation was the predominant source of GHG emissions, which accounted for 50.20% of total emission. In conclusion, the carbon footprint evaluation of goat production via life cycle assessment showed GHG emissions produced by goat farms could be significantly reduced by increasing goat production performance and herd production efficiency and reducing enteric CH_4 of goat. Therefore, one can expect that CO_2e emission per unit goat production might be effectively reduced.
(Y. C. Chi, C. H. Chung, M. P. Cheng, S. T. Chen, G. J. Fan and C. F. Lee)

The concentrate and reduction of anaerobic sludge

The purpose of this study is to establish simple sludge concentration and drying technology, to perform gravity sedimentation and concentration of anaerobic sludge, to increase the solid content of concentrated sludge, and to develop a small sludge filter bed to evaluate the dewatering and drying effect. The results showed that the wastewater plant and the vertical fermentation tank anaerobic sludge were injected into the cylindrical and square cone-shaped stainless steel sludge thickening tanks. After 24 hours of sedimentation and concentration, the total solid content increased by 0.47 and 0.96% and 1.14 and 1.94%, respectively. The converted total solids improvement rate is 11.9 and 50.0% and 31.8 and 131%. Take the concentrated sludge and inject it into a dehydration drying filter bed (sludge thickness 10 cm). After 7 days of dehydration and drying, the sludge volume will be reduced by 72.0 and 86.4%, and the sludge moisture content will be reduced to 80.0 and 69.2%. The moisture removal rates reached 16.8 and 28.8%. In summary, the concentration of anaerobic sludge in the vertical fermentation tank is better than that in the wastewater plant. The square cone-shaped stainless steel sludge thickening tanks has a higher solid lifting rate than the cylindrical type. The anaerobic sludge of the vertical fermentation tank has been dehydrated and dried for 7 days, and the moisture content of the sludge has been reduced to 69.2%. Considering the characteristics of the sludge composition, it is suitable for mixing with other agricultural waste materials for composting, or as a source for the subsequent development of sludge resource products.
(Y. C. Chi, C. H. Chung, T. M. Su, M. P. Cheng and T. H. Hsiao)

Research and development of microalgae wastewater treatment system and evaluation of nitrogen and phosphorus removal effect

The three-stage wastewater treatment system currently used in pig farms significantly reduces the concentrations of COD, BOD, and SS in wastewater, and can reach the discharge water standard, but the nitrogen and phosphorus content in the discharge water is still high. In this study, a 6-ton capacity track type microalgae wastewater treatment system was designed for preliminary operation tests. An attempt was made to prepare algae fluids that were initially cultured with *Chlorella sorokiniana* TJ5 in BG-11 medium. After the proportion of anaerobic treatment, pig wastewater was cultured under the conditions of 24 hours light and aeration for 3, 6, and 9 days, and centrifuged at 3,500 rpm for 10 minutes to separate the algae to determine the total nitrogen and total phosphorus in the supernatant. The results showed that the algae content was 665 mg / L, which was added to the pig wastewater after anaerobic treatment in a proportion of 50% in a half batch. The total nitrogen was 439 ± 22 mg / L and the total phosphorus was 326 ± 39 mg / L. The removal rate of nitrogen and phosphorus in the sky can exceed 50%, which are 52.2 ± 7.4% and 66.6 ± 1.7%, respectively. The current problem of treating pig wastewater with microalgae is that it is difficult to control outdoor large-scale culture conditions. Further tests will follow to evaluate the feasibility of introducing microalgae culture into pig wastewater treatment systems.

(W. Z. Liu, R. B. Liaw, T. H. Hsiao and T. M. Su)

Microalgae incremental culture and track type culture system operation test

Evaluation of nitrogen and phosphorus removal and recovery from swine anaerobic wastewater

Phosphorus rock is an important and non-renewable resource, making a major contribution to agricultural and industrial development. Anaerobically digested swine wastewater and sludge contain high concentrations of P and N. Phosphorus can be recovered from wastewater through crystallization of struvite ($MgNH_4PO_4 \cdot 6H_2O$) and it can simultaneously remove P and N from the wastewater. The experiment was carried out with continuous - flow of pig anaerobic wastewater and continuous aeration. Air stripping was added with NaOH solution to increase the pH of the reaction tank to 9.43, and an additional $MgCl_2$ solution

was added to satisfy the magnesium ion. The operations of HRT in 24 h, the PO_4^{3-}-P, TP, NH_4^+-N removal rates were reached 85.3, 83.9 and 40.3%, respectively. The other sequencing batch operations under the same test conditions, the removal rates were 80.5, 77.8 and 49.8%, respectively. The experiment results show that increasing the Mg:P molar ratio in wastewater can significantly increase the removal rate of PO_4^{3-}-P and TP, but the NH_4^+-N was lower. In addition, the struvite crystals of the pig farm was used to carry out the sweet corn fertilizer efficiency experiment. The results showed that the struvite crystals was applied as the base fertilizer, which could increase the soil pH value, increase the soil available phosphorus content, and during the whole period of sweet corn growth and harvesting, the plant height and ear weight yield were better than the fertilizer group, which was comparable to the dry chicken manure group. In conclusion, the recovery of struvite crystals from pig anaerobic wastewater can effectively remove PO_4^{3-}-P, TP and a part of NH_4^+-N. However, due to the low phosphorus content in wastewater, the recovery rate of crystal formation is not good. In the future, it is advisable to use high-concentration N and P wastewater were cost-effective. The struvite crystal is used as a plant base fertilizer source, which can provide nutrients for plants such as N, P, Mg and Ca, and also has the effect of improving soil physical and chemical properties.

(C. H. Chung, T. M. Su, Y. C. Chi and T. H. Hsiao)

Evaluation of energy conservation and carbon reduction strategy for different types of pig house

The purpose of this study was to investigate on different types of pig house for a detailed survey, including the animal husbandry ventilation and cooling system into the amount of water and electricity and other electrical equipment, and the other floor type of livestock, feeding density, manure and wastewater output. The water and kilowatt hour meters were installed at each farms to record water, kilowatt hour meters data, and the number of rearing heads. The daily electricity and water consumption of pigs at each site were calculated. The results show that the daily water consumption of pigs in open-type solid floor pigs was 35.8–39.1 L/d/head, while the close-type with cooling pad and stainless steel full strip floor pigs were 15.7 L/d/head. The pig house of strip floor with cooling pad could decrease water consumption and reduced quantity of wastewater than the solid floor type. The electricity consumption of each farm was between 0.005 and 0.043 kWh/d/head. The daily electricity consumption of pigs the close-type was higher than open-type pig house. The consumption of electricity and energy in the growth and finishing period of pigs was low. The life cycle assessment of the pigs relevant input and output data will be collected later, and the carbon emissions of the production process will be estimated, and the assessment of the carbon emissions per unit pig production will becompleted.

(C. H. Chung, T. M. Su, Y. C. Chi and T. H. Hsiao)

Value-added and reuse of poultry manure

The project plans to set up a set of poultry manure value-added product treatment kits, which are specially developed for laying hen farms, and use automated processing technology to produce high-quality pelletized chicken manure products. The raw material of the processing kit is dry chicken manure of the laying hen farm, the moisture content of the raw material is set to about 19 ± 2%. The kit is mainly composed of feeder, grinder, pelletizer, heater and electrical control equipment. The diameter length of pelletized was 6 mm, with a production capacity of more than 200 kg/h. The heating equipment is mainly composed of an inclined heating conveyor. The bottom of the body is equipped with an electric heating sheet (set temperature above 75°C). The body is covered with thermal insulation cotton, and it is equipped with a thermal insulation storage bucket. The heated chicken manure uses its own residual heat to achieve the effect of sterilization. In addition to the announcement of the future livestock manure processing fertilizer (5-08) item standard announcement, it is also necessary to analyze and measure the number of relevant index pathogenic microorganisms in laying hen manure, in order to comply with the future livestock manure processing fertilizer addition related indicators regulations. The development period of this set can alleviate the problems of chicken excrement disposal and elimination. In addition, chicken manure can reduce volume, increase mass density, reduce odor and improve safety after drying, pelletizing and sterilizing, which is beneficial to the subsequent diversification of products utilization, increase the added value of chicken manure.

(C. H. Chung, T. M. Su, Y. C. Chi, M. P. Cheng and T. H. Hsiao)

The evaluation of irrigation of dairy cow anaerobic wastewater at the pasture area

The purpose of this study was to investigate the effects of dairy cow anaerobic wastewater on properties of soils, production and quality of pasture, and quality of ground water after irrigating on forage corn, Napiergrass, and Pangola grass. After irrigating on forage corn, the results showed that the production in the chemical fertilizer group was significantly higher than that in the wastewater groups (W1.5 and W2 group). There was no significant difference between W1.5 and W2 group. Furthermore, the pH value of soils in chemical fertilizer group was significantly lower than that in wastewater groups, and the increment of total organic contents in W2 group were noticed. After irrigating on Napiergrass, the results showed that the production and height showed no significant differences in all

The pangolagrass was irrigated with wastewater carried by the tank truck

groups. However, the contents of magnesium and copper were significantly increased. In long-term monitoring (2013 to date) of the effect of dairy cow anaerobic wastewater on the quality of soil and groundwater after irrigating on pangolagrass, the results showed that the electrical conductivity of soils and the contents of copper and zinc met the of irrigation. Moreover, the contents of copper and zinc in ground water of upstream 1, upstream, and downstream met the criteria of irrigation. The contents of ammonium nitrogen and nitrate nitrogen also met the criteria of irrigation.

(Y. L. Huang, C. H. Liu, H. J. Lee, C. H. Lu, and T. H. Hsiao)

The evaluation of irrigation of swine anaerobic wastewater at the pasture area

The purpose of this study was to investigate the effects of swine anaerobic wastewater on properties of soils, production and properties of pasture, and nutritional ingredients after irrigating on forage corn. In addition, we also monitored the swine anaerobic wastewater irrigation on the effect of soil properties and groundwater quality. In the experiment of irrigating on forage corn, the experiment was divided into control (C), chemical fertilizer (CF), 1.2 fold of wastewater (W), and 0.6 fold of wastewater mixed with 0.5 fold of chemical fertilizer (WCF). The results showed that the total nitrogen of soils was significantly increased along with the increase of wastewater application ($P < 0.05$). The groups used wastewater significantly increased the total organic carbon in soils when compared with the group before irrigation, C group, and CF group ($P < 0.05$). The fresh weight of forage corn did not show significant difference in the all groups, and the dry weight of forage corn in C and WCF group was significantly higher than that in W1.2 group ($P < 0.05$). The leaf tip height, the toppest leaf collar height, and the diameter were increased as the amount of wastewater increased, but the result showed no significant difference.

(Y. L. Huang, H. J. Lee, T. M. Su and T. H. Hsiao)

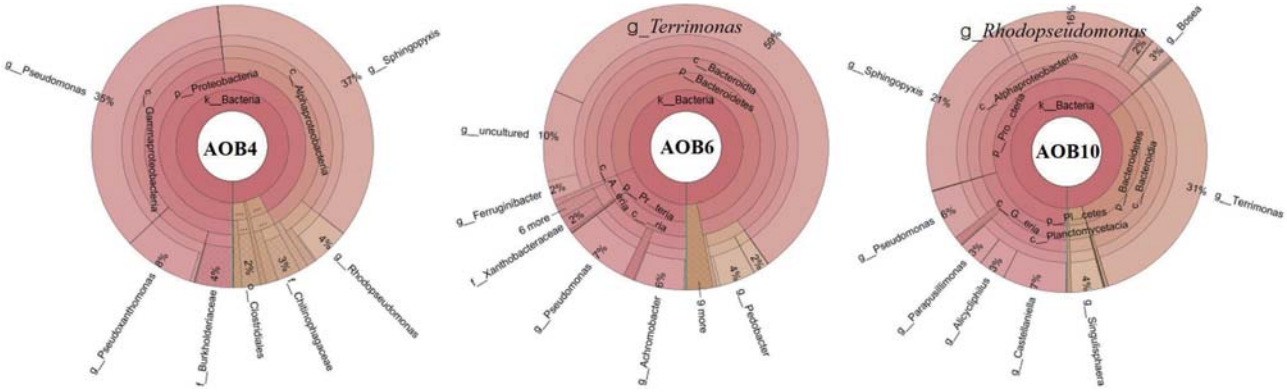
The growth of silage corn under different treatments

Analysis of ammonia-oxidizing isolates by NGS technology

In this study, the next-generation sequencing (NGS) technology was used to analyze the autotrophic ammonia-oxidizing isolates, in order to gain a deeper understanding of the bacterial community composition and the possible application in the future. The DNA of three autotrophic ammonia-oxidizing isolates (named AOB4, AOB6 and AOB10) from the activated

sludge samples of cattle raising farm, pig raising farm and the total wastewater treatment facility in Livestock Research Institute was extracted by a commercial kit. The V3–V4 fragment of the 16S rRNA gene was amplified, purified, and constructed into the sequencing library. Then the DNA library was sequenced by the Illumina Miseq platform. Metagenomic biodiversity indexes of three isolates were analyzed by bioinformatics software. The results showed that the number of possible bacterial species and the Shannon diversity index of the three autotrophic ammonia-oxidizing isolates AOB4, AOB6 and AOB10 were 134 vs. 208 vs. 111 and 2.69 vs 3.04 vs. 3.23, respectively. The most abundant bacterial genera in each isolate were as follows: AOB4 with *Sphinopyxis* (37%), AOB6 with *Terrimonas* (56%), and AOB10 with *Terrimonas* (31%).

(R. B. Liaw, J. F. Jiang and M. P. Cheng)



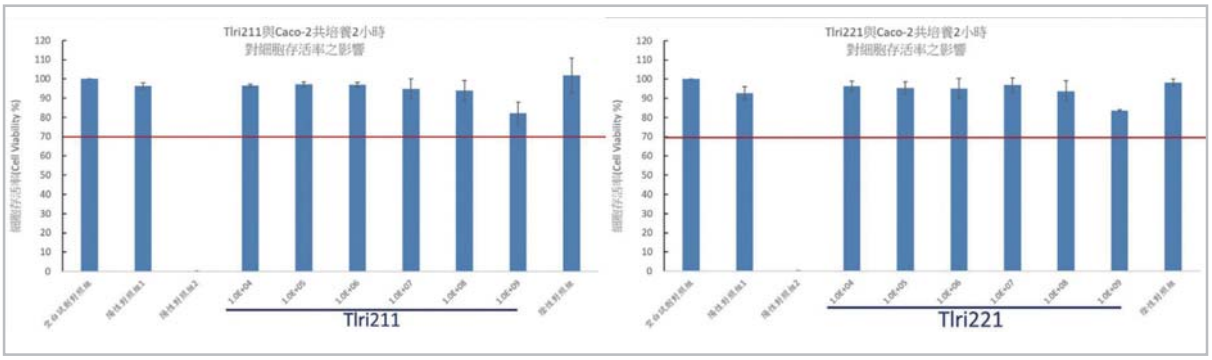
OTU analysis for ammonia-oxidizing isolates by NGS

Antioxidant capacity and cytotoxicity of Bacillus isolates

The purpose of this study was to analyze the antioxidant capacity and cytotoxicity of *Bacillus* isolates as a reference for the evaluation and development of potential probiotics. The isolates TLRI211 and TLRI221 were previously screened from activated sludge, and their extracellular enzyme activity was better than that of the control group. The supernatants of TLRI211 and TLRI221 cultured for 24 hours were analyzed by ABTS and DPPH methods. The antioxidant activities for ABTS and DPPH were 5.94 vs. 6.14 and 0.48 vs. 0.58 mmol TE/L, respectively. The inhibition rate of SOD activity of the two isolates was analyzed. The result showed 79.22 vs. 60.69%. The BSCiPSC chicken cell line was used to analyze the cytotoxicity of the two isolates. It was preliminarily shown that after the 1E6/mL isolate was co-cultured with the cells for 24 hours, most of the cells were still intact under microscopic observation. When the isolates Tlri211 and Tlri221 at a concentration of 1E4–1E9 (CFU/mL) were co-cultured with human intestinal epithelial cells (Caco-2) for 2 hours, the results showed that the percentage inhibition of cell activity was less than 30%. There was also no significant change in the appearance of the cell morphology observed under the microscope. According to the ISO 10993-5:2009, Caco-2 activity was tested after co-culture with Cao-2 cells and 1E4–1E6 (CFU/mL) Tlri211 and 1E4–1E5 (CFU/mL) Tlri221,

respectively, for 24 hours. The cell inhibition rates were all less than 30%, indicating that the two Bacillus isolates were not cytotoxic to Caco-2 under the conditions designed in this test. In summary, the two Bacillus isolates have the potential to be developed as feed additives.

(R. B. Liaw, J. F. Liou, C. F. Jiang and M. P. Cheng)

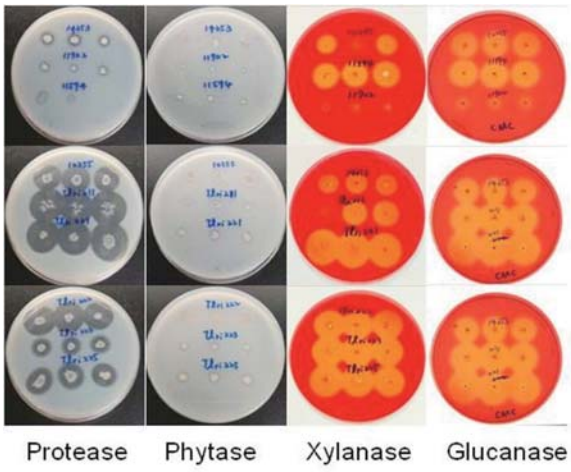


Survival rates of Caco-2 cells cocultured with isolates Tri211 and Tlri221 for 2 h

Isolation of potential probiotics from livestock environments

This study was to screen for potential probiotics as feed additives from the activated sludge samples of livestock wastewater treatment facilities. By conventional isolation approach, the activated sludge samples were diluted properly and smeared on tryptic soy agar plates containing 2.5% skim milk and cultured at 55°C overnight. The transparent halos around some colonies were found on the agar plates, which is an isolate capable of producing extracellular protease activity, and these isolates were further purified. A total of 5 isolates were screened in this study. The 16S rRNA gene sequences of 5 isolates were obtained and compared with the sequence database. The results showed that three of them were identified as *Bacillus licheniformis*, and the other two were *Bacillus subtilis*. Comparison of protease, lipolytic enzyme, amylase, xylanase, glucanase and phytase activities between 5 isolates and 4 type strains or patent strains purchased from the Bioresource Collection and Research Center (BCRC) was conducted. It was found that most isolates had higher enzyme activity than type strains or patent strains. Therefore, these isolates have the potential for further research and application.

(R. B. Liaw, C. F. Chiang, Y. L. Huang, T. M. Su, M. P. Cheng and T. H. Hsiao)



Multiple extracellular enzymatic activities of potential probiotics

Screening of autotrophic ammonium oxidizing bacteria from activated sludge

The purpose of this study was to screen autotrophic ammonia-oxidizing bacteria from the activated sludge samples of livestock wastewater treatment facilities for deodorizing bacteria. The activated sludge samples were inoculated into the special medium for autotrophic ammonium oxidizing bacteria and cultured at 30°C with shaking. When the color of medium turned yellow, it was titrated back to red with sodium carbonate. After four weeks of continuous shaking, the fresh medium was inoculated with 1% of the original bacterial culture. After four more weeks of culturing, the DNA of the microorganisms in the medium was extracted, and the 16S rRNA gene fragment was amplified for sequencing. The results showed that the ammonia-oxidizing isolate was not a single strain. Therefore, the 16S rRNA gene library was further constructed, and the clones were randomly selected for insert size analysis. The clones with insert size about 1.5 kb in accordance with the expected size were selected for sequence analysis. Among the 11 clones analyzed, 7 clones showed more than 95% identity to the NCBI nucleic acid sequence databank. The possible genera were *Hyphomicrobium, Terrimonas, Sphingobacterium* and *Achromobacter*. Therefore, it was likely that these strains might participate in ammonia oxidation. In the future, we will produce a large amount of culture and perform the ammonia removal test.

(R. B. Liaw, J. F. Chiang, C. H. Chung, Y. C. Chi, T. M. Su, T. H. Hsiao and M. P. Cheng)

Testing for ammonium oxidation abilities of candidate isolates

Effects of floor types on growth performance of grower finisher pig and pig house's, wastewater quantity and quality during cool season

The purpose of this study was to investigate the effects of floor types on growth performance of grower-finisher pig and pig house's wastewater quantity and quality during cool season. A total of 72 heads of LD (Landrace ♀ × Duroc ♂) pigs, were assigned to three types of floor pen, inclusive of solid floor (SOF), partially slatted floor (PSF) and totally slatted floor (TSF) when their average body weights were 48 kg during the cool season (from Jun. to Sep.). Each group consisted of four pen replicates of six pigs with half barrows and half gilts. The floor of groups SOF and PSF were

flushed once daily by fresh water, and the ditch of TSF group was flushed every 3 or 4 day by recycled water. Feed and water were supplied ad libitum. The feeding trial was terminated when the average BW of pigs reached 115 kg. The water consumption, wastewater quantity and quality, and the growth performances of pigs were investigated. The Results show that the floor types did not affect the average daily feed intake and feed efficiency of pigs. During the grower stage, the flush water consumption of SOF, PSF and TSF groups were 41.60, 34.98 and 17.79 L/d/head, respectively and the wastewater quantity were 33.87, 28.80 and 16.43 L/ d/head, respectively. The water consumption of PSF and TSF groups were about 84.09% and 42.78% of SOF, respectively and the quantity of wastewater of PSF and TSF groups were about 85.00% and 48.50% of SOF, respectively. During the finisher stage, the water consumption of SOF, PSF and TSF groups were respectively 39.51, 29.37 and 13.86 L/d/head and the wastewater quantity were respectively 34.65, 27.44 and 13.06 L/d/head. The water consumption of PSF and TSF groups were respectively about 74.33% and 35.09% of SOF, and the quantity of wastewater of PSF and TSF groups were respectively about 64.76% and 37.69% of SOF. In conclusion, the pig house installed partially slatted floor or totally slatted floor could decrease water consumption and reduce quantity of wastewater during the cool season. Key words: Grower-finisher pig, Floor type, Flush water consumption.

(T. M. Su, Y. H. Weng, C. H. Chung, T. H. Hsiao and M. P. Cheng)

Group SOF | Group PSF | Group TSF

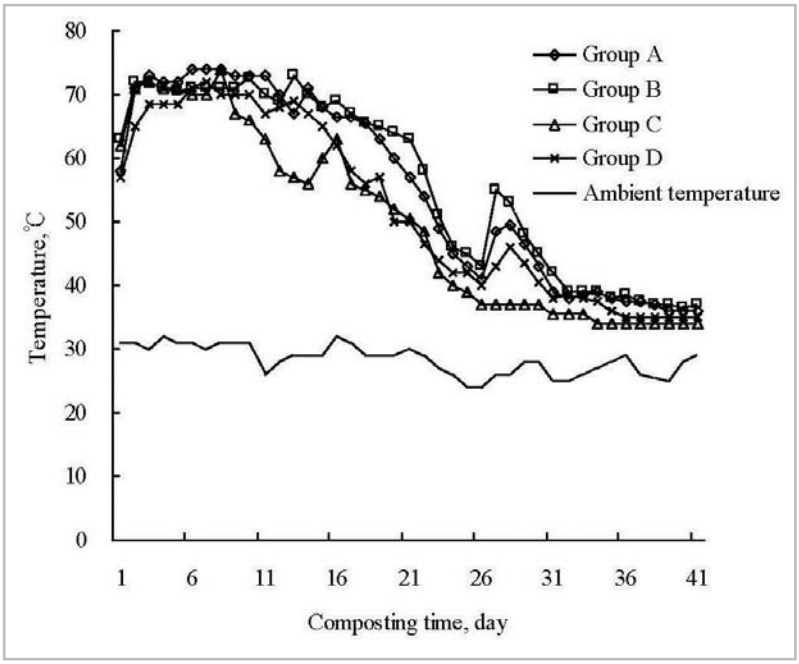
Pig pen of different floor types (Group SOF: solid floor; Group PSF: partially slatted floor; Group TSF: totally slatted floor)

Effects of the compositions of bulking agents on the composting of layer excreta

The purpose of this study is to investigate the effects of the carbon source bulking agent as raw materials on the composting process and compost compositions of layer excreta. Used fresh layer excreta were assigned to four treatments with different volume ratio of rice hull: rice straw as bulking agents i.e., 100:0 (group A; control group), 75:25 (group B), 50:50 (group C) and 25:75 (group D) with raw materials of compost. The raw materials of compost was mixed and composting treatment for 40 days. The composition of compost piles were analyzed before composting, 14th day of composting and after composting. The results showed that the fermentation temperature reached 55°C for more than 15 days in each group. At 14th day

of composting, the germination rates (RSG) of for group C was 70%, while RSG of alfalfa and rapeseed all reached over 80%. After composting for 40 days, the RSGs of alfalfa and rapeseed all over 90% for all groups. During the composting period, the groups A and B had lower dry matter loss than the groups C and D. After composting, the moisture and organic carbon contents were respectively decrease than those before and at 14th day of composting, and the pH value gradually increased during composting in all groups. The contents of nitrogen, phosphorous, potassium, calcium, sodium, organic carbon and carbon nitrogen ratio after composting were similar than at 14th day of composting in all groups. The copper and zinc concentrations after composting were 1.14 to 1.25 times and 1.14 to 1.53 times of those before composting, respectively. In conclusion, using rice straw to replace rice hull as bulking agents do not affect the composting process.

(T. M. Su, Y. H. Weng, C. H. Chung, T. H. Hsiao and M. P. Cheng)



The temperature change during composting period

Assessment of biogas power generation in a large pig farm

The purpose of this study was to evaluate the quality of influent wastewater, digesting substrates and effluent water of the continuous stirred tank reactor (CSTR) . The CSTR was set up in a large pig farm, and data such as daily operating time of generator, power generation and generation efficiency was recorded to infer biogas production. The results showed that the average concentrations of COD, TS and VS in influent were 36,440, 36,350 and 28,460 mg/L in 2017, and 26,690, 23,170, 15,560 mg/L in 2018, respectively. The organic loading rate in 2017 and 2018 were 1.91 kg COD/m^3/d, 1.90 kg TS/m^3/d, 1.49 kg VS/m^3/d and 1.40 kg COD/m^3/d, 1.21

The continuous stirred tank reactor

kg TS/m^3/d, 0.82 kg VS/m^3/d, respectively. The average time of power generation and generating capacity were 11.2 h/d and 774 kWh/d in 2017, while 12.4 h/d and 818 kWh/d in 2018. The daily biogas yields in CSTR were 504 and 530 m^3 estimated by power generation efficiency in 2017 and 2018, respectively.
(T. H. Hsiao, Y. L. Huang and M. P. Cheng)

Evaluation of biogas production in anaerobic fermentation tank with additional heating device

The study was to evaluate the effect of increasing the reaction temperature of anaerobic fermentation tank on increasing biogas yield. The vertical anaerobic fermentation tank covered by insulation material and heated by solar heating device was used in this study. The feed substrate was the cow dung and urine after solid-liquid separation and reacted in the vertical fermentation tank with 20 days of hydraulic retention time. The inlet water temperature, water temperature in the fermentation tank and biogas production were measured. The inlet water temperature of the vertical fermentation tank was between 28.2–28.6°C. The average temperature of the mixing liquid in the fermentation tank was 29.8, 33.5 and 36.1°C, respectively, before and after the installation of the insulation layer and after the installation of solar heating panels, and the average biogas daily yield was 34.7, 42.3 and 46.4 m^3, respectively. The temperature was more than 6.3°C before the heating device was installed, and the biogas daily yield increased 11.46 m^3.
(T. H. Hsiao, T. F. Hsiao and M. P. Cheng)

The continuous stirred tank reactor and preheating facilities

The agriculture and animal husbandry circular management model in the irrigation of the livestock wastewater

The project was regulated that setting the agriculture and animal husbandry circular model farm to irrigate the livestock waste water with pipe, and monitoring the long-term assessment of the impact of livestock waste water irrigation on the environment and crops could be used as livestock waste water reuse specification for the reference. The result showed that the amount of the waste water irrigated could be 1.2 times than the complex fertilizer because of the nitrogen emission. About the monitor data of the soil and underground water in high risk area of the waste water irrigated land, the pH of the underground water in Tainan, Kaohsiung and Pingtung were all over 7. All of the EC values in under stream well were higher than upstream well. The EC values

and the amount of the NH_4^+-N in Tainan were all higher than other two cities. The soil pH were about 5.6 to 7.4, and the EC value of surface soil in E and G site were higher. The OM, TN and Available P of soil in the C site were highest than others. Monitored the anaerobic waste water in different seasons in six cattle and swine farms, all the pH of waste water were over 7, and the EC value of the three cattle farms were all lower than three swine farms, which had the highest EC in the first season. The TN of the waste water in the cattle farms were lower the than swine farms, and all of them had the highest TP in the first season. The content of the Cu and Zn of the cattle farms in the first season were higher, resulted from the different management or the feed in different seasons. Monitoring continuously the high risk area of the irrigation land, and understanding the benefit of the agriculture and animal husbandry circular management model in the irrigation of the livestock wastewater, could rise the willing of the waste water irrigation for the farmers, and could approach the target of the circular agriculture.
(H. J. Lee, Y. L. Huang, T. R. Li, Z. Y. Hseu and T. H. Hsiao)

Agriculture and animal husbandry circular model farm

The dry fermentation technology and biogas circular application of the swine recycling area

The purpose of this study is to treat the wastewater with high TS by dry fermented and anaerobic co-digestion tank, and compatible with the swine circular area in Tai-Sugar Company. The maximum benefits of biogas production from pig manure will be promoted of the swine circular area. The result showed that for the 100 L fermented tanks with 70 L digestate, TS 8, 10, 12, 14% with 20% sludge seeding, the highest biogas productivity are 8% and 10%, the highest daily biogas amount is 85L. The highest CH_4 productivity is 65% in all treatment after 10 days, and the highest CO2 productivity is 60% in TS10% treatment after 4 days. For, for all the agriculture residue, the highest biogas productivity is wine lees (57.2 ± 39 mL CH_4/g VS) in the BMP test and 5L CSTR test. The data also showed that it was good for biogas productivity with low pH and high CN ratio. The most suitable ratio for co-digestion for the green swine farm in DHF is swine manure: lemon residue and wine lees (100:90:10), which had the highest CH_4 productivity (1,846 CH_4 mL/VS g).
(H. J. Lee, Y. L. Huang, P. C. Chou and T. H. Hsiao)

Anaerobic co-digestion tank in Tai-Sugar Company

Long-term operation efficiency evaluation of biogas desulfurization with an aeration tank

The aim of this research was to update desulfurization system for removal H2S in biogas. Evaluation the system feasibility and stability with long periods and full-scale operation. The results show that the system has been tested for 113 days (times), and the raw biogas was completely scrubbed in each test. The hydrogen sulfide removal rate and the pH value of the outflow water tend to stabilize at 40–50 minutes after the start-up. The purification of biogas can be collected after 30 minutes later. The average concentration of H2S was 2047 ± 285 ppm, the removal rate is about 65%, and the average H2S concentration after scrubbing was 713 ± 125 ppm. The average pH of the influent and outflow wastewater were 7.73 ± 0.18 and 6.89 ± 0.22, respectively. The difference in water quality analysis between the influent and the outflow washing liquid is small, so it is feasible to use the aeration tank wastewater as the water washing liquid. By adjusting the aeration rate, the liquid depth ,increasing the circulating rate of liquid or increasing the volume of the aeration tank to maintain or delay the pH drop, the biogas H2S removal rate can be flexibly adjusted. Finally, the outflow water is introduced into the original aeration tank, and the H2S in the water is continuously oxidized to a less polluted product by microorganisms. We Assume that the biogas aeration rate was 200 LPM, two 1 HP pumps were used in this system and the biogas product 80 m3 per day. Accounting for the operation cost was about NT$32 per day.

(H. W. Ou, T. F. Shiao, D. W. Yang, C. T. Chang and Y. F. Lin)

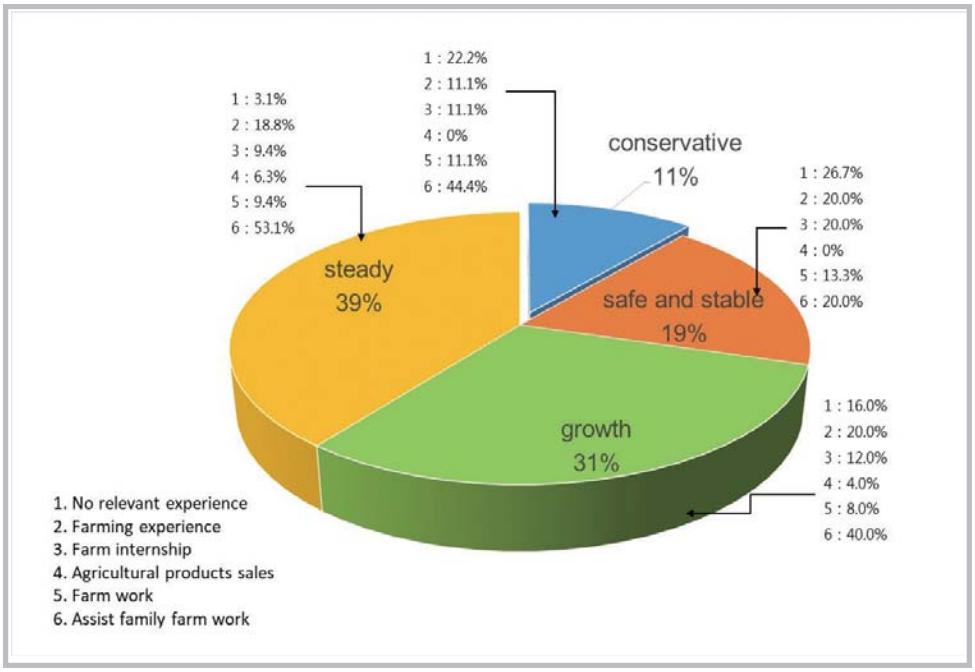
Aeration tank

Evaluation and analysis of agricultural risk assessment of young farmers in livestock industry in Taiwan

This study is to evaluate the agricultural risk of students of farmers academy in farming by questionnaire survey. In addition to comparing the risk-taking ability from pre-farming and after post-farming, it is also to realize the management and perspectives of young farmers engage in the livestock industry, and the related verification or identification strategies that young farmers need. After discussing with the tutoring team of Taipei University, the contents of the questionnaire were divided into: (1) basic information/financial information-10 questions; (2) from the agricultural risk attribute-16 questions, weighted, the higher the score, the higher the risk that can be taken from the post-agriculture. The 8≦total score≦14 is the first level: conservative, indicating that the risk from the farmer can be very low; 15≦ total score ≦18-second level : safe and stable, indicating low risk from farmer's affordability; 19≦ total score ≦24-Level 3: steady type,

indicating that the farmer can bear the risk of moderate; 25≦ total score ≦30-Level 4: growth type, indicating from the farmer can bear high risk; 31≦ total score ≦50-the fifth level: positive type, indicating that the risk from the farmer can be extremely high. As of September 30, 2007, the study had collected 3 classes, 90 questionnaires, and deducted invalid questionnaires. There were 82 valid questionnaires, including 32 in the introduction of animal husbandry, 24 in the processing of livestock production and 26 in beef cattle management class. According to the results of statistical analysis, there have been 63 people from the agricultural sector, 19 not yet in agriculture, and 47 young farmers under the age of 45, of which 58 have education level of university and above. Most of the farming experiences, 34 people are to assist families in farm work. Most of the purpose of farming, 50 people, are to become a professional farmer to create the personal career. Total scores include 32 people in aggressive type and 25 in growth type. It indicated that the risk-taking ability of the participants was generally good.

(B. Y. Wang and Y. I. Lai)



Evaluation of ability to take risks from agricultural experience

Development of pig farm intelligent epidemic prevention of mobile management reminder function system

The self-defense and epidemic prevention of pig farms is an important issue for pig farm operators. It is also one of the key factors for the stable production and profitability of pig farms. Our country is currently a vaccine-free area for foot-and-mouth disease, and has no vaccination since July, 2019. This study is to strengthen the independent epidemic prevention capacity of pig farm and cooperate with the "Pig Farm e-catch" of the Council of Agriculture,

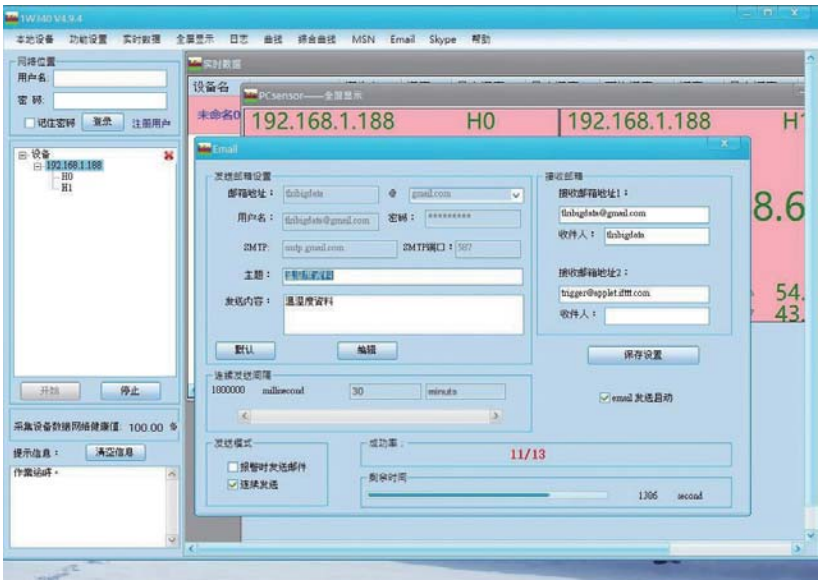
Executive Yuan to establish the platform of the system. In the first year, the reminder function is given priority and is expected to cooperate with the implementation of the "Pig Farm e-catch" system to achieve the goal of epidemic prevention without loopholes. This reminder function is mainly divided into three parts: (1) setting the epidemic prevention function in the backstage; (2) epidemic prevention reminding function; (3) setting the vaccine information in the backstage. The purpose of the system function is to: (1) provide reminder function of epidemic prevention program, strengthen the implementation of the pig farm epidemic prevention program; (2) provide a web backstage system for system users to carry out epidemic prevention program; (3) provide mobile device application software (including Android and iOS versions), for system users to quickly report the use of vaccine records. The types of system users are divided into: system administrators, farm managers, regional administrators, and feeding operators, and different work contents can be assigned according to different authorities. In response to the popularization of mobile devices in recent years, the COA has developed the "Pig Farm e-catch" system for the practical needs of pig farm operators in reproduction management, pig breeding records management, epidemic prevention and abnormal event reminders. The pig farmers use mobile equipment to obtain the information management channel for production management. By applying this information service, the purpose of improving the management and operational efficiency of pig production operations is promoted, which in turn drives the development of agricultural industry information. *(B. Y. Wang, Y. I. Lai, M. Y. Tsai, F. J. Liu and J. B. Lin)*

The periodic epidemic prevention plan function of "Pig Farm e-catch"

Establishment of pig farm environment sensing big data collection and integrated analysis system

This experiment was to design a set of mobile, monitoring equipment for temperature, humidity, THI and wind speed, to monitor the impact of house environment on growth performance of livestock, and draw various 2Y axis graphics. It was to quickly understand the immediate relationship between the environment and livestock performance. This system consists of (1) waterproof temperature and humidity sensor and transmission recorder; (2) a transmitter and data transmission; (3) 4G Wi-Fi wireless sharer; (4) 4G LTE antenna; (5) PoE network power supply switch; (6) Cup anemometer SD recorder. Another record integration program set included (1) integrated temperature, humidity, THI and wind speed; (2) database system; (3) Instantly present data and time. This case integrated test data of the LRI, and database of test station of the NAIF. Data such as temperature, humidity and wind speed were stored. The data were instantly sent by E-mail and LINE messages to the administrator via the Internet. At this stage, we found change of the 4G SIM card of Taiwan wireless network to Wi-Fi sharer the card category had a great influence. Wired Internet, such as ADSL is suggested.

(B. Y. Wang, Y. I. Lai and F. J. Liu)



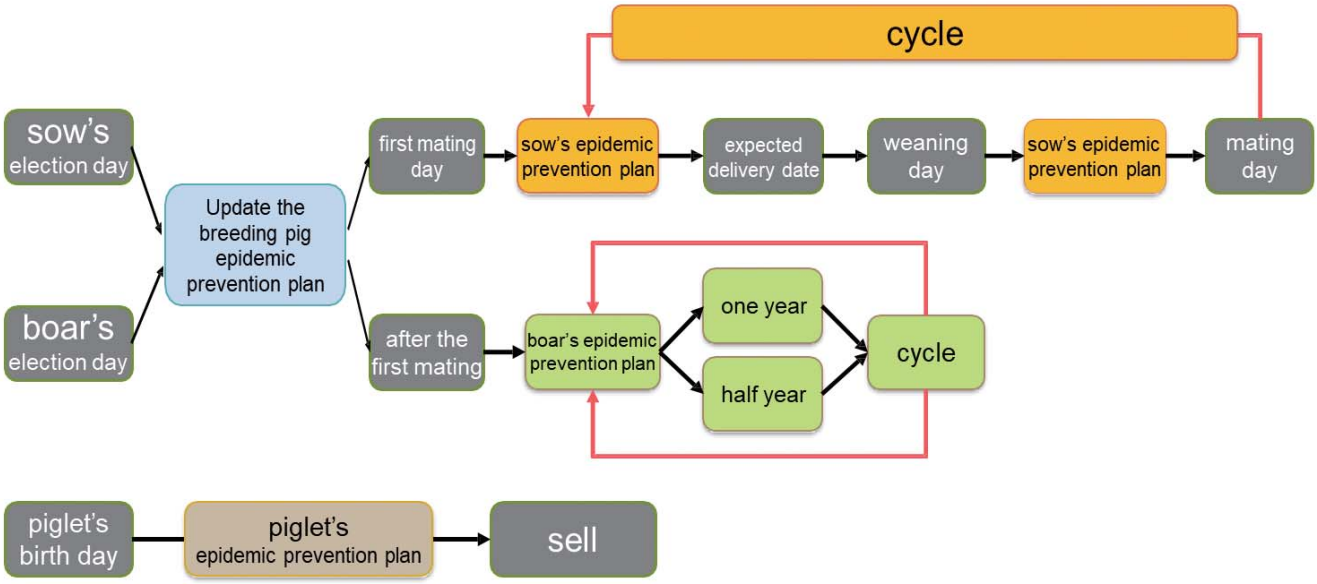
Control system operation main screen

The pig farm intelligent epidemic prevention of mobile management system-New features and promotion

Taiwan is free from foot-and-mouth area since July 1, 2019. To avoid occurrence of the diseases has become a joint effort of the industry, academia and research community. This study cooperated with the "Pig Farm e-catch" of COA to establish a platform. The first year, reminder function is given priority and to cooperate with the "Pig Farm e-catch" system to achieve epidemic prevention. The second year, some new functions were added and implemented according to the feedback. Three parts: (1) Improve the method for obtaining the preset value; (2) Management of medical medicinal materials; (3) Management of personnel accounts. New functions are mainly

aimed at users' opinions, adjusting and correcting the epidemic prevention plans, the framework, improving the setting and display information of recommended medications and disease information, and providing the counselors of LRI. The feeding records and enquiry reports of the farms can be reviewed. At the same time, in the improvement of the default value acquisition method, the user account can be verified by E-mail, and the backend automatically establishes the preset vaccine data and the anti-epidemic meter.

(B. Y. Wang, Y. I. Lai, M. Y. Tsai, F. J. Liu and J. B. Lin)



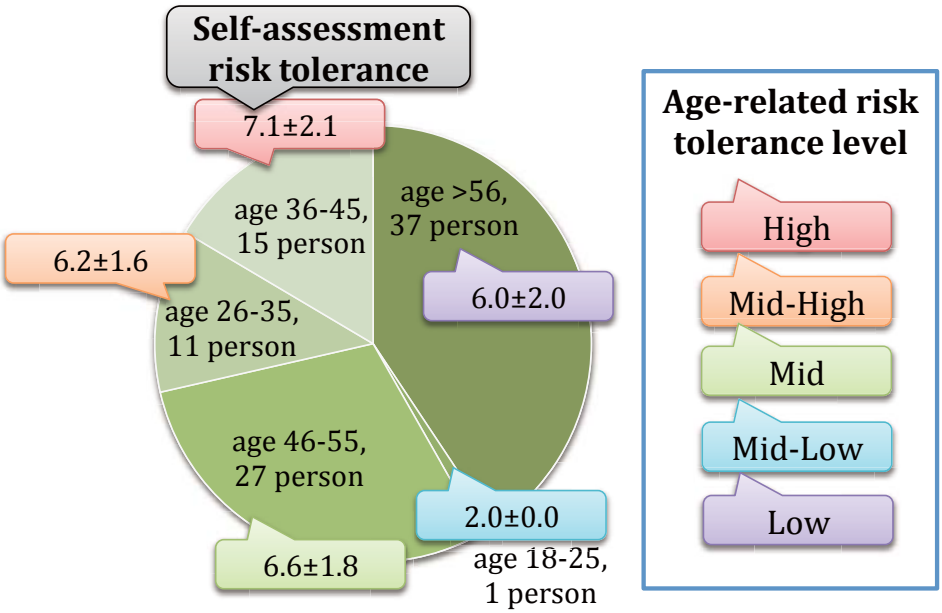
- **Update the breeding pig epidemic prevention plan:** Based on the date of selection and stay as a reminder, until the first breeding record, after the breeding is transferred to the boar or sow epidemic prevention plan.
- **Sow's epidemic prevention plan:** From the date of breeding, each parity is a cycle.
- **Boar's epidemic prevention plan:** Starting from the first breeding, every six months or one year is a cycle.
- **Piglet's epidemic prevention plan:** Based on the birth age.

Setting range of pig farm epidemic prevention plan

Investigation and analysis of risk tolerance and risk attributes on Taiwan poultry farmers

The perceptions of risk and risk management of farmers have considerable influence on their management and implementation of preventive strategy. The study investigated the agricultural background, finical background, and risk self-assessment of poultry farmers in Taiwan, to provide the references of management strategy and self-risk checking for poultry industry. There were 81.3% male respondents in 107 valid questionnaires, 81.7% were full-time farmers and 82.2% was the breadwinner of a family. 35.5% loaned from the farmers' association and 46.7% were own funds. Most poultry farmers did not have a relevant academic background but hold

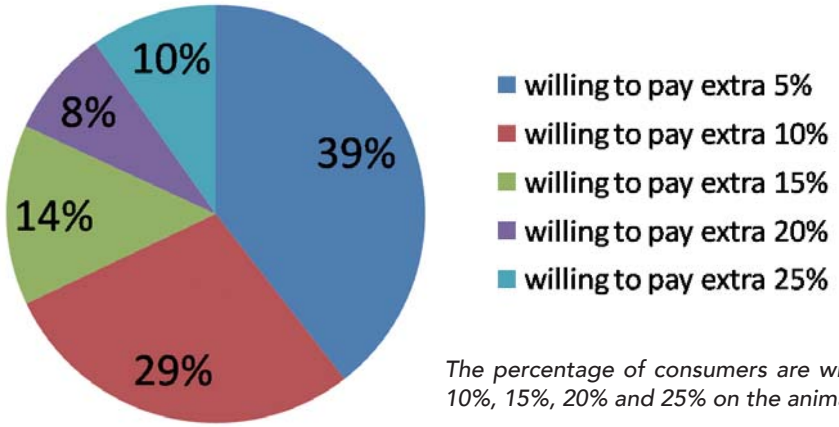
actual experiences. 57.0% of respondents were second generation of farmer, 74.0% had more than 5-year farming experiences, and 84.9% had at least one agriculture-related job before thought only 9.3% had agricultural academic background. The average of self-assessment risk tolerance level of poultry farmers were 6.3, high risk tolerance group seemed higher than other groups divided by age-adjusted risk interval.
(I. H. Chang)



Self-assessment risk tolerance by age-adjusted risk interval of Taiwan poultry farmers

The study of the intention of livestock industry to produce animal welfare products and purchase intention of consumers

This study was conducted to investigate the extent and acceptance of animal welfare in swine industry, also investigated the acceptance and purchase intention of animal welfare in consumers. The results showed that most of producers had a good acceptance of animal welfare. Over 60% of porducers and 80% of consumers agreeded that if consumers had high williness to pay on animal-welfare products, producers will pay equal attention to animal welfare. 38%, 27.43%, 13.43%, 8% and 9.43% of consumers are willing to pay extra 5%, 10%, 15%, 20% and 25% on the animal-welfareproducts. Only 3.71% of consumers had no willingness. However, it showed a significant difference in willingness to pay on the animal-welfare products in different ages. Consumers from 51 to 60 years old had a higher willingness to pay on the animal-welfare products than others, which could be the target of the animal-welfare certified pork products producers.
(H. W. Hung, Y. H. Hsieh and C. J. Lee)

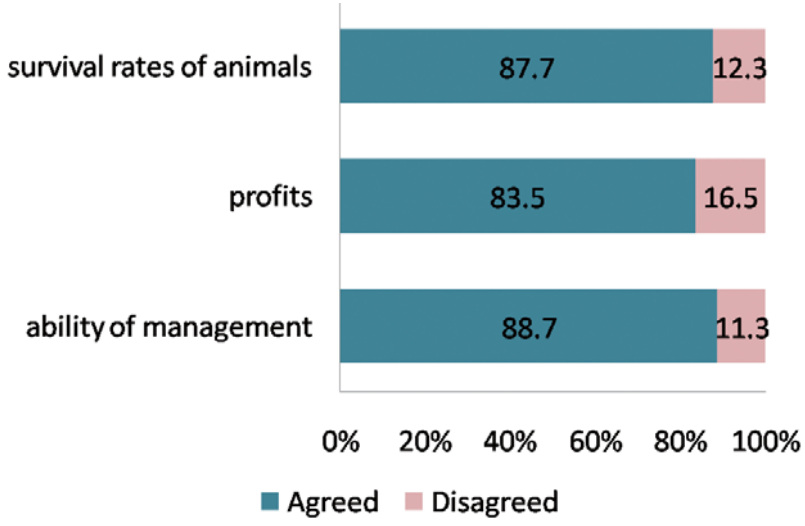


The percentage of consumers are willing to pay extra 5%, 10%, 15%, 20% and 25% on the animal-welfare products

The analysis of training effectiveness and the status of engaged in livestock husbandry

This study was conducted to trace and evaluate the effects of animal husbandry training. Moreover, through the understanding of the risk of engagement in husbandry and the effects of training to strengthen the training efficiency of Farmers College. According to the statistics of questionnaires, 53 responses from the trainees of husbandry primary class in 2019 and 98 responses from the graduated trainees during 2016–2018 were included. The survey of the risk of engaging in husbandry showed the trainees of husbandry primary class who can afford the higher risk in production and tend to make the steady choices of financial loss. However, the trainees behaved conserved in the price, markets, and human risk. Overall, the risk of engagement in husbandry tended to stable and steady. The survey of training consequent showed that 88.7% of trainees agreed their ability of management was enhanced, 83.5% of trainees agreed their profits were increased, and 87.7% of trainees agreed the survival rates of animals were elevated. This result indicated that the effectiveness of the husbandry training for trainees was excellent.

(H. W. Hung)



The percentage of trainees agreed their ability of management, profits and survival of animals were improved

Applying balanced scorecard of performance evaluation of agribusiness counseling in the agricultural innovation incubation center

This study applied the balanced scorecard (BSC) to examine the differences between the expected and actual performances of 137 tenant firms in five agricultural innovation incubation centers (AIIC), COA, through the use of questionnaire survey and in-depth interviews with four performance facets of BSC, "Financial", "Customer", "Internal process", and "Learning and growth". The result showed tenant firms have lower expected performance than AIiC did, while their satisfaction in most performance indicators became higher after counseling. This indicates AIIC fully satisfied the expectation of tenant firms from the incubation processes.However, tenant firms showed a lower satisfaction level after counseling as compared to the expectation for two of the performance indicators, "return on total assets ratio" in the finance facet and "produced rejected and returned material ratio" in the customer facet. Finally, to help agribusinesses overcome difficulties, an inventory of gaps in business process was discovered through deep case interviews, and management solutions were than proposed.

(Y. Y. Wu, Y. I. Lai, S. H. Ko, C. H. Sung, S.S. Lin and L. F. Chan.)

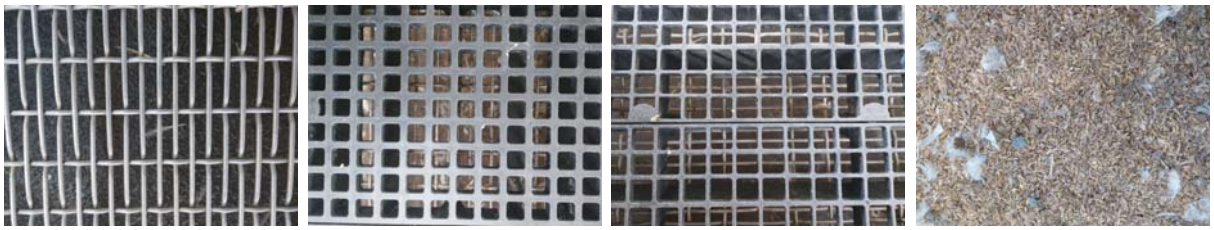
Interview in progress

Different floor materials and type effects on white Muscovy duck growth traits and animal welfare

This experiment investigated the effects of different floor materials and types on Muscovy Duck growth traits and animal welfare. This work will provide a reference for breeding ducks in non-open poultry houses, and reduce duck footpad dermatitis and improve overall animal welfare. This experiment was conducted with 4 treatments according to different floor types and materials. The floor types and materials include stainless steel mesh floor, small aperture plastic floor, large aperture plastic floor, and rice hull litter floor. Ducks were weighed weekly after birth. After 3 weeks of brooding, ducks were allocated randomly into 12 pens in the non-open duck house (4 treatment x 3 replicates). Each pen contained 15 male white muscovy ducks. A total of 180 ducks were used in the experiment. The experiment lasted for 16 weeks. The animal welfare related traits include footpad damage, feather condition, and gait score. Animal welfare traits were measured weekly from 6 weeks of age. At 4, 8, 12 and 16 weeks of age, three fixed ducks in each pen were chosen for determining the corticosterone concentration in the blood to understand the degree of duck stress. When the ducks were 12 and 16 weeks of age, 2 male ducks

from each pen were selected to determine carcass traits. The results showed that the ducks in the rice hull litter floor group had the highest body weight and daily feed intake. The animal welfare related traits performed well for all groups during the experiment. The large aperture plastic floor group had higher blood corticosterone concentration, indicating the duck stress condition may be the reason this group had the lowest body weight. The duck carcass traits in each group did not present significant differences. The experimental results showed that rearing male white muscovy ducks in a non-open duck house with stainless steel mesh floor, small aperture plastic floor or large aperture plastic floor did not have adverse effects on the animal welfare related traits and duck stress condition. This suggests that a duck breeder can construct the duck house using various floor materials according to cost and characteristics.

(C. H. Su, C. H. Cheng, J. H. Lin and H. C. Liu)



Four different floor types applied in the experiment

Different floor material and type effects on white Mule duck growth traits and animal welfare

This experiment investigated different floor material and type effects on mule duck growth traits and animal welfare related traits. This work provides a reference for breeding ducks in non-open poultry houses that reduce duck footpad dermatitis and therefore improve duck animal welfare. These experiments were conducted using 4 poultry house floor treatments using different floor types and materials. The poultry house materials were stainless steel mesh floor, small aperture plastic floor, large aperture plastic floor, and rice hull litter floor. Ducks were weighed weekly after birth. After 3 weeks of age, ducks were allocated randomly into 12 pens in a non-open duck house (4 treatment x 3 replicates). Each pen contained 20 mule (10 males and females respectively) ducks. A total of 240 ducks were used in these experiments. The experimental series lasted for 12 weeks. The animal welfare related traits determinations were conducted weekly from 4 weeks of age, including footpad damage, feather condition, and gait score. At 8 and 12 weeks of age, three fixed ducks from each pen were chosen for the corticosterone concentration in the blood determination to understand the duck stress degree. When the ducks were 10 and 12 weeks of age, 2 male ducks from each pen were randomly chosen and sacrificed for carcass traits determination. The results showed that there were no significant differences in body weight and feed intake for each group of 10 to 12 week mule ducks. Ducks from each treatment performed well in animal welfare traits during the experiment period. The stress level results showed that there were no significant differences in blood corticosterone concentration between the treatments at 8 and 12 weeks of age. The mule duck carcass trait results

in each treatment may be affected by the sacrificed individual effects and as a result, carcass traits have a treatment effect on the dressing percentage and breast meat weight. Further data is needed to analyze and confirm this theory. From the experimental results, it is recommended that stainless steel mesh and small-aperture plastic floors be used in non-open duck houses if the duck's body weight, feed intake, and animal welfare are taken simultaneously into concern.

(C. H. Su, C. H. Cheng, J. H. Lin and H. C. Liu)

Illustration of different foot pad damage scores in the experiment (from 0 to 5)

Study of the feeding mode for decreasing the incidence of footpad dermatitis in geese

The aim of this study was to investigate the effects of different floor designs, floor types and pool conditions on growth performance and footpad dermatitis in White Roman geese. Two experiments were conducted in indoor geese house during the hot season. One hundred and eight White Roman geese at 3 weeks of age were randomly allotted into 6 commercial floors with different designs in the first experiment. The results showed that the geese reared in the floors with arc surface design presented the better foot health and growth performance. However, poor growth performance were found when geese reared in the floor designs with the wire diameter under 0.7 cm. In the second experiment, the ninety six White Roman geese were randomly divided into a factorial design of 2 floor types and 2 pool conditions at 3 weeks of age. The floors were designed as mud land and plastic with full mesh floor, whereas the pool conditions were supplied water pool or not. The results showed that geese body appearance could be improved

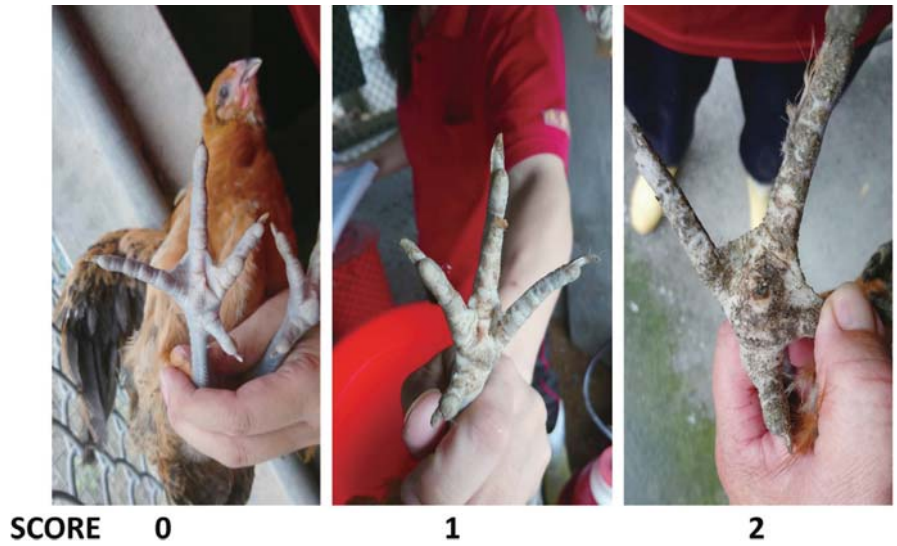
by suppling the water pool. Nevertheless, their growth performance might be decreased. In conclusion, the environment and the space ratio of related facilities should be considered when the water poor were offered in geese house.

(S. C. Liao, S. Y. Shen, C. C. Hsiao, C. Y. Lien, M. J. Lin, T. Y. Lin and S. D. Wang)

A factorial design of two floor types (mud land and plastic with full mesh floor) and 2 pool conditions (water poor was supplied or not) was used in this study

The effects of footpad dermatitis in chicken on the different ratios of biochar in the litter

This study was conducted to understand the influence of the chicken footpad dermatitis (FPD) on the litter contained 0%, 10% and 20% of biochar. Crossbred chickens were reared in this experiment. The extra water was added into the litter for inducing the FPD symptom. The results



The 3 point grading standard of FPD

showed that the average litter' moisture content, seemed inversely proportional to the biochar added, in the three groups were 53.8, 51.8 and 50.3%, respectively. Finally, the incidence of FPD in the three groups at the end of the trial was 49.5, 71.4, and 70.2%, respectively. The highest FPD score was 0.83 in the 10% biochar group and 0.53 in the 0% biochar group. The birds with 2 points FPD score is 3.8% in the 0% biochar group. In general, although the moisture content in the litter is reduced by added certain proportion of biochar, the effect of improving the incidence and dermatitis on the foot of the chicken is not as effective as expected.

(Y. L. Lee, C. J. Hsieh and A. K. Su)

Studying the effects of different perches types on footpad dermatitis of broiler chickens in Taiwan

The purpose of this study was to investigate the preference of broiler chickens in Taiwan for different types of perches and the effects of perch design on chicken body weight, footpad dermatitis, and production efficiency. Three hundred and sixty 5-week-old red-feathered chickens were divided into control group, treatment group A (metal round tube) and treatment group B (metal square tube) randomly, with 3 repetitions in each group and 40 birds per treatment. The test ranged from 5 weeks of age to 12 weeks of age. In the end of 12 weeks of age, the average body weight of control group, group A and group B was 3061.32 ± 343.48g, 2988.72 ± 359.33g and 3087.12 ± 411.98g, respectively. The feed consumption was 361.82 ± 17.27 , 364.94 ± 34.84 and 361.82 ± 21.51, respectively. There was no significant difference between the groups, indicating that the form of the perch had no significant effect on the growth performance of the birds. The percentages of footpad dermatitis in the control group, group A and group B were 64.96%, 85.34% and 98.29%, respectively. It showed that the group B had significantly more severe footpad dermatitis than the others. The chicken, which in group B, was extremely low on perch utilization. It showed that birds didn't like the design of the perch of group B. The percentage of footpad dermatitis and the frequency of use of the perch on test chicken showed that the perch occupies part of space. If the design of the perch is not good, the frequency of chicken occupied the perched is low. This led to an increase in the stocking density, which affected the health of the red-feathered chicken footpad. However, as an environment-enriched facility, the perch can improve animal welfare. Therefore, it is

The metal round tube of perch

recommended that the platform can be developed in the future, in order to improve the utilization frequency of the perch, reduce the incidence of footpad dermatitis and take into account animal welfare.
(X. Y. Chen, S. S. Yang and A. K. Su)

Exploring the effects of different perches types on footpad dermatitis of Taiwanese meat-type chickens

The health of the poultry's feet is not only related to its economic value and production efficiency, but also to the welfare issue. The purpose of this study was to investigate the performance of broiler chickens in Taiwan for different types of perches and the effects of perch designed for chicken body weight, foot pad dermatitis, and production efficiency. Three hundred and sixty birds of red-feathered chickens at 5-week-old were divided into control group, treatment group A (round tube perch) and treatment group B (plastic platform), randomly, with 3 repetitions in each group and 40 birds per repetition. The experiment started from 5 weeks of age until the end of 12 weeks of age. From the overall foot pad dermatitis score on this test, the score of the control group, group A, and group B at the end of 12 weeks were 0.53, 0.49, and 0.93, respectively. The degree of foot pad dermatitis in the group A was the slightest. The score of foot pad dermatitis in the group A was significantly lower than that of in the group B ($P < 0.05$). It showed that the group B had significantly more severe foot pad dermatitis than others groups. The result showed that environmental facilities can affect the health of chicken foot pads. It is suggested that when designing the perch in the future, it can be oriented to the three-dimensional design with the function of keeping the foot pads clean without squeezing the space where the chickens existence. This type of perch is expected to improve the utilization of facilities, reduce the incidence of foot pad dermatitis, and take into account the welfare of animals.
(X. Y. Chen, S. S. Yang and A. K. Su)

Footpad dermatitis of chicken

Effect of raising environment on the health of hooves and legs of TBP sows

Raising space is one of the needs for animal expressing behaviour and affecting the activity of animals. Furthermore the space might affect the health of legs and hooves. Based on the concern of animal welfare and production, the project dealt with the friendly feeding environment in terms of space allowance to evaluate the effect of space allowance on the health of legs and hooves, activity and reproduction performance of sows. Ten gilts of TLRI Black Pigs (TBP) were allocated to control group or treatment group. The control group was traditional pregnant crate (60 x 175 cm) and farrowing crate (55 x 180 cm) for fours weeks. The treatment group was un-crate pen (90 x 175 cm) and adjustable farrowing crate which was widen to 155 x 205 cm at the second week of parturition. Results showed that the score of legs and hooves of gilts and multi-parity sows was 87.70 ± 1.35 and 86.83 ± 1.77, respectively. There was not different of score of legs and hooves within three parities of sows. Sows fed in un-crate group had higher ($P < 0.05$) activity at one hour prior to feeding and three hours after feeding than the sows fed in crate. Lying occupied the most account of behaviour of the six hours observation (83.1% vs. 90.0% for control and treatment) in pregnant house and in farrowing house two weeks after parturition (90.8% vs. 93.1% for control and treatment). When sows were moved to farrowing housed from pregnant house, the walking speed of sows raised in crate and adjustable pen was 35.6 and 41.7 m/min, respectively. When sows were weaned and moved back to the pregnant house, the walking speed of sows raised in crate and un-crate pen was 43.7 and 48.9 m/min, respectively. There was not different of survival rate of piglets from the second week of birth to weaning between treatments. Therefore raising space had not effect on the legs and hooves of sows and survival rate of piglets, but sows raised in un-crate pen had higher activity might contribute the expression of activity behaviour of sows.

(H. F. Lee, T. C. Yang, W. F. Wu, C. J. Wu, F. C. Liu and N. T. Yen)

Effect of raising environment on the health of hooves and legs of Landrace gilts

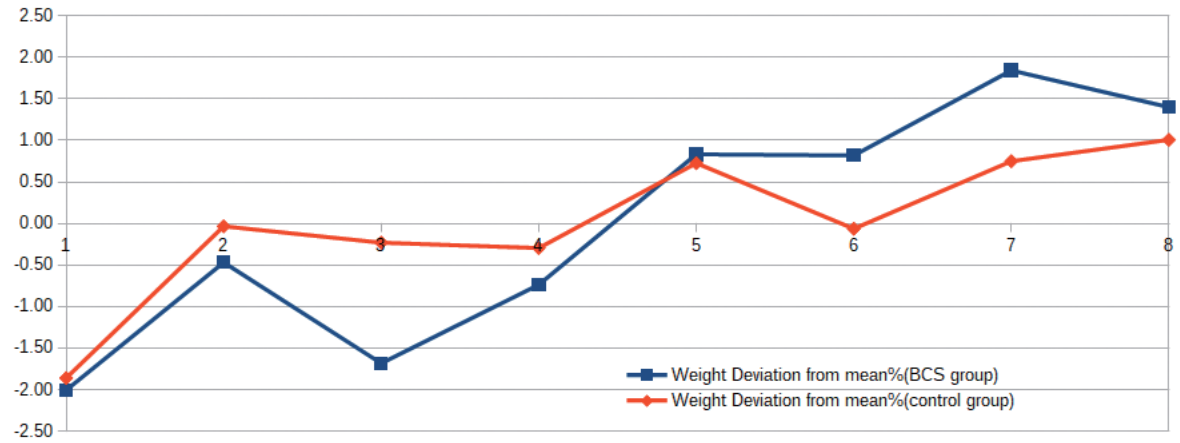
Feet and hooves problem is one of the major reasons for culling breeding sows. Sows suffered with feet and hooves problem caused welfare issue, and affected the production too. Good conformation and structure of feet and hooves is one of the essential conditions for breeding sows. Therefore in this investigation, sixteen Landrace gilts after the on-farm testing were selected for the evaluation of feet and hooves. The evaluation was carried out by three working members. Total score was 100 points. Fore leg including angel at the knee joint, legs turning, condition of the pasterns and size and uniformity of claws accounted for 40 points while hind leg including angle at the hock joint, legs turning, condition of the pasterns and size and uniformity of claws accounted for 60 point. Results revealed that the angel at the hock joint, legs turning, condition of the pasterns and size and uniformity of claws for the fore legs, angel at the hock joint, legs turning,

condition of the pasterns and size and uniformity of claws for the hind legs was 8.8 ± 0.3, 9.0 ± 0.5, 8.8 ± 0.4, 9.0 ± 0.3, 13.8 ± 0.3, 14.0 ± 0.2, 13.6 ± 0.5 and 13.7 ± 0.4, respectively. The overall score was 90.7 ± 1.4. There was no difference of activity between sows fed in un-crate or crate at one hour prior to feeding and five hours after feeding. Standing occupied half account of behaviour of the observation. When sows were moved to farrowing housed from pregnant house, the walking speed of sows raised in crate and un-crate pen was 35.4 and 35.9 m/min, respectively. When sows were weaned and moved back to the pregnant house, the walking speed of sows raised in adjustable pen had faster speed ($P < 0.05$) than sows raised in crate (40.6 vs. 37.4 m/min). There was no difference of survival rate of piglets from the second week of birth to weaning between treatments. Results indicated the feet and hooves conformation of Landrace gilts were good for breeding basis and reproduction purpose. Raising space had no effect on the survival rate of piglets, but sows raised in adjustable pen had better mobility might contribute to on-site operation.

(H. F. Lee, T. C. Yang, W. F. Wu, C. M. Wang, F. C. Liu and N. T. Yen)

The study of body condition score (BCS) used to Taiwan Holstein dairy cattle grouping arrangement systems

The plan was to take samples of Holstein dairy cows birthed from 2017 to 2018 at Hsinchu Branch. During the test period, body measurement and body condition score (BCS) data of the milking cows were monitored. The experiment was designed on a completely randomized paired basis. The BCS group milking cattle for BCS scores under 2.5 (BCS ≤ 2.5) were divided into BCS group area. And those dairy cattle were paired with non BCS area groups (control group) according to age, parity and lactation days during the same milking period. BCS physical examination and other data, 80-day statistics of computer automatic weighing, step counting and milk weight data were collected additional 20 days before and after the 40-day test (September 12 to October 23). Stage 1 (days 1–12) 4 cows were not yet for intestinal health



The weight deviation from mean of each 10-day period average % trend for BCS grouping management trail from August 23, 2018 to November 12, 2018

management, then in the second stage (days 13–40), 7 cows completed the whole treatment. And the preliminary results showed that the BCS group with bowl health management (September 26 to October 23) performance were better than the BCS group without bowl health management (September 12 to September 25) in weight condition. The intestinal health management average per head weight increased by 0.23% (untreated) and 0.78% (treated). The statistical preliminary results appeared that the average weight volume showed a contrarian upward trend difference after BCS group intestinal health management, which indicating BCS grouping bowl health technology has potential application feasibility.

(S. Y. Hao)

The study of bovine ephemeral fever antibody titer in cows' serum

Bovine ephemeral fever (BEF) is a serious disease in dairy cattle industry. The characteristics of the disease are the sudden onset of fever, drop of milk yield, stiffness, and lameness. BEF often causes hypocalcaemia which in turn generates clinical signs such as depression, cessation of rumination, and muscle tremor. A vaccination is available to prevent this disease. The aim of this study is to maintain high antibody titer of bovine ephemeral fever and reduce morality rate of dairy cattle in Taiwan. We compare the influence of the number of in vaccination and different brands of vaccine on the antibody titer of cattle. Through monitor the antibody titer of bovine ephemeral fever in vaccinated cattle to exploit the best vaccination strategy of bovine ephemeral fever in Taiwan.

(Y. M. Chen, Y. H. Chen, and K. H. Lee)

Applications of the friendly environment to improve the bovine lameness

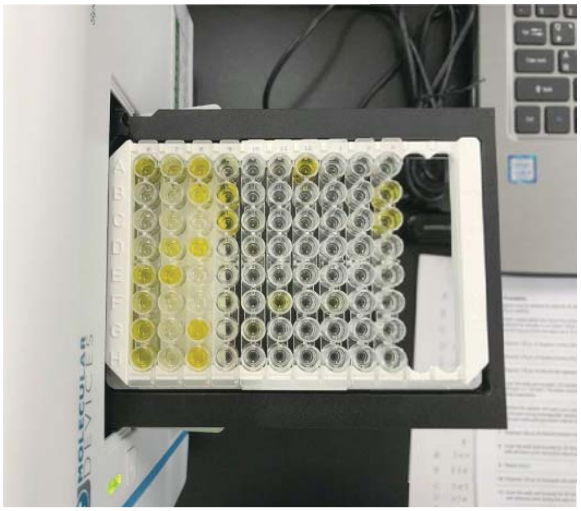
The purpose of this experiment was to evaluate the effects of barn floor with different material and design on dairy cows moving activity and foot health. Dairy cows were randomly allocated into a milking cows barn. Experiments was a factorial design with main effects barn floor (cow bed provide with concrete, or with bedding). Locomotion scoring, daily milk production and moving activity were measured in the experiment for 3 months. As for the statistics, the amount of activity and the amount of milk in the mat group were only slightly increased. The amount of milk in the mat group was 3% higher than that of the control group, so laying on the soft mat will give the cow a more comfortable environment, it can increase the amount of activity and the production of milk.

(Y. M. Chen, Y. H. Chen, K. H. Lee and P. A. Tu)

The estimation of pregnancy diagnosis accuracy by transrectal ultrasonography and laboratory detection of pregnancy-associated glycoproteins in dairy cows

Accurate diagnosis of pregnancy is an essential component in the reproductive management plan for dairy cows. Indirect methods of pregnancy detection can be performed soon after breeding, without requiring an experienced veterinarian, and it thus offers an advantage over traditional direct methods for having automation potentials. The objective of this study was to estimate the sensitivity and specificity of pregnancy-associated glycoprotein (PAG) detection ELISA in raw milk and transrectal ultrasound (TRUS) in dairy cows using a Bayesian latent class approach. Three hundred and seventy dairy cows were used in this study. Cows were examined at 28–35 days after artificial insemination (AI). The TRUS method was performed to detect pregnancy and PAG detection ELISA kits were used on collected serum and raw milk. A total of 307 cows had complete test information for use in the Bayesian latent class model. The estimated sensitivity (95% probability interval) and specificity for PAG detection serum ELISA were 97.4% (91.2, 99.8) and 99.4% (93.5, 100.0), respectively. The estimated sensitivity and specificity for PAG detection milk ELISA were 99.0% (94.7, 100.0) and 84.5% (71.9, 93.3), respectively. Sensitivity of veterinarian performed TRUS at 28–35 days post-AI varied between 92.7% and 99.8% and specificity varied between 80.5% and 97.6%. In summary, using PAG ELISA is an accurate method for use in dairy cows pregnancy detection. The method is apparently more sensitive than TRUS performed by a veterinarian and therefore could be a viable addition to future Dairy Herd Improvement Program.

(M. K. Yang and P. A. Tu)



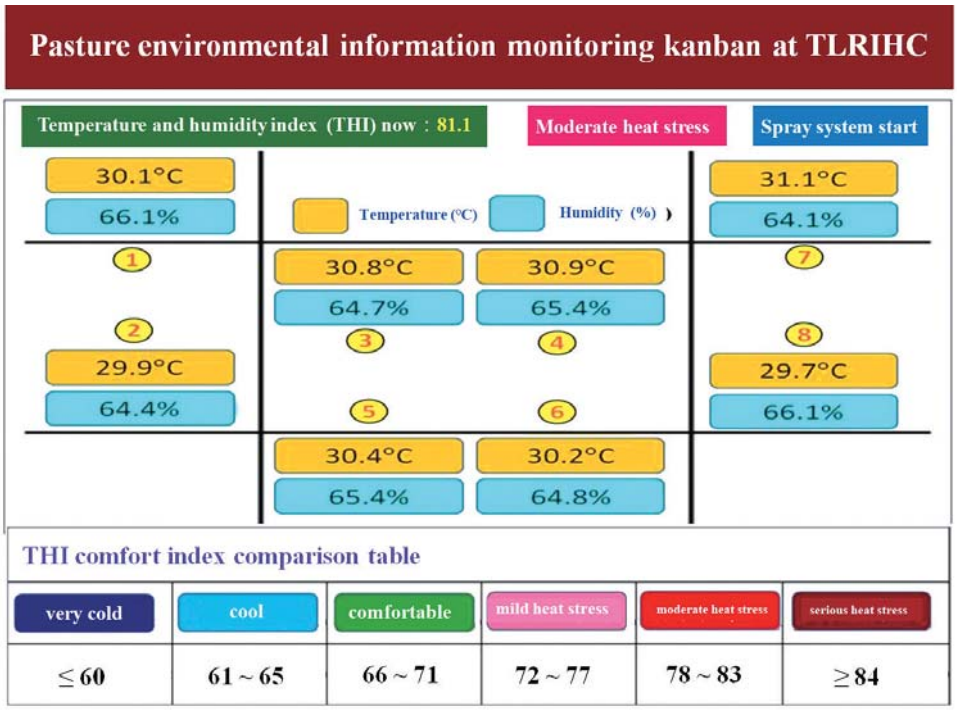
The sensitivity and specificity of pregnancy-associated glycoprotein (PAG) detection using ELISA in raw milk

Correlation between THI (temperature and humidity index), and milk yield and somatic cell count in dairy cows

This trial aims to explore the correlation (r) between the mean of daily milk yield (MY), and somatic cell counts (SCC) with the temperature (T) and humidity (H) index (THI) of dairy cows under specific conditions, as a reference for the dairy herd feeding model in extreme climate. The dairy barn (L × W × H: 37 × 34 × 11 m^3) was used as the trial field in the Hsinchu branch. The large fan and the automatic spray system to cool the barn when the T is greater than 24 °C. And, 8 sets of sensors were used to collect the T and H data from Jan. to Jun. 2019. The ratio of cows in the

traditional and robotic milking area was 3.9:1 (n = 53), and the latter's MY and SCC were 32.7kg and 391,000/mL, with the difference than former were + 10.1kg (P < 0.05) and -13,000/mL, respectively. The results showed that the THI in Jun. was 78.5 higher than others (P < 0.05), showing moderate heat stress. The r between MY and SCC was - 0.25 (P < 0.01). But the r of MY and SCC with THI was - 0.02 and + 0.03, respectively.

(J. Y. Chen, K. H. Lee, I. S. Chen, Y. H. Yeh and J. W. Shiau)



Temperature and humidity sensing components information board of dairy barn in the Hsin-Chu branch

Trend of THI (temperature and humidity index) in the dairy barn at different times during the hot season

The trial was to investigate the difference and correlation of the temperature and humidity index (THI) in a dairy barn during the hot season at four times a day (divided into late night, L, morning, M, afternoon, A, and evening, E). It would be as references for the dairy herd feeding model in extreme climate. The dairy barn (L × W × H: 37 × 34 × 11 m) was used as the trial field in the Hsinchu branch. We used 6 large fans and an automatic spray system to cool the barn. And, 8 sets of sensors were used to collect the temperature and humidity data from Jun. to Sep.

Temperature and humidity sensing components of dairy barn in the Hsin-Chu branch

2019 and converted into THI. The results showed that THI from high to low in each period was A (81.7 ± 1.1), M (79.8 ± 1.1), E (77.9 ± 1.0) and L (76.5 ± 0.8) ($P < 0.05$), showing mild to moderate heat stress. The correlation analysis showed that the correlation coefficient (r) between L and E was 0.33, showing no difference, and the others were significantly different ($P < 0.05$), especially the r of M and A was up to 0.65 ($P < 0.01$).
(J. Y. Chen, K. H. Lee, I. S. Chen, Y. H. Yeh and J. W. Shiau)

Application of black soldier flies on recycling agricultural and livestock surplus materials resources

Due to the global population continuously growth, the demand for animal protein are significantly increasing. In order to meet the demand for animal protein among the middle classed. Alternative protein source is needed to fill the gap of demand. Insects as food and feed emerge as an especially relevant issue in recent years due to the rising cost of animal protein, food and feed security, environmental pressure and increasing demand for protein for people. Thus, alternative solutions to conventional livestock and feed sources urgently need to be found. The utilization of insects protein therefore contributes positively to environment, health and livelihoods. The purposes of this study are 1. To establish the demonstrated field of black soldier fly (BSF) to treat livestock organic resources. 2. To set up quantitative operation machine unit to increase the mass production. 3. To analyze the DNA sequence of BSF larva that feed cattle's waste and study the relationship with environmental microbial.
(S. H. Liang, S. H. Wang and J. W. Shiau)

Demonstration field visiting by industrial operator and Director – General of TLRI

The demonstration field of small scale breeding of black soldier flies

Improvement of the feather pecking and leg weakness in indoor raising meat-type geese

The aim of this study was to investigate the effects of different stocking density, roof designs and dietary vitamin D3 concentrations on growth performance, body condition score and the incidence of feather pecking and leg weakness in indoor raising White Roman geese. Two experiments were conducted in indoor geese house with floor during the hot season. In the first experiment, the ninety-six one-day-old geese were raised in different stocking density of 6, 12, and 18 geese/m^2 at 1 week of age; 3, 6, and 9 geese/m^2 at 2 weeks of age; 2.4, 3.6, and 4.8 geese/m^2 at 3 to 8 weeks of age, and 1.2, 1.8, and 2.4 geese/m^2 at 9 to14 weeks of age. The results showed that the growth performance were not affected when the stocking density were adjusted to 2.4 geese/m^2 at finishing period (9–14 weeks of age). However, the geese showed the severe feather pecking, footpad injury and breast blister injury with the increasing stock density (1.2, 1.8, and 2.4 geese/m^2 at 9–14 weeks of age). It was recommended to reduce the stocking density as much as possible and preferable to 6 geese/m^2 at 1 week of age; 3 geese/m^2 at 2 weeks of age; 2.4 geese/m^2 at 3 to 8 weeks of age and 1.2 geese/m^2 at 9 to 14 weeks of age. In the second experiment, one hundred and forty four geese were randomly allotted into a factorial design with 2 roof designs and 3 concentrations of dietary vitamin D_3. The roofs were designed for lower and intensive natural lighting. The levels of dietary vitamin D_3 were supplemented with 200, 2,000 and 4,000 IU/kg. The results showed that the best growth performance was exhibited on the treatment supplemented with vitamin D_3 for 2,000 IU/kg. The intensive natural lighting treatment presented the better feather cleanliness and blister score at 12 weeks of age but showed the poor body weight and body weight gain at 8 and 5–8 weeks of age, respectively. In conclusion, in hot season, the concentration of dietary vitamin D3 could be supplied 2,000 IU/kg in indoor raising White Roman geese. Replacing 17% area of roofs by PVC transparent sheets to enhance natural lighting could improve feather cleanliness and blister score, but the ventilation and temperature should be noticed to avoid the heat stress in indoor raising geese.

(S. C. Liao, S. Y. Shen, C. C. Hsiao, C. Y. Lien, M. J. Lin, T. Y. Lin and S. D. Wang)

Two roof designs of lower and intensive natural lighting were applied to indoor floor raising White Roman geese

Development of high biosecurity and intelligent monitoring management system in poultry (2018)

A total of 2 high biosecurity meat waterfowl houses were built. Two pieces of high biosecurity goose feeding management and intelligent management mode of waterfowl hatching were completed. High biosecurity poultry manure treatment system, goose crouching image identification model prototype system, and waterfowl incubator high biosecurity subenvironment module were also developed. The project was to evaluate the efficacy of ozone disinfection system in incubator air intake and the biosecurity assessment of breeder egg cleaning system, and to test intelligent modular environmental control, production decision and disinfection system. The results showed that ozone could be used to disinfect the air in the incubator, thus reducing the number of Escherichia coli and the number of bacteria in the hatching room. Egg washing machine with commercial disinfectant can reduce goose egg eggshell surface bacteria number from 5.55–5.97 log cfu/ml to 2.25–3.93 log cfu/ml. This project has completed the test of wireless sensing module and applied it to the environmental control system of duck house. In addition, the incubator environmental monitoring platform has been built, so that the incubation room temperature and humidity information can be monitored remotely. The duck house air flow simulation has been completed without the installation of equipment to obtain a uniform air flow method. Completion of the bird image location detection algorithm optimization can capture an image in the goose house. It can be set time for photo and cloud access and the accuracy of poultry positioning optimization. The goose crouching image identification mode has been completed. The goose crouching image capture process has been tested for the goose overlap rate in order to judge the crouching situation. We also completed the design and construction of the small-scale high-biosecurity poultry manure treatment system. The system will be tested for drying efficiency, uniformity, photoelectric and electrothermal drying efficiency and pathogenic bacteria killing effect.

(C. Y. Lin, S. D. Wang, M. Y. Tsai, H. L. Liu, C. M. Hung, Y. F. Lin, C. H. Su, C. H. Cheng, J. H. Lin, H. C. Liu, S. Chen, C. Y. Tsai, J. M. Tsai, K. W. Hsieh, P. K. Lei, H. M. Chen and F. P. Shih)

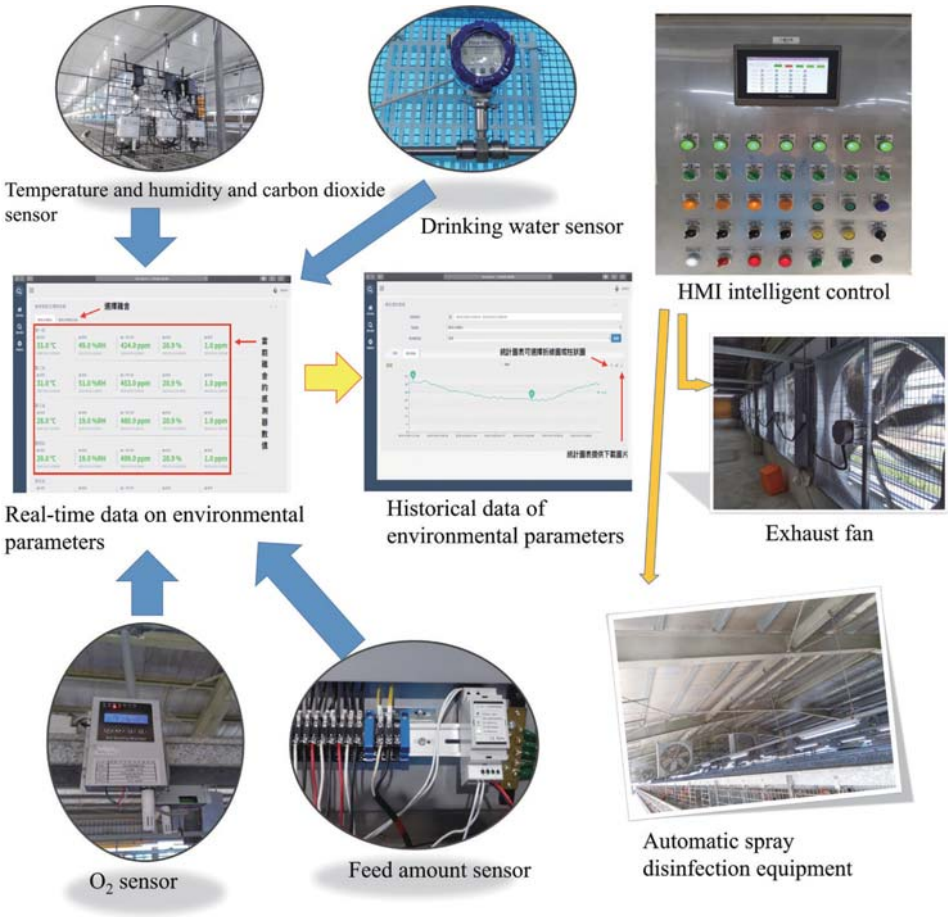
High biosecurity meat-type duck house

Prototype of small scale high biosafety poultry manure processing system

Development of high biosecurity and intelligent monitoring management system in poultry (2019)

In order to improve the bio-safety protection ability of poultry production system and solve the problem which ignoring disinfection poultry barn due to lack of manpower, a wastewater treatment system by using batch activated sludge process and ozone treatment was designed and constructed at a high bio-safety duck house. After 48 hours of activated sludge treatment, the effluent water came from this duck barn can meet the standards of livestock drainage law. In addition, treated this effluent water with 0.8 ppm ozone water for 30 minutes can remove 90% of the total bacterial count, Coliform count and E. coli count in the effluent water. The sensor of temperature, humidity, carbon dioxide, ammonia, illumination, water metering and feed metering which connecting energy saving fans, spray cooling system, the network server and the NAS system were constructed on the wet-pad cooling chicken

Duck image recognition system



The intelligent biological control system in high biological safety poultry house

barn and non-open chicken barn at the same time. A duck image recognition system was constructed for analyzing 2,278 duck images. The accuracy rate and the recall rate of duck image recognition system were 0.98 and 0.99, respectively. Besides, this system set up a calculation model and early warning indicators for individual separation of duck. The position in which the eggs were located in the incubator affected the hatchability of duck eggs. The hatchability of duck eggs in the mid-front section of incubator was the worst, and it has a significant difference ($P < 0.05$) between the upper-front section and the lower-front section of incubator. There was a high coefficient ($r > 0.75$) of the hatchability of duck eggs between the mid-level section of incubator with the wind speed inside the incubator. Through image acquisition, position detection system and database, the time of stop moving in geese can be calculated. The result showed that it can automatically capture goose images at 5 sec intervals and upload it from the goose barn to the server for data storage. Right now, this system already reached 98.7% accuracy and 99.8% coverage rate for goose moving detection. The accuracy rate was 91.5, 96.5, and 99.8% for the time of stop moving in geese within 30 sec, 60 sec, and 300 sec, respectively. According to the questionnaire data, the average investment budget for the smart modular environmentally-control system and the high bio-safety layer manure processing system was about 50,144 and 1.58 million N.T. dollars, respectively. Meanwhile, goose farmer would like to pay an additional 3.44 and 4.14 N.T. dollars for each gosling hatched from the high bio-safety sub-environmental module and cleaned by egg washing machine.

(S. D. Wang, C. Y. Lin, C. H. Su, C. M. Hung, M. Y. Tsai, H. L. Liu, Y. F. Lin, C. H. Cheng, J. H. Lin, H. C. Liu, K. W. Hsieh, P. K. Lei, H. M. Chen, F. P. Shih, S. Chen, C. Y. Tsai and J. M. Tsai)

The investigation of ostrich behaviors during the growing periods

This research was conducted to survey and analyze the behavior of ostriches from the birth to the age of second or the age of sixth months, respectively. The results demonstrated that the behavior of eating (22.63–28.15%) and standing (21.08%) of ostrich were the highest frequency behavior from two weeks to two months of age or from two weeks to 6 months of age. During the daytime interval of 11:00-14:00, the eating frequency was the lowest behavior of ostrich. In the rainy day, the standing behavior of ostrich was replaced by the sitting behavior, which was increased from 11.68% to 18.72% in the flocks significantly. The goals of this research were educated farmers to improve the husbandry skill, provide the appropriate shelter, pens and prevent the disturbance issue from the outside of ostrich farm. Hopefully, this know how will help to improve the breeding rate of ostriches.

(P. H. Chuang, H. W. Hung, Y. T. Chen and A. K. Su)

Behaviors of sitting and standing

The effects of intelligent temperature monitoring and control fan system on the growth performance of Lanyu pigs

The purpose of this study was to investigate the effects of intelligent temperature monitoring and control fan system on the growth performance and blood biochemical parameters of Lanyu pigs during the nursery period. A total of sixteen ten-week-old Lanyu pigs with male and female halves were allocated into a control group without fans in barn and a test group with intelligence temperature monitoring and control fan system in barn, for 8 weeks. The results showed that the growth traits of the test group had significantly higher body weight at 4 weeks than those in the control group ($P < 0.05$), and the other growth traits were not significant differences. In terms of average daily feed intake and feed efficiency were also not significant differences. In terms of blood biochemical parameters: Alanine aminotransferase AST), Total protein (TP), Creatine kinase (CK), and Cortisol were not significant differences. In summary, the fan system effectively reduced the ambient temperature, increased pig feed intake, and significantly improved growth performance in first half of test on relatively hot weather condition in September. But there were no differences in other growth traits. In order to evaluate the effectiveness of fan system, it is still necessary to continue to conduct tests and collect data in the hot season like July and August in the future.

(Y. L. Chen, H. S. Wang, S. Y. Wu, Y. L. Huang and C. C. Chang)

Intelligent temperature monitoring and control fan system set in the nursery pig house

VI Study on the improvement of goat milk flavor

The annual production of domestic goat milk was about 14,000-15,000 metric tons, the self-sufficiency rate was 78%, and the value of annual production was about NT $ 500-600 million in recent years in Taiwan. Goat milk, which is like cow milk, delivers many nutrients with relatively low energy consumed, and is relevant to the health of consumers throughout the life cycle. However, the special flavor of goat milk has been the main reason that most consumers do not fit. This study was aimed to investigate the effect of domestic goat milk production conditions, can identify the impact of the cause of goat milk flavor. According to the survey, the domestic goats are mainly Alpine breed, accounting for 80-90%, followed by Saanen breed. Most dairy goat farms use automatic temperature-controlled storage tanks, and the milk temperature is maintained at 2-4°C, which cannot significantly increase the total plate count of milk and maintain the quality of raw milk. The test results showed that the raw milk was stored at 8°C, compared with 3°C, there were higher medium and short-chain saturated fatty acids, consist of butyric acid, caproic acid, caprylic acid and capric acid. Long-chain fatty acids myristic acid and palmitic acid, there is the case of slightly decreased. According to the test results, raw goat milk stored at 3°C can reduce the change of goat milk flavor and maintain the good flavor of goat milk. In the production process of fresh goat milk, only a slight increase in short-chain fatty acid butyric acid was found, which may be one of the reasons for the off-flavor of goat milk.

(C. Y. Kuo and R. H. Yeh)

The domestic dairy goat breed is dominated by Alpine, followed by Saanen

Domestic goat milk products

Effect of exposure of fresh milk to different light illumination on milk quality

This study was to investigate the effect of illuminance of light-emitting diode (LED) on milk quality. The fresh milk display racks in Taiwan mainly use LED lights (3,500-14,000 Lux). Therefore, this study assigned glass bottles of milk into 0 (control), 2,000, 8,000 and 14,000 Lux groups in refrigerator for 7 days with 3 replicates. The light treatment significantly increases the milk pH and a value, and the b value decreased significantly as the illuminance increases. The milk fat, solid of non-fat and L value also significantly affected by light treatment, but these measurements had no linear relationship with the illuminance level. The illuminance more than 2,000 Lux significantly reduced the smell, flavor, texture and overall acceptability of the sensory evaluation. In conclusion, the illuminance more than 2,000 Lux caused significant adverse effects on the milk composition, color and sensory evaluation.

(R. H. Yeh, Y. C. Lin and C. Y. Kuo)

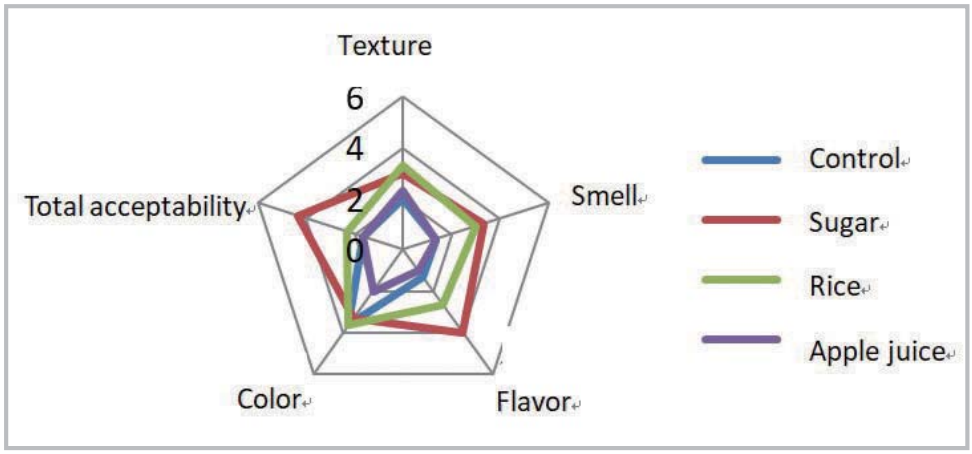
Fresh milk storage under the chilled room with the light-emitting diode (LED)

Development of coagulated-type fermented egg product

The purpose of this study was used liquid eggs and natural fruits, and then through fermentation and coagulation operation to develop the coagulated-type fermented egg products. The sugar, rice and apple added to coagulated-type fermented egg products and with only liquid eggs was the control treatment. pH value , microbiological measurement, sensory evaluation and storage test of cheese-like egg product were detected. The result indicated added ingredient over 10% that egg cheese products were unable coagulation. The product treated with 5% sugar showed higher overall acceptability score than other treatments. However refrigerated storage for four weeks in vacuum packaging had similar result to the products treated with 5% sugar.

(Y. C. Liu and Y. C. Chen)

Cheese-like egg product

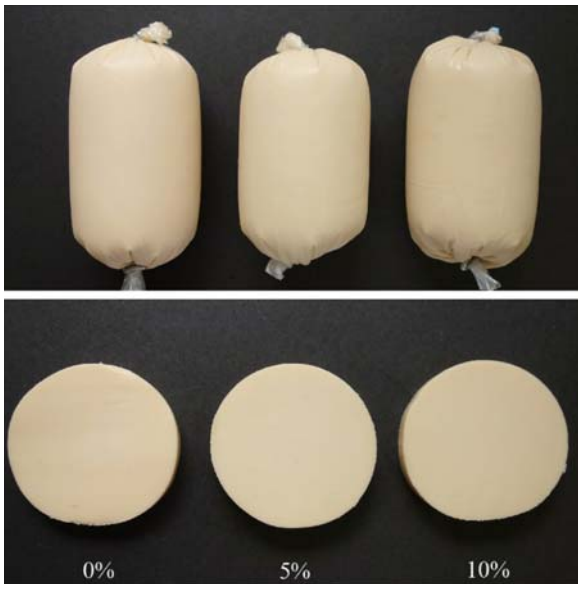


Sensory evaluation result of cheese-like egg product

Development of the domestic recombined cheese

This experiment was conducted to analyze the effects on quality of recombined cheese adding dry okara powder. The control group (C) had no okara powder, the O_5 and O_{10} groups were recombined cheese adding 5% and 10% okara powder. All treatments were analyzed the proximate analysis, color, texture analysis, dietary fiber, isoflavones contents and texture total plate counts. The results showed the moisture and crude fat content of control group was the highest at 56.69% and 15.55%, but the protein content of O_{10} group was the highest at all treatment groups. The L value, a value and b value of control group were significantly higher than other groups at 81.79, 7.95 and 29.18, respectively. When increasing the adding ratio, isoflavones and dietary fiber contents were increased. The hardness and cutting force were also increased with increasing the adding ratio, and the O_{10} group was the highest at 1,833.54 g and 483.29 g, respectively. After stored for 4 weeks, the total plate counts were less than 3 log cfu/g and there was no E. coli or Enterobacteriaceae. In conclusion, although the color and texture of recombined cheese would be

Mixture of okara powder and other ingredients of cheese



Recombined cheese added different amount of okara powder

effected significantly by adding okara powder, but the recombined cheese still had other advantages for the dietary fiber and isoflavones contents.
(M. R. Lee and C. Y. Kuo)

The study on improvement of domestic goat Gouda cheese making process

This study was to investigate the effects of stirring and heating the curd on the texture of goat Gouda cheese. The trial 1 was divided into a control group and a settling group. The control group was stirred directly after the curd was cut, and the settling group stood for 20 minutes before stirring. The results showed that there was no significant difference in surface hardness and internal average hardness between the control group and the settling group. The trial 2 was divided into a control group and a mild heating group. The curd in the control group was performed hot water treatment for two times, and the mild heating group was performed only once time with 1°C/min heating rate. The results showed that the surface hardness, internal average hardness, ash and crude fat in the mild heating group were significantly higher than the control group, while the moisture content was significantly lower. There was no significant difference in sensory evaluation between the control group and mild heating group. In addition, the sensory evaluation of goaty flavor, flavor and texture of domestic goat milk Gouda cheese was similar to commercial goat milk Gouda cheese. Although the surface hardness and internal average hardness of the control group was better, its appearance had serious defects, so the mild heating group was the better process. In this study, a better goat milk Gouda cheese making process was established based on the conditions of trial 1 and trial 2. The basic ingredients, physical and chemical properties, microbial analysis, amino acid and fatty acid composition data have been established. These data can be used for future research and improvement.
(R. H. Yeh and C. Y. Kuo)

Goat Gouda cheese
(left: the control; right: the mild heating group)

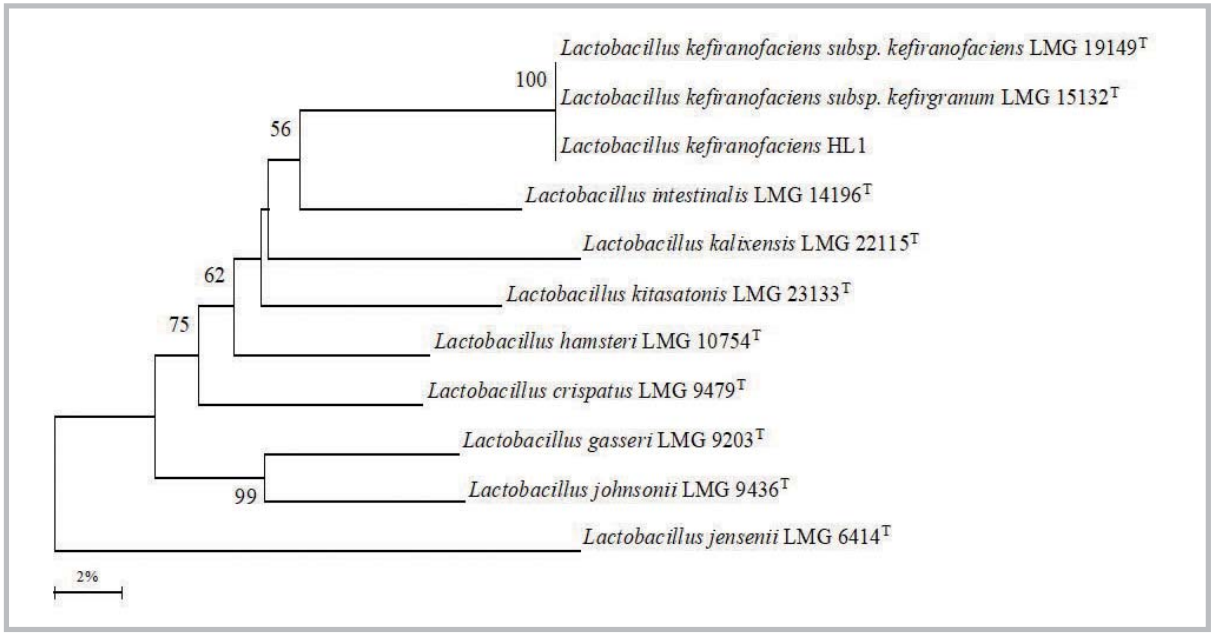
Detection of the hardness of goat Gouda cheese

Developing a novel fermented dairy product by lactic acid bacteria with Anti-oxidative and neuroprotective properties

As the medical advances and fertility declines, the global population aging issue becomes more and more severe. Hence, many countries are facing the challenge of the elderly care and disease prevention. One of the diseases has a higher occurrence in the elderly named Alzheimer's disease. Alzheimer's disease, also known as dementia, is a slowly-progressing neurodegeneration disease and worsening as disease developing. Amyloid plaques and Tau protein phosphorylation are highly related to the progress of the disease. The population of dementia in Taiwan exceeded 260,000 in 2018, and about one in every 100 people suffered from dementia. Currently, there are no drugs and nutritional supplements holding invincible evidence for prevent or reverse the disease. Only few methods could temporarily alleviate the symptoms. Thus, the patients would only rely more on others. Recently, studies found dysbiosis would accelerate deterioration of brain nerve, reduce activity, and affect longevity in Alzheimer's patient. Therefore, in this study, lactic acid bacteria will be screened by anti-oxidative and neuroprotective effects in vitro. Then, animal experiments would detect the cognitive function and beta-amyloid plaques accumulation after oral lactic acid bacteria. We anticipate to select lactic acid bacteria against Alzheimer's disease, and apply the lactic acid bacteria for novel fermented dairy product.

(C. Y. Kuo, R. H. Yeh and M. J. Chen)

Lactic acid bacteria screened and isolated from Kefir grains



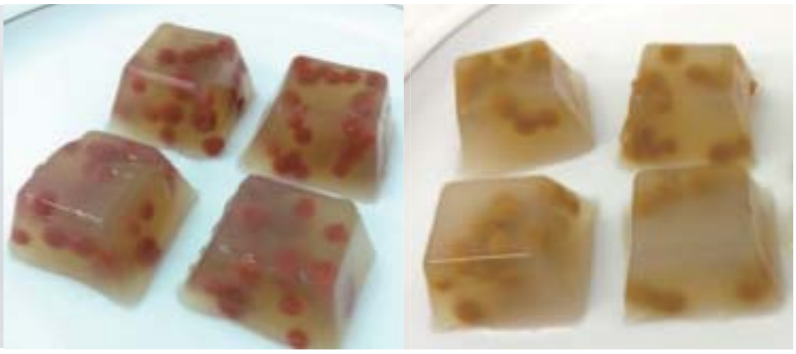
Phylogenetic tree based on housekeeping gene sequences pheS which was used to confirm the identification of the screening strains

Development of jelly-type leisure product with livestock byproduct

This study was conducted to utilize the microcapsulation on the preparation of microcapsule gel with turmeric powder and astaxanthin powder and also to investigate the effect of sodium alginate concentration (1.0, 1.5 or 2.0%) and molding speed on the pellet formation of calcium alginate gel. The development of chicken soup, which was combined with the gel jelly products, would be able to increase the utilization and value-added of livestock and poultry products. The results showed that except for the concentration of 2.0% sodium alginate combined with chicken soup, the colloid concentration was high; the speed of preparation of pellet was lower than that of the other two groups ($P < 0.05$). However, there was no significant difference between the diameter and the generation speed of the crystal granules of 1.0 and 1.5% sodium alginate concentration. The sodium alginate concentration of 1.0% had a better texture and hardness. Also, the color of pellets of turmeric powder and astaxanthin powder was good enough when 1% ratio of powders was added. Due to the result of this study, utilization of chicken soup could produce a salty and sweet flavor of leisure jelly products and could be a reference for the industry to develop relative products.

(R. J. Tu, M. R. Lee and W. S. Chen)

Slices of turmeric and powders of turmeric and astaxanthin



Jelly products with pellets of astaxanthin powder (left) and turmeric powder (right)

Development of seasoning product with livestock byproduct

The study was to investigate the appropriate ratio of culled chicken and dried cured ham for the development of seasoning powder, and to analyze of the quality and process benefits of seasoning powder by freeze or spray drying. Culled chicken with 0, 5, 10% of dry cured ham was cooked at 100 ± 5°C for 8 hours, then was filtered. After refrigerated to remove the fat, the stock broth was powdered by freezing (F) or spray-drying (S). The original broth and broth powder were sampled and analyzed the proximate composition, water activity, pH, solubility, color, microbiological detection, and sensory evaluation. The results showed that the production rates of freeze drying powders were 4.9 (F_0), 5.8 (F_5), and 7.6% (F_{10}), and the production rates of spray drying powders were only 2.1 (S_0), 2.4 (S_5), and 2.6% (S_{10}). The b* value of freeze-dried powders were higher

than those of spray-dried powders, especially the b* value of F_{10} was significantly higher than other groups. But, the L* values of spray-dried powders were higher than freeze-dried powders. The water activity of each group was lower than 0.5, and the total plate counts and *Escherichia coli* of each group were not detected. The data also showed that the time required for dissolution of F_{10} and S_{10} were lower than other groups ($P < 0.05$). According to the sensory evaluation results, the scores of flavor and total acceptance of broth with 5 or 10% of dry cured ham was higher than that of commercially available broth products.

(R. J. Tu, M. R. Lee and W. S. Chen)

Seasoning and freeze-dried powders with Chinese style flavor

Dried cured ham bought from market

Effects on quality of reformed ham with adding different starches (1/2)

This experiment was conducted to analyze the effects on quality of restructured ham adding black rice powder which replaced polyphosphate. The control group (C) was restructured ham adding polyphosphate, the H_3, H_6 and H_9 groups were restructured hams adding 3, 6 and 9% black rice powder. All treatments were analyzed the proximate composition, color, texture profile analysis (TPA), Thiobarbituric acid reactive substances (TBARS) and total plate counts. The

Black rice powder

Restructured ham added black rice powder with 0, 3, 6 and 9% (from left to right)

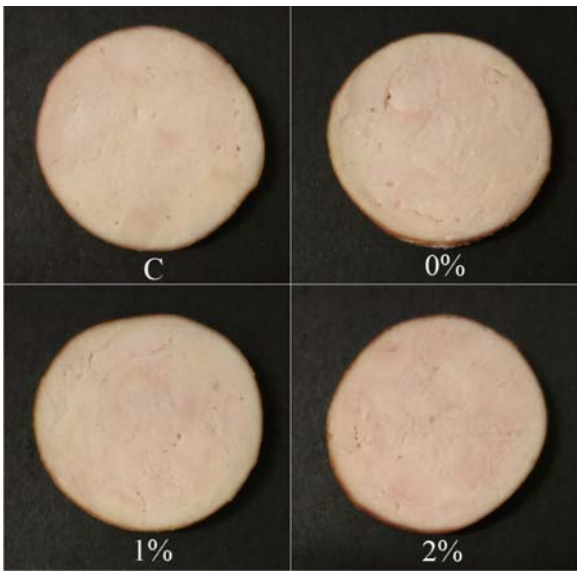
results showed the moisture of H_9 group was the lowest at 66.10%, and the crude protein content of control group was the highest at all treatment groups. The crude fat and crude ash contents of H_6 and H_9 groups were lower than control group, but there were no significant different between H_6 and H_9 groups. The L* value and b* value of H_9 were significantly lower than other groups at 50.84 and 3.06. The a* value of control group was highest but a* value of treatment groups were increasing with increasing the adding ratio, H_3 was 10.18 and H_9 was 11.76. The hardness, gumminess and chewiness of control group were highest at 4.32 kg, 3.67 kg and 3.15 kg × cm respectively. The breaking strength and ultimate elongation of sliced ham were decreased significantly with increasing the adding ratio. After storing for 2 months, there was no significant difference between control group and all treatments at TBARS and the total plate counts. In conclusion, the color, hardness and breaking strength of ham were increased when adding over than 3% rice powder due to the structure of meat plasma was effected by starch particle. In order to making the better quality of restructured ham, the adding ratio of rice powder should be lower than 3%.

(M. R. Lee, R. J. Tu and W. S. Chen)

Effects on quality of reformed ham with adding different starches (2/2)

This experiment was conducted to investigate the feasibility of replacing the polyphosphate in restructured chicken ham by red rice powder. The treatments divided into control group C (adding polyphosphate), 0% (without adding polyphosphate and red rice powder), 1% and 2% (adding 1% and 2% red rice powder). These samples were analyzed the proximate composition, color, shear force, tension, TBARS value, total plate counts and sensory evaluation. The results showed the moisture content, pH value, L and b value of 2% group were decreased ($P < 0.05$). The breaking strength of 2% group was lower than control group (1.18 N/cm) but higher than 0% group at 0.88 N/cm ($P < 0.05$). There were no significant differences at shear

Red rice powder



Slices of restructured ham added with red rice powder for replacing polyphosphate

force and cooking loss between all groups. After stored for 12 weeks at 4°C, TBARS values and total plate counts of the control group and 2% group had been the lowest and the highest respectively. There was no significant difference at sensory evaluation. In conclusion, the most qualities of restructured ham were maintained even no polyphosphate or added red rice powder in ham. In contrast to no polyphosphate ham, there was still higher breaking strength at ham slice adding red rice powder to provide better product quality. In conclusion, replacing part of polyphosphate by rice powder could be a feasible method.

(M. R. Lee, R. J. Tu and W. S. Chen)

Development of seasoned and modified processing technology in multiple livestock products for seniors

The experiment was conducted to develop tenderized animal product combination meal including a low-fat meat ball with soy sauce (meat balls), a pig-chicken mixed softened burger (pig-chicken burgers), a green papaya tenderized pig tenderloin (pig tenderloins), a pineapple tenderized chicken leg strip (chicken leg strips) and tenderized braised beef shank (beef shanks). The analysis items included approximate composition (moisture, crude protein, crude fat, and ash), oxidized acid value (TBA value), total plate count, and sensory evaluation (tenderness, juiciness, and total acceptability). The results showed that the meat balls and pig-chicken burger products contained 10% of the pork back fat, so the crude fat content was higher than other products. The freezing period was 3 months. As the storage period prolonged, the TBA value lue of various meat products increased. The highest TBA value was 1.13 mg/kg of beef shanks, followed by 1.03 mg/kg of pig-chicken burgers. During the 3 months of frozen storage, the total plate count in various processed meat products was quite low, which also met the standards of food hygiene regulations. Moreover, the tenderness of the sensory evaluation is quite popular among the tasters, and the total acceptance of the meat products of different products is quite high, indicating that the product combination meal has the potential of commercial application.

(W. S. Chen, R. J. Tu and M. R. Lee)

Pig-chicken burger products

Low-fat meat ball with soy sauce

Value-added and reused the remaining materials for slaughtering and processing -Extraction of peptides powder from pig lungs, pancreas and spleen

The purpose of this study was to extract peptide powder from pig viscera which was less utilized after slaughter. Peptide powders were heating extracted and then frozen drying from pig lungs, pancreas and spleen, respectively, and the yield, proximate composition, water activity, color, total plate count, peptide contents, antibiotics, heavy metals (lead, cadmium, zinc, iron, selenium) of these products were measured. The results showed that the yield of peptide powder from pig lung was higher than those from pig pancreas and spleen. The water activity of the three powders was lower than 0.5. Spleen powder was higher significantly than lung and pancreas powders in Hunter a value, but, pancreas powder was higher than lung and spleen powders in Hunter L and b values ($P < 0.05$). The peptide contents of lungs, pancreas and spleen were 73.4, 205.3 and 88.2 mg/mL, respectively. The total plate count (TPC) was detected in one-month storage during chilled storage. Except that TPC was 2.8 log CFU/g in spleen powder, TPCs of lung and pancreas were non-detected. Moreover, the results of heavy metals were negative for lead and cadmium, and the iron contents of lungs, pancreas and spleen were 0.5, 0.4 and 7.0 mg/100g, respectively. However, zinc content was 4.4 ppm found in pancreas powder.

(W. S. Chen, R. J. Tu and M. R. Lee)

Pig viscera extract (left to right: lung, spleen and pancreas)

Powders from pig viscera extract (left to right: lung, pancreas and spleen)

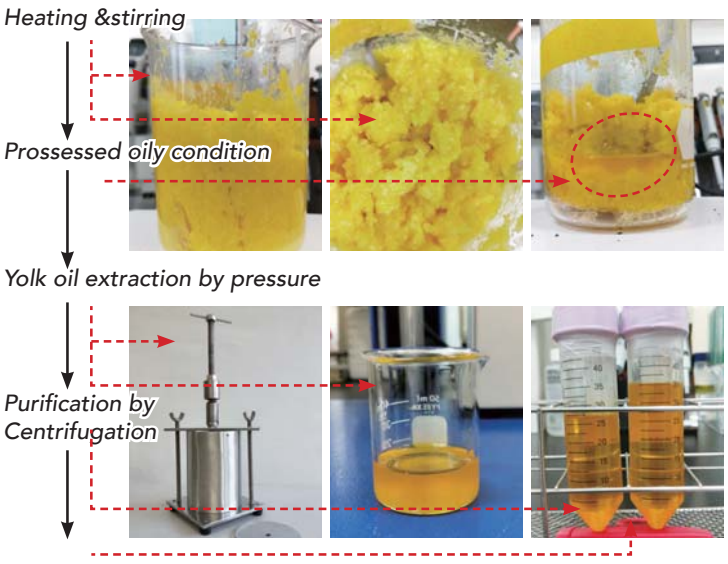
Studies on the manufacture of yolk oil using protease hydrolysis of chicken egg yolk

The objective of this study was to promote the quality of the yolk oil by protease hydrolysis of chicken egg yolk and to establish the yolk oil process with low temperature. Liquid chicken yolks were obtained from egg breaking plants carried out stirring and heating after homogenized. Addition of 0.15% protease A (Grain-root Corp.) to liquid yolk when its temperature was up to 45°C. Another 0.15% papain (Amano Enzyme Inc.) and 0.15% bromelain (MasterAsia Marketing Co., LTD) were added to the yolk which temperature was up to 55°C and the moisture content was down to 40 – 42%. Then proceeded with stirring and heating until the temperature was up to 75 – 80°C. At the moment, yolk possessed oily condition and its

viscosity decreased. Sequentially the yolk was expressed oil by squeezer. Another treatment was addition of all three proteases together to the yolk which temperature was up to 55°C, and expressed oil at same condition. The control was processed at the same condition without any protease added. Results showed two-stage protease adding way was better than one-stage protease adding way. The oil yield of two-stage adding way was about 27.3% increase compared to that of one-stage adding way. The lipid content of that yolk oil was close to 99%, and their TBARS values were stable for six months storage at 5 – 7°C.

(Y. C. Chen, L. T. Wu and W. S. Chen)

Liquid egg



Processing of yolk oil designed by LRI

Studies on the functional properties of cleanser with chicken eggshell powder

The objective of this work was to develop the facial cleanser with chicken eggshell powder. Eggshells were obtained from Tainan egg product company and processed to rinse for membrane out, stir-fried dry, and then get two particles sizes of 0.177 – 0.150 mm and smaller than 0.150 mm after screening. 4 base formulae of cleanser were done including 2 saponification styles (SS) and 2 gelation styles (GS). The viscosities of SS were higher than GS (930 – 1,200 mPa.s vs 700 – 850 mPa.s). The foaming and extended properties of SS were better than GS (10 – 11 cm^3/ml vs 8.8 – 9.6 cm^3/ml, 20 – 23 cm^3/ml vs16 – 18 cm^3/ml). SS creams were alkaline owing to display pH

Facial cleanser with chicken eggshell powder

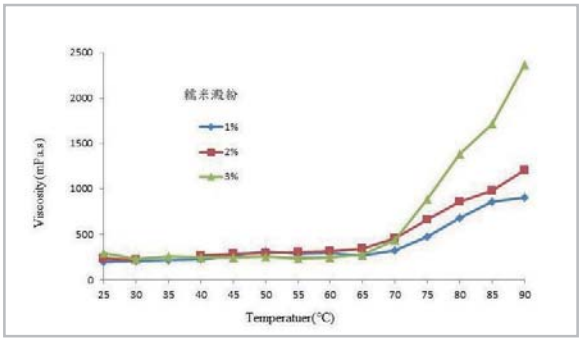
9.3 – 9.6. GS gels were acidity (pH 4.1 – 4.9). The gel structure of GS would be collapsed after eggshell powder added and mixture, and that made the viscosity decrease. SS still kept their cream structure. Evaluation test showed the better of those cleansers with 1 – 3% 0.177 – 0.150 mm particle eggshell powder and 3 – 7% smaller than 0.150 mm particle eggshell powder.

(Y. C. Chen and L. T. Wu)

Development of the seasoning dipper products by using fermented salted duck egg white

This experiment used the all product homogenous mixture of fermented salted duck egg white (AFSDEWPs) as raw material sauce, and added 20% distilled water into AFSDEWPs as the original sauce paste recipe (AFSDEWPs recipe) to add starch thickening test. The results showed that the gelatinization temperature of potato starch, corn starch and waxy rice starch added to the AFSDEWPs recipe was 65°C, 75°C and 70°C respectively, and the treatment added 3% potato with the highest viscosity (2,878.5 mPa. s), followed by 3% rice treatment (2,364.3 mPa. s) and added 2% potatoes, corn and rice starches treatments those viscosities were all of more than 1,000 mPa.s; The colloidal behavior of potato starch in the AFSDEWPs recipe was negative set-back value (the set-back ratio was less than 1), indicating that the viscosity after paste cooling was less than the paste gelatinization viscosity, and the set-back value of corn and waxy rice starch was positive (except 1% corn starch addition treatment). That indicated an increase in viscosity after paste cooling. In the 3% corn and waxy rice starch added treatments of process test results showed that the paste viscosity of the un-gelatinized process treatment is higher than the gelatinized process, especially added waxy rice starch treatment and those viscosity as high as 7,139 mPa.s that increased by about 2.2 times, and also the sauce paste added 3% waxy rice starch by the un-gelatinized process could get satisfactory evaluation results, and no pathgens was detected during storage at chill temperature for 1 month.

(Y. C. Chen, L. T. Wu and W. S. Chen)



The effect of different kinds and amounts of waxy rice starch on the properties of the paste gelatinization

The sauce paste of fermented salted duck egg white (A: corn starch- gelatinized process; B: corn starch- ungelatinized process; C: waxy rice starch- gelatinized process; D: waxy rice starch- ungelatinized process)

02

Research Projects in Progress

Animal Breeding and Genetics

1. Health risk assessment and product safety of livestock fed genetically modified feed
2. Development of a genome and trait database for the breeder of poultry
3. Intensification of breeding stock performance and breeding system and industry application of poultry
4. Study abroad for the maintenance and utilization of genetic diversity of breeding stocks in farm animals
5. Study abroad of breeding and genetic selection in geese
6. Cooperation Study on Breeding Project of Heattolerant Dairy Cows and Milk Quality Analysis for Tropical Climate ASEAN Countries
7. The exchange about genome-wide association study and genomic selection in poultry
8. The genomic evaluation system for Taiwan heattolerant dairy cattle
9. The breed recording of Yuan-Hsin cattle germplasm
10. Technology Improvement for Production of Gene Selected Livestock and Poultry After Coping with Adversity Climate
11. Establishment of Genetic Database of Disease Tolerance Trait and Innovation of Value Chain in Breeding Stocks of Farm Animals
12. Research and Application of Value-Added Products of Genetic Material of Breeding Livestock and Poultry Industry
13. On farm test of reproduction traits and meat quality gene screening for male goats.
14. Selection and application of longer duration of fertility in Pekin duck
15. Cryopreservation and application of semen in excellent deer
16. Study on the relationship between goat heat tolerance and heat stress gene polymorphism
17. Construction of Taiwan Farm Animal Genetic Resources Database
18. The conservation of Taiwan water buffalo and gene polymorphic analysis
19. Preservation and Application of Genetic Resources in Taiwan Yellow Cattle
20. Genetic resources conservation and genetic monitoring of ducks
21. Collection and preservation of forage germplasm - the study on DNA molecular markers applied to the breeding of napiergrass
22. Conservation and Utilization of Genetic Resource of TLRI Chickens

23 Conservation, utilization, and analysis of diversity in domestica Black Swan

24 Laboratory Rearing and Germplam Conservation of Minipigs

25 Breeding of biomedical Micropig

26 Selection a hybrid native chicken from LRI Kaohsiung native chicken No.9 with Kaohsiung native chicken No.12

27 Analysis of genetic structure in White Roman geese

28 The selection of black pigs with HH6 haplotype of H-FABP gene

29 Selection of optimized cow herd by using genome selection technology

30 Selection of the pure cockfighting breed

31 Selection and breeding of silky chickens with blue shell eggs

Animal Nutrition

1 Development of novel anti-stress metabolic molecules for livestock husbandry and healthcareDevelopment of novel anti-stress metabolites as livestock and animal health care

2 Development of novel anti-stress metabolic molecules for livestock husbandry and health careDevelopment of porcine anti-stress probiotic and related products in husbandry animals

3 Process development of traceable chitosan products as feed additive from black solider fly

4 Evaluation of health care on economic animals with purpureal napiergrass-Theme (1) Screening of traditional medical herbs for dietary supplements

5 Evaluation of anti-inflammatory effects and effective fractiontion of purpureal napiergrass

6 Establishment of extraction and drying technology for purple napiergrass

7 Development of duck feed additive products with polysaccharides from the black fungus by-product

8 Evaluation of black fungus polysaccharides on duck digestibility and intestinal gut bacterial flora growth

9 Development of novel anti-stress metabolic molecules for livestock husbandry and health care

10 Nutritional strategies to improve udder health and transition reproduction in dairy cows

11 A development on production traceability of feed additive production process of black soldier fly oil and chitin

12 Construction of the platform for feed additives pilot production to improve livestock health (III)

13 Research and development on commercialization of Bacillus coagulans as feed additives

14 Evaluation of health care on economic animals with purpureal napiergrass grass

15 Development of a healthy pellet diet containing Napier grass meal for Herbivore companion animal

16 The plant antibiotic feed supplements for dairy udder health

17 Application of Lycium chinense Miller for health care and commercialization in geese

18 Application of Phytogenics in Pigs

19 Screening and application of potential probiotics and deodorizing bacteria from livestock environments

20 Application of forage biochar and biochar vinegar to develop health care products for animals and the odor reduction effect assesment

21 Establishment of Immunity model and effect evaluation of piglets by the addition of native herbal extracts

22 Combinatory products fermented by Bacillus natto with fungus supplementation improvement on the growth performance and diarrhea incidence of piglet

23 Nutritional strategy for improving laying performance and egg quality in hot season and second laying period of hens

24 Effects of medium-chain fatty acids on pigs in heat stress

25 Developement of microbial metabolites as animal feed additive

26 Determination of arsenic species and accumulation in carcasses and feces of broiler by HPLC-ICPMS

27 Application of Bacillus subtilis to improve diet digestibility and growth performance of broilers

28 Application black soldier flies to recycling of surplus agriculture and livestock resources

29 Pilot production of housefly larvae fed on agricuture by-products as livestock feed resource

30 Application of feeding and nutrition technology to improve the productive efficiency of breeding geese in the environmental control house

31 Comparison of goat carcass and meat characteristic among different feeding systems

32 The study on weaning calves use different treatments: Effect on feed, weight gains, behavior signs and milk performance

33 Establishment of the analysis methods for heavy metal in complete feed and their background levels

Animal Physiology

1. The study of porcine induced pluripotent stem cells on the human vascular diseases
2. Study on the application of waterfowl iPSC cell line in vaccine production
3. The establishment of feeder-free culture system on porcine induced pluripotent stem cells
4. In Vitro Differentiation Potential of germ cells from Avian induced pluripotent stem cells
5. Study on vitrification of pig oocytes and embryos in pigs
6. The investigation and analysis of reproductive performance and restriction or ad libitum feeding on growth performance of biomedical Lanyu pig
7. Study of miRNA regulation on sex-determining gene in chicken embryo
8. Association of HSPs with semen performance after freezing of goat
9. Effects of different oocyte sources and components of in vitro maturation medium on in vitro production efficiency of goat embryos
10. Effect of environmental temperature on metabolism and reproduction in animals and plants
11. Investigation on physiological characteristics of swine in hot and cool seasons
12. Investigation on physiological characteristics of herbivores in hot and cool seasons
13. Investigation of physiological characteristics in poultry in the hot and cool seasons
14. Effects of pre-mature oocyte culture on in vitro maturation and subsequent developmental ability of bovine oocytes
15. Studies on monitoring pathogen of biomedical Lanyu pig
16. Establishment of rabbit production and supply system for quality experiment
17. Investigation on artificial hatching period of ostrich eggs
18. Effect of grazing at night on milk performance and locomotion score of Holstein dairy cows under the high temperature-humidly index (above 72)
19. Construction reproductive management modeling of dairy cattle under hot and humid environment
20. Study on the pregnancy test of pregnancy associated glycoproteins (PAG) detection in milk sample

Processing of Animal Products

1. Value-adding and reusing the remaining materials for slaughtering and processing- development of collagen drinks and powder products using animal viscera as raw materials
2. Developing a novel fermented dairy product with antioxidative and neuroprotective properties lactic acid bacteria
3. Development of ready-to-eat meat product of colored broiler
4. Development of concentrated jelly type product with low production breeder broilers and goat byproducts
5. Study on the processing technology of flavor shell eggs
6. Studies on the manufacture of yolk oil by pressure and their quality researches
7. The study of cheese ripening conditions of domestic goat Gouda cheese
8. Effects of processing conditions on lipase activity and flavor in goat milk
9. Comparison of carcass and beef characteristics among Taiwan Yellow Cattle and its crossbreds
10. Value-added and reused the remaining materials for slaughtering and processing - Extraction of gelatin powder from pig lungs, pancreas and spleen

Livestock Management

1. The agriculture and animal husbandry circular management model in the irrigation of the livestock wastewater
2. Co-construction of biogas plant in livestock wastewaster treatment system
3. Techniques of Recycling and Value-added by Charring for the Livestock Waste
4. Value-added and reuse from poultry manure
5. Study of the pretreatment of manure drying in livestock farms
6. Optimizing high-efficiency microalgae conversion technology for swine wastewater and high-value byproducts application
7. Evaluation, management and promotion of research effectiveness for the integrative project

8 The dry fermentation technology and biogas circular application of the swine recycling area

9 Addition and reuse of microalgae wastewater treatment

10 Establishment of precise feed for pigs and manure and urine irrigation feed crop of production technology

11 Establishment of the thermal imaging database for dairy cattle disease

12 The analysis of training effectiveness and the status of engaged in livestock husbandry

13 Research on the effectiveness of counseling andagricultural risk assessment of Taiwan young farmers operating livestock industry

14 Development and application of pilot robotics in raw milk production industry

15 The development of sensing and pre-analysis system for swine health monitoring and housing environment

16 The adaptation for livestock production in high temperature climate

17 The platform of strategy for livestock under climate change

18 Establishment of dairy cow's hoof health management model to improve the incidence of dairy hoof disease

19 Application of friendly environment to improve goat hoof traits

20 Effect of raising environment on the health of hooves and legs of breeding sows

21 Study on the application of friendly environment to improve the healthy legs of broiler

22 Investigation on improving duck's foot health by application of environment friendly production

23 Study of the feeding mode about decreasing the ratio of footpad dermatitis in geese

24 The study of the intention of livestock industry to produce animal welfare products and purchase intention of onsumers

25 Establish the humane supply system of the deer production

26 Maintenance and production improvement in mimimal diseases geese

27 Study on stable supply and production efficiency improvement of minimal disease Muscovy duck

28 Evaluation of energy conservation and carbon reduction strategy for different types of pig house

29 Evaluation of the treatment models of wastewater and odor from the pig house with slot floor and wet pad cooling system

30 The reduction and resourcezation of anaerobic sludge

31 The evaluation of irrigation of swine anaerobic wastewater at the pasture area

32 Establishing the indoor production model of mule duck

33 Improvement of hatched chick numbers of LRI silky chicken

34 Study of improving the feather pecking and leg weakness condition with indoor raising in meattype geese

35 Reinforcement of pig industry by upgrade of counseling program

36 The strategy evaluation and improvement method for increasing survival rate of pig farms with over 5,000 heads

37 Study on animal behavior and milk quality by utilizing robotic feed handling system

38 Smart grazing of beef cattle

39 Strengthening the medication safety of chicken and production techniques of safety eggs

40 Development of high bio-security and intelligent monitoring management system in poultry

41 The development of intelligent systems for poultry oriented image sensing and environment monitoring in poultry house for epidemic prevention

42 Development of non-invasive dairy disease detection services

43 A feasibility study of applying thermal imaging technology to detect the health status of captive sambar deer

44 Application of pig farm intelligent epidemic prevention management system

Forage Crop

1 Application of weather prediction system in the production of pangolagrass and forage corn

2 Breeding of napiergrass new lines

3 Breeding of nilegrass (Acroceras macrum) elite lines

4 Forage corn breeding

5 New cultivar breeding of forage soybean for intercropping

6 Change of anti-nutrients and evaluation of utilization benefits of forage sorghum

7 The development of prompt drying grass technology for the companionate animals

8 Feasibility assessment for forage use of featured crops

9 Evaluation of quality-protein maize for forage use

10 Development of the forage utility system with the residue substrate of king mushroom cultivated by napiagrass

11 Establishment and evaluation of feeding domestic gramineae-legume mixture for goats

03

Technical Service

Paper Published in Journal of Taiwan Livestock Research

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- Determination of hematological parameters in miniature pigs
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- The Feeding Value of NPcv.TS3 and NPcv.TS7 for Lactating Dairy Goats
  Geng-Jen Fan, Tzu-Rung Li, Tzong-Faa Shiao and Churng-Faung Lee
- Study on forage yield, quality and ensiling of black oat harvested on different days
  Ming-Hung Chu, Shu-Min Wang, Tsui-Huang Yu and Chia-Sheng Chen
- Establishment of a DNA vector system for doxycycline-inducible and β-cell-specific transgene expression
  Jiun-Shuan Chao, Chiun-Jye Yuan and Yu-Shine Jea
- Evaluation of quality protein corn on egg production performance and egg quality of native chicken hens
  Yih-Fwu Lin, Che-Ming Hung, Min-Yang Tsai, Yu-Ru Chen and Hsin-Tsung Huang
- The fate and distribution of antibiotic residues and tetracycline resistance genes in pig manure and wastewater
  Mei-Ping Cheng, Ting-Hsun Hsiao and Ren-Bao Liaw
- Evaluation of sesbania for forage use
  Shyh-Rong Chang, Sua-Fyuan Yen and Chi-Hsin Lu
- Inheritance of coat color in piglets of Meishan and Duroc crosses in favor of black coat selection
  Shen-Chang Chang, Chin-Bin Hsu, Min-Jung Lin, Hsien-Jung Huang, Han-Sheng Wang, Hsiu-Lan Lee, Cheng-Yong Lin, Chih-Hua Wang, Ming-Che Wu and Hsiu-Luan Chang
- The effect of different rearing environment on two-way crossbred mule duck's growth performances and carcass traits
  Chin-Hui Su, Yu-An Lin, Tsai-Fuh Tseng, Chih-Hsiang Cheng, Jeng-Fang Huang, Hsiu-Chou Liu and Jung-Hsin Lin
- Effects of floor types on growth performance of grower-finisher pig and pig house's, wastewater quantity and quality during cool season
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  Sheng-Yang Wu, Ting-Chieh Kang and Chia-Chieh Chang

- Establishment of induced pluripotent stem cell lines in chicken
  Jenn-Fa Liou, Yu-Jing Liao, Ting-Chieh Kang, Jen-Wen Shiau, Yow-Ling Shiue and Lih-Ren Chen
- The recycling and processing method on hatched waste eggshell of goose
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- Effect of oat silage substitute on lactation performance of Holstein lactating cows
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- Effects of the compositions of bulking agents on the composting of layer excreta
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- Effects of cryopreservation method on the development of caprine *in vivo* blastocysts
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- The effects of metabolizable energy and crude protein diets on growth performance of juvenile ostriches
  Hsi-Wen Hung, Pi-Hua Chuang and An-Kuo Su
- Evaluation of the effect of dietary betaine supplementation on the reproductive performance of lactating sow rearing under different temperatures
  Chung-Wen Liao, Herng-Fu Lee and Tsui-Ching Yang
- Effects of oocyte recovery methods and culture media on the development of *in vitro* produced caprine embryos
  Hsin-Hung Lin, Jang-Chi Huang, Ting-Chieh Kang, De-Chi Wang, Ting-Yung Kuo, Shann-Ren Kang, Shyh-Shyan Liu, Bing-Tsan Liu, Shao-Yu Peng and Perng-Chih Shen

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- Analysis of Blood Biochemical Parameters in Lanyu pigs
  Sheng-Yang Wu and Chia-Chieh Chang
- An historical overview on the development of pluripotent stem cell technology
  Yu-Jing Liao, Pin-Chi Tang, Lih-Ren Chen and Jenn-Rong Yang
- Impact of different THI levels on milk yield and composition of Holstein dairy cows
  Chun-Ta Chang, Tzong-Faa Shiao, Der-Wei Yang, Yih-Fwu Lin, Churng-Faung Lee, Ling-Tsai Wu and Szu-Han Wang
- Study on forage palatability: I. The response of goat to forage with adding sugar, organic acids, changing the water soluble carbohydrate and ensiling
  Chia-Sheng Chen, Shu-Min Wang and Tsui-Huang Yu
- The effect of diet supplemented with fermented feedstuff (FF) and natto and fungal fermentative

products (NF) on antler velvet weight, content and immunity in Formosan sambar deer
I-Heng Chang, Shin-Hung Lin and Cheng-Yung Lin

- Effect of Zn and Cu and Mn supplementation on locomotion score and performance of Holstein cows under high temperature-humidity index
Chun-Ta Chang, Tzong-Faa Shiao, Szu-Han Wang, Ling-Tsai Wu, Ming-Yang Tsai, Churng-Faung Lee and Yih-Fwu Lin

- The characteristics of pangolagrass biochar and its effect on forage production
Shu-Min Wang, Hsin-Hung Liu, Tsui-Huang Yu and Chia-Sheng Chen

- Economic benefit evaluation of activating fallow farmland to plant oats as winter season crop in Taiwan
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- Effect of dietary supplementation of *Agaricus blazei* Murill culture silage on milking performance of Holstein lactating cows
Yi-Hsuan Chen, Yi-Ming Chen, Szu-Han Wang and Shu-Min Wang

- Research on management capacity management ability to young farmers in Taiwan livestock farm
Bin-Yeong Wang and Yu-I Lai

- Effect of dietary crude fiber content in late-gestating period on the reproductive and lactating performance of first parity sows
Chung-Wen Liao, Tsui-Ching Yang and Herng-Fu Lee

- Effects of TN57 sweet potato chip in diet on egg production and characteristics of Isa Brown hens
Shen-Shyuan Yan, Pi-Hua Chuang and An-Kuo Su

- Effect of domestic swan oat hay feeding on dry matter intake, body weight, milk yield and milk quality of Holstein lactating cows
Szu-Han Wang, Yih-min Shy, Chun-Ta Chang and Jen-wen Shiau

- Effects of diet mixed wet sorghum distillery residue on growth performance, intestinal characteristics, blood parameters, and immunoglobulin concentration in male Taiwan black feather native chickens
Yieng-How Chen, Bor-Ling Shih and Ping-Hung Lin

- The effect of inoculation of alfalfa haylage on its palatability
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- Effects of concentrate and plant extracts mixture on intake willingness in goat
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- Effects of different disinfection treatments on microorganisms and hatchability of Brown Tsaiya ducks' eggs
  Chih-Hsiang Cheng, Chin-Hui Su, Hung-Yi Wu, Hsiu-Chou Liu and Jung-Hsin Lin
- Evaluation of Sorghum Cultivar for Forage Production
  Po-Yu Chen
- The effect of the nest type on the nest egg ratio of the white Roman geese
  Chin-Meng Wang, Ching-Yi Lien, Sheng-Der Wang, Min-Jung Lin, Chih-Chang Hsiao and Tsung-Yi Lin
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  Liang-Yuan Wei, Wei-Beng Chang, Jih-Yih Chen, Chin-Hui Su, Yi-Ying Chang, Xiao-Heng Xu, Mei-Fong Lin and Hsiu-Chou Liu
- The genetic performance of fertile eggs in Pekin duck after eleven generations of selection for the duration of fertility
  Jih-Yi Chen, Liang-Yuan Wei, Wey-Peng Chang, Yi-Ying Chang and Hsiu-Chou Liu

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  Chia-Chieh Chang and Sheng-Yang Wu
- Effect of *Lactobacillus* spp. inoculation on the silage quality of rice (*Oryza sativa* L.) grain
  Bo-You Chen, Chin-Jin Hou, Chi-Hsin Lu and Jeng-Bin Lin
- Effect of adding Napiergrass powder and alfalfa pellet powder in the diet on the egg production, yolk color and blood parameter of ISA hen
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- Effect of Zn and Cu and Mn supplementation on milk composition and blood traits of Holstein cows
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- Lactating performance and calf weaning weight of straightbred Santa Gertrudis, and Brahman cows and their crossbred cows sired by Gelbvieh
  Jia-Shian Shiu, An-Kou Su, Po-An Tu, Shyuan-Chuen Yang and Guang-Fuh Li

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- The study on the colostrum quality at different parities of Holstein cows and the weekly change of body weight and blood parameters of the calf
  Szu-Han Wang, Chun-Ta Chang and Jenwen Shiau
- Comparison of palatability by goat fed on domestic alfalfa processed by different conditions
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- Breeding of the new forage sorghum variety "SB cv. KT1"
  Min-Lang Chang and Li-Jen Liao
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  Churng-Faung Lee, Geng-Jen Fan, Bor-Ling Shih, Shu-Min Wang, Tzong-Faa Shiao and Chun-Ta Chang
- Effects of dietary crude protein and metabolizable energy levels on the growth performance of White Roman Geese between 4 and 8 weeks of age
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- The effect of metabolizable energy intake on the egg production and egg quality for brown layers in cage during laying period
  Cheng-Yung Lin, Hsiao-Yun Kuo and I- Heng Chang
- The investigation of ostrich behaviors during the growing periods
  Pi-Hua Chuang, Hsi-Wen Hung, Yi-Ting Chen and An-Kuo Su

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Paper Published in Other Journals

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Scientist sent abroad for advanced study,investigation, or participation in international symposia

Position	Name	Subject	Country	Date
Director General	Jeng-Fang Huang	Conference of International Committee for Animal Recording (ICAR) and World Congress on Genetics Applied to Livestock Production (WCGALP)	New Zealand	Feb. 5-11, 2018
Researcher and Chief of Division	Ming-Che Wu	Conference of International Committee for Animal Recording (ICAR) and World Congress on Genetics Applied to Livestock Production (WCGALP)	New Zealand	Feb. 5-16, 2018
Researcher and Director	Hsiu-Chou Liu	Taiwan-Indonesia Comprehensive Agriculture Demo Modern Farm Workshop	Indonesia	Feb. 5-8, 2018
Researcher and Chief of Division	Yih-Fwu Lin	Establishment and recent development of livestock welfare and friendly environment in Australia	Australia	Mar. 9-17, 2018
Director General	Jeng-Fang Huang	Taiwan-United States Agricultural Science Cooperation Conference And Exchange Activities	United States	Apr. 13-23, 2018
Assistant Researcher	Yu-I Lai	Investigate the value-added applications of agricultural R & D results in Thailand	Thailand	Apr. 16-20, 2018
Associate Researcher and Chief	Szu-Han Wang	The study trip of dairy industry and Agritech conference in Israel	Israel	May 5-13, 2018
Assistant Researcher	Yi-Hsuan Chen	The study of milking robot in Netherlands	Netherlands	Jun. 3-11, 2018

Position	Name	Subject	Country	Date
Assistant Researcher and Chief	Min-Jung Lin	Animal health and preventive veterinary medicine of waterfowl farming system in Hungary	Hungary	Jun. 9-17, 2018
Assistant Researcher	Chia-Jung Lee	Animal Health and Welfare. Residential Course of Ecole Nationale des Services Vétérinaires in 2018	France	Jun. 18 - Jul. 6, 2018
Researcher	Fang-Chuch Liu	The 2018 NACS Overseas Training Programme.	Belgium	Jun. 23-30, 2018
Director General	Jeng-Fang Huang	The 18th Asian-Australasian Association of Animal Production Societies Animal Science Congress	Malaysia	Jul. 30 - Aug. 6, 2018
Researcher and Chief of Division	Ming-Che Wu	The 18th Asian-Australasian Association of Animal Production Societies Animal Science Congress	Malaysia	Jul. 31 - Aug. 5, 2018
Researcher and Chief of Division	Lih-Ren Chen	The 18th Asian-Australasian Association of Animal Production Societies Animal Science Congress	Malaysia	Jul. 31 - Aug. 5, 2018
Researcher and Chief of Division	Jeng-Bin Lin	The 18th Asian-Australasian Association of Animal Production Societies Animal Science Congress	Malaysia	Jul. 31 - Aug. 5, 2018
Associate Researcher and Chief	Shen-Chang Chang	The 18th Asian-Australasian Association of Animal Production Societies Animal Science Congress	Malaysia	Jul. 31 - Aug. 5, 2018

Position	Name	Subject	Country	Date
Associate Researcher	Shui-Tsai Chen	The 18th Asian-Australasian Association of Animal Production Societies Animal Science Congress	Malaysia	Jul. 31 - Aug. 5, 2018
Assistant Researcher	Yu-Hsin Chen	The 18th Asian-Australasian Association of Animal Production Societies Animal Science Congress	Malaysia	Jul. 31 - Aug. 5, 2018
Assistant Researcher	Tzu-Rung Li	The 18th Asian-Australasian Association of Animal Production Societies Animal Science Congress	Malaysia	Jul. 31 - Aug. 5, 2018
Assistant Researcher	Hsiu-Lan Li	The 18th Asian-Australasian Association of Animal Production Societies Animal Science Congress	Malaysia	Jul. 31 - Aug. 5, 2018
Assistant Researcher	Hsiu-Lien Lin	The 18th Asian-Australasian Association of Animal Production Societies Animal Science Congress	Malaysia	Jul. 31 - Aug. 5, 2018
Assistant Researcher	Geng-Jen Fan	The inspection mission of production, marketing and quality of U.S. corn in 2018	United States	Aug. 18-26, 2018
Researcher and Director	Hsiu-Chou Liu	Leaping Solutions for Advanced Civil Service Training-107 Management Development Training	United Kingdom	Sep. 2-15, 2018
Researcher	Ren-Bao Liaw	The abroad study on circular economy in 2018	United Kingdom and Netherlands	Sep. 8-22, 2018

Position	Name	Subject	Country	Date
Director General	Jeng-Fang Huang	The exchange about biogas electricity and greenhouse gas reduction of manure in livestock and poultry	New Zealand	Sep. 20 - Oct. 1, 2018
Associate Researcher	Hsin-Jung Lee	The exchange about biogas electricity and greenhouse gas reduction of manure in livestock and poultry.	New Zealand	Sep. 20 - Oct. 1, 2018
Researcher and Chief of Division	Churng-Faung Lee	The exchange about biogas electricity and greenhouse gas reduction of manure in livestock and poultry	New Zealand	Sep. 20 - Oct. 1, 2018
Junior Technical Specialist	Ya-Ling Huang	The exchange about biogas electricity and greenhouse gas reduction of manure in livestock and poultry.	New Zealand	Sep. 20 - Oct. 1, 2018
Associate Researcher	Shyh-Rong Chang	Study of the breeding and production technique of environment-friendly cultivated forage corn	Mexico	Oct. 2-15, 2018
Researcher and Chief of Division	Ming-Che Wu	Study on Usage of Farm Animal Breeds and Farming Equipment from Taiwan in ASEAN Countries: Philippines	Philippines	Oct. 16-24, 2018
Junior Technical Specialist	Chuan-Wei Tsao	Study on Usage of Farm Animal Breeds and Farming Equipment from Taiwan in ASEAN Countries: Philippines	Philippines	Oct. 16-24, 2018
Assistant Researcher	Hsiu-Lien Lin	Study on Usage of Farm Animal Breeds and Farming Equipment from Taiwan in ASEAN Countries: Philippines	Philippines	Oct. 16-24, 2018

Position	Name	Subject	Country	Date
Associate Researcher	Yih-Min Shy	The 9th international conference on mushroom biology and mushroom products	China	Nov. 12-19, 2018
Assistant Researcher	Yi-Ying Chang	Study Abroad of Genome-Wide Association Study (GWAS) and Genomic Selection in Poultry	France	Nov. 19 - Dec. 8, 2018
Researcher	Der-Yuh Lin	Study abroad of Genome-Wide Association Study (GWAS) and Genomic Selection in Poultry	France	Nov. 19 - Dec. 8, 2018
Researcher and Chief of Division	Ming-Che Wu	The 12th Taiwan-Vietnam Agricultural and Fishery Cooperation Meeting	Vietnam	Dec. 10-14, 2018
Researcher and Director	Hsiu-Chou Liu	Taiwan-Indonesia Comprehensive Agriculture Demo Modern Farm Workshop	Indonesia	Jan. 7-10, 2019
Director General	Jeng-Fang Huang	To Conduct A Survey Of Poultry And Correlated Industry In Honduras	Honduras	Jan. 15-24, 2019
Associate Researcher	Po-An Tu	Speaker: The Regional Workshop on Underutilized Animal Genetic Resources and their Amelioration - East Asia	Malaysia	Mar. 3-7, 2019
Researcher and Chief of Division	Wen-Shyan Chen	To participate in Japan International Food Exhibition and visit the Agricultural College of Hokkaido University and functional Strain Development Company	Japan	Mar. 6-17, 2019

Position	Name	Subject	Country	Date
Associate Researcher	Yu-Chun Lin	To participate in Japan International Food Exhibition and visit the Agricultural College of Hokkaido University and functional Strain Development Company	Japan	Mar. 6-17, 2019
Researcher and Chief of Division	Ming-Che Wu	Cooperation Study on Usage of Farm Animal Breeds and Farming Equipment from Taiwan in ASEAN Countries: Vietnam	Vietnam	Mar. 10-16, 2019
Assistant Researcher	Chiao-Chien Chu	Cooperation Study on Usage of Farm Animal Breeds and Farming Equipment from Taiwan in ASEAN Countries: Vietnam	Vietnam	Mar. 10-16, 2019
Junior Technical Specialist	Chuan-Wei Tsao	Cooperation Study on Usage of Farm Animal Breeds and Farming Equipment from Taiwan in ASEAN Countries: Vietnam	Vietnam	Mar. 10-16, 2019
Assistant Researcher	Yi-Hsuan Chen	The study of milking machine test in New Zealand	New Zealand	Mar. 11-24, 2019
Researcher and Chief Secretary	Mei-Ping Cheng	The 18th Taiwan-Netherlands Agricultural Working Group	Netherlands	Mar. 24-29, 2019
Researcher and Chief of Division	Churng-Faung Lee	Study of dairy goat nutrition management and animal health in France	France	Apr. 22 - May 5, 2019
Assistant Researcher	Geng-Jen Fan	Study of dairy goat nutrition management and animal health in France	France	Apr. 22 - May 5, 2019

Position	Name	Subject	Country	Date
Researcher and Chief Secretary	Mei-Ping Cheng	Training Of COA Delegation On Agricultural Innovation And Commercialization Policy	United States	May 18-27, 2019
Researcher and Deputy Director	Churng-Faung Lee	The 2nd Taiwan-Poland Consultation Meeting on Agricultural Cooperation	Poland	Jun. 9-14, 2019
Associate Researcher and Chief	Szu-Han Wang	The study trip of Maryland University and Precision Dairy Farming Conference in United States	United States	Jun. 12-22, 2019
Assistant Researcher	Ming-Kuei Yang	The study trip of Maryland University and Precision Dairy Farming Conference in United States	United States	Jun. 12-22, 2019
Associate Researcher	Yu-Chun Lin	Oral presentation at the 13th International Scientific Conference on Probiotics, Prebiotics, Gut Mirobiota and Health (IPC 2019) in Czech Republic	Czech Republic	Jun. 14-25, 2019
Director General	Jeng-Fang Huang	Congress of International Committee for Animal Recording (ICAR) and IDF/ISO Analytical Week	Czech Republic	Jun. 16-27, 2019
Researcher and Chief of Division	Ming-Che Wu	Congress of International Committee for Animal Recording (ICAR) and IDF/ISO Analytical Week	Czech Republic	Jun. 16-27, 2019
Researcher and Director	Jen-Wen Shiau	Congress of International Committee for Animal Recording (ICAR) and IDF/ISO Analytical Week	Czech Republic	Jun. 16-27, 2019

Position	Name	Subject	Country	Date
Researcher and Director	Hsiu-Chou Liu	Technical Consulting and Exchange on Taiwan-Indonesia Comprehensive Agriculture Demo Modern Farm	Indonesia	Jun. 24-28, 2019
Researcher and Deputy Director	Churng-Faung Lee	The 7th Greenhouse Gas and Animal Agriculture Conference (GGAA)	Brazil	Aug. 1-13, 2019
Associate Researcher	Hsin-Jung Lee	The 7th Greenhouse Gas and Animal Agriculture Conference (GGAA)	Brazil	Aug. 1-13, 2019
Associate Researcher	Chun-Hsuan Chao	Study on the genomic evaluation system for Taiwan heat-tolerant dairy cattle	United States	Aug. 7-22, 2019
Researcher and Chief of Division	Lih-Ren Chen	Poster presentation of "Application of Annexin V magnetic beads enhances boar sperm quality" in the 9th International Conference on Boar Semen Preservation.	Australia	Aug. 10-19, 2019
Assistant Researcher	Yu-Hsin Chen	Poster presentation of "In vitro fertilization of cryopreserved epididymal sperm in Lanyu pigs" in the 9th International Conference on Boar Semen Preservation.	Australia	Aug. 10-19, 2019
Assistant Researcher	Hsiu-Lien Lin	Poster presentation of "In vitro fertilization of cryopreserved epididymal sperm in Lanyu pigs" in the 9th International Conference on Boar Semen Preservation.	Australia	Aug. 10-16, 2019

Position	Name	Subject	Country	Date
Assistant Researcher	Hsiu-Lien Lin	Oral presentation of "Evaluation of sub-populations of rooster sperm separated by density gradient centrifugation" in the 9th International Conference on Boar Semen Preservation.	Thailand	Aug. 17-23, 2019
Researcher	Der-Yuh Lin	The 8th Taiwan-Philippines Agricultural Cooperation Meeting	Philippines	Sep. 23-25, 2019
Associate Researcher	Chin-Hui Su	Learning to Improve Brown Tsaiya Ducks Animal Welfare by Human-Animal Interatcion and Environmental Enrich Equipment Study	Malaysia	Sep. 24-30, 2019
Researcher and Chief of Division	Ming-Che Wu	Current Trends and Perspectives of IoT AI Technologies in Livestock Industry	Japan	Oct. 23-26, 2019
Researcher	Der-Yuh Lin	Current Trends and Perspectives of IoT AI Technologies in Livestock Industry	Japan	Oct. 23-26, 2019
Associate Researcher	Shyh-Rong Chang	Study of the breeding and production technique of environment-friendly cultivated forage corn	United States	Nov. 4-17, 2019
Director General	Jeng-Fang Huang	The 5th Fatty Pig International Conference	Japan	Nov. 26 - Dec. 1, 2019
Researcher and Chief of Division	Ming-Che Wu	The 5th Fatty Pig International Conference	Japan	Nov. 26 - Dec. 1, 2019

Position	Name	Subject	Country	Date
Assistant Researcher	Hsiu-Lien Lin	PHD study in Institut National de la Recherche Agronomique (INRA) and University of TOURS. The title of thesis is New advances in rooster sperm cryopreservation	France	Sep. 24, 2019 - Sep. 23, 2022

Jan. 16, 2018

Robot Technology for Dairy Cattle Farm & Prolific Ten Tons Cow Award of 2017

Akio Takenaka	Japanese Nutrient Requirement for Dairy Cattle to Meet Robot
Y. C. Wang	Hoof Care for the Dairy Cattle
H. H. Wu	Robots in Denmark Dairy Farm
C. W. Chao	Smart Dairy Farming From Wireless Sensors to Robots
I. W. Tsai	Automatic Feed Distribution and Feed Pusher Robot
C. T. Chen	Nursing Robot for Newborn Calves
H. J. Cheng	Cleaning Robot for Dairy Barn
T. Y. Kuo	Mobile Vision Gun for Artificial Insemination in Cattle

Feb. 27, 2018

First Season Academic Seminar

T. Y. Lin	Selection of KAISHING GUIDING Native Chicken and FENGHUI HSIAYING Red-Brand Country Chicken
H. H. Li	Common Reproductive Disorders in Taiwan Dairy Farms
C. H. Chang	Taiwan Native Microalgae in Pig Manure and Wastewater Treatment and Value-Added Utilization in Livestock and Aquaculture

May 03-06, 2018

13th Asian Reproductive Biotechnology Congress

Janine L. Brown	Hormone Monitoring: An Important Tool for Breeding Management of Wildlife Species
Y. C. Chang	Characterization of Noninvasive Monitoring Reproductive Endocrine Profiles from the Captive and Field Eurasian Otter (Lutra lutra) in Taiwan
B. Xiong	The Protective Role of Melatonin In Porcine Oocyte Meiotic Failure Caused by the Exposure to Benzo(a)pyrene
Noboru MANABE	Production of Prion Gene Ko Cow to Prevent Spontaneous Bse and Their Characteristics
Na Li	Application of Flow Cytometry in Semen Analysis
Koshiro Watanuki	Gain: Great Ape Information Network for Best Care and Management of Captive Apes in Japan
J. H. Xu	Improving Practical Use of Boar Semen Cryopreservation: Current Understanding

Mark Wen Han Hiew	Effect of Storage Temperature of Extenders on the Quality of Boar Semen
Ampika Thongphakdee	Reproductive Science and Technologies for Enhancing Wildlife Conservation: Thai Experiences
Eufrocina P. Atabay	Improved Pregnancy through Synchronized Ovulation and Fixed Time AI in Water Buffaloes
Jonathan T. Aaltonen	Applying Assisted Reproductive Technologies to Wildlife Conservation Management
Muhammad Usman Mehmood	Effect Of Insemination Timing Following 5 or 7 Days Cidr Co-synch in Nili Ravi Buffalo Heifers
N. H. Kim	Spindle Formation and Asymmetric Cell in Mammalian Oocytes
Jin-Hoi Kim	Single Cell RNA-seq Analysis Provide Deeper Molecular Insights into Abnormal Maturation of Tubastatin A-treated Mouse Oocytes
X. F. Wang	Treatment with Resveratrol During in vitro Maturation Improves Porcine Oocyte Quality and Embryonic Development
Thomas B. Hildebrandt	The Art of Art in Wild Patients
Bertrand Pain	Bat Stem Cell Lines for Biodiversity Conservation and Viral Studies
C. X. Lee	Semen Cryopreservation and Quality of Frozen-thawed Semen in Taiwan Holstein Bull
H. L. Lin	Separation of Rooster Spermatozoa in Silica-based Colloidal Medium by Centrifugation
Lilian P. Villamor	Animal Genetic Resources through Cryobanking in the Philippines: Management Initiatives and Future Direction
Boripat Siriaroonrat	Research and Conservation Programs at ZPO
Rangsun Parnpai	How to Improve Success of Inter-species Somatic Cell Nuclear Transfer in Endangered Species
X. X. Zhu	Generation of Transgenic-cloned Guangxi Huanjiang Xiang Pigs Systemically Expressing Green Fluorescent Protein
X. J. Yin	Double-muscled Pigs Cloned Using MSTN-disrupted Fibroblasts
Z. F. Liu	Igf2-H19 Locus Methylation Status in Cloned Goat Fibroblast Cells
Yuka Miki	Knockout Analysis of Oocyte-specific Multi-copy Gene, Oog1
Pascal Mermillod	Mimicking the Maternal Environment to Optimize the Production of Embryos in vitro in Wild and Domestic Mammals

R. Chen	The Research of the Breeding of Nomascus gabriellae in Nanjing Hongshan Forest Zoo in China
Wanlaya Tipkantha	Update on Reproductive Technologies for Endangered Clouded Leopard
Nguyen Thi Hong	Investigation of Cycle Synchronization and Artificial Insemination for Breeding Industry in Rabbits
Tamas Somfai	Comparison of Two Oocyte Maturation Media for in vitro Production of Blastocysts in an Indigenous Vietnamese Miniature Pig
H. Y. Xu	Buffalo Oocytes Matured in vitro with Acetyl-l-carnitine Improves Cryotolerance due to Change in Mitochondrial Function and the Membrane Lipid Profile
J. W. Kwon	Inhibition of Mek1/2 And Gsk3 (2i System) Affects Epigenetic Modification and Early Differentiation of Porcine Parthenotes
K. T. Shin	The Toxic Effect of Aflatoxin B1 on Early Porcine Embryonic Development
M. J. Seong	Cpeb2 is Required for Tight Junction Assembly for Establishment of Porcine Trophectoderm Epithelium
Nguyen Thi Nhung	Effect of Doner Cell Types on the Development of Pig Embryos Produced by Somatic Cell Nuclear Transfer
Q. Guo	JNJ-7706621 Improves the in vitro Development Competence of Porcine Parthenogenetic Activation and Somatic Cell Nuclear Transfer Embryos
Y. J. Jo	WHAMM Play Essential Roles in Spindle Formation and Cage Actin Mesh of Maturing Mouse Oocytes
Z. B. Luo	Co-treatment with Repsox and Lbh589 Improves the in vitro Developmental Competence of Porcine Somatic Cell Nuclear Transfer Embryos
Z. W. Nie	Thiamethoxam Inhibits Blastocysts Expanding and Hatching via Activation of Ros-induced DNA Damage Checkpoint in Pigs
Kim Dung Pham Thi	Enhancement Utilization of Reproductive Technology in Pig Herds of Vietnam to Meet the Industry Development Policy
Ruth Miclat-Sonaco	Technical Training Input of Pig Reproduction in Local and International Farmers at Philippine ITCPH
J. Pang	Influences of Different Dietary Energy Level on Sheep Testicular Development Associated with AMPK-ULK1 Autophagy Pathway
S. C. Sun	Melatonin Protects Oocytes from MEHP Exposure Induced Meiosis Defects in Porcine
S. S. Geng	The Primary Research of Over Expression Of GDNF Gene in Buffalo Testis Sertoli Cells
W. J. Zhou	Fipronil Causes Apoptosis during Meiotic Maturation in Porcine Oocytes

Y. H. Kim	Acentriolar Microtubule Organization Centers and Ran-mediated Microtubule Formation Pathways are Both Required in Porcine Oocytes
T. T. Li	The Establishment of in vitro Culture System of Buffalo Spermatogonial Stem-like Cells
Pierre Comizzoli	Gonadal Tissue Preservation in Rare and Endangered Species
Y. J. Niu	PINK1 Is Essential for Maintenance of Mitochondrial Morphology in Porcine Preimplantation Embryos
X. X. Gao	Roles of Fibroblast Growth Factor 9 and LOC105611671 in Hu Sheep Testosterone Biosynthesis
M. F. Xuan	Myostatin Deficiency Increases Type LI Fiber Formation in Skeletal Muscle by Regulating the Expression of Myod and MEF2 in Newborn Myostatin-knockout Pigs
J. R. Yang	Current Development of Porcine Embryonic Stem Cells and Induced Pluripotent Stem Cells in Taiwan
S. T. Wang	Expression and Localization of MECP2 Gene in the Reproductive Organs of Hu Sheep
K. P. Deng	Carcass Traits, Meat Quality, Antioxidant Status and Antioxidant Gene Expression in Muscle and Liver of Hu Lambs Fed Perilla Seed
P. S. Tsai	The Effects Of Type I Collagenase on the Degelification of Chimpanzee (Pan Troglodytes) Semen Plug and Sperm Quality: Improving Genetic Diversity of Zoo Captive Chimpanzee
Thanh Quang Dang-Nguyen	Germinal Vesicle Transfer as a Rescue Tool
T. Y. Kuo	Screening on Sperm Chromosomal Breakage and Oxidation Level of Young Breeding Boars
J. Zheng	Comparative Transriptome Research in Hu Sheep Hypothalamus Associated with Prolificacy
C. C. Chu	Sperm Maturity of Growth Performance Tested Boars
Y. C. Chiu	Establishment of Culture Conditions for Primordial Germ Cells from Taiwan Country Chicken
Thanee Pak-Uthai	Economic Input of Livestock Development in Farmer Based Thailand
X. L. Yao	Age-associated Expression of VDR and Vit D Metabolizing Enzymes in Male Reproductive Tract and Sperm of Sheep
Kazuhiro Kikuchi	International Collaboration for Conservation and Utilization of Pig Resources - Satreps Activity in Vietnam

L. Xie	Efficient Derivation of Primordial Germ Cells for Genetic Preservation of Indigenous Chicken
Y. C. Chen	In vitro Culture and Characterisation of Duck Primordial Germ Cells
J. X. Wang	Cryopreservation of Pig Pancreatic Islet with Trehalose Cryoprotectant

May 18, 2018

Second Season Academic Seminar

H. C. Li	The Driving Force and Prospect of the Evolution of Agricultural Products Transportation
C. P. Lee	Application of Stable Isotope Technology on Origin Authentication – A Case Study on Taiwan Milk
K. S. Hsu	Review and Prospect of Livestock Pollution Control

Jun. 12, 2018

The First Symposium on Forage in 2018

P. Y. Chen	Evaluation of Sorghum Cultivar for Forage Production
S. H. Liang	Economic Benefit Evaluation of Activating Fallow Farmland to Plant Oats as Winter Season Crop in Taiwan: Case Study of Houlong Township, Miaoli County and Fuxing Township, Changhua County
M. H. Ju	A Preliminary Study of Taiwan Oil Millet Used for Forage
S. M. Wang	Research on the Decomposition of Forage Biochar in Soil
S. T. Chen	The Investigation of Forage Quality at Different Growth Stages of Napiergrass for Pets

Jun. 21-22, 2018

The 60th Anniversary Celebration of Taiwan Livestock Research Institute Farm Animal Nutrition and By-Product Research Seminar

K. C. Fan	Research on the Application of By-Products in Ruminant Feed in the Past Ten Years
S. R. Huang	Effect of Dietary Calcium Concentration and Additional Rumen-Passed Amino Acid on Antler Performance and Blood Biochemical Value of Taiwan Sambar Deer
Y. S. Chen	Nutritional Strategies for Dairy Cattle During the Conversion Period
M.H. Ju	Upgrading the Nutrient of Ruminants-Interplanting Forage Maize and Soybean
J. D. Chang	Effects of Dietary Organic Chromium Supplementation on Milk Composition and Blood Traits of Holstein Cattles During Climate Change

S. S. Young	Study on the Production of Organic Goat Meat Using Organic Dried Mulberry Leaves
S. H. Liang	Leucaena in Penghu Area Used for Goat Feeding
B. L. Shih	Effects of Dietary Addition of Chayote Vine Powder on Laying Performance and Egg Quality of Laying Hens
L. S. Lin	Effects of Different Environments on Growth Performance and Carcass Traits of Muscovy Ducks
C. H. Su	Effects of LED Lighting on Poultry Growth Traits and Dietary Intake
M. L. Lin	Feeding Value of Mushroom Fibc Bag to White-Roman Goose
C. M. Wang	Application of Agricultural By-Products in Goose Feeding
Y. F. Lin	Evaluation of Egg Production Performance and Egg Quality of Colored Broiler with High-Quality Protein Corn
A. K. Su	Effects of Diets Containing Different Metabolic Energy and Crude Protein on Growth Characteristics of Ostrich Chicks
S. L. Li	Application of Agricultural By-Products in Commercial Red Feather Broiler
C. C. Hong	Feed Safety and Heavy Metal Inspection
H. F. Li	Development of Animal Health Feed Additives
C. B. Hs	Study on Silage and Agricultural By-Products in KHAPS Black Pig
S. L. Li	Application of Feed Rice and Sweet Potato Instead of Corn in Black Pigs
C. W. Liang	Nutrition Research of Pigs in the Nutrition Group for the Past Ten Years and Government Employee Career Review

Jul. 24-25, 2018

The 60th Anniversary Celebration of Taiwan Livestock Research Institute Seminar on Animal Breeding and Genetics – New Breeds of the Current Decade with Better Quality Improvement

K. H. Li	Analysis of the Results of Dairy Cattle Genomic Testing Program in 2017
G. F. Li	Utilization and Prospect of Taiwan Yellow Cattle
Y. T. Chen	The Current Situation and the Marker-Assisted Selection of Taiwan Swamp Buffalo
I. C. Chou	Taiwan Black Goat, Hengchun Line and Kenting Goat Current Situation and Future
P. H. Chuang	The Utilization and Prospect of the Taiwan Black Goat
C. C. Hsiao	Utilization and Prospect of Chinese Geese
M. J. Lin	Breeding Process and Current Situation of Beidou White Goose LRI-1

Y. Y. Chang	The Selection and the Perspective of Better Feed Efficiency Brown Tsaiya
L. Y. Wei	The Status of Parental Selection and Future Prospects of Mule Duck Production
D. Y. Lin	Counseling Folk Chicken Farm in Country Chicken Breeding and Application
H. L. Liu	Selection and Breeding of LRI White Silky Chicken
L. H. Mei	The Growth and Reproductive Performances of Taiwan Native Chickens Carrying Homozygous Genotypes
C. F. Chen	Establishment of Crossbreeding System for Country Chicken
Y. T. Ju	The Past, Present and Future Expansion of Leesung Pig
C. C. Chang	Selection and Prospect of White Binlang Pigs
S. C. Chang	Selection and Application of KHAPS Black Pig
T. H. Hsiao	Use Agricultural By-products to Produce Housefly Larvae for Feeding and Industrialization
C. H. Chung	Research on the Amount and Contents of Livestock and Poultry Excreta
T. M. Su	Decreasing Copper and Zinc of Livestock and Poultry Excreta
C. H. Cheng	Management and Regulation of Livestock and Poultry Excreta

Aug. 09, 2018

Taiwan-Viet Nam Symposium on Recent Progress in Swine Breeding, Raising and Resource Recycling Technologies

H. J. Huang	Marketing of Prolific and High Meat Quality Pig Breed K in Taiwan
Nguyễnhữutỉnh	Pig Genetic Evaluation and Breeding Program in Vietnam
M. C. Deng	Biosecurity to Reduce the Risk of Disease in Pig Farms
M. C. Li	Biosecurity Improvements to Reduce the Risks of FMD Transmission
Ths. Lêvănsáng	Biosecurity of Pig Production in Vietnam
F. C. Liu	Establishing Low-Antibiotic Pork Production Model with Nutritional Strategies
C. S. Lin	Development of Feed Additives Industry
Tr̀ânthịbíchngọc	Alternatives to Antibiotics in Pig Feed in Vietnam
H. J. Li	The Situation About the Circular Re-Use of Remaining Materials in Pig Industry in Taiwan
Chu Mạnhthắng	Current Practices of Pig Manure and Effluent Management in Vietnam

Aug.14, 2018

Third Season Academic Seminar

K. S. Wang	High Throughput Sequencing Accomplishes Wholegenome Investigation
Y. J. Lin	Discussion on the Application of Intestinal Microbial Regulation in Weight Management
S. Yu	The Discussion of Heat Stress Prevention and Energy Saving of Licestock Buildings in Taiwan

Aug. 21, 2018

Seminar on the Improvement of Breeding Pig Testing Technology

C. H. Lin	Breeding Pig Registration and Central Testing
M. C. Wu	The Age of Sperm Collection Before the Auction of Boars in Testing Station Is Increased Early and the Trend of the Total Sperm Count Is Increasing
Y. C. Chen	1. On-Site Testing of Breeding Farms-Verification of Basic Data on Site
	2. Central Testing the Introduction of Automated Group Feeding Equipment
E. C. Lin	Estimation of Breeding Values and Its Application in Breeding Pigs
L. L. Lo	Application of Ultrasonic Technology in the Inspection Pig of Farm Performance Test

Aug. 23, 2018

Technology Transfer and Sharing of Livestock Products Processing Seminar

C. Y. Kuo	Characteristics Analysis and Product Development of Dairy Product and the Velvet Antler of Formosan Sambar Deer
Y. C. Lin	New Functional Compound of Milk: Purification and Application of Milk Fat Globule Membrane
P. A. Tu	Ketosis Screening From Raw Milk of Dairy Cow
S. M. Wang	From Deer Raising to the Velvet Antler Processing of Formosan Sambar Deer
S. M. Wang	Review and Vision of Dairy Milk Market in Taiwan
R. J. Tu	Development of Leisure Food Stored at Room Temperature
S. W. Chen	Trends of Meat Processing
M. R. Lee	Clean Label and Development of Healthy Meat Products
W. S. Chen	Research and Development Achievements of Livestock Processing Products

Sep. 04, 2018

Seminar on Food Safety Analysis Technology

J. H. Meng	Advanced Technologies for Identification,Tracking and Tracing of Foodborne Pathogens

Sep. 07, 2018

Seminar on the feeding and management of chickens

Y. P. Lee	The Experience Sharing from Native Chicken Farms
M. T. Lin	Current Situation and Prevention Strategies of Avian Influenza in Taiwan in 2018

Sep. 12, 2018

Dairy Industry Development - Vietnam and Taiwan

Terence Sun	ICAR Certified Milk Quality Analyzers
Naruemit Nanacheewakul	Milk Analysis Lab in Southeast Asia
J. W. Shiau	DHI System & Raw Milk Pricing in Taiwan
Nguyen Thi Nga	Dairy Industry in Vietnam
C. W. Chao	Robots for Dairy Cattle Farms in Taiwan
M. C. Wu	Vision of Heat-Tolerant Ten-Tons Cow Herd

Sep. 26-27, 2018

The 60th Anniversary Celebration of Taiwan Livestock Research Institute
Seminar on Sustainable Development of Forage Industry

P. Chuang	Collection and Preservation of Forage Species
J. B. Lin	Selection and Popularization of Napiergrass
C. S. Chen	Quality Improvement of Forage Maize
M. L. Chang	Selection, Cultivation and Utilization of Forage Sorghum Lines and Its Future Prospects
Z. L. Li	Napiergrass Diversified Product Development
J. Y. Lin	Effects of Forage Carbon Vinegar on Growth Performance of Weaned Piglets
C. Y. Li	Characteristics and Decomposition of Pangola Grasst and Its Influence on Forage Growth
C. S. Lu	Carbon Storage and Soil Carbon Sequestration of Domestic Forage
C. L. Kuo	Napiergrass Biomass Energy Development
S. M. Wang	Study on the Quality of Silage and Haylage Making

S. H. Liu	Evaluation of Mechanical Efficiency of High-Quality Hay Production
C. H. Yu	Development and Application of Domestic Silage Inoculants
S. H. Liang	Analysis of Forage Yields of Pangolagrass Mixed Culture with Gramineae-legume Forage in Northern Region of Taiwan in Winter Season
M. H. Ju	Effects of Sowing Time and Cultivars for Soybeans on Forage Use
P. Y. Chen	The Cultivar and Producing Method of Regional Forage Production Mode
G. H. Fan	Application of the feeding of Domestic Forage for Lactating Dairy Goats
E. M. Shy	Production and Making and Utilization of Forage Oat
S. H. Wang	Effect of Oat Silage Substitute on Lactation Performance of Holstein Lactating Cows
S. R. Chang	Green Manure Crops Used for Forages

Sep. 27, 2018

Seminar on Egg Processing

J. H. Lin	Cognition of Duck Egg Products and Development of Egg-Flavored Frankfurter
L. H. Ou	Current State and Future of Domestic Egg Duck Industry
Y. C. Chen	Study and Product Development of Fermented Duck Egg White

Oct. 5, 2018

Ultrasonic Ovum Pick-Up Technology for Embryo Production in Dairy Cows

Kei Imai	Bovine Embryo Production and Selection System by Ovum Pick-up and in vitro Fertilization
F. H. Chu	Ultrasound Equipment for Ovum Pick-up and Pregnancy Scanning of Dairy Cows
D. W. Yang	Operational Status of Ultrasound Equipment for Ovum Pick-up and Pregnancy Scanning of Dairy Cows
Kei Imai, F. H. Chu	Workshop on Ultrasound Equipment for Ovum Pick-up
Kei Imai, F. H. Chu	Workshop on Ultrasound Equipment for Scanning Ovary and Pregnancy
Kei Imai, L. R. Chen, M. C. Wu	Utilization Vision of Ultrasound Scanning for Ovum Pick-up and Pregnancy

Oct. 15-16, 2018

The 60th Anniversary Celebration of Taiwan Livestock Research Institute Seminar on Biomedical Minipig and Herbivore Artificial Reproduction Application

Pascal Mermillod	Pig Genome Editing, Useful Tool in Translational Medicine
Eric Pailhoux	Using Genome Editing Approaches to Decipher the Gonadal Differentiation Pathway in Non-Rodent Mammals
Y. H. Chen	3R Implementation and International Trends
Y. T. Ju	Lee-Song Pig's Production, Certification and Research Status
J. J. Jhang	Research on Popularization of Biomedical Mini Pigs
L. Y. Wei	Production Management and Popularization of Biomedical Ducks
J. S. Wu	Brief Introduction of the Production and Supply System of Biomedical Used SPF Chicken Eggs and
S. H. Jhuang	Industrial Application of Biomedical Goose
J. R. Young	Study on Therapeutic Effects of Porcine Induced Pluripotent Stem Cells of Osteoporosis
Y. S. Chen	Establishment of An In-Vitro Production System for Pig Embryos
D. J. Kang	Effects of Goat Seminal Plasma Protein on Animal Reproduction
J. W. Chen	The Importance of Non-Open Or New-Style Poultry Houses for Poultry Biosafety Protection
S. H. Lin	Establishment of Artificial Reproduction Technology of Taiwan Antler Deer
T. Y. Kuo	Evaluation Technology and Industrial Application of Novel Traits of Livestock and Poultry Sperm

Oct. 25-26, 2018

2018 International Symposium on Avian Influenza and Disease Control

Cyril Gerard Gay	Gaps in Avian Influenza Surveillance and Early Warning Measures
Nathaniel Tablante	Prevention and Control of Avian Influenza Through Biosecurity, Surveillance, Early Detection, and Rapid Response: It Is Easier Said Than Done
H. M. Chow	Prevention and Control of Highly Pathogenic Avian Influenza in Taiwan
David E. Swayne	Use of Molecular Analytical Tools and Pathobiological Data in Understanding Avian Influenza Outbreaks and Designing Control Strategies
Thanawat Tiensin	Lessons Learned From Avian Influenza Outbreaks in Thailand: Biosecurity, Surveillance and Control Strategies, and Participatory Epidemiology

Y. J. Lin	Avian Influenza Viruses in Taiwan: Chronological and Phylogenetic Relationships to the Strains in Asia
Jon Moyle	Farm Management for Disease Control
Y. F. Lin	Feeding Types of Chicken in Taiwan and Its Biosecurity
Jeffrey Silverstein	Genetic Strategies to Improve Disease Resistance: Avian Influenza
Pham Thi Kim Dung	Application of Improved Breedingstrategy to Enhance Diseases Prevention and Resistance

Nov. 05, 2018

Fourth Season Academic Seminar

C. L. Kuo	Selection of Napiergrass Cv. TS8
J. P. Liao	Experience Sharing on the Circular Economy Class of Special Topic Study Abroad in 2018
Y. H. Ju	Identification of Oil Fraud and Deterioration

Nov. 07, 2018

Agricultural Circulation Technology R&D Achievements Display and Seminar

Y. H. Wu	Idea of Modernized Green Pig Farm in Taiwan
Y. G. Lai	Circular Agriculture in Aquaculture
Q. H. Liu	Value-added Research and Innovation Development in Circular Agriculture Industrial

Nov. 07-08, 2018

The 60th Anniversary Celebration of Taiwan Livestock Research Institute Seminar On Prevention and Control of Livestock Farm Pollution and Value - Added Application of Surplus Materials

T. H. Hsiao	Livestock Farm Wastewater Diversification
J. C. Wang	Case Study of Biogas Power Generation Plants Entering Livestock Farm
M. P. Cheng	Greenhouse Gas Reduction in Livestock Waste Disposal
H. J. Li	Research and Exchange of Livestock and Poultry Biogas Power Generation and Greenhouse Gas Reduction
Y. C. Chi	Case Study of Milk Carbon Footprint
Y. W. Wen	Planning and Design of Modern Pig House
Y. H. Wu	Planning of Pig Farm Green Energy Recycling Zone

T. M. Su	Pig Management, Water-Saving and Reuse of Treated Water
W. L. Chao	The Strategy and Action of Improving the Pig Industry Structure Adjustment

Nov. 13, 2018

Meat Quality Scanning Technology of Breeding pigs - Denmark and Taiwan

Soren-Brain, Lyngesen	The Development of Danish Meat Quality
C. H. Chen	The Correlations Between the Selection and the Meat Quality of Taiwan Breeding Pigs
Sussie Ketit	Adoption of Danish Technologies–"Hand-in-Hand"
R. J. Tu	Overview of Current Carcass and Meat Quality Evaluation in Taiwan
R. J. Tu	Overview of current carcass and meat quality evaluation in Taiwan

Nov. 20, 2018

Analytical Technology in Raw Milk–Malaysia and Taiwan

J.W. Shiau, P. A. Tu	Taiwan Join the ICAR Proficiency Test of Cow Raw Milk
C. M. Lin	Milk Analytical Technologies in Malaysia
Rosnaini Bt Ali	Milk Quality Control in Malaysia
Terence Sun	New Analytical Instruments for Liquid and Solid Dairy Products

Nov. 27, 2018

Symposium on Industry- Academic Technical Exchange for Poultry Industry

S. L. Liu	Poultry Foot Ring Applications
L. S. Lin	Development of Multiple Flavor Hams
S. H. Zhuang	The Technology of Clean Geese Breeding
H. M. Liang	Heat-Resistant Type-TLRI K9 Chicken Line
L. Y. Wei	Application Technology of Muscovy Duck Semen Diluent
B. H. Chaung	Ostrich Growth Feed and its Growth Traits
Z. K. Deng	KAISHING GUIDING Chicken Introduction and its Significance in Food and Animal Husbandry
Y. Q. Li	Poulary Industry Blueprint of Taiwan

Nov. 28, 2018

Symposium on Industry- Academic Technical Exchange for Pig Industry

H. J. Huang	Development of Feed Additives to Replace Antibiotics
Y. C. Lin	Endogenous Cell Guard Factor Applied to the Development of Pig Anti-Stress Feed Additives
L. C. Li	Experience Sharing of Pig Farm Management
W. L. Chao	Pig Industry Blueprint of Taiwan

Nov. 29, 2018

Symposium on Industry- Academic Technical Exchange for Herbivore Industry

Y. X. Chen	Technology of Cryopreservation of Bovine Embryos by Vitrification
D. J. Kang	New Technology of Cryopreservation of Caprine Embryos by Vitrification
R. J. Tu	Technology Transfer of Gelatin Refining from Deer Bone
Z. X. Young	Experience Sharing of Goat Farm Management
P. Y. Yue	Herbivore Industry Blueprint

Jan. 24, 2019

Robot Technology for Five Working Pathways in Dairy Cattle Farm
Fifth Annual Awards for Prolific Ten-Tons Cow of DHI Farmers

Synan S. Baguio	Challenges to the Philippine Dairy Industry
C. W. Yu, Pan Lee	Global Dairy Farm Collaborative Robot Development Status and Trends
Y. S. Chen, Y.S. Yeh	Milking Robot
Amber Su	Robot Feedpusher
Y. D. Young	Clean Robot for Dairy Barn
M. D. Hu	Cleaning and Disinfecting Robot for Flooring Shed in A Calf
C. T. Chen	Total Mixed Ration Robot
M. C. Wu	Nursing Robot for Parturition Cow
C. W. Chao	Philippine and Taiwanese Animal Genetic Sources Stock Exchange

Feb. 25, 2019

First Season Academic Seminar

Y. C. Chen	The Past, The Present, and The Future of Taiwan Black Pigs– Brief Talk on the Phylogenetic Relationship and Body Conformation of Taiwan Black Pigs
C. B. Hsu	Characteristic Feeding Strategies of Black Pigs
L. S. Lin	Pork Quality

Mar. 15-18, 2019

American Dairy Industry Application Smart Agricultural Production Technology Seminar

Robert R. Peters	Transitioning From Conventional to Automatic (Robotic) Milking Systems
	Practical Experience with Rumination and Activity Monitoring
	Transitioning From Conventional to Automatic (Robotic) Milking Systems
	Maintaining Milk Quality in the Robotic Milking Herd

Mar. 27, 2019

Technology for Working Pathways in Animal Breeding: Pig Breeding in Philippines & Taiwan

Gerry Pagarigan, Mary Ann A. Ramos	Current Challenges of Swine Industry in The Philippines
M. C. Wu	Web-Based Operation for Boar Growth Performance Test Station in Taiwan

May 31, 2019

Second Season Academic Seminar

D. Y. Lin, N. T. Yen	Poultry Heat and Disease Resistant Breeding The Current Status of Heat-Resistant Livestock Breeding Ethnic Groups and the Establishment of A Database of Disease Tolerance
P. C. Sheng	Effects of Cytoplasmic Source Varieties on Mammalian Heat Tolerance
J. Y. Young	Impact of Climate Change on Crop Production

Jun. 4, 2019

ICAR Guidelines on Sexed Semen and Insemination Technologies in Dairy Cattle

Fritz Shmitz-Hsu	ICAR Guidelines on Artificial Insemination and Related Technologies
T. Y. Kuo	Cervical Caring and Artificial Insemination in Cattle by Mobile Vision Gun
C. H. Chao, J. W. Shiau	Nations of Sexed Semen and Import Standards of Semen in Dairy Cattle

M. C. Wu	Breeds and Nations of Genomic Evaluation on Seven Traits of Dairy Cattle

Jun. 12, 2019

The First Symposium on Forage in 2019

L. C. Tsai	Mating Behavior and Identification of Branchinella Kugenumaensis
M. H. Ju	Effects of Harvesting Period and Modulation Method on Small Goosefoot As Forage
M. L. Chang	Breeding and Prospect of Forage Sorghum Kenting No.1 and No.2
S. S. Liang	Investigation of Sweet Oat Cultivation and Yield in Northern Area

Aug. 2, 2019

Analytic Needs and Challenges of Global Dairy Products

Daniel Schwarz	Global Application of Milk Quality Analytic Instruments
Terence Sun	Screening Technology for Quality Assessment of Raw Milk
M. C. Wu	Nine Standards of International Dairy Federation

Aug. 21, 2019

Third Season Academic Seminar

D. C. Liu	Advanced Utilization of Animal Co-Products
C. Y. Chen	Development of A Circular Economy Model of Microalgal Bio-Refining
Y. H. Young	Greenhouse Gas Emissions of the Livestock Industry From the View of Circular Economy

Sep. 5, 2019

Robot Feeders for Dairy Cattle Farm in Asia

Hans Scriver	Asia Market of Robot Feeders
Amber Su	Taiwan Experience of Robot Feedpusher
C. W. Chao	Wifi Vision System for Eating Behavior of Cows
Chi-Wei Yu, Pan Lee	Open Data on Technical Resources of Dairy Farming Robots in Taiwan

Sep. 6, 2019

Seminar on Goat Management

B. H. Chaung	African Swine Fever Epidemic Prevention

G. M. Young	Goat Feeding and Management
C. Z. Lin	Lamb Carcass Cutting Explanation

Sep. 9, 2019

Seminar on Dairy Cattle Management

B. H. Chaung	African Swine Fever Epidemic Prevention
T. Y. Kuo	Dairy Cow Artificial Insemination Eyepiece Guide Cervical Cervix
Y. S. Chen, Y. S. Yeh	Milking Robot Practice Sharing

Sep. 20-21, 2019

2019 Taiwan-Indonesia New Southbound Agriculture, Aquaculture and Livestockforum

Y. Y. Feng	Taiwan-Indonesia Agriculture, Aquaculture and Livestock Industry Development, Investment and Cooperation Opportunities
Saktyanu Kristyantoadi Demoredjo	Taiwan-Indonesia Agricultureindustry Development, Investment and Cooperation Opportunities
Andri Hanindyo Wibowo	Indonesia Livestock Industry, Investment Development
C. L. Huang	Sustainable Cattle Business
H. C. Liu	Current Status of Duck Industry and Its Possible Application in Indonesia
C. H. Su	Current Status of Meat Type Duck Industry and Its Possible Application in Indonesia
Y. Y. Chang	Present Status of Laying Duck Industry and Potential Technical Application in Taiwan
C. R. Chen	Taiwan-Indonesia Current Status of Aquaculture Industry and Its Possible Application
S. L. Yeh	Marine Fish Breeding and Seed Production for Aquaculture in Taiwan
C. L. Tsai	Agribusiness Cooperation Proposal for East Java Province Indonesia
T. J. Yu	Culrivation Technology of Forage Maize in Taiwan
M. H. Hsieh	An Overview of Postharvest Technology and Market Pattern of Taiwan Vegetable
M. H. Lai	Demo Faming KARAWANG Corporate Farming on Demfarm Development Project

Sep. 24-25, 2019

Genetic Selection on Climate-Resilient Farm Animal: Reproductive Technology Workshop & International Industry Forum

J. W. Shiau	ICAR Guided Technology for Global Dairy Farming
Libertado C. Cruz	Buffalo Dairying to Young Farmers in Philippines
Thanee Pak-Uthai	Thailand Smile Beef Production 4.0
Natalia Kononova	Advanced Technology Application in Cattle Breeding
Viengsavanh Phimphachanhvongsod	Laos Livestock Breeding and Research
Ngô Thị Kim Cúc	Vietnam Native Chicken Breeding to Meet the Market Needs
Pradchayaporn Akaboot	Thailand Native Chicken Breeding and Research
Y. J. Tan	Semen Evaluation Related to Sexing and Sex Determination
Maijon Purba	Developing of Laying Ducks by Selected in the Farmer Field
Aleli Arambulo Collado	Philippine Projects of Farm Animal Breeding with Technology Application

Oct. 17-18, 2019

Seminar on Hay and Haylage

B. L. Chen	Feasibility Evaluation of Regional Niche Forage Production Model
Y. F. Huang	Breeding of Oat Varieties Suitable for Cultivation in Taiwan
H. C. Wang	Evaluation of Utilization and Feeding Value of Domestic Oats
S. M. Wang	Gramineae, Leguminosae, Gramineae / Bean Haylage and Strain Screening
C. T. Hsu	Mold Inhibition of Haylage
C. S. Chen	Oat and Pangola Grass Quality Changes and Palatability
C. H. Yu	Grass-Legume Mixture, Perennial Grassland Transformation and Energy Saving and Carbon Reduction
S. H. Liu	Hay Quality Improvement-From Field Machinery, Fast Drying to Storage
L. C. Shieh	Introduction to the Development of Indigenous Forage Batch Drying System
S. H. Liu	Observation: I. Explanation of Hay Modulation Mechanical Observation

C. S. Chen	II. Product Display of Hay and Haylage
C. F. Li	Efforts to Improve the Value of Domestic Forage Feeding
C. L. Shieh	Hay Online Detection-Portable Near Infrared Light, Color and Odor
S. C. Wu	Study on the Application of Domestic Hay and Haylage to Growing Sheep
D. J. Kang	Study on the Application of Domestic Forage to Deer Feeding
M. C. Cheng	The Application of the Planting of Grass-Legume Mixture in Goat Feeding and Cost-Benefit Analysis

Oct. 31,-Nov. 2, 2019

International Forum on Innovative Cross-Sectoral Linkage for Circular Agriculture

C. C. Young	Innovation, Intelligence, and Implementation in Circular Agriculture
Chiao Fu	Eco-Friendly and Biodegradable Material Innovation for Agricultural Application
Remi Lee	Biotechnology Cross-Regional Circular Strategy
Sussie Ketit	Smart Farming for Sustainability – Agriculture 4.0
Jan Lembke Jensen	Danish Pig Breeding System – the Application of Cutting Edge Technology
M. P. Cheng	Taiwan's Sustainable Development Goals and R&D Achievements of Circular Agriculture
Gelare Nader	The Netherland's Vision on Agriculture – Transition to Circular Agriculture
Bo Mønsted	The Danish Way – Innovation and Circular Economic in the Livestock Industry
Benny Lim	Clean and Green Rendering Solutions
Ingeborg De Wolf	Facing the Challenges to Achieve Sustainable Livestock Farming and Identifying Possible Solutions (and How to Get There)
P. C. Chou	Circulareconomic in TSC
H. Y. Kuen	Total Circular for Food and Agriculture (Tbc.)
Y. H. Wu	Promotion and Practice Sharing of Donghaifeng Circulation Zone
Ingeborg De Wolf	Successful Case Sharing of Dutch Circular Agriculture
Sussie Ketit	Successful Case Sharing of Danish Circular Agriculture

Oct. 31, 2019

Genome-Wide Association Study and Selection Strategy of Livestock Animals Seminar

Steven M. Kappes	How Genomic Research Affects Future Livestock Production
Steven M. Kappes	Genomic Sequencing and Selection Strategy of Livestock Animals

Nov. 14, 2019

Fourth Season Academic Seminar

M. R. Chen	The Next Generation of Probiotics: Opportunities and Challenges
C. I. Chen	Antibacterial Peptides: A New Generation of Anti-Infective Substances in Development
C. S. Cheng	Introduction of Animal Vaccine R & D in Animal Health Institute

Nov. 19, 2019

Symposium on Industry- Academic Technical Exchange for Poultry Industry

S. L. Liu	New Breed-Black Velvet Silkie Chicken
D. Y. Lin	Application of RFID on Laying Performance Test of Hens
L. Y. Wei	Production Technology of High-Efficiency Brown Tsaiya Duck Line
L. Y. Wei	Development of Multiple Flavor Hams
Z. Z. Xiao	Application of Intelligent Waterfowl Laying Identification Technology System
B. H. Chaung	Feed Formula for 0-1 Month Old Ostrich (Chick)
C. H. Wu	Non-Open Poultry House on Waterfowl Management Experience
Y. Q. Li	Blueprint for The Development of The Poultry Industry
M. G. Chang	Intelligent Poultry Production System

Nov. 20, 2019

Symposium on Industry- Academic Technical Exchange for Pig Industry

S. C. Chang	Selection of High-Yielding Gene Black Pig
Y. C. Lin	Development and Application of Feed Additives for High-Yielding Cell Guard Factor
H. S. Wang	Production System and Management of Mini-Pig
Z. X. Chang	Livestock Product Promotion-Pork-Brand Establishment and Marketing
W. Q. Jiang	The Blueprint of Pig Industry From Denmark To Taiwan
J. Y. Huang	Tutoring and Learning-Experience Sharing of Pig Farming Management of Young Farmer

Nov. 21, 2019

Symposium on Industry- Academic Technical Exchange for Herbivore Industry

T. C. Kang	Production Technology of Goat Semen Cryopreservation
K. H. Lee	Formula of Dairy Cow Nipple Health Herbal Gel
C. Y. Kuo	Deer Antler Powder and Extract Processing Application Technology
C. W. Tsao	Wifi Vision System for Eating Behavior of Cows
K. C. Hsu	Experience Sharing of Cattle Producers
W. Q. Jiang	Herbivore Industry Blueprint
J. T. Hsu	Considerations and Precautions for Dairy Farm Automation and Smart System

Nov. 26, 2019

Application of Experimental Research Method of Precision Nutrition Function

KOIKE Satoshi	Effect of Dietary Condition on Development of Rumen Microbiota in Calves

Dec. 11, 2019

Application of Dairy Herd Improvement Data

Kasim.H Ingawa	Application of Dairy Herd Improvement Data

Dec. 11, 2019

Performance Test Technology for Breeding Pigs

N. T. Yen	Hoof Trait Evaluation of Breeding Pigs
Stella Marie D. Lapiz	Village-Based BALA Livestock Development in Philippines
C. Y. Yu	Gene Chip for Performance Evaluation of Breeding Pigs
Jason Tai	3D Imaging for Conformation Trait of Breeding Pigs
M. C. Wu	Web Data for Semen Quality-Tested Boar

Dec. 16, 2019

Keynote Speech by Christopher D. Lu

Christopher D. Lu	Goat: Science, Human Civilization, Environment, World

Program	No. of Trainee	Duration
2018		
Introduction of livestock	38	3 days
Animal products processing (advanced)	24	5 days
Beef cattle management and reproduction technology	25	3 days
Identification of forage germplasm (advanced)	36	3 days
Pig management (advanced)	9	3 days
Artificial insemination of goat (advanced)	25	5 days
Utilization and management of forage (advanced)	20	3 days
Artificial insemination of dairy cattle	20	3 days
Biosafety and management of poultry (advanced)	29	10 days
Professional manager of dairy cattle (elementary)	23	10 days
2019		
Introduction of livestock	30	3 days
Goat management (advanced)	13	3 days
Introduction of livestock	23	3 days
Chicken special skill (advanced)	30	3 days
Identification of forage germplasm (advanced)	34	3 days
Feed analysis (advanced)	14	3 days
Pig management (advanced)	16	5 days
Artificial insemination of beef cattle (advanced)	10	3 days
Pig management (elementary)	16	10 days
Artificial insemination and hoof renovation of dairy cattle (advanced)	29	5 days

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